Modelling and evaluating nitrogen transport from land into the ocean

Tobias Stacke¹, Stefan Hagemann², and Helmuth Thomas³

¹Max Planck Institute for Meteorology, The Ocean in the Earth System, Hamburg, Germany (tobias.stacke@mpimet.mpg.de)
²Helmholtz-Zentrum Hereon, Institute of Coastal Systems - Analysis and Modelling, Geesthacht, Germany
³Helmholtz-Zentrum Hereon, Institute of Carbon Cycles, Geesthacht, Germany

The representation of biogeochemical cycles in land surface and ocean models is advancing focusing not only on the carbon cycle but also on nutrient interactions such as nitrogen. Some land surface models (LSM) already compute leaching of these constituents from the soil, and some ocean models (OM) consider nutrient influx from the land for a number of processes, e.g. biological activity. However, the OMs usually use observed data or prescribed climatologies as input instead of the nutrient loads computed by the LSMs. This setup cannot readily represent the effects of climate or land use change on nutrient availability and therefore limits the applications of OMs or Earth System Models with respect to climate change impacts on coastal ocean biogeochemistry.

For this reason, we extended our hydrology models, the HydroPy (land surface hydrology) and the HD Model (river routing), to not only transport water but also nitrogen. Additionally, we account for several nitrogen processes like fixation, plant assimilation and denitrification on the land surface. Using atmospheric deposition and fertilizer application provided by the CMIP6 project as model inputs, we simulate the riverine nitrogen input to the ocean in a similar magnitude compared to observations. Furthermore, we include the effects of different socio-economic pathways with respect to climate change, land use change and fertilizer application in future projections. Based on these simulations – conducted at global scale with 0.5deg resolution using forcing from the GFDL-ESM4 model provided by the ISIMIP project - we present possible impacts on riverine nitrogen flow until the end of the century.