Geophysical Research Abstracts
Vol. 15, EGU2013-4652, 2013
EGU General Assembly 2013

Spatial patterns of Transit-Time Distributions using δ^{18}O-isotope tracer simulations at ungauged river locations

Michael Stockinger (1), Heye Bogena (1), Andreas Lücke (1), Bernd Diekkrüger (2), Markus Weiler (3), and Harry Vereecken (1)

(1) Institute of Bio- and Geosciences, IBG-3: Agrosphere, Forschungszentrum Jülich, Jülich, Germany (m.stockinger@fz-juelich.de), (2) Department of Geography, University of Bonn, Bonn, Germany , (3) Institute of Hydrology, Albert-Ludwigs-University of Freiburg, Freiburg, Germany

Knowledge of catchment response times to a precipitation forcing and of isotope tracer transit times can be used to characterize a catchment's hydrological behavior. The aim of this study was to use one gauging station together with multiple δ^{18}O-isotope monitoring locations along the main stream to characterize the spatial heterogeneity of a catchment's hydrological behavior in the context of transit times. We present a method suitable for small catchments to estimate the Transit-Time Distribution (TTD) of precipitation to any stream point using δ^{18}O tracer data, no matter if the stream point is gauged or ungauged. Hourly runoff and precipitation data were used to determine the effective precipitation under base flow conditions at Wüstebach (Eifel, Germany), a small, forested TERENO/TR32 test site. Modeling was focused on base flow due to the weekly measurement intervals of δ^{18}O. The modeling period of 2.5 years was split up in six different hydrological seasons, based on average soil water content, in order to ensure a good fit of the model. Due to the small size of the Wüstebach catchment (27 ha) we assumed the derived effective precipitation to be applicable for the whole catchment. For subsequent modeling of stream water δ^{18}O data we used effective precipitation as an input variable and corrected in a two-step process for canopy evaporation and soil evaporation. Thus we derived base flow TTDs for the ungauged stream and tributary locations. Results show a different behavior of the catchment's response time for different catchment wetness conditions with respect to base flow formation. Winter seasons show similar response times, as well as summer seasons, with the exception of one summer with a considerable higher response time. The transit time of water across the isotope observation points shows points more influenced by shallow source waters than other points, where a higher contribution of groundwater is observable.