

ID: W1899290980

TITLE: Climate change impacts on net primary production (NPP) and export production (EP) regulated by increasing stratification and phytoplankton community structure in the CMIP5 models

AUTHOR: ['Weiwei Fu', 'James T. Randerson', 'J. Keith Moore']

ABSTRACT:

Abstract. We examine climate change impacts on net primary production (NPP) and export production (sinking particulate flux; EP) with simulations from nine Earth system models (ESMs) performed in the framework of the fifth phase of the Coupled Model Intercomparison Project (CMIP5). Global NPP and EP are reduced by the end of the century for the intense warming scenario of Representative Concentration Pathway (RCP) 8.5. Relative to the 1990s, NPP in the 2090s is reduced by 2?16 % and EP by 7?18 %. The models with the largest increases in stratification (and largest relative declines in NPP and EP) also show the largest positive biases in stratification for the contemporary period, suggesting overestimation of climate change impacts on NPP and EP. All of the CMIP5 models show an increase in stratification in response to surface?ocean warming and freshening, which is accompanied by decreases in surface nutrients, NPP and EP. There is considerable variability across the models in the magnitudes of NPP, EP, surface nutrient concentrations and their perturbations by climate change. The negative response of NPP and EP to increasing stratification reflects primarily a bottom-up control, as upward nutrient flux declines at the global scale. Models with dynamic phytoplankton community structure show larger declines in EP than in NPP. This pattern is driven by phytoplankton community composition shifts, with reductions in productivity by large phytoplankton as smaller phytoplankton (which export less efficiently) are favored under the increasing nutrient stress. Thus, the projections of the NPP response to climate change are critically dependent on the simulated phytoplankton community structure, the efficiency of the biological pump and the resulting levels of regenerated production, which vary widely across the models. Community structure is represented simply in the CMIP5 models, and should be expanded to better capture the spatial patterns and climate-driven changes in export efficiency.

SOURCE: Biogeosciences

PDF URL: <https://www.biogeosciences.net/13/5151/2016/bg-13-5151-2016.pdf>

CITED BY COUNT: 166

PUBLICATION YEAR: 2016

TYPE: article

CONCEPTS: ['Primary production', 'Environmental science', 'Phytoplankton', 'Coupled model intercomparison project', 'Stratification (seeds)', 'Climate change', 'Nutrient', 'Atmospheric sciences', 'Climate model', 'Ecosystem', 'Oceanography', 'Ecology', 'Geology', 'Biology', 'Seed dormancy', 'Germination', 'Botany', 'Dormancy']