NiddaMan

From Emission Modeling to Water Quality Modeling – New Developments for MoRE

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Introduction

For effective river basin management and protection of freshwater resources the identification of emission pathways and spatial patterns are of crucial importance. In the context of the Water Framework Directive the open-source instrument MoRE (Modeling of Regionalized Emissions) has been developed. It is based on the pathway-oriented MONERIS approach (Modeling Nutrient Emissions in River Systems) and can be used to model annual substance emissions to surface waters on a catchment scale.

Approach

MoRE has been extended to model river concentrations and loads. This enables the user to compare concentrations with environmental quality standards and evaluate the effect of substance emissions. Modeling is based on a river network which consists of nodes (e.g. river junctions, point sources, dams or monitoring stations) and river segments connecting the nodes. Diffuse substance emissions are assigned to river segments while point source emissions enter surface waters at nodes.

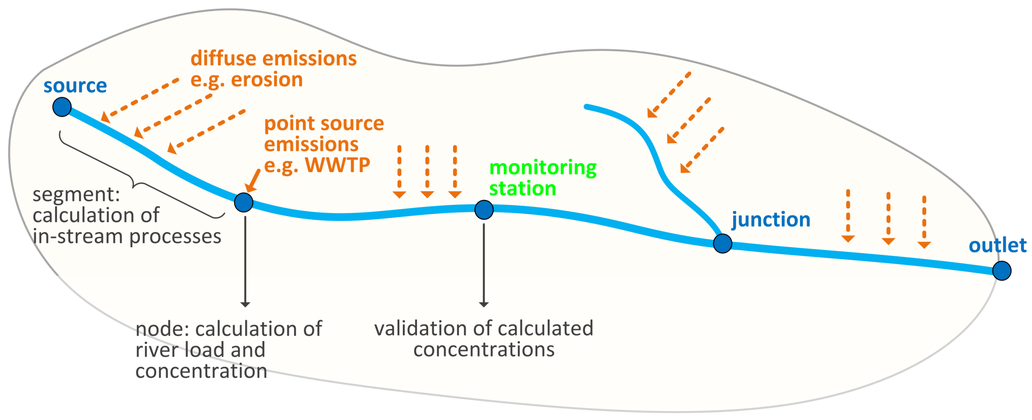

Fig. 1: Schematic concept of the node-and-segment model

In-stream processes along the river segments are accounted for using simple approaches such as first-order decay or lumped first-order rates.

Outlook

- Concentrations will be modelled using different scenarios (e.g. climate change, retrofitting of wastewater treatment plants) based on a variety of input data.
- In a further project the water quality module will be applied to model the whole federal state of Baden-Württemberg.
- Subsequently simplified approaches will be tested to model even larger river basins based on a reduced dataset of input data and covering various countries.

First Results

An example for the application of the new extension in MoRE is the BMBF funded NiddaMan Project. In this project the KIT models substance concentrations for nutrients and pharmaceuticals (carbamazepine and diclofenac) in the Nidda Catchment in Hesse (approx. 2,000 km²). The input data provided by project partners was adjusted to model at a higher spatial and temporal resolution than currently used in other MoRE applications. In a first step the Usa sub-catchment was modeled.

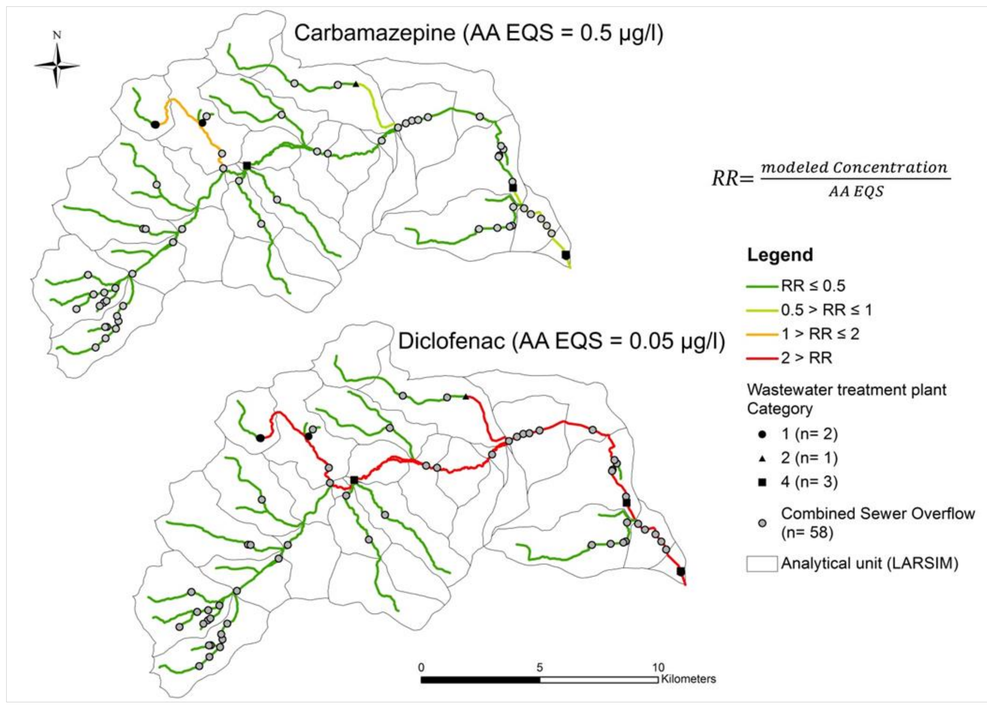

Fig. 2: Modeld risc ratio (RR) for two pharmaceutical substances within the Usa catchment area (annual mean 2015)

The modeling results are compared with data from monitoring stations to evaluate the implemented approaches. The project partners use the modeled concentrations to derive qualitative statements concerning the risk potential for biota in particular water segments.

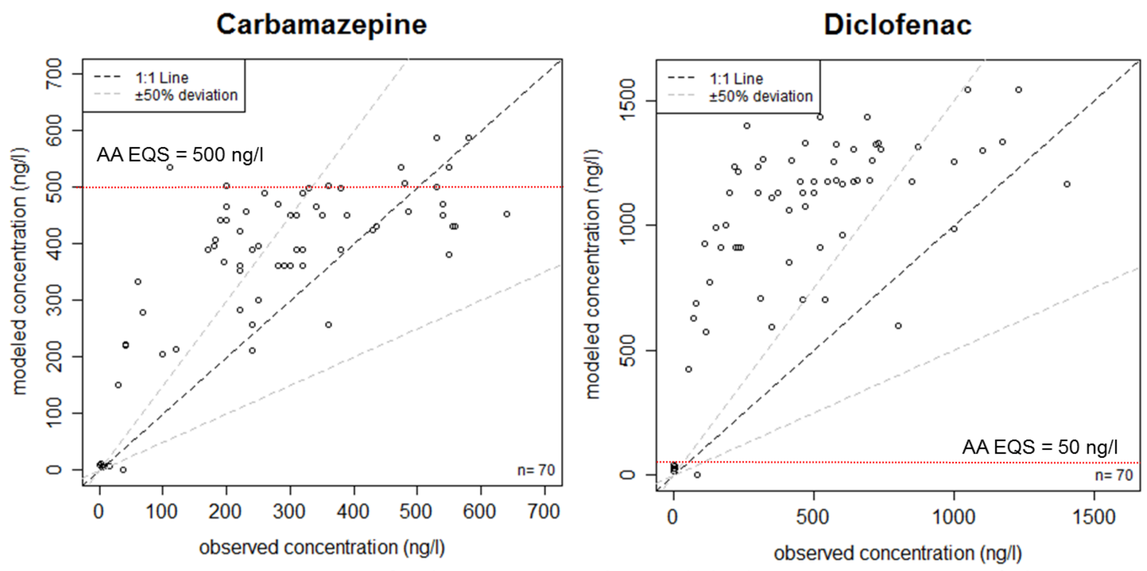

Fig. 3: Comparison of observed and modeled concentrations (observed data BfG and HLNUG)

Refrences: Fuchs, S.; Kaiser, M.; Kiemle, L.; Kittlaus, S.; Rothvoß, S.; Toshovski, S.; Wagner, A.; Wander, R.; Weber, T.; Ziegler, S. Modeling of Regionalized Emissions (MoRE) into Water Bodies: An Open-Source River Basin Management System. Water 2017, 9, 239

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