



Improved Processes & Parameterisation
for Prediction in Cold Regions



The IP3 Research Network:

Improved Processes and Parameterisation for Prediction in Cold Regions

Enhancing Understanding of Water Resources in Canada's Cold Regions



Canadian Foundation for Climate and Atmospheric Sciences (CFCAS)
Fondation canadienne pour les sciences du climat et de l'atmosphère (FCSCA)



IP3 Field Investigations in Arctic and Alpine Research Basins

IP3 investigators conduct intense field campaigns and install permanent monitoring stations to collect hydrological and meteorological data for analysis and application to cold regions modelling problems. This work is being accomplished in a series of ten highly instrumented, small (10-200 km²) research basins that characterize Canada's high latitudes and high altitudes. Six of IP3's research basins are in the Arctic and four are in the Rocky Mountains.

Field observations are focussed on mass and energy fluxes of snowpacks, permafrost, open water, vegetation, and runoff generation processes over frozen ground. The collected data are used to improve understanding and parameterisation of hydrometeorological and climatic processes in cold regions.

The IP3 Network is committed to ensuring the operation of its research basins beyond 2010 through coordinated and careful planning with federal, provincial, territorial, and First Nations governments. This will ensure the continued benefit that enhanced knowledge of cold regions hydroclimatology brings to Canadians for decision making.

IP3 is a research network funded by the **Canadian Foundation for Climate and Atmospheric Sciences** for 2006-2010. IP3 is comprised of over eighty investigators, collaborators, and students from across Canada, the US, and Europe. IP3 is a component of the Canadian and International IPY through Arctic-HYDRA and interacts closely with IPY through a Canadian project on Freshwater Ecology and Hydrology. IP3 is also a component of PUB (Predictions in Ungauged Basins) and CliC, the Climate and Cryosphere project of the World Climate Research Programme.

IP3 is devoted to an improved understanding of surface water and weather systems in cold regions, particularly Canada's western Arctic and Rocky Mountains. These issues are of key importance to agriculture, regional planning and policy making, streamflow forecasting, water management, environmental conservation, and urban and industrial development in the North and the mountain West.

IP3 will contribute to better weather and climate prediction at regional and smaller scales, estimation of streamflow from ungauged basins, prediction of changes in snow and water supplies, calculation of freshwater inputs to the Arctic Ocean, and sustainable management of mountain and northern water resources.

Canada's cold regions are important weather generators and water sources for both regional use and freshwater supply to the oceans. To accurately forecast the behaviour of weather and water including extreme events such as floods resulting from high precipitation and snow melt in the Rockies, predictive models require improvement to address the following:

- Changing annual flow and peak discharge in streams and rivers
- Difficulty in forecasting the spring freshet and seasonal runoff from mountain headwaters to streams and reservoirs
- Increasing consumptive use of Rocky Mountain water in Prairie Provinces
- Uncertainty in engineering design for resource development (oil & gas, diamond and other mines) and restoration activities in small- to medium-sized "ungauged" basins
- The need to enhance the representation of cold regions processes in coupled atmospheric-hydrological models to reduce uncertainty in:
 - Atmospheric impacts on water resources
 - Simulation of land-atmosphere interaction
 - Cycling and storage of water
 - Prediction of future climate change

Planned Final Outputs

Processes

Improved understanding of cold regions hydrology at landscape element scales:

- Soil physics for organic and frozen soils
- Hillslope flow over permafrost
- Turbulent transfer over snow and glacier ice in complex terrain
- Short and longwave radiation in vegetation canopies on snow-covered slopes
- Unique observational archive of research basin data

Parameterisation

More effective incorporation of cold regions processes into hydrological/ meteorological models:

- Runoff and streamflow, including "fill and spill" of small lakes
- Advection, evaporation, and ice effects on small lakes
- Blowing snow redistribution and other mass, phase, and radiation changes in snow

Prediction

Enhanced environmental predictive capability in cold regions, at multiple spatial scales, in response to greater water resource demands:

- Improved streamflow prediction in ungauged basins with less calibration of model parameters from gauged flows
- Improved weather forecasts and climate prediction due to rigorous model development and testing
- MESH – Land surface hydrology model for Environment Canada's Global Environmental Multiscale model (GEM)
- CRHM – Cold Regions Hydrological Model for individual applications

Havikpak Creek, NT
taiga woodland



Trail Valley Creek, NT
arctic tundra



Polar Bear Pass, NU
arctic wetlands



Baker Creek, NT
subarctic shield lakes



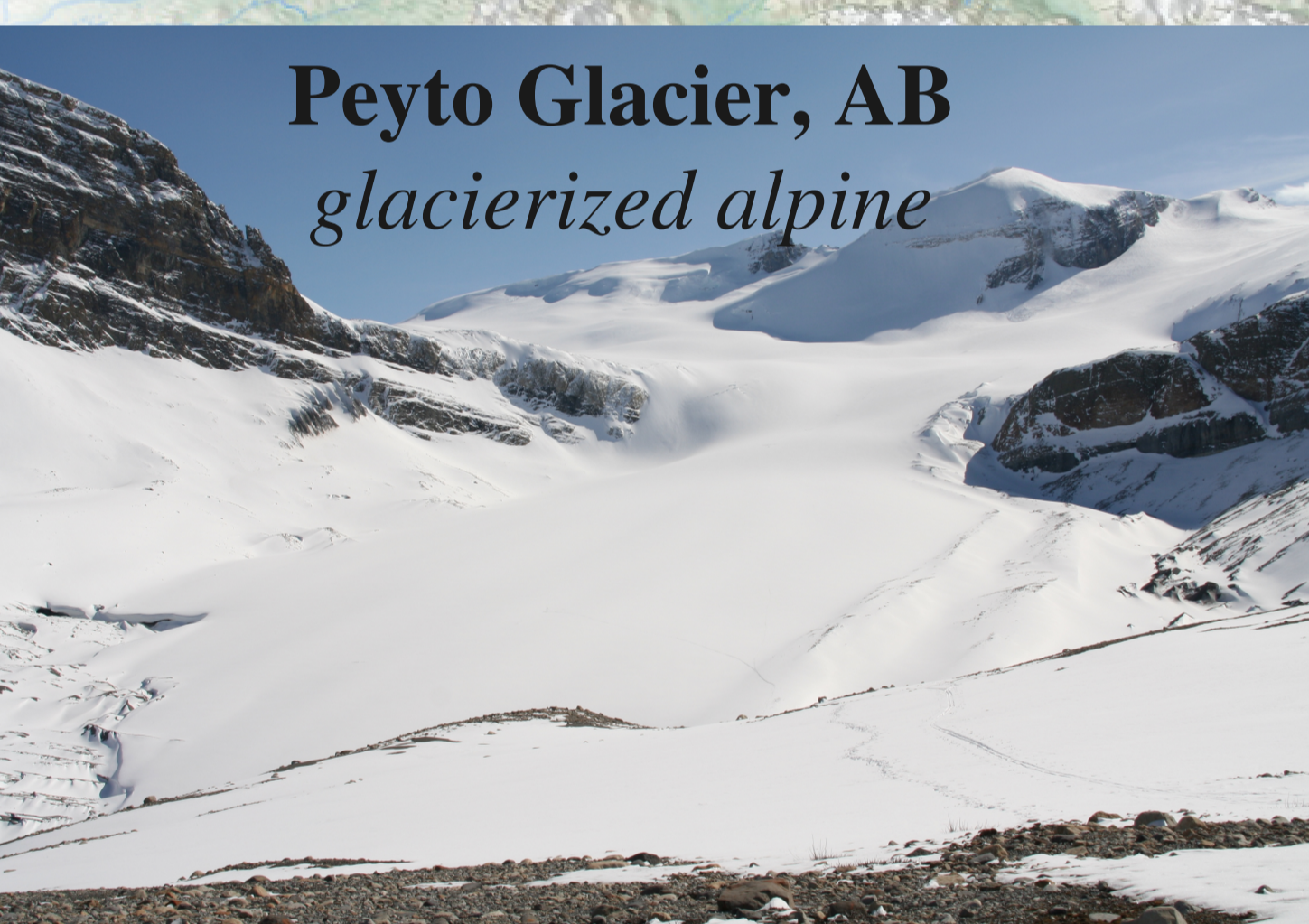
Scotty Creek, NT
permafrost wetlands



Reynolds Creek, Idaho
mountain rangeland



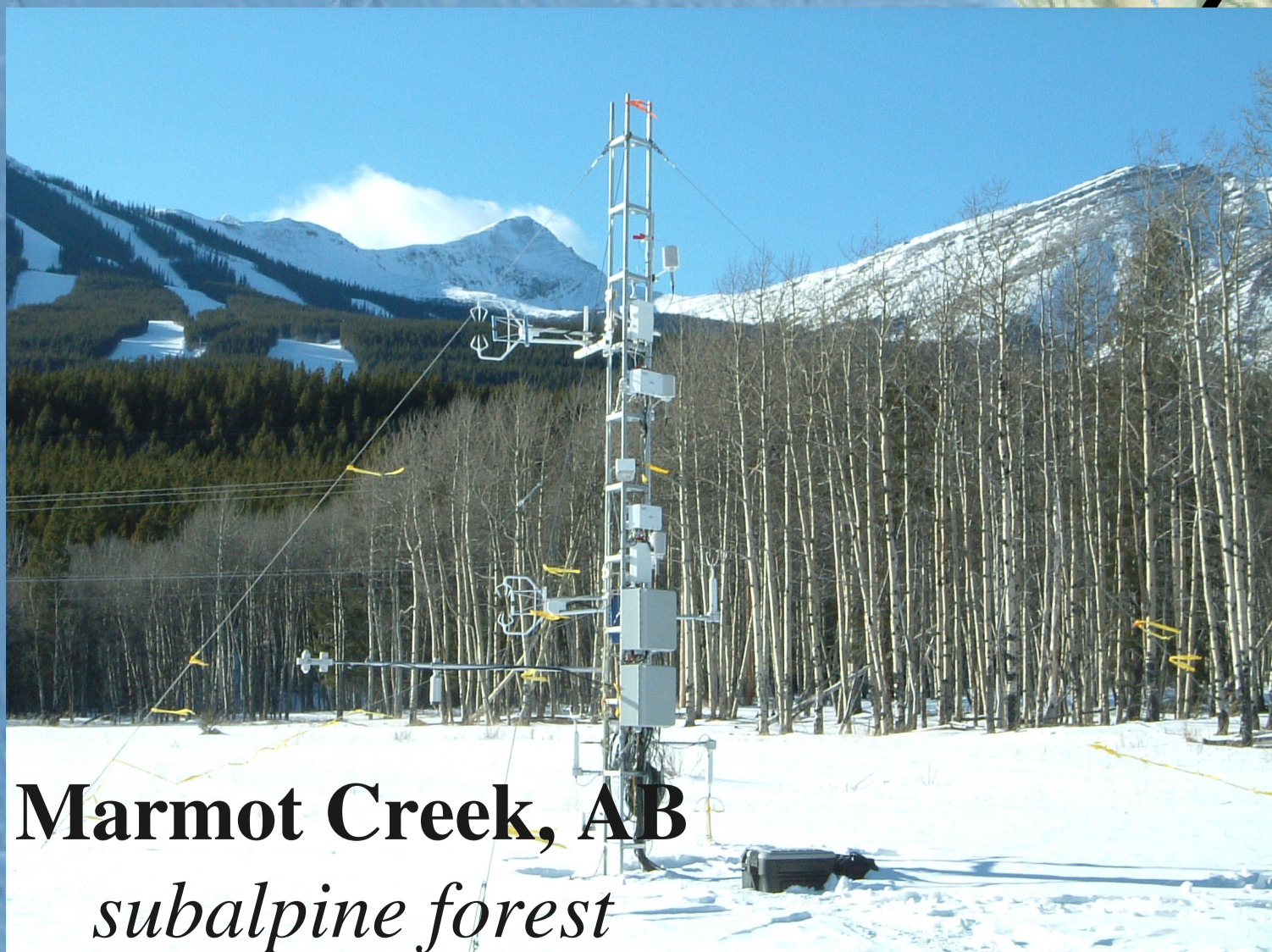
Wolf Creek, YT
subarctic tundra cordillera



Peyto Glacier, AB
glacierized alpine



Lake O'Hara, BC
wet alpine



Marmot Creek, AB
subalpine forest

To learn more about IP3, please visit www.usask.ca/ip3 or contact Julie Friddell, IP3 Network Manager, ip3.network@usask.ca, 306-966-4907 or John Pomeroy, IP3 Project Leader, john.pomeroy@usask.ca, 306-966-1426
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We welcome inquiries regarding new collaborations and partnerships.