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Extensive validation of a one-dimensional model of bulk snow density, depth and mass content using 18 years of quality-controlled multi-year data at Col de Porte (France)

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Seasonal snowpack mass dynamics represent an important issue in mountain hydrology, because of the key role snow melting plays in the hydrological cycle of many mountain watersheds in temperate areas. Snowpack mass content (usually referred to as snow water equivalent, or SWE) at a site and at a given time depends on climatic, weather and topographical conditions, which cause a high variability of this quantity both in space and time, and which makes its modeling particularly demanding, especially where few data are available. Here, we validate a simple one-dimensional model of snowpack mass dynamics (proposed by De Michele et al., 2013) by using a quality-controlled snow and meteorological dataset from the Col de Porte site, in France (Morin et al., 2012). The model, using one single layer and a temperature-index approach for melting, predicts SWE by means of the coupled evaluation of snow depth and bulk snow density, both in dry and wet conditions. To this aim, it predicts liquid water content (LWC) of the snow cover by introducing an ad-hoc equation of liquid mass conservation. Input data needed are air temperature and precipitation, in both forms. The measurement station at Col de Porte offers high-quality multi-year data series of many meteorological data (among which air and internal snow temperature, SWE, snow depth, LWC and basal run-off) at different time resolutions, suitable for an in-deep calibration and validation of the state variables and the mass fluxes involved in the model.

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