

## NEWSLETTER

# Improved Processes and Parameterisation for Prediction in Cold Regions



AUGUST 2010

### Network News

#### Modelling Workshop Offered

IP3 will be offering a training session on the CRHM (Cold Regions Hydrological Model) in Yellowknife, Northwest Territories on Monday, October 4th, 2010. This will be followed by an evening public presentation featuring Bill Quinton of Wilfrid Laurier University. On Tuesday morning, October 5th, a northern research presentation and discussion session led by IP3 scientists will take place, followed by an afternoon event chaired by Bill Quinton, discussing his NSERC Strategic Grant research in the Scotty Creek Research Basin. All members of the cold regions and water resource community are invited to attend. If you wish to register for the CRHM course or would like more information—please contact Nadine at [nadine.kapphahn@usask.ca](mailto:nadine.kapphahn@usask.ca)

#### IP3 Photo Contest deadline approaches

A reminder to all that IP3 is sponsoring a photo contest open to all members of the IP3 community. The three categories are: Fieldwork North of 60, Fieldwork South of 60 and Labs, Workshops and Conferences. Cash prizes will be awarded and the deadline for submissions is 12 noon Wednesday 1st September 2010. Photos are to be submitted to [ip3.wc2n@mapmatics.com](mailto:ip3.wc2n@mapmatics.com) with “IP3 photos” in the subject line. Detailed information on the contest can be accessed from:

<http://www.usask.ca/ip3/gallery.php>

#### HESS Special Issue

IP3 is pleased to announce its’ participation in coordinating a special issue in Hydrology and Earth System Science—an interactive open access journal of the European Geosciences Union. This issue is designed to highlight the research results of the IP3 network and its four years of cold regions research along with offering the opportunity for other scientists to publish their related work. *Cold region hydrology: improved processes, parameterization and prediction*—editors: S. Carey, W. Quinton, J. Pomeroy, and M. Weiler is available at: [http://www.hydrol-earth-syst-sci.net/special\\_issue105.html](http://www.hydrol-earth-syst-sci.net/special_issue105.html) .





- The 36th Annual Scientific Meeting of the CGU (Canadian Geophysical Union) took place in Ottawa the week of May 31 to June 4th, 2010. IP3 took this opportunity to jointly host a well-attended reception with both the WC<sup>2</sup>N and DRI networks on the afternoon of May 31st. After a short business meeting, members of the water research community shared appetizers and refreshments in catching up on the years work.
- IP3 sponsored four sessions during the congress which acted as final presentations for many of the researchers involved over the life of the four year IP3 network. The sessions titled “Improved Cold Regions Hydrology Processes, Parameterisation, and Prediction” offered presentations on various cold regions hydrological processes including snow accumulation, redistribution, ablation and melt, soil freezing and thawing, subsurface water flow in partially frozen soil, evaporation, ice melt, runoff and water redistribution.
- IP3 Process Theme Leader, Sean Carey, of Carleton University, was the 2010 recipient of the CGU Young Scientist Award. His work in frozen soils and hillslope runoff process, drawing linkages between mass and energy exchange processes in a range of northern ecosystems has already made an impact on the discipline of cold regions hydrology.

## IP3 Science presented at CGU

Four sessions titled “Improved Cold Regions Hydrology Processes, Parameterisation, and Prediction” gave IP3 researchers, collaborators and students the opportunity to share their findings from the previous four years of research. Brief descriptions of relevant IP3 presentations are listed below. Complete presentations are available on the IP3 website from: <http://www.usask.ca/ip3/outrch.php> accessed under Conference Participation and Other Meetings – CMOS/CGU Joint Congress 2010.

- ***Snowcover accumulation and soil freezeback at a site in the western Canadian Arctic***—Philip Marsh (Environment Canada) presented his work at Trail Valley Creek in the Mackenzie Delta region using the GEOtop hydrological model linked to PSBM to test for its ability to represent both snow on the ground and soil temperatures.
- ***Processes, parameterisation and prediction for a shrub tundra basin***—Richard Essery (University of Edinburgh) presented on process models for the redistribution of snow by wind, burial of vegetation by snow, and transfers of energy between snow, vegetation, and bare ground and atmosphere. Vegetation distributions were related to topographic indices so the distributed model could be used to predict impacts of vegetation changes on the hydrology and micrometeorology of Granger Basin in the Wolf Creek Research Basin, Yukon.
- ***Variability of snowcover and melt of High Arctic extensive, low-gradient wetland: Polar Bear Pass, Nunavut***—Jane Assini (York University) discussed differences in snow distribution and snowmelt at Polar Bear Pass and the implications for modelling .

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- **Topographic control on the depth of thaw in a peat covered continuous permafrost site in the arctic tundra and implication on the runoff production**—Stefano Endrizzi (National Hydrology Research Centre—Environment Canada) presented on his work using the GEOtop model in a small drainage basin in the Mackenzie delta to demonstrate the importance of subsurface flow in affecting the spatial variability in depth of thaw.
  - **Improving hydrological model representation of alpine snowcover depletion and snowmelt runoff generation**—Chris DeBeer (University of Saskatchewan) highlighted the importance of representing the high spatial variability in late winter snow cover in hydrological models by disaggregating terrain into slope and aspect based units to resolve much of the variability.
  - **Evaluation of the heat-pulse probe method for determining frozen soil moisture content**—Yinsuo Zhang (Carleton University) presented work on the establishment of guidelines for the use of heat pulse techniques in frozen soil water measurements.
  - **Factors controlling the spatial variability of soil thaw on a permafrost plateau**—Ashok Kumar Verma (Wilfrid Laurier University) presented research towards a better understanding of small scale variability of active layer thaw processes and their relationship with patterns of runoff generation over permafrost plateaus, thus allowing improved basin scale hydrological models in northern wetland dominated basins.
  - **Laboratory simulation of water and heat transport in sub-arctic peat soils: Experimental setup**—Ranjeet Nagare (University of Western Ontario) described the development of a climate simulation laboratory with controlled sunlight, precipitation, humidity and air temperature for the study of water and heat transport process in a controlled laboratory setting.
  - **A model for hourly rates of lake evaporation**—Raoul Granger (Environment Canada) discussed the results of a field study of boundary layer behaviour and open water evaporation carried out on small to medium-sized lakes in western and northern Canada and the resulting parameterisations, which allowed the development of a relatively simple, versatile model for estimating hourly lake evaporation rates.
  - **The hydrological functions of a boreal wetland**—Chris Spence (Environment Canada) discussed the nature of the collection, storage, transmission and contributing functions of a typical Precambrian Shield wetland, identifying three functional phases; with results having implications for hydrological model development including coupling to biogeochemical models.
  - **The influences of heterogeneity on connectivity at the drainage basin scale**—Ross Phillips (University of Saskatchewan) presented research on the importance of land cover types and topology in determining drainage basin scale connectivity as studied in a subarctic catchment with a heterogeneous collections of lakes, exposed bedrock and soil filled areas.
  - **Run-off generation from aggregates of peat plateaus in the discontinuous permafrost zone of the NWT**—Brendan Christensen (University of Calgary) studied the relationship between a physically based heat and water transfer model and the geometry of peat plateaus; deriving an individual peat plateau response as related to plateau geometry, which was then scaled up to an aggregate response of peat plateaus over an entire basin.
    - **Observed streamflow response trends of the upper Yukon River, Canada**—Richard Janowicz (Yukon Water Resources) discussed changes in timing and volume of peak flows in Yukon Territory with observed changes having significant impact on public safety and infrastructure.
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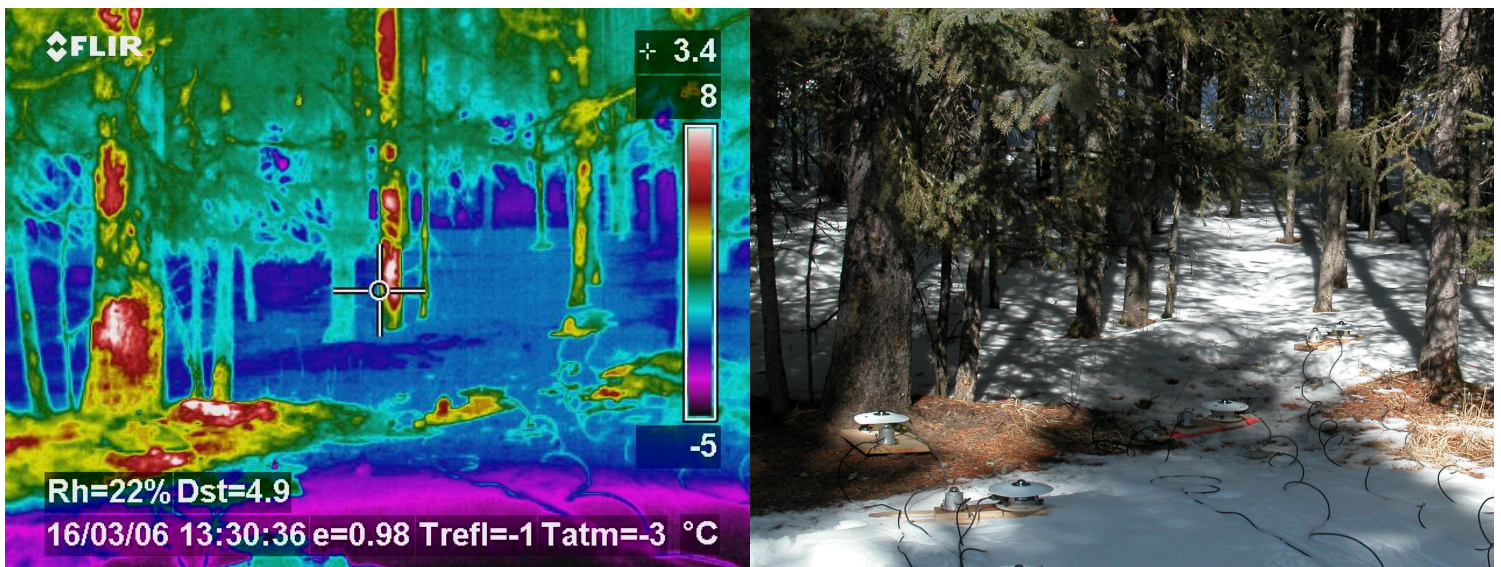


# Marmot Creek Research investigates forest cover impacts on snowmelt

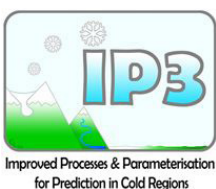
Chad Ellis is a PhD student working within the University of Saskatchewan's Centre for Hydrology, focusing on the impacts forest cover has upon radiation to snow and snowmelt in the Canadian Rocky Mountains. Snowcover represents a critical water resource, as snowmelt from the Rockies provides the bulk of river flows for agriculture, municipal and many other uses. Much of the Rockies however, are covered with needleleaf forest cover which influences both the amount of snow accumulation over the winter as well as the timing of the spring snowmelt. Generally, the canopy controls snowmelt timing through its modification of energy fluxes to snow, resulting in radiation typically dominating total energy for snowpack warming and melt. However, radiations to forest snow is itself modified by the canopy through its shading of shortwave (solar) irradiance, while elevating longwave (thermal) irradiance via emissions from the branches, crowns, and trunks of the canopy (see forest images below). Subsequently, these competing shortwave and longwave exchanges act to produce a large variation in

total radiation to snow and snowmelt timing in forest environments.

Ellis's examination of how needleleaf forest cover affects radiation and snowmelt has involved detailed field measurements of radiation and snowmelt at sites of varying topography and forest cover at the Marmot Creek Research Basin, located in Kananaskis Country, Alberta. Overall, these measurements have shown forest cover to have contrasting effects upon snowmelt energy across complex mountain terrain, with forest cover acting generally to decrease radiation to snow and delay melt timing on south-slopes relative to sites without forest cover; while advancing melts at sites of more north-sloping topography where longwave emissions from the forest more than compensate for shortwave losses from canopy shading. Consequently, such results suggest that changes in forest cover brought about either by natural or man-made means will have differing impacts upon the timing of snowmelt with respect to local topography variations across mountain headwater basins.



Corresponding thermal and visible images of a forest scene showing heating of branch and trunk material (thermal image on left) and spatial variation in shortwave (solar) irradiance on the snow surface produced by forest shading (visible image on right).



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 (CHRM) and its structure and specifications.



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