Parameter uncertainty assessment for a conceptual hydrological model in a snow-dominated catchment combining streamflow records and MODIS snow cover maps

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Conceptual hydrological models describe the different hydrological processes through empirical relationships, driven by several, often non-physical, parameters. The estimation of such model parameters introduces significant uncertainty on the prediction of both streamflow and the other components of the hydrological balance. In this work, we propose a multi-objective parameter uncertainty analysis, combining streamflow records and MODIS-derived snow-covered area (SCA) images, based on the well-known GLUE procedure in order to quantify the predictive parametric uncertainty of streamflow, SCA and mean areal snow water equivalent. This procedure was tested at Passirio river catchment, a mountainous catchment ranging from 360 m to 3500 m with a contributing area of about 400 km^2 placed in the upper Adige river basin (South Tyrol, Italy). Firstly it was evaluated at the catchment scale and secondly it was applied in an upstream sub-catchment, to spatially validate the proposed approach. Conditioning the hydrological model with the multi-objective approach instead of using only streamflow data show that: both SCA and mean areal SWE predicted uncertainty bands reduce up to 30%; the streamflow uncertainty range shrinks up to 11% at the outlet section and up to 17% in the upstream sub-catchment. These results suggest that the presented procedure might be appealing for inferring uncertainty bounds of streamflow and snow-related predictive variables at different, perhaps poorly gauged, locations across the catchment.