Research to Operation (R2O):
PWS ROMS & U.S. West Coast Modeling Testbed

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January 22, 2014
Research: Regional Demonstration in Prince William Sound

Observing System  2005-2009  Regional Ocean Modeling System ROMS

Thanks to: Carl Schoch and Molly McCammon at AOOS
Research:

Regional Demonstration in Prince William Sound

AN OCEAN OBSERVING AND PREDICTION EXPERIMENT IN PRINCE WILLIAM SOUND, ALASKA

by G. Carl Schoch, Yi Chao, Francois Colas, John Farrara, Molly MacCann, Peter Olsson, and Gaurav Singh

Twenty years after the Exxon Valdez oil spill in Alaska a unique field experiment demonstrated an integrated ocean observing system with advanced technologies to enable weather, wave, and ocean circulation forecasting.

Ocean Observing System Demonstrated in Alaska

PAGES 181–182

To demonstrate the utility of an ocean observing and forecasting system with diverse practical application—such as search and rescue, oil spill response (perhaps relevant to the current Gulf of Mexico oil spill), fisheries, and risk management—a unique field experiment was conducted in Prince William Sound, Alaska, in July and August 2009. The objective was to quantitatively evaluate the performance of numerical models developed for the sound with an array of fixed and mobile observation platforms (Figure 1).

Prince William Sound was chosen for the demonstration because of historical efforts to monitor ocean circulation following the 1989 oil spill from the Exxon Valdez tanker. The sound, a highly constrained embayment of about 11,000 square kilometers at approximately 60° latitude along the northern coast of the Gulf of Alaska, includes about 6000 kilometers of shoreline, numerous islands and islets, and an extensive system of tidewater glaciers descending from the highest coastal mountain range in North America. Hinchinbrook, Entrance and Montague Straits are the two main deep water connections with the Gulf of Alaska. The economic base of communities in the region is almost entirely resource-dependent. For example, Colville’s economy is based on commercial fishing and Valdez’s economy is supported primarily by the trans-Alaska oil pipeline terminal.

When the Exxon Valdez ran aground on Bligh Reef in the northeast corner of the sound, the resulting oil spill followed a southwesterly trajectory, with much of the oil stranded on island beaches before exiting the sound through Montague Strait. Since the incident, numerous studies conducted on oil-spill-related impacts and ecological recovery have led to the development of a prototype ocean observing and forecasting system focusing on oil spill trajectories.

Developing Operational Forecast Models

In 2003 the observing system included periodic hydrographic surveys, coastal weather stations, a high-frequency (HF) radar array imaging the central kame, and a 4-kilometer-grid regional atmospheric model.

In final form 10 March 2011

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Research:
Regional Demonstration in Prince William Sound
Special CSR Issue: 9 out of 20 contributed by AOOS authors

2 Accomplishments and future perspective of coastal ocean observing systems
Page S1
Oscar Schofield, Yi Chao

14 Demonstrating the Alaska Ocean Observing System in Prince William Sound
Original Research Article
Pages S149-S158
G. Carl Schoch, Molly McCammon

3 Forecasting near-surface weather conditions and precipitation in Alaska's Prince William Sound with the PWS-WRF modeling system
Original Research Article
Pages S2-S12
Peter O. Olsson, Karl P. Volz, Haihao Liu

4 Disruption of a cyclonic eddy circulation by wind stress in Prince William Sound, Alaska
Original Research Article
Pages S13-S25
Mark J. Halverson, J. Carter Ohlmann, Mark A. Johnson, W. Scott Pegau

8 Seasonal transport variations in the straits connecting Prince William Sound to the Gulf of Alaska
Original Research Article
Pages S63-S78
Mark J. Halverson, Claude Bélanger, Shelton M. Gay III

9 Untangling the roles of wind, run-off and tides in Prince William Sound
Original Research Article
Pages S79-S89
François Colas, Xiaochun Wang, Xavier Capet, Yi Chao, James C. McWilliams

12 Modeling tides and their influence on the circulation in Prince William Sound, Alaska
Original Research Article
Pages S126-S137
Xiaochun Wang, Yi Chao, Hongchun Zhang, John Farrara, Zhijin Li, Xin Jin, Kyungeen Park, Francois Colas, James C. McWilliams, Chris Paternostrro, C.K. Shum, Yuchan Yi, Carl Schoch, Peter Olsson

18 Impacts of distinct observations during the 2009 Prince William Sound field experiment: A data assimilation study
Original Research Article
Pages S209-S222
Zhijin Li, Yi Chao, John D. Farrara, James C. McWilliams

17 A data-assimilative ocean forecasting system for the Prince William sound and an evaluation of its performance during sound Predictions 2009
Original Research Article
Pages S193-S208
John D. Farrara, Yi Chao, Zhijin Li, Xiaochun Wang, Xin Jin, Hongchun Zhang, Peggy Li, Quoc Vu, Peter Q. Olsson, G. Carl Schoch, Mark Halverson, Mark A. Moline, Carter Ohlmann, Mark Johnson, James C. McWilliams, Francois A. Colas
Three Level Nested Prince William Sound ROMS Model

SST shaded Relieved with SSH

Outer nest 9x9 km

Middle nest 3x3 km

Inner nest 1x1 km

Level 0

Level 1

Level 2

6.8°C  21.1°C  10.7°C  15.2°C  11.9°C  15.3°C
How accurate can we predict drifting body?
A question from U.S. Coast Guard (USCG)

**Observation**

**Ensemble Forecast**

The mean distance from the ROMS ensembles to selected Microstar drifter locations

**Forecasting drifter trajectory**
Operational Oceanography: ROMS 6 hourly nowcast at AOOS Model Explorer

Salinity at Surface and Depth [1e-3]

- Metadata URL: http://ourocean.jpl.nasa.gov/PWS/Nowcast...
- Date Range: 03/30/2009 23:00 - 01/20/2014 22:00

Data set
Regional Ocean Modeling System (ROMS) Nowcast 1 km x 1 km (Prince William Sound)
- Metadata URL: http://ourocean.jpl.nasa.gov/PWS/Nowcast...

The Prince William Sound (PWS) ocean forecasting system is based on the Regional Ocean Modeling System (ROMS). The ROMS configuration used consists of a 3-level nested configuration covering the Prince William Sound at 1-km resolution, the northeastern Gulf of Alaska (GOA) at 3-km, and the northeastern Pacific Ocean at 9-km. These three ROMS domains are nested as a single system and run simultaneously exchanging boundary conditions at every time step of the coarser grid. The interactions between the components are two-fold: the lateral boundary conditions for the fine grid are supplied by the coarse-grid solution, while the latter is updated from the fine grid solution in the area covered by both grids. An important addition to the standard ROMS configuration has been made as part of this project: freshwater forcing. In order to incorporating freshwater forcing into the PWS ROMS, the digital elevation model (DEM) of Wang et al. (2004) is used, which includes glacier, snow storage, and melting processes. The model is forced by air temperature and precipitation data from 0.5 degree NCEP global forecasts.
Operational Oceanography: ROMS 48-hour forecast at AOOS Model Explorer

Salinity at Surface and Depth [1-e3]

Data set

Prince William Sound (PWS) Regional Ocean Modeling System (ROMS) Forecast 3 km x 3 km (Gulf of Alaska)

The Prince William Sound (PWS) ocean forecasting system is based on the Regional Ocean Modeling System (ROMS). The ROMS configuration used consists of a 3-level nested configuration covering the Prince William Sound at 1-km resolution, the northeastern Gulf of Alaska (GOA) at 3-km, and the northeastern Pacific Ocean at 9-km. These three ROMS domains are nested as a single system and run simultaneously exchanging boundary conditions at every time step of the coarser grid. The interactions between the components are two-fold: the lateral boundary conditions for the fine grid are supplied by the coarse-grid solution, while the latter is updated from the fine grid solution in the area covered by both grids. An important addition to the standard ROMS configuration has been made as part of this project: freshwater forcing. In order to incorporating freshwater forcing into the PWS ROMS, the digital elevation model (DEM) of Wang et al (2004) is used, which includes glacier, snow storage, and melting processes. The model is forced by air temperature and precipitation data from 0.5 degree NCEP global forecasts.
SUMMARY: PWS ROMS

• AOOS/IOOS leadership/vision/resources
• Synergy/leverage with other activities
  – PWS Science Center (other local organizations)
  – NASA co-funding (~$1M) for ROMS & PWS FE
  – U.S. Coast Guard in-kind contributions
• Scientists who care about AOOS
The US West Coast Component of the Coastal Ocean Modeling Testbed (COMT)

Principal Investigators:
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Christopher A. Edwards, University of California at Santa Cruz (UCSC)
Yi Chao, Remote Sensing Solutions, Inc.

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Frank L. Bub (Naval Oceanogr. Office)
Igor Shulman (Naval Research Laboratory)
Avichal Mehra (NOAA NWS NCEP)

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<tr>
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Three West Coast Models

10-km res. ROMS/4DVAR (CeNCOOS)

3-km res. ROMS/3DVAR (SCCOOS/CeNCOOS)

Specific Tasks:
- Model intercomparisons (HYCOM, RTOFS, climatology)
- Data assimilation schemes (3D/4DVAR; Ensemble methods)
- Coupled bio-phys models: N. Banas – NPZDO (6-component); C. Edwards – NEMURO (11-component); F. Chai – CoSiNe (31-component)
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