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**ONR/NOPP Principal Investigator's Final Report
For the period September 1, 1999 to March 31, 2001**

**Models of the Coastal Ocean off the West Coast of North America:
Comparative Study and Synthesis of Observations ONR Grant N00014-99-1-1062**

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A. INTRODUCTION

This grant was for planning activities to develop a detailed work-plan for a community proposal that was submitted to the ONR/NOPP program in May, 2001. The community proposal is for a five-year, coordinated, collaborative project from seventeen different institutions that unifies and extends existing physical, biological, and biogeochemical model investigations off the Pacific Coast of North America. The goal is to develop a coherent and comprehensive picture of the oceanic processes in this coastal region of the eastern Pacific. Current data assimilation techniques are becoming sufficiently well-developed that a synthesis of data and models is within the reach of investigators. The grant allows the participants to develop a working group or NOPP node focused on the synthesis of the principal models and data sets for the North American West Coast (NAWC).

This is the final technical report for the one-year planning grant, which was given a no-cost extension to span the time until NOPP was ready to receive the community proposal. The report covers the planning activities that Prof. J.C. McWilliams at UCLA participated in and coordinated; there will be a parallel report from Prof. T.M. Powell at UCB who was the other principal coordinator during the planning phase. The product of this planning grant, the text of the submitted community proposal, is included as Appendix A.

The scientists who participated in the planning of the proposed community project are

J. Allen (OSU), J. Barth (OSU), H. Batchelder (OSU/UCB), J. Bishop (UCB), L. Botsworth (UCD), Y. Chao (JPL), F. Chavez (MBARI), B. Cornuelle (SIO), W. Crawford (IOS CA), P. Cummins (IOS, CA), K. Denman (IOS, CA), S. Doney (NCAR), C. Edwards (U. Conn./UCB), G. Egbert (OSU), N. Gruber (UCLA), D. Haidvogel (Rutgers), R. Haney (NPS), A. Hermann (NOAA PMEL), B. Hickey (UW), J. Kindle (Stennis NRL Research Lab), G. Li (JPL), P. Marchesiello (UCLA), J. McWilliams (UCLA), A. Miller (SIO), R.N. Miller (OSU), L. Oey (Princeton), J. Paduan (NPS), P. Penven (UCLA), T. Powell (UCB), R. Samelson (OSU), F. Schwing (NOAA Pacific Fisheries Environmental Group), A. Shchepetkin (UCLA), Y.H. Spitz (OSU), K. Stolzenbach (UCLA), T. Strub (OSU), and D.-P. Wang (SUNY).

B. PLANNING ACTIVITIES

At the outset of the planning project, an Executive Committee was appointed to provide geographical and disciplinary breadth of leadership: Allen, Denman, McWilliams, Paduan, and Powell. Its first activity was to write white papers on the scientific background, observational data sets, model capabilities, and scientific objectives of a NAWC project.

A preliminary planning meeting was held in September 1999 at UCB, with broad attendance among the participating scientists. Its purposes were to debate and agree upon the objectives of the NAWC project; make an initial assessment of priorities; agree on a list of planning activities; make assignments of responsibility for carrying them out; establish arrangements for logistics and communication; identify likely participants; and discuss relationships with other NOPP projects.

In the winter of 1999-2000, prospective partners were asked to submit planning letters for their contributions and costs to the NAWC project, and the ExCom responded with guidance and budget targets for the selected contributions.

In June 2000 a scientific meeting was held at OSU on the central intellectual issue of interactions between local shelf processes and regional coastal circulations. About 20 scientists participated.

In September 2000 a progress-review meeting was held at UCB. All of the selected proposal partners attended. A straw draft of the program plan was presented by the ExCom and then extensively refined into a consensus plan; a provisional schedule and writing assignments were made for the final proposal preparation.

In December 2000 a small meeting was held at UCLA to finalize the plans for proposal preparation. During the winter and spring of 2001, the proposal was prepared cooperatively by the partners.

C. COMMUNITY BUILDING, MODEL-DATA COMPARISONS, AND NUMERICAL-MODEL DEVELOPMENT

In addition to planning activities directly related to preparing the community proposal, the UCLA group led three additional activities that helped initiate the NAWC project.

In February 1999 a three-day scientific meeting was held at SIO on the California Current System with approximately 50 participants, organized by Miller and McWilliams. The funding for this meeting was external to this grant, but the event provided a forum for the scientific issues that comprise the contents of the NAWC project. In order to inform the larger community, a paper was prepared and published: Miller, A.J., J.C. McWilliams, N. Schneider, J.S. Allen, J.A. Barth, R.C. Beardsley, T.K. Chereskin, C.A. Edwards, R.L. Haney, K.A. Kelly, J.C. Kindle, L.N. Ly, J.R. Moisan, M.A. Noble, P.P. Niiler, L.Y. Oey, F.B. Schwing, R.K. Shearman, and M.S. Swenson, 1999: Observing and modeling the California Current System: Purposes, Achievements, and Aspirations. EOS 80, 533-539.

Since a primary goal of the NAWC project will be to improve and assess a variety of coastal models in relation to observed fields, a pilot project was carried out that compares mean sea level, its seasonal cycle, and its non-seasonal variance from Levitus hydrography and TOPEX/ERS-1 altimetry with equilibrium solutions from three different models along the U.S. West Coast. The report was published as a web document (<http://www.atmos.ucla.edu/~penven/intercomparison/>): "SEA LEVEL VARIATIONS OFF THE U.S. WEST COAST: Comparisons Among Observations and Models" by Pierrick Penven (UCLA), Robert Haney (NPS), John Kindle (NRL), Jim McWilliams (UCLA), Patrick Marchesiello (UCLA), Dylan Righi (OSU), Alexander Shchepetkin (UCLA), and Ted Strub (OSU).

The Regional Oceanic Modeling System (ROMS) is a new computer model under development with the expectation of wide usage in the NAWC project, along with several other coastal models developed previously or under other auspices. In order to accelerate the development of ROMS, travel and salary support for several scientists was provided for work on open boundary conditions, pressure-gradient calculations in terrain-following coordinates, vertical mode-splitting and time integration methods, and embedded grids to allow locally higher spatial resolution (e.g., near the coastline) while adequately spanning the broader region that provides the context for the local behavior. Not all of this work has yet been completed, but several papers have been written thus far:

Marchesiello, P., J.C. McWilliams, & A. Shchepetkin, 2001: Open boundary conditions for long-term integration of regional ocean models. *Ocean Modelling* 3, 1-20.

Marchesiello, P., J.C. McWilliams, & A. Shchepetkin, 2001: Equilibrium structure and dynamics of the California Current System from a model perspective, to be submitted.

Shchepetkin, A.F., & J.C. McWilliams, 2001: A method for computing horizontal pressure-gradient force in an oceanic model with a non-aligned vertical coordinate. *Monthly Weather Review*, submitted.

Shchepetkin, A., & J.C. McWilliams, 2001: The Regional Oceanic Modeling System: A split-explicit, free-surface, topography-following-coordinate oceanic model, to be submitted.

D. EXPENDITURES

The planning grant paid travel costs for various scientists to attend the meetings described above, as well as salary support for Patrick Marchesiello, Pierrick Penven, and Alexander Shchepetkin at UCLA, who worked on ROMS development and analyses of the current models and data, and for Laurent Debreu, who visited UCLA from IMPG (Grenoble FR) for several months to implement an embedding grid method in ROMS.