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Transient storage effects on the three-dimensional exchange patterns at the stream-aquifer interface

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The transient effects on three-dimensional flow patterns at the stream-aquifer interface of the river Danube east of Vienna are investigated by applying a variable saturated numerical model. Within the study site a monitored gravel bar behaves like a riffle-pool sequence and therewith as a structure capable of high exchange flow rates and high biogeochemical activity in the surface water-groundwater mixing zone. In the groundwater model the riverbed and banks are reproduced according to a detailed digital elevation model and the variable extent of the alternating dry and wet regions along the river banks are accounted for. Subsurface heterogeneities are accounted for by distributing the hydraulic parameters according to bore hole information and by calibrating the model parameters to continuous water table data. We determine the gradients in transversal direction to the shoreline from water table measurements at the gravel bar and set them in relation to the head difference of river water tables within a certain time period. The results show a clear dependency of infiltration or exfiltration situations on the stream stage history.

The predominant flow situation is groundwater drainage into the river which reverses during rising stream water tables and leads to gaining aquifer conditions. The impact of how this dynamic behaviour influences the flow patterns in the river-aquifer mixing zone of the gravel bar is analyzed in a systematic way.