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Modeling the Impacts of Climate Change on Nitrogen Retention in a 4th order stream

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Climate induced changes of temperature, discharge and nitrogen concentration may change natural denitrification processes in the river systems. Up to now it is unclear how sensitive in stream denitrification is to temperature, discharge and nitrogen concentration. The objective of this contribution is to analyze variation of these variables, on in-stream denitrification, their seasonal variation along the year and the impact of river morphology on N-retention for changing boundary conditions.
Climate scenarios (under dry realization analysed with rainfall runoff model SWIM) have been used to characterise changing flow and climatic conditions for the period 2050-2054 in the 4th order River Weiße Elster, Germany. Nitrogen turnover was simulated with the WASP5 river water quality model investigating for a) the assumption of constant nitrogen load conditions and b) current discharge/nitrate concentration relationships. Sensitivity of denitrification to discharge, temperature and nitrogen concentration was determined by a Monte Carlo analysis. Seasonal changes in nitrogen retention were determined by simulating water quality for summer low flow and winter high flow conditions separately. Spatial changes of denitrification rate along the length of the studied river section were examined. The impact of river morphology was analyzed by comparing a natural river section with a heavy modified river section
Results revealed that boundary nitrogen concentrations had highest importance affecting the prediction of the nitrogen concentrations along the river. Discharge also played a significant role in model predictions. Temperature had lowest impact on model output. Under low and high flow conditions denitrification rate was about 50% higher in the 2050-2054 period compared to the reference year, 2000. Overall results of the study revealed significance of climate change in regulating the magnitude, seasonal pattern and variability of the nitrogen retention. Results can be valuable to manage nitrogen related environmental problems under present and future scenarios.