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Incorporating nitrogen fixing cyanobacteria in the global biogeochemical model HAMOCC

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Nitrogen fixation by marine diazotrophs plays a fundamental role in the oceanic nitrogen and carbon cycle as it provides a major source of 'new' nitrogen to the euphotic zone that supports biological carbon export and sequestration. Since most global biogeochemical models include nitrogen fixation only diagnostically, they are not able to capture its spatial pattern sufficiently. Here we present the incorporation of an explicit, dynamic representation of diazotrophic cyanobacteria and the corresponding nitrogen fixation in the global ocean biogeochemical model HAMOCC (Hamburg Ocean Carbon Cycle model), which is part of the Max Planck Institute for Meteorology Earth system model (MPI-ESM). The parameterization of the diazotrophic growth is thereby based on available knowledge about the cyanobacterium Trichodesmium spp., which is considered as the most significant pelagic nitrogen fixer. Evaluation against observations shows that the model successfully reproduces the main spatial distribution of cyanobacteria and nitrogen fixation, covering large parts of the tropical and subtropical oceans.
Besides the role of cyanobacteria in marine biogeochemical cycles, their capacity to form extensive surface blooms induces a number of bio-physical feedback mechanisms in the Earth system. The processes driving these interactions, which are related to the alteration of heat absorption, surface albedo and momentum input by wind, are incorporated in the biogeochemical and physical model of the MPI-ESM in order to investigate their impacts on a global scale. First preliminary results will be shown.