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Marine Nitrogen loss in Oxygen minimum zones: a modeling approach

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In the oxygen minimum zones (OMZ) of the global ocean fixed nitrogen is lost by two pathways: heterotrophic denitrification and anaerobic ammonium oxidation (anammox). Lab experiments show that denitrification and anammox occur at a ratio of about 70:30 depending on the amount and the C:N ratio of the available organic matter. However, observations in the OMZ are sparse and, thus, the contribution of anammox to the global loss of fixed nitrogen is still under debate. In addition, it is projected that the OMZ expand in the future due to global warming. This compels an urgent need to understand the controlling mechanisms of nitrogen loss in OMZ.
Global biogeochemical ocean models assessed in the last IPCC have a rather poor representation of nitrogen related processes, primarily focusing on nitrate. These models do not include the nitrogen loss by anammox as they lack a representation of ammonium and nitrite.
Here we present results of a more comprehensive marine nitrogen cycle including interactions between nitrate, nitrite, ammonium and organic matter in the water column and the sediments in the framework of HAMOCC, the global biogeochemical ocean model of the Max Planck Institute for Meteorology. The representation of a stepwise dissimilatory nitrate reduction to nitrite and ammonium captures observed features like the secondary nitrite maximum. We set up a global marine nitrogen budget and discuss changes in the subsurface oxygen distributions.