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Deriving the time-variant transit time distributions of an Austrian karst system by a semi-distributed karst model

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Karst systems contribute around 50% to Austria's drinking water supply. Distributions of transit times of water and hence other water quality parameters can be highly valuable when assessing the risk of contamination of a karst aquifer. In this study we assess the transit time distributions of a dolomite karst system in Austria. Using a new type of semi-distributed model that considers the spatial heterogeneity of the karst system by distribution functions we simulated a range of spatially variable pathways through the karst system. To assure a reliable calibration of the model we used observations of discharge at 2 different locations and 3 time series of solute concentrations (DOC, NO_3 and SO_4). We benchmarked the model with a split sample test using all 5 types of observations. Having enough indication for a realistic representation of the system and its flow and storage behaviour, the range of simulated pathways through the karst system was used to derive transit time distributions for different initial conditions. We use experimentally derived information about transit times (water ages, O 18 observations, tracer experiments) to evaluate the simulated residence time distributions. Finally, the process-based structure of the model allows to attribute the different transit time distributions to physical processes and pathways in the karst system and to assess the system's vulnerability on contamination.