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Influence of temporal resolution of tracer data on estimates of streamwater transit time distributions

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The streamwater transit time distribution (TTD) is often used for a better understanding of a catchment's water storage characteristics and the movement of precipitation water via various flow paths to the stream. Typically, TTDs are estimated by inverse modelling of weekly chemical or stable isotope tracer time series measured in the stream. Few studies used tracer data with a higher temporal resolution. In the present study, we estimated the TTDs for the 42 km^2 Erkensruhr catchment located in the German low mountain ranges by using weekly and higher temporal resolution of isotope tracer data with the conceptual model TRANSEP. The high resolution data consisted of subdaily precipitation and daily/subdaily streamwater measurements and was aggregated to create the weekly data resolution. Thus, the 1.5 year long time series included base flow as well as event conditions. The high temporal resolution improved the stream isotope simulation compared to the weekly resolution (0.35 vs. 0.24 Nash-Sutcliffe Efficiency), and showed more dynamics in the simulation result. The TTD based on high resolution data was considerably different from the weekly one with a shift towards faster transit times. The mean transit time of water particles was reduced by half (9.5 to 5 years) when applying high resolution data. This indicates that weekly isotopic data lacks information about faster water transport mechanisms in the catchment. Thus, we conclude that high resolution data should be preferred over lower resolution data when estimating TTDs. When comparing TTDs of different catchments, the temporal resolution of the used datasets should be considered.