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The Prediction of Wind-Driven Coastal Circulation

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LONG-TERM GOALS

To develop forecast systems for wind-driven coastal ocean flow fields.

OBJECTIVES

To understand the dynamics of and to build a predictive capability for wind-driven mesoscale oceanographic processes (2-50 km horizontal space scales, 2-10 day time scales) over the continental shelf as influenced by temporal and spatial variability of the atmospheric forcing, by spatial variability of the continental margin, and by internal mixing related to small-scale turbulence. The ocean variability of interest involves the most energetic motion over the shelf and includes the physical processes associated with alongshore coastal jets, upwelling and downwelling fronts, and eddies.

APPROACH

This National Oceanographic Partnership Program project combines modeling, data assimilation and an observational program off Oregon built around deployment of the existing OSU Coastal Radar System. A high-resolution, three-dimensional coastal ocean circulation model is being applied to an Oregon coastal region centered on Newport for direct simulations, data assimilation and process studies. The ocean model is being forced initially by observed winds and heat flux and the results compared with observations. Ultimately, the ocean model will be driven by surface fluxes from a high-resolution coastal atmospheric model, forced by an operational large-scale weather prediction model. Inverse methods, or data assimilation techniques, that combine data and models in a scientifically rigorous fashion are being developed.

The observational program involves long-term measurements from the OSU Coastal Radar System presently deployed near Newport. From April to September 1999, the land-based radar and other continuous measurements will be augmented by additional observations. The NOAA Environmental Technology Laboratory (ETL) will install additional coastal radar stations and will measure vertical profiles of winds at the coast using an upward-looking profiler. Small-boat hydrographic and velocity surveys will provide three-dimensional fields to the modeling and data assimilation efforts. Satellite-sensed sea surface temperature (via AVHRR) and roughness (via SAR) will be made available by Ocean Imaging during the six-month observational period. During the last three months of this period, three moorings equipped with current, temperature and conductivity(salinity) sensors throughout the water column will be installed off Newport. One of these moorings will also measure surface winds, pressure, air temperature and solar insolation.

During July 1999, we will conduct a three-week intensive sampling program using the R/V Wecoma. We will collect high-resolution hydrographic, velocity and microstructure data throughout the water column in a region near Newport matching the coverage of the land-based radar, roughly 50 by 50 km. The high-resolution hydrographic fields obtained with a towed, undulating measurement package (SeaSoar) and velocity fields measured by a shipboard ADCP will be used to initialize and provide ongoing data for assimilation into the high-resolution coastal model. The microstructure data, consisting of cross-shelf sections of kinetic energy and temperature dissipation rates, will be used with the model to assess the role of small scale turbulence in determining the mesoscale structure of the flow and hydrographic fields. Atmospheric soundings will be collected twice daily from a coastal station near the NOAA ETL RASS profiler.

The partnership involves oceanographers and atmospheric scientists from Oregon State University, fisheries scientists from NOAA NMFS Newport, radar specialists from NOAA ETL Boulder, and industrial partners using satellite (Ocean Imaging) and radar (CODAR Ocean Sensors) remote sensing techniques.

WORK COMPLETED

Modeling and data assimilation studies of coastal circulation off Oregon were begun in late 1998 and will build toward the 1999 field experiment. Initial runs with a regional, high-resolution atmospheric model (Univ. of Oklahoma Advanced Regional Prediction System - ARPS) have been made. This nonhydrostatic mesoscale atmospheric model is initialized and forced with the National Center for Environmental Prediction (NCEP) Eta model operational forecast and analysis. Data from Oregon State University's land-based HF radar system have been collected continuously since November 1997. Comparisons have been made between currents measured by a mid-shelf upward-looking ADCP and those from the HF radar (see the separate report by P. M. Kosro “Space-time variations in surface currents over the Oregon continental shelf mapped using HF radar”).

RESULTS

New start.

IN-HOUSE/OUT-OF-HOUSE RATIOS

10% IN-HOUSE (NOAA NMFS and NOAA ETL)
90% OUT-OF-HOUSE (OSU and industrial partners)