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A Latitudinally-Banded Phytoplankton Response to 21st Century Climate Change in the Southern Ocean across the CMIP5 Model Suite

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Abstract Text:

Changes in Southern Ocean (SO) phytoplankton distributions with future warming have the potential to significantly alter nutrient and carbon cycles as well as higher trophic level productivity both locally and throughout the global ocean. Here we investigate the response of SO phytoplankton productivity and biomass to 21st century climate change across the CMIP5 Earth System Model suite. The models predict a zonally-banded pattern of phytoplankton abundance and production changes within 4 regions: the subtropical (~30°S to 40°S), transitional (~40°S to 50°S), subpolar (~50°S to 65°S) and Antarctic (south of ~65°S) bands. We find that shifts in bottom-up variables (nitrate, iron, and light availability) drive changes in phytoplankton abundance and production on not only interannual, but also decadal and 100-year timescales: the timescales most relevant to climate change. Spatial patterns in the modeled mechanisms driving these biomass trends qualitatively agree with recent observations, though longer-term records are needed to separate the effects of climate change from those of interannual variability. Because much past observational work has focused on understanding the effects of the Southern Annular Mode (SAM) on biology, future work should attempt to quantify the precise influence of an increasingly positive SAM on SO biology within the CMIP5 models. Continued long-term in-situ and satellite measurements of SO biology are clearly needed to confirm model findings.

Topic Selection: Variability in Southern Ocean Productivity over Different Timescales

Title: A Latitudinally-Banded Phytoplankton Response to 21st Century Climate Change in the Southern Ocean across the CMIP5 Model Suite
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