Annual Progress Report Form - Oil Spill Recovery Institute

This report may be submitted by mail, fax or e-mail
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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: 11/14/2005

Name of awardee/grantee: James C. McWilliams

OSRI Contract Number: #05-10-02

Project title: Alaska Ocean Observing System

Dates this progress report covers: 10/01/04—09/30/05

PART I - Progress Report on Activities

The progress report must include the following elements.

1. Non-technical Abstract or summary of project work to date that does not exceed two pages and includes an overview of the project. The abstract should describe the nature and significance of the project and progress made toward realizing project goals. It may be provided to the Advisory Board and could be used by OSRI staff to answer inquiries as to the nature and significance of the project.
2. Brief review of the objectives as described in original proposal and progress report related to these objectives.
3. Describe problems or roadblocks encountered in project implementation.
4. Highlight accomplishments, whether or not they were part of the original proposal.
5. Conclusions to date.
6. Appendix including copies of all written reports or publications completed or in progress, resulting from the project work. This also includes abstracts of papers presented at conferences. Please note the acknowledgment of OSRI support stated in Section 10.3.4 of the Grant Policy Manual.

Prince William Sound ROMS Development – UCLA Year 1 – Summary Technical Report.

The main task assigned to the UCLA group in this project is the development of a Regional Ocean Modeling System (ROMS) configuration to improve our understanding of the circulation and its variability in Prince William Sound (PWS). Most importantly this configuration will be the backbone of the data assimilation system (JPL).

Due to the PWS convoluted topography and the numerous finescale processes that take place, modeling requires a fine resolution on the order of 1km over the domain defined by the Sound and its connection with the nearby ocean. A fundamental issue is also to accurately represent the exchange of mass and properties between PWS and the Gulf of Alaska because the Gulf dynamics is thought to have a major impact on the Sound circulation. For these reasons a 3-level nested ROMS configuration has been designed (Fig. 1). The bigger domain (L0) was extracted from the NEP3 GLOBEC grid. This allows us to interact efficiently with the other partners of the project already involved in the NEP (North Eastern Pacific). The L0 domain encompasses the whole Gulf of Alaska with a 10km resolution. Within this domain, a first nested level (L1) at 3.5km resolution centered on Cook Inlet and PWS, covers the central coast of the Gulf. The last level (L2) is a 1.1km grid resolution including PWS and its connections with the outside coastal shelf. Boundaries of this smaller domain were designed far enough away from main the connections areas (Hinchinbrook Entrance and Montague Strait) to ensure a good representation of the mass exchanges. This model, using a 2D domain decomposition technique, can be computed with the multi-thread parallelization (OPENMP).

To evaluate the performance of the configuration, the first step has consisted of running long-term solutions under climatological conditions: monthly mean atmospheric forcing and boundary conditions extracted from Levitus or from our ROMS-Pacific model. We first focused on the L0 domain. Using appropriate atmospheric forcing (most notably NCEP/QSCAT for the winds), we have reached a reasonable level of agreement with the available Sea Surface Height (SSH) data (Fig. 1). Principal features of the circulation and its seasonal cycle in the Gulf seem to be correctly reproduced by the model (*e.g.*, mean currents, SSH, eddy generations). Also, a noticeable improvement of the seasonal cycle is observed when boundary conditions from a basin-scale model are used. This completed task allowed us to run the nested configuration and then to start to focus on the PWS. We have already obtained a solution and a climatological circulation scheme for the Sound. A cyclonic gyre in the center of the Sound appears to be a robust feature of the circulation (Fig. 2) showing seasonal variation, stronger in fall and weaker in spring, as described in previous studies based on *in situ* data. As expected, exchanges between PWS and the external coastal shelf take place at the Hinchinbrook Entrance and the Montague Strait. The model reproduces the baroclinic structures of these exchanges, showing also that eddy activities on the coastal shelf may strongly regulate the exchange. Those results now need to be validated against the *in situ* data. In addition two major issues were expected in modeling the PWS: these include tides and river run-off. With regard to tides, the technical difficulties have been overcome. The tidal signal imposed at the L0 boundaries propagates cleanly across domains L0 and L1 to domain L2. The model is able to reproduce realistic tidal amplitude and phase patterns (Fig. 2). Fine-tuning would be needed but a more accurate topography needs to be implemented first. We are currently working on the rivers implementation. Prototypes of run-offs have been designed and tested. Full implementation of rivers in PWS should be completed before mid-stage of year 2. A crucial need of this task is obtaining accurate data of the rivers inputs in the region.

To summarize, all tasks assigned to UCLA for Year 1 have been 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. To keep going efficiently, we will soon need to get a more realistic topography of the Sound and *in situ* data (subsurface temperature and salinity and rivers) to validate more accurately the solution. One of the next steps will also be to force the model with the RAMS model outputs developed for the region.

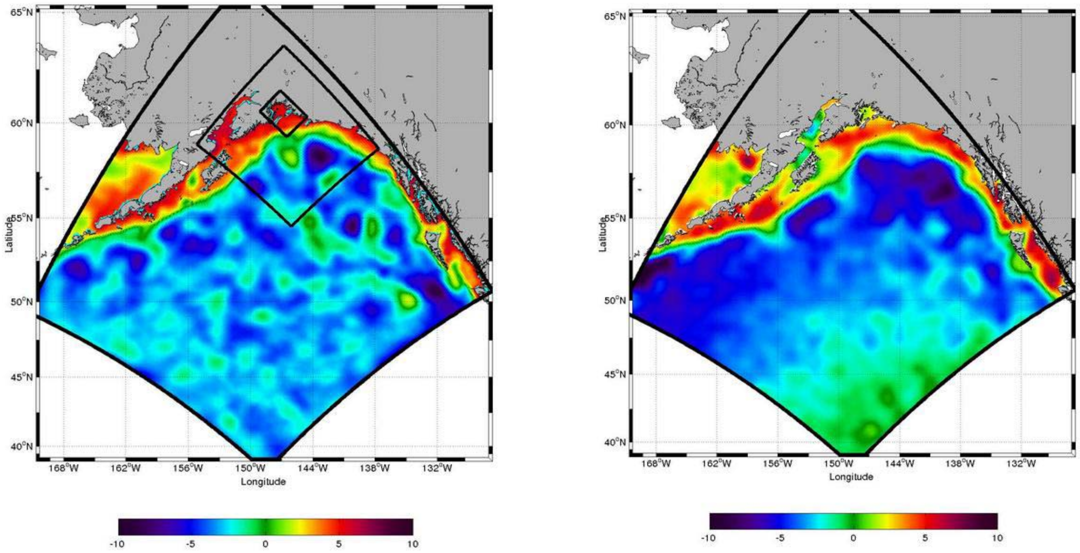

Figure 1

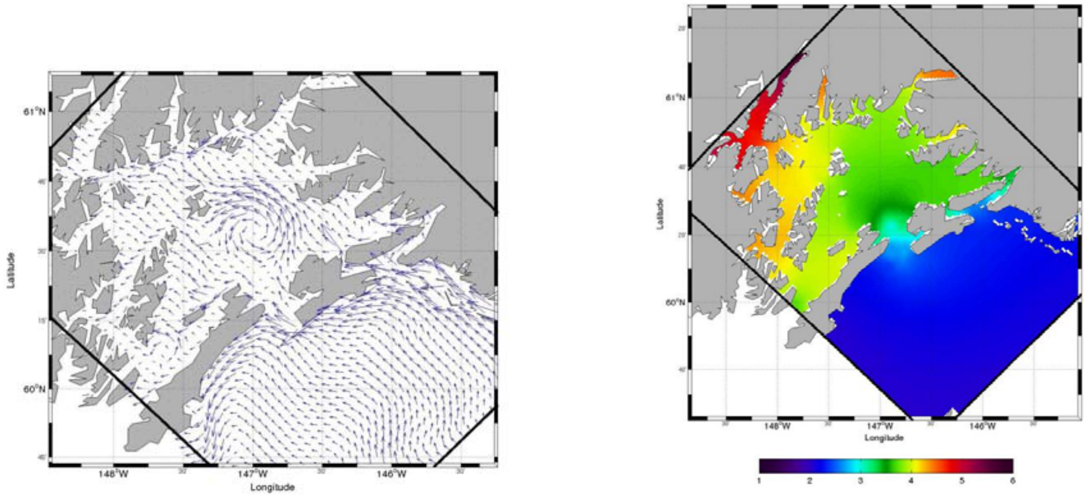

Figure 2

Caption Figure 1. Winter Sea Level Anomaly: model (left) and altimetry data (right). On the left panel thick lines indicate the 3 nested grid positions.

Caption Figure 2. Annual Surface Current in PWS level 2 (left) and M2 Tidal amplitude in PWS level 2 (right).

APPENDIX

[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

Budget Category	**Budget**	**Year-to-date Expenses**	**Balance Remaining**
Direct Costs			
Personnel	37,098.00	19,807.56	17,290.44
Travel	156.00	0.00	156.00
Contractual	0.00	0.00	0.00
Commodities	1,770.00	133.66	1,636.34
Equipment	0.00	0.00	0.00
Subtotal Direct Costs	**39,024.00**	**19,941.22**	**19,082.78**
Indirect	20,976.00	10,830.13	10,145.87
Project Total	**60,000.00**	**30,771.35**	**29,228.65**