Evaluating a 1D and 2D water quality modeling framework: A case study of the lower Bode River, Germany

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The Bode River catchment in the Harz Mountain area of central Germany is heavily influenced by anthropogenic factors. 70% of the catchment is dominated by agriculture, 23 % by forest and the rest 7% is urban in nature. The area of the catchment is approximately 3300 km2 and is characterized by sharp gradients in temperature, precipitation and land use. In order to acquire better understanding of the hydrological nature of the catchment and biogeochemical characteristics of the Bode River various monitoring stations have been deployed as a part of the larger earth observation network initiative named Terrestrial Environmental Observatories. One of the major issues with the catchment is the problem of eutrophication due to solute inputs from agriculture. The research presented here evaluated the application and development of 1D and 2D hydrodynamic and water quality models in the downstream area of the Bode River. A stretch of 30 kms between Hadmersleeben and Stassfurt in the downstream area of the Bode River was modeled using 1D model HEC-RAS, the focus of the water quality modeling was transport and uptake of nitrate in the aforementioned modeled stretch. Flood events of varying peak magnitude at different times of the year were modeled. As regards to 2D modeling, TELEMAC-2D model was applied for the same reach. The hydrodynamic simulation results were validated with the help of free surface elevation at Athensleben, 8 kms upstream from the downstream end at Stassfurt. Water quality modeling, focusing on the Nitrate removal for the aforementioned stretch, is applied and developed for both 1D and 2D modeling framework. Results from hydrodynamic and water quality modeling were validated with RMSE (Root Mean Square Error) value of 0.074 and 0.36 for the modeled state variables across various events simulated. For the nutrient-rich reach modeled in this research it was found that the nutrient removal capacity of the stream is directly proportional to the incoming nitrate concentration.