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Spatial and temporal variations of water quality in Northern German lowland catchments - modelling and management strategies

Fohrer Nicola, Quam Dung Lam, and Britta Schmalz

Dep. Hydrology and Water Resources Management, Institute of the Conservation of Natural Resources , CAU Kiel, Germany (nfohrer@hydrology.uni-kiel.de / 00494318804609)

The pollution of rivers and streams with agro-chemical contaminants has become one of the most crucial environmental problems in many European countries. The assessment of spatial and temporal variations of water quality influenced by point and diffuse source pollution is necessary to manage the environment sustainably in various watershed scales. The overall objectives of this study were to assess the capabilities of the ecohydrological model SWAT (Soil and Water Assessment Tool) to simulate flow and nutrient load in complex mesoscale lowland catchments and to evaluate the temporal and spatial variations of water quality in the whole catchment before and after implementation of best management practices (BMPs).
The study area Kielstau catchment is located in Northern Germany as a typical example of a lowland landscape. Sandy, loamy and peat soils are characteristic for this area. Land use is dominated by arable land and pasture. In this study we examined two catchment areas including Kielstau catchment 50 km^2 and its subcatchment, namely Moorau, with the area of 7.6 km^2. The water quality of these catchments is not only influenced by diffuse sources from agricultural areas but also by point sources from municipal wastewater treatment plants. Diffuse entries as well as punctual entries from the wastewater treatment plants are implemented in the model set-up. For this study, the calibration and validation of the model were carried out in a daily time step for flow and nutrients. The model results revealed that the SWAT model performed satisfactorily in simulating daily flow and nutrient load and could be used to assess the spatial distribution of nutrient load under the implementation of BMPs in mesoscale lowland catchments. Shallow groundwater is the major contributor to total nitrate load in the stream accounting for about 93% of the total nitrate load, while only about 7% results from surface runoff and lateral flow. The study also indicates that applying a spatially distributed modeling approach was an appropriate method to generate source maps showing the spatial distribution of TN and TP load from subbasins and to identify the crucial pollution areas within a watershed whose management practices can be improved to control more effectively nutrient loading to water bodies.