Implementation of the Initial

U.S. Integrated Ocean Observing System

Part I
Structure and Governance

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Prepared by Ocean.US
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Preface

The IOOS implementation plan is presented in three parts: (I) Structure and Governance, (II) The Initial IOOS: Building on Existing Assets, and (III) Improving the IOOS: Enhancements and New Initiatives.

- Part I (this document) focuses on defining a process by which priorities and budgets can be established to implement and improve a sustained and integrated system. The process includes articulating the vision of a sustained and integrated system; defining principles for its implementation and operation; establishing mechanisms to ensure synergy between research, education and the development of the operational system; and recommending a governance mechanism for implementing, operating and improving the IOOS over time.

- Part II will describe the initial IOOS that is to be built by linking existing assets across agencies to form an integrated system of measurements, data management and communications, analysis, and education. Agencies participating in the implementation, operation and improvement of the IOOS will be designated as the lead agency or a participating agency for system integration, research, operations, and development of regional associations and a national federation of regional associations. The emphasis will be on identifying activities, infrastructure and associated funds that are designated or can be used by participating agencies to build the initial system.

- Part III will address item (3) for the longer term (4-10 years). It will focus on enhancements to the IOOS and initiatives to improve the initial system as recommended by consensus at the March 2002 Ocean.US workshop, Building Consensus: Toward an Integrated and Sustained Ocean Observing System. (www.ocean.us).

The concept and structure of the IOOS is based on recommendations by experts over the last 10 years. These are articulated in many reports, the most current and relevant of which are as follows:

- “Toward a U.S. Plan for an Integrated, Sustained Ocean Observing System” (1999 NORLC report to Congress),
- “An Integrated and Sustained Ocean Observing System” (2002 Ocean.US report of the NORLC),
- “Building Consensus: Toward an Integrated and Sustained Ocean Observing System” (proceedings of the 2002 Ocean.US Workshop), and

Electronic copies of these reports may be found at www.ocean.us. Summaries of the historical development of the integrated approach to ocean observations, definitions of terms, and the conceptual design of the IOOS are given in Appendices I, II and III, respectively. Additional reports relevant to the establishment of the IOOS can be found at http://ioc.unesco.org/goos/docs. A listing of acronyms used in this report is given in Appendix IV.
The Integrated Ocean Observing System (IOOS) is a coordinated national and international network of observations, data management and analyses that systematically acquires and disseminates data and information on past, present and future states of the oceans and the nation’s Exclusive Economic Zone (EEZ). The IOOS is being developed in two closely related components that encompass the broad range of scales required to assess, detect and predict the effects of global climate change, the weather and human activities.

- The global ocean component is an international collaboration to develop a global observing system (the Global Ocean Observing System, GOOS) designed to improve forecasts and assessments of weather, climate, ocean states, and boundary conditions for regional observing systems.

- The coastal component is required to assess and predict the effects of weather, climate and human activities on the state of the coastal ocean, on its ecosystems and living resources, and on the nation’s economy. It encompasses the nation’s Exclusive Economic Zone (EEZ), the Great Lakes, and estuaries and consists of a national backbone of observations of the EEZ and a set of nested regional observing systems.

The national backbone is a federal system that targets the EEZ. It achieves economies of scale by providing observations and analyses required by all or most regions and a framework for the establishment of a national federation of regional observing systems. Regional observing systems contribute to and enhance the national backbone by increasing the time-space resolution of observations and the number of variables measured and analyzed based on regional priorities. Regional Associations (RAs) of major stakeholders (data providers and users) are established to develop products and services tailored to the unique needs of each coastal region and design, implement and operate coastal observing systems that meet these needs. Together, the global ocean and coastal components of the IOOS constitute a hierarchy of observations required to detect, predict, and mitigate the effects of large scale changes in the oceans, atmosphere, and land-based inputs on coastal ecosystems, resources and human populations.

The IOOS will improve significantly the nation’s ability to achieve seven national goals related to climate change, marine services, natural hazards, national security, public health, ecosystem health, and living marine resources. An integrated system will (1) efficiently link the specification of data and information requirements of many user groups to data acquisition, processing and modeling; (2) provide multi-disciplinary data and information from in situ and remote sensing; (3) enable synergy between research and the development of operational capabilities; (4) transcend institutional boundaries; and (5) improve public understanding of the oceans and changes occurring in them through sustained programs of education and communications.

The NORLC established an Ocean.US Office to coordinate the development of the IOOS. The initial design has been completed and endorsed by the NORLC. The implementation plan is being formulated in three parts: (I) structure and governance, (II) the initial IOOS, and (III) improving the IOOS. A governance mechanism is described herein that will enable the coordinated and systematic implementation of an IOOS for the nation.

The IOOS will develop as a partnership among federal and state agencies and regional associations that represent both users and operators of the system. The NORLC, with advice from its Ocean Research Advisory Panel, develops policies and procedures for design and implementation; in collaboration with participating federal
agencies, regional associations and user groups and under the oversight of an executive committee created by the NORLC, Ocean.US formulates and updates the integrated plan for the IOOS annually; and participating government agencies and regional associations implement those elements of the IOOS that are consistent with their missions, goals and priorities. Participating agencies prepare budget requests for their contributions to the IOOS based on the integrated plan. The entire process is implemented through a four year planning and budget cycle that is synchronized with the federal budget process. The Ocean.US Office coordinates the steps required to carry out this process. Recognizing that IOOS activities should be represented by one federal agency for administrative purposes, NOAA will perform this function including the preparation of a consolidated multi-agency annual budget request for the IOOS.
1. Background

1.1. One System, Seven Goals

The development of a sustained and Integrated Ocean Observing System (IOOS) will make more effective use of existing resources, new knowledge, and advances in technology to achieve seven related societal goals (www.ocean.us.net):

- Improve predictions of climate change and variability (weather) and their effects on coastal communities and the nation,
- Improve the safety and efficiency of marine operations,
- More effectively mitigate the effects of natural hazards,
- Improve national and homeland security,
- Reduce public health risks,
- More effectively protect and restore healthy coastal marine ecosystems, and
- Enable the sustained use of marine resources.

Achieving these goals depends on (1) more rapid detection and timely predictions of changes in marine and atmospheric systems; (2) improved understanding of the effects of human activities on these systems; and (3) enhanced public awareness and understanding of the oceans and the changes occurring in them. This is the purpose of the IOOS.

Although each goal has unique requirements for data and information, they have many data needs in common. Likewise, the requirements for data communications and management are similar across all seven goals. Thus, an integrated approach to the development of a multi-use, multi-disciplinary observing system is feasible, sensible and cost-effective.

In addition to serving the needs of the Nation, the IOOS is the U.S. contribution to the Global Ocean Observing System (GOOS) that includes both open ocean and coastal components. A summary of the history of GOOS and the IOOS, definitions of terms, and conceptual design of the IOOS are given in Appendices I, II, and III respectively.

1.2. The Vision

The IOOS is envisioned as an integrated system of measurements (monitoring), data management and communications, and analyses that provides data and information required to achieve the seven goals more effectively. It will

- Provide the foundation for an integrated approach to achieving the above goals (one system, seven goals),
- Develop in response to the data and information needs of a broad spectrum of user groups including government agencies (state and federal from resource management, environmental protection and coastal zone management to emergency response and national defense), private enterprise, scientists, educators, non-governmental organizations, and the public;
- Become a system that provides the data and information required for more rapid assessments and detection of changes in the state of the marine environment and more timely predictions of future states required to achieve the seven goals; and
Evolve as a partnership among federal and state agencies, the private sector, and the scientific community that cross the boundaries between the oceans, the atmosphere, and terrestrial environments. Achieving the vision will lead to more timely and effective translation of new scientific knowledge of the oceans into applications for the public good. The challenges are large and it is anticipated that the fully integrated system will come into being over a 10 year period.

1.3. Design Considerations Relevant to Governance

Design and implementation of the IOOS must take into consideration five basic factors:

1. there is a need for more rapid detection and timely prediction of a broad spectrum of phenomena encompassed by the seven goals (Appendix III);

2. there are impacts on society of both large scale changes in the ocean-climate system and changes in land-based inputs of water, nutrients, sediments and contaminants;

3. consistent with policies stated in the Paperwork Reduction Act of 1995 (44 U.S. Congress, Chapter 35) and OMB Circular No. A-130, the production and sale of value added information by the private sector is to be encouraged and data providers and users from both private and public sectors may contribute to and use IOOS data and information;

4. priorities for detecting and predicting changes in the marine environmental and coastal ecosystems vary among regions (e.g., priorities in the Gulf of Maine will differ from those in the Gulf of Mexico or the Pacific Northwest); and

5. regional associations, responsible for the development and operation of regional observing systems, provide the most effective means for product development and developing the user base.

To these ends, the IOOS is conceived as two closely linked components (a system of systems), a global ocean component and a coastal component. The global component is part of an international collaboration that will improve nowcasts and forecasts of weather, surface waves and currents, sea surface temperature and global climate trends. It will also provide boundary and initial conditions for higher resolution applications in the nation’s EEZ and coastal embayments. The coastal component encompasses the nation’s EEZ, the Great Lakes and estuaries. It is envisioned as a collaboration among federal and state agencies, the private sector, non-governmental organizations, and academia. The coastal IOOS is primarily concerned with nowcasting and forecasting effects of weather, climate, and human activities on the physical state of the coastal ocean, its ecosystems and living resources, and human activities in the coastal zone. It consists of regional observing systems nested in a national backbone of coastal observations. The latter provides data and information required by most regions, links global ocean and coastal ocean observations, and provides the framework for the development of regional observing systems. Regional observing systems enhance the national backbone in terms of the time-space resolution of measurements and the number of variables measured. These systems meet user requirements on the regional level.
2. An Integrated Ocean Observing System

2.1. Design Principles

Linking user needs to measurements requires a managed, efficient, two-way flow of data and information among three essential subsystems (the “end-to-end” system): measurements, data management, and data analysis (including modeling). To these ends, the design and implementation of the IOOS adheres to the following principles:

1. Development and operation of the system will be guided by coalitions of data providers and users and by a long term strategy that enables government agencies (state and federal) to achieve their missions and goals more effectively.

2. The IOOS will be a multiple use system that focuses on those aspects of the seven goals that can most effectively be achieved by integrating existing elements across agencies and programs. The IOOS will provide social and economic benefits to the nation through the sustained provision of data and information on the oceans that will benefit a broad spectrum of user groups from government agencies and private enterprise to NGOs and the science and education communities that use or benefit from the oceans or are responsible for their stewardship.

3. Design and implementation will be based on sound science. The IOOS will enable constructive and timely synergy among research, modeling and monitoring activities.

4. Data and information produced at public expense will be fully and openly shared at no more than the cost of dissemination.

5. Observing systems or elements thereof will meet national standards and protocols for measurements to ensure data quality and for data communications and management (including metadata) to ensure rapid access to data and information of known quality regardless of the source of the data or where the data reside.

6. Procedures will be established for user groups to routinely evaluate the performance of the IOOS and assess the value of the information produced. Procedures will also be established to ensure sustained data streams and to improve the system as new capabilities become available and user requirements evolve.

7. Federal investments in capacity building (training, infrastructure development) at state and regional levels will be needed to enable all states and regions to contribute to and benefit from the development of the IOOS.

8. The initial IOOS will be established by selectively linking existing assets based on national and regional priorities. It will be improved by selectively enhancing and supplementing the initial system over time. Operational ocean observing systems that may be incorporated into the IOOS are those that meet IOOS design principles as described above. It is unlikely that all observing systems will meet these criteria.

It is recognized that coordinating the mix of platforms (e.g., ships, satellites, aircraft, autonomous underwater vehicles, etc.), data streams, data management activities, and models that will be required necessitates exceptional levels of coordination with the managers of these resources. This will also require coordination and collaboration among regional associations and federal agencies. To these ends, a resolution to collaborate in the establishment of a National Federation of Regional Associations that conforms to these principles is appended (Appendix V).
2.2. Evolution of an Operational System

The initial system will be an important first step toward the development of a comprehensive, fully integrated system. System capabilities and the number of participating agencies and organizations will increase with time as the initial system evolves. Evolution of an integrated system that is responsive to user needs will require an iterative process of selection, incorporation, evaluation, and improvement over time. Successful evolution will depend on

1. advances in the state of the art in many areas of ocean science and engineering;

2. the selective incorporation of candidate operational elements into the operational observing system based on IOOS design principles (including user requirements);

3. appropriate funding for implementing and enhancing the operational system; and

4. an effective and sustained program for enhanced public awareness and education.

Candidate technologies and capabilities will pass through three stages of research and development before incorporation into the operational IOOS (Figure 1) as follows:

1. **Research Projects**: Observational (platforms, sensors, measurement protocols, data telemetry), data management and communications, and analytical (e.g., models and algorithms) techniques are developed by research groups.

2. **Pilot Projects**: Techniques that show promise as potential elements of the operational system or sustained observations for research are tested repeatedly over a range of conditions. This will illuminate weaknesses, provide opportunities to address those weaknesses, and permit a better understanding of how they may be applied. Research groups, with involvement of operational groups, are primarily responsible for this stage.

3. **Pre-Operational Projects**: Research and operational communities collaborate to ensure that incorporation of new techniques from pilot projects into the operational system are likely to lead to a value added product (is more cost-effective or improves on existing capabilities) and will not compromise the integrity and continuity of existing data streams and product deliv-

Figure 1. The IOOS consists of a continuous spectrum of activities from research to the operational system. Candidate technologies and capabilities pass through stages to be considered for incorporation into the operational system, long-term research, or both. Research and development projects in stages 1, 2, and 3 may be funded competitively through the NOPP process or through mechanisms established by participating agencies in coordination with Ocean.US. Operational elements are funded for extended periods based on demonstrated utility and performance. As the operational system evolves, it will benefit research and help guide the development of pilot and pre-operational projects. New knowledge and technologies developed in pilot projects that do not become pre-operational may be incorporated into long-term observations for the purposes of oceanographic research.
ery of the operational system. Operational groups, with the involvement of researchers, are primarily responsible for this stage.

4. **Operational System:** Routine and sustained provision of data and data products in forms and at rates specified by user groups are performed by operational groups with researchers functioning as advisors and users. This stage is improved through the incorporation of elements that are successful in a pre-operational mode. The appropriate federal agency or regional association is responsible for the coordinated incorporation of such elements into the operational system, i.e., successful pre-operational projects, or elements thereof, are transferred to an operational agency, office, center or RA for incorporation into the operational system.

Existing elements or systems (regardless of origin or sponsorship) may be considered for any stage if they meet the criteria outlined in Appendix VI. Although presented as a linear sequence, in practice all four stages will be in play simultaneously with feedback among all stages. Research and development projects (stages 1-3) may focus on elements of the system (a particular sensing technology, development of sampling protocols, model development, data management and communications protocols, etc.) or on the development of an integrated system (e.g., end-to-end, regional observing systems). Successful pilot projects, or elements thereof, may be incorporated into long-term time series observations for scientific purposes, may become pre-operational, or both. Finally, a sustained program for enhanced public awareness, education and training is critical to the development of the IOOS over the long-term.
3. Governance

“Governance” refers to the policies and processes by which design, implementation, operation, and improvement of the IOOS are controlled and managed at both national and regional levels. The IOOS will require unprecedented cooperation and collaboration among participating federal agencies and among federal agencies and RAs. The basic premise of the governance mechanism outlined below is that the IOOS will develop under the leadership of participating federal agencies in collaboration with RAs and with the guidance of user groups from private and public sectors. In this scheme, the NORLC “controls” and Ocean.US “coordinates” IOOS functions as described below and in Appendix VII. An Executive Committee (EXCOM) created by the NORLC oversees the Ocean.US activities. The general functions of all bodies expected to participate in the governance of the IOOS are described in more detail in Appendix VII.

3.1. Function

A management structure must be in place that can oversee the development and operation of a coordinated and cost-effective IOOS. In principle, the governing bodies must have the authority and responsibility to conduct the functions described below (Figure 2).

3.1.1. Planning and Selection

- Formulate and periodically update a strategic plan to achieve the seven goals and guide implementation based on short- and long-term priorities.
- Ensure collaboration among participating government agencies and RAs in establishing long-term (multi-year) and short-term (annual) priorities for developing all four stages of the IOOS and related programs to enhance public awareness and education.
- Coordinate the selection processes among agencies for funding research, pilot, and pre-operational stages intended to build the IOOS, and incorporate these elements into the operational IOOS (Appendix VI).
- Function as the nation’s focal point (“portal”) for international cooperation and collaboration in the development of the GOOS.

3.1.2. Funding

- Implement a multi-year planning cycle that is coordinated with existing budget development cycles to establish priorities and negotiate agency-specific funding-budget requests for the development of the IOOS and projects upon which the operational IOOS depends.
- Secure funding commitments from participating government agencies for the Ocean.US Office to perform the functions described herein.

Figure 2. IOOS governance functions that fall under the oversight of the NORLC and are coordinated by Ocean.US.
3.1.3. Implementation of the Operational IOOS

- Establish standards and protocols for measurements, data exchange and data management.
- Ensure effective and efficient linkage among IOOS elements (measurements, data management and communications, data analysis).
- Formulate rules of engagement for establishing the operational elements of the global ocean, national backbone, and regional components of the IOOS.
- Coordinate the development of regional observing systems and the formation of a National Federation of Regional Associations.

3.1.4. Evaluation

- Ensure the provision of data and data products in forms and at rates required by the users, and evaluate the efficiency and efficacy of the system in meeting the needs of user groups.
- Periodically verify to Congress, States and other stakeholders (and State legislatures as appropriate) that system development is proceeding according to IOOS design principles and criteria, and funds allocated for the IOOS are used for this purpose.
- Improve or remove from the IOOS those elements that are not performing up to standards.

3.2. Institutional Responsibilities

The IOOS is being designed, implemented, and improved based on plans formulated by Ocean.US and approved by the NORLC (Figure 3). Ocean.US is the primary body responsible for system design and coordinated implementation of the IOOS. An Executive Committee (EXCOM) appointed by the NORLC oversees the Ocean.US Office and works to provide the required resources. The planning cycle for these activities is described in section 3.3.

Ocean.US coordinates the development of the global ocean component, the national backbone, and regional observing systems to establish an IOOS that conforms to design principles as described in section 2.1 and the “rules of engagement” for RAs (Appendix VIII). The USGSC provides guidance concerning user needs and coordination with the international development of the GOOS. The National Federation of Regional Associations provides the means for coordinated development of regional observing systems according to the design principles and the rules of engagement. The Federation also provides the mechanism for RAs to influence the development of the national backbone, the establishment and implementation of national standards and protocols, and input from users (including the RAs themselves) concerning product development and the performance of the IOOS.

The global ocean component and the national backbone will be implemented and operated by federal agencies, federally funded operational centers, and Regional Associations (RAs) as appropriate. Guided by both national
and regional priorities, a national federation of RAs will (1) coordinate the development of regional observing systems for the provision of data and data-products tailored to the requirements of an increasing number of user groups in the respective regions, and (2) provide an important means by which RAs can influence the development of the national backbone (to ensure that the backbone does, in fact, provide data and information needed by most regions) and national standards and protocols (to promote their usage). RAs, composed of representatives from both data providers and users groups, will be responsible for the design and implementation of regional observing systems and will help guide the development of the national backbone through the National Federation (Appendices V and VII).

Implementation and day-to-day management of the operational IOOS (including deploying and maintaining sensor systems, monitoring data streams, the timely generation of products, etc.) are performed by responsible agencies, operational centers, and RAs as appropriate to their goals and missions. Evaluation and verification of the operational IOOS are performed biennially by external review teams established by Ocean.US. Ocean.US reports annually to the NORLC on the status and performance of the IOOS and recommends improvements (development of new capacity, improvement of elements that are not performing up to standards, and removal of elements from the IOOS).

3.3. The Multi-Year Planning Cycle

The IOOS will be established and enhanced with federal funds specifically authorized and appropriated for the IOOS based on an integrated plan developed annually by Ocean.US in collaboration with participating agencies. The IOOS will also be built by capitalizing on other opportunities as they occur. Research and development projects that are likely to contribute to the operational IOOS may be funded for the purposes of the IOOS (mission-driven); may emerge through research based on priorities established by the scientific community (hypothesis-driven research); or other means. Governance of the IOOS encompasses mission-driven research (specifically intended to improve the IOOS) and decisions concerning the selection of projects for incorporation into one of the four stages of development (Figure 1). Research and pilot projects may be federally funded through the NOPP process or through mechanisms established by participating agencies in coordination with Ocean.US.

Implementing and improving the IOOS over time requires specifying priorities for IOOS implementation and development, formulating a time table for these activities, working within the federal budget process to determine costs, and capitalizing on unplanned developments. To these ends, Ocean.US must work with participating federal agencies (through the EXCOM) and RAs in advance of the President’s budget submission to Congress; leverage ongoing activities; and influence the planning, budgeting, and procurement processes of participating agencies.

Central to this process is the selection and migration of potential operational elements from research and development projects to the operational mode of the IOOS (Figure 4). As the Interagency Office for the IOOS, Ocean.US, is tasked with overseeing this process. To this end, Ocean.US works with its EXCOM to (1) establish priorities for each of these stages, (2) propose time-tables for their implementation and completion, and (3) promote agency budget requests to support projects accordingly. Funded projects are reviewed annually to ensure adequate performance.

Integration of pre-operational projects, or elements thereof, into the operational IOOS is performance-based, requires a new selection procedure, and should be supported and sustained as appropriate. Ocean.US, in consultation with its EXCOM, coordinates the selection of elements for incorporation into the operational system. Participating federal agencies have the authority for annual budget requests. IOOS development will be coordinated with and involve present budget development
processes and participating agencies. Annual plans for the incorporation of elements into the operational IOOS must be approved by the NORLC.

### 3.3.1 The Ocean.US Planning Process

The proposed process for IOOS implementation requires collaboration among agencies and RAs and approval of the NORLC in advance of Congressional appropriation and authorization (Table 1). Through the EXCOM, Ocean.US works with participating agencies to establish funding priorities. Participating agencies prepare budget requests for their contribution to the IOOS (implementation, operation) based on Ocean.US plans. NOAA develops a multi-agency budget summary for the OMB and Congress.

The planning cycle begins in May, nearly three years prior to implementation (e.g., May, 2003 for FY ’06 implementation). Each step in the cycle is described in more detail below.

**Year N-3**

1. **May (Information Gathering):** Each year, reports on the "state of the IOOS" will be prepared. These will consist of status reports, results of an annual performance review, and requests to migrate projects, or elements thereof, to a higher stage in the sequential development of the operational IOOS. Reports are submitted to Ocean.US by agencies and RAs. Operational bodies submit status reports and identify research and technology needs and pre-operational projects that are ready for incorporation into the operational IOOS. These inputs are used to prepare a briefing to agencies and RAs at the Ocean.US Planning Conference in July and to initiate the development of agency budgets for all stages of the IOOS (research to the operational system).

2. **July (Initiate IOOS Planning):** The linkage between the processes of funding Research, Pilot, and Pre-Operational Projects (through NOPP) and the incorporation
of Pre-Operational Projects into and enhancements of the operational IOOS by federal agencies (through co-planning with Ocean.US) will be initiated at the annual July Ocean.US Planning Conference. Agency leaders for the IOOS and representatives from the RAs are briefed by Ocean.US on the status, objectives and rationale for sustaining and improving the IOOS over a 5 year period beginning with the current year (e.g., July, 2003). A working group is formed by Ocean.US to establish priorities, a provisional time-table for implementation, and estimated resource needs in the future Year N (e.g., FY 2006 for planning initiated in summer 2003). The specific focus is on planning for a particular year; however out-year plans and implications must be considered.

3. July – September (Formulate Guidelines for the Year of Implementation): Ocean.US establishes priorities for each of the four stages (research to the operational system) and a timetable for implementing the required activities. Due consideration is given to the development of each subsystem of the IOOS (observing, data management and communications, and data analysis-modeling) at all scales from the global ocean component to the national backbone and regional observing systems. The process includes a review of and is guided by the current status of IOOS development and activities planned for the intervening two years (e.g., FY ’04 and ’05). A report, “Guidelines for the Integrated Ocean Observing System: Year N”, is submitted to participating federal agencies and RAs for review and evaluation. While the guidelines will emphasize on Year-N, they will also reflect out-year planning.

Year N-2

4. January – August (Agency Budget Formulation): Individual agencies formulate their budgets in year N-2. For those aspects relevant to the development of the IOOS, this process will take into consideration IOOS development guidelines provided in September of the previous year.

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Table 1. Four-year cycle of planning, programming and budgeting for IOOS implementation and development (where Year-N is the year of implementation). The cycle is continuous and is initiated annually. After four years, all phases will be in play at once. Unless otherwise noted, all activities are initiated and coordinated by Ocean.US. Year refers to the federal fiscal year.
Year N-1

5. October – December (Integrated Plan, Federal Budget Formulation, Budget Consolidation): Ocean.US prepares an integrated, multi-agency implementation plan and submits the plan to the NORLC via the EXCOM; NOAA prepares a consolidated multi-agency budget based on the integrated plan and agency-specific budgets.

6. February – September (Congressional Appropriation): The federal budget submission to Congress is followed by the appropriation of funds.

Year N

7. October (IOOS Implementation): Implementation of the IOOS continues through individual agency programs and processes and NOPP. Evaluation of the success of the planning and appropriations begins.

Year N+1

8. March – May (Performance Evaluation): The status and performance of the IOOS is reviewed and evaluated. Results and “lessons learned” are used to formulate an annual report and update guidelines for future development of the IOOS (see Year N-3).

This cycle will be iterated annually as the planning process for years 2, 3, and 4 proceed as follows:

1. During the second year of the three-year planning cycle, federal agencies use the current IOOS Guidelines in the development of their IOOS budgets; Ocean.US tracks inclusion of IOOS elements as each agency prepares its budget and works with NOAA to develop a summary document that identifies agency funding requests in support of their respective roles and responsibilities for IOOS implementation.

2. In February of the third year of the cycle, the President’s budget is submitted to Congress. Congress completes the authorization and appropriations process by October, or soon thereafter, and implementation begins.

3. In January of the fourth year—solicitations (if necessary) are generated for new starts/renewals.

4. During March-May of the fourth year, a performance evaluation is conducted by Ocean.US based on evaluations of data and information flows among the three subsystems, the timely provision of data and products, and the quality of data and products.

5. In June of the fourth year – New starts and renewals begin.

3.3.2 Synchronizing the IOOS Planning Process with the Federal Budget Calendar

It will require about one year to synchronize the IOOS planning process with the federal budget process. Thus, it must be emphasized that priorities for the first year of implementation have been established by a different process (the Ocean.US workshop; www.ocean.us). These recommendations will be articulated in Part III of the implementation plan and should be acted on immediately to initiate the process of collaborative planning described above.1

3.3.3 General Responsibilities of Participating Federal Agencies

Part 1 of the Implementation Plan is focused on governance mechanisms for planning and coordinating the implementation of the IOOS. General governance arrangements are outlined in section 3.2 where the NORLC is the overall responsible body. The planning process for how participating agencies will enter their respective budget processes to implement the IOOS is outlined in sections of 3.3 above. Ocean.US formulates an integrated plan in consultation with participating agencies annually. NOAA

1With Parts II and III to be completed by Summer, 2003, the first budget year that can be fully impacted by the proposed planning process is FY ’06. Development of the IOOS during FY 2004 and FY 2005 will emphasize existing assets for the national backbone, data and information management, the development of regional observing system pilot projects and other priorities as outlined in the Ocean.US Workshop Report. Thus, IOOS funding in FY 2004 and FY 2005 will rely mainly on existing activities and initiatives.
prepares a summary of agency budgets consistent with this plan. This does not imply budget authority over the collaborating agencies. Specific aspects of agency responsibility in the implementation of the IOOS are spelled out in parts II and III of the implementation plan.

Agencies participating in the development of the IOOS will be designated as the lead agency or a participating agency for implementing, operating and improving elements of the system from research to operational modes, e.g., for system integration (federal budget crosscut, hosting Ocean.US Office), research (in situ sensing, satellite and airborne remote sensing, modeling), operations (remote and in situ sensing, data management and communications, products and services) and development of Regional Associations and the National Federation. The NORLC will oversee this process. Coordination of crosscut planning and evaluation will be led by the Ocean.US Office with broad agency participation. These activities include planning the design and implementation of the IOOS, coordination with other programs and activities concerned with external inputs to marine systems (e.g. land and atmosphere interfaces), the process of migrating elements from research to operations (including maintenance of a technology infusion plan, oversight of a user-based system performance and evaluation process), and the development of system-wide education, communication and public awareness plans.

In summary, IOOS planning and evaluation will be coordinated by Ocean.US in collaboration with appropriate agencies and administrative bodies. IOOS implementation and operational activities will be achieved through the cooperative efforts of participating federal agencies consistent with their mission, goals, and resources. Lead agencies for designated IOOS activities will be accountable to the NORLC and will work closely with Ocean.US to ensure the coordinated implementation of plans based on IOOS priorities.

In July 2003, the Ocean.US outlook for IOOS will be presented to agencies with a view to begin the process of developing the FY 2006 IOOS budget. This will be the first year that agencies will be asked to discuss IOOS pre-operational projects and operational enhancements for pre-budget formulation and vetting against IOOS needs. The introduction of this procedure will mark a major milestone in implementing an integrated, multi-agency IOOS implementation. Ocean.US will continue to work with the agencies and RAs to coordinate the incorporation of existing assets and develop agency-specific contributions to the development of the IOOS during FY '04 and '05. Development of the FY '05 budget will occur during this planning phase and will be informed by it. It is expected that the IOOS budget cross-cut can be developed in parallel with the FY 2005 budget process.
Appendix I
Historical Development of an Integrated Approach to Ocean Observations

International

1989  • Resolution passed by Intergovernmental Oceanographic Commission (IOC) to establish a Global Ocean Observing System

1991  • Created under aegis of IOC, World Meteorological Organization, United Nations Environment Programme, and International Council for Science
   • Envisioned to consist of five modules dealing with climate, marine services, pollution, living resources, and coastal issues

1995  • Initial Strategic Plan completed for the Climate Module

1997  • GOOS Steering Committee formed
   • Marine services and climate requirements combined into one global module

1999  • First International Conference on the Global Observing System for Climate; Unified operational and long-term research needs; consensus on requirements for global module

2000  • Publication of Ocean Theme (document of the Integrated Global Observing Strategy Partnership) defining ocean requirements for satellite observations and setting rolling review process
   • Initial design plans completed for pollution, marine resources, and coastal modules.
   • Three modules combined into one Coastal Module (Coastal Ocean Observations Panel)

2001  • Initial meeting of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology
   • Signaled formal beginning of operational global oceanography

2002  • Strategic Design Plan completed by the COOP for combined coastal module
   • First Forum of GOOS Regional Alliances
National

1990  • First national meeting to consider the concept
      • Interagency working group for U.S. GOOS formed

1991  • Economic benefits studies begin.

1995-1996  • Office of Global Programs in NOAA began preparation of an implementation plan for the U.S.
            contribution to the GOOS climate module.

1998  • U.S. GOOS Steering Committee established; initiated assessment of users and products needed by
       U.S. regional coastal observing systems

1999-2000  • First planning documents for U.S. GOOS by National Oceanographic Partnership Program issued

2000  • Ocean.US Office established; planning begins for development of a sustained and integrated
       ocean observing system for the U.S.

2001  • NOAA Ten-year Implementation Plan for Building a Sustained Ocean Observing System for Climate
       completed and reviewed

       reached on (1) vision for the system, (2) core elements to be federally supported, (3) need for an
       improved data and information management system, (4) need for additional economic benefits
       studies
       • Short IOOS plan with estimated first-year budget submitted to Congress via NOPP and OSTP
       • Complete report of national meeting issued
       • Planning for an integrated Data Communications and Management Subsystem initiated
       • Part I of the Phased implementation plan drafted
       • Plans formed for developing a National Federation of Regional Coastal Observing Systems
Coastal Ocean – For the purposes of the IOOS, the coastal ocean encompasses the region from head of tide to the seaward boundary of the EEZ, including the Great Lakes.

Data Providers – Individuals or organizations that monitor the environment and supply the data required by user groups for applied or research purposes. This includes both research and operational communities from academia, private enterprise, government agencies, and non-governmental organizations.

Data Users (User Groups) – Government agencies (local, state and federal), private enterprise, the general public, NGOs, and the science and education communities that use or benefit from the marine environment and its resources or are responsible for their stewardship. User groups specify requirements for data and data-products and evaluate IOOS performance.

Exclusive Economic Zone (EEZ) – An area beyond and adjacent to the territorial sea, subject to the legal regime established in Part V of the United Nations Convention on the Law of the Sea. This area shall not extend beyond 200 nautical miles from mean low water of the coastline from which the breadth of the territorial sea is measured. Within this zone, the coastal State has sovereign rights for the purposes of exploring and exploiting, conserving and managing natural resources, and other activities such as the production of energy from water, currents and winds.

Global (Open) Ocean – This region of the oceans is typically defined as the marine environment seaward of the shelf break front. It includes the deep basins of the world’s oceans where the influences of land-based processes are small compared to coastal waters. Boundaries between the open and coastal oceans are not fixed and will vary depending on the phenomena of interest, e.g., surface wave spectra, straddling fish stocks such as salmon and tuna, coastal eutrophication, and levels of enteric bacteria (One size does not fit all.)

Integrated System – One that (1) efficiently links environmental measurements, data communications and management, data analysis, and applications (to form an “end-to-end” system); (2) provides rapid access to multidisciplinary data from many sources; (3) provides data and information required to achieve multiple goals that historically have been the domain of separate agencies, offices or programs; and (4) involves cross-cutting partnerships among federal and state agencies, the private sector, and academic institutions.

Integrated Global Observing Strategy (IGOS) – An international strategic planning process for the coordinated development of the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the Global Terrestrial Observing System (GTOS). The IGOS is a collaboration involving UN Agencies (UNESCO and its IOC, UNEP, WMO, and FAO), the Committee on Earth Observation Satellites (CEOS), integrated research programs on global change within the World Climate Research Program (WCRP), the International Geosphere-Biosphere Program (IGBP), the International Council for Science (ICSU), and the International Group of Funding Agencies for Global Change Research (IGFA).

Integrated Ocean Observing System (IOOS) – An integrated system of marine monitoring, data communications and management and data analysis designed to provide the data and information required for more rapid detection and timely predictions of changes occurring in the marine environment that impact U.S. social, economic and ecological systems. The IOOS is the U.S. contribution to the GOOS. The integrated system includes research and development projects (research, pilot and pre-operational projects) upon which the development of the operational elements of the system depends. The IOOS consists of three closely linked components (“a system of systems”), (1) the global ocean component, (2) a national backbone for the nation’s EEZ, and (3) regional systems that provide an important link to the users of the IOOS. The national backbone links changes that propagate across global
and regional scales, provides observations and analyses required by all or most of the regions, and networks the regions into a national federation. This nested system of observations not only provides economies of scale, it provides the means to detect and predict the effects of basin scale changes in the ocean-atmosphere system on coastal ecosystems, resources and human populations.

**IOOS Subsystems** – The IOOS efficiently and seamlessly links three subsystems: (1) the observing subsystem (measurement and transmission of data); (2) the communications network and data management subsystem (organizing, cataloging and disseminating data and information); and (3) the data analysis and applications subsystem (translating data into products in response to user needs and requirements).

**Lead Agency** – Agency responsible for coordinating with participating agencies in the implementation, operation, evaluation, and improvement of designated elements of the IOOS.

**National Federation of Regional Associations** – A nationally coordinated union of regional partnerships formed to promote and implement regional observing systems in U.S. coastal waters, establish geographic boundaries as needed, promote collaboration among regions (where boundaries overlap, to enable effective transfer of technologies and knowledge) and implement national standards and protocols for measurements and the transmission and management of data. Regional observing systems are designed to contribute to and benefit from the national backbone by producing and disseminating ocean data and products that benefit the nation and user groups within the respective regions.

**National Backbone** – See the IOOS above.

**Operational** – An activity in which the provision of data streams and data products are routine, guaranteed, and sustained (in perpetuity) at rates and in forms specified by user groups.

**Participating Agency** – Contributes to, takes part in, or partners with other agencies and bodies in the implementation, operation and improvement of elements of the IOOS.

**Phenomena of Interest** – A broad spectrum marine properties and processes that influence the earth’s climate, the safety and efficiency of marine operations, the impact of natural hazards, national and homeland security, public health risk, the health of marine ecosystems, and the sustainability of living marine resources. These include surface waves and currents, sea level, coastal flooding and erosion; presence of human pathogens and chemical contamination; habitat modification and loss of biodiversity; harmful algal blooms and invasions of non-native species; mass mortalities of fish, mammals and birds; declines in marine fisheries; and aquaculture practices. More rapid detection and timely predictions of changes in or the occurrence of these phenomena are required to achieve the seven goals of the IOOS.

**Region** – Regions may include, but are not limited to, the Great Lakes; the Gulfs of Alaska, Maine, and Mexico; the Southern California, Middle Atlantic, and South Atlantic Bights; the Pacific NW; and Hawaii and the Pacific Territories. These correspond to the regions defined for the Regional Marine Research Program (NRC, 2000, “Bridging Boundaries Through Regional Marine Research”, National Academy Press) and are provisional. They are given here as a means to indicate the spatial scales that should be considered in the establishment of regional observing systems. Boundaries between regions should not be fixed in that they are likely to vary depending on the phenomena of interest that are priorities in a particular region.
**Regional Association (RA)** – A partnership or consortium responsible for the development, operation and improvement of regional observing systems. An RA consists of representatives of user groups that specify data requirements and products and data providers responsible for the design, implementation, operation and improvement of a regional observing system. In many cases, the same groups will act as both data providers and users. See Appendix V for more details.

**Regional Observing System** – A system that links the needs of users to measurements of the coastal oceans and the Great Lakes on regional or sub-regional scales. Like the global ocean component and the national backbone, regional observing systems consists of the infrastructure and expertise required to efficiently link the three subsystems. Development, operation, and improvement of the system are conducted under the auspices of a Regional Association. This includes oversight, evaluation, and evolution mechanisms that insure the continued and routine flow of data and information, and the evolution of a system that adapts to the needs of the user groups and to the development of new technologies and understanding.
A. The Phenomena of Interest

The IOOS is intended to provide the data and information required to

1. Improve predictions of climate change and variability (weather) and their effects on coastal communities and the nation,
2. Improve the safety and efficiency of marine operations,
3. More effectively mitigate the effects of natural hazards,
4. Improve national and homeland security,
5. Reduce public health risks,
6. More effectively protect and restore healthy coastal marine ecosystems, and
7. Enable the sustained use of marine resources.

Achieving these goals depends on more timely detection and prediction of local phenomena that reflect the structure and function of coastal ecosystems and the external forcings that impinge on them (Table 1). This requires observations and estimates (usually model calculations) of marine properties and processes, of interactions among coastal marine and estuarine ecosystems, and of exchanges across the land-sea boundary, the air-sea interface, and the boundary between shelf and deep-sea waters. Thus, the design of coastal IOOS must take into consideration both the complex nature of marine environments and the multiple forcings that impinge on them.

B. Linking Observations to Applications

Rapid detection and timely prediction depend on the establishment of an operational observing system that routinely and continuously provides required data and information in the form and at rates specified by the users. Such a system must efficiently link three essential subsystems to ensure the timely and routine delivery of data and information to users: (1) a monitoring (sensing) subsystem, (2) a subsystem for data acquisition, management and dissemination, and (3) a subsystem for data assimilation and analysis (Figure 1).

The observing (measurement, monitoring) subsystem consists of the infrastructure of platforms, sensors, sampling devices, and measurement techniques needed to measure variables on the time and space scales to needed detect and predict changes in coastal and open ocean environments. The data management and communications subsystem (protocols and standards for quality assurance and control, data dissemination and exchange, archival, user access, provision of data in real-time and delayed mode) is the “life blood” of the IOOS that links observations to the data analysis and modeling subsystem and subsequently, the products to applications and users. A major goal of the IOOS is to reduce the time required to acquire, process, and analyze data of known quality, and tune the delivery rates of these data and information to the time scales required for environmental decision.
Table 1. Examples of the drivers of change (forcings) and associated phenomena of interest in coastal marine ecosystems that are the subject of the IOOS (Ocean.US Workshop Proceedings, Airlie House, March 10-15, 2002).

### FORCINGS OF INTEREST

| “Natural” | • Global warming, sea level rise  
|          | • Natural hazards (extreme weather, seismic events)  
|          | • Currents, waves, tides & storm surges  
|          | • River & groundwater discharges, sediment inputs  
| Anthropogenic | • Alteration of hydrological & nutrient cycles  
|            | • Inputs of chemical contaminants & human pathogens  
|            | • Harvesting natural resources (living & nonliving)  
|            | • Physical alterations of the environment  
|            | • Introductions of non-native species |

### PHENOMENA OF INTEREST

| Climate & Weather | • Variations in sea surface temperature; surface fluxes of momentum, heat & fresh water; sources & sinks of carbon; sea ice  
|                  |  
| Marine Operations | • Variations in water level, bathymetry, surface winds, currents & waves; sea ice; susceptibility to natural hazards  
| Natural Hazards  | • Storm surge & coastal flooding; coastal erosion; susceptibility to natural hazards; public safety & property loss  
| National Security | • Nearshore current & wave environment; water clarity & sediment loads; acoustic performance & propagation of electromagnetic waves; nuclear, biological & chemical contamination  
| Public Health    | • Risk of exposure to human pathogens, chemical contaminants, and biotoxins (contact with water, aerosols, seafood consumption)  
| Healthy Ecosystems | • Habitat modification, loss of biodiversity, cultural eutrophication, harmful algal events, invasive species, chemical contamination, diseases in & mass mortalities of marine organisms  
| Living Marine Resources | • Fluctuations in spawning stock size, recruitment & natural mortality; changes in areal extent & condition of essential habitat; food availability & hydrographic conditions |
making. The subsystem will be developed for both real-time and delayed mode data, and will allow users to rapidly exploit multiple data sets from many diverse sources. It is envisioned that a hierarchy of local, regional, and national organizations will provide data, information, and access as required by user groups.

Monitoring and modeling are mutually dependent processes, and the development of the fully integrated system will require an ongoing synergy between monitoring, advances in technology, and the formulation of predictive models. Models will play critical roles in the implementation, operation and development of the observing system. They are important tools used to estimate quantities that are not observed directly with known certainty, i.e., predict past (hindcasts), present (nowcasts), and future (forecasts) states of coastal marine and estuarine systems and the errors associated with such predictions. A review of the current status of data assimilation and modeling for marine services and natural hazards, living marine resources, public health, and ecosystem health shows the advanced state of modeling for marine services and natural hazards relative to those available for detecting and predicting changes in phenomena that require measurements of biological and chemical variables. This underscores the importance of research for the development both improved sensor technologies and models of ecosystem dynamics.

C. The IOOS: A Hierarchy of Systems

The IOOS is designed to detect and predict the effects of climate changes (including extreme weather and human activities and global warming) and human activities (related, for the most part, to land-use, marine commerce, and the extraction of resources from the oceans) on goods and services provided by marine and estuarine systems (see section A above). Thus, the IOOS consists of three linked components (Figure 2): (1) a global open ocean component, (2) a national scale backbone for the nation’s EEZ, and (3) regional systems for coastal marine and estuarine waters. The open ocean component is primarily concerned with improving nowcasts and forecasts of the weather and physical states of the upper ocean, with improving forecasts of climate change, and with the pro-

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Figure 2. The U.S. Integrated Ocean Observing System (IOOS) consists of a hierarchy of observations from global to regional scales: a global ocean component (large, global scale), a national backbone for the U.S. EEZ (intermediate, national scale), and regional observing systems for coastal marine and estuarine waters (small, regional-local scale).
vision of boundary and initial conditions for higher resolution applications in coastal marine and estuarine systems. It is of principal interest to users in the climate, defense, maritime commerce, research, and education sectors. The coastal component encompasses the nation’s EEZ, the Great Lakes, and estuaries. In addition to improving nowcasts and forecasts of the weather, surface currents and waves, its primary purpose is to detect and predict the effects of extreme weather, climate change and human activities on coastal ecosystems, living resources and public health and safety. The national backbone links changes that propagate across global and regional scales, provides observations and analyses required by all or most of the regions, and networks the regions into a national federation. It measures and manages a relatively small set of “common” variables that are required by all RAs. RAs enhance the national backbone by increasing the time-space resolution of measurements and the number of variables measured and products produced.

The global ocean component of the IOOS will detect and predict changes in the state of the oceans that are related to changes in the ocean-climate system and that impact the nation on national to local scales. Regional observing systems are critical building blocks of the coastal component of the IOOS. The national backbone will not, by itself, provide all (or even most) of the data and information required to detect and predict changes in the phenomena of interest in each region. Thus, regional systems will enhance the national backbone by increasing the time-space resolution of observations and the number of variables measured depending on regional priorities. In this way, regional observing systems both contribute to and benefit from the national backbone.

It must be emphasized that there are categories of variables that are important globally and nationally, but the variables measured and the time-space scales of measurement change from region to region depending on the nature of the coastal zone and on user needs. These include variables in the categories of stock assessments, essential fish habitats, marine mammals and birds, invasive species, harmful algae, and chemical contaminants. For these categories, decisions concerning exactly what to measure, the time-space scales of measurement, and the mix of observing techniques are best made by stakeholders in the regions affected.
Appendix IV
Acronyms

EXCOM……. Executive Committee of Ocean.US
FOFC ........ Federal Oceanographic Facilities Committee
EEZ .......... Exclusive Economic Zone
GCOS....... Global Climate Observing System
GOOS ...... Global Ocean Observing System
GTOS........ Global Terrestrial Observing System
IGOS ....... Integrated Global Observing Strategy
IOOS ........ Integrated Ocean Observing System
IWG .......... Interagency Working Group
NGO .......... Non-Governmental Organization
NOAA ...... National Oceanic and Atmospheric Administration
NOPP ........ National Oceanographic Partnership Program
NORLC....... National Ocean Research Leadership Council
NRC.......... National Research Council
ORAP .......... Ocean Research Advisory Panel
OSTP......... Office of Science and Technology Policy
RA ............ Regional Association
USGSC....... United States GOOS Steering Committee
Appendix V
Resolution to Establish a National Federation of Regional Associations of Coastal Ocean Observing Systems

Whereas the Congress and the National Ocean Research Leadership Council have made the implementation of an integrated ocean and coastal observing system a high priority; and

Whereas the Congress has directed that a plan include the development of “integrated regional systems” as vital components of a national system; and

Whereas in the coming decade, a national, integrated ocean observing system will become operational, and information from this system will serve national needs for the following:

- Detecting and forecasting oceanic components of climate variability;
- Facilitating safe and efficient marine operations;
- Ensuring national security;
- Managing resources for sustainable use;
- Preserving and restoring healthy marine ecosystems;
- Mitigating natural hazards;
- Ensuring public health; and

Whereas the NORLC has asked the Ocean.US Office, as the National Office for an Integrated and Sustained Ocean Observing System, to draft an implementation plan for an integrated ocean observing system that calls for a federation of regional coastal ocean observing systems with sustained funding; and

Whereas a significant number of observing efforts already exist in the coastal waters of the nation’s ports, harbors, estuaries, continental shelf, and exclusive economic zone, and these systems can add greatly to the goal of an integrated national ocean observing system; and

Whereas these systems, which are in various stages of development, from nascent to well established, in general are not “integrated” in that frequently, they do not serve the multiple users or purposes called for by the NORLC, share standards and protocols, or address different spatial and temporal scales; and

Whereas it is in the vital interest of these regions to organize themselves in order to have a voice in the development of the rules and procedures that will govern a National Federation of Regional Associations of Coastal Ocean Observing Systems; and

Whereas it is in the vital interest of these systems to be prepared to effectively utilize funds that may be appropriated in the future as part of a national ocean observing system; and

Whereas these systems need continual evaluation and improvement to incorporate new methodology, technology and requirements; and

Whereas it is appropriate to begin discussion of the responsibilities and benefits of establishing regional observing systems and participation in the National Federation,

Now, therefore, the undersigned parties resolve as follows: the undersigned Signatories hereby resolve to work together toward the establishment of a National Federation of Regional Associations of Coastal Ocean Observing Systems to develop regional governance structures and foster national coordination; to work toward common data management standards; and to openly share data, metadata and related information.
A. Purpose

a. To explore the cooperative steps necessary, within the respective region of each, to establish Regional Associations that collectively will comprise a national federation of Regional Associations.

b. To collaborate with Ocean.US to establish a National Federation of Regional Associations.

B. Definitions

a. The Coastal Ocean encompasses the region from head of tide to the seaward boundary of the EEZ, including the Great Lakes.

b. A Coastal Ocean Observing System is a system designed to produce and disseminate ocean observations and related products deemed necessary to the users, in a common manner and according to sound scientific practice. The system links the needs of users to measurements of the coastal oceans and the Great Lakes on a regional or sub-regional basis. Such a system requires a managed, interactive flow of data and information among three subsystems: 1) the observing subsystem (measurement and transmission of data); 2) the communications network and data management subsystem (organizing, cataloging and disseminating data and information); and 3) analysis and applications subsystem (translating data into products in response to user needs and requirements). The regional observing system consists of the infrastructure and expertise required for each of these subsystems. It also includes oversight, evaluation, and evolution mechanisms that insure the continued and routine flow of data and information, and the evolution of a system that adapts to the needs of the user groups and to the development of new technologies and understanding.

c. A Regional Association is a partnership of information producers and users allied to manage coastal ocean observing systems within its region to the benefit of stakeholders and the public.

d. A National Federation of Regional Associations is the organization representing a nationally coordinated network of Regional Associations.

C. Signatory Qualifications

The Signatories to this Resolution are strongly committed to the establishment of a sustained coastal observing system in the United States that includes regional observing systems.

D. Implementation

The Signatories resolve to:

- Collaborate to establish the Federation, foster national coordination, and build capacity nationally
- Develop governance structures for regional observing systems (Regional Associations)
- Participate in the formulation of national standards and protocols for data management and communications
- Advocate free and open sharing of data, metadata and related information consistent with Ocean.US recommendations
- Foster improved public awareness, involvement and education.

E. Reservation of Authority

Nothing herein shall be construed in any way as limiting the authority of individual Signatories in carrying out their respective responsibilities.

Reference

REGIONAL OBS SUMMIT
RESOLUTION SIGNATURES
APRIL 1, 2003
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Jack Thigpen
Roger Lukas
Worth D. Nowlin, Jr.
Mark E. Luther
Verena Agger
Thomas C. Malone
Wayne Geyer
Philip Bogden
Stephen Weissberg
1. Research that is likely to contribute to the development of the IOOS may be specifically funded to address IOOS priorities (mission driven research) or may emerge through research designed to achieve goals established by the scientific community (hypothesis-driven research). Research priorities are established under the auspices of the NORLC (Ocean.US). Research projects may be selected for funding through the NOPP competition process or through mechanisms established by individual participating agencies.

2. Proof of concept pilot projects fall into one of two categories, those that target specific elements of the system (sensors, models, etc.) and those that constitute an “end-to-end” system (e.g., regional observing systems). Although pilot projects are expected to be conducted by researchers, collaboration with and/or endorsement by operational groups and potential users must be documented.

For potential elements, pilot projects must target high priority elements for building the fully integrated system based on existing capabilities and user needs. Proposed projects must

- Specify how the project is likely to contribute to the development of the IOOS (the national backbone and/or regional systems) and what the benefits to potential users groups are likely to be (i.e., projects must be justified in terms of elements of the IOOS that are likely to be improved and/or improved benefits to users);
- Define, in terms of the IOOS mission, objectives, milestones, project management, and performance metrics (e.g., feasibility and impact, improving existing elements of the IOOS, product development); and
- Specify goals that can be achieved within a specified, finite period (e.g., 3-5 years).

In addition to the above, candidates for regional observing system pilot projects that include all three subsystems must meet the following criteria:

- The formation of a regional association that (i) represents data providers (research and operational communities, non-profit and for profit organizations) and users (research and education communities, non-profits, for profit corporations, and government agencies) and (ii) has the authority to receive and disperse funds based on priorities and user needs in the region.
- Documentation that a governance structure is in place and can effectively link all three subsystems by integrating, enhancing and supplementing existing assets in the region.
- Provision of a business plan that has been endorsed by regional stakeholders (data providers and users) and describes the procedures by which the regional observing system will be established, sustained and developed. This should include an analysis of potential socio-economic benefits using established procedures to estimate expected economic impacts.
- Justification of the project in terms of how it will contribute to and benefit from the national backbone.
- Adopts national standards and protocols for measurements and data management.

It is anticipated that planning funds will be needed to meet these criteria.

3. Candidates for Pre-Operational Projects must

- Meet all of the criteria for selection as a pilot project;
• Justify selection as a pre-operational project in terms of how it will improve the value added nature of the IOOS;
• Specify how the project will contribute to the development of the IOOS (national backbone and/or regional systems) and what the benefits to targeted user groups will be;
• Document capabilities in terms of sustainability on time scales specified by the users;
• Involve collaboration among research and operational groups and be endorsed by operational groups and potential users; and
• Describes procedures by which the system or elements of the system will be incorporated into the IOOS.

4. To be established as part of the operational system, pre-operational projects must
• Demonstrable compliance with IOOS design principles;
• Be endorsed by operational and user communities;
• Be cost-effective and increase the value added character of the IOOS; and
• Document affordability and readiness (required assets are available including technical support – does not need a Ph.D. to operate; availability of instrumentation, computing power, etc.).

FOOTNOTES

1Pilot and pre-operational projects have defined schedules of finite duration. Guidelines for reviewing an endorsing pilot and pre-operational projects are as follows: (i) Projects may be regional in scope; they may target any stage in the end-to-end system as outlined in i-iv above; and they may be enabling research or proof of concept projects. (ii) Projects must be organized and planned sets of activities with well defined objectives, a specified schedule with milestones, specified deliverables (products), and a finite lifetime. (iii) A clear statement must be made of how the project will significantly benefit the design, implementation, or development of the IOOS on regional to global scales. That is, the project must be justified in terms of how successful completion of its goals will improve the system’s capacity to provide data and information for potential applications that are relevant to the needs of the user community. When appropriate, the project should be developed in collaboration with user groups.

2Groups operating observing systems or elements thereof that provide data and information of known quality to user groups in a sustained and routine fashion.
Appendix VII
Functions of the Organizations Involved in the Recommended Governance of the IOOS

National Oceanographic Partnership Program (NOPP)

NOPP was established by Congress in 1997 (Public Law 104-201) to (1) “promote the national goals of assuring national security, advancing economic development, protecting the quality of life, and strengthening science and education through improved knowledge of the ocean” and (2) “coordinate and strengthen oceanographic efforts” to achieve these goals by “identifying and carrying out partnerships among Federal agencies, academia, industry, and other members of the oceanographic community in areas of data, resources, education, and communications.” The NOPP provides the means to establish and develop the IOOS.

The National Ocean Research Leadership Council (NORLC), the governing body of NOPP, was established to (1) “prescribe policies and procedures to implement the NOPP; (2) review, select, and identify and allocate funds for partnership projects; and (3) assess whether there is a need for facility to provide national centralization of oceanographic data. The NORLC consists of the heads of twelve federal agencies involved in ocean research, monitoring and/or policy development. Thus, the NORLC represents the interests of Federal agencies in the design and implementation of the IOOS.

The Interagency Working Group (IWG) is a staff-level body, the membership of which reflects that of the NORLC. The IWG is the primary implementing body of the NORLC. As such, it is responsible for day-to-day oversight and coordination of NOPP functions and for making funding recommendations to the NORLC.

As required in the enabling legislation, the NORLC established the Ocean Research Advisory Panel (ORAP) to advise the Council on (1) policies and procedures to implement the NOPP; (2) selection of partnership projects and allocation of funds; (3) matters relating to national oceanographic data; and (4) any additional responsibilities the Council considers appropriate. The NORLC has made the implementation of an integrated ocean observing system its highest priority, and the Congress (House Report 106-162) has requested the Council to develop standards and plans for the establishment and administration of an integrated ocean and coastal observing system.

Ocean.US

Oversight by a body external to any given federal agency is needed to achieve the vision of an integrated observing system that is sustained. In October 2000, a NOPP Memorandum of Agreement (MOA) was approved for establishing Ocean.US as the NOPP interagency ocean observation office. The MOA articulates the responsibilities of Ocean.US as follows:

The mission of Ocean.US is to “integrate existing and planned elements to establish a sustained ocean observing system to meet common research and operational agency needs.” Ocean.US is to serve as the national focal point for integrating ocean activities and will establish and have responsibility for the ocean observation federation and, as it evolves, other appropriate components of a more encompassing ocean observation and prediction system. More specifically, Ocean.US will:
• develop and maintain the long-range vision of the IOOS which will serve as the conceptual foundation for the IOOS and will define the goals of the system; 
• ensure integration of the elements of the IOOS; 
• serve as the focal point to coordinate the implementation and development of the system with the NOPP Interagency Working Group (IWG), the ORAP, the Federal Oceanographic Facilities Council (FOFC), and the international community; 
• report regularly to the Executive Committee (EXCOM) for guidance and to the IWG for coordination and provide an annual report that assesses the status of the IOOS and its products and charts the way forward (including external reviews); 
• recommend enhancements to existing systems, new projects, needs for research and development, and identification of system components suitable for transition from research to operations; and 
• carry out all tasks as directed by the NORLC.

The MOU creating Ocean.US requires that the NORLC establish an Executive Committee (EXCOM) to provide “policy guidance, ensure sustained Agency support, and approve implementing documents.

U.S. GOOS Steering Committee

The international community has been planning GOOS for over a decade, and momentum for the U.S. contribution accelerated in 1998 with the creation of the U.S. GOOS Steering Committee (USGSC). The USGSC functions outside the confines of the federal government and is composed of representatives from industry, academia, government (state and federal), and non-governmental organizations. International coordination, the development of the global ocean and coastal components, and linking the development of the IOOS to user groups regionally have been the primarily foci of this Committee. Today, the USGSC collaborates with Ocean.US in the formulation of technical plans for the design and implementation of the IOOS and provides an important link to user groups outside the federal government and to the development of regional observing systems.

Regional Associations

Regional observing systems are needed to provide data and information on phenomena that are more effectively detected or predicted on regional scales that go beyond the jurisdiction of individual states. Depending on regional priorities, Regional Associations (RAs) will be established to design, implement, operate and improve regional observing systems by increasing the resolution at which variables are measured, supplementing the variables measured by the national backbone with additional variables, providing data and information tailored to the requirements of stakeholders in the region, and by implementing programs to improve public awareness and education. Geographic boundaries of regional systems need not be fixed; they may overlap; and they will be determined by the time and space scales of the phenomena of interest that are high priorities in each region.
Appendix VIII
Development of Regional Observing Systems: Rules of Engagement

A successful National Federation of Regional Associations requires that members of the federation follow a common set of guidelines and “rules of engagement” for the common good. RAs have the authority to receive and disperse funds based on priorities and user needs in the region. They include, but are not limited to, representatives from both data providers and users. Participation of federal agencies in regional observing systems and contributions of regional systems to the national backbone will occur via MOAs. To qualify as an RA, the following criteria must be met:

- Proof that a governance structure is in place that can deliver an integrated and sustained system by integrating, enhancing and supplementing existing infrastructure and expertise in the region.

- Provision of an acceptable business plan that has been endorsed by stakeholders (data providers and users) from the region and describes the procedures by which the observing system will be established, developed, and sustained. This must include a process for assessing potential economic benefits using established procedures to estimate the expected economic and social impacts.

- A funding strategy for sustained operations, including the development of matching funds from state governments, private foundations, private enterprise, and other stakeholders in the region.

Specifically, it must be demonstrated that the RA will (1) conform to national standards and protocols established for data communication and management, including free and open access to data; (2) be capable of routine, sustained, 24/7 operations, including (but not limited to) the provision of data and data-products (e.g., a forecast) in real-time or near real-time as required by user groups; (3) provide services that include the collection and dissemination of data and development of useful products that are delivered in a timely fashion to those who use or are affected by the oceans and its resources; and (4) establish or participate in programs that make effective use of the observing system to enhance public awareness and education.