Heat tracer and solute tests in an alluvial aquifer: field experiment and inverse modelling
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Using heat as an active tracer in different types of aquifers is a topic of increasing interest. In this study, we investigate the potential interest of using heat tracer tests for characterization of a shallow alluvial aquifer. A thermal tracer test was conducted in the alluvial aquifer of the Meuse River, Belgium. The tracing experiment consisted in simultaneously injecting heated water and a dye tracer in a piezometer and monitoring the evolution of groundwater temperature and tracer concentration in the recovery well and in monitoring wells. To get insights in the 3D characteristics of the heat transport mechanisms the space-filling arrangement of observation wells was used.

The breakthrough curves measured in the recovery well showed that heat transfer in the alluvial aquifer is slower and more dispersive than solute transport. Recovery is very low for heat while in the same time it is measured as relatively high for the solute tracer. This is due to the fact that heat diffusion is larger than molecular diffusion, implying that exchange between groundwater and the porous medium matrix is far more significant for heat than for solute tracers.

Temperature breakthrough curves in other piezometers are contrasted with what would be expected in an ideal layered aquifer. They reveal strongly unequal lateral and vertical components of the transport mechanisms. The observed complex behavior of the heat plume was explained by the groundwater flow gradient on the site and heterogeneities of hydraulic conductivity field. By using numerical model of heat and flow coupled with pilot points inverse approach main preferential paths were characterized.

References

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