IP3

Improved Processes & Parameterisation
for Prediction in Cold Regions

INTERNATIONAL POLAR YEAR 2007-2008

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...

Improved Processes & Parameterisation for Prediction in Cold Regions

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

* ...is contributing 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 50 investigators and collaborators from Canada, USA, UK, France, Germany, Italy, Austria,

* ...runs from 2006-2011
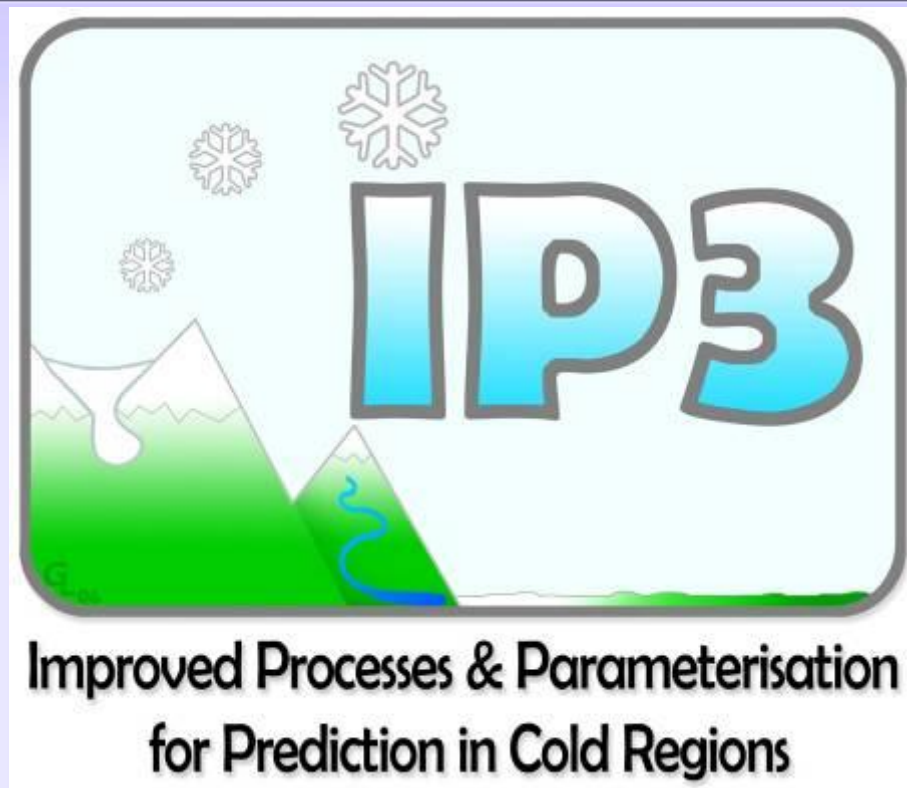
Why IP3?

* 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, forests 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, 48 SC meetings so far!)

IP3 Collaborators

Peter Blanken, University of Colorado
Doug Clark, Centre for Ecology & Hydrology, UK
Bruce Davison, McGill University/Env Canada
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

Centre for Hydrology, Univ. Sask., Saskatoon,
Coldwater Centre, Univ Sask., Canmore
UNBC, Prince George

-Terrabyte Server for Data and Model

-Archival Records

-Website, FTP

-CRHM repository

-High Speed Link to NHRC HAL Computing Cluster

Nadine Kapphahn: Network Manager, Secretary of SC, BOD & CHRUG, Outreach Coordinator

Michael Allchin: Information and Data Manager
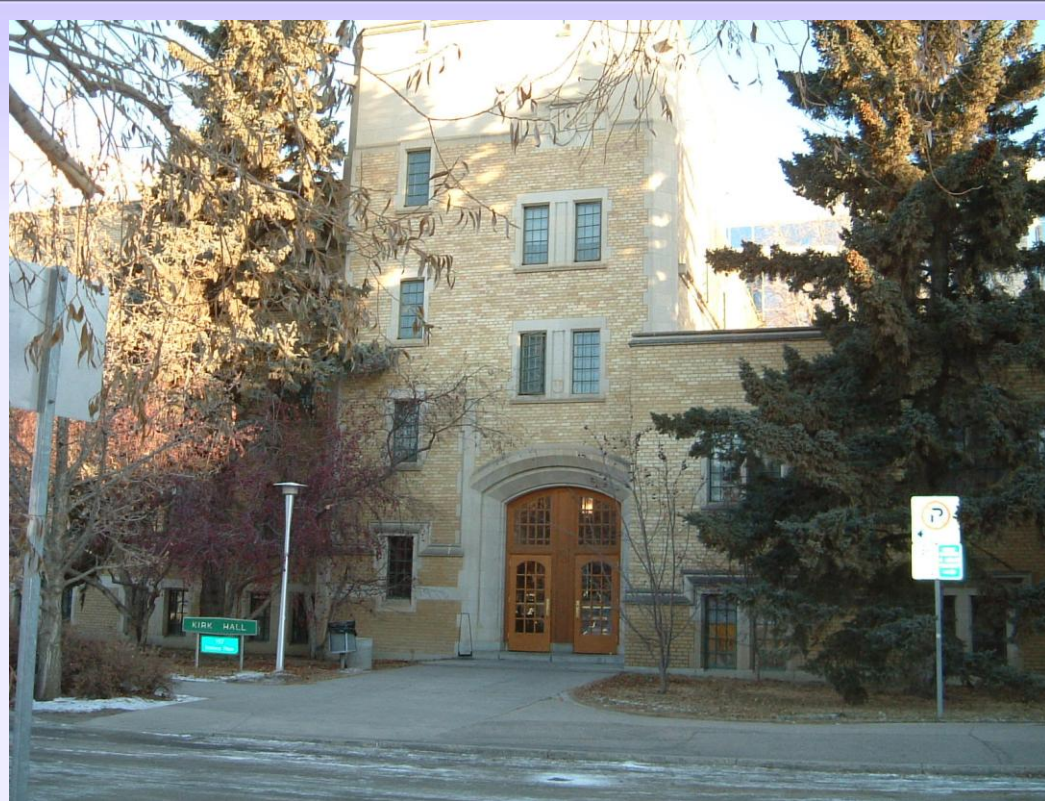
Joni Onclin: Financial Manager

Tom Brown: CRHM Modeller

Muluneh Mekonnen: MESH Modeller

Robert Sandford: Book Writer

Julie Friddell, Steen Westergaard, Former Network Managers
Edgar Herrera, Former GEM Modeller

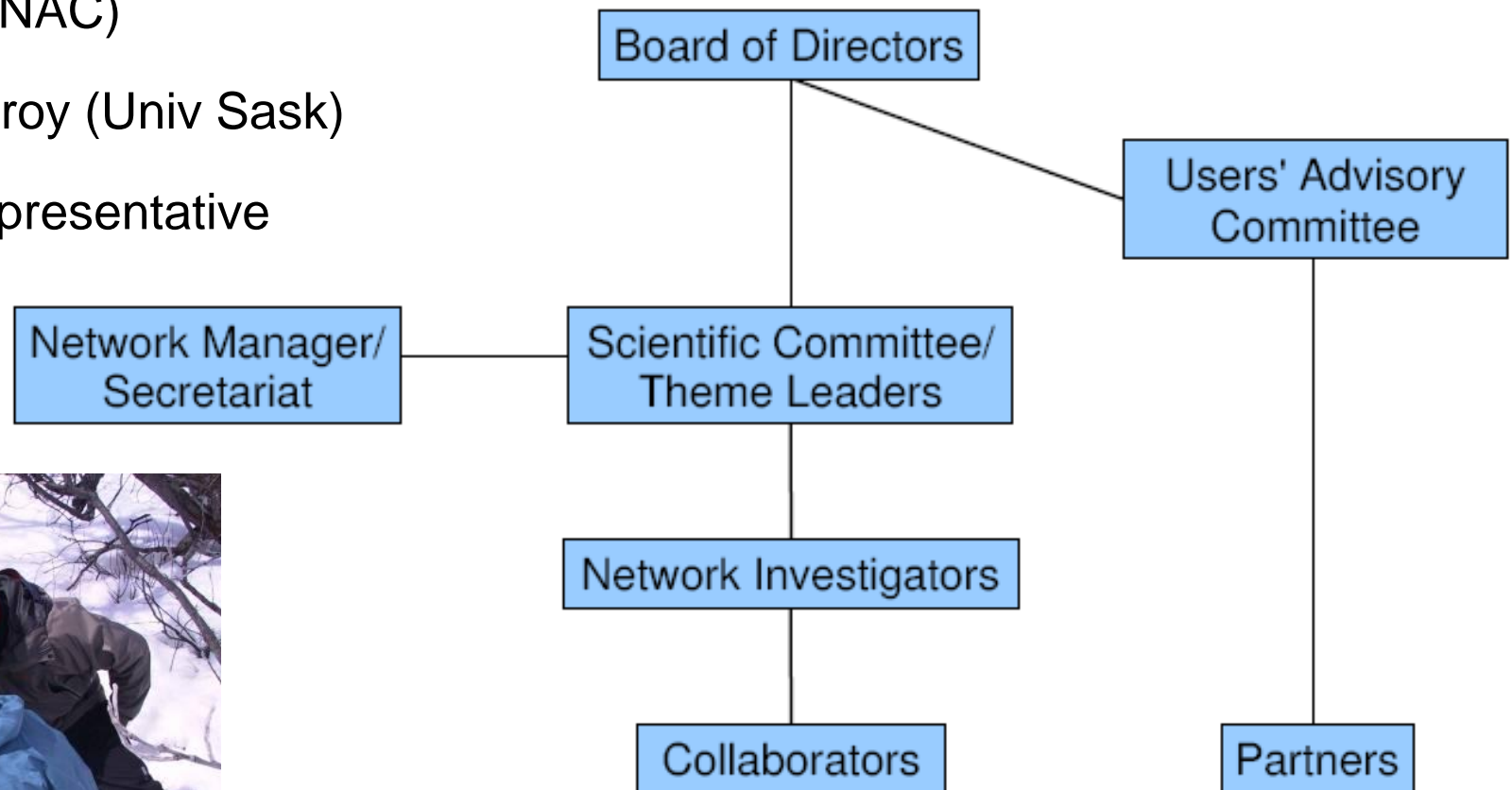# Chairman Woo

IP3 Governance

Board of Directors

- Hok Woo (McMaster Univ)*

- Vincent Fortin (Env Canada)

- Dan Moore (UBC)

- Bob Reid (INAC)

- John Pomeroy (Univ Sask)

- CFCAS Representative

IP3 Research Network
Organizational Structure
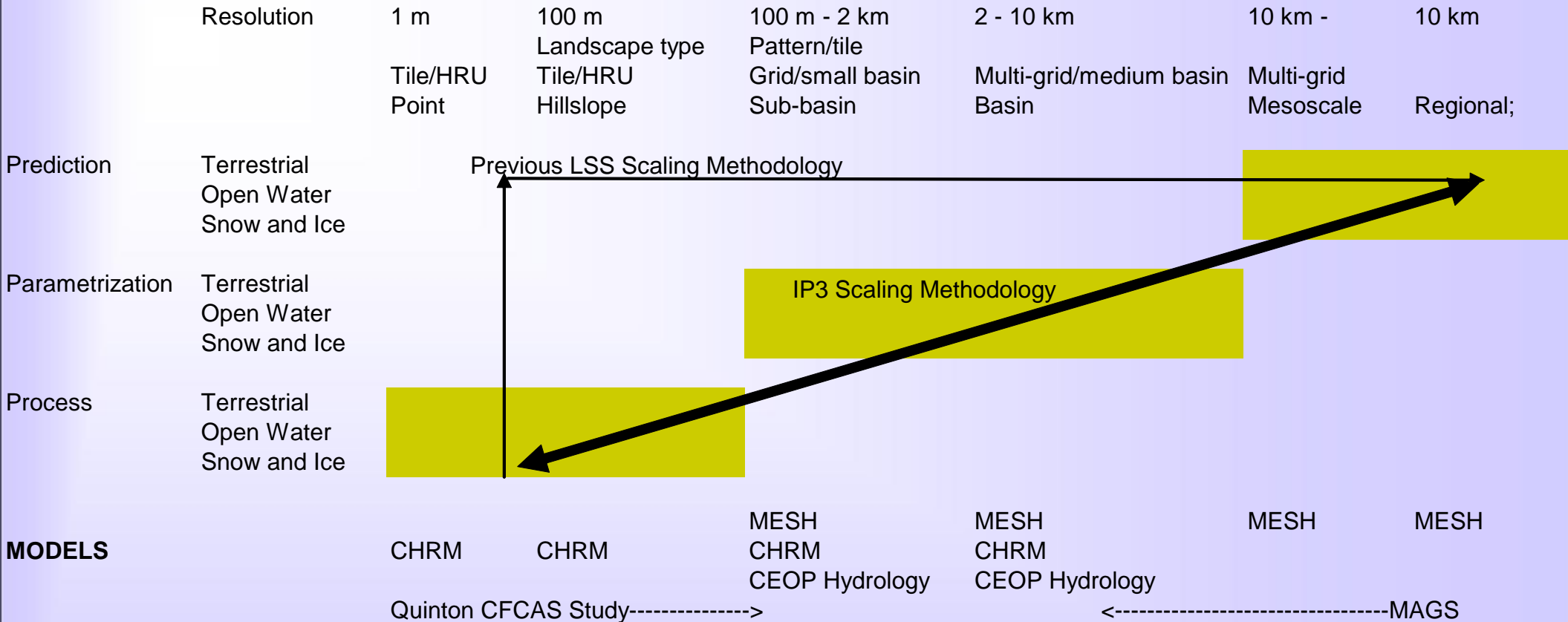
IP3 Science Focus

- 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 Scaling Methodology

	Resolution	1 m	100 m	100 m - 2 km	2 - 10 km	10 km -	10 km
			Landscape type	Pattern/tile			
		Tile/HRU	Tile/HRU	Grid/small basin	Multi-grid/medium basin	Multi-grid	
		Point	Hillslope	Sub-basin	Basin	Mesoscale	Regional;

Previous LSS Scaling Methodology

Prediction	Terrestrial
	Open Water
	Snow and Ice

IP3 Scaling Methodology

Parametrization	Terrestrial
	Open Water
	Snow and Ice

Process	Terrestrial
	Open Water
	Snow and Ice

	MESH	MESH	MESH	MESH
MODELS	CHRM	CHRM	MESH		
			CHRM	CHRM		
			CEOP Hydrology	CEOP Hydrology		

Quinton CFCAS Study-------------->   <--------------------------------MAGS
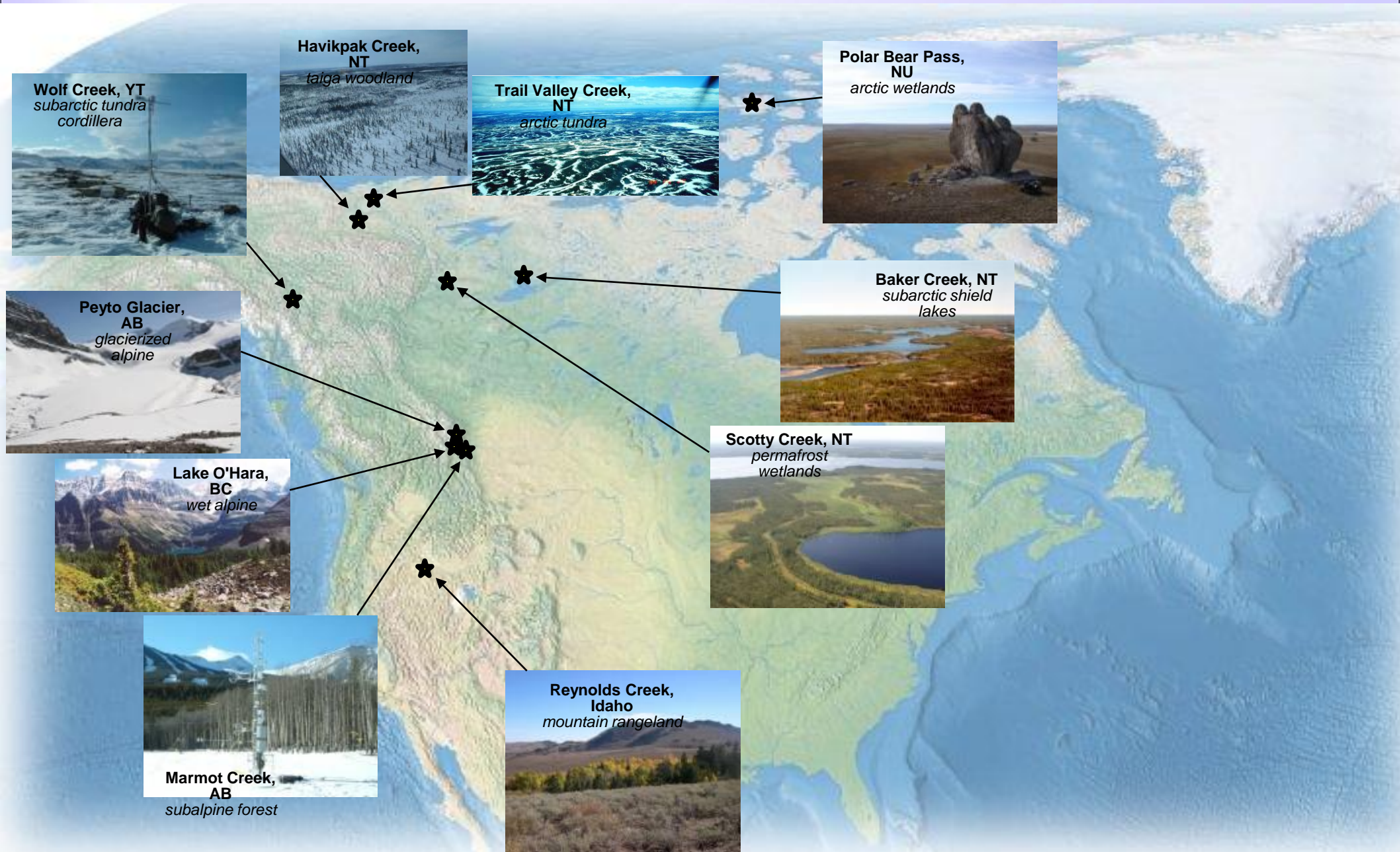
Integrating the TOP DOWN and BOTTOM UP approaches

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

IP3 Research Basins

Havikpak Creek, NT
taiga woodland

Trail Valley Creek, NT
arctic tundra

Polar Bear Pass, NU
arctic wetlands

Wolf Creek, YT
subarctic tundra cordillera

Baker Creek, NT
subarctic shield lakes

Peyto Glacier, AB
glacierized alpine

Scotty Creek, NT
permafrost wetlands

Lake O'Hara, BC
wet alpine

Reynolds Creek, Idaho
mountain rangeland

Marmot Creek, AB
subalpine forest

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

IP3 Legacy

- Better understanding of cold regions hydrology and climate

- Development of network of instrumented research basins from Canadian Rockies to Arctic

- Trained cold regions hydrologists and climatologists

- Improved predictive models

  - Cold regions hydrological models

  - Coupled atmospheric-hydrological models

- Knowledge transfer to users

  - Workshop results, presentations, papers

  - Books

  - Observational and model datasets