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Which hillslopes sustain baseflow during low flow conditions? Lessons from winter discharge observations in the alpine Poschiavino catchment, Switzerland

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Estimation of water availability during low flow conditions is important for many economic and environmental services. Yet, particularly in mountainous terrain, knowledge of which areas in a catchment store water long enough to sustain streamflow during low flow conditions is very limited. Not only the storage volume, but also the drainage time scale is important for understanding recession dynamics. To identify how alpine hillslopes contribute to baseflow recession at the catchment scale, a detailed field study of winter low flows was conducted in the 14.1 km2 upper Poschiavino catchment in southeast Switzerland. Winter discharge observations in alpine catchments are particularly suitable for studying drainage behavior because there is little recharge and groundwater reservoirs are depleted by drainage only.

The upper Poschiavino catchment with its crystalline geology is an interesting research area because of its high winter discharge (Q95 approximately 10 l/s/km2). Based on geo(morpho)logical maps, digital elevation model, aerial photographs and field observations a variety of geomorphological storages, like glacial, rockfall and fluvial deposits, was identified. Frequent discharge measurements during winter allowed obtaining a baseflow recession time series for nested subcatchments in various geomorphological settings. The discharge observations were augmented with electrical conductivity measurements and analysis of stream water chemistry.

These observations form a spatial dataset of low flow distribution in the river network that allows identifying the drainage timescales and the storages involved. We found much variation in the contribution of these hillslopes and tried to attribute these variations to properties of the storages, like catchment area, geomorphology and physical parameters of the sediments. A classification of the different storage types regarding capacity and drainage behavior was developed. This classification formed the basis for a geomorphological mapping scheme for low flow estimation that was evaluated using the discharge observations. The developed methodology may help to estimate the magnitude of low flow in ungauged alpine catchments.