Trait-based representation of diatom functional diversity in a Plankton Functional Type model of the eutrophied Southern North Sea

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We introduce a trait-based description of diatom functional diversity to an existing Plankton Functional Type (PFT) model, implemented for the eutrophied coastal ecosystem in the Southern Bight or the North Sea. The trait-based description represents a continuum of diatoms species, each characterized by a distinct cell volume, and includes size-dependence of four diatom traits: the maximum growth rate, the half-saturation constants for nutrient uptake, the photosynthetic efficiency, and the relative affinity of copepods for diatoms. Through competition under seasonally varying forcing, the fitness of each diatom varies throughout time and the outcome of competition results in a changing community structure. The predicted seasonal change in mean cell volume of the community is supported by field observations: smaller diatoms, which are more competitive in terms of resource acquisition, prevail during the first spring bloom while the summer bloom is dominated by larger species which better resist grazing. The size-based model is used to determine the ecological niche of diatoms in the area and identifies a range of viable sizes which matches observations. The general trade-off between small, competitive diatoms and large, grazing-resistant species is a convenient framework to study patterns in diatom functional diversity. PFT models and trait-based approach constitute promising complementary tools to study community structure in marine ecosystems.