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A processing-modeling routine to use rough data from automatic weather stations in snowpack mass dynamics modeling at fine temporal resolutions

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We discuss a proposal of coupled routine to process rough data from automatic weather stations at an hourly resolution and to model snowpack mass dynamics. Seasonal snow represents an important component of the water cycle in mountain environment, and the modeling of its mass dynamics is a living topic in modern hydrology, given the expected modifications of the climate in the near future. Nevertheless, model forcing, calibration and evaluation operations are often hampered by the noisiness of rough data from automatic weather stations. The noise issue include, among others, non-physical temperature-based fluctuations of the signal or gauge under-catch. Consequently, it can be difficult to quantify precipitation inputs, accumulation/ablation periods or melt-runoff timing and amounts. This problem is particularly relevant at fine temporal resolution (e.g., the hourly one). To tackle this issue, 40 SNOTEL sites from western US are here considered, and the proposed processing-modeling routine is applied on multi-year datasets to assess its performances to both process hourly data and model snowpack dynamics. A simple one-layer snowpack model is used for this purpose. Specific attention is paid to remove sub-daily erroneous oscillations of snow depth. Under these assumptions, we can separate events of different types and recover catch deficiency by means of a data-fusion procedure that relies on the mass conservation law, instead of site- or instrument-specific relations. Since the considered model needs the calibration of two parameters, and given that sub-daily physical oscillations in snow depth data are difficult to be separated from instrument noise, a coupled processing–modeling procedure has been designed. Results prove that noise can be successfully removed from data, and that sub-daily data-series can be exploited as useful sources to model snowpack dynamics.