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A modeling study on bio-physical process associated with ENSO

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Variability of marine phytoplankton associated with El Niño-Southern Oscillation (ENSO) and potential biological feedbacks onto ENSO are investigated using coupled ocean model experiments forced by realistic surface wind from 1951 to 2010. The model used in this study is the MOM4 oceanic GCM coupled to a biogeochemical model, called TOPAZ (Tracers in the Ocean with Allometric Zooplankton). In general, MOM4-TOPAZ model simulates the major observed features of phytoplankton variability associated with ENSO reasonably well.
By comparing the interactive MOM4-TOPAZ experiment and the ocean model-only experiments prescribed with the various chlorophyll concentrations, the potential impact of phytoplankton on ENSO is also evaluated. We found that chlorophyll generally plays a role in increasing the mean SST and decreasing subsurface temperature by altering the extent of penetration of solar radiation. However, as the chlorophyll concentration is increased, the equatorial Pacific SST is decreased due to the enhanced upwelling of the cooled sub-surface water with shoaling of mixed layer and thermocline. In these experiments, the presence of chlorophyll generally intensifies the ENSO amplitude by changing ocean basic state. On the other hand, interactively varying chlorophyll associated with ENSO tends to reduce the ENSO amplitude. Therefore, the two biological effects are competing each other regarding the SST variance in the equatorial Pacific.