Annual Progress Report Form - Oil Spill Recovery Institute

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Deadline for this report: This report is due within 45 days of the anniversary of the effective date of the grant.

Today's date: February 5, 2007

Name of awardee/grantee: James C. McWilliams

OSRI Contract Number: #06-10-04

Project title: Alaska Ocean Observing System

Dates this progress report covers: 01/01/06—12/31/06

PART I - Progress Report on Activities

Prince William Sound ROMS Development – UCLA Year 2 – Summary Technical Report

The main task assigned to the UCLA group is the development of a Regional Ocean Modeling System (ROMS) configuration to improve the understanding of ocean circulation and its variability in Prince William Sound (PWS). The ROMS configuration is the backbone of the JPL group's assimilation system (JPL) for this project. Our overall goal is to develop an operational system that delivers information on physical and biological conditions in real-time to research and application users. This information includes raw data on environmental conditions, such as wind speed, air temperature, precipitation, ocean currents, ocean temperature, tide height, and water salinity as well as modeled forecasts of anticipated conditions. Forecasts for atmospheric conditions in PWS already have been done with a Regional Atmospheric Modeling System. The UCLA/JPL group is now in the process of developing a real-time forecasting capability for the oceanographic conditions.

ACCOMPLISHMENTS TO DATE

To summarize, during Year 1 all tasks assigned to the UCLA group were accomplished, namely the development of an adapted PWS ROMS configuration and the evaluation of its ability to simulate the circulation in the sound, using accurate representation of the circulation in the Gulf of Alaska.

During Year 2 the focus was on a variety of different tasks. Open boundary sensitivity tests were conducted, mainly over the large L0 domain (Gulf of Alaska). An alternative L0 domain was designed to determine the best configuration for coastal currents. It appears that the mean circulation characteristics are satisfactory with the new L0 domain so new L1 (3.6km) and L2 (1.2km) nested domains were developed.

We merged new topography datasets from NOAA and OSRI producing a more accurate topography for the PWS thus overcoming an obstacle we reported in our 2005 annual report. This dataset was implemented in the PWS nested domain L2. Topography for domains L0 and L1 were also modified (GINA instead of Etopo2). The new L0/L1/L2 configuration was spun-up under climatological conditions, and we observed the same interesting features seen with the old configuration (e.g., the eddy in the central part of PWS, the baroclinic structures of the exchanges across the Hinchinbrook entrance). All the difficulties regarding the tidal forcing implementation were overcome. We began the implementation of the rivers run-off, first with simple and idealized cases, which were tested.

During the last quarter of Year 2 we modified the coastline in the L2 domain of PWS following the suggestions received from the Prince William Sound Observing System (PWSOS) group. Our aim was to make it more coherent with the coastline from the NOAA Oil Spill group. Subsequent changes were required for the L2 configuration. Currently we are testing the modified L2 domain with and without tidal forcing because the tidal processes can be quite sensitive to changes in the mask (and/or topography).

We performed two numerical experiments in L0 (Gulf of Alaska) using two slightly different tidal forcings. Our objective is to enhance the accuracy of the tides in the domain. We are currently analyzing the results. In addition, we are continuing our efforts toward understanding the relative influence of forcings in the L2 domain. With the help of numerical particle tracking, preliminary results suggest that pathways of the exchanges between PWC and the Gulf of Alaska differ between the tidal and non-tidal experiments (see Figure 1).

OBSTACLES AND CHANGES

We have no obstacles or changes to report.

YEAR THREE TASKS

1. Assess and improve the ROMS modeling capability with satellite data comparisons and incorporate river run-off in the innermost model domain for PWS.

2. Work with the JPL project researchers to validate the new PWS modeling and analysis configuration by both assimilating and testing with local measurements for August 2004 and summer 2007.

3. Complete manuscript for publication.

During Year 3 we plan to have a full implementation of the rivers run-off, and then run a long experiment (several years) for the new L0/L1/L2 configuration with both tides and run-off at the same time. Special attention will be given to the validation with the help of available *in situ* datasets. Another focus will be on process studies to understand the main circulation inside PWS, its seasonal variability and sensibility to forcings and remote influence. Experiments should be conducted to determine tides and run-off influence on the circulation inside PWS. The nature the complex exchanges at the Hichinbrook Entrance between PWS and the nearby ocean will be further investigated. Later plans will be to include interannual variability in the simulation runs.

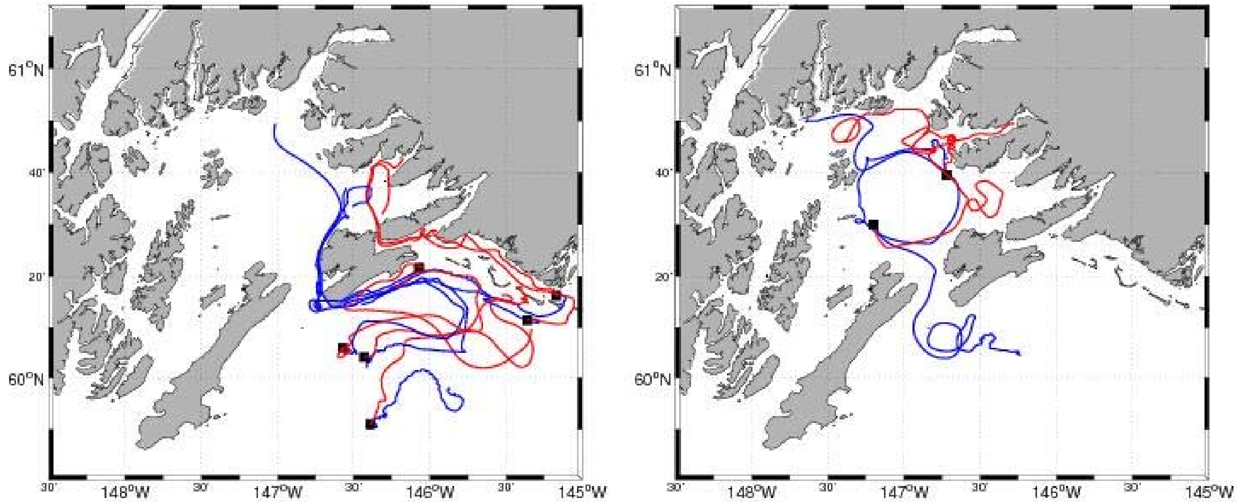

Figure 1. Tidal influence on the material exchanges between Prince William Sound and the Gulf of Alaska illustrated with several surface trajectories (blue: with tides; red: without tides; black squares: release locations). Even averaged over the tidal cycle, there are substantial differences in the exchange routes. The trajectories for the tidal case were filtered (Lanczos filter) to remove the tidal cycle. so a strong tidal oscillation along the trajectories is not seen.

APPENDIX

Abstract for presentation at the 2007 Alaska Marine Science Symposium, Anchorage, Alaska, January 21-24, 2007

Sea-Ice Variation and its Effect on Oceanic Circulation in the Bering Sea

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We investigate sea-ice variation and oceanic circulation in the Bering Sea with multiple-year solutions from the Regional Oceanic Modeling System (ROMS) with both an eddy-resolving configuration for the Pacific basin and a global configuration coupled to a dynamic thermodynamic sea-ice model. The solution is assessed by comparisons with satellite observations for interannual and seasonal variations in sea-ice concentration and extent and sea-surface height. Solutions with and without the sea-ice coupling show significant differences in the Bering Sea circulation. Due to resolution limitations for the basin configuration, mesoscale currents and sea-ice patterns cannot be satisfactorily resolved, and a higher-resolution, embedded regional configuration is now being developed.

Abstract for presentation at the October 2006 Workshop: Demonstration of the Alaska Ocean Observing System in Prince Williams Sound

ROMS Development, Validation, and Lessons Learned from the PWS Implementation

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Progress on the PWS ROMS development is discussed showing the step by step implementation of the configuration essential components.
The focus is first on improvement of the Gulf of Alaska domain: both changes in the grid design and downscaling of basin-scale model solution to better represent the seasonal cycle and the Alaska Coastal Current. Tides and synoptic winds are necessary to reproduce the mesoscale activity level and pattern distribution.
Development concerning the principal factors – tides, rivers, topography - in the smaller regions encompassed by the nested grids are then discussed. Preliminary results show the importance of the combination of these factors in simulating the PWS circulation.

Abstract for presentation at the June 2005, Prince William Sound Observing System Workshop, Cordova, Alaska

Ocean Predictions: Regional Ocean Modeling System (ROMS)

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In September 2004, UCLA and JPL ocean labs were asked to design a numerical framework to help advance the knowledge of Price William Sound (PWS) ocean dynamics. Specifically, UCLA's responsibility is to build a PWS configuration with ROMS nesting capability. My talk is a description of the modeling techniques we are using as well as an update on where we are regarding the development of the configuration as of June 2005.

3 nested grids have been generated with a mesh size of 11, 3.6 and 1.2km encompassing respectively the whole Gulf of Alaska, the central coast of Alaska and PWS (the latter extends to the Copper river delta to make sure this important source of freshwater for PWS is included at the finest scale).

The circulation in the sound is driven by an intricate mixture of buoyancy, wind, tidal and remote forcing. A number of technical issues to implement to forcing mechanisms have been overcome, and we are currently in the early phase of validation of all grid levels. Further requirements (synoptic winds, improved bathymetry for the region of PWS) will be needed but the numerical solutions (1 year for the 3 grid levels) already reproduce some interesting features. The eddy present in the central part of the sound during most of summer 2004 is also a robust feature in the model even when forced by climatological monthly winds and in the absence of freshwater inputs. The mechanisms responsible for the occurrence of this eddy will be investigated. Also, the structure of the currents across Hinchinbrook Entrance shows strong baroclinicity and temporal variability in relation with the mesoscale activity present outside of the PWS on the slope. After a validation procedure that will heavily rely on the existing dataset across Hinchinbrook entrance, a full quantification of the PWS/open ocean exchanges (residence time in the sound, mean fluxes through Hinchinbrook entrance) will be undertaken.

Part II - Annual Financial Statement
Part II - Budget Report

Budget Category	Budget	Quarter Expenses	Cumulative Expenses	Balance Remaining
Direct Costs				
Personnel	37,131.23	0.00	37,136.82	-5.59
Travel	220.00	0.00	250.00	-30.00
Contractual	0.00	0.00	0.00	0.00
Commodities	1,483.77	0.00	1,448.12	35.65
Equipment	0.00	0.00	0.00	0.00
Subtotal Direct Costs	**38,835.00**	**0.00**	**38,834.94**	**0.06**
Indirect	21,165.00	0.00	21,165.06	-0.06
Project Total	**60,000.00**	**0.00**	**60,000.00**	**0.00**