EGU22-7615
https://doi.org/10.5194/egusphere-egu22-7615
EGU General Assembly 2022

Global impact of benthic denitrification on diazotroph physiology and N_2 fixation rates

Na Li[1], Christopher Somes[1], Angela Landolfi[2], Chia-Te Chien[1], Markus Pahlow[1], and Andreas Oschlies[1]

[1]GEOMAR Helmholtz Center for Ocean Research Kiel, Kiel, Germany (nli@geomar.de)
[2]CNR-ISMAR, Rome, Italy

Nitrogen (N) is one of the crucial limiting nutrients for phytoplankton growth in the ocean. The main source of bioavailable N to the ocean is N_2-fixing diazotrophs in the surface layer. Since the global coverage of N_2 fixation observations is sparse on temporal and spatial scales, the fundamental processes and mechanisms controlling N_2 fixation are not well understood nor constrained. We implement benthic denitrification in the optimality-based plankton ecosystem model (OPEM), which is incorporated into an Earth System Model of intermediate complexity (UVic-ESCM 2.9). Benthic denitrification occurs mostly in coastal upwelling regions and shallow continental shelves, and affects significantly the marine fixed-N budget since it is the largest N-loss process in the global ocean. We carry out model calibration and parameter selection based on observations of Chl, NO_3^-, PO_4^{3-}, O_2 and $N^*=NO_3^- - 16PO_4^{3-}$. Compared to considering water-column denitrification in suboxic zones as the only N-loss process in the ocean, our new model version simulates a more realistic distribution and higher global rates of N_2 fixation, which are supported by independent rate measurements. The optimized cellular N:P ratios of diazotrophs in the model version with benthic denitrification better correspond to independent culture estimates, and result in a closer reproduction of the particulate N:P ratios. Our model results indicate that benthic denitrification plays an important role shaping patterns, rates and even physiological aspects of N_2 fixation throughout the global ocean and should be accounted for when understanding and predicting changes to N_2 fixation.