Ocean Circulation Modeling and Data Assimilation along the Oregon Coast

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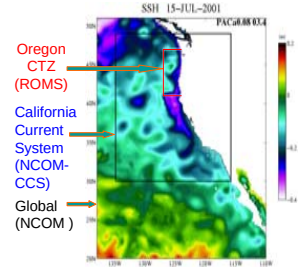
Objectives

1.Obtain the best possible model estimates for the physical fields in the region of the GLOBEC field experiments off the Oregon coast during the 2000 and 2002 summer months of May–August.

2.Determine the important physical dynamics in the region of the GLOBEC field experiment.

Approach

A high-resolution (3 km) coastal model based on the ROMS is being nested in the Navy Coastal Ocean Model–California Current System (NCOM–CCS) regional model. The ROMS model domain includes the Coastal Transition Zone (CTZ). NCOM-CCS is a 9 km data assimilating model which is nested in a global 1/8 degree model.

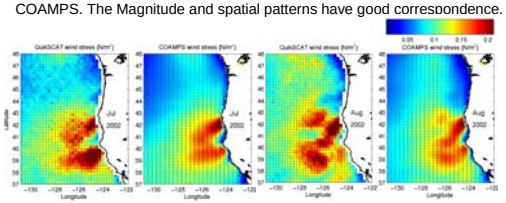


Task 1. Evaluate NCOM-CCS output

We evaluate NCOM-CCS output before nesting high-resolution CTZ model in it. Proper boundary and initial conditions are required to make realistic simulations in the nested model.

1.1 Evaluate NCOM-CCS Forcing

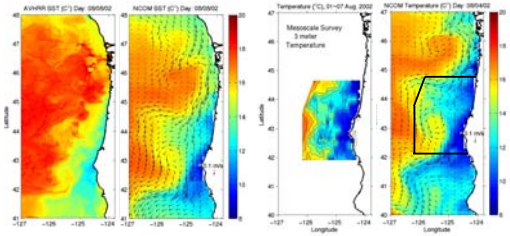
NCOM-CCS is forced by COAMPS atmospheric forcing. Monthly mean wind stress in July and August 2002 from QuikSCAT are compared with those from COAMPS. The Magnitude and spatial patterns have good correspondence.



1.2 Evaluate NCOM-CCS Temperature

(Left) NCOM-CCS surface temperature is slightly warmer than satellite observed skin temperature (MCSST). (Right) Front along the separated southward jet (outer front) and another front inshore are observed.

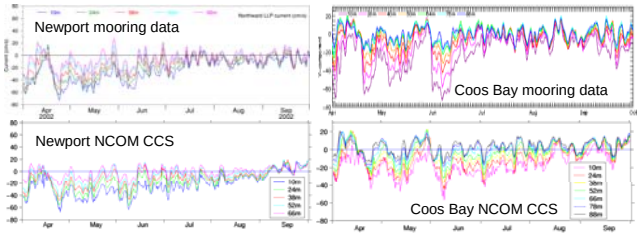
Surface Temperature (8 Aug. 2002) Temperature at 3 m (4 Aug. 2002)



We also have compared vertical sections of temperature from LTOP and Mesoscale survey to compare vertical stratification. Upwelled isotherms toward the coast are found during summer (not shown). (Hydrography data obtained from J. Huyer and J. Barth.)

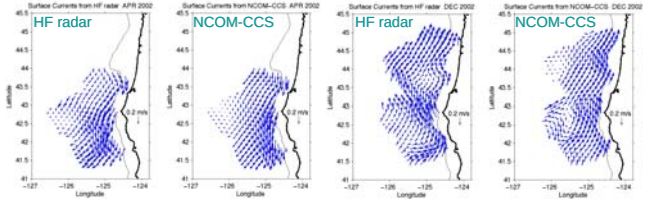
1.3 Compare with coastal mooring data

North-South velocity components from mid-shelf moorings have vertical shear from April to early July and, then, it becomes relatively homogeneous. NCOM-CCS reproduces the vertical shear of coastal flow from April to early July but it produces a somewhat stronger sheared flow during July and August. (Mooring data supplied by P. M. Kosro and S. Ramp.)

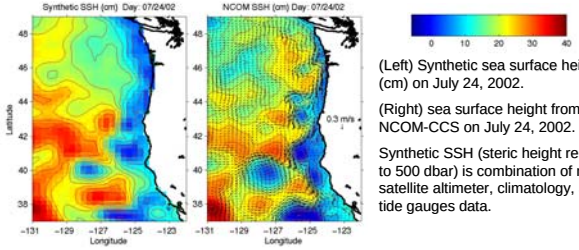


1.4 Compare with surface currents observed from HF radar

Monthly mean surface currents from NCOM-CCS are generally southward in April and northward in December in general agreement with observation from long-range HF radar. Spatial structure of surface currents from the model is slightly different from the observed currents. (HR radar data provided by P. M. Kosro.)



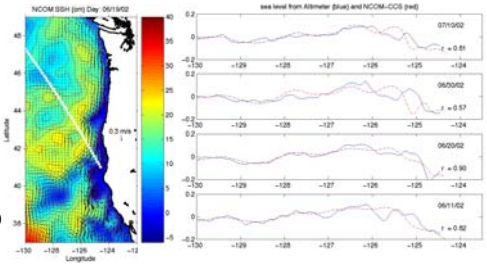
1.5 Compare with altimeter and tide gauge data



(Left) Synthetic sea surface height (cm) on July 24, 2002.

(Right) sea surface height from NCOM-CCS on July 24, 2002.

Synthetic SSH (steric height relative to 500 dbar) is combination of merged satellite altimeter, climatology, and tide gauges data.



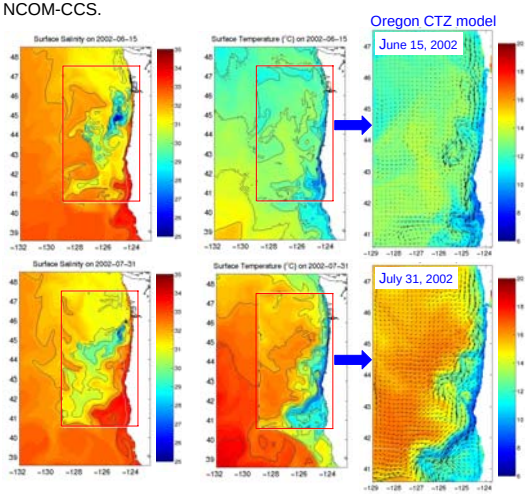
(Left) White dots are altimeter measurement points along T/P track # 206 (6.2 km spacing).

(Right) sea level from along track altimeter data (blue) and from NCOM-CCS (red)

Task 2. Nest Oregon CTZ model in NCOM-CCS

Oregon CTZ model (ROMS, 3 km) is running and effects of open boundary condition formulations has been tested:
(1) 3 km horizontal resolution, 30 vertical sigma levels
(2) Freshwater input from the Columbia River
(3) Tidal forcing across the open boundaries (6 tidal constituents)
(4) Boundary and initial conditions are taken from 9 km NCOM-CCS
(5) Surface forcing from COAMPS regional product

Oregon CTZ model was initialized on April 1st, 2002 and simulated the circulation to July 31st (122days). Upper (Lower) panels are surface salinity and surface temperature on June 15 (July 31). Values inside of the red box are from Oregon CTZ model and those outside of the red box are from NCOM-CCS.



Task 3. Data Assimilation

We are making progress on implementation of variational generalized inverse data assimilation method (GIM) in CTZ domain model. This task is coordinated with ROMS Tangent Linear and Adjoint Group and with the Inverse Ocean Modeling (IOM) project. The model will assimilate satellite altimeter measurements and long range HF radar surface current measurements. We will attempt first to adjust initial conditions and boundary conditions.

Acknowledgments

This project involves research jointly funded by CIOSS and the OSU component of the GLOBEC/NEP project "US-GLOBEC/NEP Phase IIIa – CCS: Effects of meso- and basin-scale variability on zooplankton populations in the CCS using data-assimilative, physical/ecosystem models" (OSU P.I.s: Allen, Egbert, Kurapov, Miller).The research in this project is being closely coordinated with that in the NOPP project "Boundary Conditions, Data Assimilation and Predictability in Coastal Ocean Models" (OSU P.I.s: Samelson, Allen, Egbert) and with that in the ONR project "Data Assimilation in Shelf Circulation Models" (P.I.s: Kurapov, Allen, Egbert).