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Increasing in-stream nitrogen concentrations under different bioenergy crop management practices in central Germany

Seifeddine Jomaa (1), Daniela Thraen (2), and Michael Rode (1)

(1) Helmholtz Centre for Environmental Research - UFZ, Department of Aquatic Ecosystem Analysis and Management, Magdeburg, Germany (michael.rode@ufz.de), (2) Helmholtz Centre for Environmental Research - UFZ, Department of Bioenergy

Understanding how nitrogen fluxes respond to changes in land use and agriculture practices is crucial for improving instream water quality prediction. In central Germany, expansion of bioenergy crops such as maize and rape for ethanol production during the last decade led to increasing of fertilizer application rates. To examine the effect of these changes, surface water quality of a drinking water reservoir catchment was investigated for more than 30 years. The Weida catchment (99.5 km2) is part of the Elbe river basin and has a share of 67% agricultural land use with significant changes in agricultural practices within the investigation period. For the period 2004-2012, the share of maize and rape has been increased by 52% and 20%, respectively, for enhancing bioenergy production. To achieve our gaols, the semi-distributed hydrological water quality HYPE (Hydrological Predictions for the Environment) model was calibrated for discharge and inorganic nitrogen concentrations (IN) during the period 1997-2000.The model was validated successfully (with lowest performance of NSE = 0.78 and PBIAS = 3.74% for discharge) for three different periods 1983-1987, 1989-1996 and 2000-2003, which are charaterized by different fertilizer application rates.
Results showed that the HYPE model reproduced reasonably well discharge and IN daily loads (with lowest NSE = 0.64 for IN-load). In addition, the HYPE model was evaluated successfully to predict the discharge and IN concentrations for the period 2004-2012, where detailed input data in terms of crops management (field-specific survey) have been considered. Land use and crop rotations scenarios, with high hypothetical percentage of acceptance by the farmers, revealed that continuous conversion of agricultural land into bioenergy crops, will most likely, lead to an enrichment of in-stream nitrogen, especially after spring storms.