Geophysical Research Abstracts
Vol. 20, EGU2018-10285, 2018
EGU General Assembly 2018

Quantifying and predicting river-aquifer exchange in lowland floodplains (Nete, Demer and Dijle), Belgium

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Floodplains have an important hydrological role since it is the compartment where water and solute exchange and heat transfer take place between the shallow groundwater (GW) and the surface water (SW), especially in the hyporheic zone. My research focuses on quantifying the exchange fluxes between the river and aquifers, which are often characterized by a high temporal and spatial variability.

A multi-method approach is considered to measure the fluxes in the selected study sites in the Scheldt catchment, Belgium. As groundwater head observations do not directly reveal the exchange fluxes, other state variable observations, like temperature measurements or hydrochemical analyses with different spatial support, are performed to quantify the fluxes. Initial measurements were carried out at the research site of Zwarte Beek, a tributary of Demer. Four multilevel temperature sticks were installed at six depths below the streambed, which measure the groundwater temperatures starting from October 20, 2017. With advances made in analytical and numerical methods to quantify GW-SW fluxes using heat as a tracer, we are now choosing proper codes, for example, a numerical heat-transport code STRIVE which had applied in Aa river in Belgium (Anibas et al. 2009, 2017), to calculate the exchange fluxes in our catchment. The fluxes will then be used as the input data for building the hyporheic zone model.

Other flux estimation techniques, such as chemistry survey (e.g. electrical conductivity) and hydraulic gradient analysis, will be applied to optimize the hydrological model. Upscaling by spatially interpolating the point measurements of a local scale onto a catchment scale will be performed. The overall objective is to develop an integrated multi-scale GW-SW model, which will couple the small scale hydrological model with a catchment-scale groundwater model. After the model calibration and validation, the coupled model will be able to stimulate the mid- to long-term hydrological status of the floodplains through the changes in channel morphology, climate change, land cover change, urbanization and local floodplain management actions (e.g. blocking of drainage channels), at a timeframe of ca. 50 to 150 years.

References

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