Geophysical Research Abstracts, Vol. 8, 04440, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04440

Interactions between marine biology and the El Nino Southern Oscillation: a conceptual analysis

M. Heinemann (1,3), A. Timmermann (2), U. Feudel (1)

(1) ICBM, University of Oldenburg, Oldenburg, Germany, (2) SOEST, University of Hawaii at Manoa, Honolulu, Hawaii, (3) now at MPI Meteorology, Hamburg, Germany

A conceptual model is developed and used to investigate the interaction between marine biology and the El Nino-Southern Oscillation. Ocean and atmosphere are represented by a dynamical two-box model for the equatorial Pacific cold tongue and warm pool. Marine biology is described by a three-component (nutrient, phytoplankton and herbivorous zooplankton) ecosystem model. On the one hand, the implemented biological growth rates depend on the upwelling of nutrients and the availability of photosynthetically active radiation (PAR). On the other hand, phytoplankton affects light absorption and thus the mixed layer heat budget.

To understand the bio-physical coupling mechanisms, the physical and the biological model are investigated as stand-alone models and subsequently in a coupled system. Our emphasis lies on a qualitative analysis, i.e. studying the long-term behavior with respect to a variation of selected parameters and its stability with respect to perturbations.

Self-sustained biological oscillations are found only in the stand-alone ecosystem model. In the coupled system, ENSO forces an oscillation of the ecosystem mostly due to stronger nutrient upwelling during La Nina. The ENSO-associated variation of PAR has a minor effect on the ecosystem. Phytoplankton in turn causes an additional heating of the mixed layer. For our default parameter set this heating is found to be stronger during La Nina than during El Nino. Marine biology also prolongates the period of ENSO. However, the biological feedback depends strongly on the ecosystem parameterization.