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Nitrogen-carbon cycle interactions in the MPI Earth System Model

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Nitrogen (N) is a major nutrient in marine and terrestrial ecosystems. Its biogeochemical cycle is densely interwoven with the carbon (C) cycle. While the long term ratio of C:N in the deep ocean is nearly constant at a value of 16, local and temporal variations, in particular a deficiency of nitrogen, have been observed. It is an ongoing and relatively new field in Earth System Science to investigate the mechanisms behind these deviations and how the involved processes interact with other components of the Earth System. In the framework of the EU FP7 project COMBINE, the nitrogen cycle has been included in the marine biogeochemistry model HAMOCC, which is a component of the MPI-ESM Earth System Model. In the presentation, the main biogeochemical processes and the implementation of the nitrogen cycle in HAMOCC will be outlined. The model setup including nitrogen is used in CMIP5 experiments to investigate, amongst other issues, if the loss of nitrogen due to denitrification in oxygen depleted waters is increasing or decreasing in a future warming climate. While it has been postulated from prospected lower oxygen concentrations that denitrification will increase in a warmer climate, our model results suggest that circulation changes result in a reduced nutrient input into the surface ocean, and hence lower biological export production. This leads to decreased remineralisation and, thus, lower oxygen depletion of subsurface waters. As a result, the MPI-ESM simulates a decrease in denitrification rather than an increase in the climate perturbed ocean.