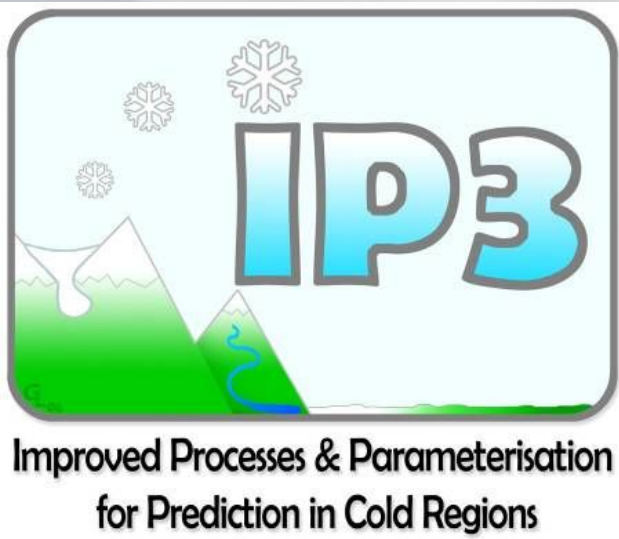


# The IP3 Research Network: Enhancing Understanding of Water Resources in Canada's Cold Regions

John Pomeroy & the IP3 Network

[www.usask.ca/ip3](http://www.usask.ca/ip3)



Canadian Foundation for Climate  
and Atmospheric Sciences (CFCAS)

Fondation canadienne pour les sciences  
du climat et de l'atmosphère (FCSCA)

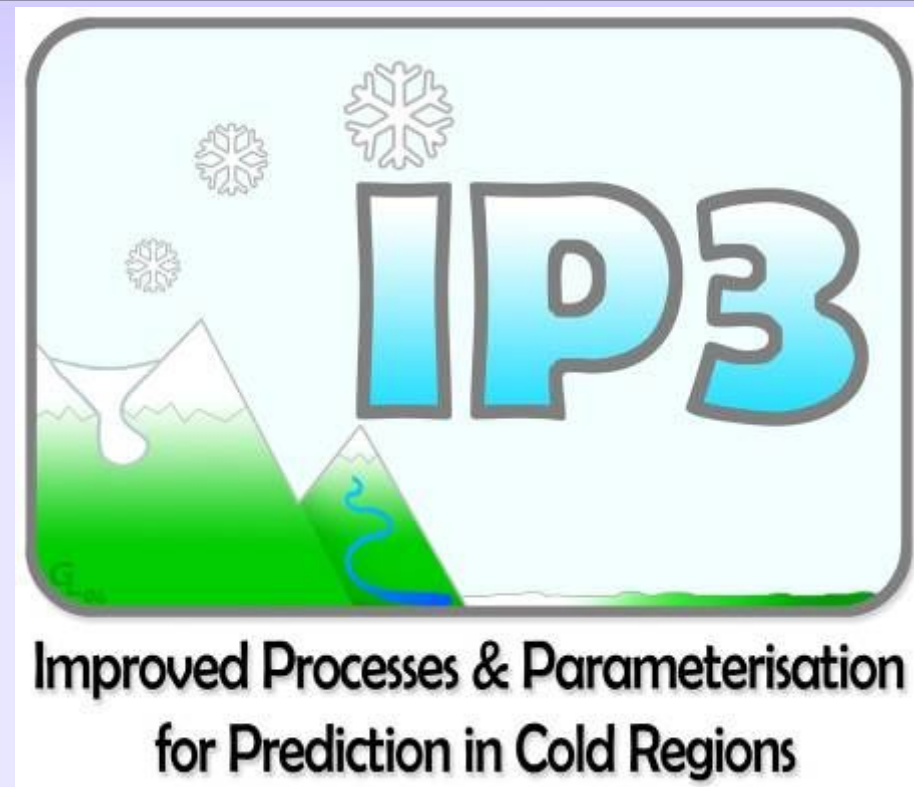
# IP3...

× ...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, Germany

· ...runs from 2006-2010



# 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

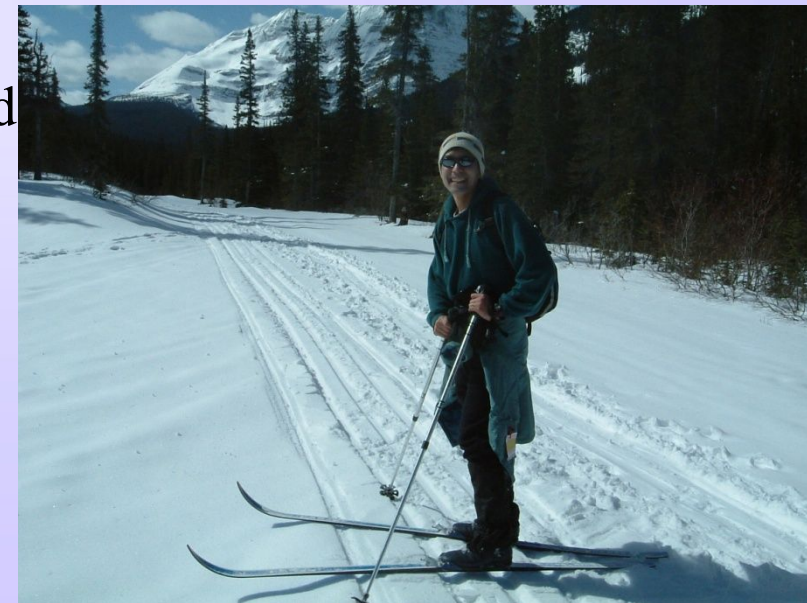
Ken Snelgrove, Memorial University of Newfoundland

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

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

# IP3 Secretariat

Housed at Centre for Hydrology,  
Kirk Hall University of Saskatchewan,  
Saskatoon, and at UNBC, Prince George

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

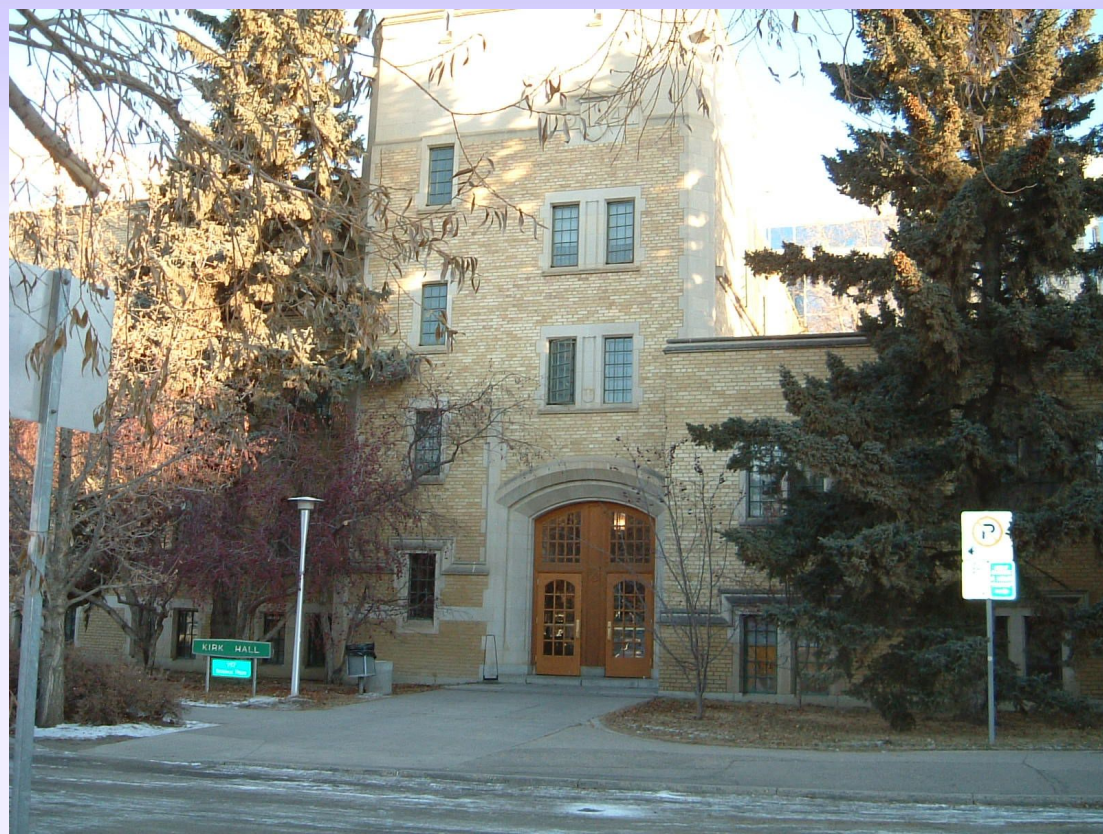
Julie Friddell, Network Manager, Secretary of SC, Secretary of BOD,

Nadine Kappahn (UNBC), IP3/WC<sup>2</sup>N Outreach Coordinator

TBD, IP3/WC<sup>2</sup>N Information and Data Manager

Edgar Herrera, GEM Modeller

Tom Brown, CRHM Modeller

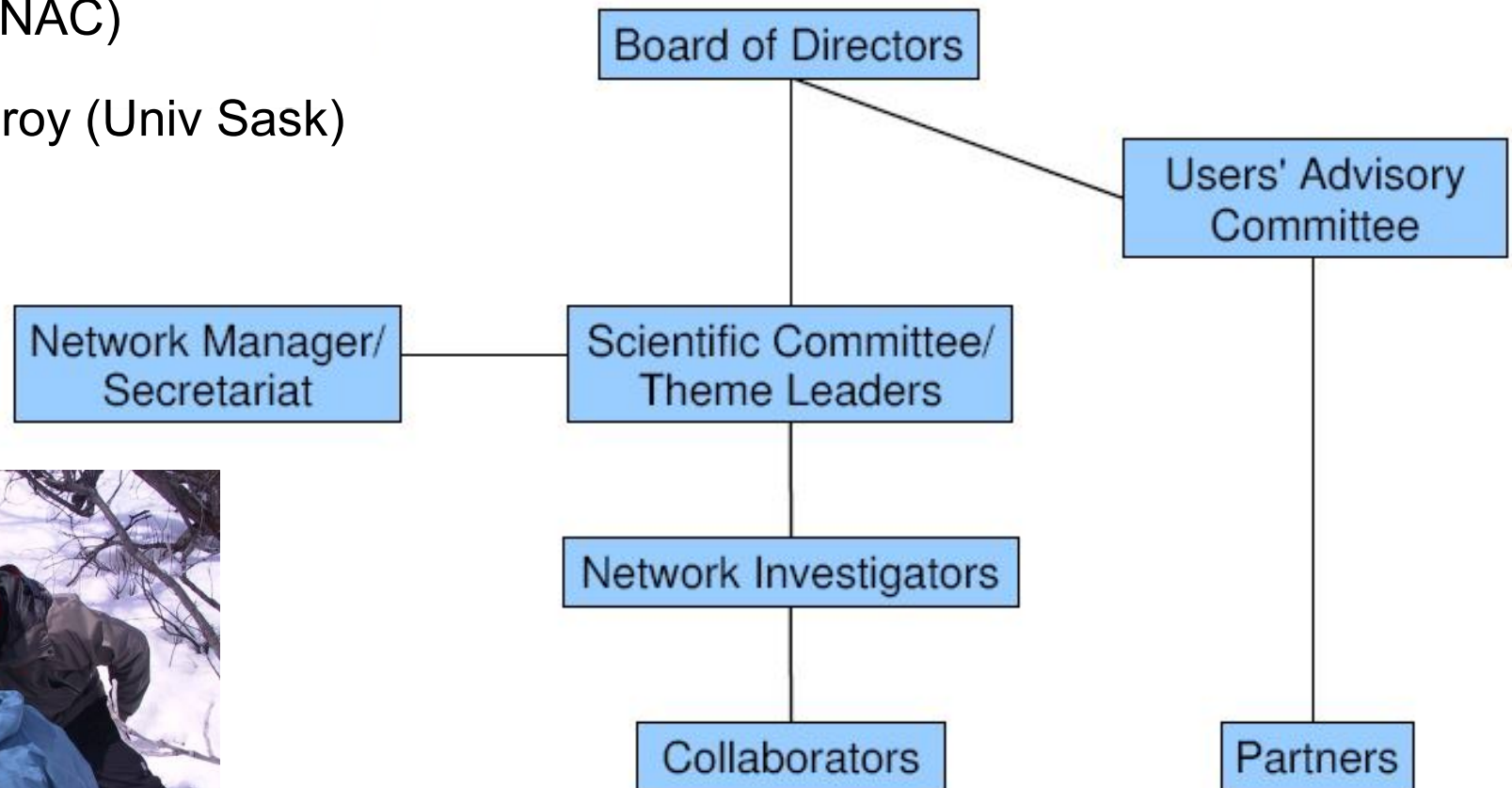


## Board of Directors

- Hok Woo (McMaster Univ)\*
- Vincent Fortin (Env Canada)
- Dan Moore (UBC)
- Bob Reid (INAC)
- John Pomeroy (Univ Sask)
- CFCAS

# IP3 Governance

## IP3 Research Network Organizational Structure



# 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 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



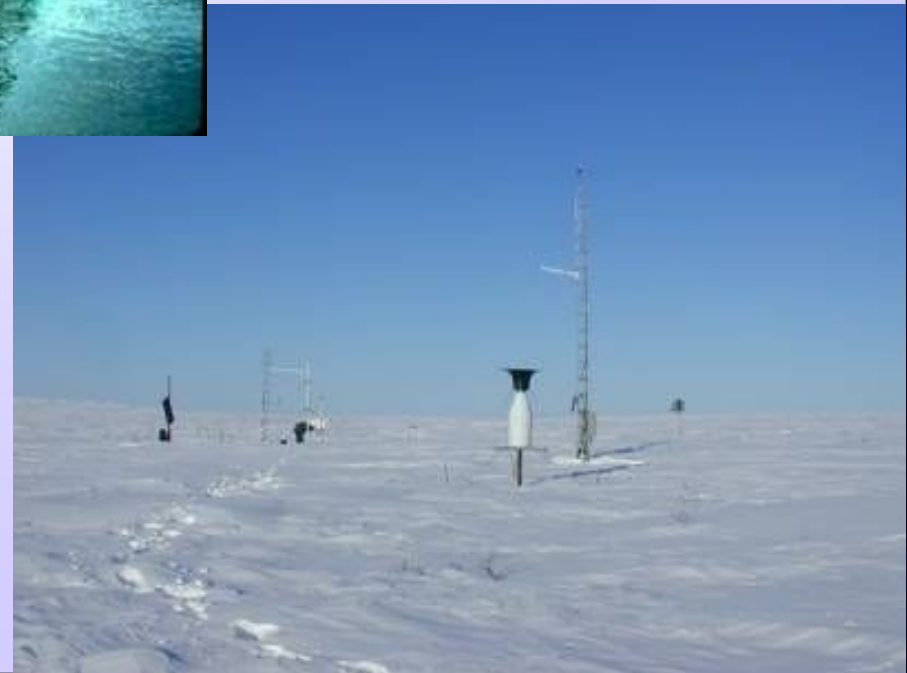


# IP3 – Goals and Theme Structure

- **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

# Processes

→ Multi-scale observations of effect of radiation, wind, vegetation, and topography on the interaction between snow, water, soil, and air

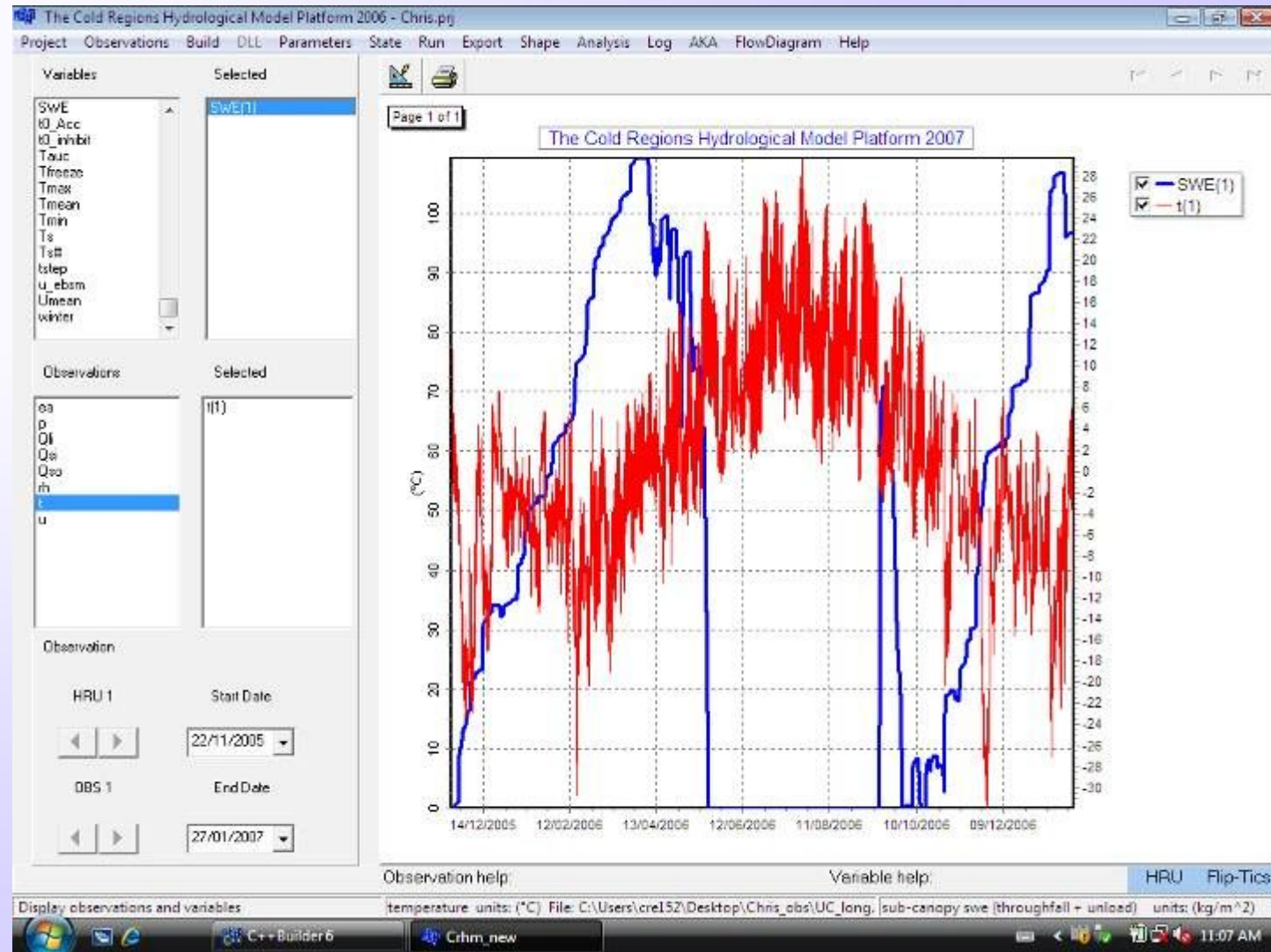


# IP3 Research Basins



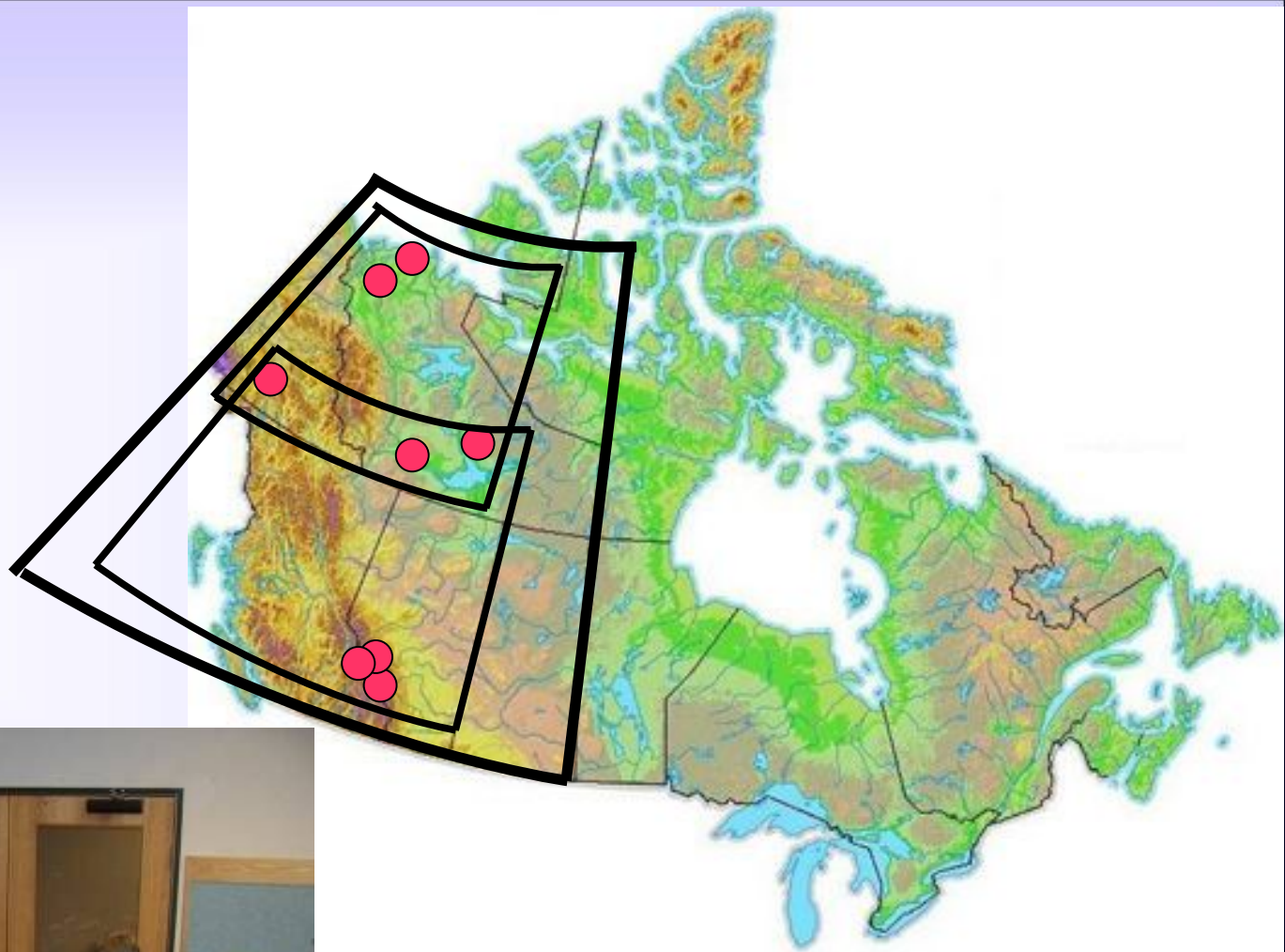
# Parameterisation

- Scaling of hydrological processes
- Minimize model complexity while reproducing the essential behaviour of the system



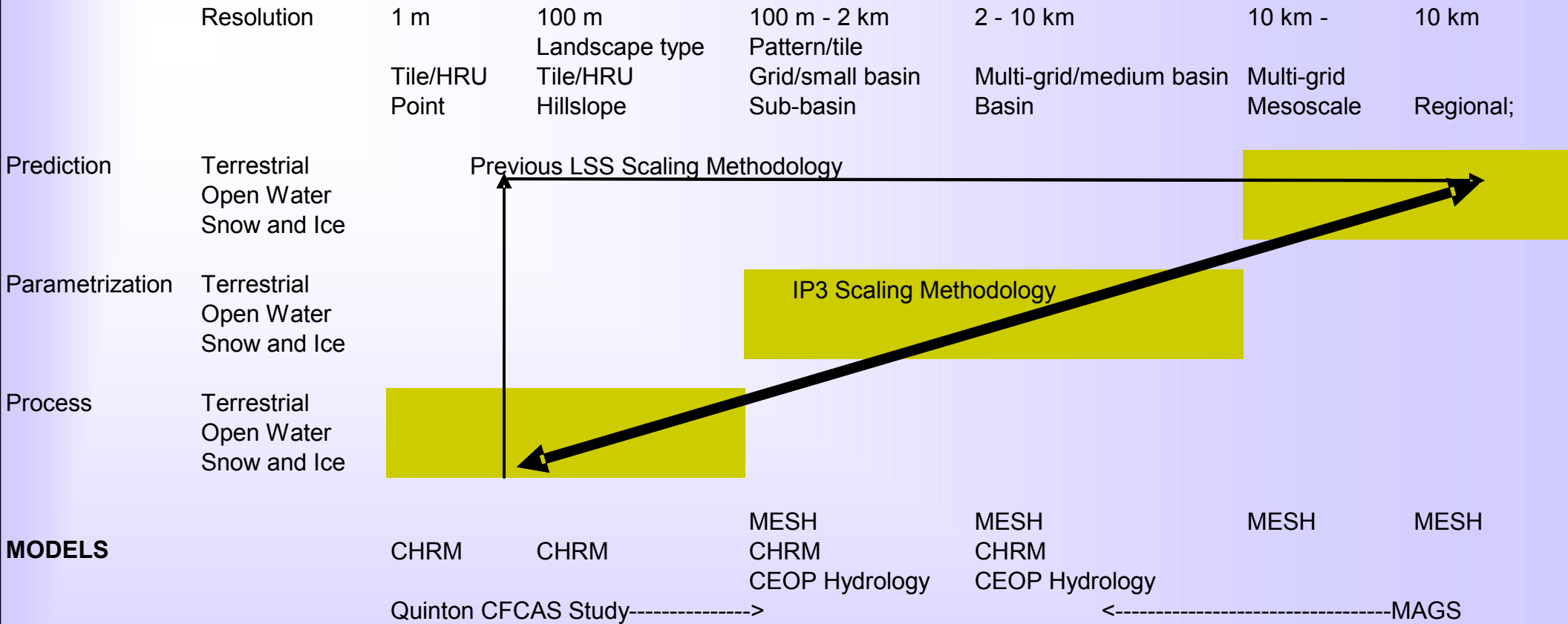
Cold Regions Hydrological Model CRHM

# Prediction



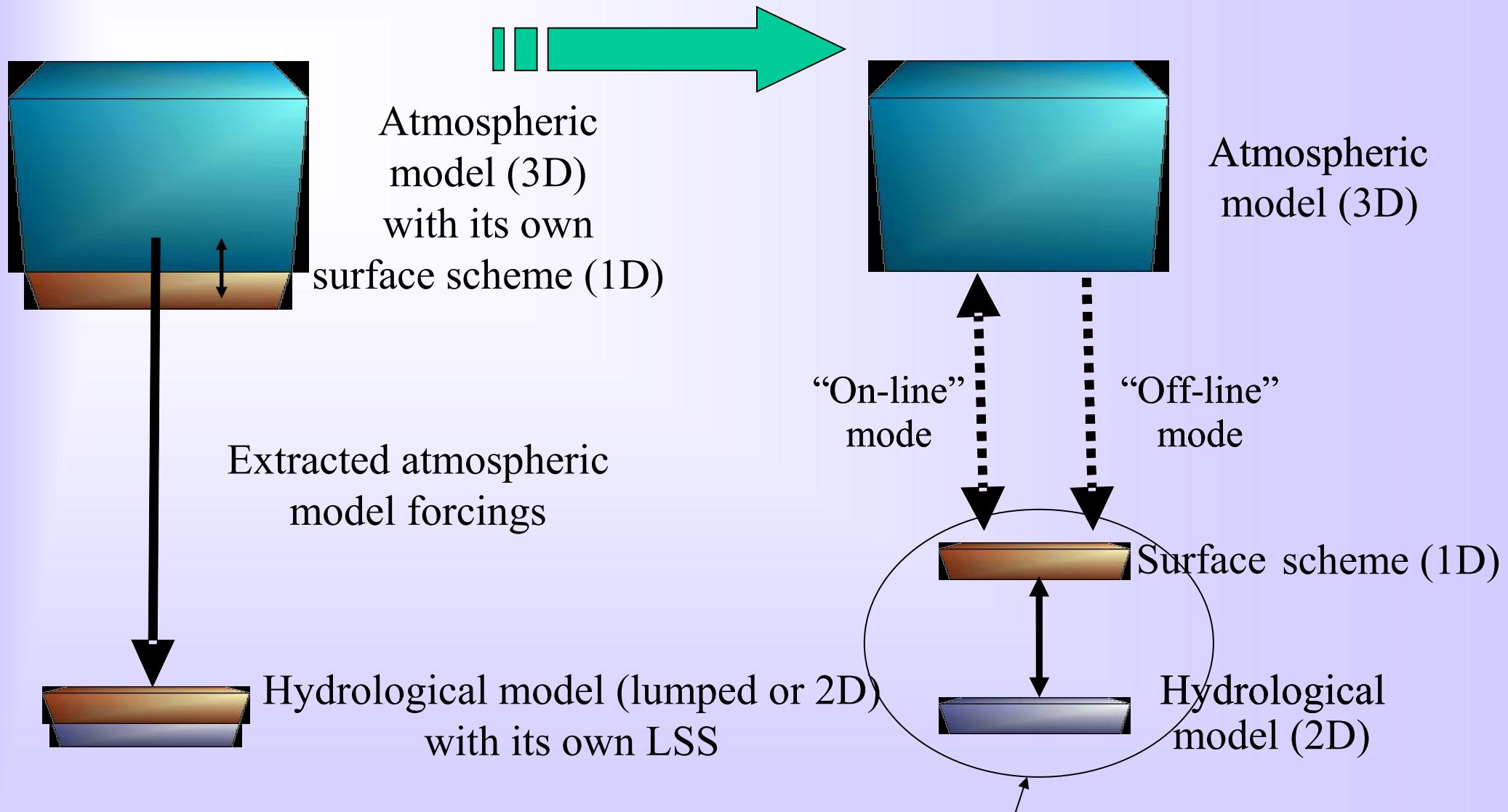
→ Water resources (storage, discharge, snow cover, soil moisture), atmosphere-ground interaction (evaporation), and weather and climate

# IP3 Scaling Methodology



Integrating the TOP DOWN and BOTTOM UP approaches

# Modélisation Environnementale Communautaire, MEC



**MESH** – MEC - Surface and Hydrology

# 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
- 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





# Recent Activities

- Substantial progress on process research and description
- *Year of Parameterisation*
  - Parameterisation progress
  - Parameterisation Workshop (Waterloo)
  - CRHM Courses (Waterloo, Calgary)
- Users/Stakeholders Workshop, Canmore
- Model Development and Tests
  - CLASS/MESH/MEC/GEM/CRHM
- IPY – major field year
- Outreach and Data Management – proposal funded, new joint activities started with WC<sup>2</sup>N



# IP3 in the World

- *CliC* – Climate and Cryosphere (WCRP) – part of Theme 1 “Terrestrial Cryosphere & Hydroclimatology of Cold Regions”
- *PUB* - IP3 hosts Working Group #16 of the IAHS Decade for Prediction in Ungauged Basins
- *GLASS* – cold regions contribution to land surface scheme component of the Global Energy and Water Cycling Experiment of the World Climate Research Programme (WCRP)
- Significant collaborations supported by Environment Canada, USDA, NERC, Japanese scientists
  - *North American Cordilleran Transect*
  - Comparisons and algorithm evaluation with European Arctic and Japan cold regions hydrometeorology researchers

# IP3 in IPY

- **“Arctic Hydra”**, the Arctic Hydrological Cycle Monitoring, Modelling and Assessment Program’ international network
- **Arctic Freshwater Systems: Hydrology and Ecology** (*Wrona and Pietroniro*)  
Canadian IPY Network
- **Theme 1, Freshwater Flux and Prediction of Arctic Freshwater Systems Network** (*Pomeroy and Pietroniro*)
  - Quantification of key hydrological/cold regions processes/parameters affecting freshwater flux to the Arctic Ocean
  - Validation and improved coupling of hydrological/land surface models to predict freshwater flow/flux to the Arctic Ocean
  - Improved assessment of the hydro-climatology of the Canadian Arctic



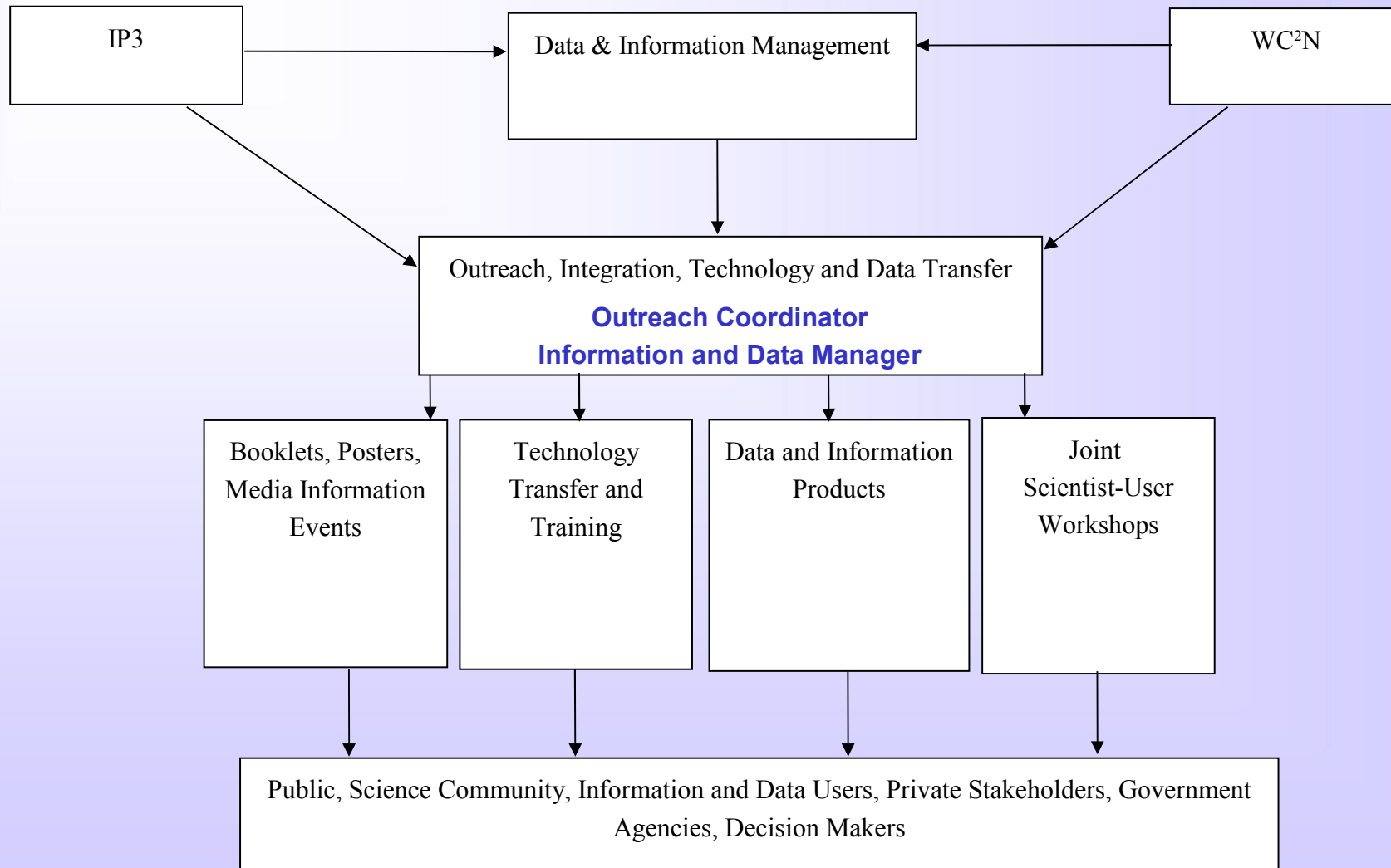
# Arctic Freshwater Systems, Theme 1

## Funded Investigators

- Barrie Bonsal (EC)
- Sean Carey (Carleton)
- Bruce Davison (EC)
- Stephen Dery (UNBC)
- Raoul Granger (EC)
- Masaki Hayashi (Calgary)
- Rick Janowicz (Yukon Env)
- Phil Marsh (EC)
- Al Pietroniro (EC)
- John Pomeroy (Saskatchewan)
- Terry Prowse (EC)
- Bill Quinton (WLU)
- Dale Ross (EC)
- Ric Soulis (Waterloo)
- Chris Spence (EC)
- Kathy Young (York)



# Integration of Data Management and Outreach for Cold Regions Hydrological, Cryospheric and Climate Science in Western and Northern Canada



# Users' Advisory Committee



- Public and private: community, government, industry,...
- Goal is to provide information that can be used in regional planning/policy making, streamflow/flood forecasting, weather/climate forecasting, water management, environmental conservation, and northern development
- Interactive workshops for outreach to practitioners and feedback on applicability of research
- Now joint IP3/WC<sup>2</sup>N User's Advisory Committee

# Data and Information Management

- Information outreach to users
- Data management and archiving
- Development of information products
- CRHM training and outreach
- Website development

# IP3 Data Access Policy

- Data originators must provide observational and model data to IP3 archive for Network use after one year, and openly available after two years.
- Network data use is restricted to IP3 investigators and collaborators for the first year after delivery
- Data users are encouraged to involve data originators in all aspects of interpretation and analysis
- Acknowledgement of data originator is required and is to be jointly agreed upon before data use for publications:
  - Co-authorship for major use of data
  - Acknowledgements and citing for minor use of data



# Upcoming Meetings

## Planned Meetings :

- CFCAS Polar Workshop, Ottawa, Nov 25 2008
- \* Monitoring and Predicting Western Water and Weather Workshop, Canmore, Dec 8-10 2008
- \* IP3/WC2N Users Workshop, Edmonton, March 2009
- \* CFCAS Water Event, Ottawa, 2009
- \* Session at CGU/AGU in Toronto, May 2009
- \* Session at 'MOCA' IACS/IAMAS/IAPSO in Montreal July 2009
- \* IHP Northern Research Basins, Nunavut, August 2009



# Network Completion

- IP3 funded to end of March 2010
- Outreach and Information Management funded to end of Dec 2010 (CFCAS to end of March 2011)
- No cost extension of IP3 to end of Dec 2010
  - Science Activities to cease by ~June 2010
- Financial Plan has been developed to support Secretariat functions and Outreach/Information Management to end of Dec 2010

# IP4?

- CFCAS to wrap up early in 2011
- Water Resources a strategic area for NSERC
- Substantial feedback from users that IP3 should *stay together* and build links to related research in WC<sup>2</sup>N and DRI amongst other groups.
- Must formulate a plan NOW.
- Discussion Friday afternoon

# IP3 3<sup>rd</sup> Annual Workshop

- First IP3 Workshop in the North
- 43 talks, 20 posters, +70 participants
  - Participants from across Canada, USA, Europe
- Investigator Reports
- Collaborator Reports
- Collaboration and Partnerships
- International Polar Year Session
- Network Assessment, Future Planning
- Users' Perspectives and Applications
- Reception/Poster Session in Beringia Hosted by Yukon Environment

# Why in Whitehorse?

- Strength of Northern hydrological science and appreciation of the need to improve cold regions hydrology for local applications
  - Wolf Creek Research Basin, +15 years as a local testbed (AES, DIAND, MAGS, EMAN, IP3, IPY...?)
  - Development of improved methods in the North, for the North
  - High river stage events, mine-site design and rehabilitation,
  - Changing glaciers, permafrost, snowmelt, vegetation and precipitation



**Thank you!**

**Please visit us at  
[www.usask.ca/ip3](http://www.usask.ca/ip3)**



*Thank you to IP3 participants for providing photos!*