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Performances of the snow accumulation melting model SAMM: results in the Northern Apennines test area

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In this work we propose a snow accumulation-melting model (SAMM) to forecast the snowpack height and we compare the results with a simple temperature index model and an improved version of the latter.For this purpose we used rainfall, temperature and snowpack thickness 5-years data series from 7 weather stations in the Northern Apennines (Emilia Romagna Region, Italy). SAMM is based on two modules modelling the snow accumulation and the snowmelt processes. Each module is composed by two equations: a mass conservation equation is solved to model snowpack thickness and an empirical equation is used for the snow density. The processes linked to the accumulation/depletion of the snowpack (e.g. compression of the snowpack due to newly fallen snow and effects of rainfall) are modelled identifying limiting and inhibitory factors according to a kinetic approach. The model depends on 13 empirical parameters, whose optimal values were defined with an optimization algorithm (simplex flexible) using calibration measures of snowpack thickness. From an operational point of view, SAMM uses as input data only temperature and rainfall measurements, bringing the additional advantage of a relatively easy implementation. In order to verify the improvement of SAMM with respect to a temperature-index model, the latter was applied considering, for the amount of snow melt, the following equation: $M = f_m(T-T_0)$, where M is hourly melt, f_m is the melting factor and T_0 is a threshold temperature. In this case the calculation of the depth of the snowpack requires the use of 3 parameters: f_m, T_0 and ρ_0 (the mean density of the snowpack). We also performed a simulation by replacing the SAMM melting module with the above equation and leaving unchanged the accumulation module: in this way we obtained a model with 9 parameters. The simulations results suggest that any further extension of the simple temperature index model brings some improvements with a consequent decrease of the mean error between model and experimental data of the snowpack thickness.