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Coordinated Regional Benefit Studies of Coastal Ocean Observing Systems

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Long-term goals

The long-term goal supported by this project is the development and sustained support of coastal ocean observing systems for the waters of the United States.

Objectives

We will first produce regional "inventories" of ocean observation user sectors, including information about the physical and economic scale of their activities, how products from improved ocean observation might be incorporated into their decisions, and a rough estimate of the potential value of improved decisions. Once the inventories are complete, we will select sectors with significant expected benefits for more detailed analysis.

Approach and work plan

Ocean observation has economic benefits because the data are used to derive products, such as forecasts, that are used by decision makers to make choices that affect economic well-being. To estimate the benefits that may accrue from an investment in ocean observation, it is necessary to compare the outcome of these decisions under two scenarios: the baseline situation (currently available information and products) and the hypothetical future situation with new and improved data and products. The new information products enabled by the new ocean data will alter decisions made in industry, recreation, and public administration, changing the economic outcome from these activities, and thereby affecting economic well-being. The difference in outcome under the two scenarios is the benefit derived from the new investment in ocean observation.

The most accurate measure of this benefit is the marginal increase in consumer and producer surplus. Consumer surplus is the difference between what consumers are willing to pay and what they actually pay. Producer surplus is the difference between the price received for a good or service sold and the costs of producing that good or service. Because this surplus is often difficult to estimate, we also use other measures of benefit, such as the change in value added, or reduction in cost to achieve the same level of output, although these are less precise estimates of true social surplus. Usually, these measures are estimated as annual values at the level of a firm or other economic unit, and then aggregated over geographic regions and industries to estimate total annual benefits.

The estimation of potential economic benefits from regional ocean observing systems requires an examination of a number of economic activities that are common across different regions (in type, though not necessarily in size). Estimation of these benefits also requires examination of economic sectors (industries or recreational activities) that are present in some regions, but not necessarily in others. To ensure that results from different regional studies can be compared and aggregated to national levels, these studies should be based on a common set of assumptions and economic methodologies. Critical common assumptions include identification of the products (e.g., forecasts) that will be available from improved coastal ocean observation, products available today (the baseline), the activities and behaviors that will be affected by information derived from the improved observations, the economic value of that information, and the increased cost associated with improved ocean observation.

Our work will proceed in four phases: (1) development of a common framework for benefit studies, (2) development of an "inventory" of the relevant ocean observation user sectors for each region, (3) detailed regional studies of the most significant sources of potential benefits, and (4) synthesis and benefit/cost analysis.

The common framework for regional inventories and detailed user sector studies will specify the improvements in nowcast/forecast products available with the hypothetical future ocean observing systems over those available at present. For the purpose of this analysis, we will focus on a subset of the full range of ocean observing variables. This subset will include those parameters of greatest relevance to the user sectors in our inventories, including among others ocean surface winds, waves, currents, and temperature; subsurface currents (in the Gulf of Mexico); waterborne contaminants that affect marine recreation and fishing; and fish stocks. If necessary, we will extend this list in the course of developing the inventories.

The regional inventories of ocean observing system user sectors will include information about:

- the physical and economic scale of their activities, measures by the number of persons engaged, the size of the capital stock utilized the activity, and/or sales and expenditures on the activity,

- a qualitative description of how they use or may use ocean observation data or products,

- a qualitative description of how improved ocean observation products might be incorporated into their decisions, and

- an "order of magnitude" estimate of the potential value of improved ocean observation.

The 2001 overview of possible benefits from improved ocean observation in the US Gulf of Maine by Kite-Powell and Colgan (2001) will serve as a baseline example for the inventories. For the purpose of this project, we have defined the following regions: Gulf of Maine/New England, Mid-Atlantic, Southeast (Virginia to Georgia), Florida (east and west coasts), Gulf of Mexico (west of Florida), California, Pacific Northwest, Alaska, and the Great Lakes.

Once the inventories are complete, we will select one or two user sectors within each region for more detailed analysis. In most regions, we will select the user sector that promises, based on the inventories, to generate the most significant benefits; but in selecting the sectors for detailed analysis we will also take into account the usefulness for the purpose of a national assessment of covering in some detail as many different user sectors as possible. An example of a more detailed sector analysis is a recent study by Kite-Powell (2000) of the benefits of polar satellite observations for commercial ship routing. In this study, Kite-Powell estimates the transit time savings achieved by commercial ships with conventional (present day) ship routing products and services, and contrasts these with transit time savings that could be realized with the improved routing products made possible by additional satellite data on ocean winds/currents. Similarly, the more detailed analyses we propose here will examine specific applications of ocean observing systems by:

- extrapolating benefits from observing systems that are already in existence and providing information to existing users, and/or

- specifying more detailed models of prospective user benefits than those produced at the inventory stage.

Project resources will not permit extensive primary data gathering in the second phase of the work. Instead, we anticipate that a combination of interviews and secondary data about the economic activities affected will produce more detailed information than in the inventory stage. These user sector studies will account for the balance of the effort in each region.

The final product of the proposed work will be a set of internally consistent inventories that together cover the major uses of ocean observing information for the nation as a whole, plus a set of region- and sector-specific studies that quantify likely benefits in some detail and will permit more reliable estimates of quantitative benefits for ocean observation at the regional and national scales. We will combine these regional and national benefit estimates with the cost data developed in phase 1 to describe the net benefits of improved coastal ocean observing systems in terms such as net present value, internal rates of return, and cost/benefit ratios.

We completed the development of the common framework in the fall of 2002 and are prosecuting the inventory phase of the regional studies during the winter of 2002-03. Detailed regional sector studies will be performed during the summer and fall of 2003, and a preliminary report containing all inventories and detailed user studies will be assembled and released in late 2003. Project synthesis will begin in early 2004.

Collaborators and responsibilities: The regional studies will be coordinated by principal investigators Dr. Hauke Kite-Powell of WHOI and Dr. Charles S. Colgan of the University of Southern Maine. Kite-Powell and Colgan have contributed to several economic studies of ocean observing system (see, for example, Adams *et al.* 2000), and most recently completed a preliminary estimate of benefits from coastal ocean observation in the Gulf of Maine (Kite-Powell and Colgan 2001). In addition to ensuring consistency among studies, the PIs plan to conduct the regional benefit studies for the Gulf of Maine/New England and mid-Atlantic regions. We will rely on team members with appropriate expertise in other parts of the country to take the lead role on the remaining studies.

The inventory has been completed for the **Gulf of Maine** (Kite-Powell and Colgan 2001). Kite-Powell and Colgan will extend this inventory to include Southern New England. The sector study will likely focus on refining estimates of benefits to search and rescue (SAR) operations, which showed the potential for significant benefits in the Gulf of Maine inventory. This work will be carried out by Kite-Powell and Colgan in collaboration with Phil Bogden of the Gulf of Maine Ocean Observing System.

Kite-Powell and Colgan will develop the inventory and sector studies for the **mid-Atlantic region** (New York south to Maryland). Marine activities and resources in this region are similar in nature to those in the Gulf of Maine/New England. Maritime transportation, commercial and recreational fishing, and recreational use of the shore will feature in the inventory. The likely focus for the sector study will be on commercial and recreational fishing. We have a good

working relationship with the NMFS Northeast Fishery Science Center in Woods Hole and plan to draw on their expertise in this process.

The **Southeast Region** inventory and sector studies will be conducted under the direction of Dr. Michael Luger, Director of the Office of Economic Development (OED) of the University of North Carolina at Chapel Hill. OED will conduct an inventory of ocean observing activities along the mid-south coast of the United States and then choose one or two specific user sectors for closer study, with the intent to ascertain the costs and benefits of that (those) activities. One presumed sector for closer study is severe storm tracking, since the coastlines of Virginia, the Carolinas, and Georgia lie in the path of most North American hurricanes (and are referred to as in or near "hurricane alley"). Another prominent sector is likely to emerge from the inventory – for example, tracking the transportation of pollutants, mapping currents, or similar scientific observation systems that affect the economy of the mid-south coast.

The **Florida** inventory and sector studies will be conducted under the direction of Dr. Ken Wieand, Director of the Center for Economic Development Research (CEDR) at the University of South Florida. The detailed sector study is likely to focus on recreational boating and fishing.

The **Gulf of Mexico** inventory and sector studies will be conducted by the Center for Energy Studies (CES) at Louisiana State University, under the direction of Center Director Dr. Allan Pulsipher. A likely focus of the sector study is offshore oil and gas.

The **California** inventory and sector studies will be conducted by Dr. Linwood Pendleton at the University of Wyoming (formerly at the University of Southern California). The sector study is likely to focus on recreational beach use and will build upon Dr. Pendelton's ongoing work in this area.

The inventory and sector studies for the **Pacific Northwest** will be conducted by Dr. Katharine Wellman, a resource economist and independent consultant working in Seattle. The sector study is likely to focus on commercial shipping and spill response, extending to northern California (San Francisco). A significant fraction of US petroleum imports (including shipments from Alaska) enter the continental United States via ports from San Francisco to Seattle. Both of these ports have been focal points for environmental concern over possible spills of hazardous cargos, and for investment spill prevention and response.

The inventory for the **Alaska** region will be produced by Kite-Powell and Colgan at WHOI, working with contacts in research (University of Alaska) and government (NMFS, USCG) offices in the state. The detailed sector study will also be carried out by WHOI, and is likely to focus on commercial fishing and search and rescue. For economy and efficiency, we plan to carry out this assessment in parallel with the detailed sector studies for the northeast and mid-Atlantic regions.

The inventory and sector studies for the **Great Lakes** region will be carried out under the direction of Dr. Tom Pelsoci of Delta Research Co, in Chicago, Illinois. The focus of the sector study is likely to be on commercial shipping and/or on freshwater resource management.

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Work Completed

Work on this project did not begin until FY2003.

Results

Work on this project did not begin until FY2003.

Impact and Applications

National Security

The work under this project will contribute to the implementation of regional ocean observing systems that can contribute to national security through better information about marine conditions for coastal operations, monitoring biological and chemical parameters, etc.

Economic Development

Better information about marine conditions in US waters will potentially improve the safety and efficiency of maritime transportation, commercial fishing, and recreational activities in these waters.

Quality of Life

Coastal ecosystem health and the management of coastal resources require information about physical, biological, and geochemical conditions of coastal waters and their resource stocks. Ocean observing systems are a primary source of this information.

Science Education and Communication

Real-time data from ocean observing systems can be used to enhance science education in the classroom and can bring benefits directly to users of ocean observing information, such as recreational boaters, surfers, beachgoers, and fishers.

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