Geophysical Research Abstracts
Vol. 12, EGU2010-8034, 2010
EGU General Assembly 2010

Hybrid modeling of nitrate fate in large catchments using fuzzy-rules

Sven van der Heijden and Uwe Haberlandt

Leibniz Universität Hannover, Institute of Water Resources Management, Hydrology and Agricultural Hydraulic Engineering, Hannover, Germany (vdheijden@iww.uni-hannover.de)

Especially for nutrient balance simulations, physically based ecohydrological modeling needs an abundance of measured data and model parameters, which for large catchments all too often are not available in sufficient spatial or temporal resolution or are simply unknown. For efficient large-scale studies it is thus beneficial to have methods at one's disposal which are parsimonious concerning the number of model parameters and the necessary input data. One such method is fuzzy-rule based modeling, which compared to other machine-learning techniques has the advantages to produce models (the fuzzy-rules) which are physically interpretable to a certain extent, and to allow the explicit introduction of expert knowledge through pre-defined rules.

The study focuses on the application of fuzzy-rule based modeling for nitrate simulation in large catchments, in particular concerning decision support. Fuzzy-rule based modeling enables the generation of simple, efficient, easily understandable models with nevertheless satisfactory accuracy for problems of decision support. The chosen approach encompasses a hybrid metamodeling, which includes the generation of fuzzy-rules with data originating from physically based models as well as a coupling with a physically based water balance model. For the generation of the needed training data and also as coupled water balance model the ecohydrological model SWAT is employed.

The conceptual model divides the nitrate pathway into three parts. The first fuzzy-module calculates nitrate leaching with the percolating water from soil surface to groundwater, the second module simulates groundwater passage, and the final module replaces the in-stream processes. The aim of this modularization is to create flexibility for using each of the modules on its own, for changing or completely replacing it. For fuzzy-rule based modeling this can explicitly mean that the re-training of one of the modules with newly available data will be possible without problem, while the module assembly does not have to be modified.

Apart from the concept of hybrid metamodeling first results are presented for the fuzzy-module for nitrate passage through the unsaturated zone.