Geophysical Research Abstracts,
Vol. 11, EGU2009-11655, 2009
EGU General Assembly 2009

Quantification of river – aquifer exchange and nitrate retention capacity in the hyporheic zone of a small UK river

C. Tecklenburg (2), M. Munz (2), and S. Krause (1)

(1) Keele University, Dep. for Earth Science and Geography, Dep. for Earth Science and Geography, Keele, Staffordshire, United Kingdom (s.krause@esci.keele.ac.uk, 0044 01782 715261), (2) Potsdam University, Geoecology Department, Potsdam, Germany

Exchange fluxes and redox processes at the river – aquifer interface can be subject to intensive spatial and temporal variability. This paper presents an approach to use the numerical groundwater model MODFLOW to simulate river aquifer exchange for a stream section of the river Leith, UK. For the parameterisation of the river-aquifer interface of the model extensive data sets of streambed stratification, hydraulic conductivities as well as hydraulic heads are obtained from experimental investigations. The un-calibrated model simulation provides good model efficiency with a Nash & Sutcliff efficiency of 0.92.

The un-calibrated model was used to simulate a summer baseflow period including several storm events. Overall aquifer discharge and discharge patterns were quantified, showing that during baseflow groundwater was predominantly discharging into the river. Surface water infiltration into the streambed was limited to small areas around riffle heads.

Scenario simulations were undertaken with the model to establish what potential head gradients are required for inducing flow inversion with surface water infiltrating into the groundwater during winter storm events. Results proved that substantial surface water infiltration into the streambed is likely to be limited to high flows during storm events.

Simulations of non-reactive transport using MODFLOW – MT3D failed to predict the observed nitrate concentration changes in groundwater along the hyporheic passage through the streambed indicating in which areas over-prediction is likely to occur due to nitrate attenuation by denitrification or vegetation uptake and at which locations under-prediction indicates likely nitrification along the hyporheic flow path.