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Coastal Atmospheric-Oceanic Coupled System (CAOCS) for the South China Sea (SCS)-a Modeling Component of the International South China Sea Monsoon Experiment (SCSMEX)

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LONG-TERM GOALS

The main goal is to establish a nowcast system for regional seas, including the South China Sea. This system will have the capability of diagnosing three dimensional velocity, temperature, and salinity fields from satellite and sparse in-situ observations. This system will be easily embedded into the prediction system (e.g., Princeton Ocean Model). The combined nowcast/forecast system will greatly enhance existing operational capability.

OBJECTIVES

This is a three-year proposal for extending the current NOMP research project (the South China Sea prediction system) to a coastal air-ocean coupled prediction system and for participating in the international South China Sea Monsoon Experiment (SCSMEX) during 1998-2002 as a modeling component. Under the current sponsorship we have developed: an optimization scheme for determining open boundary conditions, high-order difference schemes for reducing sigma coordinate error at abrupt topography, a statistical model for determining thermohaline variability, and a parametric model for obtaining physical characteristics (SST, mixed layer depth, thermocline depth, thermocline strength, ...) from vertical profiles. We propose to incorporate these new techniques into the South China Sea prediction system (POM) and to expand our modeling effort into a coastal air-ocean coupled model.

APPROACH

With the ONR support, I invited several professors and scientists from external institutions to the Naval Ocean Analysis and Prediction (NOAP) Laboratory at NPS for collaborative research.

(1) We established the Coastal Atmospheric and Ocean Coupled System (CAOCS) for coastal prediction. This system uses the National Center for Atmospheric Research (NCAR) most recent version of the regional climate model (RegCM2) as the atmospheric part, and the Princeton Ocean Model (POM) as the ocean part. The CAOCS was verified by both satellite and in situ measurements.

(2) We used an optimization method to establish an open boundary diagnosis module for determining open boundary conditions from interior observations. The module was tested by the Princeton Ocean Model (POM).

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(3) We used the GFDL Modular Ocean Model (MOM) to study the ocean surface flux correction and ocean climate drift.

(4) We proposed and verified a series of highly accurate numerical schemes to reduce computational errors.

(5) We used the Princeton Ocean Model (POM) to investigate the physical causes of the recently detected South China Sea warm-core and cold-core eddies, their transient feature, and used the NCAR RegCM2 to study the effects of the South China Sea on monsoon onset.

(6) We used the POM to investigate the response of the South China Sea to a moving cyclone.

(7) We used covariance model and parametric model to detect the South China Sea thermohaline feature and variability. Through this work, we establish a coastal environmental assessment system.

WORK COMPLETED

(1) We verified the coastal atmosphere-ocean coupled system (CAOCS) for numerical simulation and data assimilation; (2) We discovered second kind predictability in Lorenz system and climate models; (3) We identified the oceanic response to uncertain wind forcing; (4) We identified and modeled South China Sea warm-core and cool-core eddies, and the thermohaline variability of the South China Sea, Yellow Sea, and Sea of Japan. (5) We have developed and verified various high-order difference schemes for coastal modeling. (6) We developed and tested a geometric model for obtaining physical characteristics (SST, mixed layer depth, thermocline depth, thermocline strength, ...) from vertical profiles. (7) We developed and tested an optimization method has been developed for determining the open boundary conditions of coastal models. (8) We validated the P-vector inverse method using MOM model and observational data. (9) We validated the CAOCS system for South China Sea using AXBT measurements. (10) We participated the oceanographic component of the U.S. participation in the international SCSMEX.

RELATED PROJECTS

(1) International South China Sea Monsoon Experiment (SCSMEX). The current project is the U.S. oceanographic component of SCSMEX.

(2) Littoral Zone Ocean Prediction project sponsored by the Naval Oceanographic Office.

(3) Ocean modeling project (Australian Department of Environment, Sport, and Territories) sponsored my collaborator, Dr. Wenju Cai.

(4) Monsoon disturbances over southeast ans east Asia and adjacent seas (PI, Dr. C.-P. Chang) sponsored by the ONR Marine Meteorology Program.

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