Invited Speaker Abstract

Climate Sensitivity of Alpine Snow Regimes in the Canadian Rockies

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Seasonal snow regimes in the alpine zone consist of snowfall, snow redistribution by wind, and snowmelt. Sublimation can be an important ablation mechanism under highly ventilated conditions. All of these processes are strongly controlled by the energy inputs and energy state of the snowpack. Warmer winter temperatures have been observed and are predicted for many cold regions environments. The Cold Regions Hydrological Model (CRHM) has the capability to successfully model the major snow processes in a physically based manner. It is used here to explore the sensitivity of snow regimes in the alpine zone of Marmot Creek Research Basin in the Canadian Rockies to warmer winter temperatures. Under current conditions, blowing snow redistributes most snowfall from wind exposed ridges and wind-ward slopes and deposits the transported snow in drifts on lee slopes, gullies, and below treeline. Sublimation losses from blowing snow are substantial. Melt occurs in May-July. Warming is shown to reduce sublimation losses somewhat - its restriction of wind redistribution overcomes effects from the additional sensible energy available for sublimation. However the reduced component of precipitation as snowfall under warmer conditions causes dramatically reduced winter snow accumulation. Warming advances the timing of snowmelt initiation, but reduces the rate of melt. The reduction in melt rate was not expected and is due to the snowmelt period being advanced into a time of year when radiative energy is smaller. The combination of lower snow accumulation, earlier melt and lower melt rate mean that the duration of melt initially drops and then increases as warming increases. These initial snow hydrology modelling results have important implications for determining the hydrological sensitivity of these cold regions environments to climate change.