Application of a one-dimensional coupled physical-biogeochemical model for the South East Asia Time-series Station in South China Sea during recent ENSO events

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INTRODUCTION

A one-dimensional coupled physical-biogeochemical model was developed to explore the inter-annual variability of marine biogeochemistry response to atmospheric forcing at the South-East Asian Time-series Study (SEATS) site in the northern South China Sea (SCS).

BACKGROUND

Physical Model: Mellor and Yamada level 2.5 turbulence closure model (1982)

Biogeochemical Model: NPZD model with Chl/Phy changes according to photo-adaptation (Liu et al., 2002, 2007), **Fig.2.**

Coupled Physical-biogeochemical Model Conditions: There are 202 layers in vertical depth distribution with 1 m resolution, and time step is one min. Biogeochemical model works as a subroutine.

Initial Conditions: Observed Mar. & Sep. profile data (only Mar. data shown below in **Fig.3**)

Model Driving Forcing: NCEP wind-stress and heat fluxes (6 hourly) data, **Fig. 4**.

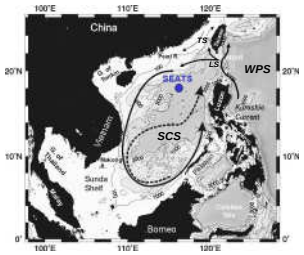


Fig.1 Study Area

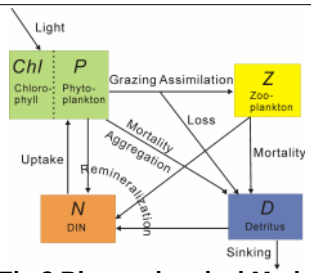


Fig.2 Biogeochemical Model

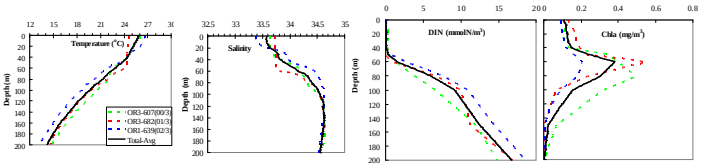


Fig.3 Dashed lines represent observed data. Solid lines are averaged data and used as model initial condition.

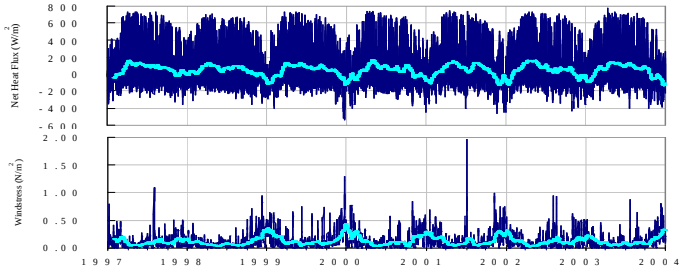
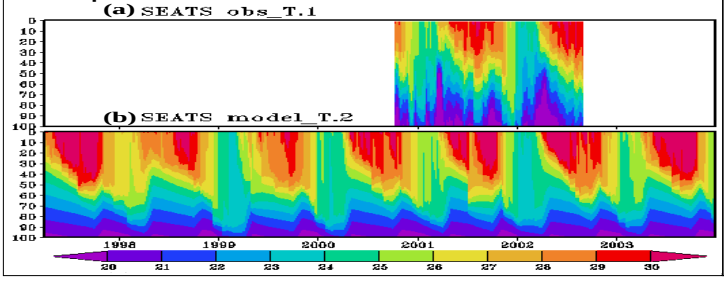


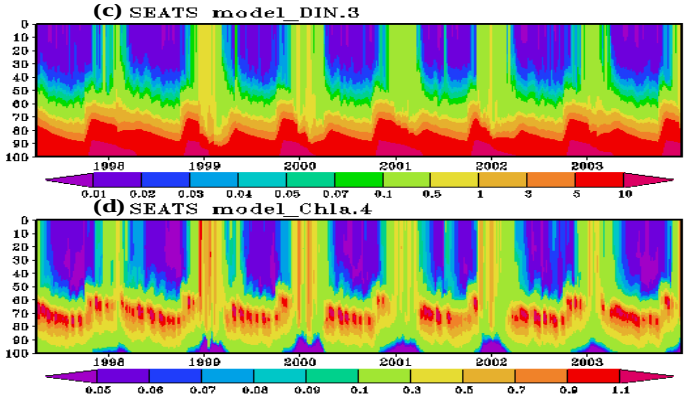
Fig.4 Model driving forcing. Dark blue lines represent 6 hourly data, and light ones are 31 days running mean data.

RESULTS

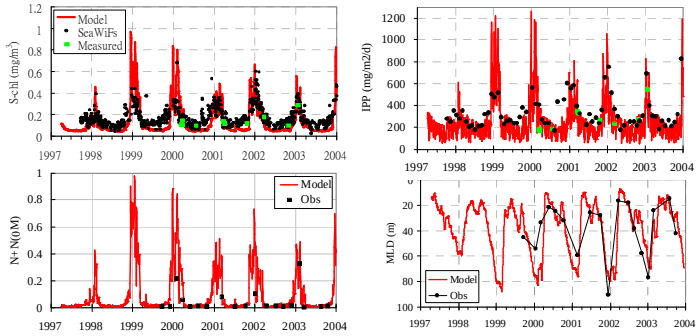
1. Temperature



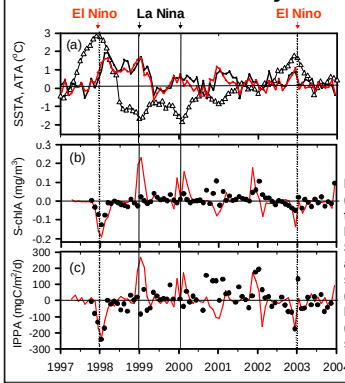
2. DIN and chl_a



3. Comparison with SEATS observations

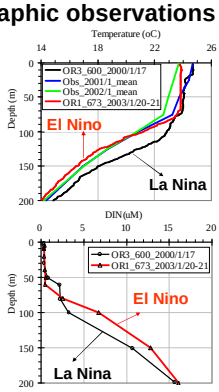


4. Interannual variability



Monthly anomalies in (a) SST (black), air temperature (red), and Nino 3.4 (triangles); (b) SeaWiFS-derived (dot) and modeled (line) surface chlorophyll-a (S-chl); (c) Integrated Primary Production (IPP), symbols are the same as in (b).

5. Hydrographic observations



CONCLUSIONS

The model successfully reproduced the seasonal cycles of S-chl and Integrated primary productivity (IPP) as compared to shipboard observations and SeaWiFS data derived values, and predicted the negative anomalies of S-chl and IPP under the 1997-98 and 2002-03 El Niño conditions. However, the model-predicted strong positive anomalies of S-chl and IPP under the 1998-99 and 1999-2000 La Niña conditions, which brought stronger winds and greater heat losses, were not substantiated by observations. Hydrographic conditions at the SEATS station indicated that, under La Niña conditions, unusual accumulation of warm and nutrient-depleted water occurred in the upper water column cancelled out the effect of stronger mixing. Therefore, the biogeochemical responses of the northern SCS to surface forcing during the recent El Niño/La Niña events were displayed in a highly asymmetrical manner.