Geophysical Research Abstracts
Vol. 21, EGU2019-11398, 2019
EGU General Assembly 2019

Flow Dynamics and Resulting Reactivity in the Transition Zone between Streams and Riparian Aquifers

Guilherme Nogueira, Christian Schmidt, and Jan Fleckenstein
Helmholtz Center for Environmental Research - GmbH, UFZ Leipzig, Hydrogeology, Leipzig, Germany
(guilherme.nogueira@ufz.de)

Stream-groundwater mixing zones are well known for their importance in biogeochemical reactions linked to enhanced water quality, as for example in river bank filtration processes and in natural attenuation of contaminants. The spatial and temporal exchange patterns between a stream and its connected riparian groundwater were assessed to evaluate the potential reactivity for redox-sensitive compounds like dissolved oxygen (DO) and nitrate under different seasonal and hydrologic conditions. Spatial pattern of stream water infiltration were obtained using time-lapse crosshole geophysics for the detection of EC contrasts during salt tracer tests under various hydraulic conditions. In addition, a numerical groundwater model was set up and calibrated against groundwater heads and tracer test data.

Our results reveal that the riparian aquifer is a highly dynamic system with flow directions and travel times changing depending on river discharge. Travel times are better correlated with the slope of the rising limb of discharge events ($\Delta Q/\Delta t$) than with absolute discharge values.

DO consumption increases with increasing temperature and with increasing travel time of the infiltrating river water. We also observe a minor DO enrichment ca. 20 m apart from the river, likely by reaeration through the shallow vadose zone. Higher DO consumption rates are observed within first few meters from the river (up to 70%) most likely linked to the dissolved organic carbon delivered by infiltrating stream water (Stream: 3-15 mg/l; GW: 2mg/l). While discharge peaks result in shorter travel times, the effects on DO consumption seem to be inferior in comparison to temperature. The width of the aerobic zone in the riparian aquifer is enlarged by peak discharge events, reducing the potential for anaerobic reduction of nitrate.

With our time and space resolved approach we were able to show that a combination of hydraulic conditions and seasonal temperature pattern shape the dynamic reactivity in the riparian groundwater, depicting its relevance and the extent of its influence for the entire aquatic ecosystem.