Geophysical Research Abstracts, Vol. 8, 07363, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07363

Implementing hyporheic zone processes in a coupled model approach in order to describe floodplain water balance and chemistry

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Hyporheic zone processes strongly control the intensity of temporally and spatially dynamic interactions at the groundwater - surface water interface of floodplains. Experimental investigations have shown that the flows, resulting from pressure head gradients, are determined by the spatially variable transmissivity of the hyporheic zone which is additionally often characterised by a very intensive chemical activity. Thus, the set up of an adequate model for the quantification of floodplain hydrological processes and of the dynamic interactions to surface waters requires sufficient knowledge about the key physical and chemical processes and characteristics of the hyporheic zone. The IWAN model, based on an advanced coupling approach of groundwater, water balance and groundwater chemistry models, was developed for modelling the water balance and groundwater dynamics in floodplains. It was applied in order to quantify the importance of interaction processes between groundwater and surface waters for the river floodplain water balance and chemistry as well as for river discharge and quality. It was successfully validated for the Havel river basin in Northern Germany and applied for a number of floodplain catchments in England and Germany where good simulation results lead to a fundamental understanding of the of temporally and spatially variable importance of groundwater supplies to the river discharge and of the controls of nitrate retention in wetlands and floodplains for instance. One of the major limitations of the model application was the simplified use of spatial mean values for the physical and chemical parameters at the hyporheic zone interface as there are hydraulic conductivity or hydro-chemical kinetic parameters. This simplifications cause a not optimal representation of the spatial pattern of processes at the groundwater - surface water interface in the model which subsequently effect the spatial distribution

of the models accuracy. Thus, detailed experimental investigations started in order to improve the spatial accuracy of the parameterisation of several hyporheic zone characteristics and controls. Geophysical investigations and tracer tests are undertaken in order to define the spatial distribution of the parameters as bulk density, layer thickness and most important the hydraulic conductivity of the hyporheic zone as a key control of the flow boundary condition. Advanced analytical chemical methods will be applied in order to characterise the spatial pattern and distribution of redox sensitive elements and of reductive agents what leads to a more adequate representation of kinetic parameters as decay rates, initial concentrations or available amounts or reductive agents for the simulation of nitrate metabolism. First results prove how the incorporating the experimentally gained more detailed information can result in a better representation of the hyporheic zone characteristics and thus in a more appropriate simulation of water balance and groundwater chemistry.