

## NEWSLETTER

# Improved Processes and Parameterisation for Prediction in Cold Regions



OCTOBER 2009

### Workshop Reports

#### MESH/CLASS Workshop in Edmonton

On October 1st, a MESH/CLASS workshop was held at the Alberta Sustainable Resource Development computer lab—training centre in downtown Edmonton. Brenda Toth, Al Pietroniro, Diana Verseghe, Erika Klyszejko and Frank Seglenieks from Environment Canada and Nick Kouwen from the University of Waterloo led eighteen participants from a variety of backgrounds including water resources management and hydrological modelling. The majority of the participants were Alberta government hydrologists and modelers from Alberta Sustainable Resource Development, Alberta Environment, and Alberta Agriculture and Rural Development. Other participants in the workshop represented Environment Canada and the Pacific Climate Impacts Consortium. Many thanks go out to Alberta Sustainable Resource Development which provided the use of their computer training facility for the workshop.



#### IP3-WC<sup>2</sup>N Joint Workshop in Lake Louise



IP3 and WC<sup>2</sup>N held a joint workshop in Lake Louise, Alberta, from 14 to 17 October, 2009. More than 90 members of the cold regions and water resource community attended the event, including researchers, users, and students. The workshop opened with a reception on Wednesday evening, October 14th. Bill Fisher, Director General, Western and Northern Canada—Parks Canada, officially opened the workshop sessions on Thursday morning, October 15th. Session topics over the next two and a half days included Modelling, Northern Basins, Mountains Basins, Glaciers, Data Archiving, and Applications of IP3 and WC2N research. A detailed workshop report will be published in the December issue of the IP3 newsletter.

# 17th International Northern Research Basins Symposium and Workshop

IP3 was pleased to be one of many sponsors for the Northern Research Basins (NRB) symposium and workshop held in the eastern Canadian Arctic from August 12th to 18th, 2009. The workshop traveled from Iqaluit to Pangnirtung, Nunavut and then to Kuujuaq, northern Quebec aboard the Lyubov Orlova, a Russian ship chartered by Inuit-owned Cruise North Expeditions, giving the workshop participants a tour of the eastern Arctic while hosting their biennial conference. Over sixty participants including hydrologists, oceanographers and interested observers from Canada, Denmark, Finland, Iceland, Japan, Norway, Russia, Sweden, the UK and the USA participated in the week long northern hydrology symposium. The conference theme **“Managing Hydrological Uncertainty in High Latitude Environments”** served to highlight uncertainties in understanding hydrological processes, water budget estimation and hydrologic modelling. Individual themed sessions included: Prediction of Precipitation in Ungauged Northern Basins; Northern Lake Systems; Hydrology and Ocean Interactions; Climate, Cryosphere and Hydrosphere; Modelling Hydrologic Variables and Climate Change; and Arctic Hydrology and Uncertainty. A poster session gave early career scientists an opportunity to share their research, while several guest speakers contributed to the success of the event; Robie MacDonald (Fisheries and Oceans Canada) spoke on hydrology–ocean interactions and Larry Hinzman (International Arctic Research Center Alaska) spoke on arctic hydrology, climate change and uncertainty. IP3 investigators and collaborators were well represented on the organizing committee: Kathy Young– Chair and Chief Delegate, Chris Spence–Deputy Delegate, and committee members Sean Carey, Richard Janowicz and Bill Quinton all contributed to the success of this event.



## Background History of the Northern Research Basins Working Group

The Northern Research Basins (NRB) working group was established in 1975 as part of the International Hydrologic Programme by national committees of Canada, Denmark (Greenland), Finland, Norway, Sweden, the USA and the USSR. The goal of the NRB is to foster river basin research in northern latitudes, specifically those in Arctic environments. Iceland joined the group in 1992 and Russia has since taken over the initial role of the USSR. Japan and the UK were admitted as associate members with polar research programs. Research symposia are held every second year and alternate between North America and Europe. Most participants are hydrologists or glaciologists, however participants have included climatologists, geomorphologists, biologists, ecologists and oceanographers. Key objectives of the NRB working group include: gaining a better understanding of hydrologic processes, particularly those in which snow, ice and frozen ground have a major influence on the hydrologic regime; providing data for the development and testing of models to be applied to regional, national and international water and land resource programmes; relating hydrologic processes to the chemical and biological evolution of northern basins; assessing the effect of human activities on hydrologic regimes in northern environments; and encouraging the exchange of personnel among participating countries, along with working towards the improvement of standardization of measurement techniques and network design in northern regions.



# Northern Research Basins Community Meetings



Members of the NRB symposia were privileged to meet with local Inuit dignitaries in Iqaluit, Pangnirtung, (Nunavut) and Kuujuaq (Quebec). A special highlight was a community meeting held in Pangnirtung, a community that experienced extreme weather in the spring of 2008 with a rain on snowmelt event resulting in extensive flooding and infrastructure destruction. Elders shared their experiences with this flood as well as their knowledge of other local signs of climate change including disappearing glaciers and high tides. In Kuujuaq, the NRB group met over lunch with the mayor to discuss the issues of deep permafrost thaw on the northwest coast of Ungava Bay which could cause an entire town to be moved in the near future.



Pangnirtung community meeting

All NRB photos courtesy of professional photographer Robert McKenna

## Excursions and Adventures

The seven day travelling symposium schedule

was filled with long days full of activity as presentation sessions alternated with field trips to various sites for hiking adventures and zodiac excursions for viewing both icebergs and wildlife.



Kathy Young with elders in Pangnirtung



More detailed information about the workshop along with a slideshow of Robert McKenna's photos can be accessed from the symposium website :

<http://www.northernresearchbasins.com/nrb17.html>





# Northern Research Basin Symposia presentations by IP3 members

IP3 members contributed numerous presentations at the Northern Research Basins symposium:

- \* Recognizing the importance of varying vegetation types and landscape topography on the fluxes of energy between the land surface and the atmosphere, and the importance of accounting for the modelling of water and energy fluxes that occurs with rapid vegetation changes in a changing climate, the GEOtop model was used to represent the effects of shrubs on the snow surface radiation balance (Marsh and Endrizzi).
- \* The relationship between ground thaw and near-surface soil moisture patterns was examined at three sites in the subarctic Canadian Shield—peatland, valley and wetland. Results suggest that one of the main controls on surface soil moisture and thaw depth is the influx of water and energy from surface inflow, with the wettest surface soils often coincident with locations of deepest thaw depth such that a scale of correlation exists between ground thaw and soil moisture among wet to dry sites (Guan, Spence, Westbrook).
- \* A decade of research from the Scotty Creek research site in the lower Liard River basin, NWT has improved understanding of and ability to predict the major water flux and storage processes within a wetland-dominated zone of discontinuous permafrost through better understanding of runoff generation on permafrost peatland plateaus and a conceptual hydrological model for peatlands with discontinuous permafrost (Quinton, Hayashi and Chasmer).
- \* Timing changes for both freeze-up and breakup of the Yukon River indicate changing trends in river ice regimes with significant implications for impacts to infrastructure, hydroelectric operations and aquatic ecosystems (Janowicz).
- \* A presentation on the Canadian Land Surface Scheme (CLASS) demonstrated results from an off-line regional simulation over eastern Canada. Model runs demonstrated that differences in subsurface treatment of modeled soil has a profound impact on snow pack simulation, and therefore generation of runoff for hydrological modelling (Verseghy).
- \* The influence of aufeis (mass of layered channel ice that forms due to successive overflow and freezing events during winter) on streamflow during the spring melt establishes the role of aufeis in streamflow quantity and quality as well as the chemical signature of the aufeis feature with the conclusion that aufeis plays a relatively minor role in water storage with some influence on altering flow pathways and timing of discharge (Boucher and Carey).



All NRB photos courtesy of professional photographer Robert McKenna



## Pacific Climate Seminar Series



The Pacific Climate Impacts Consortium (PCIC) and the Pacific Institute for Climate Solutions (PICS) have joined together to co-host the second annual Pacific Climate Seminar Series. Seminars are held at 2PM (PST) on the third Wednesday of every month at the University of Victoria. September's presentation was from Shawn Marshall (University of Calgary) titled "Glacier-Climate Processes and Glacier Response to Climate Change". October's presenter was Robert Gifford (University of Victoria), titled "Changing climate change behaviour: individual level barriers and solutions". The November 18th presentation titled "Modelling catchment hydrology and nutrient transport in the Lake Winnipeg Watershed" will be given by Rajesh Shrestha from the Water and Climate Impacts Research Centre (University of Victoria). All presentations will have presentation slides accessible from the following website: <http://pacificclimate.org/resources/seminars/> immediately after the presentation.



## International Association of Hydrological Science (IAHS) Scientific Assembly

John Pomeroy gave two presentations on IP3 research at the 8th IAHS Scientific Assembly in Hyderabad, India in September 2009. The conference theme was "Water: A vital resource under stress—How science can help". Dr Pomeroy was a co-convenor of the session—High mountain snow and ice hydrology, and presented two talks "Winter warming impacts on modeled alpine snow dynamics in the Canadian Rocky Mountains" (Pomeroy) and "Physically based prediction of hydrological cycling on a Canadian prairie basin" (Pomeroy, Fang, Brown, Shook, Guo, Westbrook). One of the participants in the workshop—Olga Semenova (State Hydrological Institute—St. Petersburg, Russia) was invited by Dr Pomeroy to present her lecture on hydrologic modelling at the IP3-WC2N workshop in Lake Louise.

## Science Outreach

### Meeting with Government of Alberta Hydrologists

John Pomeroy, Al Pietroniro and Julie Friddell met with government of Alberta hydrologists in Edmonton on October 2nd as a follow-up to the MESH/CLASS workshop held on October 1st. Model applications were discussed in relation to the operational needs of the government hydrologists. Case studies and limitations of MESH were also discussed, as were opportunities for enhancing collaborations in future use of the model.

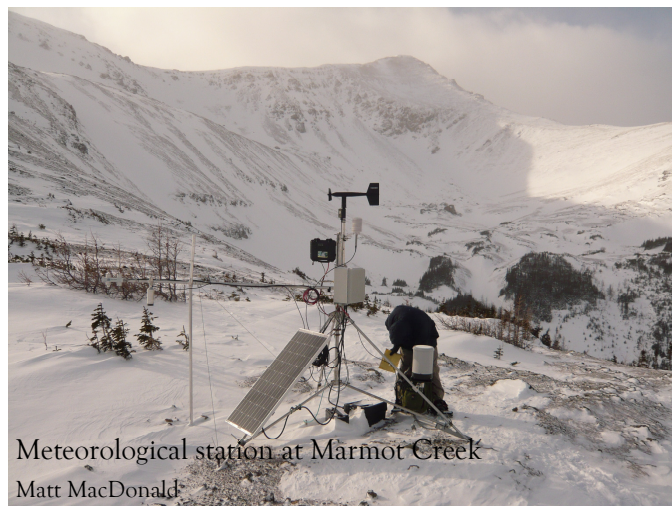


*IP3 is proposing to offer two training sessions on the Cold Regions Hydrological Model (CRHM) in the Spring of 2010. Tentative dates and locations are early 2010 in Alberta, and mid May 2010 in Yellowknife, Northwest Territories. Openings will be available for people interested in learning more about the model's application and design. Questions or declarations of interest can be emailed to [nadine.kapphahn@usask.ca](mailto:nadine.kapphahn@usask.ca)*

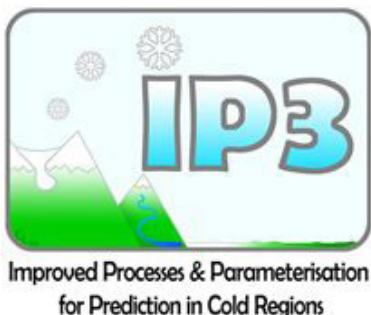


# Parameterisation of preferential snow deposition and snow redistribution by wind for distributed mesoscale hydrological models

Matt MacDonald is a MSc student working within the University of Saskatchewan's Centre for Hydrology, specializing in alpine hydrological land surface modeling. Matt was a co-recipient of the 2009 Western Snow Conference Best Paper Award for the presentation "Alpine Snow Hydrology in the Canadian Rocky Mountains" by Pomeroy, MacDonald, DeBeer and Brown. Matt has examined how to parameterize large-scale hydrological models to include blowing snow algorithms, particularly for application over mountainous terrain, using field observations from two IP3 research basins, Marmot Creek, Alberta, and Wolf Creek, Yukon. A key objective of this research is to incorporate blowing snow transport and sublimation algorithms into land surface schemes. Model development and testing used the Cold Regions Hydrological Model (CRHM), with support from IP3 CRHM modeler Tom Brown, for adapting CRHM to alpine conditions. Developed algorithms were then incorporated into the Canadian Land Surface Scheme (CLASS) within the MESH model. Since MESH domains are demarcated by landscape units, of particular interest was the demarcation of the landscape units as appropriate for modelling snow and other hydrological processes. Landscape units have traditionally been set based on radiation input (aspect and slope), but this research has shown the importance of also considering landscape aerodynamical features such as curvature. This information was obtained through high-resolution LiDAR



data. Two LiDAR campaigns were performed at Marmot Creek: during snow-free conditions in 2007; and during peak snow cover in 2008. Snow depths estimated by subtraction of summer from winter LiDAR-derived Digital Elevation Models (DEM) were used to analyze relationships between snow depth and aspect, curvature, elevation, slope, and vegetation height. Snow depth was most strongly related to curvature, indicating that landscape units may be grouped based mainly on curvature. A high-resolution empirical terrain-based wind flow model was applied to the basin and upscaled. Landscape unit-scale wind speed forcing was obtained by grouping grid cells and averaging wind speeds for each landscape unit. Model results demonstrate significantly improved snowpack simulation and ablation when blowing snow algorithms are included.



IP3 Outreach is available for setting up cold regions model training sessions or meetings between scientists and users for sharing of information. Informational brochures are available for public distribution, including brochures on IP3 research focused in the north, IP3 research in the mountain watersheds, and an overview of the Cold Regions Hydrological Model (CRHM) and its structure and specifications.



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