Impact of biological feedback on heat fluxes and sea surface temperature in global and regional ocean models

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Abstract

Ocean models require parameterization of the penetrative length scales of shortwave radiation into the surface ocean. Surface ocean biogeochemistry may modulate these length scales for climate models and this variability may, in turn, impact numerical model forecasts of surface ocean temperatures and consequent ocean heat exchanges. We present results from both global and regional ocean biogeochemical models simulating the sensitivity of the systems to various representations of surface ocean biogeo-optical variability. Global ocean models with the biogeochemical Ocean Color Model (OCM) demonstrate secondary circulation effects due to biogeo-optical variability in surface waters. Regional-scale bespoke ocean/atmosphere models further indicate a significant impact on subsurface thermal energy exchanges when coastal phytoplankton blooms are represented in the modeling system.

Global HYCOM Bio-Feedback

Global bio-feedback experiments on two scales (monthly and bi-weekly) with interannual variability are used to determine model sensitivity to alternative representations of solar attenuation. Model skill is evaluated using the thermal wind equation. Evaluation is examined via computational tools and bars of detail warranted for including increasingly detailed attenuation capabilities into the Navy global ocean models.

Regional COAMPS Bio-Feedback

Bio-feedback within regional domains is represented with the Coupled Ocean-Atmosphere Prediction System (COAMPS) on spatial scales of 3 km and finer, and temporal scales from 30 min to 1 day. Our studies show how the spatial and temporal biogeo-optical variability impacts the coupled modeling system.

Figure A: The blue model light indicates the presence of phytoplankton within the model with a large spatial extent, while the green model light indicates that there are no phytoplankton in the model. The red model light indicates the presence of phytoplankton within the model with a small spatial extent. Figure B: The blue model light indicates the presence of phytoplankton within the model with a large spatial extent, while the green model light indicates that there are no phytoplankton in the model. The red model light indicates the presence of phytoplankton within the model with a small spatial extent. Figure C: The blue model light indicates the presence of phytoplankton within the model with a large spatial extent, while the green model light indicates that there are no phytoplankton in the model. The red model light indicates the presence of phytoplankton within the model with a small spatial extent.

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