How important is diversity for capturing environmental-change responses in ecosystem models?

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Marine ecosystem models used to investigate how global change affects ocean ecosystems and their functioning typically omit pelagic plankton diversity. Diversity, however, may affect functions such as primary production and their sensitivity to environmental changes. Here we use a global ocean ecosystem model that explicitly resolves phytoplankton diversity by defining subtypes within four phytoplankton functional types (PFTs). We investigate the model's ability to capture diversity effects on primary production under environmental change. An idealized scenario with a sudden reduction in vertical mixing causes diversity and primary-production changes that turn out to be largely independent of the number of coexisting phytoplankton subtypes. The way diversity is represented in the model provides a small number of niches with respect to nutrient use in accordance with the PFTs defined in the model. Increasing the number of phytoplankton subtypes increases the resolution within the niches. Diversity effects such as niche complementarity operate between, but not within PFTs, and are constrained by the variety of traits and trade-offs resolved in the model. The number and nature of the niches formulated in the model, for example via trade-offs or different PFTs, thus determines the diversity effects on ecosystem functioning captured in ocean ecosystem models.

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