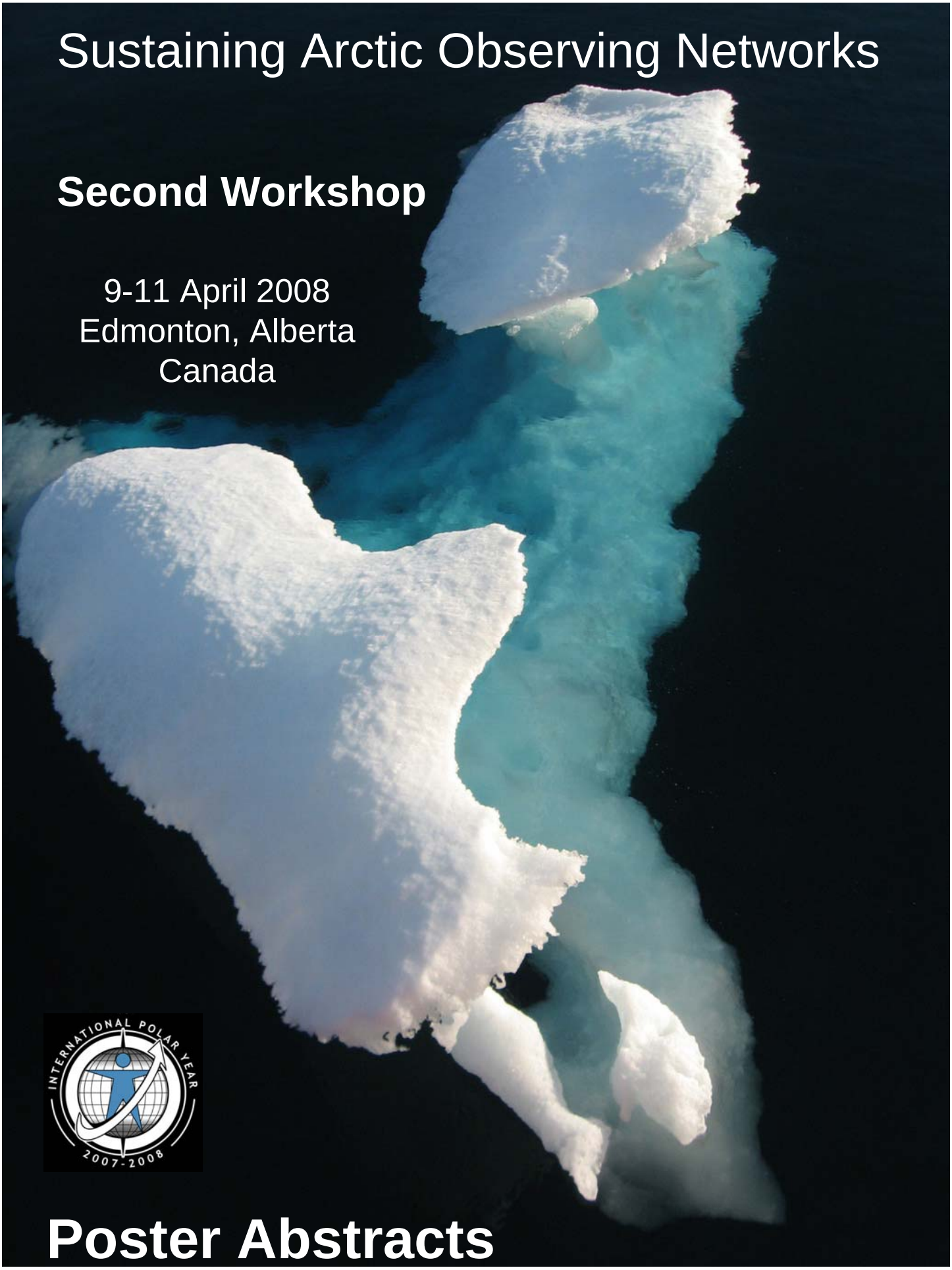
Sustaining Arctic Observing Networks

Second Workshop

9-11 April 2008
Edmonton, Alberta
Canada



Poster Abstracts

Workshop Organizing Committee
Co-chairs: David Hik & Helen Joseph

John Calder, AMAP
David Carlson, IPY Director
Patricia Cochran, Inuit Circumpolar Council
David Hik, Canadian IPY Secretariat
Helen Joseph, Department of Fisheries and Oceans - Canada
Jussi Paatero, Finnish Meteorological Institute
Volker Rachold, IASC
Odd Rogne, AMAP and IPY IPO
Sverker Sörlin, Swedish IPY Committee

SAON II workshop is hosted by the Government of Canada and the Canadian IPY Secretariat

Canada

INTERNATIONAL POLAR YEAR 2007-2008
ANNÉE POLAIRE INTERNATIONALE

On behalf of the SAON Initiating Group and Workshop Organizing Committee, we would like to welcome you to the **2nd IPY workshop on Sustaining Arctic Observation Networks in Edmonton, Alberta, 9-11 April 2008**.

Effectively harnessing the efforts, resources, and momentum of International Polar Year (IPY) to ensure that its impact is substantive and long lasting will require strategic planning, leadership and international cooperation. IPY's legacy must include well-coordinated and sustained Arctic observing networks that meet scientific and societal needs. An organizing committee composed of representatives from the scientific community, government agencies and local northern residents has initiated a process to develop specific recommendations for Sustaining Arctic Observing Networks (SAON).

Three SAON workshops are planned during IPY to address the following questions:

- What Arctic observing sites, systems and networks currently exist?
- What spatial, temporal and disciplinary gaps exist and how can gaps be filled and the observation effort sustained?
- How will operational observing, research and community-based activities to be coordinated and integrated?
- What is the interplay between modeling and monitoring?
- How can free, open and timely access to data be achieved?
- What are the technology and R&D components required for sustaining Arctic observations and information systems?

Following three workshops (Stockholm, Edmonton and Helsinki) this year, a set of recommendations will be presented to the Arctic Council, the International Arctic Science Committee, and the WMO/ICSU IPY Joint Committee, and distributed to agencies and programs that contributed to their development.

This workshop will be critical for the success of the SAON process and your participation will provide an ideal opportunity to produce a multi-agency, multi-national approach for developing and sustaining long-term Arctic observing networks for the benefit of Arctic and global societies.

Thank you for your interest in the SAON process and we look forward to the outcomes over the next three days.

David Hik
Co-Chair, SAON-2 Workshop
Canadian IPY Secretariat

Helen Joseph
Co-Chair, SAON-2 Workshop
Fisheries and Oceans Canada

ArcticNet and CCIN: Development of a metadata catalogue and data strategies

Christine Barnard[1], Warwick F. Vincent[2], Ellsworth LeDrew[3], Peter Yoon[3]

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ArcticNet is a Network of Centres of Excellence of Canada generating large data sets concerning the impacts of climate change in the Canadian coastal Arctic. It is a multidisciplinary program, with many projects in the natural, human health, and social sciences. The data generated by ArcticNet is being managed to maximize the exchange and accessibility of relevant information, and to leave a long term legacy for future comparisons and analyses. To achieve this, ArcticNet in close collaboration with the Canadian Cryospheric Information Network (CCIN) has developed the Polar Metadata Catalogue, which allows public access to clear and concise descriptions of the research from all sectors. The web-based interface for the catalogue is user friendly, producing records that are fully compatible with international metadata standards (FGDC) for interoperability and sharing between other data centres and clearinghouses. A close partnership with the federal government provides a mirror backup site for long term archiving. With GeoConnections support and partners we have also developed a Web Mapping Service interface for the search facility, allowing users to search for spatial data (all records) using spatial referencing, keywords, categories, and date range. Upcoming additions are Inuit-oriented tools and full data archiving procedures.

Arctic Biosphere Atmosphere Coupling at Multiple Scales (ABACUS)

Bob Baxter[1], Stephan Matthiesen, Mathew Williams

[1]University of Durham, Durham, UNITED KINGDOM

ABACUS is a consortium of eight UK research institutions with the objective of improving understanding of the controls on carbon, water and energy exchange between Arctic terrestrial ecosystems and the atmosphere. At field sites in mountain tundra, wetland and birch forest ecosystems in Northern Sweden and Finland, ABACUS is undertaking a linked programme of plant and soil process studies, isotope analyses, flux measurements, process modelling, and aircraft and satellite observation. Methods are being developed to link the multi-scale measurements with models representing our best current understanding of the system.

Results from the first field season in Sweden have shown that changes in growth and photosynthesis of key species can be predicted from environmental factors based on known plant physiological processes. We have been able to quantify differences in carbon uptake and respiration among key Arctic vegetation types, using a novel continuous flux system. The data have revealed vegetation responses to drivers such as snow cover, soil temperature and moisture. Links between fine root carbon stocks and leaf area, as well as new models of the links between vegetation structure and reflectance allow better estimation of relevant parameters from remote sensing data. We have found evidence of functional convergence of tundra vegetation types, and this simplifies carbon flux modelling at multiple spatial and temporal scales.

The ABACUS results are helping to improve predictions of the response of the Arctic terrestrial biosphere to global change. Through links with similar IPY projects from other Arctic regions we hope to construct a pan-Arctic synthesis on carbon and energy fluxes.

NEPTUNE CANADA the world's first regional cabled ocean observatory: Potential for remote arctic interactive marine observatories

Christopher Barnes, **Mairi Best**, Fern Johnson, Peter Phibbs, Benoît Pirenne

NEPTUNE Canada, University of Victoria, Victoria BC, CANADA

In Fall 2007, NEPTUNE Canada began the installation of an $100 million cabled ocean observatory across the Juan de Fuca Plate, North-East Pacific. This will be an innovative network of real-time sub-sea laboratories linked by over 800 km of electro-optic cables. Five nodes, providing 10kW power and 4Gb/sec data transmission, will host hundreds of interactive scientific sensors below, on, and above the seafloor over an observatory life of 25 years. Continuous real-time multidisciplinary integrated measurement series will be delivered to a Data Management and Archiving System (DMAS) and from there, through the Internet, to researchers, decision-makers and the public throughout the world. This facility will transform our understanding of biological, chemical, physical, and geological processes across an entire tectonic plate from the shelf to the deep sea. As the first regional scale interactive observatory housing a diversity of instruments and sensors, it also provides the proof of concept for the application of this novel technology other remote extreme environments. Significant challenges for NEPTUNE Canada include: securing adequate funding; innovative design of the nodes, junction boxes and vertical profiler; route planning and system deployment over challenging topography; building in-house a Data Management and Archive System with an observatory control system; periodic reduction in scope and aspirations; and developing collaborative relationships, including those with the Canadian and US navies, the commercial fisheries, and the First Nations. Opportunities abound for: extending and expanding the network and instrument arrays; international partnerships; commercial innovation and demonstration; educational and outreach programming; nurturing new applications; and promoting comparable observatory networks in other extreme environments such as the Canadian Arctic.

Canadian radiological monitoring activities in the Arctic

Tracy Bliss, Sonia Johnson and R. Kurt Ungar

Radiation Protection Bureau 6302D1, Health Canada, Ottawa, ON CANADA

The Radiation Protection Bureau of Health Canada operates two major monitoring networks. The Canadian Radioactivity Monitoring Network consists of 26 air and precipitation measurement stations across Canada which provide information on natural background radiation levels and on routine or accidental releases of radioactivity into the environment. Nine of these stations are located at remote sites in northern Canada. The Verification Incident Monitoring network operates five stations – two of which are located in the far north -- in support of Canadian obligations under the Comprehensive Nuclear Test Ban Treaty. These monitoring networks cover a total land area of 10 million km^2 and provide regular measurements (daily or weekly) of a suite of radionuclide concentrations in air. A complete archive of air filters extending back to 1972 is available for studying time trends. The operation of these networks will be presented and applications will be discussed involving long range transport of atmospheric contaminants and the use of radionuclide tracers to study climate change effects.

MANA: Monitoring remote environments with autonomous sensor network-based data acquisition systems

Philippe Bonnet, Kirsten Christoffersen, Marcus Chang

University of Copenhagen, Copenhagen, DENMARK

The overall goal of the MANA project is to improve scientific data acquisition in remote, harsh environments such as the Arctic. Because physical access and communication bandwidth are limited, manual measurements are costly, manually tapped data loggers are unreliable, and remote supervised control is impractical.

In MANA, we focus on the monitoring of limnic parameters in the Zackenberg region, North-East Greenland. The goal is to document the effects of climate change on lake environments, in particular in the winter season that has been neglected so far because of logistics constraints.

We aim at enhancing sensors and data loggers with computation and communication capabilities so that we can program them to be reliable and autonomous. We plan to develop sensor network-based data loggers that (a) check the data they collect and correlate measurements in time and space,
and (b) autonomously adapt their sampling strategy in order to optimize data quality as well as resource utilization.

The key challenge when designing a data acquisition for year-round lake monitoring in a high-Arctic environment is to take measure of the extreme weather conditions, specially in winter (September-July) where the wind is blowing, temperature reaches -40C and the lakes are covered with an ice lid of approximately 2 m as a layer of snow. A wire between sensors inside the lake and a data logger located on the shore would be exposed to the forces that are applied on the ice forming at the surface of the lake (during freeze-thaw periods or when the wind is blowing). A popular option in the context of ocean and coastal waters monitoring is to attach a sensors to a buoy that integrates a data logger, as well as communication capabilities. We investigate a slight variation of this approach, where one data logger located on the shore is connected via mid-range wireless links to a collection of buoys, each equipped with various sensors. We believe that our wireless sensor network-based approach is more flexible, as each sensor is transformed into an Internet device. Our approach is also more cost effective for dense sensor deployments, as several sensor nodes can be arranged in a multi-hop network rooted at the data logger e.g., with several multi-sensor probes per
lake, or dozens of soil moisture sensors deployed around a weather station.

We base our data acquisition system on commercial off-the-shelf components:
- Multi-sensors probe: Multi-sensors probe provide a uniform interface for several co-located sensors. Each sensor may have a different modality (e.g., chlorophyll, oxygen, temperature sensors can be attached to the same multi-sensors probe). The key challenge when transitioning from manual to unattended sensors is to deal with the biological and chemical
debris that accumulates in time. This is particularly important for optical sensors such as chlorophyll sensors. Fortunately, modern multi-sensor probe include anti fouling solutions and wipers that clean the sensitive surface of optical sensors and thus allow long-term monitoring. We are using the WQM system from Wetlabs.
- Sensor Networking: We rely on the sensor networking technology from Arch Rock: (1) each multi-sensor probe is connected to an Arch Rock Sensor Node located inside a buoy, (2) the border router is co-located with the data logger on the shore, and (3) an external antenna is used so that the mote can communicate via 6lowPan with the flash-based PC located on the shore.
- Low-power, flash-based PC: This is the low-power server connected to the sensors via the Arch Rock border router. It is the hardware component on which the data logger executes. The key

characteristic of this component are (i) that it can be aggressively duty cycled, and (ii) that its secondary storage is flash-based. Indeed, hard drives cannot operate in the extremely low temperatures of a high-Arctic environment. We are using the Vexcel Microservers, developed in the context of the SEAMONSTER project.

We expect to make our data loggers an integrated infrastructural unit in the Zackenberg Basic long-term monitoring program. The MANA project started on Feb 1st 2008. It will last three years. Our first deployment is planned for August 2008.

Developing a network of permafrost observatories in Russia and Alaska

Jerry Brown[1], Vladimir Romanovsky, Alexander Kholodov, Sergei Marchenko

[1]International Permafrost Association, Woods Hole MA, U.S.A.

Permafrost has received much attention recently because surface temperatures are rising in most permafrost areas of the Earth, which may lead to permafrost thaw. Thawing of permafrost has been observed at the southern limits of the permafrost zone and this can lead to changes in ecosystems, in water and carbon cycles, and in infrastructure performance. If the current trends in climate continue, warming of permafrost will eventually lead to widespread permafrost thawing in the colder permafrost zones. There is however uncertainty concerning where this thawing will occur first, the rate of thaw and the consequences for Arctic, Subarctic and the global natural systems.

To characterize the thermal state of permafrost, the International Permafrost Association launched its International Polar Year Project # 50, Thermal State of Permafrost (TSP). Ground temperatures are measured in existing and new boreholes within the global permafrost domain over a fixed time period in order to develop a snapshot of permafrost temperatures in both time and space. This data set 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. The first results of the project based on data obtained from Alaska and Northern Eurasia are presented. Most of the observatories show a substantial warming during the last 20 years. 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. Projections of possible changes in permafrost during the 21st century based on application of calibrated permafrost models are also presented.

The International Network of Permafrost Observatories (INPO)

Jerry Brown[1], Sharon Smith[2], Vladimir Romanovsky[3] and Hanne H. Christiansen[4]

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Several coordinated international permafrost observatory programs are underway as part of the International Polar Year (2007-2008). Our IPY “Permafrost Legacy” is to create a “snapshot” of existing permafrost conditions and to establish a sustainable network of observatories and databases for purposes of assessing future changes and to encourage the development of a new generation of permafrost researchers. The Thermal State of Permafrost (TSP) Project 50 includes temperature measurements in boreholes, the Circumpolar Active Layer Monitoring (CALM)

network, and monitoring of periglacial processes. The first two activities are part of the pre-existing the GTOC/GCOS international network of Global Terrestrial Network for Permafrost (GTN-P).

Observatory sites include more than 400 boreholes and 160 active layer sites in both hemispheres. Networks include approximately 200 borehole sties for the Alaska-Russia TSP project, 100 boreholes in Canada, and networks in Europe (PERMOS in Switzerland, several transect-oriented networks in Norway and Svalbard) and central Asia (China, Mongolia and Kazakhstan). Selection of additional TSP observatory sites need to consider under represented regions. Additional sites are included in the projects on Carbon Pools in Permafrost (CAPP) and key sites under the Arctic Coastal Dynamics (ACD) project.

Education, outreach and data management activities are key elements in these projects. Members of the Permafrost Young Researchers Network (PYRN) are developing specific boreholes in support of their own research. Outreach activities are establishing boreholes and active layer measurements in schools in an increasing number of countries. The International University Courses on Permafrost (IUCP) is providing access to courses worldwide. Investigators are expected to provide data to national and international repositories so that standard data sets can be readily available to a wide range of users. A recent example is the Norwegian NORPERM project. INPO, as is GTN-P, is coordinated by the International Permafrost Association (IPA) and its Standing Committee on Data, Information, and Communications. The data developed during the IPY will be part of the CD Rom Circumpolar Active-Layer Permafrost System (CAPS 3.O) produced in cooperation with National Snow and Ice Data Center, Boulder, Colorado. The IPA coordinates activities with the WCRP Climate and Cryosphere (CLiC) program.

Initial IPY permafrost results will be presented at the Ninth International Conference on Permafrost (NICOP) in Fairbanks, Alaska, the SCAR-IASC Science Conference in St. Petersburg, Russia, and the 33rd International Geological Congress in Oslo, Norway, during summer 2008.

Recent evidence of climate warming in the Canadian High Arctic

David Burgess and Roy M. Koerner

Natural Resources Canada, Ottawa, ON CANADA

While global warming has increased by ~ 1^0C over the last 50 years parts of the High Arctic have seen a ~2.5^0C rise over the same period. As a consequence, all of the glaciers and ice caps we monitor in our High Arctic have lost ice by varying amounts. This poster presents this information from four of our ice caps in addition to the changing amount of sea ice that we observe each spring in Jones Sound.

The International Arctic Systems for Observing the Atmosphere (IASOA) – A building block for the atmospheric component of SAON

Lisa S. Darby[1], Taneil Uttal[1], John F. Burkhart[2,3], James R. Drummond[4,5], Alexander P. Makshtas[6,7], and Valery A. Martyschenko[6]

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The International Arctic Systems for Observing the Atmosphere (IASOA) is an IPY-endorsed program with the aim of coordinating Arctic atmospheric research and observations (http://classic.ipy.org/development/eoi/proposal-details.php?id=196). The member stations are Abisko, Sweden; Alert and Eureka, Canada; Barrow, USA; Cherskii and Tiksi Russia; Ny-Ålesund, Norway; Pallas and Sodankylä, Finland; and Summit, Greenland. All of these stations are intensive, long-term, and permanent. In our poster, we will explain the what? why? who? and how? of IASOA.

IASOA will easily form a strong base for the expansion, planning and implementation of a long-term network for atmospheric Arctic observations. For instance, a comprehensive network can be designed based, in part, on the existing gaps in the IASOA network. The types of gaps that will stimulate network enhancement include geographical gaps, gaps in the uniformity of measurements, and issues with data availability. A sustained Arctic network can also be built upon existing networks that some IASOA stations participate in already, such as the Global Atmosphere Watch (GAW) and the Baseline Surface Radiation Network (BSRN).

The observational gaps can be assessed using the information at the IASOA web site (www.iasoa.org). One tool for this assessment is an overview of the instrumentation currently operating at the IASOA sites, found on the Observatories-at-a-Glance page. This chart indicates the array of observations that are available from the IASOA network, from basic surface meteorological instrumentation to sophisticated profiling instruments such as lidars and radars. For more detailed information, each observatory has its own page at www.iasoa.org, which includes web links to data and principal investigator information, if available, plus links to the observatory's home page.

Observational gaps can also be addressed by the IASOA network through coordinated validation of numerical models and reanalysis products, and satellite data validation. IASOA, while not a data management activity, will interact with data management groups to facilitate data management and archival. We invite SAON scientists to review the web site, use it for planning purposes, and to provide comments on the information at the site.

The Canadian Glacier-Climate Observing System – Towards understanding the state and evolution of Canada's glaciers

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The State and Evolution of Canada's Glaciers initiative provides information and data products produced by the Federal Government's National Glacier-Climate Observing System (monitoring, assessment and data portal) and related freshwater vulnerability research in western and northern Canada. The Glacier-Climate Observing System is delivered through an integrated monitoring and research collaborative comprised of Natural Resources Canada-Geological Survey of Canada (lead agency), Geomatics Canada-Canada Centre for Remote Sensing, Environment Canada-National Water Research Institute and Water Survey of Canada, Parks Canada Agency, C-CORE PolarView, and partner universities and their related initiatives such as the Canadian Foundation for Climate and Atmospheric Sciences IP3 and WC^{2}N research networks.

Our glacier-climate observations are derived from the in-situ measurement of a network of reference glaciers in the Cordillera and the Canadian Arctic Islands. Both aircraft and orbital remote sensing are applied in a multi-scale/multi-mode fashion to generate regional perspectives on the state of land ice and its responses to climate variations. With this data the collaborative conducts research on the relationship between climate, glacier fluctuations and their impacts on freshwater systems (e.g., river flow, cold stream ecology, groundwater recharge, and flow to oceans).

The development of improved remote sensing tools is also a major research thrust. With the support of the Canadian Space Agency, European Space Agency, Canadian Consortium for Lidar Environmental Applications Research (C-CLEAR), and NASA - Wallops Flight Facility, new tools and a systematic approach are increasingly brought to bear to understand more completely and with reduced uncertainty the magnitude, causality and impacts of Canada's changing glaciers.

System outputs are used to a) inform national and international climate change programs and process; b) improve knowledge regarding the nature and locations of historical, current, and potential future impacts of climate change, c) assist Canadians in understanding and adapting to climate change impacts on natural resources at a regional and national scale. The System provides leadership and co-ordination of Canada's contribution to WMO's Global Climate Observing System (GCOS) - Global Terrestrial Network for Glaciers (GTN-G), the contribution of Essential Climate Variables for GEO/GEOSS, and providing such as Official Communications to the Parties of the Convention UNFCCC. For additional information: http://pathways.geosemantica.net/WSHome.aspx?ws=NGP_SECG&locale=en-CA

The Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut CANADA

James Drummond[1], T. Duck[1], J. Sloan[2], K. Strong[3], W. Ward[4], P. Fogal[3], S. Argall[5], Hans Fast[6], D. Hudak[7], A. Manson[8], B. McArthur[6], T. McElroy[6], Norman O'Neill[9], G. Shepherd[10], M. Shepherd[10], R.J. Sica[11], Kevin Strawbridge[6], K. Walker[3], J. Whiteway[12]

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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 and how they 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).

Seasonal patterns in the surface energy balance from a fen and a ridge site in Northern Alaska: Preliminary findings for the autumn and winter seasons '07 – '08

Eugenie Euskirchen, Glenn Scott, Marion Syndonia Bret-Harte

Institute of Arctic Biology, University of Alaska Fairbanks

Energy exchange between the land, sea ice, and atmosphere controls the Earth's climate system on local, regional, and global scales. In particular, numerous studies have established the key role that Arctic terrestrial vegetation by means of biophysical exchanges of radiation, sensible heat, latent heat, and ground heat, has on the climate system. However, one of the foremost challenges in studies of high-latitude climate is combining an ecological understanding of the terrestrial system with the physical understanding of the climate system. While much attention has been paid to the biogeochemistry of Arctic terrestrial ecosystems, less well studied is the interplay between the vegetation and climate, where the climate may be sensitive to changes in the energy balance due to such ecosystem variables as vegetation type, permafrost, and snow

cover. Until recently, there was a complete lack of long-term field-based energy balance data from Siberia and a poor representation of other terrestrial regions of the Arctic. Likewise, in those regions where energy balance data exist, data were collected only during the snowfree summer months, and not over the full annual cycle. The advent of a network of eddy covariance towers measuring surface energy fluxes over the full annual cycle in the Arctic provides us with a better ability to evaluate these fluxes. Here, we present a preliminary characterization of the seasonal energy balance for two types of tundra ecosystems, a seasonally wet fen and a drier ridge site, in Arctic Alaska. Measurements to date suggest large rates of change in the energy fluxes in the fall, at the time of snowpack formation. Further, the differences in rates of change of the fluxes between fen & ridge sites are not statistically significant ($p>0.01$). We are continuing to perform measurements at the study site, and it is our hope to synthesize the measurements over the full annual cycle from this site with those data collected over the full annual cycle at other Arctic sites in the Arctic Observatory Network. This synthesis would provide a valuable dataset on surface energy balance across the Arctic that could be used in validating Arctic-specific land surface and ecological models.

Thirty years of data management for Earth observations at the National Snow and Ice Data Center (NSIDC)

Florence Fetterer, Roger Barry, Ronald Weaver, Richard Armstrong

National Snow and Ice Data Center, University of Colorado, Boulder, CO U.S.A.

Over the past 30 years the National Snow and Ice Data Center (NSIDC) has managed data in a way that directly or indirectly supports earth observation systems. NSIDC's Distributed Active Archive Center (DAAC) supports the cryospheric missions of the NASA Earth Observing System's satellites. The new Cooperative Data and Information System (CADIS), joint with NCAR and UCAR, supports the (largely) NSF funded Arctic Observing Network (AON). Indirectly, NSIDC supports the Global Climate Observing System and other Earth monitoring efforts by archiving data that contribute to their missions. Some simple truths about observing systems emerge from our long history of storing and serving their data. They include:

- New instruments have to be 'backward compatible' with old. A few long, continuous, records are at least as valuable as numerous sporadic new short records from a number of PIs or satellite programs, even if the short records are more precise.
- International collaborations are essential for building networks and for establishing data sharing protocols. Examples of currently active NSIDC affiliations include International Polar Year Data Coordination Service of ICSU (International Council for Science), the International Permafrost Association, the World Glacier Monitoring Service, and the Joint WMO-IOC Commission for Oceanography and Maritime Meteorology (JCOMM) for the Global Sea Ice Data Bank.
- While some observations are useful on their own (like sea ice or snow extent) many are only informative when combined with other like or contrasting observations in some way. It is difficult to get funding for developing higher level or integrative products like atlases, climatologies, near-real-time data streams, or even data on the same grid or in the same format, but these are some of NSIDC's most used data sets. They include the first global assembly of data and information on frozen ground (CAPS), Environmental Atlases for arctic meteorology, oceanography, and sea ice; and passive microwave gridded time series products from the ESMR, SMMR, SSMI, and AMSR-E sensors.
- Strategic IT decisions impact the cost and effectiveness of systems for managing and distributing observing system data. The challenge to IT managers is the continuing need to drive costs downward yet continue the same level of service in an ever changing technology and user requirements world. The NSIDC DAAC EOSDIS Core System has evolved over the past 10 years and will no doubt change even more in the near future.

The Global Land Ice Measurement from Space (GLIMS) project exemplifies the effective linking of older limited-coverage IGY-era paper maps to a modern geospatial data base with web-based interactive maps allowing access to a global satellite data set to monitor the world's glaciers. The outgrowth of these projects is a strong respect for the needed scientist-to-scientist communication and coordination as well as innovative IT tools.

In the coming decades we expect reinforcement of these trends, increasing emphasis on multi-sensor products and multi-disciplinary data sets, all in a rapidly changing IT environment.

Monitoring and assessing coastal change in the Canadian Arctic

Robert Taylor, **Don Forbes**, D. Frobel, G. Manson, S. Solomon, D. Whalen

Geological Survey of Canada Atlantic, Dartmouth, NS CANADA

The Canadian Arctic hosts one of the most diverse and extensive polar coasts in the world. It has a long history of human occupation based predominantly on marine resources. The Inuit and Inuvialuit population of the Canadian Arctic is concentrated in more than 40 communities which are almost exclusively coastal. Apart from inland mines, almost all industrial, transportation, military, and research infrastructure is located on or close to the coast. Climate-change impacts in the Canadian Arctic involve a number of factors affecting coastal stability. Coastal erosion contributes to the Arctic marine carbon budget and contaminant loading.

The Geological Survey of Canada (Natural Resources Canada) is the only federal organization that has conducted long-term repetitive surveys of shoreline changes in northern Canada. Observations at 24 sites span more than 25 years. More than 280 sites have been occupied and surveyed in an east -west transect across the Canadian Arctic to document regional variations in shoreline character, stability and thermal regime. Airborne video surveys complement the ground surveys. These aerial surveys cover 6000 km of coastline, some repetitive over time. They help to fill a gap in repetitive vertical air photography in the Arctic (outside communities) since the late 1950s. Recent availability of high-resolution satellite imagery (pixel size <1 m) in a number of places including most communities has provided new opportunities for coastal change detection. Other satellite and airborne sensors, including synthetic aperture radar and LiDAR, have been used in some areas to document changes in shoreline position, coastal topography, and hazards from storm-surge flooding, wave run-up, and sea-ice interaction with the coast. Limited shallow-water charting, including some multibeam bathymetry, has been undertaken in recent years, in partnership with the Canadian Hydrographic Service and university partners in the ArcticNet Network of Centres of Excellence.

Baseline information from coastal monitoring has contributed to scientific understanding of coastal change and hazard processes at high latitudes. It has supported Canadian contributions to international initiatives and assessments such as Arctic Coastal Dynamics (ACD), the circumpolar Arctic Coastal Observatories Network (ACCO-Net) under IPY, the Arctic Climate Impact Assessment (ACIA), and assessments of the Intergovernmental Panel on Climate Change (IPCC). Coastal monitoring results have contributed to environmental assessment and engineering design for major resource developments and to marine oil spill response and planning strategies, which become more critical with increased shipping in Arctic waters. Results of coastal monitoring have also enabled provision of advice to Parks Canada, territorial agencies, and co-management boards regarding erosion threats to archaeological and other cultural heritage sites. Current program objectives include the integration of scientific data and insights into regional and local planning for climate-change adaptation in Nunavut and other jurisdictions. Close collaboration with community partners and links to ArcticNet and IPY projects focused on community impacts, adaptation and resilience are leading to new opportunities for community-based coastal monitoring.

Technological developments, particularly high-resolution satellite imagery and airborne laser altimetry (including bathymetric LiDAR), offer great potential for more detailed and efficient surveys and assessment of coastal dynamics. Operational capacity and costs of using this new technology are changing rapidly, raising new opportunities for coastal monitoring in the Canadian Arctic.

ArcticNet's Arctic Observation Networks

Martin Fortier, Louis Fortier and dozens of ArcticNet researchers, students and collaborators

ArcticNet, Université Laval, Québec, QC, CANADA

ArcticNet is a Network of Centres of Excellence of Canada that brings together scientists and managers in the natural, human health and social sciences with their partners in Inuit organizations, northern communities, government and industry to help Canadians face the impacts and opportunities of climate change and globalization in the Arctic. Over 100 ArcticNet researchers and 275 graduate students and postdoctoral fellows from 28 Canadian universities and five federal departments collaborate with over 100 partner organizations in Canada and nine foreign countries. Long-term funding and access to major core research infrastructure such as the Canadian research icebreaker CCGS *Amundsen* and the Qaujisarvik Network allows ArcticNet to maintain observatories of key climatic, oceanographic, ecological, health and socio-economic indices in the coastal Canadian Arctic. As part of its annual expedition onboard the *Amundsen*, ArcticNet maintains three Long-Term Oceanic Observatories (LTOOs) of 4 oceanographic mooring lines in the Beaufort Sea, Northern Baffin Bay and Hudson Bay. ArcticNet is also maintaining two additional LTOOs in the Laptev Sea and East Siberian Sea in collaboration with the Nansen and Amundsen Basins Observational Systems Network (NABOS).

On land, ArcticNet researchers have access to the Centre d'Études Nordiques' Qaujisarvik Network of eight land-based research stations into which feeds 88 automated stations acquiring data on environmental and geological variables. Located along a north-south transect, the Qaujisarvik Network stretches 3500 km from Radisson, Quebec in the South (53 ºN) to Ward Hunt Island, Nunavut in the North (83 ºN).

On the human health front, ArcticNet researchers are leading a research initiative with colleagues in Greenland, Alaska and Siberia to develop an international longitudinal study to assess the impacts of dietary and environmental changes on cardiovascular disease, cancer and diabetes in Inuit populations around the world.

ArcticNet is participating massively in the International Polar Year (IPY), both as a successful proponent of new research projects and as a supplier of expertise, services, and logistics in support of the IPY. ArcticNet will strive to consolidate the scientific legacy of this augmented Arctic research effort in partnership with its numerous Canadian and international partners.

The IP3 Research Network: Enhancing understanding of water resources in Canada's cold regions

Julie Friddell[1] and John Pomeroy[2]

[1]IP3 Network Manager, University of Saskatchewan, Saskatoon, SK CANADA; [2]Centre for Hydrology, University of Saskatchewan, Saskatoon, SK CANADA

IP3, Improved Processes, Parameterisation, and Prediction in Cold Regions, is a Canada-wide research network devoted to enhanced understanding of surface water and weather systems in cold regions, particularly the Yukon, Northwest Territories, and the Rocky Mountains. The Network has been funded by the Canadian Foundation for Climate and Atmospheric Sciences for 2006-2010. IP3 is a component of the Canadian and International IPY through Arctic Hydra and interacts closely with IPY through a Canadian project on Freshwater Ecology and Hydrology. Through improved understanding and parameterisation of hydrological, hydrometeorological, and climatic processes in cold regions, IP3 will make contributions to better weather and climate prediction at regional and smaller scales, estimation of streamflow from ungauged basins, prediction of changes in Rocky Mountain snow and water supplies, calculation of freshwater inputs to the Arctic Ocean, and sustainable management of mountain and northern water resources. Northerners identified these issues to be of key importance to the development and sustainable management of water resources in Northern Canada during a workshop in Yellowknife in 2004.

Five of IP3's eight research basins are in the Arctic. These highly instrumented basins characterize a wide range of Canada's Arctic landscapes. Field observations are focused on mass and energy fluxes of snowpacks, glaciers, permafrost, open water, vegetation, and runoff generation processes over frozen ground. The collected data will be used to improve parameterisation of these cryospheric processes for incorporation into process hydrology and coupled land surface-hydrology models. The improved models will then be used to simulate water resources (discharge, storage, snow cover, soil moisture, ground ice), near-surface atmospheric fluxes (including evaporation), and weather and climate in cold regions, at scales that are useful to various public and private groups that require water- and weather-predictive capabilities for their sustenance and operation. Outreach activities of the network are coordinated by a Users' Advisory Committee. This Committee is organizing workshops and other activities through which the end users of IP3's data, information, and knowledge can provide direction and feedback on the applicability of the network's products. Both the field data and model outputs will be archived into a database that will be available to Network collaborators and eventually to the public.

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

Gilles Gauthier[1], Dominique Berteaux[2]

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ArcticWOLVES is an international initiative 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 Canada and its administrative center is located at the Centre d'études nordiques, Université Laval, Québec, Canada. Funding for the project has been secured in at least 4 countries and field research is underway 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. Species of primary interest include herbivorous geese and small mammals, insectivorous shorebirds, and avian and terrestrial predators. The initial phase of ArcticWOLVES will cover the period 2007-2010 but the project is intended to continue after the International Polar Year.

Circumpolar Biodiversity Monitoring Program (CBMP): Towards integrated arctic biodiversity monitoring

Mike J. Gill

Circumpolar Biodiversity Monitoring Program, Environment Canada, Whitehorse, YK CANADA

Arctic biodiversity is globally significant and under pressure, but our capacity to monitor and explain trends is limited. These challenges led ACIA to recommend that long-term Arctic biodiversity monitoring be expanded and enhanced. The Arctic Councils CAFF Working Group has responded by implementing the CBMP. The CBMP will harmonize and enhance 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 decision making from the global to local level. The program has over 60 partners and is strategically linked to other international initiatives.The Arctic's size and complexity represents a significant challenge towards detecting and attributing important biodiversity trends. This demands an integrated ecosystem-based approach that not only identifies trends in biodiversity, but also identifies underlying causes. It is critical that this information be made available to generate effective strategies for adapting to 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 an integrated, ecosystem-based approach to monitoring through the development of five Expert Monitoring Groups (Marine, Coastal, Freshwater, Terrestrial Vegetation & Terrestrial Fauna). Each group will be comprised of existing monitoring programs, representing a diversity of expertise and capabilities. The CBMP will also conduct an assessment of current Arctic biodiversity monitoring capacity to identify elemental, geographic and statistical design deficiencies to be addressed. This will lead to a strategy for building and maintaining a comprehensive, cost-effective and sustained circumpolar biodiversity monitoring program.

Canadian Arctic Sea Ice Mass Balance Observatory (CASIMBO)

Christian Haas

University of Alberta, Edmonton, AB CANADA

The University of Alberta is establishing a long-term Arctic sea ice mass balance observatory between the coast of Canada and the North Pole, with the main goal of observing and understanding changes of the sea ice mass balance in relation to variations of oceanic and meteorological boundary conditions. Observations will include biannual airborne electromagnetic measurements of the seasonal and interannual ice thickness variability, as well as measurements of ice deformation and snow properties. In-situ measurements will also comprise operation of ice-mass-balance and drifting buoys, CTD measurements, and will be complemented by satellite remote sensing and modelling work. The gathered data will contribute to the validation of new satellite products and model results.

The observational program is funded until 2012, and will be performed in close collaboration with colleagues from other countries who are involved with similar activities in other regions of the Arctic. It is also open for participation of other partners from Canada and worldwide, and can

include observations of additional, non-physical variables. The project is a contribution to international research programs like CliC (Climate and Cryosphere) and ISAC (International Study of Arctic Change), and close collaboration is sought with SEARCH, the International Arctic Buoy Program, and SAON.

An Oceanographic Observing System in Barrow Strait (Canadian Arctic Archipelago)

Simon Prinsenberg, **Charles Hannah**, James Hamilton

Bedford Institute of Oceanography, Dartmouth, NS CANADA

An in situ oceanographic observing system consisting of several moorings has been maintained in eastern Barrow Strait in the Canadian Arctic Archipelago for 8 years. The observations include currents, temperature, salinity and florescence profiles, ice draft and ice drift. The temperature, salinity and florescence profiles are collected using the new 'ICYCLER' profiler that allows the collection of near-surface profiles. A new initiative with the Department of National Defence under their "Northern Watch" program will allow some of the instruments to a cabled system through the ice shear zone region that will allow real time delivery of the oceanographic and pack ice data. We will describe the existing observing system and the plans for real time data transmission.

International Tundra Experiment

James Hudson and Greg Henry

University of British Columbia, Vancouver, BC CANADA

The International Tundra Experiment (ITEX) is a long-term international observing network whose objective is to understand the effects of climate change on tundra ecosystems. Collaborators conduct standardized small-scale manipulations and observations at over 20 Arctic and alpine sites in 11 countries around the world. The primary ITEX manipulation is passive warming using open-top chambers and other manipulations may include nutrients, light, snow cover, and moisture. Collaborators measure phenological, growth, reproductive, species composition and abundance, carbon flux, and other ecosystem function responses and record both climate and environmental data. Common protocols allow ITEX participants to contribute to biome-wide syntheses and three syntheses have been completed to date: phenology and growth (Arft et al. 1999); species composition and abundance (Walker et al. 2006); and net ecosystem exchange of CO_2 (Oberbauer et al. 2007). ITEX is a core project in IPY, and there are a number synthesis studies underway using the network of sites. ITEX, developed in 1990, remains a stellar example of how communities and countries from across the Arctic can unite to develop worldwide answers to global questions.

Climate and decreasing levels of sulphate aerosols in the High Arctic

Roy M. Koerner & the National Glaciology Programme

Natural Resources Canada, Ottawa, ON CANADA

Acid Aerosols can have a cooling effect on climate. They may be considered to *partially* counteract the warming effects of Greenhouse gases. We have been monitoring the concentrations of these acids in the snow and ice cores so that we have records going back to pre-industrial times. These records show that the acids began to increase in the snow layers of the ice caps as long as 150 years ago. The increase was due to acids coming from the industrial

regions of the world and they went on increasing until the mid-1980's. Since then they have been decreasing to levels as low as they were 100 years ago. Possibly in association with this decrease, we are finding increasing melting on the Arctic glaciers we monitor. This suggests that the cooling effect of acid aerosols may no longer be reducing the Greenhouse gas warming effect in the Arctic.

Northern Long-term Socio-ecological Research Platform (Northern LTSER Platform) - a new tool for collaborative research in Northern Finland

Kari Laine, Antero Järvinen, Pirkko Siikamäki, Kari Saikkonen, Miska Luoto, Veli Pohjonen, Jouko Inkeroinen

Thule Institute, University of Oulu, FINLAND

Northern LTSER Platform, founded as a part of Finnish LTER Network in 2007, constitutes environmental transect from northern boreal forest landscapes to arctic tundra. The main aim of the Northern LTSER Platform is to pool long-term research activities and monitoring data of the northernmost university research stations in Finland under five research themes related to socio-ecological changes in northern nature and communities. The platform covers almost entirely northern parts of Finland and the study design of the platform operates as a sensitive instrument to assess drivers, pressures and the state of environment on multiple spatial scales both on nature and human systems and their interaction. The sites maintain high-quality infrastructures that enable research with a focus on complex interactions between environmental pressures (climate change, land use change, atmospheric pollution) and ecosystem functions and services. The sites cover a wide range of ecosystems and human induced pressures and serve as bases for socio-economic research. Well-developed network of university research stations (Oulanka, Kilpisjärvi, Kevo, Värriö) and northern units of research institutes offers the basic infrastructures for conducting collaborative research, basic laboratory facilities, competent personnel and office as well as accommodation facilities for visiting scientist. About 30 senior researchers or professors with their research groups are involved in the work of the platform. LTER in Finland has objectives similar to that of the international LTER network. Research themes of Northern LTSER Platform are the following: Population dynamics and productivity of plant and animal populations living in the periphery of their distribution, Effects of global change on northern ecosystems, Changing society and livelihoods in rural and peripheral areas, Human health and wellbeing in northern communities, and Information management and research infrastructure for scientific collaboration.

Polar Alert: The development of a European Polar Advisory and Policy Support System

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Both of the worlds Polar Regions are undergoing rapid environmental changes while human activities are on the rise creating uncertainties and major policy questions at various levels. Geo-referenced data and information is increasingly available through satellite observations and an expanding infrastructure for on the ground data collection. At the same time the emergence of sophisticated visualization of geographic information enables the development of a planning environment and advisory platform.

The European Commission has recognized the need for an advisory and policy support mechanism to assist European decision makers with emerging issues in the Polar Regions. Through the 6th RTD Framework the European Commission has funded the establishment of the European Polar Consortium (EPC), a cooperation of 25 polar institutions from 19 European countries (EUROPOLAR – ERA-NET EARC 517842). Part of the Europolar programme is the conceptualization and preparation of Polar Alert, a European Polar decision support system.

The aim of Polar Alert is to integrate different types of data collected through the local infrastructure of EPC partners (stations, airstrips, logistics) with global satellite observations. 70 research stations in the Arctic and Antarctic will be networked as part of the European Polar boards Infrapolar initiative and will be an important vehicle for the implementation of the Polar Alert system. Polar Alert should be linked with existing European (and global) information systems, such as GMES and Polar View. The aim is to present the data in a high resolution geo-referenced information system and updated weekly with observed changes and threats.

The poster will present the rationale of Polar Alert and the first steps taken in the scoping process towards its design. The poster will outline some of the future steps needed in the development of this European polar decision support system.

Unifying disparate hydrologic data sets across the Pan-Arctic at the University of New Hampshire

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The Water Systems Analysis Group at the University of New Hampshire, USA has been working with numerous hydrologic data sets covering large areas of the pan-Arctic drainage system. Our goal has been to unify and harmonize disparate data from a multitude of sources representing both gridded and point data covering high latitude macro-scale hydrometeorology. We present a survey of the data holdings, both available on the Internet and under development, to highlight how these data relate to and support each other to create a cohesive picture of the key elements of the land surface hydrologic cycle.

Data sets include: R-ArcticNet v4.0 (http://www.R-ArcticNet.sr.unh.edu/v4.0) a comprehensive, long term historical monthly time series of river discharge data; ArcticRIMS (http://RIMS.unh.edu) a regional integrated hydrological monitoring system for the pan-Arctic land mass with interactive analysis tools and data holdings containing daily historical and near-real time river discharge data as well as numerous gridded hydrometeorological data sets; ART-Russia an arctic river temperature data set for 20 major Russian gauges; and a climate change analysis data base of long term daily river discharge measurements from smaller drainage basins which had limited human disturbance for the period of record.

Observing the Arctic Circumpolar Coast – ACCO-Net in SAON

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The Arctic coastal zone is sensitive to changes in marine, atmospheric, and terrestrial systems. Variations in sea ice extent, wave and storm intensity, air and water temperatures, and ground ice content affect the rate and magnitude of coastal change. A very sparsely populated region, the Arctic coastline is poorly observed when compared to temperate and tropical coastal zones, despite the fact that human systems in the Arctic are located in and dependent on processes in the coastal zone. The Arctic coastal zone needs to be monitored, both as a barometer for global change and for its human relevance. The international effort to align coastal observations in the Arctic is led by the Arctic Circumpolar Coastal Observatory Network (ACCO-Net). ACCO-Net includes a network of key sites setup by the Arctic Coastal Dynamics (ACD) project of the IASC, and 17 International Polar Year (IPY) projects from around the Arctic. ACCO-Net provides three categories of support to an SAON: 1) a network of regional experts responsible for running observations; 2) historical and current data in an Arctic circumpolar GIS database; and 3) a catalogue of site characteristics based on remotely sensed products. The regional experts have been assembled through IASC's Arctic Coastal Dynamics project, and through the IPY project cluster on Arctic coastal observatories, which ACCO-Net leads. The coastal database is currently available in beta form, and includes a segmentation and classification of the circumpolar Arctic coastline. The current coastline used is the World Vector Shoreline, which has been divided into over 8000 segments on the basis of geomorphology, coastline position change rate, and ground composition, as well as other parameters. The GIS format allows searching and querying, and the database is currently mounted as an internet map server. The catalogue of site characteristics has two principle aspects: i) a monitoring template describing the primary and secondary monitoring parameters for each observatory site, and including links to standard operating procedures for each, and ii) standardized coastline position and digital elevation models for each observatory site, based on optical and infrared satellite data collected during IPY as part of the European Space Agency's IPY program. ACCO-Net partner projects are currently selecting imagery for the catalogue and will co-ordinate their activities via a series of workshops supported by the International Space Science Institute.

Satellite base EO data for climate change and ecosystem studies

Rasim Latifovic

Natural Resources Canada, Ottawa, ON CANADA

Long-term observations sustained over decades are a critical first-step in providing the climate data necessary for scientists, decision makers and stakeholders to make adaptive choices that could improve resilience to climate change and vulnerability, as well as maintain economic vitality. In response to this recognized need Natural Resources Canada in the framework of the Earth Sciences Sectors Programs has established comprehensive satellite data record from low and medium resolution optical and IR sensors including AVHRR (1985-2007), SPOT/VGT 1&2 (1998-2004), MODIS (2000-2005) and recently MERIS.

This presentation we will show some of the results of our research on landscape response to climate change, were in-situ measurements and AVHRR satellite data archive developed at the Canada Center for Remote Sensing was used to study variability and trend in lake ice phenology and vegetation productivity. Results show the most significant effect has occurred in the North-West of Canada. Further research will explore these trends in more detail and at higher temporal resolutions. The new long-term surface reflectance and temperature data record at 1-km spatial resolution derived from NOAA/AVHRR sensors with 10 day and single day temporal resolution are unique source of information. It has potential to improve the current understanding of climate change response over Canadian landmass. New data might help in examining trends and variability of the ice-on/ice off dates for lakes of various sizes, and also for the improvement of numerical lake ice models.

Natural Resources Canada: Arctic observations, information management and logistical support

Daniel Lebel, Celina Campbell and Marty Bergmann

Earth Science Sector, Natural Resources Canada, Ottawa, ON CANADA

As Canada’s largest organization investigating natural resources in Canada’s Arctic, Natural Resources Canada (NRCan) plays a key role in Arctic observations and information management to help Canadians ensure sustainable northern development. The Arctic constitutes a strategic reserve of natural resources for Canada. Northern Canada’s future prosperity in a globalized economy will depend on our ability to develop sustainable infrastructure and communities. NRCan's Arctic observations and information management contribute to these goals: provide an integrated scientific foundation for decision-making, policy development, regulation, and standards; provide support for public health, safety, environmental and defence needs; and, enable economic and social development.

NRCan's Arctic observations and information management are key contributions towards NRCan's Strategic Outcomes which include: Economic Development- natural resource sectors are internationally competitive, economically productive, and contribute to the social well-being of Canadians (program activities include Economic Opportunities for Natural Resources and Natural Resource-based Communities); Environmental Responsibility- Canada is a world leader in environmental responsibility in the development and use of natural resources (program activities include: Clean Energy and Ecosystem Risk Management); and, Safety, Security and Governance- natural resource and landmass knowledge strengthen the safety and security of Canadians and contribute to the effective governance of Canada (program activities include: Adapting to a Changing Climate and Hazard Risk Management and Natural Resource and Landmass Knowledge for Canadians).

NRCan's Arctic observations and information management products contribute to: promoting environmentally sustainable natural resource management and economic development; enhancing federal, northern territorial and indigenous community decision-making and economic, social and environmental development; enhancing scientific monitoring and research on local, regional, national and global environmental issues; and, co-operation among Arctic nations. NRCan conducts Arctic observations in a large number of areas including: Cryosphere: permafrost (e.g., permafrost thermal state, active layer thickness), and glaciers (e.g., glacier mass balance [ice and water fluxes], glacier extent, form and flow, atmospheric pollution, palaeoenvironment [from ice cores]); Coastal (changes in physical shoreline response to changing sea ice, wave energy and changing sea levels, changes in landfast and bottomfast ice conditions and nearshore thermal regime, impacts of changing air and ground temperatures and ground ice on shoreline stability and sediment supply, evidence of changes in relative sea level, storminess, and sea ice interaction in the shore zone); Lithosphere (earthquakes); Biosphere (vegetation); and, Earth Observations (cryosphere, ice conditions, magnetic observations, radarsat calibration).

For over 50 years, NRCan's Polar Continental Shelf Project (PCSP) has been making it easier for hundreds of scientists from around the world. The PCSP coordinates support for, and offers expert advice to Canadian government and university scientists and independent, private sector and non-Canadian researchers working in isolated areas throughout the Canadian Arctic. Support includes: transportation (primarily small fixed-wing aircraft and helicopter support), communications, accommodation, field equipment and related services. Each year, Polar Shelf provides ground and air support services to approximately 150 scientific groups from more than 40 Canadian and international universities or government agencies. Scientific projects using PCSP's services cover every discipline, from archaeology to space science to zoology.

Sustained environmental radioactivity observing sites in northern Finland

Ari-Pekka Leppanen, Dina Solatie

Radiation and Nuclear Safety Authority – STUK, FINLAND

Radiation and Nuclear Safety Authority - STUK Regional Laboratory in Northern Finland is located at the Arctic Circle. The laboratory was founded at Rovaniemi in 1970. This was in the middle of the cold war and nuclear era. The laboratory is the most northern laboratory in the European Union performing radioactivity analyses and monitoring of environment. The laboratory also participates in the Arctic Monitoring and Assessment Programme (AMAP). The laboratory focuses in the studies of the northern radioecology. These include the studies of environmental samples, the northern food chains and foodstuffs produced in the Finnish provinces of Lappi and Oulu. In addition, the laboratory takes part in the national surveillance programme of environmental radiation and research projects in the Arctic and sub-Arctic.

The laboratory performs routinely radiochemical analyses for the determination of 210Po/210Pb, 238,239, 240Pu, 90Sr in environmental samples. Low background HPGe detectors are used for the determination of gamma emitting nuclides.

STUK has several sustained observation posts and sampling sites at Finnish Lapland. The main posts are for airborne radiation (aerosols) and fallout monitoring. There are three samplers for airborne and fallout monitoring which are situated at Rovaniemi, Sodankylä and Ivalo. The sampling period for fallout is one month, for airborne particles it is twice a week for Sodankylä and Ivalo and every day for Rovaniemi. The filters for airborne radioactivity are measured at Rovaniemi, the data is stored into a national data-base at Helsinki called LINSSI (LINux System for Spectral Information).

The Regional Laboratory in Northern Finland has also several locations (some fenced) for environmental sampling like lichen, berries, mushrooms and fish. The laboratory also analyses regularly reindeer meat, wild food and farm milk. The laboratory has a working co-operation with Kivalo forest research area governed by Finnish Forest re-search Institute. Annual sampling from Kivalo has been organised and extensive time series exist. For non living sampling like the surface waters are sampled regularly from river Tenojoki and from lakes Luobmusjärvi and Nitsijärvi. All the samples are treated and measured at the Regional Laboratory in Northern Finland. The measurement results are inserted into Laboratory Information Management System (LIMS).

The main interest of these studies is the Cs-137 content which is due to atomic weapons testing and Chernobyl accident. Recently due to increased mining activity in Finnish Lapland and also due to the generally low Cs-137 in nature more interest has been put to NORM (naturally occurring radioactive materials) and studies on doses from NORM.

Geophysical Observing Networks in the High Canadian Arctic - Opportunities and

David McCormack, Lorne McKee, Khalil Hayek, Stephen Halchuk

Geological Survey of Canada, Ottawa, ON CANADA

Geophysical observations for earthquake and geomagnetic studies have been made continuously in the high Arctic for many decades. Over time an infrastructure has developed to support this observatory network and to transmit the data in real-time to central facilities for analysis.

This poster details the technical details of the communications infrastructure that currently exists, and summarizes some of the future requirements for observation, to provide a basis for discussion of possible collaboration with other groups using this network or other systems.

Monitoring Ice Thickness in Arctic Seas

Humfrey Melling

Fisheries and Oceans Canada, Sidney, BC CANADA

There are two principal sea-ice types in the Arctic (first-year, multi-year), each of which may exist as either pack ice or fast ice. Among the four resulting categories, multi-year fast ice has special significance for Canada not only because it blocks the North West Passage but also because the Earth's largest accumulation lies within the Canadian Archipelago. Sustained monitoring must embrace all sea-ice categories since the impacts of changing climate are different for each.

Capability to map sea-ice thickness lags behind that to map its extent, concentration and drift. The reason for slow progress is the great difficulty of developing accurate space-borne sensors for thickness. At present there are two well established techniques for determining thickness – direct measurement following drilling, calculation from draft measured remotely by sub-sea sonar – and a number of promising contenders – airborne electromagnetic induction radar, satellite-borne laser and microwave altimeters. Among these techniques, only sub-sea sonar and the emerging satellite technologies can provide continuous year-round observations.

Single-point measurements are poorly representative of most sea-ice environments because a wide diversity of ice forms is typical. Except in first-year fast ice, the distance of relevance for a single measurement is less than 100 m. Similarly the interval of relevance for a single survey may be short: pack ice responds quickly to storms via drift and lead and ridge formation, and ablation in July and August is rapid. Unfortunately surveys based on manned platforms (e.g. aircraft or submarines) are necessarily infrequent for reasons of remoteness, environmental challenge and cost.

Canada claims two of the longest sea-ice-thickness time series, one for coastal first-year fast ice initiated in the late 1940s at Arctic weather stations and the other for pack ice in the Beaufort Sea initiated in 1990. The former is derived from weekly drill-holes and the latter from upward-looking sonar on submerged moorings.

Canadian experience is therefore useful in demonstrating the value of long-term ice-thickness data, in proving technology and methodology, in illustrating logistic challenges and in providing realistic views of cost and practicality. Canadian experience in sea-ice thickness monitoring will be noted. The present monitoring network will be described. Future possibilities will be discussed.

Integration of Retrospective Observational Time Series in International Arctic Observing Activities

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The Polar Archaeology Network (PAN) http://polararchaeologynetwork.blogg.no/, formed in the spring of 2007 in response to a perceived need by the polar archaeological research community for better engagement with broader initiatives in polar science, a desire for stronger international collaborations in discipline-based initiatives, a desire to grow polar archaeological research capacity through scholarly development and post-graduate educational activities, the wish to develop more advanced field and analytical methods particular to polar archaeology, and to ensure continued access to potential datasets that may be environmentally and/or politically sensitive in the context of a changing arctic. PAN is endorsed by the International Arctic Science Committee (IASC) http://www.arcticportal.org/iasc/ as an IASC Network.

Archaeological approaches and sources of data are frequently overlooked in arctic observation and arctic system science initiatives. Elsewhere archaeology has shown its potential for illuminating past global and regional environmental change events, and for providing data on upper trophic levels, including humans, that is relevant to developing effective local and regional scale remediation, mitigation and ecosystem restoration activities among others. The continued failure include relevant socio-ecological and climatological data derived from archaeological sources and to failure to monitor and collect such data from as yet untapped archaeological sources will most certainly hinder efforts to understand the arctic as a system, and to predict and respond to future arctic changes.

Included among the proposed activities of the PAN are:

1) The building and maintenance of an international circumpolar archaeological observing network - one that monitors the archaeological data sources increasingly threatened by arctic change including permafrost thawing, coastal erosion, development activities and geo/local political events;

2) The identification and synthesis of existing retrospective datasets, the identification and rescue of threatened data sets, the integration of diverse data streams, and the integration of relevant archaeological data and archaeological approaches into larger Arctic Change research programs;

3) The collection of new circumpolar retrospective time series on arctic environmental change and especially change among the marine, terrestrial, and human components of the arctic system, and the collection of relevant proxy data for past climate and environmental change episodes.

To effect these activities PAN has formed appropriate working groups which will develop a series of white papers recommending proposed actions and best practices for accomplishing these goals. This poster presentation highlights the role of archaeological data in arctic change research and mechanisms by which archeological observations can be sustained and integrated within in a broader arctic observing network.

Genotypic characterization of hepatitis B virus from chronic carriers living in the Canadian Arctic

Bryce Larke, **Carla Osiowy**, Elizabeth Giles

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Chronic infection with hepatitis B virus (HBV) is widespread throughout the world and is the single most common cause of liver cirrhosis and liver cancer worldwide. Prior to the time of HBV vaccination programs in the Canadian north, HBV infection was considered to be endemic within some Inuit and northern Indigenous populations, with a prevalence of chronic infection almost 20 times higher than among non-Aboriginal Canadians. The goal of the present study was to characterize the HBV genome from HBV carriers living within the Canadian Arctic. This study

expands and complements an original HBV seroepidemiological study conducted between 1983 and 1985 in this area.

HBsAg-positive sera collected during the original seroepidemiological study was extracted and amplified to detect HBV DNA. Sequence and phylogenetic analysis was performed to acquire information on HBV nucleotide variations, genotype and phylogenetic groupings observed within this cohort.

A total of 14,198 individuals living within the Canadian Arctic (encompassing Nunavut and the Northwest Territories) participated in the original 1983-1985 serosurvey. Archived sera from 401/428 HBsAg-positive participants were retrieved and tested for HBV DNA. Seventy percent of samples were DNA positive, with a median viral load of 1.9E+03 IU/ml among the 178 sera having quantifiable HBV DNA. To date, 237 samples have been genotyped: 197 HBV genotype B (83.2%), 38 genotype D (16%), and 2 genotype A (0.8%). Following phylogenetic analysis, all HBV/B strains were observed to cluster within a new subgenotype grouping, B6, recently recognized among Inuit living within western circumpolar regions (Alaska, Canada, and Greenland). Almost 80% (150/193) of HBV carriers were found to have the HBV precore mutation associated with loss of the HBeAg marker, whereas very few individuals (3/184,1.6%) had the core promoter mutation associated with development of hepatocellular carcinoma.

A very high prevalence of HBV subgenotype B6 was observed among archived HBsAg-positive samples collected during a 1983-1985 HBV serosurvey of the Canadian Arctic. This observation, along with our recent finding of a relatively benign clinical outcome in patients infected with subgenotype B6, presents the possibility of a reduced impact or health burden related to hepatitis B infection in the Canadian Arctic.

Pallas-Sodankylä Global Atmosphere Watch Station, Northern Finland

Jussi Paatero, Hannele Hakola, Juha Hatakka, Esko Kyrö, Tuomas Laurila, Heikki Lihavainen, Jouni Pulliainen and Yrjö Viisanen

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The first meteorological observations in Sodankylä, northern Finland were made during the First International Polar Year in 1882-1883. Regular aerological observations at the Arctic Research Centre of the Finnish Meteorological Institute (FMI-ARC) have been conducted already over 60 years constituting one of the longest upper atmosphere meteorological observation series north of the Arctic circle. Since 1994 the FMI's Pallas-Sodankylä site has been one of the 22 global stations of the World Meteorological Organization's Global Atmosphere Watch (GAW) programme.

Upper-air weather, ozone, aerosol and radioactivity soundings are made at Sodankylä as well as several ground-based and ground-level measurements: broad band albedo of forested and open terrain, surface spectral reflectance, spectral UV radiation, airborne radioactivity, surface weather parameters, total ozone column, deposition of acidifying compounds, and aerosol optical depth. Carbon dioxide flux between a pine forest and the atmosphere is also measured. The FMI's northernmost weather radar is situated on the top of Luosto fell 25 km south of FMI-ARC. The range of the radar covers most of the northern Finland. Satellite data CAL-VAL activities for the boreal forest (taiga) belt are currently being expanded with new instrumentation, e.g. profiling atmospheric microwave radiometer for the monitoring of water vapor and temperature profiles.

Most of the tropospheric air composition and related meteorological measurements are made at Pallas. The measurements include reactive gases, greenhouse gas concentrations, aerosol particle number concentration and size distribution, PM10, aerosol scattering coefficient, black carbon, volatile organic compounds, inorganic compounds in the air and precipitation, and stable

isotopes. We measure carbon dioxide flux between a nearby spruce forest and the atmosphere and methane and carbon dioxide fluxes between northern mire and the atmosphere.

The International Polar Year Data and Information Service: Challenges and Opportunities

Mark Parsons

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The International Polar Year Data and Information Service (IPYDIS) is a global partnership of data centers, archives, and networks working to ensure proper stewardship of IPY and related data. The National Snow and Ice Data Center acts as a coordination office for the IPYDIS to ensure the long-term preservation of broad, interdisciplinary, and non-expert access to IPY data. Another coordination office focused on near-real time and operational data streams is based at the Norwegian Meteorological Institute. Other national and international coordination offices are also being established.

Through these Data Coordination Offices, the IPYDIS tracks the data flow for IPY and helps researchers and data users identify data access mechanisms, archives, and services. The IPYDIS also provides information and assistance to data managers on compliance with standards, development of a union catalog of IPY metadata, and other data management requirements for IPY. It provides a general communication forum for all matters related to accessing, managing, and preserving IPY and related data.

The IPYDIS is guided by the IPY Data Policy and Management Subcommittee, which develops the overall IPY data strategy and policies. The IPYDIS is a supporter and participant in the Electronic Geophysical Year (eGY), which promotes a modern e-Science approach to issues of data stewardship: open access to data, data preservation, data discovery, data rescue, capacity building, and outreach.

This poster illustrates the overall structure of the IPYDIS and reviews current activities and future challenges for in creating a sustained polar data system.

The Climate and Cryosphere Project (CliC) and sustained observing networks

Angelique Prick

CliC International Project Office, Norwegian Polar Institute, Tromsø, NORWAY

The Climate and Cryosphere Project (CliC) is one of the four core projects of the World Climate Research Program (WCRP). CliC principal goal is to assess and quantify the impacts that climate variability and change have on components of the cryosphere and its overall stability, and the consequences of these impacts for the climate system. CliC co-ordinates climate activities related to all parts of the earth's cryosphere. This includes sea ice, snow, ice shelves, icebergs, lake/river ice, and permafrost. CliC is helping to co-ordinate the WCRP role in the International Polar Year 2007-2008 (IPY), in particular to insure that a legacy of data management, observational and research capabilities remain after IPY. Outcomes from CliC research will contribute to seasonal forecasting, estimates of sea-level prediction, water management, energy production and many other application areas. The IPY provides a unique opportunity to help close this gap in global observations by developing our polar observing systems further. CliC led the development of the conceptual framework for the Cryosphere Observing System http://igos-

cryosphere.org/documents.html, a sustained, robust observing system for the cryosphere and a crucial element of the future multidisciplinary observing system.

CliC supports sustained observing networks for all cryospheric components in the Arctic (e.g. the Integrated Arctic Ocean Observing System iAOOS, see: <www.iaoos.no>), in the Antarctic (e.g. Pan-Antarctic Observations System, PantOS; Southern Ocean Observing System, SOOS), and globally (e.g. Thermal State of Permafrost TSP, see www.ipa-permafrost.org).

At the 15th WMO Congress (2007), the delegation of Canada proposed to create a Global Cryosphere Watch (GCW). An ad-hoc expert group under chairmanship of Dr B. Goodison, Chair of WCRP/CliC Scientific Steering Group, has been established in January 2008 in order to prepare recommendations for the development of this GCW. GCW will contribute to WMO's integrated observing and information systems and to the Global Climate Observing System network. It will cover all aspects of the cryosphere and be an intergovernmental mechanism for supporting key cryospheric *in situ* and remote-sensing observations - while implementing the recommendations of the IGOS Cryosphere Theme. In collaboration with other international programmes and agencies, the proposed GCW will provide reliable, comprehensive observations of the components of the cryosphere through an integrated observing approach on global and regional scales, serving the needs of climate, hydrology, weather and environmental science. It will work with, and build on, existing programs such as the GTN-G, GTN-P, GTN-H, and work with external partners such as space agencies and World Data Centers for Glaciology. GCW will contribute to GEOSS through the implementation of CryOS and as an IPY Legacy for observation, monitoring and provision of data and information. GCW will have direct application to societal benefit areas, such as outlined by GEOSS. A goal of GCW would be to establish a one-stop portal for authoritative up-to-date cryosphere data and products/information.
CliC invites and encourages scientists to register in its specialist database at <http://clic.npolar.no/specialists>.

Monitoring networks for arctic chars

Michael Power[1], **Jim Reist**[2], Nikolaus Gantner[3]

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Monitoring of Arctic chars and other salmonid fishes of the genus *Salvelinus* is designed to: a) support activities of two of the working groups of the Arctic Council [Conservation of Arctic Flora and Fauna (CAFF) - Circumpolar Biodiversity Monitoring Program (CBMP); and Arctic Monitoring and Assessment Program (AMAP) - Coordinated Monitoring Effort (CME)]; b) be a key element in monitoring northern aquatic ecosystem integrity and health in a new initiative of Fisheries and Oceans Canada; and, c) link to community-based monitoring initiatives in northern communities as an element of a Canadian IPY project. Chars have been identified as a key taxon to meet these needs because they exhibit high levels of biodiversity both locally and regionally, are the only fish present in extremely high latitude freshwaters, and link freshwater, estuarine and nearshore marine Arctic aquatic ecosystems. Moreover, chars occupy a wide range of positions in aquatic foodwebs and ecosystems (i.e., both as prey and predators at different life history stages, ecophenotypes, and/or life history types). These traits and their relevance in northern fisheries make chars ideal as proxies of general health of Arctic aquatic ecosystems, tools for integrating and monitoring underlying ecosystem changes, and for documenting anthropogenic effects. Progress is outlined towards developing and maintaining a comprehensive network for char monitoring in the Canadian Arctic. This approach can serve as a model for both national and international networks designed to document pan-arctic shifts in char biodiversity in response to major drivers of change such as climate change, contaminant loading, exploitation, development and cumulative impacts.

Automated measurement of carbon dioxide fluxes at Imnaviat Creek, Alaska: Winter of 2007-2008

Glenn Scott

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Long-term, continuous measurements of CO2 and H2O vertical exchanges throughout the circumpolar Arctic are required in order to understand how this sensitive region will react and contribute to global climate change. As a part of the International Polar Year (IPY), a network of projects that measure these fluxes and forcing factors such as energy exchanges and soil and air temperatures has been initiated through the NSF- funded Arctic Observatory Networks (AON) organization. An objective of AON is to provide publicly available continuous datasets of CO2 and H2O vertical exchanges in order to improve research synthesis. Observations performed over the course of the winter of 2007-08 have addressed the following questions:

A) What is the technical feasibility of this objective considering the harsh winter conditions common to the Arctic?

B) Are the initial results congruent with our understanding of the drivers of vertical exchanges of CO2 and H2O?

C) Will the scale of the observations affect the measurements and the conclusions that are based on them?

The Circumpolar Active Layer Monitoring (CALM) Program

Dmitriy Streletskyi, Frederick Nelson, Kenneth Hinkle, **Nikolay Shiklomanov**[1], Jerry Brown[2]

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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 14 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 obtained by different methods. Metadata include detailed site descriptions and photographs for each site. Although the limited number of observational sites, their sparse distribution, and relatively short records preclude direct extrapolation of observations to entire circumpolar regions, several groups of sites have been used to create regional maps of active-layer thickness. 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.

The Canadian Permafrost Monitoring Network and the thermal state of permafrost

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Over the past two to three decades, Canadian researchers have established and maintained a permafrost monitoring network to measure two key cryospheric parameters identified by the World Meteorological Organization, permafrost thermal state and active layer thickness. The Canadian network is an important contributor to the Global Terrestrial Network for Permafrost. Information generated by the network facilitates the characterization of current permafrost conditions and the detection of change and has allowed the documentation of recent trends in permafrost thermal state. Essential information has been provided for understanding the impact of climate change on both natural and human systems, the development of strategies to deal with these impacts and the rationale planning of northern development.

The International Polar Year (IPY) provides the opportunity for the Canadian permafrost community and the International Permafrost Association (IPA) to conduct a well-designed global and coordinated, multi-national programme of permafrost observations in order to explore present conditions and their spatial and temporal variability. It also provides the opportunity to improve characterization of permafrost-soil-vegetation interactions and upgrade and maintain long-term monitoring networks. Canada is a key contributor to the IPA-led IPY project, the Thermal State of Permafrost (TSP). The TSP project will examine the ongoing impacts of climate change on permafrost conditions and will obtain a set of standardized permafrost temperature measurements for all Canadian sites (a snapshot) contributing to a global data set and map. In 2007, a collaborative proposal from the Geological Survey of Canada, University of Ottawa and Carleton University was successful in acquiring funding from the Canadian Government's IPY program for TSP-Canada. This funding along with additional support acquired by the principal investigators and collaborators has facilitated the establishment of new monitoring sites both prior to and during IPY. A number of new sites have been established in the western Arctic and northern Manitoba and several more are planned to increase the coverage in Nunavut.

The Canadian Permafrost Monitoring Network has to date been maintained through numerous partnerships and funding sources, including most recently IPY funding. Long-term commitment and funding are required to ensure ongoing maintenance of the network and that the IPY legacy continues into the future. This will also ensure that Canada continues to provide a leadership role in the development of Arctic observing systems and the provision of permafrost related data.

The foundation and pillars of a sustainable integrated monitoring and research framework for observing networks

Christopher Spence[1], Stu Hamilton[2], Paul Whitfield[2] , Dave Harvey[3], David Hutchinson[2], Taha Ouarda[4], Herman Goertz[5], Jean-Guy Deveau[6], Don Burn[7], John Pomeroy[8], Bruce Davison[1], Phil Marsh[1]

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Natural resource management in the Arctic is complex as choices must be made among increasingly valuable economic sectors competing for limited supplies. Monitoring is crucial to management because it permits characterization of the resource. Demand grows for information that will support decisions within the complexity and extensiveness of long term environmental and social changes. Observing networks can no longer be satisfied by reporting on mere abundance. The ability to generate the desired information also requires an understanding of coupled biogeophysical processes. Developing the environmental science and monitoring capacity to be able to respond to this fundamental change in natural resource management will require a fresh approach to how relates science and monitoring in the Arctic, and elsewhere. This poster addresses this gap by describing the necessary attributes of a framework of integration, using northern Canadian water science and monitoring examples. The monitoring and research activities within the framework are 1) representative, 2) relevant, 3) strategic, 4) scale appropriate, 5) worthy and 6) high quality and collaborative.

Long-term monitoring under the Canadian Northern Contaminants Program

Russel Shearer, **Jason Stow**

Indian and Northern Affairs Canada, Winnipeg, MB CANADA

In the Canadian Arctic contaminant levels in air, biota and people are monitored under the federally funded Northern Contaminants Program (NCP). Data generated by the NCP feeds into the Arctic Monitoring and Assessment Program (AMAP), a working group under the Arctic Council that coordinates monitoring activities at a circumpolar level. Since its inception in 1991, the NCP has been managed by a multi-jurisdictional group of stakeholders, including representatives from various levels of government and northern aboriginal organizations. Early research identified the sources, pathways and processes that lead to the now widely publicized levels of contamination in Arctic biota and people. These findings were instrumental in building the case for international agreements to reduce global pollution resulting from the long range transportation of contaminants, e.g. the Stockholm convention on persistent organic pollutants. One of the long term priorities of the NCP, along with the ongoing assessment of contaminant associated risks to human health, is an extensive program to monitor the spatial distribution and temporal trends of contaminants in Arctic air, biota and humans. Results of the monitoring program are used to support human health risk assessment and to assess the effectiveness and sufficiency of international agreements at reducing global levels of pollution. Monitoring is carried out by a network of researchers, institutions, community organizations and individuals. The monitoring network involves over 25 communities from every corner of the Canadian Arctic, as well as two remote air monitoring installations. Community based hunters are involved in the collection of biotic specimens including various species of freshwater and marine fish, marine and terrestrial mammals, and seabird eggs. Annual sampling will continue into the future and builds on data that has been collected periodically at well established sites since the late 1970s, in the case of seabird eggs, and the early 1980s for other species. The primary air monitoring station at Alert has been collecting data continuously since 1992. Results are published annually in a Synopsis of Research report.

Canada's Three Oceans (C3O) Project as a Framework for Sustained High-Latitude Observations

Fiona McLaughlin, **Svein Vagle**, Humfrey Melling, Bill Williams, Jane Eert, Eddy C. Carmack

Fisheries and Oceans Canada, Sidney, BC CANADA

The broad purpose of climate monitoring is to collect sets of relevant, inter-comparable data over sustained periods of time so as to allow quantification of change within a system for decision-making purposes. It is within the high-latitude seas that the consequences of global change and climate variability are expected to be biggest and fastest, and consequently the need for a national monitoring framework most urgent. Changes within the ice-cover, water column and ecosystems of Arctic Canada, for example, are inextricably linked to the global system in general and to the bordering subarctic Pacific and Atlantic in particular. Indeed, both observational and modelling results suggest that a fundamental impact of climate change on marine systems will be the re-distribution of oceanic boundaries and habitats/biomes, and this dictates the need to carry out sustained observations over broad spatial domains. C3O is a multidisciplinary IPY project that employs science-capable CCG icebreakers to collect physical, chemical and biogeographical data within the interconnected subarctic Pacific, Arctic and subarctic Atlantic waters surrounding Canada. C3O also explores methods of examining ocean and terrestrial linkages, especially with regards to changes in ice cover surface hydrology.

While C3O began as an IPY effort (2007-2011) its full scientific and social value will be realized only when extended into the future; to 2050 and beyond, as these are the time scales of social relevance as seen by international panels (e.g. Intergovernmental Panel on Climate Chance, Arctic Climate Impact Assessment). It is hoped that the job of C3O will evolve monitoring methods that will largely be turned over to local communities and carried out by northern residents, following a community-based scientific franchise model.

Development of Bias-Corrected Precipitation Database and Climatology for the Arctic Regions

Daqing Yang[1], Douglas Kane[1], Zhongping Zhang[1], Barry Goodison[2], David Legates[3]

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A consistent daily bias correction procedure was applied at 4802 stations over high latitude regions (North of 45^{o}N) to quantify the precipitation gauge measurement biases of wind-induced undercatch, wetting losses, and trace amount of precipitation for the last 30 years. These corrections have increased the gauge-measured monthly precipitation significantly by up to 22 mm for winter months, and slightly by about 5 mm during summer season. Relatively, the correction factors (CF) are small in summer (10%), and very large in winter (80–120%) because of the increased effect of wind on gauge undercatch of snowfall. The CFs also varies over space particularly in snowfall season. Significant CF differences were found across the USA/Canada borders mainly due to differences in catch efficiency between the national gauges. Bias corrections generally enhance monthly precipitation trends by 5–20%. These results point to a need to review our current understanding of the Arctic fresh water budget and its change.

Cancer surveillance among the Inuit populations in Alaska, Canada and Greenland

Kue Young

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This poster presents the methods and results of an international collaboration in collecting cancer incidence data for the period 1989-2003 among the Inuit population in Alaska, Canada [Inuvialuit, Nunavut and Nunavik] and Greenland. It offers a model for health monitoring/surveillance of a

chronic disease in the circumpolar region as a component of a comprehensive Circumpolar Health Observatory.

Khibiny educational - scientific base of the Moscow State University (Russia)

Yulia Zaika, Marina Vikulima, Sergey Konyaev

Moscow State University, Moscow, RUSSIA

Khibiny educational - scientific base of Geography Faculty of the Moscow State University is one of the oldest stations at the faculty and, perhaps, the unique one of a similar that located behind Polar circle, in mountain area. The station was founded in 1948 by professor George Kazimirovich Tushinsky. Students of Geography Faculty of the Moscow State University and other High Schools carry out educational and working practices here within six decades. Post-graduate students and scientists carry out researches on glaciology, pedology, biogeography, landscape science, meteorology and geomorphology in here. It is published more than 100 scientific articles, the large number of course and degree works, more than 10 dissertations were done on the data collected for years at the station.
The main scientific areas are:

- GIS – mapping (GIS “Khibiny Mountains” is created)
- Avalanche data base compelation (GIS)
- Avalanche mapping (GIS)
- Estimation of avalanche activity
- Estimation of avalanche hazard and avalanche risk
- Observations on snow cover
- Modeling of snow cover (GIS and SnowPack Software)
- Meteorological observations
- Observations of small glaciers of Khibiny
- Investigation of Khibiny nival processes.

Khibiny educational - scientific station cooperates with the Center of Avalanche Protection of JSC “Apatit” (town-planning enterprise) and Laboratory of Snow avalanches and Mudflows of MSU. Also it is open for cooperation and reception of students and researchers.

Presenting Author Index

Notes

Following the mandate given to AMAP in the Salekhard declaration of the Arctic Council 2006, the SAON Initiating Group was formed in 2007 by representatives of these organisations to facilitate a process towards *Sustaining Arctic Observing Networks*.

International Programme Office for the International Polar Year

Arctic Council -Arctic Monitoring and Assessment Program

Climate and Cryosphere

Forum of Arctic Research Operators

International Arctic Science Committee

International Arctic Social Science Association

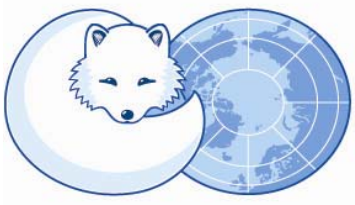
Arctic Council - Indigenous Peoples Secretariat

International Study of Arctic Change

US National Science Foundation

Arctic Ocean Sciences Board

The Global Ocean Observing System



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