Partnership for Modeling the Marine Environment of Puget Sound, Washington – Ocean Inquiry Project Report

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LONG-TERM GOALS

Estuaries, fjords and sounds are important, major components of marine ecosystems worldwide. Because of this, and their generally poor treatment by humans, large estuaries should be the focus of large-scale, multidisciplinary, integrative modeling efforts. We need to both understand how these systems work, and be able to predict how they will respond to changes, whether natural or anthropogenic. Puget Sound, Washington State's largest inland sea, is both the largest fjord in the lower forty-eight states and closest to the substantial urban centers of Seattle, Tacoma, Everett and surrounding communities. Relative to other coastal systems, Pacific Northwest fjords have seasonally high annual phytoplankton standing stock and primary production, and they support several economically valuable fisheries. Our long-term goals are to develop quantitative understanding of the seasonal and longer time-scale variability of the Sound's circulation, roles of water column stratification, nutrients, and light (and their interactions) on phytoplankton and zooplankton dynamics, and the sensitivity of the physical and the biological system to natural and human perturbations. We will develop models of Puget Sound that can aid agencies with responsibilities for environmental management in making informed decisions and serve as marine science education tools.

OBJECTIVES

The Partnership for Modeling the Marine Environment of Puget Sound consists of five separate organizations: University of Washington (School of Oceanography and College of Education), King County Department of Natural Resources, Washington State Department of Ecology, Puget Sound Naval Shipyard, and Ocean Inquiry Project. The partnership will develop, maintain and operate a system of flexibly linked simulation models of Puget Sound's circulation and ecosystem, a data management system for archiving and exchanging oceanographic data and model results, and an effective delivery interface for the model results and observational data for research, education and policy formulation. The interface, model results and observational data will be accessible to all members of the partnership as well as to the regional and oceanographic community. The partnership engages in research activities aimed at developing fundamental understanding of the Sound's working, as well as addressing practical questions raised by the regional community concerning management of the Sound and its resources. The partnership will function as an estuarine research node within the NOPP Ocean Information Commons.

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APPROACH

The Partnership is administered from the School of Oceanography, University of Washington (UW). The lead P.I., Mitsuhiro Kawase, is responsible for project oversight and coordination. Ocean Inquiry Project personnel include P.I. Stahr and Christian Sarason, Program Director. They are involved with the Partnership's Education and Visualization team, consisting of themselves and investigators from the UW College of Education (W. Winn and R. Fruland) and UW Human Interface Technology Laboratory (P. Oppenheimer). This team's primary responsibility is developing a simple web interface and associated curriculum for the models and data collected by the Partnership. Stahr is coordinating OIP activities regarding curriculum development and Partnership interaction, and Sarason is focusing on the development of the web interface.

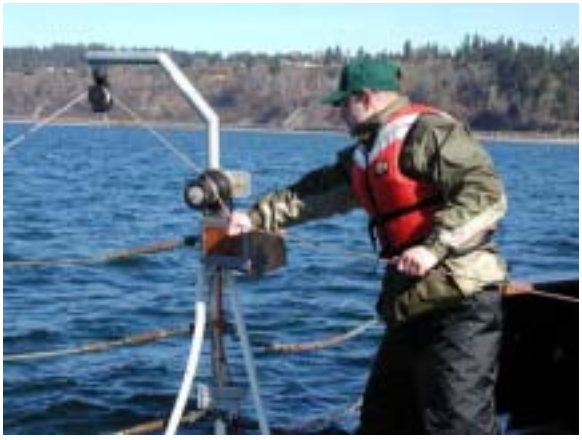

Figure 1: An OIP student participant helps gather CTD data on Puget Sound, WA. [Man uses winch to help pull CTD in from Puget Sound.]

WORK COMPLETED

The Education and Visualization Team has been meeting weekly to coordinate and work on various tasks. These fall into four broad categories: 1) moving the "Virtual Puget Sound" (VPS), a 3-D navigable learning environment based on Kawase's numerical model, from an SGI computer to a PC-based platform, 2) developing curricula using model output and VPS, as well as OIP's in-situ techniques, to educate students about circulation and oceanographic properties of Puget Sound, 3) developing assessment techniques that can measure learning in these environments, and 4) developing a browser-based interface for all (students and partners) to examine model and real data generated by the Partnership. A good start has been made on all of these, as well as working with other teams in the Partnership, such as the Aquatic Biogeochemistry (ABC) modeling team. OIP team members are primarily involved in the second and fourth activity, but are advising on all of them. The team will present a poster at the fall American Geophysical Union meeting showing past educational research results using the VPS learning environment as well as plans for its use in the present partnership.

OIP performed two cruises with an updated curriculum after funding became available in late FY02. This curriculum is a start at implementing ideas generated at the Education and Visualization team’s weekly meetings; feedback from these cruises will help us to further improve the curriculum in FY03.

In addition, OIP took delivery of a SeaBird 911+ CTD. This instrument will significantly improve our at-sea curriculum, and allow us to address more complicated questions; we are planning the first cruise with this instrument for October 12th, 2002. Data collected during two summer cruises (June 29th and August 19th, 2002) using an instrument from the UW Oceanography shared equipment pool has been shared with Kawase at UW as a first effort at model verification. Higher quality data collected with our new CTD will be shared as soon as available.

RESULTS

Results for FY02 center primarily around the creation of the Education and Visualization team, as well as design work on curriculum and evaluation techniques associated with the different types of models being created and linked by the Partnership. The most important feature of the curriculum is a design that will allow students to discover modeled phenomena for themselves, rather than just observing model runs and memorizing the significance of certain visualizations. Educational research performed using the VPS learning environment will be presented at the fall AGU meeting. The poster will highlight the importance of student discovery and exploration with the model in order to learn and retain oceanographic concepts. During FY03 OIP will develop simple web visualizations of model runs designed to facilitate this type of learning.

Figure 2: OIP students get up close and personal with benthic organisms from Puget Sound. [Woman viewing starfish in tub of water.]

IMPACT/APPLICATIONS

OIP's work has implications mostly in science education and outreach. The focus of our educational research will be to delineate the differences between learning by computer and learning with "hands-on" techniques in the field. The design of our curriculum will allow for deeper understanding of scientific concepts, and more importantly, a deeper understanding of the process of science. Of particular interest is studying how oceanographic concepts get learned: is it by watching computer models or by collecting data in the field, or is a combined approach most fruitful? If we are to significantly abate anthropogenic impact on Puget Sound, it is important that we educate as many

people as possible about it. Education of local residents is crucial for the creation of stakeholders for the Sound; only then will continued improvements and remediation occur. Finally, our curriculum will be modular in design, so that visualizations and approaches for learning about Puget Sound may be easily applied to other modeled estuarine systems, and perhaps even to large-scale oceanic phenomena.