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Modeling the effect of ENSO on the lower trophic level ecosytem of the Cold Tongue and the Warm Pool regions of the equatorial Pacific

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The effects of El Niño-Southern Oscillation (ENSO) processes on the lower trophic levels of Cold Tongue and Warm Pool regions were examined with eight-year simulations for a time, 1991-1999, that included three ENSO cycles. A one-dimensional multi-component lower trophic level ecosystem model that includes detailed algal physiology is used, which is forced by a eight-year time series of physical fields obtained from the Tropical Atmosphere-Ocean (TAO) Array mooring. The simulated response of the lower trophic levels in the two regions of the equatorial Pacific to ENSO cycles differs in community structure and level of production. For the Cold Tongue region, the ENSO warm phase results in a shift to small algal forms (e.g., $Prochlorococcus$ spp. and $Synechecoccus$) and low primary productivity (25 mmol C m^{-2} d^{-1} versus an annual average of 75 mmol C m^{-2} d^{-1}). For the Warm Pool region, the phytoplankton community is dominated by larger algal forms (e.g., autotrophic eukaryotes) and primary production increases (150 mmol C m^{-2} d^{-1} versus an annual average of 59 mmol C m^{-2} d^{-1}). Also, during ENSO events carbon production and export in the Cold Tongue are limited by iron, whereas the relative abundance of iron and macronutrients (i.e. nitrate, silicate) limits production and export in the Warm Pool. Model results suggest that the occurrance of the large bloom following the 1997 El Niño at 140°W cannot be explained by local processes and that resolving the so called "barrier layer" is critical to simulate the biological dynamics at 165°E. Inclusion of diurnally varying mixed layer depths did not greatly affected the simulated carbon export.