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Modeling the coupling of ocean ecology and biogeochemistry

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We examine the interplay between ecology and biogeochemical cycles in the context of a global three-dimensional ocean model where self-assembling phytoplankton communities emerge from a wide set of potentially viable cell types. The simulations have clear and plausible organization of the emergent community structure by the physical regime: Strongly seasonal, high nutrient regimes are dominated by fast-growing bloom specialists, while stable, low-seasonality regimes are dominated by organisms that can grow at low nutrient concentrations, and are suited to oligotrophic conditions. In the latter regions, resource competition theory is capable of predicting not only the competitive outcome amongst organisms, but also the ecosystems control on the ambient nutrients. Sensitivity experiments clearly indicate the strong coupling of ecology and biogeochemical cycles: Changes to the phytoplankton physiology had a predictable effect on nutrient concentrations. We investigate how inter-annual variability and potential future changes to the ocean impact the biogeographical organization in our model.