Assimilation of Snow Interception Information into a Cold Regions Hydrological Model

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ABSTRACT

Snow interception is a crucial hydrological process in cold regions needleleaf forests, but it is rarely measured directly. Indirect estimates of snow interception can be made by measuring the difference in the increase in snow accumulation between the forest floor and a nearby clearing over the course of a storm. Pairs of automatic weather stations with acoustic snow depth sensors provide an opportunity to estimate this, if snow density can be estimated reliably. To find an approach to assimilate snow depth measurements estimated snow interception, three approaches for estimating fresh snow density were investigated: weighted post-storm increments of density from the physically based Snobal model, fresh snow density empirically estimated from air temperature (Hedstrom and Pomeroy, 1998), and fresh snow density empirically estimated from air temperature and wind speed (Jordan *et al*., 1999). Automated snow depth measurements from adjacent forest and clearing sites and estimated snow densities were used to determine snowstorm snow interception at a subalpine forest in the Canadian Rockies. Then the estimated snow interception was assimilated into the physically based, flexible, modular Cold Regions Hydrological Modelling platform (CRHM) driven by Global Environmental Multiscale (GEM) model forcing data using the Ensemble Kalman Filter. Interception determined using density estimates from the Hedstrom-Pomeroy equation agreed best to the observations from a weighed, hanging tree lysimeter. Assimilating snow interception information from automatic snow depth measurements improved the modelled snow interception timing and magnitude by 7% and 13%, respectively; its accuracy was close to that simulated using locally observed meteorological data.

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