Preliminary results of a marine ecosystem model coupled with Ocean General Circulation model

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To predict the effects of global warming on ecosystem dynamics and the effects of those changes in ecosystem dynamics on biogeochemical cycles and oceanic CO_2 uptake, we need to develop (Biogeochemical General Circulation Models (BGCMs) which represent explicitly the dynamics of oceanic ecosystems and settling particles. During the last few years, we have been developing a one dimensional ecosystem model with Nitrogen-Silicon-Carbon cycles, which is an extension of the NEMURO model developed by PICES. We have applied this model to several Times Series Stations: HOT, PAPA, KNOT, and A7 (the last two stations are in the western North Pacific and are maintained by Japanese groups). We divide phytoplankton and zooplankton into two and three categories, respectively: large phy-toplankton, small phytoplankton, large zooplankton, small zooplankton and predatory zooplankton. Large phytoplankton represents diatoms that make siliceous shells. A fraction of the small phytoplankton and zooplankton are regarded as calcarous-shelled cocolithophorids and foraminifera, respectively. The model includes three nutrients and three kinds of settling particles: nitrate, ammonium, and silicate, particulate organic matter, opal, and calcium carbonate. Dissolved organic matter is also included in the model. We also calculate total alkalinity, total carbon dioxide and partial pressure of carbon dioxide. Now we are incorporating this ecosystem model into a three dimensional ocean general circulation model which has one degree resolution in both latitude and longitude and 40 vertical levels. After a time integration of ten years, the global distributions of chlorophyll-a and sea surface nutrients agree roughly with observations, although we still need to tune the biological parameters.