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An Oceanographic Computational System for the South China Sea

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The South China Sea (SCS) is a semi-enclosed tropical sea between the Asia landmass to the north and the west, the Philippine Islands to the east, Borneo to the southeast and Indonesia to the south, with a total area of $3.5x10^6$ km^2. It has a fairly irregular tidal current and circulation system. This is due to the influence of astronomical tidal forcing along its boundaries, surface wind forcing of the summer/winter monsoons, and the complex topographical variations with depth ranging from 30m along the continental shelf to greater than 5000m in the trenches off Luzon.

The SCS encompasses many important navigational routes for shipping. It also forms one of the ocean boundaries for the coastal waters of Singapore, namely the eastern side. As such, it has been of interest to the Singapore maritime authority to develop an engineering capability for modeling the hydrodynamics and environment of the SCS. Towards this aim, we are developing a PC-based computational system for modeling the hydrodynamics, temperature and salinity environment of the SCS region and other regional seas surrounding Singapore. In our system, we adopt the Princeton Ocean Model (POM) as our computational model and drive the model with both monthly climatological data and hourly time-varying data along the appropriate open boundaries and sea surface. Hourly tidal elevation data for the open boundaries are assembled from the TotalTide Prediction of the UK Hydrographic Office. Monthly-mean climatological values of wind-stresses from Oberhuber's processed data on the COAD Dataset are used to provide the sea surface wind stress forcing. For the temperature and salinity environment, annually-mean and monthly-mean climatological data from the World Ocean Atlas (WOA) 1998 Dataset is used to initialize the model and to provide the sea surface thermohaline forcing as the solution marches in time. To assist numerical stability, relaxation are applied on the field variables along the open boundaries and sea surface at deep water to damp back to climatology, preventing any large deviation from climatology.

As a validation test case, we focus the simulation of our SCS model on the year of 1998 and seek to compare for both the sea surface elevation temporal data at selected interior points and the mean global circulation pattern of the SCS over the period of May to June 1998 where literature data is available. As the computational time is demanding for a full 3D baroclinic run on a PC platform, the model is spinned up as a "cold start" from February 1998 in a rather short 3-month duration before evaluating the results from May 98 onwards. A typical result is shown in Figure 1 below where the instantaneous plot of the depth-averaged horizontal velocity vectors show the presence of large scale gyres inside and along the border of the deep trenches. The color contours in this figure refers the bathymetry contours. Presently, the simulations are still ongoing and their results shall be analysed and presented.

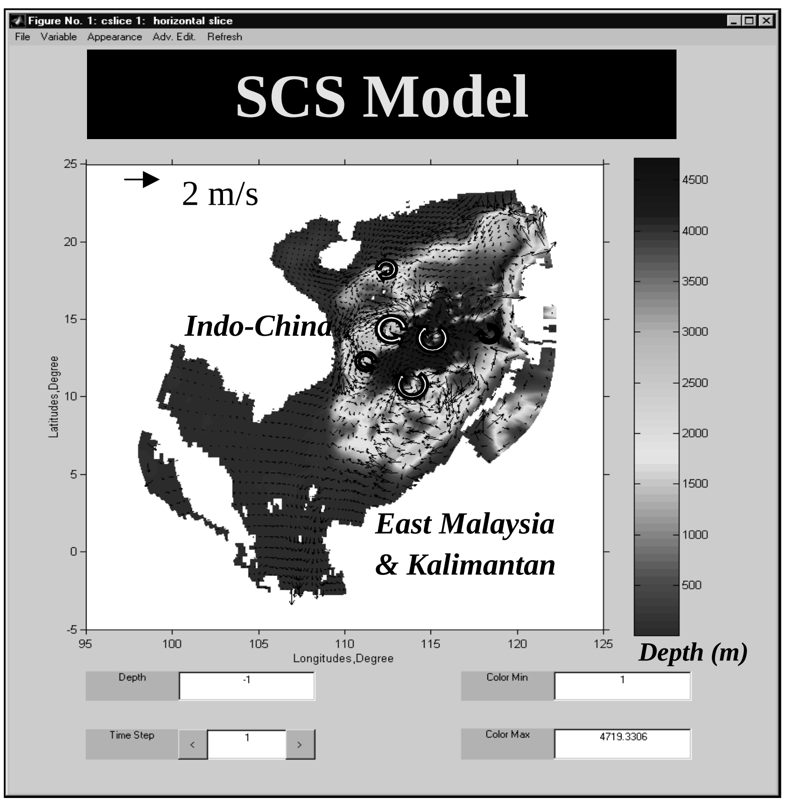

Figure 1. Typical plot of an instantaneous depth-averaged horizontal vectors showing presence of large scale gyres occurring in March 1998