

## Advancing Hydrological Processes to Better Predict Water Resources in Canada



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Prediction in ungauged basins (PUB) remains one of the great challenges for hydrological sciences and a particular challenge for Canada where we have vast areas that are ungauged or poorly-gauged. This unsatisfactory spatial density of stream gauge measurements in Canada and occurrence of inherently ungaugable condition such as drought, winter, climate change, land use change and extreme events require the development of an improved capability for PUB. One approach is physically based hydrological modelling, however successful implementation of physically based modelling is predicated on improved basin characterisations, understanding and parameterisation of hydrological systems. In Canada, PUB studies have been implemented as part of the Drought Research Initiative (DRI) which focusses on understanding and predicting droughts in western Canada and the network on Improved Processes and Parameterisation for Prediction in Cold Regions (IP3I) which focusses on better understanding and prediction of the hydrology of high latitude and altitude regions in Canada. This talk focusses on how improved hydrological understanding has been parameterised and incorporated in the modular Cold Regions Hydrological Model (CRHM). CRHM calculates the water and energy balance on hydrological response units and drainagebasins and has been applied to predict hydrology in prairie, mountain, arctic and boreal catchments and has had success with little or no calibration from streamflow observations. The results show that challenges remain in improving observations and our understanding of snow dominated catchments and that better understanding is the basis for more physically based hydrological models. Remote sensing provides a means for better parameterisation of models and reduces the need for calibration from streamflow. Improved hydrological models with good field information, meteorological data and enhanced remote sensing information can be used to describe mountain hydrology, the impacts of forest cover change on hydrology, climate change impacts on hydrology, impacts of wetland drainage, drought hydrology and hydrological prediction without calibration. However integrated observation and prediction systems (including streamflow gauges) are needed to make further advances in PUB, especially in the cold regions of Canada.