Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04161, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04161
EGU General Assembly 2008

Water quality modelling for shallow river-lake systems: Application for the Havel

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A new model for simulating mass transport and turnover in rivers and shallow lakes consists of a transport and a reaction module with the latter being highly flexible with respect to the description of turnover processes in the aquatic environment. Therefore, simulation approaches of different complexity can be chosen in consideration of the problem and data availability. The model application focuses on the analysis of options for reducing the nutrient load of surface waters to support the implementation of the WFD in the lowland catchment of the Havel lake-river-system, NE-Germany. In a first step, the model was applied for identifying the magnitude as well as spatial and temporal patterns of nitrogen retention and sediment phosphorus release in a 100 km stretch of the highly eutrophic Lower Havel. In a second step, the impact of reduced external nutrient loading on the nitrogen and phosphorus concentrations of the water quality was simulated (scenario analysis) taking into account internal retention or release. The boundary conditions for the scenario analysis such as runoff and nutrient emissions from river basins were supplied from external models or measurements. Model uncertainties were also examined. They enabled the distinction of parameter and structural uncertainty (process representation). According to the simulation, the target of the WFD could be achieved in the medium-term, if the full potential for reducing point and non-point emissions would be accomplished. Furthermore, internal phosphorus loading may ease off noticeably until 2015 due to a declining pool of sedimentary mobile phosphate. Mass balance calculations revealed that the lakes of the Lower Havel are an important nitrogen sink. This natural retention effect significantly contributes to the efforts aimed at reducing the river's nitrogen load. If a sustainable improvement of the river system's water quality is to be achieved, enhanced measures

to further reduce the immissions of both phosphorus and nitrogen are required.