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The residence time of river water inferred from stable isotopes. A comparison between two catchments with contrasting climates.

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The distribution of time it takes water from the moment of precipitation to reach a catchment outlet is widely used to characterise catchment discharge behaviour, catchment vulnerability to pollution spreading and pollutant loads from catchments to downstream waters. However, this distribution is not constant but varies in time driven by variability in precipitation and evapotranspiration.
To understand how temporal variability in precipitation and evapotranspiration is transferred into temporal variability in residence time distributions we compared two catchments: a year-round wet catchment in Sweden and a catchment in Arizona with clear wet and dry seasons. We calibrated a residence time based hydrological model on 5 years of daily discharge and isotope observations (of both precipitation and discharge) and calculated time series of residence time distributions. The Arizona catchment showed more variability and a larger range in mean residence times than the Sweden catchment. Because both catchments differ in size, topography, vegetation, and climate, the difference in residence times cannot be directly attributed to specific catchment properties. However, from the calibrated model parameters it is clear that it is the hydrological connectivity between (subsurface) water stores that controls the difference in residence time between both catchments.