New developments in the Canadian Hydrological Model (CHM) and large-extent simulations

C.B. Marsh[1], K.R. Green [3] , R.J. Spiteri [3], Z. Lv [1], V. Vionnet[2], J.W. Pomeroy [1]

[1] Centre for Hydrology, University of Saskatchewan; [2] Meteorological Research Division, Environment and Climate Change Canada; [3] Numerical Simulation Lab, University of Saskatchewan

The melt of seasonal snowcovers in cold regions provides downstream regions with a critical supply of freshwater, impacting ecosystems and human society such as agricultural, industrial, and municipal users. Late lying snowpacks support mountain glaciers, can persist into early summer in mountain headwaters and can maintain streamflow through periods of low precipitation. Large-scale modelling of these regions has been problematic due to coarse spatial resolutions in models that removed key land-surface features (e.g., ridges) and poor or non-existent representation of key cold-regions processes. Snowdrift-resolving models (1 m – 250 m spatial scales) have been proposed as a way forward to accurately simulate heterogeneity however they can be computationally intractable for large extents.

The Canadian Hydrological Model (CHM) is a multi-scale distributed model development framework capable of a multi-scale surface discretization to permit greater spatial resolution where it is warranted. Developments of CHM have improved the process representation to incorporate improved massively parallel computing. On-going development work is incorporating further multi-scale spatial representations (HRUs) via an improved coupler to allow for inclusion of hill slope hydrology and groundwater coupling. Examples of these developments are presented that include simulations of: the end of winter snowcovers at snowdrift resolving scales across the Canadian Cordillera (1.3 million km^2) and a snowdrift-permitting scale for daily forecasting purposes as the core of the SnowCast snow prediction system in the Canadian Rockies.