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Groundwater modeling and water balance in the high alpine Berchtesgaden National Park

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High alpine terrain is characterized by high altitudinal gradients, heterogeneous climatic conditions, unknown subsurface hydrological pathways and not quantified lateral snow processes. These conditions lead to uncertainties in the quantification of the water balance, especially the storage element.

We implement the deterministic hydrological model WaSiM-ETH to analyze surface and subsurface water processes in the complex high alpine terrain of the Berchtesgaden National Park (Bavarian Alps, Germany).

The region is characterized by an extreme topography with mountain ranges covering an altitude from 607 to 2713 m.a.s.l.. To encounter this in the modeling process, the model setup is based on meteorological data by a spatially dense network of meteorological stations, discharge data of nine gauges and furthermore extensive land use and soil data.

Beside the complex spatial heterogeneity, the mountain ranges in the region consist of soluble limestone, which is characterized by a high number of subsurface pathways (karst). Both, the alpine landscape and the geological situation highly affect the soil water storage.

To examine the hydrogeological situation in the area of Berchtesgaden National Park several tracer experiments were conducted in the last 20 years. Furthermore an extensive spring database is available, providing data over about 200 spring locations, discharge data and chemical parameters. The evaluation of the experiments and the spring database was leading to an extensive basic knowledge about the surface water and groundwater movement in the area. This knowledge helps to meet the challenge of modeling the unknown subsurface water pathways and the effect of the complex groundwater system on the hydrology of the region.

The integration of a high-alpine specific snow model improves the modeling of water fluxes influenced by the dynamics of the snow cover.

This new model system helps to analyze the insufficiently understood hydrological processes of the region, as well as enable a quantification of the single compartments of the water balance. The model will be forced with scenario data of a regional climate model to assess the possible impacts of a changing climate to the regional water balance.