The IP3 Research Network: Enhancing Understanding of Water Resources in Canada’s Cold Regions

John Pomeroy & the IP3 Network

www.usask.ca/ip3
IP3...

...is devoted to understanding water supply and weather systems in cold Regions at high altitudes and high latitudes (Rockies and western Arctic).

...will contribute to better prediction of regional and local weather, climate, and water resources in cold regions, including ungauged basin streamflow, changes in snow and water supplies, and calculation of freshwater inputs to the Arctic Ocean.

...is composed over about 40 investigators and collaborators from Canada, USA, UK, France, Germany, Italy.

...runs from 2006-2010.
Why IP3?

- Need to forecast changing flow regime of streams and rivers in the Western Cordillera and North
- Increasing consumptive use of Rocky Mountain water in Prairie Provinces
- Uncertainty in design for resource (oil & gas, diamond, etc) development and restoration activities in small to medium size, headwater ‘ungauged’ basins
- Opportunity to improve cold regions snow, ice, frost, soil and water processes in models to reduce predictive uncertainty in:
  - Atmospheric impacts on snow, ice and water resources
  - Simulation of land-cryosphere-atmosphere interaction
  - Cycling and storage of water, snow and ice
  - Prediction of future climate change
IP3 Network Investigators

Sean Carey, Carleton University
Richard Essery, Edinburgh University
Raoul Granger, Environment Canada
Masaki Hayashi, University of Calgary
Rick Janowicz, Yukon Environment
Philip Marsh, University of Saskatchewan
Scott Munro, University of Toronto
Alain Pietroniro, University of Saskatchewan
John Pomeroy (PI), University of Saskatchewan
William Quinton, Wilfrid Laurier University
Ken Snelgrove, Memorial University of Newfoundland
Ric Soulis, University of Waterloo
Chris Spence, University of Saskatchewan
Diana Verseghy, Environment Canada

(people in bold are on Scientific Committee)
IP3 Collaborators

Peter Blanken, University of Colorado
Doug Clark, Centre for Ecology & Hydrology, UK
Bruce Davison, McGill University
Mike Demuth, Natural Resources Canada
Vincent Fortin, MRD - Environment Canada
Ron Goodson, HAL - Environment Canada
Chris Hopkinson, Centre of Geographic Sciences, NS
Tim Link, University of Idaho
Newell Hedstrom, NWRI - Environment Canada
Richard Heck, University of Guelph
Joni Onclin, University of Saskatchewan
Murray Mackay, CRD - Environment Canada
Danny Marks, USDA - Agricultural Research Service
Nick Rutter, University of Sheffield, UK
Frank Seglenieks, University of Waterloo
Mike Solohub, University of Saskatchewan
Brenda Toth, HAL - Environment Canada
Cherie Westbrook, University of Saskatchewan
Jean Emmanuel Sicart, IRD France
Stefan Pohl, Germany

Bob Reid, Indian and Northern Affairs Canada
Rob Schincariol, Univ. of Western Ontario
Kevin Shook, University of Saskatchewan
Uli Strasser, LMU, Munich, Germany
Bryan Tolson, University of Waterloo
Adam Winstral, USDA – ARS
James Craig, University of Waterloo
Steve Liang – University of Calgary
IP3 Secretariat

Housed at Coldwater Centre, Biogeoscience Institute, University of Calgary, Kananaskis Country; Centre for Hydrology, University of Saskatchewan, Saskatoon & UNBC, Prince George.

- Terrabyte Server for Data and Model Archive
- Website, FTP
- CRHM/MESH repository
- Unix Workstation
- High Speed Link to NHRC HAL Computing Cluster

Julie Friddell, Network Manager, Secretary of SC, Secretary of BOD, Nadine Kapphahn (UNBC), IP3/WC²N Outreach Coordinator
Michael Allchin, IP3/WC²N Information and Data Manager
Edgar Herrera, GEM Modeller
Tom Brown, CRHM Modeller
IP3 Science Focus

- Snow – redistribution, accumulation, sublimation, radiative transfer and melt
- Forests – effect on radiative and turbulent transfer to snow and frozen ground
- Glaciers - interactions with the atmosphere
- Frozen ground – freezing, thaw, water transmission and storage
- Lakes/Ponds – advection, atmospheric fluxes, heat storage, flow in drainage systems
IP3 – Goals and Theme Structure

- **Theme 1 Processes**: Advance our understanding of cold regions hydrometeorological processes

- **Theme 2 Parameterisation**: Develop mathematical parameterisation of cold regions processes for small to medium scales

- **Theme 3 Prediction**: Evaluate and demonstrate improved hydrological and atmospheric prediction at regional and smaller scales in the cold regions of Canada

- Ultimately – contribute to multiscale assessment of coupled climate system, weather and water resources in cold regions
Themes to Teams

- Formation of teams to address prediction issues on IP3 basins with suites of models. Mountains, North
- Model testing and evaluation has spanned fine scale fully distributed models with detailed physics descriptions, to moderate scale cold regions models, to larger scale hydrological land surface schemes.
- Learning from failures, consolidating successes
- Models and predictive capability advancing due to synthesis of network experiences
IP3 Research Basins

- Wolf Creek, YT
  - subarctic tundra
  - cordillera

- Peyto Glacier, AB
  - glaciated
  - alpine

- Lake O'Hara, BC
  - wet alpine

- Marmot Creek, AB
  - subalpine forest

- Trail Valley Creek, NT
  - arctic tundra

- Trail Valley Creek, NT
  - taiga woodland

- Baker Creek, NT
  - subarctic shield
  - lakes

- Scotty Creek, NT
  - permafrost
  - wetlands

- Polar Bear Pass, NU
  - arctic wetlands

- Reynolds Creek, Idaho
  - mountain rangeland

- Havikpak Creek, NT
  - taiga woodland

- Havikpak Creek, NT
  - arctic tundra

- Polar Bear Pass, NU
  - subarctic shield
  - lakes

- Scotty Creek, NT
  - permafrost
  - wetlands

- Reynolds Creek, Idaho
  - mountain rangeland
IP3 Final Outputs

* Improved understanding of cold regions hydrological processes at multiple scales
* Unique observational archive of research basin data
* More effective incorporation of cold regions processes and parameterisations into hydrological and meteorological models at regional and smaller scales – CRHM, MESH
* Improved environmental predictive capability in cold regions in response to greater water resource demands:
  * Enhanced hydrological and atmospheric model performance at multiple spatial scales and at scales requested by users
  * Improved streamflow prediction in ungauged basins with less calibration of model parameters from gauged flows
  * Improved weather and climate prediction due to rigorous model development and testing
New IP3 Initiatives

- Advanced data management system
- Courses on CRHM and MESH given in Ontario, Manitoba, Alberta (Calgary, Edmonton)
- Outreach meetings
- Science monograph
Network Completion

- HESS Special Issue Cold Regions Hydrology – due date 30 Nov 2009
- Final Scientific Session at CGU/CMOS in Ottawa June 2010
- No cost extension of IP3 to end of Dec 2010
  - Science Spending to cease by ~June 2010
  - Special Prediction Effort to cease by Dec 2010
- Secretariat, Outreach and Information Management funded to end of Dec 2010
IP3 Legacy

- Canada a leader in the understanding of cold regions hydrology (snow, permafrost, ice, rivers)
- Development of network of research basins from Cordillera to Arctic
- Trained cold regions hydrologists and climatologists
- Cold regions hydrological models
- Mechanism for transfer of knowledge to users
- Coupled atmospheric-hydrological prediction models for Government of Canada and other users
Policy Implications from IP3

- Loss of hydrological “stationarity” due to climate and land use change means traditional risk management analyses are inadequate for water resources management.

- Information for water policy, allocation, conservation and development is required that cannot be provided by analysis of observations alone.

- Improved information can be obtained from the results of coordinated observation and prediction systems that incorporate aspects of data assimilation, enhanced observations, improved model development and continuing process research to deal with evolving unknowns.