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Hydrodynamic dispersion characteristics of lateral inflow into a river tested by a laboratory model

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Abstract. Groundwater and river-water have a different composition and interact in and below the riverbed. The riverbed-aquifer flux interactions have received growing interest because of their role in the exchange and transformation of nutrients and pollutants between rivers and the aquifer. In this research our main purpose is to identify the physical processes and characteristics needed for a numerical transport model, which includes the unsaturated recharge zone, the aquifer and the riverbed. In order to investigate such lateral groundwater inflow process, a laboratory J-shaped column experiment was designed. This study determined the transport parameters of the J-shaped column by fitting an analytical solution of the convective-dispersion equation for every flux on individual segments to the observed breakthrough curves of the resident concentration, and by inverse modelling for every flux simultaneously over the entire flow domain. The obtained transport-parameter relation was tested by numerical simulation using HYDRUS 2-D/3-D.

Four steady-state flux conditions (i.e. 0.5 cm hr^{-1}, 1 cm hr^{-1}, 1.5 cm hr^{-1} and 2 cm hr^{-1}) were applied, transport parameters including pore water velocity and dispersivity were determined for both unsaturated and saturated sections along the column. Results showed that under saturated conditions the dispersivity was fairly constant and independent of the flux. In contrast, dispersivity under unsaturated conditions was flux dependent and increased at lower flux. For our porous medium the dispersion coefficient related best to the quotient of the pore water velocity divided by the water content. A simulation model of riverbed-aquifer flux interaction should take this into account.

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