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Modelling of the Water Exchange between Shallow Groundwater and River during bank filtration and changing conditions

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The interaction of river water and groundwater is of importance for the hydrological cycle and water quality in rivers. Moreover, drinking water is often obtained by pumping groundwater in the direct vicinity of rivers, called bank filtration. Typically this implies a considerable dynamics, because changes in river water level and pumping activities will cause varying conditions, and in its effects modified by the local hydrogeology. Numerical modelling can be a tool to study spatial patterns and temporal changes. Often this is limited by model performance, uncertainty of geological structure and lack of sufficient observation values beyond water heads, for example water quality or temperature data.

The aim of this research is to model the hydraulic conditions for transient conditions, including a period of substantial re-construction works in the river. Later this will then be used to include the temperature and other water quality data to improve the model performance. As shown from the geological information analysis, the majority of the water volume pumped is from the first and second aquifers, where a strong exchange between the river and groundwater can happen. The implementation of the geological structure is based on 7 main geological profiles and several scattered drilling wells of difference depths. A first model has been built in FEFLOW 6.2 as a steady fluid flow model, while the pilot-points auto-calibration method is used for estimating the hydraulic conductivity of different sediment types, based on water head information of 19 observation wells. Then a transient model during the year 2011-2013 is further calibrated based on estimated hydraulic conductivity. Furthermore, the observation wells are used to make a statistic analysis with the hydrograph of the river to clarify the correlation of changes in river to changes in groundwater.