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Validating Coastal Circulation Models with Student-built, Lobstermen-deployed, Satellite-tracked Drifters

1. We propose to address the first two **priority areas**: "Data Sets to Verify Fate and Trasport Models" and “Integrating Regional Observing Systems with Circulation and Transport Forecasts”. We have an existing network of academic, research, and industry partners who have been working together over the past five years and are ideally suited to address the problem of oil spills off our coasts. Lobstermen have successfully deployed student-built, satellite-tracked drifters at various depths off the coasts of New England to help document the degree of advection and dispersion into and away from various coastal zones. By continuing our unique collaboration we have a formula to address a variety of issues associated with processes affecting our coastal waters.

2. Our **objectives** fit perfectly within the mission of CRRC, to "involve individuals and institutions, public and private, at local and regional levels... fostering integrative responses to spill response and restoration". Thanks to funding from the Northeast Consortium over the four years, we have "promoted collaborative research and development and the exchange of ideas among scientists" through a science/fishing industry/student collaboration to collect environmental data. All our findings and data are served though www.emolt.org.

3. The **methods** we use are simple. We supply lobstermen with oceanographic instruments for deployment using strict scientific protocols. Lobstermen are often able to deploy the instrumentation while at sea during regular fishing activity. In the case of our current drifter study, for example, lobstermen assemble the unit, usually with the help of a student or scientist, and release it from their vessel at the location, depth, and tidal phase determined in the survey design. Fishermen downstream of the deployment assist with recovery operations.

We propose to adapt this protocol to meet CRRC objectives by supplying lobstermen along the New England coast with ready-to-deploy satellite drifters, specially designed for testing and

deployment within shallow estuaries and harbors. These individuals will be trained to respond to emergencies and deploy drifters in real spill situations. Our past experience in tracking both lobster larvae and Alexandrium algae in various layers of the water column can now be applied to develop an alternative drifter to mark the surface skin layer associated with oil dispersion. We will continue to work with students at Southern Maine Community College to design and engineer these units.

We will have a set of "trial deployments" to a) test the new drifter designs and b) to provide data for validating numerical model runs. Each trial deployment will be conducted from a different lobster boat to provide the participants with experience in the operation and, at the same time, data in different areas and types of coast. We will work in cooperation with the lobstermen associations along with the local ocean circulation modeling groups to coordinate this effort. A collaboration of the modelling groups is already underway at: http://sole.wh.whoi.edu/~jmanning/circ/nenocm.html.

4. Given our existing infrastructure and experience, we can design and build a set of drifters during the school year at SMMC in time for testing during the summer of 2006. The students have built well over 50 satellite-tracked drifters in the last few years. Using this **new system**, these drifteres have, at the time of this writing, collectitvely logged over 45,000 kilometers of ocean! These units cost approximately a third of what traditional drifters have in the past and the satellite transmission fees (via GLOBALSTAR satellite) have also been reduced by this amount relative to ARGOS. Another **innovative approach** to the science is our dependence on the fishing community. Lobstermen are well suited to navigating in and around the shallow estuarine environments filled with fishing gear. Oceanographic research vessels are typically too large and unwelcome in these waters. We have several dozen lobstermen involved as participants in the “Environmental Monitors on Lobster Traps” project all along the New England Coast ranging from Rhode Island to the Canadian border and can call on their expertise and knowledge.

5. The project is designed with **portability** in mind. A "trial deployment" of newly developed drifters from several lobstermen’s vessels will provide us the experience of applying our methods and instrumentation to a variety of situations and locations. Our long-term goal is to implement the same strategies in different environments under different conditions. There is an increasing interest in the exchange of water in and out of estuaries. Given the complexity of the topography and variability due to tide, river, and wind, it is often difficult to document the long-term mean circulation patterns in these areas. This is the primary motivation in

developing low-cost sampling schemes to allow for the multiple deployments needed to generate the statistical confidence.

6. The **end-product** of this endeavor will be a set of web-served model simulations for several sites along the New Engalnd coast validated with drifter trajectories. Many environmental impact statements on various aquaculture endeavors, for example, are based on a few short mooring deployments at a limited number of site locations. To fully resolve the complexities of the current field, multiple deployments of low-cost drifters are needed along with numerical modeling studies that resolve very fine-scale features.

7. There will be at least five groups of "**participants**" involved in our effort:

   i. Maine and Massachusetts Lobstermen's Associations will identify lobstermen and assist with outreach. Lobstermen will deploy drifters in on at least two days of "trial deployment" and, if needed, on emergency situations.
   ii. Southern Maine Community College students and faculty will be responsible for helping to design drifters, build prototypes, and participate in "trial deployments".
   iii. The Gulf of Maine Lobster Foundation will coordinate all aspects of the project.
   iv. National Oceanic and Atmospheric Administration scientist will be responsible for coordinating drifter design, processing and archiving drifter tracks, website design, and coordinating with the numerical modelers.
   v. A numerical modeler will be responsible for making simulations associated with each of the "trial deployments" to include the effect of realistic topography, real time winds, river input, and best estimate of offshore tidal forcing.

8. All results will be **disseminated** on the web in a variety of forms. The most effective form of these presentations, given the complex, time-varying nature of the system, is animated. Sensitivity studies of various wind conditions and runoff events, for example, will documente the "scenarios" that may occur. Since we have often used NOAA weather predictions to drive circulation models in the past, simulations can be made available in forecast as well as hindcast modes.

9. The US Coast Guard Search and Rescue Group would be our closest **end-user partner**. We have worked with them in the past and will need to foster a closer relationship to ensure our operation would be beneficial to theirs. While they have drifters prepared for air-deployment,

we will supplement their program and may be able to offer additional model products. We would also coordinate with appropriate state oil response agencies.

10. Given a **one year preparation** period, we believe we can have drifters ready and deployed within the first few tidal periods (6-24 hours) following a spill. Drifters could eventually be stored at the participant's home, dockside facility, or, directly on board the vessel given that they are easily collapsible & assembled. Since lobstermen are generally reachable by cell phone or VHF radio while underway, the reaction time will be a function of their distance to the spill. In the end, we could outfit several participants at various locations along the Northern New England coast in proximity to major ports (Boston, Portsmouth/Kittery, Portland, Rockland, Searsport and Eastport) to allow for the greatest flexibility in reaching spill locations. We recognize that most of the time and effort of this study however, will be in constructing, initializing, and forcing the fine-scale grid models. The horizonalt grid size for estuaries such as Casco Bay, for example, needs to be on the order of tens of meters to resolve the channelized flows that are critical for estuarine exchange. This is the most challenging and costly aspect of the project but. once the system is setup for one or two locations in the first year, it can be applied to multiple areas.

11. **Budget**

Item	total	Justification
Administration	$15k	1/3 salary with fringe
Drifters	$6k	new instruments including design cost
Satellite Fees	$2k	Hrly fixes; 6 units x 80 days & initiation fees
Navigation Software	$1k	Assist in deployments
Travel	$5k	12 day trips, 10 overnights, 1 national conf
Subcontractors		
NOAA Oceanographer	$0k	
Numerical Modeler	$30k	2 months
Lobstermen	$12k	2-3 days work & fuel each
SMCC Faculty Advisor	$4k	~1 week
SMCC Students	$6k	2 weeks each including 50% in the field
Outreach	$6k	Based on specific tasks
Indirect on Direct @11%	3.2k	
Indirect on Subcontracts @2%	1.7k	

TOTAL	$92k	