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Utilization of snow depth patterns to derive spatially distributed precipitation correction factors for operational hydrological modelling

Thomas Pulka, Franziska Koch, Mathew Herrnegger, and Karsten Schulz
Institute for Hydrology and Water Management, BOKU Vienna, Austria

Simulations and information on snow cover dynamics and snowmelt in high-alpine catchments are essential for the operation of storage hydropower plants in order to predict reservoir inflow during the snowmelt season. The distribution of the seasonal snowpack is driven by the mountainous topography and vegetation, the predominant weather patterns as well as the microclimatic conditions in the area of interest. At the same time, observations of precipitation and its distribution, the basis for modelling the spatio-temporal distribution of the snowpack, are rare and error-inflicted in these regions. Especially winter precipitation is often largely underestimated in high-alpine areas. Due to the manifold and multiscale influencing factors and scarcity of measurements, the estimation of inputs for hydrological simulations in the mountains is challenging and afflicted by many uncertainties. Snow depth data in a high spatial resolution can, e.g., be obtained via terrestrial, airborne or spaceborne remote sensing techniques and can be used to support snow-hydrological modelling. Vögeli et al. (2016) showed that such snow depth maps, taken at the end of the snow accumulation period, can be utilized for precipitation scaling to significantly improve snowpack modelling in terms of spatial distribution and quantity. This study examines the benefit and challenges of precipitation scaling for enhancing reservoir inflow predictions by applying the conceptual hydrological model COSERO (Herrnegger et al., 2016). The model is computationally efficient and was successfully calibrated and validated in numerous catchments in Austria and neighbouring countries. Among other catchments, COSERO is used operationally by the hydropower operator VERBUND AG in the high-alpine headwater catchments of the Kölnbrein reservoir in the Malta Valley, the largest reservoir in Austria with a capacity of 200 million m³. The basis of our meteorological model forcings is the INCA precipitation analysis product, provided by the Austrian Central Institute for Meteorology and Geodynamics. We applied the precipitation scaling based on snow depth patterns on the INCA data in a sub-daily and sub-kilometre resolution. We investigate, if this approach leads to a more realistic representation of alpine snowpack and runoff simulated by COSERO, aiming to improve operational reservoir management.

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Bibliography

Herrnegger, M., Senoner, T., Nachtnebel, H.-P., 2016. Adjustment of spatio-temporal precipitation patterns in a high Alpine environment. Journal of Hydrology 556, 913–921. https://doi.org/10.1016/j.jhydrol.2016.04.068

Vögeli, C., Lehning, M., Wever, N., Bavay, M., 2016. Scaling Precipitation Input to Spatially Distributed Hydrological Models by Measured Snow Distribution. Front. Earth Sci. 4. https://doi.org/10.3389/feart.2016.00108