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Three-dimensional extent of the river water-groundwater mixing zone identified by numerical transport simulations

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The spatial extent of the stream-aquifer mixing zone is investigated by applying a three-dimensional variable saturated groundwater flow and transport model at the river Danube east of Vienna. By performing transient transport simulations of a conservative solute, the transport paths of river water penetrating into the river bed and banks are hereby determined for different flow situations. The river Danube is well connected to the aquifer at the study site and over most of the times the groundwater exfiltrates into the river. During rising stream stages the flow direction reverses and aquifer gaining conditions are predominating. The residence times are calculated from breakthrough curves at certain observation points and the lateral and vertical extents of infiltrated surface water are demonstrated. Transport simulations are also performed for dissolved organic carbon, whereby a first order decay rate is accounted for.

Constant solute concentrations in the river show a clear pattern in the aquifer after several days of simulation, whereas very short and high concentrations in the river have a negligible effect.