Scale-dependent effects on ENSO induced by ocean chlorophyll due to interannual variability and tropical instability waves

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Large perturbations in chlorophyll (Chl) are observed to coexist at interannual and tropical instability wave (TIW) scales in the tropical Pacific; their combined net effects on ENSO through ocean biology-induced heating (OBH) feedbacks are not known. Here, a new hybrid coupled model for atmosphere and ocean physics-biology (HCM AOPB) is used to quantify ways ENSO can be modulated, individually or collectively, by Chl perturbations at interannual and TIW scales, respectively. HCM-based sensitivity experiments demonstrate a counteracting effect on ENSO: the bio-feedback due to interannual Chl variability tends to damp ENSO via its influence on the stratification and vertical mixing in the upper ocean, whereas that due to TIW-scale Chl perturbations tends to amplify ENSO. A bias source for ENSO simulation is illustrated that is related with Chl effect in the tropical Pacific, adding in a new insight into interactions between the climate system and ocean ecosystem on different scales in the tropical acific. Because ENSO simulations are sensitively dependent on the way Chl effects are represented at different scales, it is necessary to adequately include the related Chl effects in climate modeling. These results reveal a level of complexity of ENSO modulations resulting from TIW-scale Chl effects associated with ocean biogeochemical processes and their interactions with physical processes in the tropical Pacific.

Keywords: Ocean chlorophyll, Interannual variability and Tropical instability waves, Compensated feedback effects , A coupled ocean-atmosphere model

