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Biological feedbacks in the tropical Pacific

J.-Y. Park, J.-S. Kug, and Y.-G. Park
Korea Ocean Research and Development Institute, Ansan, South Korea (jylovesu@kordi.re.kr)

Potential biological feedbacks onto El Niño-Southern Oscillation (ENSO) are investigated by performing coupled physical/biogeochemical model experiments. The ocean model used in this study is the MOM4, which is coupled to a biogeochemical model, called TOPAZ (Tracers in the Ocean with Allometric Zooplankton). In general, the coupled model can simulate the observed main features of phytoplankton variability associated with ENSO reasonably well.
By comparing the actively coupled physical/biogeochemical experiment with the physical model-only experiments with prescribed chlorophyll concentrations, potential impacts of phytoplankton on ENSO are evaluated. We found that chlorophyll generally increases mean sea surface temperature (SST) and decreases subsurface temperature by altering the penetration of solar radiation. However, as the chlorophyll concentration increases, the equatorial Pacific SST decreases due to the enhanced upwelling of the cooler subsurface water with shoaling of mixed layer and thermocline. In these experiments, the presence of chlorophyll generally intensifies ENSO amplitude by changing the ocean basic state. On the other hand, interactively varying chlorophyll associated with the ENSO tends to reduce ENSO amplitude. Therefore, the two biological effects on SST are competing against each other regarding the SST variance in the equatorial Pacific.