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Improved baseflow characterization in mountainous catchments

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Knowledge of the baseflow regime is crucial for managing river ecosystems during low flow periods. Then aquatic conditions, water supply or streamflow forecast highly depend on the sustainability, magnitude, timing or rate of change of the groundwater contribution to streamflow, especially in areas of water shortage or with high water demand. This study aims to improve the understanding of the interplay between quick- and baseflow components by revising a widely used baseflow separation method (WMO or IH-UK method). Baseflow Index (BFI) and quickflow-baseflow-regimes were analyzed for 50 meso-scale catchments in southwestern Germany and Switzerland along a pronounced altitudinal gradient from 200 to 3200 m asl. Since the graphical separation of the baseflow signal depends on the chosen method, we evaluated the separation procedure by analyzing the relation between the seasonal variability of the stable water isotope signal in streamflow and the contribution of the quickflow component. We found that the snowmelt signal in high-elevation catchments is mostly accounted as baseflow suggesting that the used method is only valid for catchment with pluvial regimes. The large variability of BFI values found between the low-elevation, rainfall-driven catchments indicates that here catchment controls such as hydrogeological characteristics determine the baseflow contribution to streamflow. Relationships between several physiographic characteristics and the BFI values differed systematically for rainfall- and snowmelt-driven catchments suggesting that besides quick- and baseflow another delayed storage contributes to streamflow in mountainous catchments. By adjusting the separation procedure (variation of filter parameters) we were able to separate more delayed contributions of snowmelt from the faster groundwater signal. Thus, variable filter parameters are helpful to identify delayed streamflow contributions from different sources (e.g. snow and groundwater). The study's results have implications for water management in mountainous catchments where regime shifts and wide-ranging water redistributions are expected in the future.