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Simulation of the spatial distribution of snow cover in the Dudhkoshi region of Nepal Himalaya, one of the regions of Third Pole Environment (TPE)

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A spatially distributed biosphere hydrological model with 3 layer energy balance snow physics (WEB-DHM-S; Water and Energy Budget based Distributed Hydrological Model with improved Snow physics) has been applied to the Dudhkoshi region of Nepal Himalaya, one of the regions of Third Pole Environment (TPE) to simulate the spatial distribution of seasonal snow cover. The simulations are carried out at hourly time steps and 1 km spatial resolution for the 2002/3 snow season during the CEOP Enhanced Observing Period 3 (CEOP/EOP3). The snow depth, upward shortwave and longwave radiation simulations at Pyramid (a station of CEOP Himalayan reference site) confirm the vertical-process representations of WEB-DHM-S in this region. The evaluation of the simulated spatial distribution of snow cover with the MODIS 8-day maximum snow cover extent (MOD10A2) shows that the spatiotemporal variations of snow cover is well captured by the model. The pixel-to-pixel comparisons for the snow-free and snow-covered grids reveal that the simulations agree well with the MODIS data with an accuracy of 88%. The hypsography of cumulative snow cover area(SCA) demonstrates that the overestimation of SCA is dominant in the elevation zone from 4500 to 5500 m during the pre-monsoon season and the bias error is dominant in the winter season. The evaluation of the simulated nighttime land surface temperatures (LSTs) with MODIS LSTs (MOD11A2) illustrates that they are comparable in the late winter and pre-monsoon seasons; but the snow surface temperature is largely underestimated in the post-monsoon season and the beginning of winter season. This study provides the basis for the application of WEB-DHM-S in cold and high elevation regions for the assessment of basin scale SCA, snow water equivalent and seasonal discharge for water resources management.