Geophysical Research Abstracts
Vol. 21, EGU2019-9401-1, 2019
EGU General Assembly 2019

Intra-aquifer flow in the subsurface of Berlin (Germany) – new insights from 3D numerical modelling

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In this study we investigate the degree of hydraulic interconnection between the different (regional to local) groundwater compartments and their impact onto the subsurface-groundwater safety beneath the major urban center of Berlin, capital city of Germany. To this end, we carry out a systematic study based on 3D hydrothermal models differing in terms of imposed parametric set-ups of the hydrogeology as well as different surface forcing (boundary) conditions with respect to their impact on fresh groundwater production.

The area under study is part of the Northeast German Basin and consists of a thick sequence (up to 10 km) of differently consolidated sedimentary deposits. This sedimentary succession features a sequence of alternating aquifers and aquitards (geofluid reservoirs) which are connected to different degrees, each one depicting a specific composition of its mineralized pore water. The uppermost aquifer system (made up mainly of poorly consolidated siliciclastic rocks) acts as the main freshwater reservoir utilized for groundwater production by the municipal water supply. This compartment is incompletely sealed from the brackish to saline aquifers extending at greater depths by a regional clay-enriched aquitard, the Oligocene Rupelian Clay. The latter shows a heterogeneous thickness distribution due to fluid mediated erosion during the latest glacial periods resulting in local discontinuities. This aspect opens to the potential risk of contamination of the drinking water reservoir from mixing with the saline groundwater upcoming (locally enhanced by shallow pumping activities) and therefore poses a serious problematic to develop a proper management of the available water resource in the study area.

Based on our results and their correlation with available (though sparse) isotopic analysis of water samples, we demonstrate that (and how) hydraulic connection between the different compartments is indeed likely to occur thus supporting the possibility of a contaminant rise from the saline aquifers below through either natural or anthropogenic (pumping) forcing.