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On ground water residence time in karst aquifers

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Residence time of groundwater in karst aquifers span several orders of magnitude. To demonstrate some parts of this wide spectrum, several approaches are presented here. First, a genetic numerical model is used to study the spreading of plumes through confined telogenetic karst aquifer. Digital models of fractured karst aquifer at different stages of early karstification with well defined flow velocities are used as a "test sites". A particle tracking algorithm is applied to study the advective spreading of plumes caused by instantaneous input into selected region of the modelling domain. The simulations shows high variability of the resulting transfer functions, depending on the stage of evolution, the structure of initial network, the boundary conditions and the location of particle injection.
Besides idealistic modelling scenario, several field studies in Dinaric karst systems in Slovenia are reviewed with focus to the ground water residence time. The methods include dye tracing experiments and continuous monitoring of ground water in epiphreatic caves. The studied systems have evolved in complex tectonic settings and are characterised by the network of epiphreatic conduits, interrupted by large collapse chambers and dolines. Dye tracing experiments revealed surprising flow paths and high variations of residence time at different hydrological conditions. Important information on the velocity of groundwater flow in large epiphreatic conduits can be obtained from continuous and simultaneous monitoring of ground water parameters in active caves in a selected system. Such cases from Reka – Timavo system and Postojna – Planina cave system are presented, where temperature is used as a ground water tracer and the results were compared to the results of dye tracing.
Vadose zone presents the biggest challenge for characterisation of groundwater flow in karst. Many different flow paths show extremely high variability in flow velocities/residence times. These is demonstrated by dye tracing experiments and continuous hydro-chemical monitoring of selected trickles in Postojna cave, Slovenia.