

Predicting the behavior of ocean ecology in a changing climate: theory and coupled model intercomparison

Irina Marinov[†]; Roman Shor; Anand Gnanadesikan; John Dunne

[†] University of Pennsylvania, USA

Leading author: imarinov@sas.upenn.edu

Climate driven changes to the physical structure of the ocean will modify oceanic temperature, light, and nutrients, essential ingredients for the growth of ocean phytoplankton. In turn, changes in phytoplankton growth and community structure will affect export production, deep ocean carbon storage, and ultimately feedback on atmospheric carbon dioxide levels and climate. Following previous work, we show the formulation of the growth rates suggests that in the low nutrient regions roughly corresponding to 40S - 40N, future nutrient decreases due to increasing stratification will have a bigger impact on small phytoplankton biomass than on diatom biomass. We explore the consequences for export production and the carbon cycle. More broadly, we propose an analytical framework linking changes in nutrients, light and temperature with changes in phytoplankton biomass. We assess these theoretical considerations against coupled model projections (1980-2100) from two of the leading US IPCC-class Earth System models, the NCAR CCSM3.1 and the GFDL ESM2.1. These models differ in their representation of the global iron cycle and zooplankton grazing, resulting in different phytoplankton community structures, different surface chlorophyll and productivity, and ultimately different ecological responses to climate change. We aim to predict the ecological response to future climate change and the consequences for ocean carbon storage and atmospheric carbon dioxide at the global scale, based on a theoretical analysis and on model intercomparison. Note: This work seems to be appropriate for two sessions: poster Session C44: The Changing Role of the Ocean and Land in the Global Carbon Balance (conveners: C. Sabine, T. Tanhua, V. Romanovsky, J. Canadell) and oral Session B12: Understanding Anthropogenic Climate Change in Terms of Processes and Feedbacks (conveners: C. Senior, J. Mitchell, H. Le Treut). Please send to the one you find most appropriate. Thank you.