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Snow model parameters calibration for SWE analysis and spatially-distributed hydrological modelling

R. Turcotte(1), J.P. Villeneuve(2)

(1) Centre d'expertise hydrique du Quebec, (2) Institut national de la recherche scientifique

The current study deals with the calibration of snow model parameters for both 1) snow pack water equivalent analysis (on a 0.1 degree grid covering the southern Quebec, Canada) and 2) spatially-distributed hydrological modelling.

The first step of the approach is based on a stand-alone version of the snow pack model included in the distributed hydrological model Hydrotel. This snow model uses temperature and a land cover classification to estimate the energy budget of the snow pack and hence is more complex than a degree-day model but uses the same inputs (i.e.: observed temperatures and precipitations). Six of the ten snow model parameters are calibrated using observed snow density and snow pack water equivalent obtained from a manual snow survey network. These six parameters describe general snow properties or melting rate and threshold for the "deciduous forests" land use class. After a comparison of various calibration strategies, the conclusion was reached that the same value for the six model parameters can be used for the whole domain of the snow analysis without major lost on simulation accuracy of the snow.

In the second step of the approach, the four remaining coefficients that describe melting rate and threshold for "open areas" and "coniferous tree area" land uses are calibrated using observed streamflows and the complete Hydrotel model. The Shuffled Complex Evolution optimization algorithm (SCE) is used to calibrate vertical budget and transfer parameters of the Hydrotel (7 parameters) model together with the four remaining snow parameters. This calibration approach gives comparable results over the verification period for four southern Quebec watersheds to those obtained by calibration together all Hydrotelą́s 17 parameters (vertical budget, transfer parameters and snow parameters). Having global parameters for snow models over the "deciduous forests" land use class, the approach also allows operational analysis of the snow

pack for the entire domain for water management purpose that are coherent with values computed on specific watershed within the domain.