Trait-based representation of diatom diversity in a Plankton Functional Type model

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Biogeochemical models often reduce biological complexity by assembling a large number of species sharing common ecological and biogeochemical functions into Plankton Functional Types (PFTs). In this approach, species diversity inside each PFT is generally not considered. Conversely, recent adaptive modelling approaches emphasize plankton diversity by letting communities self-assemble through competition amongst large numbers of species. Here, we combine adaptive and PFT approaches by introducing a trait-based description of diatoms in the existing MIRO model. The latter describes carbon and nutrient cycles in the Southern North Sea ecosystem with three autotrophic (diatoms, *Phaeocystis*, nanoflagellates) and three heterotrophic (bacteria, micro- and meso-zooplankton) PFTs. The new trait-based module relates fundamental properties of diatoms to their size: smaller diatoms have a higher maximum growth rate and nutrient affinity, while larger diatoms benefit from reduced grazing pressure and silicon needs. This trade-off makes optimal diatom size dependent on resource availability and predation pressure, favouring species succession in a variable environment. The diatom community is modelled as a continuum of sizes, which is represented by the total diatom biomass, their mean biovolume and its variance. The model is implemented in the Belgian coastal zone, where high quality observations allow a reconstruction of nutrients, PFT concentrations and diatom community structure for 1988-2000. The added value of the trait-based description of diatoms is evaluated by comparing outcomes from the original MIRO PFT model and the trait-based approach. Results are further analysed to identify the mechanisms driving diatom succession.