Catchment nitrate leaching and transport modeling benefitting from grid-based mHM-Nitrate model and high-frequency sensor monitoring

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Water quality in rivers and reservoirs has been dramatically changed in past few decades due to significant changes in human activities. Catchment water quality models, as scientific supporting tools, have been extensively recommended by scientists and accepted by stakeholders. However, detailed spatial information is increasingly required to match current waves of high-resolution monitoring. Here we presented a new grid-based nitrate leaching and transport model (mHM-Nitrate) at catchment scale. The model was developed based on the mesoscale Hydrological Model (mHM) and the Hydrological Prediction of Environment (HYPE). Meanwhile, several improvements have been implemented to better representing nitrate dynamic processes and agricultural practices, and to enhancing model applicability under changing anthropogenic conditions. The daily time-step model was tested in the Selke catchment, Germany. Long-term validation using biweekly observations showed the model nicely reproduced the seasonal dynamic patterns in both natural forest areas and heavily human impacted agricultural and urban areas. Benefitting from the high-frequency monitoring implemented in the Selke (TERENO project), daily Nitrate-N data were generated from 15-minute sensor measurements. The daily data were used as an additional model validation. Results showed that short-term changing of runoff partitioning and event-based dilution effects, which cannot be reflected in biweekly grab samples, were also satisfactorily reproduced by the new mHM-Nitrate model.

Moreover, the grid-based structure facilitates network in-stream investigation more precisely. Based on the new model, we proposed a new approach to better understand the spatial and temporal varieties of in-stream nitrate uptake. The uptake was calculated considering driven force (global radiation), riparian shading interception (leaf area index) and potential assimilatory nitrate uptake (general parameter). Continuous assimilatory in-stream uptake is recently available in the testing catchment calculating from high-frequency multi-parameter sensor measurements (TERENO project) [*Rode et al.*, 2016]. This newly available data was used to validating the new in-stream approach and determining the parameter without calibration. Results showed that using new experimental data for parameterizing stream network models will allow to substantially improve continues modeling of in-stream nitrogen fluxes.

Reference

Rode, M., S. Halbedel née Angelstein, M. R. Anis, D. Borchardt, and M. Weitere (2016), Continuous In-Stream Assimilatory Nitrate Uptake from High-Frequency Sensor Measurements, *Environmental Science & Technology*, *50*(11), 5685-5694.