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Tracer transport in a distributed water and energy balance model: concept and first results for Berchtesgadener Land

Florian Marshall and Harald Kunstmann
Germany (florian.marshall@geo.uni-augsburg.de)

We present first results of the new model extension GEOtop-iso, where we extend the hydrological model GEOtop with a tracer module for the calculation of transport and fractionation of stable water isotopes, in order to develop a better understanding of the overlapping hydrological processes, like precipitation, evapotranspiration and snow melt. GEOtop is a physically based, spacial distributed hydrological model, which combines water and energy balance. The water balance is computed for channels, surface and subsurface, whereas the subsurface is treated with a 3-dimensional, integral form of the Richards equation for saturated and unsaturated condisions with an implicit time discretion sceme. Moreover, the energy balance is also taking into account processes with strong influence on the water budget, such as evapotranspiration, soil freezing and snow melt. This makes the model suitable especially for complex mountain regions. Stable water isotopes carry information about origin and evolution of the water, which makes them to an ideal tracer used in hydrology and meteorology. In this study they are used to distinguish direct discharge response to precipitation and indirect discharge reponse to other processes like snow and glacier melt in spring. A first evaluation of the isotope modul with artificial test cases has shown a reasonable conservation of the mass of the tracers. Furthermore, we apply GEOtop-iso to the catchment of the river Hinterseeau within the National Park Berchtesgadener Land located in South-East of Germany, since this domain is well monitored with meteorological and hydrological observation stations, including measurements of stable water isotopes, as well it has strong elevation gradients. The catchment is convenient for further model evaluation.