



The dimethylsulfide cycle in the eutrophied Southern North Sea: a model study integrating phytoplankton and bacterial processes

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We developed a module describing the dimethylsulfoniopropionate (DMSP) and dimethylsulfide (DMS) dynamics, including biological transformations by phytoplankton and bacteria, and physico-chemical processes (including DMS air-sea exchange). This module was integrated in the MIRO ecological model and applied in a 0D frame in the Southern North Sea (SNS). The DMS(P) module is built on parameterizations derived from available knowledge on DMS(P) sources, transformations and sinks, and provides an explicit representation of bacterial activity in contrast to most of existing models that only include phytoplankton process (and abiotic transformations). The model is tested in a highly productive coastal ecosystem (the Belgian coastal zone, BCZ) dominated by diatoms and the Haptophyceae *Phaeocystis*, respectively low and high DMSP producers. On an annual basis, the particulate DMSP (DMSPp) production simulated in 1989 is mainly related to *Phaeocystis* colonies (78%) rather than diatoms (13%) and nanoflagellates (9%). Accordingly, sensitivity analysis shows that the model responds more to changes in the sulfur:carbon (S:C) quota and lyase yield of *Phaeocystis*. DMS originates equally from phytoplankton and bacterial DMSP-lyase activity and only 3% of the DMS is emitted to the atmosphere. Model analysis demonstrates the sensitivity of DMS emission towards the atmosphere to the description and parameterization of biological processes emphasizing the need of adequately representing in models both phytoplankton and bacterial processes affecting DMS(P) dynamics. This is particularly important in eutrophied coastal environments such as the SNS dominated by high non-diatom blooms and where empirical models developed from data-sets biased towards open ocean conditions do not satisfactorily predict the timing and amplitude of the DMS seasonal cycle. In order to predict future feedbacks of DMS emissions on climate, it is needed to account for hotspots of DMS emissions from coastal environments that, if eutrophied, are dominated not only by diatoms.