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Isotopic fingerprints in a nested catchment setup with contrasting landscape properties

Julian Klaus and Laurent Pfister

Luxembourg Institute of Science and Technology, Catchment and Eco-Hydrology Research Group, Esch-sur-Alzette, Luxembourg (julian.klaus@list.lu)

Physiographic characteristics control how catchments store, mix, and release water. These catchment properties, together with the hydro-meteorological conditions, also influence the transformation of the stable isotopic signal from precipitation to stream discharge. Several studies showed that catchments often exhibit a lower slope of the regression line between δOxygen-18 and δDeuterium of streamwater (Stream Evaporation Water Lines: SEWL) compared to the Local Meteoric Water Line (LMWL). We hypothesise that the combination of land use, geology, and topography is controlling the differences between the LMWL and SEWL. We test this in the nested river setup of the Attert catchment (250 sqkm), with 9 sub-catchment ranging from 0.45 sqkm to 161 sqkm. The different sub-catchments show remarkable different catchment characteristics in terms of geology and land use, while the hydro-meteorological forcing is rather uniform between the sub-catchments. We found that an elevation effect strongly controls the differences in mean δOxygen-18 and δDeuterium of streamflow between the catchments (-1.2‰ δD/100 m). Streamflow also shows remarkable evaporative enrichment, the slopes of the SEWL ranges from 3.2 to 5.1. Increasing fractions of sandstone geology and forest cover generally lead to lower slopes of the SEWL, while the extent of alluvial floodplain leads to slopes more similar to the MEWL. This contribution shows how different catchment properties influence the relationship δOxygen-18 and δDeuterium that is generally controlled by non-kinetic fractionation. Further work on the processes that lead to different slopes of the SEWL is needed.