

EGU2020-13440

<https://doi.org/10.5194/egusphere-egu2020-13440>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Modelling of in-stream nutrient uptake beyond the river reach scale

Joni Dehaspe and Andreas Musolff

Helmholtz-Centre for Environmental Research, Hydrogeology, Germany (joni.dehaspe@ufz.de)

Nutrient excess in rivers leads to ecosystem harm and can induce detrimental algae growths in coastal areas. In Germany and Europe, the management of riverine systems is complicated by the lack of understanding of nutrient pathways and effectiveness of retention processes from application to export. In this work, we hypothesize that in-stream nitrate uptake effects are linked to the shape or ‘bending’ of the concentration discharge (C-Q) relationship. Therefore, the analysis of observational C-Q data may give insight into the dominant controls of the magnitude of in-stream nitrate uptake across different catchment. To explore the concentration discharge (C-Q) behavior in a range of hydrological and biogeochemical conditions, we developed a catchment wide parsimonious (7 parameter) network model framework (spatially explicit at 1x1km²). Here, land-to-stream nutrient transfer was modelled as a power law ($C=aQ^b$), resulting in different nutrient loading according to the contributing area of each grid cell in the network and in-stream load uptake follows $L_i = L_{in} * e^{-v_f * w * L / Q}$, with v_f the uptake rate, w and L the width and length of the river section. This approach acknowledges both, spatial variability between river sections (e.g. residence time distributions) as well as at-a-station temporal variability depending on Q . Ten existing stream networks in Germany were evaluated with this model framework in a ‘Monte Carlo approach’ for about 1000 predefined parameter combinations and 10 years of discharge data. First results show total nitrate uptakes ranging from almost 0 to 15% and high bending of C-Q curves correlated to high uptake rates. Furthermore, it was found that mean in-stream residence times, more than land-to-stream loading concentrations influence exported nutrient concentrations. The final result of our analysis will allow us to argue if the observed C-Q bending can be indeed related to instream uptake and not to other processes (e.g. denitrification along the subsurface flow path) and to derive the dominant processes shaping the uptake (such as light availability, instream travel time, nutrient stoichiometry, and impact of fine sediments).