Assessing Surface water- alluvial aquifer water exchange using a multitracer approach and modelling

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Alluvial aquifers are generally highly productive in terms of groundwater and are therefore particularly exploited. The study site is a drinking water production facility located on the alluvial plain of the Rhône river, France. This site consists of several pumping wells and observation piezometers organized along the riverbank. The site is continuously supplying water to neighboring agglomerations with intermittent pumping. In this situation, the pumping produces a piezometric depression allowing leading to a water exchange from the river to the aquifer which is a common feature in the case of alluvial aquifer exploitation along a riverside.

The four pumping wells and five piezometers were equipped with continuous automatic temperature and water level measurement probes, the river stage is monitored as well. These data are used to determine the exchange (direction and magnitude) between the aquifer and the river. Although pumping is intermittent, it does not allow a sufficient recovering of the natural piezometric level, i.e. the aquifer is permanently below the river stage.

In addition to the automatic probes, additional data acquisition campaigns were carried out. During these campaigns different tracers were used such as conductivity, stable isotopes of water and radon activity. Together with the continuously measured temperature, these various tracers were used to identify hydrodynamic variables and parameters, such as Darcy's velocity, dispersivity, transit times. A MODFLOW model was developed, integrating the site geometry and hydrodynamic context, with the Rhone River at the western boundary and the Ouveze river at the eastern boundary. Model calibration was performed using the study site piezometric records and the optimization package PEST. The flow was reproduced at the site for two situations, a natural situation without groundwater pumping, and the exploitation situation with the groundwater withdrawals. Finally, the tracer's data were integrated into the model to reproduce the transport of different tracers, in order to quantify the exchanges and the water fractions coming from the different hydraulic boundaries.