An Integrated Ocean Observing System:
Suggestions for Jump Starting the Coastal Component

Last year ORAP presented its second report to NORLC on the Integrated Ocean Observing System (IOOS).[1] The report focused on such issues as organizational structure, data assimilation and distribution, instrumentation development, and system design -- issues that are a necessary and fundamental part of this large, complex, and continuing program.

ORAP believes the observational program of IOOS might roughly be divided into two components. One concerns climate and builds on the array of buoys and other instrumentation distributed along the equatorial Pacific that has had such success in tracking El Niño - Southern Oscillation (ENSO) events and in turn successfully predicting the ENSO effect on changes in our yearly weather patterns. The second is a coastal IOOS, concentrating on observing and understanding the biological, chemical and physical processes that occur in our coastal waters, roughly defined as our Exclusive Economic Zone (EEZ).

The Argo floats in the NOPP-NOAA budget are part of the climate component of the IOOS. With satellites, floats and other ocean instrumentation, those developing this program believe they will be able to build on the success of our ENSO observations and learn enough about the year to year changes in the total ocean circulation to predict the effect of ocean variability on year to year changes in the climate over the entire earth, not just those areas directly affected by El Niño. It will be some years before we will know how successful they will be, but those running this experiment have a well thought out plan of what needs to be done and how to go about doing it. If successful, the economic return will be considerable.

The objective of the coastal IOOS is both more complex and diffuse. The off shore real estate holdings of the United States are huge. Our Exclusive Economic Zone is the size of the lower 48 states. In comparison to what we know about that part of our nation that is above sea-level our understanding of what lies off our shores is limited. Recent reports calling attention to our coastal area note both problems and opportunities (see references appended

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[1] An Integrated Ocean Observing System: A Strategy for Implementing, The First Steps of a U.S. Plan. a report prepared by the Ocean Research Advisory Panel for the National Ocean Research Leadership Council, December 1999.

to this report). On the one hand these areas offer hope for sources of energy such as clathrates and new pharmaceuticals (the number and variety of different animal and plant species in the waters off our shore are many times the number found on land).

These offshore areas are not static. Shorelines shift and the populations and distributions of plants and animals that live in these waters and the sediment beneath are continuously changing. In some cases, for example, the decimation of a number of commercial fisheries, we understand why. But there have been significant changes in species distribution which cannot be attributed to increasing fish harvests. Subtropical Triggerfish have moved into North Carolina waters and have almost completely replaced the Black Sea Bass for reasons not fully understood. A slight increase in the thermocline depth is now believed to be the reason for a rapid change in the distribution and types of organisms that occurred off the New England coast some years ago. We need to understand better the interactions of this offshore region with the atmosphere and land so that we can better predict how changes in these waters affect our weather and climate, and those who go to sea and work at sea can be assured they can do so safely and effectively.

ORAP also believes we need to understand what effect we are having on this offshore area. We are concerned about the future. We believe biological changes in our EEZ have been much more rapid and severe in recent times because man's activities than at any time in our recent history. For example, in the last twenty five years there has been a significant increase in harmful algal blooms and diseases of marine organisms ranging from corals to marine mammals. In the past twenty five years an increasing percentage of our coastal waters have become hypoxic (very low dissolved oxygen level) and even anoxic (completely devoid of oxygen).

We are doing an increasingly effective job of monitoring our bays, harbor, and the waters along our coasts. But once we get a few miles off shore our observations and our understanding drops dramatically. Given what we do know about the increasing rate of harmful algal blooms and the increasing instances of hypoxia and anoxia in waters some distance from our shore, ORAP believes it is critical that we mount the coastal IOOS as soon as possible. We believe the economic return from such an investment will be significant, but we believed the coastal IOOS can be justified on the basis of what might be lurking out there. We are not prepared to suggest that we treat the rapidly increasing instances of harmful algal blooms as the ocean

equivalent of the miner's canary, but we do believe an immediate investment in the coastal IOOS is a prudent investment, independent of whatever other economic justification might be made.

Plans for a coastal IOOS are being developed at a number of levels both local and national, and by a number of groups. ORAP plans to monitor these plans as they unfold. The backbone of the observing program will be a system of physical observations (temperature, salinity, water movement) needed to constrain any models and necessary for the interpretation of any biological and chemical observations. Water movement (currents) varies considerably in both time and space, and it is the most difficult and the most expensive of parameters to measure in a comprehensive manner. Recently, high frequency radar's, Coastal Ocean Dynamics Applications Radar (CODAR) have been successfully employed and are fast becoming an accepted method for measuring surface currents. In the past ---- years, some ---- radar combinations have been successively deployed (a minimum of two radars are required at each station).

CODAR is a tested instrument that will play a significant role in the implementation of the coastal IOOS. The sooner this kind of data becomes widely available the easier it will be for those charged with implementing the various pieces of the coastal IOOS to complete the design of other components. We believe an investment that will provide a year or more head start on the detailed implementation of the coastal IOOS is a good investment. We urge the National Ocean Leadership Council to consider building into its budget immediately funds for the acquisition of enough CODARs to provide the coverage for at least the lower 48 states. A preliminary study suggests that such coverage will require about 62 CODARs at a cost of about 12 million dollars.

In contrast to the climate component of the IOOS where much of the instrumentation has been well tested and available for some years, we believe progress in the coastal IOOS is going to be restricted by the lack of adequate instrumentation. Two other instruments currently undergoing development could provide significant additional information for the coastal IOOS. These are an instrument that remotely measures sea surface salinity and NEMO (Navy Earth Map Observer Program). The latter receives ocean images between 400 and 2500 nm with a 10 nm spectral resolution from which it extracts water color and clarity. Both are presently configured for satellites. To gain maximum use in coastal areas will probably require re-configuration for an aircraft so the footprint of the signal would be reduced

to the order of a few kilometers. ORAP urges those agencies with responsibility for the development of these instruments to consider the modifications necessary to tailor these instruments for the IOOS.

Finally, ORAP notes and applauds the effort of COMPASS (Coordinating Marine Programs to Assess and Sustain the Sea) to develop a suite of sophisticated biological probes that may in time become an integral part of the coastal IOOS.

Selected Reading.

National Research Council, Priorities for Coastal Ecosystem Science. 1994, 106 pp.

National Research Council, Understanding Marine Biodiversity. 1995, 114 pp.

National Research Council, From Monsoons to Microbes. 1999, 131 pp.

National Research Council, Sustaining Marine Fisheries. 1999, 164 pp.