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Oceanic Primary production decline halved in eddy-resolving simulations of global warming

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The decline in ocean primary production is one of the most alarming consequences of anthropogenic climate change. This decline could indeed lead to a decrease in marine biomass and fish catch, as highlighted by recent policy-relevant reports. Because of computational constraints, current Earth System Models used to project ocean primary production under global warming scenarios have to parameterize flows occurring below the resolution of their computational grid (typically 1°). To overcome these computational constraints, we use an ocean biogeochemical model in an idealized configuration representing a mid-latitude double-gyre circulation, and perform global warming simulations under increasing horizontal resolution (from 1° to 1/27°) and under a large range of parameter values for the eddy parameterization employed in the coarse resolution configuration. In line with projections from Earth System Models, all our simulations project a marked decline in net primary production in response to the global warming forcing. Whereas this decline is only weakly sensitive to the eddy parameters in the eddy-parametrized coarse resolution, the simulated decline in primary production is halved at the finest eddy-resolving resolution (-12% at 1/27° vs -26 at 1°). This difference stems from the high sensitivity of the subsurface nutrient transport to model resolution. Our results call for improved representation of the role of eddies on nutrient transport below the seasonal mixed-layer to better constrain the future evolution of marine biomass and fish catch potential for decision-making.