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Hydrological and thermal response modelling based on travel time formulation of water end energy transport in snow-covered alpine catchments

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In our contribution we present a semi-distributed model for thermo-hydrologic simulations of snow-covered alpine catchments, based on the travel time formulation of water and energy transport at sub-catchment scale. The output consists of distributed information on stream flow and stream temperature along a river network. The model takes advantage of detailed descriptions of snow cover evolution, snow melt rate and soil water transport provided by Alpine3D, the physically-based and fully-distributed model of snow surface processes developed at WSL/SLF (Davos, Switzerland). The performance is tested through Monte Carlo simulations and by comparing modeled and measured hydrographs and thermographs at the outlet of the Dischma catchment (Grisons, Switzerland). The model turns out to be robust and able to provide accurate predictions of flow and temperature. The results also suggest that the thermal regime of the study catchment is determined both by the energy exchange processes taking place in the soil and by the ones occurring in the stream. Moreover, the analysis of the spatial variability of stream flow in the river network shows a more homogeneous response of the catchment during rainfall events than during snowmelt events. Finally, we investigate the relative importance of water-soil thermal exchange and transpiration flux on water temperature evolution in the soil.