Arctic Change 2008

Conference Programme and Abstracts
Programme et résumés de la conférence

Québec (Qc)
9-12 December, 2008 • 9-12 décembre 2008

WELCOME TO ARCTIC CHANGE 2008

With climate change and Arctic issues moving to the forefront of national and international agendas, circumpolar nations face an increased urgency to expand the observational basis needed to formulate strategies and policies that will minimize the negative impacts and maximize the positive outcomes of the on-going transformation of the Arctic. Building on the success of its annual scientific meeting, the ArcticNet Network of Centres of Excellence and its national and international partners welcome the international Arctic research community to Quebec City for the International Arctic Change 2008 Conference. Coinciding with the pinnacle of the Fourth International Polar Year (IPY), Arctic Change 2008 welcomes over 700 researchers, students, policy makers and stakeholders from 16 countries and from all fields of Arctic research to address the global challenges and opportunities brought by climate change in the circum-Arctic.

ArcticNet is supported by the Government of Canada through the Networks of Centres of Excellence (NCE) programs.

Additional support for the Arctic Change 2008 conference was provided through NCE's International Partnership Initiatives program.

BIENVENUE À ARCTIC CHANGE 2008

Les changements climatiques et les enjeux entourant l'Arctique se retrouvent au premier plan des priorités nationales et internationales. Les nations circumpolaires doivent maintenant élaborer des stratégies et des politiques visant à réduire les impacts négatifs et maximiser les répercussions positives des changements en cours dans l'Arctique. Le Réseau de centres d'excellence ArcticNet et ses partenaires nationaux et internationaux invitent la communauté internationale de recherche arctique à participer à la conférence internationale Arctic Change 2008. Coïncidant avec la quatrième Année polaire internationale (API), Arctic Change 2008 invite plus de 700 chercheurs, étudiants et décideurs de 16 pays et de tous les champs de la recherche arctique à venir aborder les défis et les opportunités amenés par les changements climatiques dans la région circumarctique.

ArcticNet est appuyé par un programme des Réseaux de centres d'excellence (RCE) du Gouvernement du Canada.

Arctic Change 2008 a reçu un soutien additionnel des RCE par l'entremise de son Initiative de partenariats internationaux.

PARTNERS / PARTENAIRES

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INTERNATIONAL ORGANIZING COMMITTEE

Prof. Jody Deming
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Ottawa, Ontario, Canada

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Ship-based Research Coordinator, ArcticNet

M. Sylvain Tougas
Website Developer, ArcticNet

GENERAL CONFERENCE PROGRAMME

	TUESDAY, 9 DECEMBER	**WEDNESDAY, 10 DECEMBER**	**THURSDAY, 11 DECEMBER**	**FRIDAY, 12 DECEMBER**
08:30 - 10:00	Student Day	Plenary Session *(Room 2000AB)*	Plenary Session *(Room 2000AB)*	
10:00 - 10:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break
10:30 - 12:00	Student Day	Topical Sessions	Topical Sessions	Topical Sessions
12:00 - 13:30	Lunch *(Hilton Ballroom)*	Lunch *(Hilton Ballroom)*	Lunch *(Hilton Ballroom)*	Lunch *(Hilton Ballroom)*
13:30 - 15:00	Student Day	Topical Sessions	Topical Sessions	Topical Sessions
15:00 - 15:30	Coffee Break	Coffee Break	Coffee Break	Coffee Break
15:30 - 17:00	Student Day	Plenary Session *(Room 2000AB)*	Plenary Session *(Room 2000AB)*	Meeting Adjourns
17:00 - 19:00	Registration/Reception	Poster Session *(Room 2000CD)*	Poster Session *(Room 2000CD)*	
19:00 - 23:00	Dinner on your own	Dinner on your own	Banquet *(Hilton Ballroom)*	

STUDENT DAY PROGRAMME

TUESDAY, 9 DECEMBER **Arctic Change International Student Day (Room 2000AB)** Celebrating Partnership and Collaboration in Arctic Research		
07:30	Registration	Breakout Session assignment confirmation
08:30	Sonja Ostertag	Welcome Message from the ASA President
08:35	Danielle Dubien	Student Day Objectives and Agenda
08:40	Louis Fortier	Opening Remarks from the ArcticNet Scientific Director
08:50	Mary Simon	Keynote Speech from the President of Inuit Tapiriit Kanatami
10:00	**Break**	
10:30	Cassandra Cameron	Free love in the far north: reproductive strategies used by arctic foxes on Bylot Island, Nunavut, Canada
10:45	Émilie Counil	Trans-polar fat 2008: An update on atherogenic effects and regulatory issues in Nunavik
11:00	Hugues Lantuit	Permafrost young researchers gets their hands dirty: The PYRN-Thermal State of Permafrost IPY project
11:15	Daniel Vogedes	Digital image analyses of oil sacs in copepods as a fast and cost efficient method to determine total lipid
11:30	Felicia Kolonjari	Spring Measurements of Stratospheric Composition from PEARL in 2007 and 2008 using the Portable Atmospheric Research Interferometric Spectrometer for the Infrared (PARIS-IR)
11:45	Karen Flaherty Kerri Tattuinee Kiah Hachey Janice Grey-Scott Ann-Marie Aitchison Abbygail Noah	Arctic research from the perspectives of six participants in Nunavut Sivuniksavut
12:00	**Lunch**	

STUDENT DAY PROGRAMME

12:00	**Lunch**		
13:15	Lara Mountain	Introduction to Student Breakout Sessions	
	Room	**Topic**	**Facilitators**
13:30	205C	Keys to success for young researchers	G. Gilchrist, M. Mallory, I. Laurion
	205B	Designing a dynamic research proposal	L. Brathwaite
	2000AB	Communication and outreach	E. Loring I. Myers-Smith
	206A	Northern training and involvement	M. McKenna and Inuit Research Advisors
	206B	Arctic Research on the international stage	J. Baeseman H. Lantuit
15:00	**Break**		
15:30	Jenny Baeseman	International circumpolar research opportunities	
15:40	Vicki Sahanatian	Circumpolar training opportunities	
15:50	Lucette Barber	Review of Arctic Climate Change Youth Forum	
16:00	Ryan Brooks	Engaging undergraduate university students in climate change research	
16:15	ASA Update and General Assembly		
17:00	**Arctic Change Registration and Reception**		

PLENARY SESSION PROGRAMME

WEDNESDAY, 10 DECEMBER - 8:30 TO 10:00 OPENING PLENARY Chair: Martin Fortier, Chair of the Arctic Change 2008 International Organizing Committee		
08:30	Louis Fortier *Scientific Director, ArcticNet*	Welcome from ArcticNet and Introduction
08:40	Martin Fortier *Executive Director, ArcticNet*	Welcome from IOC and Meeting Logistics
08:45	Edwin Bourget *Vice Rector, Research and Creation, Université Laval*	Welcome from Université Laval
08:50	Duane Smith *President, Inuit Circumpolar Council-Canada*	Opening Remarks
09:00	Patrick Borbey *Assistant Deputy Minister, Northern Affairs Organization, Indian and Northern Affairs Canada*	The Northern Strategy and Science
09:15	David Carlson *Director, International Programme Office, International Polar Year*	The IPY 2007-2009: An Update
09:45	Questions & Discussions	
WEDNESDAY, 10 DECEMBER - 15:30 TO 17:00 PANEL: THE FUTURE OF CIRCUMPOLAR RESEARCH AND POLICY Chairs: Duane Smith, President, Inuit Circumpolar Council-Canada & Lars-Otto Reiersen, Executive Secretary, Arctic Monitoring and Assessment Programme (AMAP)		
15:30	David Hik *Vice-President, International Arctic Science Committee (IASC)*	
15:40	Carl Christian Olsen *Executive Council Member, Inuit Circumpolar Council-Greenland*	
15:50	Marybeth Murray *Executive Director, International Study of Arctic Change (ISAC)*	
16:00	Caleb Pungawly *Inuit Circumpolar Council-Alaska*	
16:10	Lene Kielsen Holm *Director of International Sustainable Development, Inuit Circumpolar Council-Greenland*	
16:20	Lars-Otto Reiersen *Chair, Sustaining Arctic Observing Networks (SAON) Initiating Group*	
16:30	Presentation of SAON recommendations to the Arctic Council	
16:40	Questions & Discussions	

PLENARY SESSION PROGRAMME

THURSDAY, 11 DECEMBER - 8:30 TO 10:10 EXPLORING EARTH'S LAST OCEAN FRONTIER Chair: Jody Deming, Chair, International Arctic Polynya Program		
08:30	David Grimes	Thriving in the North – Canadian Arctic Environmental Prediction Services
08:50	Wieslaw Maslowski	On limits and uncertainties of predictions of Arctic warming
09:10	Larry Mayer	Mapping the High Arctic: The Challenges and the Joys
09:30	Benoit Beauchamp	Hydrocarbon Energy from the Arctic: Holy Grail or Pipe Dream?
09:50	Don Rothwell	A New Legal Regime for the Arctic
THURSDAY, 11 DECEMBER - 15:30 to 17:30 MAJOR INTERNATIONAL ARCTIC RESEARCH PROGRAMS: HIGHLIGHTS AND RESULTS Chair: Peter Schlosser, Chair, Study of Environmental Arctic change (SEARCH) Science Steering Committee		
15:30	Barry Smit	Climate Adaptation & Vulnerability in Arctic Regions (CAVIAR)
15:50	Kue Young	Is Cancer Increasing among the Circumpolar Inuit?
16:10	Gilles Gauthier & Dominique Berteaux	Arctic Wildlife Observatories Linking Vulnerable EcoSystems (ArcticWOLVES)
16:30	Paul Wassmann	Arctic Tipping Points (ATP): a new EU project on marine ecosystems dynamics in the European Arctic sector?
16:50	Jean-Claude Gascard	Developing Arctic Modelling and Observing Capabilities for Long-term / Environmental Studies (DAMOCLES)
17:10	David Barber	The International Polar Year (IPY) Circumpolar Flaw Lead (CFL) system study

TOPICAL SESSION PROGRAMME
(Schedule)

WEDNESDAY, 10 DECEMBER -- 10:30 - 12:00 AM

T01A. Impacts of Climate Change on Arctic Trophic Interactions and Ecosystem Services?
Room 206A

10:30	Lecomte, Nicolas	Metamorphosis of the Arctic Terrestrial Food Webs: between Collapse of Native Species and Explosion of Exotic Predators?
10:45	Gauthier, Gilles	Impact of climate change on arctic terrestrial food webs: examples from the Bylot Island long term study
11:00	Doiron, Madeleine	Plant-herbivore interactions and climate change: The Case of the Greater Snow Goose
11:15	Hofgaard, Annika	Land use and climate driven alteration of trophic interactions in tundra systems: an alpine example from 62N
11:30	Therrien, Jean-François	Reproductive success and long-distance movements of Snowy Owls: is this top arctic predator vulnerable to climate change?
11:45	Smith, Paul	Seabirds Indicate Change in the Arctic Marine Environment

T04A. Community-Based Research Initiatives as an Interface for Inuit and Scientific Knowledge Exchange
Room 2000AB

10:30	Simon, Mary & Smith, Duane	Opening remarks by co-chairs
10:45	Mate, David	More Talk, More Action : Cooperative Approaches for Addressing Climate Change Adaptation at the Community Level in Nunavut
11:00	Huntington, Henry	Siku-Inuit-Hila: Connecting Communities and Scientists through Community Exchanges, Experts Groups, and Measurements
11:15	Furgal, Chris	Methods and Approaches to Linking Inuit Knowledge and Science for the Understanding of Climate Change in Arctic Regions
11:30	Aatami, Pita	The inuit of Nunavik (Northern Quebec): successes and challenges
11:45		

T06A. IPY 2007-2008 Research: Cryosphere / Hydrosphere / Atmosphere
Room 206B

10:30	Bernier, Monique	RADARSAT based river ice mapping in the Nunavik context
10:45	Chung, Yi-Ching	Evaluation of a Coupled Sea Ice System Including Blowing Snow Processes Over Arctic Sea-Ice
11:00	Gyakum, John	Trends in Canadian Surface Temperature Anomaly Intensity
11:15	Shiklomanov, Nikolay	Circumpolar Active Layer Monitoring (CALM) Program: Accomplishments and Future Directions
11:30	Peterson, Ingrid	Variability of oceanographic and ice properties in the eastern Canadian Arctic Archipelago
11:45	Myers, Paul	West Greenland Current Variability

T12. The Law and Politics of Canadian Jurisdiction on the Arctic Ocean Seabed
Room 205A

10:30	Byers, Michael	
10:45	Schofield, Clive	Boundaries, Biodiversity, Resources and Increasing Maritime Activities: Emerging Governance Challenges for Canada in the Arctic Ocean
11:00	Baker, Betsy	Science-driven cooperation and policy: Addressing Canadian/US diplomatic concerns in the Arctic
11:15	Kennair, John	An Inconsistent Truth: The Arctic in Canadian foreign policy
11:30	Macnab, Ronald	Use it or lose it: Action agenda or election slogan?
11:45		Questions ans dicussion

T16A. River-Ocean Interactions and Fluvial-Marine Mass Transfer in the North: Past, Present, and Future
Room 205B

10:30	Peckham, Scott	Sediment Transport in a Changing Arctic: River Plumes, Longshore Transport and Coastal Erosion
11:00	Hall, Roland	Climate-driven shifts in quantity and seasonality of river discharge from the headwaters of the Mackenzie River Basin over the past millennium: Implications for river-ocean interactions and natural resource management in the North
11:15	Solomon, Steven	Interactions between water, ice and sediment during spring breakup at the mouth of the Mackenzie River, Northwest Territories
11:30	Lafreniere, Melissa	Impact of climate variability and permafrost landscape disturbances on runoff generation and solute loads at Cape Bounty, Melville Island, 2006-200
11:45	Hughes Clarke, John	Mapping and monitoring sedimentary processes and fluxes across fjord deltas - Baffin Island

T20. Land Surface Processes and their Climate Interactions in High-Latitude Regions
Room 205C

10:30	Samuelsson, Patrick	Experiences from RCM simulations over high latitude regions coupled to lake, snow and forest processes
10:45	Savary, Stéphane	Comparison of snowpack evolution on the Necopastic River basin (Northern Quebec) using HYDROTEL and CROCUS
11:00	Minwei, Qian	Difficulties of Climate Simulation over the Arctic Using a Regional Climate Model
11:15	McLennan, Donald	Developing Terrestrial Ecological Inventory Methods that Link Land Surface Processes to Tundra Ecosystems in Torngat Mountain National Park Reserve
11:30	Martynov, Andrey	Lakes in the Canadian Regional Climate Model
11:45	Bhatti, Jagtar	Modeling the potential hydrothermal response impact of climate change on permafrost of within the South Mackenzie Plain, Northwest Territories, Canada

T23A. Education, Communication and Outreach: Linking Research to Public Policy and Environmental Awareness

Room 208AB

10:30	Barber, Lucette & Carlson, David	Opening remarks by co-chairs
10:45	Gislason, Robin	The 2008 Schools on Board Circumpolar Inuit Field Program
11:00	Macdonald, Robie	From field work to publication: ensnaring a future scientist
11:15	Illasiak, Velma	Dietary Choices in Aklavik, Northwest Territories, Youth and Elders Promoting Change
11:30	Klinkhammer, Ruth	Popularizing Arctic science: a media relations program to promote northern research
11:45	Pulsifer, Peter L.	Representing Inuit Sea Ice Knowledge and Use for Education and Outreach: Creating an IPY legacy using emerging data management strategies

WEDNESDAY, 10 DECEMBER -- 13:30 - 15:00 PM

T01B. Impacts of Climate Change on Arctic Trophic Interactions and Ecosystem Services?

Room 206A

13:30	Bolduc, Elise	Terrestrial arthropod abundance and phenology in the Canadian Arctic; modeling the variation in resources available to arctic-nesting insectivores
13:45	Dick, Terry	Using stable isotopes of carbon and nitrogen to predict trophic structure in deep-sea Arctic fish communities
14:00	Karnovsky, Nina	Warming in the Greenland Sea: Implications for Energy Transfer to Higher Trophic Levels
14:15	Divoky, George	Annual and seasonal variation in nearshore fish availability associated with the record Arctic pack ice minimum of 2007
14:30	Wiklund, Christer G.	Global warming affects the timing of the breeding season in a top predator, the merlin Falco columbarius, on the mountain tundra in N Sweden
14:45	Hendrichsen, Ditte	Sex-specific climatic effects on the spatial distribution of a northern ungulate

T04B. Community-Based Research Initiatives as an Interface for Inuit and Scientific Knowledge Exchange

Room 2000AB

13:30	Nasogaluak, Shelia	Integrating Science and Traditional Knowledge in the Inuvialuit Settlement Region: Perspectives from a Beluga Community Based Monitoring Program
14:00	Sheldon, Tom	Building a Base Camp: Building an IPY legacy in Nunatsiavut (Northern Labrador): Inuit Students and scientists and a new way of knowing
14:15	Friesen, Max	Community-Based Inuit Heritage Research: Lessons from a Nine-Year Partnership between an Inuit Community Group and a Southern University
14:30	Laidler, Gita	Connecting Community Observations and Expertise with the Floe Edge Service
14:45	Gearheard, Shari	Inuit Led Research in Nunavut: Lessons from the Ittaq Heritage and Research Centre, Clyde River, Nunavut

T06B. IPY 2007-2008 Research: Cryosphere / Hydrosphere / Atmosphere
Room 206B

13:30	Maslowski, Wieslaw	Oceanic forcing of recent warming in the western Arctic
13:45	Langlois, Alexandre	Latitudinal variations of snow properties using passive microwave brightness temperature and in-situ measurements over Eastern Canada
14:00	Shiklomanov, Nickolay	A snapshot of permafrost temperatures during the International Polar Year
14:15	Smith, Sharon	Thermal State of Permafrost in Canada: a snapshot of current conditions and recent trends
14:30	Zheng, Jiancheng	Variations in atmospheric Cd deposition in the Arctic since AD 1840, and preliminary assessment of predominant sources
14:45	Turner, Kevin	Characterizing the Diversity of Lake Water Balances in the Old Crow Flats, YT, Using Water Isotope Tracers

T14. Quantifying the Carbon Balance of Arctic Ecosystems at Various Scales
Room 207

13:30	Atkinson, Dave	Estimating CO2 flux measurements from the integration of high spatial resolution remotely sensed data and biophysical variables
13:45	Hayne, Shari	Carbon dioxide and methane fluxes from tundra environments at Daring Lake, NWT: examination of carbon cycling mechanisms and spatial and temporal flux variation
14:00	Startsev, Natalia	Spatial and temporal changes in net ecosystem exchange and soil respiration rate in in four northern ecoregions
14:15	Lansard, Bruno	Water mass distribution on the Mackenzie Shelf and the Amundsen Gulf as determined by total alkalinity and δ18O data
14:30	Shadwick, Elizabeth	Dissolved Inorganic Carbon in the Canadian Archipelago of the Arctic Ocean: The Export of Pacific Carbon to the North Atlantic Via Baffin Bay
14:45	Kos, Gregor	(Semi)volatile Organic Compounds at Alert, Nunavut - Snow Pack and Boundary Layer Composition

T16B. River-Ocean Interactions and Fluvial-Marine Mass Transfer in the North: Past, Present, and Future
Room 205B

13:30	Déry, Stephen	Recent trends and variability of river discharge in northern Canada
13:45	Gratton, Yves	Structure and dynamics of the Amundsen Gulf Eddies
14:00	Kuzyk, Zou Zou	Sources, pathways and sinks of particulate organic matter in Hudson Bay: evidence from lignin distributions
14:15	Kirk, Jane	Inputs of Mercury to Hudson Bay from Nelson and Churchill River Discharge 2003-2006
14:30	Lorrain, Stéphane	Water turbidity and suspended sediment characteristics in the Nelson river estuary, Hudson Bay, Manitoba, Canada
14:45	Leclair, Suzanne	Seabed sediment characteristics, processes, and landforms in the Nelson river estuary, Hudson Bay, Manitoba, Canada

T17. Observing Pan-Arctic Environmental Change
Room 205A

13:30	Murray, Maribeth	The International Study of Arctic Change: Towards improving pan-arctic observations and understanding of change
13:45	Svoboda, Michael	The Circumpolar Biodiversity Monitoring Program: Towards Integrated Arctic Biodiversity Monitoring
14:00	Olthof, Ian	Approaches to monitoring northern vegetation change with satellite remote sensing
14:15	Dahle, Salve	Climate and anthropogenic studies on food webs of the Arctic marginal seas
14:30	Adamowicz, Sarah	The biota of Churchill: barcoding as a tool for biodiversity assessment and monitoring
14:45	Haas, Christian	Pan-Arctic sea ice mass balance observations - status and challenges

T23B. Education, Communication and Outreach: Linking Research to Public Policy and Environmental Awareness
Room 208AB

13:30	Green, Geoff	Passing the Torch - Engaging Youth in Global Issues through experiential learning
13:45	Walker, Kaley	CANDAC Outreach in the High Arctic: A Chilly Endeavour for IPY
14:00	Ostiguy, Diane	Nunavik wildlife and you, wildlife education program
14:15	Roburn, Shirley	The Being Caribou Project : Local stories, international policy, and grassroots civil society -- a case study
14:30	West, Peter	A Successful Experiment in Collaboration: U.S. Science Agencies Forge Major Joint International Polar Year (IPY) Outreach Efforts
14:45		Closing remarks co-chairs

THURSDAY, 11 DECEMBER -- 10:30 - 12:00 AM

T03A. Climate Change and Arctic Contaminants
Room 2000AB

10:30	Wang, Feiyue	Mercury cycling in the Arctic Ocean: The role of the sea ice environment
11:00	Berg, Torunn	Norwegian measurements of atmospheric mercury depletion events at Antarctica, Svalbard and the mainland of Norway
11:15	Kallenborn, Roland	Atmospheric monitoring of persistent organic pollutants at the zeppelin mountain research station (Ny-Aalesun, Svalbard: Indications for climate change influences?
11:30	Cole, Amanda	Effects of climate change on atmospheric mercury depletion in the Canadian Arctic
11:45	Zheng, Jiancheng	Climate and decreasing levels of sulphate aerosols in the high Arctic: an update of continues studies

T07. IPY 2007-2008 Research: Health and Well-Being of Northerners
Room 205C

10:30	Mäkinen, Tiina	Climate change and human health-how does cold exposure trouble us?
10:45	Counil, Émilie	Consumption of Sugar-Sweetened Beverages and Components of the Metabolic Syndrome in Inuit adults of Northern Québec (Nunavik)
11:00	Noël, Martin	Are Inuit Protected Against Deleterious Effect of Traditional Cardiovascular Risk Factors for Atherosclerosis?
11:15	Li, Y. Anita	The Prevalence of Human Papillomavirus and Its Impact on Cervical Dysplasia in Northern Canada
11:30	Simard, Manon	Engaging northern communities in the monitoring of country food safety
11:45		Questions and discussions

T10A. Community Adaptation and Vulnerability in Arctic Regions
Room 206A

10:30	Hovelsrud, Grete	Community Adaptation and Vulnerability in northern Norway: Some preliminary CAVIAR findings
10:45	Berkes, Fikret	Co-Management Institutions and the Use of Knowledge: Adapting to Change in the Arctic
11:00	Armitage, Derek	From Adaptation to Learning and the Potential of Adaptive Co-Management to Reduce Vulnerability in Arctic Communities
11:15	Duerden, Frank	Dawson City. A Community on the Edge?
11:30	Matthews, Ralph	Climate Change and Institutional Capacity in an Arctic Gateway Community: A CAVIAR case study of the City of Whitehorse
11:45	Bradshaw, Ben	Assessing Community Vulnerabilities in light of Climate Change: To what end?

T18A. Marine Productivity and Biogeochemical Fluxes in the Changing Arctic
Room 206B

10:30	Arrigo, Kevin	Changes in Arctic Ocean Primary Production from 1998-2008
11:00	Belanger, Simon	Satellite-based assessment of the light-driven components of the modern Arctic Ocean biogeochemical carbon cycle
11:15	Tremblay, Jean-Éric	Nutrient dynamics in the southeast Beaufort Sea during the CFL, CASES and ArcticNet campaigns: implications for primary productivity
11:30	Rivkin, Richard	Microbial dynamics and response to a changing polar ocean climate
11:45	Maranger, Roxane	Nitrous Oxide concentrations in the Amundsen Gulf of the Arctic Ocean

T19. Sea-Ice-Atmosphere Interactions and Climate in a Changing Arctic
Room 205B

10:30	Scarratt, Michael	Distributions of the natural greenhouse gas N2O in Canadian arctic waters
10:45	Luce, Myriam	Microbial production of dimethylsulfide in the Arctic
11:00	Norman, Ann-Lise	Relationships between sulphur dioxide, sulphate aerosols and dimethylsulphide in the Arctic atmosphere
11:15	Miller, Lisa	A winter carbon flux time series in land-fast sea ice
11:30	Steiner, Nadja	Modelling biogeochemical cycling and interfacial exchange of climatically important gases
11:45	Willmott, Andrew	The effect of tides on dense water formation in arctic shelf seas

T26A. Role of Arctic Marine Mammals in Northern Ecosystems and Cultures
Room 205A

10:30	Ferguson, Steven	Loss of chaos in the Arctic: what it means to ice-adapted marine mammals
10:45	Marcoux, Marianne	Characteristics of narwhal vocalizations for acoustic mornitoring
11:00	Chmelnitsky, Elly	Photo-identification of eastern Arctic killer whales, Orcinus orca
11:15	Strandberg, Ursula	Functional layering of marine mammal blubber influences the stratification of lipophilic compounds in the blubber
11:30	Dunn, J. Lawrence	Brucella c-elisa serosurveys in Arctic marine mammal populations
11:45	Simard, Yvan	The opening of Arctic shipping routes: underwater noise pollution consequences on marine mammal habitats as measured on a nearby southern seaway, the St. Lawrence

T34. Seafloor Mapping of the Arctic Ocean, Continental Shelves and Margins
Room 207

10:30	Ryan, William	A Web Mapping Service for Multi-Resolution Bathymetry of the Arctic Ocean
10:45	Brown, Tanya	Benthic habitat maps for Nachvak and Saglek fiords: A contribution to Nunatsiavut Nuluak, northern Labrador, Canada
11:00	Beaudoin, Jonathan	Mapping Canada's Arctic Seabed: Data Processing, Management and Distribution Strategies
11:15	Lajeunesse, Patrick	Rapid early Holocene deglaciation of Hudson Bay
11:30	Ferguson, James	Using Autonomous Underwater Vehicles in Under-ice Scientific Missions
11:45	Mosher, David	Seafloor mapping of the central Labrador margin: near surface geology and geohazards

THURSDAY, 11 DECEMBER -- 13:30 - 15:00 PM

T03B. Climate Change and Arctic Contaminants
Room 2000AB

13:30	Borga, Katrine	Predicting climate change-induced alteration in food web accumulation of contaminants
13:45	Chételat, John	Shifts in Zooplankton Composition Driven by Climate Change Could Alter Methylmercury Transfer to Fish in High Arctic Lakes
14:00	Ross, Peter	A changing climate may increase the risk of contaminant-related health risks in Beaufort Sea beluga whales
14:15	Dietz, Rune	Contaminant linkages to climate parameters in polar bears (Ursus maritimus) from Greenland and Svalbard
14:30	McKinney, Melissa	Does sea ice-associated variation in diet influence the temporal trends of organohalogen concentrations in Western Hudson Bay polar bears?
14:45	Knott, Katrina	Annual and individual variations in feeding ecology of Southern Beaufort Sea polar bears by stable isotope analysis: Interactions with blood PCBs and Hg

T10B. Community Adaptation and Vulnerability in Arctic Regions
Room 206A

13:30	Huntington, Henry	Demographics and Environmental Conditions are Uncoupled in the Pribilof Islands Social Ecological System
13:45	Ford, James	Opportunities for policy to support Inuit adaptation to climate change
14:00	Boudreau, Stéphane	Le développement de pratiques de restauration appliquées au milieu nordique : l'exemple de Whapmagoostui-Kuujuarapik au Québec subarctique
14:15	Fleming, Laura	Changing Governance and the Governance of Change
14:30	Malone, Leslie	Polar Climate Outlook Forum: A mechanism for improved adaptation strategies and outcomes
14:45	Numminen, Lotta	Climate change in the Arctic: perspectives to adaptation

T15. Freshwater Ecosystems, Aquatic Biodiversity and Sensitivity to Climate Change
Room 205C

13:30	Wrona, Fred	Hydro-ecological Responses of Arctic Tundra Lakes to Climate Change and Landscape Perturbation: Highlights and Preliminary Results
13:45	Balasubramaniam, Ann	Developing a framework of baseline data in a complex thermokarst lake system using relationships between hydrological processes and limnological conditions
14:00	Retamal, Leira	Aquatic processes controlling greenhouse gas exchanges in thaw ponds: the role of microbial production at Bylot Island, Nunavut
14:15	Wiklund, Johan	Limnological approaches to track climate- and human-induced hydrological changes in northern floodplain landscapes: Experiments from the Peace-Athabasca Delta
14:30	Swanson, Heidi	Transients in the north: interactions of migratory fish, climate change, and contaminant accumulation in coastal Arctic lakes
14:45	Reist, Jim	An Overview and Integration of IPY Research on Chars

T18B. Marine Productivity and Biogeochemical Fluxes in the Changing Arctic
Room 206B

13:30	Juul-Pedersen, Thomas	Marine monitoring and research studies in Greenland
13:45	Reigstad, Marit	Vertical export or retention? The fate of organic carbon in open and ice-covered regions of the Barents Sea
14:00	Tamelander, Tobias	Vertical export of organic matter from sea ice in the Barents Sea and Nansen Basin (Arctic Ocean)
14:15	Lalande, Catherine	Variations in annual cycles of vertical particulate organic carbon export on Arctic shelves: A comparison between the Laptev Sea, Northern Baffin Bay and the Beaufort Sea
14:30	Sampei, Makoto	Significant contribution of passively sinking copepods to downward export flux in Canadian Arctic waters.
14:45	Ringuette, Marc	Phytoplankton biomass, sea surface temperature and cannibalism/predation and their antagonist effects on the North Water Polynya copepods population dynamics

T26B. Role of Arctic Marine Mammals in Northern Ecosystems and Cultures
Room 205A

13:30	Petersen, Stephen	Population genetics of Canadian ringed seals: probing deeper into nature's approximation of panmixia
13:45	Obbard, Martyn	Current Status of the Southern Hudson Bay Polar Bear Population
14:00	Loseto, Lisa	Beluga contaminant levels: An ecosystem approach to a species specific question
14:15	Higdon, Jeff	Exploitation and recovery of bowhead whales in northwest Hudson Bay: implications for ecosystem dynamics
14:30	Bortoluzzi, Tara	Global Warming and Arctic Marine Mammals (GWAMM): The development of a Community-Based Monitoring (CBM) network within the Hudson Bay region of Canada
14:45	Barrett-Lennard, Lance	Fostering stewardship of marine mammals in coastal communities: Insights from the B.C. Cetacean Sightings Network

T29. Impacts of Severe Arctic Storms and Climate Change on Arctic Coastal Oceanographic Processes
Room 205B

13:30	Cooke, Melanie	The synoptic and planetary scale environment associated with significant wind events along the Beaufort Sea coast
13:45	Zhang, Shunli	A Numerical Study of Hurricane Noel (2007). Model Verification and Extratropical Transition
14:00	Zhang, Lujun	Impacts of Air-Sea Fluxes on the Evolution of an Arctic 'Bomb'
14:15	Hay, Carling	Flying into the Eye of a Polar Low
14:30	Hoque, Md. Azharul	Modeling Arctic storm waves by SWAN in the southern Beaufort Sea
14:45	Small, David	Meteorological conditions associated with significant storm surge activity along the Beaufort Sea coast

T32. Arctic Climate Feedbacks: Atmospheric Composition and Long Range Transport of Chemical Constituents
Room 208AB

13:30	Blanchet, Jean-Pierre	On the Role of Anthropogenic Aerosols in Thin Ice Clouds Formation during Winter: Implications for Arctic Climate and Decision Makers
13:45	Gong, Sunling	Identification of Natural and Human Induced Trends and Variability of 30 Year Canadian Arctic Aerosols
14:00	Grenier, Patrick	Investigation of the dehydration-greenhouse feedback trigger using satellite measurements
14:15	Girard, Éric	Modelling of the effects of acidic aerosols on arctic cloud microstructure and surface radiative budget during winter
14:30	Munoz-Alpizar, Rodrigo	Vertical transport and mixing of aerosols and moisture in Polar Regions by Cold lows systems
14:45	Walker, Thomas	Integrated analysis of the impact of long-range transport of midlatitude pollution on ozone abundances in the Arctic troposphere

T35. Measurements and Numerical Modelling of Precipitations in Cold Climates
Room 207

13:30	Rasmussen, Roy	Snowfall Measurements at Exposed, High Wind Sites
13:45	Cherry, Jessica	Performance of the Experimental Total Precipitation Sensor in Barrow, Alaska
14:00	Gultepe, Ismail	Light precipitation at cold temperatures during april of 2008 in barrow alaska
14:15	Morrison, Hugh	Observations and modeling of snow microphysics in Arctic mixed-phase clouds
14:30	Milbrandt, Jason	Forecasting the Solid-to-Liquid Ratio of Snow Precipitation in High-Resolution NWP Models
14:45	Chosson, Frederick	Simulation of precipitations over the Arctic basin: a sensitivity study with polar-gem modelling system

FRIDAY, 12 DECEMBER -- 10:30 - 12:00 AM

T02. Climate Change, Natural Hazards, Health and Well-being in the Arctic
Room 205B

10:30	Ford, James	Climate change, natural hazards, and vulnerability in small Inuit communities: A comparison between Igloolik, Nunavut, and Qeqertarsuaq, Greenland
10:45	Breton-Honeyman, Kaitlin	Climate change, search and rescue and human vulnerability in the Canadian Arctic
11:00	Boucher, Étienne	Impacts of Recurring Ice-Jams on Channel Geometry and Geomorphology in a Small High-Boreal Watershed
11:15	Edge, Victoria	Risk Perception and Mitigation Related to 'Safe' Food and Water: Impacts on Human Health
11:30	Huntington, Henry	Risk and Reward: Hazards of Hunting the Bowhead Whale
11:45		Closing remarks co-chairs

T11A. The Role of Sea Ice in Arctic Marine Ecosystem Processes
Room 2000AB

10:30	Falk-Petersen, Stig	The Calanus complex in a pan-Arctic perspective
10:45	Benoit, Delphine	Seasonal and daily scale behaviour of Arctic cod winter aggregations under the sea-ice cover at a fixed station in Franklin Bay (Beaufort Sea)
11:00	Berge, Jørgen	Ups and downs all year round: DVM patterns in Arctic zooplankton
11:15	Collins, Kate	Zooplankton communities in Barrow Strait as estimated from moored Acoustic Doppler Current Profiler (ADCP) data
11:30	Kramer, Maike	The role of sympagic meiofauna for the flow of organic matter in Arctic sea-ice food webs
11:45	Aitken, Alec	Distribution Patterns of Canadian Beaufort Shelf Macrobenthos

T21A. Climate Change and Quaternary Evolution of the Arctic
Room 205C

10:30	Rochon, André	Marine paleoenvironments in the Canadian Arctic: what have we learned in recent years?
10:45	Lisé-Pronovost, Agathe	Postglacial Sedimentation and Environmental Magnetism in the Arctic Alaskan Margin
11:00	Ledu, David	Holocene Climate Changes in the Main Axis of the Northwest Passage inferred from dinocyst Assemblages: a Possible Influence of the Arctic Oscillation at the Millennial time scale
11:15	Scott, David	Isotopic and sedimentological evidence for sea ice conditions and paleoceanography of the 15,000 years on the Beaufort sea slope and Amundsen Gulf, Canada
11:30	St-Onge, Guillaume	Evidence of Lake Agassiz final outburst flood from Hudson Bay to offshore Labrador
11:45	Bonnet, Sophie	Variability of Sea-Surface Temperature and Sea-Ice Cover in the Fram Strait over the last Two Millennia

T22A. CANDAC, PEARL, and Atmospheric Measurements in the Canadian High Arctic
Room 205A

10:30	Drummond, James	The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut CANADA
11:00	Bacak, Asan	Long range atmospheric transport of Aerosols: First Arctic measurements using Aerosol Mass Spectrometer
11:15	Duck, Thomas	CANDAC Arctic Radiative Environment Theme
11:30	Ayash, Tarek	Arctic-Winter Climatology and Radiative Effects of Clouds and Aerosols Based on Lidar and Radar Measurements at PEARL
11:45	Strong, Kimberly	Measuring Atmospheric Composition at PEARL: An Overview of the First Two Years

T24A. Hudson Bay: New Findings and Directions for Future Study
Room 206B

10:30	Macdonald, Robie	Hudson Bay: New Findings and Future Directions
10:45	Azetsu-Scott, Kumiko	Freshwater and carbon dynamics in Hudson Bay: Results from MERICA 2003-2006
11:00	Granskog, Mats	Recent observations on the distribution and dynamics of freshwater in the Hudson Bay system
11:15	Briand, Marie-Hélène	Exploring the Physical Environment of a Subarctic Estuary, the Nelson River Estuary, Hudson Bay, Canada
11:30	Mundy, C.J.	Riverine export and the effects of circulation on dissolved organic carbon in the Hudson Bay system, Canada
11:45	Sibert, Virginie	Understanding the spatial and temporal variability of primary production over the Hudson Bay, Foxe Basin and Hudson Strait marine system via coupled bio-physical models

T25. Changes in Tundra Ecosystems: Impacts and Implications
Room 206A

10:30	Fréchette, Bianca	Sunshine: an important bioclimatic control on Holocene and Last Interglacial vegetational development in eastern Baffin Island, Arctic Canada
10:45	Henry, Greg	Trends in tundra vegetation over the past 20 years: analysis of long-term data sets from the International Tundra Experiment (ITEX)
11:00	Grogan, Paul	Birch shrubs in the Canadian low arctic may respond relatively quickly to climate warming
11:15	Myers-Smith, Isla	How do natural and artificial tall shrub canopies alter tundra soil temperatures?
11:30	Buckeridge, Kate	Snow depth controls the spring nutrient flush in arctic tundra
11:45	Lévesque, Esther	Towards an Understanding of the Implications of Shrub cover Change in Nunavik

T27. Environmental change in Arctic coastal regions: biophysical processes and community adaptation
Room 207

10:30	Forbes, Don	Arctic coastal research: recent developments in Canada and the circumpolar world
10:45	Lantuit, Hugues	Comparing the last fifty years of erosion in the Canadian and Russian Arctic
11:00	Manson, Gavin	Climate-change impacts on an emergent Arctic shoreline, Hall Beach, NU
11:15	Irvine, Melanie	Linking Landscape Conditions and Community Planning in Arctic Communities
11:30	Hovelsrud, Grete K.	Exploring the implications of climate variability and change for coastal fisheries in Northern Norway: the case of Lebesby municipality
11:45	Parewick, Kathleen	Climate Change and the Built Community: Practical Lessons for Adaptation Governance

FRIDAY, 12 DECEMBER -- 13:30 - 15:00 PM

T08. The Northern Biodiversity Paradox: Global Crisis yet Local Enrichment
Room 206A

13:30	Berteaux, Dominique	The Northern biodiversity paradox: global crisis yet local enrichment
13:45	Vincent, Warwick	Extreme warming, habitat loss and abrupt ecosystem change at Canada's northern edge
14:00	McKinnon, Laura	Latitudinal trends in predation pressure: investigating the vulnerability of shorebirds to climate induced shifts in predator composition
14:15	Fernandez-Triana, Jose	Combining barcoding and traditional taxonomy to study the diversity of Microgastrinae wasps (Hymenoptera: Braconidae) in Arctic North America
14:30	Danby, Ryan	Up, Up and Away? Biodiversity and Climate Change in the Alpine Ecosystems of Southwest Yukon
14:45	Kutz, Susan	Parasite Biodiversity, Climate Change, and Arctic Ecosystems: Why Should We Care?

T09. Climate Change Studies in the Arctic: Perspectives from Young Scientists
Room 205B

13:30		
13:45	Goldhar, Christina	Food security in Western Greenland: A case study from Qeqertarsuaq
14:00	Pearce, Tristan	Adaptation to Climate Change in the Arctic: knowledge transmission and information exchange among Inuit in an arctic community
14:15	Wesche, Sonia	Impacts of Climate Change on Inuit Diet in the Western Arctic: Links Between Climate Change, Food Security and Nutritional Health
14:30	Moshøj, Charlotte	The effect of climate, environment and man on variations in wildlife population fluctuations in Greenland over 200 years
14:45	Donaldson, Shawn	Community-based health research in the Arctic: A case study from Nunavut, Canada

T11B. The Role of Sea Ice in Arctic Marine Ecosystem Processes
Room 2000AB

13:30	Deming, Jody	Winter frost flowers on sea ice: vectors for upward transport of microbes and viruses?
13:45	Leu, Eva	Seasonal changes in pelagic and sympagic algal food quality
14:00	Link, Heike	Relationship between sea ice-cover and benthic carbon turnover in the Amundsen Gulf
14:15	Margaux, Noyon	Lipid classes metabolism of the arctic amphipod Themisto libellula: growth and environmental influences
14:30	Narcy, Fanny	Seasonal and individual variability of lipid reserves in Oithona similis (Cyclopoida) in an Arctic fjord
14:45	Søreide, Janne Elin	Importance of ice algae for Calanus glacialis in the high-Arctic

T21B. Climate Change and Quaternary Evolution of the Arctic
Room 205C

13:30	Ross, Martin	New constraints on the deglaciation of Foxe Channel and Southampton Island, Nunavut
13:45	Finkelstein, Sarah	Spatial patterns of Holocene paleoclimatic change in the Canadian Arctic Islands
14:00	Rolland, Nicolas	Chironomids as indicators of postglacial paleoclimates of the Foxe Peninsula, Nunavut, Canada
14:15	Pienitz, Reinhard	The Crystal Eye of Nunavik: (Pingualuit): New insights from one of the deepest crater lakes and one of the oldest sediment records of the Northern Hemisphere
14:30	Salonen, Veli-Pekka	Weichselian glacial sedimentology and stratigraphy in Murchisonfjorden area, Nordaustlandet, Svalbard
14:45	Fritz, Michael	Ground ice studies on Herschel Island in the western Canadian Arctic: a useful paleoenvironmental proxy tool

T22B. CANDAC, PEARL, and Atmospheric Measurements in the Canadian High Arctic
Room 205A

13:30	Harvey, Lynn	The Arctic polar stratosphere and mesosphere during IPY
14:00	Walker, Kaley	Canadian Arctic Validation Campaigns for the Atmospheric Chemistry Experiment (ACE) satellite mission: 2004-2008 and beyond
14:15	Moss, Andrea	Polar Sunrise 2008 Comparison of Lidar Water Vapor Measurements From the IASOA PEARL Observatory in Eureka, Canada and the ACE Satellite
14:30	Ward, William	Instrumentation, Observations and Science associate with the Waves and Coupling Processes Theme at the Polar Environment Atmospheric Research Laboratory (PEARL)
14:45	Shepherd, Marianna	Wave perturbations in optical airglow observations at high Northern latitudes

T24B. Hudson Bay: New Findings and Directions for Future Study
Room 206B

13:30	Else, Brent	Estimation of Air-Sea CO2 Flux in Hudson Bay During the Ice-Free Season Using Field and Satellite Remote Sensing Data
13:45	Lapoussière, Amandine	Phytoplankton biomass, primary production and export in the Hudson Bay system
14:00	Chambellant, Magaly	Abundance and distribution of ringed seals in western Hudson Bay 1995-2008
14:15	Wilson, Paul	Population genetic structure in polar bears(Ursus maritimus) from Hudson Bay, Canada: Implications of future climate change
14:30	Ferland, Joannie	Spatial Variability of Summer Primary Production in the Hudson Bay Complex
14:45	Hoover, Carie	Preliminary Results of the Hudson Bay Ecosystem Mode

T33. Linking Communities and Scientists in Monitoring Long-Term Environmental Change
Room 208AB

13:30	Berkes, Fikret	Community-based Monitoring: Expanding the Range of the Kinds of Changes to Be Assessed
13:45	Huntington, Henry	Exchange for Local Observations and Knowledge in the Arctic: Data Management Support for Community-Based Arctic Observing Network
14:00	Rouillard, Remy	One Island, different Views: The Nenets Reindeer Herders of the Kolguev Island (Nenets Autonomous Okrug, Russia), and Oil Workers and Scientists
14:15	Lee, David	Linking communities and scientists: Identifying Challenges and Common Goals of Wildlife Related Research in Nunavut
14:30	Brook, Ryan	Linking Scientists and Communities in Wildlife Health Monitoring and Education: An overview and assessment of the Sahtu Wildlife Health Outreach and Monitoring
14:45	Curry, Pat	Putting Our Heads and Skills Together: Hunters and Scientists and Caribou Health Monitoring

TOPICAL SESSION PROGRAMME
(Co-Chairs and Description)

T01. Impacts of Climate Change on Arctic Trophic Interactions and Ecosystem Services?

Co-chairs
Gilles Gauthier, Université Laval, Québec, Canada, *Gilles.Gauthier@bio.ulaval.ca*
Nigel Gilles Yoccoz, University of Tromso, Tromso, Norway

Climate change is strongly affecting Arctic ecosystems, as the distribution, abundance, and interactions of species are altered. Changes in species assemblage, either through the decrease or disappearance of Arctic species or the invasion of new ones, will interact with trophic interactions such as herbivory, predation and parasitism, leading to cascading effects on ecosystem services such as hunting, reindeer herding or tourism. The speed of response to changing conditions will also vary among trophic levels, which may cause a mismatch in the timing of seasonal events between herbivore and their food plants or predator and their prey, leading to further disruption of the trophic dynamics. Arctic ecosystems, where food webs include a relatively small number of species, are especially sensitive to these changes. Although some of these changes are already apparent, predicting their outcome on ecosystem services is exceedingly complex due the paucity of information on the functioning of arctic food webs. As several International Polar Year projects attempt to fill this knowledge gap at numerous sites in the circumpolar world, this session provides an opportunity to review progress made to date and to identify challenges still ahead. The session will focus primarily on terrestrial ecosystems and will encompass a large diversity of human communities, ecosystem services and terrestrial food webs throughout the circumpolar world. Contributions from aquatic ecosystems are also welcome.

T02. Climate Change, Natural Hazards, Health and Well-being in the Arctic

Co-chairs
James D. Ford, McGill University, Montreal, Quebec, Canada, *james.ford@mail.mcgill.ca*
Chris Furgal, Trent University, Ontario, Canada, *chrisfurgal@trentu.ca*

Natural hazards are part of life in the Arctic. Oral histories recollect stories of hunters who drifted away on ice floes in dangerous sea ice environments, who suffered significant hardship when access to traditional food was constrained, and of communities destroyed by storms. At the same time, stories exist of Arctic peoples enduring exceptional environmental conditions and developing innovative and unique methods for adapting to variable and threatening conditions. While exposure to hazardous conditions has been somewhat moderated in a contemporary setting, indigenous residents throughout the circumpolar north have noted changes in the magnitude and frequency of natural hazards in recent years. These changes have had implications for safety while hunting and traveling, and in some instances have compromised food security and other components of individual and community well-being. To date, the majority of hazards research in the Arctic has focused on the nature of, and change in, biophysical conditions themselves in terms of their magnitude, frequency, and spatial distribution. Notwithstanding the physical focus of hazards research, recent years have witnessed the emergence of new approaches which focus on how human interaction with biophysical conditions shapes hazard exposure and change. This is consistent with broader trends in hazards research. This session will focus on how the interaction between the environment and human behaviour shapes hazard exposure in the circumpolar north, and how this interaction is changing over time as a consequence of climatic and societal change. In particular, papers will focus on physical risks associated with such things as hunting and traveling, hazards posed to communities, food security, and approaches to assessing hazard vulnerability.

T03. Climate Change and Arctic Contaminants

Co-chairs
Gary Stern, Fisheries and Oceans Canada, Winnipeg, Canada, *Gary.Stern@dfo-mpo.gc.ca*
Peter Outridge, Natural Resources Canada, Canada, *outridge@NRCan.gc.ca*

Climate change has already had measurable impacts on key environmental processes and characteristics in the Arctic, including sea-ice cover, precipitation, permafrost melt, aquatic productivity, and new species introductions. Only within the last decade has it has been realized that these changes may, in turn, significantly impact the pathways, fate, bioaccumulation and toxicity of chemical contaminants in the Arctic. These impacts can affect human contaminant exposure, by altering bioaccumulation in traditional wild foods.

This session will showcase the newly-realized science exploring the linkages between recent climate warming and major contaminants. The focus will be on understanding the pathways, fate and mechanisms involved, the magnitude of climate's influence compared to changing emissions, and the likely future consequences of further warming for contaminants in Arctic food chains.

T04. Community-Based Research Initiatives as an Interface for Inuit and Scientific Knowledge Exchange

Co-chairs

Mary Simon, President, Inuit Tapiriit Kanatami, Ottawa, Canada
Duane Smith, President, Inuit Circumpolar Council, Ottawa, Canada

Community involvement in arctic research, including the incorporation or consideration for Indigenous Knowledge, has become a goal and expectation among many northern research organizations, governments, Inuit organizations, research networks, funding agencies, and northerners themselves. Significant progress has been seen in terms of improving community-researcher relationships, and developing unique approaches to community-based and community-driven research in the past decade. However, many of the lessons learned regarding the processes of engaging communities and methods used to bring together or exchange knowledge between Inuit and non-Inuit researchers remain underreported. Many researchers and policy makers alike, argue that only through truly cooperative approaches to work, drawing on the best available knowledge at hand, can many of the increasingly complex arctic environmental and health issues be adequately addressed. This session will showcase community-based projects or initiatives that have successfully developed an interface for knowledge exchange between Inuit and non-Inuit scientists. We invite abstract submissions not based on research topic, but rather with a request to focus on issues of community-based research approaches, methods employed, lessons learned, and recommendations to ensure practical outputs that benefit both the northern and research communities. We propose this session in an effort to contribute to objectives within both ArcticNet and the International Polar Year to facilitate discussion on: i) engaging communities and scientists in research that helps to answer complex questions; ii) communicating and applying research results to benefit northern communities and decision-making; and, iii) ways that Inuit knowledge can inform national and international science and policy.

T06. IPY 2007-2008 Research: Cryosphere / Hydrosphere / Atmosphere

Co-chairs

David Barber, University of Manitoba, Winnipeg, Manitoba, Canada, *dbarber@cc.umanitoba.ca*
Jean-Claude Gascard, Université Pierre et Marie Curie, Paris, France, *gascard@locean-ipsl.upmc.fr*

International Polar Year 2007-2008 is the largest ever international program of polar research. Working with our circumpolar partners, Canada's IPY funding is supporting projects and activities to advance the understanding of the physical, natural and human processes and changes taking place in the Arctic. The results of this work will provide a greater understanding of how to manage the impacts of climate change on health, well-being, traditions, culture and economic development in the north.

This proposed session arises from one of the priority issues for the north - climate change impacts and adaptation. The focus of this session will be on the physical sciences associated with the broad IPY research areas "cryosphere / hydrosphere / atmosphere." The Government of Canada Program for IPY and the Natural Sciences and Engineering Research Council (NSERC) invite Canadian and international researchers to present the early results of their IPY research projects involving snow and ice, glaciers, permafrost, oceans, freshwater systems, weather, air pollution, etc.

T07. IPY 2007-2008 Research: Health and Well-Being of Northerners

Co-chairs

Kue Young, University of Toronto, Toronto, Ontario, Canada, *kue.young@utoronto.ca*
Tiina Makinen, University of Oulu, Finland, *tiina.makinen@oulu.fi*

International Polar Year 2007-2008 is the largest ever international program of polar research. Working with our circumpolar partners, Canada's IPY funding is supporting projects and activities to advance the understanding of the physical, natural and human processes and changes taking place in the Arctic. The results of this work will provide a greater understanding of how to manage the impacts of climate change on health, well-being, traditions, culture and economic development in the north.

This proposed session highlights one of the priority issues for the north - health and well-being of northern communities. The focus of this session will be on the broad IPY research area "health and well-being of northerners." The Government of Canada Program for IPY and the Natural Sciences and Engineering Research Council (NSERC) invite Canadian and international researchers to present the early results of

their IPY research projects involving such topics as health disparity elimination, factors contributing to the health of Northerners, the health effects linked to climate variability, chronic and infectious diseases, etc.

T08. The Northern Biodiversity Paradox: Global Crisis yet Local Enrichment

Co-chairs

Dominique Berteaux, Université du Québec à Rimouski, Rimouski, Canada, *Dominique_Berteaux@uqar.qc.ca*
Warwick Vincent, Université Laval, Quebec City, Quebec, Canada, *Warwick.Vincent@bio.ulaval.ca*

The Arctic is the end-member of a declining biodiversity gradient that runs from the tropics to the North Pole. Climate warming is currently shifting this gradient to the North, with a predicted acceleration of biodiversity erosion at the global level. Local patterns, however, will be heterogeneous. Whereas the Arctic will lose its ice-dependent habitats and some of its species most adapted to low temperatures and short growing seasons, biodiversity in the Arctic will generally increase with the augmentation of primary productivity and the arrival of new species from the South. The speed and details of local impacts on ecosystem services are unknown and difficult to predict, especially on islands where contingence will have large effects. It is already clear, however, that biodiversity conservation in the 21st century Arctic will have to deal at least as much with invading Southern species as with declining Arctic species, in a context where adaptation strategies for habitat and biodiversity conservation may be limited. This session will examine some of the theoretical and practical facets of the Northern biodiversity paradox described above. The session will encompass terrestrial, freshwater and marine ecosystems, and will consider a variety of biological communities in the North, from microbes to plants and animals.

T09. Climate Change Studies in the Arctic: Perspectives from Young Scientists

Co-chairs

James D. Ford, McGill University, Ontario, Canada, *james.ford@mail.mcgill.ca*
Tristan Pearce, University of Guelph, Ontario, Canada

The last five years have witnessed a proliferation of studies characterizing the speed and magnitude of climate change in Arctic regions, documenting impacts, modeling future climate change, assessing vulnerability of human communities, and exploring policy options to promote sustainable development in the context of a changing climate. Large national and international initiatives such as ArcticNet and the International Polar Year have added new impetus to climate change studies in Arctic regions. Young scientists - including undergraduate and graduate students as well as young faculty - are at the forefront of efforts to advance our understanding of climate change impacts and vulnerabilities in northern regions. Moreover, many young scientists are in the vanguard of efforts to involve communities and build bridges between disciplines to address pressing scientific questions. This special session will provide a venue for young scientists working on climate change issues in the human, physical and health sciences to profile their work. A variety of papers will be accepted, including: empirical findings, conceptual overviews, discussion pieces, and policy reviews. In particular, the session will seek to recruit provocative papers which challenge conventional wisdom and research approaches, make linkages between scientific disciplines, and provide insights into the direction tomorrow's scientific leaders will take us.

T10. Community Adaptation and Vulnerability in Arctic Regions

Co-chairs

Barry Smit, University of Guelph, Ontario, Canada, *bsmit@uoguelph.ca*
Isabelle Champagne-Shields, Inuit Tapiriit Kanatami, Ottawa, Canada, *champagne-shields@itk.ca*
Grete Hovelsrud, CICERO, Oslo, Norway, *g.k.hovelsrud@cicero.uio.no*

This session will bring together researchers, northerners, government representatives and others who are interested in the implications of climate change for people in Arctic communities. Presentations and discussion will address the ways that resources and livelihoods are affected by changing conditions and the adaptation strategies available to communities and governments.

T11. The Role of Sea Ice in Arctic Marine Ecosystem Processes

Co-chairs

David Barber, University of Manitoba, Winnipeg, Manitoba, Canada, *dbarber@cc.umanitoba.ca*
Louis Fortier, Université Laval, Quebec City, Quebec, Canada, *Louis.Fortier@bio.ulaval.ca*
Stig Falk-Petersen, Norwegian Polar Institute, Tromso, Norway, *stig@npolar.no*

The arctic marine ecosystem has evolved over millions of years to take advantage of the timing and presence of sea ice. The dramatic reduction in the summer extent of sea ice affects sea ice dynamic and thermodynamic processes throughout the annual cycle. These changes in turn affect biological, chemical and geophysical processes operating across the ocean-sea ice –atmosphere (OSA) interface at a variety of time and space scales.
This session will examine the role which sea ice has on controlling light and heat in the marine system and the commensurate effects on trophic structure and interrelationships. We are particularly interested in papers which examine the way in which sea ice affects marine ecosystem function at a variety of trophic levels (e.g., microbes up through to mammals) across various benthic, pelagic, sympagic and sea ice habitats.

T12. The Law and Politics of Canadian Jurisdiction on the Arctic Ocean Seabed

Co-chairs

Michael Byers, University of British Columbia, Vancouver, BC, Canada, *michael.byers@ubc.ca*
Ron Macnab, Canadian Polar Commission, Ottawa, Ontario, Canada

The definition and exercise of seabed sovereignty are characterized by several facets, e.g. the construction of territorial sea baselines, the delimitation of maritime zones that circumscribe the seaward reaches of coastal state jurisdiction, the development of bilateral boundaries between neighboring states, and the rights and obligations of coastal and other states within different classes of maritime zones. In principle, the procedures for dealing with these matters are enshrined in international law, but in practice, their effective realization often entails political tradeoffs and adjustments.

T14. Quantifying the Carbon Balance of Arctic Ecosystems at Various Scales

Co-chairs

David Atkinson, Ryerson University, *datkinson@ryerson.ca*
Neal Scott, Queen's University
Paul Treitz, Queen's University

With vast amounts of the global carbon pool stored in northern latitudes, climate-related changes to this reservoir could have major impacts on the global climate system. The release of this carbon could substantially increase the concentration of radiatively active gases, such as carbon dioxide (CO2) and methane (CH4), possibly generating a positive feedback to climate change. The distribution of carbon within arctic ecosystems, and the potential for that carbon to be converted to CO2, may depend on the distribution of plant community types. These plant communities are often organized across the arctic landscape in response to climate-related factors (e.g. precipitation). In spite of the importance of arctic ecosystems to the earth system, impacts from arctic warming on carbon reservoirs and land/atmosphere exchanges of carbon are poorly quantified. Studies examining components of the arctic carbon balance are often few and sporadic in the circumpolar north and regularly reveal large inter-annual and inter-site variability, making it difficult to generalize about the current status and future of the arctic carbon reservoirs. This session will examine efforts to improve our ability to quantify and monitor carbon reservoirs in the arctic at various spatial scales, and explore methods for scaling up site-specific studies to larger arctic regions. Topics can include measurement of terrestrial and aquatic carbon storage and fluxes, biophysical remote sensing, scaling of carbon cycle processes, modeling, and others.

T15. Freshwater Ecosystems, Aquatic Biodiversity and Sensitivity to Climate Change

Co-chairs

Scot Lamoureux, Queen's University, Ontario, Canada, *scott.lamoureux@queensu.ca*
Warwick Vincent, Université Laval, Quebec City, Quebec, Canada, *Warwick.Vincent@bio.ulaval.ca*
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Two linked multi-disciplinary Canadian IPY projects, Arctic BioNet investigating aquatic biodiversity and landscape processes, and Climate Change Effects on Arctic Chars, are examining the effects of climate change on key aquatic habitats and biota through a combination of primary research, monitoring across landscapes (particularly latitude) as a proxy for possible climate responses, and the establishment of

national and international networks to promote long-term observation of change. Project activities include establishing climate linkages to organismal biology and ecology (e.g., fishes and invertebrates), effects on habitats (e.g., permafrost degradation and tundra lake infilling), effects on key nodes and pathways in aquatic ecosystems (e.g., trophic structure shifts and accumulation of metals), and establishing appropriate baselines regarding aquatic biodiversity as the foundation for monitoring climate change effects throughout the Arctic. These research themes link ongoing activities involving government, university and northern native groups and are aimed to address needs identified in the Arctic Climate Impact Assessment, International Conference on Arctic Research Planning II, and the Sustained Arctic Observation Network.

T16. River-Ocean Interactions and Fluvial-Marine Mass Transfer in the North: Past, Present, and Future

Co-chairs

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Rivers deliver water, nutrients, carbon, and sediment to the coastal ocean. This mass transfer is a major control on the dynamics of coastal currents, ecosystems, ice, shorelines, and seabeds, both close to the source, and farther afield. In northern settings, the effects of ice on both land and sea near the time of peak river flow can strongly steer and regulate transfer of water and dissolved and particulate material, yielding dispersal patterns that contrast strongly with the dynamics of more temperate rivers, which have been more widely studied, and are better understood. Temperature and runoff patterns in northern settings are now changing rapidly, factors which will in turn influence river flow and dispersal, as well as marine systems dependent on mass transfer from rivers. The consequences of this change cannot be reliably predicted from our present state of knowledge. The purpose of this session is thus to explore the state, context, and implications of changing fluvial-marine interactions in northern settings, from perspectives of scientists working in marine, terrestrial, and human realms.

T17. Observing Pan-Arctic Environmental Change

Co-chairs

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The Arctic system is presently undergoing unprecedented change. This change is visible in the physical, biogeochemical, ecological and human components of the system. In order to act upon these changes and minimize adverse affects we have to characterize their scope and evolution, understand their causes and project them into the future. One major challenge in achieving these goals is the design and implementation of a pan-Arctic observing system that integrates across the physical, biogeochemical, and human domains. Initial steps towards such an observing system have been intensified during the International Polar Year.

This session presents results from existing elements of the emerging Arctic Observing System covering physical, biogeochemical, and human domains. The goal is to highlight close collaborations in cross-domain observational research and approaches to utilizing the observations in studies aimed at understanding Arctic Environmental Change. Contributions with emphasis on the integration of individual observing system components into an integrated network, observing system design, utilization of data from the Arctic Observing System in synthesis/modeling studies are encouraged. Results from the International Polar Year, as well as contributions that that utilize observational data for the development of mitigation and response strategies are especially encouraged.

T18. Marine Productivity and Biogeochemical Fluxes in the Changing Arctic

Co-chairs

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The extent of sea ice over the Arctic Ocean plummeted to a conspicuous record low in September 2007, confirming the acceleration of the decline initiated during the 20th century. Changes have also been observed in the large-scale oceanic circulation and the heat influx from the Atlantic Ocean to the Arctic. The incidence and intensity of synoptic storms is on the rise and globally, freshwater discharge increases in the Arctic coastal zone. With the added contribution of permafrost melting, rivers deliver increasing amounts of terrigenous dissolved and particulate organic matter to the marine ecosystem, altering the carbon and nutrient budgets of the Arctic Ocean. The joint impacts of these changes on primary production, food webs and the biogeochemical cycling of key elements in the Canadian Arctic are presently unknown.

Living marine resources play a crucial role in the culture, nutrition and economy of Inuit and will likely be impacted in unforeseen ways. This session will focus on, but is not restricted to, the interactive effects of environmental forcing on marine productivity, food webs, and the transformation and fate of organic matter, including horizontal and vertical fluxes of carbon and nitrogen.

T19. Sea-Ice-Atmosphere Interactions and Climate in a Changing Arctic

Co-chairs

Michael Scarratt, Fisheries and Oceans Canada, Mont-Joli, Québec, Canada, *scarrattm@dfo-mpo.gc.ca*
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Cycles of elements and energy within the Earth system are closely coupled. Exchanges of climate-active gases and aerosols between the ocean surface and the atmosphere exert important feedbacks on the global climate system. Understanding which processes are important and constraining their magnitudes are essential for diagnostic and prognostic models of contemporary and future climate. This session focuses on recent research developments from Arctic waters including, but not limited to, the Arctic SOLAS (Surface Ocean - Lower Atmosphere Study) program. We invite papers on the physical, chemical and biological processes underlying climate-relevant ocean-atmosphere interactions and feedbacks. Topics of interest include biogeochemical cycling of climatically important elements and gases in the water and ice, and the influence of oceanic gas and particle emissions on atmospheric chemistry, aerosol dynamics, and climate.

T20. Land Surface Processes and their Climate Interactions in High-Latitude Regions

Co-chairs

Laxmi Sushama, University of Quebec at Montreal, Montreal, Québec, Canada, *sushama@sca.uqam.ca*
Anne Frigon, Ouranos, Montreal, Québec, Canada

High-latitude regions, with their innumerable lakes, wetlands, rivers and permafrost, are particularly challenging for modeling. The presence of substantial surface water in the form of lakes and wetlands impact regional climate through changes in the surface albedo, surface energy and moisture budgets. These interactions, though important, are difficult to investigate due to the scarcity of relevant observations and the complexity of the underlying processes and feedbacks. This session is targeted at addressing these issues and we encourage contributions related to land surface modeling in high-latitudes including lakes, wetlands, vegetation, snow, permafrost, analysis of models and observations (validation and process studies), and land climate interactions in the context of climate change.

T21. Climate Change and Quaternary Evolution of the Arctic

Co-chairs

Guillaume St-Onge, Université du Québec à Rimouski, Rimouski, Canada, *guillaume_st-onge@UQAR.QC.CA*
André Rochon, Université du Québec à Rimouski, Rimouski, Canada, *andre_rochon@UQAR.QC.CA*

Our knowledge of climate variability and natural hazards for the Arctic is restricted to the instrumental records, which covers approximately the last 50 years at the most. In order to better constrain the rate of change and help in the forecasting and modeling of future trends, we must have access to longer time-series. The geological record can provide such time-series. In this session, we invite paleoclimatic studies dealing with the reconstruction of past climatic changes in the Arctic at all timescales. We also encourage contributions regarding past changes in sea-level, marine geohazards, as well as contributions dealing with the Quaternary evolution of the Arctic.

T22. CANDAC, PEARL, and Atmospheric Measurements in the Canadian High Arctic

Co-chairs

Kimberly Strong, University of Toronto, Toronto, Ontario, Canada, *strong@atmosp.physics.utoronto.ca*
William Ward, University of New Brunswick, New Brunswick, Canada

The Canadian Network for the Detection of Atmospheric Change (CANDAC) brings together researchers and resources dedicated to addressing the issues of air quality, climate change, and ozone depletion over Canada (see www.candac.ca). The initial focus of activities has been the revitalization of measurements in the Canadian High Arctic. Towards this goal, CANDAC has established the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut (80?N, 86?W), 1100 km from the North Pole. The PEARL complex now consists of three facilities: the main PEARL observatory situated 610 m above sea level and 15 km from Environment Canada's Eureka weather station; the Zero-altitude PEARL Auxiliary Laboratory (OPAL) located next to the weather station at sea level; and the Surface and

Atmospheric Flux, Irradiance and Radiation Extension (SAFIRE) located in undisturbed terrain about 5 km from the weather station. More than 20 instruments are permanently installed, including radars, lidars, spectrometers, interferometers and radiometers, with other instruments on site on a campaign basis.

PEARL is a unique national and international resource that is used for a variety of atmospheric research programs, including several for International Polar Year (IPY). Research at PEARL is divided into four major themes: Arctic Tropospheric Transport and Air Quality; The Arctic Radiative Environment: Impacts of Clouds, Aerosols, and "Diamond Dust"; Arctic Middle Atmospheric Chemistry; and Waves and Coupling Processes. In addition to these four themes, PEARL instrumentation is used extensively for satellite validation and has a protocol for monitoring sudden atmospheric events at high latitudes. This session invites contributions regarding atmospheric research at PEARL, including instrumentation, measurements, data analysis, modelling studies, and scientific findings. Contributions describing related atmospheric studies at other High Arctic observatories are also welcome.

T23. Education, Communication and Outreach – Linking Research to Public Policy and Environmental Awareness

Co-chairs

Lucette Barber, Schools on Board, University of Manitoba, Winnipeg, Manitoba, Canada, *barberl@cc.umanitoba.ca*
David Carlson, Director, IPY International Programme Office, United Kingdom, *ipy.djc@gmail.com*

This session will feature a wide continuum of programs and initiatives that have successfully integrated education, communication and outreach into scientific research. We invite researcher, graduate students, educators, and outreach providers to take this opportunity to share their successes and ideas by submitting an abstract for an oral presentations in one of the following categories: 1) effective research partnerships between scientists and schools, 2) unique field experiences, 3) successful community-based monitoring and mentoring programs, 4) public education and 5) education, communication and outreach outcomes from IPY – sustaining the momentum!

The session will be complemented by a poster session highlighting outreach projects and initiatives. This poster session will make it possible for anyone who is doing outreach (on any scale) to showcase their initiatives and the people (ie students, teachers, public etc.) or institutions (school, museums, media etc.) that they are working with. The poster session will be accompanied by a Smithsonian exhibit - The Arctic a Friend Acting Strangely. The aim is to showcase the breadth of outreach activities that is occurring within the Arctic research community. Schools on Board will present an award to recognize an individual or group that is taking a leading role in scientific outreach.

T24. Hudson Bay: New Findings and Directions for Future Study

Co-chairs

Robie W. Macdonald, Fisheries and Oceans Canada, Sydney, BC, Canada, *robie.macdonald@dfo-mpo.gc.ca*
Zuzu A. Kuzyk, University of Manitoba, Winnipeg, Manitoba, Canada, *ZouZou.Kuzyk@dfo-mpo.gc.ca*
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Hudson Bay is a large, estuarine, shelf-like sea at the southern margin of the Arctic. Given its location, the Bay is in the vanguard of polar change and likely provides an early-warning sentinel for change in the Arctic Ocean and its surrounding drainage basins. Indeed, reduction and change in ice cover seems already underway in Hudson Bay with consequences for marine mammals, polar bears and marine food web structure (cod-capelin-murres). Accompanying the change in ice cover is alteration of river discharge, either directly though water diversion or indirectly through change in permafrost, wetland processes and the hydrological cycle. The oceanographic changes that may result from altered freshwater inputs (both ice and river runoff) are still largely unknown. However, recently, there has been a re-invigorated research effort to study all aspects of Hudson Bay through large, multi-year projects like MERICA and ArcticNet. Data emerging from such studies promise not only to revise what we know about Canada's largest inland sea, but also to offer timely insights into how the Bay functions, how it is changing and how it might respond to future change. In this session we wish to bring together the researchers from diverse disciplines to present new findings in Hudson Bay, especially as they pertain to changing systems.

T25. Changes in Tundra Ecosystems: Impacts and Implications

Co-chairs

Greg Henry, University of British-Columbia, Vancouver, BC, Canada, *ghenry@geog.ubc.ca*
Esther Levesque, Université du Québec à Trois-Rivières, Quebec, Canada
Peter Lafleur, Dept of Geography, Trent University

Tundra ecosystems are showing responses to recent climate change that are substantiated by responses to long-term warming and other experimental manipulations. The changes in the structure and function of these terrestrial Arctic ecosystems will have consequences for northern peoples, through changes in ecosystems services, and for the planet as a whole, through changes in carbon and energy balance. This special session will bring together the latest research results on responses of tundra ecosystems to climate variability and change including: carbon and energy balance; biodiversity; plant ecophysiology; soil processes; and modelling. The session will provide an opportunity to review, among others, some of the first results from International Polar Year (IPY) projects linked to the International Tundra Experiment (ITEX), a core project in the IPY.

T26. Role of Arctic Marine Mammals in Northern Ecosystems and Cultures

Co-chairs

Steven Ferguson, Fisheries and Oceans Canada, Winnipeg, Manitoba, Canada, *Steve.Ferguson@dfo-mpo.gc.ca*
Jeff Higdon, Fisheries and Oceans Canada, Winnipeg, Manitoba, Canada, *higdonj@dfo-mpo.gc.ca*
Lisa Loseto, Fisheries and Oceans Canada, Sidney, BC, Canada, *LosetoL@dfo-mpo.gc.ca*

Arctic Marine mammals such as seals, walrus, whales, polar bears, and Arctic foxes play important ecological, social, cultural and nutritional roles in Arctic ecosystems. Many of these species are adapted to sea-ice conditions, and Inuit hunters have learned to use these habitats as well for subsistence harvesting. However these high-latitude marine systems are currently undergoing pronounced changes, with dramatic sea ice declines in many areas. Environmental changes may have marked effects on marine mammal ecosystems, which will in turn have distinct effects on northern cultures. Many Arctic marine mammals occupy top trophic positions and thus can be viewed as sentinels of marine ecosystem health. Examining health and condition in marine mammals may provide valuable information about ecosystem alterations in structure that may otherwise be difficult to document. Working with northerners to monitor changes in their subsistence hunts will provide an Arctic observation network that will improve science while empowering Inuit culture. In this session we bring together researchers representing diverse views on marine mammals, their ecosystems, and global warming. New marine mammal research findings will be presented that relate to how the Arctic can adapt to acute change.

T27. Environmental Change in Arctic Coastal Regions: Biophysical Processes and Community Adaptation

Co-chairs

Donald Forbes, Geological Survey of Canada, Dartmouth, Nova Scotia, Canada, and Memorial University, St-Jonh's, Newfoundland, Canada *dforbes@nrcan.gc.ca*
Paul Overduin, Alfred Wegener Institute for Polar and Marine Research, Potsdam, Germany *paul.overduin@awi.de*

Arctic coasts are distinctive interfaces where permafrost terrain, seasonally ice-covered seas, and cold atmospheric conditions interact to produce distinctive hazards and outcomes. Climate warming and resulting changes in environmental forcing are already recognized along Arctic coastlines, where rapid change has been documented in many places throughout the circumpolar region. Understanding the processes of wave and ice interaction with ice-bonded sediments exposed to warmer air and water temperatures is essential to enable modelling and projection of future changes and impacts on Arctic shores. Rising temperature and sea-level, reduced sea ice, increased wave attack, melting permafrost, changes in habitat conditions, and other trends can interact to create hazards, challenge traditional lifestyles and practices, and threaten the stability of coastal communities, infrastructure, and resources. Scientific understanding of past and future environmental changes and impacts can help to inform policy and decision-making at regional and local levels and ultimately minimize the impacts of these changes. This session includes oral presentations and posters that examine a range of interacting coastal processes and efforts to track changes in these processes. Papers in this session also consider the implications of environmental change for Arctic coastal communities and ecosystems, assess the adaptive capacity and resilience of northern residents and communities, and address the interface between science, planning, adaptation policy, and decision-making to prepare for change.

T29. Impacts of Severe Arctic Storms and Climate Change on Arctic Coastal Oceanographic Processes

Co-chairs

Will Perrie, Fisheries and Oceans Canada, *PerrieW@mar.dfo-mpo.gc.ca*
John Gyakum, McGill University, Montreal, Quebec, Canada, *gyakum@zephyr.meteo.mcgill.ca*

The focus of this session is coastal oceanographic processes in areas such as the southern Beaufort Sea, and related waters of the Arctic, driven by intense storms and severe weather. These areas are important because the use of the coastal marine and terrestrial environment by Northerners is an integral part of their life style, and these environments are being impacted by coastal erosion, related to marine storms that tend to be getting stronger. These areas are also undergoing hydrocarbon exploration with potential development within the next decade. We are concerned with detailed simulations of the coastal oceanographic processes, waves, storm surges, currents, and marine winds, and related

nearshore coastal erosion and sediment transport. Factors such as open water and ice, and the oceanic surface fluxes can modulate storm development and winds. Changes and variability in Arctic storm tracks and intensity, associated with climate change may further endanger coastal settlements and the expected use of coastal marine environments.
Relevant topics include (but are not limited to) fine-resolution simulations of Arctic storms to study the key Arctic processes, and coupled ice-ocean-atmosphere-wave models to study Arctic storms and coastal ocean processes, including winds, waves, currents, ice, storm surges, erosion and sediment transport. The effects of climate change are expected to have impacts on coastal ocean processes and the wave climate, and in turn, on communities, life style, aquatic species, and activities related to offshore resource development. Relevant time-scales for studies of these issues are synoptic, seasonal, inter-annual and decadal.

T32. Arctic Climate Feedbacks: Atmospheric Composition and Long Range Transport of Chemical Constituents

Co-chairs

Jean-Pierre Blanchet, *Blanchet.Jean-Pierre@UQAM.ca*
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The Arctic is one of the most sensitive regions of the world for climate change. Many feedback processes are playing important roles in determining the evolution of climate at high latitudes. Most of them are due to water in one form or another: ocean, sea ice, snow, clouds, water vapour, haze, rivers flows, etc. Other factors depend on environmental conditions: atmospheric stability, storm activities, chemical composition, long diurnal-seasonal cycles etc. The IPY has shed a renewed perspective on the Arctic environment in term of climate processes and feedbacks. Intensive new measurements from campaign, ground stations and new satellites, as well as significant developments in modelling climate processes, all have given us a welt of high quality information that have advanced our understanding of the Arctic and its relation to lower latitudes. This session invites researchers to present a summary of their findings on climate feedback related issues in an interdisciplinary context, susceptible to help decision makers and to guide initiatives in the development of the North.

T33. Linking Communities and Scientists in Monitoring Long-Term Environmental Change

Co-chairs

Ryan K. Brook, Faculty of Veterinary Medicine & Faculty of Medicine, University of Calgary, *rkbrook@ucalgary.ca*
Susan Kutz, Faculty of Veterinary Medicine, University of Calgary, *skutz@ucalgary.ca*

There are currently a wide range of approaches to developing baseline and long-term monitoring programs for assessing change in northern regions. While many community-based approaches and empirical studies that utilize more conventional science-based methods often share common goals, there remains a considerable need to identify ways of developing a common framework to use these different approaches together. Some disagreement between these different approaches is perhaps inevitable, but approaches are being developed to resolve or even prevent conflicts between communities and scientists. We invite researchers that use community based or empirical methods to participate in order to generate a dialogue regarding challenges and opportunities related to bridging these two approaches.

T34. Seafloor Mapping of the Arctic Ocean, Continental Shelves and Margins

Co-chairs

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John Hughes-Clarke, University of New Brunswick, Fredericton, New-Brunswick, Canada, *jhc@omg.unb.ca*
Steve Blasco, Geological Survey of Canada, Dartmouth, Nova-Scotia, Canada, *SBlasco@NRCan.gc.ca*

Accelerated interest in polar regions research extends to the seafloor. High resolution seabed mapping is being driven by a wide range of issues including sovereignty, navigation, resource development, biodiversity assessments, and IPY initiatives. Seafloor mapping has been greatly facilitated by the development and application of digital sonar and optical technologies including sidescan and multibeam systems and LIDAR which not only generate detailed charts of seabed bathymetry and maps of seabed morphology but provide acoustic classification maps of the composition of the seabed. Integration of acoustic and optical data with groundtruth from photographic imagery; and sediment, bottom feature and benthic community sampling is resulting in a much clearer understanding of seabed processes both spatially and temporally. The seabed of the Polar regions is much more dynamic than previously realized. Application of seabed mapping technologies is leading to the identification of ecologically and biologically significant benthic communities, observation of seabed scouring by the keels of pressure ridges, icebergs and glacial ice streams, submarine slumping, faulting, mud volcanism, fluid venting and sediment mobility.

This session provides a unique forum for polar scientists actively involved in seabed mapping research to present and discuss state-of-the-art technology, research results and opportunities for future collaboration.

T35. Measurements and Numerical Modelling of Precipitations in Cold Climates

Co-chairs
Ismail Gultepe, Environment Canada, Toronto, Ontario, Canada, *Ismail.Gultepe@ec.gc.ca*
Roy Rasmussen, NCAR, Boulder CO, USA
Jason Milbrandt, Environment Canada, Quebec, Quebec, Canada

Accurate precipitation measurements in cold climates are very important to validate numerical forecasts and climate model simulations but can be difficult due to the uncertainties involved in measuring snow and freezing particles. Cold temperatures and smaller precipitation intensities together with unknown particle shape and density can affect the precipitation rate calculations as well as related microphysical parameterizations. Uncertainties in precipitation rate measurements in the Arctic regions need to be estimated before being used for model validations. If precipitation rates cannot accurately be obtained for snow, results from climate and forecasting simulations used for snow precipitation rate validations will be questionable. This suggests that 1) microphysical parameterizations in the current models should be re-evaluated to better represent the surface precipitation amounts and 2) surface precipitation rate calculations and measurements should be improved, especially for light snow conditions.

STUDENT DAY ORAL ABSTRACTS

FREE LOVE IN THE FAR NORTH: REPRODUCTIVE STRATEGIES USED BY ARCTIC FOXES ON BYLOT ISLAND, NUNAVUT, CANADA

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The reproductive strategies used by animals vary greatly across species. Reproductive strategies also sometimes differ significantly within populations, depending on a variety of factors such as resource availability or genetic structure of the population. Reproductive strategies can influence how a population is able to face environmental changes, and it is sometimes assumed that the level of plasticity in the reproductive strategy of a population affects its ability to cope with changing conditions. Populations of the arctic fox can fluctuate greatly according to environmental conditions, especially when resource availability is variable. Populations depending on cyclic lemming populations are especially prone to such fluctuations in density. We studied the reproductive strategies used by male and female arctic foxes on Bylot Island (Nunavut, Canada), by combining genetic analyses with direct behavioural observations during cub rearing period, from 2003 to 2008. We found that female arctic foxes used a variety of strategies in their mate choice, including strict monogamy, polyandry and extra-pair fertilization. Extra-pair fertilizations events lead to increased genetic diversity among progeny, which can enhances the probability that at least some young survive to future conditions. These outbreeding strategies may also be particularly relevant in the context of climate change, given that some arctic fox populations may become more geographically isolated as maximum sea ice extent declines and winter movements of foxes are reduced.

TRANS-POLAR FAT 2008: AN UPDATE ON ATHEROGENIC EFFECTS AND REGULATORY ISSUES IN NUNAVIK

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Purpose & rationale: Following our recent observations that biological levels of *trans*-fatty acids (TFA), lipids with adverse health effects mainly found in recently introduced low quality imported foods, were high among Nunavik Inuit, we looked at the atherogenic changes associated with TFA in plasma cholesterol profiles in order to assess the health significance of this dietary exposure. At the same time, we worked on the translation of research results into public health action among Arctic communities.
Process/Approach: 795 Inuit from the 14 communities of Northern Québec (Nunavik) participated in the baseline Inuit Health in Transition cohort study and met our inclusion criteria. We measured the fatty acid profile of red blood cell (RBC) membrane phospholipids (PL) as a surrogate for individual intakes. Cholesterol (total, HDL and LDL), triglycerides, apolipoproteins, LDL size and paraoxonase activity were measured in plasma. A bootstrap approach was applied in order to account for the complex sampling design and non-response rate.
Findings: The associations varied markedly between gender and according to age. In men (n=357, age=36.3±14.3, TFA=1.24±0.54%), TFA tended to be negatively associated with HDL-c, ApoA1 and LDL particle size, and positively associated with non-HDL-c, LDL-c, ApoB100, the ratio of ApoB100 to ApoA1 and the ratio of TC, LDL-c and TRIG to HDL-c. No such trends were observed in women (n=438, age=37.0±14.1, TFA=1.16±0.54%), except for PON1 in women and for HDL-c and ApoA1 in women

aged 50 years and more. As these results were presented to the Nunavik Nutrition and Health Committee in March 2008, the Regional Board of Health and Social Services finally decided in June 2008 to follow the 2007 Makivik call to work towards the reduction of TFA in foods sold in Nunavik communities.

Implications for Inuit Health: These results suggest that TFA could raise the risk of coronary heart disease in Nunavik Inuit men at least through their physiological effects on plasma lipids. The differential associations reported in pre- and post-menopausal women need to be reproduced in other populations and in experimental studies addressing the influence of sex hormones on response to dietary fats. Thanks to mutual efforts to translate research into action, Nunavik public health authorities are now engaged in the implementation of incentive measures directed to food retailers and information campaigns that will be initiated in November 2008. Though just a first step toward better nutrition, these measures will be followed by a significant improvement in the quality of fat found in Nunavik stores.

SPRING MEASUREMENTS OF STRATOSPHERIC COMPOSITION FROM PEARL IN 2007 AND 2008 USING THE PORTABLE ATMOSPHERIC RESEARCH INTERFEROMETRIC SPECTROMETER FOR THE INFRARED (PARIS-IR)

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Springtime in the Arctic atmosphere is the most chemically active time of year. The first light the High Arctic atmosphere experiences after months of polar night triggers chemical reactions involved in stratospheric ozone depletion. The Atmospheric Chemistry Experiment (ACE) is a satellite mission on-board the Canadian satellite SCISAT. One of its goals is to understand the chemical and dynamical processes controlling middle atmosphere ozone distribution, particularly in the Arctic. The primary instrument on SCISAT is the ACE-FTS, a high resolution Fourier Transform Spectrometer. Each spring since 2004, the ground-based version of the ACE-FTS, the Portable Atmospheric Research Interferometric Spectrometer for the Infrared (PARIS-IR), has been deployed at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut (80N, 86W) as part of the Canadian Arctic ACE Validation Campaign project. PEARL is ideally located for these campaigns as a large number of ACE overpasses occur between February and March. PARIS-IR is one of eleven ground-based and balloon-borne instruments used in the campaigns each year. It records double-sided interferograms with the same maximum optical path difference (25 cm) as ACE-FTS, resulting in a resolution of 0.02 cm-1. PARIS-IR is designed to measure the full 750 - 4400 cm-1 spectral range with each measurement. This feature allows total column measurements of a range of atmospheric species to be determined from every spectral measurement, creating a data set with high temporal resolution.

During International Polar Year (IPY), PARIS-IR operated at PEARL for six weeks during February and March in 2007 and 2008. It made solar absorption measurements of a range of ozone and related trace gas species (including HCl, HNO3 and HF) during this time. This presentation will describe these trace gas measurements and interpret them relative to the different dynamical conditions observed. Additionally, results will be compared with measurements made with two high-resolution Fourier Transform Infrared (FTIR) Spectrometers, the CANDAC Bruker-IFS 125 HR and the Environment Canada DA8 FTIR Spectrometer, collocated at PEARL during the Canadian Arctic ACE Validation campaigns.

PERMAFROST YOUNG RESEARCHERS GETS THEIR HANDS DIRTY: THE PYRN-THERMAL STATE OF PERMAFROST IPY PROJECT

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The Permafrost Young Researchers Network (PYRN) (www.pyrn.org) is a unique resource for students and young scientists and engineers studying permafrost. It is an international organization fostering innovative collaboration, seeking to recruit, retain, and promote future generations of permafrost scientists and engineers. Initiated for and during IPY, PYRN directs the multi-disciplinary talents of its membership toward global awareness, knowledge, and response to permafrost-related challenges in

a changing climate.

Created as an education and outreach component of the International Permafrost Association (IPA), PYRN is a central database of permafrost information and science for more than 500 young researchers from over 40 countries. PYRN distributes a newsletter, recognizes outstanding permafrost research by its members through an annual awards program, organizes training workshops (2007 in Abisko, Sweden and St. Petersburg, Russia, 2008 in Fairbanks, Alaska and St. Petersburg, Russia), and contributes to the growth and future of the permafrost community.

While networking forms the basis of PYRN's activities, the organization also seeks to establish itself as a driver of permafrost research for the IPY and beyond. We recently launched a series of initiatives on several continents aimed at providing young scientists and engineers with the means to conduct ground temperature monitoring in under-investigated permafrost regions.

Focusing on sites not currently covered by the IPA's "Thermal State of Permafrost" project, the young investigators of PYRN successfully launched and funded the PYRN-TSP project. They use lightweight drills and temperature sensors to instrument shallow boreholes in those regions. The first phase of the project was started in the spring of 2008 at Scandinavian sites. The data and results will be incorporated in the global database on permafrost temperatures and made freely available to the scientific community, thereby contributing to the advance of permafrost science and the strengthening of the next generation of permafrost researchers.

DIGITAL IMAGE ANALYSES OF OIL SACS IN COPEPODS AS A FAST AND COST EFFICIENT METHOD TO DETERMINE TOTAL LIPID

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All classical methods of determining total lipid content of zooplankton (i.e. extraction and gravimetric measurements or chromatographic methods) are both time consuming, expensive and destructive. We have developed a method to estimate the total lipid of a copepod by taking digital pictures of the specimens and measuring the oil sac perimeter using a free image analysis software ("ImageJ"). Analyses document that there is a positive and strong correlation between the perimeter and the total volume of the oil sac. Furthermore, as the majority of lipids in overwintering stages of copepods are stored in the oil sac, this method ensures a reliable estimate of the total lipid content of the individual copepod.

Since the method is non-destructive, it is possible to follow the development of a population held in an experiment. Furthermore it can be used to make estimates of which percentage of a population is still likely to be actively feeding and which part is likely to be in diapause already. The imaging method has been used both in a study comparing the copepod development over time in an ice covered vs. a non ice covered fjord on Svalbard, as well as in a diel vertical migration study.

The relation of calculated oil sac volume to perimeter, area and prosome length has been studied on several thousand images and the imaging method has been tested against the gravitmetric method on pooled samples. We will also test it on the individual level to get a more accurate relation.

ARCTIC RESEARCH FROM THE PERSPECTIVES OF SIX PARTICIPANTS IN NUNAVUT SIVUNIKSAVUT

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Nunavut Sivuniksavut (NS) is a unique eight-month college program based in Ottawa. This program is designed for Inuit youth from Nunavut who want to prepare for the educational, training, and career opportunities created by the Nunavut Land Claims Agreement (NLCA) and the new Government of Nunavut. Since 2003, NS has been offering a second year of study for those students wanting to deepen their understanding of Inuit history and current issues, and/or prepare more specifically for college or university. Students take at least one Inuit-specific course each semester at NS; the remaining courses are delivered by Carleton University, Algonquin College, and the University of the Arctic. This year there are six second year students enrolled in this program: The NS students will provide Student Day participants with a fresh and very objective perspective to research by reminding researchers of such things as the «human» side of research, genuine collaboration and how the communication of research. This is an opportunity for student researchers to learn about the potential impacts that their research has on the people that live in the Arctic, especially youth, and how these two contrasting views can come together.

PLENARY SESSION ORAL ABSTRACTS

The International Polar Year (IPY) Circumpolar Flaw Lead (CFL) system study

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The International Polar Year (IPY) Circumpolar Flaw Lead (CFL) system study supported a large multidisciplinary overwintering in the Banks Island (NT) flaw lead over the period September 2007 to August 2008. The CFL system is formed when the central pack ice (which is mobile) moves away from coastal fast ice, opening a flaw lead. The CFL forms in the fall and continues as thin ice or open water throughout the winter. The flaw lead is circumpolar, with recurrent and interconnected polynyas occurring throughout the Arctic. The overarching objectives of the CFL project were to contrast the physical and biological systems of the flaw lead open water and thin ice to the adjacent landfast ice cover. The Canadian Research Icebreaker NGCC *Amundsen* completed the first-ever overwintering of a research icebreaker in the flaw lead. She supported a total of 11,000 person days distributed across 295 investigators from 28 different countries, making the CFL project the largest single IPY effort in the northern hemisphere. The project obtained many first-ever measurements of a complete suite of physical, biogeochemical, contaminant and marine ecosystem variables across the open water - fast ice contrast. Throughout the project we recognized that Inuvialuit and western science have two different ways of understanding the dramatic changes that are occurring in this sector of the Arctic. This 'two-ways-of-knowing' saw the integration of traditional knowledge studies with the science teams onboard the *Amundsen*. We present information on the design of the project, an overview of the sampling program completed, highlight the scientific programs conducted, and provide some preliminary results. We conclude with an overview of the various outreach programs including a World Federation of Science Journalists (WFSJ) competition and 'Schools on Board' programs.

Hydrocarbon Energy from the Arctic: Holy Grail or Pipe Dream?

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It is only a matter of time before industry embarks seriously on exploration and development of Canada's Arctic energy resources. At a time when the world's largest fields are in decline, only remote frontier areas like Canada's Arctic offer any hope for large discoveries. And while China and India are rising, our U.S. neighbour shows no sign of loosing its thirst for energy any time soon, even though the ongoing economic downturn is bound to slow down demand, at least in the short run, for oil and gas. Supply, demand, and the price of commodities will be high on the mind of industry decision-makers the day they decide to go North, but a flurry of other factors will also weigh heavily on industry's decision-makers before they commit billions of dollars in capital investment to go after Arctic resources. One of the least worrisome aspects of Arctic energy development is probably the resource itself. Large gas discoveries were made during the first round of exploration three decades ago. There is enough gas in the large three fields of the Mackenzie Delta–Taglu, Ninglintgak and Parsons Lake–to feed the yet elusive Mackenzie Valley pipeline for the next 20 years. Huge quantities of gas were also found in the Arctic islands, and shipping this gas to market is within the realm of possibilities if one is to believe a recent study by the Calgary-based Canadian Energy Research Institute (CERI). While oil was the prime reason for the early round of exploration, the paucity of sizeable oil discoveries was a disappointment for early explorers. However, the recent discovery of 250 million barrels beneath the Beaufort Sea by Devon Canada in 2006, the massive $585 million bid for a huge offshore block by Imperial Oil and Exxon Mobil Canada in 2007, and a $1.2 billion bid by BP in 2008, may have rekindled the oil flame. Beyond the known discoveries, the vast area that extends from the Delta and the Arctic islands, including both continental shelves to north and east, holds much promises for many large and medium-size discoveries. In addition to finding the resources in the ground, above or below the sea, exploration companies

face a seemingly endless list of challenges: a regulatory process that is seen as overly complicated and in the throes of too many interests, an environment that is harsh and unforgiving, a warming climate that is playing havoc with infrastructures, and political ramifications that seem far more complicated that they used to be. Still, the conditions may not be insurmountable when compared with the earth's other last remaining areas with substantial potential. These are often war-torn countries, forsaken by democracy and where corruption and terrorism rule the day. In the end, the loathed regulatory problems in the north may pale relative to dealing with war lords or with governments with a propensity to renege on sealed deals. No matter what and where, going after the big ones in the 21st century will be costly and risky.

IPY 2007 - 2008: An Update

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To achieve major advances in polar knowledge, IPY has entrained the intellectual resources of thousands of scientists, many more than expected, often from 'non-polar' nations, and representing an unprecedented breadth of scientific specialties; integration of those efforts across disciplines to achieve integrated system-level understanding remains a substantial challenge. Many national and international organizations prepare plans to sustain new and improved observational systems, but clear outcomes and the necessary resources remain elusive. International outreach networks gradually build breadth and strength, largely through IPY Polar Science Days and other internationally-coordinated IPY events. A new international and interdisciplinary Association of Polar Early Career Scientists (APECS) devotes talent and energy to shaping the future of polar research. These activities and networks may, with time and with continued international coordination, achieve an exceptional level of interest and participation in polar science. In all areas, much work remains.

Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies (DAMOCLES)

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Damocles is an integrated ice-atmosphere-ocean monitoring and forecasting system designed for observing, understanding and quantifying climate changes in the Arctic. An advanced observing system has been developed and tested, providing for the first time synoptic, continuous and long-term monitoring of the lower atmosphere, sea-ice and upper ocean. It is designed to evaluate and improve global and regional climate forecasting models based on validation, assimilation and integration of observed data. The ultimate goal will be to lengthen the lead-time of extreme climate changes predicted to occur in the Arctic within this century and thus to improve the ability of society to mitigate for its impacts.

Arctic Wildlife Observatories Linking Vulnerable EcoSystems (ArcticWOLVES): A study of the impact of climate change on tundra food webs

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ArcticWOLVES is an international project developed for the International Polar Year 2007-2008. It is a circumpolar study of tundra ecosystems aimed at understanding food webs and associated ecosystem processes, measuring current impacts of climate change on wildlife through monitoring, and predicting future impacts through modelling. Our program has two complementary goals. First, to determine the relative importance of predator-prey and plant-herbivore interactions in structuring Arctic food webs and to quantify the magnitude of these interactions. Second, to document direct and indirect impacts of climate change on terrestrial animal biodiversity, and forecast future impacts on animal populations and their Arctic ecosystem. The project is based on a circumpolar network of wildlife observatories and involves a coordinated research effort

by an international group of over 40 researchers from 9 countries (Canada, Norway, Russia, Netherlands, USA, Denmark, Sweden, Finland, and the United Kingdom). The project is led by the Centre d'études nordiques, Université Laval, Canada. Funding for the project has been secured in at least 4 countries and field research is carried out at 12 sites in Canada, Greenland, Norway and Russia. Most of these sites already have along history of wildlife-related studies. Extensive monitoring of the abundance, timing and success of reproduction, habitat use, and diet of several key wildlife species, as well as annual plant production and insect diversity and abundance, is conducted at most sites. This allows a comparative approach and ultimately will lead to modelling of these interactions at several sites. At some sites, we are also relying on the Local Knowledge of Indigenous people to expand our temporal and spatial perspective on change in abundance and distribution of some wildlife species. Species of primary interest include herbivorous geese and small mammals, insectivorous shorebirds, and avian and terrestrial predators. During the presentation, we will highlight a few preliminary results of this project.

Thriving in the North – Canadian Arctic Environmental Prediction Services

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A rapidly changing northern climate combined with unprecedented socio-economic development is resulting in new challenges for understanding and predicting the Arctic environment. This presentation will examine some of the changes that are occurring; the challenges they present, and the approach taken by Meteorological Service of Canada to address Canadian environmental prediction priorities for the North.

On limits and uncertainties of predictions of Arctic warming

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General circulation models (GCMs) predictions of warming and sea ice melt in the Arctic Ocean range between several years to centuries. The multi-model average forecast based on models participating in the Intergovernmental Panel for Climate Change Fourth Assessment Report (IPCC-AR4) suggest a 50% or more reduction of summer sea ice cover in the Arctic Ocean by the end of this century. Unfortunately the majority of those models have significant limitations in their representation of past and present variability in the Arctic. The inability of climate models to reproduce the recent warming and ice melt in the Arctic Ocean diminishes their accuracy of future climate predictions. Some of these limitations include: northward oceanic heat convergence, ice thickness distribution, and feedback processes across the ocean-ice-atmosphere interface.

In this talk we present results and argue that high resolution together with improved parameterizations of polar specific processes are part of the solution towards more realistic simulations of past and present and prediction of future climate change in the Arctic.

Multibeam Echosounder Mapping in the High Arctic: The Challenges and the Joys

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Growing evidence of the critical role that the Arctic plays in global climate as well as the strategic issues associated with navigation and sovereign rights to resources associated with the Convention on the Law of the Sea, have led to a recent flurry of scientific (and political) activity focused on the Arctic Ocean. Many of the scientific and political issues associated with the Arctic require the establishment of the best possible geospatial context (i.e., maps), but given the logistical difficulties of working in the high arctic, the Arctic Ocean remains the least mapped ocean basin in the world. Since 2003, four mapping expeditions aboard the multibeam sonar-equipped USCG Icebreaker HEALY, have been aimed at attempting to greatly expand our bathymetric data base in the region of the Chukchi Cap. While the motivation for these expeditions has been mapping in support of a potential submission for an extended continental shelf under Article 76 of the Convention on the Law of the Sea, the data collected

has also revealed numerous scientific surprises including, unmapped seamounts, a new understanding of the shape of the Chukchi Cap, the ubiquitous presence of pockmarks, iceberg scour in depths of almost 1000m and evidence for ice sheets and icesheet–related bedforms in regions where icesheets were unexpected. In the course of this work we have learned about the difficulties of collecting multibeam echosounder data in 8/10 to 10/10's ice cover and have developed strategies for working in these conditions (including "ratchet surveys" and "pirouettes"). All of the data collected from these HEALY expeditions have been made publicly available within months of acquisition (see http://ccom.unh.edu/) as well as quickly incorporated into the ongoing effort to continually update the International Chart of the Arctic Ocean (IBCAO). The HEALY data and other recently acquired data have now been compiled into the new and improved second edition of IBCAO (Version 2 see http://www.ibcao.org). These new data will play an important role in increasing our understanding of the tectonic origin of the Arctic Basin, put physiographic constraints on deep sea circulation (and circulation models), and provide important insight into the glacial and climatic history of the Arctic.

A New Legal Regime for the Arctic

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Long neglected in terms of international governance and management, the Arctic is attracting greater attention as a region in need of an effective regime. Whilst the Arctic, unlike the Antarctic, is not plagued by unresolved territorial disputes, there is the spectre of rising tension over yet to be asserted maritime claims over the vast Arctic Ocean. When this issue is added to the growing alarm over the impact of climate change upon the Arctic, which brings with it not only associated significant environmental change but also increased access within the region, it becomes clear that a region which for all of the Twentieth Century was pushed to the side when it came to the regulation of international affairs has the potential to take centre stage as state interests are awoken and global concerns advance. Arctic States have since the 1990s been skirting around the edges of creating a substantive legal regime for the region. In the past, concerns over national security have been a stumbling block to any progress towards regime formation. Now in the early part of the Twenty-First century resource, environmental and human security have emerged as key issues facing the region. It is clear that none of the Arctic states can individually deal with the challenges the region is facing. The May 2008 Greenland Meeting whilst a positive development in terms of some of the key Arctic States coming together to discuss their overlapping outer continental shelf claims did not significantly advance the thinking on Arctic regional issues. The time has come for a reassessment of the reluctance of the Arctic States to consider hard law mechanisms. The Norwegian, Russian and US experience as founding members of the Antarctic Treaty should give them confidence that a new regime approached in the right spirit of cooperation has great potential. The current Arctic regime is a patchwork of soft political responses in need of an overarching binding treaty framework. This paper will consider these issues by considering the potential for an Arctic Treaty. The scope, object and purpose of an Arctic Treaty will be considered drawing upon the Antarctic experience and the lessons learned from the polar south in the management of disputed territories. Particular attention will be given to the role Canada could play in the promotion of an Arctic Treaty.

Climate Adaptation and Vulnerability in Arctic Regions (CAVIAR)

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The unprecedented changes in the Arctic's physical environments have profound implications for the people who live in the north and rely on the environments for their livelihoods. Arctic communities are sensitive to changes in weather and ice conditions because of their importance for travel, fish and animal populations, permafrost for infrastructure, and new pathogens and viruses. Arctic peoples have a long history of adaptation, yet there are questions about the capacity of individuals and institutions to adapt to the scope and speed of changes, especially when environmental changes are considered together with rapid social and economic transformations. Policy initiatives to address risks to Arctic societies require systematic analyses of the processes that underlie vulnerabilities and analyses that identify opportunities to enhance adaptive capacity.

The interdisciplinary analysis is guided by the model $V_{ijt} = f(ES_{ijt}, AC_{ijt})$. The model is used to structure a suite of case studies in communities across the Arctic, with local collaboration, in order to document (in a comparable way) the conditions and forces that contribute

to vulnerabilities, the adaptive strategies employed, and the prospects for adaptation in the future. The aim is to identify and characterize the forces and processes linking the communities to the environmental changes. An integral part of the research involves identifying the relationships between the community vulnerabilities (including the connections with changes in physical conditions and resources that are important to people's livelihoods) and the institutions through which policies are developed and undertaken.

Results are given for selected communities, indicating the resource-dependent vulnerabilities and the institutional systems through which adaptation initiatives are undertaken. For some communities (or groups within communities) the key conditions (exposures) relate to ice dynamics and access for hunting and other social and economic activities. For others, shifts in the numbers, location and timing of wildlife are the conditions where adaptations are needed, by individuals, community groups and in management agreements. Elsewhere the need for adaptation relates to coastal erosion or developments associated with oil, gas or mining extraction. The comparative results are facilitated through the IPY-CAVIAR consortium.

Arctic Tipping Points (ATP): a new EU project on marine ecosystems dynamics in the European Arctic sector?

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There is mounting evidence that ecosystem response to certain types or magnitudes of extrinsic pressures is often abrupt and non-linear, leading to a significant reorganization of system properties and processes. Such non-linear responses are often initiated by qualitative changes in the structure or function of the ecosystem, and are so fundamental that the impacted ecosystems respond to new pressures in completely different manners than the original ecosystem did. These changes can result in alterations of the most basic ecosystem parameters, including food-web structure, the flow of organic matter and nutrients through the ecosystem, or the patterns of space occupation, leading to a cascade of changes in ecosystems. Climate drives both community structure and key organismal functions and regime shifts identified from marine ecosystems are often linked to climate.

Focusing on the Arctic Basin and particularly on the European Arctic, the currently negotiated EU FP7 project Arctic Tipping Points is based on previous (e.g. CABANERA) and ongoing (e.g. iAOOS Norway – closing the loop) projects and compiles historical trends of Arctic climate change and projections of future changes in Arctic sea climate and ice systems. Long-term time series work in the Arctic ecosystem components are also collected. Statistical analysis will detect regime shifts and ecological thresholds and tipping points, and evaluate their sensitivity to climatic forcing.

Experimental work will be carried out by ATP in the field and laboratory to approximate early warnings of climatic thresholds and tipping points of Arctic organisms and ecosystems. Genomic markers of climate-driven stress to anticipate molecular tools to estimate genomic feedback in response to climatic changes will be applied. A biological-physical coupled 3 D SINMOD model, amended with the results obtained, also investigates future trajectories of Arctic ecosystems under projected climate change scenarios. Sensitive links and processes in the European Arctic to identify potential thresholds and tipping points will be identified. Regime shifts and threshold responses of ecosystem components of the long-term time series, experimental outcomes and model IPPC trajectories (until 2100) are explored.

By focusing on activities of strategic importance in the region, such as tourism, fisheries/aquaculture and the effect on oil/gas exploration, climate change implications for the European Arctic are elucidated. Impacts on employment, income, etc. associated to these activities and legislative frameworks to conserve, adapt and mitigate the impacts of climate change are considered. The effectiveness of possible alternative, post-Kyoto policies and stabilization targets (e.g. EU +2 ºC target) in avoiding these thresholds will be examined. We will convey these results and projections to policy makers, economic sectors and the public in general.

Is Cancer Increasing among the Circumpolar Inuit?

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The major goal of this project was to review trends and patterns of cancer among the Inuit in Alaska, Canada [NWT, Nunavut and Nunavik] and Greenland during the period 1989-2003, updating an earlier review from 1969-1988.

The project is an international collaborative effort involving researchers and health officials from the three countries. Inuit cancer cases by age-sex group and anatomic site were obtained from the regional cancer registries. Incidence rates were age-standardization by the direct method to the standard world population of the International Agency for Research on Cancer.

With all sites combined, there is an increasing trend in cancer incidence over the period. Some "traditional" cancers (such as nasopharynx and salivary glands) have not shown a decrease, and Inuit are among the world's highest risk populations. Notable among the "modern" cancers is the increasing trend in lung cancer, especially in Canadian Inuit, the highest in the world for both men and women. Others such as colorectal cancer is catching up, while breast and prostate cancers are still low relative to non-Inuit. There is some success story, such as the decrease in cervical cancer.

This review provides the needed evidence for public health interventions (primary prevention and screening) and also the planning of cancer care programs and services. Urgent action is needed especially in combating lung cancer. This project also demonstrates the feasibility of international partnership in cancer surveillance, and when extended to other diseases and health conditions, contributes to the development of a Circumpolar Health Observatory.

TOPICAL SESSION ORAL ABSTRACTS

THE INUIT OF NUNAVIK (NORTHERN QUEBEC): SUCCESSES AND CHALLENGES

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Pita Aatami, President of Makivik Corporation, will focus his presentation on the successes of Makivik in the field of Arctic Research, outlining the mandate and research activities of the Nunavik Research Centre (received the Gold Award in 2007 of the Canadian Environment Awards) located in Kuujjuaq, its impact and potential collaboration with governments and academic sector. It will outline the economic success of the Inuit of Nunavik but will emphasize the challenges that people of Nunavik are presently facing: climate change, environmental health, food security, employment, training and higher education.

THE BIOTA OF CHURCHILL: BARCODING AS A TOOL FOR BIODIVERSITY ASSESSMENT AND MONITORING

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The Polar Research Observatories for Biodiversity and the Environment program (PROBE), an IPY initiative, comprises an extensive effort deployed over the past three years to obtain DNA sequences from representatives of all multicellular life occurring in the area of Churchill, Manitoba. We review the salient findings from the first 20,000 sequences from this sub-arctic site, encompassing tundra, taiga, marine, and freshwater environments. Surprising diversity and new species are detected in many groups despite the fact that this site was originally chosen due to supposedly modest diversity and extensive taxonomic work. Moreover, this endeavour has resulted in new insights into community structure and the process of characterizing a biota. This dataset provides an excellent starting point for further survey and biomonitoring. Range extensions have already been documented at Churchill using the barcoding approach. It is clear that DNA barcoding represents a viable solution – we suggest it is currently the only solution – to the taxonomic impediment for large-scale monitoring projects that include invertebrates. We hope to extend the network of collaborators interested in incorporating barcoding into their arctic research.

BUILDING A BASE CAMP – BUILDING AN IPY LEGACY IN NUNATSIAVUT (NORTHERN LABRADOR): INUIT STUDENTS AND SCIENTISTS AND A "NEW WAY OF KNOWING"

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Three years ago, with the establishment of the new Torngat Mountains National Park, Parks Canada, together with the Nunatsiavut Government piloted a base camp managed and run by Inuit at Kangidluasuk at the southern boundary of the park. The purpose of the base camp was to find a way to facilitate the challenges and cost of bringing people – Inuit, Parks Canada staff, visitors and scientists - into the park. As a result of the base camps in 2006 and 2007, researchers in particular expressed strong support for continuation of the base camp as a critical logistical support and as a "unique and wonderful gift" for the opportunity to live in an Inuit camp and to work with Inuit – students and elders - from Nunavik and Nunatsiavut.

In 2008, IPY funding allowed Parks Canada to enhance communications and safety features that allowed base camp to deploy, communicate with and support a number of remote research camps in the Torngat Mountains. IPY funds also supported 5 Inuit students who spent the summer assisting the different scientists working out of the base camp, on shore-based longliners and

zodiacs, and in remote research camps. They were exposed to scientific fieldwork in a variety of forms including marine sampling, seal tagging, glacial monitoring and tundra vegetation research. In all cases the field research was conducted in an environment familiar to Inuit with logistical support provided by Inuit from their communities. It was an opportunity to experience scientific research in the students' own cultural context. It was an opportunity for Inuit and scientists to study an issue through the dual lens of science and Inuit culture, experience and knowledge. The students were excited and engaged and in some cases this experience has fostered relationships that continue past the summer field season.

The base camp has established a bedrock for scientists and Inuit to come together with the best that each have to offer to develop a "new way of knowing" as they explore their questions and concerns about the natural environment. Parks Canada and the Nunatsiavut Government hope to continue to refine the capacity of the base camp to excite Inuit youth and support the collaboration of Inuit and scientists well into the future. We believe it offers a way to push the frontiers of science in northern ecosystems, to blur borders and cultural boundaries and to share with a larger world the results of this work.

FROM ADAPTATION TO LEARNING AND THE POTENTIAL OF ADAPTIVE CO-MANAGEMENT TO REDUCE VULNERABILITY IN ARCTIC COMMUNITIES

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Three general types of environmental change may increase the vulnerability of Arctic communities: 1) relatively gradual or incremental change in baseline conditions through time (e.g., upward temperature trends); 2) increased inter-annual variation and frequency of extreme events; and 3) the potential for social-ecological regime shifts (i.e., flips in the system or parts of a system). In combination with large-scale resource development and on-going socio-cultural change, the implications for vulnerability and adaptation in Arctic communities are profound. Responding to these multiple forms, speeds and intensities of change will require a broad range of adaptation measures in the short-term and long-term (e.g., changes to building codes, livelihood diversification, better information sharing). Efforts to reduce vulnerability and build adaptive capacity, however, may also benefit from greater attention to social learning processes achieved through multi-level institutional partnerships. Social learning is a key dimension of adaptive capacity and is defined here as the on-going action, reflection and deliberation of individuals and groups collaborating to seek solutions to complex, multi-scale challenges. How best to achieve the institutional partnerships that foster learning and adaptive capacity is not well understood, although a growing number of institutional forms are available from which lessons can be gained. Adaptive co-management is one institutional form which draws the connection between learning and collaboration. Such multi-level institutional arrangements are theorized to provide opportunities for more appropriate flows of resources, information and knowledge in ways that can bring different perspectives together in the identification and implementation of adaptation strategies, create incentives for appropriate individual and collective action, and build adaptive capacity.

Given the complexity, uncertainty and inter-connectedness of social-ecological change in the Arctic, experiences with adaptive co-management in other contexts may be valuable. Specifically, community adaptation and vulnerability reduction is more likely to emerge through process-based approaches that build on the capacity of local communities and connect them with higher-order institutions in processes of joint learning and problem solving. This represents a departure from passive, reactive and/or technology-driven adaptation and vulnerability reduction strategies. Core themes in adaptive co-management as one institutional innovation offer possible directions for adaptation and vulnerability research. These themes include the design of institutional arrangements and incentives across spatiotemporal scales and levels, the critical importance of learning through complexity and as a basis for trust-building, monitoring and assessment of interventions and strategies in the context of changing conditions, the need to address power differentials among different actors and groups, and opportunities to link climate science with bottom-up policy development directed at vulnerability reduction.

CHANGES IN ARCTIC OCEAN PRIMARY PRODUCTION FROM 1998-2008

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Arctic sea ice has undergone an unprecedented reduction in area and thickness in the last few decades,

exposing an ever-increasing fraction of the sea surface to solar radiation and increasing the amount of pelagic habitat suitable for phytoplankton growth. Here we present results of a primary production algorithm that utilizes remotely sensed chlorophyll *a*, sea surface temperature, and sea ice extent data to quantify interannual changes in phytoplankton production in the Arctic Ocean between 1998 and 2008. Our results show that between 1998 and 2006, open water area in the Arctic increased at the rate of 0.07 million square kilometers per year, with the greatest increases in the Barents, Kara, and Siberian sectors, particularly over the continental shelf. Pan-Arctic primary production during this time averaged 419±33 Tg C/yr, with the highest rates observed in 2006. However, open water area increased dramatically in both 2007 and 2008, which experienced summer minimum ice area that was 20-23% lower than any other year on record. Because of the large recession of sea ice in the summer of 2007, approximately 1.7 million square kilometers of the Arctic Ocean became ice-free for the first time in recorded history, effectively increasing the size of the open water habitat of the Arctic Ocean by an additional 20-25%, a trend that has persisted into 2008. As a result, rates of annual production reached an 11-year peak of 513 Tg C/yr in 2007. Although most of the newly ice-free waters were located in deep basins that are of generally low productivity, some continental shelf regions also were exposed. Primary productivity in all newly exposed waters in 2007 amounted to 10.6 Tg C/yr, indicating that of the 35 Tg C/yr increase in annual primary production in the Arctic between 2006 and 2007, approximately 30% can be attributed to the increased area of open water area in 2007. Much of the remaining 70% of the 2007 increase in annual production (24.6 Tg C/yr) is due to the longer phytoplankton growing season (expressed as the number of ice-free days) experienced throughout much of the Arctic. In some regions, the combination of accelerated sea ice melt in the spring and delayed freeze-up in the autumn produced an ice-free season that was >100 days longer in 2007 than in 2006. Not surprisingly, areas with lengthened growing seasons also exhibited higher annual production in 2007 than in 2006. Increases in productivity were especially large on the already productive continental shelves, particularly in the Siberian and Laptev sectors, where the growing season was 50-80 days longer in 2007 than it was in 2006. Should these trends continue, continued loss of ice during Arctic spring could boost annual primary sproductivity >3-fold above 1998-2002 levels. Increased water column production could alter ecosystem structure and the degree of pelagic-benthic coupling. Furthermore, changes in carbon export could in turn modify benthic denitrification on the vast continental shelves.

ESTIMATING CO2 FLUX MEASUREMENTS FROM THE INTEGRATION OF HIGH SPATIAL RESOLUTION REMOTELY SENSED DATA AND BIOPHYSICAL VARIABLES.

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There has been increasing concern over the effects of climate change on the Canadian Arctic. The most fundamental issue of this concern is how natural systems will respond to these changes. To fully understand how systems may react to change it is important to understand how they currently behave and how best to monitor these environments. The arctic, in the past, has been shown to be a net sink for atmospheric carbon. Currently there is a great deal of uncertainty as to how the carbon cycle within the arctic currently operates and how it will respond to climate change. Remote Sensing can provide spatially-continuous data on arctic vegetation and terrain patterns, in a range of spatial, spectral, and temporal resolutions. Detailed community level knowledge along with high resolution remote sensing can provide us with the ability to understand fine-grain spatial variation and improve our ability to scale to synoptic predictions. Remote sensing has the potential to provide valuable information for the assessment and monitoring of vegetation patterns which can then be used to predict patterns of carbon dioxide flux. Three requirements are needed for carbon storage and flux patterns to be predicted from remote sensing data: (i) unique electromagnetic signatures need to exist and correspond to variations in vegetation patterns and structure; (ii) one or more models are needed to transform remotely sensed data into derivative values pertaining to the type or condition of the land cover and then to estimate carbon flux from this derivative variable; and (iii) measurements of carbon flux rates and storage amounts to calibrate and validate the models used to estimate the carbon flux distribution from the remotely sensed data (Stow et al., 1998). IKONOS multispectral (4m spatial resolution) data were collected for Cape Bounty, Melville Island (74°55'N, 109°35'W). These data capture the spatial variability of community types and provides the ability to accurately resolve the proportions of cover types within a study area. To complement the image data, detailed community information on species composition, fraction of vegetation cover, and wet and dry biomass are combined

with spectral signature data to create statistically derived community classifications. Ordination techniques are used to determine the natural arrangement of sample sites and cluster analysis to create ecological classes. The relationship between the normalized difference vegetation index (NDVI) and above-ground biomass are linked with vegetation community information and closed chamber plot-level CO_2 flux measurements to estimate carbon dioxide fluxes within these derived ecological classes.

ARCTIC-WINTER CLIMATOLOGY AND RADIATIVE EFFECTS OF CLOUDS AND AEROSOLS BASED ON LIDAR AND RADAR MEASUREMENTS AT PEARL

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During the cold and dark Polar winter months, arctic regions are the site of interactions between aerosols, clouds, radiation and precipitations that are linked to intense cold anomalies and winter storms. The long-range transport and deep mixing into the arctic atmosphere of sulfur-enriched anthropogenic aerosols originating from northern regions result in the vast formation of thin ice clouds, which are characterized by fast-growing and precipitable crystals. This leads to significant enhancement of precipitation, atmospheric dehydration and infrared cooling with prominent climate feedbacks.

To study such processes, an algorithm is developed that identifies and classifies aerosol and cloud features based on data collected at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut by an Automated High Spectral Resolution Lidar (AHSRL) and the Millimeter-Wave Cloud Radar (MMCR). The algorithm also provides radiative properties of clouds and aerosols, which are used to compute their radiative effects and heating rates by the Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) code. Results on the climatology and radiative effects of clouds and aerosols are presented for arctic winter months of recent years, and their implications to the study of climate change are discussed.

FRESHWATER AND CARBON DYNAMICS IN HUDSON BAY: RESULTS FROM MERICA 2003-2006

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Water mass characteristics and circulation in Hudson Bay are strongly influenced by freshwater dynamics, namely, fluvial input from the large drainage basin, sea ice formation and melt, and less saline Pacific water inflow in the northern part of the Bay. Changing freshwater dynamics are considered to play an important role in the carbon cycle in Hudson Bay. The distribution of freshwater from different sources affects ocean surface chemistry, which in turn affects its capacity to sequester atmospheric CO_2. Partial pressure of CO_2 in the ocean, which drives air-sea flux of CO_2 in surface water, is determined by Dissolved Inorganic Carbon (DIC) and total Alkalinity (TA), as well as temperature and salinity. Since DIC and alkalinity concentrations are vastly different between sea-ice melt-water and river runoff, the distribution of freshwater components has a strong impact on the uptake of atmospheric CO_2 in this region. Sequestered CO_2 in the ocean forms carbonic acid, which causes a decrease of pH (ocean acidification). Ocean acidification has negative effects on marine calcifying organisms. Because of low buffer capacity and high dissolution rate of calcium carbonate shells and skeleton of organisms in cold water, regions such as Hudson Bay may be particularly affected by this threat. Annual time series studies have been conducted in the Hudson Bay Complex during 2003-2006 by the program MERICA, measuring dissolved inorganic carbon (DIC), alkalinity and oxygen isotope composition. Oxygen isotope composition ($\delta^{18}O$) is used to identify the freshwater sources including sea ice melt water and meteoric water (precipitation and river or glacier runoff). From DIC and alkalinity, pH, saturation state for calcite and aragonite and pCO_2 were calculated. Highest DIC concentrations were observed at the eastern side of Hudson Bay bottom water, where a large component of brine rejection water exists. pCO_2 concentration in the surface layer is higher than that in the atmosphere and Hudson Bay serves as a source for atmospheric CO_2 during summer (August). Saturation horizon for aragonite was shallow, around 100m deep, at the western side of section. Freshwater in Hudson Strait is a mixture of the Baffin Bay Current, which flows into

the northern part of the Strait, and meteoric water from the Hudson Bay with a large riverine input. There is little influence of sea ice melt water, while brine rejection water extends to the bottom. DIC concentrations are low (<2140 μmol/kg) through the section. Net transport of carbon from Hudson Bay to the Labrador Sea through Hudson Strait is estimated to be 0.1 PgC/year.

LONG RANGE ATMOSPHERIC TRANSPORT OF AEROSOLS: FIRST ARCTIC MEASUREMENTS USING AEROSOL MASS SPECTROMETER

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Atmospheric aerosols have a direct effect on climate by scattering and/or absorbing solar radiation, thereby modifying the radiative balance of the atmosphere. Aerosols also can act as cloud condensation nuclei, which alter cloud properties and precipitation rates, thereby indirectly influencing the climate. Aerosol surfaces also are a medium for heterogeneous reactions, modifying the chemical composition of both the gas and aerosol phases in the atmosphere. Aerosol surfaces may carry numerous different compounds (e.g. organic or inorganic, hydrophobic or hydrophilic), which naturally affect their chemical and physical properties. Since aerosol lifetimes in the free troposphere are on the order of a few days to a week, they are transported over long distances in the Earths atmosphere. To study this transport, we have installed a quadruple aerosol mass spectrometer (Q - AMS) (Aerodyne Research Inc.) in the Polar Environment Atmospheric Research Laboratory (PEARL) in August 2006. PEARL is located in the Arctic on Ellesmere Island (80°N 86°W) at an elevation of 610 m. above sea level. It provides a unique location for observing transport to the sensitive Arctic ecosystem, because it is far from anthropogenic sources of contamination and it is in the free troposphere most of the time.

In this presentation, we will report the analysis of aerosol mass concentrations, size, and chemical compositions covering the time period from August, 2006 to January, 2008. Our measurements show that sulphate dominates the aerosol composition most of the time, with a maximum concentration of 0.655 $\mu g/m^3$ and minimum concentration of 0.030 $\mu g/m^3$. The second most abundant species was organic aerosols, with concentrations in the range from 0.440 $\mu g/m^3$ to 0.050 $\mu g/m^3$. Although the sulphate dominates in general, plots of concentration time series show a seasonal change in the relative concentrations of sulphate and organic species. Relatively lower concentrations of nitrate and ammonium species were detected during the period of our observations. Occasional episodes of concentrations up to 0.050 $\mu g/m^3$ nitrate and 0.080 $\mu g/m^3$ ammonium were detected; otherwise these were below our detection limit. (The Q - AMS detection limit at PEARL was determined to be 0.009 $\mu g/m^3$, which is three standard deviations from the noise.) In addition to the above results, we will briefly report the ionic components and discuss possible aerosol transportation routes determined with the semi-Lagrangian trajectory model, FLEXPART.

SCIENCE-DRIVEN COOPERATION AND POLICY: ADDRESSING CANADIAN/US DIPLOMATIC CONCERNS IN THE ARCTIC

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In September 2008, as this abstract was submitted, a Canadian and a US icebreaker traveled together through the Arctic Ocean. Scientists on both vessels mapped the ocean floor in preparation for each country's submission to the Commission on the Limits of the Continental Shelf, established by the UN Convention on the Law of the Sea. Canada has ratified the Convention, the US has not, but both recognize its processes as the surest route to confirm the extended continental shelf entitlements that each will present to the international community.□□ How might this model – Canadian-US scientific cooperation under principles of the LOS Convention – apply to the Beaufort Sea dispute, and to other arctic areas of mutual concern? The model, if coupled with limited joint management of the region, has the potential to strengthen Canadian and US sovereignty over national maritime zones by having both countries share, as appropriate, responsibility and benefits relating to Arctic Ocean resources. One outcome might be a joint management/development area for clean exploitation of area resources alongside environmental protections. A greater role for science in setting policy and management direction in the region would alter the traditional approach of lawyers and policymakers establishing rules without sufficiently considering the scientific realities of the subject being regulated. The paper builds on progress in better integrating scientific input into oceans policy making and diplomacy (see e.g. 2006 Virginia LOS Conference on Law,

Science & Oceans Management; Davor Vidas, 2006) and in managing resources to avoid conflict (see, e.g. Saleem H. Ali, 2008).□□ The following legal instruments and principles will be examined for how they might allow joint Canadian/US protection, management and development of areas of common arctic concern on the foundation of science-driven cooperation: **LOS Convention.** Art. 76 ECS; arts. 122/123 Semi-enclosed seas/cooperation; art. 194(5) Protecting fragile ecosystems/endangered species habitats; art. 197 Regional environmental cooperation; Part XIII, Marine Scientific Research; art. 234 ice-covered areas; art. 311 LOS/other international agreements. b**Other potentially applicable bilateral and multilateral treaties, soft law and principles:** Agreements or principles regarding EIA, sharing of scientific information, integrated ecosystem management, regional seas, marine protected areas/particularly sensitive sea areas, biodiversity, preventing pollution from ships, transporting hazardous cargo, and the duty to cooperate as a *Grundnorm* of environmental protection. Each country's **domestic legal and administrative framework** for marine management and arctic science will be addressed, as well as Canadian-US cooperation in the context of **Arctic Council**. The author was the sole lawyer on the USCGC Healy mapping cruise that immediately preceded the 2008 joint Canadian-US icebreaker mission. Immersion in the cooperative, multi-dimensional world of mapping science informs her consideration of scientific cooperation as a means to strengthen national sovereignty, bilateral relations, and regional security.

DEVELOPING A FRAMEWORK OF BASELINE DATA IN A COMPLEX THERMOKARST LAKE SYSTEM USING RELATIONSHIPS BETWEEN HYDROLOGICAL PROCESSES AND LIMNOLOGICAL CONDITIONS

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The role of hydrological processes on lake ecology is not entirely understood and traditionally is not extensively used in limnological studies. However, in northern shallow lake ecosystems hydrological processes have been found to be a driving force behind biological and chemical changes within the lake. This research uses information gained from stable isotope tracer analysis ($\delta^{18}O$ and $\delta^{2}H$) to assess limnological differences in Old Crow Flats (OCF), Yukon Territory's most diverse wetland ecosystem recognized under the Ramsar convention of 1982. The OCF, located 75km north of the arctic-circle, contains over 2000 shallow lakes in permafrost terrain. Hydrological processes such as precipitation, evaporation, subsurface flow, surface flow, and melting permafrost have caused these lakes to expand, coalesce and in some cases drain naturally. However, recent observations by the local First Nation report evidence of pronounced and unprecedented hydrological changes (ie. draining and drying of lakes), which are consistent with a warming arctic. The consequences of these hydrological events on chemical and biological processes within lakes is unclear, but is a key linkage to understanding both the ecology of this dynamic lake ecosystem and the associated effects of climate change.

A set of 56 lakes spanning hydrological gradients were sampled 3 times over the ice free season of 2007 to assess seasonal relationships between hydrological processes (determined from stable isotope tracers) and water chemistry. Principal Component Analysis (PCA) suggests that hydrological differences among lakes of the Old Crow Flats strongly influence nutrient concentrations. Lakes that receive relatively higher inputs of snowmelt water, as identified by isotopically-depleted lake water compositions, are characterized by high concentrations of phosphorus and dissolved organic carbon. In contrast, lakes that have isotopic signatures suggesting a greater relative influence of rainfall tend to have low concentrations of these nutrients as well as more alkaline pH. Data analysis also suggests that these hydro-limnological relationships remain relatively consistent over the ice free season between June and September. Ongoing analysis of chlorophyll concentrations will determine the effect of hydrological characteristics on biological community composition and associated productivity. These findings indicate hydrological conditions are effective in characterizing limnological patterns in shallow thermokarst lake systems and should be used to develop hydro-limnological baseline data frameworks for long-term monitoring programs.

EDUCATION, COMMUNICATION AND OUTREACH: LINKING RESEARCH TO PUBLIC POLICY AND ENVIRONMENTAL AWARENESS – OPENING REMARKS

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Investigate and communicate...this growing trend in scientific polar research, is evident in the prevalence of Education, Outreach and Communication sessions in major national and international science conferences such as Arctic Changes. This trend reflects the growing public recognition and interest in climate change and the need to communicate the role of science and Inuit knowledge in building a better understanding of these changing times. Scientists play an important role in promoting both scientific and environmental literacy and inspiring the next generation of scientists and policy makers. The outreach initiatives represented in these sessions and the complementary poster sessions demonstrate the diversity of activity that enable scientists to engage the public in their work in a very meaningful way.

MAPPING CANADA'S ARCTIC SEABED: DATA PROCESSING, MANAGEMENT AND DISTRIBUTION STRATEGIES

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There has been recent renewed political interest in mapping Canada's north, for example the October 2007 throne speech to Parliament stated that «As part of asserting sovereignty in the Arctic, our Government will complete comprehensive mapping of Canada's Arctic seabed. Never before has this part of Canada's ocean floor been fully mapped.

The Canadian Hydrographic Service, the Geological Survey of Canada and the ArcticNet NCE program have been mapping in the Arctic for many years and have amassed considerable amounts of data. Current clients require this data for all of navigation, engineering, natural resources and benthic habitat applications. Thus, products beyond "least depths", including geomorphology, surficial backscatter and shallow subbottom data, need to be processed and distributed simultaneously. Regarding future mapping efforts, there is a need to collate existing data sets and to make them available to the various parties that will be involved. This will facilitate their task by helping (1) to avoid redundant data collection and (2) to prioritize areas which should be remapped (e.g. due to low resolution or poor accuracy).

Through its involvement in ArcticNet, the OMG has developed an expandable data distribution model that allows for web-based perusal and retrieval of the ArcticNet seabed mapping data set. As the model was developed to serve the various needs of the many parties involved with ArcticNet, the ideas are adaptable to serving the various agencies that will be tasked with mapping Canada's Arctic seabed.

SATELLITE-BASED ASSESSMENT OF THE LIGHT-DRIVEN COMPONENTS OF THE MODERN ARCTIC OCEAN BIOGEOCHEMICAL CARBON CYCLE

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Primary production and dissolved organic carbon photo-oxidation have opposing impacts on carbon fluxes in the ocean. The balance between the two processes may be significantly affected in the near future by climate change. This is especially true for the Arctic Ocean, which is increasingly exposed to light as perennial ice recedes, and which receives increasing amounts of terrigenous dissolved organic carbon (tDOC) as the permafrost thaws and river discharges increase. In this study, we used remote sensing data to estimate the pan-Arctic distributions of primary production and CDOM photo-oxidation, and how they evolved from 1998 to 2007. Ocean color (merged data from SeaWiFS, MERIS and MODIS), ozone, cloud (ISCCP) and ice (SSMI) data are combined to run a UV-visible atmospheric radiative transfer code, and primary production and photo-oxidation models. We used state-of-

the-art optical models for optically complex waters, some being specific to the Arctic Ocean. Our results provide the first pan-Arctic combined estimates of primary production and CDOM photo-oxidation based on remote sensing, and allow determining how these two processes compare. They indicate that CDOM photo-oxidation accounts for a major fraction of allochthonous organic carbon mineralization in the Arctic Ocean, and is comparable in magnitude to the fraction of gross primary production that ends up sequestered within the ocean bottom sediments. The ratio between photo-oxidation and primary production turns out being highly variable, which suggests competition for light between CDOM and phytoplankton at regional scale. As a response to sea ice decline, both photo-oxidation and primary production showed increasing trends from 1998 to 2007, but the spatial patterns are highly variable and still not well understood. Based on our results and previous estimates of vertical carbon fluxes, we propose a simplified version of the Arctic Ocean organic carbon budget, including terrestrial dissolved component.

SEASONAL AND DAILY SCALE BEHAVIOUR OF ARCTIC COD WINTER AGGREGATIONS UNDER THE SEA-ICE COVER AT A FIXED STATION IN FRANKLIN BAY (BEAUFORT SEA)

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In the Canadian Arctic, the large biomass of Arctic cod that must exist to explain consumption by predators has eluded detection. From December 2003 to May 2004, acoustic estimates of Arctic cod biomass at a 225-m deep station in central Franklin Bay (southeastern Beaufort Sea) increased progressively by two orders of magnitude, reaching maximum values of 2.7 kg m^{-3} and 55 kg m^{-2} in April. During accumulation in Franklin Bay, the fish occupied the lower part of the Pacific Halocline (140 m to bottom), where the temperature-salinity signature (-1.4 °C to 0.3 °C; 33 to 34.8 PSU) corresponded to slope waters. Currents at 200 m along the western slope of Amundsen Gulf headed SSW throughout winter, suggesting the passive advection of cod from southeastern Beaufort Sea into Franklin Bay. Retention in Franklin Bay against the general circulation resulted from the fish keeping at depth to reduce predation by diving seals and/or to benefit from relatively warm temperatures in the lower halocline. The mean Arctic cod standing biomass estimated (11.23 kg m^{-2}) would amply satisfy the requirements of predators. Furthermore, Arctic cod diel vertical migrations (DVM) were observed under the sea-ice cover, until the day/night alternation was occurring (i.e. end of April). During the dark hours, a small part of the population migrated up to 80 m, while most of the fish remained below 140 m. DVM were triggered by light and tracked the lengthening of the photoperiod. Vertical distribution of Arctic cod's main preys matched the night distribution of the fish, suggesting that they migrated to feed, while minimizing the risk of predation by seals. DVM stopped in May, at the beginning of the 24 h light period, and most of Arctic cod were distributed between 50 and 150m. This dramatic change in their distribution and behaviour suggest a seasonal switch of fish activity, triggered by light. Analysis of this very dense Arctic cod aggregation, at a seasonal and daily scale, enabled to enlighten the interactions of Arctic cod with its preys and predators, in its deep, ice-covered, and low-light winter environment. Understanding the under-ice ecology of Arctic cod is a gateway to envisage how the decrease of the sea-ice cover may affect this key-species of the Arctic pelagic ecosystem.

NORWEGIAN MEASUREMENTS OF ATMOSPHERIC MERCURY DEPLETION EVENTS AT ANTARCTICA, SVALBARD AND THE MAINLAND OF NORWAY

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The presentation show development and some highlights from eight years Atmospheric Mercury Depletion Event (AMDE) studies at Ny-Ålesund, Svalbard (78°54'N, 11°53'E), two years at Andøya (69.3° N, 16° E) at the

mainland of Norway, as well as 1 years measurements at Troll, Antarctica (72° 01' S, 2° 32' E). For the first time AMDEs have been recorded at the Scandinavian peninsula. Nearly all of the AMDEs observed at the subarctic station Andøya occurred concurrently with AMDEs measured at the high Arctic Zeppelin station, Svalbard. The events at Andøya were less pronounced as those measured at Zeppelin. AMDEs have also been observed at the Antarctic station. This was somewhat surprising due to the fact that the station is located 220 km from the coast line and 1270 m.a.s.l. The stations are completely different from each other concerning climate and the results will be discussed on basis of this fact.

UPS AND DOWNS ALL YEAR ROUND: DVM PATTERNS IN ARCTIC ZOOPLANKTON

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High latitude environments show extreme seasonal variation in both physical and biological variables, with the classic paradigm of Arctic marine ecosystems holding that Diel Vertical Migration (DVM) of zooplankton will cease both during the midnight sun and polar night. Pelagic biological processes in summer have been extensively investigated in terms of community development, reproduction and feeding, whereas much less is known about the rates and processes of pelagic communities in winter.

Acoustic data from two years of almost continuous deployment from two coastal sites at Svalbard (Rijpfjorden and Kongsfjorden) have now been analyzed for patterns of DVM. Both datasets are derived from one-year deployments of moored upward-looking acoustic Doppler current profilers (ADCPs) covering the upper ~100m of the water column. In Kongsfjorden, there is a detectable synchronized DVM pattern almost continuously between late autumn 2006 until August 2008, with the signal only becoming weaker and indistinct during December and early January. This period covers the polar night and midnight sun, as well as the regular day-night cycles of spring and autumn. Corresponding data from Rijpfjorden show DVM during autumn, late winter and spring, but in contrast to Kongsfjorden the signal does not appear to continue into summer.

COMUNITY-BASED MONITERING

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There is a need to develop monitoring frameworks that take into account both science and local traditional knowledge. Using a range of sources of information is crucially important for environmental monitoring. This helps engage user-groups, foster environmental stewardship, improve the quality of information, and expand the range of kinds of changes to be monitored. Indigenous knowledge (traditional environmental knowledge) of northern aboriginal peoples is under-represented in environmental monitoring and assessment in Canada and elsewhere, despite over ten years of experience with projects such as the Arctic Borderlands Ecological Knowledge Co-op (http://www.taiga.net/coop). There are three important lessons emerging from the experience with indigenous knowledge systems.

First, indigenous knowledge is not merely local, as often thought. Local knowledge can be pieced together to illuminate regional-level changes from multiple stresses over large areas, as done in Yukon-Alaska by the Co-op, *Voices from the Bay* project in the Hudson Bay region, and the use of a 'fat index' to monitor the health of caribou across northern Canada and Alaska. Second, indigenous knowledge has its own distinct logic. It seems to monitor a large number of indicators continuously, accumulates large amount of qualitative data, and builds a collective mental model that is flexible. Such community-based monitoring results in holistic assessments by the consideration of a large number of variables qualitatively; this complements scientific approaches that typically monitor a small number of variables quantitatively. Third, the key role of local-level observations in global assessments is being increasingly recognized, as in the MA volume, *Bridging Scales and Knowledge Systems*. Community-based monitoring can complement scientific monitoring not only in terms of knowledge, but also in terms of scale. Scientific knowledge and community knowledge are complementary because the two kinds of knowledge operate at two distinct spatial scales. Good monitoring requires the use of both, giving a more complete

accounting at the various levels of analysis from local to global.

CO-MANAGEMENT INSTITUTIONS AND THE USE OF KNOWLEDGE: ADAPTING TO CHANGE IN THE ARCTIC

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Environmental change and other drivers have been affecting Arctic resources and livelihoods. Arctic social-ecological systems possess adaptations to deal with natural variability, and recent changes have been triggering short-term coping responses as well. What are the prospects for increasing the ability of Arctic communities to adapt to further change? Institutions are important in this regard because they are related to knowledge development and social learning that can help reduce vulnerability, build resilience and increase adaptive capacity. But the mechanisms of this are poorly known. In our current project, we are examining institutions and institutional processes that facilitate or constrain adaptation. The relevant institutions in Canada, for our purposes, are mainly the co-management institutions of Arctic land claims agreements. Under the *Inuvialuit Final Agreement* of 1984, the main co-management agency is the Fisheries Joint Management Committee (FJMC). Under the *Nunavut Land Claims Agreement* of 1993, it is the Nunavut Wildlife Management Board (NWMB). However, other institutions that play a role in co-management also include those at community, regional, national and international levels. A co-management agency that properly functions as a *bridging organization* provides a platform (1) to facilitate the interactions of institutions at multiple organizational levels, (2) to bring together the different kinds of knowledge and ways of knowing (indigenous and scientific), (3) to access information and resources as needed, and (4) to build networks and partnerships for social learning. In particular, we need to identify key linkages, and the flow of communication, knowledge and resources across these linkages, both *horizontally* (across the same level of organization or across geographical space) and *vertically* (across levels of organization). By doing so, we may understand the opportunities and limitations of current institutional arrangements to provide governance systems that can learn from experience and generate knowledge to cope with change.

RADARSAT BASED RIVER ICE MAPPING IN THE NUNAVIK CONTEXT

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Over-ice transport is an essential element of life in the north. Native people are commonly using the inland rivers and lakes network to access there hunting and fishing grounds. However, these ice routes are being strongly impacted by recent warming and associated reductions in the seasonal duration and thickness of ice, which may lead to increasingly risky areas or inaccessible trails. In this context, the Kativik Regional Government of Nunavik (Northern Quebec) has initiated an ice monitoring program along the trail networks surrounding certain communities, relying on traditional knowledge and scientific measurements. Through the Canadian Government International Polar Year Program, and the project ¯'Variability and Change in the Canadian Cryosphere' a complementary monitoring approach based on RADARSAT images is being tested.

RADARSAT-1 images in Fine or Standard mode are a powerful tool to collect information on river ice development over large areas repeatedly and consistently throughout the ice season. Unsurpervised classifications algorithms based on radar image intensity and texture are used to discrimate automatically different ice types. The dominant ice cover types can be identified and ice type boundaries can be observed. The ice maps can help locate the head of the complete ice cover and the location of heavily consolidated events (very rough ice). However, misclassification of ice cover types can occur due to the complex and variable characteristics of the ice itself and to the characteristics of the sensor. Generally, overall classification accuracies of 69% to 99% could be obtained for tree to five ice classes.

This paper presents the process developed to adapt and implement radar based river ice maps to the context of the Koksoak River area (Kuujjuaq, Qc) and the needs of the local communauties. The first step was to meet with local hunters and experts to establish the trail network, to acquire the Inuit's perspective about river ice in the area (ice features, changing conditions, risky areas) and to discuss a product that would suit their needs (boundaries, frequency,

medium, language, etc.). The second step of the process was to plan for a test season, with a weekly near real-time prototype product. Aspects of this planning would involve the adaptation of image processing methods and map design, as well as developing means to deliver the maps to the users. The third step of the process was to develop a validation protocol, which relies on field observations. This part involves the installation on site of instruments such as an ice profiler (SWIP) and a high resolution webcam. But it also involves the map users themselves, with feedbacks on the maps, acquisition of ground photos and measurements of ice thickness. Results of the 2007-2008 winter season are also presented.

THE NORTHERN BIODIVERSITY PARADOX: GLOBAL CRISIS YET LOCAL ENRICHMENT

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Although there are many uncertainties about the trajectories of populations and species, we know where biodiversity will go from here in the absence of a rapid, transformative intervention: up in smoke and toward the poles (modified and simplified from Ehrlich and Pringle PNAS 2008). The Arctic is the end-member of a declining biodiversity gradient that runs from the tropics to the North Pole. Climate warming is currently shifting this gradient to the North, with a predicted acceleration of biodiversity erosion at the global level. Whereas the Arctic will lose (is losing) its ice-dependent habitats and some of its most specialized species, biodiversity in the Arctic should generally increase with the augmentation of primary productivity and the arrival of new species from the South. In terms of absolute number of species, the Arctic should gain more than it will lose, hence generating a Northern biodiversity paradox. If this hypothesis is true, biodiversity conservation in the 21st century Arctic will have to deal at least as much with invading Southern species as with declining Arctic species, in a context where adaptation strategies for habitat and biodiversity conservation may be limited. In this presentation I explore the interface between climate change and biodiversity conservation in the Arctic, in an attempt to extract some of the key issues that arctic researchers and managers have to face.

ON THE ROLE OF ANTHROPOGENIC AEROSOLS IN THIN ICE CLOUDS FORMATION DURING WINTER: IMPLICATIONS FOR ARCTIC CLIMATE AND DECISION MAKERS

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New findings from CloudSat – CALIPSO satellites and from the ground based observatory at PEARL, Eureka NU, together with concurring model simulations over the Arctic are leading us into a new perspective on the formation of cold air anomalies in the High Arctic through the dehydration-greenhouse feedback process. Our results show that vast regions of optically thin ice cloud formations (1000 to 4000 km wide and 5 to 10 km deep) are modified by anthropogenic aerosols reaching deeply in the Arctic troposphere during the cold season (November to March). The cold core from winter storms in their final life stage are often drifting into the Arctic, slow lifting cold and moist air, enriched by anthropogenic pollutants and dominated by sulphuric acid. Observations and model simulations agree that the maximum aerosol concentration in the upper troposphere (4 to 8 km) occurs during winter above the Arctic. This situation allows a cooling rate which favours the interaction between aerosol, originating for arctic haze, and clouds. The resulting thin ice cloud formations are associated to acid coating on most aerosol particles, deactivating IFN and leading to fewer but larger ice crystals. The process effectively dehydrates the air deeply into the troposphere and produces very distinct cloud types from those dominating in more pristine regions, like Greenland and Antarctica. Statistics on aerosol and thin ice clouds found in both polar regions are compared. Microphysical processes in thin ice clouds and light precipitation occurring in these regions are enhancing the lost of energy in the far IR region and can be responsible for profound alteration of the production rate of cold anomalies which ultimately feeds mid latitudes synoptic storms. This study of aerosols, thin ice clouds, radiation, light precipitation and atmospheric dehydration in cold conditions is part of the Canadian research activities during the International Polar Year. The

implications for decision and policy makers are paramount for managing the course of our future climate in the Arctic and the mid latitudes as well.

TERRESTRIAL ARTHROPOD ABUNDANCE AND PHENOLOGY IN THE CANADIAN ARCTIC; MODELING THE VARIATION IN RESOURCES AVAILABLE TO ARCTIC-NESTING INSECTIVORES.

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Many insectivorous birds breeding in the arctic tundra depend on arthropods such as insects and spiders for their survival and reproduction. Arthropods benefit from a very short period of favorable climatic conditions to grow and reproduce and birds must synchronize the hatching of their young with the short peak in arthropod abundance. This can be particularly challenging for long-distance migrants. The timing and amplitude of the peak in arthropod abundance are likely to change rapidly as a consequence of global warming. One of the possible outcomes is that peaks in arthropod abundance will occur earlier in the season but may not necessarily last longer, thereby disrupting the synchrony between nesting phenology of birds and their prey. In order to better anticipate the response of wildlife to global warming, we investigated the effect of various environmental parameters on seasonal changes in arthropod abundance and activity. Arthropod trapping provides a proxy for both arthropod abundance and activity, which in turn is reflective of their availability to insectivores. Pitfall and modified pitfall traps were set in four locations in the Canadian Arctic: Bylot Island, Ellesmere Island, Herschel Island, and Southampton Island. Traps were set for one to three consecutive summers at each location using a standardized protocol. In all instances, a set of traps were deployed in both wetland and mesic tundra and sampled every two days. By coupling trapping data with environmental parameters measured by automatic weather stations, we built a model to predict seasonal change in arthropod abundance. Model variables included precipitation, cumulative thaw degree-days and daily temperature. The model will be used to simulate past trends in arthropod abundance and activity and forecast their response to climate changes. The model will provide a tool in assessing the risk of a phenology mismatch between insectivorous birds and their prey in the arctic tundra.

VARIABILITY OF SEA-SURFACE TEMPERATURE AND SEA-ICE COVER IN THE FRAM STRAIT OVER THE LAST TWO MILLENNIA

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During the last decades, the Arctic regions have experienced significant changes, notably with respect to the extent and duration of the sea-ice cover. Although the modern sea ice decline is largely attributed to global warming, little is known about the natural variability of sea ice, and future trends remain difficult to predict. One key to address this critical issue is the use of recent geological archives for documenting past sea ice on centennial to millennial time scales.

In this context, the International Polar Year activity WARMPAST (Arctic Ocean Warming in the Past: IPY n°36) was defined for the reconstruction of past ocean and climate conditions in the Fram Strait which constitutes the main gateway between the Arctic and North Atlantic oceans. Here, we report the results obtained from a sediment core (JM-2006-04) collected during the WARMPAST 2006 expedition on the Jan Mayen along the West Spitsbergen margin of Fram Strait (78.92°N, 6.77°E, water depth: 1497 m). The chronology of the 51 cm long core was established from 210Pb and 137Cs and 14C measurements. A sedimentation rate of about 19 cm/kyrs and a mixing layer of 5 cm led to an extrapolated age of 2400 yrs BP at core bottom. Analyses of dinocyst assemblages were performed to reconstruct hydroclimatic conditions, including the sea-ice cover, using the Modern Analogue Technique (MAT) and a Northern Hemisphere reference database of 1208 sites.

The relative abundance of dinocyst taxa and a principal component analysis permitted to distinguish a particularly warm interval characterized by sea-ice free conditions at about 1350 yrs BP. A sharp transition from the Medieval Warm Period to Little Ice Age conditions is found around 640 yrs BP. It is marked by the simultaneous disappearance of the thermophilic taxa Spiniferites mirabilis-hypercanthus, Selenopemphix quanta and Impagidinium sphaericum and the increase

of the polar-subpolar taxa Impagidinium pallidum and Pentapharsodinium dalei. Sea-surface temperatures (SSTs) estimates suggest warmer conditions than present (up to 7°C in summer) until 640 yrs BP although cooling pulses are recorded circa 1900, 1550 and 900 yrs BP. These pulses associated with a high variability of sea ice suggest centennial to millennial timescale oscillations. The last 640 yrs BP show a cooling trend with summer SSTs decreasing from 7 to 2°C and a seasonal sea-ice cover increasing up to 7 months/yr.

The study of core JM-2006-04 demonstrates the Fram Strait area constitutes a particularly sensitive zone as regards the sea-ice cover and SSTs, as a result of the relative influence of the warm and saline inflow of North Atlantic water masses and of cold and fresh waters outflow from the Arctic. The thermal optimum recorded at 1350 yrs BP represents the only interval of the last 2400 yrs BP that provides a possible analogue for the modern post-2000 AD conditions.

PREDICTING CLIMATE CHANGE-INDUCED ALTERATION IN FOOD WEB ACCUMULATION OF CONTAMINANTS

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Climatic change is expected to alter environmental distribution of contaminants and bioaccumulation in organisms. This alteration is related to changes in transport, partitioning, carbon pathways and internal bioaccumulation process rates. The magnitude and direction of these changes and resulting overall bioaccumulation in the food web is not known. In the present study the aim is to quantify the effect of climate change, represented by temperature change, on internal processes resulting in bioaccumulation of organic contaminants. Thus, the study is independent of altered transport of contaminants and introduction by new species in the food web.

To asses the effect of climate change on internal processes governing bioaccumulation, we focussed on the pelagic marine food web of the Arctic, as the amplitude of climate change is expected occur largest and fastest in Polar Regions. The pelagic Arctic marine food web was represented by primary producers (phytoplankton/ particulate organic matter, secondary producers (calanoid copepods: Calanus glacialis and C. hyperboreus, and krill: Thysanoessa inermis), predators (pelagic amphipods: Themisto libellula, and fish: polar cod Boreogadus saida), piscivorous seabirds (kittiwake Rissa tridactyla) and piscivorous mammals (ringed seal Phusa hispida). The effect of climate change on bioaccumulation was studied using a well-studied bioaccumulation model that has been used in many recent bioaccumulation studies. The fundamental model concept is to estimate six different contaminant rate constants governing the intake and outflow of POPs in an organism. These six rates are: uptake (kI) and loss (kO) to water or air via gills or lungs, dietary uptake (kD) and loss due to excretion (kE), metabolic degradation (kM) and growth dilution (kG).

By defining two future scenario with increasing seawater temperature (+2ºC and +4ºC), the effect on the model processes was quantified, and the overall contribution to bioaccumulation was estimated. Interestingly, parameters that are not directly influencing bioaccumulation in a specific species had an overall effect on the species, as it affects the prey of the species. The break up of the processes rather than looking at the overall bioaccumulation was awarding, as some of the processes work in different directions. Also, the identification of how the change in parameters influence the bioaccumulation was surprising for some parameters such as lipid content, as its role in the bioaccumulation is more complicated than often considered.

In future phases of this work we focus on the other contributors to changes accumulation in an organism, such as altered exposure and food web.

GLOBAL WARMING AND ARCTIC MARINE MAMMALS (GWAMM): THE DEVELOPMENT OF A COMMUNITY-BASED MONITORING (CBM) NETWORK WITHIN THE HUDSON BAY REGION OF CANADA

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The core objective of the International Polar Year (IPY) - Global Warming and Arctic Marine Mammals (GWAMM) project was to develop a community-based monitoring (CBM) network within the greater Hudson Bay region of the Canadian Arctic. The CBM network would (1) be based on partnerships between Fisheries and Oceans Canada, University researchers, Hunting and Trappers Organizations, and hunters, their families, and associated

northerners from the Inuit communities around Hudson Bay; (2) employ an integrated ecosystem-based approach that incorporates both science and traditional ecological knowledge (TEK); and (3) involve the participation and training of northerners in all aspects of research, monitoring and sample collections; from planning and coordination to implementation and support, as well as evaluating, analyzing, communicating and applying the resultant information. The GWAMM CBM network functions to collect biological samples and information from aquatic marine mammals, with emphasis on the key co-management hunted marine mammals that dominant upper trophic levels of Arctic marine ecosystems including ringed seal, bearded seal, beluga whale, narwhal whale, and bowhead whale. Resulting collections are being used to examine changes in marine mammal health and ecology with climate warming including diet, contaminants, disease, stress, genetics, and reproduction. In addition, GWAMM is developing a model of trophic interactions for the Hudson Bay ecosystem, from marine mammals down to nutrients and phytoplankton that is based on data gathered via CBM. Currently, the CBM network is focused in four communities around Hudson Bay: Arviat, Sanikiluaq, Repulse Bay, and Igloolik, Nunavut, as well as providing umbrella support and funding to other linked community-based studies across the Canadian Arctic including Eastmain (QC), Pond Inlet, Rankin Inlet (NU), Churchill (MB), Hall Beach (NU), and Pangnirtung (NU), Kugaaruk (NU, Rigolet (NL), Hope Dale (NL), and Nain (NL), Holman (NWT) and Tuktoyaktuk (NWT), Salluit (QC), Inukjuaq (QC), Umiujaq (QC), Kuujjuaraapik (QC), and Kangisujuaq (QC). Future plans are to expand the network to additional northern communities around Hudson Bay, as well as to communities in all four Canadian Inuit territorial regions (Nunavut, Nunatsiavut, Nunavik, and Inuvialuit). Community-based monitoring partnerships are an important element in detecting changes in the ecosystem and guiding research projects specific to the needs of the local resource users. If successful, the project's legacy will be a CBM network run by northerners for northerners. The triumphs and difficulties associated with the development and long-term sustainability of the GWAMM CBM network will be discussed, including examples from participating communities, and relevant research findings.

IMPACTS OF RECURRING ICE-JAMS ON CHANNEL GEOMETRY AND GEOMORPHOLOGY IN A SMALL HIGH-BOREAL WATERSHED

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River ice-jams are generally perceived as significant erosive events and are well known to impact both channel morphology and geometry. However, the extent of these impacts and the frequency of events required to maintain ice-scoured morphologies remain unexplored. In this study, we investigated downstream variations in geometric and geomorphologic characteristics in a small high-boreal watershed. We coupled these observations to dendrochronological data on ice-jam frequency. It is shown that channels affected by ice erosion experience a rapid retreat of the upper bank and significant deposition on the lower bench. Our results show that channels appear enlarged and present a typical two-level ice-scoured morphology when ice-jams recur more often than once every five years. By contrast, channels appear unaffected when ice-jams are less frequent. We therefore conclude that ice-jam frequencies should be taken into account in order to better define the role of ice as a geomorphological agent in cold-environments.

LE DÉVELOPPEMENT DE PRATIQUES DE RESTAURATION APPLIQUÉES AU MILIEU NORDIQUE : L'EXEMPLE DE WHAPMAGOOSTUI-KUUJJUARAPIK AU QUÉBEC SUBARCTIQUE

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À Whapmagoostui-Kuujjuarapik, le couvert végétal est dégradé suite à de nombreuses perturbations de nature anthropique. Le village est en fait une mosaïque d'îlots

résiduels de végétation et de surfaces dénudées. Le substrat sableux exposé, souvent mobilisé par le vent durant la période sans neige, est à l'origine de nombreuses tempêtes de poussière. Devant ces faits, il existe un profond désir au sein de la communauté crie de solutionner le problème en favorisant le retour de la végétation. Dans ce contexte, les objectifs principaux de cette recherche étaient *i.* d'identifier les facteurs contraignant la recolonisation végétale naturelle ainsi que *ii.* de déterminer les différentes interventions pouvant favoriser la recolonisation végétale assistée. Pour ce faire, les substrats du village de Whapmagoostui-Kuujjuarapik ont été échantillonnés et soumis à des analyses physico-chimiques. Des échantillons de sol de l'écosystème de référence (dunes côtières non-perturbées) et d'un marais environnant (utilisé comme source de fertilisant organique) ont été prélevés à des fins comparatives. Des échantillons de sol ont également été prélevés pour vérifier la présence d'une banque de graines viables dans le village. Finalement, des expériences en serre et sur le terrain ont été menées pour vérifier la performance d'espèces herbacées indigènes à différents traitements de fertilisation, de piétinement, d'ensablement et de sécheresse. La disponibilité des nutriments est plus faible et les particules sont plus grossières pour le substrat prélevé dans le village. La banque de graines viables de *Leymus mollis* et de *Lathyrus japonicus* se limite aux îlots résiduels de végétation. Bien que ces contraintes ne favorisent pas la croissance et la recolonisation végétale dans le village, il semble improbable qu'elles limitent à elles seules le rétablissement du couvert végétal. La fertilisation chimique favorise l'émergence de *L. mollis* alors qu'elle influence négativement l'émergence et la survie des autres espèces (*L. japonicus* et *Trisetum spicatum*). Son effet sur la croissance et l'accumulation de biomasse est toutefois moins évident puisqu'elle agit dans la plupart des cas en interaction avec d'autres facteurs. La performance de *L. mollis* en réponse aux traitements d'ensablement et de piétinement est supérieure à celle de *T. spicatum*, alors que les deux espèces sont affectées négativement par les traitements de sécheresse. Grâce aux connaissances acquises lors de ces diverses expériences, des recommandations seront formulées aux communautés concernées pour favoriser les initiatives individuelles afin de restaurer le couvert végétal des villages.

ASSESSING COMMUNITY VULNERABILITIES IN LIGHT OF CLIMATE CHANGE: TO WHAT END?

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A critical mass of empirical research has emerged over the past few years focused on identifying vulnerabilities and adaptations in Arctic communities given current and anticipated impacts of climate change (e.g. Berkes and Jolly, 2001; Ford et al., 2006; Ford et al., 2007; Pearce et al., 2007). While seldom stated in these terms, these identified vulnerabilities inherently reflect a change from some former, presumably preferred, condition of the community under investigation; that is, all assessments implicitly start with a 'baseline' against which new vulnerabilities are revealed. As such, community vulnerability researchers, again although seldom acknowledged, also make implicit use of some sort of 'continuum of vulnerability' marked by increasing and decreasing vulnerability towards each end. If the aim of the research is to merely identify possible vulnerabilities and help generate adaptive strategies to reduce these vulnerabilities and thereby maintain the community 'baseline' condition, then making explicit what is currently implicit is neither necessary nor productive. If, however, the overarching purpose of the research, and certainly the reason for its considerable funding of late, is to enable communities, some of which are experiencing a range of significant and persistent challenges beyond those generated by climate change, to move away from their current 'baseline', then this 'continuum of vulnerability' needs to be made explicit and its ultimate positive endpoint needs to be identified and perhaps even defined.

To this end, this paper attempts to identify and define ideal Arctic community conditions by drawing on a wide range of scholarship including that focused on vulnerability, resilience, Aboriginal economic development, and community well-being and development. We appreciate that this exercise may be infeasible; indeed, Sen (1988; 1993; 1999), one of the leading contributors to community development scholarship and practice, and an author of numerous normative characteristics of 'capable communities', cautions those who would seek to define the precise attributes of such communities. That said, we see benefit in the attempt. Consistent with this effort and without diminishing current research efforts aimed at identifying (new) vulnerabilities and possible adaptations, we suggest that vulnerability research could be significantly enlivened and further justified were it to embrace community development as an explicit goal.

CLIMATE CHANGE, SEARCH AND RESCUE AND HUMAN VULNERABILITY IN THE CANADIAN ARCTIC

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The Arctic is experiencing some of the most rapid effects of climate change globally and how northern residents are able cope with the variety of changes they face is of particular concern for their health and safety. Vulnerability assessments have emerged as an informative research approach to understanding potential impacts and identifying characteristics of those communities and individuals most at-risk. Many of the climate change driven challenges facing northern residents are common across regions in the Canadian Arctic. However, understanding the nature of what these challenges mean in terms of current or future impacts on health and well-being and the opportunities and abilities of individuals to respond is unique to the individual, community or regional scale. It is for this reason that community or regionally focused and issue-specific vulnerability assessments can prove an effective tool through which to understand risks and responses and support the development of policies or programs to enhance adaptive capacity and protect human health in the Canadian North in a focused manner.

For Inuit, health and safety on the land is of particular concern in the context of climate change and variability as many communities report increasingly frequent uncharacteristic weather and sea-ice conditions putting hunters and others at greater risk than ever before. Inuit communities across the Canadian Arctic are reporting a perceived increased in the numbers of land and ice-based accidents and injuries related to these changes in environmental conditions. This issue is of great importance as injury related mortality is already 2.3 times higher in the Northwest Territories than the Canadian average and is 3 times higher among Inuit residents than others. We conducted an issue-specific vulnerability assessment to look at health and safety while on the land in the Inuvialuit Settlement Region of the Northwest Territories. We took a multi-disciplinary approach drawing on both qualitative (workshop reports, semi-directed interviews) and quantitative (primary Search and Rescue (SAR) data and secondary data on injuries) data. The results from this study will present the challenges in effectively assessing vulnerability with existing Search and Rescue data collection and organization protocols in the Canadian Arctic, highlight the characteristics of those most at-risk for land based accidents and the needs in terms of support for adaptation programs and policies in this and other Inuit regions. With the results of this assessment we will argue that it is possible to improve the monitoring and surveillance capacity at the regional and community scales to gain a more complete understanding of health and safety vulnerabilities related to climate change and land based safety for Inuit communities.

EXPLORING THE PHYSICAL ENVIRONMENT OF A SUBARCTIC ESTUARY, THE NELSON RIVER ESTUARY, HUDSON BAY, CANADA

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The Nelson River, the largest contributor of freshwater inflows to Hudson Bay, is regulated for hydroelectric generation downstream of Lake Winnipeg, and is a major component of Manitoba Hydro's hydraulic system. The Nelson River mouth, a large subarctic, mesotidal estuary, although well known for its important beluga whale gatherings, was until recently mostly unexplored, due to the remote location, difficult navigation conditions, a much shorter open-water season, compared to southern rivers, and a harsh regional climate.

Manitoba Hydro, in collaboration with its consultants, have undertaken oceanographic studies of the Nelson River estuary to support environmental studies related to potential hydropower developments along the lower reaches of the Nelson River. These studies will provide the building blocks upon which the baseline for future development projects assessments will depend. Extensive survey programmes were carried out in the estuary over the summer-fall period in 2005, 2006 and 2007 by Manitoba Hydro to describe the existing physical environment and prevailing oceanographic processes. The approach used for the monitoring programme was specifically designed to extract essential information required to describe the physical environment of his large and complex estuary.

Previous knowledge of the estuary indicated a tide dominated, homogeneous to partially-mixed environment with the presence of a stratified zone offshore whereas the information collected over three seasons (water levels, current patterns obtained from ADCP profilers, as well as temperature and conductivity gauging stations) reveals a relatively complex environment with three distinct zones each offering particular dynamics: the inner estuary submitted to tides with only occasional salt intrusions; a highly stratified middle estuary with cyclical current reversals in the bottom layer, and the well-mixed outer estuary open to Hudson Bay, characterized by a briny surface layer developing into a wide plume into the Bay. These physical processes are driven by strong opposing marine and fluvial forces.

The presentation provides an overview of the main oceanographic processes governing the physical environment, circulation and mixing of water masses into Hudson Bay. Future studies include 3D numerical modelling of the estuary.

LINKING SCIENTISTS AND COMMUNITIES IN WILDLIFE HEALTH MONITORING AND EDUCATION: AN OVERVIEW AND ASSESSMENT OF THE SAHTU WILDLIFE HEALTH OUTREACH AND MONITORING

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Many residents of the five communities within the Sahtu Settlement Area of the Northwest Territories continue a subsistence lifestyle of resource harvesting. At a workshop in 2002, elders and community leaders raised concerns regarding wildlife health, food safety, climate change, and the sustainability of health wildlife populations. They requested that efforts by scientists be put toward developing training for youth in science and for increasing involvement of hunters and youth in wildlife monitoring and research. In response, we initiated a long-term, integrated approach to foster community-based wildlife monitoring and education. This approach includes youth education, hunter training and knowledge sharing among researchers, biologists, elders, hunters, and youth. Annual trips have been made to all schools in the Sahtu from 2003-2008 to provide hands-on learning about wildlife biology and health for 250-460 students each year. Themes changed annually and reflect key issues raised by the communities and have included slide presentations, demonstrations, hands-on wildlife dissections, handling of furs, bones, and preserved parasites. Students were encouraged to ask questions and have discussions with wildlife veterinarians and biologists. Local hunters were trained as wildlife health monitors to collect samples and measurements from moose and caribou that they harvested for consumption. These data are used to assess body condition and monitor parasites and disease and to date 69 caribou and 19 moose have been sampled. In 2007 and 2008 we were invited to participate in community caribou hunts, which provided another 51 caribou for health monitoring. The value of these data for providing baseline and monitoring information on the body condition, parasite load, and presence of pathogens will be discussed. The program continues to be challenged by several issues, particularly the recent decline in caribou, which has resulted in hunters fewer caribou, particularly fewer females. Interviews were conducted with 31 experienced hunters and elders to document their local ecological knowledge of wildlife health and to develop baselines of past and current presence, absence and spatial distribution of pathogens that were readily identifiable by harvesters in caribou, muskoxen, Dall's sheep, and moose. These interviews established that, based on observations of 5870 moose since 1970, 'ghost moose' that had been impacted by winter ticks were not present in the area. In the last three years, there have been four ghost moose observed in the region, suggesting that winter ticks 'emerged' in the region around 2004. In conjunction with, and as an outcome of, the community-focused aspects of our Sahtu program, we also developed targeted scientific studies that included: evaluating blood filters strips to characterize wildlife health, dental enamel development and lesions in caribou, caribou bone density, gastrointestinal parasite ecology, caribou anatomy, parasite diversity and distribution, and a needs assessment for veterinary services. The Sahtu Wildlife Health Outreach and Monitoring Program has generated considerable capacity building and has formed trust-based relationships with local people but the scientific value of the data obtained from the community monitors requires rigorous analysis and we will discuss ways that these data are being assessed and shared with the communities.

SNOW DEPTH CONTROLS THE SPRING NUTRIENT FLUSH IN ARCTIC TUNDRA

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The availability of nitrogen (N) and phosphorus (P) determines plant communities and ecosystem carbon (C) storage in arctic tundra. Although plant growth is limited in the growing season by low soil nutrient pools, soil microbes may be mineralizing N and P over winter and these nutrients could be an important part of the annual vegetation budget upon their release during spring thaw. Despite the importance of the vernal nutrient flush for spring plant growth in many ecosystems, and although a substantial nutrient content has been characterized in arctic lakes during nival melt, a spring flush has seldom been reported in arctic tundra soil. The timing, the magnitude and the drivers of this flush, and the sensitivity to climate change, have not been previously described.

We sampled soil biogeochemistry and microbial biomass every three days for two months, from late winter frozen soils to mid-spring thawed soils, under ambient and experimentally deepened snow. Two important soil temperature periods were identified, associated with large peaks and crashes in soil solution and microbial biomass C, N and P. The thaw turnover in microbial nutrient content was three times the background microbial P and twice the background microbial N, and this N peak is double the estimated annual N uptake requirement for plant growth in this ecosystem. Daily changes in microbial C:N:P ratios suggest rapid soil microbial community succession, which is supported by microbial molecular and lipid characterization and microbial cell counts. Changes in microbial biomass nutrient pools were a magnitude larger than changes in soil solution pools, suggesting that the biomass-related flush was rapidly lost from the system or acquired by plants. Depending upon the potential for plants to acquire this resource pulse, the larger spring nutrient flush with deeper snow may be important for changing plant communities and ecosystem C budgets, or may instead maintain ecosystem-wide limitations to plant growth.

EDUCATION, COMMUNICATION AND OUTREACH: LINKING RESEARCH TO PUBLIC POLICY AND ENVIRONMENTAL AWARENESS – CLOSING REMARKS

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The Education,Outreach and Communication activities of IPY have shown that good ideas, good topics, and good practices transcend national borders, age groups, and formal and informal settings. The activities and networks developed during IPY also reveal a global hunger for climate-relevant educational resources, and the powerful impact that polar materials, polar stories, and a polar viewpoint can have as part of that climate focus. In the IPY IPO we look for mechanisms and support to continue many of these networks as effective advocates for polar research and as effective partners in global climate-related education and outreach. The legacy of IPY will be the lasting collaborations and partnerships between the education and science community result in a wide continuum of programs all aimed at creating greater awareness and understanding of the importance of both poles in these changing times.

MODELING THE POTENTIAL HYDROTHERMAL RESPONSE IMPACT OF CLIMATE CHANGE ON PERMAFROST OF WITHIN THE SOUTH MACKENZIE PLAIN, NORTHWEST TERRITORIES, CANADA

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This paper investigates hydrothermal responses of differing landscape components (forested and non-forested upland and wetland sites) with the potential to change a permafrost layer according to local variations in site type, snow pack depth, and daily weather conditions as these have varied from 1963 to 2007, with actual and somewhat increased air temperatures. Observed air temperature was consistently increasing in Fort Simpson area over last 40 years. More importantly, average January temperatures increases were more pronounced than the increases

in average July temperatures. The Forest Hydrology Model ForHyM was applied to select conditions as these would exist within the South Mackenzie Plain south of Fort Simpson, to discern likely depth and duration of frost penetration into the soil for select upland/wetland conditions, based on daily weather information, from 1963 to 2007. It was found that forested upland soils would experience deep frost and thawing cycles each year, but no permafrost, with two exceptions of two-year durations. In contrast, water-saturated wetland soils with limited drainage would have developed a permafrost layer starting from a hypothetical no-frost condition in 1963. This layer would then deepen over the course of about the next 10 years and become fairly stable thereafter, as long as the year-after-year weather conditions would remain the same. In general, the calculated frost depth varied with site type, and with depth of simulated snow pack and forest litter on the ground: the deeper these layers, the shallower the simulated frost depth. Year-to-year snow depth variations have a particularly strong influence on depth of frost penetration. These results were used to hypothesize likely permafrost distribution patterns within the study area, based on vegetative cover and landforms, local flow patterns, and likely depth-to-water from the soil surface. It was also noted that the hydrological calculations corresponding to the most recent air-temperature changes suggest fairly sudden permafrost losses in areas where the permafrost layer has already thinned to a critically low depth.

Keywords: permafrost build up and loss, hydrothermal snow and soil modeling, climate change.

ABUNDANCE AND DISTRIBUTION OF RINGED SEALS IN WESTERN HUDSON BAY 1995-2008

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Ringed seals (*Phoca hispida*) contribute the bulk of the Inuit subsistence harvest of marine mammals and are the main food resource for polar bears. The evolutionary adaptations of ringed seals to exploit the land-fast ice habitat for reproduction and survival could expose this species to critical challenges with predicted global warming. Concerns have arisen over possible declines in ringed seal numbers in western Hudson Bay as indicated by reduced pregnancy rate, reduced pup survival, older age structure and reduced growth and number of polar bears. Management concerns are fuelled by a pattern of decreasing ringed seal abundance estimates provided from five spring aerial surveys of basking ringed seals (1995-2000) that estimated population size declines from 70,000 to 45,000 seals in western Hudson Bay. In June 2008, ringed seal were declared a 'mid-priority' candidate species for assessment by COSEWIC as ringed seal populations may need conservation help with projected changes in sea ice extent. In 2007 and 2008, we conducted two aerial surveys over western Hudson Bay following the same protocol than in the 90's to assess whether ringed seal numbers have continued to decline in the 2000's. Survey results were analyzed using two different methods: the strip-transect and the distance sampling methods. The latter computes an estimation of population size taking into account the probability of detecting a seal with distance and other co-variables, like years, observers, group size and sky conditions. Satellite transmitters were attached to 18 ringed seals in autumn 2006 and 2007 in Hudson Bay. Satellite tagged seals during spring 2007 and 2008 provided haul-out time to correct aerial survey estimates done at the same time. Strip-transect and distance sampling methods are compared, results are discussed in the context of global warming and management advices are provided.

USING STABLE ISOTOPES OF CARBON AND NITROGEN TO PREDICT TROPHIC STRUCTURE IN DEEP-SEA ARCTIC FISH COMMUNITIES

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Arctic marine food web and the affects of environmental and biological variables were studied by using diet endohelminth and stable isotope data. We proposed that stable isotopes of carbon and nitrogen could predict trophic position in deep-sea Arctic fishes and that stable isotopes of carbon and nitrogen reflected diet and consequently the endohelminth community in deep-sea fishes. Multidimensional scaling and Kruskal-Wallis tests confirmed three trophic groups (benthic, benthopelagic, pelagic), each characterized by unique combinations of diet groupings and endohelminth (parasite) communities. Some overlap occurred between all groups but overlap was more significant between benthopelagic and pelagic species than between either benthopelagic or pelagic with benthic

species. Results of multiple regression analysis indicated that 1) few food groups in deep-sea Arctic fish diets could be predicted based on the nitrogen isotope signal in tissues, but carbon isotope values were significantly correlated with most benthic and one pelagic food group, and 2) nitrogen isotopes were poor predictors of endohelminth infections though carbon isotopes significantly predicted infection by six endohelminth species. Data from the present study, in contrast to the literature, was unable to show a strong positive correlation between length and $d^{15}N$ or $d^{13}C$ values for Arctic deep-sea species. The absence of or a very weak correlation between size and trophic position suggests several possibilities. Large fish shift their diet to a lower trophic level or small benthic species shift to a diet with higher $d^{13}C$ or $d^{15}N$ signals. Perhaps, in deep water benthic communities, the type and location of prey in pelagic, benthopelagic and benthic zones are also important. For example, the prey species of a benthic micropredator (polychaetes), have higher $d^{15}N$ signatures than pelagic zooplankton. Consequently, the $d^{15}N$ signals of carnivorous species feeding on same-sized prey on the ocean bottom vs. pelagic environment would be higher. In summary, $d^{15}N$ and $d^{13}C$ values were less useful to estimate trophic position of individual species, relative to size, but were good predictors of trophic position within the community in terms of feeding patterns.

PERFORMANCE OF THE EXPERIMENTAL TOTAL PRECIPITATION SENSOR IN BARROW, ALASKA

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The authors are testing at Barrow, Alaska an experimental solid precipitation sensor, the Total Precipitation Sensor (TPS), which represents a departure from the gauge-based approach. This device is designed to overcome the biases associated with gauge turbulence. It is installed as part of the U.S. Department of Energy's Atmospheric Radiation Measurement Climate Research Facility (ACRF) program. Following an extensive gauge intercomparison project supported by the World Meteorological Organization, measurement studies of snowfall at Barrow are continued with standard gauges as well as a modified Double Fenced Intercomparison Reference (mDFIR) gauge. NOAA's Climate Reference Network program maintains the mDFIR, which includes the Geonor gauge. A team of researchers from the University of Alaska Fairbanks and the Cold Region Research Lab at Fort Wainwright, Alaska have installed a state of the art snow research station at the Barrow Environmental Observatory including a solid state snow pillow (for measurement of snow water equivalent), ultrasonic depth sensors, a Wyoming snow gauge, and web cameras pointed to graduated snow stakes. Comparisons of the available data for 2008 are shown here. Additional site installations in Alaska will also be described.

SHIFTS IN ZOOPLANKTON COMPOSITION DRIVEN BY CLIMATE CHANGE COULD ALTER METHYLMERCURY TRANSFER TO FISH IN HIGH ARCTIC LAKES

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Climate change may alter the accumulation of methylmercury (MeHg) in food webs of High Arctic lakes through multiple processes including shifts in species composition. The purpose of our presentation is two-fold: (1) to present new findings on present-day determinants of the MeHg content and taxonomic composition of freshwater zooplankton in the High Arctic, and (2) to explore the implications of these patterns with respect to climate warming. In 2005 and 2006, we surveyed zooplankton in 16 lakes and ponds in the Canadian Arctic Archipelago (74-76°N), and we found that zooplankton communities containing *Daphnia* (mainly *D. middendorffiana*) had on average 5 times the MeHg content of copepod-dominated communities. The percent biomass of *Daphnia* best explained MeHg variation in bulk zooplankton compared to water chemistry and morphometric variables. Water-column concentrations of MeHg were low at most study sites (mainly $\pounds 0.07$ ng L^{-1}), and *Daphnia* strongly bioaccumulated mercury through species-specific processes. Since we observed *Daphnia* in more productive water bodies (i.e., ponds, a eutrophied lake), we then tested the role of productivity in determining the distribution of this keystone herbivore using a broad-scale literature data set of 47 High Arctic lakes (65-77°N). *Daphnia* density was positively related to the amount of organic carbon in the

water-column in both dissolved and particulate fractions (DOC partial R^2_{adj}=0.39, P<0.001; POC partial R^2_{adj}=0.05, P=0.032). The strong influence of DOC suggests that bacterial production is an important energy source for Arctic *Daphnia*. Our findings indicate that productivity influences the MeHg content of zooplankton communities through its control of species composition; specifically, low productivity limits the presence of mercury-rich *Daphnia* in many copepod-dominated lakes of the High Arctic. Aquatic productivity is expected to increase with climate warming, and we present a conceptual model that predicts how environmental drivers could extend the distribution of *Daphnia* in lakes and alter the movement of mercury in food webs of the Canadian High Arctic.

PHOTO-IDENTIFICATION OF EASTERN ARCTIC KILLER WHALES, ORCINUS ORCA

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Killer whale sightings in the eastern Canadian Arctic have increased in recent years and they have shown a recent advance in distribution associated with loss of sea ice. However, little is known about the distribution, abundance, and movements of this population. Answers to these questions may be available through photo-identification techniques which use natural markings to identify individual whales. Killer whales are an ideal species for photo-identification studies because they exhibit individually distinctive features that are constant over time and can be photographed when the animal surfaces. Identifiable features include dorsal fin shape, size and scarring, saddle patch shape (area of light pigmentation just behind dorsal fin), and eye-patch shape. A catalogue has been compiled of photographs collected by researchers and northern residents during killer whale sightings in the eastern Canadian Arctic from 2004 to present and as new photographs are obtained they will be added to the catalogue. The unique features that are visible in the photographs were used to identify individual killer whales and then photographs were compared to identify any individuals observed more than once. Repeat sightings will be used to track killer whale movements within the Canadian Arctic. The increased killer whale presence poses an increased risk to their potential prey species such as beluga and bowhead whales, narwhal, and seals which are also important species in Inuit subsistence hunts. The increased predation risk can affect prey behaviour, distribution, and movements. Anti-predator behaviours in response to killer whales, such as cessation of vocalizations, grouping, and swimming near shore, have been observed in beluga, narwhal, and bowhead whales in the eastern Canadian Arctic by locals and researchers which also indicate the potential importance of killer whales in this region. Long-term photo-identification data along with other sightings data and acoustic monitoring will be used to estimate abundance, seasonal distribution, movements, and behaviour of eastern Arctic killer whales.

SIMULATION OF PRECIPITATIONS OVER THE ARCTIC BASIN: A SENSITIVITY STUDY WITH POLAR-GEM MODELLING SYSTEM

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The Polar-GEM modelling system is a limited area model (LAM) covering the Arctic basin at its larger extent, including Alaska and northern parts of Canada with a constant grid of approximately 15km resolution. This model is the response to the primary objective of the Thorpex Arctic Weather and Environmental Prediction Initiative project (TAWEPI) which is to develop and validate a regional Numerical Weather Prediction (NWP) model for the international polar year (IPY) observation period over Arctic. The proposed experimental model is the sister-ship of the Environment Canada (EC) operational regional GEM model, used for one- to two-day weather forecasts.

As in the GEM-LAM 15km model, the Polar-GEM proposes a classical Sundqvist-like (Sundqvist, 1989) single moment microphysical scheme and a radiative transfer model (NEWRAD) also used in the Environment Canada weather forecast operational model. Also embedded are the new radiative transfer scheme CCCMARAD, based on a k-correlated method (Li and Barker, 2005) and recently implemented in the GEM-LAM 15km model, and the Milbrandt and Yau (2005) microphysical scheme, which can be used in its single, double or triple moment version and that will be implemented in a future release of the GEM operational model. This later scheme provides much more detailed description of microphysical and precipitation processes than the previous one, using six hydrometeor

classes and explicit representation of their number concentration, improving the realism of the different form of precipitations.

The objective of this work is to study the relative benefit of these new schemes compared to the previous versions, and to perform a sensitivity analysis of the various available microphysical parameterizations and cloud-radiation interactions on the modelled surface precipitations. Results from short term simulations and comparisons with ground-based and satellite observations will be addressed in this presentation.

EVALUATION OF A COUPLED SEA ICE SYSTEM INCLUDING BLOWING SNOW PROCESSES OVER ARCTIC SEA-ICE

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Blowing snow frequently occurs in the Arctic Ocean and Antarctica, transporting snow by saltation and suspension and yielding sublimation of snow particles. In this study, it is found that erosion due to blowing snow may account for snow depth overestimation in a multi-layer snow/sea ice coupled system. Atmospheric forcing measurements made during the Surface Heat Budget of the Arctic Ocean Experiment (SHEBA) were used to examine the effect of wind erosion on snow and ice evolution over the Arctic pack ice from October 1997 to October 1998. Total erosion due to blowing snow was found to be as large as 56 mm of snow water equivalent and was showed to strongly influence snowpack redistribution for the particular case under study. A sensitivity analysis of ice thickness has been also performed and revealed that ice depth depends on surface albedo, new snow density and thermal conductive fluxes at the ice/snow interface; results that are similar to those from a sensitivity analysis of snow depth. The snow/sea-ice coupled system was modified in order to account for wind erosion for low-level wind speed greater than 9 m/s. Results show that including blowing snow significantly improves the simulation of snow depth and of temperature at the snow/ice interface, but slightly degraded the simulated sea ice thickness. It also leads to other changes such as a decrease of snow temperature by an average of 0.87K and a decrease of snow depth by 4.93 cm on average. An overall effect is to shorten the duration of the snowpack and increase the underlying ice thickness. Future studies need to explore the possibilities of using this approach for 2-D modeling of snow and sea ice.

EFFECTS OF CLIMATE CHANGE ON ATMOSPHERIC MERCURY DEPLETION IN THE CANADIAN ARCTIC

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Mercury has been measured at high levels in Arctic people and wildlife, posing a threat to their health. Atmospheric transport and deposition is thought to be a significant source of mercury to this ecosystem. Much of this deposition occurs in Arctic springtime, through the chemical oxidation of stable Hg(0) to reactive Hg(I) and Hg(II) and subsequent deposition of this reactive mercury to the snow. Some details of the chemical and physical mechanism for these atmospheric mercury depletion events (AMDEs) and the fate of the deposited mercury are still unclear, making it difficult to predict the effects of future climate change. To address this question, long-term mercury and meteorological measurements at Alert, Canada, were analyzed to assess the relationship between AMDEs and meteorological parameters. It was found that the temporal distribution of AMDEs has already changed over the period 1995-2007, indicating that projected changes in Arctic climate may need to be incorporated into predictions of future mercury deposition to the Arctic. It was also discovered that local AMDEs exhibit a complex relationship with local temperature and wind direction, which not only provides a basis for more quantitative climate effects, but may also provide additional clues as to the mechanism and location of mercury depletion events.

ZOOPLANKTON COMMUNITIES IN BARROW STRAIT AS ESTIMATED FROM MOORED ACOUSTIC DOPPLER CURRENT PROFILER (ADCP) DATA

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Year-long time series of estimated zooplankton biomass and backscatter strength of suspended matter in Barrow Strait, in the Canadian Arctic Archipelago, are calculated from echo intensity data from 300 kHz ADCPs and density data from CTDs moored at various depths. Analysis of backscatter strength from the 2003-04 mooring array shows differences between the northern and the southern biological communities in Barrow Strait. The role of physical processes such as ice thickness and break-up, currents, and density on the zooplankton dynamics is discussed. Estimation of zooplankton biomass via backscatter area reveals seasonal variability, peak abundance timing, and vertical zooplankton distribution. The analysis technique was applied to the total available time series in Barrow Strait (August 1998 to August 2006) and, along with the available physical observations, provides insight into any inter-annual variations and bio-physical coupling.

DISTRIBUTION PATTERNS OF CANADIAN BEAUFORT SHELF MACROBENTHOS

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Variation in macrofaunal composition was analysed in nine regions of the Beaufort Shelf and Amundsen Gulf. We hypothesized that benthic community composition was distinctive (1) in a recurrent polynya in Amundsen Gulf and (2) in upwelling regions (Mackenzie Canyon and Cape Bathurst) and (3) changed in a linear gradient across the Beaufort Shelf. (1) No significant change in community composition was measured inside the polynya in Amundsen Gulf. (2) The Mackenzie Canyon macrofauna were similarly indistinct from the shelf community at similar depth. However, there was a 10-fold increase in inshore abundance in the upwelling region of Cape Bathurst due to large numbers of the amphipod *Ampelisca macrocephala* and the polychaete *Barantolla americana*, species that were not abundant elsewhere. (3) In the inshore fast ice and flaw lead regions of the Beaufort Shelf, under the influence of ice scour, storm effects, coastal erosion and the Mackenzie River, the macrofauna were dominated by the bivalve *Portlandia arctica* and the polychaete *Micronephthys minuta*. Offshore, where these influences were less and upwelling of deep Atlantic water occurred, the polychaete *Maldane sarsi* dominated. Faunal distribution across the Beaufort Shelf correlated with depth, water mass and sediment changes but was not significantly linear. Benthic anomalies such as mud volcanoes, natural gas seeps, artificial drilling islands and submerged glacial beaches modified community composition locally.

THE SYNOPTIC AND PLANETARY SCALE ENVIRONMENT ASSOCIATED WITH SIGNIFICANT WIND EVENTS ALONG THE BEAUFORT SEA COAST

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Strong wind events along the Beaufort Sea coast have potentially damaging effects on populations and geology as is evidenced by storm surge events at Tuktoyaktuk, Northwest Territories. A set of significant wind events is identified from coastal station data. In an attempt to further our understanding of these events, their characteristic environments at the synoptic and planetary scales are defined using global reanalysis data. They are described in the context of large-scale atmospheric circulation regimes, teleconnection patterns, and climate change.

BENTHIC HABITAT MAPS FOR NACHVAK AND SAGLEK FIORDS: A CONTRIBUTION TO NUNATSIAVUT NULUAK, NORTHERN LABRADOR, CANADA

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Nunatsiavut Nuluak is a research network of Inuit, government, industry and universities who are concerned with the ecological integrity of the marine environment of

northern Labrador. It forms part of ArcticNet's integrated regional impact study for the eastern subarctic of Canada. Specifically, the network addresses Inuit concerns about the effects of climate change, modernization and contaminants on fiord-based marine ecosystems. The goal of our project is to conduct a baseline inventory and comparative assessment of benthic fiord habitats using multibeam sonar data and bottom sampling. Our study sites are Nachvak and Saglek fiords – the former represents a pristine ecosystem adjacent to the Torngat Mountains National Park, whereas the latter has been exposed to a historical source of PCB contamination. Nachvak and Saglek fiords are 40 to 45 km-long glacial troughs that cut through the Torngat Mountains and open to the Labrador Sea. Their sidewalls are generally steep, rising in places 1000 m vertically from sea level. They have characteristic fiord bathymetry with multiple steep-sided, flat-bottomed, deep basins separated by narrow, steep-sided shallow sills. Surveyed water depth ranges from 5 to 258 m and basin margins attain maximum slope angles of 80-90°. Nachvak and Saglek bays represent the seaward limit of their respective fiords and tend to have variable water depth and complex bathymetry. Outlet glaciers from the Laurentide Ice Sheet advanced eastward through the fiords during the last glaciation, eroding the landscape and depositing a range of sediments from bouldery gravel to fine mud. Steep slopes, both above and below sea level, generate slumps and rockfalls. Over 450 km^2 of multibeam sonar coverage was used to characterise seafloor bathymetry and acoustic backscatter intensities in each fiord. Seabed sampling at 130 sites included substrate and biota imaging and grab sampling. Eight substrate classes were identified from the sampling program in both fiords. Exploratory Data Analysis (EDA) was used to examine the distribution of multibeam sonar-derived depth, backscatter and slope for sampled stations in each substrate class. The results of the EDA were then used to generate supervised classification rules for the substrate mapping, which were applied to the full multibeam coverage in each fiord. Between 31 and 45% of the surveyed areas in Saglek and Nachvak fiords were uniquely classified according to this classification procedure. The biota on many of the substrate classes were statistically identical and consequently only two mappable and statistically distinct habitat types were defined: (1) gravel-bottom habitat found mostly on basin margins and fiord sills; and (2) muddy-bottom habitat on basin floors. A further six substrate classes were identified by towed video transects across the shallow inlet of Saglek Anchorage in outer Saglek Bay. The biota associated with the six nearshore substrates indicated four distinct shallow-water habitats aligned along a depth gradient. From shallow to deep water these were: *Laminaria* kelp on boulder, *Agarum* kelp on boulder, *Agarum* kelp on gravel, and gravelly sand. This habitat distribution is primarily influenced by the light requirements of the different kelp species and general fining of substrates away from shore.

CONSUMPTION OF SUGAR-SWEETENED BEVERAGES AND COMPONENTS OF THE METABOLIC SYNDROME IN INUIT ADULTS OF NORTHERN QUÉBEC (NUNAVIK)

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Rationale and objective: In spite of large body size and increasingly high intakes of bad nutritional quality foods - including soft drinks, the Inuit still experience a low prevalence of diabetes and favourable blood lipid profiles. Higher intakes of sugar-sweetened beverages (SSB) have been associated with weight gain, type 2 diabetes and the metabolic syndrome. Our aim was to examine the association between the consumption of SSB, the prevalence of the metabolic syndrome, and its components in the Inuit of Nunavik. **Methods:** 616 adults who were enrolled in the baseline of the Inuit Health in Transition Cohort Study answered a food frequency questionnaire and passed clinical examinations, including venipuncture. Metabolic syndrome was assessed according to the International Diabetes Federation definition. Logistic regression was adjusted on age and gender. **Results:** Median consumption of SSB was 868ml/day (soda contributing the most) and was higher in the young (p=0.02). The prevalence of central obesity, diabetes and metabolic syndrome were respectively 57.6%, 4.2% and 17.5%. Consumption of 3.7 cans of SSB or more per day (third tertile) was associated with a higher prevalence of metabolic syndrome (OR=1.56, 95% CI [0.84;2.92]), and this association was much stronger among new onset cases (OR=6.19, 95% CI [1.89;20.29]). Central obesity was the only single component of the Metabolic Syndrome that was significantly associated with SSB consumption (OR=1.80, 95% CI [1.10;2.95]), although the association with elevated triglycerides was close to significance. Further adjustment on energy intakes, physical

activity, smoking and other types of dietary fat (saturated, n-3, n-6 and *trans*) did not alter our findings. **Conclusion:** Although the Inuit may still be protected by their omega-3 fatty acids and selenium rich traditional foods, the dietary shift towards store-bought junk food rich in refined sugars already has a visible impact on their cardio-metabolic profile.

TRENDS IN CANADIAN SURFACE TEMPERATURE ANOMALY INTENSITY

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Much of the previous work on trends in temperature extremes has considered anomalies relative to a stationary base period climatology, over the entire period of record or over a selected 30-years. Calculated this way, trends toward more extreme warm events and less extreme cold events will be found if the climate itself is warming. In this study we calculate anomalies relative to a 30-year running mean in order to examine trends in surface temperature variability and extremes separately from changes in the mean

CANDAC OUTREACH IN THE HIGH ARCTIC: A CHILLY ENDEAVOUR FOR IPY

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The Canadian Network for the Detection of Atmospheric Change (CANDAC) has an outreach program which focuses on working with students in Northern schools and colleges. This outreach program has three main components during International Polar Year (IPY). The first component involves bringing scientists to Northern schools to deliver workshops on topics such as climate change, ozone depletion, and weather. To date, CANDAC scientists have visited schools in Resolute, Pond Inlet, Grise Fiord, and Arctic Bay, Nunavut. Outreach visits to other communities in Nunavut will occur in the spring of 2009. We have also implemented a co-operative education program for Northern college students. Two students, one from Nunavut Arctic College, and the other from Aurora College, have successfully completed work terms through this program. The third component of our outreach program, the Northern Experience Program, will bring 15 students and 6 teachers from across Canada on an educational excursion to Resolute and Eureka, Nunavut. Canadian students in grades 11 and 12 and their teachers are eligible to enter the Northern Experience Contest and the winners will participate in the Northern Experience Program in April 2009. This presentation will describe the CANDAC IPY Outreach Program, including the activities that we have accomplished and our plans for the future.

PUTTING OUR HEADS AND SKILLS TOGETHER: HUNTERS AND SCIENTISTS AND CARIBOU HEALTH MONITORING

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The rapid climate and industrial changes currently unfolding in the Arctic are expected to have profound impacts on animal and human health. One predicted outcome is shifts in patterns of wildlife disease involving emerging or existing pathogens. Barrenground caribou (*Rangifer tarandus* ssp.) are central to culture, food supply, and economy in most northern communities. Hunters are already noting abnormalities in caribou and unusual herd movements, and recent aerial population survey data show severe declines in several herds across Canada. Resilience of caribou populations and the safety of country foods with respect to diseases transmissible to humans ("zoonoses" such as brucellosis) are key concerns, and even more so in the context of the "new Arctic.

Environmental conditions and distances pose tremendous challenges for scientific surveillance of disease in northern wildlife. Indigenous knowledge of caribou is profound and has great historical and current value; however, formal disease surveillance systems are outside this realm and rapid climate warming is introducing many

unknowns for scientists and Northerners alike. There is need for communities and scientists to work together on caribou health issues and ensure that acquired knowledge benefits or safeguards public and animal health.

One innovative step in this direction is *hunter-based caribou health monitoring*, wherein harvesters and scientists blend their wildlife expertise to monitor and manage caribou populations. Participating hunters collect a small set of samples and data from caribou they kill for subsistence, and also report abnormal observations to scientists. The scientists then analyze the samples and data, and return information to communities as quickly as possible. One particularly interesting component of this community-based sampling is blood collection on filter paper. Whereas traditional blood collection requires glass tubes and expertise and equipment to process and store serum, the field-friendly filter paper method can be performed in minutes by a lay person. Paper blood strips are conveniently transported, dried and stored for multiple possible analyses at a later date, thus, the caribou hunter collects a quick and easy sample that can potentially detect caribou exposure to a variety of pathogens. Hunters in wildlife health monitoring programs in the Northwest Territories and Nunavut are now collecting filter paper samples, and progress with validation of this method (part of an IPY project) will be presented as an illustration of the potential value of hunter-scientist caribou health monitoring. Methods undertaken and lessons learned in implementing filter-paper caribou blood collection in northern communities will be discussed (a simple technique is not necessarily simple to implement!).

CLIMATE AND ANTHROPOGENIC STUDIES ON FOOD WEBS OF THE ARCTIC MARGINAL SEAS

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As diversification of resource demands intensifies in the Arctic, so too have stakeholder discussions on how to balance environmental and industrial interests in the region. Viewing potential industrial development in context with a changing arctic climate, there is a pressing need to obtain additional scientific knowledge on the environmental framework: arctic ecosystems and their processes. The international petroleum company, StatoilHydro has launched a major arctic environmental research program that integrates complimentary biological research fields to improve understanding of the vulnerability of Arctic ecosystems to anthropogenic influences. The program addresses two main objectives: to improve knowledge of the ecology, natural life history and sensitivity to oil of key arctic species and to develop new tools to assess environmental changes related to diverse anthropogenic pressures on ecosystems. The program is being carried out by the Research Network ARCTOS (http://www.nfh.uit.no/arctos/), a consortium of institutes with diverse expertise in the fields of Arctic marine ecology, ecotoxicology and biogeochemical processes. While initially focussing mainly on the Barents Sea, the program takes a Pan-Arctic perspective, including research in the Canadian and Russian Arctic. For example, in 2008, ARCTOS scientists took part in two legs of the Amundsen expedition to study Arctic *calanus* and under ice fauna as part of the International Polar Year Circumpolar Flaw Lead Program. This effort to increase core basic knowledge on the biology, ecology, and ecotoxicology of the Arctic, is part of StatoilHydro's objective to improve the basis for environmental risk and impact analyses for operations. The information generated supports StatoilHydro's corporate zero harm strategy. It will also aid in the development of appropriate regulatory guidelines to protect biological resources from adverse impacts.

UP, UP AND AWAY? BIODIVERSITY AND CLIMATE CHANGE IN THE ALPINE ECOSYSTEMS OF SOUTHWEST YUKON

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The mountains of southwest Yukon provide a useful analogue for the changes in biodiversity expected to continue across the circumpolar north. Extreme terrain variation results in strong environmental gradients, particularly a decrease in temperature with increasing elevation. Because of a similar suite of species, the

biological gradients in southwest Yukon correspond well to those found spanning the latitudinal gradient of the western North American Arctic. As part of International Polar Year we developed a hierarchical typology of the region's major alpine and subalpine vegetation types. A suite of multi-resolution satellite imagery was used to map these areas and model their phytological characteristics, including biomass and leaf area index. A long history of field investigations and experimental studies is being used to develop habitat suitability maps for the region's major herbivores as well as rules governing potential state transitions of different plant communities and vegetation types. The collective set of data is then to be incorporated into a complex spatio-temporal model to forecast distribution of the different vegetation types under future climate scenarios. A preliminary static model suggests a significant potential for change, particularly with respect to an advance of trees and shrubs. A map of this potential advance indicates that continued climate warming would result in the loss of habitat for alpine obligates as alpine vegetation types are reduced to smaller areas upslope. However, the upslope shift of vegetation types will be mediated by the availability of suitable substrate as well as changes in other climate-related variables, especially snow cover. It is still unclear as to the extent to which these additional variables will affect these potential changes.

WINTER FROST FLOWERS ON SEA ICE: VECTORS FOR UPWARD TRANSPORT OF MICROBES AND VIRUSES?

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The CFL project provided a unique opportunity to observe formation of new ice in leads during Arctic winter, features expected to increase in future. Common to the surface of new ice is the growth of frost flowers, delicate ice-crystal formations that, once fully formed, have bulk salinities typically three times that of seawater. Although atmospheric moisture may be required to initiate the growth of frost flowers, the source of the salt they contain is the brine within the new ice on which they grow. Frost flowers have been implicated in the alteration of sea ice albedo and in atmospheric ozone depletion events (via dispersion of bromide salt needed for such events) and mercury depletion events (mercury levels in frost flowers are very high relative to surrounding snow). To our knowledge, frost flowers have not been examined from a biological perspective. We took advantage of late fall and winter opportunities during CFL to sample frost flowers and environs and evaluate their salinity and microbial content. We assumed that microbes observed microscopically in melted flower and ice samples were originally present in the brine fraction of the ice and that reasonable estimates of frost flower brine volume could be calculated using ice surface temperature (range of –7.6 to –23.6°C) and frost flower bulk salinity (30–55 in late fall, 65–140 in winter). Although our sample sets are small (n = 2–10), we observed that bacterial concentrations in frost flower brines (5.5–9.2 x 105 ml–1) were similar to those in new ice brines (5.2–8.0 x 105 ml–1) and higher than those in seawater (1.6 x 105 ml–1) or melted snow (1.1–2.5 x 104 ml–1) in winter. On an ice-volume basis, the winter frost flowers contained more bacteria than the underlying new ice (1.9–4.7 x 105 versus 0.81–1.0 x 105 ml–1 ice). The opposite was observed in late fall, when the frost flowers were of lower salinity. The one (late fall) sample examined for the presence of viruses contained enough of them (1.5 x 107 ml–1 brine) to indicate virally-mediated bacterial mortality, either in the flowers, the briny slush that develops at their base or the ice below. Attempts to culture frost flower bacteria have been successful for the winter samples using organic media of high salinity (up to 182) incubated at –1°C. The seasonal implications for upward transport, concentration and dispersal of bacteria and viruses via frost flowers, as well as the possible roles of microbial processes in the fate of mercury and other elements or contaminants deposited on flower-rich new ice await further study.

RECENT TRENDS AND VARIABILITY OF RIVER DISCHARGE IN NORTHERN CANADA

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This talk will present an overview of recent trends and variability of river discharge in northern Canada, with a focus on our contributions to the IPY project "Arctic Freshwater Systems". To begin, a brief description of the pan-Arctic hydrological cycle and its climatology will be presented. The presentation will then focus on observed trends and variability of discharge in as many as 64 rivers covering an area of 5.6×10^6 km^2 of northern Canada from

1964 to the present. Possible factors leading to the observed trends and variability will be explored. A discussion of some 21st century projections and implications of changing rivers in northern Canada will follow. The talk will end with a summary and a list of research priorities concerning the impacts of climate variability and climate change on Canadian Arctic rivers.

CONTAMINANT LINKAGES TO CLIMATE PARAMETERS IN POLAR BEARS (URSUS MARITIMUS) FROM GREENLAND AND SVALBARD

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East Greenland polar bears sampled 1984-2006 were measured for mercury (Hg) and organohalogen contaminants (PCBs, OHCs and PFCs) in 7-19 of the years. Most legacy organochlorines and mercury have shown decreasing trends in East Greenland during the last 2-3 decades before the turn of the Millenium, but there are indications for increases after 2000. Other contaminants such as the PFCs showed an exponential increasing trend in ringed seals and polar bears from East Greenland between 1984 and 2000 but again a steeper increase have been documented between 2000 and 2006. The most powerful time series were analysed to evaluate whether the residual from trend line (linear or non-linear, using the ICES methods) calculated from the annual medians could be linked to climate variables such as temperature, polar sea ice coverage and North Atlantic Oscillation Index (NAOI). This was done to resolve whether the climate changes over the recent decades have affected the pathways, bioaccumulation and time trends of the contaminants in East Greenland where the polar sea ice exits and extension has decreased dramatically. With respect to mercury, East Greenland and Svalbard are relevant locations to initiate studies of climate change vs. mercury interactions,, as the majority of the polar ice passes out along the East Greenland coastline and because differences in temperature, ocean currents and the NAOI is detectable between East Greenland and Svalbard. A significant ($P=0.05$) negative correlation was detected between the NAOI and the Hg in East Greenland polar bear hair whereas an opposite non-significant ($P=0.07$) positive trend was detected for bears from the Svalbard area. Significant negative correlations were also found between Hg in East Greenland bear hair and the polar ice extent the same year ($P=0.02$) and two years before ($P<0.01$) dependant on how the hair samples were allocated to the exposure year. No linkages could be detected between Hg in Northwest Greenland polar bear hair samples versus temperature and NAOI and likewise no climate relationships could be established to the PFC (PFOS and PFOA) concentrations in East Greenland polar bear liver.. Additional contaminant time series in combination with biomarkers are being exploited in the coming years for other contaminant groups, extended time periods, other regions and species within the IPY Fuller #134 *BearHealth*.

ANNUAL AND SEASONAL VARIATION IN NEARSHORE FISH AVAILABILITY ASSOCIATED WITH THE RECORD ARCTIC PACK ICE MINIMUM OF 2007

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Highly visible apex predators, such as seabirds, can be valuable tools in monitoring temporal variation in marine ecosystems. This is especially true in the Arctic where logistical constraints and the near ubiquity of sea ice impose major constraints on traditional oceanographic sampling. The 2007 record summer ice retreat could be expected to have major effects on species dependent on the sympagic zooplankton and fish community associated with

pack ice, As part of a long-term study of arctic seabirds near Point Barrow, Alaska,, we were able to document temporal variation in the prey of the arctic race of the Black Guillemot (*Cepphus grylle mandtii*), a pack ice obligate. Both guillemot parents provide fish to nestlings from late July to early September, the period of rapid pack ice retreat. Prey are typically captured within 30 km of the colony and visible in the parents bill as they return to the nest. We conducted photo documentation and observations of prey items delivered to nestlings in the breeding seasons in both 2006 and 2007. In 2006 local pack ice retreat was minimal, with ice <30 km from the colony during chick rearing, typical of ice conditions in the 1970s and 1980s. In 2007, during the record ice retreat, distance to the pack ice went from <20 km from the colony in late July to >250 km in early September.

The prey obtained by guillemot parents reflected the changes in the location of the pack ice, the species' preferred foraging habitat. Arctic Cod *(Boreogadus saida*), a species closely associated with pack ice, comprised >90 percent of prey in 2006 and displayed no significant seasonal trend in size. In 2007 Arctic Cod comprised >90 percent of the prey at the beginning of the nestling period but declined to <20 percent after pack ice had retreated to well outside the species' foraging range. Distance to the pack ice explained >75 percent of the daily variation in cod abundance. Additionally most late-season cod in 2007 were subadult, a life stage with less affinity to pack ice and also typically avoided by parents when adult cod are available. The alternative prey in 2007 consisted mainly of nearshore demersals, primarily sculpin (*Myoxocephalus* spp.). The decrease of cod and increase of sculpins in 2007 was associated with annual and seasonal decreases in nestling growth and increased frequency of brood reduction, a sign of nutritional stress. Ongoing and future decreases in nearshore summer ice extent could be expected to cause high arctic species to turn to alternate prey or move to areas where summer ice is persisting.

A)PLANT-HERBIVORE INTERACTIONS AND CLIMATE CHANGE: THE CASE OF THE GREATER SNOW GOOSE

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In arctic regions, the distribution and abundance of organisms and interactions between species are highly constrained by abiotic conditions (e.g. temperature) because of the harsh climate. While several studies have focused on the impacts of climate change on individual species, few have examined the possible effects of global warming on trophic interactions, which play a crucial role in the dynamic of ecosystems. The objective of this project is thus to test experimentally the hypothesis that global warming will have a negative impact on the synchrony between the reproductive phenology of the Greater Snow Goose and plant growth in the High Arctic. In many herbivores such as geese, the growth and subsequent survival of young is dependent upon the seasonal change in plant nutritive quality. If plants respond more quickly than geese to global warming, this may lead to a mismatch between the availability of high quality food (expected to occur earlier with warming) and hatching date of goslings. We manipulated environmental parameters most likely to be affected by global changes (surface temperature and date of snow melt) using small plexiglass open-top chambers (OTC) and by adding or removing snow in spring. In 2007 and 2008, from shortly after snow melt in mid-June until the end of July, we collected plant biomass every 10 days in all treatments. Samples were dried, weighed and analyzed for nitrogen content in order to examine the seasonal changes in the quality of plants. Experiments were conducted in two different habitats used by geese, wet polygon fens and mesic tundra. We predict that the warming and snow removal treatments will lead to an earlier peak in plant quality and higher total biomass, and that the snow addition treatment will produce the opposite effects. We also predict that this effect will be more pronounced in mesic habitats compared to wetlands because of the high thermal inertia of water. Results from the first year of this experiment will be presented. In parallel to this experiment, we are examining how the synchrony between hatching date of young and peak in nutritive quality of their food plants affects the growth of goslings. This is being tested using a 9-year database that includes annual hatching date of goslings (determined on several hundred nests), body measurements and mass of goslings shortly before fledging (also determined on several hundred individuals) and seasonal sampling of the nitrogen content of plants.

COMMUNITY-BASED HEALTH RESEARCH IN THE ARCTIC: A CASE STUDY FROM NUNAVUT, CANADA

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Community-based health research (CBHR) is considered to be one of the frameworks that can be used to engage researchers and community organizations and members in research. This approach is important to ensure that the research responds to community-level health needs and concerns. The objective of this paper is to outline a community-based approach that was applied to a dietary decision-making study in Cape Dorset, Nunavut, Canada. The discussion details the importance of research partnerships, the involvement of community members in all phases of research (including the research question), the process that was employed to collect, analyze and interpret the findings, and the mediums used to communicate the research results. The results of this paper provide a foundation that could be used to build future community-based health research projects in the circumpolar region.

THE POLAR ENVIRONMENT ATMOSPHERIC RESEARCH LABORATORY (PEARL) AT EUREKA, NUNAVUT CANADA

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The PEARL laboratory is situated at 80N, 86W. Instrumentation at the laboratory provides a large range of atmospheric measurements from surface to about 100km altitude using lidars, radars, spectrometers, radiometers, imagers and other methodologies. At present over 25 instruments are operational at the site. Data from the laboratory is processed and supplied to several international databases.

As part of International Polar Year (IPY) a number of new projects have been initiated at PEARL. These address specific issues of radiation balance, precipitation, long-range transport and the like. In addition, the measurements at PEARL have been intensified.

Canada is providing a high-level research activity in the High Arctic which is attracting a growing interest in the community. This presentation will provide an overview of activities at PEARL as a prelude to other papers in the session and discuss how these activities fit with each other and the broader activities of IPY.

PEARL is supported by the Canadian Foundation for Innovation (CFI); Canadian Foundation for Climate and Atmospheric Science (CFCAS); Canadian Space Agency (CSA); Environment Canada (EC); Government of Canada IPY funding; Ontario Innovation Trust (OIT); Natural Sciences and Engineering Research Council (NSERC); Nova Scotia Research Innovation Trust (NSRIT); Ontario Research Fund (ORF); and the Polar Continental Shelf Program (PCSP).

CANDAC ARCTIC RADIATIVE ENVIRONMENT THEME

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Surface temperatures at Eureka (80N, 86W) have increased considerably over the past 30 years, which is consistent with an Arctic warming trend that has dramaticaly reduced the summertime sea-ice extent. Surface temperatures are determined largely by the radiative exchange, which is in generalpoorly observed and understood given the relative inaccessibility of the High Arctic. A comprehensive new data set for studying radiative transfer is emerging from the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, which hosts lidars, radars, radiometers and other instruments operated by the Canadian Network for the Detection of Atmospheric Change (CANDAC) with important contributions from the NOAA SEARCH programme. An overview of results from the CANDAC Arctic Radiative Environment Theme will be given. Surface and satellite measurements reveal the importance of ice crystals lofted from the mountainous terrain on the downwelling infrared fluxes. Diamond dust has only a small impact, which supports results from the SEARCH SHEBA experiment, but is contrary to much past research. Thin water clouds and aerosols have been optically characterized in a statistical study. As new instrumentation comes online we will have the opportunity to measure continuous profiles of temperatures and water vapour, and observed the key 20 micron window in the Arctic infrared absorption spectrum.

DAWSON CITY. A COMMUNITY ON THE EDGE?

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In this paper we utilize a vulnerability framework to assess the probable response of Dawson City, Yukon, to anticipated changes in the physical environment. Dawson with a permanent population of some 1500 sits on a flood plain at the confluence of the Klondike and Yukon rivers close to the junction of two significant bio-zones. The community has much in common with many high latitude circumpolar communities including an Indigenous\non-indigenous demographic mix and a highly seasonal economy based on an amalgam of mining, country food harvesting, tourism and government transfer payments.

Dawson has long dealt with exposure to the volatility of global markets and local environmental conditions, the latter manifest in extreme weather conditions, flooding, and forest fire. Historically vulnerability to such stresses have been reflected in population fluctuations, and adaptation in the emergence of a mixed economy, investment in flood abatement measures and a cycle of interaction and economic activity that closely reflects the rhythm of the land. It postulated that warming, increased spring run-off and drier summers will bring with them accelerated permafrost melt. and the possibility of increased flooding and incidence of forest fire. The community's economy has varying degrees of exposure to both climate induced events and the vagaries of the broader national and international economies.

In our work we recognize that vulnerability and the capacity to adapt to changing circumstances are the outcome of a synergistic mix of the magnitude of environmental and economic challenges facing a community, and endogenous characteristics conditioning adaptive capacity such as community memory, experience coping with stress, economic well-being, and the breadth of human resources. Working with the community and building on a synthesis of secondary data, community interviews and workshops, we examine responses to contemporary stresses as a basis for assessing the ability to cope with the implications of a changing physical environment. Preliminary analysis has resulted in a framework for a community strategy to adapt to emerging trends that incorporates the future expectations of Dawson's population, the pace and magnitude of anticipated environmental changes and the significance and life-cycle of economic activities and infrastructure components.

BRUCELLA C-ELISA SEROSURVEYS IN ARCTIC MARINE MAMMAL POPULATIONS

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Beginning with the 1994 discovery of marine origin *Brucella* (currently identified as *B. ceti* and *B. pinnipedialis*) concerns have been raised about the prevalence and significance of infection with this organism in marine mammal populations as well as the possible risks of exposure in humans who interact with marine mammals. These concerns dictated the need for the development of new tools to enable confident diagnoses, whether in marine mammals or humans. We conducted a multimodal study comparing extant diagnostic tools with these newer

testing methods, including direct comparisons between gold standard classical microbiology and newly developed molecular method results with, where possible, c-ELISA results in order to address issues of sensitivity and specificity of the c-ELISA.

In our multiyear study of marine *Brucella* we have processed thousands of marine mammal samples from the arctic and elsewhere and demonstrated significant differences in seroprevalence rates between marine mammal species as well as seroprevalence differences in conspecifics from different geographic locations. We have demonstrated transplacental *Brucella* infection in aborted fetuses of California sea lions and documented its presence in some marine mammal species regularly consumed by arctic native populations. A serosurvey of selected at risk human populations is currently underway.

The significance of a positive c-ELISA test in some marine mammal species remains elusive. Large numbers of pinnipeds, some, whose sera demonstrate very high levels of competitive inhibition indicative of high titers show no clinical or histopathologic evidence of disease. Only three naturally acquired human cases of disease caused by marine origin *Brucella* have been reported despite large populations of marine mammal consuming subsistence hunters. Whatmore *et al (2008)* recently demonstrated that all of the isolates from naturally-acquired human marine origin *Brucella* infection shared the same ST27 genotype. Our isolates from aborted California sea lions and bottlenose dolphins also share this genotype. It is possible that this particular genotype has a greater pathogenicity than that of the more common marine isolates.

RISK PERCEPTION AND MITIGATION RELATED TO 'SAFE' FOOD AND WATER: IMPACTS ON HUMAN HEALTH

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Public trust in our food and drinking water is fundamental but repeatedly threatened by outbreaks of associated illness. Building and safeguarding of this trust is the responsibility of multiple stakeholders in government, industry and also with each of us as individuals.
The complexity of this shared responsibility to assess and manage risk of illness and death due to the consumption of unsafe food and water may itself be an important factor that impacts the ability to mitigate health risks.

Competing interests and accountabilities can affect how officials address their responsibilities. Moreover, public health officials face a myriad of health issues in their communities, demanding constant prioritisation and flexibility for responding to emerging or unexpected crises. Since health issues do not exist in isolation of environmental health, social and cultural factors, addressing one aspect will invariably effect change in another.

These pressures are compounded in remote northern regions. Rapidly changing environments in the north may have a more dramatic impact on Inuit who live closely tied and attuned to the land and what it provides. For many Inuit communities, cultural habits and historical perceptions of the level of risk of contamination in traditional foods and drinking water sources are being challenged both internally and externally.
A response to this is improved surveillance and the use of rigorously collected data that addresses community concerns and questions regarding the safety of their food and water. A key element of effective surveillance is sharing of results to the community in a way that is respectful, coherent, sensible and useful.

Community based studies in the Inuit regions of Nunavik (northern Quebec) and Nunatsiavut (northern Labrador) are investigating questions concerning the current status of biological hazards (pathogens) in traditional foods from hunting and fishing (Simard et al., Pufall et al.) and in raw water sources (Harper et al) and related impacts of climatic change.

Identification and presentation of hazard surveillance data from these studies, and how the risks will be received and acted upon, will likely involve a degree of conflict between the assessment of risk by the researchers and government officials at different bureaucratic levels, and the public's risk perception and risk tolerance.
With the ultimate goal of mitigating health risks and improving community health, recognition of these different perspectives and the use of scenario development can guide public and environmental health officials' actions regarding use and dissemination of research results.

ESTIMATION OF AIR-SEA CO2 FLUX IN HUDSON BAY DURING THE ICE-FREE SEASON USING FIELD AND SATELLITE REMOTE SENSING DATA

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The lack of baseline estimates of air-sea CO_2 exchange in Arctic and sub-Arctic regions represents a major shortfall in our ability to understand how climate change may affect CO_2 fluxes at high latitude. The 2005 ArcticNet cruise of Hudson Bay provided a rare comprehensive oceanographic survey of one such region. Ship-based observations of sea-surface fugacity of CO_2 (fCO_{2sw}) were made at 56 locations between September 15 and October 26, and were found to range from 259µatm in Hudson Strait to 425µatm at the entrance to James Bay. Strong relationships between fCO_{2sw} and river discharge were identified, with coastal waters observed to be supersaturated in fCO_{2sw} with respect to the atmosphere (and thus a source of CO_2), while off-shore waters were undersaturated (thus a sink). High correlation of fCO_{2sw} with salinity, sea surface temperature (SST), and colored dissolved organic matter (CDOM) suggest that thermodynamic effects and possibly the oxidation of riverine carbon were driving supersaturation in the coastal zone.

To expand the spatial and temporal domain of the study, a remote sensing approach was applied. A SST-fCO_{2sw} algorithm was used with monthly maps of SST obtained from the MODIS aqua sensor to extrapolate fCO_{2sw} in Hudson Bay for the 2005 ice-free season (August-October). Gas transfer velocities were estimated using twice-daily QuikSCAT wind retrievals, and by using a bulk aerodynamic approach the monthly flux of CO_2 in Hudson Bay was calculated. The results of these calculations revealed that Hudson Bay acts as a source of CO_2 during August and September (4.73 and 5.95 mmol m^{-2} day^{-1}, respectively), but reverts to a sink of CO_2 in October as the water temperature cools (-4.61 $mmol^{-2}$ day^{-1}). By integrating over the spatial extent of Hudson Bay and the 92 day open-water season, a positive flux of 1.60 TgC was estimated. This result is in contrast to most Arctic or sub-Arctic continental shelf seas, where usually strong absorptions of CO_2 are observed.

THE CALANUS COMPLEX IN A PAN-ARCTIC PERSPECTIVE

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As light intensity increases during spring in high latitude ice covered marine systems, ice algae start to grow under the sea ice as early as in March, Ice melting with subsequent stratification of nutrient-rich water masses facilitate short and intense blooms of phytoplankton, which propagate through Arctic waters producing a luxury of high quality food for zooplankton grazers. The three *Calanus* species *Calanus finmarchicus, Calanus glacialis* and *Calanus hyperboreus* are the major herbivores in the Arctic system transferring energy through the lipid based food web, from the primary producers to the higher trophic levels. They convert low energy carbohydrates and proteins in ice algae and phytoplankton into high energy wax esters through their specific biosynthesis. We have studied the role of *Calanus* in a pan-Arctic perspective (Canadian-and-European Arctic) over two decades. We here present a synthesised overview the three dominant *Calanus* species in Arctic waters, including their geographic distributions, overwintering, feeding, life strategies and the role of lipids.

USING AUTONOMOUS UNDERWATER VEHICLES IN UNDER-ICE SCIENTIFIC MISSIONS

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Since the mid 1960's, Canadian companies and universities have been leaders in the development of unmanned underwater vehicles and sensing systems. Over the same period, there has been increasing interest in the use of the Arctic, both as an ocean waterway and as a source of natural resources and food. In support of these objectives, scientific studies and research to characterize the Arctic environment are being initiated with increasing frequency. With an Arctic landmass second only in area to that of Russia, Canada has a major interest in the focus and impact of these studies, and it has started to use unmanned vehicles as a platform to aid in the collection of polar

ocean data. The Remotely Operated Vehicle or ROV has been used fairly routinely for under-ice observation since the 1970's and the procedures associated with its use are now quite straightforward. However, the real coverage that an ROV can achieve is limited by its umbilical tether, and its value to the polar ocean science mission is a matter of some question. In terms of mobility, a more versatile platform is the Autonomous Underwater Vehicle (AUV). Operating without a tether, the AUV can make undersea transits or surveys hundreds of kilometres in length. So far, use of the AUV in polar regions has been sparse and there is not a large body of operational experience with under-ice operations. In 1995 and 1996, however, the Canadian Department of National Defence (DND) and International Submarine Engineering Ltd. (ISE), operated a large AUV through ice in the Lincoln Sea, north of Alert, NWT, conducting missions with lengths in excess of 450 km. ISE is now using this experience to adapt the smaller 3000m depth Explorer AUV for Antarctic missions with Memorial University and the University of Tasmania, in south polar regions. The company is also working with DND, Memorial University and the NRC, to adapt its 5000 meter AUV for sea-floor mapping operations in the Canadian Arctic. The paper will review experience gained on Arctic operations and outline the considerations and decisions that were made to adapt AUV technology and procedures for the Arctic mission. Both pre-deployment and operational aspects will be covered. Pre-deployment aspects that will be presented include training, fail-safe provisions, mission planning and simulation, the use of local knowledge or lore, mission logistics and finally, loss provisions and insurance coverage for the vehicle. Operational aspects to be discussed will include dealing with extremely cold, ice-surface temperatures, high latitude, inertial initialization and navigation, under-ice acoustic positioning, communications with the AUV, acoustic homing to the recovery site and the procedures for recovery. Procedures for turning the vehicle around between missions including options for battery charging, data download and mission upload will also be presented. The paper will demonstrate that technology and procedures needed to operate AUVs successfully in polar regions have been proven to work and are readily available to the scientific researcher. The paper will also highlight the need for a thorough AUV training program ahead of the polar deployment.

LOSS OF CHAOS IN THE ARCTIC: WHAT IT MEANS TO ICE-ADAPTED MARINE MAMMALS

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Contrary to expectations, a warming Arctic will be more predictable. Predictable climate without as many extreme events will favour human aspirations for economic development of Arctic waters. But will a more predictable climate be good for Arctic animals? Life-history adaptations of mammals in polar environments can be described according to a punnett square categorizing bet-hedgers, reproducers, competitors, and survivors. Environmental change results in competition and predation causing temporal and/or geographic displacement of one group by another. Arctic bet-hedgers and competitors that have evolved reproductive adaptations to variable environments will be replaced by reproducers and survivors from temperate environments. For example, Arctic marine mammals will respond to an ecosystem shift that is expected to result in the loss of polar bears and Inuit hunters as top predators being replaced by killer whales and a new suite of marine mammal prey that will include minke and humpback whales and dolphins. How to mitigate this redistribution may require creating reserves for ice-adapted species, restricting migratory tendencies, and management of killer whale activity. A research program is required to obtain information necessary to predict how, when, why, and where species redistribution will occur and provide critical advice to assist northerners adapt to the loss of their subsistence culture within a more predictable world.

SPATIAL VARIABILITY OF SUMMER PRIMARY PRODUCTION IN THE HUDSON BAY COMPLEX

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Phytoplankton production and biomass were measured in the Hudson Bay Complex (HBC) during August-September of 2004 to 2006. Phytoplankton production and biomass were overall similar during the three sampling years, but showed large horizontal variability. They were generally lower in Hudson Bay and Foxe Basin (51 to 1218 mg C m^{-2} d^{-1}; 5.4 to 86.9 mg chl *a* m^{-2}) than in Hudson Strait (412 to 3132 mg C m^{-2} d^{-1}; 28.0 to 202.4 mg chl *a* m^{-2}). On average, the upper water column of Hudson Bay and Foxe Basin was more stratified than Hudson Strait (the difference in sigma-t between 80 and 5 m being 3.82, 1,79 and 1.21 kg m^{-3}, respectively) and was

characterized by a deeper nitracline (47 m, 51 m, and 33 m, respectively) and euphotic zone (56 m, 55m, and 38 m, respectively). In Hudson Bay and Foxe Basin, phytoplankton production was higher at stations with a weaker stratification index and a higher nitrate+nitrite concentration (value integrated over the euphotic zone). In Hudson Strait, south shore stations, which are influenced by Hudson Bay surface water, showed more productive waters than north shore stations. These results suggest that vertical mixing and advection are major factors controlling primary production in the HBC. Therefore, future enhancement of surface water column stratification by warming and freshwater input from precipitation may affect carbon fluxes and food web dynamics of this subarctic marine system.

COMBINING BARCODING AND TRADITIONAL TAXONOMY TO STUDY THE DIVERSITY OF MICROGASTRINAE WASPS (HYMENOPTERA: BRACONIDAE) IN ARCTIC NORTH AMERICA

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Within the context of global warming, insect diversity will increase in the Arctic, most likely bringing in invasive species to the region with considerable affectations to ecosystem productivity and functioning. Therefore, a better understanding of the beneficial fauna to deal with the new insect pests becomes a priority. Here we present a combined approach to study the Microgastrinae wasps (Hymenoptera) in the Arctic North America (ranging from Alaska to Greenland). We chose that group of parasitoids because of its high diversity, difficult taxonomy and potential applications in biological control programs. Microgastrinae is the single most important group parasitizing Lepidoptera larvae; they comprise around 1500 described species worldwide, with 30 recorded for America north of 60º N, but those figures are far from complete. During the last two years we have been combining molecular techniques (DNA barcodes), with traditional (i.e. morphological) taxonomy, the study of available collections (over 6000 specimens, half of them collected before 1960), and literature. Our preliminary results show that: a) The diversity of microgastrine wasps in arctic ecosystems of North America is much larger than previously thought (around a hundred of species identified so far); b) Barcoding can speed up considerably the process of identification of species; c) The combination of molecular and traditional taxonomy approaches increased the accuracy of the work in such a difficult and diverse group; d) The old specimens available in collections might provide a useful baseline to compare the changes in biodiversity patterns with present and future data; e) More collecting and study are needed to complete the picture we presently have on the diversity of this group of parasitoids.

CHANGING GOVERNANCE AND THE GOVERNANCE OF CHANGE: FACILITATING ADAPTATION ACROSS MULTI-LEVEL INSTITUTIONS IN HOPEDALE, NUNATSIAVUT, LABRADOR

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Scientists and northerners agree that changing environmental conditions in the Canadian Arctic are now affecting the livelihoods and well-being of northern residents who rely on natural resources. To reduce current and future vulnerability, adaptation planning initiatives are needed. Initiatives to enhance adaptive capacity need to integrate local knowledge and be facilitated through the existing systems of governance including formal and informal institutions, organizations across multiple scales. There exists limited research on how adaptation can be mainstreamed into existing risk management and resource management systems in Canadian arctic communities.

This research centered on vulnerabilities associated with access and availability of wildlife and other natural resources based on previously identified concerns by the community. Through a multi-level, community-centered assessment of the decision making structures and processes of Hopedale, Nunatsiavut this research identifies the role of governance and local knowledge in facilitating adaptation of the community. Fifty six in-depth, semi-structured interviews were conducted with participants from the community, regional, provincial and federal government and non-governmental organizations. This was complimented with a survey, participant observations and an analysis of secondary sources.

Findings suggest that existing and historical

institutions as well as new governance systems are both facilitating and hindering the capacity of individuals and households to adapt to changing conditions. This is evident through key examples at the community scale such as changes in caribou migration patterns which has led to further distances to travel for the annual harvest and fewer residents involved in the hunt. Community sharing norms, however, facilitate the supply of caribou meat for most households. Current open subsistence harvest regulations, though, have many residents concerned about overharvesting of migratory bird species, particularly in the face of a longer spring season due to earlier break up. Furthermore, although the new system of self government assures residents of preserved Inuit culture and heritage, others are unfamiliar with the changing system of governance, potentially compromising their ability to access resources such as employment. At regional and provincial scales, differences in perceptions of local knowledge integration pose potential challenges to multi-level adaptation planning. These examples reinforce the notion that climate change adaptation initiatives must be tailored to the specific local and multi-scale institutions and systems of governance.

DRDC IN CANADA'S HIGH ARCTIC

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The Canadian Arctic is fast becoming an area of increasing strategic and economic importance to Canadians and its federal and territorial governments. As a result, the need for the Canadian Forces (CF) to monitor and surveil activities in this area; particularly in the navigable passages, is quickly increasing. However, due to the large expanse, low population density, and lack of extensive infrastructure (i.e. buildings, communications, and transportation) in the Canadian Arctic, this is a difficult task. Presently, surveillance is primarily limited to information gathered by over-flights carried out by the CF's Maritime Patrol Aircraft (Auroras), to ground patrols carried out by the Canadian Rangers, and patrols by the Canadian Coast Guard and occasionally by the Canadian Navy. To improve the ability of the CF to obtain an Operational Picture (OP) for the high Arctic, Defence Research and Development Canada (DRDC) started a four year Technology Demonstration (TD) project in April 2007 to investigate and demonstrate technologies that could be used to monitor and surveil the waters of the high arctic. During these years, the work will require significant effort from managerial, scientific and technical personnel at DRDC Corporate, DRDC Atlantic, DRDC CORA, DRDC Ottawa, and DRDC Valcartier. This presentation will discuss the various technologies that the team will investigate, develop and demonstrate and presents the program of work that has been proposed and which we are in the process of realizing. In particular, it focuses on the sensor detection technologies and sensor data integration techniques that will be investigated. These include passive underwater sonar and electromagnetic detection, active and passive radio frequency detection, and active and passive optical and infrared detection. The performance of such integrated sensors will be evaluated using two types of methodologies. The first type involves experiments with a suite of ground-based sensors able to provide continuous coverage at certain strategic locations in the Canadian Arctic. This will be tested through the development and installation of a multi-sensor system at a test site near Gascoyne Inlet on Devon Island. It will include an Automatic Identification System (AIS), an underwater hydrophone and electromagnetic sensor suite that is part of the Rapidly Deployable System (RDS) developed at DRDC Atlantic, a navigational radar (RF) system, a radio direction finding system developed at DRDC Ottawa, and a new DRDC Valcartier electro-optical (EO) system called the Canadian Arctic Night and Day Imaging Surveillance System (CANDISS). In addition, using meteorological data obtained from on-site sensors, other ground stations and radio-sonde launches within the Arctic, and similar data obtained from Environment Canada's Global Environment Model (GEM), the performance of the EO and RF systems will be modelled for many strategic locations. This will be accomplished using a modified version of DRDC's Shipborne Integrated Environment System for Tactics and Awareness (SIESTA) software that was developed to predict the performance of shipborne EO and RF systems. The second type involves studies and simulations of other detection technologies such as RF and EO satellite surveillance, high-frequency surface wave (HFSW), RF and EO aerial surveillance, and other platforms of opportunity. This would include information provided by citizens working or traveling in the North, and by commercial shipping and air services. The investigation of these possibilities will only be conducted using computer modelling without field-testing at this point since it is beyond the scope of the project budget.Finally, we

discuss the schedule of work and the major work elements associated with each of the sensing technologies to be developed during this program. In particular, we will present some of the results of our first Arctic campaign carried out during the summer of 2008.

ARCTIC COASTAL RESEARCH: RECENT DEVELOPMENTS IN CANADA AND THE CIRCUMPOLAR WORLD

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Scientific research on coastal biophysical processes in the Arctic developed slowly in the second half of the past century and accelerated in recent decades. Early pioneers included Felix Aré in Russia, Erk Reimnitz and colleagues in Alaska, and Ross Mackay and Brian McCann in Canada. The Geological Survey of Canada developed an extensive network of coastal monitoring sites throughout northern Canada, beginning in the 1970s, but this has been difficult to maintain. Work on sea-ice dynamics, seabed scour, and oil-spill sensitivity of coasts was initiated in the first wave of Arctic oil and gas exploration in the 1970s and has continued intermittently since, with much work currently underway in the Mackenzie Delta region and on the North Slope of Alaska. Renewed efforts related to coastal and sub-sea permafrost were initiated in the 1990s in northern Russia and more recently, in part with funding from the ArcticNet Network of Centres of Excellence, in Nunavik and other parts of northern Canada. Two projects in the initial phase of ArcticNet, one focused on vulnerability of Arctic coasts and coastal communities, another on coastal permafrost issues, spurred new efforts in northern Canada. At the international level, the Arctic Coastal Dynamics Project (ACD) fostered broad collaboration around the circumpolar world. The International Polar Year led to development of new activities, including projects such as *Community Adaptation and Vulnerability in Arctic Regions* (CAVIAR), *Sea Ice, People, and Weather* (Siku-Inuit-Hila), and the *Arctic Circumpolar Coastal Observatories Network* (ACCO-Net), involving partnerships from Siberia and Alaska east to the Canadian Arctic, Greenland, and northern Europe. These and new projects under ArcticNet emphasize active participation by northern residents and close involvement with communities to address needs for adaptation to climate variability and change. Monitoring change, projecting future impacts, and discovering new approaches to planning and community development are key elements of recent efforts on many fronts. Current projects under ArcticNet include *Permafrost and Climate Change in Northern Coastal Canada* and *Instability of Coastal Landscapes in Arctic Communities and Regions*. These and complementary work by Natural Resources Canada (with other federal and territorial government agencies and the Canadian Institute of Planners) are directed to strengthening the links between western science, traditional ecological knowledge (Inuit Q***aujimajatuqangit***), and local and regional planning and policy to improve the knowledge base for robust decision-making and enhance resilience in northern communities. Efforts are underway to increase the extent and scope of Arctic coastal monitoring, building on national networks and international collaborations such as the *Arctic Monitoring and Assessment Programme* (AMAP) and ACCO-Net through the SAON initiative (*Sustaining Arctic Observing Networks*). Specific challenges include the need for increased spatial and temporal density of observations and better integration of coastal research across international boundaries. Coastal issues received limited attention in the *Arctic Climate Impact Assessment* (2005) and a new effort is underway to review the current state of knowledge on coastal change, hazards, vulnerability, and response strategies in the circumpolar Arctic. This work, sponsored by the International Arctic Science Committee (IASC) and Land-Ocean Interactions in the Coastal Zone (LOICZ), is intended to stimulate post-IPY efforts internationally.

CLIMATE CHANGE, NATURAL HAZARDS, AND VULNERABILITY IN SMALL INUIT COMMUNITIES: A COMPARISON BETWEEN IGLOOLIK, NUNAVUT, AND QEQERTARSUAQ, GREENLAND

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Climate change presents risks to the well-being of Inuit communities across the Arctic. Many of these risks are associated with hunting, fishing, and travelling in the Arctic environment. Research from the Canadian Arctic has demonstrated how vulnerability differs between communities within the same region, a function of

physical location, livelihood strategies, economic situation, governance, demographics, and availability of natural resources (Ford et al., 2008). However, few studies have assessed differences (or similarities) in vulnerability and its determinants between Inuit communities in *different countries*. This raises some important research questions. Can we, for example, generalize on the processes that shape vulnerability regionally, nationally, or even internationally? Does vulnerability exist to similar climatic risks? Are policy impacts on vulnerability of a similar magnitude in different countries? These questions have important ramifications for the development of adaptation policy at a local to international level, yet little comparative research has been undertaken in an Arctic context. This paper presents some early results from an evolving project characterizing Inuit vulnerability to climate change in Igloolik, Nunavut, and Qeqertarsuaq, Greenland. The case studies focus on hazards associated with resource harvesting and travel, and use the vulnerability approach of Ford and Smit (2004), where vulnerability is conceptualized as a function of exposure of a community to climatic conditions and its adaptive capacity to deal with that exposure. Both studies also utilize detailed place-specific case studies, close collaboration with community members, and multiple participatory methodologies to characterize vulnerability. The use of a consistent and systematic approach permits comparison and integration of case studies, including identification of commonalities and differences in the two regions and the generation of policy-relevant outcomes which draw on findings from the case studies.

OPPORTUNITIES FOR POLICY TO SUPPORT INUIT ADAPTATION TO CLIMATE CHANGE

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For the Arctic's Inuit population, climate change is challenging internationally established human rights. Moreover, «dangerous» climate change might already be occurring in the Arctic thereby compelling Parties to the UNFCCC to stabilize greenhouse gas emissions. Mitigation can help avoid 'runaway' climate change, adaptation can help Inuit reduce the negative effects of current and future climate change, take advantage of new opportunities, and can be integrated into existing decision-making processes and policy goals. Indeed, adaptation is emerging as a priority area for action on climate change among the member states of the Arctic Council, and can help Inuit manage changes in climate that are now inevitable. This paper identifies entry points where policy can support Inuit adaptation to the social, cultural, health, and economic effects of current and predicted climate change. These include supporting the teaching and transmission of traditional skills, enhancing emergency management capability, promoting co-management of natural resources, targeted economic support to facilitate adaptation for groups with limit income, and the need to catalogue and preserve at risk cultural sites. These policy entry points are targeted at different levels of decision making, including recommendations to strengthen and prioritize existing management and support systems, target government institutions charged with wildlife management and education, and enhance municipal decision making and planning.

SUNSHINE: AN IMPORTANT BIOCLIMATIC CONTROL ON HOLOCENE AND LAST INTERGLACIAL VEGETATIONAL DEVELOPMENT IN EASTERN BAFFIN ISLAND, ARCTIC CANADA

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The past can play a tremendously important role in helping us understand future climate change and associated tundra ecosystem response. Feedbacks in Arctic climate system associated with clouds (or inversely, sunshine conditions) is still a major source of uncertainty in model projections of global warming. At polar latitudes, the availability of light and the atmospheric moisture are interrelated with cloud cover, which should indeed play an important role in plant physiology. This study presents Last Interglacial (ca. 125,000 years ago) and Holocene (last 11,500 years) vegetation and climate changes at Fog Lake (67°11'N, 63°15'W) on eastern Baffin Island, Arctic Canada. The vegetation cover is reported as structural vegetation types, or biomes. July air temperature and sunshine during the growing season (June-July-August-September) were reconstructed from pollen assemblages with the modern analogue technique. The vegetation of the Last Interglacial period evolved from a prostrate dwarf-shrub tundra to a low- and high-shrub tundra vegetation. The succession of four arctic biomes was distinguished from the Last Interglacial sediments, whereas only one arctic biome was recorded in the Holocene sediments. From ca.

8300 cal. year BP to present, hemiprostrate dwarf-shrub tundra occupied the soils around Fog Lake. During the Last Interglacial, growing season sunshine was higher than during the Holocene and July air temperature was 4 to 5°C warmer than present. A Principal Component Analysis helped in assessing relationship between floristic gradients and climate. Major changes in vegetation cover through the Last Interglacial and Holocene are clearly shown in the July air temperature reconstruction curve, whereas minor changes seem to be better depicted in the growing season sunshine reconstruction curve. We thus suggest that July air temperature is the climate parameter that has driven the major vegetation changes through the Last Interglacial and the Holocene at Fog Lake, and that these vegetation changes might have been induced by changes in growing season sunshine which affected the length of the vegetation period available to tundra species, especially during September. During the Last Interglacial, summer warming and lengthening of the growing season helped the development of a shrub tundra vegetation on eastern Baffin Island. Increasing deciduous shrub abundance (e.g., *Betula*) during the Last Interglacial is an important result, as it suggests that the directional changes that occurred on eastern Baffin Island are consistent with experimental tundra warming. A shift from herbaceous to woody tundra would have important implications for processes and interactions within tundra ecosystems and between tundra and the atmosphere, notably through a decrease in albedo. An increased cloudiness (or decreased sunshine) is expected to accompany a climate warming. It is thus important that we improve our understanding of how a change in shrub cover and sunshine likely influence the behaviour of the climate system. This study demonstrates that growing season sunshine conditions can be reconstructed from arctic pollen assemblages, thus providing information on feedbacks associated with cloud cover and summer temperatures, and therefore growing season length.

COMMUNITY-BASED INUIT HERITAGE RESEARCH: LESSONS FROM A NINE-YEAR PARTNERSHIP BETWEEN AN INUIT COMMUNITY GROUP AND A SOUTHERN UNIVERSITY

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From 1999 to the present, the Kitikmeot Heritage Society of Cambridge Bay, Nunavut, and the University of Toronto have engaged in a research partnership dedicated to local cultural history as expressed in Traditional Knowledge and archaeology. Through the years, the personnel and goals of this project have gradually changed, and its latest manifestation is as a key part of one of the Government of Canada's International Polar Year research projects. In this paper, I will outline the different phases through which this partnership has developed, report on the perceived value to both of the participating groups, and reflect on practical aspects of what does and does not work in cooperative research situations like this one.

GROUND ICE STUDIES ON HERSCHEL ISLAND IN THE WESTERN CANADIAN ARCTIC – A USEFUL PALEOENVIRONMENTAL PROXY TOOL

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Herschel Island lies approximately 4 km off the Yukon Coastal Plain within the zone of continuous permafrost in the western Canadian Arctic. The island is a terminal moraine resulting from a push of the Laurentide Ice Sheet during the Early to Middle Wisconsin and represents the likely easternmost edge of Beringia. The region presumably remained ice-free during the Late Wisconsin glaciation and has therefore been intensively affected by periglacial processes for at least the last 50 ka BP. Ground ice is ubiquitous on the island and contributes to the shaping of the landscape since deglaciation. Cryostratigraphic, cryolithological and stable isotope analyses ($\delta^{18}O$, δ D) have been performed on various ground ice types (e.g. ice wedge ice, segregated ice, texture ice, potentially buried glacier ice) recovered to unravel their genetic processes, their relative age as well as responsible freezing processes and different temporal periods of ground ice aggradation and degradation. Since ground ice is a valuable record of paleoclimate information regarding the prevailing temperatures during precipitation and ice formation, it can be used for paleoenvironmental reconstructions.

Ice wedges on Herschel Island have begun to form in outwash and morainic deposits of Wisconsin age

after deglaciation, when dry and harsh climatic conditions supported frost cracking. A recovered Pleistocene ice wedge – recognised by its truncation by the early Holocene thaw unconformity – is remarkably depleted in its mean $\delta^{18}O$ isotope signature (−29 ‰) compared to all other occurring ice wedges (–24 to –21 ‰) that penetrate the unconformity or that are not truncated. Thus, significantly colder winter temperatures are assumed during the formation of Pleistocene ice wedges in contrast to Holocene and more recent ones. Evidently, Herschel Island comprises ice wedges that formed likely prior to the Holocene Thermal Maximum (HTM) and afterwards up to the present.

Within glacially-affected and ice-rich Herschel Island sediments, bodies of massive ice are exposed whose appearance and isotopic composition is completely different from all other sampled ground ice types. $\delta^{18}O$-isotopes are strongly depleted (between -33 and -37‰) thus suggesting a Pleistocene origin with slope and d-excess near the global meteoric water line (GMWL), which indicate that the moisture is likely of meteoric origin without substantial alterations. The question arises, whether the ice body aggraded prior to glaciation as massive segregated ice and was then deformed by glacier ice thrust. Or if the ice was originally basal glacier ice that was buried by supraglacial till as a remnant of the Laurentide ice lobe.

METHODS AND APPROACHES TO LINKING INUIT KNOWLEDGE AND SCIENCE FOR THE UNDERSTANDING OF CLIMATE CHANGE IN ARCTIC REGIONS

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Inuit communities are considered to be some of the most vulnerable populations to climate and environmental change globally. Their close relationship with the land, coastal geographic location, and reliance on the local environment for aspects of diet and economy, in addition to the current dynamic state of social, cultural, economic and political change in many regions places these communities at particular risk to perturbations in the local environment. Historically, traditional knowledge systems have been critical in supporting response to local scale change and stress among many Indigenous groups. Currently, local observations and knowledge of changes in climatic conditions coming from Inuit and other Indigenous communities in the Arctic represent some of the best and only local scale data on human-environment interactions in these changing environments. Although there is growing support for the complementary use of Inuit or other Indigenous knowledge and science the acceptance of their combined use still remains contentious. This presentation will provide an analysis of methods and approaches used to link Inuit and other forms of Indigenous knowledge and science through a review of existing and past research in the areas of climate change in northern regions. The analysis identifies three general categories showing promise for understanding how convergence or complementary use may occur. They include: parallel observation and analysis, serial observation and analysis and collaborative observation and analysis. A fourth category, parallel, serial or collaborative conceptualization is also identified. The majority of projects conducted to date have employed either parallel or serial observation in which convergence or data connections are made in a retrospective manner. Very few projects to date have proactively developed and conducted collaborative work involving both Indigenous knowledge and science on these subjects. Projects in which 1) a common application or goal exists (e.g. human safety and climate change, weather prediction); 2) there is a common geographic and temporal foci and scale for the work (e.g. investigation of a specific location or 'Cultural Landscape Unit' such as polynya), 3) there is a common phenomenon being investigated (e.g. weather persistence / unpredictability), or 4) there is a common unit of analysis between the two systems (e.g. climate indicator of relevance or importance to the community e.g. factors influencing ice safety) show greatest promise for supporting convergence between Inuit knowledge and science. Finally, it is argued that the complementary nature of these knowledge systems may only be realized if processes and efforts are established to: i) understand the issue from both perspectives; ii) establish meaningful and reciprocal research partnerships with knowledge holders and communities; iii) utilise and improve cross-cultural collaborative research methods; and, iv) establish and maintain open and ongoing dialogue. Many of the community-based approaches to research presented in this session provide examples of lessons learned in this regard.

SPATIAL PATTERNS OF HOLOCENE PALEOCLIMATIC CHANGE IN THE CANADIAN ARCTIC ISLANDS

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A greater understanding of the potential impact of climatic change on terrestrial and freshwater ecosystems can be obtained by observing how climate variability of the past affected Arctic ecosystems. Fossils extracted from lake sediment cores are used to identify long term environmental change and reconstruct past climates. However, few records spanning the Holocene have been produced from the Canadian Arctic, and the spatial patterns of historical climate variability across the region remain poorly known. We present data from a series of lake sediment cores from across the Canadian Arctic Islands to quantify spatial variability in Holocene paleoclimates, and to determine local effects of climatic changes on ecosystems. A multi-proxy approach is used to provide independent paleoclimatic records. Due to the availability of calibration datasets of ecological data, it is now possible to attempt quantitative reconstructions of past temperatures and biological production. Pollen, diatom and chironomid-based paleoclimate reconstructions, as well as high resolution analyses of biogenic silica and sediment properties, are broadly coherent within one site, although there remain some differences between paleoclimate values estimated by the different proxies. Using fossil pollen data and an extensive modern calibration set, we estimate early Holocene temperatures of 1-2 degrees C higher than the early 20th century across a broad area of the Canadian Arctic; this «Holocene Thermal Maximum» occurred about 10000 to 6500 cal yr BP in the western Canadian Arctic at site KR02 on Victoria Island, and at about 9000 cal yr BP in the central Arctic at Lake PW02 on Prince of Wales Island. Elevated biological production across different trophic levels, measured using a combination of biogenic silica, percent organic matter and the concentrations of microfossils, is also noted at that time at many sites. Neoglacial cooling is observed in many records after 4000 cal yr BP; the transition to cooler climates is often associated with declines in diatom production, and a rise in diatom diversity. Millennial-scale climate variability is identified in both terrestrial and freshwater fossil sequences. For the past millennium, these changes are broadly coherent across several cores, with some spatial variability both in terms of timing and magnitude across the Archipelago. Non-analogue conditions, that is, communities in the past which do not resemble any observed today in the Arctic, have been identified, as has been found in temperate regions, but it is still unclear if this is due to insufficient calibration data or true non-analogue conditions. Although significant progress has been made in mapping Holocene paleoclimates across this region, more progress is needed on modern calibration of the proxies, taxonomic harmonization, obtaining better chronologies and increasing the density of sites available for reconstructions.

IMPACT OF CLIMATE CHANGE ON ARCTIC TERRESTRIAL FOOD WEBS: EXAMPLES FROM THE BYLOT ISLAND LONG TERM STUDY

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Measuring the impact of climate change on arctic wildlife populations is exceedingly difficult for several reasons. First, mechanisms of actions are complex, are still poorly known and are often indirect, e.g. either through the food (bottom-up) or predators (top-down) of an animal. Second, short-term trends are difficult to interpret because of the large natural variability of the climate. Third, it is virtually impossible to manipulate the climate to disentangle its effects on wildlife. I argue here that a profitable approach is to combine long term monitoring of key species of the food web in combination with short term studies aimed at improving our understanding of the mechanisms involved. I will illustrate that with examples from the work that my colleagues and I have been conducting on snow geese and lemmings on Bylot Island, Nunavut, over the past 2 decades. Plant production in wetlands of this site has increased 84% over the period 1990-2007. This is likely a direct consequence of climate warming because air temperature and precipitation were the most influential factors on plant production, and our study area has experienced a strong warming rend (2.1 C over the last 30 years). Climatic variations appear to be the most important driver of the annual production of snow geese as shown by the close association between the breeding phenology or their breeding effort and air temperature in spring. As the summer temperature and plant production both increased, one could think that this would have beneficial effects on

geese. However, our analysis also revealed some unexpected negative effect of warm temperature, as gosling growth was reduced in years with warm spring temperature and early snow-melt, possibly because such conditions may lead to a mismatch between the peak in plant quality and hatching date of goslings. In lemmings, we found evidence that their 3 to 4-year cycle of abundance may have been disrupted, as recent peaks of abundance were weaker than older ones. The strong warming trend detected could be one explanation for the low recent abundance of lemmings, as other sites in the circumpolar world experiencing warming have also found similar collapse of the lemming cycle. This phenomenon could have far-reaching impacts on the whole tundra food webs as lemmings are the primary prey of most tundra predators and play a key role in the population dynamics of these predators and of alternative prey species due to shared predators.

MODELLING OF THE EFFECTS OF ACIDIC AEROSOLS ON ARCTIC CLOUD MICROSTRUCTURE AND SURFACE RADIATIVE BUDGET DURING WINTER

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The effect of pollution-derived sulphuric acid aerosols on the aerosol-cloud-radiation interactions is investigated. Observations suggest that acidic aerosols can decrease the heterogeneous nucleation rate of ice crystals and lower the homogeneous freezing temperature of haze droplets. Based on these observations, we hypothesize that the cloud thermodynamic phase is modified in polluted air mass (Arctic haze). Cloud ice number concentration is reduced, thus promoting further ice crystal growth by the Bergeron-Findeisen process. Hence, ice crystals reach larger sizes and low-level ice crystal precipitation from mixed-phase clouds increases. Enhanced dehydration of the lower troposphere contributes to decrease the water vapour greenhouse effect and cool the surface. A positive feedback is created between surface cooling and air dehydration, accelerating the cold air production. This process is referred to as the dehydration-greenhouse feedback (DGF).

Simulations using 0D, 1D and 3D models are performed to assess the potential effect of the DGF on the Arctic cloud microstructure and surface radiative budget. Results with the explicit size bin 0D model show that acidic aerosols promote the formation of larger ice crystals in smaller concentration, which enhance precipitation and air dehydration. Results with the 1D and 3D model show that the DGF has an important effect on cloud, atmospheric dehydration, and temperature over the Central and Eastern Arctic, which is the coldest part of the Arctic. Cloud ice is significantly reduced and the total atmospheric water path is decreased by as much as 12%. This results in a surface cooling ranging between 0 and –3K. Moreover, the lower tropospheric cooling over the Eastern and Central Arctic strengthens the atmospheric circulation at upper level, thus increasing the aerosol transport from the mid-latitudes and enhancing the DGF. Over warmer areas, the increased aerosol concentration (caused by the DGF) leads to longer cloud lifetime, which contributes to warm these areas.

THE 2008 SCHOOLS ON BOARD CIRCUMPOLAR INUIT FIELD PROGRAM

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The Schools on Board program is a major outreach program of the Circumpolar Flaw Lead (CFL) system study - a $40M Canadian-led international research project that examines the physical-biological coupling within the flaw lead system near Banks Island in the Western Canadian High Arctic.

In celebration of the International Polar Year, Schools on Board hosted 2 International Field Programs, and 1 circumpolar Inuit field program (CIFP). The CIFP is the field program Schools on Board will focus on in this presentation.

The CIFP was truly a unique field program in the sense that it involved circumpolar Inuit students from the Canadian Inuit Regions; Inuvialuit Settlement Region, Nunavut, and Nunavik, as well as students from Alaska, Greenland, and Russia.

The program addressed the CFL's *Two Ways of Knowing* philosophy by combining both Traditional Knowledge and western science research field projects in one unique field program. The highlights of this *two ways of knowing* field program included;

1. Students collecting TK research in their home communities before coming onboard the field program
2. Students participating in community visits in both Inuvik and Sachs Harbour, NT
3. Students were fully immersed in the science fieldwork activities onboard the CCGS Amundsen, Canada's premier research ice breaker

4. An elder/youth/scientist knowledge exchange workshop took place onboard the CCGS Amundsen; community members from Sachs Harbour, NT participated in the one day workshop onboard the ship
5. Follow-up activities with Inuit students will occur throughout the fall/winter seasons with an output minimum of student posters, oral presentations, and booklet publications

FOOD SECURITY IN WESTERN GREENLAND: A CASE STUDY FROM QEQERTARSUAQ

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This article presents results from an exploratory study of food security in the community of Qeqertarsuaq, Greenland, characterizing food security of community members and identifying the exposure-sensitivity and adaptive capacity of the food system to present and future climate changes. Approximately 8% of Qeqertarsuaq residents were classified as food insecure in this study; a value that is higher than the Canadian average of 9%, as assessed by the Canadian Community Health Survey (Health Canada, 2005). While food security levels may be high in Qeqertarsuaq relative to Canadian examples, the ability to obtain culturally (and nutritionally) important Greenlandic foods among certain groups is cause for concern. Women, elders and non-hunters are at particular risk due to restricted traditional food access and reliance on community food sharing systems. Of all women surveyed 46% indicated that Greenlandic foods made up less than half of their diet in the last year while 21% of men consumed similar amounts of Greenlandic foods. As Greenlandic food security is contingent upon access to these highly valued foods further research is needed to identify strategies for increasing Greenlandic food access and ensuring community food security in small, mixed subsistence-cash economies in the context of social, economic, and climatic changes.

IDENTIFICATION OF NATURAL AND HUMAN INDUCED TRENDS AND VARIABILITY OF 30 YEAR CANADIAN ARCTIC AEROSOLS

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The trends and inter-annual variations of the 30 year Canadian Arctic aerosols were analyzed and are separated into both human and natural contributions. It is found that both sulphate and black carbon aerosols are continuing the decline trend but start to level off. The trends are consistent with the decline trends of anthropogenic emissions largely in Europe and North America from 1990s. After de-trending the time series of sulphate, the inter-annual variations were indentified and correlated with two indices derived from the 700 hPa geo-potential heights. Together with the emissions from Europe and North America, the indices can re-produce the 80% of the trends and inter-annual visibilities of the Arctic aerosols

RECENT OBSERVATIONS ON THE DISTRIBUTION AND DYNAMICS OF FRESHWATER IN THE HUDSON BAY SYSTEM

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Freshwater, both from runoff and sea-ice formation and melt, profoundly affects the functioning of the Hudson Bay system (HBS). The system is vulnerable to human disturbance including climate change, as evidenced

by changes in runoff and sea ice conditions. In contrast to the total fluxes, which are relatively well known, where and how long the freshwater resides in the Bay remain open questions. These questions pose a particular challenge because of the complex water masses and exchanges in the HBS and the very limited data that contains tracers of freshwater source. Here, we combine temperature, salinity, dissolved nutrient and oxygen isotope data gathered in late summer, 2004-2007, to describe horizontal and vertical variations in composition of waters in the HBS, with special focus on the distribution of freshwater components.

Summer surface waters, which form a ubiquitous surface mixed layer 5-25 m thick in the Bay, exhibit strong inshore-offshore gradients, related to concentration of river water within a narrow coastal domain (<100-150 km from shore). The influence of sea-ice melt increases toward the interior basin. Using information from a 3-D ocean model, we estimate that the (surface) freshwater transport in this corridor is high and residence times during the ice-free season correspondingly short, in the order of 2-4 months for river water transiting through southwestern Hudson Bay. Despite the short transit time there is evidence for significant loss of colored dissolved organic matter (CDOM).

Subsurface waters also appear to play a key role in the freshwater cycling in the HBS. Subsurface waters exhibit strong lateral compositional gradients. Near-freezing subsurface layers (at about 40-90 m depth), enriched in brine and river water and thus presumably formed through convection during previous winter(s), were present particularly in the southern parts of the Bay. In the north there is less evidence of these layers and it appears that they are replaced by subsurface advection by the end of the summer. The temperature and nutrient properties of the replacement waters imply contributions from Hudson Strait inflow and deep waters within the Bay. Deep waters from different parts of the Bay were also variably enriched in brine and river water. Their properties varied from year to year, consistent with interannual variability in deep water overflow from Foxe Basin to Hudson Bay an/or dense water formation on the Bay's own shelves. Overall, our results indicate that surface and subsurface layers are interconnected through dense water formation in winter, and play different roles in storing and exporting freshwater. It is likely that this interconnection is sensitive to climate variables which then alter the dynamics of freshwater. The composition of the subsurface and deep waters suggests a net export of sea-ice melt from the HBS in summer, which is significant for understanding variation in freshwater export downstream (e.g. the Labrador current).

STRUCTURE AND DYNAMICS OF THE AMUNDSEN GULF EDDIES

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The source of freshwater, nutrients, dissolved and particulate material found in the Amundsen Gulf can be both local and remote. One coherent feature that can transport freshwater, mass and even complete ecosystems over large distances is the eddy. Canada Basin eddies have been recently observed to last for months. They can be generated in late fall or winter as far as the shelf break in the Chukchi Sea or formed locally at freezing time and / or melting time. One eddy was observed in Franklin Bay in December 2003 during CASES (Canadian Arctic Shelf Exchanges Study) and two more were observed in the Amundsen Gulf in January and March of 2008 during CFL (Circumpolar Flaw Lead Study). The 2003 eddy was probably generated locally while the 2008 eddies may have drifted in from the Canada Basin. In this paper, we discuss the biological, chemical and physical properties of the observed Amundsen Gulf eddies and speculate on their possible generating mechanisms.

PASSING THE TORCH - ENGAGING YOUTH IN GLOBAL ISSUES THROUGH EXPERIENTIAL LEARNING

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Through the award-winning 'Students on Ice' (SOI) program, more than one thousand students, scientists and educators have gained a new understanding and respect for the planet. 'Students on Ice' provides the extraordinary opportunity for today's youth (and tomorrow's leaders) to better understand the Poles, the Planet, the implications of environmental issues, and teaches them how to get involved and active in local, national and global solutions. These unique, educational ship-based expeditions give youth the rare opportunity to mentor with world-class scientists, researchers, experts, teachers, artists and young leaders.

The program encourages youth and young adults to pursue careers in polar research, applied sciences, environmental studies and more. In his role as Students on Ice founder & executive director, and as a member of Canada's National Committee for the IPY, Geoff passionately addresses the environmental issues facing the Pole Regions today – and by extension, the interconnectedness of the entire global ecosystem. Having led more than 100 expeditions to both the Polar Regions over the past 20 years, Geoff's presentation will take the audience on an inspiring journey from one end of the Earth to the other. He will also address some of the upcoming SOI expeditions which include a pioneering Antarctic University Expedition, another important contribution to the IPY legacy of engaging youth and young adults in understanding the importance and urgency of protecting the Poles and the Planet. The Students on Ice – IPY Arctic & Antarctic Expeditions 2007-2009 are the most comprehensive educational expeditions for youth of their kind. They serve as powerful and unique international platforms to create change, inspire, educate, give cause for hope, and raise awareness globally. The IPY expeditions to date have involved over 130 international students, aged 14-19, including 35 northern aboriginal youth from the Yukon to Nunatsiavut. The students traveled on these transformative adventures together with a team of 30 scientists, environmentalists, artists and polar educators. Geoff will talk about his most recent experiences as expedition leader of the ship-based journeys and the unique and powerful experiences lived by the youth and educators who have participated in the Student on Ice International Polar Year expeditions to the Arctic and Antarctic thus far. Students on Ice (www.studentsonice.com) is empowering youth through experiential learning and fostering opportunities for them to live their creativity and inspire change in their lives, their communities, and the Planet. Geoff's presentation will speak about the success of Students on Ice and share stories of youth that have returned home as ambassadors and leaders for our planet's environment, with new levels of inspiration and motivation for the future. There has never been a more important time for the world to have active and motivated youth who can help change the way societies manage themselves for a more sustainable future.

INVESTIGATION OF THE DEHYDRATION-GREENHOUSE FEEDBACK TRIGGER USING SATELLITE MEASUREMENTS

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Datasets from CloudSat radar reflectivity and CALIPSO lidar backscattering measurements provide a new regard on Arctic winter cloud systems, as well as on the way aerosols determine their formation and evolution. Especially, links between the cloud ice crystal size and the surrounding aerosol field may be further investigated. In this communication, the satellite observations are used to heuristically separate polar thin ice clouds into two crystal size modes, and an aerosol index based on the attenuated backscattering and color ratio of the sampled volumes is used for identifying haze in cloud-free regions. Statistics from 386 Arctic satellite overpasses during January 2007 reveal that regions with the highest proportion of thin ice clouds having large ice crystals at their top are the same for which the aerosol index is highest. Moreover, a weak but significant correlation between the cloud top ice effective radius and the above-cloud aerosol index suggests that more polluted clouds tend to have ice crystals with higher effective radii, in all sectors investigated. These results are interpreted in terms of a sulphate-induced freezing inhibition effect. Direct implications for the Arctic climate are also discussed, mainly in the framework of the dehydration-greenhouse feedback.»

BIRCH SHRUBS IN THE CANADIAN LOW ARCTIC MAY RESPOND RELATIVELY QUICKLY TO CLIMATE WARMING

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The structure and functioning of arctic terrestrial ecosystems can be strongly influenced by the presence of deciduous shrubs. Their distinctive growth form and tissue chemistry alter microclimate and tend to enhance net carbon storage at the ecosystem-level. Deciduous shrubs are also an important food source for caribou during summer. Furthermore, since these shrubs tend to absorb more incoming radiation than other species, they may contribute a significant positive feedback to regional climate warming where they proliferate.

Climate warming trends at high latitudes since 1980 seem to correlate well with satellite observations of increased seasonal photosynthetic activity over the following decade, especially in low arctic tundra regions where shrubs are relatively common. A variety of experimental studies at differing scales across the Arctic indicate that growth of

tundra deciduous shrubs can be significantly enhanced by warming. Birch in particular is able to respond relatively rapidly to changes in temperature and resource availability because of the plasticity inherent in its short shoot/long shoot growth habit. Together these results, and aerial photographic data, suggest that enhanced growth and expansion of deciduous shrubs may be an important factor driving increases in overall ecosystem net carbon gain across the Arctic as the climate warms and the growing season extends. However the magnitudes of growth enhancement observed in the experimental warming studies is typically far lower than the response to chronic large fertiliser additions, suggesting that although shrubs have the potential to greatly increase in density and landcover, actual increases may be quite modest over decadal time scales.

Here, I report the first data from a Canadian low arctic tundra site where a range of experimental manipulations (summer warming, snowfences, caribou exclosures, fertilisation) has been running since 2004. These experiments are located in birch hummock tundra – a low-arctic ecosystem-type that extends from the MacKenzie valley right across northern Canada to the Hudson Bay. Initial measurements indicate that tundra birch growth was much more strongly stimulated by warming at our site than in any previous warming studies elsewhere. These results suggest that birch responses to climate warming may vary substantially across the Arctic.

LIGHT PRECIPITATION AT COLD TEMPERATURES DURING APRIL OF 2008 IN BARROW ALASKA

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The main objective of this work is to study light snow precipitation (LSP) rate (<1 mm hr^{-1}) and its occurrence during the Indirect and Semi-Direct Aerosol Campaign (ISDAC) and the Fog Remote Sensing and Modeling (FRAM) field programs that took place at the U.S. Department Of Energy (DOE) ARM Climate Research Facility in Barrow, Alaska, for the April of 2008. The objectives of ISDAC project were related to clouds, aerosols, and climate. On the other hand, FRAM focused on LSP and cold fog/frost that reduce the visibility (Vis). Objectives of both projects were complimentary each other to better understand cloud-climate interactions, and cloud and fog processes e.g. LPS/frost at the surface. During the project, numerous in-situ measurements were obtained, including droplet and ice particle size distributions, wind, precipitation, lidar and radar retrieved parameters, and Vis. The LPS measurements collected by the OTT distrometer, YES TPS (Yankee Environmental Systems total precipitation sensor), Vaisala VRG101 and FD12P, and DMT FMD (Droplet Measurement Technologies fog measuring device). Vis related to precipitation measurements were also collected by Vaisala FD12P, ETS (EnviroTech Sentry), OTT distrometer, and DMT FMD instruments. During measurements, FD12P reported the LSP cases accurately compared to other instruments. Vis for small particles was indicated by both FD12P and FMD but ETS Vis sensor missed the particles with low number concentrations. The YES TPS and Vaisala VRG101 usually missed LSP conditions and underestimated precipitation rates for conditions with strong winds (>3 m s^{-1}). It is concluded that 1) LSP conditions in the Arctic occur often but it is not detected accurately, 2) LSP occurrence was ~90% over snowing conditions during April of 2008, 3) snow precipitation occurrence (>0.05 mm h^{-1}) was ~18% of time, and 4) LSP can affect the surface heat and moisture budgets, hydrological cycle, and comparisons with regional and global model simulation results. These suggest that mean annual snow precipitation rates and accumulation amounts over the Arctic regions need to be revised to consider LSP.

PAN-ARCTIC SEA ICE MASS BALANCE OBSERVATIONS - STATUS AND CHALLENGES

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Sea ice is an important element of the Arctic system, and its areal extent shows arguably the most dramatic change among all other elements, with fundamental consequences for the physical, biogeochemical,

ecological and human domains. The observed reductions of summer ice extent are much more rapid than predicted by most climate models, pointing to a lack of understanding of the underlying processes governing the sea ice mass balance. In addition, there are only few systematic ice thickness measurements which could provide detailed information about mass balance changes due to ice redistribution and deformation, or due to variations in ocean and atmospheric heat fluxes. The presentation will review the current status of pan-Arctic ice mass balance observations, including activities using ice profiling sonars, airborne laser and electromagnetic profiling, ice-mass-balance buoys, and satellite altimetry, and their integration with observations of oceanic and atmospheric boundary conditions. Most recent results obtained during the IPY by a consortium of researchers from Canada, Germany, Norway, the USA, and Russia will be presented, particularly from airborne electromagnetic sounding, which was performed in various regions of the Arctic and shows variable magnitudes of ice thickness change. The presentation will also discuss future activities and opportunities to enhance the observational data base, and their value for improved model development. As long as satellite methods are not sufficiently validated, ice mass balance observations will depend on airborne, marine, or submarine logistics and surveys, which gradually become more challenging particularly due to the increasing cost of fuel. Access to the Arctic sea ice cover is a key challenge for the gathering of systematic, pan-Arctic ice mass balance data.

CLIMATE-DRIVEN SHIFTS IN QUANTITY AND SEASONALITY OF RIVER DISCHARGE FROM THE HEADWATERS OF THE MACKENZIE RIVER BASIN OVER THE PAST MILLENNIUM: IMPLICATIONS FOR RIVER-OCEAN INTERACTIONS AND NATURAL RESOURCE MANAGEMENT IN THE NORTH

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Shrinking headwater glaciers, decreasing alpine snowmelt runoff, and declining river discharges at the headwaters of the Mackenzie River Basin (MRB) continue to alter the seasonal distribution and flux of water, materials and heat to downstream landscapes and the Arctic Ocean. Rapidly increasing industrial development (e.g., Oil Sands) also raises concerns over the future availability of water resources for continued economic growth and to maintain integrity of downstream ecosystems. Assessment of contemporary relations between climate and river discharge is limited by the short duration of meteorological and hydrometric records, and so longer hydrological records are needed to evaluate the responses of river discharge to a range of natural climatic conditions. Here, we assemble high-resolution 1,000 year paleohydrological records from multiple proxies measured in lake sediment cores obtained from a flood-prone oxbow lake, a climate-sensitive upland perched basin, and two lowland basins in the Peace-Athabasca Delta adjacent to Lake Athabasca, as well as from a lagoonal pond on nearby Bustard Island in Lake Athabasca, to examine the effects of changing climate and runoff generation on the quantity and seasonality of river discharge at the headwaters of the MRB. Our reconstructions include a broad range of climatic conditions during the medieval (ca.1000 to 1530 CE), Little Ice Age (LIA; 1530 to 1890) and post-LIA intervals. As we will show, the site-specific paleohydrological trajectories are complex at the landscape scale, but can be reconciled by considering the quantity and seasonality of river discharge originating in the eastern Rocky Mountains in the context of climate and glacier mass balance variability over the past 1000 years. Glacier expansion in the Rocky Mountains during the medieval (mainly 1100-1380 and 1450-1505) created hydroclimatic conditions conducive for frequent, severe ice-jam flooding downstream, but that did not sustain river discharge and Lake Athabasca water levels beyond the spring melt period. Glacier advances during the LIA, in response to colder conditions between the sixteenth and nineteenth centuries, resulted in delayed generation of snowmelt runoff at the headwaters and reduced the frequency and magnitude of ice-jams downstream, but sustained higher river discharge that elevated water levels in Lake Athabasca despite locally arid conditions and reduced contributions from local precipitation. The hydrological conditions of the twentieth century are unique in the context of the past millennium, characterized by low frequency and magnitude of ice-jam floods and low Lake Athabasca levels -- a probable outcome of shrinking headwater glaciers and decreasing alpine snowmelt runoff since the conclusion of the LIA. The temporal perspective offered by these paleohydrological reconstructions indicates that climatic changes over the past millennium have led to characteristic responses in the quantity and seasonality of streamflow generated from the hydrographic apex of

North America. A key feature is that the hydrograph of the twenty-first century may be evolving towards conditions unprecedented over the past 1000 years. Continuing reduction in both peak and total discharge clearly underscores the need for stringent allocation of freshwater resources in these watersheds, and effective management of downstream ecosystems and coastal areas.

THE ARCTIC POLAR STRATOSPHERE AND MESOSPHERE DURING IPY

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The International Polar Year (IPY) is an international scientific program focused on intensive observations in the Arctic and Antarctic from March 2007 to March 2009. As part of this effort, we have established a web site to show near-real time monitoring of the Arctic troposphere and stratosphere. In the stratosphere, the position and vertical structure of the Arctic vortex and anticyclone circulation systems provide a global context to aid in the interpretation of single-site lidar temperature measurements collected during IPY winters. Three-dimensional animations of the Arctic vortex and anticyclones will illustrate current conditions in the stratosphere and mesosphere as well as notable events during last winter 2007-2008. Temperature measurements from the Poker Flat Observatory are interpreted based on the air masses in which the lidar measures. Summer profiles show very little variability in the stable summer anticyclone while winter and fall data vary considerably depending on whether the vortex or Aleutian anticyclone is sampled. This talk will introduce our IPY web site as a means to encourage coordinated measurements during the 2008-2009 winter.

FLYING INTO THE EYE OF A POLAR LOW

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Surrounded by mountains, glaciers, and the cold waters of the North Atlantic, Greenland's coastal communities experience some of the world's most extreme weather. One severe event that can affect Greenland is known as a polar low. The most common definition of a polar low requires that the maritime mesoscale cyclone be small but intense. The cyclone needs to have gale force surface winds and must form north of the main baroclinic zone. Storms that meet these conditions put both mariners and coastal communities in danger. Greenland's small population and northern location make data measurements sparse; and severe weather events difficult to forecast. The Greenland Flow Distortion Experiment (GFDex) was an IPY project designed to overcome this challenge. With the use of the Facility for Airborne Atmospheric Measurements (FAAM), 12 missions were flown throughout a 3 week long campaign. This included a flight on February 25, 2008 that was designed to study the 3D structure of a polar mesoscale cyclone in the Norwegian Sea. The flight consisted of two high-level dropsonde legs through the system's centre of circulation, as well as a low-level leg close to Greenland to examine the influence of the topography on the system's wind field. In order to investigate the dynamics and evolution of the cyclone, a mesoscale simulation was performed with the Weather Research and Forecasting (WRF) model. With an inner domain resolution of 3km, the model output was able to reproduce the dominant features observed in-flight. This included the presence of a low-level jet approximately 100 km offshore. The in-flight measurements combined with the model output shed light on the structure and dynamics of this mesoscale cyclone, suggesting that it is does fall in the class of severe maritime storms known as a polar low.

CARBON DIOXIDE AND METHANE FLUXES FROM TUNDRA ENVIRONMENTS AT DARING LAKE, NWT: EXAMINATION OF CARBON CYCLING MECHANISMS AND SPATIAL AND TEMPORAL FLUX VARIATION.

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Arctic ecosystems consist of a heterogeneous mix of vegetation types over short distances. Processes controlling arctic terrestrial carbon dynamics are complex, occurring at various spatial and temporal scales. This causes the exchange of carbon between the tundra and the atmosphere to be highly variable across arctic landscapes. This leads to significant uncertainty when trying to predict how the carbon budget of this landscape may respond to short-term variations in weather and long-term climate

change.

The objectives of this study are 1) to assess the temporal and spatial variability of Carbon dioxide (CO_2) and methane (CH_4) efflux within different arctic tundra ecosystems and 2) quantify and understand the mechanisms that control CO_2 and CH_4 efflux in order to relate these processes to a changing climate. CO_2 and CH_4 fluxes and subsurface concentrations were measured at a variety of vegetation community plots over the growing season of 2008 at Daring Lake, NWT (64°52' N, 111°34' W), a site within the zone of continuous permafrost in the Southern arctic. Vegetation community plots included sedge fen, low shrub, and heath tundra. Opaque and clear static chambers were used to quantify carbon efflux and net ecosystem exchange of CO_2, respectively. Simultaneous monitoring of abiotic (soil and air temperature, water table and active layer depth, soil moisture, net radiation, precipitation) and biotic (leaf area index) variables occurred.

Research activities were in collaboration with the Canadian Tundra Ecosystem Carbon Study established in 2004 at Daring Lake (P.I.: Dr. Peter Lafleur, Trent University). Two micrometerological towers are already constructed within the research area measuring tundra-atmosphere exchanges of CO_2 and water vapour since 2004 and 2006. One tower is located at a fen site, which has tussock and hollow topography and is dominated by mosses and sedges. The other tower is located within an upland area characterized by a mixture of mesic lichen heath mat tundra and shrub-hummock tundra (Lafleur & Humphreys, 2008). The results from these towers suggest that over a 3-yr period growing season (May 15-Aug 31) CO_2 uptake is greater in the fen (85 +/- 13 g C/m2, mean +/- SE) than in the mixed tundra (66 +/- 3 g C/m2) largely due to reduced ecosystem respiration at the fen.

The results of chamber and subsurface sampling within the fetch of the towers aim to provide further understanding of component processes in this larger scale carbon exchange. For example, chamber measurements will be used to identify which vegetation communities/ topographical areas are responsible for the bulk of the CO_2 and CH_4 emissions and which areas respond most to seasonal variations in temperature and moisture. Additionally, as fluxes of CH_4 within the fetch of these towers have not been investigated, including measurements of CH_4 will provide a more complete picture of the total C budget and the radiative forcing potential of these sites.

SEX-SPECIFIC CLIMATIC EFFECTS ON THE SPATIAL DISTRIBUTION OF A NORTHERN UNGULATE

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The spatial component of species behavioural ecology is central for our understanding of life history evolution and population processes. The recent dramatic changes in climate suggest that even short-term environmental changes may induce significant variation in long-term adaptive patterns of spatial distribution. Here we analysed the spatial distribution of different age-sex groups of muskoxen (Ovibos moschatus) in relation to climatic variability, using 10 years of data from the comprehensive long-term monitoring programme at Zackenberg, Northeast Greenland. We used a recently developed modification to Ripley's K-function to compare models with different types of environmental heterogeneity, investigating how the inter-annual variation in spatial distribution of muskoxen was influenced by NDVI (Normalised Difference Vegetation Index), snow cover, vegetation cover and altitude. Our results showed that whereas the distribution of males was similar in snow rich and snow poor years, the distribution of females with calves changed between years. The factors explaining the spatial distribution varied between snow rich and snow poor years, but with similar effects on male and female groups. Our results show that male and female muskoxen perceive environmental factors differently and, more importantly, suggest that, in general, effects of large-scale environmental changes such as climate change may be highly sex-specific in sexual dimorphic species.

TRENDS IN TUNDRA VEGETATION OVER THE PAST 20 YEARS: ANALYSIS OF LONG-TERM DATA SETS FROM THE INTERNATIONAL TUNDRA EXPERIMENT (ITEX)

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There are a growing number of studies showing responses of northern (polar) ecosystems to recent climate warming. In arctic terrestrial systems, the notable changes have included increased cover of shrubs in observational

and experimental warming studies. However, there are very few long-term data sets available throughout the tundra biome to examine whether and how these systems are changing. The International Tundra Experiment (ITEX), a network of researchers and sites throughout the tundra biome, was established in 1990 and vegetation changes in experimental and control plots have been measured since 1992 in some sites. Control plot data from long-term experiments, such as ITEX, represent a unique resource for exploring how tundra vegetation may be responding to these changes. We present preliminary results from a synthetic analysis of long-term vegetation trends in a select set of arctic and alpine sites. Patterns suggest that total above-ground growth is increasing, largely as a result of increases in shrubs and graminoids. Such patterns largely support predictions based on warming experiments, and suggest climate-induced vegetation change may already be occurring in many tundra areas.

EXPLOITATION AND RECOVERY OF BOWHEAD WHALES IN NORTHWEST HUDSON BAY: IMPLICATIONS FOR ECOSYSTEM DYNAMICS

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Bowhead whales (*Balaena mysticetus*) were historically abundant in northwest Hudson Bay, Canada before commercial whaling started in 1860. By the early 1900s voyages were no longer profitable and bowhead whales had been reduced to severely low numbers. In recent decades the population has shown significant recovery, and bowheads are again becoming common in northwest Hudson Bay. Bowheads are a mid-trophic level species that may have significant impacts on species both higher and lower in the food chain. It seems likely that the near extinction, and rapid (and continuing) recovery, of this species would have significant effects on local ecosystem structuring. We use a simple population model and historic harvest data to estimate bowhead biomass and zooplankton consumption rates in northwest Hudson Bay from 1860 to the present. The historic bowhead population in northwest Hudson Bay likely numbered over 600 animals of all age and sex classes and consumed nearly 200 tonnes of zooplankton per day. Within two short decades the population declined by ca. 80%, and reached a nadir in 1910 (mean 30, 95% CI 0-126) when estimated daily zooplankton consumption declined to < 5% of that of the historic population. In recent years zooplankton consumption has increased significantly as the bowhead population grows. Population growth continues, and zooplankton consumption will continue to increase. The historic "freeing up" of a vast amount of zooplankton biomass undoubtedly had major impacts on ecosystem structuring and processes, and increased consumption by a growing population will again result in changes. A better understanding of bowhead population dynamics and foraging ecology is needed to better predict ecosystem changes, and using these results as input into mass-balance ecosystem models would be instructive.

LAND USE AND CLIMATE DRIVEN ALTERATION OF TROPHIC INTERACTIONS IN TUNDRA SYSTEMS: AN ALPINE EXAMPLE FROM 62ON

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Demands for goods and services from tundra systems is multifold and in constant change. Arctic areas are regionally exposed to intense human use but a large part of the Arctic still has low degree of exploitation. However, eventually, change is to come at a broad scale around the circumpolar north in time with changed sea routes, improved accessibility to arctic resources, and increased tourism. Intensified land use ultimately will change arctic systems from being primarily climate driven to being climate and land use driven. Further in the future, the land use component will, hypothetically, move towards the role of a more dominant ecosystem driver although the speed will vary among trophic levels and climatic regions.

To understand causes of change, disentangle the effects of the various underlying factors and produce reliable scenarios for the future a large set of reference sites is needed, representing the diversity of Arctic climate and land use regions. The IPY framework is ideal for this, but the representation at circumpolar level will still, for the foreseeable future, be restricted. However, study sites in northern alpine areas can contribute valuable added knowledge. *"Alpine 62°N"* is a regional scale project in Norway aiming at deepening knowledge on climate and land

use driven changes in trophic interactions and consequences for ecosystem services. The project (2007 - 2010) uses baseline environmental and land use data derived from digital cartography, DEMs and other geo-referenced data, and sampled biological data in randomly selected sets of 1x1 km grid units in three alpine regions in central Norway with oceanic, intermediate and continental climates, respectively. The environmental and land use data includes e.g. altitude, landscape mosaic (e.g. abundance of water bodies and mires), terrain ruggedness, climate section, meteorological data, snow cover regime, distance to forest covered areas, and proportion of shrub covered areas; Infrastructure variables such as distance to roads, power lines and buildings; Land use variables such as frequency and timing of grazing by domestic and semi-domestic animals, hunting, and legal carnivore population regulation. The biological data includes numerous variables linked to four key biotic components representing different trophic levels: vegetation (species composition, physiognomic structure, recruitment after disturbance), herbivory (voles, lemming, hare, sheep, reindeer), small and meso-carnivores (mustelids, arctic fox, red fox), and one species of large carnivores (wolverine). Carbon and nitrogen flows through selected food chains are being quantified through stable isotope analysis

Preliminary results are presented along with interpretation of short- and long-term consequences of changes in land use and climate. Both trophic-level specific results and trophic-level interaction data will be used in construction of scenarios for alpine tundra ecosystems under changing climate and land use regimes. In addition to the central Norwegian focus, the project is designed to enable latitudinal analyses of tundra ecosystem functioning through inclusion of standardized data from other regions along a north-south arctic-alpine transition across Norway.

PRELIMINARY RESULTS OF THE HUDSON BAY ECOSYSTEM MODEL

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This is the first study to create an ecosystem model of Hudson Bay, and while there are many components which remain unknown, this type of model allows the opportunity to identify areas needing more research while continuing to assess the ecosystem. Using the Ecopath with Ecosim software, a complete ecosystem model was created with special attention to higher trophic level organisms, where a majority of the research in this region has been focused. To date there are 15 marine mammal functional groups, 11 fish groups, 10 invertebrate groups and one primary production group. Mid and lower trophic level organisms were estimated from various studies, mass-balance methods and comparisons with other ecosystems. Collaborations with various research groups have provided the opportunity to access unpublished data and incorporate the use of expert opinions for parameter estimates where published data were lacking. Preliminary results indicate that the composition of the ecosystem is not unlike other polar regions of similar latitude. Monte Carlo simulations provide confidence limits to estimated parameters. Harvest data for marine mammal and fish species have been incorporated to assess the impact on the ecosystem. While the model remains to be validated, preliminary temporal simulations demonstrate the impact various levels of harvest may have on the ecosystem.

MODELING ARCTIC STORM WAVES BY SWAN IN THE SOUTHERN BEAUFORT SEA

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Predicted changes in the global climate are expected to be most severe at high latitudes. Changes in the Arctic climate will likely involve greater ice-free open water areas and for longer periods of time and potentially increasing storm activity. These changes will lead to increasing wave energy in the southern Beaufort Sea. As interest in the oil and gas resources in the regions grows, forecasting and hindcasting of wave conditions becomes increasingly important for industrial and community development as well as for examination of the safety and vulnerability of existing structures and sites of cultural importance. In this study the wave model SWAN (Simulating Waves Nearshore) is implemented for wave hindcasting in the southern Beaufort Sea. SWAN, a third generation spectral wave model, is widely used for computation of wave fields in shelf seas, coastal areas and lakes. The model represents wave generation, propagation and dissipation by whitecapping, bottom friction and depth-induced breaking. SWAN is implemented in non-stationary mode over two nested grids: a coarse resolution (0.15˚x0.05˚) domain and a fine

resolution (0.015°x0.01°) domain that covers the Mackenzie Delta and adjacent coastal waters. Wind fields are from the Meteorological Service of Canada Beaufort (MSCB) wind reanalysis, which produced an hourly wind hindcast for the period 1985-2005 at 3442 grid points over the coarse grid computational domain. ETOPO2 bathymetry is used for coarse grid hindcasting. For the nested region, a fine resolution (0.015°X0.005°) bathymetry is generated based primarily on data from Canadian Hydrographic Service charts and field sheets. Measured water level at Tuktoyaktuk is used as model input for storm surge. The ice cover is determined from chart issued by the Canadian Ice Service. Moving boundaries of the ice edge during storms are incorporated by considering the computational grid points with greater than 50% ice as land points with no wave generation or propagation.

Eight storms during the MSCB wind hindcasting period are studied. Five storms are selected (from 1985, 1986, 1987, 1991 and 2004 respectively) for model verification. Computational results are compared with observations using time series of wave parameters, spectral distributions as well as statistical analysis. Model predictions are in good agreement with the observations. After validation of the model, four severe Arctic storms (from 1985, 1993, 1999 and 2000 respectively) are studied to evaluate wave conditions in the Mackenzie Delta and adjacent coastal waters. Severe waves are found to be predominantly from the northwest direction. Fully developed seas in the northwest quadrant of the nested region reached wave height and peak period of 6.1 m and 10 s respectively in the 1999 storm; and 2.76 m and 6.7 s in the 2000 storm. Although the storm intensities were similar during the 1999 and 2000 storms, waves were substantially higher in the 1999 storm because of the large ice-free fetch in the western Arctic Ocean. The model can be used for operational wave forecasting as well as for studies of the impacts of severe Arctic storms and climate change on coastal processes in the southern Beaufort Sea.

COMMUNITY ADAPTATION AND VULNERABILITY IN NORTHERN NORWAY: SOME PRELIMINARY CAVIAR FINDINGS

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In this paper we present some preliminary findings on the exposure-sensitivity to climatic and other social, environmental and economic changes, from four different CAVIAR case communities in northern Norway. Our focus is on the linkages between the environmental conditions, including climate, and the community livelihoods in terms of natural resource use. We will explore how the local communities have identified the same or similar climatic exposures (e.g. increasing temperatures and/or precipitation, extreme events), but that the local consequences (sensitivities) of these exposures vary between the communities. We suggest in a preliminary analysis that this is likely a function of differential local adaptation/adaptive capacity. Our case study sites are the coastal communities of Hammerfest, Kjøllefjord, Nesseby in Finnmark County, and the Lofoten archipelago in Nordland County. In each the focus is on understanding community adaptation and vulnerability to climate change by exploring important linkages between the community, natural resources, and other relevant social, economic, institutional factors that might facilitate or constrain adaptive capacity locally. In Hammerfest a major increase in economic activity due to recent offshore gas and petroleum activities poses challenges to the social cohesiveness and environmental sustainability. Uncertainties over changes in sea level, wave height, storm surges and ocean currents – and the implications for pollution, whether in the harbour, along the coastline or within fish stocks, represent additional challenges. For Kjøllefjord changes in ocean temperature, sea ice extent, and surface temperatures in the Barents Sea region have been linked to changes in the distribution and migration of key commercial fish stocks climate change, and have an impact on vulnerability and adaptation in the coastal fisheries. In Lofoten, increased ocean temperatures affect the spawning areas of cod, shifting the fishery activities northward. Together with socio-economic drivers of change such as the current management policies for the fishery sector, it may contribute to abandonment of already marginalized communities. For Nesseby a variety of possible climate triggered events have been registered. Increasing Autumnal Moth attacks are destroying vast areas of birch wood and berry plants, and the ecosystem in the Varanger Fjord is changing: blue whiting and king crab are now parts of the ecosystem. The exposure-sensitivities to change that are being analyzed have, consistent with the CAVIAR framework, been identified as important and relevant to local livelihoods by community members.

MAPPING AND MONITORING SEDIMENTARY PROCESSES AND FLUXES ACROSS FJORD DELTAS - BAFFIN ISLAND

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The modern sedimentology, benthic ecology and oceanography of fjords in the Baffin Island region is strongly influenced by the influx of fresh water and sediments from ice-proximal rivers and streams. These streams are discharging across recently developed deltas at the head and flanks of fjords. The morphology of the deltas and adjacent basins varies strongly, depending on the preexisting topography (much of it bedrock or glacial drift) and the provenance of the sediments within the interior watersheds.

Airborne and spaceborne remote sensing clearly indicate the morphology of the subaerial deltas and the fluctuations and extent of sediment laden plumes. Existing knowledge of typical fjord subaqueous environments dates back to the SAFE experiments (1983-85) prior to the advent of precise seabed imaging. As part of ArcticNet a new multibeam mapping program has been developed to image the detailed morphology associated with both the proximal and distal mass wasting processes active on the submerged delta fronts and adjacent fjord basins. In one case (Oliver Sound), we already have the first repetitive mapping results, indicating the style, rate, and extent of modern mass wasting. As part of the program, the summertime (August/September) oceanography and suspended sediment concentrations in the plume are investigated through underway profiling coincident with the multibeam mapping. This provides a snapshot (albeit after the main melt phase) of the active oceanography and suspended sediment transport in the fjord. A complimentary dense coring and grab program has also been initiated to groundtruth the sedimentary facies imaged.

By precisely imaging the present state of these depocentres, and establishing the current processes, future changes in the style and volume of sediment influx can be established. Coring in the basin is providing a past history of sedimentation to compare with future, possibly climate-induced, changes.

RISK AND REWARD: HAZARDS OF HUNTING THE BOWHEAD WHALE

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Iñupiat and Yupik whalers in Alaska pursue one of the largest animals on the planet: the bowhead whale. They do so from small boats in icy waters, often camping on shorefast sea ice. The hunt has always been hazardous, from environmental conditions, the reactions of the whales, accidents with whaling equipment and explosives, and so on. The reward has also been great: many tons of meat and maktak, providing for the whaling crews, feasts and festivals, and for extensive sharing that is so culturally important around the Arctic.

In recent years, against the background of hazard that has always been part of whaling, the question of natural hazards has become increasingly prominent as the sea ice environment has changed in several ways. First, shorefast ice has become less reliable. The large, grounded pressure ridges that provide stability and create a safe zone have become less common, leaving more and more of the ice vulnerable to breaking off. In 1997, 140 whalers in Barrow were carried out to sea when the ice broke between them and shore. Thanks to helicopters and GPS, no lives were lost and much of their equipment was also retrieved. But the margin of safety was thin.

Second, weather has become less predictable in many respects. Around St. Lawrence Island in the northern Bering Sea, Yupik whalers have noticed that spring weather is more variable, reducing their whaling opportunities while increasing the risks that come from being on the water in a small boat. A few years ago, tragedy struck in Gambell when a boat with young children swamped and lives were lost. The boat had been helping tow a whale to shore when the weather deteriorated.

Third, thinner ice has made it harder to find suitable places to haul a 50-ton whale out of the water for butchering. Whalers in Wainwright on the northern coast now begin their scouting of whaling camps and trails by seeking a suitable butchering site, something they never had to worry about before. When it can take hours and hours to haul a large whale out of the water, watching the ice break underneath it can be discouraging.

Changes in ice and weather create objective hazards. Knowledge about those changes and the new conditions that are created affect the subjective hazard associated with whaling. If whalers are unfamiliar with the new conditions and the indicators of safety or danger that now apply, they may either take on greater risk than they realize, or

overcompensate and lose opportunities to hunt because they have unnecessarily returned to shore.

The transmission of knowledge about sea ice and whaling is an essential part of the equation. Even if the old ways no longer hold perfectly, they nonetheless provide a foundation for adaptation. Modern equipment and search-and-rescue capability can help reduce risk, but not nearly as effectively as prevention based on sound knowledge and awareness of risk.

SIKU-INUIT-HILA: CONNECTING COMMUNITIES AND SCIENTISTS THROUGH COMMUNITY EXCHANGES, EXPERTS GROUPS, AND MEASUREMENTS

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The Siku-Inuit-Hila (Sea Ice-People-Weather) project involves Inuit, Inughuit, and Iñupiat from Clyde River, Nunavut; Qaanaaq, Greenland; and Barrow, Alaska, respectively, along with academic researchers from several institutions. The project has three major components.

The first component includes a series of "sea ice knowledge exchanges," visits by all participants (residents of all three communities plus the visiting researchers) to each of the study locations for participant observation. During these trips, the emphasis is on travelling the sea ice together. The sea ice itself acts as the common denominator for the participating hunters and elders from different communities and scientists from different disciplines. The host community leads each visit, allowing the visiting team members to experience local hunting and travel techniques and to exchange knowledge about diverse issues such as tools, clothing, food, and navigation.

The second component involves regular meetings of sea ice experts in each community. Led by local team members of Siku-Inuit-Hila, these working groups provide an opportunity to assess current sea ice conditions throughout the sea ice season and to document local knowledge of sea ice, ranging from traditional stories and mythology of sea ice, to sea ice terminology, to extreme events, to strategies for hunting and travelling in different sea ice environments.

The last component involves the establishment of a sea ice monitoring network in the three communities. Trained by the project's sea ice physicist and supported by a handbook created especially for the local monitors, local technicians measure physical properties of sea ice and snow on a weekly basis at 2-4 stations installed at each community. Local sea ice experts chose the location of the stations according to key areas of importance for sea ice use. In combination with local historical records, available climate data, and local knowledge, the data from the observing network provides detailed information about local and regional sea ice processes.

The different components of the project are tied together in a number of ways. For example, the expert working groups review the latest data (visualized graphically) collected in the sea ice monitoring program, sparking discussion about current conditions and progression of the sea ice season. In turn, local knowledge about currents, winds, snow accumulation, and other environmental factors affecting sea ice characteristics and processes documented during expert meetings are used to help understand the sea ice station data. For example, local knowledge of changing ocean currents near Qaanaaq have helped to explain early and dramatic thinning of sea ice during spring in recent years. The team visits to each community and the ongoing expert meetings provide the face-to-face and discussion time needed to continually link different components of the project and work toward multi-layered research products in the form of journal articles, maps, and a book.

EXCHANGE FOR LOCAL OBSERVATIONS AND KNOWLEDGE IN THE ARCTIC: DATA MANAGEMENT SUPPORT FOR COMMUNITY-BASED ARCTIC OBSERVING NETWORK

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Over the last decade, Arctic residents and indigenous peoples have been increasingly involved in research concerning their communities and their environment. Arctic communities have made significant contributions to understanding recent environmental change, and community-based research, including traditional

knowledge research and community-based monitoring, will be an important part of IPY activities and any Arctic Observing Network (AON). One of the greatest challenges of local and traditional knowledge (LTK) research and community-based monitoring to date has been effective and appropriate means of recording, storing, and managing data and information. It has been a challenge to find effective means of protecting sensitive information while also making community-based data and information available to Arctic residents and researchers, as well as other interested groups such as teachers, students, and decision makers. Without a network and data management to support LTK and community-based research, a number of problems have arisen such as: misplacement or loss of extremely precious data (e.g., information from Elders who have passed away); lack of awareness of previous studies and repetition of research in the same communities resulting in research fatigue and waste of resources; and a reluctance or inability to initiate or maintain community-based research or monitoring because no data management system is available. There is an urgent need for effective and appropriate means of recording, preserving, and sharing data and information being collected in Arctic communities. ELOKA seeks to fill this gap. In 2006, ELOKA responded to the NSF IPY Announcement of Opportunity to 'develop and deploy a pan-Arctic observing system that will measure the full range of continuing environmental changes underway.' ELOKA was successful in obtaining funding and is working toward providing the needed support to local and traditional knowledge research, and community-based observations and monitoring, which are key components to any Arctic Observing Network (AON). ELOKA will provide a data management and networking service for community-based research that keeps control of data in the hands of community data providers, while still allowing for broad searches and sharing of information. We understand that the development of a circumpolar network and data management service for Arctic LTK and community-based observations will take time, collaboration, and input from many sources. Our hope for IPY is to get ELOKA off the ground and build a strong foundation for its development. To reach this goal, ELOKA has been launched through partnerships with several community-based projects that represent different regions, cultures, and data management needs. We are developing data management systems and testing their utility with our partners. We expect to be able to offer data services to more projects in the near future as we refine our system and learn more about the needs of different community-based projects around the Arctic.

DEMOGRAPHICS AND ENVIRONMENTAL CONDITIONS ARE UNCOUPLED IN THE PRIBILOF ISLANDS SOCIAL ECOLOGICAL SYSTEM

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The communities of St. Paul and St. George are located on the Pribilof Islands, Alaska, in the southeastern Bering Sea. The islands have been inhabited by Aleut people since the late eighteenth century, when Russian traders brought them there to hunt Northern fur seals (*Callorhinus ursinus*) for their pelts. The islanders have established a strong sense of identity and place, as demonstrated by their unwillingness to relocate when that option was proposed in the 1960s. Until it ended on St. Paul in 1984 (having ceased earlier on St. George), commercial seal hunting was the dominant economic activity on the islands. Since then, the Pribilofs have engaged in commercial fishing, fish processing, fisheries support services, capital improvements projects, ecotourism, and other activities, none of which has yet provided a lasting economic basis for the communities.

As a contribution to an islands-based effort to understand and promote effective management of the Pribilof Islands as a social-ecological system, we examined current and recent conditions on the islands to assess local perceptions of and prospects for economic, social, and environmental well-being. We also gathered data on a suite of environmental, economic, and demographic indicators. We found few correlations between environmental conditions and socioeconomic or demographic indicators. Furthermore, responses differed between the two communities. The lack of apparent connection between population levels and economic or environmental stimuli is likely attributable to one or more of several factors: (a) modest economic dependence on the environment, (b) predominance of other economic inputs to the islands' economies, (c) islanders basing residence choices largely on non-economic factors, and (d) islanders' tolerance for economic fluctuations and uncertainty.

These results suggest economic analysis alone is insufficient to explain the dynamics of this social-ecological system, contrary to many other case studies and an expectation of tight coupling and clear connections between society and ecology. It appears that in the case of the Pribilof Islands at least, resilience and vulnerability are the products of multiple factors, producing a variety

of responses among individuals and at times divergent responses between communities.

DIETARY CHOICES IN AKLAVIK, NORTHWEST TERRITORIES, YOUTH AND ELDERS PROMOTING CHANGE

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The community of Aklavik in the NWT has initiated a research project working with youth and elders to explore dietary choices. The study is based at the Moose Kerr School and is carried out in partnership with the Arctic Health Research NT project lead, Aklavik Health Committee, Moose Kerr School principal, teachers, youth and elders in the community.

The research project explored dietary choices made in the community. The research project was integrated into the youth's daily studies and they participated in the project through the administration of dietary recalls, compiling recycling data and conducting interviews with elders in the community. The findings were compiled and the students made conclusions about the dietary choices in the community. The students findings were compiled using video methods.

This presentation will focus on the partnerships between the Arctic Health Research Network and the Moose Kerr School, methods for youth participation and project outcomes will also be highlighted.

INUIT LED RESEARCH IN NUNAVUT: LESSONS FROM THE ITTAQ HERITAGE AND RESEARCH CENTRE, CLYDE RIVER, NUNAVUT

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The Ittaq Heritage and Research Centre was established by local residents of Clyde River, Nunavut, in 2007. One of Ittaq's goals is to increase local participation in, and direction of, research in the community, simultaneously creating local job opportunities and better research projects. Ittaq leads and supports diverse research projects ranging from the documentation of traditional knowledge to studies in geology, glaciology, health, adaptation to environmental change, alterative energy options, and beyond. Some of the projects are linked to national and international studies, while others are designed, executed, and delivered entirely within the community for local use. Whether led by local, government, industry, or university researchers, Ittaq provides projects with quality services such as access to local research expertise, logistics support, guiding, traditional knowledge input, environmental monitoring, sample/data collection and processing, interpreting/translating, outreach design and facilitation, and liaison work with local and territorial individuals and organizations. With a focus on facilitating collaboration between local and visiting experts, Ittaq allows both groups to benefit. For example, scientists can include local expert knowledge as part of their project, access expert help for land travel, and contract trained individuals to carry out data collection, observations, or oversee equipment maintenance or experiments year-round. Local Inuit benefit from jobs in research, training in various scientific disciplines and skills, exposure to and experience in science and technology, and scientific input into locally-led projects. Ittaq actively seeks partnerships with science projects in Nunavut that are interested in collaboration and currently has major projects with Natural Resources Canada, the University of Colorado, the State University of New York at Buffalo, the Government of Nunavut, and the Inuit Circumpolar Council.

This presentation will outline Ittaq and how it came to be the first Inuit led, community-based research centre in Nunavut. We will present how Ittaq itself is an interface for knowledge exchange and we will share our successes, challenges, lessons learned, and hopes for the future.

LINKING LANDSCAPE CONDITIONS AND COMMUNITY PLANNING IN ARCTIC COMMUNITIES

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This study examines aspects of the physical landscape in order to assess issues of infrastructure stability, and how this may be affected under proposed future climate changes. Additionally, the project determines how

this information can be integrated into local and regional community planning and development guidelines. To lessen community vulnerability, successful planning and infrastructure growth must incorporate environmental characteristics, in addition to the commonly reviewed social, economic and cultural aspects. This presentation focuses on community-scale vulnerability and landscape instability in Kangiktugaapik (Clyde River), Baffin Island, Nunavut. Vulnerability is assessed by categorizing the stability of the landscape for infrastructure development and determining individual and community responses to the identified hazards. This work draws upon the Community Adaptations and Vulnerability in Arctic Regions framework (cf., Ford and Smit 2004) and will contribute to the Nunavut Climate Change Adaptation Plan.

Methodological approaches used to assess hazards include surficial mapping and shallow permafrost coring. Through field observations, aerial photograph mapping, substrate analysis, thaw depth measurement and ground surveys, a surficial geology map is being created; mapped features include surficial materials, periglacial processes, hydrology, and human/natural disturbances. Using a portable permafrost drill, (cf., Calmels et al. 2005), shallow cores, 10cm in diameter and up to 3.2m in length, were extracted from 14 sites; laboratory analyses this fall will test for volumetric ice content, grain size and salinity. All information collected will be combined to create a landscape hazard map, employing a three-category classification scheme based on vulnerability for infrastructure.

Preliminary terrain mapping and core analysis reveal information on the glacial history of the area, sea level trends, and permafrost conditions. Two key hazard types have been identified in this analysis: ground instability and impacts of hydrology. For example, most of the community is built on saline permafrost, comprised of raised marine silty-sand that in some areas contains high ice content. Ground thaw is causing uneven subsidence, damaging infrastructure not adapted to withstand such movement. Moreover, thermal erosion related to artificial ponding of meltwater and rainfall, and physical erosion along stream channels and coastal bluffs, are causing permafrost and ice wedges to thaw, also damaging infrastructure.

This research contributes to ArcticNet's integrated regional impact studies in the context of landscape sensitivity and climate change adaptation in coastal arctic communities. Work conducted in Kangiktugaapik will serve as a methodological template that can then be applied to other Nunavut communities. This research has benefited from a key partnership with the Ittaq Heritage and Research Centre, a local initiative that facilitates and provides research guidance. Research outputs also contribute to Natural Resources Canada's Enhancing Resilience in a Changing Climate Program, and is being conducted in collaboration with the Government of Nunavut and the Canadian-Nunavut Geoscience Office.

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FROM FIELD WORK TO PUBLICATION: ENSNARING A FUTURE SCIENTIST

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After being introduced to a DFO Research Scientist during a poster session for *Schools on Board*, a grade 11 student from Glenlyon-Norfolk School in Victoria, British Columbia spent the summer of 2007 working at the Institute of Ocean Sciences. She participated in a sampling cruise in the Strait of Georgia, where she assisted in the collection and sub-sampling of sediment cores and sorted and measured juvenile fish. In the laboratory she measured coloured dissolved organic matter with a spectrophotometer, and she took on a project to characterize the distribution of dissolved and particulate organic carbon in the Strait of Georgia, during which she learned to formulate and test hypotheses. The organic carbon work has been developed into a paper accepted for publication in the journal *Marine Environmental Research*, with the student as second author. This particular example has illustrated that within a two-month summer term, a motivated high-school student can experience many aspects of conducting scientific research.

MARINE MONITORING AND RESEARCH STUDIES IN GREENLAND

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Climatic changes will likely affect the environmental

conditions in Greenland. Particularly the highly productive coastal waters around Greenland are of interest as they play an important cultural and economical role. A network of projects was therefore initiated to improve our knowledge of past and present conditions of the Greenlandic marine ecosystems and to better be able to observe and predict future changes. A central aspect of these projects is the link to the Greenland Ice Sheet and the possible changes to glaciers and freshwater runoff, along with changing sea ice conditions. The basis for this work is continuous monitoring of a sub-arctic (Godthåbsfjord, SW Greenland) and a high-arctic (Young Sound/Tyrolerfjord, NE Greenland) marine ecosystem, combined with *in situ* and laboratory experimental work. The sub-arctic Godthåbsfjord system is ca. 150 km long and covers 2013 km^2 with an average depth of 250 m (max 620 m). Sea ice only occurs regularly in the inner-parts and smaller branches of the fjord. Furthermore, the fjord is connected to the Greenland Ice Sheet through several glaciers and consequently receives a substantial freshwater input from icebergs and meltwater in addition to terrestrial runoff. Year-round monthly sampling near the fjord entrance depicts two peaks in primary production in May and July. Part of the annual primary production (76 g C m^{-2} yr^{-1} from 2005-08) is channelled through the pelagic food web (15 % is grazed by copepods), while the majority is vertically exported or advected. Thus, the fjord is net autotrophic throughout the year which is also reflected in very low pCO_2 levels. Compared to historical data from the fjord, pelagic primary production has decreased significantly over the past 50 years (159 g C m^{-2} yr^{-1} from 1955-65), particularly in spring and fall. The decrease may partly be attributed to increased meltwater runoff from the Greenland Ice Sheet delivering large amounts of suspended matter reducing the light availability for phytoplankton. Furthermore, large scale changes in oceanographic conditions offshore may also play a role in regulating the spring bloom.The high-arctic Young Sound/Tyrolerfjord system is ca. 90 km long and covers 390 km^2 with an average depth of 100 m (max 360 m). Sea ice generally start forming in late-September and lasts until mid-July. Pelagic primary production (10 g C m^{-2} yr^{-1}) is mainly utilized by the pelagic food web, while organic material from the Greenland Sea and land (32 g C m^{-2} yr^{-1}) contributes to sustaining a rich benthic community. Thus, the Young Sound is net heterotrophic. A regional climate model (HIRHAM4) for Greenland predicts increased precipitation and warmer air temperatures by the end of this century, which is expected to increase the ice and meltwater input from the Greenland Ice Sheet. At present it is difficult to predict how this will affect primary production in the Godthåbsfjord system. However, the model also predicts a doubling of the ice-free period by 2100, which combined with an expected increased input of nutrients through a stimulated estuarine circulation, may triple annual primary production in the Young Sound/ Tyrolerfjord system.

ATMOSPHERIC MONITORING OF PERSISTENT ORGANIC POLLUTANTS AT THE ZEPPELIN MOUNTAIN RESEARCH STATION (NY-AALESUN, SVALBARD: INDICATIONS FOR CLIMATE CHANGE INFLUENCES ?

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Persistent organic Pollutants (POPs) have been monitored at the Zeppelin station (Ny-≈lesund, Svalbard, Norway) for almost two decades. A core program including 4 cyclodiene pesticides, 2 hexachlorocyclohexane-isomers (HCH), hexachlorobenzene (HCB), 6 dichlorodiphenyltrichloroethane derivatives (DDT) as well as 33 polychlorinated biphenyls (PCB) has been performed during the entire monitoring period.

As a part of the ongoing Arctic Monitoring and Assessment Programme (AMAP) a temporal trend evaluation has been performed for the entire monitoring period (1993 - 2007) using digital filtration (DF) as statistical tool developed by Environment Canada.

A first evaluation revealed that during the past 8-10 years an increased frequency of atmospheric long-range transport episodes occurred. Becker et al (2008) identified a clear correlation between the characteristic patterns of the Arctic Oscillation (AO) and the variability of the HCH concentrations found for Zeppelin air samples.

Due to DF assessments for most of the POPs downward trends have been established. However, for the volatile hexachlorobenzene (HCB) as well as for selected PCBs levels are continuously increasing during the past 4-5 years. This findings are clearly indicating changes in sources, and/or distribution processes. In-depth discussions of the results as well as the implications for potential influences of climate change will be given in the presentation.

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WARMING IN THE GREENLAND SEA: IMPLICATIONS FOR ENERGY TRANSFER TO HIGHER TROPHIC LEVELS

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The purpose of this study was to examine the impact of warming trends in the Greenland Sea on energy flow to top predators. During IPY we studied the behavior of seabirds foraging at three sites, each characterized by contrasting oceanographic conditions. In the Greenland Sea, Arctic water flows south from the Arctic Ocean along east Greenland and warm water flows north from the Atlantic Ocean. On the eastern side of Spitsbergen, cold Arctic water flows south and then enters the Greenland Sea and subsequently flows north again along the Southwest coast of Spitsbergen as the Sorkapp current. Each of these water masses carries with it different zooplankton species which differ greatly in their energy content. Adjacent to Greenland, there are high densities of the large, lipid-rich copepod *Calanus hyperboreus*. The Atlantic influenced water carries with it high densities of the small *Calanus finmarchicus*. The Sorkapp current carries high densities of the medium-sized *Calanus glacialis*. We examined the impact the different physical and biological conditions of these diverse water masses on little auks (*Alle alle*). Little auks are zooplanktivorous seabirds that migrate to the Greenland Sea in summer to feed in its productive waters. We chose this species because it is sensitive to changes in oceanographic conditions and it is a key component of Arctic marine and terrestrial ecosystems. While flying to and from their nest sites, little auks fertilize the tundra which herbivore such as reindeer and geese take advantage of. Little auks are also consumed in high numbers by land predators such as the Arctic fox (*Volpes lagopus*). Furthermore, in some Greenlandic communities, little auks are an important food resource. To assess differences in the diving behavior of little auks foraging under different conditions, we used time-depth-recorders on little auks at each of the three sites. In addition, we examined differences in the stress levels of provisioning little auks through analysis of their corticosteroid hormone levels. We compared the zooplankton prey they feed their chicks under different oceanographic conditions by collecting chick diet samples. We found strong differences between little auks foraging in warm, Atlantic derived water versus cold water with origins in the Arctic Ocean. Recently, there have been large scale increases in the temperature and the extent of Atlantic water in the Greenland Sea. Because little auks are sensitive to the heterogeneous conditions in the Greenland Sea, our results provide a good model to understand how increases in warm, Atlantic water impact energy flux to Arctic upper trophic predators.

"AN 'INCONSISTENT' TRUTH": THE ARCTIC IN CANADIAN FOREIGN POLICY.

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Though Canada continues to lay claim over its Arctic Archipelago, its message to the international community has been less than consistent. Canada is an Arctic nation, though its inabilities to control this region bring its sovereignty into question: the legal status of the Northwest Passage has still to be resolved; Canada's inchoate actions, with regard to the Law of the Sea Convention (1982), has allowed other nations to gain advantages in mapping the Arctic seabed; and Canada has pursued an multilateral environmental strategy to protect the region, but such strategies have been limited. In short, with 'climate change' and the melting of the Arctic Ice shelf, this issue has returned as a concern for Canada – one that it can no longer vacillate upon. It needs a definite strategy. The challenges in developing a Canadian foreign policy strategy come from many angles. The latest threat comes from Russian economic expansions, and there are the ever present European interests. It is the American challenge to the Northwest Passage that offers Canada the best opportunity to build a united front to meet Canadian interests in this region. A solution, however, is not just a military one, but rather one that must be founded in both politics and law: Canada must find a political solution that can appease American security concerns and be formalized in a binding legal means to protect its future interests. This paper will explore these implications in foreign policy, using the Northwest Passage as the case study, and offer some suggestions for Canada's future.

INPUTS OF MERCURY TO HUDSON BAY FROM NELSON AND CHURCHILL RIVER DISCHARGE 2003-2006

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Methylmercury (MeHg), a toxic form of Hg that bioaccumulates through foodwebs, is present in some Canadian high Arctic and Hudson Bay marine mammals at concentrations high enough to pose health risks to Northern peoples using these animals as food. It was recently shown that methylation of inorganic Hg(II) in Arctic seawater is an important source of MeHg to Arctic marine foodwebs; however inputs of Hg to Arctic marine waters from river discharge may also be substantial, particularly to Hudson Bay. Although Hudson Bay is large, it is shallow and is therefore greatly influenced by river discharge. In fact, Hudson Bay has the largest drainage system in Canada and receives a cumulative discharge of ~710 km^3 $year^{-1}$. Furthermore, of the few Arctic rivers that have been examined, several are known to export large quantities of total Hg (THg; includes both Hg(II) and MeHg) to Arctic seas. Rivers draining into Hudson Bay are of particular interest as several have been altered for hydroelectric power production. When the landscape is inundated due to river diversion and/or reservoir creation, flooded soils and vegetation decompose creating anoxia in the sediments and stimulating the microbial production of MeHg, which can then be bioaccumulated through foodwebs or exported to downstream waterbodies. Beginning in 1970's, ~75% of the flow of the Churchill River was diverted into the Nelson River to increase its hydroelectric power potential. Concentrations of MeHg in fishes in many flooded lakes dramatically increased and remained elevated above pre-impoundment levels for 20-30 years. Interestingly, however, Hg inputs to Hudson Bay from this system were never determined. We quantified Hg inputs to Hudson Bay from Nelson and Churchill River discharge by continuously monitoring concentrations of unfiltered and filtered THg and MeHg in these rivers from 2003-2006. Surprisingly, concentrations of Hg, particularly MeHg, were quite high in the Churchill River (THg and MeHg concentrations were 1.96±0.8 and 0.18±0.09 ng L^{-1}, respectively) but low in the Nelson River (0.88±0.33 and 0.05±0.03 ng L^{-1}, respectively). Furthermore, most of the Hg in the Churchill River was in the dissolved form, and is therefore likely DOC-bound Hg originating in the vast wetlands surrounding the lower Churchill River. Therefore, although Nelson River flows are ~7.5 times greater than Churchill River flows, average annual THg and MeHg exports from the Nelson River (111 and 6.9 kg, respectively) were only 2-3 times greater than Churchill River exports (36.9 and 3.5 kg, respectively). These results demonstrate that for its size, the Churchill River is a large exporter of MeHg to Hudson Bay and may be an important source of MeHg to organisms feeding in the Churchill River estuary. In fact, annual inputs of MeHg to Hudson Bay from this small river are >3 times those from spring-time melt of snow that has accumulated over Hudson Bay throughout winter (1.1±0.8 kg $year^{-1}$). Combined inputs of THg from Nelson and Churchill River discharge are, however, comparable to inputs of THg from Hudson Bay spring snowmelt (177±140 kg $year^{-1}$).

POPULARIZING ARCTIC SCIENCE: A MEDIA RELATIONS PROGRAM TO PROMOTE NORTHERN RESEARCH

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International Polar Year has occurred at a time when a firestorm of issues is coalescing around the North. These issues, such as climate change, biodiversity and Arctic sovereignty, are drawing media and public attention to northern regions. It seems that every week the Arctic is featured prominently in a news story in one of Canada's national or local news outlets. At the same time, the communication of science to the public is receiving increased attention from both academics and journalists. Scholarly journals are devoted to the subject. Journalism schools are developing courses and programs to help train budding writers.

The Arctic Institute of North America is launching a program that takes advantage of these two trajectories. A grant from the federal IPY Training, Communications and Outreach portfolio is being used to develop a media relations program to popularize Arctic science. This project will make research in academic journals about the North, such as Arctic, Northern Review and Polar Research, more accessible to northern and southern audiences by rewriting select articles into easy-to-read formats. The articles will then be sent to media outlets and posted to the Arctic Institute website.

Our goal is to provide to interested persons solid, complex information in an easy-to-read format. A key feature of the project will be a focus on distributing the results of research back to northern communities. Too

frequently, researchers conducting work in northern regions fail to report results back to local communities. This project will help address this issue by fielding stories of research directly to journalists that work in relevant northern communities. In addition, an intern will be hired to work in the North as a community liaison and writer.

This project is taking place at a time when the communication of science is increasingly important. Science has always been a driver of innovative change and technological advances. But the public is becoming aware that every innovation has unintended effects. Spurred on by highly visible controversies, such as the outbreak of Mad Cow disease in the UK and the looming spectre of climate change, the public mood is cautious when it comes to new scientific developments. Yet, as levels of trust in traditional sources of information are declining, faith in scientists remains high. This project will provide information on scientific discoveries and phenomena to the public through a trusted source of information – the researchers themselves.

ANNUAL AND INDIVIDUAL VARIATIONS IN FEEDING ECOLOGY OF SOUTHERN BEAUFORT SEA POLAR BEARS BY STABLE ISOTOPE ANALYSIS: INTERACTIONS WITH BLOOD PCBS AND HG

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Polar bears are an important sentinel species to study the effects of contaminants in wildlife and the health of the arctic marine ecosystem because of their placement at the top of the food chain. Changes in sea ice dynamics and climate warming will alter prey availability in marine environments, thus forcing polar bears to change prey species, rely longer on catabolic processes, or use more terrestrial sources of food (i.e., carcasses of subsistence harvested bowhead whale, human sources) to meet metabolic demands. Changes in prey selection or longer periods of food deprivation in polar bears may result in changes in contaminant exposure and / or toxicodynamics among bears. We examined feeding ecology of polar bears and the subsequent changes in contaminant concentrations in Southern Beaufort Sea (SBS) polar bears during 2003-2007. Stable isotope analysis ($d^{15}N$, $d^{13}C$) was used to examine prey choice in bears across years and season (comparison of tissues representing different dietary time periods for individual bears) to evaluate how feeding ecology can modify the exposure of polychlorinated biphenyls (PCBs) and mercury (Hg) to apex predators. We examined: 1) temporal and regional changes in the feeding ecology of SBS polar bears; 2) variations in feeding ecology by age and sex class; and 3) the interactions between feeding ecology and blood concentrations of select contaminants (PCBs and Hg). This examination investigates the variation of contaminants from an individual (e.g., age and sex cohorts) to an ecological (e.g., geographic trends in contaminant exposure) perspective to provide a better understanding of the causes and effects of contaminants in wildlife in a changing environment.

(SEMI)VOLATILE ORGANIC COMPOUNDS AT ALERT, NUNAVUT - SNOW PACK AND BOUNDARY LAYER COMPOSITION

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The snow pack at Alert, Nunavut (82° 29' 58" N, 62° 20' 05" W) was analysed on-site for eighteen different (semi)volatile organic compounds with halogenated, aromatic and oxygenated functions. Concurrent sampling was carried out for surface air samples, which were determined for the same compound set upon return to Montreal. The investigation of atmosphere-snow interactions based on the determined concentrations was the prime goal of the study, with the sampling date at the start of the snow melt period between May 22 and June 2, 2006. Ancillary data collected included the assessment of the snow metamorphism state, air and snow temperatures and strata from depth profiles. Snow sample data was collected employing solid-phase micro-extraction with gas chromatography and flame ionisation detection (GC/FID). Air samples were analysed in the lab with a home-built cryo-trap GC/FID system. A depletion event (measured concentrations < limit of detection; LOD) was observed for eight compounds in snow or air (e.g. for trichloroethene, benzene) on May 30. At the same time ground ozone concentrations showed a sudden increase together with a shift of air mass origin form polar to a source region over

Ellesmere Island. 24-hr daylight supported melting and a transformation from dendritic to highly metamorphous snow and provided ample opportunities for photochemistry. Varying concentrations were observed for the investigated species (µg/L in snow and ng/L in air) with different behaviour over the sampling period: o-Xylene shows that dropping concentrations are accompanied by rising concentrations in snow and vice versa. Bromoform on the other hand shows high concentrations in snow (up to 33 µg/L), but concentrations below the LOD for air samples. Depth profiles show enrichment of several species (e.g. trichloroethene and chlorobenzene) in surface layer snow (0-2 cm) suggesting an exchange between the snow pack with overlying air for samples collected on June 2. A May 26 profile did not show this enrichment.

THE ROLE OF SYMPAGIC MEIOFAUNA FOR THE FLOW OF ORGANIC MATTER IN ARCTIC SEA-ICE FOOD WEBS

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The brine channels within sea ice make up the habitat of sympagic (ice-associated) organisms, including – besides bacteria, funghi, algae and protozoans – also metazoans > 20 µm, referred to as sympagic meiofauna. This diverse group, in Arctic sea ice comprising copepods, nematodes, rotifers, plathyelminthes, polychaete larvae and cnidarians, can reach high abundances. We hypothesize sympagic meiofauna to play an important role within the sea-ice ecosystem, and for the flow of organic matter and energy in polar marine food webs. Changes in Arctic sea-ice cover may dramatically change the composition of sympagic meiofauna and the timing of ice-algae blooms, and subsequent changes in the food-web structure are likely to effect higher trophic levels. Understanding the trophic role of sympagic meiofauna, including quantification of the carbon storage within this compartment (i.e. the biomass) as well as the carbon flux through the compartment (i.e. grazing / predation rates) is crucial for prognosis concerning the effects of climate change on the polar marine ecosystems. Nevertheless, studies on sympagic meiofauna are scarce, often focusing on few dominant taxa (copepods, nematodes), or being restricted to analyses of community composition. This is mainly due to the small size, taxonomical constraints and challenges with handling and culturing sympagic meiofauna, which complicate experimental and analytical studies. Consequently, knowledge on the ecology of this group is sketchy, in particular concerning its trophic role.

To close this gap of knowledge, we combine abundance and biomass studies, feeding experiments, gut content analyses and the use of biochemical tracers. New data from two recent expeditions to the Central and Siberian Arctic (ARK-XXII/2, August–September 2007) and to the Western Canadian Arctic (CFL, March–June 2008) show that meiofauna abundances were within the range of earlier studies, but diversity was higher than previously observed: taxa new to this habitat, such as rhabditophore plathyelminthes and the cnidarian *Sympagohydra tuuli*, occurred regularly and, for the first time, rotifers were found to be an abundant component of the sympagic community also in the Western Canadian Arctic. Feeding experiments conducted with animals from both expeditions have revealed that, contrary to previous assumptions, sympagic meiofauna does not predominantely graze on algae. Copepods and plathyelminthes feed on algae and ciliates, for the copepod *Tisbe* sp., also cannibalism and coprophagy were observed, and the cnidarian *Sympagohydra tuuli* preys on rotifers and copepod nauplii. To reveal *in situ* diets, we have specifically adapted the methods for stable isotope, fatty acid and gut content analyses for application to sympagic meiofauna. First results from stable isotope analyses are presented. Quantitative evaluations of feeding experiments show that predation rates vary by 1-2 orders of magnitude within predator taxa and can fluctuate strongly with time. Opportunistic feeding and highly variable ingestion rates are probably adaptations to fluctuating food availability in the highly dynamic sea-ice ecosystem. A distinct response of predation rates to predator density was observed for the copepod *Halectinosoma* sp., indicating intraspecific concurrence. We discuss potentials and constraints of modelling for the estimation of the feeding impact of sympagic meiofauna.

PARASITE BIODIVERSITY, CLIMATE CHANGE, AND ARCTIC ECOSYSTEMS: WHY SHOULD WE CARE?

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Parasites, both macro- (worms, arthropods, protozoa) and micro- (viruses, bacteria, prions) are important components of the biodiversity of all ecosystems (Hudson et al., 2006). They are integrated within the food webs and are powerful evolutionary drivers. At an individual host level they can alter physiology, behaviour, and productivity and at a population level they can force population cycles and drive host populations to extinction. They can cause subtle ongoing, disease with low mortality rates or they can result in explosive disease outbreaks and mass mortality events. They influence intra and inter-specific interactions and can lead to parasite-mediated competition among species. As is apparent from the increased rate of emergence of infectious disease globally, many parasites are powerful invaders, opportunists, and generalists (e.g., West Nile Virus). Under suitable ecological settings host-switching is common, often with catastrophic results to people, domestic animals, and wildlife (Brooks and Hoberg 2006, 2007). In the Arctic, parasites have evolved to persist under harsh environmental conditions and in many cases in areas of low host density. Current empirical research and predictions suggest that climate warming will release many of these parasites from environmental constraints and result in invasion of new host and parasite species from more southern latitudes (Kutz et al., 2005; Hoberg et al., 2008a, 2008b). Anecdotal reports indicate that northward range expansion is already happening with the moose winter tick in the Northwest Territories, Canada. Thus, under the current climate change scenarios we anticipate profound effects on parasite biodiversity and abundance, host-parasite interactions, emergence of disease, and the sustainability of wildlife populations. Despite the clear and broadly accepted importance of parasites in the resilience and dynamics of ecosystems, and the immediate threat of climate change on arctic host-parasite systems, our knowledge of parasite biodiversity in northern wildlife is far from complete. This is reflected in our ongoing discoveries of new species of helminth parasites, new geographic locations and new host records in arctic ungulates over the last 15 years (Kutz et al., 2004, 2007). In this paper we present lessons learned from past and ongoing research on parasites in Arctic ungulate populations. In particular we discuss i) the impacts of climate change on parasite biodiversity and abundance and the effects on host-parasite interactions and the sustainability of arctic wildlife populations, ii) the IPY funded parasite research program of the CircumArctic Rangifer Monitoring and Assessment network, iii) the critical need for enhanced biodiversity monitoring and archival repositories, and iv) future research and management directions. Brooks, D.R. and E.P. Hoberg (2006) *Journal of Parasitology* 92: 426-429.Brooks, D.R. and E.P. Hoberg (2007) *Trends in Parasitology* 23: 571-574. Hoberg, E.P. et al. (2008a) *Emerging Infectious Disease* 14: 10-17.Hoberg, E.P. et al. (2008b) *Rev. sci. tech. Off. Int. Epiz.* 27: In press.Hudson, P.J., et al. (2006). *Trends in Ecology and Evolution* 21: 381-385.Kutz, S.J. et al. (2004). *Integrative and Comparative Biology* 44: 109-118.Kutz, S.J. et al. (2005) *Proc. Royal Soc. B.* 272: 2571-2576.Kutz, S.J. et al. (2007) *Canadian Journal of Zoology* 85: 1143-1156.

SOURCES, PATHWAYS AND SINKS OF PARTICULATE ORGANIC MATTER IN HUDSON BAY: EVIDENCE FROM LIGNIN DISTRIBUTIONS

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Hudson Bay is a large, estuarine, shelf-like sea at the southern margin of the Arctic, where changes in seasonal ice cover and river discharge appear already to be underway. Here we present lignin data for dated sediments from eleven box cores and evaluate sources of terrigenous carbon, transport pathways, and whether terrigenous organic matter has been influenced by recent environmental change. Lignin yields (0.04 to 1.46 mg/100 mg organic carbon) decreased from the margin to the interior and from south

to north, broadly reflecting the distribution of river inputs. Lignin compositional patterns indicated distinct regional sources with boreal forest (woody gymnosperm) vegetation an important source in the south, vs. tundra (non-woody angiosperm) in the north. Lignin patterns suggest redistribution of a fine-grained, mineral-associated fraction of the southern-derived terrigenous carbon to the northeast part of the Bay and ultimately into west Hudson Strait with the Bay's cyclonic coastal circulation. A small component of the carbon makes it to the central basins of Hudson Bay but most of the terrigenous organic material in that area appears to derive from resuspension of older, isostatically-rebounding coastal and inner shelf deposits. Most modern plant debris appears to be retained near river mouths due to hydrodynamic sorting, with the exception of the southwest inner shelf, where these materials extend > 30 km from shore. Temporal changes in the composition of terrigenous organic carbon recorded in most of the southern Hudson Bay cores perhaps reflects increases in erosion and cross-shelf transport from coastal deposits, possibly mediated by change in ice climate. In contrast, temporal changes in the northwest may relate to changes in the supply of modern plant debris under recent warmer conditions. On the western shelf, changes may relate to ice climate and the distribution of northern coastal water and/or changes in the delivery of materials by the Churchill River due to water diversion. Although the cores show evidence of change related to the ice climate, there is little evidence that ice itself transports terrigenous organic carbon within the system.

IMPACT OF CLIMATE VARIABILITY AND PERMAFROST LANDSCAPE DISTURBANCES ON RUNOFF GENERATION AND SOLUTE LOADS AT CAPE BOUNTY, MELVILLE ISLAND, 2006-2008

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Climate change in the Arctic is projected to substantially affect winter snowpack, summer precipitation, and active layer development. There is significant interest in the response of permafrost and surface runoff to changes in climate because permafrost and water exert significant control over most ecosystem and surface processes such as terrestrial and aquatic biogeochemical processes, sediment erosion, and water supply and quality. The research program at the Cape Bounty Arctic Watershed Observatory (CBAWO) has included the comprehensive monitoring of surface water hydrology and hydrochemistry from two adjacent watersheds since 2003, with the aim of developing a long term record to investigate the relationships between climate change, landscape conditions, runoff volumes and solute, sediment and nutrient fluxes.

This research investigates the impact of climate warming and active layer detachments on the response of runoff and hydrochemical regimes in the two main catchments at Cape Bounty, Melville Island, NU (74.5°N, 109.5°W) over three consecutive melt seasons (2006, 2007 and 2008). The 2006 end of winter snowpack was high, and the melt season was relatively cool with respect to 2007 and 2008. Record summer temperatures and summer rainfall in 2007 lead to the extensive active layer detachments (ALD) in the West catchment, as well as a number of minor detachments in the East catchment. ALD continued to develop and expand throughout the 2008 melt season, which was similar to 2007, although the end of season snowpack and mean July temperatures were lower than the previous year. Hence, this inter-annual comparison includes pre- and post-disturbance data and provides the basis for assessing the catchment scale impacts of geomorphic disturbances on runoff and hydrochemical regimes.

Stream discharge and electrical conductivity (EC) were monitored, and samples were collected for major ion concentrations and the oxygen isotope composition (δ18O) of water in both streams. Rapid increases in EC and strong isotopic enrichment in late July and early August in both catchments in 2007 and 2008, suggest that warm July temperatures and late season rainfall events lead to increases in active layer meltwater contributions to late season runoff in both streams. The similarity of the isotope enrichments in the two rivers and the relatively high rates of EC increases in the East River during 2007 suggest that the active layer disturbances had limited immediate impact on water sources and solute acquisition at the catchment-scale.

CONNECTING COMMUNITY OBSERVATIONS AND EXPERTISE WITH THE FLOE EDGE SERVICE

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Building on previous collaborative research in the Nunavut communities of Cape Dorset, Igloolik, and Pangnirtung, the Polar View Floe Edge Service (www.noetix.ca/floeedge) was expanded to these three Baffin Island communities in May, 2007 with funding support from the Northern Ecosystem Initiative (Environment Canada), and the Inuit Sea Ice Use and Occupancy Project (Government of Canada International Polar Year Program). This new service implementation was a result of several years of working together with community organizations and key individuals, as well as building larger collaborative networks with government and other researchers, in order to better merge community interests with scientific funding priorities. Initial expansion of the service was followed up with local information sessions and a research workshop in each community to:

1. publicly introduce the service and provide tips on accessing and interpreting the image products
2. work with the local hosts of the Floe Edge Service (i.e. Hamlet employees), several local sea ice experts, and several other community organization representatives, to undertake a preliminary evaluation of the service utility in order to tailor products to community needs and priorities.

This presentation will examine the utility of local workshops - from both community and research perspectives - in creating opportunities for knowledge exchange and intersection, as well as the challenges and learning that arose through such exchanges, including:

- communication (cross-cultural, and inter-generational)
- incorporating Inuit expertise into image products
- drawing from Inuit and scientific expertise to understand seasonal and long-term sea ice/weather changes
- moving from collaboration to decision-making contributions

Combined, these initiatives aimed to enhance the local utility of sea ice and weather monitoring/forecasting products, and to improve region-specific services and information access for travel, land/sea ice use, and safety of northern residents.

RAPID EARLY HOLOCENE DEGLACIATION OF HUDSON BAY

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Deglaciation of Hudson Bay was a rapid and catastrophic global event marked by the drainage of Glacial Lake Agassiz-Ojibway at ~8.5 ka BP and the following division of the Laurentide Ice Sheet (LIS) into the Keewatin Ice Sector (KIS) to the west and the Québec-Labrador Ice Sector (QLIS) to the east. In this paper, we report on the dynamics of the collapse of the LIS in Hudson Bay based on marine geophysical data coupled with terrestrial geomorphic and radiochronological data. Here we show that the drainage of Lake Agassiz-Ojibway took place subglacially under buoyant glacial ice (i.e., an ice shelf) in Hudson Bay, indicating a thin and unstable ice cover at time of deglaciation. Flutings mapped on the seafloor and on the Belcher Islands provide further evidence for the previously reported James Bay ice stream that flowed from the center of the bay towards Lake Agassiz-Ojibway (southeastward) shortly before its drainage. In the same manner as the recent collapse of the Larsen B ice shelf in Antarctica, this ice stream might have also contributed in thinning the LIS in Hudson Bay prior to the drainage by creating a dense network of crevasses. This gradual thinning of the ice cover caused a hydraulic lifting of the LIS that then triggered the lake outburst flood. Following the lake drainage and the marine incursion, the western margin of the QLIS began stabilisation phase along a hill range on the eastern coast of Hudson Bay between ~8.45 and 8.2 ka BP. The timing of this stabilisation leaves only little time for the LIS to disappear from Hudson Bay before its margin reached the western coast of northern Québec, further supporting a rapid collapse of the LIS scenario in the region.

VARIATIONS IN ANNUAL CYCLES OF VERTICAL PARTICULATE ORGANIC CARBON EXPORT ON ARCTIC SHELVES: A COMPARISON BETWEEN THE LAPTEV SEA, NORTHERN BAFFIN BAY AND THE BEAUFORT SEA

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The rapid decline in sea ice cover is expected to cause large variations in the fate of organic carbon over the different Arctic continental shelves. Long-term moored sediment traps were deployed in 2005-2006 at 200 m in the Beaufort Sea and Northern Baffin Bay in the Canadian Arctic and in the Laptev Sea in the Siberian Arctic to compare the magnitude and nature of particulate organic carbon (POC) export over these continental shelves. Annual POC fluxes ranged between 1.6 and 5.9 g C m^{-2} y^{-1} with the highest annual POC flux observed in Northern Baffin Bay and the lowest annual POC flux observed over the Mackenzie Shelf in the Beaufort Sea. Each annual cycle exhibited an increase in POC export a few weeks before, during, or immediately following sea ice melt in May or June, but showed different patterns for the rest of the deployment periods. Enhanced primary production, discharge from the Lena River, and resuspension events contributed to periods of elevated POC export over the Laptev Sea slope. High POC fluxes in Northern Baffin Bay reflected periods of elevated primary production in the North Water polynya, whereas in the Beaufort Sea sediment resuspension contributed to most of the large export events. Our results suggest that the Laptev Sea will likely sustain the largest increase in POC export in the next few years due to the potentially large reduction in ice cover and increase in the Lena River discharge. The variability observed among the annual cycles of POC fluxes reinforces the importance of measuring POC export over different Arctic shelves to assess the eventual variability of carbon export in response to climate change.

LATITUDINAL VARIATIONS OF SNOW PROPERTIES USING PASSIVE MICROWAVE BRIGHTNESS TEMPERATURE AND IN-SITU MEASUREMENTS OVER EASTERN CANADA

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Snow thermophysical properties are known to be sensitive to climate variability and change and are of primary importance for hydrological and climatological processes in northern regions. Specifically, spatial and temporal variations of snow extent and thickness are good indicators of warming climate, and better tools are required to assess those changes from space. Previous studies looking at the linkages between passive microwave brightness and snow properties had reasonable success over flat and vegetation-free surfaces, but lingering uncertainties remain with regards to the role of vegetation and snow grain size distribution in the extinction of the signal. Of particular relevance, new adequate methods to characterize snow grains *in-situ* are required to assess the variations observed in the measured and predicted brightness temperatures.

A latitudinal transect study was conducted over northern Québec, Eastern Canada in February 2008, spanning from southern boreal forest towards northern taiga and tundra during the Canadian IPY campaign. Moreover, detailed gridded sampling of snow and vegetation properties was conducted in three areas (8 x 14 km) of boreal forest, taïga and tundra. Similar sampling also occurred along a north-south helicopter transect with a spatial sampling resolution of 40 km from 50 to 58° N encompassing the gridded areas. Coincident AMSR-E passive microwave brightness temperatures were extracted at 18 and 36 GHz in both vertical and horizontal polarizations both along the transect and at the three sites. On the ground, a method was developed to retrieve snow grain information using infrared photography. The method makes use of an infrared-converted digital camera which measures the reflectance between 823 and 1000 nm. The reflectance is converted into snow grain diameter using the method of published snow optical model, which is expected to provide great improvement for microwave emission modeling. Using the latitudinal information of snow properties and brightness temperatures, snow multi-layered thermodynamic models (CROCUS and SNOWPACK) information will be coupled to microwave emission models (MEMLS and HUT), in order to enhance the brightness temperature predictions widely used in regional snow studies. This paper presents the results of the ground campaign as well as some preliminary modeling results.

Keywords: Latitudinal transect, passive microwave, snow grain, specific surface area, infrared reflectance, snow metamorphism model, microwave emission model, brightness temperature simulation.

WATER MASS DISTRIBUTION ON THE MACKENZIE SHELF AND THE AMUNDSEN GULF AS DETERMINED BY TOTAL ALKALINITY AND δ18O DATA

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Sea ice formation leads to brine rejection and contributes to the formation of dense water that sinks to intermediate and greater depths. Hence, high latitude areas can act as a sink for atmospheric CO_2 and thus represent a direct pathway for CO_2 exchange between the atmosphere and the deep ocean. The sites of deep water formation in the Canadian Arctic are unknown and the analysis of water masses is a first step towards this objective.

During the Canadian Arctic Shelf Exchange Study (CASES) and the Circumpolar Flaw Lead project (CFL) an extensive dataset including total alkalinity (TA), dissolved inorganic carbon (DIC), pH and $\delta^{18}O$ of seawater was collected on the Mackenzie Shelf and the adjacent Amundsen Gulf. This study area is a complex zone because of the interaction of numerous water masses, as revealed by temperature-salinity diagrams. The identification of water masses and their distribution within the study area was successfully accomplished using an optimum multi-parameter analysis (OMP) based on temperature, salinity, dissolved O_2 concentrations, TA and $\delta^{18}O$.

Surface waters (depth<100 m) display a strong seasonal variability and are composed of a mixture of the Polar Mixed Layer (PML), fresh water from the Mackenzie River (MW), and sea ice melt (SIM). Water originating from the Mackenzie River is characterized by low $\delta^{18}O$ (-20 ‰) and low TA (<1600 μmol kg^{-1}) values whereas sea ice melting generates higher $\delta^{18}O$ (-2.0 ‰) and very low TA (<400 μmol kg^{-1}). Below the upper halocline (depth>100m), three water masses are clearly identified. A first water mass is characterized by a 33.1 salinity and is of Pacific origin (PW). The PW layer has a mean TA of 2280 ±8 μmol kg^{-1} and a mean $\delta^{18}O$ of -1.60 ±0.14 ‰. At 200 m depth, a strong thermocline separates the PW from the Atlantic layer water (ALW) which has mean TA and $\delta^{18}O$ values of 2300 ±11 μmol kg^{-1} and 0.24 ±0.06 ‰, respectively. The Canadian basin deep water (CDW) is found below 1000 m depth in the Beaufort Sea and carries TA and $\delta^{18}O$ values which are slightly higher than those of the ALW.

This typical distribution is counter balanced by a seasonal and inter-annual variability which is mainly driven by meteorological conditions. In this presentation, we examine the water mass distribution, its modification and variability on the Mackenzie shelf with regards to the carbonate system.

COMPARING THE LAST FIFTY YEARS OF EROSION IN THE CANADIAN AND RUSSIAN ARCTIC

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The erosion of Arctic coasts has received considerable attention from the media over the last two to three years, resulting in the generalization of yearly rates of erosion captured locally over short amount of time to longer periods and to the entire Arctic coastline. In reality, coastal erosion in the Arctic is a complex and highly variable spatially and temporally. In this study, we use rates from the Bykovsky Peninsula (Russia) and from Herschel Island (Canada) to highlight the difficulty of capturing erosion over long sretches of coast. We show that erosion has often been increasing and/or decreasing in connection with events occurring in the backshore zone such as thermokarst and/or the longshore movement of sedimentary features, both above and under water. We highlight the need for an integrated approach to coastal dynamics at the Arctic scale to refine the current diagnostic and provide better boundary conditions parameters to modellers attempting to create predictive models of erosion

PHYTOPLANKTON BIOMASS, PRIMARY PRODUCTION AND EXPORT IN THE HUDSON BAY SYSTEM

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Surface hydrographic conditions (salinity and temperature), surface nutrient concentrations (nitrate (NO_3) and silicic acid ($SiOH_4$)), total chlorophyll *a* (chl *a*) biomass (B_T), total primary production (P_T) and organic material sinking export were determined in the Hudson Bay system (i.e. Hudson Bay, Hudson Strait and Foxe Basin) in September-October 2005. The surface hydrographic conditions and nutrient distribution differed among three distinct regions, i.e. Hudson Strait, eastern Hudson Bay and western Hudson Bay, which also showed contrasted patterns of production and sinking export. Hudson Strait had a marine signature with high salinity (32.3) and low temperature (2.1°C), high nutrient concentrations (3.97 and 4.72 µM for NO_3 and $SiOH_4$, respectively), high P_T (189 mg C m^{-2} d^{-1}) and the highest B_T of the system (23 mg chl *a* m^{-2}). In this region, the suspended carbon biomass was dominated by diatoms and was exported mainly as amorphous detritus and intact cells. Nevertheless, the export ratio (i.e. sinking export to primary production ratio) was the lowest (average = 0.20) of the Hudson Bay system. The eastern and western Hudson Bay regions were contrasted in that the former experienced a stronger riverine influence. This was evident from lower salinity (26. 8 *vs* 29.4), higher temperature (7.6°C *vs* 4.4°C), higher $SiOH_4$ (5.26 *vs* 2.39 µM) and lower NO_3 concentrations (0.35 µM *vs* 0.55 µM) to the east compared to the west. B_T and P_T were higher in eastern than western Hudson Bay (23 mg chl *a* m^{-2} and 248 mg C m^{-2} d^{-1} *vs* 16 mg chl *a* m^{-2} and 96 mg C m^{-2} d^{-1}, respectively). In eastern Hudson Bay, diatoms dominated the suspended biomass and were exported as part of fecal pellets produced by herbivorous zooplankton. In this region, export ratios were low (average = 0.29). In western Hudson Bay, ciliates and choanoflagellates dominated the suspended biomass and the sinking material was mainly in the form of amorphous detritus and bacterial carbon. In spite of that, export ratio were high in this region (average = 0.55). This study highlights that the Hudson Bay system encompasses a range of hydrographic conditions which lead to strong regional patterns in primary production and export during early fall.

SEABED SEDIMENT CHARACTERISTICS, PROCESSES, AND LANDFORMS IN THE NELSON RIVER ESTUARY, HUDSON BAY, MANITOBA, CANADA

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Rivers flowing into Hudson Bay provide sediments that may ultimately be delivered to the Arctic Ocean, and hence understanding sedimentary processes in estuarine zones is critical for e.g., assessing global sediment budget or characterizing Northern habitats. Despite this, the sedimentology of the Nelson River estuary - the main freshwater and sediment contributor to Hudson Bay, was not well known until this study. As part of an extensive multi-year monitoring program initiated by Manitoba Hydro, grab sampling was done at more than 100 stations over a 1200 km^2 area of the Nelson River Estuary. In 2006, offshore deep stations were surveyed. In 2007, sampling was done in the estuary reaches and tidal flats on both North and South shores of the Hudson Bay. The 2007 survey also included ground investigation of the processes and landforms at the mouth of smaller streams discharging directly to the Bay. In addition, aerial georeferenced videos were produced along all coasts of the study area. Sediment samples were sent to the laboratory for grain size and chemical analyses such as Total Organic Carbon (TOC), Carbon: Nitrogen Ratio (C:N), etc., and maps were produced to illustrate the spatial variation of these characteristics.

Here we present results describing the dominant sediment size in various parts of the estuary, e.g., along the Nelson channel, on the North versus South shores of the Bay, etc., and the occurrence of ice-related erosion or

deposition. The spatial distribution of grain-size, TOC and C:N values will be related to the spatial distribution of freshwater/sediment input to the estuary, and main processes and bed/landforms.

Future studies will include analysis of substrate relationships with flow velocity field and suspended sediment concentration in order to better understand the hydro-sedimentary dynamics of the Nelson River Estuary.

METAMORPHOSIS OF THE ARCTIC TERRESTRIAL FOOD WEBS: BETWEEN COLLAPSE OF NATIVE SPECIES AND EXPLOSION OF EXOTIC PREDATORS?

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Arctic terrestrial ecosystems are facing drastic changes in their structure and function, with the collapse of some key herbivores populations (e.g. lemmings) and the increasing presence of exotic predators (e.g. red foxes). Such recent metamorphosis raises conservation issues for native predators such as arctic foxes. Yet, how widespread these changes are still remains unclear. Here we present evidence for the competition between arctic and red foxes at our IPY study sites located in Northern Norway and Western Siberia. This competition occurs through the overlap in both prey and habitat use, where the dominant red fox excludes arctic fox from the richest areas. Historically, native predators have switched between small-mammal prey and migratory birds during the former regular cycles. Thus, we expect alternative prey to constitute a more important part of the diet for native predators in the near future. The resulting picture of the terrestrial Arctic will then imply structural conversion of animal guilds as well as a greater reliance of this ecosystem upon allochthonous flows of energy.

HOLOCENE CLIMATE CHANGES IN THE MAIN AXIS OF THE NORTHWEST PASSAGE INFERRED FROM DINOCYST ASSEMBLAGES: A POSSIBLE INFLUENCE OF THE ARCTIC OSCILLATION AT THE MILLENNIAL TIME SCALE

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Instrumental data in the Arctic reveal an important decline of both sea-ice thickness and extent between 1978 and 2000. In order to better understand the Arctic long-term climate variability, 2 piston cores were collected along the main axis of the Northwest Passage, in Lancaster Sound (core 2004-804-009 PC) and Barrow Strait (core 2005-804-004 PC). Both cores have been sub-sampled every 10 cm for the analysis of dinoflagellate cyst (dinocysts) assemblages. Transfer functions were used for the quantitative reconstructions of sea-surface parameters. Radiocarbon ages indicate that both cores span the last 10 000 cal yrs BP. Sedimentation rates range from 122 to 45 cm/ka and from 28 to 122 cm/ka for cores 009 and 004 respectively, allowing for a centennial to millennial time scale resolution.

Grain size analyses show the prevalence of the fine fraction in the major part of both cores, except at the base where higher percentages of sand and high magnetic susceptibility values are recorded. This is accompanied in core 009 by high detrital CaCO3 content and high C/N ratio.

Core 009 shows four different zones based on the relative abundance of dinocysts. The first zone between 600 and 560 cm (12 180 to 11 000 cal yrs BP) is characterized by the absence of dinocyst and other palynomorphs suggesting high terrigeneous inputs. The second zone, between 560 and 260 cm (11 000 to 7500 cal yrs BP) is dominated by the heterotrophic taxa Brigantedinium spp. and Islandinium minutum. Quantitative reconstructions indicate summer (August) temperatures 2oC colder than modern conditions and sea-ice cover of about 10 month/years (1 month more than at present). The third zone, between 260 and 60 cm (7500 to ~ 2900 cal yrs BP) is characterized by an increase in the relative abundance of the phototrophic taxa Operculodinium centrocarpum, Spiniferites elongatus/frigidus and Pentapharsodinium dalei. This is marked by reconstructed summer (August) temperatures slightly warmer than today. Finally, the fourth zone, from 60 cm to

the core top is again dominated by the heterotrophic taxa Brigantedinium spp. and Islandinium minutum and marks the establishment of modern conditions.

Core 004 reveals an absence of phototrophic taxa and the dominance of Brigantedinium spp. and Islandinium minutum throughout the length of the sequence. An increase in the relative abundance of the three taxa Islandinium minutum var Cezare, Echinidinium aculeatum and cyst of Polykrikos arctic morphotype between 500 and 400 cm (9200 to 6500 cal yrs BP) suggest a correlation with the lowest part of the zone 3 of core 009. This is accompanied by reconstructed summer (August) temperatures 1.5oC warmer than modern conditions. From 6500 cal yrs BP to the late Holocene, both cores show opposite trends (warmer/colder in Lancaster Sound, colder/warmer in Barrow Strait).

We associate the records at the base of both cores as the results of the Laurentide-Innuitian readvance during the late Pleistocene associated with a glaciomarine sedimentation. After a thermal maximum in the early/middle Holocene, opposite trends could be the results of the Arctic Oscillation creating a marked East/West variations in sea-ice cover.

LINKING COMMUNITIES AND SCIENTISTS: IDENTIFYING CHALLENGES AND COMMON GOALS OF WILDLIFE RELATED RESEARCH IN NUNAVUT

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We examine current approaches that link communities and scientists through case studies of natural resource management research in Nunavut. The difference in cultural perspectives and language pose unique challenges for scientists and communities engaged in research monitoring environmental change. For example, there is an expectation that *Inuit Qaujimajatuqangit* (Inuit knowledge) will be utilized respectfully. Efforts have been made to quantify and to qualify local and traditional Inuit knowledge. Steps forward likely include expanding our understanding of the range and depth of core values held and expressed by individuals. We need to understand better the history and backgrounds of communities and scientists including the role of standing and access to resources. It is critical to clarify goals, methods and potential consequences of research activities prior to their commencement through adequate consultation with communities and accommodation of community concerns. Community members and scientists often share common goals, but uncertainty associated with scientific results and Inuit knowledge often create challenges in understanding. This is especially relevant for understanding the potential impacts of climate change on arctic systems. Inuit and scientists need to engage each other respectfully with shared common goals in order to incorporate meaningfully each other's observations and perspectives of arctic environmental change.

SEASONAL CHANGES IN PELAGIC AND SYMPAGIC ALGAL FOOD QUALITY

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The ice cover in high Arctic marine ecosystems puts severe limitations on the productive period for autotrophic organisms representing the basis of the marine food web. Upon the return of the sun in spring, sea ice algae start to grow underneath the ice, where they are able to produce substantial amounts of biomass despite very low light intensities. Thereby, they extend substantially the period of high-quality food available for herbivorous zooplankton and ice fauna. The pelagic algal bloom usually starts only when the ice breaks up and can therefore occur very late in the season at high latitudes. During the Norwegian IPY-project CLEOPATRA we carried out an extensive seasonal study of the lower trophic levels in high Arctic Rijpfjorden (Nordaustlandet, Svalbard). The aim of the project is to investigate the role of light for timing, quantity and quality of primary and secondary production in a seasonally ice-covered ecosystem. In 2007, Rijpfjorden was ice-covered from early February until mid July. Sea ice algae were found from March to June, with the highest biomass in late April and early June. The pelagic bloom peaked in late June, approximately two weeks prior to ice break up. Algal food quality expressed as fatty acid composition changed substantially throughout the different seasons. The highest amounts of polyunsaturated fatty acids (PUFAs) were found in ice algae in April (37%) and in pelagic POM after the major bloom event in July (up to 50%), respectively. Algal food quality depended both on taxonomic composition and

physiological state, with the latter reflecting the prevailing environmental conditions. We suggest that the observed differences in the timing of primary production of high nutritional quality have implications for the life cycle of potential grazers.

TOWARDS AN UNDERSTANDING OF THE IMPLICATIONS OF SHRUB COVER CHANGE IN NUNAVIK

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Shrubs are dominant above the treeline in most tundra ecosystems and they are already observed to increase in abundance in some parts of the North. The warming trend in Nunavik started relatively late compared to other parts of Arctic Canada yet, in some areas, community members are already noticing an increase in vegetation cover. In other communities, however, no clear evidence of vegetation change is reported. Our group is studying the impact of vegetation changes near communities with a range of approaches including ethnobotany, plant population ecology and dendrochronology. We focus on berry producing species and on various shrubs for which we evaluate cover changes due to new colonisation from seeds and to increased growth of established plants. Berry picking is an important activity in all northern communities. Berries producing shrubs are abundant and well known for their inter-annual variability in productivity. This productivity may benefit from warmer seasons only if the increasing shrub cover does not out-compete the lower berry producing species. Shrub density and height may impact snow pack distribution, soil temperature and other physical variables as well as herbivores. We will present results illustrating the variable and dynamic nature of shrub cover in Nunavik and attempt to present an integrative view of the processes at play using scenarios for regions with rapid *vs* slow change.

THE PREVALENCE OF HUMAN PAPILLOMAVIRUS AND ITS IMPACT ON CERVICAL DYSPLASIA IN NORTHERN CANADA

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Background: Cervical cancer rates are higher among aboriginal populations than the general population in Canada. Since Human Papillomavirus (HPV) are highly associated with cervical cancer and the routine screening tool - Pap test- is less than ideal, it is essential to understand the prevalence of HPV infection and identify if incorporating HPV test into routine screening will be more effective for cervical cancer prevention.
Objectives: The objectives are to determine the prevalences of type-specific of HPV infections and cervical dysplasia among women in northern Canada, to determine the impacts of social, demographic, and behavioural factors on HPV infection, and to provide evidences for decision makers to establish more effective programs for cervical cancer prevention and control.
Methods: The targeted population are women living in territories in Canada, the Northwest Territories (NT), Nunavut, and Yukon. The inclusion criteria are: women at screening targeting ages, no cancer history, and attending routine clinics for Pap test. Data collection is incorporated into the routine sample collection for Pap test by physicians or community health nurses, therefore no extra samples are

required. After the Pap testing, the remaining specimens are sent to the National Microbiology Laboratory in Winnipeg using Luminex assay for HPV typing. Women who agreed to be collected their risk factor information are asked to sign a consent form and answer a questionnaire which is self- administered with nurse assistance. Questionnaire data will not be collected in Nunavut. Pap test results, HPV types, and risk factor data will be linked for analysis by the Centre for Chronic Disease Prevention and Control of the Public Health Agency of Canada. A descriptive analysis of socio-demographic characteristics will be performed. The prevalences of HPV type-specific infections and cervical dysplasia will be calculated with 95% confidence intervals. Multivariate logistic regression analyses will be used to explore the associations between type-specific HPV infections and cervical dysplasia as well as the associations between risk factors and type-specific HPV infections.
Potential benefits: This project will contribute to the knowledge of HPV prevalence among women in Northern Canada. The results may be useful for the development of strategies to prevent HPV infections and reduce the burden of illness associated with high-risk HPV infections. It is also expected to demonstrate that more effective cervical cancer screening programs can be developed by incorporating HPV test with the conventional Pap test as tools.
Current status: More than 5,000 samples from the NT and Nunavut have been tested for HPV types. The NT and Yukon are both in the process of collecting questionnaire data.

RELATIONSHIP BETWEEN SEA ICE-COVER AND BENTHIC CARBON TURNOVER IN THE AMUNDSEN GULF

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Dynamics of the tight pelagic-benthic coupling, as reported from a number of Arctic shelf seas, are likely to respond significantly to changes in external forcing. It has been shown, for instance, that benthic carbon mineralization, measured as sediment oxygen demand, is enhanced by the input of a strong food pulse represented by sedimenting sea ice algae. To estimate the effect of global warming on carbon cycling in marine Arctic ecosystems, it is important to understand how the rapidly reducing sea ice-cover and associated ice algae will influence benthic processes. In this study we investigated the variation in benthic carbon turnover under different conditions of ice-coverage in the Amundsen Gulf between March and August 2008. Sediment cores were obtained over both a temporal gradient, sampling the same study site under closed ice cover in spring and open water in summer, and a spatial gradient of ice-edge – open water in early summer. Sediment carbon turnover was generally low compared to previous studies and ranged between 10.7 mg C $m^{-2}d^{-1}$ and 43.9 mg C $m^{-2}d^{-1}$. Preliminary results indicate that it increased over the ice-cover – open water gradient at some sites, but remained stable at others. We suggest that the proposed relationship between benthic activity and ice coverage can be masked by further factors such as e.g. water depth and is hence more complex than commonly assumed. This insight would have important implications for all efforts to understand and predict the ecological effects of climate change in the Arctic.

POSTGLACIAL SEDIMENTATION AND ENVIRONMENTAL MAGNETISM IN THE ARCTIC ALASKAN MARGIN

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Two long sedimentary sequences were recovered on board the USCGC Healy in the Arctic Alaskan margin as part of the Healy-Oden Trans Arctic Expedition

(HOTRAX) in order to reconstruct climate variability in the Western Arctic during the Holocene. Here we present the sedimentation history recorded in cores HLY0501-06JPC and HLY0501-08JPC (hereinafter referred to as cores 6JPC and 8JPC, respectively). Core 6JPC was raised from the continental slope and core 8JPC was collected 100 km southward on the continental shelf near Barrow Canyon. On board, the piston cores were ran into a Multi Sensor Core Logger for the determination of wet bulk density and volumetric magnetic susceptibility, then split and described. In the laboratory, the magnetic properties (natural, anhysteretic, isothermal and saturation isothermal remanent magnetizations) of both cores were determined using a cryogenic magnetometer on u-channel samples with a 1-cm downcore resolution. Cores 6JPC and 8JPC are composed of several meters (9 and 12 m, respectively) of postglacial sediments overlying glacial/deglacial deposits.

The chronology of core 8JPC is based on 8 accelerator mass spectroscopy (AMS) 14C dates, whereas the chronology of core 6JPC was constrained by 1 AMS 14C date and a full vector paleomagnetic correlation (inclination, declination and relative paleointensity) using core 8JPC and other previously published and independently dated high latitude sedimentary and volcanic paleomagnetic records from Western North America. The postglacial chronology of core 8JPC indicates sedimentation rates as high as 348 cm/ka on the continental shelf near Barrow Canyon from approximately 8000 to 5000 cal BP, followed by a major decrease in sedimentation rates. Such a rapid diminution is not observed on the continental slope at core site 6JPC and at the nearby core site 5JPC, indicating that despite their proximity to each other, cores 8JPC and 6JPC have considerably different sedimentation histories as core 8JPC is located on the continental shelf and is strongly controlled by changes in sea level and changes in hydrodynamic conditions. Finally, centennial- to millennial-scale variability is observed in several magnetic parameters of both cores and will be explored.

WATER TURBIDITY AND SUSPENDED SEDIMENT CHARACTERISTICS IN THE NELSON RIVER ESTUARY, HUDSON BAY, MANITOBA, CANADA

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The Nelson River is the largest contributor of fresh water in Hudson Bay. Flowing to the East of the Nelson, the smaller Hayes River drains a catchment with similar surface materials, which range from fine-grained glacio-marine sediments to ice-drifted boulders. The hydro-sedimentary dynamics of the Nelson River estuary is still not well known, hence making it difficult to estimate any potential changes in the Bay or the Arctic Ocean further away. In particular, the characteristics of suspended sediments and their relationships with tidal propagation and variation in turbidity of fresh-saline waters, which is important to marine biota, needed to be investigated.

As part of an extensive Manitoba Hydro monitoring program in the Nelson River estuary, up to 21 moorings with more than 50 loggers for measuring temperature, salinity and turbidity were installed during the summers of 2006 and 2007, and extensive suspended sediment sampling was conducted at 9 of these stations (limited, but detailed TSS profiles exist for 2005). In addition to these estuary campaigns, upstream reaches unaffected by tides on both the Nelson and the Hayes Rivers were surveyed twice in 2008, under ice-cover shortly before break-up, and again in early July. Isokinetic methods included integrating the water column and point-integrated sampling at selected depths, including the near bottom layer.

Here we present the spatial and tide-related variation in sediment concentration and turbidity in the Nelson River estuary, and compare these results with fluvial conditions. Organic content and grain-size fraction of the suspended loads in this fluvial-marine continuum will also be described.

Results from this study will help computing sediment budgets and modelling the hydro-dynamic processes in the Nelson River Estuary.

BELUGA CONTAMINANT LEVELS: AN ECOSYSTEM APPROACH TO A SPECIES SPECIFIC QUESTION

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Beluga whales (*Delphinapterus leucas*) represent an important food source and traditional way of life for Inuit. Concerns of contaminants in country foods have resulted in the need to understand beluga diet and dietary sources of contaminants. In partnership with Inuvialuit communities we examined beluga behaviour and ecosystem processes to describe the trophic level transfer of mercury (Hg) to the Beaufort Sea beluga whale population; a population that has had some of the highest Hg levels. Resource selection function was used to analyze satellite telemetry data to describe beluga habitat use of sea ice concentrations and bathymetry. Belugas were found to segregate into habitat use groups defined by their length, sex and reproductive status. To test if beluga were exposed to different dietary Hg levels among habitat use groups we sampled whales representative of the habitat use groups and collected likely prey items that corresponded with those habitats. The diet biomarkers, stable isotopes and fatty acids, were used to examine beluga diet in relation to the factors driving habitat selection. Fatty acid analysis revealed beluga predominantly fed on arctic cod (*Boreogadus saida*), yet arctic cod diet biomarkers and Hg levels differed among habitats. The δ15N and δ13C results supported the fatty acid analysis and together showed that habitat use was important in describing dietary Hg exposure. In conclusion our results showed that the trophic level transfer of Hg in food webs differed in each habitat and was the driving factor in beluga Hg body burdens rather than bioaccumulation over time. Therefore, using an ecosystem approach provided important information about beluga contaminant levels that can be further evaluated under future climate scenarios.

MICROBIAL PRODUCTION OF DIMETHYLSULFIDE IN THE ARCTIC

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One of the most striking impacts of global warming in the Arctic is the reduction of the annual ice cover, a process which could profoundly alter the structure and dynamic of the pelagic ecosystem and the related production and sea-air flux of climate active trace gases such as dimethylsulfide (DMS). This paper presents new information on the microbial metabolism of DMS and its algal precursor dimethylsulfoniopropionate (DMSP) in Arctic waters, obtained during incubations using radioactively marked ^{35}S-DMSP. The measurements were conducted across the Canadian Archipelago, from Baffin Bay to the Beaufort Sea, during the fall of 2007 as part of the Canadian International Polar Year program. DMSP and DMS concentrations in surface waters tended to decrease westward and as the season progressed. The physiological capacity of the bacteria to use DMSP (DMSP loss rate constant) and the bacterial DMS production efficiency (DMS yield) exhibited a similar westward decrease. Significant positive relationships were observed between DMS concentrations and the DMS yield (R^2=0.35, $p<0.05$), as well as between DMS yield and total DMSP concentrations (R^2=0.40, $p<0.05$). Bacterial DMS production was driven by rates of dissolved DMSP (DMSPd) consumption, which in turn was limited by the concentration of DMSPd. In the context of a warming Arctic, these results suggest that if a reduction in ice cover leads to greater phytoplankton abundance, the associated rise in DMSP concentrations could trigger an increase in DMS concentrations through higher bacterial DMS production and yield. This would lead to a greater sea-air flux, with a potential cooling effect.

HUDSON BAY: NEW FINDINGS AND DIRECTIONS FOR FUTURE STUDY

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Hudson Bay is a large, estuarine, shelf-like sea at the southern margin of the Arctic. With this location, the Bay is in the vanguard of polar change and, indeed, reduction and change in sea ice cover seems to be already underway. Accompanying the change in ice cover is alteration of river discharge, both directly though water diversion and indirectly through change in permafrost, wetland processes and the hydrological cycle. The oceanographic changes that may result from altered freshwater inputs (both ice melt and river runoff) are still largely unknown, as are the consequences of all these changes for the marine food web and polar bears.

Marine research in Hudson Bay has been relatively limited partly because of its remote location, seasonal sea ice cover, and shallow coastal waters, and partly because the marine resources have not attracted commercial interest. Coastal conditions near river systems affected by hydroelectric development have received the most attention, while observations of Bay-wide circulation, water mass properties, primary production and food web structure are extremely sparse. It is significant that overviews of knowledge of the Hudson Bay system, published twenty years apart (Martini, 1986; Stewart and Lockhart, 2005), draw mostly on data collected in the 1970s.

Recently, Hudson Bay has seen a re-invigorated research effort supported largely by two multi-year, multidisciplinary programs - MERICA (étude des MERs Intérieures du Canada) and ArcticNet (http://www.arcticnet-ulaval.ca/). New findings emerging from these research efforts address sea ice, freshwater dynamics, ocean surface chemistry, spatial and temporal variability in primary production, carbon flux, ecosystem structure, and proxies for reconstructing past conditions. The consequent advances in our knowledge about how the Bay functions, and its vulnerability to change, suggest this to be a critical time to disseminate these findings in a dedicated journal issue.

USE IT OR LOSE IT: ACTION AGENDA OR ELECTION SLOGAN?

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During the recent federal election, the expression "use it or lose it" was frequently articulated in conjunction with calls for Canadians to respond to issues affecting the present and future development of the North. Implied in this phrase was a warning that inaction posed a threat to Canada's control of its northern regions, and that the very notion of Arctic sovereignty was under threat unless Canadians took early and strong action to exercise effective stewardship of their northern lands and waters. The spectre of outside pressures and threats was invoked at regular intervals, presumably to mobilize concern among the electorate and to inspire calls for action.

This message of "use it or lose it" was underscored by several high-profile announcements of major initiatives that were delivered in northern communities, and which promised to set Canada's polar house in order.

While there can be little doubt that concerted action is required to deal with a host of current and emerging problems in the North, it is by no means a certainty that a failure to act would lead to a loss of Canada's right to exercise sovereignty and control over its northern lands and waterways. Except for tiny Hans Island that lies between Greenland and Ellesmere Island, the country's land territory north of the Arctic Circle is widely recognized as Canadian, and no part of it is perceived as a likely target for foreign invasion or takeover.

Where the country's northern waterways and seabed are concerned, the UN Convention on the Law of the Sea (UNCLOS) clearly spells out Canada's rights and obligations. There is contention between Canada and other states concerning the status of the Northwest Passage as an international waterway, but there has been little dispute so far over rights of access to the other and more restricted inter-island waterways of the Canadian Arctic Archipelago, nor have there been open challenges to the provisions of the Convention that regulate international usage of the 200 nautical mile zone north of the Archipelago. There are ongoing disagreements with Denmark and the United States concerning bilateral boundaries within 200 nautical miles in the east and the west, respectively, but these do not alter the fact that coastal states have specific rights in these zones which must be respected by the international community.

Concerning use and control of the seabed, the Convention grants significant rights to Canada within the entire Exclusive Economic Zone, which in essence extends from the country's coastlines out to 200 nautical miles or to bilateral boundaries with neighbouring states, encompassing the entire Arctic Archipelago in the process. These provisions include the exclusive right to explore, to exploit, and to manage the resources of the seabed; no foreign state can presume to engage in any of these activities without Canada's approbation.

The Convention also grants Canada the right to extend certain sovereign rights into an Extended Continental Shelf (ECS) which lies beyond 200 nautical miles and where a coastal state has the authority to control and to exploit the resources of the deep seabed. This same right is available to Canada's Arctic neighbours, which are

similarly engaged in their own ECS delimitations. At some future date, it will be necessary for all Arctic states to engage in negotiations with a view to devising an equitable sharing of the seabed resources within their combined ECSs. Indeed, last May the Arctic coastal states met in Ilulissat, Greenland, to affirm their commitment to "the orderly settlement of overlapping claims". At the end of that process, Canada and its Arctic neighbours will be able to exercise undisputed control over seabed resources beyond 200 nautical miles.

Canadian sovereignty in the Arctic is firmly enshrined in international law. While regulatory and enforcement measures will no doubt be needed to prescribe and to uphold that sovereignty in some areas, these would not imply any loss or diminution of Canada's authority to control its northern land and sea areas. "Use it or lose" might be a catchy political slogan, but it does not take into account the verities of international law.

CLIMATE CHANGE AND HUMAN HEALTH-HOW DOES COLD EXPOSURE TROUBLE US?

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Projections of the changing climate indicate not only permanently warmer weathers, but an increasing amount of climatic extremes. This includes a higher amount heat waves and cold spells, as well as high winds, storms and precipitation. A cold environment causes thermal discomfort, performance degradation, adverse health outcomes and injuries. The adverse effects may be potentiated in special population groups. The presentation showcases results related to the effect of cold on human health from Finnish population studies. According to national questionnaire studies (FINRISK-surveys) of people aged 25-74 yrs, different symptoms and complaints are common in the general population. These are musculoskeletal pain, respiratory (dyspnoea, wheezing of breath, sputum production), episodic peripheral circulation and cardiovascular symptoms (chest pain, arrhythmias). Most of these emerge below -10°C, and the first symptoms to appear are musculosceletal complaints (-3°C) and sputum production (-5°C). Persons with a pre-existing disease have an increased prevalence of respiratory, cardiac, peripheral circulation and white fingers symptoms during the winter compared with healthy individuals. Women are more susceptible to cold-induced symptoms than men, and the prevalence of symptoms show only little variation with age. Respiratory symptoms are more common among patients with asthma and chronic bronchitis compared with healthy. Furthermore, for persons having asthma, chronic bronchitis or emphysema the threshold temperatures for respiratory symptoms to emerge are higher compared to healthy individuals. A cold environment is associated with respiratory tract infections (RTI), too. A population study where diagnosed RTI episodes, outdoor temperature and humidity in conscripts were analysed showed that a decrease in temperature was associated with an increased risk for upper (URTI) and lower (LRTI) respiratory tract infections, and separately for common cold and pharyngitis. Also, a decrease in absolute humidity was associated with an increased risk for URTI and pharyngitis. Furthermore, a decrease in temperature and humidity preceded the occurrence of RTIs. Finally, according to national questionnaires, the prevalence of annually occurring superficial and more severe cold injuries in the general population is 12.9% (330/2550) and 1.1% (95/8788), respectively. The occurrence of frostbite is more common in men, and frequent in industries such as agriculture, forestry, industry and also among population groups such as pensioners and unemployed. Risk factors for the occurrence of frostbites are for example employment in an outdoor occupation, higher amount of physical strain at work, living in the north, having diabetes, mental depression and Raynaud's phenomenon. Based on the results environmental and individual risk factors should be taken into account when developing risk assessment and management strategies for mitigating the adverse health effects of cold. Due to the climate change, cold extremes will remain common, and require development of national temperature related warning systems. These extreme weather health warning systems are more effective if they are especially focused on specific populations groups at risk, such as people suffering from chronic diseases (e.g. respiratory or cardiovascular disease, diabetes), elderly people (and especially those living alone), and people involved frequently in recreational outdoor activities or outdoor work.

POLAR CLIMATE OUTLOOK FORUM: A MECHANISM FOR IMPROVED ADAPTATION STRATEGIES AND OUTCOMES

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The people that live and work at high latitudes have a great need for climate information, in order to make effective decisions related to the rapid climate-related changes that are occurring in these regions, and to the socio-economic opportunities and risks that ensue. People, communities, businesses and governments also would benefit from learning how to make optimal use of the available information in developing and implementing their strategies for adaptation to climate variability and change, and in conducting their lives in a changing environment. The World Meteorological Organization (WMO) recognizes a unique opportunity, based on the legacy of the International Polar Year 2007-2008 (IPY), for the National Meteorological and Hydrological Services (NMHSs) of its Members to build collaborative mechanisms for generating sustained, practical, operational products and services, to meet user needs for climate risk management in Polar Regions.

In tropical and sub-tropical regions, such mechanisms, Regional Climate Outlook Forums (RCOFs), have become a highly valued and regular activity of WMO Members. RCOFs owe their increasing success to a number of factors including predictability of the climate at seasonal to longer time frames and to the direct participation of user communities in the Forums. Recognizing the scientific challenges of climate predictability in high latitude regions, but also the acute vulnerability of Polar Regions to climate variability and change, consideration must be given to extending the benefits of the RCOF process to high latitudes.

WMO, along with the World Climate Research Programme (WCRP) and the IPY are working with polar-relevant NMHSs, scientists from climate and socio-economic fields, and a growing list of partnering organizations to develop and implement a Polar Climate Outlook Forum (PCOF). This forum would be a sustained, regular international collaboration between climate and user representatives with interests in Polar Regions, to share currently available information, to identify additional user requirements for climate information, products and services, and to engage in awareness and technical training of both climate providers and users. The PCOF is recognized as a WMO legacy of IPY 2007-2008, and as a contribution to the future WMO Global Cryosphere Watch (GCW).

The WMO/WCRP/IPY Workshop on CLIPS (**CL**imate **I**nformation and **P**rediction **S**ervices) in Polar Regions: Climate product generation, user liaison and training, held 8-11 September 2008, St Petersburg, Russian Federation, was the first step in building the collaboration required for a PCOF. This workshop brought together specialists from climate modeling, IPCC, ACIA, observations, climate services, climate risk management, and representatives of user communities (e.g. AMAP) from both circumpolar regions. Steps are underway to publish a concept paper and to develop and conduct a survey of user requirements for polar regions. These efforts will be undertaken in full collaboration with interested organizations and related programmes active in the region. This presentation will review in more detail the outcomes of the Workshop, opportunities for further collaboration, and future activities.

CLIMATE-CHANGE IMPACTS ON AN EMERGENT ARCTIC SHORELINE, HALL BEACH, NU

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This research is undertaken in support of the Nunavut Climate Change Adaptation Plan, as part of a collaborative effort to foster adaptation planning across Nunavut. In Hall Beach, where vulnerability to coastal erosion is a particular concern, climate change is expected to increase existing exposure. Adaptation measures such as increased setback or retreat are currently being considered. Understanding the coastal response to storms and other environmental forcing under present and future climate conditions is a prerequisite for development of appropriate adaptation plans. Hall Beach is located on an emergent coast in northwestern Foxe Basin. The area is low-lying, with raised gravel beach ridges interspersed with bouldery ground moraine. Thin-bedded grey limestone is exposed locally near the shore, providing a ready source of gravel and showing that the sediment cover is thin. Despite the permafrost setting, there is little excess ground ice. Fairweather and storm winds are predominantly offshore from the northwest, but ice-free fetch is unrestricted to the southeast and 65 to 150 km to the east through north. It is thought that alongshore sediment transport is driven by relatively rare storms from these directions in the fall prior to freeze-up. The climatological median freeze-up date is

October 22 but in recent years freeze-up has occurred in mid November, suggesting that storm-wave activity and associated sediment transport may be increasing. Hall Beach is situated in a broad bight fringed by gravel beaches with minor sand. A 1 km wide shallow irregular bench extends out to 6 m depth. Shoals adjacent to headlands to the north and south are covered with shore-migrating sheets of pebble gravel, providing a sediment source for beach progradation in those areas. The most dynamic area is a barrier spit complex that has been heavily impacted during construction and reclamation of the nearby DEW Line site. Several shore-normal ridges in this area have likely been modified for use as barge landings, but now show a progression to cuspate forelands and a related southward-prograding shore-parallel spit. Within the bight to the north, a 50 m wide foreland with an erosional hotspot fronts the community of Hall Beach. The foreland has occupied two quasi-stationary locations. In location 1 it reached maximum extent in 1987, then migrated approximately 250 m northwest by 1997 to location 2, where it continues to prograde. The erosional hotspot is located immediately north of the foreland and threatens several residences. Shore protection was installed in 2003 but was partly destroyed by a fall storm shortly after completion and continues to succumb to sea ice and wave impacts, possibly exacerbated by seepage. A subtle headland north of the community anchors northwestward directed spits and a breached spit-lagoon complex with spits recurved southward into the lagoon. The morphology of coastal features suggests bi-directional alongshore transport, which appears to be important in controlling erosion and deposition at Hall Beach. Continuing research is examining storm waves and currents to gain a better understanding of sediment transport and the impacts of changing climate on coastal processes.

NITROUS OXIDE CONCENTRATIONS IN THE AMUNDSEN GULF OF THE ARCTIC OCEAN

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Nitrous oxide (N2O), a byproduct of both nitrification and denitrification, is a potent greenhouse gas with a global warming potential of 311 times greater than CO2**.** Surpringly few measurements exist of N2O concentrations in the ocean and none from the Arctic. We measured N2O in the Amundsen Gulf in the high Canadian Arctic from December 2007 until July 2008 in surface waters and under the ice at several depths in the water column. We observed an 50-60% increase in N2O concentrations at all depths from December until the beginning April, coinciding with an increase in the concentration of nitrate. Concentrations of N2O remained high throughout April and decreased during May. In a spatially explicit survey of the Gulf during June and July, surface waters were always slightly supersaturated (110%) but varied little among sites. Given the observed increase N2O concentration with the production of nitrate over winter and in the deeper waters during the summer, nitrification is the most plausible metabolic mechanism responsible for its production. Indeed nitrification may be an important source of oragnic carbon for the Arctic foodweb.

CHARACTERISTICS OF NARWHAL VOCALIZATIONS FOR ACOUSTIC MORNITORING

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Monitoring wildlife is essential to assess human impacts. This is especially true for Arctic marine mammal species that are both subjected to changes in their environment and are harvested by local peoples. Because marine mammals are vocal species, acoustic methods can be used to monitor their population size and behaviour. As a first step in designing an acoustic detection and monitoring program, we characterized the acoustic repertoire of narwhals (*Monodon monoceros*) in Milne Inlet, northern Baffin Island. Narwhals produce characteristic whistle calls and we analysed the whistles heard in one minute intervals from 35 hours of recordings. We quantified the calling rate, the duration of whistles, the minimum and maximum frequency, the number of inflection points and other features. We also correlated the characteristics of whistles with the behavioural states of narwhals. The acoustic frequency produced by vessels that travelled in the area during the recording period was also analyzed in order to determine the possible impact of noise pollution on narwhals. Finally we make recommendations for the implementation of an acoustic monitoring program for narwhals in the Arctic.

LAKES IN THE CANADIAN REGIONAL CLIMATE MODEL

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Covering 9% of the Canadian territory, lakes are an important element of Canadian climate system and are essential for the regional climate modeling in Canada. The current version of the Canadian Regional Climate model (CRCM) incorporates a simple mixed layer lake model, using the thermal flux residuals calculated by CRCM using prescribed SST. This model simulates adequately the influence of Great Lakes to the regional climate, but not very flexible while changing domains due to the need to recompute residues. In addition, this approach is not applicable to the sub-grid lakes.

The next generation of the Canadian RCM will have many advanced land-surface modules including interactive lakes, both resolved and sub-grid type. The interactive coupling of 1D lake models in CRCM is in progress. As a first step, several lake models, including the Fresh water Lake (FLake) and the Hostetler model were tested off-line in conditions, reflecting different lake configurations (subgrid and resolved, deep and shallow lakes). The second step, including the development of the CRCM/lake models interface, providing the interactive coupling of lake models as well as tests and validation of coupled models, is currently underway. First coupled simulations will be presented and discussed.

OCEANIC FORCING OF RECENT WARMING IN THE WESTERN ARCTIC

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We analyze output from a high-resolution ice-ocean model of the pan-Arctic region forced with realistic atmospheric data and validated with available observations to determine the relative importance of internal oceanic forcing of the recent Arctic sea ice melt. In particular, the thermodynamic coupling at the ice-ocean interface in the western Arctic Ocean is investigated. Under-ice ablation by anomalously warm water advected from the Chukchi shelves and distributed at the subsurface layer in the western Arctic Ocean by mesoscale eddies is found to explain over 60% of the total variance of sea ice thickness. We hypothesize that the excess oceanic heat that in recent years has accumulated below the surface during summer is a critical initial factor in reducing ice concentration and thickness in the western Arctic Ocean at the early melting season and onwards the following year. Observational data of oceanic and sea ice synoptic states such as collected during the IPY 2007-2008 and more realistic model representation of feedback processes between the upper ocean and the atmosphere under diminishing ice cover are critical to test this hypothesis and to advance Arctic climate prediction.

MORE TALK, MORE ACTION : COOPERATIVE APPROACHES FOR ADDRESSING CLIMATE CHANGE ADAPTATION AT THE COMMUNITY LEVEL IN NUNAVUT

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Effective solutions for complex Arctic issues such as climate change require cooperation between communities, researchers and other decision-makers. These collaborative relationships foster successful delivery and impact of broad Arctic initiatives like ArcticNet and International Polar Year. An ambitious and successful approach for developing community-based cooperative relationships in Nunavut has been underway since 2006. This has been part of a large collaborative project initiated by the Government of Nunavut, Natural Resources Canada and the Canadian Institute of Planners. The goal of this work is to link science, traditional knowledge and territorial decision-making in order to build local planning capacity and develop a Nunavut climate change

adaptation plan. To date, significant cooperative work has been conducted in Clyde River, Hall Beach and Iqaluit and some in Resolute, Arctic Bay, Pond Inlet, Qikiqtarjuaq, Pangnirtung and Igloolik. New work and community partnerships are being planned for 2008 in the Kivalliq and Kitikmeot regions. The focus of this presentation will be on the varied community-based approaches that have been implemented in the above project. Examples from Clyde River, Hall Beach and a new permafrost monitoring effort will be used. Methods employed, lessons learned and the impacts of these cooperative relationships will be discussed. A comparison of cooperative relationships involving a community-based NGO and hamlets will be provided as well as a glimpse of an exciting new community-led research centre (Ittaq Heritage and Research Centre, Clyde River). In addition, a business case will be presented showing how proper cooperative relationships have economic benefits for communities and ensure successful delivery for research projects. In summary, this presentation will share experiences and provide information and advice to assist other communities and researchers integrating local expertise and scientific knowledge to help understand and address local climate change issues.

CLIMATE CHANGE AND INSTITUTIONAL CAPACITY IN AN ARCTIC GATEWAY COMMUNITY: A CAVIAR CASE STUDY OF THE CITY OF WHITEHORSE

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This study is part of the international CAVIAR Project (Climate Adaptation and Vulnerability in Arctic Regions) funded by the International Polar Year and led jointly by the Global Environmental Change Group at University of Guelph, Canada and the Centre for International Climate and Environmental Research, Oslo, Norway. The focus on the City of Whitehorse, Yukon provides a unique perspective on northern climate vulnerability and adaptation issues through its focus on a mid-size northern "Gateway City". The presentation discusses early results from first rounds of interviews in which we explore issues of governance, planning, decision making and organizational culture in the context of climate and other changes facing the north. Working within the framework of the CAVIAR project our specific focus is on understanding the application of governance in the context of near term, adaptive strategies and future adaptive capacity. We apply a new institutional analysis approach through an exploration of key linkages, relationships and decision processes both within the civic government structure and between the City and other jurisdictions and levels of government, including two First Nations upon whose traditional territory the City is situated. The goal is to increase understanding of how the City of Whitehorse works and thereby demonstrate the institutional capacity of the City to adapt to a changing economy and a changing environment.

Keywords: new institutionalism, adaptive capacity, social capital, resilience, adaptation, climate change, governance, sustainability.

DOES SEA ICE-ASSOCIATED VARIATION IN DIET INFLUENCE THE TEMPORAL TRENDS OF ORGANOHALOGEN CONCENTRATIONS IN WESTERN HUDSON BAY POLAR BEARS?

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Diet is the major route of organohalogen exposure for top Arctic predators, like polar bears. Recent use of stable isotopes and fatty acids as dietary tracers has revealed differences in polar bear prey items at least over limited time periods of 2-3 years, which has direct implications for the interpretation of contaminant temporal trends. It has been proposed that variation in the diet of Western Hudson Bay (WHB) polar bears may be related to climate change-induced, long term changes in ice coverage in the Bay, as their main hunting location for marine mammals is the winter sea ice. There has been a significant shift in the date of ice break-up in WHB of approximately one week earlier per decade over the last 30 years, coinciding with an increase in mean annual air temperature over the same period as measured at Churchill, Manitoba. In the present study, we first investigated if dietary variation influences the temporal trends of organohalogen contaminant concentrations in polar bears. We analyzed archived fat samples of WHB polar bears that were selected from years spanning 1991 to 2007 for stable carbon isotopes ($\delta^{13}C$) and fatty acids

(FA), as well as legacy chlorinated and emerging brominated contaminants. Examining samples from all years together demonstrated that, e.g., the sum-PCB concentrations were correlated with $\delta^{13}C$ values ($r = 0.36$, $p = 0.007$) and with the FA index (represented by PC1 from a PCA of all dietary FAs; $r = -0.56$, $p = 0.000008$), and that by controlling for the influence of these diet variables, we were able to reduce previously unexplained inter-annual variation in sum-PCB concentrations. There was, however, no clear trend in $\delta^{13}C$ values or FA index over the entire 16 year time span, which is probably due to the small number of years sampled and the inter-annual fluctuation in diet. The date of ice break-up has been occurring increasingly earlier, but also shows large inter-annual fluctuation; we therefore examined whether diet actually fluctuates as a function of ice break-up date. For the selected years, mean $\delta^{13}C$ was positively correlated with the ice break-up date. This supports the hypothesis that temporal diet variation may, in part, be due to climate change, but other influences cannot be ruled out such as decreases in $\delta^{13}C$ due to the incorporation of $\delta^{13}C$-depleted CO_2 from fossil fuel combustion into Arctic marine food chains. In this study, we show that organohalogen contaminant trends in WHB polar bears are affected by alterations in diet, which may be mediated by ice changes. As ice patterns shift in relation to climate change, this research demonstrates that consideration of diet will become increasingly useful for the interpretation of trends and health consequences of contaminants for polar bears, and possibly for other pagophilic Arctic species.

LATITUDINAL TRENDS IN PREDATION PRESSURE: INVESTIGATING THE VULNERABILITY OF SHOREBIRDS TO CLIMATE INDUCED SHIFTS IN PREDATOR COMPOSITION

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Recent studies have stressed the importance of local interactions in defining species distributions especially in the context of climate-induced shifts in species distributions. Historically, species distribution models have been rooted in simple species-environment relationships, with little consideration for inter-specific interactions such as predation. The extent to which local ecological processes affect large scale bio-geographical processes, such as species distributions, remains unclear. The 'predation hypothesis' suggests that the reduced predation pressure at higher latitudes can be used to partly explain latitudinal gradients in species richness. The eastern Canadian arctic exhibits the greatest latitudinal range in shorebird distribution. Shorebirds are among the longest distance migrants with several species travelling up to 20,000 km from wintering areas in South America to high arctic breeding grounds. It remains a 'migration paradox' why long distance migrants pass over suitable southern nesting habitats to nest in more northern and often harsher climates of the high arctic. If latitudinal trends in predation pressure exist in the arctic, then reduced predation pressure at more northern sites could compensate for increased costs of migration to these sites. Here, we experimentally investigated spatial variation in predation pressure on shorebirds by conducting artificial nest experiments at 7 sites throughout the eastern Canadian Arctic (Churchill, Akimiski, Is., Southampton Is., Coats Is., Prince Charles Is., Bylot Is., and Ellesmere Is.). Experiments were conducted over a minimum of two years at each site between 1996 and 2008 following a standardized protocol. Survival analyses were conducted to test for the effects of latitude, year and environmental variables. Testing for a latitudinal gradient in predation pressure may confirm its role in defining shorebird distribution in the arctic, and reveal the vulnerability of shorebird populations to climate induced shifts in predator composition.

DEVELOPING TERRESTRIAL ECOLOGICAL INVENTORY METHODS THAT LINK LAND SURFACE PROCESSES TO TUNDRA ECOSYSTEMS IN TORNGAT MOUNTAIN NATIONAL PARK RESERVE

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All of Canada's national parks are in the process of designing and developing ecological integrity (EI) monitoring programs aimed at assessing and reporting to Canadians any significant changes in park EI. Arctic national parks have a special set of challenges to accomplish this task, including the remoteness and size of the parks, and the relatively subtle short and intermediate term changes that may result from predicted climate change. As a component of the design and implementation of EI monitoring programs for arctic national parks, terrestrial ecological inventories are being completed in 4 model parks (Ivvavik NP, Torngat Mountains NPR, Wapusk NP, Sirmilik NP) to provide baseline status of park terrestrial ecosystems, and to link the distribution, composition and structure of these ecosystems to the land surface processes (for e.g., fluvial, depositional, aeolian, cryogenic) that determine their distribution and character. A two-stage approach is being developed where detailed ecosystem mapping using high resolution aerial photography or satellite imagery is being completed for a targeted 'focal watershed', and intermediate scale satellite imagery (SPOT5) will be used to complete the inventory across the park. In this presentation we will show first year results from Torngat Mountains NPR, including a Terrestrial Ecosystem Mapping product for a focal watershed, McCornick Brook. We will discuss the communities/ecotypes mapped, their links to land surface processes, and how we intend to use this information to design a long term EI monitoring strategy for the watershed. We will also discuss the development of vegetation classification using Canadian National Vegetation Classification principles, how we use the vegetation classification and community distribution to identify key climatic zone boundaries (Submontane, Montane and Alpine), and linkages between Coastal, Freshwater, Tundra, and Glacier EI Indicators that are facilitated by this inventory approach. Finally, we will outline plans to link the detailed inventory to a broad scale terrestrial inventory for the entire park.

FORECASTING THE SOLID-TO-LIQUID RATIO OF SNOW PRECIPITATION IN HIGH-RESOLUTION NWP MODELS

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The horizontal grid-spacing of numerical weather prediction models is continually increasing and high-resolution cloud-resolving models are quickly becoming important tools in operational meteorology. In these models, the precipitation is predicted almost entirely from the cloud microphysics parameterization scheme. The total frozen precipitation comes from the sum of the precipitation of the various ice-phase hydrometeor categories in the scheme. Typically, the precipitation rate from the model is given as the mass flux at the surface, which is used in turn to compute the accumulated liquid-equivalent precipitation. For some applications in the Arctic and other regions, the depth of the unmelted snow that is forecast is desired. Typically, this quantity is obtained by applying a solid-to-liquid ratio, either an assumed value or one obtained by some post-processing algorithm, to the forecast liquid-equivalent amount. The methods, however, are generally based on rules-of-thumb and do not always work well to forecast snow depth.

In this study, we propose an approach of exploiting information in the microphysics scheme to obtain an estimate of the instantaneous bulk snow density. With this, the volume flux of precipitating snow at the surface can be obtained. The instantaneous solid-to-liquid ratio of precipitating snow, which can change in time with changing environmental conditions, can therefore be determined. The approach to estimating the snow density is essentially to compute a mass-weighted average of the bulk densities of the precipitating ice-phase categories in the cloud scheme: pristine ice crystals, large crystals/aggregates, and graupel (rimed crystals). The bulk densities of pristine ice and graupel are prescribed constants, while the density of the large crystal/aggregate category is a diagnostic function of the mean-mass equivalent-volume diameter, based on distrometer measurements. While this method is simple and still depends heavily on assumptions made in the microphysics scheme, it is able to make use of information in the model about the growth environment at given points in time and space. For example, the solid-to-liquid ratio will be relatively large, reflecting a low bulk snow density, for a dry environment (i.e. no supercooled liquid water) in which snow is grows by depostion only and the ratio will increase further as the ambient temperate warms and the rate of

aggregation increases. On the other hand, if riming occurs and graupel forms, the solid-to-liquid ratio will decrease.

A description of the method, as applied in the cloud microphysics scheme of the Canadian GEM-LAM model, will be presented along with demonstrations from case studies on the GEM-LAM Arctic grid for cases in the Baffin Island region.

A WINTER CARBON FLUX TIME SERIES IN LAND-FAST SEA ICE

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A winter time series (January – May) of carbon fluxes and dynamics in land-fast ice of the southern Beaufort Sea has shown that sea ice does not prevent air-sea CO_2 exchange. To the contrary, through deep winter and into the start of the spring melt season, there appears to have been a net carbon transport from the atmosphere into the underlying water, via the sea ice. In deep winter, as temperatures declined to their lowest values, a consistently downward CO_2 flux in the lower atmosphere was associated with low inorganic carbon contents at the top of the sea ice and very high pCO_2 values within the ice, presumably due to $CaCO_3$ precipitation from highly concentrated brines. As the season progressed, we observed very large fluxes (mainly downward, but also some upward) in the atmospheric boundary layer at times when the temperature was either rising or at a temporary maximum, likely the result of increasing ice permeability as brine channels expanded. Throughout the time series, the total carbon content of the ice increased significantly, but not enough to account for the observed atmospheric fluxes. During the same time period, the total carbon content of the surface waters below the ice also increased, along with salinity, implying that the carbon increase was due to drainage of ice brines. Because of the uncertainties in the observed carbon fluxes and reservoirs, we cannot say whether the budget is balanced for carbon transfer from the atmosphere to the ice and into the water; we can only say that some transport is occurring.

OBSERVATIONS AND MODELING OF SNOW MICROPHYSICS IN ARCTIC MIXED-PHASE CLOUDS

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Recent field experiments (e.g., SHEBA, MPACE, ISDAC) have indicated the prevelance of mixed-phase clouds in the Arctic, even at temperatures substantially below freezing (less than -25 C). These clouds have a large impact on the surface radiative fluxes and hence the surface energy budget and sea ice mass balance. Despite their importance, Arctic mixed-phase clouds are poorly represented in current weather and climate models. Previous studies have suggested that the treatment of ice and snow microphysics plays a key role in simulating these clouds. In this study, detailed observations of the snow particle size distributions from SHEBA and MPACE are analyzed. Results for low-level, shallow stratiform mixed-phase clouds and deeper mixed-phase clouds associated with synoptic disturbances are compared. It is found that the intercept and slope of fitted exponential size distributions (for particles larger than 100 microns) are much smaller in the shallow, low-level mixed-phase clouds than the deeper clouds. Implications for modeling of snow microphysical processes are described. Finally, sensitivity of high-resolution mesoscale model simulations of a low-level, mixed-phase cloud observed during MPACE to the representation of the snow size distribution are presented.

SEAFLOOR MAPPING OF THE CENTRAL LABRADOR MARGIN: NEAR SURFACE GEOLOGY AND GEOHAZARDS

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The central Labrador margin is experiencing renewed hydrocarbon exploration interests; 2008 land sales commit a minimum of $180M to explore the region over the next five years. The central Labrador continental slope is being investigated to document seafloor instability features and processes that may constrain hydrocarbon exploration and development. Currently, there is minimal geoscience knowledge or data availability to properly design or regulate future deepwater drilling or development. Between 2005 and 2007, CCGS Amundsen collected 5730 km^2 of EM300 swath bathymetric data from 1000 to 3000 m water depth, and follow-on geophysical and geological surveys were conducted aboard CCGS Hudson. The resulting reconnaissance-level data provide a regional geological context to assess the nature, distribution and severity of seafloor conditions and seabed instabilities.

The overall Quaternary geological architecture of the Labrador margin is similar to southeastern Canadian slopes, dominated by glacial processes. In the Labrador margin case, however, glaciers reached the outer shelf much later than to the south and there is an absence of salt tectonics, a persistent and strong Labrador and North Atlantic Deep current, and an abundance of near-surface and surficial ice-rafted sediment. Multibeam data show the degree of erosion of the Labrador margin is intensive but highly variable. The Makkovik - Hopedale sector is highly dissected, much like some of the eastern and western parts of the Scotian margin, whereas in other areas there is substantial net slope sediment accumulation, as off Hamilton and southern Saglek Banks. Transverse troughs ("saddles") on the Labrador Shelf were conduits for ice streams during glaciation and the sites of major sediment input, creating trough-mouth fans on the continental slope and rise. Erosional gullies and valleys on the upperslope coalesce downslope to create a heavily incised margin, probably resulting in coarse-grained sediment at or near the seafloor. Stratigraphy in the flanks of the channels shows a strong erosional phase followed by levee construction. Additionally, BSRs are detected within these upper slope sediments.

Similar to the southern Canadian margin, mass transport deposits form a significant proportion of the Quaternary sedimentary succession. Multibeam data show large (50-100 m high) linear (1-5 km long) angular protuberances standing proud of the seafloor at abyssal depths. Correlation with seismic profiles show these features to be the tops of protruding slide blocks transported within a mass-transport deposit that is greater than 30,000 km^2 in area and hundred's of metres thick. Bottom photos on these features show them to be composed of diamict, thus likely originating from shelf depths. From these preliminary data, it would seem that risk of modern submarine landsliding is low and similar to the Canadian margin to the south, but significant coarse sediment in the shallow geologic section due to more recent glacial deposition, IRD, allochthonous blocks and erosional lag deposits will likely present constraints to drilling and pipeline routing.

THE EFFECT OF CLIMATE, ENVIRONMENT AND MAN ON VARIATIONS IN WILDLIFE POPULATION FLUCTUATIONS IN GREENLAND OVER 200 YEARS

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The underlying factors of species fluctuating population dynamics has been the dominant focus of attention in population ecology throughout much of this century. In arctic regions where a severe climate with high seasonal and annual variability and simplistic ecosystems prevail, species of fish, birds and mammals display distinct population fluctuations of varying temporal and spatial scale. In Greenland, historical records, archaeological findings and oral accounts passed on from Inuit elders all document that the presence of wildlife species and their population sizes have undergone pronounced fluctuations throughout recordable historical time. The most detailed accounts are found for the species that were harvested or had economical value. While several recent studies from northern latitudes have shown the relative roles of climate, the exogenous and endogenous environment of species and man as factors driving species population dynamics, the relative contributions and potential interactions among these factors remains unsolved. In Greenland, these fluctuations in the harvests of individual species are believed to be related to changes in climate, as well as variations in hunting pressure. Dating back 200 years, these hunting records therefore represent a unique time series for retrospective modelling of annual and decadal fluctuations in relation to long-term climatic data, environmental factors and temporal variations in social and demographic parameters in the existing society. The results of this study will model future predictions of wildlife populations under changing climate variables and human hunting pressure.

POLAR SUNRISE 2008 COMPARISON OF LIDAR WATER VAPOR MEASUREMENTS FROM THE IASOA PEARL OBSERVATORY IN EUREKA, CANADA AND THE ACE SATELLITE

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Water vapor is an important part of the atmosphere due to its roles in the hydrological cycle, greenhouse heating and ozone chemistry. The stratospheric ozone lidar located at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut (80.2 °N, 86.4 °W) is jointly operated by the Canadian Network for Detection of Atmospheric Change (CANDAC) and Environment Canada. It has recently been upgraded to measure water vapor at 150 m vertical resolution in the polar troposphere up to about six kilometers, with measurements extending above this at lower vertical resolution. Successful validation of these measurements will allow scientific studies to begin with the coincident measurements from the lidar and suite of CANDAC instruments at PEARL. In concert with the lidar's well-established ozone and temperature profiles these new water vapor measurements will allow incidents of stratosphere-troposphere exchange to be monitored as well as, when combined with other measurements from PEARL instrumentation, detailed studies of ozone chemistry to be performed. With the motion of the polar vortex bringing it overhead and away from PEARL during the course of a campaign, it is possible to look at interactions between upper tropospheric jets and the vortex. Water vapor measurements have been taken and analyzed for eleven nights during the Canadian Arctic ACE Validation Campaign in February and March 2008. Calibration of the lidar has been obtained by comparing lidar measurements from seven clear nights to water vapor measurements from the regular radiosonde launches at the Eureka Weather Station. A consistent altitude dependent bias between the two instruments is found, giving us confidence in the calibration. Calibrated lidar measurements are currently being compared to water vapour measurements from overpasses by the Atmospheric Chemistry Experiment (ACE) satellite, as well as compared to the ozone measurements obtained during the campaign.

RIVERINE EXPORT AND THE EFFECTS OF CIRCULATION ON DISSOLVED ORGANIC CARBON IN THE HUDSON BAY SYSTEM, CANADA

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The distribution of dissolved organic carbon (DOC) in Hudson Bay (HB), Foxe Basin (FB) and Hudson Strait (HS) was examined during 1-14 August 2003. The Hudson Bay system displayed relatively high DOC concentrations with medians of 109, 90 and 100 μmol L^{-1} for measurements made in HB, FB and HS, respectively. Waters were significantly modified as they circulated through the Hudson Bay system. A dominant influence of marine derived DOC was inferred for waters entering the system from northern HS and FB into northwestern HB, whereas a considerable input of terrigenous DOC was observed as waters circulated cyclonically in HB. In particular, DOC-laden rivers in southern Hudson Bay increased the surface water DOC concentration, which then displayed a conservative behavior as water exited the Bay along the southern coast of HS. Additionally, the late stages of ice melt observed during this study had a significant dilution effect on surface DOC concentrations within eastern HB. We estimated a near equal input and export of riverine DOC in the HB system of ~5.5 Tg C yr^{-1}. This estimate equates to approximately 23% of the annual DOC input from rivers to the Arctic Ocean and therefore represents an important contribution of terrigenous carbon to northern seas.

VERTICAL TRANSPORT AND MIXING OF AEROSOLS AND MOISTURE IN POLAR REGIONS BY COLD LOWS SYSTEMS

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Measurements from CloudSat and CALIPSO reveal two types of very extensive thin ice clouds in Arctic regions: thin precipitating ice cloud layers (TIC-2) detected by both instruments and lofted thin ice cloud layers of smaller crystals (TIC-1) seen by the lidar only The vertical distribution of the TIC-1 and TIC-2 clouds is the result of a combination of transport and microphysical processes experienced by the air mass along its trajectory. An important mechanism in the vertical transport and mixing of aerosols and moisture is the presence of dominant quasi-stationary cyclones over the Arctic Ocean. These systems are characterized by a deep vertical cold core in a dissipation phase. The resulting stratified aerosol layers from these systems have been observed between 3 and 7 km forming with the cold air mass an aerosol dome across the Arctic basin. The frequency and concentration of anthropogenic aerosols often exceed that of most polluted regions of the world at the same altitude. NARCM simulations agree that the maximum aerosols concentration in the upper troposphere may occur during winter above the remote central Arctic. The role of cold lows and the significance of the Arctic TIC layers in relation to aerosols will be discussed. Implication of the dehydration-greenhouse feedback (DGF) process and the slow aerosol-cloud interaction observed over several days will be also discussed.

THE INTERNATIONAL STUDY OF ARCTIC CHANGE: TOWARDS IMPROVING PAN-ARCTIC OBSERVATIONS AND UNDERSTANDING OF CHANGE

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The changes to climate and environment in the Arctic are more rapid and profound than in most other regions on the Earth. These changes already have large impacts on the ecosystem and on the societies of those that live in the Arctic. Many of the changes appear on a pan-Arctic scale and are interrelated with the effects of human response to changes in the living conditions. This complex system of changes is poorly understood and to be able to properly respond and to develop sustainable mitigation and adaptation strategies, there is an urgent need to develop a deeper knowledge of the causes to these changes and the feedbacks in the entire system.

ISAC is a long-term, multidisciplinary program developed to study the effects of environmental changes on the circumpolar Arctic system and connections to the global system. ISAC includes the physical and chemical, biological and ecological as well socio-economic and cultural systems and concerns both effects due to the enhanced greenhouse warming and other anthropogenic activities, and the effects of the natural variability affecting the Arctic. ISAC will take a system approach to facilitate expansion and deepening of our knowledge of the arctic system and to document changes in the Arctic with respect to spatial and temporal patterns. ISAC will engage in observational, synthesis and modelling activities in response to societal and scientific needs and will provide the necessary scientific background for future impacts assessments.

WEST GREENLAND CURRENT VARIABILITY

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Six historical summer sections across the West Greenland Current are examined. Three sections have been regularly occupied since the late 1950s, while the three southern ones have been taken since 1984. Significant variability in hydrography is observed on all sections, both for the freshwater core of the coastal current on the shelf, and for the warm and saltier Irminger Water offshore. This includes the presence of significant amounts of low salinity water in 2008. The section data is used in combination with a theoretical frontal model to produce estimates of velocities and transports. Maximum mean transports of are observed at the Cape Desolation section. Transports decrease to the north, with the majority of the exchange with the interior of the Labrador Sea occurring between Cape Desolation and Fylla Bank. Freshwater transport is largest at Cape Desolation, with a significant flux into the Labrador Sea interior as one goes north in the West

Greenland Current. Recent changes in freshwater transport, and the transport of salty Irminger Water, over recent years will be examined. Linkage with two modelling efforts, focussing on the North Atlantic, and the Canadian Arctic Archipelago, will also be discussed.

HOW DO NATURAL AND ARTIFICIAL TALL SHRUB CANOPIES ALTER TUNDRA SOIL TEMPERATURES?

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With a warming climate, northern ecosystems will experience shifting ecosystem boundaries such as the spread of tall shrubs into tundra communities. Rapid shrub expansion has been documented in arctic Alaska and the Northern Yukon and NWT using repeat aerial photography, and satellite imagery shows a greening of the arctic tundra. The correlation between warming and greening has been used to link climate change with shrub expansion; however, the exact mechanisms driving shrub increase are probably a more complex interaction between nutrients, snow, soil temperatures and disturbance. We are investigating the spread of willows up slope into the alpine tundra of the mountains around Kluane National Park to identify mechanisms promoting shrub expansion and the impacts on the tundra ecosystem. To measure the influence of snow-capture by shrubs on soil warming, we manipulated willow (*Salix* spp.) cover to compare soil temperatures beneath plots with intact shrubs, shrubs removed, artificial vegetation canopies, and adjacent, shrub-free tundra. In summer, a shrub canopy can shade the ground surface, and in winter, snow trapping can insulate the soil. Enhanced nutrient cycling from warmer winter soil conditions may provide a positive feedback mechanism promoting the expansion of shrubs in the arctic. Results from the first year of our experiment indicated that a shrub canopy cooled soils by a maximum of 3.5ºC at 2 cm depth and 2.8ºC at 5cm depth across the 2008 growing season, and warmed soils by as much as 10.8ºC at 2cm depth and 8.8ºC at 5cm depth over 2007-2008 the winter. Shrub plots had 21cm greater snow depth in January 2008 than adjacent shrub-free plots. Artificial shrub canopies and shrub removals functioned similarly to unmanipulated shrub and tundra plots indicating that the shrub canopy, rather than the soil composition or moss cover, is the major factor influencing the soil thermal regime in this alpine tundra ecosystem.

SEASONAL AND INDIVIDUAL VARIABILITY OF LIPID RESERVES IN *OITHONA SIMILIS* (CYCLOPOIDA) IN AN ARCTIC FJORD

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Despite their high abundance, small copepods (<1mm) are usually not considered when it comes to energy transfer in polar pelagic ecosystems. Among them, *Oithona similis* (Cyclopoida) is a cosmopolitan and ubiquitous copepod which might thus not be affected by the reduction or different timing of ice-cover in the Arctic. The lipid storage of the *O. similis* was investigated from early spring to late summer 2006 and 2007 in Kongsfjorden (Svalbard, Norway), using both optical and biochemical approaches. The volume of lipid droplets in each individual reflected the amount of stored wax esters, thus seasonal changes of lipid storage coupled with informative inter-individual variability were obtained. The seasonal pattern showed an increase in lipid store during the spring bloom, starting before the chlorophyll *a* maximum for both copepodids stage V and females. Females used those reserves during the main reproductive event in June. Individual variability was very high, with a significant proportion of copepods having no lipid droplet while others were lipid rich. Particularly in autumn, females could have different age and feeding history due to the overlap of generation. Consideration of intra-population variability in lipid storage improved our understanding of *O. similis*'s ecology and life cycle.

INTEGRATING SCIENCE AND TRADITIONAL KNOWLEDGE IN THE INUVIALUIT SETTLEMENT REGION: PERSPECTIVES FROM A BELUGA COMMUNITY BASED MONITORING PROGRAM

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Since the 1980's beluga whales have been sampled from subsistence hunts by communities in the Inuvialuit Settlement Region (ISR) for contaminant and health research. The partnership between science and communities has resulted in one of the largest available long term data sets for an arctic marine mammal in Canada. The collaboration was largely fostered by the Fisheries Joint Management Committee (FJMC), a co-management body representing the Inuvialuit and Government of Canada. FJMC was created out of the Inuvialuit Final Agreement as the first of its kind in the Northwest Territories to meet some of the goals of the land claim. The FJMC was developed based on previous successes using co-management; the model is now being used in other land claimant groups as a blueprint. FJMC is responsible for the collection of harvest information of subsistence fisheries and makes recommendations on fish and marine mammal quotas. To fulfill the co-management mandate information provided from science and traditional knowledge are needed. Here we present a program that bridges science and community based monitoring to examine the successes and next steps needed to enhance TK and science integration into co-management.

In the year 2000 a community based monitoring program was based out of Hendrickson Island, near Tuktoyaktuk NT in partnership with the community, FJMC and the Department of Fisheries and Oceans. Monitors at Hendrickson Island work closely with all hunters to collect samples as well as record observational information. The data and samples have been used by various researchers to address questions ranging from contaminant levels, to diet and health. The success of the Hendrickson Island beluga community based monitoring program has attracted new researchers and new questions. This will increase the capacity of the program to address issues ranging from local to global concerns as well as increase the capacity for community based monitoring. Given these successes, the community based monitoring program is beginning to address on how to better incorporate community perspectives. This phase brings new and unique challenges that science has not fully addressed in past programs. Here we present and discuss the future directions of TK and science integration in community based monitoring programs.

ARE INUIT PROTECTED AGAINST DELETERIOUS EFFECT OF TRADITIONAL CARDIOVASCULAR RISK FACTORS FOR ATHEROSCLEROSIS?

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Introduction: Prospective studies reported an association between subclinical atherosclerosis evaluated by ultrasonographic carotid intimal to medial thickness (CIMT) with traditional risk factors for cardiovascular disease (CVD). However, less is known for subjects whom diet is particularly rich with omega-3 (n-3) which has been suggested to convey cardioprotective effect. We thought to determine if Inuit's traditional diet high in marine n-3 have an impact on CIMT.
Methods: The near and far wall of both common CIMT, free of plaque, were measured in randomly selected Inuit (n=272) from Nunavik older than 40 years (range 40-74) who participated in the 2004 Nunavik Health Survey. Prevalence of diabetes mellitus (DM) and hypertension (HBP) were confirmed from medical files. Membrane red blood cell phospholipids fatty acid composition was determine from fasting blood samples and body mass index (BMI) from anthropometric measurements. Groups comparisons of CIMT were calculated using analysis of variance (ANOVA) adjusted not only for age and gender but also in order to take into account the complex sampling strategy.
Results: Mean CIMT was lower compared with what is currently being reported for southerners (0.57 ± 0.18 mm) and n-3 expressed as a percentage of total fatty acid in the red blood cell membrane phospholipids was higher (12.4 ± 3.4%). There was no difference of CIMT between DM and none DM group (0.53 ± 0.14 vs 0.57 ± 0.13 mm; p=0.17) as well as between hypertensive groups (0.59 ± 0.14 mm vs 0.61 ± 0.24 mm; p=0.06). When categorized in groups of normal (BMI<25), overweight (BMI 25-30) and obese (BMI≥30), CIMT did not differ (0.53 ± 0.15, 0.58 ± 0.17, 0.59 ± 0.15 mm respectively; p=0.54). Age and gender positively correlate with CIMT.
Conclusion: Despite the fact that CIMT has been suggested to further refine CVD assessment, it may not be the case in Inuit as it is not well correlated with some traditional risk factors. Our results also suggest that high concentration of n-3 in the red blood cell membrane may have atherosclerotic protective effect in the presence

of risk factors for CVD. Further analysis of other pro atherosclerotic risk factors are needed to better understand our findings.

RELATIONSHIPS BETWEEN SULPHUR DIOXIDE, SULPHATE AEROSOLS AND DIMETHYLSULPHIDE IN THE ARCTIC ATMOSPHERE

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Where and when aerosol initiation occurs in the arctic boundary layer are important factors to consider if we are to improve estimates of the direction and magnitude of radiative effects from biotic emissions. Measurements of the concentration of a reduced sulphur compound associated with biota in the surface ocean, dimethylsulohide, and its oxidation products, sulphur dioxide and sulphate, were made aboard the Canadian Coast Guard ship, the Amundsen, through the Northwest Passage in the fall of 2007, and in the eastern arctic in 2008. Results from a previous study of sulphate from dimethylsulphide oxidation for aerosols at Alert, Nunavut, showed an increase in this source of atmospheric sulphur during the fall and early winter over the period 1993-2003. Does this reflect a relationship between sulphur emissions from algae and the reduction of multi-year ice? Atmospheric sulphur compounds were studied with the use of isotope apportionment to discriminate between anthropogenic and biogenic sulphur. Comparisons of the data with observations of sea-ice conditions and atmospheric conditions will be discussed.

LIPID CLASSES METABOLISM OF THE ARCTIC AMPHIPOD THEMISTO LIBELLULA: GROWTH AND ENVIRONMENTAL INFLUENCES

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Total lipid and lipid classes composition of the pelagic amphipod *Themisto libellula* were determined for different size classes (4mm to 40mm), from May to September 2006 and 2007 in two fjords in Svalbard. High amount of lipid (0.71 up to 21.06 % wet weight) were found with dominance of either triglycerides (TAG), wax esters (WE) or phospholipids (PL). In 2006, lipid dynamic of newly recruited individuals revealed a continuous deposition of neutral lipid along the somatic growth, mainly WE and to a lesser extent TAG. In 2007, organisms differed significantly from this pattern: low neutral lipids were accumulated during spring and summer and thus PL constituted the dominant class (45% of the total lipid in mean). PL were also positively correlated with total lipid content suggesting a potential role in lipid storage. In addition, low levels of biochemical condition indexes were observed in 2007 and could be due to changes in food quality and/or availability for *T.libellula*. This hypothesis can be regarded in relation with higher sea water temperature in 2007 than in 2006 which is linked to the amount of Atlantic water in the West Spitsbergen Current. This study gives insights on the potential implication of Arctic warming on *T.libellula* lipid deposition and, to a larger extent on energy transfer through the arctic marine food web due to its key role as a link between herbivorous zooplankton and higher trophic levels.

CLIMATE CHANGE IN THE ARCTIC – PERSPECTIVES TO ADAPTATION

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Climate change in the Arctic – perspectives to adaptation

Climate change causes melting of Arctic sea ice, and the Arctic region is warming faster than the rest of the world. Although the new economic opportunities are very relevant in the future development in the Arctic, their implications for the Arctic environment and present climate change may have even greater impacts on the Arctic communities. These communities need to adapt.

Sometimes adaptation has been viewed in a simplistic manner. According to such view, adaptation means just replacing of one renewable resource base with another one. The main argument of my presentation is that adaptation in the Arctic is complex and multi-dimensional. I want to provide perspectives to adaptation

in Arctic communities from a case study considering Inuit in Greenland. I show that the Greenland Inuit have throughout the history been challenged by environmental (and other) change and I give perspectives and examples to how adaptation has taken place.

The Inuit have been able to adapt, for example, because of their flexible and highly developed hunting techniques and equipments on land, sea, and ice. They have been able to use large and varying renewable resource base and they have diversified subsistence activities. The Inuit have also been familiar with environmental variations. Very important has been that the Inuit were mobile and they established flexible settlements. The society based on well-defined rules and practices, which protected its members.

In the 1900s, the Greenlandic society had to adapt the whole national economy in a new environmental (and market) situation, which had great effects on people's spatial organization. The case of Greenland is a success story of adaptation, in a sense the Inuit have been able to survive in marginalized environmental conditions. I point out in my presentation that adaptation has required very much flexibility. Adaptation has also been a process that has affected the society in multiple levels, which have caused changes from household level to entire national economy.

It is important to learn lessons from the past, but one has also to understand that the situation with melting ice will cause totally new situations to adapt to. Great flexibility will be required, and close monitoring of changes in the environment.

CURRENT STATUS OF THE SOUTHERN HUDSON BAY POLAR BEAR POPULATION

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Polar bears in Hudson Bay are at risk due to changes to the distribution and duration of sea ice that have already occurred or are predicted to occur in the future. For example, the Western Hudson Bay population has shown declines in body condition and has declined in abundance by >20% in the past 2 decades. The Southern Hudson Bay population is less well studied and its status is less well known. However, recent work indicates that body condition for all age and sex classes declined significantly between 1986 and 2005. Results of a recently-completed capture-recapture study show that there has been no decline in abundance in the past 2 decades; however, there is evidence of declines in survival for several age and sex classes. This information, coupled with the projected changes to sea ice in the future, suggests that the Southern Hudson Bay population may be at a tipping point. Declines in abundance similar to those experienced by the Western Hudson Bay population can be expected in the near future.

APPROACHES TO MONITORING NORTHERN VEGETATION CHANGE WITH SATELLITE REMOTE SENSING

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Northern vegetation changes have local implications for wildlife and the northern communities that rely on their populations for food. They also have farther-reaching implications on feedbacks to the global climate system, such as albedo. Vegetation changes in Canada's northern regions due to climate warming have been documented through experimental warming, anecdotal evidence and plot-based analyses in few, select areas in the north. Remote sensing provides the ability to assess and monitor these changes across vast, distant northern regions. Researchers have documented widespread changes in satellite-based vegetation indices, such as the Normalized Difference Vegetation Index (NDVI), across Northern Canada and Alaska and have speculated that these changes are caused by increasing shrub and graminoid biomass resulting from temperature fertilization. This presentation highlights some of the approaches used to monitor northern vegetation change based on archived satellite remote sensing data. Medium resolution (~30m) sensors such as Landsat provide spatial detail on the land surface, but are acquired every 14 days over a given point on the earth's surface. Usable Landsat data are further reduced by cloud cover and a short growing season in the north. Coarse resolution (1km) data from sensors such as AVHRR provide daily observation over all of Canada, increasing the probability of acquiring frequent cloud-free surface measurements. At the Canada Centre for Remote Sensing, we have combined the best attributes of both data types by merging the high spatial frequency information from Landsat with the high temporal frequency of coarse resolution sensors to monitor northern vegetation change. We used 30-m medium resolution land cover maps generated from Landsat data to detect homogeneous vegetation targets that are subsequently monitored through time using frequent coarse resolution

satellite measurements from sensors such as AVHRR. In contrast to other studies that have examined change across all vegetation types simultaneously, this approach allows us to monitor vegetation-specific change. Examples of this approach include investigation of the effects of short-term temperature anomalies that enhance vascular vegetation productivity while suppressing non-vascular vegetation types. From this investigation, we show that the outcome of more frequent temperature anomalies leads to longer-term vegetation composition change.

NUNAVIK WILDLIFE AND YOU, WILDLIFE EDUCATION PROGRAM

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Nunavik is a vast territory that spans more than 500,000 km2 and that is home to an incredible abundance of natural resources. The exploitation of these resources may, in some cases, jeopardize animal populations and habitats. The Ministère des Ressources naturelles et de la Faune, Fisheries and Oceans Canada, and the Kativik School Board have agreed to pool their awareness promotion and education efforts when it comes to wildlife resources in Northern Quebec, to insure the sustainable wildlife exploitation.

The educational program entitled *"Nunavik Wildlife and you"* complements the teaching program and develops the notion of the sustainable use and management of wildlife resources and species in a precarious situation. This program allows students to reflect on the conditions necessary for the renewal of wildlife. The goal of the program: Bring participants to understand that wildlife, as a renewable natural resource, must benefit from favourable conditions to maintain its populations at acceptable levels.

The "Nunavik Wildlife and you" program adheres to the main orientations and the aims of the Quebec Education Program. The activities proposed by the program are in line with the mission statement of the Kativik School Board.

The educational program is given by two officers in the presence of the teacher. They have received a formation and the material needed to visit the schools. Before the officer's visit, the teacher must do preparatory activities such as, illustrating a scene that represents a form of wildlife use by humans. The drawings will then be on line in the drawing gallery.

The visit is made up of two main parts. During the first part (half a day), the officers begin by looking at students' drawings. They discuss with students about their perceptions of wildlife. Afterwards, with the help of a visual presentation, students discover Nunavik wildlife. To conclude this first part, young people participate in a quiz to learn about the role of wildlife protection officers.

During the second part (half a day), various activities centering on the Beluga Whale allow students to infer the two essential conditions for the renewal of wildlife. That way, students are able to validate the hypotheses put forward during the preparatory activities. They locate the various Beluga Whale populations on a map; they discover the biology and anatomy of this marine mammal; they have the opportunity to handle anatomical parts of the Beluga Whale; upon reading a comic strip, students they have to take a position regarding the behaviour of a character during a hunting activity.

Last year, for the first year the program was offered, 103 students in 9 communities were visited.

CLIMATE CHANGE AND THE BUILT COMMUNITY: PRACTICAL LESSONS FOR ADAPTATION GOVERNANCE

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Climate and coastal changes have been monitored in four small communities across the Canadian Arctic. The most pressing physical hazards were observed in Tuktoyaktuk, NWT where erosive storm action and floods act on low-lying thermokarst terrain and shoreline infrastructure. Sachs Harbour, NWT is also experiencing rapid coastal erosion and permafrost ablation, although risks are moderated by the greater elevation of the townsite. Relatively few physical hazards were identified in Gjoa Haven, NU but a sudden reservoir failure above the townsite in 2005 highlighted latent risks in infrastructure engineered to suit former climatic norms. Preliminary assessment of Hall Beach, NU places it in a moderate physical hazard category, with several residences and other

buildings subject to shoreline erosion. In concert with local physical hazard evaluations, community resilience assessments have been undertaken in three of the coastal communities. They reveal significant community adaptation challenges stemming from human resource, organizational and relational factors. This approach leads to a working understanding of the many cross-scale interactions that ongoing physical changes are precipitating in tandem with globalizing economic and social influences on northern populations. Rapid changes in ice-rich terrain have raised concerns in relation to traditional Inuit livelihoods, knowledge and practises, but significant implications for northern community governance must also be recognized. Resilience is not an absolute but rather a dynamic, composite property of communities. From an adaptive system perspective, an apparent decline in a physical or 'resource' dimension of the community, can be responded to and compensated for to some extent by other socio-ecological system dimensions - ***people***, ***organizations*** and the ***relationships*** that bind them to the land and one another. Taking climate change into account regularly entails a variety of site-specific responses to apparent physical changes. In all four communities, there are buildings and other municipal infrastructure at risk from flooding, erosion or other mass movements necessitating removal or relocation. Identifying less affected sites for new development is often challenging. Tuktoyaktuk and Sachs Harbour have very little suitable land remaining within their existing municipal areas. Across the region, public works design and management tends to react to rather than anticipate forthcoming changes, and inter-agency conflicts regularly stall responsive efforts. The importance of institutional memory is also underappreciated: human resource turn-over interferes with the transmission of 'standard' and acquired operational procedures, leading to an erosion of preventative maintenance and even the loss of key infrastructure. Identified differences in resiliency among communities have practical climate change adaptation policy implications. They suggest mechanisms to strategically enhance or restore critical capacities (e.g. countering losses of institutional memory with appropriately delivered human resource development) and so build greater adaptability into every aspect of the community - "built" and otherwise.

ADAPTATION TO CLIMATE CHANGE IN THE ARCTIC: KNOWLEDGE TRANSMISSION AND INFORMATION EXCHANGE AMONG INUIT IN AN ARCTIC COMMUNITY

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This presentation outlines the rationale and objectives of research that documents and describes the degree to which the transmission and exchange of knowledge about the local environment and related skill sets among Inuit in an arctic community mediates vulnerability and shapes adaptation to climate change. It is well documented that climate change, together with other social, economic, and political changes, is already being experienced in the Arctic with implications for Inuit and the natural resources on which they depend. Previous research on vulnerability to climate change in the Arctic identified the transmission of environmental knowledge and related skill sets and the strength of social networks as key determinants of Inuit adaptive capacity to climate change. This collective social memory affords Inuit dynamic and flexible use of the environment and its resources and represents an asset base from which adaptations can be made to deal with routine and novel events. However, Inuit have expressed concern that as a result of rapid societal changes, the traditional modes of intergenerational knowledge transmission by which Inuit have developed the skills to hunt safely and successfully no longer function effectively. Research has reported that some knowledge and skills have been lost, some are being transmitted later in life and incompletely, and others are new skills that the older generation did not possess. However, little data on the nature and processes of knowledge transmission have been presented to explain these observations. This research analyzes the vertical (older to younger) and horizontal (hunter to hunter) transmission and exchange of knowledge about the local environment and related skill sets among Inuit in the community of Ulukhaktok, Northwest Territories, Canada. The results are expected to provide a greater understanding of Inuit social relationships and the means by which a traditional culture adapts to a novel and challenging social and physical environment.

SEDIMENT TRANSPORT IN A CHANGING ARCTIC: RIVER PLUMES, LONGSHORE TRANSPORT AND COASTAL EROSION

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Reduced sea-ice cover and warmer temperatures are leading to rapid changes along Arctic coasts. Where fast ice once protected coastlines from erosion during the worst winter storms, there is now an increased liklihood of a large fetch and increased nearshore transport due to storm surge and wave-induced currents. The relative contributions of some sediment transport processes like longshore transport and bluff collapse are increasing while the contribution of others, such as ice-push (ivus) appears to be decreasing. Sediment within watersheds and along coastlines is now more likely to be mobilized and is likely to be carried further offshore by river plumes. While the net effect of these changes is difficult to predict, there are a number of hydrologic and sediment transport models that have been designed for use in a high-latitude setting. This talk will discuss some of these existing models and how they tend to differ from the models that are used in temperate regions. A particular challenge is that some of the physical processes that are important in the Arctic are much less well understood and new research and data is needed in order to model them with greater confidence.

POPULATION GENETICS OF CANADIAN RINGED SEALS: PROBING DEEPER INTO NATURE'S APPROXIMATION OF PANMIXIA

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Circumpolar marine species with large population sizes present a unique challenge for population genetics, in that many approximate panmixia. However, the identification of a single population does not adequately describe the functional genetic structure of that population. Furthermore, quantifying pattern of gene flow will be increasingly important for ice-associated species that may be facing range contraction or fragmentation due to climate warming. Ringed seals (*Pusa [=Phoca] hispida*) are one such species where gene flow among regions is high but that are also predicted to lose breeding ice habitat in the next 50 years. To investigate the patterns of gene flow in the Canadian Arctic, 890 ringed seals collected between 1992 and 2005 from 12 locations between Sanikiluaq in the south to Eureka in the north. These seals were genetically profiled at 14 microsatellite loci and similar to previous research, we observed high levels of heterozygosity (H_{obs} = 0.83) and mean number of alleles per locus (N_a = 19.9). Bayesian analysis to determine the number of genetic clusters in the data indicated the presence of a single unit. Traditional frequency based analyses reflected the low genetic differentiation among locations ($\leq$ 0.0165). However, statistically significant deviations were identified that differentiated Eureka from Arviat and Sanikiluaq. A weak but significant pattern of isolation-by-distance was identified (R^2 = 0.145, P = 0.02) and the first two axis of a correspondance analysis encapsulated a north-south cline in allele frequencies. To further explore this relationship, individual- and location-based analyses were also conducted using a graph theoretic approach. Individual-based analyses revealed that the network of sampled ringed seals is highly connected (average path length = 1.87), has higher clustering coefficient than expected (transitivity = 0.33), and an approximately normal degree distribution; all suggestive of a small-world network. These networks are characterized by clusters of highly connected individuals and are hypothesized to be robust to random removal of individuals. This type of structure has implications for genetic drift should clusters become isolated. Location-based analysis revealed a north-south cline and that locations that are farthest north (Grise Fiord and Eureka) and farthest south (Arviat and Sanikiluaq) were the least connected nodes in the network. Combined, these results reflect a high level of gene flow that is currently occurring or has occurred in the recent past among areas of the Arctic. Local breeding and limited dispersal on some scale, has created a pattern of isolation-by-distance. The presence of a north-south cline and the higher connectedness of mid-Arctic seals suggest that maintaining healthy local populations in these areas will be critical for maintaining overall population connectivity.

VARIABILITY OF OCEANOGRAPHIC AND ICE PROPERTIES IN THE EASTERN CANADIAN ARCTIC ARCHIPELAGO

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Year-long moorings have been in place since August 1998 in eastern Barrow Strait to measure pack ice properties and oceanographic transports of Arctic surface waters passing through the Canadian Arctic Archipelago. In addition, ice charts provide a 28-year time series describing the interannual variability of mobile and land-fast pack ice conditions in eastern Parry Channel. The volume transport estimated from the moorings shows large interannual variability, but generally has a maximum in the summer and a minimum in the autumn. Regression analysis with the Arctic wind field shows that the highest correlation between monthly transport anomalies in Barrow Strait is with far-field wind anomalies at a grid location west of Parry Channel in the Canadian Beaufort Sea some 1000km from the mooring site. This is consistent with the flow being driven by a sea level difference between opposite ends of the Passage, and the difference being determined by setup caused by alongshore winds in the Beaufort Sea. In contrast, local atmospheric conditions determine the position of the spring consolidated ice edge in eastern Parry Channel, and therefore ice velocities measured at the mooring site.

FOSTERING STEWARDSHIP OF MARINE MAMMALS IN COASTAL COMMUNITIES: INSIGHTS FROM THE B.C. CETACEAN SIGHTINGS NETWORK

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Community-based monitoring programs for marine mammals will become increasingly important as environmental conditions change in the Arctic. The developing Arctic Observation Network will achieve two important, mutually reinforcing goals: efficient and cost-effective acquisition of reliable data on relative density and seasonal distribution of cetaceans and pinnipeds in the Arctic, and fostering a tradition-based stewardship ethic in northern communities. We present insights from a well-established program for monitoring marine mammal populations using a network of volunteer observers in British Columbia. By sharing the successes and pitfalls of our program, we aim to provide Arctic researchers with experiences that may be relevant to the new Arctic Observation Network. Since 1999, the B.C. Cetacean Sightings Network (BCCSN) has worked to foster stewardship of at-risk marine species, by collecting sightings of cetaceans and sea turtles and providing outreach to coastal communities. Our sightings database currently includes 40,000 records of 21 species of cetaceans and 2 species of sea turtles; sightings are reported via a toll-free hotline, email, webform, or logbook. Our network of over 1,800 observers includes ecotourism companies, government agencies, academic researchers, lighthouse keepers and commercial fishers, as well as recreational boaters and waterfront residents. Over half our sightings are received via a logbook program, which enables mariners who frequently encounter marine mammals to efficiently compile their sightings. Our observers are our most valuable asset, and observer retention is predicated on receiving personal responses to each report submitted. We also employ numerous other strategies to recognize and retain observers, such as producing customized maps showing individual sightings for top observers. We provide data upon request for conservation and research purposes, to agencies such as DFO, Parks agencies, and consulting firms conducting environmental impact assessments. Because our data are collected opportunistically, they are necessarily limited by observer effort, particularly in areas and seasons that aren't favourable for ocean travel. We are implementing GIS modelling to predict levels of observer effort based on factors such as proximity to urban areas, fishing activity and vessel traffic. We also use two confidence metrics to assess the reliability of species identification in sightings: observers rate their confidence in each sighting report using a 1-5 scale, and we rate observers' expertise similarly. These assessments enable us to filter our data at various tolerance levels for different analyses. Our outreach efforts are effective in engaging coastal residents and recruiting new observers. We conduct community presentations that inform people about threats to marine mammals, and inspire them to minimize their impact on these species. We also use a blog on our website to provide news about marine conservation. Some other sightings networks provide real-time information on locations of their target species. In B.C., however, the rapid growth of the whale watching industry may result in increased disturbance of killer whales and other species. To protect whales from these threats, the BCCSN has chosen not to release sighting data to the public. This may also be a consideration in the Arctic, where

real-time sighting information could give advantages to local hunters.

THE "CRYSTAL EYE OF NUNAVIK" (PINGUALUIT): NEW INSIGHTS FROM ONE OF THE DEEPEST CRATER LAKES AND ONE OF THE OLDEST SEDIMENT RECORDS OF THE NORTHERN HEMISPHERE

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Most lakes in the northern circumpolar region are of glacial origin and allow hindcasts that date back only until the last deglaciation several thousand years ago, because of glacial erosion of their sediment infill. With the exception of the El'gygytgyn Crater Lake in Siberia, all other climate archives of the Arctic covering several interglacials originate from marine sediments or ice cores. The sediments of the 1.4. Ma old Pingualuit Crater Lake (Nunavik, Canada; 61°17'N, 73°41'W) - known as the "*Crystal Eye of Nunavik*"- offer the unique opportunity to study terrestrial climate dynamics not only during the postglacial period, but potentially over several hundreds of thousands of years as its deep sediment infill promises to yield an uninterrupted arctic paleoclimate record covering several interglacial-glacial cycles. Previous attempts to core the lake have resulted in the collection of only 14 cm of sediments that spanned the last ~5000 years. Almost 20 years later (May 2007), we managed to extract about 10 m of sediments from the crater lake at a water depth of 270 m using a UWITEC piston percussion corer system under harsh climatic conditions and severe water environmental protection measures. Here we will present initial results of limnological measurements (PAR, UV light transparency) performed on the water column of one of the deepest and most transparent lakes on this planet, as well as preliminary sedimentological, micropaleontological and stratigraphic interpretations. The initial results revealed the presence of at least two decimetre-thick intervals composed of laminated, dark grey clayey silts characterized by a relatively low density and magnetic susceptibility that contrast sharply with the thicker over- and underlying sections with light grey, denser, sandy sediments (see also Guyard et al., this session). The sediment characteristics in the darker laminated intervals are also similar to the ones observed in the small surface gravity core sampled at the site. Moreover, these two intervals revealed the presence of fossil diatoms and chrysophytes, suggesting that these two intervals represent ice-free conditions and thus possible interglacials, whereas the more extensive light grey and sandy sediments likely reflect glacial intervals. This interpretation will be tested by ongoing paleomagnetic (i.e., magnetostratigraphy) and multi-proxy biostratigraphic analyses (diatoms, chironomids, cladocerans, pollens), as well as radiocarbon and thermoluminescence (TL) dating. In fact, a first TL estimation in the uppermost laminated (interglacial) interval suggests an age older than 100 ka BP.

THE EFFECT OF TIDES ON DENSE WATER FORMATION IN ARCTIC SHELF SEAS

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Dense water formation occurs in ice covered seas when brine is rejected from newly forming ice. Dense water formation can be modulated by tides in several ways. Tidal mixing can hinder ice growth or even cause melting, as oceanic heat is transported upwards. A layer of fresh melt water can inhibit convection. Additionally the ebb and flow of the tide can cause sea-ice to pile up (in areas of convergence) or separate (in areas of divergence). Thicker, piled up ice thermally insulates the ocean from the atmosphere and thus further dense water formation

becomes less likely. Conversely, areas of open water exposed as the tides pull the ice cover apart, start to produce dense water as brine is rejected from newly formed sea-ice.

We present results from a dynamic/thermodynamic sea-ice model (CICE) coupled to a baroclinic coastal ocean model (POLCOMS) of the Barents and Kara Seas. Although introducing tides into the model does not alter the annual salt flux to the ocean significantly, some regions show significant changes to ice volume and ocean salinity. In particular, the seasonally ice covered seas in the south of the domain have up to 25% less ice volume during freeze up and melting when tides are included in the model. Conversely, the shallow area around Svalbard has increased ice volume throughout the year. The distribution of increased brine rejection due to tides is similarly inhomogeneous and, although some coastal regions show significantly increased salinity throughout the water column, this appears to be dominated by advection by residual tidal currents. Further work will determine the significance of these results and indicate whether future Global Climate Models should include tide/sea ice interactions to make more accurate predictions.

REPRESENTING INUIT SEA ICE KNOWLEDGE AND USE FOR EDUCATION AND OUTREACH: CREATING AN IPY LEGACY USING EMERGING DATA MANAGEMENT STRATEGIES

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As part of the International Polar Year (IPY) Inuit Sea Ice Use and Occupancy Project (ISIUOP)(http://gcrc.carleton.ca/isiuop), we are expanding on previous community-based sea ice research in Nunavut to develop innovative ways of representing Inuit knowledge of sea ice (e.g. floe edge position, tidal cracks, polynyas, travel routes, dangerous areas, changing ice conditions, safety indicators, and Inuktitut terminology), to create new educational materials, and to facilitate community-centred narratives. Results of the project are being represented using an innovative cybercartographic atlas development framework (Nunaliit) to make qualitative and quantitative information accessible in an online, interactive, multimedia form. This presentation will highlight current progress being made towards the creation of the Cybercartographic Atlas of Sea Ice .

The Cybercartographic Atlas of Sea Ice aims to provide an important contribution to the IPY knowledge base. However, to ensure that the data, information, and knowledge constructed in this project remain as a legacy for future generations, there are a number of data management challenges that must first be addressed: i) ensuring interoperability of disparate data resources; ii) integrating different knowledge domains; iii) producing appropriate digital representations of Inuit expertise; and, iv) preserving information systems in the context of rapidly evolving technologies. This presentation will thus provide an overview of the strategies being used by project participants to address these challenges. We will also discuss the potential benefits of such online, interactive, multi-media representations for northern education, research collaboration, community-initiated projects, and community empowerment.

DIFFICULTIES OF CLIMATE SIMULATION OVER THE ARCTIC USING A REGIONAL CLIMATE MODEL

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The Canadian Regional Climate Model (CRCM5) is used to simulate Arctic climate using different sized domains. Analysis of results suggests different sources of error in summer and winter, which are associated with the circumpolar vertex and Icelandic Low respectively. The Icelandic Low, the strength and position of which are linked to planetary scale flow, makes RCM simulations too sensitive to the domain size. Likewise in summer due to the circumpolar vertex, it becomes difficult for the RCM to control error growth in the center of domain. Study suggests that careful setting of the CRCM domain could improve the Arctic climate simulation under certain circumstances but not always. The implementation of spectral nudging in CRCM5 is recommended.

SNOWFALL MEASUREMENTS AT EXPOSED, HIGH WIND SITES

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Precipitation in the Artic environment often occurs under high wind conditions (> 5 m/s). Current

liquid water equivalent gauges typically under-catch in these conditions by factor of 2-4, making it necessary to apply a wind correction to these gauges. NCAR has conducted tests of various gauges at exposed sites in Colorado for the last 10 years, with the goal of obtaining real-time estimates of snowfall rate every minute. An especially challenging aspect is the measurement of light snowfall rates at high winds. The truth gauge for these tests has been the Double Fence Inter-comparison Reference (DFIR) gauge, as well as manual pan measurements. This paper will report on the results of these tests, providing transfer functions for a variety of commonly available snow gauges (GEONOR, OTT, Vaisala VRG, and Yankee Hotplate) for high wind conditions.

VERTICAL EXPORT OR RETENTION? THE FATE OF ORGANIC CARBON IN OPEN AND ICE-COVERED REGIONS OF THE BARENTS SEA

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The fate of primary production is closely linked to the ecosystem-structure in aquatic environments. High pelagic consumption and recycling reduce quantity and quality of vertically exported organic material, while low to moderate pelagic consumption allow more carbon of higher quality to reach benthic communities. Recent investigations in the Barents Sea also points to the impact of the physical structure of the water masses on vertical carbon export and the fate of primary production. Due to the strong gradient between open Atlantic Waters (AW) and seasonally ice-covered Arctic water (ArW) present in the Barents Sea, the effects of changing ice conditions and physical water-mass structure on vertical carbon export can easily be studied.

Results from three years field investigation in the Barents Sea with focus on the fate of primary production through vertical export and grazing will be presented. Short-time sediment-traps with high vertical resolution in the upper twilight zone identified high flux-attenuation layers, and the microscopic investigations of the sediment-trap material revealed that the contribution from ungrazed phytoplankton groups and faecal pellets in different phases of the bloom and under different mixing conditions. Based on field experiments, grazing estimates of the larger zooplankton fraction was also estimated. The retention processes are keys to understand vertical flux regulation, and a compilation of all available vertical flux and primary production measurements from the AW and ArW region of the Barents Sea points to a decreasing retention towards more Arctic waters. A change towards a warmer climate can thus have implications for the total distribution of energy within the ecosystem, with a strengthening of the pelagic system.

AN OVERVIEW AND INTEGRATION OF IPY RESEARCH ON CHARS

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Chars are iconic northern fishes found throughout fresh, estuarine and nearshore marine waters of the Holarctic. Wherever they occur, chars exhibit great diversity at both the species' level (i.e., 5-22+ species defined), and also at lower taxonomic, life history (e.g., migratory and non-migratory life history types), and ecological (e.g., ecophenotypes) levels. This is particularly true for more northerly waters where fish diversity is generally low and in areas where Arctic char is the only fish species present in fresh waters. As a result of their diversity and wide distribution chars occupy many aquatic habitats both seasonally and ecologically, thus they are pivotal components of most northern aquatic ecosystems. Chars are also mainstays of the social and economic fabric of life for northerners, thus are fished wherever they occur.

Arctic change driven by climate shifts, industrial development, human population increase and other anthropogenic stressors will substantively affect chars and their ecosystems. Other than qualitative scenarios, little knowledge exists regarding how such changes will be manifested particularly at the char population level nor how such changes will be propagated throughout northern aquatic ecosystems. Also, the effects from multiple stressors will change char populations to unknown degrees and

directions. This, in turn, will affect humans who rely upon chars and their ecosystems, however, these knowledge gaps limit our capacity to both project the nature and degree of char responses and to develop strategies for addressing the changes.

Whether chars themselves have sufficient capacity to adapt to these changes and thus whether populations will remain productive and sustainable are open questions. Accordingly, to address these issues, to provide an understanding of probable changes in char populations and their ecosystem, and to lay the foundation for mitigative and adaptive management measures, an interdisciplinary project was undertaken in the Canadian IPY Programme. The overall project consists of three integrated components: Scientific Research, Monitoring and Network Development. Research activities encompass biodiversity at inter- and intra-specific levels, relationship of char biology to climate parameters, ecosystem structure and function, and dynamics of key contaminants. Monitoring activities include community-driven projects using standard fishery and gis-based approaches, and are designed to develop a basic approach suitable for community-based implementation throughout the North. Networking activities include the development of an international network aimed to provide expertise and input to international assessments of biodiversity and change in chars globally.

Individual research components conducted by graduate students, northerners and the principal investigators address a wide range of specific topics and many areas of northern Canada. Moreover, these IPY-project activities link directly with those of other IPY projects and with ongoing university-based, community-based and government research. In combination these efforts are designed to address fundamental issues of char diversity and the potential responses of chars and their diversity to Arctic change. Project activities are also linked with similar work being conducted in other Arctic countries through an international IPY node to promote wider understanding of the effects of Arctic change on chars.

AQUATIC PROCESSES CONTROLLING GREENHOUSE GAS EXCHANGES IN THAW PONDS: THE ROLE OF MICROBIAL PRODUCTION AT BYLOT ISLAND, NUNAVUT

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The objectives of our study are to understand the main processes affecting greenhouse gas exchanges in thaw ponds and to determine the controlling factors of these processes, especially those that are influenced by climate change. The increasing number and high activity of thaw ponds during the ice-free period is now of major concern because of their potential role on the global carbon budget. Different aspects of the microbial dynamics were investigated in an active area of polygons and channels at Bylot Island (73°N) in 2008. In several studies, dissolved organic matter (DOM) was suggested to largely control CO2 emissions in lakes. The organic matter released from eroding soils is a dynamic component in thaw ponds (spatially and temporally variable) that will be closely examined and linked to microbial productivity. Newly formed ponds will be compared to ponds formed on low-center polygons and colonized by cyanobacterial mats. The pelagic bacterial production rate (BP) ranged between 0.1 and 1.1 mg C m^{-3} per day (mean value of 0.4 mg C m^{-3} d^{-1}) and was not correlated to dissolve organic carbon but positively correlated to the organic particulate fraction. The benthic BP was also measured, in addition to the pelagic and benthic primary production. This study should provide a better understanding of this overlooked system of increasing importance at high latitudes and help to estimate their role on global carbon budget.

PHYTOPLANKTON BIOMASS, SEA SURFACE TEMPERATURE AND CANNIBALISM/ PREDATION AND THEIR ANTAGONIST EFFECTS ON THE NORTH WATER POLYNYA COPEPODS POPULATION DYNAMICS.

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In Arctic ecosystems, trophic linkages through primary production are believed to be the controlling variable in recruitment. The various life cycle strategies of polar copepods revolved around the onset of the primary

production but also leave a larger place to other important variables. Sea Surface Temperature (SST), solely, can also interfere either directly on the various physiological mechanisms or indirectly by altering the interactions between predator and prey. Density-dependent cannibalism/predation of adult female on their eggs and naupliar stages during the pre-bloom period could play an important role in the control of cohort development. Here, we present in-situ egg production rates (EPr) followed by species-specific mortality rates in eggs and early naupliar stages of Calanus glacialis, C. hyperboreus and Metridia longa in the North Water Polynya. Given the nature of the sampling, mortality was estimated using the Vertical Life Table (VLT) approach based on the population EPr from species-specific in situ EPr and abundance of C6f, stage-specific abundance of naupliar stages and temperature-dependent development time. In first instance, the strong relationship between the onset of the PP and the EPr of C. glacialis ($R2 = 0.591$, $P < 0.0001$) tend to enhance the idea of this strong trophic relationship in the success of cohort. A multiple regression model using temperature, C6f abundance and phytoplankton biomass as independent variables explain only to 21% of the variability in daily mortality rates from Egg to N3 stage ($p = 0.012$). The first two variables being positively correlated and the phytoplankton biomass being inversely correlated, it suggests a relaxation of the predation by cannibalism during the phytoplankton bloom. Different oceanographic conditions prevailing in the polynya to define 2 distinct regions: a Greenland region characterised by a warm surface water an a early onset phytoplankton bloom, and an Ellesmere cold, nutrient rich region where the phytoplankton onset occurs over a month later. Within these regions, the general regression model explains 42 % of the mortality rates in the Ellesmere region and 24 in the Greenland region. In either region the mortality rates are positively related to temperature, while it shows no relationship with the chlorophyll-a biomass, and the female abundance is positively related only in the Ellesmere region, putting more emphasis in temperature and density-dependent cannibalism/predation in the fate of a new cohort. With extremely low temperature, even the surface layer in summer almost never reach over 4°C and athoer trying environmental conditions, it may not be surprising that slight difference prevailing within the two distinct region of the polynya could yields different responses in survival rates. The classical match-mismatch hypothesis thus became an oversimplification of the complex Arctic food web, where opportunistic behaviour often prevails over specialist.

MICROBIAL DYNAMICS AND RESPONSE TO A CHANGING POLAR OCEAN CLIMATE

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Marine heterotrophic microbes (i.e. prokaryotic bacteria and eukaryotic protozoa) dominate the fluxes of organic carbon in the upper ocean, where they typically remineralize >75% of primary production back to CO2. Although these small organisms and their interactions are well studied in low latitudes, there is far less known about their distributions, community structure, activity and food web interactions, and their impact on upper open biogeochemistry in high latitudes. Despite the low temperatures, microbial processes are highly active and the rates of growth and elemental transformations are similar to those in lower latitudes. Profound climate changes are predicted for high latitude regions. These include altered temperatures, ice cover, mixing and nutrient supply. These changes will influence the distribution of ice, physiochemical, biological and food web properties. The present study reports on a meta-analysis of a large database on heterotrophic microbes and associated variables from the Arctic Ocea and marginal seas. Using the results of database analyses, and conceptual and analytical models, we examine the influence of predicted changes in the climate in polar regions on microbial activity, their mediation of upper ocean biogeochemistry, and potential feedbacks on the cycling and flux of climate active properties.

THE BEING CARIBOU PROJECT: LOCAL STORIES, INTERNATIONAL POLICY, AND GRASSROOTS CIVIL SOCIETY-- A CASE STUDY

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On April 8th, 2003, Leanne Allison and Karsten Heuer set off alone, on foot, to follow the 123 000 strong Porcupine Caribou herd as it migrated through its spring, summer, and fall ranges in northern Yukon and Alaska. Their goal in undertaking this journey was twofold: to 'be caribou'--to go through and truly experience the living conditions of the migrating herd; and to bring forward this «story of the caribou» as effectively as possible, in order to increase public support for the conservation of the herd's

endangered calving grounds.

One of their most successful initiatives was a film, *Being Caribou*, which garnered awards at several major film festivals, was broadcast on Canada's main public television network and on several North American specialty channels, and became a mainstay of public and educational institution library collections throughout Canada and the United States. Most remarkably, however, the majority of the film's circulation and viewership did not come through any of these means, but through local community and 'house-party' screenings that were closely intertwined with actioning specific campaigning objectives in the fight to prevent drilling in the ANWR/1002 lands that encompass the Porcupine herd's calving grounds. In the period from March to December of 2005, when American legislative attempts to allow drilling in ANWR were decided by as little as a single vote, *Being Caribou* was systematically used by grassroots organizers as a significant tool in mobilizing hundreds of thousands of voters to write letters, call their elected officials, and demonstrate publicly against opening the refuge to development.

The case of *Being Caribou* opens up an important window on the role of local and global civil society, and of grassroots political organizing, in impacting debates on northern resource development and on climate change. My research quantifies and concretely demonstrates how a large network of civil society actors--from local Yukon ENGOs to the pan-American Alaska Coalition which includes over one thousand member groups--coalesced around specific, concerted political actions that prevented drilling in ANWR. Examining the institutional linkages, viewing environments and discursive strategies that situated *Being Caribou*--such that the film was used to encourage dialog between geographically disparate communities, build civil society, and promote 'actionable' activity from film audiences--highlights the possibilities and tensions of grassroots political work. Do such initiatives circulate local northern stories in new ways, amplifying the impact of northern experiences on southern policy makers, and increasing ordinary southern people's connection to and understanding of how their lifestyles impact Arctic regions? Or is civil society merely participating in the latest iteration of colonialism, reinforcing southern entitlement to the Alaskan 'frontier' by engaging in a debate over whether this symbolic frontier is best secured by protecting its last remaining pristine wilderness areas, or by conquering these areas and harnessing the potential of their natural resources?

MARINE PALEOENVIRONMENTS IN THE CANADIAN ARCTIC: WHAT HAVE WE LEARNED IN RECENT YEARS?

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Prior to the onset of the CASES program in 2002, which was followed by ArcticNet in 2004, our knowledge of the Holocene (last 10,000 years) paleoceanographical changes that took place in the Canadian Arctic was limited. Although sediment distribution from the different areas was relatively well known, no high-resolution sedimentary sequences were available for paleoceanographic studies. The extensive multibeam and sub-bottom profiling programs of these areas, which began in 2002, helped identifying areas of high sediment accumulation, with sedimentation rates at least one order of magnitude higher (i.e., >100 cm/ka) than previous paleoceanographic records. Since then, we have collected several sediment cores throughout the Canadian Arctic that provided, for the first time, time-series of Holocene oceanographical changes at resolutions varying from millennial to multi-annual. The major feature of these studies illustrate the opposite climate trends between the Eastern and Western Canadian Arctic. In the Eastern Arctic, the Holocene climatic optimum occurred around ~6500 to 4000 BP (depending on the location), after which sea surface temperatures began to cool until modern times through a series of warm/cold oscillations. In the western Arctic (Beaufort Sea), we observe the opposite trend, with sea surface conditions increasing over at least the last 9000 years, also through a series of warm/cold oscillations. In the Mackenzie Through we were able to document paleoceanographic changes at a resolution <10 years, and therefore document changes associated with the onset of the industrial era. The analysis of sediment cores from the central part of the Northwest Passage indicates that sea surface conditions remained stable over the last 8000 years (see Ledu et al., this meeting). In addition, we have now documented the spatial distribution of foraminifers and dinoflagellate cysts, two of the main proxies for the reconstruction of sea surface (temperature, salinity, sea ice cover) and bottom water conditions. One of the main problems that we encountered when studying Arctic sediment cores is the lack of datable material, which limits the accuracy of the chronological framework of

each core. Usually, the tests of foraminifers (composed of $CaCO_3$) are used for radiocarbon dating, but because calcium carbonates are dissolved in cold environments, there is often not enough material to obtain a reliable age. Another problem is that the sediment supply is low in the Arctic, and basins where suitable sediments accumulate are usually in water depths >500 meters. Few mollusks live in these environments, which further reduces the possibility of obtaining age control. Furthermore, the low abundance of organic matter in the sediments prevents the use of bulk sediment dating techniques. Therefore, other means for dating sediments must be used. As such, we now rely on the relative dating technique provided by the study of the variations of the Earth's magnetic field (inclination, declination, relative paleointensity). Indeed, paleomagnetic studies of sediment cores now provide means of correlating different cores located in various areas of the Arctic, therefore providing a chronological framework for cores where no datable material is available (see Lisé-Pronovost et al.; Barletta et al., this meeting, for example).

CHIRONOMIDS AS INDICATORS OF POSTGLACIAL PALEOCLIMATES OF THE FOXE PENINSULA, NUNAVUT, CANADA

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Climate change reports show that many High Arctic regions are affected by unprecedented environmental changes because global warming effects are amplified at high latitudes. However, paleoclimate studies completed in areas surrounding the southern Foxe Basin, Labrador and northern Quebec, so far suggest that these regions only experienced relatively subtle climatic and environmental changes over the recent past. These contrasting scenarios underscore the necessity to increase our knowledge of past and present environmental conditions across the Arctic in order to refine our capacity to model its past, present and future environmental changes. Unfortunately, the generally short time series data available for developing regional and global climate models does not adequately capture the natural environmental variability that has affected these regions in the past. One way to extend such environmental time-series data sets is to explore the sediment archives preserved in lake basins. The use of biological and sedimentological proxy indicators provides a novel method for quantitatively reconstructing physical and chemical conditions throughout the history of arctic lakes. Among these indicators, chironomid head capsules (Insecta: Diptera: Chironomidae) have proven to be especially useful in the development of statistical inference models for hindcasts of past air and water temperatures.

As part of a concerted study of the Foxe Basin and its surrounding regions, our research presents the Holocene evolution of a lake located on the Foxe Peninsula, Nunavut, Canada. Combined with sedimentological analyses (X-ray profiles, grain size, organic matter content), changes in the composition of fossil chironomid assemblages provide the first Holocene paleotemperature record for the Foxe Peninsula region which is compared to results obtained through previous studies of sediment records from neighboring Southampton Island, Nunavut, Canada.

A SNAPSHOT OF PERMAFROST TEMPERATURES DURING THE INTERNATIONAL POLAR YEAR

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To characterize the thermal state of permafrost, the International Polar Year Project # 50, Thermal State of Permafrost (TSP) was developed under the coordination of the International Permafrost Association. Ground temperatures are being measured in existing and new boreholes. The Circumpolar Active Layer Monitoring (CALM) project is focused on observing seasonal thaw of permafrost terrain. Both sets of observations will provide a snapshot of permafrost conditions in both time and space. The data sets will serve as a baseline against which to measure changes of near-surface permafrost temperatures and permafrost boundaries, to validate climate model scenarios, and for temperature reanalysis.

Results of borehole temperatures based on past and current data from Alaska and Northern Eurasia are presented. Approximately 100 boreholes in Russia have been instrumented with data loggers to compliment the Alaskan network of existing boreholes. Most of the permafrost temperatures showed a substantial warming during the last 20 years, with a recent leveling off in this trend. The magnitude of warming varied with location, but was typically from 0.5 to 2°C at the depth of zero seasonal temperature variations in the permafrost. Thawing of the Little Ice Age permafrost is on-going at many locations. There are some indications that the late-Holocene permafrost started to thaw at some specific undisturbed locations in the European Northeast, in the Northwest

Siberia, and in Alaska. Our collective IPY permafrost legacy is to establish a permanent, bipolar network of observatories and to encourage the development of the next generation of permafrost researchers.

NEW CONSTRAINTS ON THE DEGLACIATION OF FOXE CHANNEL AND SOUTHAMPTON ISLAND, NUNAVUT

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New AMS ^{14}C dates from Southampton Island (Nunavut) indicate that by about 7.0 ^{14}C ka BP the Laurentide Ice Sheet (LIS) had retreated off the southern portion of Foxe Channel. Prior to this study, age constraints on the deglaciation of the northern coast of Southampton Island were lacking. A total of sixteen samples were analyzed, six of which are from the northern coast. A correction of 630 years (dR = 230 yrs) was applied to the normalized marine ages. This value was calculated by comparing the ^{14}C ages of marine and terrestrial pairs from two sites on Southampton Island. The results provide the basis for refining existing regional deglacial models. Other data (glacial striae, till compositional data) suggest that the role of the depression (Foxe Channel) between Southampton Island and Foxe Basin in controlling regional ice flow systems was more important than previously thought. Ice over the northern part of Southampton Island clearly flowed toward the east and northeast and not southward from the Foxe Dome. In the revised model, ice streaming lead to ice surface drawdown over Foxe Channel. This, together with rapid calving, accelerated ice retreat and collapse of the Foxe Dome.

A CHANGING CLIMATE MAY INCREASE THE RISK OF CONTAMINANT-RELATED HEALTH RISKS IN BEAUFORT SEA BELUGA WHALES

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Changes in the extent and distribution of Arctic sea ice may have profound consequences for the health of beluga whales (*Delphinapterus leucas*), as these cetaceans rely heavily on ice edge-associated prey such as Arctic cod (*Boreogadus saida*). The concentrations of persistent environmental contaminants in Arctic food webs will likely change as the physical and biological environments change. Changes in beluga feeding ecology may take place in part due to changes in the quality, abundance and/or distribution of prey. This may result in reduced beluga fitness as they consume prey of sub-optimal quality (e.g. less lipid) or as they undertake increased foraging efforts to locate sufficient food. During 2007 and 2008, we worked with Inuvialuit hunters to obtain samples from 42 beluga whales near Hendrickson Island in the Beaufort Sea, NT, Canada. Blubber was analyzed for polychlorinated biphenyls (PCBs) using high resolution gas chromatography/mass spectrometry. Variation in condition and feeding ecology influenced contaminant concentrations, with one group of whales being longer, having a thicker blubber layer, exhibiting higher $\delta^{15}N$ ratios, and having higher PCB concentrations (4.6 mg/kg vs 2.1 mg/kg). In addition, negative correlations between blubber thickness and PCB concentrations within each of the two feeding groups indicated a contaminant 'concentration effect' in animals with reduced blubber reserves. In order to explore the health risks associated with a changing climate in the Arctic, we used these observed blubber thickness parameters to derive individual-based beluga life history models for PCBs under two contrasting scenarios: 1) a 'best case' scenario where decreased exposure results in a 33% decline of PCB in beluga blubber, and 2) a 'worst case' scenario, where increased foraging effort and reduced prey quality results in a doubling of PCB concentrations in beluga blubber. At present, 0% of beluga exceed the published threshold (10 mg/kg lipid weight) for disease-associated mortality in bottlenose dolphins (*Tursiops truncatus*). Under our 'best case' future scenario, this remained at 0%, but under the 'worst case' scenario, 30% of the beluga exceeded this threshold for increased risk of mortality. These results underscore the vulnerability of these long-lived, high trophic level marine mammals to changes in climate and ice edge-related food webs, and the utility of these life history models to evaluate future scenarios under varying climate, sea-ice, food web, and chemical regulatory regimes.

ONE ISLAND, DIFFERENT VIEWS: THE NENETS REINDEER HERDERS OF THE KOLGUEV ISLAND (NENETS AUTONOMOUS OKRUG, RUSSIA), AND OIL WORKERS AND SCIENTISTS

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This presentation is based on a doctoral research which examines the ways in which oil workers, scientists, as well as Nenets reindeer herders relate to the environment, and to each other based upon their respective interactions and agendas with the environment in the Nenets Autonomous Okrug (District), Northwestern Russia. The results presented here emerge from an earlier phase of doctoral anthropological fieldwork which took place on the Island of Kolguev, in the Barents Sea, and in the district's capital, Naryan-Mar, in the summer and fall of 2008. In the last few years, the Nenets Autonomous Okrug has become an increasingly significant oil-producing region, although the exploration and extraction of oil have already been happening for decades. The island of Kolguev constitutes a particularly relevant case, revealing how people with different agendas perceive and interact with the same environment and with each other: the island's Nenets people have been practicing reindeer herding for centuries; oil workers have been conducting oil exploration and extraction since the early 1980s; and, various scientists have been involved in ECORA, a project sponsored by the United Nations Environment Program to «conserve biodiversity and minimize habitat fragmentation» on the island, in the context of both oil extraction and climate change. Considering that the world's arctic regions are attracting more extractive industries, and various scientists are involved either in the extraction or preservation of the natural resources, this presentation especially aims to make scientists and those involved in extractive industries aware of the ways in which indigenous peoples living in such regions perceive them and their ways of interacting with an environment upon which indigenous peoples depend, not only for subsistence, but also for the preservation of their way of life and culture.

CLIMATE AND DECREASING LEVELS OF SULPHATE AEROSOLS IN THE HIGH ARCTIC: AN UPDATE OF CONTINUES STUDIES

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Acid aerosols (microscopic drops of acids in the air) have a cooling effect on climate; they may be considered to partially counteract the warming effects of Greenhouse gases like carbon dioxide and methane. Pollution sampling of snow and near surface firn layers since the 1980's, in conjunction with ice core measurements extend this record back to pre-industrial times. These results show that the acids began to increase in the snow layers on the ice caps beginning as long as 150 years ago. The increase was due to acids coming from the industrial regions of the world which continued to increase until the mid-1980's. Acid aerosols in the snow pack over ice caps in the high Arctic have decreased over the past ~20 years so that concentrations are now as low they were 100 years ago. This trend coincides with an increasingly negative mass balance of Arctic glaciers suggesting that the cooling effect of acid aerosols is now less of a factor in suppressing the Greenhouse gas warming effect in the Arctic. This presentation will show our updated results of sulphate retrieved from Agassiz, Penny and Devon ice caps, comparing to sulphate emission patterns in different regions in the world. We are aiming to get a realistic estimate of North American and Eurasian pollution entering the Arctic in the future and provide a better estimate of industrial emissions than the national records themselves as suggested by recent research in Europe. This presentation will also link sulphate results to the increased summer melting since the mid-1980s. Because acid aerosols have been shown to have a cooling effect on climate, their reduced concentrations in the atmosphere may explain the increasing glacier melt.

A WEB MAPPING SERVICE FOR MULTI-RESOLUTION BATHYMETRY OF THE ARCTIC OCEAN

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The new version 2.23 digital grid of the International Bathymetric Chart of the Arctic Ocean (IBCAO) at 2 km resolution has been combined with the latest version 10.1 of the Smith and Sandwell (2008) predicted global topography at 1' resolution into a northern hemisphere polar stereographic projection. The combined grid has been sub-sampled into successive layers of tiles with nine doublings in resolution from the global scale to size of a city block. For resolutions beyond the first five doublings suitable for the IBCAO grid, we have incorporated available multibeam swath bathymetry with grid node spacing appropriate to the particular sonar instrument used. There are three full multi-resolution tile sets. One is binary and contains elevations and depths. The second consists of sun-illuminated images. These images provide the content of a Web Mapping Service. The third tile set is also imagery, however regions are masked where high-resolution multibeam swath mapping coverage is not yet available. The Arctic bathymetry is viewable in WMS-compliant applications such as OpenLayers® (openlayers.org) and GeoMapApp (www.geomapapp.org) capable of display in polar stereographic projection or in virtual globes such as Google Earth®, NASA World Wind® and our own Virtual Ocean (www.virtualocean.org). Users of GeoMapApp can import their own gridded data in various common formats (e.g., GMT, ArcGIS, Surfer, GEODAS) as well as visualize contributed grids and other data sets served over the Web from our Marine Geoscience Data System (www.marine-geo.org). We are preparing the Web services and visualization tools to bring the results of the research activities of the International Polar Year (2007-2008) directly to the scientist's desktop as well as to the classroom and the interested public.

WEICHSELIAN GLACIAL SEDIMENTOLOGY AND STRATIGRAPHY IN MURCHISONFJORDEN AREA, NORDAUSTLANDET, SVALBARD

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Compared to the other islands in the Svalbard archipelago, Nordaustlandet offers only limited stratigraphical or sedimentological information. We present here new results from glacial geological, sedimentological and chronological studies in the southern Murchisonfjorden area, 19°E - 80°N. The data were collected during a three-week-long field campaign in July–August 2007, and it consists of reconnaissance mapping and detailed logging of vertical sections along cliff-face outcrops few metres high adjacent to the present-day shoreline. The main goal of the studies is to provide a framework to understand dynamics of the Kara-Barents Sheet in its northwestern corner during the last full glacial cycle.

A diverse record of glacial and non-glacial strata was discovered. Sedimentological analyses indicate that the tills display a variety of depositional environments (lodgement, melt-out and deformation). The tills are often underlain or incorporated to littoral sands and gravels, rich in mollusc remains, ostracods and foraminifers. Holocene strata include mostly raised beaches and terraces moulded by shore or frost action.

Combined with OSL and AMS age determinations, these data provide evidence of three successive Weichselian sequences, each represented by the deposition of till followed by the accumulation of shallow marine deposits. This study demonstrates that, contrary to some earlier conclusions, the area was occupied by a Late Weichselian glacier (LWG), although the LWG till is thin and discontinuous. Interstadial sub-littoral sand related to the Mid-Weichselian interstadial was dated to 38–40 ka, and an Early Weichselian interstadial to 76–80 ka. The preservation of older sediments indicates weak glacial erosion within the study area. During the Late Weichselian, the glacier was relatively inactive, because the glacier drainage was conducted through the fast flowing ice stream in Hinlopenstretet. The studied sections can be considered a new key site that offers further potential to complete our understanding of the Weichselian stage within the northwestern sector of the Barents-Kara Ice Sheet.

The study is a contribution to the IPY-Kinnvika expedition (IPY 2007-08 ID 564).

SIGNIFICANT CONTRIBUTION OF PASSIVELY SINKING COPEPODS TO DOWNWARD EXPORT FLUX IN CANADIAN ARCTIC WATERS

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"Swimmers", metazoans caught in sediment traps, are traditionally removed from sediment trap samples before analysis to prevent overestimation of downward particle flux. However, passively sinking copepods (PSC) which have died in the water column and are caught in sediment traps should be included in the downward flux. The present study aims to estimate the temporal variability of PSC fluxes and its relative contribution to the non-living particle flux (i.e. other than swimmers). In laboratory experiments, *Calanus hyperboreus*, *C. glacialis* and *Pareuchaeta glacialis* that died without formalin (representative of PSC) were morphologically different from copepods that died with formalin (representative of actively intruded copepods into sediment traps) in their antennules and swimming legs. These differences were used to estimate PSC fluxes with a sediment trap in Canadian Arctic waters. The estimated PSC flux in terms of particulate organic carbon (POC) was highest in spring (19.3 mg C m^{-2} d^{-1}), being ca. 30% of the non-living particle flux, and was ca. 5 times higher (6.4 mg C m^{-2} d^{-1}) than the non-living particle flux in winter. The DW/POC ratio in winter for PSC was 2.0 which was one fifth of non-living particles of 11.0. Therefore, PSC could be an important food resource for pelagic and benthic heterotrophs such as *Metridia longa* in winter. The annual PSC flux (2.5 g C m^{-2} yr^{-1}) was equivalent to ca. 60% of the non-living particle flux (4.2 g C m^{-2} yr^{-1}), suggesting a substantial quantitative contribution of PSC to the vertical export of biogenic particles.

EXPERIENCES FROM RCM SIMULATIONS OVER HIGH LATITUDE REGIONS COUPLED TO LAKE, SNOW AND FOREST PROCESSES

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Rossby Centre at the Swedish Meteorological and Hydrological Institute (SMHI) has been working on Regional Climate Modelling (RCM) since 1997 to provide society and researchers with climate scenario information. Today we have an RCM, the Rossby Centre regional climate model RCA, which includes interactive coupling between dynamical processes in atmosphere, soil, vegetation and lakes. RCAO is a system which also includes our regional ocean model. RCA is applied over several regions around the world including Europe, Arctic and North America. Here we will show examples on our experience in simulating processes especially coupled to cold climates.

In regions where lakes represent a non-negligible fraction of the surface their large thermal inertia, when compared to the land surface, may cause them to have a substantial impact on the regional climate. Simulations over Europe and North America where RCA has been coupled to the lake model FLake illustrates this effect. In a first set of simulations lakes were present (applying FLAke) while in a second set of simulations all lakes were replaced by land. A comparison of the two sets shows that the presence of lakes has a warming effect on the climate for all seasons except spring. In cold winter climates the warming effect during winter is explained by the fact that the ice covered period usually extends from mid winter until mid spring. Thus, during the first half of the winter the lakes are warmer than a corresponding open land area would be. During summer the warming effect of lakes is due to a relatively warm lake surface temperature during night time. The results also show that many small lakes (as in Southern Finland) act differently on the summer climate than a few big lakes. Many small, and relatively warm, lakes enhance the summer precipitation due to more evaporation while big, and relatively cool, lakes suppress evaporation and consequently also the precipitation.

In a warming climate we will see how trees start to occupy now tree-less areas. One of the largest differences between tree and tree-less areas in snow-dominated climates is the one on albedo. When trees are established the albedo decreases substantially. This will have a local warming effect which through positive feedback mechanisms may even further favour the establishment of new trees. The full potential through such feedback mechanisms can only

be investigated in a system where the RCM is interactively coupled to a dynamic vegetation model. We will show results from simulations where RCA has been coupled to the dynamic vegetation model LPJ-GUESS. The results are based on a scenario where RCA-GUESS has been forced by output from the GCM ECHAM5 using emission scenario A1B. We see how the tree line climbs upwards in the Scandinavian mountain range and how that affects local conditions in albedo, temperature and evaporation.

COMPARISON OF SNOWPACK EVOLUTION ON THE NECOPASTIC RIVER BASIN (NORTHERN QUEBEC) USING HYDROTEL AND CROCUS

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Between 1950 and 1980, subarctic and arctic regions of boreal Quebec went through a cooling period, but since then they have experienced a 3°C warming. If this trend persists, the hydrologic regime of boreal watersheds will change. Within this context, there is a need to predict reservoir inflow conditions for optimal planning of hydroelectric generation. To meet this goal, Hydro-Quebec (HQ)/Ouranos are pursuing the development of the distributed hydrological model HYDROTEL, undertaking its adaptation to the boreal environment in order to further our understanding of past and future watershed dynamics. This project involves four work packages, namely: (i) application of the current version of HYDROTEL to a pilot watershed, the 250-km^2 Necopastic River basin (latitude/longitude : 53°43'36"N /78°13'59"O), to identify the problems associated with the use of the model in the James Bay region; (ii) adaptation/improvement of modeled processes associated with the thermal energy balance and the water balance of wetlands and lakes; (iii) development of a calibration strategy adapted to available data; (iv) determination of the potential use of UQÀM's RCM for simulating past behavior and future responses under changing climatic conditions. This presentation introduces preliminary results related to work package (ii); that is the evaluation of HYDROTEL's snow model: a single-layer, mixed degree-day-energy-budget, model. The approach used to achieve this goal involves an inter-comparison study with the multi-layer, energy budget French model CROCUS developed at Centre d'Études de la Neige (CEN/Météo-France). Snow height (and eventually snow water equivalent) registered at the Neco-1 meteorological station is being used to evaluate the performance of both models. Since we had already applied CROCUS on La Grande River basin (namely at LG4) in a previous study, only HYDROTEL's snow model needed to be calibrated. Preliminary results indicate CROCUS simulates well snowpack evolution and that these results could serve as guidelines to improve HYDROTEL's snow model when detailed meteorological data are unavailable. Also, future work will involve integrating CROCUS into HYDROTEL to investigate the ensuing benefit of a detailed snow model when predicting reservoir inflows.

DISTRIBUTIONS OF THE NATURAL GREENHOUSE GAS N2O IN CANADIAN ARCTIC WATERS

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The Arctic environment is currently undergoing significant long-term changes including an increase in average temperatures and a progressive loss of sea-ice cover, especially in the summer. In 2007-2008, the Arctic SOLAS (Surface Ocean Lower Atmosphere Study) project, a component of the International Polar Year, investigated biogenic trace gas dynamics and sea-air fluxes in Arctic waters in order to elucidate the effects of changing oceanographic conditions on regional and global climate. Nitrous oxide (N_2O) is a biogenic greenhouse gas produced by microbial action in the water column. Its production is intimately linked to nitrogen cycling, where it is an intermediate in both nitrification and denitrification processes. Few data presently exist for N_2O in polar waters. We measured the vertical distribution of N_2O in water column profiles at 44 stations extending from northern Baffin Bay to the Beaufort Sea. The relationship of N_2O to nutrient and oxygen distributions, bacterioplankton abundance, primary production and other oceanographic variables will be explored, and the relevance of Arctic waters as a source of N_2O to the atmosphere will be evaluated.

BOUNDARIES, BIODIVERSITY, RESOURCES AND INCREASING MARITIME ACTIVITIES: EMERGING OCEANS GOVERNANCE CHALLENGES FOR CANADA IN THE ARCTIC OCEAN

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The Arctic region is undergoing rapid environmental and socio-economic change. As one of the most rapidly warming places on the planet, the Arctic is experiencing climate change related impacts such as a severe downward trend in sea ice cover. The scientific community has projected that this trend could result in a sea ice-free summer by 2030 and perhaps even earlier. As conditions warm, the retreat of sea ice is driving an expansion of political and economic activity.

Recent world media attention has been focused on the Arctic to an unprecedented extent. Much of the discourse has been devoted to a perceived Arctic "scramble" or "gold rush" for jurisdictional rights and marine resources, especially potential seabed energy resources, in the context of major changes in the Arctic environment. In particular this was highlighted by the planting a flag on the seabed of the North Pole by the Russian Federation in August 2007, sending a further wave of excitement and speculation throughout the world press concerning the geopolitical future of the Arctic.

This paper explores recent developments in the Arctic region, notably in terms of environmental changes and maritime claims with a particular emphasis on the Canadian Arctic. The paper then examines some of the potential impacts of expanding maritime industries such as fishing, seabed resource exploration and navigation on the conservation of biodiversity in, particularly, the Canadian Arctic and the consequences in terms of oceans governance.

ISOTOPIC AND SEDIMENTOLOGICAL EVIDENCE FOR SEA ICE CONDITIONS AND PALEOCEANOGRAPHY OF THE 15,000 YEARS ON THE BEAUFORT SEA SLOPE AND AMUNDSEN GULF, CANADA

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Data from cores on the Beaufort Slope (site 750) and in the Amundsen Gulf (site 124) have been compared in a previous paper in regards to foraminiferal assemblages with relation paleo-sea ice conditions. Here other proxies are examined: carbon and oxygen stable isotopes from both planktic and benthic foraminifera and sedimentological markers from clays and coarse fractions of the IRD that were identified but not studied previously. Site 750 is particularly sensitive to paleo-ice cover because at present it rests beneath the present margin of the permanent Arctic ice pack. In the Holocene section of the core (except the very surface) there is little carbonate and therefore no isotopic data could be obtained but commencing at 120cm and to 380cm, there is strong evidence of IRD. Occurring with the IRD are many calcareous foraminifera, both planktic and benthic, that provide isotopic signals for both a surface and bottom water signal. Oxygen isotopes in the IRD units (dated from ~11,500calBP to over 13,000calBP) were uniformly high for the benthic species (>+4‰) and lower for the planktics (as would be expected more variation-+.5 to almost +3‰); the fact that the oxygen isotopes of the benthic species do not change between glacial and interglacial suggests that there is no global ice volume signal in the Arctic as suggested earlier for Alpha Ridge cores. However the changes in the planktic species indicate salinity and/or temperature changes with ice melt influences. Below 400cm the IRD disappears as do the

calcareous foraminifera. Site 124 is very close to the former glacial margin in the Gulf. Isotopes indicate both surface and bottom water conditions similar to site 750 which is interesting because this core is in only 350m of water and in an enclosed gulf. The paleomagnetic data suggest that both cores have the same source of IRD for the upper IRD units but the lower one in core 750 is older and different composition. The commencement of ice rafting can only occur if the ice pack starts to move to allow glacial calving and iceberg movement so the date of over 12,000calBP marks the beginning of deglaciation in the Amundsen Gulf and into the Beaufort Sea. However the older IRD unit in 750 suggests glacial movement prior to 13,000calBP. These new data combined with the previous foraminiferal data make it possible to reconstruct bottom and surface water conditions both before and during ice break up as well as suggest what sea ice conditions were throughout the Holocene and before.

DISSOLVED INORGANIC CARBON IN THE CANADIAN ARCHIPELAGO OF THE ARCTIC OCEAN: THE EXPORT OF PACIFIC CARBON TO THE NORTH ATLANTIC VIA BAFFIN BAY

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The Arctic Ocean is expected to be disproportionately sensitive to climatic changes, and thought to be an area where such changes might be detected. The Arctic hydrological cycle is influenced by: runoff and precipitation, sea ice formation/melting, and the inflow of saline waters from Bering and Fram Strait, and from the Barents Sea Shelf. Pacific water is recognizable as low salinity water, with high concentrations of dissolved inorganic carbon (DIC), flowing from the Arctic Ocean to the North Atlantic via the Canadian Arctic Archipelago. We present DIC data from an east-west section through the Archipelago, collected as part of the Canadian International Polar Year initiatives. The fractions of Pacific and Arctic Ocean waters leaving the Archipelago and entering Baffin Bay, and subsequently the North Atlantic, are computed. The eastward transport of carbon from the Pacific, via the Arctic, to the North Atlantic is estimated.

Altered mixing ratios of Pacific and freshwater in the Arctic Ocean have been recorded in recent decades. These changes lead to a redistribution of Arctic waters entering the North Atlantic potentially masking changes due to anthropogenic carbon dioxide (CO_2) loading. Export of water with high DIC from the Pacific to the North Atlantic via the Canadian Archipelago has implications for CO_2 uptake, and hence ocean acidification, in the subpolar and temperate North Atlantic.

WAVE PERTURBATIONS IN OPTICAL AIRGLOW OBSERVATIONS AT HIGH NORTHERN LATITUDES

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Two ground-based instruments called SATI (Spectral Airglow Temperature Imager) monitoring the airglow temperature and emission rate in the polar Mesosphere and Lower Thermosphere (MLT) region have been in operation at Resolute Bay (74.68 N, 94.90 W) and at Eureka (80.00 N, 86.25 W) since November, 2001, and November, 2007, respectively. The Eureka SATI was developed for the Canadian Network for the Detection of Atmospheric Change (CANDAC) project and is a part of a suite of optical instruments installed at the Polar Environment Atmospheric Research Laboratory (PEARL) providing a unique insight in the dynamics of the Northern Pole MLT region. The SATI instrument is a two-channel, Fabry-Perot interferometer, and measures the OH and O_2 airglow emissions at 87 km and 94 km, where the airglow emission peaks are located. The SATI annular field of view is divided into 12 sectors in horizontal direction and temperature and emission rates are separately calculated for each of the sectors. These horizontal and vertical measurements are used to investigate the atmospheric wave dynamics in the MLT region at the two locations. Strong gravity wave and planetary wave perturbations are identified and the results on the wave propagation characteristics are compared and discussed.

CIRCUMPOLAR ACTIVE LAYER MONITORING (CALM) PROGRAM: ACCOMPLISHMENTS AND FUTURE DIRECTIONS

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The Circumpolar Active Layer Monitoring (CALM) program, established in the early 1990s, is designed to observe temporal and spatial variability of the active layer, near-surface permafrost parameters, and their response to changes and variations in climatic conditions. The CALM network involves 15 participating countries and is comprised of 168 sites distributed throughout the Arctic, parts of Antarctica, and several mountain ranges of the mid-latitudes. Owing to historical circumstances and logistical constraints, the distribution of sites is not uniform within the permafrost regions. The majority of the sites are in Arctic and Subarctic lowlands. At 77 sites, direct active-layer measurements are conducted on standard rectangular grids ranging from 10 x 10 m to 1 x 1 km. The locations of grids were selected to represent generalized surface and subsurface conditions characteristic of broad regions. The size of each grid reflects the level of local geographic variability. At 91 sites, active-layer values are inferred using soil temperature measurements from boreholes of variable depth. Approximately 60 CALM sites have continuous active-layer records longer than five years and 30 have ten-year records or longer. Auxiliary information includes air temperature, soil moisture, soil temperature at different depth, snow cover, soil composition, and landscape characterization. Several sites have records of frost heave and thaw subsidence that are contributing to a reconceptualization of the role of the active layer in global-change studies. Metadata include detailed site descriptions and photographs for each site. CALM is the world's primary source of information about the active layer. Data obtained from the network have been used in validation procedures for permafrost, hydrological, ecological, and climatic models, at a variety of geographic scales. CALM is making significant contributions to International Polar Year 2007-08 as a major component of the *Thermal State of Permafrost* IPY project. This presentation summarizes decadal results and accomplishments of the CALM program and project future directions.

UNDERSTANDING THE SPATIAL AND TEMPORAL VARIABILITY OF PRIMARY PRODUCTION OVER THE HUDSON BAY, FOXE BASIN AND HUDSON STRAIT MARINE SYSTEM VIA COUPLED BIO-PHYSICAL MODELS

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The temperature increase over the Arctic Ocean and its adjacent seas, as predicted by General Circulation Models, implies multiple environmental changes such as: intensification of the hydrological cycle, changes in stratification and water mass circulation and most importantly, large decrease in sea ice thickness and duration. The associated marine biogeochemical responses (marine production and associated fluxes) to such changes are still largely unknown. The focus is the Hudson Bay system (Hudson Bay, Foxe Basin and Hudson Strait), the largest inland sea in Canada with typical Arctic characteristics including cold, fresh waters and a complete seasonal sea-ice cover. This project attempts to better understand the Hudson Bay marine ecosystem in response to climate and ocean variability using coupled biological/physical models. Two biological models are in development for the understanding of sea-ice and pelagic biota respectively. These models are driven by the sea ice-ocean model of Saucier *et al.* (2004) with realistic tidal, atmospheric and hydrologic forcing. We present here some of the most important results concerning spatial and temporal variability for both ice-algae and phytoplankton production.

ENGAGING NORTHERN COMMUNITIES IN THE MONITORING OF COUNTRY FOOD SAFETY

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Zoonoses in country food is a concern for Canadian northerners because hunting wildlife is an integral part of their daily life, and southern food can be expensive to buy in the North. Scientific knowledge on zoonoses in Northern Canada (?) is scarce and dispersed throughout different governmental organizations. Furthermore, due to the different methods of food preparations, food safety concerns differ throughout the Canadian Arctic. The involvement of northern communities in our research is essential to get on-the-ground information to understand wildlife and disease ecology. Our goals are five-fold: (1) Establish the distribution of *Trichinella sp*, *Toxoplasma gondii*, Anisakidae worms, *E.coli 0157* and *Salmonella sp* of food safety concern, (2) set-up laboratory facilities in Nunavik, NWT and Labrador, (3) train local people for wildlife sampling and diagnosis of the five diseases of interest (4) develop rapid screening tests for the pathogens and adapt them to the North, and (5) develop a Canadian web-based database of Arctic wildlife diseases that can be accessed by all northerners. Our communication strategy is to share the results with the regional public health personnel and to help develop recommendations for the safe consumption of country foods. Once the recommendations are created, they will be disseminated to the public in various, culturally appropriate forms, including radio interviews, posters and pamphlets. We want to empower northerners to take informed decisions about food safety and to be better equipped to prevent foodborne disease. This presentation will be an update of the third year of a five-year project.

THE OPENING OF ARCTIC SHIPPING ROUTES: UNDERWATER NOISE POLLUTION CONSEQUENCES ON MARINE MAMMAL HABITATS AS MEASURED ON A NEARBY SOUTHERN SEAWAY, THE ST. LAWRENCE

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Among the large changes expected to occur in the Arctic Ocean as a result of ice melting in response to global warming, we find the opening of new sea routes to inter-ocean navigation. The development of the Northwest or Northeast passages through the Arctic are obvious from the clear economical advantage of transiting cargo from Asia to Europe via much shorter routes than the present alternative of circling around North America. Although environmental risks of such development through chemical pollution from spills or collisions are acknowledged, the more subtle –but likely as relevant for marine mammals and fish– is the inevitable introduction of severe anthropogenic noise into this pristine, relatively silent, remote marine environment. Marine mammals, and to some extent several fish species, extensively use underwater sound to communicate, navigate, feed and breed. The high level of noise pollution associated to seaways risks to affect these vital functions and change the quality of the habitat along the shipping routes. Recent multi-year investigations of noise budget on a major continental shipping route of North America, the St. Lawrence Seaway, have documented the high noise level associated to the transiting international shipping fleet. This information is used here to gauge the expected change in noise conditions along the anticipated seaways to cross the Arctic Ocean. A large area of the basins along the shipping lanes will likely experience substantial changes in underwater noise conditions, in response to merchant ship noise radiated over tenths of km. The periods of low noise conditions, favourable to sound detection over large ranges, will decrease as function of the traffic density. Marine organisms intensively using sound in their vital activities, especially in critical time periods or areas, will likely experience large changes in underwater sound conditions

of their habitat by increasing shipping through the pristine Arctic marine environments.

METEOROLOGICAL CONDITIONS ASSOCIATED WITH SIGNIFICANT STORM SURGE ACTIVITY ALONG THE BEAUFORT SEA COAST

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Coastal regions in the Beaufort Sea have experienced significant shoreline erosion over the last several decades. The most dramatic impacts are observed during storm surge events that tend to occur in the early fall months (August through early October; ASO) before the sea ice coverage in the Beaufort Sea becomes complete. In this study, nine events that produced significant damage at Tuktoyaktuk are examined to isolate the dominant mechanisms responsible for producing storm surge events.

The monthly climatology of ASO hourly winds at Tuktoyaktuk indicates that a majority of large wind events, including the nine storm surge events, are westerly. The largest winds observed at coastal stations in western Alaska are also predominately oriented from west to east, suggesting a role for the nearby Brooks Range in producing severe winds along the coast. The evolution of wind, temperature and sea level pressure fields suggest that cold air damming to the north of the Brooks Range is responsible for producing the large westerly winds observed during storm surge events. In the hours leading up to the storm surge events, the passage of a cyclone through the Beaufort Sea causes a dome of cold air to build along the north slope of the Brooks Range to the west of Tuktoyaktuk. As the cold air causes the geopotential heights to rise, a strong pressure gradient is induced parallel to mountains along the Beaufort coast. The resulting down gradient acceleration produces winds throughout the lower troposphere that are approximately geostrophic. Model soundings at Tuktoyaktuk and diagnostic analysis confirm that the surface winds at Tuktoyaktuk during the storm surge events are enhanced by momentum mixing in the unstable boundary layer. The roles of antecedent sea level height and sea ice are discussed.

SEABIRDS INDICATE CHANGE IN THE ARCTIC MARINE ENVIRONMENT

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Climate change is accelerated at high latitudes, and arctic marine environments are among the most profoundly affected on the globe. Some impacts are already evident, but monitoring changes in marine ecosystems in the arctic is difficult because of the geographic extent and relative inaccessibility of the seasonally ice-covered waters. Seabirds are long-lived top predators that return to fixed colony locations to breed. They have a variable diet and forage over large distances at a variety of ocean depths. They have long been proposed as cost-effective sentinels of change in marine ecosystems, and their use as indicators has already provided insights into the climate-driven changes taking place in the Canadian arctic. Our IPY project examines how seabird diets and breeding biology respond to changes in oceanographic conditions, and what these signals may tell us about changes at lower trophic levels. These observations should enable us to predict future change in marine food webs. To illustrate the potential of these techniques we present data from more than 25 years of observation on Thick-billed Murres (*Uria lomvia*) at colonies across the species' range in the eastern Canadian arctic. The timing of birds' arrival at the colony has tracked the advances in timing of ice-out, but the period between arrival and laying is longer than it previously was, suggesting energetic limitation. Diet changes demonstrate a shift towards fish species from subarctic waters such as the capelin (*Mallotus villosus*) and away from Arctic fishes such as the Arctic cod (*Boreogadus saida*). Overall, reductions in ice cover have had negative consequences for individuals at the southern edge of the species' range, and positive effects for those at the northern edge of the range, creating the conditions for a future range shift.

THERMAL STATE OF PERMAFROST IN CANADA – A SNAPSHOT OF CURRENT CONDITIONS AND RECENT TRENDS

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Over the past two to three decades, Canadian researchers have established and maintained a permafrost monitoring network consisting of boreholes in which ground temperatures are measured. This network is a key contribution to the Global Terrestrial Network for Permafrost. Data collected from the monitoring sites have facilitated documentation of recent trends in permafrost thermal state. These results have contributed significantly to the characterization of changes in permafrost conditions across the circumpolar north, as reported in a number of recent international assessments including the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

The International Polar Year (IPY) provides the opportunity for the Canadian permafrost community and the International Permafrost Association to conduct a well designed global and coordinated multinational programme of permafrost observations in order to explore present conditions and their spatial and temporal variability. A collaborative IPY project led by the Geological Survey of Canada, University of Ottawa and Carleton University represents the main Canadian contribution to this larger international project. Key objectives of the project include: (1) continued collection and synthesis of data from all monitoring sites to extend the time-series and improve characterization of the response of permafrost to climate change and variability; (2) establishment of new monitoring sites prior to and during IPY to increase coverage in underrepresented regions; (3) obtain a set of standardized temperature measurements for all Canadian monitoring sites (snapshot).

Funding acquired through the Canadian Government's IPY program along with additional support acquired by the project investigators and collaborators has facilitated the establishment of over 50 new monitoring sites over the last three years. New sites include: seven sites in the Baffin region of Nunavut established in collaboration with communities; collaboration with Parks Canada to instrument sites in northern Manitoba; increased coverage in the western Arctic including the Yukon Territory. Initial thermal data have been acquired from a number of these new sites providing information on permafrost conditions in areas for which little recent information was available. Data from these sites and the existing long-term sites have been utilized to produce a preliminary snapshot of permafrost conditions during the first portion of the Polar Year providing an improved baseline against which change can be measured.

The extension of existing time series and associated analyses indicates that there is generally an ongoing increase in shallow permafrost temperatures across the Canadian north. The magnitude of rate of increase however varies regionally. Smaller increases for example are observed in ice-rich terrain in the southern portion of the permafrost region where ground temperatures are approaching 0°C. In addition, the role of local factors such as variations in snow cover is being investigated to improve understanding of permafrost-climate relationships and the response of permafrost to climate change and variability.

INTERACTIONS BETWEEN WATER, ICE AND SEDIMENT DURING SPRING BREAKUP AT THE MOUTH OF THE MACKENZIE RIVER, NORTHWEST TERRITORIES

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Breakup of northerly draining large Arctic rivers is controlled by early thaw in their upper (southerly) drainage basins, while cold temperatures initially persist in their lower reaches. This leads to dramatic increases in river discharge while the river mouths are still encumbered by thick ice. The Mackenzie River is the largest northerly draining river in North America, both in terms of water discharge and sediment delivery. Recent hydrocarbon exploration activities and proposed development have instigated a series of studies to investigate the interaction between rising discharge and sea ice and the impacts on sediment transport at the river outlet in the Beaufort Sea.

Satellite-based observations were combined with data from in situ sensors and helicopter-borne reconnaissance to document the progression of breakup during the May-June period in 2006 to 2008. Synthetic Aperture Radar (SAR) was used to map the development and distribution of bottomfast sea ice (BFI) at the mouths of distributary channels. Data from optical sensors (MODIS and MERIS) were used to map the progression of overflow and subsequent drainage. BFI was found to play a critical

role in controlling the timing and location of overflow early in the breakup season. Overflow occurs when rising river discharge encounters decreased channel capacity where distributary channels enter the ocean. Energetic and extensive upwelling was observed at the landward edge of the BFI during the rising limb of the spring freshet several weeks prior to the peak. Overflow velocities over the surface of the ice were on the order of 0.15 metres per second. Pressure gauges placed on the ice surface at two locations showed that overflow depth increased from zero to 30 cm in 15-30 minutes. BFI also controls the locus of overflow waters because it is topographically lower than the surrounding ice which is free to float as water levels rise. However, maximum overflow extent overshoots the boundaries of BFI to where it encounters cracks and flaws in the ice canopy at which point drainage through the ice occurs. Drainage vortices have been termed "strudels". Extensive fields of strudel drainage features were encountered in both 2007 and 2008 and are concentrated at the seaward edge of the BFI. This area appears to be associated with ice that is only tenuously bonded to the seabed so that the warming associated with the overflow causes it to float upward driving drainage of the overlying flood water. Strudel drainage is known to cause scours on the seabed several metres deep and 10s of metres in diameter along the North Slope in Alaska. Probing and acoustic surveys have documented "strudel scours" off the Mackenzie Delta up to 1.2 m deep and 15 m in diameter. In 2007, the scours persisted at least until August when the surveys were undertaken, whereas, in 2008, scours mapped in June had disappeared by August. These observations indicate that mediation of discharge by sea ice in shallow nearshore waters can have significant impacts on sediment mobility with implications for human activities such as pipeline operations and dredging.

IMPORTANCE OF ICE ALGAE FOR CALANUS GLACIALIS IN THE HIGH-ARCTIC

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During the Norwegian IPY-project CLEOPATRA we carried out an extensive seasonal study of the lower trophic levels in Rijpfjorden, a high-Arctic fjord (80ºN) in Svalbard. The aim of the CLEOPATRA project is to investigate the role of light for timing, quantity and quality of primary and secondary production in a seasonally ice-covered ecosystem. Due to the predicted loss of sea ice we were particularly interested in the importance of ice algae for reproduction and growth of the herbivorous copepod *Calanus glacialis*, representing the key link between primary producers and higher trophic levels in Arctic shelf seas. In 2007, Rijpfjorden was ice-covered from early February until mid-July with maximum ice thickness in June. Ice algae were present from March to June, with peak biomass in April and June. In April, 2 months prior to the phytoplankton bloom, *C. glacialis* were observed with green guts, and in June high amounts of typical ice algal fatty acids were found in *C. glacialis*. Eggs were produced in March, but highest egg production was measured in June. From July to October females were rarely found. Highest occurrence of nauplii and young copepodites coincided with high phytoplankton biomass in July. Future scenarios with open waters all year round may have severe impact on the population success of *C. glacialis*. Experimental studies confirmed that food is of crucial importance for gonad development and high egg production rates. In Rijpfjorden, the occurrence of ice algae ensured early reproduction, which again gave the opportunity for the offspring to feed on the later occurring phytoplankton bloom. In Rijpfjorden, most of the *C. glacialis* population had descended to overwintering depths in October, and at that time the majority had reached copepodite stage V, suggesting a predominately 1 year life cycle. By utilizing both ice algae and phytoplankton *C. glacialis* extend its growth season substantially, which can explain its rapid development and population success in relatively extreme Arctic environments.

SPATIAL AND TEMPORAL CHANGES IN NET ECOSYSTEM EXCHANGE AND SOIL RESPIRATION RATE IN IN FOUR NORTHERN ECOREGIONS

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The northern regions of Canada have undergone greatest increase in annual temperature over the last 30 years as compared with rest of Canada. Increase in temperature affects carbon assimilation and release, which in term affects carbon source-sink relationship of the entire area.

Permafrost thawing exposes deeper thickness of active layer to decomposition, which affects the fate of large organic C stored in these northern ecosystems and could result in increased release of GHG in the atmosphere. On the other hand, increased photosynthesis in warmer conditions and extended frost-free period could accelerate organic C accumulation in the wettest parts of the landscape, thereby increase C storage.

The study was initiated to evaluate source-sink relationship of CO_2 across climatic gradient and forest-peatland landscape position, and to identify climatic and biological factors affecting CO_2 assimilation/released in northern ecosystems.

To achieve this, sites were selected across four ecoregions and permafrost zones i.e. low boreal, high boreal, low subarctic and high subarctic throughout the Mackenzie Valley. These four sites are located in the regions of Inuvik, Norman Wells, Fort Simpson, and Fort McMurray. Temporally and spatially explicit carbon dioxide assimilation/emissions monitoring was initialized in late summer of 2007 and continued throughout growing season of 2008. Along with CO_2 monitoring, sites were also instrumented to continuously monitor water table depth, soil moisture, soil temperature, water chemistry, redox and oxygen concentration. Early results shows that soil respiration rate decreased with increase in latitude and thereby could be related to the decrease in mean annual temperatures. The greatest respiration rates were observed in the upland forested sites, while the most significant assimilation of C took place in the water saturated peatland areas across ecoclimatic zones. Diurnal and seasonal observations of net ecosystem exchange (NEE) and climatic variables provide explicit database for C source-sink relationship for the area and correlation-based modelling for GHG emissions from the surface, utilizable for large area extrapolation. Results from our study provide some indication that with permafrost thawing, northern ecosystems are likely to increase growing-season CO_2 uptake.

MODELLING BIOGEOCHEMICAL CYCLING AND INTERFACIAL EXCHANGE OF CLIMATICALLY IMPORTANT GASES

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We have developed a 1-D coupled atmosphere-ocean-biogeochemical model to study gas exchange at the atmosphere-ocean interface. The coupled model consists of an atmospheric Single Column Model (SCM), based on the CCCma AGCM (Canadian Centre for Climate Modelling and Analysis-Atmospheric General Circulation Model), the General Ocean Turbulence Model (GOTM) and a 7-component ecosystem model embedded in GOTM. The ecosystem model also includes oxygen, nitrogen, carbon and silica cycling as well as a marine DMS (dimethylsulfide) module. The AGCM includes a comprehensive sulphur cycle which is now coupled to the ocean DMS model.

The study focuses on the representation of gas exchange processes in models, including formulations for gas exchange via bubbles (e.g. O2 and N2, CO2) and dispersion in the atmosphere (DMS).

The model has been extensively tested for Ocean Station Papa (OSP, 145 W, 50 N) in the Northeast Pacific, where observations are available from a long-term air-sea exchange mooring which has been maintained at a location near OSP from September 2002 to June 2007 as part of the Canadian Surface Ocean Lower Atmosphere Study (C-SOLAS). The mooring provides a new long-term data set for gas measurements. In addition to Conductivity, Temperature and Depth (CTD) recorders at two depths, the mooring is equipped with ProOceanus Gas Tension Devices (GTDs) measuring the total gas pressure at four different depths, a pCO2 sensor, two oxygen sensors, two fluorometers for chlorophyll estimates, and an upward-looking 200~kHz echo-sounder for bubble measurements. Additional observations are derived from regular cruises along Line P and an intense measurement period during the Subarctic Ecosystem Response to Iron Enrichment Study (SERIES) in July 2002. We are now in the process of extending the model with a snow - sea ice - ice algae module to study gas exchange processes in high latitudes.

EVIDENCE OF LAKE AGASSIZ FINAL OUTBURST FLOOD FROM HUDSON BAY TO OFFSHORE LABRADOR

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Hudson Bay and Hudson Strait were the sites of a dynamic and rapid deglaciation that culminated in the catastrophic drainage of proglacial Lake Agassiz into the North Atlantic around 8500 cal BP. It has been suggested that this catastrophic event may have triggered the 8200 cal BP cold event recorded in Greenland ice cores and in northern Europe. Evidence for that outburst flood was the identification of a centimeter to decimeter-thick red layer that was observed in Hudson Strait sediments around 8000 yr BP. In this paper, we have identified a sequence of two flood-induced turbidites (i.e., hyperpycnites) in a reddish layer from two cores collected in northern Hudson Bay (core AMD0509-27bLEH) and western Hudson Strait (core AMD0509-28PC) onboard the ice-breaker CCGS Amundsen as part of the ArcticNet program, demonstrating the flood-induced and two-pulse nature of the red bed. The cores also reveal that the red bed is coarser and thicker in Hudson Bay, indicating its proximity to the sediment source. In addition, the apparent absence of hemipelagic sediments and ice-rafted debris (IRD) between the two turbidites along with the presence of IRD in sediments above and below the red bed indicate its rapid deposition and that there was little time between the two flooding events. Similarly, based on the sediment color and magnetic susceptibility of several cores, we identified and traced a red bed throughout Hudson Strait and offshore Labrador near Cartwright Saddle. Radiocarbon ages and X-ray analysis indicate that these red beds have a similar timing and mineralogy, suggesting a western Hudson Bay and Strait sediment provenance following Lake Agassiz final outburst flood.

FUNCTIONAL LAYERING OF MARINE MAMMAL BLUBBER INFLUENCES THE STRATIFICATION OF LIPOPHILIC COMPOUNDS IN THE BLUBBER

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Marine mammal blubber is frequently used for biomonitoring of marine ecosystems; different lipophilic substances are analyzed from the subcutaneous lipid layer. However, detailed vertical profiling (throughout the blubber column from skin to muscle) of different lipid components: fatty acids, triacylglycerols and phospholipids (phosphatidylcholine; PC, sphingomyelin; SM, and phosphatidylethanolamine) revealed that ringed seal (*Pusa hispida*) blubber is highly specialized and biochemically layered into three different segments: superficial, middle and deep blubber. The superficial blubber had a high degree of fatty acid Δ9-desaturation, indicating adaptation to low temperature, and also a high SM/PC ratio which has been associated with insulin insensitivity and hence impaired lipid metabolism. These findings indicate that the superficial blubber might serve a primary a thermoregulatory role and have low metabolic activity. The high variance in the lipid composition in the deep blubber suggests that this layer is metabolically very active and is probably strongly affected by recent lipid mobilization/deposition. The thicknesses of both the superficial and deep blubber were quite stable under different nutritional conditions, whereas the middle blubber seems to expand and contract with food availability, and thus it can be defined as the storage site for energy. This kind of functional layering of the blubber is certain to strongly affect the deposition, distribution and mobilization of lipophilic substances such as lipid soluble vitamins and organic pollutants in the blubber. Indeed, detailed vertical profiles of vitamin A demonstrated that vitamin A is unevenly distributed in the blubber column, which is probably due to the functional layering of the lipids in the blubber. The biochemical and metabolic layering of the blubber should be taken into consideration when sampling marine mammal blubber for various types of biomonitoring.

MEASURING ATMOSPHERIC COMPOSITION AT PEARL: AN OVERVIEW OF THE FIRST TWO YEARS

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The recently established Polar Environment Atmospheric Research Laboratory (PEARL) is located in the Canadian high Arctic at Eureka, Nunavut (80N, 86W). It has been equipped with a suite of instrumentation to investigate chemical and physical processes in the atmosphere from the ground to 100 km. The complexity of the atmosphere and the different spectroscopic signatures of its many chemical constituents make it impossible to measure all relevant species using any one remote sounding technique. Rather, these measurements are being made using the complementary capabilities of several of the PEARL instruments, including Fourier transform infrared (FTIR) spectrometers, UV-visible grating spectrometers, and an Atmospheric Emitted Radiance Interferometer. This presentation will provide an overview of spectroscopic trace gas measurements made during the first two years of operation, which largely coincide with International Polar Year. These will include both tropospheric and stratospheric constituents, with a focus on those relevant to the Arctic Middle Atmosphere Chemistry theme, whose overall goal is to improve our understanding of the processes controlling the Arctic stratospheric ozone budget and its future evolution.

THE CIRCUMPOLAR BIODIVERSITY MONITORING PROGRAM: COORDINATING FOR ARCTIC CONSERVATION

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In response to the global importance of the Arctic's biodiversity, the increasing pressures on Arctic biodiversity and human communities, and our limited capacity to monitor and understand these changes, the Arctic Climate Impact Assessment (ACIA) recommended that long-term Arctic biodiversity monitoring be expanded and enhanced. In response to these recommendations, the Arctic Council's Conservation of Arctic Flora and Fauna Working Group (CAFF) began development of the Circumpolar Biodiversity Monitoring Program (CBMP).

The CBMP is a mechanism for harmonizing and enhancing long-term biodiversity monitoring efforts across the Arctic in order to improve our ability to detect and report on significant trends and pressures. The resulting information will be used to assist policy and decision making at the global, national, regional and local levels.

Considering the size and complexity of the circumpolar Arctic, it is essential that the CBMP promote and develop an integrated ecosystem-based approach to monitoring. Such an approach involves monitoring that bridges ecosystems, habitat and species and demands information not only on the status and trends in Arctic biodiversity, but also on their underlying causes. It is critical that this information be collected and made available to generate effective strategies for adapting to the changes now taking place in the Arctic —a process that ultimately depends on rigorous, integrated, and efficient monitoring programs that have the power to detect change within a reasonable time frame. Towards this end, the CBMP will facilitate the integration and coordination of a multidisciplinary, integrated ecosystem-based approach to research and monitoring through the development of five integrated Expert Monitoring Groups (Marine, Coastal, Freshwater, Terrestrial Vegetation and Terrestrial Fauna). Each group will be comprised of existing place-based and network-based research and monitoring programs utilizing both community-based and other scientific monitoring approaches, representing a diversity of expertise and monitoring capabilities. Special attention will be paid to community-based observations and citizen science, understanding the value and significance of local people living in the Arctic environment and their contribution to the monitoring of Arctic biodiversity. Over the next five years, the CBMP will focus its efforts on the following key areas:

- Developing a strategy for building and maintaining a comprehensive and cost-effective circumpolar monitoring program that addresses current deficiencies;
- Coordinating and integrating biodiversity monitoring programs and promoting standardized measures and harmonized data protocols;
- Assessing current monitoring capacity and design to identify elemental, geographic, and statistical design deficiencies and inefficiencies;
- Interpreting, integrating, and communicating existing biodiversity information (establishing statistical baselines and retrospective assessments);
- Developing data-management structures and a Web-based data portal for the synthesis, analysis, and dissemination of biodiversity information;
- Identifying and initiating pilot monitoring projects, where clear gaps exist;
- Reporting on the status of Arctic biodiversity and the issues facing it, using diverse formats for communication, education and outreach at the global, national, regional and local levels.

TRANSIENTS IN THE NORTH: INTERACTIONS OF MIGRATORY FISH, CLIMATE CHANGE, AND CONTAMINANT ACCUMULATION IN COASTAL ARCTIC LAKES

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Freshwater lakes on the coast of Nunavut, Canada, are subject to a variety of stressors, including climate change, industrial development, and deposition of contaminants from both local and remote sources. Our current knowledge of food web structure, community composition, and contaminant bioaccumulation in coastal Arctic lakes does not allow us to accurately model contaminant concentrations in fishes or predict the effect of climate change on these concentrations. This is especially important in lakes that are used for subsistence fishing. To address this knowledge gap, we studied food web structure and concentrations of bioaccumulating metals (e.g., mercury, selenium, rubidium) in 6 lakes on the mainland coast of the Canadian Arctic. Three lakes contained populations of sea-run fishes (fish that migrate between marine and freshwater environments) whereas the remainder contained only landlocked fish species. Sea-run fishes are especially susceptible to climate warming because increased water temperature and decreased stream flow may result in extirpation of sea-run fishes from lakes with small migration streams. We found that the presence of a sea-run fish species, Arctic charr (Salvelinus alpinus), significantly altered food web structure and contaminant accumulation in lakes where they were present. In 2 of 3 lakes with sea-run Arctic charr, lake trout (the top predator fish; Salvelinus namaycush) had a relatively lower trophic position and significantly lower contaminant concentrations than in lakes without sea-run Arctic charr. We also found that lake trout in lakes with sea-run Arctic charr were in significantly better condition. This was likely due to juvenile Arctic charr serving as an alternate, high-quality prey source. We conclude that climate-induced extirpations of sea-run Arctic charr from coastal Arctic lakes will alter food web structure and may result in increased contaminant concentrations.

VERTICAL EXPORT OF ORGANIC MATTER FROM SEA ICE IN THE BARENTS SEA AND NANSEN BASIN (ARCTIC OCEAN)

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Ice-associated algae contribute to the total primary production, fluxes of organic matter between the ice and water column, and to deep export of organic carbon in ice-covered seas. Export of organic matter from sea ice was studied in the offshore marginal ice zone (MIZ) of the northern Barents Sea and Nansen Basin north of Svalbard. Water masses, ice conditions, and total primary production differ markedly from regions dominated by land-fast ice, where investigations of sub-ice fluxes traditionally have been carried out. Hence, characteristic patterns in the magnitude, composition and temporal variation in export can be expected in this region. The results are contrasted to sub-ice export and fluxes from the pelagic system elsewhere in the Arctic.

Organic matter fluxes measured by short-term sediment trap deployments at 1 m depth directly below the ice and at 30 m were generally higher in spring (May) than in summer (July). Maximum fluxes of particulate organic carbon and chlorophyll *a* from the ice (1537 mg C $m^{-2}d^{-1}$ and 20 mg Chl *a* $m^{-2}d^{-1}$) exceeded the flux at 30 m by a factor of 2 during the early melting phase, a pattern that typically was reversed later in the season. These values are also higher than fluxes observed under land-fast ice in the western Arctic. The composition of algae revealed a pattern of increasing importance of flagellates in the vertical flux during the progression of ice melting, with diatoms only being dominant in the early melting phase. Overall, flagellates contributed significantly to the ice-associated algal biomass and to exported algal carbon. The simultaneously high export of ice-derived organic matter and phytoplankton in the offshore MIZ differs from export in land-fast ice systems, where export from sea ice typically precedes export from the pelagic system.

REPRODUCTIVE SUCCESS AND LONG-DISTANCE MOVEMENTS OF SNOWY OWLS: IS THIS TOP ARCTIC PREDATOR VULNERABLE TO CLIMATE CHANGE?

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As a top predator of the terrestrial ecosystem, the Snowy Owl is believed to play a key role in the regulation of cyclic lemming populations in the Arctic. Their ability to move over long distance between years mean that owl populations could contribute to the stability of the food web over a large spatial scale. However, because of these erratic movements, we know very little on the biology of this species. The paucity of information on Snowy Owls in Nunavut is most unfortunate because it limits our ability to evaluate its vulnerability to current change occurring in the Arctic. The primary goals of this project were to study the reproduction and the long-distance movements of Snowy Owls breeding in Nunavut in relation to the variations in lemming abundance. Since 1993, we monitored the annual reproductive success of Snowy Owls and the abundance of lemmings on Bylot Island, Nunavut. In addition, in summer 2007, we marked 12 adult female snowy owls with satellite transmitters and tracked their movements over a full year. In summer 2008, we revisited the sites where most birds had settled. Owls showed enormous variability in their migration patterns and showed no breeding site fidelity. Although 2 birds spent the winter in southern Canada, most birds wintered in the Arctic. Birds wintering in the north spent a significant amount of time on the sea ice (from 1 to 2.5 months) mostly along South Baffin Island, suggesting that it is an important wintering habitat in Nunavut. In summer 2008, 7 out of 8 marked females that we were able to visit throughout Baffin Island were nesting, confirming for the first time that Snowy Owls can breed in two consecutive years in sites very far apart (700 km on average). Preliminary analysis of regurgitation pellets revealed that 95% of the food items taken by owls in summer are lemmings, thus supporting the strong correlation between reproductive success and lemming abundance we observed on a long-term basis. Therefore, we believe that this top predator could be severely impaired by the collapsing of small mammals' population cycles, as observed in Scandinavia and Russia. New information on winter habitat use revealed by satellite tracking also suggests that this species may be vulnerable to the rapid melting of the sea ice due to climate change.

NUTRIENT DYNAMICS IN THE SOUTHEAST BEAUFORT SEA DURING THE CFL, CASES AND ARCTICNET CAMPAIGNS: IMPLICATIONS FOR PRIMARY PRODUCTIVITY

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Nutrients play a major role in Arctic marine ecosystems by setting an upper bound to the yield of primary producers and renewable living resources. The evidence is mounting that net productivity and the associated fluxes of biogenic carbon respond to the modulation of nitrogen supply by climate, through its effects on the freshwater balance, sea ice and atmosphere-ocean coupling. With the successful completion of the CFL sampling program in 2008, we now have comprehensive information on nutrient renewal from autumn to winter in the gulf of Amundsen. This data set builds on the previous CASES overwintering, which provided similar information for the adjacent Franklin Bay (2004), and three ArcticNet expeditions (2005, 2006, 2007) that complete our time series of autumn data. While some of these years are generally similar despite contrasted ice regimes, striking anomalies occurred in relation to local physical forcing and the passage of physical singularities generated remotely. In this presentation, we put these events into perspective through a comparison with the "average" setting, assess possible links with weather patterns and discuss their implications for primary production on a local and remote basis.

CHARACTERIZING THE DIVERSITY OF LAKE WATER BALANCES IN THE OLD CROW FLATS, YT, USING WATER ISOTOPE TRACERS

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The Old Crow Flats (OCF), located in northern Yukon Territory, is a 5600 km2 wetland of international significance recognized by the Ramsar Convention. Over 2000 shallow thermokarst lakes provide key habitat for wildlife including waterfowl, fish, muskrat, moose and the

Porcupine Caribou Herd, which the Vuntut Gwitchin First Nation (VGFN) depend on for subsistence. The VGFN have observed reduced lake levels over the past few decades and consequently the OCF has become less accessible by boat during times of low river flow. Furthermore, there are concerns about how the changing landscape may affect wildlife.

As part of the multidisciplinary Government of Canada International Polar Year project, "Environmental change and traditional use of the Old Crow Flats in northern Canada", studies are being conducted to identify the relative importance of hydrological processes that control the water balance of lakes in the OCF. Using water isotope tracers, 56 lakes spanning the OCF are being monitored throughout the ice-free seasons of 2007-09. Results from the 2007 field season indicate marked diversity in lake water balance characteristics. Snowmelt-dominated lakes are located in the south, west and northern sub-regions, where more dense vegetation cover entraps snow transported by prevailing northeasterly winds. Rainfall-dominated lakes tend to have larger surface areas and occupy the central corridor from the east to the northwest where there is less vegetation cover. Groundwater-influenced oxbow lakes are located along the floodplain of the Old Crow River and receive input throughout the ice-free season from snowmelt-recharged channel fens and sub-surface flow. The degree and effects of evaporation among these lake types are variable. Although the influence of evaporation on snowmelt and rainfall-dominated lakes is generally similar, the greater input of snow to the former maintains a positive water balance for many of these basins. In contrast, several rainfall-dominated lakes show evidence of water level drawdown by the end of the ice-free season. Groundwater-influenced lakes are less affected by evaporative drawdown because of the input of sub-surface flow throughout the ice-free season. Drained lakes are also commonly observed throughout the landscape and in most cases are likely the result of slumping banks from thermo-erosion. High amounts of input can also cause lake drainage, as was the case for Zelma Lake in early June 2007. Record rainfall triggered the rapid overland drainage of the lake into a nearby creek.

Ongoing analysis will assess variability of the hydrological processes that control the water balances of lakes in the OCF on contemporary time-scales and in the recent past from multi-proxy analyses of lake sediment cores. Ultimately, results will help to determine whether present-day water balance characteristics are reflective of natural hydrological variability or are unique as a consequence of recent anthropogenically-enhanced climate change.

EXTREME WARMING, HABITAT LOSS AND ABRUPT ECOSYSTEM CHANGE AT CANADA'S NORTHERN EDGE

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According to the "biodiversity paradox", northern latitudes will gain many new species in the future due to increased invasions. Higher biodiversity is generally correlated with desirable ecosystem features, including increased biological productivity and increased ecological stability in the face of ongoing change. A latitudinal gradient in eastern Canada, from boreal forest to extreme polar desert, illustrates the south-north pattern of ecosystem properties that are now subject to the increasing effects of climate warming. During the summer of 2008 we recorded many pronounced changes at the northern limit of this gradient (Ellesmere Island, Nunavut), including loss of perennial sea ice, loss of ice-dammed freshwater lakes and record open water conditions in lakes and the coastal ocean. The northern Ellesmere Island ice shelves experienced dramatic and irreversible disintegration, with a 60% loss (122 km^2; approximately 5 billion tons of ancient ice) of the Serson Ice Shelf ecosystem and probable loss of its ice-dammed epishelf lake, and complete loss of the Markham Ice Shelf (50 km^2), the richest microbial ecosystem along the northern coast in terms of standing stocks and biodiversity. Overall, 23% of the total area of the ice shelves (which comprise the thickest and oldest marine ice in the Arctic basin) collapsed over a three week period (details at: www.trentu.ca/iceshelf/). Mean daily air temperatures were mostly above 0ºC throughout June-August and often above 5ºC, with an unprecedented daily maximum of 19.7ºC at Ward Hunt Island Observatory and 20.5ºC on northern Ellesmere Island. These record high temperatures were accompanied by substantial meltwater production and record losses of lake ice cover. Several habitats and ecosystem types were lost, however the unusual open water conditions allowed the establishment of aquatic birds on lakes that were usually inaccessible due to perennial ice cover. These observations illustrate how climate change can induce local species enrichment, but at the expense of ecosystem perturbation and collapse.

CANADIAN ARCTIC VALIDATION CAMPAIGNS FOR THE ATMOSPHERIC CHEMISTRY EXPERIMENT (ACE) SATELLITE MISSION: 2004-2008 AND BEYOND

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Five springtime validation campaigns have been conducted in the Canadian high Arctic to provide correlative measurements for the Atmospheric Chemistry Experiment (ACE) satellite mission. There are two instruments on-board the satellite: a high-resolution (0.02 cm-1) infrared Fourier Transform Spectrometer (ACE-FTS) and a dual UV-visible-NIR spectrophotometer called MAESTRO (Measurements of Aerosol Extinction in the Stratosphere and Troposphere Retrieved by Occultation).

The validation campaigns took place at the Polar Environment Atmospheric Research Laboratory (PEARL) (formerly Environment Canada's Arctic Stratospheric Ozone (AStrO) Observatory) in Eureka, Nunavut (80 N, 86 W) during spring (February - April in 2004 - 2008). This period coincides with the most chemically active time of year in the Arctic and a significant number of satellite overpasses. Seven ground-based instruments were operated during the 2004 campaign: a ground-based version of the ACE-FTS (PARIS - Portable Atmospheric Research Interferometric Spectrometer for the Infrared), a terrestrial version of the ACE-MAESTRO, a SunPhotoSpectrometer, a zenith-viewing UV-visible grating spectrometer, a Bomem DA8 Fourier transform spectrometer, a Differential Absorption Lidar and a Brewer spectrophotometer. For the 2005 campaign, a Systeme d'Analyse par Observations Zenithales (SAOZ) instrument and a second Brewer were added to the instrument complement. In 2007 and 2008, a Bruker 125HR Fourier transform spectrometer and a second UV-visible grating spectrometer also participated. Also, balloon-borne ozonesonde and radiosonde sensors were flown frequently during the five campaigns.

This presentation will provide an overview of the campaign measurements throughout the five years. Comparisons of ozone and other constituent measurements made by the ground-based, balloon-borne and satellite-borne instruments will be presented. Examples will be given to show how these measurements have been used for validation and scientific studies. Plans for future ACE Arctic Validation Campaigns will be presented.

INTEGRATED ANALYSIS OF THE IMPACT OF LONG-RANGE TRANSPORT OF MIDLATITUDE POLLUTION ON OZONE ABUNDANCES IN THE ARCTIC TROPOSPHERE

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We use the GEOS-Chem global chemical transport model and its adjoint, together with satellite and in situ observation of tropospheric ozone, to assess the impact of transport of pollution from midlatitudes on the abundance of ozone in the Arctic. The model reproduces well the seasonal cycle in the abundances of PAN and ozone as measured at the surface at Alert. However, relative to ozonesonde measurements, the model overestimates ozone in the middle and upper troposphere in spring, while it underestimates ozone in summer. We use the adjoint model to conduct a detailed analysis of the sensitivity of the modeled ozone abundances in the Arctic to midlatitude precursor emissions. Using two different versions of the model with different assimilated meteorological fields

we quantify the impact of discrepancies in transport in the model on the ozone distribution in the Arctic, with a particular focus on the transport of ozone from the stratosphere. We also examine the utility of assimilating tropospheric ozone profile retrievals from the Tropospheric Emission Spectrometer (TES) satellite instrument at midlatitudes to provide an improved boundary condition for ozone at midlatitudes to better quantify the transport of ozone into the Arctic.

MERCURY CYCLING IN THE ARCTIC OCEAN: THE ROLE OF THE SEA ICE ENVIRONMENT

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Mercury is a major contaminant of concern in the Arctic marine ecosystems. While long-range atmospheric transport from the South continues to be an important source of mercury to the Arctic Ocean, evidence is mounting that the rapid and highly variable bioaccumulation of mercury in the Arctic marine mammals is increasingly driven by changes in internal biogeochemical processes due to climate change. One of the major changes is the sea-ice environment. As part of the International Polar Year (IPY) – Circumpolar Flaw Lead (CFL) System Studies, a major research project was undertaken from December 2007 to July 2008 in the Amundsen Gulf and west Beaufort Sea onboard the Canadian Research Icebreaker CCGS Amundsen. The main objective was to assess the NET atmospheric mercury flux to the underlying aquatic environment and its uptake by the marine food web, and their response to the projected change in the sea ice environment. Mercury concentrations and speciation in the lower troposphere, snow, sea ice, brine, underlying seawater, phytoplankton and zooplankton were analyzed at high spatial and temporal resolutions at various drift ice, landfast ice, and open lead stations with different sea ice environments. A mechanistic model is developed to describe the transport and transformation processes of mercury across the ocean-sea ice-atmosphere interface and its implication for mercury cycling in the Arctic Ocean under a changing climate.

INSTRUMENTATION, OBSERVATIONS AND SCIENCE ASSOCIATE WITH THE WAVES AND COUPLING PROCESSES THEME AT THE POLAR ENVIRONMENT ATMOSPHERIC RESEARCH LABORATORY (PEARL)

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During the winter of 2007/2008, observations from the full suite of instruments relevant to the Waves and Coupling Processes Theme at the Polar Environment Atmospheric Research Laboratory (PEARL) in the Canadian Arctic (Eureka, Nunavut, 80N, 86W) were taken for the first time. The instruments involved include the E-Region Wind Interferometer, the meteor radar, the Spectral Airglow Temperature Imager SATI), the PEARL All-Sky Imager, the ozone and Rayleigh/Mie/Raman lidars, the VHF and cloud radar, the Fourier Transform Spectrometer and the Atmospheric Emitted Radiance Interferometer. With these instruments we are able to determine the background temperature and wind profiles and the wave environment above Eureka. Using this information along with the contextual information on the large scale state of the atmosphere, the coupling of the dynamics between atmospheric layers and geographical locations can be studied. The contextual information is obtained by collaborating with modelling groups, other ground based observatories in the Arctic, and satellite teams. In this paper

we describe the capabilities of the instrumentation involved in these studies, outline the scientific approach and present some initial results.

IMPACTS OF CLIMATE CHANGE ON INUIT DIET IN THE WESTERN ARCTIC – LINKS BETWEEN CLIMATE CHANGE, FOOD SECURITY AND NUTRITIONAL HEALTH

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In the Arctic, Inuit are part of the nutrition transition occurring globally. While market foods now make up more than half of Inuit dietary intake, the consumption of traditional foods remains key to dietary quality and important to local identity and livelihoods. Traditional foods provide important nutrients, vitamins and minerals, and help restrict the intake of the saturated fats, sucrose and excess carbohydrates often found in store-bought alternatives. The access to, availability of, and condition of traditional food species in the Western Arctic are affected by changing climatic conditions, with implications for food security and human health. This study examines critical impacts of climate change on Inuit diet and nutritional health in four communities in the Western Arctic to identify both community-based and regional trends. The vulnerability of each community to changing food security is differentially influenced by a range of factors, including current harvesting trends, levels of reliance on individual species, opportunities for food substitution, and exposure to climate change hazards. At a regional scale, declining harvests of caribou are of common concern, as this species is a primary meat source for all communities in both summer and winter. Nutritional implications of lower traditional food use include likely reductions in iron, zinc, protein, vitamin D and omega-3 fatty acids, among others. Understanding linkages between climate change and traditional food security provides a basis for strengthening adaptive capacity and determining effective adaptation strategies to respond to future change.

EXPLORING THE IMPLICATIONS OF CLIMATE VARIABILITY AND CHANGE FOR COASTAL FISHERIES IN NORTHERN NORWAY: THE CASE OF LEBESBY MUNICIPALITY

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This paper explores the implications of past, present and future climate variability and change in the Barents Sea region for the coastal fisheries sector in Lebesby municipality, Finnmark County, Northern Norway. The research is being undertaken within the IPY-endorsed EU 6th Framework Integrated project DAMOCLES (Developing Arctic Monitoring and Observing Capabilities for Long-term Environmental Studies). We find that the vulnerability and adaptive capacity of the coastal fisheries sector and of individual fishermen to climate variability and change are connected to the vulnerability and adaptive capacity of the coastal fisheries sector to change *more generally*, and to the social and economic vulnerability of the wider communities to which fishers belong. Based on the identification by community stakeholders of salient climate elements connected to natural resource-based activities as a part of the research, we discuss how local climate information needs could inform the development of more responsive Arctic monitoring and observing systems. The results of this ongoing research show that engaging natural and social scientists and a wide range of local stakeholders in a partnership throughout the research are essential for producing results and information that are both scientifically robust, and acceptable and useful to communities. The findings should contribute to improving understanding of and for climate change adaptation in natural resource-dependent coastal communities in Northern Norway, with lessons for coupled Arctic systems more generally.

A SUCCESSFUL EXPERIMENT IN COLLABORATION: U.S. SCIENCE AGENCIES FORGE MAJOR JOINT INTERNATIONAL POLAR YEAR (IPY) OUTREACH EFFORTS
A SUCCESSFUL EXPERIMENT IN COLLABORATION: U.S. SCIENCE AGENCIES FORGE MAJOR JOINT INTERNATIONAL POLAR YEAR (IPY) OUTREACH EFFORTS

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The International Polar Year (IPY) provided U.S. federal agencies involved in polar research with a major outreach challenge: how to portray a unified view of the wealth of federal activity through a communications network dominated by agency-focused channels.

To meet this challenge, 16 federal agencies with a scientific presence in the Arctic and / or the Antarctic joined in an ongoing interagency working group, lead by the National Science Foundation that resulted in a series of successful media and public-outreach endeavors to raise the «average persons' " awareness of the importance of the Polar regions and the potential fate of both the Arctic and its inhabitants in the face of changing climate.

These included:

- a unique interagency U.S. IPY web site (http://www.ipy.gov) that allows participating agencies and their grantees to independently upload relevant information every day and act as a focal point for national IPY efforts. The site has seperate pages where the public may download IPY posters (http://www.ipy.gov/DesktopModules/Articles/ArticleDetails.aspx?ItemID=257); where funding opportunities may be found (http://www.ipy.gov/Default.aspx?tabid=74); where news media contacts may be searched (http://www.ipy.gov/AboutIPY/ContactUs/tabid/79/Default.aspx); where news releases about Polar science are frequently posted (http://www.ipy.gov/IPYHome/NewsEvents/PressReleases/tabid/75/Default.aspx) and a variety of «theme» pages on major IPY research intiatives (http://www.ipy.gov/DesktopModules/Articles/ArticleDetails.aspx?ItemID=336).
- a major IPY kickoff event at the U.S. National Academies of Science
- Several coordinated interagency events throughout the IPY period designed to provide the public with virtual "first-hand" experience of complex, international scientific investigations of Arctic climate change.
- The creation of series of posters representing various aspects of IPY sciene, including one that specifically highlighted the Arctic Observing Network, a project to link various sensor systems into a circum-Arctic, climate monitoring system (http://www.nsf.gov/od/opp/ipy/posters/nsf_ipy_posters.jsp)

The key to these successes was the interagency working group, which facilitated in-depth and sustained interaction between the agencies--whose public affairs agendas generally are competitive, rather than cooperative--in coordinating development of outreach strategies both at the agency and federal level.

A parallel working group of agency education specialists worked in tandem with the public affairs group and both groups met to cooperatively share their goals and strategies.

GLOBAL WARMING AFFECTS THE TIMING OF THE BREEDING SEASON IN A TOP PREDATOR, THE MERLIN FALCO COLUMBARIUS, ON THE MOUNTAIN TUNDRA IN N SWEDEN.

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Several studies have demonstrated responses to climatic warming among passerine species, although the responses observed have been limited to certain populations of individual species. It is less well known, however, if such changes in phenology cascades through the food chain and thus involve more than two trophic levels. Some studies propose that global warming can cause a mismatch between the breeding time of birds and the emergence of the most important prey items, which may result in reduced reproductive success and poor survival of the adult birds. In this report, I show that the merlin has responded to global warming and now starts clutch initiation about one week earlier than 20 years ago. The merlin is an important top predator hunting small passerines on the Swedish mountain tundra. Yet, there is no evidence that the reproductive success has changed but yearly fledgling production is similar to that recorded in the preceding three decades. There was a certain variation among breeding pairs because pairs breeding in certain some territories appeared to start egg laying earlier than other pairs. However, this variation in egg laying time among territories was recorded also during the previous three decades of study. Thus, an entire food

chain appears to have responded to climatic warming in my study area.

LIMNOLOGICAL APPROACHES TO TRACK CLIMATE- AND HUMAN-INDUCED HYDROLOGICAL CHANGES IN NORTHERN FLOODPLAIN LANDSCAPES: EXPERIMENTS FROM THE PEACE-ATHABASCA DELTA

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Flooding is an important process regulating the structure and function of extensive landscapes in Canada's North, but its role is vulnerable to changes in climate and river regulation. This is particularly true for the Peace-Athabasca Delta (PAD) where variability of the frequency and magnitude of floods has been the source of conflict. Here we conduct field-based experiments that compare flooded and non-flooded ponds to explore the role of flooding on physico-chemical and biological pond conditions. We show that ponds receiving floodwaters become elevated in concentrations of total P, total suspended solids (TSS), dissolved reactive silica and sulfate. Flooding also flushes DOC, N and dissolved ions, which accumulate to elevated levels in closed-drainage ponds. Standing crop of phytoplankton (Chl *a*) is highest in ponds that have received spring flooding, while macrophyte biomass is highest in ponds that have not received spring flooding. In this study the composition of epiphytic diatom communities that accrued on *Potamogeton zosteriformis*, *P. perfoliatus var. richardsonii* and false substrates (polypropylene sheets) in four ponds during the summer of 2005 were analyzed to assess the influence of substrate, spring flooding and individual basin. Two ponds flooded in spring of 2005 (PAD 8 and 54), but two ponds had not flooded for several years (PAD 1 and 5). The first PCA axis of physico-chemical variables showed that flooding was a dominant factor accounting for variation among ponds, and that differences persisted throughout the growing season. Analysis of Similarity (ANOSIM) identified that the greatest amount of variation in epiphytic diatom community composition occurred between individual ponds, followed by variation between flooded and non-flooded ponds, and lastly by variation between different substrates. Pair-wise comparisons (ANOSIM) identified significant differences in epiphytic diatom community composition on the three substrates, and that differences in community composition between false substrates and macrophytes were similar to differences that between the two macrophyte species. Similarity percentage (SIMPER) analysis was used to identify epiphytic taxa of indicator potential for assessing hydrological conditions. The relative abundance of those taxa identified as 'strongly flood tolerant' was used to a construct an event-scale flood history record from analyses of sedimentary diatom assemblages in a perched basin in the delta where a published multi-proxy study did not detect occurrence of individual flood events. The epiphytic diatom flood record was found to be in close agreement with previously published flood record derived from magnetic susceptibility measurements from a nearby, flood-prone oxbow lake. Identification of 'flood-tolerant' epiphytic diatom taxa has allowed us to refine paleolimnological interpretations of hydroecological changes that have occurred during the past several centuries in a closed-drainage pond of the PAD. This approach appears promising for assessing variations in flooding and flood frequency at other closed-drainage ponds that are too remote from rivers to record geo-physical signals in the sediments, but which leave a record of change in epiphytic diatom community composition in response to fluctuations in hydro-ecological dynamics.

POPULATION GENETIC STRUCTURE IN POLAR BEARS (URSUS MARITIMUS) FROM HUDSON BAY, CANADA: IMPLICATIONS OF FUTURE CLIMATE CHANGE

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The primary habitat for polar bears is sea ice, yet unlike most of the high Arctic, Hudson Bay undergoes a summer ice-free period that forces all bears ashore until ice forms again in fall. Polar bear populations in the greater Hudson Bay region have been placed in four management units based primarily on data from tag returns from harvested animals, capture–recapture studies, and conventional and satellite telemetry. Our results indicate that

there is a high level of gene flow among management units observed using 26 microsatellite loci and analysis of genetic profiles of 377 polar bears. However, individual-based Bayesian analysis identified population genetic structuring into three clusters and significant FST differentiation. Specifically, our data suggest differentiation of polar bears sampled from islands in James Bay. These results were in spite of the extensive dispersal capabilities of polar bears that could homogenize the population. Mapping of high-ancestry individuals suggests that two of the three clusters have foci in southern Hudson Bay and may be a result of predictable annual freeze-thaw patterns that are maintaining breeding 'groups'. Predicted changes in the distribution and duration of sea ice in Hudson Bay suggest that gene flow among these clusters may be reduced in the future.

HYDRO-ECOLOGICAL RESPONSES OF ARCTIC TUNDRA LAKES TO CLIMATE CHANGE AND LANDSCAPE PERTURBATION: HIGHLIGHTS AND PRELIMINARY RESULTS

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The Arctic Climate Impact Assessment (ACIA) concluded that the annual mean warming for the areas north of 60ºN to be 3.7ºC for the period 2070-2089. Arctic land areas are expected to display a warming that is more rapid than the global average in the cold season, a decrease in diurnal temperature range, a decrease in daily variability of surface air temperature in winter and an increase in daily variability in summer, and a decrease/degradation of the cryosphere (snow, permafrost and ice cover). Such significant changes/shifts in climatic regimes are expected to have far-reaching first- and second-order impacts on the hydrology and ecology of northern/Arctic freshwater ecosystems. Freshwater systems are particularly sensitive to climate variability and change (CVC) because numerous hydro-ecological processes respond to even small changes in the climate regime. Furthermore, hydrological and ecological processes may change either gradually or in an abrupt manner when environmental/ecosystem thresholds are exceeded. A significant amount of uncertainty still remains however, in predicting the direct and indirect physical, geochemical and ecological responses of arctic freshwater ecosystems to CVC. The lake-rich upland tundra landscape east of the Mackenzie River Delta, NT, contains aquatic ecosystems that are projected to be impacted by CVC and other environmental stressors (e.g., resource development) in the next few decades. Large-scale permafrost degradation (increased depth of seasonal active layer and/or landscape slumping) is predicted to increase with the effects of climate warming, along with enhanced addition of geochemical loadings (e.g., carbon, nitrogen, phosphorus) to the freshwater environment. In addition, changes in the timing and duration of lake-ice characteristics in conjunction with altered geochemical loadings are projected to dramatically affect under-ice and open- water oxygen regimes, 1º and 2º production relationships, and carbon flux. To investigate and reduce the uncertainties pertaining to the sensitivities and responses of Arctic tundra lakes to CVC and other environmental stressors, the ArcticNET project "Hydro-ecological Responses of Arctic Tundra Lakes to Climate Change and Landscape Perturbation" was designed to: (i) improve our regional understanding of the sensitivities/responses of the Mackenzie upland tundra lakes to CVC through integrated landscape-lake process and modelling studies; and (ii) develop and validate an integrated landscape-lake ice, hydro-ecological model applicable to cold regions/Arctic systems. This presentation provides an overview of the project design along with highlights and preliminary results.

IMPACTS OF AIR-SEA FLUXES ON THE EVOLUTION OF AN ARCTIC "BOMB"

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The Arctic is a significant region for because of its unique thermodynamic characteristics and its potential role in global climate change. Intense Arctic storms are examples of «extreme» weather which can has impact on coastal oceanographic processes in the southern Beaufort Sea and

waters of the west Canadian Arctic. This area is important because the coastal marine environment used by Canadian Northerners is an integral part of their life style. The area is also undergoing hydrocarbon exploration with potential development within the next decade. Factors such as open water and ice, and the oceanic surface fluxes can modulate storm development and winds. Climate change in the Beaufort-Chukchi region may endanger coastal settlements and marine environments. In tropical and extratropical latitudes, it is well known that hurricane intensity is influenced by factors such as the storm's initial intensity, the spatial extent of the storm, the thermodynamic state of the atmosphere through which the storm moves, the storm propagation speed, and sea surface fluxes along the storm track. Although several of these factors are also known to modulate the strength of midlatitude cyclone systems, little is known about the impact of atmosphere–ocean–ice interactions on storms in the Arctic Ocean. In this study we investigate the ability of surface heat fluxes to influence Arctic storm development, including processes that control their atmosphere–ocean–ice dynamics. We use the Canadian Mesoscale Compressible Community (MC2) atmospheric model coupled to the Princeton Ocean Model (POM) and Hibler Ice Model. As a case study we simulate an Arctic storm from late 1999. Comparing our results to NCEP, NARR and CMC reanalysis data, we demonstrate very good simulations of the storm pattern, track and intensity. This cyclone is a mesoscale Arctic storm that developed over the NE Pacific and western Bering Sea. It intensified explosively in the Gulf of Alaska, developing into a meteorological bomb on 21 September 1999. The storm made landfall with surface winds > 30 m s^{-1} at Cape Newenham, Alaska, on 22 September and rapidly moved north northeastward. Thereafter, it crossed the Rocky Mountains to the Yukon and Northwest Territories and re-intensified over the coastal waters of the southern Beaufort Sea, over a zone of high sea surface temperature gradients, causing extensive coastal damage to communities in that region. During with its mature stage, satellite images reveal mesoscale scale and spiral cloud bands of unusual symmetry. The track of the low pressure center passed over Anchorage, Alaska where time series show a pronounced maximum in equivalent potential temperature at the storm's core. We show the role of sea surface fluxes on the storm's explosive development as a bomb in the NE Pacific and in its re-intensification over the Beaufort coastal waters. We compare these processes to the other factors that modify the storm's development as it passes from the generation region in the Pacific, across the Rockies, to its final decay region in the Arctic.

A NUMERICAL STUDY OF HURRICANE NOEL (2007). MODEL VERIFICATION AND EXTRATROPICAL TRANSITION

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The fifth-generation Pennsylvania State University-National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model (MM5) is used to simulate Hurricane Noel (2007) from its evolution as a category 1 hurricane off Florida on 2 November 2007, through a period of extratropical transition (ET), making landfall at eastern Canada and finally moving into Labrador Sea toward Greenland on 5 November 2007. The model reproduced Noel's evolution throughout its lifecycle. The ET began around 1200 UTC November 2 2007 when Hurricane Noel became significantly asymmetric. Right after Noel made landfall over eastern Canada, the cold core of cyclone developed at lower-troposphere, indicating the completion of the ET. Noel started intensifying 15 hours after the beginning of ET when it interacted with the southern portion of an approaching upper-level middle latitude trough. At 0600 UTC November 4, the landfalling cyclone merged with the northern portion of the upper level trough and maintained its intensity (minimum surface pressure) until moving over the colder waters of the Labrador Sea. During each interaction between the upper level trough and Noel, potential vorticity (PV) was transferred downward from the upper troposphere to the lower troposphere, resulting in the intensification of cyclone. To illustrate the upper-level trough's forcing upon the cyclone, the Eliassen-Palm flux was diagnosed in cylindrical isentropic coordinates, which indicates that as the cyclone intensifies, the upper-level eddy momentum forcing is more important than the upper-level eddy heat forcing.

VARIATIONS IN ATMOSPHERIC CD DEPOSITION IN THE ARCTIC SINCE AD 1840, AND PRELIMINARY ASSESSMENT OF PREDOMINANT SOURCES

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Cadmium is one of the 3 toxic metals (Hg, Pb and Cd) currently being focused on in the Arctic environment. Due to insufficient data available from current Arctic studies on Cd, AMAP summarized that "monitoring data on cadmium in the abiotic and biotic environment to date provide no conclusive evidence of trends or effects…" Therefore, AMAP suggests "The monitoring of cadmium in the Arctic be continued to support human exposure estimates." This study aims to reconstruct a high resolution record of atmospheric Cd deposition with ice/snow samples from the Canadian High Arctic for the time period since the industrial revolution. Applying ultra clean procedures for sampling, processing and analysing, over 567 samples covering 15800 years were retrieved and analyzed for Cd in ice cores and snow samples from Devon Ice Cap taken in 1999, 2000 and 2004. Results show that Cd concentrations are significantly different in different time periods while the highest and the most variable (3.01±8.41 pg g-1, N=511) was found in the last 162 years when anthropogenic contribution became much more severe. Compared to the results of Pb, which reached its peak concentration at around 1970, Cd however, reached its peak concentration about a decade earlier at around 1960. This could be due to earlier US Clean Air Acts starting in 1955 and 1963 (with multi amendments). Although the early Clean Air Acts did very little to prevent air pollution legally, they did make the public and government aware of the problem and promoted newer technology development for the purpose of air pollution reduction. Since the Cd concentrations varied while Sc concentrations were constantly stable with no change in trend, the variation of Cd is not likely caused by air borne soil particles. Instead, it is likely caused by other natural and anthropogenic sources, mainly volcanic and human activities considering the change in amplitude of Cd concentrations. In this presentation, the aim is to correlate the Cd variations to sporadic volcanic eruptions and the path of economic/industrial development, as well as historical events since industrial revolution. Tentative data analyses suggest that the general trend of Cd deposition on the ice cap be due to anthropogenic contribution while the large sporadic variations are mainly due to volcanic activities. It is also worth noting that obvious lower Cd concentrations during WWI and WWII were observed in the profile. Comparison of results from this study to those of emission/production of Cd (as well as Zn due to their coexistence) in Northern America and Eurasia will also be presented in order to carry out source-of-origin apportionment.

POSTER ABSTRACTS

MONITORING EFFECTS OF CLIMATE CHANGE IN THE GREENLAND TERRESTRIAL ENVIRONMENT

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The monitoring program "Zackenberg Basic" in high arctic North-east Greenland has been running since 1994 and has provided valuable data which have been synthesized in "High Arctic Ecosystem Dynamics in a Changing Climate (Meltofte et *al.*, ed. - Academic Press 2008)". In 2007 a low arctic counterpart, "NuukBasic", was initiated in Kobbefjord close to Nuuk in West Greenland. Together the programmes embrace continuous seasonal and inter-annual monitoring of most geophysical, biological ecosystem parameters in the arctic. The monitoring of biological parameters include plant phenology, breeding phenology of birds, measurement of CO_2-flux, effects of UVB on plant stress, and numbers of arthropods and micro-arthropods. Geophysical parameters include snow and snow cover, hydrology and a series of climatic parameters. The programmes offer unique possibilities to analyse ecological responses to climate change on the background of consistently sampled climatic and physical parameters.

OZONE, NO2, AND BRO MEASURED WITH GROUND-BASED UV-VISIBLE SPECTROMETERS AT EUREKA, NUNAVUT DURING INTERNATIONAL POLAR YEAR

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Ozone is well known as a highly effective absorber of solar UV-B radiation, which is the dominant source of heating in the stratosphere. Stratospheric ozone has declined significantly since about 1980 in response to anthropogenic emissions of chlorofluorocarbons (CFCs), particularly in the polar regions. Arctic ozone columns show large inter-annual variability, with chemical loss critically dependent on low temperatures. With the signing of the Montreal Protocol and its amendments to regulate CFCs and halons, a gradual recovery of global stratospheric ozone is anticipated. However, model predictions of the future evolution of Arctic ozone vary. Bromine concentrations in the atmosphere are a large source of uncertainty in model predictions. Although concentrations of bromine-containing species are significantly lower than chlorine-containing species, bromine destroys nearly as much ozone as chlorine because bromine is much more reactive with ozone. Bromine chemistry is not as well understood as other halogens. There are few bromine measurements, specifically at the high latitudes, so most of the current understanding of bromine chemistry comes from model calculations. The Canadian Network for the Detection of Atmospheric Change (CANDAC) has established the Polar Environment Atmospheric Research Laboratory (PEARL) to address these and other questions through measurements at Eureka, Nunavut, Canada (80N, 86W).

We will discuss measurements of ozone, NO_2, and BrO from two UV-visible spectrometers at PEARL during the International Polar Year (IPY) 2007-2008. One of these instruments, the UT-GBS (University of Toronto Ground-Based Spectrometer) has been deployed at Eureka nine times during polar sunrise between 1999 and 2008. The other instrument, the PEARL-GBS was installed permanently in PEARL in August 2006 for year-round operation. Both of these instruments measure vertical column densities of ozone and NO_2, as well as slant column densities of BrO and OClO when possible. We will discuss the diurnal and seasonal variations of stratospheric ozone, NO_2, and BrO above Eureka during IPY, and relate these measurements to dynamical conditions above Eureka.

ASSESSING CELL VIABILITY IN ARCTIC ICE ALGAE COMMUNITIES

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Cell viability in ice algae was quantified during spring 2008 in the Canadian Beaufort Sea during the CFL project.Percentages of live and dead cells were estimated using two different methods: a staining method (BacLight™ Kit) and an enzymatic cell digestion assay (non-staining). Temporal changes in the cell viability of ice algae were studied over 6 days. The influence of light was examined by comparing light and dark-exposed samples. The influence of temperature was tested by exposing ice algae samples to two different temperatures. Decreased viability was observed in the samples exposed to a higher temperature and darkness. This preliminary study will enable us to better understand the influence of light and temperature on the viability of ice algae in a changing Arctic.

COMPARISON OF ADAPTATION AND VULNERABILITY TO CLIMATE CHANGE IN ULUKHAKTOK AND TUKTOYAKTUK

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This poster compares adaptation and vulnerability to climate change in two Inuit communities in the western Canadian Arctic (Ulukhaktok and Tuktoyaktuk). The research was guided by the analytical framework used in the pan-Arctic IPY project "Community Adaptation and Vulnerability in Arctic Regions" (CAVIAR). The comparison highlights similarities and differences in vulnerabilities and adaptations in the domain of subsistence economies.

Both communities have mixed economies, with residents relying on subsistence harvesting and wage employment. Subsistence activities in each community give rise to different sets of sensitivities related to the availability, timing and location of wildlife and associated use of sea ice, open water, and other environmental conditions. In both communities, changes in seasonal patterns, sea ice dynamics, and weather variability have affected the health and availability of some important wildlife species and have exacerbated risks associated with hunting and travel. Adaptive responses of individuals in both communities are conditioned by multiple factors, including access to capital resources, sharing networks, species availability and diversity, and knowledge of the local environment. Tuktoyaktuk has greater access to capital resources due to oil and gas development, as well as closer proximity to larger centers. These capital resources provide some Tuktoyaktuk residents with flexibility for dealing with harvesting shortages. Comparatively, Ulukhaktok has a strong reliance on traditional means of subsistence. These differences are assessed in the context of regional institutional structures that influence wildlife management regimes. This comparison provides insights into the ability of these communities to adapt to projected future climatic conditions.

STUDENTS AT HOME ON LAND AND SEA: INUIT INTERNSHIPS IN TORNGAT MOUNTAINS NATIONAL PARK

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Five Inuit students from Nunatsiavut (Northern Labrador) spent the summer assisting the different scientists working out of the Parks Canada / Nunatsiavut Government base camp, on shore-based long liners and zodiacs, and in remote research camps. They were exposed to scientific fieldwork in a variety of forms including marine benthos and food web studies, ringed seal telemetry, stream sampling, arctic char studies, and tundra vegetation research. In all cases the field research was conducted in an environment familiar to Inuit with logistical support provided by Inuit from their communities. The students experienced scientific research in their own cultural context. It was an opportunity for Inuit and scientists to study an issue through the dual lens of science and Inuit culture, experience and knowledge. Through the course of the summer, the students' confidence and understanding grew.

The students were excited and engaged and in some cases this experience has fostered relationships that continue past the summer field season.

Researchers expressed strong support for the "unique and wonderful gift" to live in an Inuit camp and to work with Inuit – students and elders - from Nunavik and Nunatsiavut. Scientists and Inuit have been able to come together with the best that each have to offer to develop a "new way of knowing" as they explore their questions and concerns about the natural environment. Parks Canada and the Nunatsiavut Government hope to continue to engage and excite Inuit youth and to support the collaboration of Inuit and scientists well into the future. We believe it offers a way to push the frontiers of science in northern ecosystems, to blur borders and cultural boundaries and to share with a larger world the results of this work.

NORTHERN ICE SHELVES WERE STABLE FOR MILLENNIA BEFORE RECENT ABRUPT BREAKUP

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Northern Ellesmere Island (Nunavut, Canada) is home to several rare ecosystem types that are currently threatened by recent climate warming, including ice shelves and epishelf lakes. Ice shelves fringed much of northern Ellesmere Island in the early 20th century, but have since shrunk by over 90% due to climate warming. During the last decade, several ice shelves have either fractured or detached from the Ellesmere coast and floated away entirely. Although estimates of their age range from 5,500 and 3,000 calendar years before present, there is no direct evidence for the establishment of these ice shelves and their dynamics since formation remain unknown. In order to place the significance of recent breakup in a long-term context, a better understanding is required of the history and evolution of these northern ice shelves.

Epishelf lakes (ice-dammed fiords with stratified water columns) depend on ice shelves for their existence, and sedimentary records from these fiords can yield insights into past ice shelf dynamics. Here we report on two radiocarbon-dated sediment cores collected with a percussion corer that document several thousand years of the history of Disraeli Fiord (just south of the Ward Hunt Ice Shelf), using sedimentary pigment (HPLC) and geochemical (XRF) analyses. Changes in elemental concentrations, including Ca, Fe and Mn, are interpreted to reflect variation in runoff and catchment influence related to the formation of the Disraeli epishelf lake, while pigment ratios and concentrations record climate-mediated changes in freshwater/marine conditions and past productivity, respectively. These data indicate that, prior to its disintegration, the Ward Hunt Ice Shelf was stable for millennia, and therefore that recent changes are significant in a long-term climate context.

SPATIO-TEMPORAL VARIABILITY OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN THE HIGH CANADIAN ARCTIC IN SUMMERS 2005 TO 2008

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The spatio-temporal variability of phytoplankton production and biomass was studied along a transect from the Beaufort Sea to Baffin Bay via the Northwest Passage, during summers 2005 to 2008. Phytoplankton production and chlorophyll *a* biomass of small (0.7-5 μm) and large (>5 μm) cells were determined at 7 depths in the euphotic zone. Environmental variables such as irradiance, temperature, salinity and nutrients were also measured in the upper 100 m of the water column from a minimum of 18 stations in 2005 to a maximum of 40 in 2008. Our results show a strong contrast between northern Baffin Bay and the Beaufort Sea. Phytoplankton production and biomass were generally higher in the weakly stratified Baffin Bay than in the strongly stratified Beaufort Sea. In addition, primary production and biomass were generally dominated by large phytoplankton in Baffin Bay and by small phytoplankton in the Beaufort Sea. In contrast to the other 2 regions, the Northwest Passage showed a large interannual variability in phytoplankton production and biomass. These results demonstrate strong spatial gradients in primary production and biomass in the High Canadian Arctic, underpinning a diversity of ecozones that may be significantly altered by on-going Arctic changes.

ON-SITE, ULTRA-TRACE ANALYSIS OF MONOMETHYLMERCURY IN THE ARCTIC OCEAN

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Elevated mercury (Hg) concentrations have been found in marine mammals in the Arctic Ocean, particularly in the Beaufort Sea region, which has raised serious concerns over the health of the marine ecosystems and the Northern people who consume mammal tissues as part of their traditional diet. While efforts have been undertaken to study the fluxes and cycling of total mercury in the Arctic Ocean, reliable data on monomethylmercury (MMHg), the neurotoxic form of mercury that biomagnifies along the food chain, in the Arctic environment have been scarce, due to its very low concentration in the abiotic environment and instability during storage and sample transport. To address this data gap, we report here the first on-site, ultra-trace measurements of MeHg in the Arctic Ocean carried out as part of the International Polar Year (IPY) – Circumpolar Flaw Lead (CFL) System Study. Measurements were made using the automated MERX Methylmercury Analyzer (Brooks Rand) in the Portable In-Situ Laboratory for Mercury Speciation (PILMS), a class 100 cleanroom laboratory installed on the Canadian Research Icebreaker CCGS Amundsen. We used the EPA 1630 method and reached a detection limit of 0.01 ng/L with high precision using the on-site method. This allows us to report the depth profiles of MMHg, along with total Hg and other chemical parameters, in the coastal and oceanic waters from the Amundsen Gulf region. This method of analysis is being used for other Arctic regions and is expected to provide crucial MeHg data needed to understand the role of the aquatic system in the production/degradation and cycling of MMHg in the Arctic marine ecosystem under a changing climate.

EARLY MIGRATION OF BELUGA (DELPHINAPTERUS LEUCAS) INTO THE AMUNDSEN GULF IN THE SPRING OF 2008

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Beluga of the eastern Beaufort Sea population winter in the Bering Sea in and along the edge of the ice pack. In spring, using leads and cracks in the ice, they migrate from the Bering Sea to the Amundsen Gulf where they have been reported to arrive in late May and early June. The timing of the migration is thought to be either dependent on ice conditions or determined by photoperiod. Multiple beluga sightings were made from a Twin Otter aircraft, a helicopter and from the CCGS Amundsen during May 2008 surveys of the eastern Beaufort Sea. These animals were observed on the west side of Banks Island and in the Amundsen Gulf. The early arrival of belugas into the Amundsen Gulf may be due to unusually light sea ice conditions throughout the Beaufort Sea in the winter of 2007-2008. The impacts on beluga of changing ice conditions resulting from climate change could encompass variations in their migration patterns, their ability to evade predators and the availability of their prey.

SNOW COVER DISTRIBUTION AND MELT ACROSS A HIGH ARCTIC WETLAND, POLAR BEAR PASS, NUNAVUT

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Extensive high arctic wetlands are areas of lush vegetation cover in an otherwise barren arctic landscape. They help to store and cleanse water and are critical ecosystems for arctic wildlife such as migratory birds, caribou and muskoxen. To date, an understanding of the hydrology of these regions has eluded us but we need to better understand how these extensive wetlands will sustain themselves under both shifting climatic conditions (warm/

dry; cool/wet seasons) and eventually a warmer climate. Snow is considered the predominate input of water to most hydrological systems in the north. This study examined the end-of-winter snow cover and spring melt of a High Arctic wetland ecosystem located at Polar Bear Pass, Bathurst Island, Nunavut (98° 30' W, 75° 40' N) from mid-May until July, 2008. This wetland (ca. 20 km x 5 km) is composed of a myriad of terrain-types (ponds, lakes, wet meadows) and is bordered by rolling hills. Late-lying snowbeds occur in the lee of slopes and small and large steam channels dissect the bordering hills. Snow surveys were conducted across the different terrain types, and both snow depth and density was measured along a series of transects in order to determine the end-of-winter snowcover (snow water equivalent units-mm, SWE). Ablation sites were established at representative sites (pond, wet meadow, late-lying snowbed, plateau) and daily estimates of snow surface lowering along with surface snow density measurements allowed surface melt to be quantified. In addition, a physically-based snowmelt model was used to define the daily melt and to examine the spatial melt pattern across the different terrain units and hillslope stream channels. End-of-winter snowcover on the ponds ranged from 28 to 73 mm. Lake snowcover was comparable at 52 mm. Deepest snowcover occurred at the sheltered late-lying snowbed sites (129 mm) and incised stream channels (59 mm). Spring 2008 was cool (avg. Tair = 2.5°C) and melt did not begin until June 9 and persisted for about 20 days. Good agreement between modelled and measured melt indicate that exposed areas with little snow (plateau zones) and windswept ponds melted out earlier (June 17, 2008), while sheltered areas (late-lying snowbed sites) and stream channels melted out 10 days later. Accurate estimates of snowcover and melt are required for assessing the water budget of this wetland system both at the local (pond) and the regional scale. Our plans for 2009 include expanding our snow survey to other areas in the pass and defining more clearly the link between climate and snowmelt across the wetland.

MERCURY AND STABLE ISOTOPES IN TEETH AS TRACERS OF A POTENTIAL DIET CHANGE OVER FOUR DECADES IN POLAR BEARS (URSUS MARITIMUS) FROM SVALBARD

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Polar bears (*Ursus maritimus*) depend on sea ice for the hunting of seals, being their main prey. Because of the earlier break-up of the Arctic sea ice, resulting from the climate warming, their access to seals is reduced during the summer season and the polar bears may be forced to fast for longer periods and search for alternative food sources. This study investigates the use of total mercury (Hg) and stable isotopes of carbon ($d^{13}C$) and nitrogen ($d^{15}N$) in polar bear teeth as tracers of a potential diet change over four decades. The hypothesis is that the elemental and isotopic values will reflect changes appearing from altered food sources.Mercury levels were determined in teeth (n=87) of polar bears from Svalbard (Norway) sampled between 1964 and 2003. The concentrations of Hg were low, ranging from 0.6 to 72.3 ng/g dry weight. In addition, they were found to decrease significantly over time ($P<0.02$). Stable isotopes were also determined in the dental tissue. Stable nitrogen isotopic ratios ranged from 17.75‰ to 21.78‰ reflecting the high trophic level of this species while $d^{13}C$ values ranged from -17.44‰ to -14.77‰ reflecting a primary use of the marine food chain by the polar bear. Neither $d^{15}N$ nor $d^{13}C$ signatures showed significant temporal trends.

Although Hg values were found to be significantly correlated to $d^{15}N$ values, the temporal variations in Hg concentrations could not be related to them. The decreasing time trend reported for Hg levels in the dental tissue of polar bears appears therefore to reflect a reduction in environmental mercury burden and not a diet change of this species.

WINTER DYNAMICS OF SMALL ZOOPLANKTON IN AMUNDSEN GULF

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In the marine ecosystem, zooplankton is a particularly important component of the food web as it actively participates in various ways in the carbon fluxes. The effects of climate warming are most strongly felt in the Polar Regions and emphasize the need to better

understand the role of zooplankton in the functioning of the Arctic marine ecosystem. The highly abundant small copepod species dominate numerically most Arctic marine zooplankton communities. They remain active and sustain reproduction even during the dark winter period. Their growth rates are believed to be high, making their contribution to the marine ecosystem productivity worth consideration. The winter dynamics of the mesozooplankton small size fraction was investigated in Amundsen Gulf (southeastern Beaufort Sea) during the International Polar Year – Circumpolar Flaw Lead system study (IPY-CFL 2008). In this study we considered 29 stations sampled from 19 November 2007 to 17 March 2008 using a 50 μm fine mesh net towed vertically from bottom to surface. Moreover, in March a rosette cast was used to assess the vertical distribution of small zooplankton. Cluster analysis and non-metric multidimensional scaling revealed three distinct mesozooplankton assemblages that were separated chronologically. An autumn community was present until early December and was replaced by two successive winter assemblages. An outlier corresponding to a shallow coastal station was occupied by a neritic community dominated by *Pseudocalanus* spp. The three assemblages were essentially comprised of various nauplius and copepodite stages of the small copepods: *Cyclopina* spp., *Oithona similis*, *Oncaea borealis*, *Pseudocalanus* spp., nauplius stages of the large copepods *Calanus hyperboreus* and *Metridia longa*, as well as larvae of the pteropod *Limacina helicina* and bivalves. Cyclopoid nauplii contributed predominantly to the discrimination of the three assemblages. Their abundance and proportion increased over the sampling period, representing 61% of the total zooplankton in the winter communities. This enhanced production in the middle of winter should be beneficial to the survival of the first larvae produced by the Arctic cod early spawners. Indeed Arctic cod larvae that hatch under the sea ice cover start feeding by preying on cyclopoid nauplii. However the source of energy to fuel this cyclopoid production, in the absence of primary production, remains to be investigated. Eggs and nauplii of the large *Calanus hyperboreus* that dominates the Arctic zooplankton assemblage appeared in December and their importance increased over time, confirming the winter reproduction of this species. In March most of the zooplankton was distributed below 100 m depth at day time and Calanus eggs were found in higher abundance at depth. This study reports on a very abundant and active small mesozooplankton assemblage in winter, with values that can exceed abundance measured later in the season in other Arctic locations. Further analysis of zooplankton samples covering most of the annual cycle and investigation of the environmental variables potentially responsible for the observed fluctuations in abundance will permit a better understanding of the zooplankton dynamics in Amundsen Gulf.

ARCTIC BIOLOGY ON THE LAND - THE IVVAVIK NATIONAL PARK EXPERIENCE

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Situated in the Canada's northwestern corner, bordered by Alaska and the Beaufort Sea, Ivvavik National Park was the first National Park in the country to be established as a result of a land claim agreement. Ivvavik, like all national parks, is part of our heritage as Canadians. Ivvavik is also specifically part of the heritage of the Inuvialuit people, who have asked Canada to safeguard it and to ensure that Canadians learn about it. For the past four years, Parks Canada in the Western Arctic partnered with Samuel Hearn Secondary School in Inuvik to take Biology 20 high school students, a local elder, teachers and parks staff into Ivvavik National Park for a week long science camp. In the camp, students are introduced to biology field research, which helps them learn first-hand about how a natural arctic ecosystem works. They also explore Ivvavik National Park and learn about the Yukon North Slope environment protected by the national park. Along with the scientific purposes of the excursion, there is also a cultural objective. Helped by a local elder, students learn about the cultural history of Ivvavik and how it continues into this day, including learning some Inuvialuit names for plants and animals. Every year students find that through the program they gain scientific knowledge, a connection to the land and an appreciation of the survival skills and traditional living of their ancestors. According to the teachers, students also gain a new awareness and understanding of themselves. All parties involved consider the program to be of great value and continue to support its offer in the Western Arctic.

VERTICAL MIGRATION OF HIGH ARCTIC ZOOPLANKTON IN AUTUMN: ACOUSTIC DATA AND DEPTH STRATIFIED NET SAMPLES FROM TWO SVALBARD FJORDS

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The diel vertical migration (DVM) of the three copepods (*Calanus finmarchicus*, *C. glacialis* and *C. hyperboreus*) in two fjords on the west coast of Spitsbergen (78°N) was investigated this autumn from August 25- September 7. The study period fell during the transition between the Arctic midnight sun and the onset of autumn diurnal variations in light. Depth-stratified samples of the zooplankton community were taken every six hours for 24h in Billefjorden and Kongsfjorden. Each fjord was sampled twice, with an interval of one week between sampling dates. The abundance of *Calanus glacialis*, *C. finmarchicus* and *C. hyperboreus*, and a proxy of lipid sac size were measured. Changes in the light conditions during the course of the study period were measured with a LiCor light logger onboard the ship. A 300 kHz acoustic Doppler current profiler (ADCP) provided data on the backscatter (as a proxy for biomass) and vertical movements of particles in the water column continuously for 24h at each station. Billefjorden is a threshold fjord dominated by locally formed cold water. The Arctic shelf species *C. glacialis* dominated in this fjord, and its population consisted mainly of older copepodite stages (≥ CIV). Kongsfjorden is an open fjord influenced by relatively warm Atlantic water. *C. finmarchicus*, an indicator species for Atlantic water masses, dominated in this fjord. Copepods in the deeper layers of both Billefjorden and Kongsfjorden had significantly larger lipid sacs than the copepods in the upper 50 m. No DVM was detected for older stages of *Calanus* spp. in Billefjorden. They had most likely performed their seasonal vertical migration (SVM) to depth, i.e. entered diapause for overwintering. This was supported by the large lipid sacs of copepods in the deep layers. In contrast, DVM was detected for both older (≥ CIV) and younger stages of *Calanus* in Kongsfjorden. The ADCP data showed a clear DVM pattern in Billefjorden. A DVM pattern was also seen from the ADCP recordings in Kongsfjorden, but the pattern was weaker than in Billefjorden. The lack of evidence for *Calanus* spp. DVM in Billefjorden strongly suggests that other species than *Calanus* performed DVM there, whereas in Kongsfjorden *Calanus* spp. contributed to the DVM pattern seen. The DVM patterns were more pronounced during the second sampling period in both fjords, which can be explained by the larger difference in light between day and night at that time. In conclusion, vertical migration of zooplankton, which represents one of the largest synchronized movements of biomass in the world, occurred in these Arctic fjords on both diurnal (DVM) and seasonal (SVM) time scales. The timing of SVM differed between fjords, and may be explained by different hydrographical regimes.

WHIMBREL, NUMENIUS PHAEOPUS, NESTING HABITAT USE AND CHANGE IN CHURCHILL, MB

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Whimbrel nesting habitat was studied at two scales during the 2007 breeding season. Percent cover of dominant vegetation, water and substrate classes were quantified at mesohabitat (within 150m radius of nest) and microhabitat (within 1m radius) scales. Mesohabitat analysis compared nest areas to randomly selected, available areas. Whimbrel occupied two main habitat types characterized either by high percent cover of lichen and Ericaceae and Dryas, or standing water and sedge. Whimbrel avoided shrubby and treed habitats. Microhabitat anaylsis compared nest sites to other potential nest sites within perceived territories. At the microhabitat level nest sites in drier tundra habitat had significantly more lichen and Ericaceae and Dryas than non-nest sites; while in wetter, sedge and standing water dominated habitats nest sites had significantly more vegetative cover than non-nest sites. Nests were commonly placed on hummocks and lichen ridges (30/44, 68%), and protrusions often rimmed nest cups (37/44, 84%). Hatch success, with predation as the cause of high nest failure, was 40% (18/45 nests) in 2007 and 28% (11/39) in 2008. Daily nest survival rate calculated with the constant logistic exposure model was 0.94704 in 2007 and 0.92399 in 2008, corresponding to a hatch success of 26% and 14% respectively. These hatch successes are lower than previously reported.Under climate change scenarios, increases in forest extent and shrub cover, drying of wetlands, and an overall reduction in lichen and graminoid dominated tundra ecosystems and arctic ponds are expected for sub-arctic and arctic regions (Suarez et al. 1999, Sturm et al. 2001, Smith et al. 2005, Sturm et al. 2005, Kaplan and New 2006, Tape et al. 2006). Habitat may also be lost as sea level rise outpaces isostatic rebound (Gough 1998). Furthermore, other negative implications exist such as mistimed phenology between food sources, migration and nesting activities, and changes in the biological community which may introduce new predator types (Crick and Sparks 1999, Cotton 2003, Parmesan and Yohe 2003, Visser et al. 2004). Land changes

associated with industry and human settlement are also likely. Such projected changes would cause a decrease in Whimbrel nesting habitat. Current nesting distribution contrasts that reported in the 1930s (Taverner & Sutton 1934) and 1970s (Skeel 1976), but resembles the distribution reported in the 1990s (Lin 1997), with greater use of sedge-meadow, fen and coastal tundra habitat, and much lower use of hummock-bog habitat adjacent to tree lines. Most notably nesting use of a 2.56km^2 hummock-bog habitat, just north of the tree line and west of the airport, which historically had the highest nesting density and hatch success (Skeel 1976) has drastically declined. The causality of this shift is currently unknown. It has been hypothesized that the drying up, shrub and tree encroachment, and increases in Canadian Geese and Common Ravens in the area are possible reasons. A habitat change analysis based on historic aerial photography from 1973 and 1986, and recent high-resolution satellite imagery from 2006 will explore the hypothesis that Whimbrel nesting use of the area has decreased due to shrub and tree encroachment.

ARCTIC CLIMATE CHANGE YOUTH FORUM (ACCYF) – FORUM JEUNESSE DES CHANGEMENTS CLIMATIQUES DANS L'ARCTIQUE (FJCCA)

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Piloted in 2006 in conjunction with the CASES science meeting, the Schools on Board Arctic Climate Change Youth Forum has become a standing component of the program, co-hosted every two years with a high school; planned by a student organizing committee with the guidance from Schools on Board and teachers; in conjunction with an international science conference (ArcticNet/CASES/IPY-CFL).

The forum focuses on: 1) the science behind Arctic climate change research, featuring keynote presentations and science sessions by leading scientists and graduate students, and 2) the role of science in policy and decision making – engaging participants in discussions and debates on environmental issues related to climate change in the Arctic. The aim of the forum in to extent outreach activities of the Schools on Board program to greater number of students and teachers, raising awareness of the science and environmental issues; and promoting science and environmental education. This presentation includes a description of this program and the 2008 experience of co-hosting the FJCCA in Quebec City in conjunction with Arctic Changes 2008.

PROJET ANT-ARCTIQUE – A CLASSROOM APPROACH TO POLAR RESEARCH

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In the fall of 2006, two teachers from le Collège Jeanne Sauvé (Winnipeg, MB) collaborated with Schools on Board in a project that examined their grade 10 science curriculum to explore the links between classroom science education and polar climate change research. Meetings with teachers revealed areas in the science program where connections could be made between science concepts learned in the classrooms, and the same concepts being used in scientific research. From September to December, these two teachers committed to including a polar theme to their science program. Scientists onboard two very different vessels, the CCGS Amundsen in the Arctic and the Sedna IV in the Antarctic interacted by email with two grade 10 classrooms on a weekly basis, addressing questions linked to their science class, as well as questions related to life at sea. The email interactions were complemented by classroom visits by scientists from the Centre for Earth Observation Sciences (University of Manitoba). This project led to the school sending a student on the 2008 International Schools on Board Field Program, and hosting their first Climate Change Expo.

This poster describes the process used to connect these two classrooms to polar research and the lessons that were learned by both educators and Schools on Board on the bridges between science education and scientific research

PALEOMAGNETIC DATING OF HOLOCENE WESTERN CANADIAN ARCTIC SEDIMENTS: COMBINED USE OF SECULAR VARIATION AND TIME-VARYING SPHERICAL HARMONIC MODEL OF THE GEOMAGNETIC FIELD

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A major problem in Holocene paleoceanographic reconstruction from the Canadian Arctic is the difficulty to derive a robust chronology due to an often poorly constrained radiocarbon reservoir effect and the paucity of both datable material and well-dated paleoclimatic records. Here we assess the potential of using both Holocene regional paleomagnetic secular variation records and a time-varying spherical harmonic model of the geomagnetic field (CALS7K.2) to establish a preliminary age model for a marine sedimentary record recently recovered from the Beaufort Sea.

Core 2004-804-650 (hereinafter referred to as core 650) was raised from the Mackenzie Shelf (Beaufort Sea) at a water depth of 246 m. The magnetic properties were studied using a 2G-Enterprises high-resolution cryogenic magnetometer in order to isolate the characteristic remanent magnetization (ChRM). In addition, the anhysteretic and the isothermal remanent magnetizations were induced in order to identify the magnetic mineralogy and grain size. The ChRM is characterized by a stable single component magnetization carried by pseudo-single domain magnetite, implying that core 650 recorded coherent paleomagnetic secular variations. A preliminary age model was constructed for the last ~6000 cal BP utilizing one AMS-^{14}C date and four paleomagnetic tie-points derived from the comparison between core 650 ChRM declination record and the expected magnetic declination computed using the CALS7K.2 model. Based on this age model, a significant inclination low was recorded at ~2500 cal BP and is synchronous with a distinct inclination low observed in radiocarbon-dated Holocene Arctic and North American paleomagnetic secular variation records, further supporting the initial age model of core 650. Finally, the preliminary age model depicts a constant sedimentation rate of ~30 cm/ka during the last ~6000 cal BP, much lower than cores collected closer to the mouth of the Mackenzie River, thus reflecting lower sediment supplies from the Mackenzie River.

EVALUATING MARINE ECOLOGICAL INTEGRITY MONITORING MEASURES FOR NACHVAK AND SAGLEK FIORDS, NORTHERN LABRADOR

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Labrador Inuit are concerned about the impact of stressors, such as climate change, industrialization, and contaminants, to the marine environment in northern Labrador. Nunatsiavut Nuluak, an ArcticNet project providing a baseline inventory and comparative assessment of three fiords in northern Labrador, examines the impacts of these stressors. This particular Nunatsiavut Nuluak research in Nachvak and Saglek Fiords, adjacent to the newly established Torngat Mountains National Park Reserve, examines the utility of two key indicators to assess and monitor ecosystem change through time. Fieldwork from both shore and ship-based platforms was conducted during the summers of 2007 and 2008. Preliminary results include productivity profiles for the mouth and head of the fiords, bathymetric mapping, and data collected to generate habitat maps. Mollusc and sculpin samples also were collected throughout the fiords, in collocation with water column profiles. These data will be used to analyze clam-community compositions, establish fish health indices, and provide contaminant loading information. Results of this study will provide Parks Canada with significant baseline data required to establish the park's long-term marine monitoring program. It will also provide Labrador Inuit with a comparative snapshot of ecosystem health in relatively pristine reference sites.

CHARACTERIZING THE ARCTIC STRATOSPHERE USING A COMBINATION OF GROUND-BASED FTIR TRACE GAS MEASUREMENTS, DYNAMICAL VARIABLES AND MODELS

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Atmospheric changes resulting from ozone depletion and greenhouse gas emission are felt particularly strongly in the Polar Regions. Since the early 1980's, significant ozone depletion has been observed each spring in the Antarctic stratosphere. Similar ozone depletion has also been experienced in the spring-time Arctic stratosphere, but as conditions are far more dynamically variable in the North, this is not an annual, Arctic-wide phenomenon, but varies considerably from year to year and place to place. In order to fully understand changes occurring in the Arctic stratosphere, it is thus important to combine information from a range of complementary information sources to better understand the dynamics and chemistry as a whole.

A new Bruker IFS 125HR Fourier transform infrared (FTIR) spectrometer was installed at the Polar Environment Atmospheric Research Laboratory (PEARL) at 80°N, 86°W, in July 2006. This high resolution instrument is capable of measuring a wide variety of trace-gas species, including important ozone-related stratospheric species O_3, HCl, HNO_3, $ClONO_2$ and HF. This presentation will introduce the new instrument, and will highlight the findings of the first two years of its measurements. Discussion of these findings will incorporate Arctic-wide observations of the dynamics of the polar vortex in 2007 and 2008, and comparison of the measurements with those predicted by two meteorologically assimilated global chemistry models, the Canadian Middle Atmosphere Model – Data Assimilated (CMAM-DA), and the Environment Canada Global Environmental Multiscale stratospheric model, run with the BIRA (Belgian Institute for Space Aeronomy) online chemistry package (GEM-BACH). In addition, select results from FTIR instruments at other Arctic research stations will be presented and compared with those observed at PEARL and predicted by the dynamical and chemical conditions of the Arctic atmosphere.

TREE RING STUDIES IN LABRADOR: INVESTIGATING SPATIAL AND TEMPORAL PATTERNS IN CLIMATIC AND ECOLOGICAL FACTORS INFLUENCING TREE GROWTH

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IPY-funded collaborative research between the Mount Allison Dendrochronology Laboratory and the Labrador Highlands Research Group of Memorial University is addressing questions that explore annual tree growth sensitivity to past and present climate variability and ecological disturbance in Labrador. Our research approach varies from intensive, multi-species, single-site studies that illuminate species-specific disturbances (e.g. insect infestations), to regional, multi-species networks that illustrate the spatially complex radial growth/climate relationship across Labrador.

Specific research questions include: (1) what are the temporal and spatial patterns in radial growth among the primary species at alpine and latitudinal treeline in Labrador? (2) How do climate parameters, forest disturbance events, and coastal proximity to the frigid, foggy Labrador Sea explain the variability in radial tree growth over space and time (last 150 years or so)? (3) What factors explain the high degree of variability in the climate sensitivity of spruce trees across central Labrador and how do these factors relate to the phenomenon of divergence?

Using living tree-ring chronologies from up to 4 species (*Picea mariana*, *Picea glauca*, *Abies balsamea*, *Larix laricina*) at more than 30 sites – for the most part arranged in a systematic gridded network (1° latitude by 2° longitude) with some opportunistic sampling conducted to accommodate altitudinal and latitudinal treeline – we have developed a powerful database to understand how environmental factors control the growth of Labrador trees.

Added to this network, *in situ* sub-fossil trees preserved in bogs and shallow ponds on highland tundra well above present day treeline, attest to more favourable environmental conditions for tree growth in Labrador 3000-

4000 years ago. Crossdated tree ring chronologies from more than 200 log samples from a single upland – locked into time by radiocarbon dates – are being used to generate annual-resolution reconstructions of temperature and/or precipitation that signify what the climatic conditions were like when treeline was higher than at present.

In a related project we are slowly attempting to link these live and upland master tree-ring chronologies for these same species in central Labrador. All of the main river systems draining central Labrador contain subfossil wood in abandoned terrace sediments. The age of the wood has been radiocarbon-dated to hundreds and thousands of years before present. Dendrochronological analysis of over 150 samples from the Churchill, Goose and Crooked rivers is providing an initial feasibility study to better understand if the wood samples collected could generate sufficient data to bridge the gap between chronologies.

Together, the tree ring data from these various studies will improve our understanding of treeline ecosystems in Labrador, with particular emphasis on their sensitivity to local climates, their evolution under past climates, and their predicted response to future, perhaps very different, climatic conditions.

GLACIER OBSERVATIONS IN THE TORNGAT MOUNTAINS, NORTHERN LABRADOR

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Cirque glaciers in the Torngat Mountains of northern Labrador are the only glaciers on mainland Canada east of the Rocky Mountains and represent the southernmost limit of glaciers in the eastern Arctic. A compilation of recent inventories suggests that there may be as many as 86 ice masses in the Torngat Mountains, though not all of them are strictly glaciers. The largest glaciers are <2 km^2 in area and tend to be shaded by high cirque backwalls. The earliest detailed observations were made by Edward Bryant and Henry Forbes on Bryant's Glacier in the Four Peaks range in 1908. Their photographs of the glacier snout were used by Noel Odell during a subsequent visit in 1931 to calculate a retreat rate of ~3.5 m a^{-1}. Mass balance studies on four glaciers in the Selamiut and Cirque Mountain ranges by Robert Rogerson between 1981 and 1984 indicated an overall negative balance, averaging -0.26 m. Abraham Glacier was the only one of the four that measurably re-advanced (1.2 m a^{-1}) during the monitoring interval.

A new initiative to measure glacier change in the Torngat Mountains National Park is part of *ArcticNet*'s Nunatsiavut Nuluak project and operates in partnership with Parks Canada and the Nunatsiavut Government. It has as its primary goal to establish a baseline of current glacier conditions to be used for future monitoring, recent change detection and local hydrological assessment. The research plan involves remote sensing, field surveys and local knowledge from Inuit elders who lived and travelled in the Torngat Mountains.

Field activities in 2008 focused on some of the glaciers previously studied by Rogerson in the early 1980s. Precise surveys of glacier surface elevation and margin position were carried out on Abraham, Hidden and Minaret glaciers using a differential global positioning system (DGPS). DGPS was also used to measure a selected number of static points on stable, non-moving (i.e. rock) terrain surrounding the three glaciers. These points, which are identifiable in metric vertical aerial photographs, are used as three-dimensional ground control points, essential to deriving stereo-photogrammetric measurements of surface elevation. The high-quality DEM surfaces of each glacier and its surrounding terrain will be compared with archival elevation data sources (e.g. satellite laser altimetry from the Geosciences Laser Altimeter System (GLAS) aboard NASA's Ice, Cloud and land Elevation Satellite (ICESat)).

Glacier surface elevation data are complimented by bed topography derived from ground penetrating radar (GPR) data. These data, once filtered, processed, and topographically-corrected (using DGPS elevations along coincident survey lines) will provide accurate bed elevations which may be subtracted from surface elevations to measure ice thickness. These data may be used to estimate total ice volume and in combination with repeat surface elevations to measure volume loss over time.

Preliminary highlights of the 2008 data indicate significant ice marginal retreat, on the order of 100s of metres, over the last 25 years. Bryant's Glacier, for example, which was re-photographed in 2008 from the same location as in 1908, shows substantial loss in ice volume.

VARIABILITY OF CHLOROPHYLL-A FROM OCEAN COLOR IMAGES IN THE BEAUFORT SEA

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Satellite remote sensing offers a powerful tool for regional and global scale monitoring of the spatial distribution of key environmental parameters. This is particularly true for the study of the arctic marine ecosystem that is highly undersampled. In the framework of the Canadian Arctic Shelf Exchanges Study (CASES) and the Arcticnet programs we investigated seasonal and interannual variability of chlorophyll in the Beaufort sea in order to better understand the biological processes occurring and to evaluate the variability of environmental conditions and physical forcing affecting phytoplankton. Multiple remote sensing data sources were used in the study. SeaWiFS and MODIS weekly and monthly composites from 1998 to 2008 were used to measure the phytoplankton biomass, AVHRR-derived sea surface temperatures were used to detect oceanographic features and SSMI data were used to measure the ice cover. Using a set of in situ measurements gathered during CASES (2004) and the Arcticnet (2005, 2006, 2007) field programs, we first conducted an evaluation of the current ocean color operational algorithms as the region is strongly influenced by dissolved organic matter coming from the Mackenzie river. We were able to show that these algorithms overestimate the actual in situ biomass by roughly a factor of four. To solve that problem, we built our own algorithm using optical data measured during CASES-2004. Results show that we are now able to estimate phytoplankton biomass in the Amundsen Gulf region with a much better precision. However, given the strong influence of the Mackenzie River outflow on the optical properties along the Beaufort Sea coast, we selected to eliminate these areas based on the R490/R669 reflectance ratio that is highly correlated to salinity. After this screening was done, time series were built for five sub-areas (Cape Bathurst, Franklin Bay, Amundsen Gulf, Sachs harbour coast and offshore Beaufort). These areas were selected to correspond to locations where long term oceanographic moorings are deployed. Because of the ice cover and the high latitude, phytoplankton in these areas can be observed by ocean color satellite only from April to September. Results show that monthly mean chlorophyll concentration for all sub-areas has a high interannual variability in the timing, importance and duration of blooms. The seasonal trend shows that chlorophyll-a normally reaches a maximum value between May and July but fall blooms are also seen at some occasions. Spatially, Sachs harbour and Amundsen Gulf are the only regions having similar trends showing regional scale variability. Future work will try to explain how the phytoplankton distribution is influenced by various environmental parameters and physical processes.

MARINE RECORDS OF SEDIMENT FLUX FROM GLACIATED AND UNGLACIATED CATCHMENTS, TORNGAT MOUNTAINS, CANADA

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Records of environmental processes and conditions (over decadal to millennial timescales) are very sparse for the Torngat Mountains National Park Reserve (Nunatsiavut, Canada), although recent evidence indicates that the surrounding Labrador Peninsula is undergoing rapid environmental changes. In order to evaluate marine sedimentary records of river discharge (of sediment, a proxy for water discharge), a program of sonar seabed mapping, sediment coring, water-column measurements, and stream measurements was initiated in 2008 for the McCornick River (a presently glaciated catchment of 80 km^2 area), Nachvak Brook (presently unglaciated, 170 km^2 area), and associated marine basins in Nachvak Fjord and Saglek Fjord, respectively. In summer 2008, approximately 180 km of sidescan and subbottom survey lines were collected from deep, muddy marine basins closest to the two river mouths, to augment data collected during previous ArcticNet cruises. Boxcores were collected to sample specific acoustic facies identified in sonar, and cores were subsampled for analysis of sedimentary structures (X-radiography), radioisotope geochemistry (Th-234, Be-7, Pb-210, and Cs-137, to evaluate sediment depositional processes), and granulometry.

Preliminary analysis of sonar results suggest that the thickness of postglacial sediments in the marine basin for the McCornick River (16 km^2 area, 150-170 m deep) is 5-10 m, and 10-20m in the basin off Nachvak Brook (20 km^2, 250m deep), implying that sediment volumes are proportional to catchment area. In both basins, sediments have been deposited in wedges that thicken towards the river mouth. X-radiographs of sediment cores show very

faint stratification in mostly bioturbated clay-rich sediments. The presence of stratification in bioturbated sediment, however faint, is suggestive of rapid episodic sediment delivery (such as by gravity-driven mechanisms), rather than from water-column plumes. This possibility is being evaluated in more detail at present through radiometric and granulometric analyses of cores. Rapid transfer via gravity-driven flows from river mouth to a deep, proximal marine basin would enhance the preservation potential of such episodic deposits, improving the utility of such sediment records as proxies for fluvial discharge in the recent past.

POLAR CONTINENTAL SHELF PROJECT: 50 YEARS OF SUPPORTING ARCTIC SCIENCE

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This year marks the 50th anniversary of Polar Continental Shelf Project (PCSP), a federal government agency that provides essential logistical support to Canadian Arctic researchers from national and international universities, and government and non-government agencies. PCSP has undergone much development over the years, but safe, cost-effective and efficient logistical support has remained its primary objective. Currently, PCSP provides support to ~130 research projects each year that involve ~1100 people in total. Support is provided through:
1. air transport for researchers to and from remote field camps located across the Canadian Arctic,
2. accommodation at the PCSP facilities in Resolute, Nunavut, prior to and following the field season, and
3. field equipment loans and daily information and advice on arctic logistics.

To celebrate 50 years of Polar Shelf operations, two major events were held that involved northern residents, researchers, government officials and high-school and university students. On May 14th, 2008, a science workshop was held at the Canadian Museum of Civilization in Gatineau, Quebec. Presentations were given on topics such as the early days of PCSP field work, the evolution of the organization, current research being conducted by PCSP-supported scientists, and ideas about the proposed High Arctic Research Station. A panel discussion also allowed participants to discuss the important issue of how to engage northern communities and involve Northerners in research. Additionally, students from an Ottawa high school visited the workshop and interacted via videoconferencing with a class at the school in Resolute, Nunavut.

Polar Shelf also held an Open House at the PCSP facilities in Resolute on July 12th, 2008. Residents of Resolute, scientists and business and government officials had the opportunity to tour PCSP's facilities, watch a throat singing demonstration, see presentations on current scientific research, and visit the *CCGS Louis S. St. Laurent*, which was anchored in Resolute Bay. These two events were resounding successes and PCSP will continue to build on these important outreach initiatives that engage Northerners, scientists and government officials alike in PCSP's operations and supported science.

During the past year, Polar Shelf has been discussing plans for rejuvenation as the agency moves forward in delivering logistical support to researchers for decades to come. No new funds have yet been identified to date for these plans; however, components being considered are:
1. expanding the operations network in the Arctic to include operations centres in Eureka and a western arctic location,
2. designing a longer operational season, beginning in February and ending in late September,
3. developing closer interactions with research agencies and granting councils to improve logistical capacity for arctic researchers, and
4. building on international linkages to support exchange programs, such as PCSP's Canadian Arctic-Antarctic Exchange Program.

These developments will strengthen PCSP's ability to provide logistical support to researchers across the Canadian Arctic and improve connections with national and international groups who have a vested interest in continued enhancement of polar research.

THE ROLES OF NON-PHOTOSYNTHETIC PROKARYOTES IN THE MARINE NITROGEN CYCLE IN THE EASTERN AND WESTERN HIGH CANADIAN ARCTIC

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Recent evidence suggests that the productivity of the marine ecosystem is controlled by the supply of nitrogen to the euphotic zone. While studies generally focus on physical delivery mechanisms (e.g. upwelling, mixing), the nitrogen cycle is complex and there are many biological pathways that can supply or remove the nitrogenous species

that most primary producers utilize. The role that non-photosynthetic prokaryotes (bacteria and Archea) play in this respect is unclear in the Canadian Arctic. Among other things, these organisms can (1) breakdown complex molecules to release small inorganic or organic nitrogen forms that phytoplankton can take up (2) oxidize biological waste products (NH_4 or NO_2) into nitrate to obtain energy (nitrification), (3) compete with primary producers for the use of labile nitrogen, favouring its retention within the microbial food web. In this project, we performed a coupled investigation of ammonification, nitrification, and bacterial uptake of inorganic (NH_4, NO_3) and organic (urea, glycine) nitrogen near the surface and at the base of the euphotic zone where the subsurface chlorophyll maximum lays. In order to distinguish bacterial uptake from phytoplankton uptake during simulated in-situ incubations, we used a three-prong approach combining trace additions of dual $^{15}N/^{13}C$-labelled organic nitrogen sources, post-incubation size-fractionation on 0.8 and 0.2 mm silver membranes and a treatment with antibiotics. Here we describe this novel approach, discuss its merits and present a few preliminary results obtained during the 2007 campaigns of CFL and ArcticNet.

TEMPORAL PATTERNS OF BENTHIC COMMUNITY STRUCTURE IN AN ARCTIC FJORD IN RELATION TO CLIMATE VARIABILITY

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We investigated temporal variations and patterns of recolonisation and disturbance in a benthic hard bottom community in high-arctic Kongsfjorden (Svalbard, Norway) from 1980 to 2003 through annual photographic surveys. A manipulative sampling design was applied, where half of the study area (treatment areas) was cleared at the beginning of the study. Abundance and area covered by macrobenthic organisms were estimated based on image analysis of high-resolution photographs, and community summary parameters were calculated as the basis for examination of interannual patterns. Interannual variability in abundance and species diversity were related to climate variability.

Twenty-three different taxa and groups of benthic epifauna were found in the photographs. The benthic community structures of treatments and controls converged within the first decade, but significant differences prevailed until ≤13 years after the start of the study. We could distinguish between three different time intervals with increased inter-annual changes. While the observed differences during the first two intervals could be attributed to recolonisation and succession, the changes in the last interval were mostly due to increased external forcing and characterised by low inter-group and high inter-annual differences. Different recolonisation patterns for individual species were related to life span, rate of maturity, predators and larval settlement.

45% of the variability of the benthic community in Kongsfjorden could be attributed to environmental factors linked to the North Atlantic Oscillation index (NAOI) and its local manifestations. The temperature of the West Spitzbergen Current (WSC) was a link between the NAOI and the benthic community. Biodiversity was negatively correlated to the NAOI. Severe changes in the benthic community were observed between 1994 and 1996 coinciding with a shift of the NAOI from a positive to a negative mode. The increase in biodiversity during this period was accompanied by an increase of brown algae (mainly *Desmarestia*) and the sea urchin *Strongylocentrotus droebachiensis*, while sea anemone populations declined.

EFFECT OF LANDSCAPE POSITION ON THE PROCESSES CONTROLLING METHANE EMISSIONS IN FOREST-PEATLAND SEQUENCES IN FOUR NORTHERN ECOREGEONS

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Soils in the northern permafrost regions contain large amounts of organic carbon which is vulnerable to release to the atmosphere as carbon dioxide (CO_2) and methane (CH_4) in response to climate warming and thawing of permafrost. High latitude regions have already experience significant change in temperature over last 30 year but the effects of these changes on CH_4 emission

are poorly understood. In the subarctic region and the northern part of the boreal region, where most of the perennially frozen soils occur, the increased temperatures are expected to cause increased thawing of the perennially frozen soils. Thawing of the organic C rich soils will initially result in water-saturated conditions. These water-saturated conditions, together with the higher temperatures, result in anaerobic decomposition, leading to the production of CH_4.

To improve our understanding of CH_4 dynamics in the northern regions under climatic change, it is important to understand the dynamics of CH_4 fluxes from forest-peatland ecosystems and the processes affecting fluxes in relation to environmental factors. The overall aim of the current study was to understand and describe the different modes of variations in CH_4 fluxes from northern ecoregions under current conditions and to predict the fluxes under changing climate conditions in future.

In order to meet these objectives, four sites were selected along Mackenzie Valley in the spring of 2007. The sites are located in the regions of Inuvik, Norman Wells, Fort Simpson, and Fort McMurray representing boreal and subarctic regions over four permafrost zones. Methane (CH_4) measurements were initialized in September 2007 and continued throughout winter, spring and summer of 2008. Instruments to continuously monitor soil moisture, soil temperature, redox and oxygen concentration were installed to relate the environmental variables with CH_4 measurements. Early results show that significant surface CH_4 production was occurring only in the submerged parts of the soil profile. There are not sufficient data yet to assess the climatic variables that drive CH_4 production, however early observations illustrates how CH_4 concentrations rapidly increase below the water table level in a permafrost thawed areas. Contradictory to the initial expectations greatest CH_4 production was not taking place during the spring thaw, but was reaching maximum during the warmest months. Both under upland and aerated peatlands areas soil layers showed negligible CH_4 emissions. Though significant CH_4 concentration were recorded in the water-saturated layers immediately above permafrost in peat plateaus, practically none was found in the surface layer. These results suggest that CH4 emissions from northern ecosystems are more sensitive to changes in moisture regime than temperatures. However, increased relative area of watersaturates soils as a result of permafrost thawing is expected to increase of CH_4 emissions from affected parts of landscape. The CH_4 release/consumption distribution patterns within the study area is intricate and highly variable, and varies with the local hydrology including depth-to-water and corresponding vegetation cover.

IMPORTANCE OF N2 FIXATION AND DISSOLVED ORGANIC NITROGEN FOR PRIMARY PRODUCERS IN THE SOUTHEAST BEAUFORT SEA AND NORTHERN BAFFIN BAY

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Studies of the Beaufort Sea have shown that once nitrate is depleted from the upper euphotic zone, the concentrations of soluble reactive phosphorus (SRP) and dissolved inorganic carbon (DIC) continue to decrease. Understanding this phenomenon is a crucial step toward assessing the response of net community production and ecosystem productivity to environmental forcing and climate change. Based on the paradigm that phosphorous is recycled more readily than nitrogen in the upper ocean, we hypothesize that the continued depletion of SRP and DIC is not tied to the use of recycled nitrogen by phytoplankton, but to the consumption of an alternate nitrogen form not considered in previous investigations. In this project, we considered the possibility that new nitrogen enters the system via nitrogen fixation by cyanobacteria and that the phytoplankton use allochthonous organic nitrogen directly or via its photochemical degradation into labile inorganic nitrogen forms. To do so we incubated water samples from the upper euphotic zone with ^{15}N-labelled nitrogen gas (N_2), with dual ^{15}N-^{13}C labelled organic nitrogen or with trace amounts of ^{15}N-labelled sources of inorganic nitrogen. For the latter, ^{13}C-bicarbonate was also added to estimate rates of primary production simultaneously. A preliminary assessment of the photo production of NH_4 and NO_3 was also performed by incubating 0.2-mm filtered seawater in partially UV-transparent bottles for several days on deck. This presentation describes the project rationale and shows preliminary results obtained during mid-summer in the southeast Beaufort Sea (CFL program) and late summer across northern Baffin Bay (ArcticNet).

ANALYSIS OF THE POTENTIAL FOR RETRIEVING CLOUD OPTICAL DEPTH AND SUPER-MICRON, ICE-PARTICLE SIZE USING IR RADIOMETRY IN AN ARCTIC ENVIRONMENT (EUREKA, NUNAVUT).

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An important goal, within the context of improving climate change modelling, is to enhance our understanding of aerosols and their radiative effects (notably their indirect impacts as cloud condensation nuclei). Ice-crystal size and cloud optical depth (COD) are key modelling parameters whose variation strongly influences radiative effects in the Arctic environment. The presence, for example, of sulfuric-acid bearing aerosols (Arctic haze) can significantly change ice-particle size formation leading to significant cooling (relative to ice-particle generation by more pristine aerosols) during the Polar-winter (the dehydration greenhouse feedback or DGF effect proposed by J. P. Blanchet's group at the Université du Québec à Montréal). The presence or absence of diamond dust particles («clear sky precipitation») in the winter can lead to significant changes in surface heating (as proposed by Lesins et al. of Dalhousie University in a recent submission to GRL). It is therefore crucial that ice-crystal size and COD be well characterized in order that such radiative effects be properly modelled.

The general objective of the project is to employ passive, multi-band, zenith pointing, IR radiometry as a means of inferring the effective ice-crystal size and COD. This will be accomplished using a split-window (combination of band differences) approach along with MODTRAN radiative transfer simulations to parameterize the behavior of the downwelling zenith radiance as a function of the key optical parameters (including the intensive parameter of effective particle size). A knowledge of other extensive and intensive optical and microphysical parameters derived from radiosonde data, lidar and radar will serve as both auxiliary input data to the model retrieval procedure as well as data for the validation process. Specific input auxiliary data include integrated water vapour content from radiosonde data and effective layer height from lidar backscatter data. Specific validation elements include effective ice-particle radius profiles which can be extracted from the combination of lidar and millimeter cloud radar (MMCR) backscatter coefficients (as per the technique developed by Ed Eloranta at the University of Wisconsin) as well as indicators of particle shape and phase which can be extracted from lidar depolarization profiles. COD will be compared with estimation of optical depth from integrated lidar backscatter profiles.

The observation site will be the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut which is part of the CANDAC network (Canadian Network for the Detection of Atmospheric Change). Preliminary results derived from the spectral integration of P-AERI (Polar Atmospheric Emitted Radiance Interferometer being developed by Von Walden) zenith-pointing radiance spectra are analysed. Comparisons with ModTran 4 simulations are discussed.

NUTRITION AND FOOD CONSUMPTION AMONG THE INUIT OF NUNAVIK

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Significant changes in food consumption patterns have been occurred in the Inuit traditional diet since the last decades, especially because communication and transportation with southern regions was improved. It seems that the Inuit population is vulnerable to nutritional inadequacy and is facing to important increase of nutrition-related health problems. The Nunavik Health Survey conducted in 2004 allowed to collect important information about the Inuit diet. The general purpose of the nutrition part of the survey was to provide reliable, updated information on dietary intake, nutritional status, food habits, food insecurity, and to verify changing in consumption since the last decade.

Methods: Information on food and nutrient intakes and on eating habits was obtained using a Food Frequency Questionnaire and a 24-Hour Dietary Recall. These dietary questionnaires were completed by women and men aged 18 to 74 in a face-to-face interview. Questions about cooking, eating habits, food perceptions and food insecurity were also asked to the respondents. The statistical analysis of the food frequency questionnaire data permits to estimate the consumption frequency and the usual intake in grams of traditional foods on a daily, weekly, seasonal or annual basis. The 24-hour dietary recall provides estimates of mean and median intakes of energy and nutrients, the contribution of foods to nutrient intakes – all according to socio-demographic factors.

Results: In 2004, the contribution of traditional foods to energy intake was 16% among the Inuit adults whereas it reached 21% in 1992. The contribution of traditional foods to the Inuit diet was higher among older Inuit than among young people whereas store-bought foods contributed more to the diet of younger Inuit. The intakes of protein, most of vitamins and minerals were acceptable for more than half of the Inuit adults the day before the survey. The consumption of marine country foods provided important amounts of omega-3 fatty acids. However, intakes of vitamins A, C and D, calcium and of dietary fibre were particularly low among the Inuit adult people. These low nutrient intakes reflect the low consumption of milk products, fruits and vegetables and whole-grain cereal products in Nunavik. Sodas and fruit beverages were the most important sources of carbohydrates and this consumption was much higher among young people. Finally, food insecurity appears to be a major problem for several Inuit households. Nearly one person on four declared having lack food during the month before the survey.
Conclusion: In view of the results, main recommendations to improve it include the preservation or the increase of the traditional food. The Inuit should also increase their consumption of healthy store-bought foods such as fruits and vegetables, whole-grain cereal products or milk products which can reduce the risk of some chronic disease. In contrast, intakes of sweet foods must be reduced because there are known to increase the risk of obesity and diabetes. Finally, the Inuit should be educated about healthy store-bought food choices at low cost should be offered to the Inuit in order to reduce the food insecurity in Nunavik households.

MODELLING THE IMPACT OF CLIMATE CHANGE ON THERMAL AND MOISTURE REGIMES OF PERMAFROST WITH THE NEW DEEP SOIL CONFIGURATION IN CLASS

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Most of the climate models, including Regional Climate Models (RCMs), employ land-surface schemes that vary in depth between 3 and 10 meters; for example the current version of the Canadian Regional Climate Model (CRCM, Laprise 2006) has a physically based land surface scheme, CLASS (Canadian LAnd Surface Scheme; Verseghy et al., 1991, Verseghy, 1993), which is 4.1m deep, with three soil layers that are 0.1, 0.25 and 3.75m thick respectively. As shown by many recent studies (Smerdon and Stieglitz, 2006; Alexeev et al., 2007, Nicolsky et al., 2007, Stevens et al., 2007), such shallow soil models, though coupled, cannot simulate active-layer and near-surface permafrost realistically. For instance, those types of shallow soil models have inappropriate lower boundary condition, which gives rise to a null heat ground flux near the surface. In the context of climate changes, this could have an impact on many positive feedbacks related to the active layer thermo- and hydrodynamics; for example, extended snow cover period, snowmelt hydrology, terrestrial albedo, greening period, etc.

To simulate realistic soil thermal and moisture regimes in the CRCM, it is intended to use the latest version (v3.4) of CLASS, which is particularly suitable for permafrost studies due to its more flexible layering scheme and bottom boundary conditions. For example, with this new configuration, the soil model can now reach 100m deep and incorporate the geothermal flux at its bottom boundary. It is surely a step towards a greater realism of the energetic balance of permafrost, especially with long simulations reaching the end of the 21st century. Moreover, CLASS is also more realistic in its soil composition. It allows in its parametrization schemes not only clay and sand soil types, but also complete organic ones (Letts et al., 2000), which will contribute to decouple the atmosphere temperature with the ground surface temperature because of the traditionally low thermal conductivity of the organic matter.

Sensitivity of the permafrost soil thermal and moisture regimes to organic matter and the soil model depth/configuration is assessed using offline simulations with this latest version of CLASS, which is presented in this study. Preliminary results seem to confirm that adding deeper layers and organic matter to CLASS brings a new thermal inertia that changes the active-layer and near-surface permafrost behavior.

GEOLOGIC FEATURES AND SEABED PROCESSES OF THE NORTHWEST PASSAGE

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Multibeam sonar systems have been utilized for mapping of seabed transects through the Northwest Passage and Canadian Beaufort Shelf. Survey platforms include the CCGS Amundsen, equipped with a hull-mounted Simrad EM300 multibeam sonar and the CCGS Nahidik which carries a 9m launch equipped with a Simrad EM3002 multibeam sonar. Multibeam data combined with 3.5 kHz sub-bottom data have been collected in support of seabed issues related to the opening of the Northwest Passage including: sovereignty, safe navigation, geohazards to resource development, paleoceanography, geological evolution of the seabed, and benthic ecosystem investigations. Navigation hazards include shoals and submerged artificial islands. Geohazards related to offshore hydrocarbon development include unstable foundation conditions, slope instabilities, shallow gas and oil seeps, faulting and scouring by sea-ice and icebergs. Holocene sediment depocentres have been located for sediment sampling for high resolution paleoenvironmental reconstructions. Flutings and drumlinized seabed clearly define the flow patterns of glacial ice streams. Seabed morphology and backscatter mapping provide the framework for benthic ecosystem assessments. Data analyzed to date have contributed significantly to the knowledge and understanding of seabed processes, geohazards, geological features and history of the seabed of the Northwest Passage and Beaufort Shelf.

VARIABILITY OF SEA-SURFACE TEMPERATURE AND SEA-ICE COVER IN THE FRAM STRAIT OVER THE LAST TWO MILLENNIA

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During the last decades, the Arctic regions have experienced significant changes, notably with respect to the extent and duration of the sea-ice cover. Although the modern sea ice decline is largely attributed to global warming, little is known about the natural variability of sea ice, and future trends remain difficult to predict. One key to address this critical issue is the use of recent geological archives for documenting past sea ice on centennial to millennial time scales.

In this context, the International Polar Year activity WARMPAST (Arctic Ocean Warming in the Past: IPY n°36) was defined for the reconstruction of past ocean and climate conditions in the Fram Strait which constitutes the main gateway between the Arctic and North Atlantic oceans. Here, we report the results obtained from a sediment core (JM-2006-04) collected during the WARMPAST 2006 expedition on the Jan Mayen along the West Spitsbergen margin of Fram Strait (78.92°N, 6.77°E, water depth: 1497 m). The chronology of the 51 cm long core was established from 210Pb and 137Cs and 14C measurements. A sedimentation rate of about 19 cm/kyrs and a mixing layer of 5 cm led to an extrapolated age of 2400 yrs BP at core bottom. Analyses of dinocyst assemblages were performed to reconstruct hydroclimatic conditions, including the sea-ice cover, using the Modern Analogue Technique (MAT) and a Northern Hemisphere reference database of 1208 sites.

The relative abundance of dinocyst taxa and a principal component analysis permitted to distinguish a particularly warm interval characterized by sea-ice free conditions at about 1350 yrs BP. A sharp transition from the Medieval Warm Period to Little Ice Age conditions is found around 640 yrs BP. It is marked by the simultaneous disappearance of the thermophilic taxa Spiniferites mirabilis-hypercanthus, Selenopemphix quanta and Impagidinium sphaericum and the increase of the polar-subpolar taxa Impagidinium pallidum and Pentapharsodinium dalei. Sea-surface temperatures (SSTs) estimates suggest warmer conditions than present (up to 7°C in summer) until 640 yrs BP although cooling pulses are recorded circa 1900, 1550 and 900 yrs BP. These pulses associated with a high variability of sea ice suggest centennial to millennial timescale oscillations. The last 640 yrs BP show a cooling trend with summer SSTs decreasing from 7 to 2°C and a seasonal sea-ice cover increasing up to 7 months/yr.

The study of core JM-2006-04 demonstrates the

Fram Strait area constitutes a particularly sensitive zone as regards the sea-ice cover and SSTs, as a result of the relative influence of the warm and saline inflow of North Atlantic water masses and of cold and fresh waters outflow from the Arctic. The thermal optimum recorded at 1350 yrs BP represents the only interval of the last 2400 yrs BP that provides a possible analogue for the modern post-2000 AD conditions.

CLIMATE CHANGE AND RECENT PERMAFROST DISTURBANCE IMPACTS ON HIGH ARCTIC TUNDRA VEGETATION

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The effect of environmental change on High Arctic vegetation is still uncertain, particularly soil surface disturbance cause by rapid slope failures due to permafrost changes. Vegetation plots were established at the Cape Bounty Arctic Watershed Observatory (CBAWO), Melville Island, Nunavut, as part of broader effort to examine how permafrost disturbance and simulated climate change would affect the vegetation present. The study contributes to the IPY CiCAT and Cape Bounty projects and introduces plot-level vegetation to the western Arctic Archipelago.

Extensive permafrost disturbance occurred in 2007 in several areas at Cape Bounty. Active layer detachments resulted from unusually warm conditions in July 2007 that deepened the active layer and considerably increased ground ice melt, together with several major rainfalls. Both contributed to increased soil moisture and widespread slope failures that moved downslope. These slope failures entrained soil and vegetation, leaving behind areas of newly exposed soil and parent material. The landscape at Cape Bounty continues to be unstable, with slope failures increasing in size and number during the summer of 2008. The extent to which disturbances could impact vegetation through physical disruption of plant and root systems, alteration of moisture regimes, and continued instability and erosion of soil and plant material remains poorly understood and represents a major focus of this research. One of these failures is located adjacent to an area that experienced a similar slope failure at least 56 years ago. In 2007, 20 vegetation plots were established around and within these failures to examine how areas re-vegetate and plant species and communities respond to permafrost disturbance over time.

Additionally, vegetative response to climate change will be experimentally studied using an International Tundra Experiment (ITEX) site that was established at Cape Bounty in the summer of 2008. ITEX open-topped chambers (OTC) and snow fences were erected to increase air temperature and water availability. Vegetation plots were established both inside and outside of the experimental footprints of these alterations. The phenology of the vegetation within each plot will be carefully measured during the summer of 2009 to determine the effect of increased temperature and/or snow depth. The results of these studies will be integrated into the broader hydrological and landscape research framework present at Cape Bounty.

POPULATION STRUCTURE IN POLAR COD (BOREOGADUS SAIDA): FIRST RESULTS FROM A CIRCUMPOLAR STUDY USING MICROSATELLITES

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The importance of polar cod in the Arctic marine food web is well documented. However, very few information is available for other aspects of the species biology. Migration patterns and breeding structure are almost unknown but some indices about those could be unveiled by the study of population structure using genetic tools. So far, the genetic analyses carried out with polar cod, using fish from a restricted geographical range and genetic markers which are not extremely powerful to detect low genetic differentiation, revealed no population structure. Here, we present a population structure study with samples of polar cod from several locations around the Arctic (Beaufort, Laptev and East Siberian seas, Hudson, Baffin and Iqualuit bays, Oliver, Lancaster and Scoresby sounds, Amundsen and Boothia gulfs, Kongsfjord) analyzed with recently-developed microsatellites markers. As expected from the geographic locations and major currents within the Arctic Ocean, the largest genetic differentiation is found between Canadian and Siberian fish (Fst between 0.0138 and 0.0643) while the lowest is found between samples from the eastern part of the Canadian Arctic Archipelago (Baffin and Iqualuit bays, Oliver and Lancaster sounds, Fst between 0.0000 and 0.0052). Low genetic differentiation between distant locations (Hudson Bay and Beaufort Sea, for

example) still need to be explained but could support one of our hypothesis about population sub-structure in polar cod.

PARTICLE CHARACTERIZATION BY COMBINING CLOUD RADAR AND LIDAR MEASUREMENTS OVER EUREKA, NUNAVUT

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Large uncertainties exist in the understanding of Arctic clouds. In order to get insight into cloud macro-and microphysical properties, reliable long term datasets are required, particularly regarding cloud particle size, shape and phase, which are directly related to radiative transfer.

As a combined effort by the Canadian Network for the Detection of Atmospheric Change (CANDAC) and NOAA's Study of Environmental Arctic Change (SEARCH), atmospheric data are collected almost continuously at the Zero-altitude PEARL Auxiliary Laboratory (OPAL). Cloud and aerosol scattering properties are investigated with the combination of measurements from the CANDAC Millimeter-wave Cloud Radar (MMCR) and the University of Wisconsin's Arctic High Spectral Resolution Lidar (AHSRL). Histograms of the scattering properties, as well as their vertical distributions, are computed from a dataset spanning the 2005-2008 period. Selected cases of various wintertime particle types such as cloud droplets, precipitation and Arctic Haze aerosols are also studied in order to investigate their respective properties. The results have implications for our understanding of cloud microphysical properties and the relative occurrence of the different particle types.

PHYTOPLANKTON LIGHT ABSORPTION PROPERTIES IN THE ARCTIC REGIONS: A GLOBAL VIEW

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The Arctic Ocean is currently experiencing major ecosystem changes due to the accelerated decline of its summer sea ice cover. This is virtually opening a whole new ocean for phytoplankton to grow. Due to its remoteness, this region is however hard to sample using traditional ship-based approaches. Remote sensing appears as a promising way to monitor the ecosystem changes that are likely to occur with the shrinking sea ice cover.

Remote sensing of phytoplankton biomass and of derived products such as primary production are fundamentally determined by the inherent optical properties of phytoplankton, dissolved matter and non algal particles. Previous studies conducted in arctic coastal waters showed that current operational algorithms were generally overestimating chlorophyll concentrations due to the presence of dissolved and suspended matter and because of significant pigment packaging in the arctic phytoplankton species.

The light absorption capacity of phytoplankton (a_{ph}) is thus the key to the accurate monitoring of possible climate change effects in the Arctic Ocean. To evaluate this parameter for arctic waters, we thus gathered a new set of measurements of a_{ph} as part of a series of expeditions: the Canadian Arctic Shelf Exchanges Study (CASES) field program conducted in 2003 and 2004; the Circumpolar Flaw Lead study in 2007-08, the 2005 and 2007 Arcticnet cruises, and finally the Nansen Amundsen Basin Observing System cruise in 2007.

These cruises sampled the major coastal regions surrounding the Arctic central basin: the eastern Beaufort Sea, the northern Baffin Bay, the Canadian archipelago, and the Laptev Sea. The presentation will describe the spatial and temporal variability of a_{ph} and evaluate its similitude with the database covering the southern waters.

CLIMATE CHANGE, SEARCH AND RESCUE AND HUMAN VULNERABILITY IN THE CANADIAN ARCTIC

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The Arctic is experiencing some of the most rapid effects of climate change globally and how northern residents are able cope with the variety of changes they face is of particular concern for their health and safety.

Vulnerability assessments have emerged as an informative research approach to understanding potential impacts and identifying characteristics of those communities and individuals most at-risk. Many of the climate change driven challenges facing northern residents are common across regions in the Canadian Arctic. However, understanding the nature of what these challenges mean in terms of current or future impacts on health and well-being and the opportunities and abilities of individuals to respond is unique to the individual, community or regional scale. It is for this reason that community or regionally focused and issue-specific vulnerability assessments can prove an effective tool through which to understand risks and responses and support the development of policies or programs to enhance adaptive capacity and protect human health in the Canadian North in a focused manner.

For Inuit, health and safety on the land is of particular concern in the context of climate change and variability as many communities report increasingly frequent uncharacteristic weather and sea-ice conditions putting hunters and others at greater risk than ever before. Inuit communities across the Canadian Arctic are reporting a perceived increased in the numbers of land and ice-based accidents and injuries related to these changes in environmental conditions. This issue is of great importance as injury related mortality is already 2.3 times higher in the Northwest Territories than the Canadian average and is 3 times higher among Inuit residents than others. We conducted an issue-specific vulnerability assessment to look at health and safety while on the land in the Inuvialuit Settlement Region of the Northwest Territories. We took a multi-disciplinary approach drawing on both qualitative (workshop reports, semi-directed interviews) and quantitative (primary Search and Rescue (SAR) data and secondary data on injuries) data. The results from this study will present the challenges in effectively assessing vulnerability with existing Search and Rescue data collection and organization protocols in the Canadian Arctic, highlight the characteristics of those most at-risk for land based accidents and the needs in terms of support for adaptation programs and policies in this and other Inuit regions. With the results of this assessment we will argue that it is possible to improve the monitoring and surveillance capacity at the regional and community scales to gain a more complete understanding of health and safety vulnerabilities related to climate change and land based safety for Inuit communities.

RECONSTRUCTION OF LATE HOLOCENE SEA SURFACE PARAMETERS ON THE MACKENZIE SLOPE (BEAUFORT SEA, CANADIAN ARCTIC): PRELIMINARY RESULTS

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This study aims at reconstructing past sea-surface parameters in the Beaufort Sea area (Western Canadian Arctic) on the base of sedimentary cores collected over the Mackenzie slope, and covering the last 4500 years. Piston, trigger and box cores were sampled at station 803 (70°38'N, 135°55'W) in 2004 aboard the CCGS Amundsen (CASES) at 218 m water depth. Sedimentation at this particular location is influenced by both the Beaufort gyre and the Mackenzie River, whose sedimentary discharge is by far the largest among all other Arctic rivers.

Dinoflagellate cysts are used as proxies for paleoceanographic reconstructions. Past sea-surface temperature, salinity, sea-ice cover and productivity are estimated using transfer functions (modern analogue technique). Other palynomorphs such as freshwater algae (*Halodinium*, *Pediastrum*) and reworked material provide insight on the freshwater input (via the Mackenzie), and thus the hydroclimatic conditions over the late Holocene.

Preliminary results from the upper 330 cm of the piston core are presented. According to the age model based on 4 AMS-^{14}C datations along the core, this section represents the last 2600 calibrated years BP and the core was subsampled at a 10 cm interval. Dinocyst concentrations are relatively low throughout the section (from 198 to 1240 cysts/cm^3). Dinocyst zone II (from 2600 to 1600 cal yr BP) is characterized by assemblages dominated by *Operculodinium centrocarpum* (~45% on average), accompanied by *Islandinium minutum* (~19%) and cysts of *Pentapharsodinium dalei* (~15%). Assemblages in dinocyst zone I (from 1600 cal yr BP to present) are dominated by *I. minutum* (~31% on average), with the accompanying taxa *O. centrocarpum* (~26%) and *P. dalei* (~20%).

Changes in dinoflagellate cyst assemblages between zone I and zone II provide insights that are expressed quantitatively by transfer function analyses. In zone I, at the base of the core, summer sea-surface temperatures decrease up to 2°C below present value, as the duration of sea ice cover increases by 1 month a year (below actual value). The autotroph *vs* heterotroph (G:P) dinoflagellate ratio drops from 3,14 to 0,38, which suggests limited primary productivity due to increasing sea ice cover during this period. In zone II (from 1600 cal yr BP to present), summer

sea-surface temperatures increase to reach modern value, and a decrease in duration of sea ice cover is observed. The G:P ratio increases up to 3,12 at the top of the core. These data are consistent with similar studies held in adjacent areas. It is also consistent with other studies describing the warming of Western Canadian Arctic, in comparison with a cooling Eastern Arctic. Spectral and wavelet analysis will also be run on the entire dataset in order to document hydroclimatic cycle(s) prevailing in the Beaufort Sea area, such as the Arctic Oscillation.

These results will provide useful data on the evolution of sea surface conditions in the Western Canadian Arctic for the late Holocene as well as for the hydroclimatic variability (freshwater inputs). This will contribute to document the natural variability of Arctic's climate, a key component in the understanding of earth's warming climate.

PRESENT AND PAST RIVER DISCHARGE AND SPRING FLOODING IN THE SLAVE RIVER DELTA, NWT, USING WATER ISOTOPE TRACERS AND LAKE SEDIMENTS

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The Slave River Delta (SRD), NWT, is a productive northern freshwater ecosystem in the Mackenzie River Basin. Recent concerns about the impacts of upstream water use, declining river discharge and the effects of climate variability on the hydroecology of the SRD have prompted the need to further understand the crucial role of water in this freshwater ecosystem.

Stable isotope (^{18}O, ^{2}H) and suspended sediment data obtained from SRD lakes over three consecutive thaw seasons (2003-2005) provide a unique opportunity to tease apart the roles of the Slave River and climate on SRD hydroecology. While climate conditions were remarkably similar during the monitoring period, the spring break-up varied significantly. Moderate spring flooding occurred in 2003, flooding was absent in 2004, and a major flood occurred in 2005. Floodwater serves as a key hydrological input to lakes in the active delta, where the spatial extent of flooding is positively correlated with discharge on the Slave River. Later in the thaw season, evaporation becomes one of the major hydrological factors controlling SRD lakewater balances.

Sedimentary flood deposits from a delta lake, identified using peaks in C/N ratios, correspond to high magnitude events in the ~45-year Slave River discharge record, demonstrating the potential for reconstructing Slave River flood frequency using lake sediments. Notably, paleohydrological reconstructions from this lake sediment core are similar to records from the upstream Peace-Athabasca Delta (PAD) suggesting upstream snow accumulation, rate of snowmelt and discharge are the primary drivers of periodic ice-jam flooding in the PAD and SRD.

To extend Slave River flood history beyond the instrumental record, a ~7 m sediment core was collected from another SRD lake adjacent to the Slave River using a vibracorer. The sediment core is laminated throughout and contains light grey sediment with frequent medium to dark brown beds and laminations. Light grey sediment is consistently very fine grained (clay to very fine silt). Medium and dark brown beds and laminations are <0.5 mm to ~8 cm thick (commonly 0.5-2 cm), and are typically fine to medium grained sand that fine upwards from a sharp lower contact, suggesting deposition during high energy events and subsequent suspension settling. X-ray imagery and magnetic susceptibility will be used to quantify changes in the sediment sequences and results will be used to hindcast Slave River flood frequency. Results will be compared to a ~600-year record of flood frequency from the PAD, and will be key to understanding drivers of historical deltaic evolution and anticipating future changes in the SRD in light of changing climate and river discharge.

SPATIAL AND TEMPORAL VARIABILITY OF THE PHYTOPLANKTON COMPOSITION, BIOMASS AND PRODUCTION IN THE FIORDS OF NORTHERN LABRADOR

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Knowledge of phytoplankton taxonomic composition, abundance, biomass and ecology in northern Labrador is relatively scarce. Furthermore, the spatial and temporal variability of primary production in these fiords is not well known. To better understand the phytoplankton dynamics across a latitudinal gradient in northern Labrador, sampling was conducted in Nachvak Fiord, Saglek Bay, and Anaktalak Bay during fall 2006 and 2008 and summer 2007 at a total of 6 stations. At each station, we determined the vertical profiles of irradiance, temperature, salinity, transmissiometry and chlorophyll fluorescence, as well as nutrient and dissolved organic carbon concentrations, using a CTD-rosette system. Water samples were also collected at 3 optical depths (50%, 15% and chlorophyll max) for the determination of phytoplankton abundance. Picophytoplankton (<2 μm) and nanophytoplankton (2-20 μm) were counted using flow cytometry and phytoplankton cells >2 μm were identified and enumerated by light microscopy. Phytoplankton chl *a* biomass (fluorometric method) and production (^{14}C-assimilation method) were determined for small (0.7-5 μm) and large (>5 μm) cells for samples collected at the mouth of the fiords. The spatial and temporal variability in species composition, abundance, biomass, and production rates were investigated in the fiords. Preliminary results on environmental data, species composition and phytoplankton abundance will be presented.

COLLABORATIVE, MULTI-PURPOSE SEAFLOOR MAPPING IN THE CANADIAN ARCTIC ARCHIPELAGO

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With the increasing open water due to climate change, the accessibility and interest in the coastal waters of the Canadian Arctic Archipelago is growing. The interests of mariners, resource developers, communities and scientists all require improved definition of the seafloor.

The state of seafloor mapping in the Archipelago is variable but generally sparse outside the prime chokepoints. Large areas, previously predominantly ice-covered, have been surveyed only using through-ice heliborne soundings. These regions are opening up and the typical spacing of these spot soundings (2-6km) are inadequate to guarantee safe shipping corridors. The potential for grounding incidents involving either commercial, research, security or search and rescue platforms is significant.

The existing ArcticNet transit multibeam philosophy has served to open up access to remote areas. But this is only viable by building on existing corridors. There is a pressing requirement for search and rescue, sovereignty patrols, and scientific investigations to be able to enter into previously inaccessible regions.

The collaborative and opportunistic launch and ship-based mapping programs between ArcticNet and the Canadian Hydrographic Service (CHS) is herein described. Through the combination of ice-escort standby time, CHS charting commitments and ArcticNet infrastructure and personnel, a 48 day program has just been completed. This program combined the specific research objectives of ArcticNet scientists (geographers, marine geologists, benthic ecologists and hydrodynamic modelers), with the core charting mandate of the CHS and search and rescue navigational requirements of the Canadian Coast Guard. Scientific results include detailed morphologic mapping of actively changing seabeds, subbottom profiling of the surficial sediments and transects through the dynamic oceanography of the coastal region, as well as bathymetry, shoreline and vertical datum data for the purposes of hydrographic charting.

DOES SEA ICE RETREAT SHAPE THE SIZE STRUCTURE OF PHYTOPLANKTON IN THE AMUNDSEN GULF?

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In June 2004, the size structure of the phytoplankton community was investigated in the upper water column (50 m) of the Amundsen Gulf region in relation to sea ice dynamic. In order to characterized the phytoplankton size structure, we used total and fractionated (5 and 20 μm) chl *a* concentrations and the size fractionation of small phytoplankton (<20 μm) abundance by flow cytometry (<3 μm, picophytoplancton and >3 μm, nanophytoplankton). South of the Amundsen Gulf, sea ice retreat occurred later compared to the northern areas, and was fast (one week). There, the phytoplankton community was under pre-bloom conditions with a biomass due to <20 μm cells. Picophytoplankton abundances were 4 to 5-fold higher than their abundance under ice in the area, suggesting that picophytoplankton responded faster to sea

ice retreat than larger phytoplankton cells. In the middle of the Amundsen Gulf, sea ice retreat lasted 2.5 weeks and this area was free of ice since one week. The phytoplankton community was already in post-bloom situation, under nitrate depletion with low phytoplankton biomass and contribution of >5 μm cells, though no deep chlorophyll maximum was detected. Moreover, picophytoplankton abundances were high while nanophytoplankton abundances were only moderate. Finally, at stations close the eastern part of the Mackenzie shelf and slope, sea ice retreat was only slightly faster (two weeks), but the phytoplankton size structure was very different from the middle of the Amundsen Gulf and formed a deep maximum of biomass and <20 μm cells abundance. Over the upper water column, at least 40 % of the biomass was due to >20 μm cells, although <20 μm cells were abundant, and particularly nanophytoplankton. Overall, phytoplankton growth in spring in the Amundsen Gulf seemed closely linked to sea ice dynamics. Slow ice retreat seemed to favour high picophytoplankton growth, while fast sea ice retreat favoured the growth of pico-, nanophytoplankton and >20 μm phytoplankton and their accumulation at depth.

CIRCUMPOLAR YOUNG LEADERS PROGRAM

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The Circumpolar Young Leaders Program (CYLP) is a project of the International Institute for Sustainable Development. Developed in 1999, in partnership with the Arctic Council's Sustainable Development Working Group, CYLP places Northern Canadian youth that demonstrate leadership potential, in organizations throughout the circumpolar region. The program is supported by the Department of Foreign Affairs and International Trade and through the Government of Canada's Program for International Polar Year.

For six months, youth have positions in institutions that deal with current Arctic issues. Presently, participants are located in the University of the Arctic in Finland, the Canadian Embassy in Norway and the United Nations Environment Programme- GRID at Arendal, Norway. Recently, the program has extended to include Southern Canadian placements that focus on Northern issues. There are current internship placements at Students on Ice and Schools on Board. Participants gain, not only professional experience, but learn from the cross-circumpolar cultural experience.

The goal is to foster Northern leadership with a foundation in sustainability. The program increases networks for participants with peers and Arctic leaders and institutions, within Canada and the circumpolar region. During the program, participants work in an array of sectors that deal directly with Arctic issues and require research, work on communication projects and the attendance of relevant conferences. As Northern citizens, it is important that participants get exposure to the region's unique decision-making process. This individual experience increases leadership capacity in local, regional and circumpolar development.

This session will examine how non formal educational training opportunities for young northerners such as, the CYL program are helping to produce the next generations of researchers, scientists, communicators, policy makers and local leaders.

ARE ATMOSPHERIC MERCURY DEPLETION EVENTS A POTENTIAL SOURCE OF MERCURY TO ALGAL POPULATIONS OF THE AMUNDSEN GULF?

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Atmospheric mercury (Hg) depletion events (AMDEs) have been observed to occur in the Arctic during polar sunrise. While some of the mercury (Hg (II)) deposited onto the snow and ice surface has been shown to photoreduce back to the atmosphere as Hg (0), it is unknown to which extent the AMDE-deposited Hg enters the marine food web.

As part of the International Polar Year (IPY) - Circumpolar Flaw Lead (CFL) System Study, we report here the distribution of Hg in the ice and planktonic algae populations in the Amundsen Gulf throughout the 2008 spring-time AMDEs. In addition to sea ice and planktonic algae sampling, simultaneous measurements of atmospheric gaseous elemental mercury (GEM), particulate, and reactive gaseous mercury (RGM) were monitored in real time. Total Hg (THg), methyl Hg (MeHg), and dissolved GEM in snow, ice, and water were analyzed on board the CCGS Amundsen under clean room conditions at the Portable In-situ

Laboratory for Mercury Speciation (PILMS). By comparing the spatial and temporal differences between ice-covered and open-water systems, the relative contribution of AMDE-deposited Hg bioaccumulated at the lower trophic levels of the arctic ecosystem is assessed. Understanding the processes by which toxic contaminants such as Hg are transferred to lower trophic levels in the Arctic Ocean, especially under rapidly warming conditions, will help to advise remediation and adaptation strategies so as to minimize the adverse impact of contaminants on the health of marine ecosystems and Indigenous People.

AVIAN CHOLERA CONTINUES TO CAUSE MORTALITY AMONG COMMON EIDERS NESTING IN THE CANADIAN ARCTIC

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In North America, avian cholera outbreaks caused by the bacterium *Pasteurella multocida* appear to be occurring with increasing frequency and spreading to new regions, particularly in Canada's north and Atlantic coast. Avian cholera has been detected among snow geese in northern Hudson Bay, and outbreaks occur regularly among snow geese nesting on Banks Island in the Northwest Territories. Prior to 2004, there have been few reports of avian cholera in the Canadian eastern Arctic, and none reported among marine birds. Avian cholera was recently detected among breeding common eider ducks in Hudson Strait, northern Quebec, and at East Bay, Southampton Island when it appeared in 2004. Since then, the disease has re-occurred annually and in 2006, the peak year, the disease killed over 3200 East Bay females (32% of the breeding hens) between late June and early August. After a promising decline in mortality in 2007 to 14.6% of all breeding females, avian cholera returned in 2008 to the diminished colony with over 31% mortality rate among breeding hens. The continued mortality observed at East Bay may have significant conservation implications to common eiders in the north, whose populations may have difficulty recovering following repeated large scale outbreaks. Here we review the development of the disease over the years and its impact on the colony dynamics and reproductive success of common eiders.

MODELLING THE EFFECTS OF CLIMATE CHANGE ON MERCURY DYNAMICS IN THE BEAUFORT SEA

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High mercury concentrations are consistently reported in Arctic marine mammals and are increasing temporally. Not only does this represent a threat to the health of the animals, but it also represents a danger to native communities that consume them as part of their traditional diets. Recently, the first mass balance inventory for mercury was developed for the Arctic which suggested increases in total mercury inputs to the Arctic were considerably lower than increases in fish and marine mammals observed over the same time scale. Research has suggested that climate change might be modifying the factors governing the uptake and transfer efficiency of mercury in food webs and that current mercury fluxes from inputs and losses are likely the change considerably in a warming Arctic. The overall objective of this study is to expand the usefulness of mass balance inventories by constructing a predictive dynamic model for mercury in the Beaufort Sea, where warming is predicted to have the most dramatic effect. Defining an assortment of climate change scenarios such as reduced ice cover, increased nutrient availability, and food-web regime shifts, this model will link abiotic and biotic systems and predict mercury concentrations at several environmental levels (e.g. water column, ice pack, marine mammals). Atmospheric fluxes will be derived by coupling the Global\Regional Atmospheric Heavy Metals (GRAHM) model to our model. Calibration will be achieved by drawing on the vast data sets collected by the "ArcticNet" network. Additional data will be collected onboard the CCGS Amundsen or in the Mackenzie Delta region if knowledge gaps are identified. The model is currently in early development, and due to the large scope of the study, considerable dialogue with experts

in several fields is necessary to continue logical and factual development.

FREE LOVE IN THE FAR NORTH: REPRODUCTIVE STRATEGIES USED BY ARCTIC FOXES ON BYLOT ISLAND, NUNAVUT, CANADA

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The reproductive strategies used by animals vary greatly across species. Reproductive strategies also sometimes differ significantly within populations, depending on a variety of factors such as resource availability or genetic structure of the population. Reproductive strategies can influence how a population is able to face environmental changes, and it is sometimes assumed that the level of plasticity in the reproductive strategy of a population affects its ability to cope with changing conditions. Populations of the arctic fox can fluctuate greatly according to environmental conditions, especially when resource availability is variable. Populations depending on cyclic lemming populations are especially prone to such fluctuations in density. We studied the reproductive strategies used by male and female arctic foxes on Bylot Island (Nunavut, Canada), by combining genetic analyses with direct behavioural observations during cub rearing period, from 2003 to 2008. We found that female arctic foxes used a variety of strategies in their mate choice, including strict monogamy, polyandry and extra-pair fertilization. Extra-pair fertilizations events lead to increased genetic diversity among progeny, which can enhances the probability that at least some young survive to future conditions. These outbreeding strategies may also be particularly relevant in the context of climate change, given that some arctic fox populations may become more geographically isolated as maximum sea ice extent declines and winter movements of foxes are reduced.

PARTICULATE TRACE ELEMENT AND CARBON DISTRIBUTION ALONG THE GREAT WHALE RIVER AND HUDSON BAY

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In April 2008 an intensive scientific campaign was perform in the Great Whale River and Hudson Bay near Kuujjuarapik-Whapmagoostui, Québec (Canada). Four sampling stations were settled: one upstream of the village (St. 1), two in the river front (St. 2 and St. 3) and the other downstream Great Whale River discharge, in the Hudson Bay (St. 4). In each site, ice cores, river water and sediments were collected and analysed for particulate Al, Si, Fe, Mn by Flame-AAS, organic carbon (dissolved: DOC; particulate: POC) by HTCO or elemental analysis and Co, V, As, Zn, Cd, Cr, Cu, Ni, Pb and U levels were determined by ICP-MS.With the exception of As, concentrations of all other elements were higher in sediments collected in the Hudson Bay, where a slight contamination of Cr and Ni was observed (Cr: 94 μg/g; Ni: 40 μg/g). The concentrations of Co, V, and As decrease downstream, but for POC and the other trace elements, levels were higher in both ice and water particles in St. 2 and St.3, at the Kuujjuarapik-Whapmagoostui waterfront. Normalization of elements concentrations for Al, C_{org} and Suspended Particulate Matter content indicate a sharp increase of Zn, Cd, Cu, Ni, Pb near the village waterfront (St. 2 and 3) suggesting that besides other potential sources, the village may contribute to the increase natural concentrations of these elements in the Great Whale River system.

Vertical profiles of element concentrations in ice cores and water column indicate that ice suspended particles are enrich in POC while, in water the concentrations of Al, Fe and Mn and DOC are higher. As a result elements like As, Cd, Cr, Cu, Ni, Pb and U tend to accumulate in particles scavenge on ice due to their affinity to organic matter. The enrichment factor determine for these elements varied between 1.2 for As and 67 for Cu. These results are of great environmental concern because during ice melt an additional input of these contaminants to the aquatic system is expected becoming available for living organisms along springtime bloom.

YEAR-ROUND SURVEY OF DMS AND DMSP DYNAMICS IN ARCTIC SEA ICE (BEAUFORT SEA, NOVEMBER 2007 - JUNE 2008)

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Dimethylsulphide (DMS) is a volatile sulphur compound produced by the degradation of dimethylsulphoniopropionate (DMSP), a metabolite synthesized by some phytoplanktonic species to act as a cryoprotectant and osmoregulator. It is also a main component of the biogeochemical sulphur cycle and the primary source of marine-derived sulphate aerosols which play an important role in the earth-atmosphere radiation balance. So far, very few studies have investigated the dynamics of DMS and DMSP in sea ice despite the fact that sea ice has been shown to contain considerably higher DMS and DMSP concentrations than the water column.

This study presents the first year-round data set ever measured of high resolution concentration profiles for DMS and its biologically produced precursor DMSP in Arctic sea ice. This experiment was undertaken during the IPY's Circumpolar Flaw Lead System Study, which extended between September 2007 and August 2008 in the Amundsen Gulf region of the Beaufort Sea onboard the CCGS Amundsen. This area of the Beaufort Sea provided a unique and interesting environment for sampling, complete with a dynamic assemblage of leads and sea ice that covered a broad spectrum of age and dimensions. Ice core, brine and under-ice water samples were regularly collected from ice environments spanning the evolution of seasonal sea ice from its initial formation to decay. The cores were either processed on board of the ship or stored at -26°C for later measurements in order to minimize loses of DMS. A novel technique called dry-crushing was used to extract the gaseous compounds from the ice. This technique avoids bias related to the artificial and partial transformation of DMSP into DMS on melting. DMS concentrations were then measured using the standard «purge and trap» method and a GC-FPD. DMSP concentrations were also determined using the same technique through the addition of NaOH to the samples. A set of relevant sea ice biogeochemical variables (incl., temperature, salinity, Chla, nutrients) was also collected in support of the study. The experiment duration and vast sampling area provides the opportunity to develop a comprehensive understanding of DMS and DMSP dynamics, considering ice types, thickness, season and microclimate. The information resulting from this dataset, the most comprehensive ever collected in the Arctic, is required to further the development of sea ice biogeochemistry models and is requisite if we are to understand the mechanisms that regulate the exchanges of DMS at the ocean-sea ice-atmosphere interfaces.

MERCURY DYNAMICS IN THE MACKENZIE RIVER BASIN

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Mercury (Hg) is a toxic contaminant in the environment, particularly methyl mercury (MeHg), and is known to bioaccumulate and biomagnify up the foodweb. However, the bioavailability of Hg depends upon its speciation (form) in the environment. Hg tends to be more bioavailable when associated with organic matter, and less when associated with recalcitrant mineral matter. We have sampled waters throughout the entire Mackenzie River Basin (MRB) for total and dissolved Hg, dissolved sulfate and chloride, and DOC. Sediment samples have been sampled for Hg and analysed with Rock-Eval pyrolysis and organic petrography. Our results show that, in the basin as a whole, Hg is mainly inorganically associated, with most of the Hg deriving from the mountainous tributaries in the west. The most likely source of this Hg is from sulfide mineral oxidation, as is evidenced by the literature and our sulfate data. However, MeHg concentrations (though not fluxes) are highest in the peatlands, concomitant with higher DOC values. Five of these lake-fed tributaries also show significant correlation of Hg with labile organic matter (S1 from Rock-Eval), suggesting higher bioavailability at

these sites. The peatland sites are home to virtually all of the communities in the MRB, and are also fished by these communities, with two of these communities (Fort Good Hope and Fort Providence) situated near the lake-fed tributaries. Because of the likely high bioavailability of Hg at these sites, linking with fish data is thus crucial, and recommended.

OPPORTUNITIES FOR FUTURE COLLABORATION IN ARCTIC SEAFLOOR MAPPING

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Current and planned mapping activities of the high arctic seafloor represent the tip of the iceberg (pun intended) in relation to Canada's need for mapping of our arctic archipelago. This effort represents a huge technical challenge, but also a broad effort that will require the collaborative efforts of a multi-disciplinary group of industry, academia, government, and the local population.

This paper provides an overview of the anticipated collaboration needs and opportunities. It provides an overview of current stakeholders and their roles and collaboration. It goes on to identify additional specialties required, where they can be met, and proposes a collaboration framework for how they can work together to meet Canada's arctic mapping challenge.

MOLECULAR APPROACHES TO BIODIVERSITY, DISTRIBUTION AND ECOLOGY OF HIGH ARCTIC AQUATIC MICROBES

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Microbes are ubiquitous and represent the hidden biodiversity in all aquatic habitats. High Arctic fjords, lakes, streams and seeps are productive oases in polar deserts and iceshelfs, and are the bases of the food webs that support the larger visible animals in the High Arctic. Our goals are to identify, catalogue and map microbial diversity and ecologically important characteristics of these aquatic systems.

The High Arctic landscape is changing rapidly and the consequences of short- and long term changes in physical and chemical properties on microbial communities is impossible to predict without basic knowledge of the populations and genetic plasticity of the species that make up these communities. Longer ice free periods for Cornwallis Island lakes, disappearing summer ice in Northern Ellesmere Island lakes, and the dramatic break-up of Ward Hunt, Markham and Serson Ice Shelves, add urgency to our work discovering diversity, evolutionary history, dispersal and physiological properties of these communities.

Lakes and ponds on Cornwallis (Char Lake), Ellesmere (Lake A and Antoniades Pond) and Ward Hunt Island (Ward Hunt Lake) and Markham and Ward Hunt Ice Shelves are the focus of our work on bacterial, archaeal and eukaryotic diversity in benthic microbial mats and planktonic communities. While exploration of diversity is the centre of our field and lab studies, specific student originated projects address key aspects aimed at understanding the wider implications of diversity and distribution. For example, one of our projects on the seasonal population dynamics of photosynthetic and phagotrophic protists and organisms that do both (mixotrophic) will also investigate consequences on bacterial dynamics and food web complexity in high arctic lakes. Another study, aimed at discovering the extent of endemic versus globally dispersed microbes in the Arctic, along with detailed taxonomic analysis of cyanobacterial mats explores the notion that there is a global cryobiosphere with common species occurring in cold environments including the Antarctic, continental mountain ranges and glaciers. Our studies on local versus long range transport of microbes and how capacity for aeroplankton to arrive and thrive in ecologically suitable environments will have implications predicting community stability, trait evolution, and need for conservation in these habitats. Techniques used to reach these goals range from morphological characterisations, to polymerase chain reaction (PCR) based techniques, including quantitative PCR, fluorescence *in situ* hybridisation (FISH), and metagenomics of whole communities using high throughput pyrosequencing.

COMPARISON OF INFLAMMATORY MARKERS BETWEEN HYPERTENSIVE AND PREHYPERTENSIVE INUIT FROM NUNAVIK

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Background: In the context of the detection of subtle modification of cardio-metabolic parameters as predictor of cardiovascular disease, prehypertension is a physiological state that retains many scientific interests. Inflammation process is suspected to be an important determinant of hypertension. Yet, there is little knowledge on comparisons of inflammatory markers between pre-HTN and HTN. This study aimed to investigated and compared the independent associations of serum interleukin-6 (IL-6), C-reactive protein (CRP), and tumor necrosis factor-α (TNF-α) according to status of HTN in Nunavik Inuit. **Methods & results**: Using the cross-sectional setting of the Inuit Health Survey in Nunavik (Québec), a population-based study, we analyzed biological, anthropometrical data and medical history from 832 men and women. Categories of blood pressure were defined as HTN (≥ 140/90 mmHg or use of medication); pre-hypertension (Pre-HTN) (systolic blood pressure within [120-139 mmHg] and or diastolic blood pressure within [80-89 mmHg]). People with blood pressure <120/80 mmHg were classified as normotensive (NTN). Prehypertensives and hypertensives accounted for 32% and 19%, respectively, in all participants. Adjusted for age and gender, proportion obese (BMI>30kg/m2) is 32% among HTN, 17 % among PreHTN and 16% among NTN. In linear regression model, adjusted for age, gender, smoking, measure of obesity, cholesterol, CRP was related to the severity of HTN in Inuit population. There was a trend of increase of CRP level according to HTN severity (p=0.008). NTN had different value than HTN (p=0.01)and PreHTN(p=0.01). However, PreHTN Inuit and HTN had similar level of CRP (p=0.60). In contrast, IL6 and TNF-α were not associated the severity of HTN (IL6 p=0.11; TNF-α=49) **Conclusion:** Among inflammatory marker analysed here, CRP is the only marker independently associated with hypertension, and also preHTN. This study identified a high proportion of people at risk for developing hypertension. Because long term obesity and chronic inflammation has been identified as risk factor of HTN, Pre-HTN group should be target of intensive public health intervention in order to reduce the cardiovascular risk.

MERCURY TRANSPORT ACROSS THE OCEAN-SEA ICE-ATMOSPHERE INTERFACE IN THE ARCTIC OCEAN

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Mercury (Hg) is ubiquitous in the Arctic and is currently the major contaminant of concern to northerners. The discovery of atmospheric mercury depletion events (AMDEs) provided a possible mechanism for increased Hg deposition from the atmosphere during polar sunrise. However, during the time of year when AMDEs occur, much of the Arctic Ocean is ice covered. The extent to which this atmospherically deposited mercury, Hg (II) or Reactive gaseous mercury (RGM), impinges on the underlying ocean through ice surface remains unknown. One possible pathway for the exchange is via brine channels in first year sea ice. As part of the International Polar Year (IPY) - Circumpolar Flaw Lead (CFL) System Study, we report here the profiles of mercury distribution in sea ice cores and brine leaching at various drift and landfast ice sites in the western Arctic Ocean throughout the 2008 Arctic AMDE season. At each station, sack holes were drilled in the ice at varying depths and sampled at different intervals for total mercury, salinity, and conductivity. Ice cores were also taken in close proximity of the sack holes and analyzed for total mercury, salinity, conductivity, temperature, and microstructure. The mercury analysis was completed onboard the CCGS Amundsen at the Portable In-situ Laboratory for Mercury Speciation (PILMS). Total mercury concentration in brine ranged from 71.2 ng/L to 2.7 ng/L, decreasing from shallow sack holes near the surface to deeper holes near the bottom, and was always much higher than that in the underlying seawater (typically around 0.2 ng/L). Bulk ice cores showed similar profiles with higher Hg concentrations in the surface layer, particularly in the surface frazil layer. No appreciable difference was found between brine profiles of landfast and drift ice sites, though drift ice sites generally had greater variation in ice microstructure and mercury concentrations. Top-down (transport from

the atmosphere) and bottom-up (freeze rejection from the seawater) processes are evaluated and discussed. This work marks the first time that brine and ice profiles for mercury are reported in the Arctic Ocean which will shed new light on the cycling of mercury, and possibly other contaminants, across the ocean-sea ice-atmosphere interface.

YOUTH ENVIRONMENTAL AWARENESS: PERSPECTIVES ON INTERGENERATIONAL KNOWLEDGE TRANSFER IN CHURCHILL, MB

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Knowledge transfer is critical to understanding the impact and opportunities that environmental change has on a group or region. The purpose of this research is to document intergenerational knowledge transfer between elders and youths aged 11-14 in Churchill, MB. This research relies on an individual's own knowledge, beliefs and attitudes towards environmental change issues. As well to identify whether children are aware of their changing environment as a result of learning traditional, local and scientific knowledge.

There are three main objectives for this research. The first objective is to understand how knowledge from the indigenous elders in Churchill is being transferred from one generation to the next. This research will look at different generations of knowledge being transferred; from elder's parents to the elder's themselves to the elder's grandchildren and/or children in the community. The second objective is to identify factors influencing intergenerational knowledge transfer. This research will look at factors that promote and impede intergenerational knowledge transfer. Lastly, the third objective is to determine elder's and children's perspectives on the positive and negative aspects of intergenerational knowledge transfer.

There are three proposed methods for this research. The first method is observation. The researcher will be observing the relationship between youths and elders to see what knowledge is being shared. The second method is participant observation. The researcher will participate in activities that youths and elders may do together. As well as participating in activities in which only the elder or the child is involved with. Lastly, the third method involves conducting open-ended and semi-structured interviews. Interviewees are able to lead the discussion and talk freely about what their interests are and what are the biggest concerns towards environmental change. Community-based methodology was also used; members of the town of Churchill have asked for this research to be done and will be involved in the planning, implementing and analysis phases.

The significance of this research is to provide guidance to teachers by showing various teaching methods provided by local community members. Using a holistic framework that links traditional, local and scientific knowledge, children will be able to better understand and play a role in recommending action to minimize the impact of environmental changes.

DEVELOPING STRATEGIES TO IMPROVE GPS POSITIONING AND TIDAL INFORMATION TO FACILITATE LONG TERM SEABED MONITORING IN THE CANADIAN ARCTIC

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As international shipping, interests in commercial activities and resource development increase in the Canadian Arctic, the impact of these stresses on the local environment must be monitored. The capability exists to repeatedly survey areas of interest with high resolution multibeam echo sounders, which provide a complete picture of the seabed, in an effort to detect changes over time and identify potential geohazards. The difficulty is that temporal changes in the seabed morphology are often hard to detect and measure due to complexities in the local tidal regime and inherent errors in high latitude GPS observations.

The head of the Oliver Sound fjord, on northern Baffin Island, was surveyed in September of 2006 using the Ocean Mapping Group's survey launch, the Heron, with a 300 kHz multibeam echo sounder and CNav Globally Corrected GPS. The head of the fjord was then resurveyed in September of 2008, again with the Heron. Changes in the seabed morphology are evident, but quantifying these changes requires improvement of the horizontal and vertical GPS positioning solutions. Steep fjord walls and the latitude of the site, at 72 degrees north, present conditions which obstruct the view of geosynchronous CNav correction satellites and the majority of the GPS constellation. Lack of tidal information at the head of the sound also results in a source of sounding error and prevents subsequent surveys from being compared and analyzed.
Methods of improving the external sources of error of GPS positioning and tidal influences have been investigated using post processed positioning solutions and

hydrodynamic tidal models. This will allow for detection of decimetre level changes in the seabed morphology and successful long term monitoring projects utilizing the capability and resolution of the available multibeam systems.

TH-DERIVED PARTICULATE ORGANIC CARBON (POC) FLUXES AND MICROBIAL EXTRACELLULAR ENZYMATIC ACTIVITY IN ARCTIC POLYNYAS

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We have used the water column ^{234}Th deficit relative to its parent ^{238}U, coupled with measurements of the POC/^{234}Th ratio on filterable particles >70 mm, to estimate late summer POC fluxes at stations in the Laptev Sea (2005) and North Water (2006) Polynyas. POC fluxes at 100 m were generally greater in the North Water Polynya relative to the Laptev Sea. Rates of extracellular enzyme (protease and carbohydrase) activities were determined on particles (1-70 mm and >70 mm) filtered in situ to test the hypothesis that POC fluxes in the Arctic Ocean are related to extracellular enzyme activities. Protease activities were greater than carbohydrase activities in both size fractions and in both polynyas, and correlated positively with particulate N (PN) and POC. Carbohydrase activities correlated with POC and, in the Laptev, with PN. Activities of both protease and carbohydrase correlated negatively with POC flux such that lower POC fluxes had higher extracellular enzyme activities. The negative relationships between POC flux and enzyme activity in the two polynyas did not fall along the same trend however, possibly due to interannual differences or differences in sources of organic matter to the two systems.

IMPACTS OF PRESENT-DAY AND PAST ANIMAL POPULATIONS ON THE NUTRIENT AND CONTAMINATION STATUS OF FRESHWATER LAKES ON BYLOT ISLAND, NUNAVUT (CANADA)

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Arctic freshwater ecosystems are highly sensitive to external environmental stresses, but the knowledge of their developmental history and natural variability is still very limited. Our study focused on lakes and ponds on Bylot Island (Nunavut, Canada), located within the largest breeding and nesting colony of the Greater Snow Goose (*Chen caerulescens atlantica*) in the Arctic. Due to protection measures and changes in the overwintering habitats, the population of breeding snow geese has increased dramatically over recent years. As a result, the nutrient loading originating from faecal goose droppings has increased, which may profoundly change the relative concentrations of C, N and P in the usually dilute and unproductive ((ultra-)oligotrophic) arctic lakes. Both nutrient loading (increased numbers of birds) and environmental changes (rapid warming at high latitudes) have the potential to cause large shifts in the composition and functioning of these tundra lake ecosystems.

We used a combined limnological and a paleolimnological approach in order to track any recent or past bird impacts on the chemistry and trophic state of the lake and pond systems. First, we conducted a limnological survey of 29 lakes and ponds to determine if the presence/absence of birds in their catchments had an impact on the nutrient concentrations. The variance among the study sites was not explained (as expected) by feces-related variables (mainly P and N) but rather by other variables, such as Mg, Na, Ca, K, dissolved organic carbon (DIC), conductivity and pH. The concentrations of the major ions were lower or equal to what was reported by other arctic limnological surveys. This could indicate that the freshwater ecosystems of Bylot Island are still limnologically stable, and that the limit of their carrying capacity has not yet been reached. The paleolimnological

aspect of our research included extracting sediment cores from impacted lakes near breeding bird colonies and from non-impacted lakes, to track short- and long-term changes in lake nutrient (trophic) status and contamination. Reconstruction of past levels of trophic state (nutrients like P and N) using algal fossils (diatoms) and stable isotopes δ15N, δ13C) allowed us to define the relationship between known changes in bird population size over the past 30 years and our paleolimnological data. The results confirm those obtained through our limnological survey, though diatom composition and organic matter content display recent changes in these lakes and ponds that do not seem to be linked to the Greater Snow Goose population. At the present time, the ecological integrity of the freshwater ecosystems in Sirmilik National Park appears to be intact, as none of the studied lakes and ponds have attained a eutrophic state. However, subtle changes observed in the recent sediments of some lakes can be viewed as early signals of potentially more profound perturbations of these environments in the near future. With accelerated warming of the Arctic, which will likely lead to increasing stress caused by wildlife migration and expansion of bird populations, we will have to monitor the evolution of these freshwater ecosystems, and compare future changes against the baseline conditions determined through our study.

DO ARCTIC ZOOPLANKTON PERFORM VERTICAL MIGRATION DURING THE POLAR NIGHT?

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High latitude environments show extreme seasonal variation in both physical and biological variables, with the classic paradigm of Arctic marine ecosystems holding that most biological processes will slow or cease during the polar night. One such key process that is generally assumed to cease during winter is Diel Vertical Migration (DVM) of zooplankton. Here we present acoustic data that demonstrate a synchronised DVM behaviour of zooplankton that continues throughout the Arctic winter, in both open and ice-covered waters. We argue that even during the high Arctic polar night, DVM is regulated by diel variations in illumination, but at intensities far below the threshold for human perception. We also demonstrate that winter DVM is stronger in open waters compared to ice-covered waters, implying that the active vertical flux of carbon will become more effective if there is a continued retreat of the Arctic winter sea-ice cover.

INVESTIGATING ARCTIC SHELF PROCESSES: 7 YEARS OF PHYSICAL AND BIOGEOCHEMICAL MARINE OBSERVATIONS IN SVALBARD (A UK-NORDIC CO-OPERATION)

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The Scottish Association for Marine Science, in close cooperation with Norwegian institutes, has maintained a near-continuous capacity for moored observations in Kongsfjorden, NW Spitsbergen, since April 2002. The instrumentation has enabled full water-column sampling of physical, biological and geochemical parameters and subsequently coupled to allow cross-disciplinary studies of shelf-fjordic processes. The oceanography of teh West Spitsbergen Shelf is strongly influenced by the Atlantic Water transported in the off-lying West Spitsbergen Current (WSC). Here we describe the key scientific results that have emerged from this dataset which link the interactions between the WSC and the shelf. Specifically we shall present observations of a wind-driven shelf-basin exchange mechanism that results in a massive seasonal shift in hydrography on the shelf and its impact on sea ice formation in the coastal zone (Cottier et al 2005, 2007). We aim to exploit these datasets across a range of Arctic marine projects with international research groups to answer new questions on shelf-basin interactions and responses.

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TRANS-POLAR FAT 2008: AN UPDATE ON ATHEROGENIC EFFECTS AND REGULATORY ISSUES IN NUNAVIK

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Purpose & rationale: Following our recent observations that biological levels of *trans*-fatty acids (TFA), lipids with adverse health effects mainly found in recently introduced low quality imported foods, were high among Nunavik Inuit, we looked at the atherogenic changes associated with TFA in plasma cholesterol profiles in order to assess the health significance of this dietary exposure. At the same time, we worked on the translation of research results into public health action among Arctic communities.
Process/Approach: 795 Inuit from the 14 communities of Northern Québec (Nunavik) participated in the baseline Inuit Health in Transition cohort study and met our inclusion criteria. We measured the fatty acid profile of red blood cell (RBC) membrane phospholipids (PL) as a surrogate for individual intakes. Cholesterol (total, HDL and LDL), triglycerides, apolipoproteins, LDL size and paraoxonase activity were measured in plasma. A bootstrap approach was applied in order to account for the complex sampling design and non-response rate.
Findings: The associations varied markedly between gender and according to age. In men (n=357, age=36.3±14.3, TFA=1.24±0.54%), TFA tended to be negatively associated with HDL-c, ApoA1 and LDL particle size, and positively associated with non-HDL-c, LDL-c, ApoB100, the ratio of ApoB100 to ApoA1 and the ratio of TC, LDL-c and TRIG to HDL-c. No such trends were observed in women (n=438, age=37.0±14.1, TFA=1.16±0.54%), except for PON1 in women and for HDL-c and ApoA1 in women aged 50 years and more. As these results were presented to the Nunavik Nutrition and Health Committee in March 2008, the Regional Board of Health and Social Services finally decided in June 2008 to follow the 2007 Makivik call to work towards the reduction of TFA in foods sold in Nunavik communities.
Implications for Inuit Health: These results suggest that TFA could raise the risk of coronary heart disease in Nunavik Inuit men at least through their physiological effects on plasma lipids. The differential associations reported in pre- and post-menopausal women need to be reproduced in other populations and in experimental studies addressing the influence of sex hormones on response to dietary fats. Thanks to mutual efforts to translate research into action, Nunavik public health authorities are now engaged in the implementation of incentive measures directed to food retailers and information campaigns that will be initiated in November 2008. Though just a first step toward better nutrition, these measures will be followed by a significant improvement in the quality of fat found in Nunavik stores.

PHYSICAL THREATS TO CULTURAL RESOURCES ON HERSCHEL ISLAND, YUKON, CANADA

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Island lies of the Yukon coast in the Canadian Beaufort Sea. The island is unique, both physically and culturally. It is a push moraine formed during the last glacial period, and much of the island is underlain by thick deposits of ground ice. Over the last 1000 years, successive groups of occupants have left behind evidence of their presence, resulting in a rich heritage of cultural resources on the island. Expected physical changes as a result of a warming climate include a rising sea level, increased storminess, a greater extent of open water for longer periods of time, and increased water and air temperatures. All of these make the island vulnerable to inundation and erosion. Much of the island will be washed away due to increased coastal erosion. Relative sea levels are projected to rise by as much as 1.2 metres by the middle of next century, effectively wiping out most of the archeological and historical artifacts on the islan.

MANY STRONG VOICES: ARCTIC AND ISLAND ACTION ON CLIMATE CHANGE

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The Many Strong Voices (MSV) programme brings together vulnerable regions in the Arctic and Small Island Developing States (SIDS) in a collaborative effort to document and respond to the common challenges that climate change presents to these regions. MSV supports a consortium of policy-makers, researchers, and advocates to:
-Conduct state of the art, comparative, climate change vulnerability and adaptation research.
-Develop regionally-appropriate climate change adaptation strategies.
-Produce communications, outreach and education tools that will raise the profile of their regions, highlight their concerns, and enable communities to outline their own solutions.
-Combine regional research, the design of adaptation strategies, and the production of outreach and communications materials to increase the visibility of these regions, enhance their influence on global dialogues on reducing greenhouse gas emissions, and facilitate the articulation of their adaptation needs.

The peoples of the Arctic and SIDS are particularly vulnerable to climate change because their cultures and livelihoods are closely tied to land and sea environments. While communities in both regions have proven adept at adapting to changing conditions in the past, climate change will pose new and unprecedented challenges to the regions' adaptive capacity and resilience.

The impact of climate change on coastal zones is a common denominator between the two regions and provides a context for comparing vulnerability and adaptation processes and developing strategies that contribute to sustainable development in both regions by meeting the social, livelihood, and environmental needs of present and future generations. The Arctic and SIDS are barometers of global change and in this context are considered testing grounds for applied processes and programmes that will strengthen the ability of human societies confronting climate change and other forms of social and environmental change. Lessons learned through the Many Strong Voices Programme feed into policy processes at local, regional, and international levels, and provide decision-makers with the knowledge to safeguard and strengthen vulnerable regions.

Finally, the magnitude of present and forecasted climate change in the Arctic and SIDS means that these regions can be considered harbingers of what may be in store for the rest of the planet. The rest of the world therefore has an interest in the responses and solutions to climate change being generated in both regions.

PREDICTING SPATIAL VARIABILITY OF CARBON FLUX IN TUNDRA VEGETATION COMMUNITIES USING NDVI AND LEAF AREA INDEX

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Arctic ecosystems play an important role in the global carbon cycle due to the large amount of stored organic matter found at high latitudes. Thus, changes in carbon dynamics in northern ecosystems may have significant consequences for the global climate. Quantification of carbon exchange in arctic ecosystems is difficult due to the vast geographic area, scarcity of sampling sites, and high spatial variability of tundra vegetation. Tools such as the Normalized Difference Vegetation Index (NDVI), which is derived from remotely-sensed measures of absorption properties of vegetation, are often used for measuring ecosystem properties at a landscape scale in the arctic. NDVI has been used to measure leaf area index and has been correlated with trace gas exchange in pan-arctic models. However, it is uncertain how well these large-scale predictions correspond to small-scale field measurements. During the growing season of 2008, variables including leaf area index, NDVI, biomass and carbon flux were measured in a variety of vegetation communities near Daring Lake, Northwest Territories (64°52' N, 111°34' W). The temporal and spatial differences between NDVI, biomass and leaf area between vegetation communities are compared, with implications for improving the accuracy of arctic carbon budgets.

CLIMATE AND ANTHROPOGENIC STUDIES ON FOOD WEBS OF THE ARCTIC MARGINAL SEAS

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As diversification of resource demands intensifies in the Arctic, so too have stakeholder discussions on how to balance environmental and industrial interests in the region. Viewing potential industrial development in context with a changing arctic climate, there is a pressing need to obtain additional scientific knowledge on the environmental framework: arctic ecosystems and their processes. The international petroleum company, StatoilHydro has launched a major arctic environmental research program that integrates complimentary biological research fields to improve understanding of the vulnerability of Arctic ecosystems to anthropogenic influences. The program addresses two main objectives: to improve knowledge of the ecology, natural life history and sensitivity to oil of key arctic species and to develop new tools to assess environmental changes related to diverse anthropogenic pressures on ecosystems. The program is being carried out by the Research Network ARCTOS (http://www.nfh.uit.no/arctos/), a consortium of institutes with diverse expertise in the fields of Arctic marine ecology, ecotoxicology and biogeochemical processes. While initially focussing mainly on the Barents Sea, the program takes a Pan-Arctic perspective, including research in the Canadian and Russian Arctic. For example, in 2008, ARCTOS scientists took part in two legs of the Amundsen expedition to study Arctic *calanus* and under ice fauna as part of the International Polar Year Circumpolar Flaw Lead Program. This effort to increase core basic knowledge on the biology, ecology, and ecotoxicology of the Arctic, is part of StatoilHydro's objective to improve the basis for environmental risk and impact analyses for operations. The information generated supports StatoilHydro's corporate zero harm strategy. It will also aid in the development of appropriate regulatory guidelines to protect biological resources from adverse impacts.

DYNAMICS OF MESOZOOPLANKTON RESPIRATION IN AMUNDSEN GULF (SOUTHEASTERN BEAUFORT SEA)

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Most of the organic matter produced during the short but intense season of Arctic marine primary production is remineralized through planktonic respiration *in situ* or during export of this biogenic carbon to the sea bottom. Metazoan zooplankton should play a significant role in the recycling of particulate carbon in the photic zone as well as in its active transport to the deep-sea where it can be respired during the overwintering period. Thus, the assessment of zooplankton contribution to total biological respiration in the water column is necessary to better understand the global carbon cycle. Vertical profiles of zooplankton metabolic rates are very difficult to obtain using traditional incubation methods as the time constraints of the latter usually prevent sufficient data to be collected. On the other hand, measurements of the electron transfer system (ETS) activity, the mitochondrial enzymatic machinery that catalyses respiration at the cellular level, provide a useful alternative to estimate physiological rates in zooplankton assemblages from several depths at one given station. During the ArcticNet 2007 mission and CFL project in the Beaufort Sea, we examined the vertical distribution of zooplankton metabolic rates by means of ETS essays at stations in Amundsen Gulf, sampled from October 2007 to early August 2008. Zooplankton samples collected at nine depth strata with a multinet sampler Hydrobios® were first split to obtain one subsample for taxonomic analysis, and two for biomass and ETS activity measurements, respectively. The latter was size fractionated with a 1000 µm mesh sieve and the 200-1000 µm and >1000 µm size classes were homogenized directly with a INT reagent following the protocol of Båmstedt (2000). We converted the ETS activities to respiration rates using R/ETS constants assessed regularly for each season from a mix of zooplankton organisms. For most of the data, there is a high correlation between the vertical profiles of community respiration and biomass. The large size fraction assemblage had higher respiration rates than the small fraction, reflecting their dominance in terms of biomass. Respiration in the small size fraction was higher in the near-surface layers for the autumn and summer periods, declining sharply with depth. This pattern was less clear during winter and spring when profiles showed multimodal vertical

distribution of respiration. The large size fraction showed a maximum of respiration at depth from October to early May corresponding to the depth of the overwintering population of *Calanus* spp. The respiration maximum followed the seasonal vertical migration of this group to the surface layer (60-0m) at the beginning of the biological production season. During this period this pattern of surface distribution did not seem to change with day and night samplings, implying an absence of diurnal migration. These preliminary results will be supplemented with data on zooplankton biomass and environmental variables in the near future that will help for their interpretation.

FILLING IN THE GAPS: SPATIAL PATTERNS WITHIN THE FOREST-TUNDRA ECOTONE ACROSS CANADA

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The forest-tundra transition is predicted to respond to climatic changes in part through the process of infilling. Infilling results in an increase in stand density, through the establishment and survival of trees in previously uninhabited microsites. Although studies have documented infilling in the past century using satellite imagery, these studies have tended to operate at a course resolution, leaving the question of how infilling is occurring unanswered. The current spatial relationships between shrubs, juvenile and adult trees are explored in this study. Specifically, the distances where juvenile trees tend to establish and survive from adult trees are determined. In addition, the spatial relationship between shrubs and trees at various distances is determined. Data for this study was collected in the Ruby Ranges, Yukon, Canada and in the Mealy Mountains, Labrador, Canada. At each location all trees and shrubs were mapped in 30 m x 30 m plots. Spatial relationships are examined using bivariate point pattern analyses and spatial covariance statistics. The processes that have shaped the spatial patterns are inferred from the exhibited spatial relationships. The differences in spatial pattern between sites are explored and discussed in terms of the climatic changes that are predicted in each region.

This study will be conducted with PPS Arctic Canada, a component of PPS Arctic. PPS Arctic is an International Polar Year endorsed research program on the causes and consequences of change of the forest-tundra ecotone.

PLACE OF RESIDENCE AND NEONATAL OUTCOME IN THE NORTHWEST TERRITORIES

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Purpose: To examine the relationship between transfer for childbirth has on neonatal outcomes within the Northwest Territories

Background and Rationale: In the Northwest Territories, available prenatal care and birthing options vary widely by community. Due to the perceived need for secondary or tertiary services for all births, only women in Yellowknife, and low-risk women in Inuvik and Fort Smith, have the option to give birth in their own community. All other pregnant women are required to leave their communities at 37 weeks gestation to give birth at the nearest regional or territorial center, regardless of their level of risk. Though there have been a number of qualitative studies regarding the effects of transfer policy on maternal health, there has been little analysis conducted regarding perinatal outcomes. This study hypothesizes that living in a community with more perinatal care options, including the option to give birth in their home community, will subject women to fewer physiological and psychological stressors, and as a result, will lead to better neonatal outcomes.

Study Population: All women who gave birth within the Northwest Territories between April 1st, 2005 and March 31st, 2008.

Exposure: Transfer for Childbirth

The ability to stay in their place of residence to give birth will be measured by the availability of services recognized by the Northwest Territories as being capable of supporting childbirth. These women will be evaluated as being in either a "non-transfer" group, consisting of women who have the option to give birth in their own community, or as in a "transfer" group, consisting of women who reside in communities where transfer for childbirth is mandatory.

Outcome: Composite Neonatal Outcome Variable

A composite neonatal outcome variable will be used to compare the two groups, in which a negative neonatal outcome will be recorded if the newborn exhibits one or more of the following: a five-minute Apgar score of less than seven, a birth weight of less than 2500 grams, a birth weight of greater than 4500 grams, or stillbirth.

Analysis Strategy: Relative risk will be calculated for the composite negative outcome variable between exposure groups, and relative risks will be calculated for

each individual negative outcome. The analysis will then be stratified by potential confounding variables to test whether or not any observed relationship is the result of confounding; these variables include maternal age, ethnicity, pre-pregnancy BMI, gestational diabetes, and use of drugs, alcohol or tobacco. Following the individual analysis of confounders, logistical regression will be used to analyze the effect of potential covariates and any interactions between independent variables.

Relevance: This study is designed to provide a more accurate picture of the programming available to pregnant women and the effects of choice in care and availability of care on perinatal health outcome. The findings of this study will hopefully provide evidence to inform future decision-making regarding childbirth policies in rural and remote regions.

COSTS OF REPRODUCTION IN COMMON EIDERS IN THE PRESENCE OF AVIAN CHOLERA: BEING A POOR BREEDER CAN SAVE YOUR LIFE

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Life history theory predicts that an increase in reproductive effort should lead to a decrease in survival and/or future reproductive success. Such fitness costs of reproduction are expected to be more pronounced when breeding conditions deteriorate. Although disease can have important effects on life history traits, its influence on reproductive costs has rarely been investigated. We took advantage of a natural experiment to investigate the cost of reproduction among common eiders nesting in the Arctic, where an avian cholera epizootic appeared in 2006. We found that an increase in clutch size was associated with lower survival of female eider ducks but only when the impact of avian cholera was large. This supports the hypothesis that fitness costs of reproduction are higher under unfavourable breeding conditions, and indicates that being a poor breeder can increase survival probability under the presence of a highly virulent disease.

OCCURRENCE OF ARCTIC STORMS IN THE FUTURE .. SOME INITIAL DOODLES

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Climate change and its associated variability is a key issues for the Arctic. With some evidence of more extreme storms occurring in the Arctic regions, it is essential to better understand the nature of these storms and how their frequency may change in the future. This work will identify relationships between the large scale flow patterns, local factors such as topography and sea ice conditions, and the occurrence/intensity of Arctic storms. Along with studying specific events documented during the STAR (Storm Studies in the Arctic) project during autumn 2007, more historical events will also be examined. Once the dominant large scale flow patterns have been identified and associated with storms and their local conditions, comparisons to historical regional climate models will be carried out and such models, once verified, will be used for examining future storm activity. This poster provides an overview of the project as well as initial results.

IPY ARCTIC FRESHWATER SYSTEMS: HYDROLOGY AND ECOLOGY

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The Arctic has been identified as the region in the Northern Hemisphere that is most susceptible to the effects of climate variability and change, and is expected to display a warming that is more than twice the global average, show decreases in snowcover and sea-ice extent, display further retreat of permafrost, glaciers and ice-caps, and have increased interannual variability in weather conditions. Such significant changes/shifts in climatic regimes are expected to have far reaching first- and second-order impacts on the hydrology and ecology of northern/Arctic freshwater

systems by impacting the ability of rivers, lakes and wetlands to maintain adequate streamflows, water levels and water quality for ecosystem sustainability. Changing climate is expected to directly impact not only the magnitude and timing of freshwater fluxes, but also a range of physical, chemical and biological processes in northern aquatic ecosystems. It is difficult to project the affects changing climate and environmental factors will have on Arctic freshwater systems partly due to a poor understanding of their interrelationships, and partly due to a paucity of long-term monitoring sites and integrated hydro-ecological research programs in the Arctic.

In light of the need for better understanding of Arctic freshwater hydrology and ecology, through integrated, multidisciplinary hydrological, climatological, and ecological field studies and laboratory analyses, "IPY Arctic Freshwater Systems: Hydrology and Ecology" has the research priorities to: (i) improve our process-level understanding of freshwater and nutrients flow, (ii) develop improved predictive models for freshwater and nutrient flux, (iii) develop a unique legacy database of freshwater biodiversity (structure and function) and related environmental information on Arctic freshwater ecosystems (lentic and lotic) and (iv) develop and provide tools and capacity in northern communities for improved community-based monitoring and assessment of the status and trends of the health and integrity of Arctic freshwater ecosystems.

This poster presentation provides a thematic overview of Arctic Freshwater Systems: Hydrology and Ecology and the research and monitoring activities that address its four research priorities.

WAYS OF KNOWING MORE: FOSTERING TWO-EYED SEEING IN ARCTIC COLLEGE STUDENTS

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As Canadian and global environmental problems increase steadily in number and severity, we are being challenged to find new ways of thinking about the earth's complex systems. In the Canadian North, Inuit people can provide valuable insight on changing Arctic ecosystems, as Inuit Qaujimajatuqanjit (IQ) embodies a depth and breadth of adaptive and ecological understanding.In the Canadian Arctic, bringing Inuit voices into environmental management and research is of critical importance to addressing the current ecological crisis as well as systemic health and socio-economic issues facing many Arctic communities. Not only does Inuit knowledge (Inuit Qaujimajatuqanjit) offer unique and beneficial insight on nature, but it is instrumental to Inuit beneficiaries who have been empowered to play a leadership role in management and stewardship of wildlife and natural resources under the Nunavut Land Claims Agreement.

My research investigates how to foster the concept of «Two-Eyed Seeing» in Inuit students enrolled in an Environmental Studies program at the Nunavut Arctic College. Two-Eyed Seeing, suggested by Mi'kmaq Elder Albert Marshall of the Eskasoni First Nation, is the guiding principle for the Integrative Science program at Cape Breton University in Nova Scotia. Professor C. Bartlett (in Dornadic, 2007) explains that it is «learning to see from one eye with the strengths of Indigenous knowledges, and learning to see from the other eye with the strengths of Western knowledge systems...and then learning to use both these eyes together for the benefit of all.»

Inuit college students present a great opportunity for the cultivation of two-eyed seeing. In particular, Environmental Technology program students, who will contribute to the field of environmental management and research, could be excellent ambassadors for the merits of applying integrative approaches to environmental research and management. My research explores how an Integrative Science education approach could support deeper environmental understanding among cross-cultural research and environmental management teams and instil leadership among Inuit students. Recognizing the critical need for both environmental interdisciplinarity and dialogue between Western science and IQ, this project utilizes participatory action methodology to engage local Elders, community members, scientists, and students themselves in determining how together we can find «ways of knowing more». Although my research will be in its preliminary stages during Arctic Change 2008, a conference presentation will help foster early meaningful and multi-stakeholder dialogue surrounding integrative science and cross-cultural research. I will present preliminary ideas on integrative science education in Iqaluit, using the Cape Breton University program as a model of success.

LeDuc (2007) points out that cross-cultural research is often inhibited by barriers to meaningful dialogue between IQ and science. The construction of cross-cultural bridges in addition to academic interdisciplinarity are needed to remove these barriers. It would appear that the most effective approaches to engaging Inuit perspectives in environmental research do not attempt merely to «translate» testimony from Elders and IQ knowledge-holders into science. As exemplified in Watson & Huntington (2008), creating opportunities to bring different ways of knowing into conversation fosters environmental understanding

that is co-produced and contextualized. In this way, environmental research becomes integrative in nature.

QAUJISARVIK NETWORK AT UMIUJAQ: COMMUNITY-BASED RESEARCH IN EASTERN HUDSON BAY

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The recently established Qaujisarvik Network is an agreement between the Anniturvik Landholding Corporation of Umiujaq, Centre d'études Nordiques of University Laval, Makivik Corporation and the Kativik Regional Government to further scientific research at the community level in Nunavik. The newly converted abattoir in Umiujaq serves as logistic base for terrestrial and marine studies within the Hudson Bay Arc. During the summers of 2007 and 2008, community members worked with Makivik and Laval researchers on seabed mapping and studies of permafrost. Funding from the Canadian Foundation for Innovation has enabled the building to be renovated. The inventory of field equipment to safely support field parties has been expanded through support from the IPY logistic and safety program. Under the Qaujisarvik agreement, the community is directly involved in research through various aspects of planning, participation, and direct onsite reportage of field studies. The new field station builds on past cooperative work that includes supporting habitat improvement of charr streams, basic permafrost research, permafrost settlement of the airport road, and marine and geomorphic seabed mapping. These studies are providing the baseline data needed to measure the effects of climate change in the Hudson Bay Arc. The work of the Qaujisarvik Network demonstrates that science can be relevant at the community level. The field station at Umiujaq provides a nucleus from which these cooperative efforts can grow and new innovative projects can build upon.

RÉGÉNÉRATION DE L'ÉPINETTE NOIRE À LA LIMITE DES ARBRES : EFFETS SYNERGIQUES DU RÉCHAUFFEMENT CLIMATIQUE ET DE L'ACTIVITÉ DU CARIBOU

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La régénération sexuée (par graines) des épinettes noires (*Picea mariana*) dans les pessières à lichens à la limite latitudinale des arbres est limitée par de nombreuses contraintes tant climatiques qu'écologiques. En effet, alors que la rigueur des conditions environnementales diminue la production de graines viables, la présence d'un couvert lichénique continu limite le nombre de sites propices à la germination des graines (sol minéral exposé). Or, à la limite des arbres au Québec subarctique, ces contraintes pourraient être amoindries au cours des prochaines années suite aux impacts respectifs du réchauffement climatique et de l'activité du caribou (ouverture de la strate lichénique suite au piétinement). Les objectifs de ce projet de recherche sont de : *i.* déterminer l'effet du réchauffement climatique récent sur la viabilité des graines d'épinette noire à la limite des arbres et *ii.* de quantifier le succès d'établissement et *iii.* la croissance de plantules d'épinette noire dans des sites perturbés et non-perturbés par l'activité du caribou. Pour ce faire, des graines d'épinette noire provenant de cônes produits en 2006 et 2007 ont fait l'objet de tests de germination. De plus, le succès d'établissement des plantules a été évalué tant en milieu naturel que sous conditions contrôlées lors d'expériences d'ensemencement. Finalement, la croissance de plantules s'étant établies naturellement dans les sentiers de caribou et en milieu non perturbé (sur un couvert de lichens continu) a été déterminée suite à une analyse dendrochronologique. Alors que les tests de germination et les analyses de croissance sont en cours, les résultats d'expériences en milieu naturel et sous conditions contrôlées suggèrent que la destruction du couvert lichénique par le piétinement du caribou favorise l'établissement de l'épinette noire. En effet, un nombre supérieur de plantules a été retrouvé dans les sites perturbés, laissant supposer que le caribou pourrait avoir un impact positif sur la régénération de cette espèce.

INVESTIGATING THE FORMATION OF HIGH CONDUCTIVITY BOTTOM WATER IN A FRESHWATER HIGH ARCTIC LAKE

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At the Cape Bounty Arctic Watershed Observatory, Melville Island, the snowmelt-fed freshwater West Lake has been studied since 2003. One of the most intriguing discoveries from this research is a shallow zone of high conductivity, anoxic waters in the deepest portion of the lake during the early season. During the peak snow melt period, the layer disappears, and the lake becomes isohaline. To investigate the initiation, development and destruction of the high conductivity zone at the lake bottom, a CTD and a high-resolution acoustic Doppler current profiler were moored in the deepest section of the lake over the melt period of 2008. In addition, CTD profiles were taken every three days in three locations in order to understand the vertical extent of the conductive waters. Preliminary results reveal a strong temporal connection between bottom water conductivity, dissolved oxygen, turbidity and the initial establishment of bottom currents during melt. It appears that river-generated turbidity currents may displace the conductive water during peak river discharge.

As the conductivity profiles seen in West Lake are not unique to the area, identifying the processes associated with developing and flushing concentrated bottom water is critical for understanding changes in lake chemistry throughout the Arctic. If a conductivity signature is held in equilibrium by nival flow, climatically-induced changes in snow water equivalence could greatly reorder the chemical signature in Arctic lakes, impacting the ecosystem functioning of the systems. More broadly, if the formation of the conductive zone is due to groundwater solute intrusion, this could have implications for the formation of hypersaline lakes, also found in the region.

MODELLING SUBSURFACE CHLOROPHYLL MAXIMA IN THE AMUNDSEN GULF

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A nitrogen-based ecosystem model coupled to a water column turbulence model (Global Ocean Turbulence Model) is used to simulate the structure and evolution of the pelagic phytoplankton bloom in the Amundsen Gulf. The formation of subsurface chlorophyll maxima (SCM) is studied with respect to different scenarios of photoacclimatation and settling velocity. Other parameters influencing the phytoplankton growth are taken from values relevant to the region or other arctic ecosystems. Simulation results are compared with fluorescence and nutrient data collected from 2003 (CASES) to 2008 (ArcticNet, CFL) which reveal a strong correlation between the depth of SCM and the nitracline. Photoinhibited algae sinking at a constant velocity (~0.4 m/day) reproduce the main characteristics of the spring bloom in the Amundsen Gulf. The settling velocity determines if the bloom manifests as a SCM while photoinhibition controls the productivity when the maximum nitrate intake parameter and the initial conditions are unchanged. For particular sinking rates, photoinhibited algae grow much faster than photosaturated ones, demonstrating the strong coupling that exists between physical and physiological parameters and the complexity of this rather simple biological model. The ecosystem model includes a microbial loop and a parameterisation of the higher trophic levels that triggers a phytoplankton production based on regenerated nitrogen (ammonium). The turbulence model uses a wide variety of well-tested turbulence closures, and is designed to be embedded in 3D circulation models. Thus, the model presented here has the potential to further investigate the role of SCM in the carbon and nitrogen cycle at the basin scale.

NITROGEN UPTAKE BY CAREX AQUATILIS DURING SPRING THAW IN A LOW-ARCTIC WET SEDGE MEADOW

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Plant productivity in Arctic ecosystems is typically limited by the availability of nitrogen and sometimes phosphorus, however the seasonal timing of nutrient availability and plant nutrient uptake is not well understood

for these systems. Soil nutrient properties and microbial biomass levels have been monitored over several years at low-arctic wet sedge-meadow sites near Churchill, Manitoba, and both nutrient and microbial biomass levels have been found to peak annually at the end of winter. These levels then decline rapidly and concurrently during the early part of spring thaw. It is not known when the dominant graminoid in this system (Carex aquatilis) begins to take up nutrients in spring and how the early growth phenology of this plant relates to below-ground nutrient availability and the timing of soil thaw. A study was conducted to determine whether Carex aquatilis has the capacity to take up available nitrogen early in spring when levels are still moderately high but soils are cold. 15NH4Cl was used as a tracer and was injected in soil cores containing living C. aquatilis shoots that were sampled at three times during the nutrient decline phase between winter and spring. On each occasion soils were incubated in the field for 8-day intervals, followed by sorting of plant tissues (roots, shoots, rhizomes, mosses) and soil processing to obtain microbial and soil 15N pools.

Analyses of plant tissues revealed that plants took up a large proportion (40-70%) of the injected 15N into their roots during all three incubation periods, but little nitrogen was reallocated from roots to shoots and only trace amounts were found in mosses. This period of uptake coincides with the increase of liquid water in the soil and with soil temperatures (at 10cm depth) rising above 0°C. This study demonstrates that C. aquatilis is able to take up nitrogen immediately after soil thaw when sources of nitrogen are still high for a short time. This has implications for plant growth phenology under changing climatic conditions, particularly as winters become warmer. For example, as soils thaw earlier in the year, nutrients may become available when high-latitude systems are still experiencing winter-time darkness, potentially resulting in a mis-match between nutrient and light availablility for these plants.

SPECIALIZATION BY A GENERALIST: WHAT DO INDIVIDUAL CHANGES IN DIET TELL US ABOUT CHANGING ARCTIC ECOSYSTEMS?

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The Canadian Arctic is currently undergoing large-scale climatic changes. A changing climate will tend to impact the bottom of the food chain first, and then make their way up the food chain to impact top carnivores through changes in diet. For generalists, the changes in diet tend to be observed as diet-switching. Yet, generalist predators are made up of individuals, and it is unclear whether diet-switching at a population level represents diet-switching by individuals and changes in the proportion of various specialists. To understand the role of specialization in diet-switching, we monitored the diet of akpa, a marine seabird, at Akpatordjuark in northern Hudson Bay, over 16 years (1993-2008). During this time period, the population switched from largely consuming Arctic fish (Arctic cod) to primarily eating temperate fish (capelin) as average sea-ice departure date advanced by three weeks. We watched what adult akpa brought to feed their chicks and we used stable isotopes to examine what adult akpa fed themselves. We measured specialization by three different indices, and in every case individual akpa were shown to be highly specialized. Specialization was higher over short time scales than long time scales and was linked to specialization in foraging behaviour (dive depth, dive shape and flight time). Specialization did not change with age or between sexes and did not influence reproductive success or survival. We found that despite the high level of specialization, the observed population-level changes were due to both the arrival of new birds that tended to specialize in capelin and diet-switching within individuals towards more capelin-oriented diets. We suggest that monitoring individual animals over time may be a more useful index of dietary changes in response to climate change than monitoring population-wide changes.

A COMPARISON OF THE EFFECTS OF MUSKOX GRAZING ON GRAZED AND UNGRAZED SEDGE MEADOWS IN THE CANADIAN HIGH ARCTIC

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Muskoxen (*Ovibos moschatus*) are one of two large herbivores in the Canadian High Arctic and their densities are highest in wet sedge meadow plant communities, which are the most productive plant communities in the High Arctic. However, muskoxen do not distribute themselves evenly amongst these sedge meadows due to historical events and geographic barriers. The purpose of this study

is to determine the effects of different grazing regimes by muskoxen on wet sedge meadows in the High Arctic by comparing grazed and ungrazed systems and conducting simulated grazing experiments.

Ungrazed sedge meadows are found at Alexandra Fiord, Ellesmere Island (78°53 N, 75°55W). Muskoxen have not grazed this site for at least the past 100 years, partially because of its small size and geographic isolation. The lack of grazing at Alexandra Fiord has led to the development of wet sedge plant communities with different characteristics than those of grazed sedge meadows.

Two wet meadow sites were chosen in the ungrazed lowland at Alexandra Fiord in 2007. In each meadow, a grid of 7 x 6 plots was established in a homogeneous area. Within the plots, 50 cm x 50 cm sub-plots were randomly selected to receive one of various clipping and litter removal treatments in order to simulate muskox grazing. Net aboveground and belowground primary production was compared amongst the various treatments by harvesting the plots after peak production in 2008. Changes in soil temperature and soil moisture levels were monitored throughout the experiment and nutrient availability was measured in the second year using ion exchange membranes. Carbon dioxide flux was also compared between one of the treatments and the control in 2008. Wet sedge communities at a heavily grazed site at Sverdrup Pass, Ellesmere Island (79°09 N, 79°38 W) were chosen to compare with the ungrazed sites at Alexandra Fiord. Sverdrup Pass is about 65 km from Alexandra Fiord and has the same general climate and geology. During peak biomass (end of July) in 2007 and 2008, all aboveground biomass was clipped from ten randomly located plots (20cm x 50cm) at two different sites at Sverdrup Pass and near the clipping grids at Alexandra Fiord. The harvests were used to determine aboveground net primary production. Soil cores were extracted from the same plots to determine belowground primary production. Soil nutrient availability was determined at each site and carbon dioxide flux was measured in the summer of 2008. Extensive knowledge exists on the effects of grazing by large mammals in temperate and sub- tropical ecosystems; however, these effects are less understood in polar ecosystems. Studying the effects of muskox grazing on High Arctic sedge meadows will increase our comprehension of nutrient cycling and productivity in arctic ecosystems. Improved understanding of these processes will aid in our understanding of the potential responses of these arctic systems to future climate change.

DIRECT MEASUREMENTS OF CO2 FLUX DURING THE ARCTICNET/CFL INTERNATIONAL POLAR YEAR CRUISES ON THE CCGS AMUNDSEN

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For 336 days between August 2007 and September 2008, a micrometeorological tower was deployed on the front deck of the *CCGS Amundsen* during the ArcticNet and Circumpolar Flaw Lead Study (CFL) International Polar Year projects. The tower utilized both open and closed path eddy covariance systems which are capable of directly measuring fluxes of CO_2, H_2O, heat and momentum. To complement the tower measurements, an on-track pCO_2 system was operated on the ship's clean water intake to provide measurements of dissolved CO_2 in the surface seawater. In this presentation, we report on this exceptional data set and present preliminary results to highlight its potential for bettering our understanding of heat and gas exchange dynamics within the Arctic marine system.

COMPOSITION AND DISTRIBUTION OF VEGETATION ALONG MICROTOPOGRAPHICALLY- AND CLIMATICALLY- INDUCED PERMAFROST GRADIENTS IN THE MACKENZIE VALLEY, NWT

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Permafrost is an important component of northern landscapes, underlying from 10 to 100 percent of the terrain in Canada's Northwest Territories. Not only does permafrost directly affect soil processes, but its indirect affect on soil hydrology and active layer depths also has a substantial influence on plant species distribution, and community composition. The relationship between vegetation and permafrost is particularly interesting in peatland environments, with plant communities both affected by changes in the permafrost conditions, and yet also able to influence the permafrost environment. The Mackenzie Valley region of Canada presents a unique

opportunity to study vegetation along a climatic gradient spanning 10ºC MAT and 227mm PPT, in a region rich in peat deposits, and predicted to be one of most sensitive areas to climate warming in Canada. With permafrost distribution controlled largely by topography and climate, this study endeavours to document current vegetation composition along a climatic gradient extending from the sporadic discontinuous permafrost zone in southern NWT to the continuous permafrost environments near the arctic tree line at Inuvik. At each of 25 sites, plots were established in areas of permafrost-affected peatlands (peat plateaux), areas of permafrost thaw (collapse scars), and adjacent forest environments occurring on mineral soils (upland forests). At the northernmost sites, collapse scar features were not present on the landscape, and so were not included in the study, resulting in a total of 69 plots distributed throughout the Mackenzie Valley. Exploratory analysis of the understorey vegetation data was conducted through the use of non-metric multidimensional scaling ordinations. Preliminary results indicate that the non-vascular vegetation is primarily structured along a gradient from upland forest to peat plateaux to collapse scars. This gradient reflects variation in local site factors, and is positively correlated with peat depth, and negatively correlated with water table depth. Vascular vegetation is also structured along this site factor gradient and, additionally, varies along a north-south climatic gradient. In the context of future climate change, these results indicate that, while vascular vegetation may be more directly influenced by a changing climate, any climate change which influences the local site factors, such as permafrost collapse, will have a dramatic impact on both the vascular and non-vascular plant communities.

LATE SUMMER ZOOPLANKTON COMMUNITY STRUCTURE, ABUNDANCE AND DISTRIBUTION IN THE HUDSON BAY SYSTEM AND THEIR RELATIONS WITH ENVIRONMENTAL CONDITIONS, 2003-2006

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Zooplankton communities were examined for the first time in three different hydrographic regions of the Hudson Bay System in early August – early September of 2003 to 2006 during the DFO-MERICA program. Sampling was conducted at fifty stations distributed along three transects located in the Hudson Bay (HB), Hudson Strait (HS) and Foxe Basin (FB). The variations in zooplankton biomass, abundance, species composition and diversity in relation to environmental variables were studied using multivariate (MDS, ANOSIM) and Canonical Correspondence Analysis (CCA) techniques. In all years, total zooplankton biomass was, on average, 4 times lower in HB (14.1 ww g $\cdot m^{-2}$) than in HS (64.2 ww g $\cdot m^{-2}$) and FB (60 ww g $\cdot m^{-2}$). Clustering samples by their relative species compositions revealed no interannual variation in zooplankton community (ANOSIM test, R = 0.10), but did reveal a markedly interregional variability between the three regions (ANOSIM test, R = 0.68). Water column stratification explained the greatest proportion (46 %) of this spatial variability in the structure of zooplankton communities. The zooplankton species that contribute most significantly to the separation of the three regions are: *Microcalanus* spp., *Oithona similis*, *Oncaea borealis*, and macrozooplankton larvae in the HB; hyperiid amphipods in the FB; and *Metridia longa*, *Calanus finmarchicus* (CI-CVI), *C. glacialis* (CI-CVI), and *C. hyperboreus* (CIV-CVI) in the HS. In the HB, the younger copepodite stades of (*Calanus glacialis* CI-CIII, *Acartia longiremis* CI-CV, *Pseudocalanus nauplii* N3-N6, Polychaeta, Echinodermata, and Chaetognatha larvaes) were mainly found on the west side of the Bay whereas the older stages (*Metridia longa* CIII-CVI, *C. glacialis* CV, *C. finmarchicus* CIV-CV) were concentrated on the east side. In the HS, Calanoid species (mainly *C. finmarchicus* & *C. glacialis*) were mainly observed in the northern stations associated with the Atlantic water inflow. Overall, both the zooplankton biomass and species diversity index were lower in the most strongly stratified environment (i.e. HB) than in the deeper and more turbulent regions (i.e. FB & HS).

THE STRUCTURE AND EVOLUTION OF THE POLAR STRATOSPHERE AND MESOSPHERE DURING IPY – RESULTS FROM SPARC-IPY

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The SPARC-IPY main objective is to document the dynamics, chemistry and microphysical processes within the polar vortices during IPY, with a focus on the stratosphere-troposphere and stratosphere-mesosphere coupling. The SPARC-IPY project is facilitating analysis of available research and operational satellite data while encouraging work on data assimilation and inter-comparison of assimilated data sets. The SPARC-IPY will deliver a well-organized data set of polar observations for the period of IPY (March 2007 to March 2009) as well as analysis products from two Canadian assimilation systems (GEM-BACH and CMAM-DAS) and major operational centers (ECMWF, Met Office, NCEP, and GMAO). All data sets are being archived at the SPARC Data Center. The analysis products will be among the best available self-consistent representations of the state of the atmosphere during this period.

One of the most active components of SPARC-IPY is the Pan-Arctic Study of the Stratospheric and Mesospheric Circulation which is a coordinated aeronomical study to extend our understanding of upper atmospheric circulation and features as well as its interaction with the lower atmosphere. The Pan-Arctic observational network consists of five Arctic Lidar Observatories for Middle Atmosphere Research. Analysis of the dynamics and chemistry associated with Stratospheric Sudden Warmings (SSWs) in the Arctic during IPY is of particular interest to SPARC-IPY. To date the data sets from the Arctic Lidar Observatories as well as satellite data, in particular data from Microwave Limb Sounder (MLS) on baord of Aura satellite, have been used to perform SSWs analysis for the IPY period. In this presentation results from the analysis of SSWs will be presented.

DIETARY PATTERNS AND CARDIOVASCULAR DISEASE RISK FACTORS IN NUNAVIK INUIT

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Objective: Most analysis of the Inuit diet have examined rates of disease in relation with individual foods or nutrients. However, the impact of dietary patterns that reflect Inuit eating behaviors on cardiovascular disease (CVD) risk factors is largely unknown. Our objective was to examine the association of major dietary patterns with CVD risk factors in Nunavik Inuit.
Methods: We used dietary information collected in 2004 from 518 male and female Inuit subjects. We identified 3 major dietary patterns: «Inuit traditional diet», «Western diet» and «Healthy diet».
Results: The Inuit traditional pattern was characterized by higher intakes of fish, marine mammal meat, organ and fat, wildfowl, wild berries, and whole grains (bannock). The Western pattern was characterized by higher intakes of red and processed meats, French fries, high-energy drinks, chips and refined grains. The Healthy pattern was characterized by higher intakes of fruits, vegetables, legumes, eggs and beans. After taking potential confounders into account, the Inuit traditional pattern was associated with lower triglycerides and n-6 plasma fatty acids levels, and with higher plasma n-3 fatty acids concentrations (all $p<0.01$). The Western pattern was associated with an altered lipid profile, higher blood pressure, plasma glucose, total n-6 and *trans* fatty acid concentrations, body fat and waist circumference, and lower HDL cholesterol and n-3 fatty acids levels (all $p<0.05$). The Healthy pattern was associated with higher body weight and fat mass (all $p<0.05$).
Conclusion: The Inuit traditional dietary pattern, which is associated with high levels of n-3 fatty acids, may beneficially affect CVD risk factors. The Healthy diet pattern is predictor of higher body weight and fat mass. On the other hand, adoption of a Western dietary pattern is associated with unfavourable CVD risk profile in Nunavik Inuit.

MEASURING ATMOSPHERIC TOTAL WATER VAPOR OVER SEA ICE USING PASSIVE MICROWAVE REMOTE SENSING

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Satellite remote sensing has opened a window of observation to the Arctic, an area plagued by data sparsity in both temporal and spatial scales. Microwave signals are unrestricted by the presence or absence of solar input, or by atmospheric obstacles such as clouds. The Advanced Microwave Scanning Radiometer – Earth Observing System (AMSR- E), launched in 2002, provides brightness temperatures at six microwave frequencies, each at vertical (V) and horizontal (H) polarizations. Atmospheric water vapor, which is detectable in microwave signatures, is a major greenhouse gas, a mode of latent heat transfer, and remains poorly resolved and modeled. In addition, satellite detection of water vapor in the Arctic atmosphere is made difficult due to the variable radiative properties of the surface below it. Fractional concentrations of open ocean, first-year and multi-year ice differ in their dielectric properties in space and time. The work presented here is an initial step in the measurement of atmospheric water vapor over the polar environment, using in-situ data collected during the Circumpolar Flaw Lead study as a means to verify the passive satellite microwave retrievals of atmospheric and surface properties. The optimum outcome would be a means to describe the seasonal characteristics of the atmosphere-snow-ice/ocean column by way of passive satellite microwave radiometry, and to quantify the linkages between the distribution and advection of atmospheric water vapor to the rate of change of surface properties in these ice regimes.

CHANGING GOVERNANCE AND THE GOVERNANCE OF CHANGE: FACILITATING ADAPTATION ACROSS MULTI-LEVEL INSTITUTIONS IN HOPEDALE, NUNATSIAVUT, LABRADOR

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Scientists and northerners agree that changing environmental conditions in the Canadian Arctic are now affecting the livelihoods and well-being of northern residents who rely on natural resources. To reduce current and future vulnerability, adaptation planning initiatives are needed. Initiatives to enhance adaptive capacity need to integrate local knowledge and be facilitated through the existing systems of governance including formal and informal institutions, organizations across multiple scales. There exists limited research on how adaptation can be mainstreamed into existing risk management and resource management systems in Canadian arctic communities.

This research centered on vulnerabilities associated with access and availability of wildlife and other natural resources based on previously identified concerns by the community. Through a multi-level, community-centered assessment of the decision making structures and processes of Hopedale, Nunatsiavut this research identifies the role of governance and local knowledge in facilitating adaptation of the community. Fifty six in-depth, semi-structured interviews were conducted with participants from the community, regional, provincial and federal government and non-governmental organizations. This was complimented with a survey, participant observations and an analysis of secondary sources.

Findings suggest that existing and historical institutions as well as new governance systems are both facilitating and hindering the capacity of individuals and households to adapt to changing conditions. This is evident through key examples at the community scale such as changes in caribou migration patterns which has led to further distances to travel for the annual harvest and fewer residents involved in the hunt. Community sharing norms, however, facilitate the supply of caribou meat for most households. Current open subsistence harvest regulations, though, have many residents concerned about overharvesting of migratory bird species, particularly in the face of a longer spring season due to earlier break up. Furthermore, although the new system of self government assures residents of preserved Inuit culture and heritage, others are unfamiliar with the changing system of governance, potentially compromising their ability to access resources such as employment. At regional and provincial scales, differences in perceptions of local knowledge integration pose potential challenges to multi-level adaptation planning. These examples reinforce the notion that climate change adaptation initiatives must be tailored to the specific local and multi-scale institutions and systems of governance.

THE INFLUENCE OF RECENT ACTIVE LAYER DISTURBANCES ON FLUVIAL SEDIMENT FLUXES IN PAIRED CANADIAN HIGH ARCTIC WATERSHEDS

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By unit volume, the Arctic Ocean is the largest ocean recipient of terrestrial sediment and freshwater. As climate warming progresses, resultant changes in runoff patterns and landscape morphology could lead to increased fluxes of sediment into the coastal environment. Here we report the results of a fluvial sediment delivery study conducted in paired High Arctic catchments, located at Cape Bounty, Melville Island, NU (74.9°N, 109.5°W). This work represents part of a research program that has been underway at the Cape Bounty Arctic Watershed Observatory (CBAWO) since 2003.

In 2007, record summer temperatures and summer rainfall resulted in formation of an unusually deep active layer and high soil moisture levels. These conditions triggered a large number of active layer detachments in both catchments at CBAWO, although the disturbances were more extensive in the West catchment. Throughout the 2008 melt season, many of these disturbances continued to expand and contributed considerable sediment to the rivers. The concentration of suspended sediments (SSC) in the two main rivers reached 2,500 mg/l during both nival melt and late season rain events. During low flow periods, SSC were also substantively higher than pervious years and showed clear influence of inputs from the disturbed sites. Comparison with previous years' SSC provides an indication of the integrated impact of the permafrost disturbance on watershed particulate fluxes and will assist with evaluating modelling efforts that estimate sediment delivery changes under predicted climate changes.

TEMPORAL VARIABILITY OF THE DEEP PARTICLE FLUX IN CENTRAL AMUNDSEN GULF (WESTERN CANADIAN ARCTIC): EVIDENCE FOR CHANGE OR CONTINUITY?

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Monitoring the downward flux of particulate matter in Arctic marine environments is of crucial importance to our understanding of climate-related changes in sediment transport and biological production. As part of the ArcticNet Marine Observatory Program, mooring lines equipped with sequential sediment traps have been maintained in Amundsen Gulf (southeastern Beaufort Sea, Inuvialuit) to collect settling particles *in situ*. In particular, the large particle interceptor trap Technicap© PPS 5/2 (24-cups, 1-m^2 aperture) deployed at ca. 430 m depth over the deepest isobath (~550 m) of Amundsen Gulf allowed us to build a 4-year time series (October 2003 to August 2007) of the deep particle export in the region. Here, we present the mass (dry weight, DW), particulate organic carbon (POC) and particulate nitrogen (PN) downward fluxes obtained at this deep location during the entire mooring deployment. Vertical fluxes of aluminum (Al), silicates (BioSi/ LithoSi), carbonates ($CaCO_3$) and stable isotopes ($\delta^{13}C$/ $\delta^{15}N$) analyzed during the 2003-2004 campaign of the Canadian Arctic Shelf Exchange Study (CASES) are also reported to estimate the amount of terrigenous matter transported to the deep water column. Changing sea ice conditions together with relevant current meter data and CTD profiles recorded in Amundsen Gulf over the study period are presented as well to put the particle flux time series in an environmental context. All these complementary results are discussed in order to document the potential relationships between surface-water regime, lateral mid-water advection, and the deep export of particulate matter (especially organic carbon).

SEASONAL USE OF SPACE BY ARCTIC-NESTING PEREGRINE FALCONS

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We deployed 11 GPS-accurate Platform Terminal Transmitters (PTTs) on male peregrine falcons trapped on territory and raising young. We present results depicting the changes in use of space as it relates to initial arrival and

territory defense, pre-laying, brooding, chick rearing and post fledging. We compare use of space of breeding males to that of one male that was initially trapped on territory, but was subsequently dispossessed of the territory by a previously resident male. Additionally, we present summary data describing the migratory patterns of male peregrines returning to their respective wintering locations.

BASELINE ECOLOGICAL MAPPING IN CANADIAN ARCTIC PARKS BY INTEGRATING REMOTE SENSING AND TOPOGRAPHIC INFORMATION

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Predictions from General Circulation Models (GCMs) suggest that climate warming will be a primary driver of vegetation change in Canada's arctic. These are predicted to include the densification and expansion of shrubs and trees and shifts in vegetation community composition. Such changes have already been documented in recent field and satellite-based studies from Alaska and Russia. Parks Canada Agency (PCA) is responsible for monitoring and maintaining the ecological integrity (EI) of 12 national parks lying within Northern Canada, which cover 238,800 km^2 (85% of area of all National Parks). EI monitoring in arctic parks poses a considerable challenge owing to their size and remote locations. Satellite-based monitoring therefore has great potential for this purpose, and if proven technically and operationally feasible, could make a large contribution to the sustainable management of Canada's northern land resources. PCA has partnered with Natural Resources Canada and the Canadian Space Agency to develop remote sensing based methodologies for monitoring and quantifying changes in the EI of Canada's Arctic National Parks. The production of a baseline vegetation map has been identified as a prerequisite for EI monitoring, and this is often derived from classification of optical satellite imagery. In many cases, however, the vegetation types deemed to be ecologically relevant by parks managers cannot be reliably separated using imagery from workhorse sensors, such as those on the Landsat and SPOT satellites. This is especially true in the case of mapping broader Ecotypes that contain distinct vegetation communities. One solution to this problem is to exploit ancillary environmental data that are able to predict the distribution of Ecotypes. We are exploring an Ecotype classification method that integrates EO-based vegetation mapping with predictive modeling based on terrain attributes derived from a Digital Elevation Model. A decision tree (See 5) is used to create classification rules for labelling Ecotype polygons, which are delineated using an image segmentation procedure. Results from the approach are demonstrated for a portion of Ivvavik National Park in the Yukon Territory.

CONNECTIONS WITH THE LAND: EXPLORING THE RELATIONSHIP BETWEEN SENSE OF PLACE, ADAPTIVE CAPACITY AND VULNERABILITY

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Current research within the CAVIAR network has focused on understanding global change at the community level and how adaptive capacity and vulnerability affect Arctic communities at a threshold of unprecedented change (Smit, Hovelsrud & Wandel, 2008). Within adaptive capacity, emphasis has been on characteristics termed 'objective capacity' (e.g. resources, political support, institutional arrangements) (Grothmann & Patt, 2005). Grothmann and Patt (2005) also identify an individual cognitive component as part of adaptation to global change risks, suggesting that cognition influences perceptions of risk and change, and the subsequent development of adaptation behaviours and strategies. The authors of this poster suggest that sense of place is an important aspect of the cognitive influence on adaptation, an area which has not yet been explicitly examined. Sense of place (SOP) is defined as a centre "of felt value" (Tuan, 1977, p.4), and comprises the emotional connections people have with landscapes (Eisenhauer, et. al., 2000). Research has shown that SOP may influence behaviours (Stedman, 2003), including participation in environmental management (Fresque & Plummer, under review). The purpose of this poster is to begin to explore the interconnections between the theoretical concepts of SOP, adaptive capacity and vulnerability in an Arctic context, and frame research which examines the influence of SOP on the development of adaptation strategies. Unique implications for the existing CAVIAR framework and case data will be identified. Inferences will be drawn from existing SOP and environmental management cases (e.g. Fresque, 2008; Fresque & Plummer, under review;

Kaltenborn, 1998), and the potential for future research highlighted.

CONTAMINANTS, HEALTH, AND EFFECTIVE RISK ASSESSMENT & COMMUNICATION IN THE CIRCUMPOLAR NORTH

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There have been certain challenges in assessing and communicating environmental health risk information with communities in the North, especially related to issues involving contaminants in traditional diet. Indeed, a better understanding of the current or possible contributions of Northern Indigenous knowledge to contaminants and traditional diet benefit-risk management processes will contribute to addressing the existing challenges (i.e. cross-cultural misconceptions) of benefit-risk management related to health and environment in Indigenous communities in the North and elsewhere. What is more, the collaboration of Indigenous approaches to risk assessment may provide a more holistic understanding of interrelated factors (social, cultural, nutritional, spiritual, economic) of environment and health risk issues, as well as reveal or emphasise the limitations of conventional assessment processes.

What are the current and possible contributions of Indigenous knowledge to benefit-risk management related to environmental health issues in Northern Indigenous communities? With a better understanding of Northern Indigenous risk perceptions related to environmental health issues, my thesis research will contribute to creating a more holistic and complete process of environmental health benefit-risk management, which may be more applicable or appropriate in Indigenous communities in the North. My research will focus specifically on the topic of the perceptions, assessment and communication of benefits and risks associated with food safety and exposure to long-range transport contaminants through traditional diet, via particular case studies in one to two circumpolar communities (Yukon and Alaska).

PERMAFROST AND PERIGLACIAL PROCESSES AT THE EASTERNMOST EDGE OF BERINGIA IN THE WESTERN CANADIAN ARCTIC − HERSCHEL ISLAND (YUKON COASTAL PLAIN)

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Herschel Island − about 70 km east of the Yukon-Alaska border − occurs as the only major elevation on the Yukon Coastal Plain facing the Southern Beaufort Sea. Being accumulated as a terminal moraine during the Early to Middle Wisconsin the island has been intensively affected by periglacial processes for at least the last 50 ka BP. Since Herschel Island most likely remained ice-free during the last glacial maximum (LGM) it became part of the vast unglaciated land mass − Beringia − and is therefore an excellent study area to reconstruct paleoenvironmental dynamics on the easternmost edge of Beringia where records since the Late Pleistocene are still sparse.

Multi-proxy analyses on sediments and stable isotope analyses on ground ice samples have been performed to unravel periglacial processes towards sedimentary history, permafrost aggradation and degradation through time as well as to link these processes to distinct periods of climate change. Sediments generally consist of clayey diamicton and sandy silts with varying amounts of pebbles, cobbles and organic remains. However, stratigraphic appraisals are difficult due to the deformed nature of Herschel Island sediments by glacial ice thrusting, subsequent cryoturbation and recent mass wasting. Nevertheless, radiocarbon dated peat suggests that until 8.4 ka BP bioproductivity was inhibited due to continuous harsh climate conditions. During the Holocene Thermal Maximum (HTM) thaw lakes developed and a rapid accumulation of peat followed on degrading polygonal ground. An extensive active layer thickening is recorded by a widespread thaw unconformity along the island's coast at depths between 1.2 to 2 m below surface. Different types of ground ice recovered range widely regarding their isotopic composition, thus reflecting different types of water and strongly variable climatic conditions during ground ice development. The oxygen isotopic signature of Holocene ice wedges varies between −20 to −24 ‰ VSMOW, which generally agrees with the supposition that

recent temperatures are supposed to produce $\delta^{18}O$ values of about −20‰ in the study area. In contrast, a relict wedge truncated at 1.5 m below surface revealed oxygen isotopic values ranging from −27 to −30 ‰. This leads to the assumption that Herschel Island comprises ice wedges that formed likely prior to the Holocene Thermal Maximum (HTM) and afterwards. The isotopic composition of intrasedimental ice recovered from sediment profiles varies between −17 to −27 ‰ and mostly decreases with depth, indicating that ground ice in different depths preserves paleo-temperatures during the aggradation of permafrost sequences.»

MERCURY IN RINGED SEALS (PHOCA HISPIDA) FROM THE WESTERN CANADIAN ARCTIC: TRENDS WITH SEA ICE

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The magnitude of change in the Arctic's climate combined with the presence of contaminants is unprecedented. While the predicted impact of sea ice reduction on ice-adapted species is unfavourable it is less known to what degree the loss of sea ice will have on contaminant exposure to Arctic biota. In the case of mercury, the Arctic Ocean appears to be in a steady state with the trace element. However, temporal trends of mercury concentrations in Arctic marine mammals seem to vary, particularly for ringed seals (*Phoca hispida*). To investigate marine mammalian mercury burdens in the context of a changing climate, we examined ringed seals taken in the subsistence harvests from Ulukhaktok, NT (formerly Holman) from 1973-2007 as well as local sea ice conditions in Eastern Amundsen Gulf during the corresponding period. We found that in ringed seal adults of both sexes (ages >7 y) and sub-adults (1-6 y) mercury concentrations in muscle best fit a curvilinear relationship with ice-free days in the year prior to sampling. Ringed seals appear to experience greater mercury burdens after both short (i.e. 2 month) and long (i.e. 5 month) ice-free seasons likely due to eating at higher trophic levels under both scenarios. In heavy ice years, greater mercury exposure may have resulted from the consumption of more highly contaminated prey such as older Arctic cod cohorts as a result of young and/or larval fishes dying from harsh environmental conditions. Conversely, light ice years may have provided ringed seals with a greater proportion of Arctic cod in their diet due to enhanced primary productivity channelling upwards through the food chain. Results suggest that the net outcome of longer ice-free periods in the Arctic, as predicted from global warming, may result in higher mercury levels in circumpolar seal populations in the future.

ASPECTS OF KNOWLEDGE ACQUISITION AND TRANSFER TO ASSESS THE VULNERABILITY AND RESILIENCE OF TWO ARCTIC COMMUNITIES TO ENVIRONMENTAL CHANGES

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Throughout Canada, Arctic communities share a close relationship with their environment. They form coupled systems of Human and Nature that are often called social-ecological systems. Projecting the future effects that stressors such as climate change, economic development, or increased extraction of resources will have on social-ecological systems is extremely difficult. Yet anticipation is important to adapt to new conditions, and the first requirement to anticipation is a good knowledge of ongoing changes. Thus, examining how a human community acquires knowledge about the environment, and how this knowledge is then transferred and used within the community is essential to any analysis of vulnerability and resilience in the North. We introduce a research project dealing with one aspect of knowledge acquisition (community-based monitoring) and one aspect of knowledge transfer (transfer of ecological knowledge among generations).

Community-based monitoring (CBM): CBM is assumed to build collective ecological understanding, to help link traditional and scientific knowledge, and to increase the likelihood that information will be transferred to and used by the broader community. Yet, the actual benefits

of CBM have seldom been investigated in the Arctic. Drawing on 12 years of knowledge acquired via the Arctic Borderlands Ecological Knowledge Co-op, we will work with the community of Aklavik, Northwest Territories, to address the following questions: what insights about ecological changes were gained through the CBM? How is the acquired information transferred to and used in the community, especially with regards to younger generations? How did CMB contribute to the integration of knowledge and the build up of a community of various stakeholders? A comparative analysis will be made with the community of Mittimatalik, Nunavut, where no formal community monitoring exists.

Knowledge transfer across generations: Poor transfer of knowledge across generations is a concern often expressed in both Aklavik and Mittimatalik, where 45% and 58% of the population is under 25, respectively. Intergenerational transfer of knowledge will be address in our project through the research process (by involving young people) and by addressing questions such as: how do young people characterize the importance of environmental knowledge for their future livelihood? How the knowledge of elders and experienced hunters influence practices of resources use adopted by young people? What sources of information and social networks influence knowledge transfer to younger generations?

ARCTIC FOX VERSUS RED FOX IN THE CANADIAN ARCTIC: IS THERE A CLEAR WINNER AFTER 37 YEARS OF MONITORING IN THE WARMING NORTHERN YUKON?

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Many projections predict shifts in the ranges of plant and animal species as a result of climate change. In the northern hemisphere, some northward shifts are already documented. However, data conclusively linking these northward shifts to changes in climate are scarce and difficult to obtain. Shifts occurring in higher trophic levels (predators) are particularly important because such changes can trickle down and impact whole ecosystems, especially in short food chains such as those often found in the Arctic. One dramatic range shift is the 20th century (and still ongoing) northward expansion of the red fox (Vulpes vulpes) into the circumpolar tundra habitats that are home to the competitively inferior arctic fox (Vulpes lagopus). In northern Fennoscandia, where the issue has been most studied, red foxes are now abundant and arctic foxes are facing local extinction. However, concurrence of diverse disturbances of human origin, such as agricultural expansion, over-grazing by reindeer, extirpation of larger predators, or unsustainable trapping, make it difficult to determine if climate change was a key factor in shifting the fox community from arctic fox-dominated to red fox-dominated. The Yukon Coastal Plain ecoregion of northern Yukon (Canada) has experienced the highest level of warming in North America during the past century (i.e., 2 to 4 degrees Celsius difference in mean annual surface temperature from 1950 to 2000), a trend which is projected to continue. The region has no permanent human settlements, and there have been no extensive anthropogenic disturbances compared with inhabited and developed Fennoscandia. We tested the hypothesis that the fox community has also progressively shifted in favour of the red fox. In 2008 we conducted aerial den surveys to determine den occupancy for both fox species. We compare our results with past survey data from 1971-1972 and 1986-1990, a comparison across 37 years. Our results indicate that red fox abundance has not increased, that arctic fox abundance has not decreased, and that there has been no contraction of the range of the arctic fox. Our results came as a surprise given the intensity of climate warming in the region. They warn us against accepting scientific hypotheses too quickly. A more detailed test of our hypothesis will now be performed as we analyse longer and spatially broader time series generated by fur returns from trappers trading with the Hudson Bay Company during the last two centuries.

MULTIDISCIPLINARY CHARACTERIZATIONS OF THE ARCTIC CHAR (SALVELINUS ALPINUS) OF PINGUALUK LAKE (NUNAVIK, CANADA): GENETICS, MORPHOLOGY, AND CONTAMINANT ANALYSES

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Pingualuk fills a deep crater in the Parc National des Pingualuit on the Ungava peninsula in northern Quebec. The lake is completely cut off from all other surface waters, presenting a rare opportunity to examine the ecology and bioaccumulation of contaminants in an isolated group of Arctic char (*S. alpinus*). Pingualuk was selected as it may serve as a reference system for several environmental parameters. In 2007 and 2008, Arctic char were collected with help of local people. Morphological measurements were obtained from each individual, tissue samples were taken for stable isotope, contaminant, and genetic analyses. Genetic analysis confirmed all fish collected from Pingualuk are *S. alpinus* that likely entered the lake from the neighboring Lac Laflamme several thousand years ago. We detected contaminants in these Arctic char, that are partly, or wholly derived from the atmosphere, i.e. mercury (Hg) and perflorinated acids (PFA), respectively. Concentrations of Hg ranged from 0.04 to 0.46 μg/g (ww) and have remained constant compared to the only previous measurement in 1983. These concentrations are comparable to levels in other arctic lakes. The total of PFAs detected in Pingualuk was 0.064 ng/g (ww) (ΣPFCAs = 0.052 ng/g, ΣPFSAs = 0.012 ng/g), and are the lowest reported in the literature. These very low concentrations are in agreement with the lack of considerable drainage into the lake and a high dilution effect due to the large volume of water contained in Pingualuk. Further, a multifaceted approach was used to examine the habitat use by char, including examination of stomach contents, carbon and nitrogen stable isotope analysis, body morphology and genetics. Stable isotope signatures indicate the presence of three distinct feeding groups among the char sampled, and along with morphological analysis suggest at least two trophic forms may be present in the lake. Cannibalism was confirmed by stable isotope analysis, and may be the explanation for the high Hg concentrations in some individuals. We present results from our multi-disciplinary study on this lake and its char population, and draw conclusions on how this lake may serve as a reference site for lakes across the Arctic.

ARCTIC CEPHALOPODS – KEYSTONE SPECIES IN A TURBULENT ENVIRONMENT

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Cephalopods are key species in the eastern Arctic marine food web, both as prey and predator. The squid, *Gonatus fabricii* in particular, can be classified as a keystone species due to its presence in the diets of Arctic fish, birds and mammals. It preys on high energy invertebrates as well on higher trophic level species (e.g. commercial finfish).

Considerable research has been conducted in the North Atlantic and the west side of Greenland where cephalopods (primarily *G. fabricii*) are often taken as bycatch. The sheer numbers caught in these areas has sparked interest in a potential fishery. By contrast, data on the biogeography and abundance of Arctic cephalopods throughout the whole region is still incomplete. This study presents the circumpolar distribution of Arctic cephalopods. It provides a baseline for monitoring the distribution of polar species and potential invasions of their southern counterparts (e.g. *Illex illecebrosus*, *Loligo forbesii*).

International and national databases, museum collections, government reports, published articles, and personal communications were used to develop distribution maps. Additional specimens from the Beaufort Sea and Hudson Strait were caught during fishery surveys in 2007-2008. Species common to the Canadian Arctic include: *G. fabricii*, *Rossia moelleri*, *R. palpebrosa* and *Bathypolypus arcticus*. *Cirroteuthis muelleri* is abundant in the waters off Alaska, Davis Strait and Baffin Bay. Although distribution data is still incomplete, groupings of cephalopods were found in some areas which may correlate with oceanographic, anthropogenic and predator/prey interactions (e.g. Pond Inlet, Nunavut (NU), Cape Vera, NU and the west side of Greenland).

Predator data was compiled to determine the importance of cephalopods in Arctic food webs. Predators include: Sperm Whales in the Norwegian Sea whose diet consisted of 96 % *G. fabricii*, 82 % of Hooded seals sampled from pack ice around Greenland had *G. fabricii* remains in their stomachs and Northern Fulmars from Cape Vera provided 100+ *G. fabricii* samples from their stomach contents.

COMMUNICATING THE SCIENCE OF EARTH'S POLAR REGIONS ONLINE AT WINDOWS TO THE UNIVERSE

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Earth's Polar Regions (www.windows.ucar.edu/polar.html), a section of the Windows to the Universe educational web site, made its debut in March 2007, at the start of International Polar Year. During the following eighteen months, nearly 1.4 million people from around the world visited the site, including several thousand people each day who are learning about, and hopefully gaining an appreciation for, the Arctic and Antarctic.

With this online resource we seek to communicate information about the science of the polar regions as well as the history of exploration and the cultures of the Arctic to students, teachers, and the general public. Earth's Polar Regions resources have a special focus on how these areas, and especially the Arctic, are changing in response to climate change and other global changes and includes brief articles about diverse aspects of the science of polar regions including the cryosphere, geography, oceans, magnetic poles, the atmosphere, and ecology. Polar science topics link to related areas of the broader Web site. For example, content about Arctic sea ice melt connects with the large section of information about climate and global change including articles about how changes in Earth's albedo impact climate, potential changes in thermohaline circulation as ice melts, and the plight of the polar bears.

Online Postcards from the Field allow contributing scientists to share their polar research with a broader audience and allow the public to gain an appreciation for field research in high latitudes. We continue to build content to complement and expand the existing resources. A new section about the poles of other planets is in development.

A collection of classroom activities which allow students to explore aspects of the polar regions is available on the site for K-12 educators. An image gallery of photographs from the polar regions and links to IPY and related educational programs provide additional resources for educators. We have been disseminating information about the Earth's Polar Regions web resources to educators via National Science Teacher Association workshops, the Windows to the Universe educator newsletter, various education Listservs, and Climate Discovery courses for educators offered through NCAR Online Education.

Windows to the Universe (www.windows.ucar.edu), a long-standing and widely-used Web resource (with over 20 million visits in the past 12 months), provides extensive information about the Earth and space sciences at three levels - beginner, intermediate, and advanced – to serve the needs of upper elementary through lower undergraduate students as well as the general public. These resources are available in both English and Spanish languages. Funding for polar content development is provided by the National Center for Atmospheric Research, the US National Science Foundation, and NASA.

MODERN AND LATE-HOLOCENE CARBON DYNAMICS IN A PERMAFROST PEATLAND NEAR KUUJJUARAPIK, HUDSON BAY, SUBARCTIC QUÉBEC

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In Canada, peatlands cover more than 1 million km^2 and most of them are located in the boreal and subarctic regions. Important greenhouse gas exchanges take place in these ecosystems as they store 1/3 of the world soil carbon. Overall, carbon dioxide (CO_2) is absorbed by the surface vegetation through photosynthesis and methane (CH_4) is released through decomposition of organic matter under depleted oxygen conditions. In permafrosted peatlands, CO_2 and CH_4 exchanges are of smaller magnitude compared to boreal peatlands because the colder peat temperatures slow the bacteria activity. Therefore, peat accumulation-CO_2 absorption and CH_4 release are less important than in non-permafrosted environments. Recent climate scenarios predict that sub-arctic regions of Canada will face an important increase in mean annual temperature over the next century. In the Kuujjuarapik region, the expected warming rates range from 0.03 to 0.01°C/year. On the eastern side of James Bay some frozen peatlands have already lost 25% over their permafrost coverage over the last 50 years (Vallée and Payette, 2007). Carbon (C) dynamics of these peatlands in the subarctic area will be greatly affected

by the melting of this permafrost, as the created surface water table will affect the decomposition of the unfrozen organic components. In order to study the impacts of melting of the permafrost peatland on C dynamics, surface greenhouse gas exchanges were measured using static chambers (CO_2 and CH_4) and an Eddy covariance tower (CO_2) in a degradating palsa field located 8 km south of Kuujjuarapik (55°13'36"N, 77°41'18"W). Peat/ice cores were collected to study Late-Holocene C dynamics using C/N ratios and ^{14}C dating. Multi proxy data (isotopic O^{18} of cellulose, macrofossils and Testate Amoebae) will be used to reconstruct past temperatures and related water table depth variations. This study will provide a better understanding of the present and past C dynamics of peatlands in order to predict the effect of climate change and rising temperature on future C dynamics from subarctic region.

COULD THE IMMENSE AGGREGATION OF ARCTIC COD (BOREOGADUS SAIDA) FOUND IN FRANKLIN BAY EXTEND TO THE AMUNDSEN GULF?

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During the CASES program (2003-2004), the continuously operating EK-60 echosounder of the CCGS Amundsen revealed the progressive building up over the winter months of an immense aggregation of Arctic cod in the deeper half of the water column of Franklin Bay (140-235 m). Gill netting and underwater photography confirmed that the aggregation was nearly monospecific. Preliminary visualisation of the hydro-acoustic data recorded by the same instrument during the Circumpolar Flaw Lead System Study (CFL, 2007-2008) shows significant winter aggregations of fish in some distinctive areas of the Amundsen Gulf, mainly south of Banks Island in the 300-400 m depth zone. The comparison of target strength (TS) between the CASES and CFL records should enable us to verify that these new aggregations consist of Arctic cod as well. As in Franklin Bay, the preliminary CFL results suggest that the species tends to aggregate over the continental slope in winter, mostly in lower Pacific Halocline water (140-400m). Biomass distribution from different locations and depths along the track of the ship will be projected in the temperature-salinity field to test this hypothesis. Understanding Arctic cod migrations and distribution in the Canadian Arctic Ocean is needed to anticipate the response of this key species to climate change and sea ice cover reduction.

USING LOCAL AND TRADITIONAL ECOLOGICAL KNOWLEDGE TO COMPARE INUIT PERCEPTION OF CLIMATE CHANGE IMPACTS ON PLANTS, ANIMALS AND ENVIRONMENTAL FACTORS BETWEEN COMMUNITIES OF NUNAVIK AND NUNAVUT

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Northern communities are the most susceptible to experience impacts of climate change. This project is looking at Inuit perception of changes that have occurred over the last decades concerning plants, animals and environmental factors. Regarding plant information, we focused on shrubs and berry bearing plants, especially commonly used berries (*Vaccinium vitis-idaea, Empetrum nigrum*, *Vaccinium uliginosum*, *Rubus chamaemorus)*. We interviewed Elders from two communities in Nunavik, Kangirsualujjuaq and Kangirsujuaq, and two communities in Nunavut, Pond Inlet and Pangnirtung. Semi-structured interviews were held with an interpreter and the interviews were recorded and filmed with consent of Elders. Interviews were later transcribed and Elders' observations have been organized under general topics such as observed changes and description of evidences or impacts, for each interviewee. Perceptions are compared within and among communities. Inuit Elders have already noticed some changes related to environmental factors, but also related to plants and animals. Some changes have been affecting their way of life, such as traveling, predicting temperature, clothing and timing of hunting and fishing activities. The changes observed by Inuit people can vary between communities at different latitudes.

THE SEA ICE COMPONENT OF THE NEW ARCTIC CRYOSPHERE CLIMATE PROJECT «SWIPA»

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The main objective of the new Climate Change and Cryosphere assessment project SWIPA (Snow, Water, Ice, and Permafrost in the Arctic) is to provide the society and the Arctic Council with timely, up-to-date, and synthesized scientific knowledge about present status, processes, trends, and future consequences of changes in Arctic sea ice, melting of the Greenland ice sheet and changes in Arctic snow cover, permafrost, mountain glaciers and ice caps, and related hydrological conditions in the Arctic. In April 2008, SWIPA was adapted by the Arctic Council, and the work in the SWIPA sea ice component started in August 2008. The main aim of the project will be to produce an updated report on the status of the Arctic Cryosphere by 2011. One third of SWIPA is devoted to Arctic sea ice, and this component is lead by Norway through the Norwegian Polar Institute. Over the past decades, Arctic sea ice has changed: Ice extent has been decreased for all seasons, ice thickness has been reduced, and recently there was observations of less multi-year ice versus first-year ice. At the same time the leading climate models as summarised in the fourth assessment of the Intergovernmental Panel for Climate Change (IPCC) from 2007 deviate from direct observations, when modelling sea ice extent in the Arctic. In the report of the Arctic Climate Impact Assessment (ACIA) from 2005 it was stated that there are gaps of understanding and knowledge about climate processes and feedbacks. In the sea ice component of SWIPA, the following topics are dealt with: *Sea ice extent*, *sea ice thickness*, *biology related impacts* and *socio-economic impacts*. The results from latest *model predictions* will also be synthesized. Each of these topics will be lead by a pair of key experts who will gather a number of contributing authors from the research community. The SWIPA component on sea ice anticipates to include the newest results that came out after the last IPCC and ACIA assessments, especially those related to in the still ongoing International Polar Year (IPY). Ongoing IPY projects represent a considerable basis for accelerated progress in understanding and we *urge the sea ice research community to actively take part in the preparation of this status report*, especially in regards to incorporating the newest findings from the past few years of intensive research in the Arctic.

FORAMINIFERAL PROXIES FOR LATE HOLOCENE PALEO-SEA ICE AND PALEOCEANOGRAPHIC CONDITIONS IN THE AMUNDSEN GULF AND VISCOUNT MELVILLE SOUND

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Sea ice extent and its response to warming throughout the Arctic varies spatially, requiring regional, high resolution investigations to determine paleo-sea ice patterns paleoceanographic conditions. Changes in the abundance and composition of foraminiferal assemblages within the Amundsen Gulf and Viscount Melville Sound allow some reconstruction of the dynamics of paleo-sea ice cover within the Western Canadian Arctic Archipelago and Northwest Passage during the late Holocene. The Canadian Arctic Shelf Exchange Study (CASES) and ArcticNet have collected sediment cores and surface samples from 2002 to 2006 in the Beaufort Sea, Amundsen Gulf and the interstitial waters of the Canadian Arctic Archipelago. In the summer of 2004, five boxcores were collected along a transect through the Amundsen Gulf. These cores range from 15 to 35 cm in length, and were collected from depths of 172 to 569 m. Two of the cores are correlated chronostratigraphically with radiocarbon AMS ages. The foraminiferal assemblages demonstrate increased amounts of sea ice from approximately 1000 to 1400 cal years BP, decreasing to seasonally open waters by approximately 300 cal years BP, assuming constant sedimentation rates. One core was collected from the Viscount Melville Sound. It revealed a different foraminiferal assemblage than the cores from the Amundsen Gulf, indicating different water masses were passing through the North West Passage. These paleoceanographic records may also provide insights on the spatial and temporal variability of the Cape Bathurst Polynya, and how this region will respond to continued changes in climate.

COMMUNITY PLANNING ON PERMAFROST IN SALLUIT, NUNAVIK

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The present study is part of the ArcticNet IRIS4 project as well as of Ouranos' northern program.

Salluit, as all other Arctic communities, faces a strong demographic expansion, with related housing needs. The immediate need for new housing is about 150% of the current capability. The topography and permafrost conditions make the situation more complex as the community is located in a valley bounded by steep rock walls and floored by ice rich, fine-grained, permafrost. The present state of the community is already very vulnerable to recent observed climate changes, as some ground settlement and small active layer slides occurred in the valley. These geomorphologic processes are expected to intensify with future climate changes, creating a challenge for land management and the selection of adequate adaptative measures.

The present interdisciplinary study focuses on finding applied solutions reducing the community's vulnerability to present and future risks as well as how to best adapt.
In order to best identify the local impacts, the degree of vulnerability and the capacities for adaptation, geoscientific and climatic data are used and community perspectives are integrated.

Regular meetings with the local decision makers help to identify specific needs that have to be addressed. Optimisation of urban space and assessment of prospective areas are developed in order to best accommodate community needs in terms of housing and municipal infrastructures.

A detailed survey of existing infrastructures and foundations was made and lead to a compilation into a geodatabase which is being overlayed onto maps of actual and projected permafrost conditions.

In this context, one specific experiment on how pads settle and interact with permafrost is done in Salluit. Thermistors and settlement plates are installed on a lot showing a perturbed thermal profile (due to former constructions) in order to measure future movements of the ground and the pad, as well as to measure the recovery of permafrost into the newly installed pad. Knowledge from this experience will show to what extent perturbed space in the community could be recycled into future housing lots.

An economic analysis of the possible choices of solutions will complete this study as cost-benefit analysis will be used to draw recommendations for local land use planning.

THE SCHOOLS ON BOARD TRADITIONAL KNOWLEDGE COLLECTION KIT

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The Schools on Board program is a major outreach program of the Circumpolar Flaw Lead (CFL) study - a $40M Canadian-led international research project that examines the physical-biological coupling within the flaw lead system near Banks Island in the Western Canadian High Arctic.

In celebration of the International Polar Year, Schools on Board hosted 2 International Field Programs, and 1 circumpolar Inuit field program (CIFP). The CIFP was truly a unique field program in the sense that it involved circumpolar Inuit students from the Canadian Inuit Regions, Alaska, Greenland, and Russia. This field program was also a great platform to introduce more Traditional Knowledge research into the Schools on Board field program.
We achieved this goal by sending pre-trip Traditional Knowledge collection kits to each of our participating students.

The kits included everything needed to begin a Traditional Knowledge research project within their home community. Once onboard the field program students had the opportunity to share their research with each other, local elders, and scientists onboard the CCGS Amundsen, Canada's premier research icebreaker.

The program addressed the CFL's *Two Ways of Knowing* philosophy by combining both Traditional Knowledge and western science research field projects in one unique field program. By introducing the Traditional Knowledge Collection Kit Project, this field program also served as a gateway to inspiring the next generation of Arctic researchers; Inuit youth working as both science and social science researchers in their own backyard.

EVOLUTION OF THE THERMAL REGIME OF PERMAFROST IN GASPÉSIE, SOUTHERN QUEBEC, CANADA OVER THE LAST 30 YEARS

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The Parc National de la Gaspésie at the northern extremity of the Appalachian Mountain Range in southern Québec exhibits multiple contemporary periglacial phenomena associated with both contemporary and relic permafrost. Its relative accessibility allowed a long term study of the thermal regime of a 50 -60 m thick permafrost body beneath the 1270 m high summit of Mont Jacques Cartier Data from a 30 m long string of thermistors, installed in 1977 ina drill-hole in bedrock, beneath a 3 m thick layer of felsenmeers (Gray and Brown, 1979, 1982) has been since obtained on an almost annual basis. In 2007 a data-logger was connected to 7 of these thermistors, in an effort to provide detailed diurnal and seasonal geothermal data. Monitoring of the thermal regime of this permafrost body offers an excellent opportunity to detect the presence and propagation of warming, or cooling trends from the surface downwards towards the base of the permafrost, and to predict its long-term evolution.

Gray and Brown (1979) evaluated the depth of the active layer to be around 5.7 m in 1977,with a permafrost thickness of 45 -60 m, based on extrapolation from the thermal gradient. Our preliminary analysis indicates that the active layer is now deeper and that the temperature of the permafrost has shown a general increase in temperature of 0.5°C down to a depth of 23 m. However at a depth of 26 m no change is as yet detectable. It appears from a preliminary analysis of the data between depths of 14 and 23 m, that both cooling and warming trends on a decennial or five year wavelength can be observed. An analysis of the historical regional air temperature recorded by Environment Canada and local air temperature measured by the staff of the Gaspésie National Park will be used to explore the thermal response of the permafrost in the last decades. However, since the permafrost responds not only to air temperature changes, but very much to changes in snow cover, it is essential that future monitoring of the geothermal regime be augmented by surface climatic and snow cover data. Such installations are being planned in the context of this study.

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Gray, J.T. et Brown, R.J.E. (1982). «The influence of terrain factors on the distribution of permafrost bodies in the Chic-Choc Mountains, Gaspésie, Québec.». *Proceedings, Fourth Canadian Permafrost Conference*, Calgary, Alberta 1981, pp. 23-25.

THE CANADIAN IPY PUBLICATIONS DATABASE

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The Canadian IPY Publications Database (CIPYPD) describes publications from IPY 2007-2008 and the three previous IPYs. The database includes publications from or about Canadian IPY projects, as well as publications from or about foreign IPY projects that have studied northern Canada or the adjacent waters. The records in the CIPYPD contain citations, abstracts, detailed subject and geographic indexing terms, and DOI or URL links to online publications. The database is available from a bilingual website at www.aina.ucalgary.ca/ipy, and currently describes 700 publications. All records in the CIPYPD are also included in the national Arctic Science and Technology Information System (ASTIS) database, relevant ASTIS subset databases, the international IPY Publications Database and the international Arctic & Antarctic Regions database. The CIPYPD is part of the IPY Data and Information Service and plays a key role in identifying, disseminating and preserving Canada's achievements during IPY 2007-2008. The CIPYPD was made possible by the generous support of the Government of Canada Program for International Polar Year and EnCana Corporation.

THE EARLY BEAR GETS THE GOOSE: CLIMATE CHANGE, POLAR BEARS AND LESSER SNOW GEESE

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As climate change advances the date of spring breakup in Hudson Bay, polar bears are coming ashore earlier. Since they will have lost some of their opportunities to hunt ringed seals from a sea ice platform, they may be deficient in energy. Subadult polar bears appear to come ashore before more mature individuals and the earliest subadults are beginning to overlap the nesting period of the large colony of snow geese also occupying the Cape Churchill Peninsula. The eggs these bears are known to eat would make up some of their energy shortfall. The earlier these eggs are consumed during the snow goose nesting period, the greater would be the energy that is available. Recent studies have shown that the annual survival rate for subadult bears is less than that of prime aged individuals. If this reduction in survival is related to an increasing energy deficit, as suggested by some, the consumption of goose eggs may reverse the trend and help stabilize the population, at least for some period of time. The total number of polar bears that could benefit from this resource will depend on increasing temporal overlap with the nesting period and on the foraging behaviors of individuals eating the eggs. It is likely that other food sources will also have to play a role if the polar bears are to persist.

PASSING THE TORCH - ENGAGING AND INSPIRING YOUTH THROUGH EXPERIENTIAL LEARNING AT THE POLES

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Through the award-winning 'Students on Ice' (SOI) program, more than one thousand students, scientists and educators have gained a new understanding and respect for the planet. 'Students on Ice' provides the extraordinary opportunity for today's youth (and tomorrow's leaders) to better understand the Poles, the Planet, the implications of environmental issues, and teaches them how to get involved and active in local, national and global solutions. These unique, educational ship-based expeditions give youth the rare opportunity to mentor with world-class scientists, researchers, experts, teachers, artists and young leaders. The program encourages youth and young adults to pursue careers in polar research, applied sciences, environmental studies and more. In his role as Students on Ice founder & executive director, and as a member of Canada's National Committee for the IPY, Geoff passionately addresses the environmental issues facing the Pole Regions today – and by extension, the interconnectedness of the entire global ecosystem. Having led more than 100 expeditions to both the Polar Regions over the past 20 years, Geoff's presentation will take the audience on an inspiring journey from one end of the Earth to the other. He will also address some of the upcoming SOI expeditions which include a pioneering Antarctic University Expedition, another important contribution to the IPY legacy of engaging youth and young adults in understanding the importance and urgency of protecting the Poles and the Planet. The Students on Ice – IPY Arctic & Antarctic Expeditions 2007-2009 are the most comprehensive educational expeditions for youth of their kind. They serve as powerful and unique international platforms to create change, inspire, educate, give cause for hope, and raise awareness globally. The IPY expeditions to date have involved over 130 international students, aged 14-19, including 35 northern aboriginal youth from the Yukon to Nunatsiavut. The students traveled on these transformative adventures together with a team of 30 scientists, environmentalists, artists and polar educators. Geoff will talk about his most recent experiences as expedition leader of the ship-based journeys and the unique and powerful experiences lived by the youth and educators who have participated in the Student on Ice International Polar Year expeditions to the Arctic and Antarctic thus far. Students on Ice (www.studentsonice.com) is empowering youth through experiential learning and fostering opportunities for them to live their creativity and inspire change in their lives, their communities, and the Planet. Geoff's presentation will speak about the success of Students on Ice and share stories of youth that have returned home as ambassadors and leaders for our planet's environment, with new levels of inspiration and motivation for the future. There has never been a more important time for the world to have active and motivated youth who can help change the way societies manage themselves for a more sustainable future.

SEASONAL VARIATION IN NET CARBON EXCHANGE IN THREE HIGH ARCTIC VEGETATION COMMUNITIES

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An important factor in present and future carbon cycling in the arctic is soil moisture and, in turn, vegetation distribution and phenology over the brief snow free growing season. The high arctic tundra environment of Melville Island, Nunavut, currently consists of three main vegetation community types: wet sedge meadow, mesic heath, and polar desert, distinguished by moisture regime, biomass, and species diversity. Beginning shortly after

snow-melt (late June) through until the peak of the growing season (early August), weekly to biweekly carbon dioxide flux readings were recorded at 2-3 collar locations within twelve plots. The plots were chosen to represent four examples of each community type, and further characterized by concurrent sampling of soil and vegetation variables (soil temperature, moisture, active layer depth, nutrient status, and vegetation percent cover and biomass). This poster will highlight the preliminary results of this exploration of spatial and temporal variation in carbon dioxide exchange during a high arctic summer.

FORAMINIFERA AS PROXIES FOR PHYSICO/ CHEMICAL CONDITIONS IN HUDSON BAY AND STRAIT

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In 2005, box cores were collected at strategic locations within the Hudson Bay and Strait to gain a coupled set of geochemical and geophysical data of the region. These data are compared to determine the common trends. This particular study uses $10cm^3$ samples at 1cm intervals from four of these box cores (BC10 – central, BC12 – NW, BC8 – SE , BC15) to examine the benthic foraminifera which can then be compared to the physical data. Here we have the advantage of having a full set of physio-chemical data as well as ^{210}Pb-dating with the core sections, which provides the recent chronology (last 200yrs). BC12 has the highest sedimentation rate at 15cm/100yrs, whereas BC10 and BC15 are only accumulating at 6-10cm/ 100yrs. These data along with the chemical data are crucial in interpreting the effect of changing dissolved organic content (DOC) on benthonic foraminiferal abundances. The calcareous species in BC10 (*Islandiella teretis*, *Fursenkoina fusiformis* and *Cassidulina reniforme*) show a prominent increase in abundance downcore, signifying a decrease in calcareous foraminiferal abundance in the recent past. This trend is also present in BC12. The presence and abundance of tintinnids (ciliates used as freshwater and SPM indicators) were observed in both BC10 and BC12. These organisms, calibrated with the physio/chemical data in this study, can provide proxies for the chemical parameters in cores where there are no chemical measurements and also provide evidence for the distal extent of the freshwater plume that extends into Hudson Bay from the numerous surrounding rivers. Foraminiferal percentages and other microfossils identified in this study can also be used to extend the record past the chemical measurements, providing for a more dynamic look at the more distant past conditions of the Hudson Bay and Strait as well as ecological impacts from nearby rivers and anthropogenic sources.

OCEAN SURFACE ROUGHNESS IN MODERATING OCEAN-SEA ICE-ATMOSPHERE PROCESSES WITHIN THE MARGINAL ICE ZONE

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Ocean surface roughness plays a very important role in moderating the ocean-sea ice-atmosphere processes especially in the Marginal Ice Zone (MIZ). The ocean surface winds and the sea ice concentration alter the ocean surface roughness under varying conditions such as sea surface temperature, ocean surface waves etc. We have acquired the ocean roughness data over a period of beginning of formation of sea ice in the autumn to the melting of sea ice in the summer and over the open waters in the Southern Beaufort Sea including Amundsen Gulf of the Arctic Ocean. This study demonstrates the role of atmospheric turbulence in moderating ocean processes. The horizontal and vertical transport of gas and mass fluxes is drastically changed in the MIZ with changing ice roughness characteristics.

Sea ice dynamics processes, for example, turbulent ocean waves, circulation, wind storms etc. are responsible for affecting the ice roughness conditions. The ocean circulation and atmospheric turbulence add to the roughness conditions in the MIZ. An understanding of ocean surface roughness provides better knowledge of heat fluxes transfer across the ocean-sea ice-atmosphere interface. An effort has been put into understanding these processes using ship-borne and satellite remote sensing data in the Arctic Ocean surrounding Banks Island in North Canada. The study is based on the data acquired in the CFL (Circumpolar Flaw Lead) System Study Project.

Key words: Ocean surface roughness, remote sensing, arctic sea ice, marginal ice zone, ocean-sea ice-atmosphere interface

SEDIMENTARY ANALYSES FROM PINGUALUIT CRATER LAKE (NUNAVIK, CANADA): A UNIQUE LONG-TERM PALEOCLIMATIC RECORD IN THE TERRESTRIAL CANADIAN ARCTIC

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The Pingualuit crater lake (Nunavik, Canada) resulted from a meteoritic impact that occurred ca. 1.4 million years ago. Due to its unique morphometry (depth and shape) and its location at the center successive North American glaciations, the lake bottom likely escaped glacial erosion. The sedimentary infill thus constitutes a unique long-term terrestrial record of environmental and climatic conditions in the Canadian Arctic. Based on a punctual seismic profile obtained by a Knudson echosounder and using both gravity and piston corers, we recovered the uppermost 8.5 m of sediments. High-resolution physical (CAT-Scan, multi sensor core logger, diffuse spectral reflectance), geochemical (ITRAX core scanner, CNS, ^{13}C of the organic matter) and magnetic (magnetic susceptibility; natural, anhysteretic, isothermal and saturation isothermal remanent magnetizations) analyses were performed. Two main lithofacies were clearly identified by the different measurements and likely represent successive interglacial/glacial cycles. Most of the sediment consists of light grey silts containing several angular rock fragments, and characterized by a very low organic carbon content (<0.5%), high density and magnetic susceptibility values, suggesting a deposition during glacial conditions. On the other hand, at least two organic rich (up to 7% of organic carbon) finely laminated horizons, older than the Holocene, are characterized by lower density and magnetic susceptibility values and likely represent earlier ice free periods. Thermoluminescence dating and paleomagnetic investigations are still ongoing for the older layers, but are very promising as a first estimation in the uppermost laminated interval suggests an age in excess of 100 ka. Finally, ongoing micro-sedimentological analyses of smear slides will also be used to define the depositional environments of each laminated interval.

HIGH-RESOLUTION PALEOENVIRONMENTAL RECONSTRUCTION SINCE THE LAST OUTBURST FLOOD OF LAKE AGASSIZ IN HUDSON BAY AND STRAIT

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During the last two decades much effort has been put in the reconstruction of paleoenvironmental conditions of Hudson Bay and Strait as well as adjacent areas. However, those investigations mainly focused on seismic or geomorphologic studies distinguishing large scale variations of environmental change like glacial and interglacial conditions. Alternatively, continuous or high resolution studies focused on the last outburst flood of Lake Agassiz around 8.5 ka. Nevertheless, sediments of the Hudson Bay complex consisting of Foxe Bay, Hudson Bay and Hudson Strait hold the complete history of that area, i.e., the final stages of the Laurentide Ice Shield and the remaining Holocene.In combination with several radiocarbon dates, we present continuous and high resolution sedimentary records from the east coast of Hudson Bay, the central Hudson Bay area and Western Hudson Strait, enabling a deeper insight into the development of postglacial paleoenvironmental changes. Up to 4 m long sedimentary cores were collected as part of the ArcticNet program during the AMD0509 (CCGS Amundsen) expedition aiming for regions with high Holocene sedimentation rates. Sites were carefully selected using a 3.5 kHz subbottom profiler and multibeam sonar to avoid areas affected by mass wasting deposits or iceberg scouring.While the central area of Hudson Bay is generally characterised by stable depositional conditions after the outburst flood (i.e., no variations in grain sizes or color), Eastern Hudson Bay and Hudson Strait show a more diverse pattern. However, the general trend in those cores is a tendency towards increased terrestrial input with time. The highest sedimentation rates were observed in the center of the Hudson Bay complex (1.03-1.60 mm a^{-1} / mean: 1.13 mm a^{-1}), i.e., the westernmost tip of Hudson Strait between Mansel Island and Nottingham Island. In this area the highest total (in-)organic carbon and total nitrogen contents were also observed. Similar sedimentation rates, although

slightly lower, were recorded in Nastapoka Sound (0.58-1.21 mm a^{-1} / mean: 0.86 mm a^{-1}), southeastern Hudson Bay. As expected due to its distal position, sedimentation rates are lowest in the center of Hudson Bay (0.17 mm a^{-1}). Even if age-control 20 km off the mouth of la Grande Rivière de la Baleine is less constrained, the general trend towards more minerogenic terrestrial input is also evident there. This is inferred from an increase in magnetic susceptibility, density and grain sizes as well as from CN analyses, suggesting a grater fluvial influence either due to a general increase in discharge, more extreme events due to the lack of water storage in the glacier or a closer proximity of the coast to the coring location due to isostatic rebound since the final flood of Lake Agassiz.

IMPROVING PERMAFROST DISTRIBUTION MAP BY SUPERIMPOSING SURFACE MATERIAL MAPS

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Climate change scenarios predict that global warming will be greatest over high latitudes and that permafrost areas will be among the regions most heavily affected. Data obtained from spacecrafts offer a significant advantage for studies conducted in Arctic and sub-Arctic areas where measurement stations are geographically scattered. The land surface (skin) daily global temperature 1-km (LST) products of the MODerate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra and Aqua satellite platforms were used as a mean to approach limits of permafrost zones. A model simulating the temperature time evolution has been driven to generate maps and compensate for the large number of cloudy days (more than 50% of cloudy days in every year) in Arctic regions. Hence, calculations of mean monthly and annual surface temperatures, thawing index (Ti), freezing index (Fi) for each pixel lead to the production of regional maps at a small cartographic scale, through northern Canada and Alaska.

The maps follow a logical (expected) geographical distribution of surface temperatures with isotherms corresponding to known climatic, permafrost and biogeographical boundaries or transitions. Nevertheless, if the most important parameter, surface temperature that controls the ground thermal regime in permafrost is accessible via this model, it needs to be improved. The surface temperature retrieved is the "skin" temperature, in other words it is the envelope temperature above vegetation and water bodies in summer and at the surface of snow cover in winter rather than true soil surface temperature at the atmosphere/soil interface over permafrost terrain. New investigations involving the physical characteristics of surface materials (vegetation, snow, organic layers of soils, moisture content) are in process.

Some sites in northern Canada are chosen for their variety in degrees of landscape heterogeneity (*e.g.* barren, dry/moist/wet/ tundra, open forest near tree line). This will allow us to determine how snow, vegetation, and moisture conditions can change the strength of the relationship between the satellite-based measurement (1 km^2 pixel) and that recorded in the field. The project is to improve the permafrost map drawn previously by adding surface material maps – MODIS snow product, SSMI snow water equivalent product, land cover map and surficial geological map – as layers to a GIS software.

DECLINING SEASONAL ICE COVER ON THE HUDSON BAY MARINE ECOSYSTEM: STRATEGIC RESEARCH TO BETTER ANTICIPATE AND ADPAPT TO A RAPIDLY TRANSFORMING MARINE ECOSYSTEM

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Hudson Bay is the largest seasonally ice-covered inland sea in the world. This ice cover is a fundamental and defining feature of the hydrological cycle in the region. Its existence is a reflection of, and a major influence on, regional climate and it has a profound influence on the physical, chemical and biological oceanography of the Hudson Bay marine ecosystem. The release of brine and freshwater during the freeze-thaw cycle as a result of less ice cover and the diversion and shifting of river runoff from spring and summer to winter months as a result of hydroelectric developments are major changes occuring in the hydrologic cycle. In western and southern Hudson Bay the duration of ice cover has been declining during the last three decades at rates approaching one-day per year. It is likely that these trends will continue and perhaps accelerate. The loss of winter ice cover would have large and cascading consequences for the Hudson Bay marine ecosystem. Changes in freshwater inputs, storage, transport and export would occur and be reflected in the timing and strength of the freshwater pulse along the Quebec coastline, with

uncertain consequences for biological productivity and ocean circulation in the Labrador Sea and the North Atlantic. Within the Hudson Bay system the loss of ice cover would have a major influence on biologically critaical parameters such as light penetration, and the mixing and fluxes of nutrients, heat, salt and frshwater. It seems certain that the overall biological productivity would increase - probably substantially. Will the Hudson Bay system be a net source or sink for carbon dioxide? At the same time it is clear that the ice-dependent food web - from ice algae to ringed seals and polar bears would be negatively impacted. The harvest of ice-dependent species would be compromised, but what are the new opportunities and would they compensate for the loss of existing resources? A major challenge is to develop a future-oriented research strategy that encompasses large scale changes in the Hudson Bay marine ecosystem as well as local-scale changes that are of direct interest and concern to coastal comunities. Designing such a research strategy will require sensitivity to policy questions as well as an appreciation of opportunites for coastal communities to adapt and benefit from changes that are likely to occur in marine and coastal ecosystems. The aboriginal hunters, trappers and other observers have, of necessity, been astute observers of conditions in the marine and coastal regions of the system and their observations and the questions that they raise can play an important role in identifying key research questions. Future scenarios, buttressed and validated by future-oriented research and monitoring activities, can provide a clearer vision of the future and hence enable governments, as well as local communities, hunters and entrepreneurs to plan for a future that is unlikely to be a mere extension of the past.

CH4 AND CO2 FLUX MEASUREMENTS USING THE EDDY COVARIANCE TECHNIQUE FOR A EUTROPHIC SUBARCTIC FEN AT CHURCHILL, MANITOBA

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A novel ecosystem-scale methane (CH4) and carbon dioxide (CO2) emission measurement system is being applied to a eutrophic subarctic fen located at Churchill, Manitoba (58°45'N 94°4'W) within the Hudson Bay Lowlands. Reliable determinations of net carbon and greenhouse gas emissions for northern ecosystems is of great value to determine the impact of soil warming and altered precipitation on emissions. Previous emission determinations at this site using static chambers indicated CH4 to contribute as much as 30% of net ecosystem greenhouse emissions (as CO2 equivalents). Also static chambers used to estimate CH4 emissions from the three dominant landscape elements at this fen site (hummocks, sedge-lawns, and pools) resulted in great variation between elements. Obtaining representative ecosystem-scale emissions using static chambers was thus problematic. Chamber systems have many advantages in greenhouse gas studies but ecosystem-scale estimation of emissions is more suited to micrometeorological techniques such as eddy covariance (EC). The measurement system described here uses the EC technique to estimate ecosystem emissions from high frequency (10 Hz) atmosphere gas concentration and wind velocity determinations. The measurement system consists of a closed-path Fast Methane Analyzer (Los Gatos Research Inc.) along with an open-path LI-7500 analyzer (Li-Cor Biosciences) for CH4 and CO2 concentration determination, respectively. A 3-D sonic anemometer (CSAT3, Campbell Scientific) provides wind velocities. The system is operated remotely without access to power from an electrical grid incorporating wind, solar, and gas generator power production and power storage in a high-capacity deep-cycle battery bank. The design, instruments, power requirements, and performance of the system will be detailed in this presentation.

CONTEMPORARY AND PRE-INDUSTRIAL MASS BUDGETS OF MERCURY IN THE HUDSON BAY MARINE SYSTEM: THE ROLE OF SEDIMENT RECYCLING

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Based on extensive sampling of the rivers, troposphere, seawater and sediments, mercury (Hg) mass

budgets are constructed for both contemporary and pre-industrial times in the Hudson Bay Marine System (HBS) to probe sources and pathways of Hg and their responses to the projected climate change. The contemporary total Hg inventory in the HBS is estimated to be 98 t, about 1% of which is present in the biotic systems and the remainder in the abiotic systems. The total contemporary Hg influx and outflux, around 6.3 t/yr each, represent a 2-fold increase from the pre-industrial fluxes. The most notable changes are in the atmospheric flux, which has gone from a nearly neutral (0.1 t/yr) to source term (1.5 t/yr), increased river inputs (which may also reflect increased atmospheric deposition to the HBS watershed) and in the sedimentary burial flux which has increased by 2.4 t/yr over pre-industrial values, implying that much of the modern Hg loading entering this system is buried in the sediments. The capacity to drive increased Hg loading from the atmosphere to sediment burial may be supported by the resuspension of an extraordinarily large flux (120 t/yr) of shallow water glacigenic sediments uncontaminated by anthropogenic Hg, which could scavenge Hg from the water column before being transported to the deeper accumulative basins. Under the projected climate warming in the region, the rate of the sediment recycling pump will likely increase due to enhanced Hg scavenging by increasing biological productivity, and thus strengthen atmosphere–ocean Hg exchanges in the HBS.

CAUSES AND CONSEQUENCES OF CHANGE AT TREELINE: PRELIMINARY RESULTS FROM THE INTERNATIONAL POLAR YEAR PROJECT PPS ARCTIC CANADA

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PPS Arctic Canada (Present processes, Past changes, Spatio-temporal variability in the Arctic delimitation zone, Canada) is the Canadian component of PPS Arctic, an International Polar Year interdisciplinary research program on the causes and consequences of change of the forest-tundra ecotone (the treeline). Our research team of 20 principal investigators, more than 40 students and postdoctoral fellows and extensive community involvement have been conducting studies in over a dozen locations in the Yukon, Northwest Territories, Nunavut, northern Manitoba, northern Quebec and Labrador. The arctic treeline, a prominent biogeographical boundary, may be shifting due to climate change, affecting both regional biodiversity and northern communities. Our objectives include: 1) an analysis of recent change in tree and shrub distributions, 2) the collection of environmental and microclimate data to accompany treeline change, 3) an investigation of the mechanisms of vegetation change at treeline, 4) the mapping of the spatial pattern of tree and non-tree species at treeline and in tundra islands within the boreal forest to predict future changes as treeline migrates, 5) an assessment of the role of disturbance, and 6) the development of models of the long-term relationship between environmental change, resource availability and human health and well-being in the forest-tundra ecotone. Together with international researchers we have developed and used common protocols to collect quantitative, qualitative and anecdotal data on change across treeline. Early results show detectable changes including a reduction in permafrost and treeline advancement.

CLIMATE CHANGE, WATER QUALITY, AND HUMAN HEALTH IN NUNATSIAVUT, CANADA

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Background: Generally it is suggested that climate change will cause changes in precipitation, runoff, and hydrological extremes which will alter the environmental conditions that we live in. These ecological changes may increase the risk and incidence of infectious disease. For example, heavy rainfall events, flooding events, and increased temperature increase the risk of waterborne illnesses substantially.
Objectives: The main purpose of our study was to investigate associations among weather patterns and drinking water quality and infectious gastrointestinal illness (IGI) outcomes in Nunatsiavut, Canada. The main objectives of the study were to (1) compare water quality variables with recorded weather events and turbidity data collected from raw water sites; (2) compare weekly water quality and weather events with local health clinic records of IGI; (3) provide the summary results in the form of educational material on climate change, water quality, and health for local residents.

Methods: Meteorological stations with turbidity monitors at raw water sites provided **weather and turbidity data** (objectives 1-2). Trained personnel conducted **water quality** testing using Colilertã tests. **Health data** related to IGI was obtained from both retrospective (2005-2007) and prospective (2008) clinic records (objective 2). Community members were encouraged to **collaborate** in all phases of planning, implementation, assessment, and evaluation of this study. An interactive workshop for local high school students will show how data are collected and analysed, and encourage students' participation in competitions to develop educational media for communicating study results to the larger community (objective 3).
Outcomes: Our study engages Inuit in a study that will use generated knowledge to create sustainable interventions, while developing the community's capacity to adapt and manage changes in water quality due to a changing climate. Results from our study may inform policy making decisions, and help improve Inuit public health infrastructure.

MICROSATELLITE GENOTYPING OF POLAR BEAR HAIRS AND THE IMPLICATIONS FOR AN INUIT POLAR BEAR ACTIVITY SURVEY

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Management and conservation of polar bears (*Ursus maritimus*) in Canada is based extensively on aerial capture-mark-recapture surveys. For most areas these surveys are completed every 12 to 15 years, however with growing concern about rapid Arctic habitat change, more frequent monitoring of polar bear populations is desirable. Here we report on the genotyping success of non-invasively collected polar bear hairs which may form part of a non-invasive bear activity survey and which will potentially include Inuit estimates of bear sex, age, and size from tracks and the analysis of digital images from tracks. From seven sampling stations, comprising cordons of barbed wire erected on the sea ice off northern King William Island in May 2006, samples of hair were collected from 79 barbs in nine days. Most of the samples comprised one to four hairs, with the numbers of barbs involved in singular polar bear contacts ranging from one to 16. Of fifteen hypervariable polar bear microsatellite loci assayed, 11 were reliable, with even single hairs providing score-able data. Our genotyping error with this tissue was on average five percent across all loci – similar to that expected by chance. We generated twenty consensus genotypes comprising 18 unique individuals. This was two less than the number of unique polar bears that our Inuit collaborators suggested contacted our sampling station based on tracks alone. The fact that two of the sampled bears visited the stations twice accounts for this discrepancy. Our estimate of observed heterozygosity (Ho=0.6515) for eight loci was no different than a previous estimate derived from the same loci for 15 bears (Patkeau *et al.* 1999). The immediate implications of this study are i) non-invasive sampling of polar bear hairs provides valuable and reliable genetic data and ii) the numbers of bears in this area is at variance with the single bear sampled in the area during an aerial capture-mark-recapture survey in 1998-2000 – suggesting polar bear distribution in this area may have changed. These findings and our ongoing efforts to optimize genotyping from faeces and genetic sexing from hairs and faces, suggest non-invasive genetic data can form part of a ground based survey that may include Inuit diagnoses of tracks for sex, age, size and age of track and the multivariate analysis of digital images. Such an inexpensive survey may be executed more frequently out of any community in the Arctic allowing for increased monitoring of polar bear responses to Arctic habitat changes.

SMARTER THAN SATELLITES: SMALL ICE FLOES AS KEY SEABIRD FORAGING HABITAT

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The arctic pack ice is essential habitat for a wide variety of marine predators (and obviously their prey) including at least 12 species of seabirds and seven species of marine mammals, such as whales and seals. Recent decreases in summer ice extent have resulted in more areas of the Arctic Basin being "ice free" but standard satellite images do not capture extremely low density ice. Areas with low density ice could become increasingly important foraging habitats for marine apex predators, as annual summer ice continues to decline. We developed a protocol to detect low-density (subpixel) ice-covered habitat at a biologically relevant spatial scale from free, easily accessed satellite images. To ground-truth the relevance of these

small, "subpixel" ice floes as habitat for Arctic Cod and other marine predators, we sampled surface waters at two subpixel ice floes. Plankton tows were performed (0 - 2 m depth) with a plankton net (5 mm2 mesh) to quantify the presence/absence of various zooplankton species. The at-ice observations revealed that Black Guillemots (Cepphus grylle), a diving seabird associated with pack ice and highly reliant on the under-ice (sympagic) fauna, were present at subpixel ice floes (n = 1 - 7). Most of the birds (57 %) observed next to ice were diving. Dive duration ranged from 38 - 47 s, which are generally regarded as feeding dives. Out of the eight dives observed, guillemots surfaced twice with Arctic Cod (Boreogadus saida). Guillemots are able to consume fish under water and other dives may also have been successful in obtaining prey.

Detecting the presence and extent of areas with subpixel ice is important in assessing the annual and seasonal changes occurring in the rapidly changing Arctic pack ice. It requires a technique that allows detection of ice hidden in the original true-color composites but detectable in a transformed image (such as a band ratio). Our masked-band ratio technique revealed the presence of daily fine-scale ice where it was not detected using standard visualization techniques. The detection of small (< 250 m2) ice floes extending south from the edge of the pack ice is important as it reveals important habitat for ice edge animals but would be overlooked using only true-color composites. Our technique for detecting subpixel ice could have increased utility with the predicted decreases in summer ice extent and increases in the areas of the Arctic Basin that could potentially contain "subpixel" ice.

SHARING HEALTH RESEARCH KNOWLEDGE IN NUNAVUT: A DYNAMIC AND MULTI-PRONGED APPROACH

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INTRODUCTION: Commonly, the concept of knowledge translation has been developed to refer to the creation and implementation of a strategy to translate health research results into applicable findings for those requiring the information. In the context of Qaujigiartiit/Arctic Health Research Network - Nunavut and the work that is conducted by this Iqaluit-based organization, Knowledge Sharing is defined as "the synthesis, translation and communication of health knowledge between various knowledge holders, such as policy-and decision-makers; researchers; community members; and health care providers. Knowledge is dynamic and does not flow in a line from top to bottom, but fluidly between people and groups."
APPROACH: A multi-level approach has been implemented at Qaujigiartiit to facilitate knowledge sharing among 4 identified stakeholder groups in Nunavut: researchers; policy- and decision-makers; community members; and front-line health workers. This approach has included:
• electronic communication, via website and electronic mailing list, in English and Inuktitut;
• face-to-face meetings including community visits and community consultations;
• the printing and distribution of a quarterly newsletter in English and Inuktitut, to which policy-makers, health care providers, researchers and community members are invited to submit;
• the development of teaching resources and delivering of community workshops on relevant and community-identified topics in northern health research;
• placing an ad in the local newspaper soliciting involvement in Qaujigiartiit's initiatives
• a review of the literature on knowledge sharing with various stakeholder groups in the North and in Canada
• a pilot project to test and evaluate knowledge sharing projects within the Qaujigiartiit specifically targeting 2 groups: policy- and decision-makers in Nunavut on the issue of food security, and community members in Nunavut on the issue of youth mental health and wellness. The former will entail the development of a brief pending consultation with a sample of policy- and decision-makers in Nunavut. The latter is a youth-led photovoice project to facilitate the sharing of key youth mental health and wellness issues with community members.
FINDINGS: Evaluation of these initiatives in on-going, however at this time we have found:
• national and territorial organizations; researchers; and non-governmental organizations make the greatest use of the Qaujigiartiit web site and publications section.
• the electronic mailing list has been very helpful in sharing information and soliciting feedback from community members, front-line health workers, and other stakeholders in Nunavut communities.
• face-to-face meetings and workshops in Nunavut have been well-attended by community members across the territory and have been the arenas where knowledge sharing has been most effective between community members, health professionals, and policy-makers. They have been positive and exciting learning and sharing forums to date.
• Community radio is well-known to be an effective knowledge sharing tool for communities. While we have not yet had opportunity to incorporate community radio into our initiatives, it is a planned part of the pilot project on

youth mental health and wellness.
CONCLUSION: A multi-pronged, creative and dynamic approach to knowledge sharing is necessary to ensure effective communication and opportunities for knowledge sharing with different audiences in Nunavut. Knowledge Sharing is an essential part of northern health research and Qaujigiartiit/Arctic Health Research Network-Nunavut is playing a key role in the process.

THE ARCTIC SEA ICE / PEOPLE OF A FEATHER INTERNATIONAL POLAR YEAR EDUCATION AND OUTREACH INITIATIVE

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Background and Objectives
The Arctic Sea Ice / People of a Feather project is an interdisciplinary education and outreach initiative that combines Inuit, scientific and filmmaking approaches to document and broadly disseminate knowledge about sea ice ecosystems and environmental change. The outreach project evolved from the use of multi-media techniques (video and timelapse photography) to quantify sea ice dynamics and wildlife ecology for a research collaboration between the Sanikiluaq Hunters and Trappers Association, The Nunavut Wildlife Management Board, the Canadian Wildlife Service, and the Ph.D. research of JPH at the Centre for Wildlife Ecology, Simon Fraser University. Our outreach efforts have been ongoing since 2002, and our objective under funding from International Polar Year is to use our existing materials, field infrastructure and high definition production capacity to complete and broadly distribute a feature documentary (*People of a Feather*) and a multi-media educational package (*The Arctic Sea Ice*) for schools and interpretation centers. Due to an interdisciplinary approach, the project also includes training and capacity for a *multi-scale community based research and monitoring program*.
People of a Feather
Eider down, the warmest feather in the world, allows a unique Inuit community to survive the arctic winter. The struggle of Inuit and eiders to adapt to environmental change in sea ice habitats is tightly linked. Before *Nanook of the North* (the first documentary ever made), scientist Robert Flaherty had made another film capturing the way of life of Inuit on the Belcher Islands. That film was destroyed by fire and never seen. One hundred years later, we are recreating components of that documentary and contrasting these scenes with the modern environment of Hudson Bay. Using modern and traditional sequences including «a day in the life» of an Inuit family and dialogue between hunter and youth, the film will teach ecological themes in a manner accessible to a broad audience.
The Arctic Sea Ice educational package is based on a modular concept, where educators can adapt and organize the various components of each unit to fit their own teaching methods and lesson plans. The package will be distributed on interactive DVD accompanied by a teachers guide. Each component will include a multi-media feature, a lesson plan for educators linked to curriculum, activities, resources and supporting materials.

Unit 1: Sea Ice Dynamics
Ice of the Arctic - properties, formation, habitats, Inuit classification
Sea Ice Ocean Systems - seasonality, freshwater budgets, circulation, meterology, climate regulation
A History of Sea Ice - paleohistory, inter-annual variability, current issues
Unit 2: Sea Ice Ecology
Sea Ice Food Webs - microrgaisms & plankton, benthic intertebrates, fish, birds, mammals
Eider Winter Survivor - a case study
Unit 3: People of the Ice
Inuit Then and Now
Explorers
Modern Research

A major objective of this poster is to initiate collaborations with arctic researchers working on sea ice to facilitate development and production of an effective comprehensive educational package that represents the broad diversity of research and issues facing sea ice ecosystems in the Canadian Arctic.

POLAR 5 – A NEW ACCESS TO THE ARCTIC

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Since 1983 the Alfred Wegener Institute (AWI) operates two with ski equipped research aircraft (Dornier 228-101) for the German science community. Every year several surveys are carried out in polar region for studies

of the interaction of lithosphere, ocean, cryosphere, and atmosphere. End of 2006 a new aircraft, a Basler BT-67, has been purchased, replacing POLAR 4, and this aircraft came into service as POLAR 5 one year later. The new aircraft is a heavily modified Basler BT-67. The aircraft is based on the hull of the well-known DC-3 and is fitted with state-of-the-art, modern avionics, turbo prop engines. The fuselage provides sufficient space for scientific instrumentation. It has special large-belly doors, several large openings in the cabin, wing stations for antennas and probes, nose and tail booms as well as more powerful generators for operating instruments. Equipped with combined ski-wheel gearing, permits open field landings on unprepared surfaces such as sea ice. POLAR 5 were successfully utilized in its first Antarctic season for logistics as well as for scientific surveys. The ability to take off at high altitudes and the large endurance of POLAR 5 allowed for the first time to carry out geophysical surveys over the Antarctic plateau during the program Dome connection in January 2008 and an evacuation from the drifting station NP 35 in the Arctic in April 2008.

During March/April 2009 it is planned to fly the POLAR 5 on a circum-navigation of the Arctic. The proposed project PAM-ARCMIP (Pan-Arctic Measurements and Arctic Regional climate model simulations) provides a unique opportunity to obtain a snapshot of aerosol and cloud distributions and associated meteorological and atmospheric conditions as well as measurements of sea ice thickness in a latitude band between about 70°N and 90°N It also presents the possibility of making in situ, discrete or continuous trace gases measurements in the Arctic for the first time, providing a baseline from which future monitoring can be referenced. The mission will be closely coordinated with ground and satellite observations (like CryoVEx, Calipso), particularly with the network of observatories established by international institutions and universities from Europe, Canada and US. The intent is to assimilate a latitudinal snapshot of critical parameters in a very short period in order to close key gaps in our understanding of Arctic processes, to ultimately reduce uncertainties in model simulations important for weather and climate predictions. Data can be used for validation of satellite retrievals as well as for verification of various models currently in use. The suite of measurements will allow characterization of atmospheric state from drop sondes, as well as aerosol and cloud properties and hopefully the distribution of important gases, their longitudinal variation and vertical distribution as well as sea ice thickness distribution in the central Arctic. The timing coincides with the culmination of the International Polar Year (IPY), and as such will foster scientific collaboration, provide important linkages between observatory operations and the satellite community.

MONITORING AND PREDICTING CHANGE IN TUNDRA ECOSYSTEMS OF TORNGAT MOUNTAINS NATIONAL PARK RESERVE, LABRADOR

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There is general lack of data on the impacts of climate change on eastern Canadian terrestrial ecosystems, especially in northern Labrador. Monitoring and experimental manipulation of vegetation and climate are underway in the Torngat Mountains National Park Reserve (TMNPR) in northern Labrador to document how plant communities are likely to change under the scenarios of climate change and to ultimately inform a spatially explicit model to predict large scale vegetation change. This research is of special significance to Inuit of Nunatsiavut and Nunavik, as this land is their traditional territory.

Our main study area is located north of Saglek Fiord, and west of Nachvak Brook, with additional sites in Parks Canada Base Camp in St. John's Bay (Nunatsiavut land) and along the McCornick River Valley from its headwaters to where it discharges into Nachvak Fiord. Vegetation studies include the 1) experimental manipulation of temperature using OTC (open top chambers); 2) understanding the role keystone species such as shrubs play in the community structure of the tundra and riverine ecosystems; 3) vegetative vs. sexual recruitment of dominant species of mosses; and 4) understanding the ecology, productivity and use of berries (*Vaccinium vitis-idaea*, *V. uliginosum, Empetrum nigrum, Rubus chamaemorus*) by Inuit. The 20 paired OTCs and control plots compare plant communities in dry vs wet tundra sites using the CANTTEX protocols (100 pin drops within 1m^2 permanent quadrats). Analysis of baseline data indicate that wet sites are dominated by herbs such as sedges and mosses while the dry sites are dominated by lichens; both have similar density of shrubs (but different species) but the wet sites have a much higher density of individuals and 100% cover. Shrubs are keystone species that orchestrate the change to shrub tundra via light competition, but they can also facilitate establishment of other species, acting as "nurse

plants" in harsh environments. Our data suggest that shrubs do structure communities as vegetation is clustered in areas dominated by shrubs such as dwarf birch, and northern Labrador tea in dry habitats.

A study of the Torngat Mountains climatology has begun using a combination of field measurements and downscaling from regional climate data sets. An automatic climate station, snow measurement stations and soil temperature probes were installed in the central study area in 2007, followed by additional installations during the 2008 summer. The first year's field data are being used along with permanent station records and gridded data in a preliminary statistical analysis to estimate long-term temperature and moisture patterns. The resulting relationships will be used in downscaling future climate scenarios to the Torngat Mountain region.

To develop a spatially explicit model for vegetation change, ground truthing for image classification and percent vegetation cover for the study site has been completed. Hybrid process models, that integrate spatial autoregressive models, spatial Markov Chains and Cellular Automata, will be used to analyse field data, and current satellite imagery as well as historical aerial photographs to determine if vegetation cover or density has changed over the last 40+ years.

THE INFLUENCE OF VEGETATION COMMUNITIES AND HYDROLOGICAL GRADIENTS ON SOIL BIOGEOCHEMISTRY IN MID- AND HIGH-ARCTIC ECOSYSTEMS

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A significant portion of the global carbon reservoir is stored in Arctic soils. Whether the Arctic continues to store carbon in the future depends on how these ecosystems respond to future changes in climate. With warming, precipitation and depth of permafrost are likely to increase, contributing to an overall increase in soil moisture. In the high-Arctic, plant community types are spatially distributed depending on moisture availability, and categorised in three main groups: wet sedge, where there is standing or running water from snowmelt; mid-moisture, where vegetation cover is continuous and undergoes episodic or seasonal water inputs from precipitation or ground ice melt over the course of the growing season; and semi-polar desert, which is characterised by little water input from precipitation only and bare mineral soil with long, narrow patches of vegetation. Vegetation cover may change as a response to changing hydrological gradients, thereby influencing the biogeochemical cycling of carbon and nitrogen between plants and soils. We examined variation in carbon storage and soil biogeochemical processes in the major plant community types in high-Arctic ecosystems. Our research was carried out over two growing seasons at two sites: 2006 at Boothia Peninsula, Nunavut (70ºN 93ºW), and 2007 at Cape Bounty, Melville Island (75ºN 110ºW). The objective of this research is to test the variability of biogeochemical soil properties under these vegetation communities across a latitudinal gradient. At Boothia, 5 soil cores to 5 cm depth were collected during the summer of 2006 under the three community types. At Cape Bounty, soil cores to 20 cm depth were collected in 2007 in 12 plots representing the three community types. Our results at Cape Bounty showed that there is a strong relationship between C and N throughout the top 20cm of the soil profile (r^2=0.8703). Soil moisture did not vary significantly between mid-moisture and polar desert sites. These sites were significantly drier than wet sedge sites (p=0.000). Soil moisture tended to decrease with depth in the soil profile. The total amount of C and N was greater in the O-horizon than in the mineral soil fraction. C and N did not vary significantly by depth (p>0.778). Wet sedge sites stored the most C and N, however, polar desert and mid-moisture stored similar amounts of C and N. This indicates that there is a relationship between vegetation cover type, hydrological gradient, and C and N storage at Cape Bounty. The Boothia Peninsula work showed that C and N varied along a hydrological gradient. By comparing mid-Arctic and high-Arctic sites, the future of the C balance in the Arctic, with respect to vegetation cover and hydrological gradients, may become clear.

THE IMPACTS OF SNOW GOOSE HERBIVORY ON RHIZOSPHERE INTERACTIONS IN AN ARCTIC SALT-MARSH AND FRESHWATER SEDGE MEADOW

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Arctic tundra ecosystems are typically nitrogen (N) limited, with changes in N availability affecting plant and

microbial biomass production, and soil carbon (C) fluxes. Soil microbes strongly influence the availability of nutrients to plants during the growing season, and indirectly affect the productivity of higher trophic levels by controlling the amount and quality of available plant forage. Resource-limitations in the Arctic raise several interesting questions regarding the nature of plant-herbivore interactions and the influence of such interactions on soil microbes. Some recent studies suggest that plants can have a positive influence on soil microbial activity, and the availability of nutrients, under the influence of herbivory. When some plants are subjected to aboveground herbivory they have been shown to exude greater amounts of labile organic C into the rhizosphere, benefiting C-limited microbes. Increased microbial activity results in higher rates of net N and phosphorus (P) mineralization, which increases the availability of inorganic N and P for plant growth and the production of new photosynthetic tissue.

To test the effects of grazing on belowground nutrient dynamics, I set up experimental plots in 2006 and 2007 at two field sites near Churchill, Manitoba, that have been exposed to different histories of grazing pressures. One site is located in an intertidal salt marsh on the Hudson Bay coast that has been intensively grazed each summer by lesser snow geese (*Chen caerulescens caerulescens*) for over 40-years. In contrast, the second site is located in a fresh water sedge meadow that only recently has been subjected to grazing pressures from snow geese, brought about by overgrazing of intertidal vegetation and the degradation of salt marsh habitat. *Puccinellia phryganodes*, the dominant salt marsh grass, and *Carex aquatilis*, the common freshwater sedge, are primary sources of food for lesser snow geese at each of the two sites respectively.

Experimental plots were given one of four nutrient addition treatments (C, N+P, N+P+C, and control), with or without the exclusion of geese. The grazing treatment in plots at the freshwater site was simulated, due to lower goose densities, by clipping *C. aquatilis* down to the shoot base.

Preliminary results from the salt marsh site, across both years, show that microbial C did not increase in grazed plots in comparison to ungrazed plots. This indicates that grazing in this system does not lead to an increase in microbial biomass as the result of a likely increase in root C exudates. The severe loss of aboveground plant photosynthetic tissue in the grazed plots appears to limit the release of C into the rhizosphere for microbial uptake. Any photosynthetic C is mostly likely used in the regrowth of aboveground plant biomass, and fecal N from the birds provides a readily available source of N.

This research is relevant for evaluating differences in the various degrees of impacts herbivores have on the interactions that occur belowground between soil microorganisms and plant roots, and how that in turn will affect plant re-growth and resource consumption at higher trophic levels.

HIGH ARCTIC HEATH RESPONSES TO AMBIENT AND SIMULATED CLIMATE CHANGE

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The Canadian High Arctic has warmed recently, and this trend is expected to continue. Increased temperatures may alter the composition and functioning of plant communities. For the past 16 years, we have measured plant responses to both ambient and simulated climate change in a heath community at Alexandra Fiord, Nunavut. Over this period, mean annual temperature, thawing degree days, and growing season length have increased, which caused maximum thaw depth to increase but did not affect soil moisture content. Ambient warming has shifted the composition of the heath community. Evergreen shrub and moss cover have increased while lichen cover has decreased. Also, canopy height and species richness have both increased. Notably, this community has become significantly more productive over time.

The simulated climate change experiment produced similar responses as ambient warming. In the experiment, we first manipulated temperature in 1992. The strongest treatment effects were observed after three years of warming, but have dampened over time. Passive warming increased evergreen shrub and moss cover, and decreased lichen cover.

It appears as though both ambient and simulated warming have affected community structure and functioning in this High Arctic heath. Because this is a conservative, slow-growing community, these results suggest that many tundra plant communities may have already shifted as a result of recent climate change.

IDENTIFICATION OF FOOD INSECURITY DETERMINANTS IN INUIT COMMUNITIES AND INDIVIDUALS

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Various factors affect food security in Inuit communities. Availability and accessibility of resources, household crowding, environmental change and nutrition transition are likely compromising food security in the Canadian Arctic. For example, these factors alter food choices and ability to fish and hunt. As cultural practices change, food security can become more prevalent. There are many different effects of food security on home, individuals and communities such as risk of nutrient insufficiency and compromised health. Various tools exist to measure food security. However, none have yet been designed to assess and understand food security specifically in Inuit communities. As a part of the "Inuit Health Survey" (IHS) for Nunavut, Inuvialuit Settlement Region and Nunatsiavut, this study will validate a food security questionnaire. Further, it will identify determinants of individual, household and community food security. The IHS took place in summer/fall 2007 and 2008 aboard the icebreaker CCGS Amundsen. The research team aboard the Amundsen travelled to coastal communities to meet with randomly selected participants. Men and women, aged 18 and older were eligible to participate. Questionnaires about the household and food security were administered on land and answered by the head of the household. All participants then came on board the ship for various clinical measurements and an interview which included four questionnaires: a 24-hour dietary recall, a food frequency questionnaire for traditional food and some market foods, a health history questionnaire and a community and personal wellness questionnaire. The total sample size is approximately 2000 individuals. Biomarkers of nutrient status and dietary adequacy, community specific indicators as well as household living conditions will be used to validate the food security questionnaire and identify societal, household and individual determinants. This observational study will develop a portrait of food security in the North. Indeed, validating the food security questionnaire will help to better assess the current situation in Inuit communities. A greater understanding of these determinants of food security as it exists in Canadian Inuit communities will also help develop prevention and intervention strategies and improve resiliency as arctic food systems rapidly change.

FACTORS CONTROLLING RIVER RUNOFF INTO THE HUDSON BAY AT THE EXAMPLE OF THE GREAT WHALE RIVER AND NELSON RIVER DRAINAGE BASINS

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In this study we apply a suite of hydrological modeling tool to evaluate factors controlling dramatic decreases in river runoff into the Hudson Bay Basin (HBB) during the past four decades (Déry et al., 2005). Runoff patterns can be considered to evolve over multiple time scales: Seasonal variations in freshwater discharge are mainly controlled by the timing of snowmelt, whereas decadal changes seem to be related to large scale athmospheric oscillations, especially the Arctic Oscillation (Déry and Wood, 2004). Centennial to millennial scale variations are yet poorly understood but basinwide several climatic oscillations have been discovered during the entire Holocene, including changes in temperature, humidity and vegetation cover. These oscillations might be influenced by solar forcing and probably were of such extent that they could have influenced river runoff into the HBB. However, to give reasonable statements on how individual rivers react to environmental change and their potential impact on the marine ecosystem there are still too many knowledge gaps in the understanding of factors controlling river runoff into the HBB and potential effects of global change. Studies from Eurasian rivers show that river runoff across different river basins is highly variable depending on local conditions such as basin area, relief, soil properties (including permafrost) and vegetation cover (e.g., Berezovskaya et al., 2004). To establish benchmarks by which recent changes in freshwater discharge into the HBB can be measured, further paleohydrological studies are necessary, as well as the modeling of factors, such as variations in temperature, precipitation, snowcover and active layer thickness, which can have dramatic effects already in the closer future due to rising global air temperatures. Two contrasting rivers, the Nelson River (a large anthropogenically modified basin at the western coast of Hudson Bay) and the Great Whale River (a smaller more pristine basin at the eastern coast of Hudson Bay), have been selected for this study. Geomorphometric data have been extracted from DEMs, and factors controlling river runoff are currently being analyzed with the spatial-distributed hydrologic model TopoFlow and statistical hydrological models of Syvitski, Peckham and coworkers (e.g., Syvitski et al., 2003).

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STUDYING THE IMPACT OF POLLUTANT TRANSPORT FROM THE PACIFIC RIM TO THE ARCTIC: THE IPY PROJECT OF INTERCONTINENTAL ATMOSPHERIC TRANSPORT OF ANTHROPOGENIC POLLUTANTS TO THE ARCTIC (INCATPA)

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The presence of anthropogenic pollutants -- such as persistent organic pollutants (POPs), other semivolatile organic contaminants (SOCs), and mercury -- in the Arctic ecosystem has raised significant international concerns in recent years, especially in circumpolar countries such as Canada. This is mainly because (1) these chemicals are persistent in the environment and can be transported over long distances from source regions to the remote Arctic; (2) they tend to bioaccumulate and biomagnify through terrestrial and aquatic food chains and may pose significant health risks to humans and wildlife; (3) most northern and indigenous populations rely on a high fat diet of country food which is a major source of human exposure to these chemicals; and (4) most northern peoples have not used or directly benefited from activities associated with the production and use of such chemicals. Transport via the atmosphere is the most rapid route of pollutant input to the Arctic. Atmospheric measurements of POPs and mercury enable the estimation of pollutant input into the Arctic from external sources. However, these measurements are very limited in the western Arctic and the Pacific Rim, rendering the assessment of pollutant transport to this part of the Arctic difficult. The Asian Pacific region is now undergoing the world's fastest economic growth. With this growth, chemical use and energy consumption, which results in chemical by-products, is expected to increase substantially. It is, thus, important to determine what relative risks chemical emissions from this region pose on the Arctic environment and the health of Northerners compared to emissions from the North American Pacific region. The IPY INCATPA project is an international collaboration between Canada, Russia, China, Vietnam, Japan and the U.S.A. focused on addressing this issue. This project measures these chemicals in air simultaneously in the Canadian, Russian and American Arctic, as well as at potential source regions on both sides of the Pacific Ocean. Measurement results will be coupled with global-scale three-dimensional, multi-compartment atmospheric transport and soil/air, water/air exchange models developed to investigate the transport of POPs [CanMETOP (**Can**adian **M**odel for **E**nvironmental **T**ransport of **O**rganochlorine **P**esticides) and MEDIA (**M**ulticompartment **E**nvironmental **DI**agnosis and **A**ssessment Model)] and mercury [GRAHM (**G**lobal/ **R**egional **A**tmospheric **H**eavy **M**etals Model)] to forecast trans-Pacific and intracontinental transport to the Arctic. This project will provide sound scientific information which can be used on the international negotiation table for emission/use/production control strategies to reduce pollutant input to the Arctic.

THE IMPLICATIONS OF CLIMATE CHANGE FOR ARCTIC MARINE MAMMALS: KEY FINDINGS FROM A SUPPLEMENT TO "ECOLOGICAL APPLICATIONS"

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Arctic temperatures are rising and sea ice is decreasing. Global warming is amplified in the Arctic, which is the region of the Northern Hemisphere most sensitive to climatic change. Recent late summer sea ice retreats have been dramatic and are expected to be persistent. By the middle of this century or sooner, late summer sea ice extent will likely be limited to the Canadian Arctic Archipelago. After that, even these areas are likely to be without ice in summer. Arctic marine mammals have evolved and adapted in an Arctic Ocean characterized by sea ice. For several hundred thousand years at least, the Arctic Ocean has always had at least some sea ice throughout the year. While today's species have been able to move north and south with the ice in response to changes in climate, species less able to adapt perished. Polar bear, walrus and ice seals (e.g., ringed, bearded, ribbon, spotted) typically spend much of their lives on, around, or near sea ice. Less sea ice means less habitat. When sea ice forms later and melts earlier, polar bears have fewer feeding opportunities. Seals have difficulty finding suitable places to have their pups and to molt. With less ice and warmer water, the Arctic marine food web will also change. Ice-edge productivity will decline and whales may have to travel farther offshore to find concentrations of their prey. Walrus often rest on sea ice when they are not feeding. With the retreat of the ice pack beyond the continental shelf where they typically feed, they will have to swim farther to find food, and their feeding areas may be overgrazed. Warmer water will bring new species to the Arctic, including novel disease vectors. A disease outbreak could affect large numbers of animals, particularly if they are already stressed by changes in food or habitat. Polar bears, whales, walrus, and seals are symbols of a pristine Arctic wilderness. For indigenous peoples in the Arctic, marine mammals are a vital connection to heritage and environment. Loss of the Arctic and its charismatic fauna, by our own hand, would greatly diminish the world's beauty, diversity, and wonder. Some conservation measures will help, at least in the short term. We can protect areas where sea ice is likely to remain. We can minimize impacts from other sources, such as offshore development of oil and gas, commercial fishing, shipping, and military activities. In the long term, however, we must either address the causes of climate change, or accept that at least some Arctic marine mammals will become first threatened, then endangered, and finally extinct.

AN ARCTIC TUNDRA IN SOUTHERN NEWFOUNDLAND: THE INVESTIGATION OF ENVIRONMENTAL FACTORS UPON THE FLORA AT CAPE ST. MARY'S ECOLOGICAL RESERVE

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The Eastern Hyper Oceanic Barrens (EHOB) covers a small fragmented area along the Southern Avalon and Burrin peninsulas of Newfoundland, Canada. This classified ecoregion is unique due to its interesting topography; bare arctic tundra landscape, which is dotted sparsely with short, stunted trees (tuckamore). Located in the EHOB ecoregion is Cape St. Mary's Ecological Reserve. Cape St. Mary's is situated on the very southern tip of the Avalon Peninsula and is exposed to frequent heavy fog episodes and gale force winds. Currently there is little data on the local flora even though there is a unique combination of arctic/alpine and temperate forest vegetation. The focus of this investigation was to begin to understand why arctic/alpine flora species subsist in such a southern geographical location. It was hypothesized that arctic/alpine flora species located at Cape St. Mary's would be attributed to the environmental stresses (fog and wind). Wind speed and gusts were measured using two Hobo Weather stations during the summer of 2008, as were other factors: relative humidity, air temperature, photosynthetically active radiation (PAR), and solar radiation. Initial findings have demonstrated a severe reduction of PAR and solar radiation; an estimated decline of 83 – 85% during extreme fog episodes in comparison to sunny days. Soil temperatures were monitored using Hobo data loggers of five diverse vegetation communities, three tundra sites and two bog locations. Initial findings of soil temperature have demonstrated an average summer soil temperature between 12 – 14 Cº. Soil analysis tests are being completed with results pending.

MICROWAVE REMOTE SENSING OF FROST FLOWERS DURING THE CFL PROJECT

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Frost flowers are a commonly found feature on newly formed sea ice. The nature of their formation and their very presence are indicators of local meteorological conditions. As part of the Circumpolar Flaw Lead (CFL) System Study, remote sensing studies of frost flowers were conducted. Measurements of the backscattering signatures were obtained using a ship based C-band scatterometer system with concomitant physical sampling. The sea ice physical characteristics, microstructure, and the frost flower coverage were analyzed in conjunction with studies of the radar signatures. We present our preliminary results of the radar signatures and physical analysis of the frost flowers and the underlying sea ice. A case study was conducted, during which the frost flowers were physically removed from the region under the sensor footprint. The results indicate that the presence of a layer of frost flowers creates backscatter enhancement, which is in agreement with previous laboratory studies. To date, similar field studies of frost flowers are relatively scarce and therefore this project presents a rare dataset. The remote sensing data provides a calibration tool to interpret satellite images and also for understanding the growth mechanisms of sea ice during the fall freeze-up and near flaw leads during the winter months in the Canadian Arctic.

MOVING IN? CONIFEROUS SEED PRODUCTION AND ITS IMPORTANCE IN THE INVASION OF ARCTIC HABITAT

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One of many threats currently facing arctic habitats is the encroachment of treeline species. Trees and shrubs rely on sexual reproduction to expand their range under scenarios of climate change, but if the production and dispersal of viable seed is limited, a bottleneck to northern or altitudinal migration could occur. With environmental conditions changing across the north, an understanding of current seed productivity is necessary to predict future forests and what affect their movement will have on arctic and alpine habitats. An alpine taiga-tundra ecotone within the Mealy Mountains of Labrador was used as a model system to explore the production and viability of conifer seed during the 2007 and 2008 growing seasons. Mature pollen, developing cones and mature cones were collected from the four conifer species (black spruce, white spruce, balsam fir and eastern larch) across an elevational gradient to assess reproductive potential, seed development, viability and the presence of other seed limiting factors. Surveys of cone production were conducted in closed and open canopy forests as well as tree islands and krummholz to assess their potential as sources of seed dispersal. Results suggest that the incidence of a species' cone production varies strongly by habitat type and by year. Regardless of this variation, black spruce yields the most coniferous seed to the system because of their dominance across the landscape. Results also indicate that cone insects play a significant role in limiting seed health and dispersal within this system. As climate studies in this region have been ongoing since 2002, seed viability will also be linked to limiting bioclimatic factors, including the growing degree-days experienced over various altitudes and habitats. The findings of this project provide a baseline for studies concerning seed dispersal and give insight into which species have the potential to invade increasingly threatened arctic environments. Results will also be used as an important feed for biogeographical models concerning northern treelines and their predicted advance.

AIR-WATER GAS EXCHANGE OF PESTICIDES IN THE CANADIAN ARCHIPELAGO

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Pesticides were investigated to determine occurrence and levels air and water in the Canadian Archipelago and estimate the net flux direction. These pesticides include 'legacy' or banned compounds and

currently used pesticides. Parallel air and water samples were collected on Leg 1, 8 and 9.
Hexachlorocyclohexanes (HCHs) are the most abundant organochlorine pesticides in Arctic air due to their facile atmospheric deposition in the cold environment and slow degradation rates. In the past two decades, there has been a reduction in primary emissions of technical HCH with an accompanying decline in atmospheric HCHs concentrations. As a result, a reversed direction of air-water flux from net deposition to net volatilization has been observed in some arctic regions. This study was carried out to determine the gas exchange of HCHs using gradients of HCH concentrations and enantiomer fractions of "-HCH.

Transport of pesticides from agricultural fields to non-target areas is of great interest because they are manufactured to be toxic to biota. Currently used pesticides (CUPs) are generally less persistent than the older style organochlorines, but they can still undergo atmospheric transport through volatilization and deposition followed by re-emissions. Some ultimately make their way to sensitive ecosystems such as the Canadian Arctic. The CUPs chlorpyrifos, trifluralin, dacthal, chlorothanonil and endosulfan are found in areas where no usage occurs. Endosulfan has been reported in temperate Canadian lakes and Arctic Ocean water and dacthal and chlorothalonil have been detected in temperate and arctic lakes.

EXPERIMENTAL STUDIES OF REPRODUCTION AND FEEDING FOR TWO ARCTIC DWELLING CALANUS SPECIES EXPOSED TO CRUDE OIL

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The exploration and development of petroleum resources in the Arctic is projected to increase in the coming years and so too will the risks of transport-related accidents. In order to evaluate risks to the environment, there is a need for ecotoxicology studies on the effects of crude oil exposure on Arctic animals. Due to storage of large amounts of lipids and relatively long life cycles, responses of exposed Arctic animals are predicted to differ from comparable boreal species. Here we examine some behavioral effects of exposure to the Water Soluble Fraction (WSF) of crude oil for arctic copepod species of the genus *Calanus*. *Calanus* is a keystone species in the energy transfer from lower trophic to higher trophic levels of the Arctic/sub-Arctic food web. Females of *C. glacialis* were exposed to High, Low and Control concentrations of WSF (initial concentrations 10.4, 3.6, 0 $\mu g\ l^{-1}$ (16-EPA), respectively) in 100 ml egg production chambers. Copepods were fed and water renewed daily throughout the 11 day experiment. Egg and fecal pellet production was observed daily while hatching of eggs was examined on the first two days only. We observed no significant difference in the cumulative egg or fecal pellets production throughout the experiment (1 way ANOVA; $p>0.05$). However, egg quality for the High concentration exposure was reduced as the hatching success was significantly lower on the first day (1 way ANOVA followed by post hoc Tukey; $p<0.05$). In a second experiment, stage CV of *C. finmarchicus* were exposed to 7.0, 3.4 and 0 $\mu g\ l^{-1}$ of WSF (16-EPA, initial concentrations) for 10 days to examine if crude oil accumulation influences copepod feeding. A flow through exposure system was employed for the experiment. Six specimens of each exposure were allowed to feed for 24 h in 300 ml amber bottles containing 8800 cells ml^{-1} of *Chaetoceros* sp. We observe a significant higher concentration of food (algae) in the High treatment (1 way ANOVA followed by post hoc Tukey; $p<0.05$), suggesting that feeding was inhibited for specimens exposed to the high concentration of WSF. These behavioral studies for a keystone species of the Arctic/sub-Arctic food web are relevant for assessing appropriate exposure limits for individual organisms and for evaluating possible population level effects resulting from exposure to chemical compounds in crude oil.

RESPONSE OF LOWER TROPHIC LEVEL PRODUCTION TO RISING TEMPERATURE AND REDUCING SEA ICE IN THE SOUTHEASTERN BERING SEA

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The ecosystem in the Bering Sea has undergone profound changes in response to climate regime shifts in the past decades. The lower tropic level production is assessed with a vertically 1-D coupled ice-ocean ecosystem model, which was applied to a NOAA/PMEL mooring from 1960 to 2005. The physical model is forced by sea surface winds, heat and salt fluxes, tides, and sea ice. The biological model includes coupled pelagic and ice algae components. Model results are validated well with daily mooring temperature, fluorometer and daily SeaWiFS *chl a* data. There are two distinct ocean conditions and phytoplankton bloom patterns

related to the Pacific Decadal Oscillation (PDO) index regimes with warmer temperature and later bloom of warm water phytoplankton species in PDO>1 years, and colder temperature and earlier bloom of cold water phytoplankton species in PDO<-1 years. The phytoplankton production of different species experienced dramatic changes after the 1976 climate shift, but the total annual net primary production (NPP) remained flat over the past four decades under similar nutrients regulation. Climate shift also affected the vertical distribution of lower trophic level production and energy flow to the upper ocean pelagic ecosystem or the benthic community. There were a long-term PDO regime shift in 1976 and short-term PDO reversals in 1990s. Phytoplankton biomass responded to both short and long-term climate changes. Zooplankton biomass responded to long-term climate shift as well but not to those short-term variations in 1990s. This indicates that the lower the trophic level, the more sensitive to climate changes.

PERMAFROST YOUNG RESEARCHERS GETS THEIR HANDS DIRTY: THE PYRN-THERMAL STATE OF PERMAFROST IPY PROJECT

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The Permafrost Young Researchers Network (PYRN) (www.pyrn.org) is a unique resource for students and young scientists and engineers studying permafrost. It is an international organization fostering innovative collaboration, seeking to recruit, retain, and promote future generations of permafrost scientists and engineers. Initiated for and during IPY, PYRN directs the multi-disciplinary talents of its membership toward global awareness, knowledge, and response to permafrost-related challenges in a changing climate.

Created as an education and outreach component of the International Permafrost Association (IPA), PYRN is a central database of permafrost information and science for more than 500 young researchers from over 40 countries. PYRN distributes a newsletter, recognizes outstanding permafrost research by its members through an annual awards program, organizes training workshops (2007 in Abisko, Sweden and St. Petersburg, Russia, 2008 in Fairbanks, Alaska and St. Petersburg, Russia), and contributes to the growth and future of the permafrost community.

While networking forms the basis of PYRN's activities, the organization also seeks to establish itself as a driver of permafrost research for the IPY and beyond. We recently launched a series of initiatives on several continents aimed at providing young scientists and engineers with the means to conduct ground temperature monitoring in under-investigated permafrost regions.

Focusing on sites not currently covered by the IPA's "Thermal State of Permafrost" project, the young investigators of PYRN successfully launched and funded the PYRN-TSP project. They use lightweight drills and temperature sensors to instrument shallow boreholes in those regions. The first phase of the project was started in the spring of 2008 at Scandinavian sites. The data and results will be incorporated in the global database on permafrost temperatures and made freely available to the scientific community, thereby contributing to the advance of permafrost science and the strengthening of the next generation of permafrost researchers. «

THE FATE OF ORGANIC CARBON RELEASED BY PERMAFROST DECAY, EASTERN COAST OF HUDSON BAY

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Recent evaluations indicate that large amounts of organic carbon can be released in fluvial and costal systems because of permafrost degradation, with impacts on ecosystems. In order to obtain quantitative data on those transferts, we have installed instrumentation and have made first measurements in an intensive permafrost degradation area. The study area is located on the eastern coast of Hudson Bay, in the region of the Sheldrake river (drainage basin, river mouth and offshore area), near Umiujaq, in the discontinuous permafrost zone. Permafrost mounds (palsas, lithalsas) and plateaus are the most abundant permafrost landforms. This area contains one of the largest concentrations of frost heave landforms in the world. They developed principally in east-west oriented valleys in postglacial marine silts from the Tyrrell Sea which inundated low areas around Hudson Bay, following the receding ice front eastward and inland, about 8000 years BP. Palsas are covered by peat. Organic matter and clay released by thermokarst are transferred to the sea through the river system as suspended sediments, suspended organic matter and dissolved organic carbon. We postulate that continuing warming will further accelerate permafrost erosion, favour

thermokarst and have an impact on carbon transfers. The adopted methodology should permit to quantify the release of clay and carbon through fluvial transport and deposition in coastal marine depocenters. Two leveloggers and two Optical Backscatter Sensors (OBS) have been installed during summer 2008, about 2km upstream from the Sheldrake river mouth in order to estimate transportation. Moreover, bathymetric surveys (eco-sounder coupled with sidescan sonar) have been made in a 20km2 area offshore the Sheldrake river mouth. We have located deeper basins (88m deep) in submerged valleys, which are likely efficient sediments traps for recent river inputs. Some sediment cores will be extracted in March 2009 from the ice pack in order to correlate recent marine sedimentation with erosion in the drainage basin and permafrost degradation. Grain-size studies, C-14 dating, use of 137Cs, 210Pb, C/N ratios and δ13C will allow to ascertain carbon sources and calculate sedimentation rates.

THERMAL SENSITIVITY OF THE HUDSON BAY SEA ICE CLIMATE

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The oceanic water masses play an active role on climate variability either at a global or regional scale. The integration of the Hudson Bay marine system, a seasonally ice covered Canadian inland sea, is still deficiently represented in regional ocean - atmosphere climate modeling studies. Freezing and melting of sea-ice in Hudson Bay are determined by atmospheric forcing and oceanic heat storage. A regional sea ice-ocean model is used to investigate future trends of sea ice conditions and oceanic heat storage in the Hudson Bay system in the context of climate change. We show here how the sea ice-ocean system responds to a warming perturbation in the atmospheric forcing. Projections of future air temperature (2051-2060) obtained from the Canadian regional climate model (CRCM), which is driven by the Canadian general circulation model (GCM) for both the lateral and the sea ice – ocean boundaries, are used to drive a single sensitivity experiment. In this warmer climate scenario the sea ice season is reduced by 5 weeks in Hudson Bay and Foxe Basin, and by 6 weeks in James Bay. The highest change in summer sea surface temperature, up to 4°C, is found in southeastern Hudson Bay, along the Nunavik coast and in James Bay. In central Hudson Bay sea surface temperature are raised by 3°C in average. Analysis of the heat content stored inside the water column reveals an accumulation of additional heat, exceeding 2MJ.m^{-2}, trapped along the eastern shore of James and Hudson Bays during winter. Despite the stratification due to meltwaters and river runoff during summer the shallow coastal regions demonstrate a higher capacity of heat storage than what is observed in present climate conditions. The seasonal production of dense water is halved. The maximal volume of sea ice is reduced by 28% while difference in the cover between scenarios reaches only 30,000 km^2. The sea ice cover in Hudson Strait and Ungava Bay is 45% thinner than present climate conditions during wintertime. In the center of Hudson Bay sea ice thickness is reduced by 25% with higher depletion coastward. The region southward of 57° N shows a sea ice thinning that ranges from 30 to 40%. The greatest changes both in sea ice conditions and heat content to a warmer climate have been located by the model in the southeastern Hudson Bay, the James Bay and the Hudson Strait.

THE INFLUENCE OF CARRY-OVER EFFECTS ON THE REPRODUCTION OF A MIGRATORY SPECIES, THE GREATER SNOW GOOSE

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The reproductive success and breeding phenology of migratory birds nesting in the Arctic is influenced by local and regional climatic effects on the nesting grounds. However, carry-over effects of events occurring during the spring migration on the reproduction of arctic birds can potentially be important but have seldom been considered. We investigated this question in the Greater Snow Goose (Chen caerulescens atlantica), a migratory species that winters along the East Coast of the USA and breeds in the eastern part of the Canadian high Arctic. In previous analyses, it has been shown that climatic conditions experienced upon arrival in the Arctic (local temperature, snow cover and the Arctic Oscillation index) could explain up to 50% of individual variation in breeding phenology and in some components of reproductive success. We expanded this analysis by examining the relative effects of conditions experienced by the birds during their spring migration vs those encountered upon arrival in the Arctic. We looked more specifically at two factors, climatic conditions and disturbance in spring. Since 1999,

the population has been hunted while staging in southern Quebec, a special conservation measure aimed at stopping its exponential growth, and the disturbance caused by hunters has reduced the accumulation of body reserves by the birds in spring. We used a long-term dataset (1989 to 2008) based on the annual monitoring of the nesting activity of geese at one of the largest breeding colonies in the Arctic (Bylot Island, Nunavut, Canada; 73°N, 80°W). Explanatory variables included in the model included detailed climatic data obtained at the study site in the Arctic and at the staging area and statistics on hunter activities collected in spring since 1999 . We predict that extreme climatic conditions (e.g. storms, high precipitations or droughts) at stopover sites and along the migration corridor will have a negative effect on breeding phenology of geese. Furthermore, their reproductive success should be negatively influenced by spring hunting. We expect that the breeding phenology and reproductive success of geese will be determined by a strong interaction between conditions during migration (i.e. carry-over effect) and conditions upon arrival to the nesting site.

ARCTIC MICROBIAL LIFE: A GENETIC RESOURCE?

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Arctic microbial communities are assemblages of diverse groups of organisms with different physiologies, habitat requirements and adaptive strategies. A particularly interesting group of microbial consortia is dominated by cyanobacteria, forming microbial mats that coat the sediment surface of many polar aquatic ecosystems. These communities often dominate the total ecosystem biomass and productivity of shallow waters. In the Canadian High Arctic, well-developed microbial mat communities can be found in the lakes and ponds of Ellesmere and Ward Hunt Islands, as well as in the meltwater lakes of ice shelves along the northern coast of Ellesmere Island.

In extreme environments such as permanently cold regions, deserts and hypersaline lagoons, microbes need to have special adaptation mechanisms to withstand the harsh conditions of their surroundings. In polar habitats, microbes need to deal with highly variable salinities, UV radiation, freeze-thaw cycles and low temperatures. Their adaptive mechanisms in the face of these severe conditions are often manifested by the production of compounds with unusual properties. For example, bioactive compounds from microbial communities living in Antarctic soils and hypersaline marine ponds have attracted interest for biotechnology applications, and therefore have been classified as genetic resources that could be harnessed for societal benefit. Recent developments in intellectual property issues have also shown that novel technologies to discover and identify such compounds are useful and patentable.

This presentation will describe the microbial mat consortia that we have found in High Arctic Nunavut, and will outline some of the approaches used by scientists in environmental microbiology to identify genetic resources from analogous communities in other parts of the world. The latter will be illustrated through case studies dealing with molecular screening for novel compounds and the development of novel genetic technologies in the field of environmental microbiology.

RECENT SEDIMENT DELIVERY AND ACCUMULATION IN THREE SUBARCTIC FJORDS

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Sediment cores from three subarctic fjords on the Nunatsiavut/Labrador coast (Canada) have been studied to evaluate patterns of sediment delivery and accumulation over the past century. The fjords span a gradient of human impact, from Nachvak Fjord (a pristine fjord within the Torngat Mountains National Park), to Saglek Fjord (on the southern edge of the Torngat Mountains ,undeveloped except for a small military installation), to Anaktalak Fjord, the site of significant mining and associated activities over the past two decades. Onboard the CCGS Amundsen in 2007, boxcores were collected from deep muddy basins (depth 100-250m) in each fjord. Basin floor coring targets were selected in sonar data collected during and before the Amundsen 2007 cruise. Cores were subsampled and analyzed for grain size, sedimentary fabric and structures (via X-radiography), and Pb-210/Cs-137 radioisotope geochronology. X-radiographs show that sediments in each core have been bioturbated moderately to intensely, bioturbation imparting relatively homogeneous fabric

to each core, with no obvious physical stratification. Radioisotope analyses suggest that sediment accumulation rates vary among fjords from 0.14 cm/y (basal portion of Anaktalak Fjord core) to 0.3 cm/y in Nachvak Fjord (basal portion of core), to 0.35 cm/y in the seawardmost muddy basin of Saglek Fjord. Using the landward reaches of Nachvak Fjord as a specific example, seabed bathymetry appears to tightly constrain the location of depocenters for fluvial sediment. Accumulation rates estimated for one basin with an area of ~10 km^2 suggest that annual total sediment accumulation is on the order of 16 x 10^6 kg/y. This equates to relatively modest sediment yields from adjacent river catchments of <10^5 kg/y, despite the steep topography and mostly unvegetated landscape. Thus, the bathymetry in fjord basins appears to focus modest sediment supply and creates a relatively high resolution stratigraphic record of fluvial sediment supply over the past 100-200 y.

CONSTRUCTION OF INUIT PERSPECTIVES ON CLIMATE CHANGE

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Do Inuit communities in the north of Canada have different views on climate change than those in the south? This research investigates the difference in Inuit perspectives on climate change. Interviews were conducted in Igloolik, Nunavut with Inuit participants to evaluate their own perspectives and personal experiences with respect to climate change. Findings indicate that Inuit community members generally regard climate change on a local rather than global level. Most were concerned mainly with human and animal adaptations in the Arctic. As global perspectives are often delivered through the media borrowing scientific terms and concepts, they do not always translate in a meaningful way for community members and therefore are misunderstood. This research shows that global environmental change is a topic of lesser interest when compared to local social, economic and cultural issues that are considered much more important by the community. Thus community members' views indicate that cultural and language barriers continue to restrict communication and understanding between scientific research and community members. The findings of this research may have significant implications for the implementation of future research, effective policy, communication and cooperation between researchers and community members since cultural and linguistic barriers continue to persist.

LINKING THE SEDIMENTOLOGICAL RECORD TO THE FLUVIAL RESPONSES OF MULTIPLE INFLOWS AT PELLY BAY, NUNAVUT

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With the lack of hydrometric instrumental data in the Canadian arctic, sedimentological records are often relied upon to infer past conditions. However, quantifying the spatio-temporal variability of fluvial sediment transportation in the arctic is rare. Regional hydroclimatic conditions will variably affect sediment transportation in different sized drainage basins. A more complete interpretation of past and modern hydroclimatic conditions can be completed if sedimentological records are placed in a framework of how multiple inflows are providing sediment to the basin and the integrated preservation of these multiple signals in a sedimentological package.

Initial analysis of the sediments and sedimentary environment at Pelly Bay (68°21'N, 90°10'W), near Kugaaruk, Nunavut, was carried out in 2008. Constrained by a series of bedrock islands to the north and with complex localized bathymetry, the bay contains moderately isolated marine sedimentological basins. The Arrowsmith (7400 km^2) and Kellet (local name: Kooa, 10200 km^2) Rivers discharge into the southern end of the bay along with numerous smaller rivers. These river basins contain abundant silt and clay-rich marine deposits below the regional Holocene marine limit of ca. 200 m (Ozyer and Hicock, 2006). Hence, this setting allows for high potential sediment loading of the regional rivers to evaluate the linkages between hydroclimatic conditions (i.e. discharge) and fluvial sediment transportation in each of these regional river systems.

The goal of this study is to utilize sedimentological interpretation of sediment cores taken from Pelly Bay in combination with monitoring of the modern interactions between the various southern inflows and the oceanographic environment. This will provide insight into the variable response of large and small scale fluvial environments to hydroclimatic conditions.

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THE IMPORTANCE OF EATING CAPELIN: USING FATTY ACID SIGNATURES TO DETERMINE BELUGA FEEDING HABITS IN HUDSON BAY

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Beluga whales (*Delphinapterus leucas*) are an integral part of the eastern Canadian Arctic and are an important species in the diet of local Inuit communities, as well as providing economic resources to communities through whale-watching tourism. However, little is known about their diet and the different stocks are not clearly defined, particularly in Hudson Bay. Beluga are believed to obtain the bulk of their energy from Arctic Cod (*Boreogadus saida*) in the winter and fast during the summer months. The importance of capelin in the diet of Hudson Bay beluga is debated, as beluga have been seen capturing and ingesting Capelin (*Mallotus villosus*) in the Churchill River estuary. Determining the energetic contribution of capelin to beluga is important, as industrial and hydroelectric activities in the Churchill River have the potential to disrupt capelin stocks, which may impact capelin predators.

Techniques using fatty acids have been used to obtain information on trophic relationships, diet, foraging locations, and stock structure in marine mammals. We analysed blubber samples collected from 98 beluga whales hunted in Arviat, Pangnirtung and Grise Fjord in the 1980s, as well as cod and capelin samples. We analysed the data using a PCA covariance model to determine which fatty acids characterized the beluga populations and the degree to which the populations differed. We found that high arctic beluga populations (Grise Fjord) had diets with higher levels of fatty acids associated with Arctic cod, while low arctic populations (Arviat) had higher levels of fatty acids associated with capelin. Results indicate different feeding regimes for high and low arctic populations of beluga whales and we discuss possible conservation implications.

CLASSIFICATION OF VEGETATION IN ARCTIC REGIONS

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Vegetation data has been collected throughout the Canadian arctic for decades. However, this data is widely dispersed and largely inaccessible. The goal of this project is to identify and acquire arctic vegetation data stored in archives and institutions; build a centralized database of arctic vegetation and ecological data; classify and describe arctic vegetation associations, consistent with the Canadian National Vegetation Classification (CNVC). This project will initiate linkages between Canada and other circumpolar jurisdictions to develop a common international nomenclature for arctic vegetation.

The development of an arctic vegetation classification will be invaluable in providing an ecological framework for all biological and environmental studies in the region. A standardized arctic vegetation classification constitutes a fundamental tool for communication of ecological information between jurisdictions. Applications include: monitoring permafrost, biodiversity, wildlife habitat, species at risk; land use planning, protected areas management; conservation strategies; and monitoring climate change, as reflected by vegetation cover.

Project deliverables include: a centralized database of vegetation and associated ecological data collected in arctic Canada; classification and description of arctic vegetation associations, as an expansion of the CNVC; posting of detailed arctic vegetation association descriptions on the CNVC website and a georeferenced GIS database of site locations for all data sources.

NUNAVUT COASTAL RESOURCE INVENTORY: METHODS, LINKAGES AND OUTCOMES OF A COMMUNITY-BASED RESEARCH PROJECT

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A coastal inventory is a collection of information on coastal resources and activities, gained from community interviews, research, reports, maps, etc., which can be spatially mapped, to assist in management, development and

conservation of coastal areas. Information gained from a coastal inventory could: be the foundation for an integrated coastal management plan; provide essential information to enable protection of important coastal areas; and, be used for environmental impact assessments, sensitivity mapping, and community planning. Inventories of coastal resources provide communities and governments with the necessary tools to engage in active and informed development and stewardship of coastal resources. Inventories of resources found along the coast have been conducted in many jurisdictions throughout Canada, specifically in the Atlantic and West Coasts of Canada, but have yet to be conducted in the North. The principle source of information for community-based coastal inventories in Nunavut is knowledge gathered through community interviews; whereby interviewees are questioned about: fishery resources; habitat; community infrastructure; fish; marine mammals; aquatic plants; invertebrates; birds; cultural, recreational and tourism-related resources; significant or unique coastal features; shoreline classification; and others. Other sources of information include existing reports, documents, maps and other such materials containing information relevant to the inventory; including both traditional knowledge and science based reports. Visual surveys of the coastline and coastal community provide information on important coastal features, the types and condition of infrastructure, such as wharves and fish plants, as well as locations of various coastal activities and sources of pollution, such as town dumps and sewage sites. In Nunavut, two other very important applications exist for the coastal resource inventory; preserving Inuit Qaujimajatuqangit (IQ) and rapid environmental changes, particularly climate change. Some communities are exploring development options where they can use a database of information that has its origins in the living memories, experience, history and skills of the people who live there. Other communities may wish to sustain existing practices which means gathering together existing knowledge into a form that will allow informed decision-making. Fundamental to this process is the recognition that IQ is historical and also contemporary information that helps to anticipate the future; recognizing the growing urgency throughout the Territory to identify, record, and conserve Nunavut's biological, cultural and ecological knowledge. So far a coastal resource inventory has been completed for Iglulik, Nunavut and four more communities have agreed to participate this year in completing an inventory (Arctic Bay, Kugluktuk, Chesterfield Inlet and Kimmirut). Vital to the inventory's success is an ongoing refinement of the methodologies employed and the linkages being made between community-based traditional knowledge work and the broader more science-based networks within Canada. Among the lessons learned from the pilot project in Iglulik, collaboration and cooperation emerge as key elements in creating successful, broadly applicable, and locally relevant project outcomes. The unique approaches to conducting the coastal inventory combined with the range of organizations actively participating in the inventory process provide an opportunity to explore and refine the exchange that must occur between community-based and science-based research.

STRATIGRAPHIC ANALYSIS OF AN ICE CORE FROM THE PRINCE OF WALES ICEFIELD, ELLESMERE ISLAND, ARCTIC CANADA, USING DIGITAL IMAGE ANALYSIS: HIGH-RESOLUTION DENSITY, PAST SUMMER WARMTH RECONSTRUCTION AND MELT EFFECT ON ICE CORE SOLID CONDUCTIVITY

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High-resolution (1 mm) stratigraphic information was derived from digital image analysis of an ice core from the Prince of Wales (POW) Icefield, Central Ellesmere Island, Canada. Following careful image processing, a profile of ice core transmitted light was derived from the greyscale images and used to reconstruct high-resolution density variations for the un-fractured sections of the core. Images were further classified into infiltration and glacier ice using an automatic thresholding procedure, and converted to a high-resolution melt percentage index. The mean annual melt percentage over the last 580 years was 9%, and melting occurred in eight years out of ten. Melting obliterated most of the original depositional sequence, and seasonal density cycles were mostly unrecognizable. The ice core solid conductivity was greater and more variable in melt features than in glacier ice, due to melt-induced elution and chemical enrichment upon refreezing. This hindered the identification of acid volcanic layers and further compromised dating by annual layer counting. Comparison of the melt record with those from other Arctic ice caps shows that the melt-temperature relationship on POW Icefield is site-specific. We speculate that this is due to the peculiar position of

the icefield, which rests on the periphery of the Baffin Bay maritime climate zone, and to the proximity of the North Open Water polynya, which control snow accumulation variability on the icefield and affect the melt percentage index.

ANALYSIS OF LOCAL AND SCIENTIFIC KNOWLEDGE OF ARCTIC CHAR TO DEVELOP A COMMUNITY-BASED MONITORING (CBM) PLAN TO MONITOR LONG-TERM CHANGES IN LOCAL POPULATIONS FROM THE EFFECTS OF CLIMATE VARIATION AND CHANGE (CVC) IN SACHS HARBOUR, NWT

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Arctic char are an important resource to the people of Banks Island NWT. In recent years, major climate change and variability (CVC) has been observed in the area. Concerns have been raised by local residents and scientists about the potential effects climate change and variability could have on this valuable resource. As part of the *International Polar Year Climate Variability and Change (CVC) Effects on Chars in the Arctic*, a community-based monitoring (CBM) plan is being developed to bring together local knowledge and scientific knowledge of chars and biodiversity for this area. Within the context of char biodiversity, assessment of changes in the resource and attributing cause will be studied to determine key indicators of changes in the Arctic char fishery suitable for long-term community-based monitoring of the resource. The first step in this process is to determine baseline conditions against which future changes can be compared. Scoping sessions conducted with local residents determined potential indicators through local expert observations of change in both the fishery and the environment. Potential indicators (for fish this included numbers, length, condition; for the environment this included mean annual temperatures, ice coverage in Thesiger Bay) were incorporated into the summer field sampling. Potential indicators suggested by local knowledge dictated the parameters studied during baseline sampling efforts. Multi-mesh gillnets were used to sample three lakes (Fish Lake, Middle Lake and Capron Lake) used for subsistence fishing. Fish were examined for a variety of morphological parameters to catalogue local biodiversity. Historical char data collected from 1994 to 1995 from the same three lakes utilizing similar methods were compared to recent information. Fish Lake, Banks Island, NWT was chosen as a reference lake to look at the relationship between inter-annual growth rate of individual Arctic char in relation to climate changes (mean annual temperature, mean annual precipitation, Thesiger Bay ice cover) between the two time periods. Otolith back-calculation techniques were used to assess inter-annual growth of each individual char from Fish Lake. Meteorological data collected from Environment Canada and analysis of satellite imagery of mean annual ice cover in the Bay were analyzed to examine mean annual environmental variation. Age-specific inter-annual growth of char in relation to mean annual climate variation was compared between the 1994 and 2008 time series. Development of a long-term monitoring protocol to detect early changes in the fish populations which can be implemented by the local people is the ultimate goal of this work. The approach developed for Sachs Harbour will serve as a model for similar local monitoring programmes in other communities in the Arctic.

SPRING MEASUREMENTS OF STRATOSPHERIC COMPOSITION FROM PEARL IN 2007 AND 2008 USING THE PORTABLE ATMOSPHERIC RESEARCH INTERFEROMETRIC SPECTROMETER FOR THE INFRARED (PARIS-IR)

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Springtime in the Arctic atmosphere is the most chemically active time of year. The first light the High Arctic atmosphere experiences after months of polar night triggers chemical reactions involved in stratospheric ozone depletion. The Atmospheric Chemistry Experiment (ACE) is a satellite mission on-board the Canadian satellite SCISAT. One of its goals is to understand the chemical and dynamical processes controlling middle atmosphere ozone distribution, particularly in the Arctic. The primary instrument on SCISAT is the ACE-FTS, a high resolution Fourier Transform Spectrometer. Each spring since 2004, the ground-based version of the ACE-FTS, the Portable Atmospheric Research Interferometric Spectrometer for the Infrared (PARIS-IR), has been deployed at the Polar Environment Atmospheric Research Laboratory (PEARL) in Eureka, Nunavut (80N, 86W) as part of the Canadian Arctic ACE Validation Campaign project. PEARL is ideally located for these campaigns as a large number of ACE overpasses occur between February and March. PARIS-IR is one of eleven ground-based and balloon-borne instruments used in the campaigns each year. It records double-sided interferograms with the same maximum optical path difference (25 cm) as ACE-FTS, resulting in a resolution of 0.02 cm^{-1}. PARIS-IR is designed to measure the full 750 - 4400 cm^{-1} spectral range with each measurement. This feature allows total column measurements of a range of atmospheric species to be determined from every spectral measurement, creating a data set with high temporal resolution.

During International Polar Year (IPY), PARIS-IR operated at PEARL for six weeks during February and March in 2007 and 2008. It made solar absorption measurements of a range of ozone and related trace gas species (including HCl, HNO_3 and HF) during this time. This presentation will describe these trace gas measurements and interpret them relative to the different dynamical conditions observed. Additionally, results will be compared with measurements made with two high-resolution Fourier Transform Infrared (FTIR) Spectrometers, the CANDAC Bruker-IFS 125 HR and the Environment Canada DA8 FTIR Spectrometer, collocated at PEARL during the Canadian Arctic ACE Validation campaigns.

MEASUREMENTS OF AEROSOLS IN THE CANADIAN HIGH ARCTIC USING AN AEROSOL MASS SPECTROMETER

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An aerosol mass spectrometer (AMS) from Aerodyne Research Inc. has been installed in the Polar Environment Atmospheric Research Laboratory (PEARL) in summer 2006.
PEARL is located on Ellesmere Island (80°N 86°W) in the Canadian high Arctic on top of a ridge at an elevation of 610 m, and hence, most of the time the laboratory is situated within the free troposphere and therefore well suited as a receptor site to study transport of pollutants through the troposphere into the Arctic region.

The AMS is measuring the aerosol mass concentrations as well as the composition and size distribution of ambient aerosol at this site. Here we report on the design of the air sampling system and installation of the instrument. Preliminary data show the capabilities of the AMS in this location. Sulfate was at most times the predominant aerosol component and during the analyzed period from 2006-8-5 to 2006-10-13 it had an average concentration 0.115 μg m-3 (detection limit was estimated 0.003 μg m-3). The second most abundant component was organic aerosol, with on average 0.111 μg m-3 (detection limit 0.042 μg m-3). The nitrate component, which averaged 0.007 μg m-3, was above its detection limit (0.002 μg m-3), whereas ammonium was on average approximately 0.02 μg m-3, close to its detection limit. A few episodes having increased mass concentrations and lasting from several hours to several days are apparent in the data. On a long term, there are only moderate correlations between the different components. However, short term episodes can be identified with higher or very poor correlation among certain components, as for example sulfate and organics, which are associated with common or different sources, respectively. Back-trajectory analysis can identify potential source regions and pathways of long-range transport of aerosol. This is demonstrated for one strong sulfate episode.

A SEDIMENT AND ORGANIC CARBON BUDGET FOR HUDSON BAY

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A preliminary sediment and organic carbon budget is constructed for the Hudson Bay marine system on the basis of literature data and new information derived from river samples and 13 sediment boxcores. The budget considers the main inputs of sediment and organic carbon, both terrestrial and marine, and the main sinks (sediment burial and oxidation) and losses (export to Hudson Strait). Despite the considerable influence of river discharge on the Bay's oceanography, the modern supply of sediment and terrigenous particulate organic carbon (POC_{terr}) by rivers is presently minor compared to the redistribution of old deposits in shallow water undergoing erosion due to isostatic rebound. Marine (autochthonous) primary production represents the largest source of POC and, despite large losses by oxidation or leaching in the water column and surface sediments, contributes roughly 60% of sedimentary carbon burial. The relatively high marine carbon burial rates (equivalent to roughly 3% of estimated new primary production) may be enhanced by a component of old recalcitrant marine carbon, which was deposited in the post-glacial Tyrrell Sea and now lies in eroding shallow water deposits. However, terrigenous POC, including part of the material recycled from shallow-water deposits, appears to undergo large losses (>50%) in the water column. Its degradation may be enhanced by repeated cycles of resuspension and deposition during transport to offshore sinks. Dissolved organic carbon (DOC), for which riverine and marine inputs are roughly equivalent, is poorly constrained due to a scarcity of marine data. However, DOC appears to be the major carbon export from the system and conversion of POC to DOC likely represents an important internal POC_{terr} loss pathway. A better understanding of DOC composition, production and loss mechanisms is needed to assess whether or not the Bay is net heterotrophic or autotrophic. The sediment and POC budgets imply that the Hudson Bay system is already in transition due to past and present isostatic rebound. The dynamic redistribution of shallow-water sediments complicates predictions of future change consequent to altered river discharge and coastal resuspension resulting from change in ice climate.

INFLUENCE OF SNOW COVER THICKNESS ON THE TAXONOMIC COMPOSITION AND ABUNDANCE AND ECOLOGICAL ROLE OF SYMPAGIC MEIOFAUNA IN THE CANADIAN BEAUFORT SEA DURING SPRING

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Sea ice plays a pivotal role in the biology and ecology of polar marine systems, supporting a productive community of microalgae as well as a diversity of heterotrophs ranging from bacteria to metazoan. Unprecedented changes of the Arctic sea ice cover in response to climate change, have brought forth an urgent need to further document its biological diversity and its role in polar marine ecosystems. During the Circumpolar Flaw Lead (CFL) system study, the taxonomic composition and abundance of the bottom sea ice meiofauna were investigated from March to June 2008 at 15 stations on pack ice in the southeastern Beaufort Sea. At each station, bottom ice samples were collected at high (>20 cm) and low (<5 cm) snow cover sites. Preliminary results show that the average of bottom ice meiofauna abundance and chlorophyll *a* (chl *a*) concentration were 3 times higher under low snow (6162 ind. m^{-2} and 69.6 mg chl *a* m^{-2} respectively) in comparison to high snow (2148 ind. m^{-2} and 18.7 mg chl *a* m^{-2} respectively) covers. The meiofauna was mainly composed of crustacean nauplii which numerically dominated the samples (average = 66%) followed by copepods (12%), rotifers (11%) and nematods (9%). The taxonomic composition of the meiofauna was comparable between the snow cover sites except for the presence of rotifers which were only observed at low snow cover sites. Additional samples are currently under analysis for determination of meiofaunal carbon biomass and potential carbon ingestion rates. Potential ingestion rates, determined using allometric equations, will in turn enable us to assess the importance of meiofauna to in the overall carbon flow in the sea ice biota.

SEASONAL CHANGES IN THE VERTICAL DISTRIBUTION OF GEL-LIKE AND PARTICULATE ORGANIC MATERIAL IN FIRST-YEAR SEA ICE DURING SPRING IN THE CANADIAN BEAUFORT SEA

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Understanding the role of exopolymeric substances (EPS) in first year Arctic sea ice is important as these gel-like substances play a central role in carbon and elemental cycling. This study, which was conducted from the 8 May to 2 June 2008 in the eastern Beaufort Sea, as part of the CFL (Circumpolar Flaw Lead) study, was designed to investigate relationships amongst sea ice bacterial and algal assemblages, EPS, and the physical characteristics of ice cores. On 5 occasions, first-year sea ice vertical profiles were analyzed for salinity, temperature, bacterial abundance, EPS, and total chlorophyll *a* (chl *a*). The same variables were measured at the ice-water interface and in the surface water (1 m) at the time of sampling. This paper focuses primarily on the vertical distribution of EPS and chl *a* in sea ice and comparisons with interfacial water. Concentrations of chl *a* and EPS-carbon ranged from 0.22 to 18.3 mg m^{-3} and 80.5 to 374 mg C m^{-3} respectively at the ice-water interface, from 0.34 to 45.9 mg m^{-3} and 326 to 2645 mg C m^{-3} in the bottom 3 cm of the ice, and from 0 to 2.32 mg m^{-3} and 30.8 to 608 mg C m^{-3} in the remainder of the ice cores. EPS was more evenly distributed in the ice compared to chl *a*, as bottom ice EPS-carbon consistently made up < 50% of integrated sea ice EPS-carbon concentrations, whereas bottom ice chl *a* contributed an average of 83% of integrated sea ice chl *a* concentrations. Sea ice integrated chl *a* and EPS-carbon concentrations both decreased during the study, with a greater decrease for chl *a* than EPS. Concentrations were highest in early May, 21.8 mg m^{-2} and 217 mg C m^{-2} for chl *a* and EPS respectively, and decreased thereafter to averages of 0.92 mg m^{-2} and 164 mg C m^{-2}. Bottom ice salinity also decreased during the study, reflecting the onset of melt. These results indicate that EPS is preferentially retained in the sea ice at the time of melt, with potential large-scale implications for the cycling of carbon in a changing Arctic.

CONTRIBUTION OF MEDUSAE TO THE INCREASING ANNUAL PARTICULATE ORGANIC CARBON EXPORT IN HUDSON BAY

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An important component of the ArcticNet marine observatory is the deployment of moored sediment traps to measure the annual cycle of carbon export over several Arctic shelves. In Hudson Bay, sediment trap AN01 was deployed at 80 m on the western side of the bay in 2005-2006 while sediment trap AN03 was deployed at 100 m on the eastern side of the bay near the mouth of the Great Whale River in 2005-2006 and 2006-2007. Although annual cycles were different, annual particulate organic carbon (POC) fluxes at AN01 and AN03 were similar in 2005-2006 (12.4 g C m^{-2} y^{-1} and 12.0 g C m^{-2} y^{-1}, respectively). In 2006-2007, the annual POC flux at AN03 increased to 15.0 g C m^{-2} y^{-1} and the sinking material collected was marked by a substantial abundance of *Aglantha digitale*, an ubiquitous medusa feeding on small zooplankton. The considerable amount of small, undeveloped medusae (~3 mm) collected mostly in summer and fall suggests that these animals were passively sinking and were therefore a component of the POC flux. The increase in POC flux and the important contribution of medusae to vertical carbon export (1.0 g C m^{-2} y^{-1}) in 2006-2007 in eastern Hudson Bay may reflect a changing ecosystem, as medusae are highly opportunistic and can rapidly dominate an ecosystem. Considering the role of the Hudson Bay as an early-warning sentinel for change in the Arctic Ocean, these results reflect what may occur in the next few years over the Arctic continental shelves, i.e. an increase in POC export and a change in ecosystem structure. Further measurements of pelagic ecosytem structure are required in conjunction with the continual monitoring of POC export through the ArcticNet marine observatory to determine if these results reflect a long-term trend.

THE IMPACT OF LOCALIZED PERMAFROST DISTURBANCES ON SEDIMENT YIELD IN A COASTAL, HIGH ARCTIC CATCHMENT

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Melt season active layer thickness in permafrost regions is projected to deepen substantially in response to increased melt energy and longer snow-free seasons. Deep active layers can melt buried ground ice and lead to increased landscape instability due to the presence of subsurface water arising from this melt. One common response to these changes is the formation of active layer detachments (ALD), where the thawed overburden becomes unstable and slides down slope. ALD occur rapidly and represent both an infrastructure risk and introduce poorly-understood impacts on downstream aquatic and marine systems. Due to the localized nature of ALD, the impact on sediment erosion has received only limited research attention. We investigated the sediment erosion and yield dynamics of extensive ALD that formed in 2007-8 at the Cape Bounty Arctic Watershed Observatory (CBAWO), Melville Island, Nunavut (74°55'N, 109°30'W) to provide observations to constrain the localized and watershed-scale impacts of this common permafrost disturbance feature.

Systematic sediment transport measurements from four tributaries subject to different degrees and age of disturbance by ALD, and an additional control tributary were carried out during the 2008 melt season. The yield from the control and pre-1950 ALD systems was low, although the latter was still able to generate sporadic high suspended sediment concentrations (SSC) during high discharge periods. By contrast, the tributaries with recent ALD were characterized by high SSC, exceeding 14 000 mg/l on some occasions. While most tributaries were ephemeral and did not flow during the mid-season, the largest ALD at CBAWO continued to flow all season due to meltwater supply from a perennial snow bank. This tributary, along with one other site, dominated sediment transport at the watershed scale for much of July, indicating the importance of limited contributing areas to catchment fluxes. These results provide important information to understand the watershed-scale fluxes of sediment from coastal catchments and will provide a means to test novel approaches to represent Arctic sediment fluxes in hydrological and sediment transport models.

CONDUCTING RESEARCH WITHIN THE NUNATSIAVUT REGION

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The Nunatsiavut Inuit Research Advisor (IRA) is a position administered by the Nunatsiavut Government and made possible by the support of the Nasivvik Centre for Changing Environments, ArcticNet (Network of Centres of Excellence for arctic research), the Northern Contaminants Program and the Nunatsiavut Government.

The Nunatsiavut IRA oversees the management of the Nunatsiavut Government Research Office in Nain, Labrador, serving as the first point of contact for all researchers conducting work in Nunatsiavut and requiring contact with or assistance from the Nunatsiavut Government.

The Nunatsiavut IRA serves as administrator of the Nunatsiavut Research Review Committee and oversees the research review and approval process, ensuring that research conducted in Nunatsiavut addresses the Inuit concerns and contributes to the goals of the Nunatsiavut Government and the Inuit Communities.

The Nunatsiavut IRA, like the three other Inuit regions, is witnessing a major increase in all fields of human and environmental research. This in turn places increased demands on the capacity of the region's environmental review, regulatory, and project support structures. This increased level of activity also impacts the ability of our communities to be aware of, comment on, and be fully involved in the conduct of this research. These challenges reinforce the need for early contact with the Nunatsiavut IRA on all research projects within the region.

ON THE RELATIONSHIP BETWEEN SNOW GRAIN MORPHOLOGY AND IN-SITU NEAR INFRARED CALIBRATED REFLECTANCE PHOTOGRAPHS

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Seasonal and permanent snow covers a significant portion of our planet, and its impact on climate is significant. Through specific thermophysical properties, snow controls radiative and turbulent fluxes between the ground and the atmosphere, but many aspects of the energy balance are poorly understood due to lingering uncertainties regarding snow properties, such as grain size in particular. Rapid and accurate measurement method has yet to be developed given the reality of field and laboratory logistical constraints, and the sensitivity of snow to such manipulation away from its natural environment.

In this paper, we describe and discuss the practical implementation in the field of two methods for characterizing snow grain morphology parameters form 'traditional' snow photography and instantaneous near infrared (NIR) reflectance photographs of snow walls. A total of 54 snowpits were analyzed during our International Polar Year field campaign across a 1000 km South-to-North transect over Eastern Canada. We compared the measurements with the theoretical model of Kokhanovsky and Zege (2004). We show that infrared reflectance can quickly and accurately provide snow grain optical diameter information, which can be applied to various studies such as passive microwave radiative transfer models. The relationship between measured snow grain geometrical diameters from 'traditional' photography and optical diameters derived from IR photos is discussed, considering the problem of different shape factors.

Keywords: Snow grain, infrared reflectance, model, *in-situ* measurements

WINTER VARIABILITY OF CARBONATE SYSTEM PARAMETERS IN THE WATER COLUMN OF FRANKLIN BAY (CANADIAN ARCTIC, CASES WINTER STATION)

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In the context of climate change, the time variability of carbonate system parameters in the Arctic Ocean remains an open question. During the Canadian Arctic Shelf Exchange Study (CASES), the research icebreaker Amundsen was ice-bound in Franklin Bay between 29th November 2003 and 1st June 2004 to study the winter variability of this arctic coastal zone. This presentation describes the temporal variability of carbonate system parameters (total alkalinity (TA), dissolved inorganic carbon (DIC) and pH) from this unique time-series of 33 vertical profiles recorded over the winter. CTD profiles revealed that the density stratification was mainly driven by the salinity and the presence of a stable mixed layer whose thickness (0-30 m depth) varies with the tidal cycle. The seawater temperature was close to the freezing point (-1.5°C) up to 150 m depth and increased to 0°C deeper. Total alkalinity ranged from 2215 to 2267 µmol kg^{-1} in the mixed layer while it was nearly constant at 2295 ±8 µmol kg^{-1} in the deep layer. Surface water pCO_2 increased slightly from 350 ±20 µatm in December to 400 ±30 µatm in May. During the same period, the $\delta^{18}O$ of seawater ranged from -4.1 to -2.2 ‰ in surface water and was close to 0.2 ‰ in the deep layers. The identification and distribution of water masses within the study area was accomplished using an optimum multi-parameter analysis (OMP) based on temperature, salinity, dissolved O_2 concentrations, TA and $\delta^{18}O$. The analysis reveals a strong variability in the upper mixed layer probably due to (i) sea ice formation and brine rejection and (ii) changes in the water mass circulation. Below the upper halocline, a water mass with a 33.1 salinity, derived from the Pacific water, was found around 100 m depth. Below the deep thermocline, a water mass of Atlantic origin was always found in the bottom of the Franklin Bay.

INTERACTION BETWEEN THE ACCELERATE THAW OF DISCONTINUOUS PERMAFROST AND DRAINAGE NETWORK ORGANIZATION, NORTHERN QUEBEC

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Since 1990, the fast rising of air temperature caused important changes in subarctic ecosystems. The discontinuous permafrost is a very sensitive indicator of air temperature fluctuation. Recent studies showed that permafrost temperature in Subarctic regions is close to the freezing point (Calmels, 2005; Buteau, 2004; Osterkamp and Romanovsky, 1999). The degradation of ice rich permafrost mounds strongly influences the surrounding hydrological regime. The creation of new thermokarst ponds and taliks zones alter surface and groundwaterr flow. The drainage network in recently thawed zoned is influenced by this

new excess amount of water and is unbalanced as long as it cannot adapt to the new situation. Preliminary field observations of two watersheds show severe permafrost mounds degradation where the drainage networks are not structured, where as in zones with structured streams, less permafrost degradation is observed.The aim of this research is to determine how drainage network organization influences degradation of discontinuous permafrost in a region of rapid thermokarst.The study area is located near the Hudson's Bay coast 40 km north of Umiujaq. The analysis is performed on two adjacent watersheds which drain into the Nastapoka river. We will use a systems approach to correlate watershed structure and impacts of excess water on ground thermal regime. Analyses of satellite images and aerial photographs will allow to define the geomorphologic structures of the studied watersheds. The elaboration of 2D thermal models in FORTRAN© language is used to recreate part of the permafrost mound conditions. We reconstruct its past thermal evolution in function of different environmental parameters, such as the contribution of water flow as heat conveyor in the warming of the permafrost.We expect to show the existence of a link between the actual transformation of the drainage network and the accelerating deterioration of the permafrost mounds. Furthermore we will determinate by modeling to what extent thermokarst act as heat reservoirs.The scientific contribution of this research will increase the understanding of discontinuous permafrost degradation. It will show the importance of taking into account the environmental structure in model interpretations. Moreover it will increase knowledge of actual and future subarctic ecosystem evolution.

INHERENT OPTICAL PROPERTIES IN HUDSON BAY (CANADA): RESULTS FROM THE 2005 ARCTICNET EXPEDITION

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Accurate determination of phytoplankton biomass and its derived products (primary production, dominant species, etc) using remote sensing techniques is dependent on the inherent optical properties (absorption and backscatter) of the various constituents (organic and inorganic suspended matter, dissolved organic matter). Hudson Bay is a large inland water body highly influenced by river runoff leading to estuarine type characteristics of its optical properties. Accordingly, actual operational remote sensing algorithms do not perform well in this type of environment as dissolved organic matter has the same spectral absorption signature than phytoplankton. Moreover, some areas of Hudson Bay (e.g. James Bay) are known to have important concentrations of inorganic suspended matter due to the river runoff and relatively shallow depths. Finally, it is possible that sub-arctic phytoplankton species have different light absorption characteristics than temperate water species leading to a bias in the biomass estimation. All these factors lead to a large uncertainty of phytoplankton biomass estimation using remote sensing techniques in Hudson Bay.
In order to improve the performance of actual algorithms, it was thus necessary to increase our knowledge of the inherent optical properties (IOP) in Hudson Bay. The presentation will focus on the analysis of IOP measurements (aph, aCDOM and aNAP) that were collected during the Arcticnet expedition in September-October of 2005 at 21 stations representing water masses of various freshwater and suspended inorganic matter content.

ATMOSPHERIC MERCURY DEPLETION EVENTS OVER THE AMUNDSEN GULF AND THEIR NET CONTRIBUTION TO THE MERCURY FLUX TO THE FLAW LEAD SYSTEM

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Since their discovery in 1998, the spring-time atmospheric mercury depletion events (AMDEs) have been found to be ubiquitous in the Arctic and Antarctic. Several major knowledge gaps however remain, including the detailed mechanism of the AMDEs (particularly the role of the sea ice surface) and their NET contribution to the mercury flux into the aquatic marine ecosystems. As part of the International Polar Year (IPY) – Circumpolar Flaw Lead

(CFL) System Study, we report here the concentrations and speciation of tropospheric mercury measured continuously in the Amundsen Gulf from early February to mid July 2008 while onboard the Canadian based ice breaker CCGS Amundsen. The atmospheric mercury measurements include gaseous elemental mercury (GEM), particulate mercury (Hg_p), reactive gaseous mercury (RGM), and total atmospheric mercury (TAM). Measurements began on the 2nd of February and continued until the 10th of July with a temporal resolution of 5 minutes for GEM and TAM and 2 hours for RGM and Hg_p. AMDE episodes were first observed on the 16th of February and occurred sporadically until snowmelt in early June. The timing, amplitude, frequency, and speciation pattern of the AMDEs observed directly above the ocean were compared with data from previous studies; most of which were recorded from coastal stations. Particular emphasis was given on the role of the surface area of the open lead as well as local meteorological conditions. Together with the concurrent measurement of mercury in the cryosphere (snow, ice, brine, and frost flowers) along with seawater, melt water, zooplankton and phytoplankton, this study aims to quantify the relative contribution of AMDE-deposited Hg to the aquatic ecosystem as well as to further our understanding of AMDEs directly over the Arctic Ocean in both open and ice covered areas.

THE INFLUENCE OF INCREASED SNOW ACCUMULATION ON RUNOFF FROM HIGH ARCTIC HEADWATER CATCHMENTS

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The predicted influence of climate change on High Arctic environments includes an increase in fall and winter precipitation. Increased accumulation of winter snow can alter the rates and timing of melt runoff, affect the hydrological flow routing and the quantity and quality of surface water runoff in permafrost environments. The purpose of this study is to examine the impact of increased snow accumulation on the flux of water and solutes from High Arctic catchments.

Two catchments, each paired with a control, have been amended with snow fences to artificially increase snow accumulation. The catchments and controls range in size from 0.6 to 3 ha and are all located on the same slope within a larger watershed. One of the two altered catchments has also experienced an active layer detachment, due to extreme summer temperatures and summer precipitation in 2007

Snow accumulation was determined with a detailed snow survey within each catchment, with measurements taken every 25 meters. More detailed snow surveys, with measurements taken every 3 meters, were conducted over the drifts created by the snow fences . The snow surveys indicate an increase in snow water equivalence of 11 and 40% for the two amended catchments. Discharge has been derived from stage records (10 minute intervals), obtained using pressure transducers that were deployed behind thin plate weirs and in each catchment. Daily peak and low flow samples were collected for analysis of electrical conductivity (EC), pH, alkalinity and major ion concentrations. Soil moisture of the upper 10 cm, and temperature at 10, 20 and 50 cm depths were also monitored at two hour intervals at a site within each catchment. Soil pore water samples were collected periodically from vacuum lysimeters and analyzed for EC, pH, alkalinity and major ions.

Preliminary results indicate that the increase of snow had little effect on the timing of initial melt, but did extend the runoff period relative to the control catchments. The site with 40% increase in snow accumulation exhibited a strong dilution in EC during the early snowmelt period compared to the control,which suggests late season runoff contributions from meltwaters that have had a longer residence time in the subsurface. The EC and alkalinity in this amended site increased after peak discharge, a trend that is not observed in the site with 11% increase in snow accumulation and the active layer detachment or the control sites. The amended and disturbed catchment showed no clear differences in chemical trends from the control sites. These preliminary results will be combined with detailed statistical analyses and comparisons of the dissolved solute loads in the stream and soils to elucidate the impact of the snow accumulation on flow routing and solute acquisition. Comparison with previous years data (prior to amendments and disturbances) will also assist in evaluating the impact of changes in snow accumulation on the hydrology in these catchments.

GREENHOUSE GAS EMISSIONS FROM PERMAFROST THAW PONDS

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One of the consequences of Arctic warming is the accelerated melting of permafrost which leads to the formation of thaw ponds and the mobilization of a pool of carbon that has accumulated over thousands of years. The organic carbon released in these aquatic systems is then exposed to photolysis and microbial transformations, processes that produce greenhouse gases (GHG). We sampled several ponds in the Canadian subarctic (55°N) and arctic (73°N) regions in order to relate greenhouse gas exchanges to their limnological characteristics. They are relatively productive systems for these latitudes (in average 11.2×10^6 bacteria ml^{-1}, 4.9 μg Chla L^{-1} and 51 μg TP L^{-1}), with abundant and diverse microbial assemblages. Thaw ponds are optically variable, most often supersaturated in CO_2 and CH_4 and net heterotrophic, except for the ponds on low-center polygons colonized by photosynthesizing cyanobacterial mats that drive down the CO_2 concentration. However, arctic ponds are more important CH_4 emitters than subarctic ponds (at least in mid-summer). Despite their shallowness, subarctic thaw ponds are stratified during most of the year, with CO_2 and CH_4 building up at depth, the autumnal overturn being a critically important period for GHG emissions. Gas fluxes were measured using a floating chamber and compared to estimations based on dissolved gas concentrations, wind speed and considering diffusive mixing at low wind speed. Dissolved CO_2 and wind speed recorded during 8 days in one subarctic pond yield large variability in gas fluxes.

BERRY PRODUCTIVITY IN A WARMER NORTH: NATURAL VARIATION AND IMPACTS OF FIELD EXPERIMENT

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Berry picking is an important autumn activity in northern communities, providing a healthy and locally abundant source of food (Usher, 1976). Warming in the Arctic may affect biotic components of terrestrial ecosystems, including dwarf and prostate berry producing shrubs. This in turn may affect the people who rely on this particular food source. The ecology of berry producing shrubs in relation with a warming climate and associated land-cover changes is poorly known. We will investigate the response of berry producing shrubs to natural variation and simulated environmental changes for four species commonly used by Inuit communities. The four study species include bilberries, cranberries, crowberries, and cloudberries.

The main objectives of this project are to assess the response of berry producing shrubs to experimental warming, and to gain traditional ecological knowledge of the uses of these shrubs. The three study sites are located in Kangiqsualujjuaq and Kangiqsujuaq, in the Nunavik region, and in Baker Lake, in the Kivalliq region. To evaluate the impact of warmer and longer growing seasons we will use standard ITEX (Molau and Molgaard, 1996) open top chambers (OTC). We will also be conducting interviews with elders of the communities.

We expect that a warming climate will impact berry shrub production. Lengthening the growing season will affect flowering times and sexual reproduction of each of shrubs differently. Interviews with local elders will determine traditional uses of the shrubs, the importance of these shrubs to the communities, as well as the areas traditionally used by local people for the harvest of berries.

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COUPLED 3D PHYSICAL–BIOLOGICAL MODELLING STUDY OF THE RIVER-INFLUENCED BARENTS/KARA SEA SYSTEM

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Global models converge towards the consensus that climate change should be enhanced in the Arctic more than elsewhere. By the end of this century, the Arctic Ocean is predicted to be ice free in summer and this is a major concern for policy makers and the fisheries industry. The Barents/Kara Sea (BKS) system is an important fishing ground and one of the most productive areas of the World Ocean. It became recently one of the new Arctic "hot spots" with mean surface air temperatures increased by 1-4°C in average. Sea ice extent and concentration and the length of the ice-free season all decreased since the 1970's. The freshwater discharge from the six largest Eurasian rivers also increased in the past 70 years. Four of those lie along the BKS shores and account for about 50% and 60% of the total annual freshwater and dissolved organic carbon input in the Arctic Ocean, respectively. Inferring the effects of such changing environmental conditions on the BKS plankton dynamics and productivity poses, therefore, as a pressing issue. In the past two decades, coastal numerical models have considerably evolved to infer the ocean variability and processes with a high spatial and temporal resolution hard to achieve with field surveys alone. For the BKS, a biological model is being coupled to a three-dimensional sea ice-ocean model (POLCOMS-CICE) to simulate the plankton ecosystem response to the prevailing oceanographic conditions from the synoptic (e.g. diurnal tides, storm events) to seasonal (e.g. winter mixing, summer stratification, sea ice dynamics, river runoff) time scale. Preliminary results from hindcast simulations (2000-2001) will be presented with a focus on the physical-biological coupling and the role of the Yenisey and Ob rivers on the plankton ecosystem function.

BIOGEOCHEMICAL STUDIES IN THE SEA-ICE, MARGINAL ICE ZONE AND OPEN WATERS OF THE ARCTIC NORTH OF SVALBARD: PRELIMINARY RESULTS FROM THE INTERNATIONAL "ICE CHASER" CRUISE, (SUMMER 2008)

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Rapid climate-induced changes in Arctic sea-ice and water column structure will have a significant impact on the Arctic marine ecosystem and carbon cycle, and the accurate prediction of such changes is a major challenge for the Arctic marine science community. During July and August 2008 a multidisciplinary programme of observational and experimental research was undertaken on the RRV *James Clark Ross* in shelf seas to the north of Svalbard in the European Arctic. The objective of the UK-led expedition was to improve our understanding of the ecology and biogeochemistry of the region and thereby help refine models of ecosystem response to environmental change. A range of physical, chemical and biological observations and experiments were conducted in the water column and sediments at ice-covered, marginal ice zone and open water stations. Oceanographic conditions were colder than expected with extensive ice cover due to northerly winds driving pack ice into the region; the marine ecosystem was therefore characterised by typical Arctic species. Preliminary results revealed the presence of a post-bloom recycling community characterised by an active but relatively slow growing phytoplankton community, and a active bacterial community which was uncoupled from the phytoplankton. Healthy populations of large herbivorous zooplankton were also found in deep waters indicting the presence of an earlier under-ice phytoplankton bloom. This poster summarises these and other preliminary findings from the expedition.

METHYLATION AND OCEAN-ATMOSPHERE FLUXES OF MERCURY IN HIGH ARCTIC MARINE WATERS

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Methylmercury (MeHg), a vertebrate neurotoxin which bioaccumulates through foodwebs, is found in some Arctic marine mammals at levels that may be harmful to northern peoples consuming them as traditional food. Unfortunately, the sources of MeHg to polar marine food webs remain unknown, in part due to the complex nature of Hg cycling in polar marine waters. During the 2005 and 2006 ArcticNet cruises aboard the CCGS Amundsen, we sampled seawater at sites in the NOW Polyna, Northwest Passage and Hudson Bay and found elevated concentrations of methylated Hg species, such as MeHg and dimethyl Hg (DMHg, a toxic and volatile form of Hg) in deeper regions of the water column, even though concentrations of total Hg at those same sites were low. Therefore, we hypothesize that MeHg and/or DMHg are produced directly in the water column of polar oceans from inorganic Hg(II), a species which is not as toxic or as readily bioaccumulated. While aboard the CCGS Amundsen in 2006 and 2007, we tested this hypothesis experimentally using stable-isotope Hg tracers to quantify the rates of production of methylated Hg species from Hg(II). Seawater samples were amended with ^{198}Hg(II) and incubated for 8,16 or 24 hours to measure the production of Me^{198}Hg and DM^{198}Hg, as well as gaseous elemental ^{198}Hg(0), over time. A second tracer, Me^{199}Hg, was also added to seawater samples to quantify both the production of DM^{199}Hg and ^{199}Hg(0) from Me^{199}Hg and demethylation rates of Me^{199}Hg. Preliminary results indicate that methylation of Hg(II) to MeHg occurs in the water column of polar oceans, but that the rate of methylation is low. We also show that DMHg is produced fairly rapidly in deeper regions of the water column (below the oxycline), and that the rate of DMHg production is about 50x faster with MeHg as the substrate compared to Hg(II). Furthermore, Hg(II), and to a lesser extent MeHg, are reduced to gaseous elemental Hg(0) (GEM) in the water column, resulting in a net efflux of 130 ng·m^{-2}·d^{-1} of GEM to the atmosphere during the ice-free season. Arctic marine waters are also a source of DMHg to the atmosphere during the ice-free season (27 ng·m^{-2}·d^{-1}), despite low DMHg surface concentrations. Rate constants for some of the major processes involved in the biogeochemical cycling of Hg (methylation/demethylation, and reduction) will be calculated from the results of these experiments, which will provide valuable information for Hg models. This research will not only help to determine sources of MeHg to polar marine organisms, it will also broaden our understanding of Hg cycling in the Arctic.

ECOLOGY AND GEOMORPHOLOGY OF RIPARIAN VEGETATION IN A LARGE HIGH-BOREAL LAKE DURING THE 20TH CENTURY

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The riparian biodiversity surrounding large northern lakes is mostly concentrated in flat shores which are periodically affected by ice pushes and wind storms. These shores are characterized by organic-mineral platforms colonized and stabilized by a mosaic of riparian vegetation that reflects its exposure to physical disturbances. The development and long term viability of the vegetated platforms depend on the stability of the mean water level which directly determines the disturbance regime. In northern Québec, many studies reported an increase in precipitations during the 20th century. This study focussed on the shore section of a large high-boreal lake to decipher whether this secular trend in precipitations affected the riparian platform dynamics. The hydroclimatic analysis of the ice-scar chronology within the shore section allowed detection of a rapid increase in ice-push frequency at the start of the 1930s, associated with an increase of spring flood discharge leading to high water level. The vegetation mosaic analysis showed that the vegetated riparian platforms underwent severe erosion, which clearly indicated that they were not in equilibrium with the current disturbance regime. Along the studied shore section, it was noted that about 61% of the vegetated platforms were lost due to erosion. In the context of global warming which is manifested by increasing precipitations in this area, this study documents an increase of the erosion process that could ultimately lead to a loss of riparian ecosystems and northern biodiversity. Because riparian zones are known to play a central role in landscape ecology, and because they undergo severe erosion worldwide, there is an urgent need to test and evaluate

ecological evolution models in natural contexts to provide insight for conservation and restoration purposes.

PREDICTING 21ST CENTURY DISCHARGE AND SEDIMENT FLUX IN SMALL UNGLACIATED ARCTIC RIVERS

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Large arctic rivers are important contributors of sediment, water, and nutrients to the Arctic Ocean, and their historical and anticipated discharge and sediment flux characteristics have been relatively well studied. However, small rivers have received less attention. While small rivers individually contribute small volumes of sediment, water, and nutrients, this is not the case cumulatively. In addition, small rivers contribute more than large rivers on a specific yield basis. Relationships between runoff and basin area, and sediment yield and basin area are strongly negative. Proportionately less sediment is trapped in the deltas of small rivers, so more of their load reaches lakes and oceans (Milliman and Syvitski, 1992).

This project predicts discharge and sediment yield over the 21st century at the Cape Bounty Arctic Watershed Observatory (CBAWO), Melville Island, Nunavut. Two small (~10 km^2) watersheds are studied. Output from the Canadian Coupled Global Climate Model (CGCM3) for IPCC scenarios A2 and A1b were obtained for the closest grid cell to Cape Bounty, and statistically downscaled. Under the A2 scenario, annual air temperature at Cape Bounty is projected to increase by about 8 *C, and precipitation is projected to increase by about 40% by 2100.

These changes will substantially increase discharge and sediment flux. In particular, the large increase in precipitation will not only increase winter snowpack and the magnitude of the nival flood, but also increase the frequency and magnitude of large summer rainfall events. Preliminary results using the hydrologic and sediment transport model Hydrotrend (Kettner and Syvitski, 2008), suggest that runoff and sediment yield will approximately double by 2100 under the A2 scenario. The largest summer rainfall event, and the number of large (>10 mm) events per summer will also roughly double.

Kettner, A.J., Syvitski, J.P.M. (2008). HydroTrend v.3.0: A climate-driven hydrological transport model that simulates discharge and sediment load leaving a river system. Computers & Geosciences. 34: 1170-1183.

Milliman, J.D., Syvitski, J.P.M. (1992). Geomorphic/tectonic control of sediment discharge to the ocean: the importance of small mountainous rivers. The Journal of Geology. 100: 525-244.

CHARACTERISTICS OF DISCONTINUOUS PERMAFROST, SOUTHERN YUKON TERRITORY

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Two-dimensional DC resistivity profiling was used to examine the characteristics of shallow permafrost at three lowland and eight mountain sites in the southern Yukon Territory. Ground temperatures from logged thermistor cables or annual manual readings were available for most of the sites. Frost table depths along the transects also helped constrain the interpretations. Ground temperatures at or close to the depth of zero annual amplitude were all warmer than -0.5°C. Interpreted permafrost depths were generally less than 10 m but reached 25 m at one location. Sites with coarse materials showed sharp transitions in resistivity values at the base of permafrost while those in fine-grained materials showed gradational boundaries, interpreted as being due to progressively increasing unfrozen moisture contents close to 0°C. There were large differences in the relative resistivity values for frozen and unfrozen ground but the absolute values for permafrost were lower than many others reported in the literature for mountain sites. The DC resistivity technique proved to be extremely useful in characterizing the distribution and continuity of frozen ground at these shallow and sensitive permafrost sites and provided a baseline data-set for monitoring future change.

PREY CONSUMPTION OF BREEDING PEREGRINE FALCONS IN RANKIN INLET

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Understanding the mechanisms linking climate to wildlife populations is difficult because a large number of parameters can interact. Moreover, growth, survival and reproduction of organisms can be affected both directly and indirectly by climatic variations. For example, a change in precipitation patterns could directly influence wildlife survival and breeding success via increased thermoregulation costs or indirectly through decreased food availability. We investigated the breeding ecology of peregrine falcons (*Falco peregrinus*) nesting in the surrounding of Rankin Inlet, Nunavut (62ºN, 95ºW). A dense population of falcons (36 nests 450 km^2) has been monitored at this site since 1982. The population productivity (i.e. the total number of young produced per year) has decreased significantly over the last decades. However, very little is known about the mechanisms driving adult survival and breeding success of these arctic-nesting falcons. In order to better identify the factors driving the population, we first described the spatial and temporal variation in prey availability and linked these with the diet of falcons nesting in different location (i.e. island, shore or inland). We used stable isotopes and digital scouting cameras to evaluate the relative contribution of prey items to falcon diet. These techniques have been coupled to space used data obtained with GPS-Argos transmitters deployed on adult falcons. Our results indicate a shift in diet over the breeding period according to the breeding phenology of prey species that influence their density over time. Island nesting birds have been found to feed mainly on terrestrial prey items at the beginning of summer while they switch to marine prey items from juvenile stage at the end of summer. Marine and terrestrial prey items can be used in different proportion by breeding birds, depending on nest location. For island nesting birds as for inland nesting birds, the diet can be represented either by marine and terrestrial prey items but specialisation can occur.. Describing the variation in the diet of falcon and linking such variation with prey availability is essential to identify the potential causes of decline in peregrine falcon productivity and better evaluate the vulnerability of arctic falcons to global warming.

MONITORING CHANGE OF VEGETATION PHENOLOGY AND BIOMASS IN WAPUSK NATIONAL PARK FROM EARTH OBSERVATION SATELLITE DATA

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Monitoring vegetation phenology and biomass is required for understanding interannual variations of ecosystem associated with the changing climate in the arctic and sub-arctic region. In this study, the 10-days AVHRR NDVI composite data at 1-km resolution for the years 1985 to 2005 produced by Latifovic et al. (2005) at Canada Centre for Remote Sensing from NOAA/AVHRR satellites was used. A logistic growth model was used to fit the 10-days NDVI composite data and further to derive the vegetation phenology parameters: start date, end data, length, and integrated NDVI (iNDVI) of vegetation growing season. Based on biomass baseline map derived from high resolution satellite data with ground-measured aboveground biomass data, the biomass maps can be derived from growing season iNDVI year by year by using the recently developed approach for mapping biomass with coarse resolution satellite data (Li et al., 2008). The poster presents preliminary results showing annual change of vegetation phenology and biomass with 1-km resolution AVHRR NDVI time-series data for the Wapusk National Park.

USE OF OTOLITH MICRO-CHEMICAL ANALYSES TO PROVIDE INSIGHT INTO CANADIAN CHAR DIVERSITY AND ITS RELATIONSHIP TO ENVIRONMENTAL PARAMETERS

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Arctic char (*Salvelinus alpinus*) and Dolly Varden (*Salvelinus malma*) are two fish species within the Canadian Arctic that exhibit high levels of diversity within and among populations. A key driver of the diversity exhibited within and between char populations is environmental variability. With large climatic changes expected to occur in Arctic regions, better knowledge of char diversity and the mechanisms creating or maintaining such diversity will aid conservation and sustainable management of char populations. Otoliths are a part of a fish's inner ear which are composed mainly of calcium carbonate deposited in layers as the fish grows. During otolith formation, trace elements are incorporated into the calcium-carbonate structure from the ambient environment and/or the diet of the fish. Thus, the analysis of trace elements such as strontium that are incorporated into otoliths can provide insight into many aspects of a fish's life history, diet, habitat and migratory patterns. Our proposed research objectives are to utilise available micro-chemical analytical techniques such as laser ablation and electron and proton microprobe analyses of otoliths to correlate life histories, diet and migration patterns within char populations to environmental parameters. Specific objectives are: 1) to examine first-time migration to and from the sea and its relationship to environmental factors over long periods of time, 2) to identify stocks for the purpose of determining straying and homing consistency and its relationship to environmental factors over a long period of time, and, 3) to examine the source of trace elements such as zinc and to determine its relationship to environmental factors. By addressing the objectives outlined we hope to provide insight into Canadian char diversity and its link to environmental variability.

INVERSE RELATIONSHIP BETWEEN ERYTHROCYTE OMEGA-3 AND SERIOUS PSYCHOLOGICAL DISTRESS AMONG NUNAVIK INUIT

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Background
Studies indicate that omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) are associated with beneficial effects in mood disorders, especially depressive symptoms.
Objective: To examine the relationship between the proportion of omega-3 in the erythrocyte membranes and serious psychological distress (SPD) among Nunavik Inuit adults.
Design
The study population consisted of 746 Nunavik Inuit adults who took part in the Qanuippitaa cross-sectional survey (2004). Fatty acids composition of erythrocyte membranes was quantified by gas chromatography and expressed as percentages of total fatty acids. Nonspecific psychological distress was measured by the Kessler 6-Item Psychological Distress Scale (K6), a brief screening instrument for DSM-IV mood and anxiety disorders in the past 30 days with established validity in the general population. A score ≥ 13 on K6 was used as a threshold to differentiate cases of SPD from non-cases. The risk of SPD according to the proportion of omega-3 in the erythrocyte membranes was assessed by logistic regression analysis. Weighted estimates were calculated by the SUDAAN statistical package to account for the complex survey design.
Results
The 30-day prevalence rate of SPD was 12.4%. A lower erythrocyte EPA+DHA mean was observed in the SPD group (5.8±0.2 [SEM]) compared to the non-distressed group (7.1±0.1, p<.0001). After controlling for confounders, the odds ratio for SPD was 0.90 (95%CI: 0.81, 0.99; P=0.0357) for each 1% increase of EPA+DHA in erythrocyte membranes.
Conclusions
In this cross-sectional study, we observed that the proportion of EPA+DHA in erythrocyte membranes, a marker of marine omega-3 consumption, was inversely associated with SPD among Nunavik Inuit. Our findings suggest that low marine omega-3 consumption may play a role in mood and anxiety disorders.

MOVEMENTS, HAUL-OUT, AND FORAGING BEHAVIOUR OF RINGED SEALS IN HUDSON BAY

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The Hudson Bay marine environment is already showing effects of climate warming through reduced sea ice period. Ice-breeding ringed seals (Phoca hispida) are expected to respond to the warming climate with reduced distribution and lower survival. Concerns have arisen over possible declines in ringed seal numbers in western Hudson Bay as indicated by reduced pregnancy rate, pup survival and abundance, and older age structure. Similar data for eastern Hudson Bay are currently unavailable. The condition of polar bears, the main predator of ringed seals, has also declined. Ringed seals are numerically, nutritionally, and economically one of the most important marine mammal species to Inuit communities of Hudson Bay, so knowledge of where and how seals use the bay is needed. This study focused on ringed seal movements and haul-out behaviour, assessed critical habitat, and investigated characteristics of foraging behaviour. The aim of the project is to provide management information and advice for the Hudson Bay ringed seal stock by: (1) delineating movements that may bring juveniles and possibly adults into areas hunted by other communities; (3) assessing sex- and age-specific site fidelity of individual seals during the breeding season; (4) defining critical spring habitat that affects susceptibility of seal pups to polar bear predation; (5) defining spatio-temporal variation in ringed seal foraging habitat and behaviour to complement diet studies and address a purported shift in diet associated with climate change. To achieve this goal, we deployed Platform Transmitter Terminals (PTT) on a total of 25 seals in the Belcher Islands, Hudson Bay, from 2006 to 2008. PTTs remained on seals for periods from one to eight months, and during this period, we found three major patterns in the movement of seals deployed in this region. Most (17) seals made only relatively small-scale movements (less than 80 km) from the site of deployment. A smaller number of seals (5) moved over larger distances (up to 250 km) around the Belcher Islands. Three seals ranged relatively large distances (more than 500 km) in a westward direction. There were no differences between sexes in movement characteristics, but large-scale movements were almost exclusively observed among young of year seals. The implications of these results for the management of this ringed seal stock in terms of climate change are discussed.

PRODUCTIVITY OF CANADIAN ARCTIC VEGETATION (1981-2000)

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Recently observed alterations in surface temperature, active layer depth, soil moisture and nutrient have the potential to influence the productivity of vegetation, defined as the rate of plant carbon uptake. Net Primary Productivity (NPP) and Normalized Difference Vegetation Index (NDVI) are established indicators of Arctic plant productivity, though NPP refers to the net uptake of carbon by plants and NDVI estimates the photosynthetic capacity of plants using a red to infra-red band ratio. Field studies have indicated a direct correlation between NDVI and productivity. Questions remain regarding: 1) the relationship between NDVI and NPP at the regional scale; and 2) whether the relationship between NDVI and NPP is influenced by environmental characteristics or climatic changes. Results are discussed according to implications for large-scale remote sensing studies of vegetation, and contributions to understanding the underlying ecosystem dynamics.

DEVELOPMENT OF A PERINATAL SURVEILLANCE SYSTEM FOR THE NORTHWEST TERRITORIES, CANADA

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Background: Perinatal surveillance systems have the capacity to monitor maternal and infant health, to guide the development of public health policies and programs related to maternal and infant health, to generate evidence required to improve the effectiveness of health-related services and to elucidate factors affecting perinatal outcomes. The term 'perinatal' refers to the time period surrounding pregnancy, labour and birth, as well as the postpartum period for both the mother and infant.

Rationale: Currently, a comprehensive territory-wide perinatal surveillance system does not exist in the Northwest Territories (NWT). At present, the only initiative underway for perinatal data collection in the Northwest Territories is the evaluation of perinatal services at the Fort Smith Health and Social Services Authority Midwifery Program in Fort Smith, NWT. In addition, data from the Canadian Institute for Health Information Discharge Abstract Database (CIHI DAD) are used by clinicians as an overview, but have been found to be insufficient for comprehensive evaluation of programs or generation of research hypotheses. Government, clinicians and researchers have expressed interest in and a need for a perinatal surveillance system in the NWT that would collect data on all women conceiving and/or giving birth as well as their fetuses/newborns.
Objectives: The objectives of the research conducted were to undertake an assessment of the needs for a perinatal surveillance system in the NWT and to design a perinatal database that would reflect these needs.
Methods: Stakeholder consultations to identify the needs for a perinatal surveillance system in the NWT were undertaken. Objectives and the design of the database were elucidated. Perinatal database development was based on a number of background sources, including variables suggested by the World Health Organization, the Canadian Perinatal Surveillance System, the Canadian Perinatal Programs Coalition, the Canadian Congenital Anomalies Surveillance Network, and the Fort Smith Health and Social Services Authority Midwifery Program Evaluation Framework, amongst others.
Results: Stakeholder consultations identified the need for a flexible perinatal database that would meet a variety of objectives. Objectives included: program evaluation and quality assurance, surveillance and research. Special considerations for northern populations included documenting variables such as transfers for birth, types and numbers of caregivers, ethnicity, and risk factors such as smoking and alcohol consumption during pregnancy. Results indicated that data collection must be dynamic, including the ability of a variety of stakeholders to use the database for the different objectives outlined.
Conclusions: The proposed NWT perinatal database has the capacity to meet data collection needs for surveillance, program evaluation and research related to maternal and infant health. A number of considerations for the NWT perinatal database still remain to be addressed, including the following: the ability to link with other surveillance systems; the scope of data collection; logistical issues such as the individuals responsible for data entry, the time period that data would be entered, and where the NWT-wide database would be housed; and the implications for the database of the future implementation of the electronic medical record in the NWT.

GLACIAL FLUTE MARKS AND ICEBERG SCOURS INSCRIBED ON THE SEABED IN PEEL SOUND, FRANKLIN STRAIT, LARSEN SOUND AND M'CLINTOCK CHANNEL, CANADIAN ARCTIC ARCHIPELAGO. GLACIAL FLUTE MARKS AND ICEBERG SCOURS INSCRIBED ON THE SEABED IN PEEL SOUND, FRANKLIN STRAIT, LARSEN SOUND AND M'CLINTOCK CHANNEL, CANADIAN ARCTIC ARCHIPELAGO

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The study area lies within the central part of the Canadian Arctic Archipelago; a region that was covered by Laurentide ice during the Late Wisconsinan and earlier. Multibeam imagery from widely spaced transects indicates the presence of both parallel - sub-parallel ice keel features and randomly oriented iceberg scours on the seabed at localities in Peel Sound, Franklin Strait, northern Larsen Sound, and in M'Clintock Channel. Linear parallel – sub-parallel groove and ridge features are interpreted to be sole marks emplaced on the seabed by ice streams that formerly occupied these marine areas. These features have been observed on multibeam imagery at various localities along the channels, and are especially well developed in an overdeepened area at the junction of Franklin Strait and Peel Sound. The trend of these features is parallel to the axes and coastlines of the channels. Their north-south orientation in Peel Sound is normal to that of glacial ice flow features on Somerset and eastern Prince of Wales islands, which border Peel Sound to the east and west, respectively. The seabed in many areas also displays scours formed by grounding icebergs. These are primarily single keel features. Maximum iceberg grounding depths are variable relative to present day water depths. Ice stream sole mark features in water depths deeper than 350 m in the overdeepened area in Peel Sound have not been impacted by grounding icebergs. Above 350 m, iceberg scours of variable orientations increase in number and decrease in

size as depths shallow. However, in the southern M'Clintock Channel – Larsen Sound area, apparently unmodified parallel - sub-parallel ice keel features occur in depths as shallow as 145 m. Seabed sediments revealed by 3.5 kHz sub-bottom profiles are interpreted to consist primarily of ice-contact deposits that in a few localities are draped by later sediments. The age of the ice stream features has not been established. Their formation was possibly coincident with an ice stream in the M'Clintock Channel – Victoria Island region, which formed an ice shelf in Viscount Melville Sound that grounded on southern Melville and Byam Martin islands at ca. 10.4 – 9.6 ka. Or they could have resulted from later glacial events. The iceberg scours observed on the multibeam imagery are inferred to be mainly relict features.

EFFECTS OF SEA ICE ON REPRODUCTION OF NORTHERN FULMARS IN THE CANADIAN HIGH ARCTIC

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Northern fulmars (*Fulmarus glacialis*) are a ubiquitous marine bird found across much of the North Atlantic Ocean, northwards to circumpolar waters. They are generalist, surface-feeding carnivores that forage in the pelagic zone, feeding primarily on marine zooplankton, squid, and fish, as well as scavenging carrion, or fisheries discards. Fulmars can fly tremendous distances to access food resources. At Arctic breeding colonies, extensive sea ice cover should place constraints on the timing of fulmar reproduction and access to food resources which are not experienced by fulmars breeding at more southern colonies in the Boreal oceanographic zone. We studied fulmar reproduction at the Cape Vera colony on northern Devon Island, Nunavut, from 2003-2005. Our high Arctic fulmars exhibited a markedly compressed breeding schedule compared to Boreal fulmars, and also took the longest known "exodus" from the colony, at which time the female gathers nutrients for egg formation and the male stores fat for incubation. Moreover, high Arctic fulmars exhibited differences in their pattern of storage and use of nutrient reserves, arriving at the breeding colony with larger endogenous stores and using much of these in a short period before departing for the exodus, compared to Boreal fulmars. We suggest that these larger stores on arrival are required because fulmars at Cape Vera lack nearby food sources early in the season, while having high energetic needs for digging through snow to their nest site, and for thermoregulation. An amelioration in the timing and extent of sea ice cover due to climate change may have positive effects for fulmars breeding at high Arctic colonies.

NASKAPI OF KAWAWACHIKAMACH: PRIVILEGED WITNESS OF THE CLIMATE CHANGES IN THE ARCTIC

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Naskapi of Kawawachikamach : privileged witness of the climate changes in the Arctic During the spring 2008, we did an anthropological study on the impacts of the establishment of the Hunting Support Program (H.S.P.) on the memory and the identity of the Naskapi of Kawawachikamach. During this study, we had the opportunity to collect data on the challenges poses by climatic changes relative to the application of the H.S.P. and on the accomplishment of traditional activities. The aboriginal Naskapi nation is part of the algonquian linguistic family and its traditionnal land stretch cover the southern part of the Ungava Bay, from the Labrador coast to the Hudson Bay. The H.S.P. was implemented almost 30-years ago. It supports individuals from the Kawawachikamach community struggling with low annual income or who are unemployed. The H.S.P. also supports the Naskapi in carrying out their traditional activities. We used an ethnographic approach in this qualitative and empirico-inductive study. We performed participant observation in the community and semi-directed interviews (n=12) with Naskapi from the Schefferville area, including Kawawachikamach (54° 51' 47" North, 66° 45' 45" West). The interviewed individuals claimed that they have observed the effects of the climate changes in the Kawawachikamach area. The qualitative analysis of the interviews allows us to identify the concerns of Naskapi in relation with climate changes. Among them, we retained behavioral changes in the movement patterns of the hunters and the animal, the increasing risks linked with the practice of some traditional activities (ice-fishing, goose hunt), changes in the availability and the distribution of the resources on the territory and variation in the length of the hunting, fishing and trapping periods. These concerns may influenced the application of the H.S.P. as well as the transmission of traditional knowledge and the Naskapi

identity. In summary, our datas suggest that climate changes will and already exert impacts on the traditional activities of the Naskapi of Kawawachikamach. Consequently, climate changes in the Arctic are becoming a new challenge in the implementation of the Naskapi's H.S.P. that could eventually jeopardize the transmission of the traditional knowledge, the culture and the identity of the Naskapi.

PREVALENCE, PROPERTIES AND IMPLICATIONS OF SUBSURFACE CHLOROPHYLL MAXIMA IN THE WESTERN ARCTIC

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Investigations of the vertical structure of the water column during late summer and early fall in the western Arctic revealed widespread and recurrent subsurface chlorophyll maxima (SCM) in 2005, 2006 and 2007. In waters exempt of seasonal ice, these SCM generally occurred well below the pycnocline in close association with the nitracline. This observation implies that the SCM is not driven by the passive accumulation of sinking algal cells at physical discontinuities, but is maintained by active growth *in situ*. The consistently high photosynthetic yields (F_v/F_m) of algae at the SCM are indicative of a healthy community well acclimated to ambient conditions. Since a large part of phytoplankton biomass occurs in this layer, climate-driven changes in their integrity and productivity could impact food web, renewable resources and biogeochemical fluxes. The strength and vertical configuration of SCM also affect the accuracy of remote sensing estimates of chlorophyll and primary production. Our results imply that chlorophyll and particulate organic carbon may be invisible to orbiting sensors over most of the High Canadian Arctic,, resulting in the underestimation of productivity. We analyzed the profiles to determine if there are statistical or empirical ways to correct for this problem.

STABLE ISOTOPE PROBING ANALYSIS OF METHANOTROPHIC BACTERIAL POPULATIONS IN ACTIVE LAYER SOILS FROM EUREKA, NUNAVUT

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Northern soils, including those found in the Canadian high Arctic, are estimated to contain one third of the world's carbon, raising serious concerns about whether thawing permafrost will be a major new contributor of greenhouse gases, such as carbon dioxide and methane, to the atmosphere. This study used stable isotope probing (SIP) to investigate methane oxidation activity in three active layer soils collected from Eureka (Ellesmere Island, Nunavut) during the summers of 2006 and 2007. Soil samples were incubated in microcosms under a ^{13}C-methane enriched atmosphere, with or without the addition of a nutrient medium and at 25 °C or 4 °C. Methane degradation and CO_2 production in the microcosms was monitored by gas chromatography. ^{13}C-labelled DNA was retrieved by ultracentrifugation in cesium chloride density gradients and bacterial diversity of the ^{13}C-DNA was analyzed by denaturing gradient gel electrophoresis (DGGE) of the PCR-amplified 16S rRNA and particulate methane monooxygenase (*pmoA*) genes. Results showed that the three soils had different methane oxidation and CO_2 production rates and that these rates also differed from 2006 to 2007. When no nutrient medium was added to the soils, methane oxidation rates were much lower. Analysis of the ^{13}C-DNA fraction from the three soils incubated with the nutrient medium showed that the same organisms were implicated in the observed methane oxidation processes. Nucleotide sequence analysis of the DGGE bands identified *Methylobacter luteus* and *Methylobacter tundripaludum* as the dominant bacteria at 25 and 4°C, respectively. However, analysis of the ^{13}C-DNA fraction of the samples incubated without the addition of the nutrient medium showed that different and more diverse methanotrophic bacterial populations were active under these conditions. This work indicates that active methanotrophic bacteria are present in soils of the Canadian high Arctic and that they could potentially mitigate methane emissions from the melting permafrost, even though the lack of essential nutrients might restrain their activity.

CALANUS GLACIALIS: FOOD DEPENDENT OR FOOD INDEPENDENT GONAD DEVELOPMENT AND EGG PRODUCTION?

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The gonad status and egg production rates of the Arctic key herbivore *Calanus glacialis* were investigated in ice-covered and ice-free seas in Svalbard May 2008. Females in the ice-covered Rijpfjorden (80ºN) and Billefjorden (78ºN) had just started to develop the oocytes in diverticulas in early May, whereas females in the ice free part of Isfjorden (78ºN) and south of Spitsbergen (75ºN) had at the same time well-developed gonads with ripe eggs, ready to be released. The gonad maturation time for immature females was checked for starved and surplus fed females. None of the starved females reached maturity after 14 days whereas 70% of the fed females reached maturity. Food was also important for high egg production. Starved females stopped to produce eggs after one week, whereas fed females continued to lay eggs for the 2 weeks period investigated. The average clutch size, however, did not differ between starved and fed females. Several egg production peaks were observed for individual females during the two weeks, suggesting that a 24 h egg incubation time is too short to estimate proper egg production rates for *C. glacialis*.

SEASONAL AND INTER-ANNUAL VARIABILITY IN THE LIGHT ABSORPTION COEFFICIENT OF PHYTOPLANKTON FOR WESTERN ARCTIC WATERS: PHYTOPLANKTONIC RESPONSE TO ONGOING CLIMATE WARMING

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The light absorption properties of phytoplankton provide information on phytoplankton physiological status in oceanic waters. Therefore, this parameter is useful for ocean color based primary production models. While the general properties of this absorption have been reported for Arctic waters, their seasonal and inter-annual variability remains unknown. This is of particular importance as recent declines in sea ice cover have made possible longer seasonal ocean color observations of the Arctic and biogeochemical processes in these regions that is sensible to ongoing climate warming needs to be assessed to predict future Arctic conditions. We investigated the light absorption coefficients of phytoplankton [$a_\varphi(\lambda)$] in the Arctic using both *in situ* and ocean color data. The chl *a*-specific $a_\varphi(440)$ [$a^*_\varphi(440)$] declined significantly from spring to autumn periods. The lower $a^*_\varphi(440)$ can be explained by pigment composition resulting from the seasonal succession of smaller sized phytoplankton species during the periods at lower chl *a* (< 1.0 mg m^{-3}) and by package effect that is attributed to larger size phytoplankton at higher chl *a* concentrations. The increase in area for $a_\varphi(440)$ using ocean color showed apparent negative correlation with decreasing sea ice extent from 2002 through 2007, showing the spatial characteristics. These results suggest that the seasonal and inter-annual variability in $a_\varphi(440)$ can reflect the phytoplanktonic response to ongoing climate warming.

RESEARCH AND MONITORING PROGRAMS AT THE TUNDRA ECOSYSTEM RESEARCH STATION, DARING LAKE, NORTHWEST TERRITORIES

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In 1994, the Department of Environment and Natural Resources (ENR), Government of the Northwest Territories established the Tundra Ecosystem Research Station at Daring Lake, NWT largely in response to impending diamond development in the central barrens. Over the past 15 years, ENR has developed many partnerships with other government departments, universities, industry, and communities to conduct a wide range of short-term research and long-term environmental monitoring programs. Many of the research and monitoring programs address issues related to climate change, wildlife disease, biodiversity and species at risk, and the impacts of industrial development. The International

Polar Year program has enhanced the overall research and monitoring program in the Daring Lake area. Over the past two years, many new research initiatives have begun that will contribute to our understanding of ecological processes in the low arctic tundra. This paper will provide an overview of past and current research and monitoring programs that have been conducted from the Tundra Ecosystem Research Station. The Department of Environment and Natural Resources is interested in developing new partnerships in its research and monitoring program to complement on-going studies in this sub-arctic region of the Northwest Territories. Research and monitoring priorities will be discussed along with opportunities for new initiatives.

DEVELOPMENT AND APPLICATION OF A DIATOM-BASED CALIBRATION SET FOR A HIGH ARCTIC WARM OASIS, QUTTINIRPAAQ NATIONAL PARK, NORTHERN ELLESMERE ISLAND

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The High Arctic is far from homogenous, as evidenced by regions characterized as atypically warm oases. Arctic oases are zones of comparatively high levels of biological production and biodiversity relative to the vast expanses of barren landscape most commonly associated with high latitude regions. Lakes and ponds within these regions exhibit reduced ice cover, longer growing seasons, higher pH and conductivity, and enhanced biological production, all of which have dramatic implications for the development of biological communities. Limnological studies in these regions are limited; little is known about the baseline limnological characteristics of these atypically warm lakes and ponds. The Lake Hazen basin in Quttinirpaaq National Park, Northern Ellesmere Island, includes an oasis that is unusually warm, even by Arctic oasis standards. The park encompasses four climatic zones: a continental climate predominates at Lake Hazen and Tanquary Fiord, mainly due to its inland location and placement on the leeward side of the Grant Land Mountains; a cool marine climate in the northern coastal region; a very cool climate in the high-elevation ice cap region; and a moderate marine climate in the south eastern coastal region. Paleolimnological investigations of the Hazen oasis, by way of a diatom calibration set, may help researchers place their observations of other Arctic oases into perspective, as well as serve as a useful comparison study for other High Arctic calibration sets. Surface sediment samples from 55 ponds (<2m deep) and lakes (>2m deep), 23 inside the boundaries of the Hazen oasis and 32 outside, were collected in July 2003 and were specifically chosen to represent an environmental gradient based on temperature. Water chemistry analyses indicated that lakes and ponds located within the oasis have distinct characteristics when compared to lakes outside its boundaries. Oasis lakes and ponds have relatively high specific conductivities, as well as elevated major ion and nutrient levels. As all sample sites are located inland, the high conductivities are not likely a result of marine influence, but rather from increased evaporation levels during the ice free season due to warmer ambient temperatures. Major ion and nutrient levels are likely elevated due to more heavily vegetated catchments compared to sample lakes and ponds located outside the oasis boundaries. The calibration set will be based on diatom species assemblages enumerated from the surface sediment samples collected from each sample site. Analysis of this High Arctic oasis may provide a rare glimpse of future typical high latitude limnological conditions under predicted climate warming scenarios. A further application of this calibration set will be to put paleolimnological investigations of lakes in more southern regions of the Arctic into perspective. In July 2008, several sediment cores were collected from lakes near archaeological sites on Southern Baffin Island in an effort to reconstruct ancient migration patterns, and settlement, of the region. The Hazen oasis calibration set, coupled with other Arctic calibration sets, should help tease apart the impacts of historical environmental change and those impacts resulting from historical settlement by Early Arctic Peoples.

THE DEVELOPMENT AND DISPERSAL OF NELSON ESTUARY SEDIMENT AND CDOM PLUMES IN HUDSON BAY

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Hudson Bay receives more river runoff per unit area or volume than the Arctic and other world's oceans, with potentially larger effects on circulation and vertical mixing, and light distribution in the euphotic zone. Recent studies have highlighted the significance of terrigenous dissolved organic matter to the light field in Hudson Bay. Shore plumes visible in satellite imagery indicate a plume of suspended solids along the entire Hudson Bay lowlands portion of the Hudson Bay coast that further restricts light fields in at least those coastal regions. The persistence of a turbid plume up to 50-100 km from the mouth of the Nelson River, the second largest river draining into the Hudson-James Bay system, indicates that river-borne suspended solids are important regionally. Remote sensing data also shows persistently turbid coastal waters along the entire Hudson Bay lowlands portion of the Hudson Bay shore, only very weakly dependent in either concentration or spatial extent on proximity to large river mouths, indicating that littoral erosion also contributes SSC to Hudson Bay. We use validation data collected from surveys in the Nelson River estuary, and from the Hudson Bay leg of the 2007 Amundsen cruise to calibrate MODIS and MERIS suspended sediment concentration and chromophoric dissolved organic matter determinations. We use data from these two satellites to distinguish fluvial from littoral erosion plumes, and to describe the extent of their influence on water colour and the light regime in southern and southwestern Hudson Bay.

A YEAR IN THE NORTH: USING PHOTOGRAPHY AND SCIENCE TO EXPLORE CIRCUMPOLAR CULTURES AND CLIMATE CHANGE

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High Arctic communities sharing unique northern ecosystems face increasing challenges with climate change. A circumpolar examination of northern communities is required to understand the variety of climate-based cultural changes occurring in the north. This cross-cultural examination can, in turn, provide a spectrum of possible solutions in addition to illuminating discrepancies in international public policy. In 2006-2007, I set out on a year-long journey through Arctic Canada, Greenland, Norway, and Russia to live in four of the northernmost communities in the world. Funded by the Thomas Watson Foundation, my project was based on immersion in scientific and educational groups, using photography to document social interactions and climate influence in the high-north. In each location, I lived not merely as an observer, but also as a participant. The first segment of my year was spent working as a biochemical research assistant with ArcticNet on the CCGS Amundsen, traveling the northern Canadian coastline. My next location was in Ittoqqortoormiit (Scoresbysund) on the north-east coast of Greenland, where I worked as an English teacher and lived with a native Greenlandic family. Next I traveled to Longyearbyen on the Norwegian archipelago of Svalbard, which gave me the opportunity to work as a marine biology research assistant at the University Center in Svalbard. Finally, I ended my year in Cherskii, Siberia, working as an assistant at the Northeast Science Station and living in a cabin on the Kolyma River. The result of my year in the north was not only an extensive photo-documentation of life and culture in the Arctic, but also an appreciation for the effects of climate change on northern communities, in addition to the development of personal relationships with the people I was living with. Witnessing altered ice flow patterns, noting the changes in local ecosystems, and living in communities of both scientists and natives drives home the knowledge that these areas are being changed forever, naturally and socially. Via those stories and photographs, I have been able to present the cultural effects of northern climate change to audiences around the world. Such exposure will hopefully motivate increased awareness for the necessity of effective and immediate policy measures to protect not only northern wildlife, but also the northern communities that depend on those landscapes.

A PROPOSED MODEL FOR IMPROVING INUIT PARTNERSHIP IN ARCTICNET

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In 2007, ArcticNet successfully completed its first mid-term review. The Network of Centres of Excellence (NCE) Expert Panel, responsible for this review, produced a report which highlighted the strengths of the program, as well as the need for increased investment and resources for capacity building and improved partnerships with Inuit at the community, regional and organizational levels. The second phase of ArcticNet (2008-2011) provides an opportunity to address the challenges identified by the NCE, improving the overall possibility for renewal and leaving an appropriate legacy for both research and Arctic inhabitants.

With the goal of acting upon the recommendations of the mid-term review, this poster presents: 1) how Inuit are currently involved in ArcticNet, and, 2) suggestions for an improved Inuit model to enhance Inuit participation at all levels of ArcticNet (including: governance/ organizational, science, and community interaction and capacity building). The model identifies a coordinated approach for Inuit involvement allowing for streamlined communications in the governance aspects through the regional, national and international Inuit organizations and meaningful involvement in research by Inuit Land Claim Organizations and the communities they are responsible for. The model also recognizes and builds on past experiences to ensure adequate support and mentorship to improve the foundations for success of the positions identified. Each of these committees and positions, we believe, will work in a structure that is effective and efficient for ArcticNet and Inuit to meet their mutual goals.

A PELAGIC SEABIRD SURVEY OF ARCTIC AND SUBARCTIC CANADIAN WATERS DURING FALL

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Information on the distribution and abundance of marine birds at sea is often lacking or sparse, particularly in polar environments. Here we provide results of ship-based surveys undertaken in Canadian Arctic and sub-Arctic waters during September and October 2005, a time of year when very few systematic surveys have been conducted. We performed 500, 10-minute long strip transects, covering an area of ~553 km^2, throughout the Northwest Passage, along the East Coast of Baffin Island, in Hudson Strait and Hudson Bay and along the Labrador Coast, ending in the Strait of Belle Isle. Densities of seabird species sitting on the sea were generally low (≤2 birds/ km^2) in the eastern Canadian Arctic with the exception of a few areas of high concentration along the southeast coast of Baffin Island (≤27.5 birds/km^2) and at the eastern mouth of the Hudson Strait (≤132 birds/km^2 sitting on the sea). We documented a total of 951 birds of 13 species sitting on the sea and 1564 birds of 14 species in flight during instantaneous counts within transects. Mean densities of seabirds sitting on the sea were highest in Hudson Strait (4.5±16.6 birds/km^2) and lowest in Hudson Bay (0.34±1.6 birds/km^2). Where mean densities were high (East Coast Baffin Island and Hudson Strait), sightings were dominated by Northern Fulmar (*Fulmarus glacialis*) and Dovekie (*Alle alle*). Our abundance and distribution data are consistent with a single previously published study which suggested that several marine bird populations migrating eastward through Hudson Strait and south along the coast of Baffin Island converge at the eastern mouth of the Hudson Strait. This study presents further evidence that the eastern margin of Hudson Strait constitutes an important staging area for migrant seabirds during September and October, particularly for the Northern Fulmar, Dovekie and Thick-billed Murre.

RETROGRESSIVE PERMAFROST THAW SLUMPS ALTER SEDIMENT CHEMISTRY, SUBMERGED MACROPHYTE BIOMASS, AND BENTHIC INVERTEBRATE ABUNDANCE ON ARCTIC TUNDRA LAKES (N.W.T)

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Global warming is forecast to cause significant thawing of the permafrost that surrounds lakes and rivers across the Arctic, with wide-scale effects on the water quality and biotic characteristics of these water bodies. The benthic environment is believed to be especially sensitive to permafrost-induced ecological change, and this was the focus of field intensive research in upland tundra lakes in the Northwest Territories. Five lakes affected and three lakes not affected by retrogressive thaw slumps

were sampled during late summer of 2006 to assess the potential effects of permafrost slumping on benthos. Water quality parameters, submerged macrophytes, benthic invertebrates and sediment were collected. GLM, Kruskal-Wallis and ANOVA were used to test for differences between both groups, as well as for possible interaction effects from sample depth. A significant difference ($p<0.05$) between disturbed and undisturbed lakes was found for macrophyte, invertebrates, underwater light attenuation, and some sediment variables. In general, undisturbed lakes had sediments rich in organic material and some micronutrients, while disturbed lakes had sediments richer in calcium, magnesium and strontium, a higher water-column transparency, and the presence of a developed benthic invertebrate and macrophyte community. It is suggested that enriched runoff chemistry may alter nutrient availability at the sediment-water interface and also the degradation of organic material affecting lake transparency and submerged macrophyte communities. In addition to the mentioned variables, changes in littoral slope that can alter habitat complexity and food availability (macrophytes, detritus, periphyton and bacterial mats) are suggested to explain the observed differences in invertebrate abundance. Changes in the littoral zone can have further effects on freshwater benthic production and the linkages between benthic and pelagic food webs, possibly altering water quality and upper level production in arctic tundra lakes.

LABORATORY STUDIES OF THE FRACTIONATED RELEASE OF ORGANIC CONTAMINANTS FROM MELTING SNOW.

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Snow efficiently scavenges organic contaminants from the atmosphere. Those chemicals can be released in short, concentrated pulses during spring snowmelt, potentially affecting both aquatic and terrestrial ecosystems in Arctic and Sub-arctic regions. In order to investigate the behavior of organic contaminants in melting snow laboratory experiments were conducted using artificial snow spiked with organic target substances. The behavior of those substances during melting is dependent on their partitioning between the different phases present within the bulk snow. Very water soluble organic chemicals are preferentially released at an early stage of melting similar to inorganic ions. This first chemical flush becomes more pronounced when a deep, aged, and relatively homogeneous snow pack is exposed to intense melting. Hydrophobic substances attached to particles, such as high molecular weight polycyclic aromatic hydrocarbons, are often released at the very end of the melt period. Dirt cones at the surface of a deep snow pack amplify this late chemical enrichment. Whereas chemicals that are clearly hydrophilic or hydrophobic are likely to be released in pulse loads, the snowmelt behavior of chemicals with intermediate partitioning properties is more dependent on the varying snow pack and melt characteristics. A notable fraction of volatile chemicals may transfer from the melting snow pack to the lower atmosphere due to evaporation. The understanding gained in this project and the new modelling tools to be developed will be of assistance to assess the effects that such contaminants may have on organisms living in the systems that receive significant amounts of snowmelt water (marine waters, lakes, rivers and other freshwater bodies, terrestrial ecosystems), and on humans that consume these organisms. One overarching objective of the research is to predict the likely impact of climate change on the behaviour of organic contaminants. Climate change will influence the extent of snow and ice cover in Northern regions, and it will influence the conditions of snow and ice melt.

IMPACT OF THE GREAT WHALE RIVER SPRING FRESHET ON THE VERTICAL DISTRIBUTION AND FIRST-FEEDING SUCCESS OF MARINE FISH LARVAE UNDER THE ICE COVER OF HUDSON BAY

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We monitored the vertical distribution of fish larvae and their microzooplankton prey under sea ice over a 4-day period in 1990, covering the spring expansion of the turbid plume of the Great Whale River plume in coastal southeastern Hudson Bay. In this region in spring, wind mixing is effectively blocked by ice and the river run-off forms a 4-5 m thick plume that expands over 1000 km^2, immediately under the ice cover of the Bay. Over the 4-day period, increasing turbidity associated with a 4-fold increase (400 to 1600 $m^3\ s^{-1}$) in river discharge resulted in an exponential increase in the coefficient of light attenuation

and a 100- to 1000-fold decrease in under-ice irradiance, without any significant change in the temperature (0°C), salinity (<2 PSU) or thickness (4-5 m) of the under-ice plume. Coincident with the turbidity increase, the concentration of copepod nauplii (the main prey of fish larvae) decreased 5 fold in the 0-25 m layer and the diel incursion of first-feeding Arctic cod *Boreogadus saida* (5-8 mm standard length) into the photic zone ceased. After the increase in surface turbidity, Arctic cod larvae remained in the 5-20 m layer where irradiance was well under the feeding threshold. The more euryhaline sand lance larvae (*Ammodytes* sp., 5-8 mm SL) re-distributed at the basis of the thin photic layer in daytime. In both species, feeding incidence declined abruptly from >75% to <25%. The average number of prey in the gut decreased from 4-5 to 0-1 in Arctic cod and from 1 to 0.1 in sand lance. Present and future climate-related change in the timing of river freshet around the Arctic basin could affect the early survival of Arctic cod, a key circumpolar species in the Arctic food web. Although probably transient, the impact of the river freshet on the first-feeding success of the larvae could affect the early survival and recruitment of these two key fish species in this sub-arctic ecosystem.

DISTRIBUTION OF DIMETHYLSULFIDE AND DIMETHYLSULFONIOPROPIONATE IN THE CANADIAN ARCTIC

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We conducted seawater measurements of the climatically active gas dimethylsulfide (DMS) and its precursor dimethylsulfoniopropionate (DMSP) during the fall of 2007 from the west coast of Greenland to the Beaufort Sea. 2007 was a year of record low sea-ice extent in the Arctic basin. The expedition took place on the Canadian research icebreaker *CCGS Amundsen* as part of the new Arctic Surface Ocean Lower Atmosphere Study (SOLAS) research project funded by the Canadian International Polar Year (IPY) Program, and supported by the ArcticNet network. Measurements were conducted at five depths at 26 fixed stations. Concentrations of DMS ranged from below the level of quantification (0.03 nmol l^{-1}) to ca. 4 nmol l^{-1}, averaging 0.58 nmol l^{-1}. DMSPt varied from 0.3 to 52 nmol l^{-1}. Both DMSP and DMS concentrations exhibited a gradual westward decrease with the lowest concentrations measured in the Beaufort Sea in November, although this may be related to seasonal progression rather than geographic effects. Our results show that waters of the Canadian Archipelago represent a weak source of DMS to the atmosphere during that time of the year.

EFFECTS OF CLIMATE CHANGE ON MOVEMENT PATTERNS AND GENETIC STRUCTURING OF POLAR BEARS OF SOUTHERN HUDSON BAY AND JAMES BAY.

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Results of recent research on polar bears in Hudson Bay suggest genetic structuring of subpopulations within the larger population, and identify a separate James Bay group. Though there is still considerable gene flow among these subpopulations, current ice forecasts suggest a reduction in the distribution and duration of sea ice in the future due to climate change. We hypothesise this will result in a reduction of gene flow among genetic groups, especially between the Southern Hudson Bay and Western Hudson Bay subpopulations, and potential isolation of the James Bay group. We present initial movement data for adult female polar bears during the mating season, and plans for future research on bear movements in this region. Movement data will be presented along with recent and projected deviations in ice extent from the 1979 – 2000 average.

THE RESPONSE OF ARCTIC CHAR TO A CHANGING ARCTIC: INSIGHTS FROM THE PAST

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Predicting how Arctic species will respond to predicted changes in the Arctic represents a daunting

challenge. Past large-scale climatic events such as the late Pleistocene glaciations can be used as analogues to study the consequences of projected global warming. Indeed, despite major differences between past and contemporary climatic change, insights about key response mechanisms can be gained from the signature such events leave in the genetic make-up of populations. The present study's objectives are to (1) document where Arctic char (*Salvelinus alpinus*) persisted during the last glaciation and how it subsequently re-colonized the Canadian Arctic following deglaciation and (2) determine the consequences of these processes on genetic diversity and adaptation. Microsatellites are neutral nuclear DNA markers appropriate to address such issues. First, the plausibility of different putative glacial refugia will be evaluated under the assumption that genetic diversity should be higher in long established as opposed to recently colonized populations. Second, spatial analyses of genetic variation used in combination with modern tools of molecular data analyses allowing the reconstruction of historical demographic processes will provide information about the rate (colonization occurred fast or significant lag-times between deglaciation and colonization occurred), the mode (colonization occurs in a series of founder events or as a big wave of individuals) and most plausible routes (colonization follows coastlines or low-salinity areas) of post-glacial re-colonization. Finally, by using microsatellite markers linked to adaptively significant traits such as growth rate or temperature tolerance (QTLs), I will examine evidence for past adaptations to latitudinal environmental gradients providing an indication of how fast adaptation to future change may be expected to occur. Not only will my study provide insights as to how Arctic char may be expected to respond to a major climatic event, it will also provide a map of genetic diversity across the Canadian Arctic that may identify areas of particular importance for conservation.

PELAGIC-BENTHIC COUPLING OF THE BARENTS AND BEAUFORT SEAS, ARCTIC, REVEALED BY SEDIMENTARY PIGMENTS

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Pelagic-benthic coupling over much of the Arctic shelves is thought to be particularly tight. The study of sedimentary pigments in the Barents and Beaufort seas showed very different pelagic-benthic coupling patterns, reflecting the important contrast of primary productivity, secondary production, and hydrography between the two ecosystems. Physical parameters seemed more responsible for spatial differences. In the Barents Sea, spatial changes were highly influenced by currents while in the Beaufort Sea, spatial changes were related to depth and river influence. From a seasonal point of view, productivity regime, especially ice-algae production and the match/mismatch of zooplankton grazing, seemed important in shaping organic matter inputs to the benthos. In the spring, ice-algal production largely influenced organic matter inputs to the benthos in both the Barents and Beaufort Sea. In the summer, grazing was responsible for inputs of degraded material in both ecosystems. In addition to biological parameters, environmental factors were also important in summer and fall. In the Barents Sea during summer, the different currents lead to phytoplankton taxonomy variations, and in the Beaufort Sea during fall, riverine inputs were found to be responsible for the presence of allochtonous material in the sediment.

CURRENT USE PESTICIDE BIOACCUMULATION IN CANADIAN RINGED SEAL (PHOCA HISPIDA) FOOD-WEBS

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The pathways by which top predators in Arctic marine food webs are exposed to current use pesticides (CUPs) are not well studied. In particular, the influence of melting snow and sea ice in delivering atmospherically deposited contaminants has received relatively little attention. CUPs such as dacthal, endosulfan, and chlorothalonil have previously been reported at relatively high concentrations in Arctic seawater compared to legacy POPs such as PCBs. The present study investigated concentrations of CUPS in seawater and in under ice food-webs to ascertain bioaccumulation factors (BAFs). Work was conducted with community members, in conjunction with the Hunter's and Trapper's Associations in Gjoa Haven and Resolute Bay, Nunavut. Samples were collected in June 2007 (Barrow Strait) and 2008 (Rae and Barrow Straits). Seawater was collected using novel pump systems designed at Environment Canada, and 2008 collection was performed using the POP AttachéÓ. This system was designed to

reduce contamination during sampling by situating the filter and resin columns at the beginning of the sampling unit. Samples were drawn at depths of 2 and 10 m (200-400 L; using XAD-2, stainless steel resin columns). Biota sampling was completed as follows: Under-ice algae were sampled at break points in the pack ice by netting; zooplankton samples were collected by manual vertical tows from depths of 50 m and sorted by size class in the field; Arctic cod (*Boreogadus saida*) were collected by netting or jigging; ringed seals (*Phoca hispida*) were collected with local subsistence hunters and sampled with 15 minutes of capture. All extractions were conducted in a clean room (carbon and HEPAÔ filters, positive pressure system). Fractionation and quantification was achieved using GC-electron capture negative ion MS. Stable isotope analyses were also applied to establish the trophodynamics of each food-web. In 2007, Dacthal was the most abundant CUP detected at both 2 m and 10 m (3.7 and 2.4 pg/L). α-endosulfan and endosulfan sulphate were detected at 2 m (2.2 and 3.2 pg/L), but only endosulfan sulphate was detected at 10 m (1.9 pg/L). Dacthal, α-endosulfan and endosulfan sulphate were detected in zooplankton (0.1, 0.3 and 0.5 ng/g lipid) and Arctic cod (0.6, 0.5 and 1.1 ng/g lipid). No CUPs were detected in ringed seal. Calculated bioaccumulation factors (BAFs) indicate varying degrees of bioaccumulation in zooplankton and Arctic cod (dacthal logBAFs = 4.3 and 4.7; α-endosulfan and endosulfan sulphate logBAFs of 5.3 and 5.6]. Biomagnification of CUPs in ringed seal was not observed in 2007, all calculated biomagnification factors (BMFs) were less than 1. These data will be compared with data from 2008.

DYNAMICS OF UNDER-ICE PHYTOPLANKTON BLOOMS OBSERVED IN TWO ADJACENT COASTAL ARCTIC BAYS

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Phytoplankton blooms are transient events where primary productivity greatly exceeds losses resulting in a rapid accumulation of algal biomass. During springtime, the under-ice water column of the Arctic can become nutrient-rich due to winter mixing processes and seasonal darkness. The positive-feedback processes of snow melt and meltpond formation at the ice surface result in a rapid increase in the average euphotic zone irradiance that, when combined with meltwater input that influences surface stratification, provide the perfect conditions for a bloom. However, under-ice blooms have not been extensively documented, probably due to logistical difficulties of collecting data at this time of year. During the International Polar Year – Circumpolar Flaw Lead system study (IPY-CFL 2008), two separate under-ice blooms were monitored over a four week period in the western Canadian Arctic's Darnley and Franklin Bay. Preliminary observations show that blooms in both bays formed a deep chlorophyll *a* maximum at approximately 30 to 35 m prior to ice break-up. At their greatest extent, phytoplankton chlorophyll *a* concentrations exceeded 400 mg m^{-2} over the upper 35 m of the water column in Darnley Bay whereas they were < 150 mg m^{-2} in Franklin Bay. In this work, we describe the biological properties of both phytoplankton blooms and explore the different bio-physical mechanisms that lead to the large discrepancy in phytoplankton accumulation between these two adjacent ice-covered bays. We also discuss the role under-ice blooms may play in the Arctic marine ecosystem in the context of a rapidly changing climate.

THE CLIMATE CHANGE AND HEALTH ADAPTATION IN NORTHERN FIRST NATIONS AND INUIT COMMUNITIES PROGRAM

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Over the last decade, scientists have become more aware of the magnitude of climate change in Canada, and its impacts on human health. The expected outcomes of a warmer planet are numerous and complicated and will have both direct and indirect health implications, particularly for

northern and remote First Nation and Inuit communities. These health implications will not be distributed evenly: current health status, geography/demographics, economics, gender, genetics, and age are all key variables affecting the ability of individuals and communities to mitigate and adapt to the effects of climate change. Although there are differences to the capacity to adapt to a changing climate, no one person, community or region can accomplish this alone. Much of the existing climate change research and program development in Canada has focused on impacts to natural and built physical environments and on ways of mitigating or reducing green-house gases which contribute to climate change. Very little research has been done on its implications to human health. To fill the gap, Health Canada - First Nations Inuit Health Branch has developed a community-based research program, which aims to integrate both scientific studies and traditional knowledge, to help northern First Nations and Inuit increase their knowledge and capacity to develop health-adaptation strategies. The ultimate objective of this program is to develop community relevant scientific expertise, build capacity and relevant messaging that will help in decision-making with respect to human health and a changing environment in Canada's First Nation and Inuit communities.To achieve this objective, northern First Nations and Inuit communities apply for funding from the program. Eligible proposals are those that are community-based, have a strong dissemination plan and that will examine, but are not limited too, the following: exposure models for health risk assessment, health impact assessment, identification of health risks including those effecting vulnerable peoples, risk management, and adaptation approaches to climate change impacts. The program works closely with various stakeholders such as the Assembly of First Nations, Inuit Tapirrit Kanatami, Council of Yukon First Nations and the Arctic Health Research Network who work directly with communities and have the expertise needed to get the program running on the ground. They can help communities with the application process and provide key information with regards to the program. As well, we work closely with our federal counter-parts such as Environment Canada, Indian and Northern Affairs Canada, Natural Resources Canada, Public Health Agency of Canada to discuss the program, proposed projects, and steps forward.

This program is an opportunity to allow northern community-based researchers to develop their own research and find ideal solutions to their particular climate change and health issues. This program will provide learning opportunities for First Nation and Inuit communities apprehensive about the potential impacts of climate change, and to conduct community-based research on environmental health concerns related to their specific situation.

USING SURFACE INDICATORS TO PREDICT PERMAFROST DEPTH

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Permafrost depth is expected to increase as the climate becomes warmer, with increasing amounts of ice melting each successive summer. As the permafrost thaws, one irreversible change is the release of methane (a greenhouse gas) from underneath the permafrost. In some locations, methane gas has been observed bubbling over the permafrost, preventing it from freezing over again. Industries dependent on the permafrost are adversely impacted and native peoples are being forced to find new ways to hunt for meat on the unusually slushy ground. It is therefore of environmental and societal importance to obtain robust data on temporal and geographic changes in permafrost depth. However, the most common method for measuring permafrost depth is to probe the ground and record the depth of active layer, which is extremely labor intensive. Some investigators have explored the possibility of using surface indicators for determining permafrost depth. A reliable indicator would facilitate future research on permafrost depth.In this research we evaluated the utility of lichen cover and water cover as indicators of permafrost depth. We hypothesized that greater amounts of surface water would be associated with a thicker active layer. This is because water would absorb more sunlight, heating the ground and melting the permafrost. We further hypothesized that a specific white lichen, *Cladina arbuscula*, would both increase albedo and act as an insulator, protecting the permafrost.Thirteen sites near the Churchill Northern Studies Centre (CNSC), Manitoba Canada, were selected for study. The sites represented discrete habitat types yielding a diverse cross-section of the surrounding area. At each site, two 50-meter parallel transects were selected, with flags placed every two meters. Vegetation was identified and recorded for each 1x1 m square around every flag, and the surface area of standing water, if present within the square, was recorded. In addition, the ground within each square was probed using a 54 cm long metal probe to measure the depth of the permafrost. To obtain a more detailed list of the vegetative species, a 2x2 m quadrat was placed over two randomly selected markers in each transect. All of the vegetative species and percent ground cover of each species were recorded from each

quadrat.Analyses of the data (Spearman's rank correlation test) revealed a statistically significant inverse association between lichen cover and permafrost depth. Conversely, greater amounts of water cover were significantly associated with deeper permafrost. We plan to conduct additional investigations at this site which could include assessments of soil type, pond depth and proximity, and identification of other bioindicators.

MICROBIAL COMUNITY RESPIRATION IN SEA-ICE IN THE AMUNDSEN GULF

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Microbes play an important role in carbon cycling. Altough bacteria convert an important amount of C into biomass through their production, significant amounts of C are used for bacterial respiration. Studies have already shown bacteria in sea-ice are highly productive, but to our knowledge, there are no direct estimates of respiration.

Using melted ice core and seawater incubations, we developped a method to measure community respiration using optical fiber sensors (FIBOX) at several sites of Amundsen Gulf in the Canadian Arctic, as part of the CFL ecosystem study. When possible, we measured rates at the ice-water interface and for low and high snow covers, at each location. Microbial respiration has has never been directly measured in sea-ice and rates are usually assumed to be low due to cold temperature.

Our preliminary results show a measurable respiration rate that could be useful in carbon balance estimates for the gulf. Rates measured up to now show higher respiration in ice than water column. Additional data for bacterial production and abundance measures was taken at each site. With this data, we hope to gain a better understanding of possible consequences of arctic ice melt on carbon cycling by sea-ice microbial communities.

SURVIVING THE DARK WINTER PERIOD: DISTRIBUTION AND STRATEGIES OF SEA-ICE MICROORGANISMS

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A changing Arctic ecosystem has been highlighted by rapid changes in annual cycles of sea-ice formation and melt. To describe and predict the intricate effects of sea-ice changes on marine biogeochemical and physical processes, a thorough understanding of annual cycles of sea-ice productivity is needed. Knowledge of winter (i.e. dark period) sea-ice assemblages and processes in the Arctic is largely lacking. However, winter communities are the originating members of the spring sea-ice bloom, which can contribute significantly (>25%) to total Arctic primary productivity. In this study we sampled sea ice within the vicinity of the Cape Bathurst polynya during the darkest period of the Arctic winter (December-January). The distribution of sea-ice nutrients, exopolymeric substances (EPS), chlorophyll *a* (chl *a*), protists and bacteria was assessed and compared to concentrations at the ice-water interface. Sea-ice chl *a* concentrations were very low (average 0.02 $\mu g\ l^{-1}$) whereas winter nutrient concentrations (average NO_3 2.0 μM) were similar to spring-time concentrations. Maximum bacterial abundances were observed near the top of the ice, in contrast to chl *a* concentrations which generally increased near the ice-water interface. EPS concentrations were significantly higher in the sea-ice than at the ice-water interface ($p < 0.01$). EPS were observed surrounding cells within the sea-ice, pointing to their role in cell survival during the winter period. Taxonomic investigations may also reveal differing over-wintering protist assemblages based on the variable age of ice in the dynamic and changing flaw lead system of the Arctic.

UNEXPECTED PRO ATHEROSCLEROTIC EFFECT OF OMEGA-3 AMONG NUNAVIK INUIT

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Introduction: The traditional diet of the Inuit from Nunavik (Canada) is particularly rich in omega-3 (n-3) and has been proposed to be beneficial for cardiovascular risk factors. However, the mechanistic link of this effect remains unknown. We ought to determine the effect of n-3 membrane concentration dosage from traditional diet of

marine mammals and fish on the atherosclerotic burden in a representative sample of Nunavik Inuit population.
Methods: High resolution ultrasonographic carotid intima media thickness (CIMT) was used as a surrogate marker of atherosclerosis and was evaluated in 272 Inuits older than 40 years (range 40-74 years) who participated in the 2004 Nunavik Health Survey entitled « Quanuippitaa ». At clinical visits, we collected blood from which red blood cell was analysed for phospholipid fatty acid composition. Multivariate linear regression analysis was used to determine the independent linear association of n-3 with CIMT. Analysis were performed in order to take into acount the compex strategy sampling used to correct the related error.
Results: Total n-3 fatty acids, expressed as a percentage of total fatty acid in the plasma phospholipids was 12.3 ± 3.4%. Mean CIMT was 0.6 ± 0.2 mm (range 0.4 to 1.6 mm). As expected, age and gender were the most powerful predictors of CIMT. However, as opposed to what as been previously reported, n-3 fatty acids were positively associated with CIMT ($p<0.05$, r-square 0.45).
Conclusion: Our results suggest that the high polyunsaturated fatty acid (n-3) dietary intake of Inuit from Nunavik that was shown to be associated with a lower incidence of ischemic heart disease is probably not explained by an anti atherosclerotic mecanisim.

ORGANIC MATTER CHARACTERIZATION OF A THERMOKARST POND IN WINTER SEASON

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As a consequence of permafrost melting, thermokarst landforms and ponds formation are increasing. In order to improve the knowledge of thermokarst ponds during winter, and their potential to act as a source of carbon to the atmosphere, a study was performed in April 2008 in a thermokarst pond located 7km southeast Kuujjuarapik – Whapmagoostui, Québec, Canada. The thermokarst pond was found under 2 m of snow pack with a 20 cm cap of ice. Water and sediment samples were collected and analyzed for carbon and nitrogen content. Concentrations of nutrients (nitrate and ammonium) as well as other interpretative parameters were determined.

Results obtained in this study show that the system is highly anoxic due to low concentrations of oxygen (9% of saturation), nitrate (0.02 mg/L), ammonium (1.71 mg/L). This assumption was supported also by field observation of methane bubbling in water and a strong smell. In this pond, organic carbon appears to be the major carbon fraction accounting for 96% of the overall carbon pool in suspended particles, 98% in sediments and 68% in dissolved carbon. The amount of carbon determined in suspended material (415 mgC/g) is quite similar as the one contained in sediments (445 mgC/g) but C/N ratios are slightly different. In sediments, C/N is 39, characteristic of terrestrial vascular plants while in suspended particles C/N is lower, 19, still an indicator of terrestrial origin but suggesting some loss in carbon, probable due to organic matter mineralization. In the water, particulate (POC) and dissolved organic carbon (DOC) account for 90% of the total carbon pool. DOC is as high as 13 mgC/L, while POC is 75 mgC/L. DOC/POC ratio was 0.18, indicating that POC is the major fraction of carbon in the water column. Excitation-Emission Matrix Spectra of DOC allowed characterizing DOC as essentially from terrestrial humic origin and no trace of proteins was found in contrast to other reported studies performed during summer season. Therefore, methane production seems to be the principal mechanism for organic matter turnover during winter. This study supports the hypothesis that thermokarst ponds represent a source of carbon to the atmosphere with methane as the primary source of carbon to be release to the atmosphere during the beginning of spring melting.

COMMISSIONING OF A NEW RAMAN-MIE-RAYLEIGH LIDAR IN EUREKA (79°58'N, 85°55'W), CANADA

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As a contribution to the CANDAC themes `The Arctic Radiative Environment' and `Waves and Coupling Processes', Dalhousie University has constructed a Raman-Mie-Rayleigh lidar. This laser-based system uses these three different optical scattering mechanisms to probe the atmosphere from near ground level into the mesosphere. The lidar measures aerosols, clouds, and water vapour, important variables in the radiative exchange question, and temperature profiles from near-ground into the stratosphere and mesosphere. The high vertical and temporal resolutions afforded by the lidar technique allow wave-induced

perturbations in temperature and density profiles to be measured for the study of atmospheric dynamics. Long term datasets will allow climatologies of the structure and properties of the Arctic atmosphere to be constructed, so offering additional insights into regional atmospheric change.

The lidar operates at ultraviolet and green wavelengths and a 1m diameter telescope collects the backscattered light which is then reflected into a polychromator. Series of narrow-band interference filters isolate each of the required wavelengths before analogue and photon counting techniques are used to record the signal. The entire laboratory is computer controlled for remote operation. With seven measurement channels and features to optimise the system for different atmospheric conditions, significant work was required to install, characterise, and calibrate the instrument. These efforts shall be discussed before presentation of some initial results achieved with the new lidar.

MEANINGFUL PARTICIPATION OF YOUTH IN BELUGA HEALTH RESEARCH IN THE INUVIALUIT SETTLEMENT REGION

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Researchers carrying out studies in northern communities have the opportunity to provide training to local youth during their research. In 2008, two students from Mangilaluk School in Tuktoyaktuk participated in a beluga-sampling program in the Inuvialuit Settlement Region (ISR). The research projects represent a collaborative approach to assessing beluga health status through the analysis of contaminant exposure, physiological and biochemical endpoints. The presence of a research team on Hendrickson Island provided an ideal situation to teach local youth a variety of sampling techniques and to discuss the rationale for beluga health research in the western Arctic. The role of the two youth in this project was to assist in fieldwork and to receive training that will assist them in participating in future research in the ISR. Their presence on Hendrickson Island led to the transfer of scientific and traditional knowledge about belugas to a younger generation of Inuvialuit. Following the field season, the two students traveled to three laboratories and learned about the analytical techniques being used to study the samples collected on Hendrickson Island. Northerners and scientists can greatly benefit from the inclusion of a training component within their research programs. For example, the participation of youth in this project provided them with meaningful summer employment, improved their understanding of the research process and led to increased awareness for community members regarding beluga research in the ISR. Researchers learned about Inuvialuit culture and language, effective communication and developed the skills required to mentor youth.

SEASONAL VARIATION IN THE ENERGY BUDGET OF THE BENTHO-SYMPAGIC AMPHIPOD ONISIMUS LITORALIS

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Onisimus litoralis is a bentho-sympagic amphipod inhabiting Arctic shallow waters. It has a 2.5 year life cycle, reproduces in December, and releases its brood in March-April, synchronized to the spring bloom. *O. litoralis* is omnivorous, feeding on ice algae and phytoplankton as newly released juveniles, while larger specimens are scavengers feeding on detritus. Monthly sampling (May 2007-June 2008) for cellular energy allocation (CEA) analyses was conducted in Adventfjorden, Svalbard, Norway. Adventfjorden is seasonally ice covered, but was only covered by sea ice during two weeks in April during the study period.

The energy content of *O. litoralis* varies from 6 000 J/g wwt to almost 11 000 J/g wwt, generally higher values in summer. The largest part of the energy is in form of lipids (up to 74 % in July). However, this includes the structural polar lipids e.g. in membranes, which are not available for consumption by the organism. The amount of lipids is

relatively stable through the year, suggesting that most lipids are polar, with slightly higher values in summer. Highest lipid content was recorded in July with around 8 000 J/g wwt. The content of proteins varies with season. In the summer months there is more than 2 500 J/g wwt, which rapidly decrease in the autumn and in the winter there is less than 1 000 J/g wwt, indicating tissue growth in the summer. The carbohydrate content is low during the whole year only contributing with some 100 J/g wwt. Carbohydrates are probably consumed directly and not used as a media to store energy.

The energy consumption is highest in July (over 280 J/g wwt h^{-1}) and stays over 200 J/g wwt h^{-1} until October, thereafter decreases to a minimum in December with only 120 J/g wwt h^{-1}. During the winter the energy consumption increase again, but is still less than 200 J/g wwt h^{-1}. The CEA-value is lowest during the autumn. It increases rapidly after October due to the lower energy consumption and is highest in December. During the winter the CEA-value stays high and slowly decreases towards the summer and autumn.

The results show that *O. litoralis* continues feeding throughout the winter, but the changes in energy, and especially protein, content indicates shifts in diet and growth pattern. Tissue growth in summer can explain the higher protein content and increased metabolism. The increase in the CEA-value in November may be connected to the preparation for reproduction. To better understand the possibility of *O. litoralis* to store energy further studies on the lipid composition are needed to separate the polar and neutral lipids.

INUIT RESEARCH ADVISORS AND ARCTICNET: THE COMMUNITY LINK

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Inuit Research Advisors has existed in Canada's Inuit regions since 2005. The IRA position has evolved over time by finding more ways to benefit Inuit and their respective regions through meaningful participation and capacity building. My poster will cover the history of the IRA position and advise students and researchers on how the position has developed as well as how the list of IRA partners has grown to include many other Inuit and Government organizations that believe IRAs are playing a significant role for research in the North. In this poster, I will focus on the Inuvialuit Settlement Region and discuss what my roles are and how I can assist visiting researchers to our region. I will outline how I monitor research, find and access education and training opportunities, ensure capacity building and meaningful participation of northerners and how I can ease the process for researchers looking to license their research and consult with communities. I also go into detail about regional community dynamics and how IRAs can help with more logistical concerns of conducting research in the North. For example, IRAs can assist in planning your transportation, accommodations, booking venues and finding local help. Another important aspect to being an IRA is monitoring research in our regions. I describe the tools I have developed for my region to efficiently keep a handle on research such as the Health and Environment Research Newsletter and an internal IRA researcher database. Involving communities in research is another reason why IRAs exist. Communities are usually first involved with projects during the initial stages of consultation, during licensing and approval, but they have much more to offer the scientific community than their support of a project. It has been recognized by IRAs and our partners that funding organizations and researchers now need to spend more time and effort into budgeting for training and capacity building for northerners and an IRA can be the link to ensure this happens across the North. Lastly, I have included my suggestions and recommendations on how researchers can most effectively deliver their results to the people of the ISR, through such activities as community feasts and presentations. In conclusion, I will like to reiterate that the focus of IRAs and their partners has changed over time from educating and communicating to our target groups, to building actual capacity and competence in our people to become the next set of researchers and scientists in the North. That is why our emphasis is on involving communities and making sure that they understand what their new more involved role in Arctic research is for the future.

HIGH RESOLUTION MODELING OF FLOW CHANNELS, WET AREA AND CARTOGRAPHIC DEPTH TO WATER IN REALTION TO PERMAFROST OCCURRENCE WITHIN THE SOUTH MACKENZIE PLAIN, NORTHWEST TERRITORIES, CANADA

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A GIS-algorithm was developed to determine flow channels, wet-area regimes and cartographic depth-to-water (DTW) at high geospatial resolution (10 m) for a 1,500,000 ha section within the South Mackenzie Plain south of Fort Simpson, with the potential to expand along the Mackenzie Valley to Inuvik at a later date. This algorithm combines digital elevation modeling (DEM) with other digital surface information such as existing digital elevation data, hydrographic data, and/or digitally classified wetland areas from air photos and or satellite images. The South Mackenzie Plain is quite flat and contains a multitude of wetland formations and associated flow channels. In particular, areas with mapped DTW within 0-10 and 10-100 cm from the surface amount to 18 and 41% of the study area, respectively. This closely resembles the eco-region-wide estimate of 18% with surface water features, and 40% covered with peat (Ecosystem Classification Group, 2007). It was determined that forested upland soils would be free of permafrost in this area. In contrast, water-saturated wetland soils with limited drainage, or DTW<1 m, and away from major flow channels and water bodies would have developed and still maintain a permafrost layer under current and preceding climate conditions. The areas between forest uplands and the more fluid wetland conditions (large flow channels and large lakes) would either be free of permafrost as well, or are starting to show major landscape change by way of frequent occurrences of collapse scars. These findings generally agree with the already proposed permafrost distribution map for the area (http://gsc.nrcan.gc.ca/permafrost/mapping_e.php). The results from this modeling and mapping exercise suggest that the permafrost distribution pattern within the study area is very intricate, as already revealed through aerial photography. For the study area, mapping topographically derived variations in flow channels, wet areas and associated depth to water at the 10 m scale, or finer, should significantly (1) increase the reliability and precision of the mapping process and related predictions regarding likely permafrost locations (and likely freeze-thaw depths), and (2) facilitate reliable land surface interpolations and classification. In this regard, best performances can undoubtedly be achieved with LiDAR-based land-surface imaging and bare-ground DEM generation.

Keywords: geospatial distribution, permafrost, digital elevation modeling, flow channels, wet areas, cartographic depth-to-water index, collapse scars, climate change.

ANNUAL PERIOD TEMPERATURE AND SALINITY SIGNALS OF SURFACE WATERS IN PRINCE WILLIAM SOUND, ALASKA

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Temperature and salinity measurements acquired during thermosalinograph surveys conducted throughout Prince William Sound (PWS) between March 2006 and January 2008 are used to identify annual period temperature and salinity signals of surface waters. Mean states and annual period changes in oceanic conditions throughout PWS reflect proximity to glaciated watersheds. Mean temperatures are coolest in northern and western PWS and warmest in southeastern PWS. Annual period temperature amplitude is greatest in western PWS. Mean salinities are lowest in northern and western PWS and highest in central and southeastern PWS. Annual period salinity amplitude is greatest in northern and western PWS. These results represent the most spatially comprehensive descriptions to date of annual period temperature and salinity signals in PWS. The results are applicable as benchmarks for validation of numerical PWS circulation models and as a decision support tool for the use of dispersants in the event of an oil spill.

MERCURY DISTRIBUTION IN THE BRAINS OF BELUGA WHALES (DELPHINAPTERUS LEUCAS) FROM THE WESTERN CANADIAN ARCTIC

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Mercury has been shown to damage mammalian nervous systems and is known to accumulate in the brains of exposed animals. We measured mercury in brains from hunter-harvested belugas in the Inuvialuit Settlement

Region, NWT in 2006 and 2008. Brain samples were collected from harvested whales with the assistance of local hunters during two summer harvests (N=75). Hunters collected brains from stranded belugas harvested in the Husky Lakes, NWT in November 2006 (N=30). Samples collected in 2006 were frozen whole and then dissected; in 2008, fresh samples were dissected in the field prior to freezing. Total mercury was analyzed in the frontal cortex, temporal cortex, cerebellum and brain stem using heat-vaporization mercury measurement equipment. Mercury concentrations in the four brain regions are presented and the correlation of mercury in various brain regions is investigated. Mercury concentrations in liver samples collected from the same individual animals were correlated to concentrations detected in brain regions. This study aims to improve our understanding of the levels of mercury in the brains of belugas and to determine whether certain areas accumulate higher levels of mercury than others. This information will be valuable for assessing neurotoxic effects of mercury exposure in whales. Future analyses will be carried out to identify whether exposure to mercury is associated with neurochemical variation in whales sampled in the western Canadian Arctic.

PARKS CANADA IPY INITIATIVES: WATERSHED APPROACH PILOT RESEARCH PROJECT FOR INTERDISCIPLINARY, INCREMENTAL AND MODULAR NORTHERN MONITORING

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Long-term, effective monitoring of large, remote areas such as northern national parks require innovative, integrative approaches that can provide knowledge from multiple sources, at multiple scales and for multiple ecosystems systematically. Moreover, as all expertise and resources are not always available from the start of a monitoring project, the Parks Canada Agency (PCA) needs monitoring approaches that can be implemented incrementally and in modular fashion. PCA is proposing a watershed-based monitoring approach that can address northern challenges in long-term monitoring and can facilitate integration of information for more effective interpretation of monitoring data. This watershed-approach processes information in two independent yet related phases where information is collected and integrated at watershed-scale and at park-scale. This presentation will address the development and preliminary implementation of the watershed-scale phase in Torngat Mountains National Park Reserve (TMNPR), a 9700 square kilometre protected area at the northern tip of Labrador.

IPY has provided an opportunity for the Parks Canada agency to acquire information and test and develop methods adapted to the northern context, to better combine remote sensing and ground truthing data and methodologies, and to integrate further multi-disciplinary monitoring and research in northern park ecosystems. An IPY pilot project, regrouping several of those initiatives, has been initiated in summer 2008 in the McCornick River watershed in the Nachvak Fiord area of Torngat Mountains National Park Reserve. TMNPR is co-managed by PCA and Inuit from the area. PCA is also working with IPY partners and ArcticNet partners, under a series of related International Polar Year (IPY) initiatives, and in collaboration with the Nunatsiavut Nuluak ArcticNet project. The McCornick River valley is a watershed of interest to the park and the co-management board.

This presentation will address the steps needed at the front end, prior to starting work in the field, present the steps that were taken this summer, and provide the next steps in the development of this approach.

Ultimately, the watershed approach underlines a long-term vision that offers both sustainable long-term monitoring opportunities and opportunities for sustainable economic development for local communities. Opportunities for sustainable community development are vital to maintain and evolve landskills and traditional and local knowledge in relation to local changes. In turn, landskills, traditional and local knowledge are essential aspects of the preservation of the ecological integrity of the northern national parks.

MODELLING THERMAL DEGRADATION OF NEARSHORE PERMAFROST IN THE WESTERN LAPTEV SEA

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In 2007 and 2008, newspapers and journals reported on methane dissolved in and bubbling out of the waters of the Siberian Seas. A number of scientists have drawn ties between these observations and the degradation of subsea permafrost. Completion in 2008 of sediment

analysis from a drilling project in the Laptev Sea in 2005 has given us more detailed insights into the progression of permafrost degradation after inundation. The boreholes reached a maximum depth of 77 m below sea level in a water depth of 6 m. Less than 5000 years of inundation were sufficient to warm the sediment over this depth range by 12 °C to within a degree of the porewater melting point. The very low temperature gradient with depth indicates that sediment porewater is undergoing change of state but gives no indication of degradation below 77 m. Modelling of heat flow in the sediment requires coupling of conductiv heat flow with phase change, and buoyancy, temperature and concentration gradient diffusion in the pore space. Since the main factor determining porewater phase is salinity, we begin modelling by including only conductive heat flow with phase change using experimentally determined freezing characteristic curves. Permafrost warming on shore is currently 0.3 °C per year at 20 m depth. We present initial backtesting of temperature profiles and speculate on the relative importance of the salt water front penetration into the sediment of the Laptev Sea shelf.

PHOTOSYNTHETIC CHARACTERISTICS OF NATURAL PHYTOPLANKTON ASSEMBLAGES IN THE BEAUFORT SEA, CANADIAN ARCTIC

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Photosynthesis-irradiance measurements were performed on natural phytoplankton assemblages at 15 sites within the flaw-lead polynya of the Beaufort Sea during the spring bloom of 2008. The physiological response of phytoplankton to light levels ranging from 6 to 900 µmol photons m^{-2} s^{-1} was used to assess photoacclimation, photosynthetic efficiency (α*), and maximum chlorophyll *a*-normalized rates of carbon (C) fixation (P^*_m) following the model of Platt et al. (1980). Sampling locations were selected within the flaw polynya to represent a range of ecological and environmental conditions, including sea ice-covered, melt pond, open water, and river-influenced areas. Size-fractionated photosynthetic parameters generally fall well within the natural range reported in the literature for cold temperature phytoplankton. The initial slope, α*, ranged from 0.005-0.030 mg C mg chl a^{-1} h^{-1} (umol photons m^{-2} $s^{-1})^{-1}$ and was generally lower for deeper, lower light samples. The assimilation number, P^*_m, ranged from 0.29-1.06 mg C mg chl a^{-1} h^{-1}, with shallower samples exhibiting higher values across all locations and classes, representing acclimation to higher light. Phytoplankton exhibited greater photoinhibition (β*) with increasing sample depth; near-surface samples showed little or no tendency to photoinhibition. Samples taken at the subsurface chlorophyll *a* maximum along a transect from under ice cover to open water showed a >3-fold change in α* and P^*_m, showing that large variations in photosynthetic efficiency and C assimilation can occur on relatively small spatial scales. Results suggest that photosynthesis in Arctic phytoplankton is highly influenced by physical factors and imply a considerable degree of photoacclimation resulting from physiological adjustments to ambient conditions. Furthermore, the larger algal size fraction (>5 µm) generally exhibited lower P^*_m and photoacclimation parameter (E_k) values across locations, which may have substantial impact on biogenic C drawdown if species composition changes in response to future global change. Increased stratification or other physical changes caused by future warming may have a large impact on biogeochemical cycling as phytoplankton vary their photosynthetic machinery in response to changing environmental conditions.

ADAPTATION TO CLIMATE CHANGE IN THE ARCTIC: KNOWLEDGE TRANSMISSION AND INFORMATION EXCHANGE AMONG INUIT IN AN ARCTIC COMMUNITY

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This poster outlines the rationale and objectives of research that documents and describes the degree to which the transmission and exchange of knowledge about the local environment and related skill sets among Inuit in an arctic community mediates vulnerability and shapes adaptation to climate change. It is well documented that climate change, together with other social, economic, and political changes, is already being experienced in the Arctic with implications for Inuit and the natural resources on which they depend. Previous research on vulnerability to climate change in the Arctic identified the transmission of environmental knowledge and related skill sets and the strength of social networks as key determinants of Inuit adaptive capacity to climate change. This collective social memory affords Inuit dynamic and flexible use of the environment and its resources and represents an asset base

from which adaptations can be made to deal with routine and novel events. However, Inuit have expressed concern that as a result of rapid societal changes, the traditional modes of intergenerational knowledge transmission by which Inuit have developed the skills to hunt safely and successfully no longer function effectively. Research has reported that some knowledge and skills have been lost, some are being transmitted later in life and incompletely, and others are new skills that the older generation did not possess. However, little data on the nature and processes of knowledge transmission have been presented to explain these observations. This research analyzes the vertical (older to younger) and horizontal (hunter to hunter) transmission and exchange of knowledge about the local environment and related skill sets among Inuit in the community of Ulukhaktok, Northwest Territories, Canada. The results are expected to provide a greater understanding of Inuit social relationships and the means by which a traditional culture adapts to a novel and challenging social and physical environment.

NEARSHORE CIRCULATION AND STORM SURGE ALONG THE MACKENZIE DELTA COAST

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The Mackenzie Delta is a 150 km long section of coastline characterized by muddy sediments where the Mackenzie River outflow, dispersed over 20 distributary channels, discharges into the southern Beaufort Sea. The marine environment in this region is an important and integral part of the lives of Canadian Northerners. The area is also undergoing hydrocarbon exploration with potential development within the next decade. Changes to Arctic climate, such as increasing ice-free western Arctic Ocean and intensifying storm activity, may endanger the coastal settlements and marine environment in the Mackenzie Delta region. The low gradient of the delta and the adjacent inner shelf makes it very susceptible to flooding during storms. Field observations in the nearshore zone collected in August of 2007 and 2008 indicate strong gradients in temperature and salinity in shallow water of 2-6 m. The fluctuations are associated with the movements of warm and fresh river plumes and wind-driven upwelling of cold and saline water below the thermocline. The observations are in agreement with 3D model simulations of the nearshore delta region using Delft3D, which includes wind, tidal, storm surge, buoyancy and river forcing. The results validate the model and indicate that it can be used to hindcast the nearshore oceanographic conditions during severe Arctic storms. As a case study we present preliminary model results for an Arctic storm from late 1999 that caused extensive vegetation die-off in the outer delta. This cyclone was a mesoscale Arctic storm that developed over the NE Pacific and western Bering Sea, intensified explosively in the Gulf of Alaska and developed into a meteorological bomb. The storm made landfall at Cape Newenham, Alaska, crossed the Rocky Mountains to the Yukon and Northwest Territories and re-intensified over a zone of high sea surface temperature gradients in the southern Beaufort Sea. Using the Canadian Mesoscale Compressible Community (MC2) atmospheric model, simulations of the storm pattern, track and intensity are in very good agreement with the NCEP re-analysis. This is model coupled to the Princeton Ocean Model (POM) and Hibler Ice Model, which are used to provide basin-scale driver fields and define the boundary conditions of the nearshore Delft3D model for the Mackenzie Delta region. Coastal damage was predominately caused by storm surge, and the high salinity flood waters that flowed over the surface of the outer delta.

LINKING CONTRIBUTING LANDSCAPE AND LAKES IN AN ARCTIC TUNDRA REGION IMPACTED BY PERMAFROST DISTURBANCE

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Numerous international scientific assessments (e.g., Intergovernmental Panel on Climate Change & Arctic Climate Impacts Assessment) have identified critical knowledge gaps that need to be addressed to improve our understanding of the vulnerability of Arctic freshwater ecosystems to climate variability/change, and to other anthropogenic environmental stressors (e.g., increased land-use disturbance, direct and indirect impacts of resource

extraction, point and non-point source contaminant inputs, etc.). A field-, process- and modelling-based research program (co-operation between Environment Canada, University of Victoria and Indian and Northern Affairs Canada) was initiated with the basic goal of improving the understanding of climate-, landscape-and lentic-driven processes in northern Canadian freshwater aquatic ecosystems.

The study area is located in the Mackenzie Delta Region along the proposed Mackenzie Gas Pipeline Route. A set of 60+ tundra lakes over a climatic gradient from Inuvik to Richards Island, Northwest Territories have been selected on a paired basis - one undisturbed and the second disturbed. Disturbance in this case means affected by obvious shoreline thermokarst slumping. Comparison of the set of lakes provides a 1st-order estimate of the potential effects of altered hydrology and geochemical loading from permafrost degradation, and an insight into possible future effects of climate change on the hydrology and ecology of lakes in the continuous permafrost zone of northwestern Canada. The goal of this poster is to present an overview of an International Polar Year/ArcticNet funded study that investigates the hydrological and geochemical linkages between the contributing landscape and the lake water quantity/quality in arctic tundra lakes impacted by permafrost disturbance.

RECENT CHANGES IN THE DYNAMICS OF ICE ALGAE IN THE CANADIAN BEAUFORT SEA

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Global warming has affected polar regions first and foremost, but its impact on primary production of polar ecosystems remains under debate. The Arctic Ocean sea-ice environment, where ice algae contribute to a significant fraction of the total primary production, is rapidly changing. Furthermore, few studies have examined the differences between algal communities of land-fast ice and pack ice. During the International Polar Year – Circumpolar Flaw Lead (CFL) system study, we had the opportunity to study the vernal development of the bottom ice communities in both land-fast ice and pack ice. Ice samples were collected at two bottom ice-horizons (i.e., 0–3 cm and 3–10 cm) in the land-fast ice and pack ice of the Amundsen Gulf (Canadian Beaufort Sea) for the determination of the taxonomic composition and abundance of algae and other protists, pigments, nutrients and salinity. In this work, we focus on samples taken when chlorophyll *a* (chl *a*) concentrations peaked during the ice algal bloom (i.e., 27 April – 16 May 2008). Preliminary results showed that bottom ice chl *a* concentrations attained values >250 mg m^{-2} in land-fast ice yet remained <50 mg m^{-2} in pack ice. The maximum chl *a* concentration measured during this study was nearly a factor of magnitude higher than the maximum value reported for the Beaufort Sea area over the last 30 years, but similar to the highest concentrations observed in the Northern Hemisphere, in Resolute Passage. Our results suggest that the dynamics of ice algae in the Canadian Beaufort Sea has changed drastically during recent years.

18TH CENTURY INUIT PLANT USE: PHYTOLITH ANALYSIS OF SOAPSTONE RESIDUES

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Archaeologists have been working to demonstrate how climatic changes during the Little Ice Age era and contact with Europeans impacted 18th century Inuit culture. The phytolith record is a powerful tool for reconstructing aspects of past ecology and human behavior. Phytoliths (microscopic silica plant remains) can be found in many cultural contexts including soils, teeth, stone tools, coprolites and importantly food residues. In an attempt to capture the range of Labrador Inuit plant use at an 18th century winter site (Oakes Bay, HeCg-08) a phytolith analysis was conducted on residues from seven soapstone vessels and one midden soil matrix sample. Goals of this study were to: (1) evaluate and explore potential methods of phytolith extraction from vessel residues, (2) create a phytolith reference collection for Labrador and (3) utilize a comparative method to identify phytoliths within these residues. Phytoliths recovered from the residues suggest that edible food plants (*Empetrum nigrum, Rubus chamaemorus, Vaccinium sp.*) and other medicinal plants (*Epilobium latifolium, Ledum decumbens, Salix spp.*) were included in heated mixtures which created the carbonized residues on the pot fragments

examined in this study. There is also possible evidence of phytoliths from imported cereals (*Avena sp. Secale sp.*) in these residues which has important historical and cultural implications. The results of this phytolith analysis demonstrates how archaeolobotanical research advances our understanding of past ecology, reconstructs human and plant interactions and offers insight into how the Labrador Inuit have dealt with change in the past. The information resulting from this phytolith analysis provides a contribution on plant resource use by the Labrador Inuit to Dr. Cynthia Zutter's (Grant MacEwan College) SSHRC funded palaeoethnobotanical investigation of the region.

CO2 AND CH4 FLUX MEASUREMENTS SURVEY IN THE VICINITY OF KUUJJUARAPIK, 2006 TO 2008

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The mean global surface temperature is expected to increase by 1 – 3.5 °C within the course of this century, and global circulation models indicate that warming will be the greatest at high latitudes. Several causes could be related to this natural or anthropogenic fluctuation, but environmental factors such as temperature, precipitations and soil moisture are known to control gas exchange. However it is difficult to predict their response to the climate change. Since 2006, greenhouses gas fluxes were measured at Kuujjuarapik, on the east cost of Hudson Bay, in various conditions with small and large scale micro-meteorological devices. In summer 2006, net average CO_2 fluxes is significantly lower than in 2007, -237.45 mg/m²/h versus -155.76 mg/m²/h, for the same period. CO_2 fluxes is mainly correlated to soil temperature, R^2 = 0.37 & 0.52. In 2007, CO_2 fluxes over grass is significantly lower than shrub, -131.57 mg/m²/h & -210.01 mg/m²/h. CO_2 fluxes is mainly correlated to air temperature, R^2 = 0.28 & 0.44. Vascular plant with the photosynthesis process seems to play an important role in trace gas exchange. Static Flux Chamber was also used to measure soil's respiration and CH_4 exchange on different substrate during day time (~10:00 EDT). Maximum CH_4 fluxes were found in Thermokarst ponds, 12.96 mg/m²/h, while the highest CO_2 fluxes where measured over mosses and lichens, 56.56 and 42.31 mg/m²/h. Isotopic tracer in soil, plant, water and air, δC13 & δN15, are also use to understand gas exchange. Clearly, rich organic habitats tend to have a different signal than poorly organic environments. In spring 2008, δC13 over snowpack, significantly increase from the surface to the bottom, close to the frozen soil, -11.61 to -6.91 % (R^2 = 0.50). In winter time, over snowpack, net CO_2 emission is measured contrary to summer season. As a whole, the Kuujjuarapik site acted as a net sink of CO_2 and a net source of CH_4. The CO2 gas exchange is more related to terrestrial ecosystem and associated with photosynthesis and respiration processes. In the other hand, the CH4 emission is mainly associated with aquatic ecosystems and more subject to precipitation variation. In the Nunavik, water surface counts for approximately 5 % of the whole territory.

STABLE ISOTOPIC SIGNATURES OF THE SYMPAGIC AND PELAGIC BIOTA IN THE SOUTHEAST BEAUFORT SEA

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The release of particulate organic matter (POM) from the ice into the water column during the spring-summer transition is a major feature of polar marine ecosystems, but many questions remain about the nature and fate (or function) of this material. Does it simply sink to the benthos or does it also provide food and seeding material for the pelagic biota? The analysis of stable isotopes is a powerful tool to trace the flow of ice-derived matter in pelagic and benthic environments. This is possible because the different growth conditions and trophic positions of organisms affect the stable isotopic signature of carbon and nitrogen in their biomass. For particulate nitrogen, this signature also provides information on the main source of dissolved allochtnous nitrogen used by primary producers. In the Arctic, however, the mechanisms controlling the isotopic signature of the major constituents of POM in the ice and the water column are not well known. In this study we used an innovative combination of approaches to investigate key potential determinants of the stable isotopic signature of POM and to detect the possible contribution of ice algae to pelagic biomass. Coupled sampling of the ice and the water column for stable isotopic and taxonomic analyses was conducted in the southeast Beaufort Sea during CFL, allowing a tight tracking

of the spring-summer transition from April to late July 2008. In order to partially isolate the major constituents of POM, replicate samples were size-fractionated or held into settling columns (SETCOL). The latter treatment aimed at separating organisms on the basis of their buoyancy or motility. Here we describe the experimental approach and present initial results.

IRON DEFICIENCY AMONG NON-PREGNANT INUIT WOMEN IN NUNAVIK, QUEBEC, CANADA

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Introduction: Iron deficiency and anemia have major consequences on health and socioeconomic development, but to our knowledge, no data exist about the prevalence among Nunavik women.
Objective: Our goal was to assess the prevalence of anemia, iron deficiency (ID) and iron deficiency anemia (IDA) and their associated risk factors among a representative sample of Inuit women from Nunavik.
Design: Subjects sample consisted of 466 Inuit women aged 18-74 who participated in the 2004 Inuit Health Survey. Non-Inuit women, pregnant women and those who took supplements the month preceding the survey were excluded. Iron deficiency was identified using the model of Patterson et al. (based on hemoglobin, ferritin, serum iron, transferrin saturation and total iron binding capacity) and an additional adjustment for inflammation based on CRP measurement. Dietary data were based on one 24-hour recall and a food frequency questionnaire. Absorbable iron intakes were estimated using the model proposed by Tseng et al. Iron status association with social, economic and dietary characteristics was assessed using chi-square test, linear regression and logistic regression. All statistics were weighted using a boostrap technique in order to obtain a representative sample.
Results: Anemia, ID and IDA affected 43%, 36% and 21% of the women in Nunavik respectively. The main type of anemia found in women of childbearing age (aged 18-49) was iron deficiency anemia while older women (aged 50-74) were more affected by anemia of chronic disorders. Inadequate absorbable iron intakes were significantly associated with an increased prevalence of ID and iron depletion. A younger age, the presence of food insecurity, unemployment or the absence of abdominal obesity, a lower consumption of mollusks and a higher consumption of cereals and sweet beverages were related to a poorer iron status.
Conclusion: The prevalence of anemia found in Nunavik women is similar to levels observed in non-industrialized countries and reaches the category of severe public health problem according to the WHO's classification. For such high rates of iron deficiency anemia, the WHO suggests a universal iron supplementation without individual screening in the age group at high risk. Since compliance to iron supplements is low in Nunavik and that iron supplementation is a short term solution, a long-term nutrition intervention program is urgently needed in Nunavik. However, further research on the presence of occult blood loss and of helicobacter pylori infection would be very useful to appreciate iron loss and to obtain a global perspective of the iron balance among Inuit women.

OZONE AND MERCURY DEPLETION EVENTS AT KUUJJUARAPIK (QC, CANADA) IN CONNEXION WITH COBRA AND CICAT IPY PROJECTS IN 2008

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Total gaseous mercury and ozone concentrations are measured at Kuujjuarapik (Québec, Canada) since 1999. Results indicated ozone (ODEs) and mercury (AMDEs) depletion events in this subarctic region in springtime similarly to the high Arctic. About 2-15 AMDEs and 1-7 ODEs are measured annually in Kuujjuarapik. The Arctic atmosphere in springtime exhibits very unusual chemistry involving halogens (e.g., bromine and iodine) released from sea-ice. Once in the atmosphere these compounds cause very rapid destruction of ozone, and the oxidation of elementary mercury (Hg°). Oxidized mercury then deposits on the snow (up to 100 ng/l), and may become available for methylation processes and to further enter the food chain. Hg methylation involved specific environmental

conditions such as, carbon sources, bacteria and anaerobic conditions and may represent up to 8% of the total mercury in snow. In spring 2008, international reseach campaigns under International Polar Year (IPY) were undertaken in Kuujjuarapik, namely COBRA (Combined impact Of Bromine and iodine on the Arctic atmosphere) and CiCAT (Climate Change Impacts on Canadian Arctic Tundra Ecosystems: Interdisciplinary and Multi-scale Assessments) to better understand the cycling and fate of mercury, halogens and carbon within the sub arctic region. This paper will present an overview of those campaigns.

WHALING CAMP AT HENDRICKSON ISLAND, 2008

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At Hendrickson Island, near Tuktoyaktuk NT, Frank and Nellie Pokiak along with their family lead the sampling of harvested beluga whales for community based monitoring program. They work closely with all hunters to collect samples as well as record observational information. Samples are collected for the Department of Fisheries and Oceans contaminant and health monitoring program, but have been used by other researchers interested in various aspects of ocean health. Samples collected include beluga muscle, skin and blubber, kidneys, liver, blood and lymph nodes. In addition, measurements of beluga taken (e.g. length, girth, blubber thickness) in partnership with the Fisheries Joint Management Committee (FJMC) monitor. Frank and Nellie Pokiak recommend more communication take place between them and scientists so they can effectively communicate with the hunters about the beluga samples they take. Finally they strongly support the need for more youth to become in the program that will strengthen relations between science and community as well as the learning process with elders and their traditional way of life.

BIOPHYSICAL CHANGES RELATED TO COASTAL THERMOKARST ON HERSCHEL ISLAND, WESTERN CANADIAN ARCTIC

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Herschel Island is located 3 kilometers off the mainland of the Yukon coast in the Canadian Beaufort Sea. The island is made up of highly deformed fine-grained sediments that were pushed into place by advancing ice sheets during the last glacial period. Herschel Island and the adjacent Yukon coastal plain are underlain by ice-rich continuous permafrost which is subject to dramatic landscape changes related to thermokarst and coastal erosion. Large bodies of almost pure ground ice, often several metres thick and extending for hundreds of metres laterally are common and when this massive ice becomes exposed at the ground surface, large retrogressive thaw slumps and landslides frequently develop and erosion is intensified. Our studies over the past decade indicate that the nature and magnitude of these changes may be increasing. As part of an IPY project entitled the "Vulnerability of ice-cored environments" we began an integrated study concerned with the analysis of changes related to degrading permafrost on Herschel Island. This poster reports the preliminary findings of a 2008 field program by a team of students and researchers from McGill University. Included are (1) detailed observations on permafrost stratigraphy and ice contents, (2) GPR mapping of ground ice distribution, (3) biogeographical analysis of revegetation patterns for disturbed surfaces and (4) a survey of thermokarst activity for the island. These data presented focuses on 2 areas of thermokarst activity where annual retrogressive thaw slump retreat rates average 10-15 metres per year. In addition we present information on coastal processes. Our ongoing observations indicate annual coastal retreat rates of 0.5 to 1.0 m/yr. The results of this study are being incorporated into a GIS that helps characterize both the spatial pattern and rates of change. The significance of these changes pertains to the cultural importance of Herschel Island to the Inuvialuit of the western Arctic.

FORAGING ECOLOGY AND HABITAT SELECTION OF BOWHEAD WHALES (BALAENA MYSTICETUS) IN THE CANADIAN HIGH ARCTIC

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The overriding question this project hopes to answer is the determination of bowhead whale habitat needs by focusing on (1) foraging ecology and (2) resource selection. The areas of interest include both the Eastern and the Western Arctic range of the Bowhead whale. Focusing on summer and fall, this research project will look at Bowhead whale movements and aggregations in relation to zooplankton assemblages and water masses structures. First, to understand foraging ecology we will use archived and recently collected biopsy samples of Arctic bowhead whales to test stable isotope (carbon, nitrogen and sulphur), and fatty acid chemical signals that can be compared to prey thereby differentiating seasonal food selection and prey composition. Second, using past and current satellite telemetry location data, we will model resource selection functions in conjunction with analyses of the temporally changing bowhead environment (e.g. primary productivity such as chlorophyll a) to understand habitat requirements. The proposed research aims to provide information necessary for the short-term recovery objective of identifying and protecting important whale habitat required for the Conservation Strategy for Eastern Canadian Arctic Bowhead Whales. Bowhead potential prey items were collected in the Eastern Arctic in the summer 2007 onboard the Icebreaker Louis S. St-Laurent and in the Western Arctic in the summer 2008 on board the Sir Wilfrid Laurier as part of the Canada Three Oceans (C3O) IPY project. Physical and chemical data were also collected at each site and will be included in the analysis of bowhead distribution.

GENETIC MONITORING: AN APPROACH FOR CONSERVATION OF BELUGA WHALES IN THE TARIUM NIRYUTAIT MARINE PROTECTED AREA (TN-MPA) IN THE BEAUFORT SEA

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The beluga whales of the Beaufort Sea constitute an important subsistence fishery. With an average Canadian annual landed catch of 111 per year (1990-1999), beluga serve as an important source of food – particularly the muktuk (skin) which is rich in vitamin C and high in energy content. The subsistence harvest of beluga also provides meat, fat, oil, leather, tools and materials for arts and crafts, and are a source of food for sled dogs. The Mackenzie River Delta contains the only known traditional summer concentration areas for the Beaufort Sea stock and the Aboriginal people of the Western Arctic have harvested the beluga in the Mackenzie estuary for more than 500 years. The areas used by summer aggregations of beluga in the Mackenzie River Delta (Shallow Bay, east Mackenzie Bay and Kugmallit Bay) have been designated an MPA within the Beaufort Sea Large Ocean Management Area (LOMA). This MPA, the Tarium Niryutait Marine Protected Area, has a stated conservation objective under the biodiversity theme of maintaining the genetic fitness and integrity of beluga assemblages. The strategy proposed to meet this objective is to develop an understanding of the genetic structures within beluga assemblages. Work is underway to increase the amount of genetic information used to investigate genetic stock structure in beluga aggregations in the Beaufort Sea and try to identify management units for monitoring the effects of human activity upon species abundance. In addition, data from genetic markers can provide information relevant to both ecological and evolutionary timeframes and can contribute to the monitoring of biological diversity. We propose to expand the spatial and temporal range of beluga samples analyzed with genetic markers and use the data to assess the potential of genetic monitoring for beluga in the Tarium Niryutait Marine Protected Area. These data may also be used to examine potential behavioural and genetic responses of beluga to climate change, such as the rapid loss of sea ice. Changes in biological productivity and seasonal

abundance of sea ice will likely proximally affect movement patterns, hunting and foraging strategies, and breeding behaviour. Ultimately, environmental changes will affect gene flow and dispersal, group and population structure. Satellite tracking studies and fatty acid analyses have revealed that beluga segregate in the Beaufort Sea according to age, sex, and reproductive status and may represent characteristics of beluga social structure. This segregation is also linked to habitat use and feeding behaviour. It has been shown, for example in humpback whales, that there is an influence of maternal lineages on the social organization of whales within a regional feeding ground. We intend to examine mtDNA sequence data in beluga from the Mackenzie Delta to test this hypothesis and compare genetics results with chemical signals, including results from fatty acids

GENETICS AND CYST-THECA RELATIONSHIP OF THE ARCTIC DINOFLAGELLATE CYST ISLANDINIUM MINUTUM

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Resting cysts produced by dinoflagellates, an important group of phytoplankton, are used as paleoecological indicators of sea-surface conditions in the Arctic. Knowledge of the ecology of dinoflagellates is mainly restricted to cysts settled in surface sediments or motile forms living in the upper part of the water column. The unification of these could draw a better picture of the relationships between the species and the environmental factors. However, little is known on the link between the cysts and the motile forms who produce them, especially for the Arctic environment. In this study, we chose to work with the dinoflagellate cyst *Islandinium minutum* because of its wide distribution throughout the Arctic and its importance to reconstruct the duration of seasonal sea-ice cover. To establish the relationship between *Islandinium minutum* and its motile form, we used morphological analyses through incubation experiments.

Cysts were incubated in a F/2 culture medium at 4°C and at a light: dark cycle of 18 hrs: 6 hrs. When germination occurred, the empty cyst was mounted in glycerine jelly between slide and coverslip. The specimens were observed under transmitted light microscope equipped with differential interference contrast (Nomarski). To identify the germinated motile forms, the thecae, outer cellulose skeleton composed of multiple plates, were described. Thecal plates were stained with calcofluor white and observed using epifluorescence microscopy. The Kofoid plate numbering and codifying system was used to label thecal plates.

We obtained three similar but distinct thecae from cysts very alike *Islandinium minutum*. The cysts possess all the general characteristics of *Islandinium minutum*, but differ only by the morphology of the aperture (archeopyle) through which the motile forms emerge. Based on morphological observations, two hypotheses can be drawn: 1) *Islandinium minutum* is a species expressing variability for theca and cyst morphology or 2) *Islandinium minutum* is part of a species complex. No correspondence has been found yet in the literature for the observed specimens; so, they have to be considered as one or multiple new species. If the latter hypothesis is true, the relative ecologies of each of these species are not available. Due to palynological sample mounting techniques, it is often impossible to have a clear view on the archeopyle and differentiate these cysts. Then, detailed studies and long-term monitoring of the motile forms will be needed to have a better picture of the relationships between the species and the environmental factors. Genetics on each specimen will be done using single-cell PCR to test the exposed hypotheses.

INTERANNUAL CHANGES IN PACK ICE PROPERTIES IN THE GULF OF ST. LAWRENCE AND THEIR EFFECT ON HARP SEAL PUP MORTALITY

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Sea ice is an important component of the harp seal habitat. A stable ice platform is required for whelping and nursing, and for the young seals before they enter the water and feed independently. The survival of the pack ice for the required period after seal birth depends on weather conditions that alter between years and may permanently alter due to global warming. Little is known about the vulnerability, sensitivity or adaptive capacity of ice-breeding seals to perturbations of their habitat. Changes in the pack ice evolution and the timing or geographic distributions of seals, perhaps induced by climate change, could strongly influence their natural mortality. Ice thickness

and ice roughness profiles were successfully sampled in the southern Gulf of St. Lawrence during the harp seals' early whelping stage on March 2 and 3, 2007 and again on February 29 and March 1, 2008. Helicopter-borne sensors collected ice property and video data along transect lines over the pack ice both at the whelping site and in surrounding areas. In both years, 3-4 satellite-tracked ice beacons were placed on the ice to track the herd and follow the ice signature seen in SAR imagery around the herd. The pack ice at the 2007 whelping site did not remain within the Gulf for more than a week for two of the three beacons. This implies a high seal pup mortality rate, since the seals need a stable ice platform for at least 4 weeks. In contrast, most of the pack ice at the 2008 whelping site lasted more than four weeks resulting in a lower mortality rate. The durability of the pack ice selected by seal herd, and thus the rearing success of the Gulf Harp seals, depend on the location of the whelping site, the succession and strength of storms during the whelping season, and the total ice extent (winter severity) of the specific year. The environmental parameters, including ice extent, are expected to change due to global warming, and thus are likely to affect future pup morality rates.

PARASITIC INFECTION OF THE HYPERIID AMPHIPOD THEMISTO LIBELLULA IN THE WESTERN CANADIAN ARCTIC, INCLUDING A DESCRIPTION OF GANYMEDES THEMISTOS SP. N. (APICOMPLEXA, GREGARINIA)

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Changes in the Arctic climate will influence the life dynamic in the water column. Thus studies of the food web structure and the interaction between its components drive a new understanding of the topic. Two parasites were found in the Arctic hyperiid Amphipod *Themisto libellula* in the Canadian high Arctic: the gregarine *Ganymedes themistos* sp. n. infected the intestines and an unidentified parasitic ciliate infected the body cavity. Effects of the parasite infection on the ecology of *T. libellula* population were evaluated in a study carried out in the vicinity of Beaufort Sea from 2002-2004. Net collections and sediment trap samples were used. The infection of the amphipod population with *Ganymedes themistos* sp. n. reached 94% to 89% in the net and sediment trap samples, respectively. There was a spatial difference in the infection rates between Cape Bathurst Polynya and the open ocean area but no significant differences between Mackenzie Shelf and the polynya. The amphipods from the oceanic region appeared to be less infected, while those from the shelf and polynya were heavily parasitized. Winter 2003 was the season with the highest infection rates. Females were the most frequently parasitized, whereas males had the highest number of parasites in their intestines. *Ganymedes themistos* sp. n. had no effect on the growth of the female oostegites or male antennae and hence on the development of *T. libellula*. The gregarines were found mainly in the midgut, which may prevent them from being discharged when the host is molting. Neither of the parasites had an effect on the hosts feeding rate. Infection of the parasitic ciliates reached 81% in sediment traps and 55 % in net collections. These data indicate that the gregarines are non-harmful to their hosts, while the ciliates cause mortality in the infected individuals.

INFLUENCE OF A RIVER PLUME ON ICE ALGAL ASSEMBLAGES IN WESTERN HUDSON BAY

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We studied the bottom land-fast ice protist assemblage at two stations located in a transitional zone off the Churchill River in western Hudson Bay, Canada. From 3 to 21 April 2005, surface water (0.5 m) and bottom ice cores (4 cm) were collected on 10 occasions at two stations characterized by high (28–30 psu) and low (12–14 psu) surface water salinity. Surface water and ice cores were analyzed for salinity and nutrient concentrations (i.e. NO_3, PO_4 and $Si(OH)_4$). Ice cores were also analyzed for chlorophyll *a* (chl *a*) and the enumeration and identification of algae and other protists, with emphasis on diatom taxa. The bottom ice diatom flora comprised 80 taxa at the marine station and 54 taxa at the brackish station, yet diatom abundances were twice higher at the brackish compared to the marine station ($0.76 \pm 0.45 \times 10^9$ cells m^{-2} *versus* $0.37 \pm 0.26 \times 10^9$ cells m^{-2}, respectively). Pennate diatoms were strongly dominant and represented

86 ± 7% and 97 ± 2% of total cell numbers at the marine and brackish stations, respectively. However, the species composition of the diatom assemblages was different between the two stations. At the marine station, the genus *Nitzschia* (37 ± 14% of total diatom numbers) dominated the bottom ice assemblage with *N. frigida* representing 67 ± 19% of cells in this group. At the brackish station, *Pauliella taeniata* and freshwater *Eunotia* spp. dominated the assemblage, with 25 ± 15% and 28 ± 9% of total diatom numbers, respectively. At that station, the genus *Nitzschia* represented only 17 ± 10% of total diatom numbers in the bottom ice. At the marine and brackish stations, the genus *Navicula* accounted for ca. 17 ± 7% and 17 ± 10% of total diatom numbers, respectively. *Navicula pelagica* was the dominant taxon of this group with 54 ± 18% and 49 ± 27% of cell numbers at the marine and brackish stations, respectively. The seasonally averaged chl *a* concentrations were not significantly different between the marine and brackish stations. These results suggest that the presence of the river plume did not have much influence on the ice algal biomass but played a key role in controlling the taxonomic composition of the ice algal assemblage in western Hudson Bay.

ENVIRONMENTAL CHANGES AND NUTRITION TRANSITION : OMEGA-3 POLYUNSATURATED FATTY ACIDS AND THEIR RELATION WITH CARDIOVASCULAR RISK FACTORS IN THE INUIT POPULATION OF NUNAVIK, QUÉBEC, CANADA

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Environmental changes have important impacts on the Arctic ecosystems, and affect the sustainability of the traditional food system of the Northern populations. The Inuit traditional country food is essentially composed with marine fish and mammals, naturally rich in omega-3 polyunsaturated fatty acids (n-3 PUFA), essentially EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), which have been documented as having a positive effect on the risk factors of cardiovascular diseases (CVD). Now, the tendancy observed since the past decades of a partial shift from highly nutritious traditional country food to store bought food with a poor nutritive value, comes along with the emergence of chronic diseases, named as «modern diseases» associated with diet such as diabete, high blood pressure, CVD and cancer, which were rare until recently.

The main objective of this study was evaluate the impact of a changing environment on the health of Inuit people, examining the relation between food habits and n-3 fatty acids intake, and their effects on plasma lipids. Specifically, we aimed to examine the association of n-3 PUFA concentrations with the consumption of marine food, and to verify the relation between membrane phospholipid concentrations of EPA and DHA and the levels of CVD risk factors in the Inuit population from Nunavik.

Data were collected among 1058 Inuit ≥18y in the 14 Nunavik communities in 2004 through directed interviews and clinical questionnaires and examinations, and physiological measurements. Levels of plasma lipids were determined in blood samples from the participants ; n-3 PUFA concentrations were analyzed in membrane phospholipids. Analysis of variance was used to compare n-3 fatty acid mean concentrations between groups ; simple and multiple regression analyses were used to evaluate the association between n-3 fatty acid concentrations and CVD risk factor levels.

The mean consumption of marine food by Inuit people was 84 $g.j^{-1}$ and accounted for 48 % of the daily intake of traditionnal food. The consumption of marine food varied significantly according to age and gender, with older people and Inuit men having higher values than younger and than Inuit women (>31y), respectively. The mean relative concentrations of combined EPA+DHA (5.8 to 8.2 % of total fatty acids, depending on daily marine food intake category) and the ratios EPA:AA and n-6:n-3 varied significantly according to the quantity of marine food consummed daily and to gender, with Inuit women having higher values than Inuit men. Concentrations of EPA and DHA were significantly positively associated with HDL-cholesterol (but not with LDL-chol) levels, and were inversely associated with triacylglycerol concentrations. The n-6:n-3 ratio (2.1-3.2) observed in the Inuit population was associated with triacylglycerol and inversely associated with HDL-chol levels.

This study showed that the content of EPA and DHA measured in membrane phospholipids is indicative of the average daily intake of marine fish and mammals. Higher concentrations of EPA and DHA were positively associated with higher concentrations of HDL-chol, and lower concentrations of triacylglycerol. The low n-6:n-3 ratio observed among the Inuit of Nunavik may explain the low death rate in this population.

α- AND γ-HEXACHLOROCYCLOHEXANE (HCH) CONCENTRATIONS IN THE SEA ICE FROM CANADIAN HIGH ARCTIC AND ITS RELATION TO THE SEA ICE GEOPHYSICAL STATE

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Hexachlorocyclohexane (HCH) is an organochlorine insecticide. It was used heavily throughout the world in two formulations: technical HCH and lindane. Technical HCH contains the following isomers: 55-80% of α, 5-14% of β, 8-15% of γ, 2-16% of δ and 3-5% of ε, whereas lindane consists of almost only γ-HCH. All isomers of HCH are acutely and chronically toxic but α- and γ-HCH are of particularly high risk to arctic marine ecosystems due their high volatility and susceptibility to long-range transport (LRT). Although there is a number of publications on the HCHs in the arctic sea water, air and biota in the literature, there is scarcely anything available regarding sea ice. In the era of climate change and rapid thinning and shrinking of the arctic sea ice cover, HCH as a class of compounds, but in particular α-HCH due to it predominance in the Arctic and it's chirality, can be used to understand the effects of climate change on contaminant pathways and to predict potent future scenarios of significant and urgent importance.α- and γ-hexachlorocyclohexane concentrations were measured in sea ice samples from the Amundsen Gulf, Canadian High Arctic, as a part of Circumpolar Flaw Lead – International Polar Year program (CFL-IPY). The geophysical parameters of sea ice to which the levels of contaminants were related to included sea ice type characterized primarily by its thickness, salinity, temperature, brine volume and texture. The sampling period started during freeze-up in late October 2007, progressed throughout the winter and ended up in the spring 2008 covering a variety of sea ice types ranging from new ice, through young ice to thick first-year ice (FYI). In addition, two samples of multi-year ice (MYI) were included in the analysis. There was a significant negative correlation found between the arctic sea ice thickness and the concentration of both α- and γ-HCH, although more pronounced for the first isomer. Concentrations of α- and γ-HCH reached 856 pg/L and 216 pg/L in 5-cm thick new ice, respectively; 422 pg/L and 114 pg/L in 70-cm thick medium FYI, respectively and only 172 pg/L and 107 pg/L in 330-cm thick MYI, respectively. The ratio of α-HCH to γ-HCH averaged roughly 4 in new and young ice and only 1 in multi-year ice suggesting different rates of removal with brine rejection corresponding to physical-chemical characteristics of the two HCH isomers such as Henry's law constant (0.10 Pa/m^3/mol for α-HCH and 0.029 Pa/m^3/mol for γ-HCH in -2 °C seawater). During winter 10 first-year ice floes of 100 to 200 cm and one multi-year ice floe of 400 cm were sampled in layers corresponding to different ice textures (granular, transitional or columnar crystals). Relations between arctic sea ice crystal structure and brine volume calculated from ice temperature and salinity and concentrations of α- and γ-HCH were subsequently discussed.

MONITORING COUNTRY FOOD SAFETY IN NUNATSIAVUT

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Zoonotic diseases are those that are naturally transmissible between vertebrate animals and humans. Included in this definition are infections acquired from foodborne sources, often caused by inadequate cooking of infected meat. This is of particular concern in northern communities, as traditional methods of preparing food often include eating raw or partially cooked meat. This project deals with three major zoonotic pathogens of concern in the arctic: *Anisakis simplex*, *Toxoplasma gondii*, and *Trichinella spp.*. Each can be transmitted to humans by eating raw or partially cooked fish, marine mammals, ungulates, birds, or bear meat, among others. *A. simplex* is an ascaridoid nematode found worldwide in a wide range of fish, marine mammals and bears. In Canadian Atlantic waters, larvae of *A. simplex* are common parasites of several species of marine fish. *T. gondii* is a cyst-forming protozoan coccidian parasite among the most common in animals. Although generally transmitted by the fecal-oral cycle, *T. gondii* can also be transmitted by eating uncooked, infected meat. *Trichinella*, a genus of nematode worm, is one of the

most widespread zoonotic pathogens in the world. *Trichinella nativa*, as opposed to *Trichinella spiralis*, is adapted for survival in the cold arctic environment, and *T. nativa* larvae have been found to tolerate several months of storage at below zero temperatures without any noticeable decrease in survival. All three parasites are of possible concern in northern Inuit communities because hunted game provides large quantities of meat which may be rapidly and widely distributed among community members. This could pose a serious food safety risk when the disease status of the food remains unknown. To better inform the communities of the risks that their food may pose to them, it is necessary to determine the distribution and prevalence *of A. simplex, T. gondii* and *T. nativa* in the arctic. Depending on these results, a food monitoring and testing program may be recommended. The second objective of this study is to prepare baseline data for future comparisons with regards to climatic changes and the impact that this has on parasite prevalence. At this time, little information is available on the impact that climate change may have on the prevalence of zoonotic pathogens in the arctic. To achieve both goals, the project will build wildlife disease surveillance capacity in Nunatsiavut by creating a small local lab and training a local resident in the techniques required to detect the three listed pathogens in wildlife food sources. We will work with traditional local hunters who will submit samples from their hunts to the local lab technician. Once data from the study begin to come in, a results database will be established and results disseminated to the community in a culturally appropriate manner.

LARGE AREA ICE THICKNESS MEASUREMENTS USING AIRBORNE ELECTROMAGNETICS

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For the prediction of sea ice conditions, consideration of sea ice thickness is inevitable. This basic parameter influences several processes like heat exchange between ocean and atmosphere, light penetration, or surface momentum balance. Since all these processes are considered in realistic sea ice models, a comprehensive and accurate input dataset of measured thickness can improve the quality of sea ice forecast models enormously. Furthermore, a thinner sea ice cover is more trafficable. But still sea ice thickness is one of the most difficult parameters to obtain via routine observations.

Airborne Electromagnetics (AEM) is a method to measure sea ice thickness directly. The basic idea behind it is to obtain two different distances with sensors mounted on an aircraft. A laser altimeter measures the distance from the sensor to the ice or snow surface, and an EM system measures the distance between sensor and ice-ocean interface. Additionally, the laser altimeter provides surface roughness data. This method was first applied by the US Army Cold Regions Research and Engineering Laboratory in 1987. The Alfred Wegener Institute (AWI) started AEM sea ice thickness measurements in 2001 on a routine basis. It owns three sensors, so called EM Birds, which can be operated from any aircraft that is capable to carry an external sling load. The spatial coverage solely depends on the range of the used aircraft, and the temporal coverage solely depends on its availability. The operating range can be significantly increased if icebreakers are uses as a platform for helicopters.

During the past years, the AWI conducted several sea ice thickness surveys of regional thickness distributions, e.g. since 2004 spring thickness distributions in the Lincoln Sea on a yearly basis. Here we present a dataset from summer 2007, collected along helicopter flight tracks of 4000 km total length covering 20 different regions of the Transpolar Drift. It shows the capability of AEM measurements to determine pan arctic thickness distributions. With these measurements, we covered approximately one third of the area of the 2007 minimum sea ice extent, most of it in the eastern part of the Arctic Ocean and around the North Pole. All over the study area, the thickness distribution was homogeneous with a single maximum around 0.9 m, which strongly supports the assumption that multi year ice has disappeared entirely from this part of the Arctic Ocean.

Furthermore, we compared the presented dataset with thickness maps of two sea ice models, one developed at the AWI and another at the Polar Science Center of the University of Washington. Both models agree with our measurements inasmuch as they predict a relatively low summer minimum ice thickness for the surveyed area. However, the actual differences between our HEM results and the models (and the differences between the two models) are typically around 0.5 m, at some locations considerably more. Measured sea ice thickness data are still to sparse for data assimilation but are important for model verification.

ARSENIC RESPONSES TO ORGANIC CARBON FLUXES IN ARCTIC OCEAN SEDIMENTS

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We have measured solid-phase profiles for redox-sensitive elements (As, Fe, Mn and S) in sediment cores collected from the Chukchi, Alaskan and Mackenzie Shelves. These regions differ widely in their primary productivity and in the relative strength of terrigenous sediment and organic inputs from rivers or coastal erosion. Our results indicate strong contrasts in sediment inventories for these elements from one place to another. For instance, the As profile from the Mackenzie Shelf sediment core shows enrichments of up to 14 times the mean concentration of As typically found in Chukchi Shelf sediments, which underlie a much more productive area. This contrast in enrichment of As is likely explained by the difference in organic forcing through metabolism at the sea floor and the sensitivity of As to redox conditions within sediments rather than by, for example, variation in composition of depositing minerals. Sediment profiles from the Mackenzie Shelf suggest sub-oxic conditions, with Mn and Fe oxyhydroxides enrichment and practically no reduced sulfur species, even deep in the sediment (30-40 cm). In contrast, Chukchi Shelf sediments reflect reducing conditions, with no Fe and Mn oxyhydroxydes and comparatively large amounts of reduced sulfur species. Arsenic and Fe exhibit parallel behaviour, consistent with As-Fe oxyhydroxide association. Arsenic pore-water/solid phase data derived from Arctic sediment cores also support this hypothesis. Similarities between As, Fe and S profiles, which prevail in reducing sediments, likely indicate an As–Fe–S phase association. Our results, together with the current understanding of As behaviour during diagenesis, suggests that the uneven distribution in production of labile carbon over Arctic shelves clearly controls the transport and sequestration of As within the Arctic Ocean. Accordingly, projected change in ice climate, as it impacts primary production and organic carbon transport, will be reflected in the pattern of As sequestering in Arctic Ocean marginal sediments.

MULTIPROXY RECONSTRUCTIONS: COMBINING STABLE ISOTOPE ANALYSIS AND DENDROCHRONOLOGICAL TECHNIQUES TO RECONSTRUCT CLIMATE IN THE EASTERN CANADIAN ARCTIC

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Our understanding of past environmental and climatic change has improved in the last decade through intensive investigations of tree-ring chronologies using multiproxy techniques. In arctic environments where trees are not present, we can develop chronologies from woody shrubs, such as *Salix* (willow) species and *Cassiope tetragona* (arctic white heather). The goal of this project was to investigate the potential of six measures of climate (annual growth, production of leaves, flower buds, flowers, stable carbon and oxygen isotope ratios) extracted from *C. tetragona* plants sampled at sites on Bathurst and Devon Islands, Nunavut, Canada. When two or more proxies measures are combined, correlation strength is increased and the range of extractable climate signal extended (i.e., maximum temperature). In addition, when the dominant or secondary climate control differs between proxies, a useful bi-variate climate signal may still be extracted and calibrated (i.e., maximum temperature and precipitation). The multiproxy method offers a powerful means of reconstructing variation in individual parameters, as well as the potential to provide a holistic view of changing climate at the regional scale in the Canadian Arctic.

STRENGTHENING PARTNERSHIPS IN LABRADOR: THE TRUE LEGACY OF A LOCAL SOURCE OF CONTAMINATION IN NUNATSIAVUT

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For twenty years, the southern headland shore of Saglek Bay, Labrador was the home of a large United States Air Force (USAF) communication station. Although the USAF vacated the site in 1971, an assessment in the mid-1990s found polychlorinated biphenyls (PCBs) in three regions of the site, including a beach adjacent to the ocean. A stakeholder group was formed to guide the cleanup of the contaminated soil over three seasons from 1997 to 1999. The cleanup effectively removed the terrestrial sources of contamination to the surrounding land and to the marine environment of Saglek Bay. However, because of the local source of PCB contamination near the beach area, elevated PCB levels were measured in sediments, shorthorn sculpin (*Myoxocephalus scorpius*; benthic feeding fish) and black guillemots (*Cepphus grylle*; diving seabird) in 1998-2000. Concentrations measured in marine sediments and biota were found to be orders of magnitude above background, creating sub-lethal effects, and ultimately risk to these receptors. On-going work with these receptors in 2006-07 confirmed that PCB concentrations in both sediment and biota have decreased substantially, although sub-lethal effects are still detected in black guillemots. The rapid decreases in the physical and biotic PCB concentrations from the local ecosystem at Saglek Bay demonstrate the resilience and efficiency with which natural ecosystem recovery can take place in a dynamic and highly energetic coastal marine environment once a chronic input source is removed. More importantly, the decision-making process and guidance of the research program has created partnerships and built relationships among all major stakeholders in the region. The success of the work has allowed the inclusion and continuation of our stakeholder group in the expansion of work in Saglek to a broader area in Nunatsiavut to address the impacts of multiple stressors, such as climate change, long-range transport of contaminants, and industrialization. In particular, a marine food web study, including four fiords across a latitudinal gradient in northern Labrador, is looking at the effects of climate change and associated contaminant transfer throughout the food web. The involvement of stakeholders in the expansion of research in Nunatsiavut is a direct testament to the trust that has been built between stakeholders, local government and researchers over the past decade and is a strong framework upon which to build Integrated Regional Impact Studies within the eastern sub-arctic region in ArcticNet.

RADAR/LIDAR SYNERGY AT EUREKA TO STUDY ARCTIC CLOUDS AND PRECIPITATION

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Arctic clouds play a very important role in the surface radiation budget, but remain poorly observed mainly due to the lack of ground stations in high latitudes and the difficulty in determining clouds properties over snow-covered surface from satellites. As part of the CANDAC activities, a millimeter wave cloud radar (MMCR) and a high spectral resolution lidar (HSRL) have been deployed at Eureka, in the OPAL facility of the PEARL complex. These active remote sensors are continuously profiling the troposphere since mid-August 2005, providing a unique dataset to study aerosols, clouds and precipitation on a continuous base. The combination of the synergetic measurements taken by the two instruments allows us to determine the clouds coverage, overlap, height and depth, the presence of precipitation and the particles phase (liquid, solid or mixed). With the dataset now covering more than three years, we are able to study the variations of those properties with time and look for seasonal cycles and interannual variability. The monthly-averaged cloud fraction is over 60% for the entire period, except at the minimum observed during late spring-early summer. On average, single-layer conditions were observed 50% of the time, while clouds were organized in multi-layer systems around 20% of the time, usually with only two layers. Low clouds exhibit the strongest variability and the role of topography and local dynamics is investigated. Finally, cloud liquid is detected throughout the studied period,

with a minimum occurrence in winter. A persistence of the supercooled liquid was observed and linked to turbulence and high relative humidity regions. The possible links of the results with the synoptic and dynamic situations are also investigated.

PALEOCEANOGRAPHIC CONDITIONS IN THREE LABRADOR FJORD ECOSYSTEMS (CANADA): PRELIMINARY RESULTS

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Labrador Inuit depend on the sea and sea ice for their hunting and harvesting activities. They are concerned about the ecological integrity of the marine environment of northern Labrador especially with respect to the impacts of climate change, industrialization (maritime navigation, mining) and contamination of their traditional foods. To understand recent changes, we need to look at the past environmental records. In November 2006, the ice-breaker CCGS Amundsen cruised along the East coast of the Labrador as part of the ArcticNet project 3.7 "*Nunatsiavut Nuluak*". Three sediment cores have been collected in three fjords along a north-south transect.

The cores have been analyzed for various physical and chemical properties, such as sediment density, magnetic susceptibility and contaminant levels. The biostratigraphic analyses involved sediment sub-sampling at 1-2 cm intervals to determine changes in the composition and concentration of fossil diatoms and dinoflagellate cysts (dinocysts) throughout the cores. These are two importants proxy indicators organisms in marine environments that allow for reconstructions of past climatic and environmental trends (e.g. changes in sea-surface temperature and salinity, sea-ice duration and ocean productivity) in both pelagic and benthic habitats. The chronology of each core has been established based on ^{210}Pb measurements on dry sediments from the cores.

The core retrieved from the northernmost pristine Nachvak fjord, next to the Torngat Mountains National Park Reserve, covers the last ~1750 years and will be used to study the natural variability of environmental conditions in Labrador fjord ecosystems, while serving as a reference for the assessment of human-induced perturbations in the two other southern fjords (Saglek and Anaktalak). The core from Saglek fjord covers the last ~600 years. The sediments at the top of the core have been contaminated with PCBs (PolyChloroBiphenyls) due to erosional inputs from a former military site. We will try to track the ecosystem response to this kind of contamination by comparing pre- and post-perturbation conditions. The Anaktalak fjord is extensively used by Inuit for harvesting and traveling. The core from this fjord covers the last ~520 years. Since the beginning of mining activities by the Voisey's Bay Nickel Company (VBNC), the fjord's Anaktalak Bay has received mining effluents and wastes from shipping. This part of the project aims at determining the impacts of these activities, as well as developing appropriate indicators for the long-term monitoring of the environmental and ecological conditions within this fjord ecosystem.

Here we present our preliminary results from the sedimentological and biostratigraphic analyses of the sediment cores.

A BASELINE ASSESSMENT OF STREAM ECOSYSTEM STRUCTURE AND FUNCTION IN THE TORNGAT MOUNTAINS NATIONAL PARK RESERVE, LABRADOR

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The eastern Canadian subarctic had a relatively stable climate for several thousand years until the mid-1990s. Climate change impacts are less advanced in the east than in other circumpolar regions, where a warming trend has been evident since the 1960s, but climate models predict that temperatures will continue to increase in the future. The subarctic landscape of the Torngat Mountains National Park Reserve (TMNPR) in Northern Labrador is dominated by streams, lakes and wetlands which are at risk of experiencing climate-induced changes in their biotic structure and function, which could threaten ecological integrity. As part of the proposed TMNPR management initiative to develop conservation strategies that accommodate changing environmental conditions, our project aims to assess baseline conditions of stream ecosystems in and around the Park. Specifically, we are investigating the structural and functional differences between glacial-fed, snowmelt-fed and lake-fed streams.

Structural investigations include the diversity and abundance of algae and benthic macroinvertebrates, and food web dynamics. We are particularly interested in understanding the position of young of the year and juvenile Arctic char (*Salvelinus alpinus*), a culturally valuable species, within the food web. Functional investigations include cellulose decomposition rates as well as growth rates of benthic macroinvertebrates and their division into functional feeding groups. Culmination of these studies will contribute to the development of an effective and comprehensive biomonitoring program for the Torngat Mountains National Park Reserve.

MEASURING FOOD CONSUMPTION AMONG THE INUIT OF NUNAVIK

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Introduction

The health survey conducted among the Inuit of Nunavik in 2004 allowed to estimate food and nutrient intake of the Inuit adult population. Two dietary questionnaires were used to collect dietary data, a food frequency questionnaire and a 24-hour dietary recall. A **food frequency questionnaire** allows the measurement of long-term intake, thus providing the usual intake. A major limitation of the food frequency questionnaire is its list of foods. A longer food list may overestimate individual intake, whereas shorter list underestimate individual intake. A **24-hour dietary recall** is a method very often used to quantify the food and nutrient intake. Multiple 24-hour recalls improve the accuracy of individual intake estimates because a single 24-hour recall is rarely representative of usual intake.

There is no method of choice for measuring the food consumption of individuals, especially when the survey population is composed of individuals with a strong sense of ethnic identity. For example, the use of standard food lists for a food frequency questionnaire may be inappropriate for Natives. Thus, the cultural context of Nunavik may have made it difficult to use the food measurement models when reporting usual serving size. Moreover, it may be difficult for participants to recall the details regarding the consumption frequency of foods consumed. Therefore, participants may have underestimated or overestimated their food consumption. The main objective of this paper consists to document the reproducibility of dietary questionnaires used for the nutrition part of the Nunavik health survey.

Methods

The dietary questionnaires were completed by individuals aged 18-74 years in a face-to-face interview. For the 24-hour recall, 664 respondents reported the country and store-bought foods consumed the day before the interview. Food models of standardized portions were used to help respondents better describe the amounts of food eaten. The food frequency questionnaire completed by 778 persons measured the consumption of *country foods* which refers to Inuit foods and of *store-bought foods* referring to most foods imported from southern regions. Foods were grouped in food groups: fruits&vegetables, meats&substitutes, dairy products, grain products, fatty and sweetened foods. Data analysis comprised the estimation of mean intakes in grams of foods on a daily basis. The reproducibility of dietary questionnaires was assessed by correlation coefficients.

Results

Results showed that the correlation between both questionnaires was weakly positive, the coefficients of correlation varying only between 0.22 to 0.35. The food frequency questionnaire seems to have overestimated intakes of fruits and vegetables and dairy products whereas the 24-hour dietary recall appears to have slightly underestimated daily intakes of meat and substitutes and of cereal products. Further analyses will be performed to verify the consumption of traditional foods using both questionnaires.

Conclusion

The results of the present study will be helpful in the choice of the method suitable for measuring accurate food consumption among Natives populations.

COLONISATION D'UN SYSTÈME DUNAIRE EN MILIEU SUBARCTIQUE : L'IMPORTANCE DE LA REPRODUCTION SEXUÉE POUR LA CAMARINE NOIRE (EMPETRUM NIGRUM)

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La régénération des espèces végétales dans les environnements subarctiques rigoureux se fait soit par croissance clonale, soit par reproduction sexuée. Alors que la croissance clonale permet le maintien des espèces végétales dans certains sites où la reproduction sexuée est inhibée, l'établissement de nouveaux individus issus de la reproduction sexuée (par graines) est nécessaire pour la colonisation de nouveaux sites. Les différentes espèces

d'éricacées, en particulier *Empetrum nigrum*, sont d'ailleurs reconnues pour leur habileté à se régénérer par croissance clonale, certains travaux suggérant même que l'établissement par graines est quasi-inexistant. L'objectif de ce projet de recherche était donc d'étudier la dynamique populationnelle d'*Empetrum nigrum* en milieu dunaire. Pour ce faire, nous avons cartographié et mesuré tous les individus de cette espèce dans un quadrat de 6 hectares (200m x 300m). Nous avons de plus échantillonné 112 individus à l'extérieur du quadrat pour établir des relations allométriques entre l'âge et la superficie de la couronne des individus. Finalement, nous avons déterminé la topographie du site à l'aide d'un théodolite optique. Un total de 1154 individus ont été cartographiés, la grande majorité étant retrouvée dans les dépressions entre les différentes crêtes dunaires. La structure de taille des individus à l'intérieur du quadrat suggère que l'établissement par graines est un phénomène très fréquent et que la population d'*Empetrum nigrum* est en forte expansion. D'ailleurs, aucun individu sénescent n'a été observé. Il existe également une forte relation entre la superficie de la couronne et l'âge des individus (Superficie de la couronne = 0,032 âge ^{4,0303}; $R^2 = 0,91$). Cette relation suggère que la colonisation du site d'étude a débuté dans les années 1950 et s'est accéléré au cours de la dernière décennie. Elle pourrait être liée à l'augmentation des perturbations d'origine anthropique ayant débuté sensiblement à la même période.

SPATIAL AND VERTICAL DISTRIBTUION OF PERFLUORINATED COMPOUNDS IN CANADIAN ARCTIC AND SUB-ARCTIC OCEAN WATER

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Perfluoroalkyl acids (PFAs) are fully fluorinated carbon-atom chains bonded to either a sulfonate or carboxylate functional group and are used primarily as surfactant compounds in consumer based applications. Perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) are two PFAs that have received the most attention and much of the concern surrounds the ubiquitous presence of both compounds in the environment. PFOS and PFOA have been detected in human serum, freshwater and marine biota, and surface water. The stability that makes fluorinated surfactants so desirable appears to preclude any degradation or metabolism, and contributes to the global bioaccumulation and persistence of PFOS and PFOA. The objective of the current study was to examine the spatial and vertical distribution of PFAs in Canadian Arctic seawater. Water samples were collected off the Canadian Coast Guard icebreaker *CCGS Amundsen* in 2007, extracted on-board the ship using a novel solid phase extraction technique. Samples were then eluted off the cartridge and analyzed by LC/MS/MS. C_6 to C_{11} PFCAs as well as PFBS, PFHxS and PFOS were detected in almost all samples. PFOA was the major PFCA with concentrations ranging from 7 pg/L measured at the mouth of Nachvak Fjord to 234 ng/L near the town of Kuujjuarapik on Hudson Bay. Our mean PFOA concentrations in water from the Labrador Sea at the Makkovik Margin was 182 pg/L. Concentrations of PFOS in seawater ranged from ~ 10 pg/L from McClintock Channel to 424 pg/L from Kuujjuarapik. PFOS was the dominant PFSA detected and accounted for over ~ 75% of the ΣPFSAs. Our sampling sites also allowed us to the study movement of PFAs from coastal waters to the open ocean. For both Fjords sampled, there is an apparent decrease in PFCAs concentrations from waters within the Fjords relative to concentrations at the mouth of Fjords. For example, coastal PFOA concentrations within the Anaktalak Fjord (202 pg/L) was ~ 4x smaller than at the mouth of Fjord (66 pg/L). A similar trend is observed for the Nachvak Fjord. Taken together, these results support the hypothesis that coastal waters may be delivering PFCAs to the open ocean.

INFLUENCE OF SNOW AND MELTING SEA ICE ON LIGHT AVAILABILITY FOR PRIMARY PRODUCTION

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The physical properties of snow and sea ice modulate the magnitude and spectral distribution of radiation that reaches the upper ocean in the Arctic. With

the thickness and extent of Arctic sea ice decreasing every year, the increase in the amount of radiation absorbed in the ocean is tightly linked to the ice-albedo feedback effect and the Arctic amplification of temperatures and is also important for primary production. In this paper we examine how ice edges, snow, and melting sea ice, including melt ponds, affect light availability for primary production in the euphotic zone. Conductivity, temperature, depth and photosynthetically available radiation (PAR) profiles that were collected during the International Polar Year-Circumpolar Flaw Lead system study will be analyzed. This included down- and upwelling irradiance measurements with an extended range radiometer (350–2500 nm) and a quantum sensor (400-700 nm). Measurements were made from March to June 2008 in the southern Beaufort Sea, McClure Strait, Amundsen Gulf, and Darnley and Franklin Bay, focusing on ice edges and different snow, ice, and melt pond conditions during variable light conditions and sun angles to examine the effect of different snow and ice regimes on transmitted PAR in the water column below the ice to a depth of sixty metres. Profiles were also accomplished through thin ice and open water between ice floes.

IQALUIT'S PLATEAU SUBDIVISION: A VISION FOR SUSTAINABLE CITY PLANNING IN CANADA'S EASTERN ARCTIC

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In late 2004, the City of Iqaluit released a feasibility study on the development of a sustainable arctic subdivision. Sponsored by the Federation of Canadian Municipalities' Green Municipal Fund and the Canada Mortgage and Housing Corporation, the study explored sustainable best practices that could be applied to an arctic subdivision. Recommendations from the report were used to produce a development scheme for unused land to the north-west of the city, called the Plateau. Phase I of the new subdivision was slated for development in 2005.

This paper examines that development process in the context of climate change, rapid population growth, and the emergence of a private housing market. First, it presents the political, economic, and environmental factors which led to the Plateau's development. In doing so, it constructs a model for understanding Iqaluit's unique housing situation in comparison to other Nunavut communities. Second, it will survey the design, development, and implementation of Phase I and II of the subdivision. This section draws upon comprehensive interview responses from city planners, government officials, architects, and Plateau residents. Finally, this paper analyzes the Plateau's suitability as a model for sustainable city planning in Nunavut. It finds that the unique economic conditions of Iqaluit make its applicability as a model for other communities tenuous, but that several promising practices emerge which could be adapted for use elsewhere.

SYNCHRONICITY OF AEROSOL OPTICAL MEASUREMENTS ACQUIRED AT ARCTIC AND SUB-ARCTIC SITES.

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The ARCTAS (Arctic Research of the Composition of the Troposphere from Aircraft and Satellites) campaign during the spring of 2008 provided a unique opportunity to compare and interpret a variety of airborne, groundbased and satellite aerosol measurments. In this communication we focus on the Arctic-wide interpretation of sunphotometry measurements acquired at a variety of Arctic and sub-Arctic sites and their link with available lidar and satellite data. The presentation will focus on sites in Barrow, Alaska (NOAA Earth System Research Laboratory), the PEARL (Polar Environment Atmospheric Research Laboratory) Arctic observatory in Eureka, Nunavut (Canada) and AEROCAN / AERONET sites in Resolute Bay, Nunavut, Yellowknife, Northwest Territories (Canada), and Iquluit, Nunavut. Emphasis will be placed on the synchronicity and propagation of extensive and intensive aerosol properties.

POLAR BEAR MOVEMENTS IN RELATION TO SEA ICE STRUCTURE, FOXE BASIN, NUNAVUT

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Polar bears (*Ursus maritimus*), as an ice-obligate species, can be studied to understand the effects of increasing sea ice habitat fragmentation on the top trophic level of arctic sea ice systems. Climate change effects on polar bear habitat, distribution and populations are projected to be most pronounced in regions of seasonal sea ice (Foxe Basin, Hudson Bay, Baffin Bay, Davis Strait). Analysis of Foxe Basin and northern Hudson Bay sea ice structure, using sea ice concentration data, showed that the amount of available polar bear habitat and patch size has declined and habitat fragmentation increased. Polar bear movement information was collected for females with cubs and adult male polar bears using Telonics GPS Argos satellite linked telemetry collars and Wildlife Computers SPOT5 Argos satellite linked ear tags. Movement metrics (e.g. step length, speed, turning angle) for 2007 and 2008 are presented for each habitat patch type and matrix by family group type, sex, age, month and season.

CIRCULATION INDUCED BY SUBSURFACE FRESHWATER INFLOW IN ARCTIC ESTUARIES

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Estuarine circulation is classically understood as the spreading of freshwater from a river input over saltier and denser oceanic water. The strength and type of the resulting circulation is largely determined by the amount of mixing that exists between the fresher surface layer and the bottom layer. This mixing creates a baroclinic pressure gradient that not only enhances the flow of the surface layer seaward but that also brings into circulation the bottom layer landward. This is the classical estuarine circulation, a conceptual model that may apply to some Arctic estuaries, like the Mackenzie, during summer conditions.

Here we examine another type of estuarine circulation that is peculiar to glacial environments but that remains largely unstudied: the response of an estuary to subsurface freshwater inflow. This situation is not well documented from observations but is thought to be common and important to high-latitude estuarine environments as well as around Antarctica. One example of such subsurface forcing is seen in glacial fjords and tidewater glaciers, where subglacial and inglacial freshwater discharges at the glacier terminus into the fjord. Another example arises with the presence of "stamukhi" that can form near the mouth of Arctic estuaries. The stamukhi may act like an inverted fence extending down to tens of meters, trapping the freshwater under fast ice. The trapped freshwater may leak through or underneath the stamukhi into the oceanic environment on the other side.

We are addressing this problem with the help of idealized nonhydrostatic two-dimensional model simulations. We simulate the details of the rising turbulent plumes and resulting estuarine circulation as freshwater is forced underneath or through a glacier into a pool of dense oceanic water. Intriguing turbulent flow patterns are created during the adjustment to steady state. When steady state is reached the rising plume of freshwater tends to sticks to the face of the glacier. As preliminary results we have found that increasing the subsurface freshwater inflow rate enhances the estuarine circulation and decreases the surface density, as we had anticipated. On the other hand, widening the inflow source without changing the freshwater transport reduces the estuarine circulation and lowers the density of the surface layer. Finally, by changing the location of the source of freshwater reduces the estuarine circulation proportionally to the distance from the bottom.

The next step is to incorporate sediment fluxes into the model and examine sediment suspension and deposition caused by subsurface freshwater flow.

VERTICAL SINKING EXPORT OF ORGANIC MATERIAL FROM EUPHOTIC ZONE IN THE CANADIAN BEAUFORT SEA DURING SUMMER 2008

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The downward fluxes of particulate organic carbon (POC) and other organic materials were studied in the eastern Beaufort Sea and Amundsen Gulf on 11 occasions from 10 June to 26 July 2008, using short-term particle interceptor traps deployed at 2-3 depths under the euphotic zone (50, 100 and 150 m). This investigation was conducted under the framework of the Circumpolar Flaw Lead (CFL) system study. Samples from the traps were analyzed

for POC, particulate organic nitrogen, biogenic silica, chlorophyll *a* (chl *a*), pheopigments (pheo), exopolymeric substances (EPS), stable isotopes (^{13}C and ^{15}N), thorium, bacterial abundance, phytoplankton and fecal pellets. Here, we present the sinking fluxes of pigments and EPS at 50 m. Sinking fluxes of chl *a* and pheo ranged from 0.14 to 3.90 mg m^{-2} d^{-1} and from 0.18 to 10.61 mg m^{-2} d^{-1}, respectively. The highest chl *a* and pheo sinking fluxes were recorded on the eastern side of the Amundsen Gulf and offshore Cape Bathurst. Between the second half of June and the second half of July, chl *a* and pheo sinking fluxes increased four times in the center of the Amundsen Gulf, whereas these fluxes varied little at the margin of the Gulf and the Beaufort Sea. Algal cells larger than 5 mm contributed 69.8 ± 24.2 % of the total chl *a* sinking fluxes during our study. EPS carbon sinking fluxes varied between 14.7 and 281.1 mg C m^{-2} d^{-1}. Sinking fluxes of pigments were positively correlated with those of EPS ($r^2 = 0.98$, $p < 0.01$) at stations where the sinking fluxes of pigments were high (>3.8 mg m^{-2} d^{-1}). The high contribution of pheo to the pigment sinking fluxes (average = 72.5 ± 8.6 %) indicates that a large fraction of carbon was exported in the form of fecal pellets. These preliminary results emphasize the role of grazers and the potential significance of algal-derived exopolymers as key factors that contributed to shaping the sinking export of organic material in the Canadian Beaufort Sea, during summer 2008.

BIODIVERSITY OF CHAR IN CANADA - DEVELOPMENT OF A NETWORK FOR MONITORING CHANGE

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The Arctic environment is undergoing rapid change due in part to multiple anthropogenic stressors such as climate change, contaminant loading, exploitation, industrial development, and local habitat change. The monitoring and assessment of change, the determination of potential causes, and the projection of future changes and their effects are essential to preparedness and adaptation. The inherent complexity of Arctic ecosystems limits options for comprehensive monitoring programmes. Therefore, attention should also be paid to key, valued components of ecosystems which integrate effects of change in perceptible ways. Chars, fishes of the genus *Salvelinus*, have been identified to meet these needs because they exhibit high levels of biodiversity, are the only fish present in extremely high latitude freshwaters throughout the Arctic, and link freshwater, estuarine, and nearshore Arctic aquatic ecosystems. An international network (Arctic Biodiversity of Chars Network) is currently in development fostered in part as a legacy from the Canadian International Polar Year (IPY) Char Climate Change Project. This network aims to document biodiversity and change in chars and key stressors nationally and eventually internationally throughout their range by: 1) developing approaches for community-based monitoring; 2) developing approaches for research-based monitoring; 3) testing these in the Canadian Arctic; 4) acting as a focal point for parallel pan-Arctic activities; and, 5) assessing status and change for chars throughout the Arctic. The Arctic Biodiversity of Chars Network will have linkages to international programmes such as the Coordinated Monitoring Effort (CME) of the Conservation of Arctic Flora and Fauna's (CAFF) Circumpolar Biodiversity Monitoring Program (CBMP) and the Arctic Monitoring and Assessment Programme (AMAP) and will be a focal activity for aquatic monitoring by Fisheries and Oceans Canada in the Canadian Arctic.

SEARCH: STUDY OF ENVIRONMENTAL ARCTIC CHANGE - A SYSTEM-SCALE, CROSS-DISCIPLINARY, LONG-TERM ARCTIC RESEARCH PROGRAM

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The Study of Environmental Arctic Change (SEARCH) is a multi-agency effort to observe, understand, and guide responses to changes in the arctic system. Interrelated environmental changes in the Arctic are

affecting ecosystems and living resources and are impacting local and global communities and economic activities.

Under the SEARCH program, guided by the Science Steering Committee (SSC), the Interagency Program Management Committee (IPMC), and the Observing, Understanding, and Responding to Change panels, scientists with a variety of expertise—atmosphere, ocean and sea ice, hydrology and cryosphere, terrestrial ecosystems, human dimensions, and paleoclimatology—work together to achieve goals of the program. Over 150 projects and activities contribute to SEARCH implementation. The Observing Change component is underway through National Science Foundation's (NSF) Arctic Observing Network (AON), NOAA-sponsored atmospheric and sea ice observations, and other relevant national and international efforts, including the EU-sponsored Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies (DAMOCLES) Program. The Understanding Change component of SEARCH consists of modeling and analysis efforts, with strong linkages to relevant programs such as NSF's Arctic System Synthesis (ARCSS) Program. The Responding to Change element is driven by stakeholder research and applications addressing social and economic concerns. As a national program under the International Study of Arctic Change (ISAC), SEARCH is also working to expand international connections in an effort to better understand the global arctic system.

SEARCH is sponsored by eight (8) U.S. agencies, including: the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the Department of Defense (DOD), the Department of Energy (DOE), the Department of the Interior (DOI), the Smithsonian Institution, and the U.S. Department of Agriculture (USDA). The U.S. Arctic Research Commission participates as an IPMC observer.

AN INTERDISCIPLINARY APPROACH TO STUDYING CLIMATE CHANGE: A CASE STUDY FOR ALASKA'S KOYUKUK REGION

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The polar regions are seeing evidence of strong changes in climate and environmental impacts as compared to the lower latitudes. Global climate model simulations project these trends to continue into the foreseeable future. A significant percentage of the population living at high latitudes currently have a subsistence lifestyle and as such are highly vulnerable to even slight shifts in climate, specifically if the change occurs during a key season. Most studies of climate change and variability rely on data from meteorological, hydrological, and terrestrial observing systems. However, to broaden the view climate change patterns, one can incorporate traditional indigenous knowledge and use an interdisciplinary approach. In this study, climate change and variability in the Koyukuk region of west-central Alaska was investigated using a variety of metrics that include local community perspectives, climatological data, and area wildlife biological information. The autumn in particular was focused on due to key events that take place during this transition season. A significant outcome of this project was the identification of the importance of seemingly slight climate shifts that have explicit and considerable consequences for those with a subsistence lifestyle.

ANISAKID NEMATODS IN FISH AND MARINE MAMMALS OF NUNAVIK

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Anisakid nematodes have been reported in the Subarctic and Arctic regions throughout the world. Some members of this family such as *Anisakis simplex* and *Pseudoterranova decipiens* are considered zoonotic diseases and have been of public health concern in Greenland for example (Møller et al., 2007). Due to climate change, migration of these parasites through their host is possible. In Arctic Canada, Anisakidae worms are not considered a big health concern, partly due to limited studies in different species of fish and marine mammals. We want to monitor these parasites throughout the Canadian Arctic in Inuit marine traditional food to determine the regional distribution of the parasite, to compare with other records

in the same region and the circumpolar North, and to identify species at risk for human consumption. Simply by looking in the 2003 to 2008 archived parasites collection of the Nunavik Research Center, we have identified some Anisakidae worms. Two ringed seal *Phoca hispida* (Schreber, 1775) from Inukjuak were infected, with an intensity of 7 to 16 adult *Pseudoterranova decipiens* (Krabbe, 1878) in their stomach and intestine. Three out of four cod *Gadus ogac* (Richardson, 1836) collected in Eastern Hudson Bay had their body cavity infected with *Contracaecum osculatum* (Rudolphi, 1802) with an intensity of 1 to 34 specimens. There were no Anisakidae worms in one Atlantic salmon *Salmo salar* (L.) from the Koksoak River and one Arctic char *Salvelinus alpinus* (L.) from George River. 2008 preliminary results from the parasite collection for this IPY project, show that Anisakidae worms were present in 6 out of 8 beluga stomachs from Quaqtaq with an intensity of 1 to 39 nematodes. None of the 7 salmon, 2 white fish, 1 brook trout from the Koksoak river and 1 walrus from Akpatok island were infected with Anisakidae worms. The presence of adult nematodes in beluga and ringed seals from Hudson Bay indicate that the parasite is present in the marine food web of Hudson Bay to Labrador. Further identification and sampling will determine which marine fish species will be of concern for human consumption. During collection of these parasites, northerners were trained in fish dissection, parasite collection and preservation methods.

PROGRESS ON BARCODING PARASITIC WASPS (HYMENOPTERA) FROM CHURCHILL, CANADA, AND ITS IMPLICATION ON BIODIVERSITY AND ECOSYSTEMS STUDIES WITHIN THE ARCTIC

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Knowledge of Arctic food webs involving insects is restricted by the paucity of information regarding higher order insect predators. Among them, the parasitic wasps (PW) belonging to the Order Hymenoptera play a key role as parasitoids of many herbivore insects and thus have a major impact regulating trophic interactions. However, as the identification of PW is extremely complex due to their extreme diversity and the common occurrence of morphologically cryptic species, studies involving this ecologically important group have had limited scope and applications. A different approach is needed. We present the results of an ongoing program where DNA barcodes are used to unravel the diversity of PW in Churchill, Manitoba, Canada. As part of the PROBE program (Polar Research Observatories for Biodiversity and the Environment), DNA barcodes were obtained from over 5000 specimens likely representing one thousand PW species. Higher-than-expected taxon diversity was revealed by the barcode survey and illustrates the feasibility of using this technique as a fast and effective triage tool for biodiversity assessment.

UNDERSTANDING THE IMPACT OF ARCTIC SEA-ICE COVER REDUCTION ON THE PLANKTONIC ECOSYSTEM

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Significant decline of Arctic sea ice has been observed in the last two decades exceeding predictions of decline during the summer of 2007 when Arctic sea ice extent reached its lowest level since the beginning of satellite observations in the late 70s. Ice cover impacts ecosystems through light limitation for primary producers, thermal and freshwater stratification, and wind-driven vertical mixing and shelf break upwelling that in turn control the nutrient supply to the surface waters. Recent estimates of primary productivity (PP) from satellite observations between 1998 and 2007 show a general increase of the pan-Arctic PP, confirming the impact of ice reduction on the Arctic ecosystem. This reduction of ice cover will certainly have cascading consequences on the food web that need to be understood and quantified.
To address the complex effects of ice-cover reduction on the ecosystem, a coupled physical-biological model approach is used. The food web model includes multiple nutrients, two phytoplankton classes, two zooplankton species and a microbial loop, and is coupled to the three-dimensional pan-Arctic ice-ocean circulation model, POIM. Regional impacts on primary production, nutrient flux and community structure are analyzed. We focus on three regions, the ice-free Greenland Sea, the seasonally ice-covered Chukchi Sea,

and the permanently ice-covered Canada Basin, where in situ observations are available. Preliminary results reveal a complex interplay between light and nutrient limitation in the ice-covered regions and between mixing and nutrient limitation in the ice -free regions.

MEASUREMENTS TO INVESTIGATE ARCTIC TROPOSPHERIC OZONE AND MERCURY DEPLETIONS UNDER IPY-OASIS

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While our understanding of the chemistry responsible for the episodic depletion of boundary layer ozone in the Arctic springtime has improved vastly since the discovery of the phenomenon in the mid-1980's, many questions remain. What is the relative importance of processes at the surface vs. those in the boundary layer? What types of surfaces deplete ozone most effectively? What exactly are the links to the related depletion of mercury? Are satellite-based maps of BrO a good indicator of the spatial distribution of ozone-depleted air masses? The Circumpolar Flaw Lead (CFL) System Study in 2008 provided a unique platform for sophisticated measurements to address these questions directly on the frozen ocean. For the first time, a combination of ground-level ozone data, a DIAL ozone lidar, a microwave temperature and humidity profiler, a sodar, and a MAX-DOAS was employed to characterize the Arctic boundary layer over the ocean. In addition, ground-based measurements of ozone concentrations and eddy covariance fluxes, halogen concentrations and mercury species were conducted. Finally, a fully instrumented sled was deployed on different ice surfaces to observe gradient fluxes of ozone, gaseous mercury and carbon dioxide and to provide additional MAX-DOAS data. The first results from this unprecedented combination of observations will be presented.

THE CHURCHILL RIVER: OBSERVATIONS OF SUMMER AIR-WATER CO2 EXCHANGE AND WATER CHEMISTRY AS IT ENTERS THE HUDSON BAY.

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Very little is known about the basic carbon chemistry and nutrient load of high latitude rivers. This situation is the result of a general lack of good baseline observations and it prevents us from understanding the relationships that exist between river and estuary systems and the dynamics of CO_2 exchange between the atmosphere and high latitude estuarine systems. Research along this line is important in order to facilitate a better understanding of how projected climate change will affect these aquatic systems. In this paper, we present observations from a field study that was undertaken during the summer of 2007 in the lower reaches of the sub-arctic Churchill River. A continuous air-water equilibration instrument was moored in the central channel of the Churchill River with the purpose of describing the water chemistry and air-water CO_2 exchange of the river as it enters the estuarine system. This instrument monitored air/water CO_2 and O_2 and the resulting CO_2 flux was estimated using the thin boundary layer technique. The CO_2 flux ranged between -101.98 and 5.05 with a mean flux of -13.1 mmol m^{-2} day^{-1}, identifying the Churchill River as a net CO_2 sink throughout much of the 2007 open-water season. Net production (P) and respiration (R) were estimated for two depth extremes of the Churchill River, 1.5m and 10m, resulting in a mean P of 33.96 (1.5m) and 294.78 (10m) mmol m^{-2} day^{-1} and a mean R of 30.17 (1.5m) and 285.71 (10m) mmol m^{-2} day^{-1} respectively. The delivery rate of CO_2 to the Hudson Bay via the Churchill River estuary ranges from 3.04 and 103.8 mmol day^{-1}, with a mean rate of 27.64 mmol day^{-1}. These results are striking given that high latitude rivers and estuaries are considered strong sources of atmospheric CO_2.

A GEOMORPHOLOGICAL ENGINEERING APPROACH TO CLIMATE WARMING-INDUCED PERMAFROST DEGRADATION AFFECTING TRANSPORT INFRASTRUCTURES

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Construction of road infrastructures in the Arctic has always been a big challenge. The presence of ice-rich permafrost implies that disturbance of the surface and of the ground thermal regime during and after construction of the infrastructure will result in permafrost degradation, thaw-settlement, subsidence and structural damages to the infrastructure. The Alaska Highway (ALCAN), which is located in thaw-sensitive permafrost areas, has experienced severe damages due to permafrost degradation. As a result, high maintenance costs and security issues affect this important and widely used transportation link in north-western America. The degradation of such problematic permafrost will undoubtedly be aggravated in the near future by climate warming. In Alaska, a recent study has showed that public infrastructure cost could increase by 10-20% with respect to various climate projections and considering design adaptations (Larsen et al. 2008). In this context, the Yukon Government in collaboration with the Alaska University Transportation Center and Laval University have initiated a project to control permafrost degradation under the ALCAN by testing innovative engineering techniques such as 1) air convection embankment (ACE), 2) heat drain, 3) air duct cooling system, 4) thermo-reflective snow shed, 5) grass covered embankment, and 6) light-colored aggregate bituminous surface treatments (BST). The ground thermal regime and the mechanical response of the permafrost and the road embankment will be monitored for the next 15 years. Geomorphological engineering provides an integrative approach for the adequate implementation of engineering techniques to rehabilitate the permafrost under linear infrastructures in sensitive permafrost areas. A test site representative of terrain conditions along the ALCAN was selected based on aerial photographs and satellite images interpretation together with a thorough analysis of a permafrost borehole database covering the whole ALCAN. Drilling and coring was realized to confirm the presence of thaw-sensitive ice-rich permafrost. Prior to construction of the road test section, we conducted a detailed characterization of the cryostratigraphy and of the geotechnical properties of the permafrost in order to adequately evaluate the effectiveness of the mitigation techniques. Very ice-rich syngenetic permafrost in alluvial silt deposits, ice-rich epigenetic permafrost in till and inactive to weekly active ice wedges network were identified, and characterized. Significant thaw-strain values were measured on the ice-rich permafrost cores. Analysis of the ground thermal regime showed that the active layer depth is now below the road embankment, i.e. significantly deeper than in the natural ground adjacent to the road. Extensive and widely distributed deep talik zones were encountered and mapped. We present the results of our analyses which will lead to the creation of a best practice guide of geomorphological and geotechnical permafrost characterization prior to the implementation of mitigation measures to control permafrost degradation under transport infrastructures. P.H. Larsen, S.Goldsmith, O.Smith, M.L.Wilson, K.Strzepek, P.Chinowsky, B.Saylor (*In Press*) Estimating future costs for Alaska public infrastructure at risk from climate change. *Global Environment Change*

UNRAVELING THE ENVIRONMENTAL CONTROLS THAT MODULATE THE IMPACT OF SEA-LEVEL RISE ON ARCTIC COASTLINES

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There exists a general consensus that four basic environmental controls interact to alter beach morphology: sediment supply, relative sea-level (RSL) change, bathymetric and terrestrial basement geometry, and wave climate (Carter et al., 1989; Roy et al., 1994; Forbes et al., 1995; Orford et al., 1996; 2002). Despite good agreement on the significance of these four controls, the relative contribution and morphological signature of each is still debated. Further

clarification is therefore required if the impact of rising sea level on coastal dynamics is to be more fully understood.

Three complementary approaches are being used to study the role of RSL on the morphodynamics of Arctic gravel coastlines. (1) Shallow-water mapping of transgressive coastal systems using multibeam sonar, side-scan echo-sounder and sub-bottom profiler. This set of data provides insight into how offshore topography is influencing the development of coastal systems under rising RSL and provides valuable information on past coastal and RSL history. (2) Land-based surveys using RTK GPS, sediment analysis and qualitative observations. These provide information on modern and past sediment sources, patterns of sediment deposition and erosion, and overall coastal dynamics. (3) Remote observations using multi-temporal aerial photographs, which permit a temporal perspective on coastal morphodynamics.

These three approaches were used at one study site, Cape Charles Yorke (CCY), Baffin Island, in July and August 2007 and 2008 with the aim of understanding the relative contribution and morphological signature of the four basic environmental controls on beach morphology. CCY is a prominent 4 km-long foreland composed of more than 20 prograded gravel ridges that parallel one another in a SSW-NNE orientation. Despite a poorly constrained RSL curve for the area, morphological evidence points towards deposition of these ridges under rising RSL.

Preliminary results suggest continuous progradation in the past. In contrast, truncation of relict ridges by the modern shoreline suggests a regime shift to predominantly erosion. RTK GPS surveys, however, show important progradation of the upper foreshore between 2007 and 2008. Offshore surveys suggest the presence of a submerged landscape in the form of drowned deltas. These preliminary observations indicate that an abundant supply of sediment probably counteracted the impact of rising RSL and resulted in coastal progradation at CCY. In contrast, modern-day erosion is the likely result of depleted sediment supply and greater accommodation space created by ongoing RSL rise.

WHAT CONTROLS THE DISPERSION OF RIVERINE FRESH WATER IN HUDSON BAY DURING THE SUMMER?

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The rivers surrounding Hudson Bay deliver about 635km^3 of fresh water per year, which represents a sizable fraction of the total Arctic runoff (12%). Such large fresh water input is particularly relevant for biological processes that often rely on nutrients input from rivers. The riverine waters may also negatively affect the biological production by increasing the vertical stability of the water column. We do not know which mechanisms control the structure of the fresh river flow once it enters the marine system, explicitly, the relative role of wind-driven circulation, density-driven circulation, tidal mixing, and wind mixing. We will discuss these contributions to the fresh water flow of Hudson Bay from experiments performed with a 3-D ocean model and realistic forcing for rivers, tides, ocean and atmosphere. Passive tracers, injected at the mouth of several key rivers in early summer, confirm that the freshwater generally flows around the shores of Hudson Bay in a counterclockwise motion, as described in earlier studies. The vertical expansion of the fresh waters is found particularly sensitive to the wind forcing. The horizontal expansion is about three times faster in the direction of the flow than in the across-flow direction, consistent with the diffusion of a dye cloud in a sheared flow. The results suggest that the riverine waters are mainly confined to the nearshore region and contribute little to the stratification in the offshore region during the summer period.

CLASSIFICATION OF FRESHWATER ECOSYSTEMS IN NORTHERN NATIONAL PARKS

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Freshwater ecosystems are the dominant features of many northern landscapes, and the numerous lakes,

ponds, streams and rivers located within northern parks can result in considerable variation in responses to both human-induced and natural disturbances. Because most Arctic parks are remotely located, there is often relatively little information on the distribution and ecology of freshwater habitats within a park and the surrounding region. As a consequence, designing an effective assessment and monitoring program can be difficult. By classifying waterbodies with similar features together, resource managers can ensure that long-term monitoring sites are representative of the key aquatic ecosystems within an area, and can identify ecologically sensitive habitats to focus their research and monitoring efforts. As part of the International Polar Year project, Arctic-BIONET, Parks Canada is developing a hierarchical ecological classification system for freshwater resources in northern parks. We will present classification approaches from two very contrasting parks: Nahanni National Park, located in the SubArctic Cordillera, a highly mountainous park dominated by flowing water (streams and rivers) and Wapusk National Park, a park with little vertical relief, located in the Hudson Bay Lowlands, and dominated by thousands of small lakes and ponds. In both cases, landscape-level information from mapping and remote sensing was combined with local limnological measurements to structure waterbodies into groups with similar ecological characteristics. By improving our understanding of the variability among freshwater habitats within northern parks, we can better understand responses to disturbances, such as climate change, and provide a framework for water quality assessment and monitoring.

NET ECOSYSTEM EXCHANGE AT A SUB-ARCTIC SEDGE FEN IN THE HUDSON BAY LOWLANDS

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Northern peatlands represent only 3% of the total land area of the Earth yet they store about 30% of global soil carbon. The expansive organic soils across the Hudson Bay Lowlands ranks that region amongst the highest peat accumulations in the world. High latitude regions within the northern hemisphere are predicted to experience substantial warming over the next century, which will affect the processes within these organic soils impacting soil organic carbon dynamics. The northern peatlands have historically been carbon sinks, although recent evidence has shown that the system is slowly converting to that of carbon source. There remains considerable uncertainly in the possible responses of these regions to warming, however one possible outcome will see the widespread break-down and release of this carbon to the atmosphere, further enhancing the greenhouse effect and global warming.

To this end, heat and carbon flux measurements have been made over tundra environments using eddy covariance in the Hudson Bay Lowlands near Churchill, Manitoba since 2005 as part of ArcticNet (Phase I). This paper reports on observations from the 2007 and 2008 field campaigns within a sub-Arctic sedge fen, and highlights fundamental relationships between the system's net ecosystem exchange (NEE) and basic metrics of surface phenology, microclimate and hydrology, all of which figure into parameterizations within current ecosystem models. This work also assesses the robustness of widely used parameterizations.

INTEGRATION AND COMPARISON OF ARCTIC COMMUNITY VULNERABILITY: RESULTS FROM THE IPY CAVIAR RESEARCH CONSORTIUM

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Escalating changes in climate and environmental conditions in the Arctic pose significant challenges for communities. Our understanding of the nature of these risks and the most effective means of dealing with them is improving gradually as the number of case studies and place-based research projects accumulates. The IPY CAVIAR (Community Adaptation and Vulnerability in Arctic Regions) project is addressing the need for integration and synthesis of this knowledge to improve its utility in the development and application of adaptation policy in the north. CAVIAR research employs a vulnerability framework to identify the types of conditions and, in particular change, to which people and resources are

sensitive and exposed and to compare these results across communities. The CAVIAR framework is being applied in over two dozen communities in eight countries with the aim of providing practical insights and guidance for adaptation decision-making and policy.

This presentation will draw on examples from several case studies across the Arctic to demonstrate the results generated through CAVIAR research. Some communities are facing stresses related to the availability of, or access to, wildlife that are important for subsistence or provide a source of income. Communities that rely on reindeer husbandry are experiencing stresses related to the health of herds, changing social circumstances (especially out-migration of youth), and unreliability of markets. Individuals and community groups are adapting through adjustments to management practices or changes in harvesting or herding strategies. Other communities are experiencing new opportunities (and risks) associated with oil and gas developments, mines, or other forms of resource extraction. In some cases, these activities are causing additional stress to traditional livelihoods due to conflicting land uses. Elsewhere, communities are adapting to risks to infrastructure associated with melting permafrost, flooding, or coastal erosion.

The institutional contexts (governance and decision-making structures and processes) that influence these communities are highly variable across the Arctic and result in differences in the ways that people are able to adapt. For example, land claim settlements in Canada play an important role in ensuring that the use of wildlife resources takes precedent over other land uses. In larger, "gateway" community of Whitehorse, climate is part of a complex suite of challenges and opportunities tied to its role as an administrative centre, a rapidly changing economy, and its strong linkages to both the south and the north. Through understanding the underlying risks and opportunities for Arctic communities related to environmental conditions, social and economic circumstances and issues of governance and institutional capacity, this research seeks to identify policy alternatives that are appropriate for dealing with future challenges associated with the profound changes taking place in the north.

CHALLENGES IN MONITORING A SUB-ARCTIC ESTUARY AND DEVELOPMENT OF AN OCEANOGRAPHIC MOORING PROGRAM FOR THE NELSON RIVER, HUDSON BAY, CANADA

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The Nelson River (Manitoba) is one of the two main tributaries to Hudson Bay with an average discharge of over 3000 m³/s. Manitoba Hydro, in collaboration with its consultants, has undertaken a major oceanographic program to describe the physical processes in the estuary to support environmental studies in the context of the hydroelectric development of the river..

In 2005, the first detailed map of the estuary since 1912 was produced using bathymetry and LIDAR data. In addition, data on water levels, waves, weather, water physical properties (temperature, salinity, turbidity), current velocity and direction and velocity fields, bottom and suspended sediment characteristics was collected. The physical oceanography program relied on a series of moorings with instrumentation installed at various depths in the water column, for periods up to 2 months during the summer-fall season. Currents are strong in the estuary and the study area is well exposed to weather systems and many moorings were lost or displaced during the first campaign.

In 2006, another oceanographic campaign was conducted on an even larger study area. A total of 21 moorings with 69 loggers (CT-Tu, tide gauges, wave buoy, ADCP) were deployed and bottom sediment sampling was carried out from the upper estuary to areas ~ 60 km offshore. The moorings were designed taking into account the experience from the previous year and the objectives of the study. The designs were studied using numerical simulations to make sure they would withstand the forces of nature they would be subjected too and meet the data requirements of the study. Some requirements included keeping the loggers at fixed depths below the surface and near real-time satellite telemetry. Environmental conditions included current speeds up to 3 m/s and wave height up to 2m. This required a modification of the catenary and inverse catenary mooring design where the main buoy was towed rather than anchored and the installation of data logger/controllers to monitor up to 5 instruments and satellite communication. All of the moorings were recovered, most of them complete and some lost components with a success rate of 90%.

A reduced program was conducted in 2007 involving the installation of a few moorings in the upper estuary area and the collection of bottom samples to finalize the geomorphological characterization of the estuary and its

tidal flats.

Reliable time-series data from these sites now provide reference frames for a thorough study of the oceanographic processes. Altogether, combined to weather information and satellite imaging, this multi-year program has produced a large database for understanding and modelling the Nelson River Estuary dynamics.

SELECTION OF CALVING GROUNDS BY MIGRATORY CARIBOU IN A CHANGING TUNDRA ENVIRONMENT

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There is increasing evidence that climate change is affecting ungulate populations in widely different ecosystems, from African plains to boreal forests. Much recent research effort has focused on tundra ecosystems that are rapidly responding to these changes. Caribou, Rangifer tarandus, is a dominant herbivore in this ecosystem and a good model to examine how climate changes may affect the population dynamics and the life history traits of large herbivores. Two large herds of migratory caribou occur in Northern Québec and Labrador: the Rivière aux Feuilles herd and the Rivière George herd. Over the past 25 years these two herds have shown large fluctuations in size, recruitment rates and individual body condition.

The objective of this study is to identify the factors that influence the selection and use of calving grounds of both herds in a context of climate change. Many ungulate populations undertake large seasonal migrations that are usually associated to specific habitat requirements for parturition, or to the exploitation of seasonal resources. For migratory caribou, early spring migration is usually associated with calving, a period of high energetic requirements for females and high vulnerability to predation for newborns. The choice of calving ground can affect the early survival and growth of calves. Between 1990 and 2007, we fitted more than 190 female caribou with satellite transmitters and identified the location of annual calving grounds for each herd. Calving grounds were determined by a spatial aggregation of parturient females and by an obvious decline in individual daily movements, from more than 20km/day during spring migration to less than 5km/day during calving. The location and geographical extent of calving grounds varied substantially among years, while the period of use ranged from 10 to 30 days. Although caribou females are thought to show strong fidelity to their calving grounds, we noted a spatial displacement of the calving grounds over time in both herds. The Rivière aux Feuilles calving ground has shifted northward in the Ungava peninsula, whereas the Rivière George calving ground has moved eastward to the Labrador coast. Several factors, such as the pattern of snow melt, the topography, the presence of predators and the access to early vegetation, could potentially influence the choice and use of calving grounds. Future analysis will identify which of these factors determine the choice and use of calving grounds, as well as their consequences for the survival and body condition of calves.

SATELLITE TRACKING OF ARCTIC FOXES REVEALS THEIR DEPENDENCE ON SEA ICE IN THE HIGH CANADIAN ARCTIC

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Sea ice extent and duration are declining in the Canadian Arctic and the biological consequences of these declines are probably major. The ecology of female polar bears (Ursus maritimus) has received much attention with this respect, because the species is charismatic and important economically and culturally. In addition, technology has allowed for many years to measure use of sea ice by females by means of satellite telemetry. Much less data exist on most of the smaller species, however, in part because available radio-collars were too big until very recently. Yet information is needed on a large array of species to understand the consequences of declining sea ice on arctic ecosystems. Interestingly, declining sea ice not only affects marine ecosystems, but also terrestrial ecosystems because many terrestrial species use sea ice to travel between islands or to find food. The arctic fox (Vulpes lagopus) is well known to use the sea ice, and Inuit knowledge gathered by C. Gagnon and D. Berteaux in the Pond Inlet area informed us on some of the patterns of sea ice use by the species in this region. Many observations and studies from different localities are also reported in the scientific literature. Yet some critical aspects of the patterns of sea ice use by foxes are unavailable. For example, one recent study has shown that juvenile arctic foxes can spend

up to five months on the sea ice during the winter in Alaska, traveling distances of over 2500 km. However such data do not exist for reproducing adults, a critical fragment of the population. Here we present an ongoing study taking place on Bylot Island, Nunavut, where the arctic fox population is being monitored since 2003. We show the results of more than one year of satellite tracking of adult and juvenile arctic foxes. Between July 2007 and August 2008 we fitted 22 individuals with Argos collars. These collars now allow us to track arctic foxes every day in summer and every second day in winter, for one year. We show that if juveniles seem to disperse rapidly from their natal area, adults are rather highly philopatric. However, this philopatry is still associated with an important use of the sea ice in winter and spring, through short excursions of a few days on average.

MICROBIAL GENETIC DIVERSITY IN ARCTIC SEAS

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Microbes are a heterogeneous group that includes bacteria, archaea and small single celled protists, and are key to understanding the dynamics of marine ecosystems. They are numerically the most abundant organisms in arctic seas and despite their small size they account for the bulk of biomass. Marine microbes are responsible for much of global carbon and nitrogen cycling and are important players in other nutrient cycles. The study of different genes, their function, diversity, and expression leads to a better understanding of the detailed role of microbes in our ecosystems. Here we present some insights on the microbial diversity in arctic seas. Marine archaea make up a significant proportion of the prokaryotes in arctic marine systems. Recent studies suggest that members of this major clade could be responsible for much of the nitrification in the ocean. A key gene in the nitrification metabolic pathway is the ammonium monooxygenase subunit A (amoA) gene. Results show the presence of this gene in Arctic waters. Another gene of interest related to nitrogen metabolism is assimilatory nitrate reductase (NR), present in phytoplankton cells. This enzyme is responsible for the reduction of nitrate to nitrite and is essential for the utilization of nitrate by photosynthetic plankton. Results show unexpected diversity of this gene throughout Canada's three oceans (Arctic, Atlantic and Pacific). The diversity of protists has also been studied using the 18s rRNA gene. We have found a diverse community of protists with geographic and seasonal distribution patterns, the recurrence of these organisms is evident with many of the sequences retrieved from organisms reappearing under similar conditions in different years. Furthermore, composition of this protist community varies seasonally, for example the mesopelagic microbial community was dynamically coupled to the upper mixed layer and to the deep offshore ocean. An especially abundant group of sequences retrieved from the Arctic were related to microparasites, and the diversity of one of such groups, Amoebophryra, reflects different infection types. Overall, arctic seas present a distinct and diverse microbial community that harbours a pool of microbial genes implicated in nutrient cycles and food webs. Our work tracking these microbes and their genes and interactions within microbial communities will provide essential information for modellers and others who wish to predict the consequences of changing circulation and ice cover in the arctic.

WHERE DO THESE CAPTURED LARVAL ARCTIC COD COME FROM? A BACKTRACKING EXPERIMENT WITH A COUPLED BIOPHYSICAL MODEL IN THE NORTHWATER POLYNYA (1998)

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Arctic cod, *Boreogadus saida*, affect an estimated 93% of the energy transfer between zooplankton and upper trophic levels in the Arctic marine food web. Both year-class strength, and the overall abundance of Arctic cod populations, depend largely on the survival of the larval and juvenile stages. These, in turn, depend on biotic factors, like prey and predator abundance, and abiotic factors such as sea-ice, temperature, and transport by currents. The on-going reduction of ice cover in the Arctic Ocean is expected to severely impact the population dynamics of Arctic cod, raising the need to develop numerical models to forecast the fate of this ice-dependent fish.

The early life of Arctic cod is simulated using an Individual-based numerical model, the results of which are compared to a dataset obtained in the Northwater polynya in 1998. This model is used to calculate growth (mean length-at-age) and survival (frequencies of individuals at age). A physical model of ocean circulation in the Canadian

archipelago (finite volume type, with a triangular mesh grid of variable resolution) is then used to transport 2640 particles, acting as passive tracers, from May 1st to July 30th 1998. The biological model is coupled to the physical model by distributing 2,000,000 larvae over the transported particles, allowing their trajectories to be tracked in a Lagrangian framework.

In addition to growth and survival, which are validated for the biological model, the biophysical coupling allows the spatial distribution of individuals surviving simulations to be revealed. The model is sampled by following the ship's position, reproducing therefore the spatial under-sampling caused by the inevitable discontinuity of sampling at sea. The virtual larvae captured in the model following this under-sampling are presumed to be more representative of the field dataset than if the model is sampled continuously (both chronologically and spatially). Furthermore, this under-sampling permits the backtracking of individuals, assumed to have been captured by the ship, to produce distribution maps of hatching areas, showing therefore the locations where the captured larvae may have hatched. A dominant hatching area South of Kiatiak Island (close to Qaanaaq (Thule) – Greenland, 77.5°N , 71.0°W) emerges from model results. This area appears to act as a retention zone, which is in agreement with field observations.

TRACKING THE TIMING OF PERMAFROST THAW USING DIATOMS IN SEDIMENT CORES FROM LAKES NEAR INUVIK, NWT

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Major changes in permafrost tables are predicted under increased global temperatures. Permafrost extent in the northern hemisphere is predicted to decrease by between 4 and 9 million km^2 by 2100, a third of which will occur in Canada. Despite these major changes, little information exists regarding the impact this loss will have on various ecosystems, including freshwater. In the western Canadian Arctic near the Mackenzie Delta, where permafrost ice content is generally high (>80%), permafrost thawing often results in retrogressive thaw subsidence, where thawed soil and water enter nearby lakes, resulting in often large permafrost slumps. Based on water chemistry analyses it is known that systems with histories of thaw slumping have altered chemical characteristics; however, the timing of this change in water chemistry is not known from these sampling programs. In order to track the timing and extent of permafrost thawing, pre-disturbance information is necessary. Using paleolimnological techniques our aim was to track permafrost thaw by comparing sedimentary diatom assemblages from lakes currently affected by permafrost slumping, with those that lack visible slump scars. Our study lakes are located in the uplands east of the Mackenzie Delta approximately 20-30 km from Inuvik. The lakes are small, headwater systems connected by ephemeral drainage channels. Gravity sediment cores were collected through the ice during the early spring of 2007, and their sedimentary diatom assemblages analyzed. In Lake INV-2a, a system which lacks catchment disturbances characteristic of permafrost thaw, small benthic taxa common to Arctic lake systems, including *Staurosirella pinnata* and *Staurosira construens* var. *venter* have dominated the diatom assemblage for the period represented by this 32 cm sediment core. In the uppermost portion of the core small, planktonic *Cyclotella pseudostelligera* has increased in relative abundance, which has been shown regionally to be an indication of increased stratification and longer open-ice season related to climate warming. Lake INV-2b, located just 350 m north of INV-2a, has a stable slump scar on its margin, which was likely initiated, or accelerated by an intense fire that burned the area around Inuvik in the summer of 1968. A decrease in the relative abundance of periphytic diatoms corresponding to the timing of slump activation/acceleration suggests that slumping results in changes in diatom habitats. Our next step will be to further analyze systems impacted by thaw subsidence, including several systems with active slumps. Based on these preliminary results, we believe sedimentary diatoms will prove a valuable tool for tracking the timing of permafrost thaw, which may then be used to determine other impacts associated with thawing permafrost, such as increased release of contaminants to these freshwater ecosystems.

BENTHIC ALGAL BIOASSESSMENT IN NORTHERN CANADA. AN ASSESSMENT OF WATER QUALITY AND ECOLOGICAL INTEGRITY IN RIVERS OF THE SOUTH NAHANNI WATERSHED

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Increasing pressures on water quality and quantity, both due to natural and human-related processes have led to increased awareness and concern over our water resources. Climate change, increasing development (industrial and residential), pollution, and changing resource use are all important stressors that impair water quality and alter water quantity. To protect the ecological integrity of our water resources from impairment, we need high-quality long-term monitoring records as a basis for development of effective management strategies and to assess effectiveness of policies.
Biomonitoring (i.e., the use of aquatic organisms rather than the more traditional measurements of water quality) possesses many promising attributes because organisms integrate information over larger spatial and temporal changes than can be achieved from periodic sampling of water chemistry conditions and they provide information on ecological integrity that cannot be gained using chemistry-based approaches. Continual long-term monitoring allows for the detection of changes and trends that occur in a system. The objective of this project is to develop and evaluate benthic algal monitoring protocols in the South Nahanni watershed, NWT. These protocols will be used to monitor changes in water quality and ecological integrity and to recommend a best practice for agencies ranging from national government to local First Nations organizations and conservation groups. These protocols will be used in combination with benthic invertebrate (CABIN) protocols developed by Environment Canada as well as water chemistry analysis.

In the South Nahanni watershed (Including Nahanni National Park, NWT - a UNESCO World Heritage Site), mining activities have raised local concerns over the quality of the water in the park downstream of the mines. With the potential to increase the park boarders, innovative biomonitoring protocols need to be put in place to monitor the impact of the mines on the South Nahanni River and its tributaries. Similar protocols are also being developed in heavily utilized Ontario lakes (Muskoka-Haliburton area). Field samples were collected in August of 2008. Water chemistry, isotope and benthic invertebrate samples were collected along with the benthic algal samples for water quality analysis. Analysis of these samples will be undertaken in the fall and winter of 2008-2009. A second field season with reduced sites, concentrating more around the mine sites of the Flat and Prairie Creek Rivers will take place in August of 2009. The project involves partnerships with Parks Canada, and so has the potential to lead to significant improvements in public policy and environmental programs. Through this project, we hope to develop new, innovative and cost effective protocols that can be used to improve the quality of data collected by long-term monitoring programs throughout Canada's North and provide better early-warning detection of water-quality changes.

COMPLEX PROCESSES GOVERN THE IMPACTS OF THAWING PERMAFROST IN SMALL TUNDRA LAKES

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Underlain by ice-rich permafrost, many small tundra lakes in the western Canadian arctic are affected by shoreline thermokarst slumps. The frequency and intensity of thermokarst slumping appears to be increasing with average mean air temperatures, and changes to Arctic freshwater systems have been predicted to occur as a result. A large-scale sampling program supplemented by experimental work has highlighted water chemistry differences between tundra lakes affected by shoreline slumps and lakes unaffected by slumping, along with possible mechanisms for the observed water chemistry changes. In general, lakes affected by thaw slumps have a clearer and less humic (tea-stained) water column than similar unaffected lakes, and phytoplankton-nutrient relationships appear to be different between the two classes of lakes. The implications of increasing permafrost thaw associated with climate variability/change for pelagic communities in tundra lakes is discussed.

SPATIAL DISTRIBUTION OF PHYTOPLANKTON AND OTHER PROTISTS IN THE COASTAL WATERS OF THE HUDSON BAY SYSTEM

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The aim of this study is to assess the spatial distribution of pico-, nano-, and microplankton in the coastal waters of Hudson Bay system. The sampling was conducted at 20 stations in the Bay and at 2 stations in the Strait between 3 and 16 August 2007 during the ArcticNet expedition onboard the CCGS *Amundsen*. The samples were collected in surface waters and at the maximum chlorophyll fluorescence depth. Picophytoplankton (0.2-2 μm) and nanophytoplankton (2-20 μm) were counted by flow cytometry while cells >2 μm were counted and identified using the inverted microscope method. At the depth of maximum fluorescence, the picophytoplankton made up, on average, 90 % and 52 % of the total abundance of cells ≤20 μm in the Bay and Strait, respectively. A total of 100 phytoplankton species have been identified for the entire study area. This includes 27 centric diatoms, 12 pennate diatoms, 36 flagellates and 25 dinoflagellates. The total number of taxa was higher in the Bay (*ca.* 160) than in the Strait (*ca.* 70). The maximum number of taxa has been observed offshore the Nelson River. The total abundance of phytoplankton >2 μm ranged from 0.8 x 10^6 to 4.1 x 10^6 cells l^{-1} in the Bay and from 0.4 x 10^6 to 1.5 x 10^6 cells l^{-1} in the Strait. Flagellates, diatoms and dinoflagellates made up, on average, 69 %, 28 % and 3 % of the total abundance of cells >2 μm. The dominant species of diatoms was *Arcocellulus cornucervis* in the Bay and *Chaetoceros socialis* in the Strait. These preliminary results show significant differences in the taxonomic composition and abundance of phytoplankton between the southwestern region of the Bay and the rest of the Bay and between the Bay and the Strait.

THE USES OF RADIOLOGICAL MONITORING TO STUDY CLIMATE CHANGE EFFECTS IN THE ARCTIC

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The Radiation Protection Bureau of Health Canada operates a network of radiological monitoring sites across Canada, including nine sites in the Canadian Arctic. These monitoring stations provide regular information on background levels of natural radionuclides and on routine or accidental releases of radioactivity into the environment. Data on atmospheric radioactivity have been collected since 1958 and archived air filters are available back to 1972. Spatial and temporal trends in radionuclide levels can serve as indicators of changing climate conditions. Long term trends in concentrations of airborne lead-210 and beryllium-7 will be presented. Lead-210 occurs in the atmosphere as the result of the decay of radon gas emanating from soil. Its presence in the Arctic serves as a tracer of the movement of continental air masses. Beryllium-7 is produced by cosmic ray bombardment of air molecules in the stratosphere. Any changes in its concentration at ground level can serve as a measure of changing conditions in the upper atmosphere. Local measurements of radon and its short-lived decay products can give information on changing permafrost conditions.

INCREASING ERECT LIGNEOUS VEGETATION IN THE CANADIAN EASTERN ARCTIC: A CASE STUDY FROM THE FOREST-SHRUB TUNDRA TRANSITION ZONE

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Indications of Arctic warming are numerous. A major response of arctic terrestrial ecosystems is land-cover change, and studies show that erect shrubs are amongst the vegetation types that respond the most to climate warming. Increasing shrub cover has profound implications on ecological processes (*e.g.* soil nutrient cycling) and environmental parameters (*e.g.* snow deposition, albedo). A substantial erect shrub increase in the past 50 years has been documented in Alaska and satellite image analysis show steady increase of NDVI in northern latitudes of North America for at least the past 20 years. However, the nature and extent of shrub cover increase remains unknown for most of the Arctic. The main objective of this project is to determine if and how an expansion of erect ligneous vegetation is ongoing in the Canadian Eastern Arctic, by studying a key area in Nunavik: Kangirsualujjuaq (George River), located at the extreme northern limit of the forest tundra. Comparative analysis of erect shrub and

low tree cover was made with ArcGIS on 1964 and 2003 orthophotos, in order to determine absolute area of erect ligneous vegetation increase and classify changes. Ground truthing was done during the summer of 2008, consisting of 350 vegetation plots in a *ca.* 6 km radius around the community. Preliminary results indicate a substantial and almost ubiquitous erect shrub increase in the past 40 years; dwarf birch (*Betula glandulosa*) being the main species responsible for this. Moreover, results show that low tree cover, consisting chiefly of larch (*Larix laricina*), is also expanding and that local tree line is moving upslope. Larch seedlings and saplings are extremely abundant in the vicinity of pre-existing forest cover, and 2008 cone production was very high. These results are in concordance with NDVI change analysis for the period 1988-2002 and with local ecological knowledge obtained from community Elders.

THE ONSET OF PERENNIAL SEA ICE COVER IN THE ARCTIC

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A recent paleorecord from the Arctic Core Expedition (ACEX) close to the North Pole and covering the Cenozoic period (0-65 Myr ago) show first appearance of ice rafted debris in the middle Eocene epoch (45 Myr ago) suggesting bi-polar symetry between the North and Southern Hemisphere. A more detailed analysis of the core top sediments shows a shift in the provenance of minerals and sand grains from the Barents, Kara and western Laptev seas to the eastern Laptev, East Siberian and Beaufort seas in the middle Miocene (approx 13 Myr ago). It is argued that this change in provenance from regions more than 1 year ice drift away from the core site implies the onset of a perennial sea ice cover in the Arctic. We present sediment deposit results from a regional sea ice model with a mean climate similar to that of today as well as one with a much reduced sea ice cover and one with only seasonal sea ice cover. For each climate, the model is run with different atmospheric forcings (e.g. positive/negative NAO) and the regions where eastern Arctic sediments can be deposited identified. We pose the following question: To what extent can ice-transported sediment deposition in the Central Arctic be taken to be a signature of perennial sea ice? And what insight does this give into past periods that may have had summer ice free conditions?

THE EFFECTS OF IRRADIANCE AND NUTRIENT SUPPLY ON THE PRODUCTIVITY OF ARCTIC WATERS: A NEW ANALYSIS OF HISTORICAL DATA

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How the productivity and structure of the arctic marine food web will respond to climate change is under debate. Primary producers at the base of the ecosystem rely on two resources for their growth: nutrients and light. The relative importance of these two factors in controlling the productivity of strongly seasonally-pulsed coastal systems is unclear. A previous analysis of published data suggested that annual, pelagic primary production in the Arctic Ocean relates linearly to the duration of the ice-free period, presumably through cumulative exposure to solar irradiance. However, the regions with the longest ice-free periods are located in peripheral seas and polynyas where nutrient supply by advection or the vertical mixing induced by winds and convection can be extensive. The ensuing replenishment of nutrients drives primary production to levels unattained in the strongly stratified interior (e.g. the Beaufort Sea), with the exception of upwelling areas. A reanalysis of published data showed no relation between cumulative production and incident solar radiation during the growth season. We propose that changes in annual primary production per unit area in seasonally ice-free waters are controlled primarily by the environmental forcing of nitrogen supply, although several aspects of the nitrogen cycle in these systems are poorly understood. Incidental changes in light regime should mostly affect the timing and, possibly, the species composition of the main production pulse(s) in the upper mixed layer and, underneath, the ability of phytoplankton to exploit nutrients at the base of the euphotic zone. While the ongoing rise in the supply of heat and freshwater to the Arctic Ocean should bolster vertical stratification and further impede the mean upward supply of nutrients, episodic subsidies by rivers and enhanced atmospheric forcing of the upper ocean may act in synergy with the prolonged exposure to light and greatly augment pelagic productivity.

LATE SUMMER PHYTOPLANKTON DISTRIBUTION ALONG A 3500 KM TRANSECT IN CANADIAN ARCTIC WATERS: STRONG NUMERICAL DOMINANCE BY PICOEUKARYOTES

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A number of recent studies showed that photosynthetic picoeukaryotes are an active and often dominant component of Arctic algal assemblages. In order to place these observations in a large-scale context, samples were collected in the euphotic zone along a 3500 km transect across northern Baffin Bay, the Northwest Passage and the Beaufort Sea during late summer 2005. Picophytoplankton (<2 μm) and nanophytoplankton cells (2–20 μm) were enumerated using flow cytometry and phytoplankton cells >2 μm were identified and counted by light microscopy. Pigment composition of the total community was assessed by reverse-phase high-performance liquid chromatography to determine the relative contribution of different algal groups. The spatial distribution of phytoplankton was heterogeneous along the transect. The highest abundance of picophytoplankton was observed in the Beaufort Sea/Northwest Passage region, whereas nanophytoplankton increased numerically toward the eastern Canadian Arctic. Picophytoplankton abundance reached a maximum of 18,400 cells ml^{-1} and accounted for > 70 % of total cell counts in two thirds of the samples. The <2 mm size fraction held a similar share of total chlorophyll *a* (Chl a), which reached a maximum of 6 $\mu g\ l^{-1}$. Overall, the picophytoplankton community was strongly dominated by eukaryotes (presumably the Prasinophyceae *Micromonas*). Maximum abundances of picocyanobacteria (120 cells ml^{-1}) were observed in brackish waters of the Beaufort Sea. These results confirm that picophytoplankton can dominate not only in warm oligotrophic waters, but also in a perennially cold ocean during late summer.

PERSISTENT ORGANIC POLLUTANTS IN LAKE SEDIMENTS FROM THE WEST COAST OF SPITSBERGEN (SVALBARD): LOCAL AND LONG-RANGE TRANSPORTED INFLUENCES

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A ^{210}Pb-dated gravity sediment core from Skardtjørna, a small lake on western Spitsbergen (77°57' N, 13°49' E), was analysed for persistent organic pollutants. The lake is located within 20 km of the Russian settlement of Barentsburg, where coal has been actively mined since the early 20th century. The lake is also situated in a sentinel position to record atmospheric pollution from distal sources tranported northward by atmospheric flow. Concentrations of individual PCBs (polychlorinated biphenyls) range from hundreds of pg/gdw (gram dry weight) to several ng/gdw down-core, with tri- and tetra-CBs being the dominant congeners. There is an apparent decrease in PCB-concentrations during the Second World War, which coincides with the evacuation of Barentsburg in the early 1940's. Concentrations then rise since ~1970. Overall down-core trends differ somewhat from the general application data, suggesting that local PCB sources mask partially the long-range atmospheric signals of transport and deposition. However, PAH (polycyclic aromatic hydrocarbon) concentrations in these sediments are relatively high (i.e., in the order of ng/gdw) and, given the geological and geographical location of the lake, are likely attributable to multiple origins. Isomer ratios and principal components analysis techniques are applied in order to estimate PAH sources. General trend of both PAHs and PCBs over the last century contain both similarities as well as striking differences, which implies that contaminant sources have varied between local and distal in recent decades. This underscores complexities inherent to understanding the transport and fate of persistent organic pollutants in polar environments, mandating the need for multiple environmental archives in order to satisfactorily apportion their inventories to discrete sources.

BELUGA POPULATION GENETICS IN HUDSON BAY AND EASTERN ARCTIC

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Beluga hunting is a traditional activity practiced in most Nunavut and Nunavik communities. In recent years, there has been concern with regards to the decline of particular populations of belugas, namely those found along the East Hudson Bay arc. We reassessed the global population genetic structure of belugas (Delphinapterus leuca) caught in the waters of Hudson Bay, Southern Baffin Island and Foxe Basin. The analysis was based on mtDNA partial D-Loop haplotypes and 14 microsatellite loci from some 1500 individuals. The spatial and seasonal distribution of haplotypes confirmed the genetic differentiation of belugas caught in the eastern Hudson Bay arc, suggesting maternal fidelity to this summering area. It also revealed the contribution of South Baffin Island whales to Hudson Bay. Nuclear (microsatellite) data indicated two main genetic components in the global area, one being closely associated with South Baffin Island. The other component was, by contrast, most abundant in James Bay, but was also found in other sites of Hudson Bay, along with the first genetic group. These results strongly support the notion that summering and reproductive grounds are not correspondent. Moreover, eastern Arctic and Hudson Bay belugas do not form genetically independent units and appear to commonly interbreed.

IMPACTS DE LA CONSTRUCTION DU COMPEXE HYDRO-ÉLECTRIQUE LAGRANDE SUR L'ACTIVITÉ DU CARIBOU

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Le développement du complexe hydroélectrique LaGrande, localisé dans la région de la Baie-James (Qc), a débuté au cours des années 1970. Comme ce complexe est situé à la limite sud de l'aire de répartition des caribous migrateurs du Québec, il pourrait avoir des répercussions à court et long terme sur ces populations d'ongulés. Ce projet de recherche a donc pour objectif d'évaluer l'impact de la construction et de la mise en eau des réservoirs hydroélectriques sur l'activité des caribous à l'aide d'une analyse dendroécologique. Cette méthode, basée sur la formation de lésions (cicatrices de piétinement) produites par l'impact des sabots du caribou sur les racines superficielles des conifères, permet en effet de retracer l'activité des caribous dans une région donnée. Les résultats préliminaires suggèrent que l'activité des caribous dans la région de LG4 est très récente. Par conséquent, il est probable que la construction et mise en eau de ce réservoir n'ont que très peu influencées l'activité du caribou. Par contre, l'activité aux environs du réservoir Caniapiscau date des années 1970, suggérant un possible conflit entre le développement hydroélectrique et le caribou. Une analyse détaillée des structures d'âge des cicatrices de piétinement permettra de préciser et de quantifier cet impact.

INFLUENCE OF N-3 FATTY ACIDS ON HEART RATE AND HEART RATE VARIABILITY AMONG NUNAVIK INUIT ADULTS

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Background: The Inuit of Nunavik (North of Quebec) consume large quantities of fish and marine mammals which are important sources of n-3 fatty acids. These substances have been suggested to have a beneficial effect on heart rate and heart rate variability; this latter representing the cardiac sympathetic and parasympathetic modulation of the autonomic nervous system (ANS). However, it is unknown if this effect remains significant in mercury-exposed populations. **Objective:** To assess the impact of n-3 fatty acids [Docosahexaenoic (DHA) and Eicosohexaenoic acid (EPA)] on HRV among Nunavik Inuit adults taking into account possible confounding factors such as age, gender, cholesterol, diabetes, obesity, smoking, alcohol consumption, socio-economic status,

physical activity and mercury levels. **Methodology:** The Health Survey « Qanuippitaa? » was conducted in the 14 coastal villages of Nunavik in fall 2004 and information was collected among 280 adults aged 40 years and older. Several indices of HRV from the time and the frequency domains were derived from a 2-hour Holter monitoring assessment. Simple linear regression was used to analyse the relation between mercury levels and Holter parameters while multiple regressions were carried out to control for confounders. **Results:** In overall analyses, EPA was associated with SDANN (β= 0.16, p= 0.012) after controlling for confounders. Among women, positive associations were observed between DHA and VLF (b= 0.11, p= 0.03), RR interval (b= 14.8, p= 0.02), SDNN (b= 0.05, p=0.03) and pNN50 (b= 0.26, p= 0.02) after adjusting for mercury and other confounders. Also, EPA was positively associated with RR interval (b= 57.8, p= 0.009), SDNN (b= 0.17, p= 0.026), SDANN (b= 0.21, p= 0.032), pNN50 (b= 0.75, p= 0.02) and rMSSD (b= 0.18, p= 0.04) in multivariable analysis. Both DHA and EPA slowed HR (β= -1.40, p= 0.03 and β= -2.61, p= 0.004 respectively) after controlling for mercury and other confounders. No association was observed in men. **Conclusion:** The results of this study suggest a beneficial effect of n-3 fatty acids on HR and HRV among Nunavik Inuit adults exposed to environmental mercury.

NUMERICAL AND FUNCTIONAL RESPONSES OF A GENERALIST AVIAN PREDATOR, THE GLAUCOUS GULL, TO VARIATIONS IN LEMMING ABUNDANCE IN THE ARCTIC

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The small mammal population cycle is one of the major ecological events occurring in the tundra ecosystem. The population dynamic and feeding ecology of many animals species living or breeding in the tundra are affected by these fluctuations in rodent abundance. However, climate change may disturb the population cycles of small mammals, and a dampening or an interruption of these cycles could have major consequences on the entire tundra food web. In this context, the objective of this project was to study the numerical and functional responses of the glaucous gull (*Larus hyperboreus*), a little known avian predator of the tundra, to annual variations in abundance of lemmings (*Lemmus sibiricus* and *Dicrostonyx groenlandicus*) on Bylot Island (Nunavut, Canada). At this study site, the greater snow goose (*Chen caerulescens*) is the other major herbivore present and is also a potentially high quality prey for gulls. Since 2005, we monitored the abundance of breeding pairs in our study area and their reproductive success. Each summer, we collected regurgitation pellets at gulls nest in order to analyse their diet. Automatic cameras were also used to identify the prey brought back to the nest or regurgitated to the young by the adults and determine the frequency. Finally, blood samples were taken from both adults and juveniles to asses their diet with isotopic analysis. Over the last 4 years, the number of breeding pairs remained relatively constant despite large annual fluctuations in lemming abundance, and these birds showed a high nest site fidelity. However, the mean clutch size and the fledging success seemed to fluctuate in relation with the lemming abundance. The reduced fledging success in years of low lemming abundance was apparently explained by a higher predation rate on gull eggs and young by the others generalist predators. The prey remains found in the regurgitation pellets revealed that lemmings are an important prey for the gulls in the early summer, until the goslings hatch. From this time until the end of the breeding season, goslings were the most important prey for gulls. However, the proportion of lemming remains found in the pellets differed among years in relation to the cyclic variations in lemming abundance. Furthermore, remains of fishes, marine invertebrates, insects and other avian and mammalian species were found in the pellets but in smaller proportion. Because the reproductive success and diet of gulls appeared to be influenced by lemming abundance, this gull population may be affected by any negative impacts of climate change on small mammal populations of the tundra.

SATELLITE SAR APPLIED TO THE MONITORING OF RIVER ICE AND SPRING BREAKUP FLOODING IN THE MACKENZIE DELTA

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River ice governs the winter regime of northern rivers and can be a cause of overland flooding during spring breakup. Up-to-date information on river ice conditions (in terms of coverage, type and thickness) and associated flooding during spring can support hydrological modeling. Thanks to the weather and daylight independent imaging

capability, radar remote sensing systems make potentially outstanding tools to collect the information on the conditions of ice covered and breaking northern rivers. In this poster we will present some preliminary results of a study into the potential of satellite SAR (i.e. RADARSAT-1, and Envisat ASAR) for the monitoring of ice and flooding in the Mackenzie River, NWT, Canada. The work presented is being carried out under the umbrella of IPY project 'Arctic Freshwater Systems: Hydrology and Ecology'. The available data cover the winter 2007 & 2008, and breakup season 2007 & 2008 (May-June). Initial results show great promise re the use of satellite SAR for the mapping and monitoring of river ice and spring breakup flooding.

A NOVEL DATABASE ARCHITECTURE FOR DIVERSE BATHYMETRIC DATASETS: APPLICATION TO THE CANADIAN ARCTIC AND THE NORTH WEST ATLANTIC

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Modern bathymetric databases need to integrate many different flavours of bathymetric data into a consistent, accurate and intelligible whole. In many cases, the data is a collection of depth measurements that are assembled with full knowledge of the horizontal location and sampling time of each data point. This data has to be stored in a manner that accounts for the different nature of the collection mechanisms without overloading the storage capacity of the organization. In other cases, the bathymetric data is a gridded data set where the temporal information is lost and the original data points are not recoverable. The purpose of this paper is to showcase a statistical architecture that harmonizes the two scenarios, called the VCH specification. The application spans the Canadian Arctic and the North Atlantic and includes data from digitized field sheets, single beam, multibeam, LIDAR, seismic, and gridded data. The temporal coverage ranges from 1758 to 2007. The VCH architecture allows for variable data densities to satisfy storage restrictions while maintaining source resolution and statistics. A system for internet delivery is being created that includes automated query tools and real time statistical aggregation that will generate proper statistics on the extracted data, based on the defined scale of extraction.

PERFLUORINATED ACIDS CONTAMINANTS IN A HIGH ARCTIC MEROMICTIC LAKE: TRANSPORT PATHWAYS AND IMPLICATIONS OF CLIMATE CHANGE

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Widespread distribution of perfluorinated acids (PFAs) has been recorded in Arctic marine and freshwater ecosystems and several studies have pointed to their bioaccumulative potential. PFAs are used in a variety of industrial products such as cosmetics, fire fighting foams, and water and grease repellent coatings for fabrics and food packaging, and they enter the terrestrial Arctic mainly by long-range atmospheric transport. The most northerly lakes that have sampled and analyzed for PFAs to date are in the latitudinal range 73-75°N. The primary objective of the present study was to extend this sampling range, and to determine the occurrence and distribution of PFAs at the far northern limit of Canada. Specifically, we sampled Lake A (83°00'N, 75°30'W), a meromictic lake (i.e., permanently stratified as a result of its strong salinity gradient) located on the northwestern coast of Ellesmere Island, Nunavut (Canada), in Quttinirpaaq National Park. We analyzed its water column and sediments, its foodweb (zooplankton and Arctic char, *Salvelinus alpinus*) and its catchment (snow, inflow and outflow water) to quantify the PFAs burden in each component. Our additional objective was to understand the transport pathways of this class of contaminants in the Lake A ecosystem, within the context of ongoing climate change. This lake is known to be perennially ice-capped, however it is now in transition to complete ice cover loss during summer (e.g., 2008) as a result of climate change. This major change would enable wind-induced mixing which could enhance contaminant capture in the water column, causing significant impacts for the lake biota and its contaminant transport pathways. Water column temperature and salinity profiles were obtained with a CTD logger. Water

and snow samples were collected in 4 L polyethylene bottles. PFAs analyses were performed by LC-MS/MS and stable isotopes analyses ($\delta^{15}N$ and $\delta^{13}C$) were utilized to assess diets and trophic relationships in the Lake A food web. Our results show the presence of several PFAs compounds in the foodweb and catchment of Lake A, thereby making this lake the northernmost site where PFAs have been reported. The concentrations were the lowest ever reported (0-9 ng $\cdot g^{-1}$ for fish and 0-1 ng $\cdot L^{-1}$ for water). Consistent with previous studies, PFOS, PFNA and PFDA were the predominant compounds in the aquatic biota, while PFOA and PFNA were the main compounds detected in water and snow. Arctic char, until recently the top predator in this ecosystem, had the greatest concentration of PFAs (mean = 2.37 ng g^{-1}) which indicate that these compounds are bioaccumulative and biomagnify through the food web. The water column profiles and catchment PFAs burden suggest that a through-flow conduit, from snow melt and catchment inflows, is present in Lake A immediately under the ice. This implies that most contaminant loading into Lake A ends in the Arctic Ocean, but that this would change as a result of ice cover loss and mixing. This work highlights the synergistic impacts of contaminants and climate change on Arctic freshwater ecosystems.

RÉPONSE DE LA STRATE ARBUSTIVE SUITE À UNE PERTURBATION DE LA STRATE ARBORESCENTE À LA LIMITE NORDIQUE DES ARBRES AU QUÉBEC SUBARCTIQUE

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Le rôle fonctionnel des strates basses des écosystèmes forestiers est souvent ignoré dans les modèles de succession forestière. Afin de mieux comprendre les interactions entre les différentes strates végétales des écosystèmes forestiers subarctiques, l'impact d'une coupe à blanc expérimentale (1987) sur la strate arbustive à la limite nordique des arbres a été étudié. Des relevés de végétation et de diversité ont été effectués afin de comparer l'abondance et la diversité des espèces dans la coupe et dans la pessière adjacente. Une analyse dendrochronologique de *Betula glandulosa* a également été réalisée afin d'étudier les changements dans la croissance radiale des individus. Les résultats indiquent que le recouvrement de *B. glandulosa* est 10 fois plus important dans la coupe que dans la pessière (6,5% vs 0,7%). Le recouvrement total des espèces arbustives (coupe : 22,8%; pessière : 18,8%) ainsi que l'indice de diversité de Shannon (coupe : 0,33; pessière : 0,29) ne révèlent toutefois pas de différence majeure entre les deux environnements. La coupe résulte cependant en une forte augmentation de la croissance radiale chez *B. glandulosa*. L'élimination de la strate arborescente semble donc profiter à *B. glandulosa*, ce qui à long terme pourrait interférer avec la régénération de la strate arborescente.

DIGITAL IMAGE ANALYSES OF OIL SACS IN COPEPODS AS A FAST AND COST EFFICIENT METHOD TO DETERMINE TOTAL LIPID

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All classical methods of determining total lipid content of zooplankton (i.e. extraction and gravimetric measurements or chromatographic methods) are both time consuming, expensive and destructive. We have developed a method to estimate the total lipid of a copepod by taking digital pictures of the specimens and measuring the oil sac perimeter using a free image analysis software ("ImageJ"). Analyses document that there is a positive and strong correlation between the perimeter and the total volume of the oil sac. Furthermore, as the majority of lipids in overwintering stages of copepods are stored in the oil sac, this method ensures a reliable estimate of the total lipid content of the individual copepod.

Since the method is non-destructive, it is possible to follow the development of a population held in an experiment. Furthermore it can be used to make estimates of which percentage of a population is still likely to be actively feeding and which part is likely to be in diapause already. The imaging method has been used both in a study comparing the copepod development over time in an ice covered vs. a non ice covered fjord on Svalbard, as well as in a diel vertical migration study.

The relation of calculated oil sac volume to perimeter, area and prosome length has been studied on several thousand images and the imaging method has been tested against the gravitmetric method on pooled samples. We will also test it on the individual level to get a more accurate relation.

SATELLITE OBSERVATIONS OF TEMPERATURE AND OZONE AT EUREKA: COMPARISONS WITH MODEL RESULTS AND GROUND-BASED MEASUREMENTS

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MIPAS/ENVISAT and MLS/AURA measure the stratospheric and mesospheric temperature and ozone distributions with nearly pole-to-pole coverage by using limb-viewing infrared emissions and microwaves, respectively. The two satellite instruments are launched on 1 March 2002 and 15 July 2004, in the same sun-synchronous orbit plane (98° inclinations) with a 10:00 AM and 1:45 PM equator crossing time, respectively. Climatology of monthly mean temperatures and ozone mixing ratios at Eureka are derived from the satellite data. The satellite-measured temperatures are compared with those of the CMAM and WACCM-GEOS5 models and ground-based measurements collected from the CANDAC project. In particular, studies of the atmospheric tides at the high latitude are stressed, since the two data sets combined together provide a daily coverage of four local times for given latitude and can be used to derive tidal signatures better than those from the measurements of a single satellite.

POLARTREC: SUCCESSFUL METHODS AND TOOLS FOR ATTAINING BROAD EDUCATIONAL IMPACTS WITH INTERDISCIPLINARY POLAR SCIENCE

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PolarTREC—Teachers and Researchers Exploring and Collaborating, a program of the Arctic Research Consortium of the U.S. (ARCUS), is a National Science Foundation (NSF)-funded International Polar Year (IPY) program in which K-12 educators participate in hands-on field experiences in the polar regions, working closely with IPY scientists as a pathway to improving science education. Developing long-term teacher-researcher collaborations through PolarTREC ensures up-to-date climate change science content will permeate the K-12 education system long after the IPY.

By infusing education with the cutting edge science from the polar regions, PolarTREC has already shown an increase in student and public knowledge of and interest in the polar regions and global climate change. Preliminary evaluation results have shown that PolarTREC's program activities have many positive impacts on educators and their ability to teach science concepts and improve their teaching methods. Additionally, K-12 students polled in interest surveys showed significant changes regarding the importance of understanding the polar regions as a person in today's world. Researchers have been overwhelmingly satisfied with PolarTREC and cited several specific strengths, including the program's crucial link between the teachers' field research experiences and their classroom and the extensive training provided to teachers prior to their expedition.

This poster will focus on successful components of the PolarTREC program and how researchers and organizations might use these tools to reach out to the public for long-term impacts. Best practices include strategies for working with educators and the development of an internet-based platform for teachers and researchers to interact with the public, combining several communication tools such as online journals and forums, real-time Internet seminars, lesson plans, activities, audio, and other educational resources that address a broad range of scientific topics. These highly relevant, adaptable, and accessible tools and resources are available to educators across the globe and have connected thousands of students and citizens to the excitement of polar science.

PolarTREC provides a tested approach and a clear route for researcher participation in the education community, facilitating increased educator, student, and community understanding of science and the polar regions during times of interrelated global change.

For more information, visit the PolarTREC website at: http://www.polartrec.com or contact ARCUS at: info@polartrec.com or 907-474-1600.

DEVELOPMENT AND APPLICATION OF PHYLOGENETIC MICROARRAY FOR MONITORING THE MICROBIAL COMMUNITIES OF THE ARCTIC REGION

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Phylogenetic microarrays can rapidly detect the presence of thousands of microbial species in an environmental sample, leading to the comprehensive characterization of the composition and inferred function of complex natural communities. This project involved testing the ability of a phylogenetic gene microarray (PGMA) to observe the microbial community in various Arctic environments. The PGMA contains representative sequences for Bacterial and Archaeal diversity (based on 16S rRNA cladistics) augmented with hundreds of sequences specifically from Arctic soils. To test the PGMA, a comparison of the scope of genera identified and the accuracy of identification was made between the PGMA and clone libraries (a separate molecular technique for sampling microbial communities). The samples came from disparate Arctic environments (permafrost, cold saline springs and ice shelf microbial mats). Preliminary results, used for the development of the augmented array (ie. without Arctic specific species), show that the PGMA will detect similar levels of diversity as the clone library at each site. The total average coverage of the array was 38% of what was revealed by the clone library at the genus level. The PGMA was able to reveal a surprising degree of overlap between the environments, upwards of 60% overlapping hybridizations, previously undetected by clone libraries (mainly due to the nature of the results produced). At the time of the poster presentation, results will be available from the newly developed PGMA's initial testing. The development of an Arctic specific PGMA will improve the study of changes to microbial diversity in the Arctic, since microarrays offer a comprehensive standard for monitoring temporal and spatial changes in community structure. Examples of how microarrays are successfully used in this application will be provided.

LACUSTRINE SEDIMENT RECORDS OF THE LAST THREE INTERGLACIAL PERIODS FROM LAKE CF8, BAFFIN ISLAND, ARCTIC CANADA

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Due to the glacial history of northern Canada, lacustrine sediment records typically extend only to the end of the last glaciation, and thus longer sequences, which would capture warmer interglacial periods and possible analogues for future climate changes, are generally unavailable. However, the Clyde foreland region of eastern Baffin Island, Nunavut, contains lakes with well-preserved sedimentary records from the last several interglacial periods (Briner et al. 2007), due to the non-erosive nature of the eastern edge of the Laurentide Ice Sheet (LIS). Our study site, Lake CF8, has retained successive organic sediments dating to 250,000 years BP, including Marine Isotope Stages 7, 5 and 1 (Briner et al. 2007). This rare sediment archive, one of the longest recovered from within the limits of the LIS and successfully dated with radiocarbon, ^{210}Pb, and optically-stimulated luminescence dating, allows for an explicit comparison between our modern, human-influenced warm period and past interglacials of naturally-mediated warmth, thereby extending our temporal knowledge of long-term Arctic ecosystem variability. This research examines the fossil diatom record through the entire composite core to explore the response of diatoms to natural and anthropogenic changes over the past 250,000 years. In addition, we quantitatively reconstruct past shifts in lakewater pH, through which climate is known to have a first-order influence through regulation of within-lake DIC dynamics (Wolfe 2002; Michelutti et al. 2007). An analysis of sediment chlorophyll a concentrations, a reflection of whole-lake production, is also being undertaken using reflectance spectroscopy (Michelutti et al. 2005). This unique paleoecological data enables a comparison between lake ontogeny during the Holocene and previous interglacials, which provides important insight into the past ecological responses to shifting climate and thus allows for a more comprehensive understanding of future changes in Arctic lakes.

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GREENHOUSE GAS FLUX AND THE CARBON BALANCE AT MUDBOILS IN THE CANADIAN ARCTIC

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Greenhouse gas exchange between the tundra and the atmosphere is as variable as the arctic landscape itself. One particular landform that commonly develops in arctic terrain is the low-center mudboil, a type of nonsorted patterned ground, typical in poorly drained areas. An example of such forms can be found at Daring Lake, NWT (64°52' N, 111°34' W). These 2 to 5 m diameter forms display different biotic and abiotic characteristics from the surrounding areas. As such, the mudboils are expected to contribute to CO2 and CH4 fluxes in a unique way. Opaque and transparent chamber systems were used to sample respiration and net ecosystem exchange of CO2 (NEE), respectively, at two mudboils during the summer months in 2008. Other microclimate features, such as active layer depth, volumetric water content, soil temperature and soil texture, were also studied at the sites. These measurements are contrasted against those made within the surrounding sedge fen terrain. Dramatic differences in the depth of peat and vegetation cover were observed between the mudboils and control plots. The two representative mudboils exhibited significantly deeper active layer, at times double the depth of the control. Both plant cover and active layer reflect the thermal and hydrologic regime and, therefore, gas fluxes of an area. Hence, both are key indicators of the nature of carbon cycling at these sites. These flux measurements will be used to test the hypothesis that in similarly saturated conditions, CO2 and CH4 emissions will be greatest from the mudboils. Their warmer soil temperatures should promote decomposition of organic matter that has been frost-churned throughout the profile, releasing more CO2. The nature of the landform also causes rainwater to pool at the surface, drowning vegetation and creating an anaerobic environment where methane can be released. Should these forms prove to be biogeochemical hot spots, there are implications for the carbon balance on a larger scale as mudboils appear all across the Arctic.

LIPID COMPOSITION OF THE HIGH ARCTIC HERBIVOROUS CALANUS HYPERBOREUS DURING SPRING IN THE AMUNDSEN GULF, ARCTIC CANADA

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The herbivorous copepod *Calanus hyperboreus* plays a key role in energy transfer within the pelagic ecosystems in the Canadian Arctic Ocean. *C. hyperboreus* efficiently transfer energy from ice algae and other phytoplankton to fish, seals and whales. They over-winters at depths of 500 to 2000m, where eggs are released, before ascending to the productive surface waters to feed during the Arctic spring and summer. Little is known about the physiological status of *C. hyperboreus* during the spring ascent, and the aim of the present work was to describe their total lipid content, lipid class composition and fatty acid / fatty alcohol composition during this event.

THE NEW KID ON THE BLOCK: E-AERI AT PEARL

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The Extended-range Atmospheric Emitted Radiance Interferometer (E-AERI) is a moderate-resolution (1 cm-1) Fourier Transform Infrared Interferometer (FTIR) for measuring the absolute downwelling infrared (IR) spectral radiance. Based on the heritage of 14 such instruments developed at the University of Wisconsin, ABB Bomem Inc. produced a slightly modified commercial version of the instrument for the Canadian Network for the Detection of Atmospheric Change (CANDAC). In September 2008, the instrument was characterized and calibrated at the Space Science and Engineering Center (SSEC) at the University of Wisconsin-Madison. It will be deployed on the roof of the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka (80N), Nunavut, Canada, in October 2008. After successful installation, autonomous measurements are scheduled to start immediately. IR radiance spectra of the sky and two calibrated blackbodies will be collected continuously every 10 minutes during light and dark periods, as well as under clear-sky and cloud-covered conditions. An automated hatch will close to protect the optics and electronics of the instrument when a precipitation sensor senses rain or snow.

The new E-AERI will provide complementary measurements to the suite of instruments already installed at PEARL, with three primary objectives: (1) Application of a retrieval method developed at the University of Wisconsin will provide temperature and humidity profiles of the planetary boundary layer, allowing for high-temporal-resolution records and analyses of temperature and water vapor changes due to mesoscale meteorological features. (2) The extended spectral coverage of the E-AERI (400-3000 cm-1 or 3-25 micro-m) includes the so-called dirty window (the 20-micro-m region) which dominates the current Arctic radiative transfer. This may change in the near future as a consequence of climate change; these changes will be quantified with the E-AERI radiance measurements. (3) Furthermore, we are planning to retrieve total columns of various trace gases using emission features within the measured wavelength range, e.g. ozone, nitric acid, water, carbon dioxide, and methane.

In contrast to solar absorption measurements of atmospheric trace gases, which depend on clear sky and Polar day conditions, the use of emission spectra allows measurements essentially all the time (except precipitation cases). This capability will allow the E-AERI to extend the data series of the PEARL solar absorption FTIRs throughout the Polar night. This paper will present the specifications of the E-AERI and the results of the calibration. We will describe the installation at PEARL and show the very first spectra from Eureka and compare them with the University of Idaho/SEARCH (Study of Environmental Arctic Change) P-AERI at Eureka. An overview of the retrieval methods will be given along with an outlook on the expected results.

PRELIMINARY RELIABILITY ASSESSMENT OF INUIT DIAGNOSES OF SEX, AGE, SIZE AND AGE OF TRACK FROM IN SITU POLAR BEAR (URSUS MARITIMUS) TRACKS

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Inuit knowledge of polar bears may be useful to monitor polar bear populations. Prior to the inclusion of Inuit diagnoses of sex, age and size of polar bears from their tracks, as components of a non-invasive polar bear-activity survey, these estimates need to be evaluated for reliability and accuracy. We report the first evaluation of reliability in Inuit estimates of polar bear sex, size, and age along with age of track based on */in situ/* track observations made in M'Clintock Channel, Nunavut, during May 2007 and 2008. In 2007, three hunters and three elders from Gjoa Haven and Taloyoak diagnosed 19 unique polar bear tracks; in 2008, three hunters from Gjoa Haven and four non-Inuit diagnosed 27 unique polar bear tracks. Without

the true value of these estimates, we evaluated reliability for sex, age, size, and age of track estimates by calculating mean inter-rater Pearson correlation coefficients (*r*) for each of the hunter and elder subgroups in 2007 and hunter and non-Inuit subgroups in 2008 using raw data and raw age and age of track data recoded into categories. For these calculations, individual pair-wise *r* values were first z_r transformed, then averaged, and finally converted back into averaged *r* values. We then estimated the reliability of the 2007 and 2008 groups using Cronbach's alpha (Cα) for all four estimated variables using raw data, age and age of track data parsed into categories, and data coded according to agreement and disagreement with the group consensus value. Mean correlation coefficients for hunters varied across variables: from 0.694 (2007) and 0.827 (2008) for sex, through 0.764 (2007) and 0.735 (2008) for age, and 0.735 (2008) for size, to 0.625 (2007) and 0.829 (2008) for age of track. The exclusion of cubs and their associated adults reduced hunter mean correlations of sex from 0.827 to 0.547. Hunter estimates of all four variables were more correlated with each other than those made by the elders and non-Inuit. When age and age of track estimates were categorized, mean correlation coefficients of the hunters, elders and non-Inuit generally decreased. However, hunter responses remained more correlated with each other than elder and non-Inuit responses. For the raw data, Cα for both years indicated that including non-Inuit instead of elders increased group reliability in age and decreased group reliability in sex and age of track. With the inclusion of non-Inuit versus elders, Cα decreased when age data were categorized according to two common methods, and increased when age of track data were categorized as ≤ 1day old or > 1 day old. However, Cα based on disagreement or agreement with consensus decreased reliability for sex and age of track estimates and had no effect on age estimates when including non-Inuit participants versus elders. A small number of 2007 size estimates means comparison between years was not possible. Should our ongoing efforts to estimate hunter accuracy indicate these track diagnoses are accurate, our current findings suggest that hunter track diagnoses can inform part of a non-invasive polar bear activity survey.

BIOGEOCHEMICAL CYCLING IN THE ARTIC OCEAN: A STORY FROM CARBON MONOXIDE

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The distribution, photoproduction, microbial uptake, and air-sea exchange of carbon monoxide (CO) were investigated in open waters of the southeastern Beaufort Sea in autumn 2003 and spring 2004. Diurnal cycles of surface water CO concentration ([CO]) occurred in autumn but not in spring. In both seasons [CO] was well above air-equilibrium at most stations (maximum of 12,500% saturation) and dropped with depth to undetectable levels below 50 m. Mean surface water [CO] and CO water column burdens (0-50 m) were 0.45 nmol L^{-1} and 5.0 *m*mol m^{-2} in autumn and 4.7 nmol L^{-1} and 64.8 *m*mol m^{-2} in spring, and the sea-to-air CO flux was 33 times higher in spring. The efficiency of CO photoproduction correlated linearly with CDOM across the Mackenzie River estuary, the Mackenzie Shelf, and the Amundsen Gulf. Modeled water column CO photoproduction in spring was 15 times that in autumn (45.8 vs. 3.0 *m*mol m^{-2} d^{-1}). Microbial CO uptake followed first-order kinetics in autumn while Hill-type, saturation, and inhibition kinetics were common in surface waters in spring. Biooxidation was the dominant CO loss term in autumn while gas exchange was almost equally important in spring. Higher photoproduction and slower bio-uptake in spring resulted in the wide autumn-spring differences in the [CO] distribution pattern and air-sea CO flux. This study reveals that CO cycling in cold northern waters differs both quantitatively and qualitatively from that in warmer seas.

ASSESSING THE PERFORMANCE OF NATURAL TUNDRA WETLANDS USED FOR THE TREATMENT OF MUNICIPAL WASTEWATER IN THE CANADIAN ARCTIC

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As Arctic communities evolve and populations become more concentrated and urbanized, there is a growing need to adopt environmental sustainable

technologies in the north. Wastewater treatment methods are a particular challenge for northern communities. Current wastewater treatment systems are rudimentary in the north because of constraints caused by remoteness, climate, and socio-economic factors. Constructed wetland systems for wastewater treatment are an example of a sustainable environmentally sound technology available for use in polar regions. Many northern communities already use lagoons in combination with natural wetlands for treatment of municipal wastewater. This study assessed existing natural treatment wetlands in six communities in the Kivalliq region of Nunavut, in the Canadian Arctic. Wetlands were assessed for nutrient, pathogen, and conventional water quality parameters. Overall, natural tundra wetlands were very effective at treating municipal wastewater during summer conditions and are a socially and environmentally appropriate technology for many northern Canadian communities. Specific findings and implications are discussed.
Keyword: cold climate, Arctic, tundra wetlands

DEGRADATION OF PERMAFROST AFFECTING LANDSCAPE AND INFRASTRUCTURES AT UMIUJAQ IN NORTHERN QUEBEC

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According to the meteorological records of Environment Canada available for the Inuit communities of Kuujjuarapik and Inukjuak along the East Coast of Hudson Bay, the mean annual air temperature has been quite variable over the record period but has increased of about 3 °C since the last 16 years. Because the climate is the main driver of the permafrost dynamics, a fast permafrost degradation has recently occurred at Umiujaq also on the East Coast of Hudson Bay due to this trend to climate warming. Using time-lapse aerial photographs collected in 1957 and 1983, and IKONOS satellite image taken in 2005 of the study area, this permafrost degradation has been assessed. The superficies occupied by ice-rich permafrost mounds and thermokarst ponds in 1957 were respectively 18.3 and 1.0% of the survey area while they were 11.2 and 2.8% in 2005. The land occupation by permafrost has thus decreased of 7.8% in 48 years. This permafrost degradation can induce geohazard such as ground subsidence affecting the performance of man-made infrastructures. For instance, along a 300-meter segment of the road leading to the airport of Umiujaq, three zones of ground subsidence were studied in summer 2006; 15 years after the road completion in 1991. The subsidence can be as high as 0.63 m and the total volume of subsidence is close to 530 cubic meters for a road embankment 7.4 m wide. The geohazards associated to permafrost degradation due to the climate warming can affect the perennity of Inuit communities in Northern Quebec.

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Government of Canada International Polar Year Program / Le programme de l'Année polaire internationale du Gouvernement du Canada

www.api-ipy.gc.ca
International Polar Year (IPY) 2007-2008 marks the largest-ever international program of scientific research focused on the Arctic and Antarctic regions. Thousands of scientists and researchers from more than 60 nations around the globe are expected to participate in IPY during the 24-month period beginning March 2007.

L'Année polaire internationale (API) 2007-2008 donnera lieu au plus important programme international de recherche scientifique jamais entrepris sur l'Arctique et l'Antarctique. Des milliers de scientifiques et de chercheurs de plus de soixante pays du monde entier devraient participer au programme de l'API, qui durera 24 mois et débutera en mars 2007.

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

Indian and Northern Affairs Canada - Northern Contaminants Program / Affaires indiennes et du Nord Canada - Programme de lutte contre les contaminants dans le Nord

"Working to reduce and, wherever possible, eliminate contaminants in traditionally harvested foods, while providing information that assists informed decision making by individuals and communities in their food use."
For more information on the Call for Proposals 2009-2010, visit our website at *www.inac.gc.ca/nth/ct/ncp/index-eng.asp*

« Travailler à réduire et, autant que possible, éliminer les contaminants présents dans les aliments récoltés de façon traditionnelle, tout en fournissant de l'information aidant les personnes et les collectivités à prendre des décisions éclairées concernant leur alimentation. »
Pour plus de renseignements sur la Demande de propositions 2009-2010, visitez notre site web au *www.ainc.gc.ca/nth/ct/ncp/index-fra.asp*

POSTER SESSION

Natural Sciences and Engineering Research Council / Conseil de recherches en sciences naturelles et en génie du Canada

www.nserc-crsng.gc.ca

Natural Sciences and Engineering Research Council of Canada | Conseil de recherches en sciences naturelles et en génie du Canada

NSERC is a federal funding agency that has taken a leadership role in supporting Canada's participation in International Polar Year and in re-invigorating Canada's long-term involvement in northern research. Our vision is to help make Canada a country of discoverers and innovators. We support more than 26,000 students and fellows and award grants to more than 11,000 university professors.

Le CRSNG est un organisme subventionnaire fédéral qui joue un rôle de chef de file par son appui à la participation du Canada à l'Année polaire internationale et à l'engagement à long terme du pays dans la recherche nordique. La vision du CRSNG est d'aider à faire du Canada un pays de découvreurs et d'innovateurs au profit de tous les Canadiens. Le CRSNG offre un appui financier à plus de 26 000 étudiants et stagiaires postdoctoraux et accorde des subventions à plus de 11 000 professeurs d'université.

GRADUATE STUDENT POSTER AWARD

FIRST PLACE

Canadian Polar Commission / Commission canadienne des affaires polaires

www.polarcom.gc.ca

Established in 1991 as the lead agency in the area of polar research, the Canadian Polar Commission has responsibility for: monitoring, promoting, and disseminating knowledge of the polar regions; contributing to public awareness of the importance of polar science to Canada; enhancing Canada's international profile as a circumpolar nation; and recommending polar science policy direction to government.

La Commission canadienne des affaires polaires, qui a été créée en 1991 en tant que principal organisme chargé de la recherche polaire, a les responsabilités suivantes : promouvoir et diffuser les connaissances relatives aux sciences polaires et suivre leur évolution; aider à sensibiliser le public à l'importance de la science polaire pour le Canada; intensifier le rôle du Canada sur la scène internationale à titre de nation circumpolaire; et recommander l'adoption d'une politique sur la science polaire par le gouvernement.

SECOND PLACE

ROMOR Atlantic Limited

www.romor.ca

ROMOR Atlantic Limited is a Canadian owned company with 25 years of experience in the Marine Industry. ROMOR is an Oceans Solutions provider exclusively representing and distributing oceanographic and geophysical instrumentation. ROMOR provides our clients with ROMOR Ocean Application Research (ROAR); a team of experts to assist with their integration requirements. Our team has the ability to offer full systems integration, new product development needs, mooring design and deployment, field service and custom training on instrumentation and technology.

GRADUATE STUDENT POSTER AWARD

THIRD PLACE

Fisheries and Oceans Canada / Pêches et Océans Canada

www.dfo-mpo.gc.ca

The Science Sector of Fisheries and Oceans Canada (DFO) participates in ArcticNet; operates six International Polar Year (IPY) research projects and participates in other IPY projects with the goal of understanding climate change and its impacts in the Arctic. The Canadian Coast Guard Service under DFO operates CCGS Amundsen.

Fisheries and Oceans Canada | Pêches et Océans Canada

Science | Sciences

Afin de mieux comprendre le changement climatique et ses impacts dans l'Arctique, le Secteur des sciences de Pêches et Océans Canada (MPO) participe à ArcticNet, pilote six projets de recherche et participe à d'autres dans le cadre de l'Année polaire internationale (API). Relevant du MPO, la Garde côtière canadienne exploite le navire NGCC Amundsen.

INUIT PARTNERSHIP OF EXCELLENCE AWARD

Inuit Circumpolar Council (Canada)

www.inuitcircumpolar.com

ICC promotes and celebrates Inuit unity and works collectively to advocate internationally on behalf of the 155,000 Inuit living in Chukotka, Greenland, Alaska and Canada. ICC (Canada) is a non-profit organization led by a board of directors comprising the elected leaders of the four land-claims settlement regions: Inuvialuit, Labrador, Nunavik, and Nunavut.

INUIT

Inuit Tapiriit Kanatami

www.itk.ca

Inuit Tapiriit Kanatami (ITK) was founded in 1971. ITK is the national Inuit organization in Canada representing the 55,000 Inuit from four Arctic regions: Nunatsiavut (Labrador), Nunavik (northern Quebec), Nunavut, and the Inuvialuit Settlement Region in the Northwest Territories. The President of ITK is Mary Simon.

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INUIT TAPIRIIT KANATAMI

TOPICAL SESSION

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www.blackwellpublishing.com/por

Published by Wiley-Blackwell in partnership with the Norwegian Polar Institute, the international, peer-reviewed journal Polar Research aims to promote the exchange of scientific knowledge about the Arctic and Antarctic across disciplinary boundaries. Publishing original primary research papers, Polar Research serves an international community of researchers and managers.

Polar Research

EXHIBITORS

Arctic Institute of North America

www.arctic.ucalgary.ca

The Arctic Institute of North America, located at the University of Calgary, is mandated to advance the study of the circumpolar Arctic through the natural and social sciences, the arts, and the humanities. The Institute publishes an interdisciplinary journal Arctic, operates the Arctic Science and Technology Information System, and maintains the Kluane Lake Research Station.

Arctic Kingdom Marine Expeditions Inc.

www.arctickingdom.com

Arctic Kingdom offers full expedition planning, outfitting services and equipment rentals for institutions, societies and field schools conducting research in the Arctic. We allow scientists to focus on research by managing arctic logistics. Improved field data is gathered through access to more locations over extended periods.

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Science | Sciences

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IPY·API
2007·2008 International Polar Year
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"Working to reduce and, wherever possible, eliminate contaminants in traditionally harvested foods, while providing information that assists informed decision making by individuals and communities in their food use."
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www.kongsberg.com

Kongsberg Maritime delivers systems for positioning, surveying, navigation and automation to merchant vessels, offshore, oil and gas installations. We are a market leader in dynamic positioning systems, automation and surveillance systems, process automation, satellite navigation and hydroacoustics. Important markets include countries with large offshore and shipyard industries.

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Makivik Corporation

www.makivik.org

Makivik is the birthright organization of the Inuit of Nunavik. It is a non-for-profit organization created in 1978 following the JBNQA (James and Northern Quebec Agreement). Makivik has several subsidiary companies, which include Air Inuit, First Air, Cruise North Expeditions, Nunavik Creations and Nunavik Bio-Sciences. Its joint venture subsidiaries are NEAS, PAIL and Nasittuq. The Nunavik Research Centre is also an important part of Makivik. Studies are done on arctic animals to help fully understand the wildlife of the arctic. It is an internationally renown facility.

Nasivvik Centre

www.nasivvik.ulaval.ca

The Nasivvik Centre for Inuit Health and Changing Environments is a multidisciplinary research and training centre funded by the Canadian Institutes of Health Research-Institute of Aboriginal Peoples' Health. The Nasivvik Centre is focused on building capacity in Inuit environmental health research through trainee support and the provision of targeted research support and facilitation.

Natural Sciences and Engineering Research Council / Conseil de recherches en sciences naturelles et en génie du Canada

www.nserc-crsng.gc.ca

Natural Sciences and Engineering Research Council of Canada | Conseil de recherches en sciences naturelles et en génie du Canada

NSERC is a federal funding agency that has taken a leadership role in supporting Canada's participation in International Polar Year and in re-invigorating Canada's long-term involvement in northern research. Our vision is to help make Canada a country of discoverers and innovators. We support more than 26,000 students and fellows and award grants to more than 11,000 university professors.

Le CRSNG est un organisme subventionnaire fédéral qui joue un rôle de chef de file par son appui à la participation du Canada à l'Année polaire internationale et à l'engagement à long terme du pays dans la recherche nordique. La vision du CRSNG est d'aider à faire du Canada un pays de découvreurs et d'innovateurs au profit de tous les Canadiens. Le CRSNG offre un appui financier à plus de 26 000 étudiants et stagiaires postdoctoraux et accorde des subventions à plus de 11 000 professeurs d'université.

Noetix Research Inc.

www.noetix.on.ca

Noetix Research Inc. was incorporated in 1988 within the province of Ontario and is located in Ottawa, Ontario Canada. The firm specializes in remote sensing and geographic information systems for land and marine applications including project management, software and engineering solutions. By combining the expertise of our full and diverse staff, Noetix Research is able to provide winning solutions for operational problems as well as client-tailored products and services.

Noetix is comprised of three groups: GeoInformation Systems, Land and Marine Applications and Interactive Learning. The combined efforts of these groups allows Noetix to offer the following services: Systems Engineering, Web Enabling Geospatial Applications, Geomatics Training and Satellite Imagery and Image Product Sales. One of Noetix's services is the Floe Edge Service which provides image maps showing the floe edge over select regions on the Arctic.

EXHIBITORS

ROMOR Atlantic Limited

www.romor.ca

ROMOR Atlantic Limited is a Canadian owned company with 25 years of experience in the Marine Industry. ROMOR is an Oceans Solutions provider exclusively representing and distributing oceanographic and geophysical instrumentation. ROMOR provides our clients with ROMOR Ocean Application Research (ROAR); a team of experts to assist with their integration requirements. Our team has the ability to offer full systems integration, new product development needs, mooring design and deployment, field service and custom training on instrumentation and technology.

SARL TECHNICAP

www.technicap.com

Specialised in the oceanographic field since 1963, TECHNICAP offers a full range of scientific marine sampling instrumentation. The TECHNICAP product line includes: sediment traps, sampling bottles, frames (composite material, titanium, stainless steel, aluminium), special surface buoys based on customer needs and specifications, and many other types of marine sampling instruments. One example is the sediment trap PPS 5/2, a 1 sqm with 24 samples.

Schools on Board

www.arcticnet-ulaval.ca

Schools on Board is an outreach program of ArcticNet developed to bridge Arctic research with science education in high schools across Canada, increase awareness of climate change, and excite young Canadians about the challenges and opportunities of Arctic research. High schools are given the unique opportunity to send students and teachers to the Arctic to participate in an educational experience completely integrated within the ArcticNet research activities onboard the CCGS Amundsen.

Students on Ice

www.studentsonice.com

STUDENTS ON ICE is an award-winning organization offering unique learning expeditions to the Antarctic and the Arctic. Our mandate is to provide students from around the world with inspiring educational opportunities at the ends of our earth, and in doing so, help them foster a new understanding and respect for the planet.

STUDENTS ON ICE est une organisation primée qui offre des expéditions éducatives et uniques en leur genre en Antarctique et en Arctique. Notre mandat est d'offrir à des étudiants des quatre coins du monde, l'occasion de vivre des expériences éducatives et inspirantes aux deux extrémités de la terre, tout en les aidants à développer une compréhension et un respect plus grand pour la planète.

ASL Environmental Sciences Inc.

www.aslenv.com

ASL Environmental Sciences specializes in physical oceanography – over 30 years in the Arctic. Our products include: the Ice Profiler- measures ice-keel depths; the Wave Profiler- measures non-directional wave height from the safety of the ocean floor; and the Water Column Profiler- monitors the presence and location of zooplankton, fish or sediments.

2007·2008 API·IPY

Année polaire internationale
International Polar Year

www.api-ipy.gc.ca • www.ipy-api.gc.ca

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est fier d'être
un promoteur or de la
conférence Arctic Change 2008

The Government of Canada
International Polar Year Program
is proud to be
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Canada

Affaires indiennes et du Nord Canada
Indian and Northern Affairs Canada

Programme de lutte contre les contaminants dans le Nord

Northern Contaminants Program

Photo © Paul Vecsei

« Travailler à réduire et, autant que possible, éliminer les contaminants présents dans les aliments traditionnels récoltés, tout en fournissant de l'information qui aidera les personnes et les collectivités à prendre des décisions éclairées concernant leur alimentation. »

Pour plus de renseignements sur la Demande de propositions 2009-2010, visitez notre site web au www.ainc.gc.ca/nth/ct/ncp/index-fra.asp ou composez le 819-994-7451

"Working to reduce and, wherever possible, eliminate contaminants in traditionally harvested foods, while providing information that assists informed decision making by individuals and communities in their food use."

For more information on the Call for Proposals 2009-2010, visit our website at www.inac.gc.ca/nth/ct/ncp/index-eng.asp or call 819-994-7451

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Natural Sciences and Engineering Research Council of Canada
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www.nserc-crsng.gc.ca

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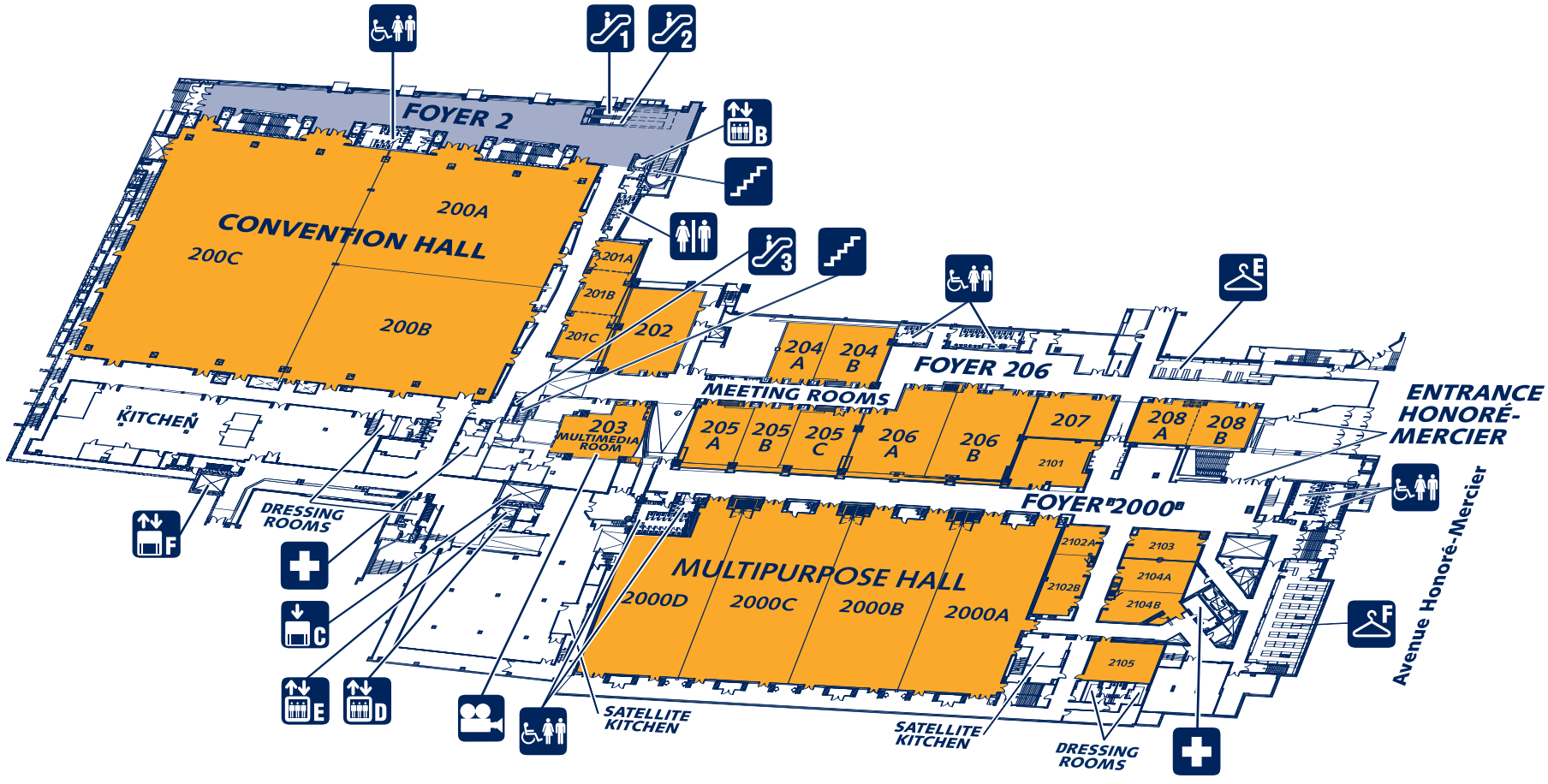
FOYER 2
CONVENTION HALL
200A
200B
200C
201A
201B
201C
202
KITCHEN
DRESSING ROOMS
203 MULTIMEDIA ROOM
204 A
204 B
FOYER 206
MEETING ROOMS
205 A
205 B
205 C
206 A
206 B
207
2101
208 A
208 B
ENTRANCE HONORÉ-MERCIER
Avenue Honoré-Mercier
FOYER "2000"
MULTIPURPOSE HALL
2000D
2000C
2000B
2000A
2102A
2102B
2103
2104A
2104B
2105
SATELLITE KITCHEN
SATELLITE KITCHEN
DRESSING ROOMS
Elevator
Escalator
Multimedia room
Washrooms Wheel chair accessible
Ticket sales
Infirmary
Audio control room and simultaneous interpretation
Cloakroom
Mobile TV Units
Information
Security
Internet café
Stairway
Freight elevator
Washrooms