1ST ANNUAL IOOS IMPLEMENTATION CONFERENCE
ARLINGTON, VIRGINIA
AUGUST 31 - SEPTEMBER 2, 2004

PROCEEDINGS

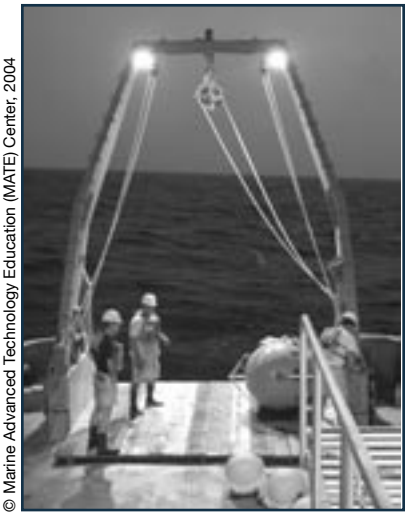
FIRST ANNUAL IMPLEMENTATION CONFERENCE FOR THE INTEGRATED OCEAN OBSERVING SYSTEM (IOOS)

Ocean.US

The National Office for
Integrated and Sustained Ocean Observations
Ocean.US Publication No. 8

IOOS

Table of Contents



Executive Summary


© Oregon Sea Grant


© Oregon Sea Grant


© Oregon Sea Grant


© Oregon Sea Grant

Ocean.US, in collaboration with federal agencies, completed a preliminary *Annual IOOS Development Plan* for the initial Integrated Ocean Observing System (IOOS) in early August 2004. Recognizing that the plan must reflect both federal and common regional priorities, the First Annual IOOS Implementation Conference provided a forum for the leaders of nascent Regional Associations (RAs) to work directly with participating federal agencies to provide guidance for completing the *First Annual IOOS Development Plan*.

By consensus, conferees made the following recommendations:

- Continue to implement and strengthen current plans for the global ocean component of the IOOS;
- Implement immediately the plan for developing the Data Management and Communications (DMAC) subsystem of the IOOS;
- Establish and adequately fund RAs and the National Federation of Regional Associations; and
- Implement selected coastal ocean data assimilation experiments as pilot projects to facilitate coordinated development of the coastal and global components.

There was also strong agreement on the pressing need to:

- Sustain existing elements of the observing subsystem for the national backbone recommended in the preliminary *IOOS Development Plan* and integrate these into an interoperable system; and
- Sustain the current investment in coastal ocean observing systems.

Given the large number of options and limited time, a consensus was not achieved on a focused set of priorities for the observing subsystem of the coastal component of the IOOS. A set of high pay-off activities was recommended that, if undertaken, would enable the effective development of a fully integrated system.

Participants further identified important aspects of IOOS development that should be addressed by groups of experts before the recommendations for developing the observing subsystem in Part III of the *First Annual IOOS Development Plan* can be implemented. Of particular importance are provisions for the development of the infrastructure required to deploy, maintain, and replace the required platforms and sensors and for training to develop the technical work force that will be needed to operate and improve the IOOS over time. These issues will be addressed in preparation for the Second Annual IOOS Implementation Conference to be held in May 2005.

Based on input from the Conference, a draft of the *First Annual IOOS Development Plan* was prepared by Ocean.US. This was posted on the Ocean.US web site for a one month public comment period beginning 15 October 2004. Recommendations received during this period were used to complete the Plan, which will be transmitted to the National Ocean Research Leadership Council, subject to endorsement by the Ocean.US Executive Committee. This plan (which will be revised and updated annually following each Annual IOOS Implementation Conference) will make recommendations to be used by federal agencies in establishing their priorities for contributing to the implementation, operation, and improvement of the initial IOOS.

1. Introduction

The Integrated Ocean Observing System (IOOS) is the U.S. contribution to the Global Ocean Observing System (GOOS) and to the oceans and coasts components of the Global Earth Observation System of Systems (GEOSS). The First Annual IOOS Implementation Conference builds on a sequence of workshops and conferences initiated under the auspices of the National Oceanographic Partnership Program (NOPP) established by Congress in 1997. Reports of these activities can be found on the Ocean.US web site at http://www.ocean.us.

This conference brought together representatives from coastal states, the Great Lakes, and the Caribbean with representatives from NOPP federal agencies to discuss and recommend priorities for establishing an initial Integrated Ocean Observing System (IOOS) that includes both global ocean and coastal components. Recognizing that implementation of the global component has begun, the conferees underscored the importance of continued development and strengthening of the U.S. contribution to this international effort and focused on first steps for developing the coastal component and on coordinated development of the coastal and global components.

1.1 Goal

Ocean.US, in collaboration with federal agencies (NOAA, NASA, NSF, Navy, EPA, USACE, USGS, MMS, and USCG), completed a preliminary *Annual IOOS Development Plan*[1] for the initial IOOS in early August 2004. Recognizing that the plan must reflect both federal and common regional priorities, the conference was organized to provide a forum for the leaders of nascent Regional Associations (RAs) to work directly with participating federal agencies to provide guidance for finalizing the *First Annual IOOS Development Plan*. The final plan (which will be revised and updated annually following each Annual IOOS Implementation Conference) will make recommendations to be used by federal agencies in establishing their priorities for contributing to the implementation, operation, and improvement of the initial IOOS. A draft of the plan was posted on the Ocean.US web site for public comment on 15 October 2004. Based on this input, the plan will be revised and, subject to endorsement by the Ocean.US Executive Committee (EXCOM), transmitted to the National Ocean Research Leadership Council (NORLC).

1.2 Objectives

Conferees were asked to formulate recommendations for the following:

- Coordinated development of global and coastal components based on global requirements of the coastal component and coastal requirements of the global component;

- Implementation of a data management and communications (DMAC) subsystem that will provide rapid access to diverse data from many sources;
- Development of the national backbone for the coastal component of the IOOS; and
- Establishment of RAs for designing, implementing, operating, and improving Regional Coastal Ocean Observing Systems (RCOOSs).

The purpose of the conference was not to review the preliminary *Annual IOOS Development Plan, per se*. Rather, it was to initiate an annual forum for federal agencies and regional groups to collaborate in the development of the IOOS over time and to make specific recommendations for IOOS implementation using the preliminary plan to frame the discussion. Consensus on a focused set of initial priorities for IOOS implementation was the primary objective of days one and two. A meeting of federal agencies occurred on day three to formulate the federal response to recommendations from the first two days. Feedback from these sessions will be used to complete the *First Annual IOOS Development Plan*.

1.3 Participants

Representatives from federal agencies, nascent RAs, the NORLC Interagency Working Group, the U.S. GOOS Steering Committee, and the Ocean.US enterprise (Ocean.US staff and EXCOM) who have been involved in planning the IOOS were invited to participate in the conference (Appendix I). It was recognized from the beginning that a major effort is needed to engage a broader community of data providers and users in the process of developing a fully integrated observing system for oceans and coasts. The consensus recommendations of the conferees reflects this and makes the engagement of users from both private and public sectors from coastal regions and the Great Lakes an immediate high priority.

1.4 Procedure

The conference agenda is given in Appendix II. The first day began with an overview of the status of IOOS planning and implementation with a session to clarify outstanding questions, issues, and conference procedures (Appendix III). The day concluded with plenary sessions on establishing (1) RAs and the National Federation of Regional Associations (NFRA) and (2) an integrated approach to DMAC. The session on regional development focused on the rationale for federal investment in a regional approach, current status of RA and NFRA development, and requirements for developing a national network of RCOOSs. The DMAC session focused on key issues and opportunities for implementing the DMAC plan. An action plan for establishing IOOS DMAC "best practices" and standards development activities was developed that will ensure periodic identification and updating of key issues and priorities.

The second day began with an overview of the status and future development of the global ocean component. This was followed by a breakout session with five Working Groups (WGs):

- WG-1 formulated recommendations for coordinated development of the global and coastal components that recognize the interdependence of the two components and the goal of developing a single, seamless IOOS for oceans and coasts.
- WGs-2, -3, -4, and -5 used high priority product-categories to guide the formulation of recommendations for phased implementation of IOOS subsystems for each product category.[2]

Day two concluded with a discussion of recommendations and a consensus on implementation priorities (summarized in section 2). On the third day, participating federal agencies met to consider and respond to the consensus recommendations of the first two days. This led to a formal response (summarized in section 3) and to an agreement to prepare a Memorandum of Understanding on "corporate responsibilities" of the federal agencies for IOOS development.

1.5 Conference Evaluation

A statistically significant proportion of the participants submitted evaluations of the conference. Most respondents were pleased with the conference and rated it highly. There was a general comment that participants needed more time to absorb the material presented and discuss it thoroughly. Quantitative ratings of various aspects of the conference are given in Table 1. Most aspects of the conference were rated highly, and most participants indicated their expectations were met or exceeded.

Table 1. Quantitative ratings of the conference on a scale of 1 (lowest) to 5 (highest).

TOPIC	AVERAGE
Organization	4.2
Day 1	4.1
Day 2	3.9
Day 3	4.0
Plenary Sessions	4.0
Presentations	4.0
Breakout Sessions	3.7
Conference Venue	4.2
Catering Services	4.1
Hotel Room	4.2
Expectations Met?	Yes

2. A Summary of Consensus Recommendations by the Conferees
(Days 1 and 2)

There was strong agreement among the conferees on the following recommendations:

(1) Continue to implement and strengthen current plans for the global ocean component of the IOOS;
(2) Implement immediately the plan for developing the DMAC subsystem of the IOOS[3];
(3) Establish and adequately fund RAs and the NFRA; and
(4) Implement selected coastal ocean data assimilation experiments as pilot projects to facilitate coordinated development of the coastal and global components.

There was also strong agreement on the pressing need to sustain existing elements of the national backbone recommended in the preliminary *IOOS Development Plan*, to integrate these elements into an interoperable system, and to sustain the current investment in subregional coastal ocean observing systems. However, given the large number of options and the limited time available to work these through systematically and consistently, a consensus on a focused set of priorities for these aspects of the system did not emerge. Consequently, a summary of high pay-off activities was recommended (section 3 of this report) that, if undertaken, would enable the effective development of a fully integrated system.

Participants further identified important aspects of IOOS development that should be addressed by groups of experts before the recommendations for developing the observing subsystem in Part III of the *First Annual IOOS Development Plan* can be implemented. Of particular importance are provisions for the development of the infrastructure required to deploy, maintain, and replace the required platforms and sensors and for training to develop the technical work force that will be needed to operate and improve the IOOS over time. These issues will be addressed in preparation for the Second Annual IOOS Implementation Conference, to be held in May 2005.

2.1 Summary of Data Management and Communications Recommendations

Conferees endorsed the May 2004 *DMAC Implementation Plan* and recommended that the plan be finalized following a formal 30-day public comment period (to be announced in the *Federal Register*) to publicize the document more widely and to move the effort forward. By consensus, it was recommended that, once finalized, the DMAC Plan's recommendations for data and metadata standards and best management practices should be officially adopted as the initial, formal guidance for IOOS/DMAC data providers, users, and stakeholders.

2.1.1 Data Management and Communications Recommendations for FY 05-06 Priority Activities

Conferees recommended by consensus the following priorities for immediate DMAC implementation during FY 05-06:

(1) DMAC Steering Team: Ocean.US will establish an IOOS DMAC Steering Team to coordinate and oversee the evolution of DMAC standards and to ensure that the DMAC standards process is conducted in an open and balanced manner.
(2) DMAC Expert Teams: Ocean.US will organize expert teams to address key Information Technology (IT) standards as identified in the DMAC Plan. Experts from the emerging GEOSS and relevant international data management standards activities will be invited to participate.
(3) Interagency Coordination: The Conference provided a consensus endorsement of the proposed recommendation that the EXCOM agencies establish an IOOS DMAC Implementation Oversight Working Group (IOWG). The role of the IOWG (a federal body) will be to coordinate the implementation of DMAC among the federal agencies.

These actions are critical for establishing the initial DMAC subsystem and a foundation for integrating existing and emerging IOOS data streams. Estimates of costs are summarized in Table 2.

Table 2. Estimated costs based on the May 2004 DMAC Plan. Numbers in parentheses refer to the three recommendations above. A more detailed budget is given in Appendix IV, Table A. These estimates are in addition to current investments of federal agencies in their existing DMAC-related data management activities and do not include the resources needed for hardware procurement or software implementation.

DMAC Activity	FY 05	FY 06	Potential Agencies Affected
Oversight and Coordination (1) & (3)	$36K	$72K	All
Standards Development (2)	$685K	$954K	All
TOTALS	$721K	$1,026K	

Outcomes of implementing these recommendations will provide a basis for determining out-year investments. Recommendations based on the May 2004 DMAC Plan include actions that should be taken by data providers immediately in order to ensure interoperability with IOOS as it evolves (Appendix IV, Table B). Cost estimates for implementation by individual agencies were not available because of the large number of systems involved and

their varying levels of maturity and compliance with DMAC guidelines. However, it is suggested (as a target goal) that agencies invest in DMAC activities approximately 10% of the amount invested in relevant observing activities.

2.1.2 Data Management and Communications Recommendations for FY 07 Priority Activities

Recommendations regarding investments for the FY 07+ timeframe were consistent with those made in the DMAC Plan. Additional recommendations provided during the breakout sessions enumerated specific, agency-focused activities that are also consistent with the DMAC Plan. These activities fall into three major categories:

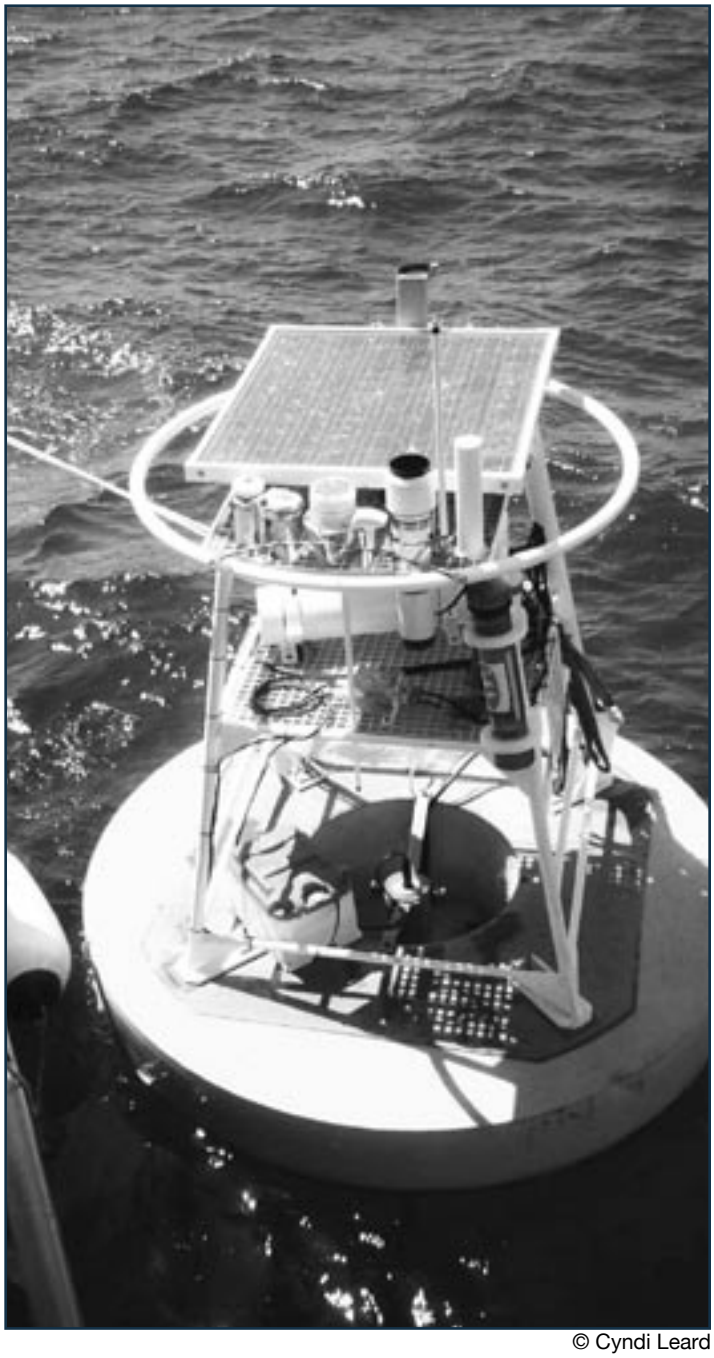
- An interoperability framework: This area focuses on the continuation of DMAC standards oversight, coordination, and development efforts that began in FY 05-06 (section 2.1.1).
- An interoperability infrastructure: These investments will augment current federal program activities, and also address core DMAC infrastructure needs of the RAs. They focus on acquisition or updating of hardware, software to enable interoperability, network capacity building, expansion of data archive center capacity, standards implementation, and enhanced national systems integration.
- Design and demonstration: These activities include pilot projects to evaluate, test, and involve end-users in capability demonstration projects, implement new technologies, and conduct end-to-end integration of observational data across sectors, disciplines, geographic areas, and organizations.

Estimated costs associated with each of these areas are given in Table 3. Table 4 summarizes recommendations from the conference breakout sessions. They are consistent with recommendations in the DMAC Plan and will be considered as part of the DMAC planning and development process.

© Oregon Sea Grant

Table 3. A summary of estimated costs for each DMAC activity (details in Appendix IV, Table C). Estimated infrastructure costs were published in the May 2004 DMAC Plan. Note that some of these costs may also be accounted for in the RA estimates of costs for DMAC implementation provided earlier in this document. Nascent RAs are in the process of developing more specific cost estimates for their DMAC implementation (order $100-500K per region per year), which may include some duplication. Ocean.US will reconcile these estimates in the future.

DMAC Activity	FY 07	Potential Agencies Affected
Interoperability framework	$7,052K	All
Interoperability infrastructure	$6,860K	All
Design and demonstration	$3,800K	All
FY 07 TOTAL	$17,712K	



© Cyndi Leard

Table 4. Summary of DMAC priority conference breakout session recommendations grouped by key areas addressed in the DMAC Plan; agencies affected by each recommendation are identified. Due to time constraints, projected costs and timeframes for these activities could not be developed during the conference. The DMAC Plan provided cost estimates for design and demonstration activities that are consistent with these conference recommendations, along with the other activities recommended for FY 07 (Table 3).

DMAC Implementation Plan Needs Area	Representative Breakout Group Priority Recommendations	Potential Affected Agencies
Inventory of current programs	• Inventory NOAA and EPA coastal and estuarine data sets, especially bottom, habitat and ecosystem-related, and by extension each IOOS core variable observing effort	• All Agencies
Data discovery	• Assure agency data inventories are "registered" and accessible through IOOS portal	• All Agencies
End-to-end integration	• Enable stream gauge observations integration • Enable wave observations integration • Interconnect High Frequency (HF) radar and fixed sensor wind and wave data	• USGS and NOAA • USACE, NOAA, and Navy • NOAA, USCG, and Navy
Metadata development	• Develop Lagrangian metadata for Autonomous Underwater Vehicles (AUVs) • Develop imagery metadata & characterization to enable fusion and assimilation • Integrate species-level information (e.g., genetics, habitat, life history, etc.)	• NSF and Navy • NASA, NOAA, USGS, and Navy • NSF and NOAA
Semantic data model(s) development	• Develop semantic data model to enable imagery fusion with models • Fuse spatial and tabular nutrient data fields	• NASA, NOAA, Navy, and USGS • EPA and NOAA
Data transport	• Develop mechanisms for providing satellite data • Interconnect HF radar and fixed sensor marine wind data	• NASA, NOAA, and USGS • USCG, NOAA, USACE, and Navy
Data archival	• Develop climatologies of oxygen, chlorophyll, nutrients and pCO_2 observational data	• EPA, NOAA, and USACE
QA/QC	• Enable integration of stream gauge data into national network across all observing elements	• USGS and NOAA

© Oregon Sea Grant

© Oregon Sea Grant

2.2 Regional Development Recommendations (FY 05 – 06)

The IOOS must evolve to meet the data and information needs of private and public sectors on state, regional, and federal levels. Thus, it is generally recognized that the IOOS must develop a hierarchy of observations, data management and analysis on global to local scales. To these ends, a national consensus has been achieved[4] to establish (1) RAs that meet established federal criteria for governance and operations to develop RCOOSs employing IOOS design principles and (2) an NFRA to coordinate the development of RCOOSs nationwide and represent regional user needs at the federal level.

The recommendations below are considered to be of the highest priority by conferees. Recommended funding levels are given in Table 5.

Table 5. Recommended funding levels to establish RAs in eleven regions[5], create the NFRA, coordinate regional DMAC development with the national effort, and fund one pilot project in each region.

Funding Category	FY 2005	FY 2006
Regional Associations (11 regions)	$ 5.5 M	$ 5.5 M
National Federation of Regional Associations	$ 0.5 M	$ 0.5 M
Regional DMAC (11 regions)	$ 1.1 M	$ 2.2 M
Regional Pilot Projects (11 regions)	$ 2.0 M	$ 3.5 M
TOTAL	$ 9.1 M	$ 11.7 M

- Priority 1 – Fund RAs and NFRA sufficiently

This is the highest priority for the regional effort and should be funded preferentially over other high priority regional requests. It is critical that the RAs and the NFRA are able to initiate and complete the substantial efforts involved in meeting the criteria for RA certification, including the engagement of user groups from both private and public sectors in the design, implementation, operation, and improvement of RCOOSs. Present levels of funding ($100K per region per year) will not permit success given the extensive outreach, economic analysis, and assessments of data and information needs of user groups that must be carried out to become a certified RA. Requested funding ($500K per region per year) provides the minimum resources necessary to allow successful attainment of these objectives by FY 07.

- Priority 2 – Fund necessary DMAC activities needed to support regional IOOS activities

The IOOS DMAC strategy involves both national and regional efforts. The national effort engages federal agencies, RAs, and other stakeholders in adopting (existing) and developing (as needed) national standards and practices that will be implemented by RAs. Both efforts are needed and are unanimously supported by the participants from the regions since the national DMAC effort must succeed before regional DMAC efforts can be properly structured. Thus, the nascent RAs support full funding of the national DMAC effort (Table 2). Regionally, modest funding is recommended for FY 05 ($100K per region) to allow initial integration of extant regional systems. Conferees recommend that this be increased to $200K per region in FY 06 to allow incorporation of the results from the national DMAC effort in the regions.

- Priority 3 – Fund Regional Pilot Projects

Conferees recommended that funds be provided to allow all regions to initiate pilot projects in their regions ($500K per region per year). Given the diversity of needs and capabilities across regions, participants further recommended that the results from ongoing NOPP-funded socio-economic analyses (that are specific to regions and economic sectors) be used to guide their selection and design. Such pilot projects provide the mechanism to entrain private sector data users and data product suppliers, provide opportunities to showcase successes to build regional and national constituencies using the NFRA infrastructure, and provide a mechanism to begin the development of new technologies necessary to address regional RCOOS needs and share these successes throughout the RA assemblage.

2.3 Priorities for Enhancing the Observing Subsystem of the National Coastal Backbone of the IOOS

Since the initial observing subsystem is to be built using existing assets, working group recommendations for the observing subsystem focused on enhancements in FY 07 and beyond. Enhancements using existing operational capabilities are summarized in section 2.3.1, and those that require research and development are summarized in sections 2.3.2 and 2.3.3. Research and development includes recommended priorities that have already been funded, as well as priorities that may be funded in FY 05 or 06. Recommendations that called for integrating data streams from various sources (e.g., *in situ* and remote sensing; NOAA and USGS tide gauges) are addressed as part of the DMAC recommendations.

In one form or another, most, but not all, recommendations of the working groups are listed below. Similar or complementary recommendations were consolidated. The resulting set of recommendations are consistent with the results of the 2002 Ocean.US IOOS Workshop (Airlie House)[6] and recommendations of nascent RAs made to Ocean.US prior to the Conference.[7] A complete list of recommendations from the conference is available on request.

2.3.1 Pre-Operational and Operational Elements

A high priority for enhancing the initial IOOS is to begin addressing the problem of under-sampling in space-time of the core variables. The following recommendations of enhancements were made with the understanding that under sampling will remain a chronic problem but that steps must be taken to reduce the magnitude of the problem and improve the accuracy of field estimates and model predictions. As a group, the recommendations emphasize non-biogeochemical variables, underscoring the need for research to develop *in situ* sensing of biological and chemical variables.

Begin to address the problem of under-sampling core variables in time and space

- Forcings

Sea surface wind and barometric pressure fields and land-based inputs are important drivers of change in coastal marine and estuarine ecosystems. Thus, increasing the density and continuity of these observations is a high priority as follows:

Winds – NOAA should increase the density of meteorological measurements of the oceans by supplementing the current National Data Buoy Center (NDBC) network with additional instrumented buoys and automated meteorological measurements on Voluntary Observing Ships (VOS).

Transports from land to sea – USGS should maintain the current stream flow and water chemistry monitoring network and increase the number of streams monitored.

- System Dynamics

Timely detection and predictions of changes in the physical environment (water column and benthos) and biologically structured habitats (sea grass beds, coral reefs, etc.) are critical to achieving the seven IOOS goals. In this context, recommendations focused on improving current observational programs as follows:

Current fields – Expand the use of cables to monitor boundary currents and associated transports of heat and water, and make use of data not usually used for this purpose, e.g., USCG Global Positioning System (GPS) equipped Self Locating Datum Marking Buoy used for search and rescue.

Waves, water level, and storm surge flooding – Increase the NDBC observing network for near shore measurements of wave spectrum, height, period, and direction; expand National Water Level Observation Network (NWLON) and increase the number of gauges reporting in real-time.

Sea ice – Maintain current Synthetic Aperture Radar (SAR) capabilities and establish *in situ* calibration and validation program; expand VOS Bering Sea ice edge observations; include RADARSAT Geophysical Processing System (RGPS) arctic "snapshots" in National Ice Center products.

Living marine resources – Implement adaptive sampling as part of living marine resource (LMR) surveys.

Begin to address the problem of under-sampling the core variables

***In situ* observations** – Instrument platforms (NDBC buoys, Physical Oceanographic Real-Time System [PORTS], International Arctic Buoy Network, additional moorings, AUVs) with oceanographic sensors (temperature, salinity, currents, dissolved oxygen, nutrients, bio-optical properties)

2.3.2 Research and Pilot Projects: Targeted Elements

Conference recommendations fall into two general categories: research and pilot projects (collectively called R&D) that target specific elements of the observing subsystem, and those that target end-to-end, product-driven development. The former are given here.

A total of 95 recommendations were received from five working groups. Most of these fall into one of the following categories: (1) waves and water level, (2) ice, (3) *in situ* sensors for real-time measurements of key biological and chemical variables, (4) LMR and ecosystem surveys, (5) development of remote sensing capabilities for coastal marine systems, and (6) *in situ* sampling.

In addition to the recommendations summarized below, one group recommended that the list of core variables be reviewed and the list updated based on new knowledge and technical capabilities. This should be done after the coastal component has been in operation for three to five years.

- Waves and water level: Surface wave fields and water level, especially nearshore, are a high priority for the IOOS.

Wave fields – Improve estimates of wave fields through development of sensors, satellite remote sensing of waves, enhanced internal wave structure measurements, vertical integration of observations, and increases in the density of *in situ* measurements for calibration and validation of wave models in complex (nearshore) regions and for "run-up" models.

Water level – Develop new sensor technologies, including the use of Light Detection and Ranging (LIDAR) technology to estimate water and flood water levels in nearshore environments.

- Ice: Knowledge of changing distributions, age, and condition of sea ice is important for all ship-based activities, for assessing and predicting coastal erosion, and as a habitat for many important species, including endangered and threatened species of marine mammals.

Ice distribution, thickness, and volume – Develop HF radar ice observations near shore and satellite-based sensors for estimating sea ice age and thickness; explore airborne and underwater long term ice thickness measuring technologies; and improve data telemetry by transitioning some International Arctic Buoy Program (IABP) buoys from ARGOS to IRIDIUM.

- *In situ* sensors for real-time measurements of key biological and chemical variables: An important objective for sustaining healthy ecosystems and LMRs is to develop the capacity to represent the state of the coastal ocean through repeated 3-dimensional representations of the distributions of dissolved O_2, pCO_2, pH (or alkalinity), and dissolved inorganic nutrients (N, P, and Si), as well as temperature, salinity, and currents.

Sensor development – Increase the longevity of *in situ* sensor performance by addressing biofouling, increase the density of observations by making them adaptable to a variety of platforms, and increase intercomparability by establishing reference and calibration standards.

- LMR and ecosystem surveys: Managing water quality and LMRs in an ecosystem context (ecosystem-based, adaptive management) will be enabled through timely characterizations and assessments of LMRs and the ecosystems upon which they depend. More rapid detection and timely predictions of changes in environmental parameters and LMRs depend on the creative use of existing technologies (e.g., LIDAR, acoustic sensors) and development of new technologies for the following:

Benthic habitat mapping – Develop functional habitat characteristics (priority on the shoreline to 30 m), and conduct repeated surveys of the distribution and condition of habitat types both nearshore (0-30 m annually) and across the U.S. Exclusive Economic Zone (five- to ten-year intervals).

Water quality – Monitor and assess point and non-point source pollutant inputs and their ecosystem impacts in terms of accumulations of phytoplankton biomass, depletion of dissolved oxygen, harmful algal blooms (HABs), and reductions in water clarity.

Species diversity – Develop and implement high resolution biological characterizations of species populations (diversity) linked to the distribution and condition of benthic habitats and changes in hydrography (modeled and observed). This should include invasive species, HABs, and pathogens, as well as LMRs.

Stock assessments – Improve the scope, precision and timeliness of LMR assessments, including implementing adaptive sampling for LMR surveys. Monitor the distribution and intensity of fishing effort remotely.

- Develop remote sensing capabilities for coastal marine systems: Spatially synoptic, remote measurements of core variables are particularly important in dynamic coastal waters. Developing operational capabilities for coastal systems in general and for purposes of ecosystem-based management should be a high priority.

Satellites – Develop new satellite missions and sensors for chlorophyll, pigment groups, and carbon proxies, and maintain current Synthetic Aperture Radar satellite (SARSAT) capabilities. Explore alternative high-resolution remote sensing technologies.

- *In situ* sampling: The ability to detect and predict changes below the surface and to provide data for calibrating and validating remote sensing is critically dependent on *in situ* observations.

Glider technologies – Use unmanned vehicles equipped with Acoustic Doppler Current Profilers (ADCPs) and conductivity, temperature, depth sensors to constrain circulation models. As sensors are developed for measuring dissolved oxygen, nutrients, phytoplankton species and biomass, and zooplankton abundance, ensure that they are compatible with gliders and other *in situ* platforms.

Adaptive sampling – Establish sentinel stations and areas to support model and other needs relevant to nutrients.

2.3.3 Research and Pilot Projects: End-to-End

Most of the recommendations for pilot projects that include all three subsystems (observations to products) fall into one of the following categories: (1) global, mesoscale nowcasts and short-range upper ocean forecasts; (2) surface current mapping, and (3) modeling.

In addition to the recommendations below, it was recommended that National Estuarine Research Reserves (NERR), National Marine Sanctuaries (NMS), National Estuarine Programs, Long-Term Ecological Research (LTER) sites, and National Association of Marine Laboratories (NAML) sites be used as test beds for pilot projects.

- Global, mesoscale nowcasts and short-range upper ocean forecasts

The vision behind IOOS is that societal and economic benefits of ocean research and observations cannot be realized without implementing a global system of observations, data telemetry, data assimilation, and modeling that will deliver regular, comprehensive information on the state of the oceans for the maximum benefit of society. The following recommendations do not cover the range of required research and development that are needed to meet the vision but, in the context of the conference, provide some insights to the issue of ice area forecasts:

Weather and climate – Improve extreme event and seasonal to interannual forecasts and continue The Observing System Research and Predictability Experiment (THORPEX) for improved weather forecasts.

Ice – Perform an operational test of the Polar Ice Prediction System (PIPS) 3.0. By 2014, transition the ice forecast product to operational status.

- Surface current mapping

Surface currents are a highly ranked core variable. Surface current maps are derived from HF radar networks in coastal waters with appropriate *in situ* sampling for calibration. Farther offshore, surface current mapping can be achieved through a combination of feature tracking and altimetry techniques, with calibration provided by traditional techniques such as *in situ* current measurements and hydrographic observations. Developing the capacity to serve surface current maps based on integrated remote and *in situ* data streams is a high priority for IOOS development. In this context, working groups offered the following specific recommendations:

Data transport and surface current mapping – Test delivery of real time currents and related environmental data to end users via USCG Automated Identification System (AIS).
Trajectory forecasting – Develop trajectory mapping tools to permit the use of general circulation models in search and rescue, oil spill, and HAB predictions.
Data fusion – Integrate data from different current mapping technologies.

- Modeling

The development of a fully integrated observing system will require a strong and ongoing interaction between observations and modeling. Model recommendations fall into four categories: coupled physical models, sediment transport, ice models, and biogeochemical models. Breakout groups calling for coupled physical models and biogeochemical (water quality) models recognized the need for coastal Global Ocean Data Assimilation Experiment (GODAE)-type projects in these areas and made this a high priority.

Coupled Physical Models – Utilize advanced data assimilation, including GODAE and data assimilating models, for cross-cutting pilot projects [e.g. improve hazardous materials (HAZMAT) spill response models and models of extreme water level changes] and tidal resolving models focusing on coastal regions of complex physical oceanography. Address the following aspects of coupled models: local to offshore models for winds, waves and currents; ocean models with embayment/river models; waves to storm surge models; influence of bottom type on wave propagation; wave to wind fields; and lake/atmosphere/ice circulation models for the Great Lakes (including operational evaluation of the latter). Perform an operational evaluation of the coupled ocean/atmosphere/ice model.

Sediment transport models – Enhance regional sediment transport models to quantify sediment budget predictions of coastal erosion through improved observations using both aircraft- and satellite-based LIDAR technology with hyperspectral technologies to provide new mapping products for hydrographers, coastal engineers and resource managers, scientists, and other decision makers.

Biogeochemical models – Promote continued development of the USGS continental 4-dimensional representation of flow and nutrient flux, e.g., Spatially Referenced Regressions on Watershed Attributes (SPARROW) in nationwide watersheds. Develop models that incorporate higher trophic levels (large pelagic and benthic animals). Use models (e.g., Oriented Scintillation Spectrometer Experiments [OSSEs]) to evaluate spatial and temporal sampling to optimize observing subsystem capabilities. Operationalize research models, developed through research programs such as Global Ocean Ecosystems Dynamics (GLOBEC) and Land-Ocean Interactions in the Coastal Zone (LOICZ), by implementing GODAE-type projects. Develop regional coupled physical-biogeochemical models that are supported by IOOS data.

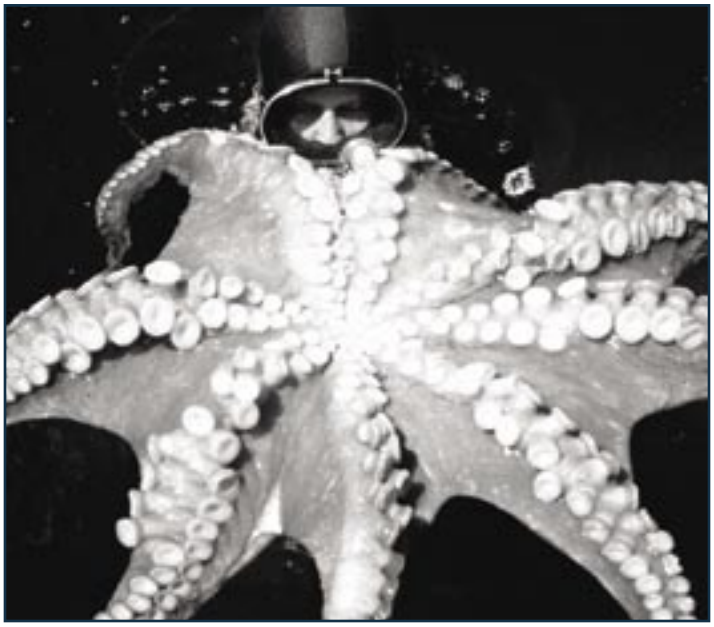
3. Federal Response

Representatives of participating NOPP agencies considered recommendations for DMAC (section 2.1) and regional development (section 2.2) and agreed to the following declaration on day three of the conference:

> "We [the federal agencies[8]] appreciate the work done by the conference attendees to formulate a clear set of consensus priorities for FY 05-06 actions and associated recommended funding. We view the priorities in the context of both maintaining current IOOS activities (including observing systems, data systems, and product-generating/delivery systems), and integrating these activities into a national backbone consistent with the *Annual IOOS Development Plan* in particular and with the Interagency Working Group on Earth Observations (IWGEO) 10-year plan for GEOSS development in general.
>
> 1) We accept the stated priorities [(1) development of RAs and the NFRA, (2) DMAC, both nationally and regionally, and (3) Regional Pilot Projects]. Although each agency may reorder these three priorities to meet its own mission constraints, the interagency consensus is to accept the priorities as given.
>
> 2) Pending appropriations for FY 05-06, we cannot yet make detailed commitments.
>
> 3) To the extent our FY 05-06 budgets and flexibility allow, we will use these priorities to guide our investment strategies.
>
> 4) We are constructing an interagency funding agreement, in which we expect all the agencies to make their best effort to participate, but not all agencies will necessarily commit to each priority topic, and the bottom line may not cover the recommended funding.
>
> 5) We are committed to using recommendations for FY 07 and beyond to help guide agency-specific program development that will contribute to the establishment of both global and coastal components of the IOOS."

The federal response to recommendations for the national backbone (section 2.3) has yet to be prepared. These recommendations were not available on day three, but were circulated to all participants within ten days of the conclusion of the conference.

© Oregon Sea Grant



© Oregon Sea Grant

FOOTNOTES

[1] "First Annual Integrated Ocean Observing System (IOOS) Development Plan." Ocean.US Report No. 9 <http://www.ocean.us>

[2] For each category, conferees were asked to formulate recommendations that address development of all three subsystems (observations and data telemetry, data management and communications, and modeling) through incorporation of existing operational assets and/or through research and development to improve operational capabilities. Product categories used to guide conferees in the formulation of prioritized IOOS implementation plans for the near term (the initial system using existing assets, FY 05-06) and the longer term (enhancing the initial system, FY 07-14) are given in the table below.

Product Category	Major Societal Goal Addressed	Examples of Potential Benefit Areas
Water Level and Surface Current and Wave Fields	Climate Change Natural Hazards Maritime Operations National Security Public Health Risks Healthy Marine Ecosystems Sustaining Living Marine Resources	• Search and rescue • Ship traffic and routing • Coastal erosion • Beach swimming safety forecasts • Beach re-nourishment planning • Coastal storm surge flooding • Fisheries habitat management • Aquaculture siting/permitting
Sea Ice Distribution, Volume and Age	Climate Change Maritime Operations National Security Healthy Marine Ecosystems Sustaining Living Marine Resources	• Maritime hazards forecasts • Search and rescue • Coastal erosion • Sustainable fisheries • Marine mammal survival
3-D fields of dissolved N, Chl, O_2, and pCO_2	Climate Change Public Health Risks Healthy Marine Ecosystems Sustaining Living Marine Resources	• Global carbon budgets • Beach closures • Harmful algal blooms • Hypoxia/anoxia • Biodiversity • Sustainable fisheries • Aquaculture siting and operations
Spatial Extent and Condition of Essential Habitats for Living Marine Resources	Climate Change Maritime Operations Public Health Risks Healthy Marine Ecosystems Sustaining Living Marine Resources	• Critical habitat mapping • Biodiversity • Exposure to marine toxins • Recruitment • Sustainable fisheries

These areas were chosen because they (1) are important to one or more of the seven societal goals of the IOOS; (2) can be improved in both the near-term, through more effective integration of existing observing subsystem assets, and the long-term, through the incorporation of additional existing operational capabilities and/or through research and pilot projects; (3) require both regional and global scale observations; (4) are high priorities in the preliminary draft of the *First Annual IOOS Development Plan*; and (5) encompass a broad spectrum of observing capabilities that will be needed to achieve all seven goals. These could be viewed as the seeds that will grow into the fully integrated system over time.

[3] http://dmac.ocean.us/dacsc/imp_plan.jsp

[4] http://www.ocean.us/documents/docs/Summit-Synthesis-Final1.doc

[5] The 11 regions are (1) the Great Lakes, (2) Gulf of Maine, (3) Middle Atlantic Bight, (4) South Atlantic Bight to the west coast of Florida, (5) Gulf of Mexico, (6) Southern California Bight, (7) Mid-California Current, (8) Pacific Northwest, (9) Gulf of Alaska, (10) Hawaii, and (11) the Caribbean.

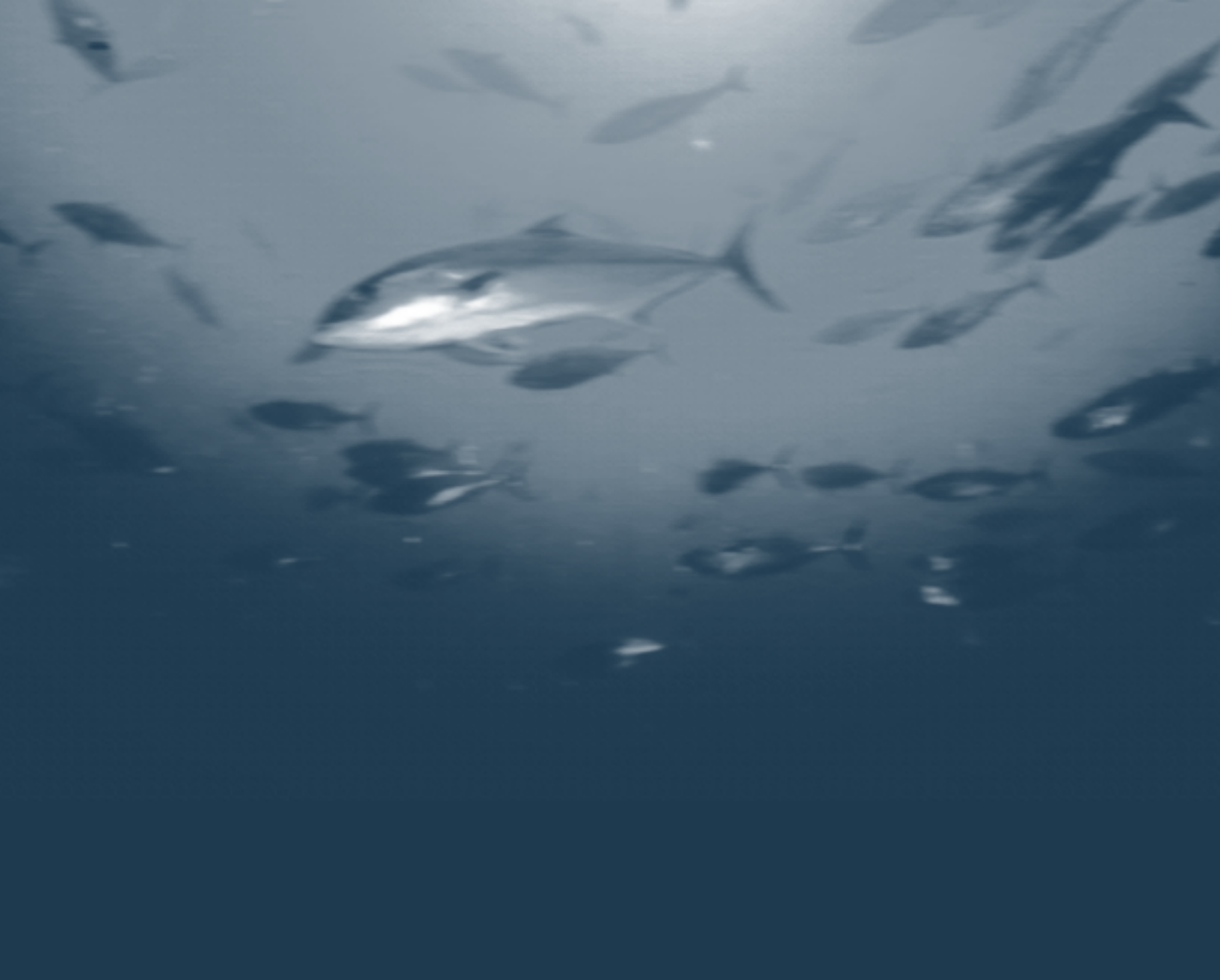
[6] http://www.ocean.us/documents/docs/Core_lores.pdf

[7] Summary of regional priorities for the operational, national backbone of the coastal component (long range (LR) HF radar and bathymetric (Bathy) – topographic (Topo) surveys of the near shore coastal zone). These capabilities are high priorities of the regions for incorporation into the operational backbone as they meet operational criteria over the next five years.

Region	Data Buoys	NWLON	CMAN	LR, HF Radar	NASQAN	Bathy-Topo, Shoreline position	Integrative Models	Remote Sensing
Arctic[a]	X[b]		X		X	X	X	X
Gulf of Alaska[d,e]	X[c]		X	X	X		X	X
Pacific NW[f]	X[c]			X		X	X	X
Central and Northern CA[g]	X	X[h]	X	X			X	X
Southern CA[i]	X			X		X	X	
Gulf of Mexico[j]	X	X	X	X	X		X	
SE – West FL								
Mid Atlantic[f,k]	X			X				X
Gulf of Maine[l]	X	X		X	X		X	
Great Lakes[m]	X[c]	X[c]	X[c]	X	X	X	X	X
Hawaii								
Caribbean								
TOTAL	9	4	5	8	5	4	8	6

[a] Additional priorities: RADARSAT ice cover, remote sensing-ground truth, Navy submarine access
[b] Ice capable with solar radiation sensors
[c] Enhance with sensors for biological and chemical variables
[d] Includes the Bering Sea
[e] Additional priorities: Status of fish stocks and ecosystems
[f] Additional priorities: Biological surveys, stream sampling and gauging, sea level sites, HAB identification, sensor technology
[g] Additional priorities: Offshore telemetry, more *in situ* observations (ship surveys, gliders), California Cooperative Fisheries Investigations (CALCOFI), AUVs, drifers, and floats
[h] Enhance to measure more variables
[i] Additional priorities: Buoys for nearshore transport and fate of pollutants and sediments; monitor ship traffic and offshore hazards, biological sampling, glider fleets
[j] Additional priorities: Wave direction, visibility, ecosystem observations, HABSOS support, sentinel stations
[k] Additional priorities: fleet renewal
[l] Additional priorities: Improve National Centers for Environmental Prediction (NCEP) forecasts; new coastal satellite
[m] Additional priorities: interconnected waterway sampling; flow metering, and enhanced remote sensing

[8] Federal agencies participating in the conference and whose representatives agreed to the declaration were as follows: NOAA, Navy, NSF, NASA, USACE, USGS, MMS, USCG, and EPA.



Appendices

APPENDIX I

PARTICIPANTS LIST

Larry Atkinson*
NSF Liaison
Ocean.US
2300 Clarendon Blvd, Suite 1350
Arlington, VA 22201
Tel: 703-588-0846
Fax: 703-588-0872
E-mail: l.atkinson@ocean.us

Jonathan Berkson
Marine Scientist
US Coast Guard (G-OPN-1)
2100 2nd Street SW
Washington, DC 20593
Tel: 202-267-1457
Fax: 202-267-4222
E-mail: jberkson@comdt.uscg.mil

Landry Bernard
Director, Programming, Plans, & Integration
University of Southern Mississippi/National
Data Buoy Center
1100 Balch Blvd.
Stennis Space Center, MS 39529
Tel: 228-688-3394
Fax: 228-688-1364
E-mail: Landry.Bernard@noaa.gov

Joanne Bintz
Program Manager, Southeastern Coastal
Ocean Observing System (SCOOP)
Southeastern Universities Research Association (SURA)
1201 New York Ave., NW
Washington, DC 20005
Tel: 202-408-7872
Fax: 202-408-8250
E-mail: bintz@sura.org

Nancy Bird
President
Prince William Sound Science Center
P.O. Box 705
Cordova, AK 99574
Tel: 907-424-5800 x 225
Fax: 907-424-5820
E-mail: bird@pwssc.gen.ak.us

William Birkemeier
Co-Chair ExCom
U.S. Army Corps of Engineers
1261 Duck Rd
Duck, NC 27949
Tel: 252-261-6840x229
Fax: 252-261-4432
E-mail: birkemw@wes.army.mil

Stanley Boc
Research Hydraulic Engineer
U.S. Army Corps of Engineers
Buuilding 230
Fort Shafter, HI 96858
Tel: 808-438-9526
Fax: 808-438-1307
E-mail: stanley.j.boc@erdc.usace.army.mil

Philip Bogden
CEO
Gulf of Maine Ocean Observing System (GoMOOS)
PO Box 4919
Portland, ME 04112
Tel: 207-773-0423
Fax: 207-773-8672
E-mail: bogden@gomoos.org

Paula Bontempi
Program Scientist, Ocean Biology and Biogeochemistry
National Aeronautics and Space Administration (NASA)
Code YS, 300 E St., S.W.
Washington, DC 20546
Tel: 202-358-1508
Fax: 202-358-2770
E-mail: paula.s.bontempi@nasa.gov

Melbourne Briscoe
Division Director, ONR Code 322
Office of Naval Research
800 N. Quincy St.
Arlington, VA 22217-5660
Tel: 703-696-4120
Fax: 703-696-2007
E-mail: briscom@onr.navy.mil

Stephen Brown
Biological Oceanographer
National Oceanic and Atmospheric Administration/National
Marine Fisheries Service (NOAA/NMFS)
F/ST7, 1315 East-West Hwy
Silver Spring, MD 20910
Tel: 301/713-2363 x133
Fax: 301/713-1875
E-mail: Stephen.K.Brown@noaa.gov

* Now at Old Dominion University (latkinso@odu.edu)

Andrew Clark†
President
HARRIS Corp Maritime Communications
1025 W. NASA Blvd
Melbourne, FL 32919
Tel: 321-674-4758
Fax: 321-674-4751
E-mail: aclark01@harris.com

Larry Clark
Section Head
National Science Foundation (NSF)
4201 Wilson Blvd., #725
Arlington, VA 22230
Tel: 703-292-8580
Fax: 703-292-9085
E-mail: hclark@nsf.gov

Roz Cohen
Data Management Liaison
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0854
Fax: 703-588-0872
E-mail: rosalind.e.cohen@noaa.gov

Jorge E. Corredor
Professor of Chemical Oceanography
Dept. of Marine Sciences, University of Puerto Rico
PO Box 908
Lajas, PR 00667
Tel: 787-899-2048 x244
Fax: 787-899-5500
E-mail: j_corredor@cima.uprm.edu

William Curry
Deputy Technical Director
Oceanographer of the Navy
2511 Jefferson Davis Hwy
Arlington, VA 22202
Tel: 703-601-1209
Fax: 703-601-1320
E-mail: william.curry@navy.mil

Lee Dantzler
Data Management Liaison
Ocean.US
538 Joyner Drive
Havelock, NC 28532
Tel: 252-444-1951
Fax: same, call first
E-mail: dantzlerl@uncw.edu

Margaret Davidson
Director
National Oceanic and Atmospheric Administration (NOAA)
Coastal Services Center
2234 S. Hobson Avenue
Charleston, SC 29405
Tel: 843-740-1220
Fax: 843-740-1297
E-mail: margaret.davidson@noaa.gov

Carlos DelCastillo
Program Scientist
National Aeronautics and Space Administration (NASA)
NASA HQ
Washington, DC 20546
Tel: 202-360-9595
Fax:
E-mail: edelcast@ssc.nasa.gov

Rick DeVoe
Executive Director
S.C. Sea Grant Consortium
287 Meeting Street
Charleston, SC 29401
Tel: 843-727-2078
Fax: 843-727-2080
E-mail: rick.devoe@scseagrant.org

Paul DiGiacomo
Scientist, Oceanography Group
Jet Propulsion Laboratory, California Institute of Technology
MS 300-323, 4800 Oak Grove Drive
Pasadena, CA 91109
Tel: 818-354-8189
Fax: 818-393-6720
E-mail: Paul.M.Digiacomo@jpl.nasa.gov

Windy Fields
Office Manager
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22193
Tel: 703-588-0853
Fax: 703-588-0872
E-mail: w.fields@ocean.us

Pierre Flament
Program Director
National Science Foundation (NSF)
4201 Wilson Blvd., #725
Arlington, VA 22230
Tel: 703-292-9557
Fax:
E-mail: pflament@nsf.gov

† Now also with Ocean.US (a.clark@ocean.us)

Bill Fornes
Program Coordinator
National Oceanographic Partnership Program
1201 New York Ave, NW, Suite 420
Washington, DC 20005
Tel: 202.448.1222
Fax: 202.332.9751
E-mail: wfornes@coreocean.org

Roger Gauthier
Great Lakes Commission
2805 South Industrial Highway
Ann Arbor, MI 48104
Tel: 734-971-9135
Fax: 734-971-9150
E-mail: gauthier@glc.org

Scott Glenn
Professor
Rutgers University
71 Dudley Road
New Brunswick, NJ 08901
Tel: 732-932-6555
Fax:
E-mail: chkohut@marine.rutgers.edu

Fred Grassle
Director
Rutgers University Institute of Marine and Coastal Science
113 Cleveland Lane
Princeton, NJ 08540
Tel: 732-9320-6555 X509
Fax: 732-932-8578
E-mail: grassle@marine.rutgers.edu

David Green
Deputy Lead, NOAA's Weather & Water Mission Goal
National Oceanic and Atmospheric Administration (NOAA)
1325 East West Hwy, SSMC2, Rm. 15326
Silver Spring, MD 20910
Tel: 301-713-3557
Fax:
E-mail: david.green@noaa.gov

John Haines
Program Coordinator, Coastal and Marine Programs
U.S. Geological Survey (USGS)
12201 Sunrise Valley Dr. MS 915B
Reston, VA 20192
Tel: 703-648-6422
Fax: 703-648-5464
E-mail: jhaines@usgs.gov

David Halpern
Senior Policy Analyst
Executive Office of the President, Office of Science and Technology Policy
New Executive Office Building
Washington, DC 20502
Tel: 202-456-6038
Fax: 202-456-6027
E-mail: dhalpern@ostp.eop.gov

Mark Hamill
NWISWeb Chief
U.S. Geological Survey (USGS)
437 National Center
Reston, VA 20192
Tel: 703-648-5298
Fax: 703-648-5644
E-mail: mdhamill@usgs.gov

Steve Hankin
Chairman, IOOS/DMAC Steering Committee
National Oceanic and Atmospheric Administration (NOAA/PMEL) & IOOS/DMAC
7600 Sand Point Way NE
Seattle, WA 98125
Tel: 206.526.6080
Fax: 206.526.6774
E-mail: steven.c.hankin@noaa.gov

Ed Harrison
Oceanographer
National Oceanic and Atmospheric Administration (NOAA/PMEL) & IOOS/DMAC
7600 Sand Pt Way NE
Seattle, WA 98115
Tel: 206-526-6225
Fax: 206-526-6744
E-mail: d.e.harrison@noaa.gov

Mike Hemsley
Deputy Director for Coastal Operations
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0187
Fax: 703-588-0872
E-mail: m.hemsley@ocean.us

Bob Houtman
Deputy Director for Operations
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201-3667
Tel: 703-588-0847
Fax: 703-588-0872
E-mail: b.houtman@ocean.us

Alexandra Isern
Program Director for Ocean Technology and Interdisciplinary Coordination
The National Science Foundation
4201 Wilson Blvd., Suite 725
Arlington, VA 22230
Tel: 703-292-7581
Fax: 703-292-9085
E-mail: aisern@nsf.gov

Koziana James
SAIC
One Enterprise Parkway
Hampton, VA 23666
Tel: 757-827-4871
Fax:
E-mail: james.v.koziana@saic.com

Walter Johnson
Oceanographer
Minerals Management Service
381 Elden Street
Herndon, VA 20170
Tel: 703 787 1642
Fax: 703-787-1053
E-mail: walter.johnson@mms.gov

Mike Johnson
Program Manager
National Oceanic and Atmospheric Administration (NOAA)
Climate Office
1100 Wayne Ave. #1210
Silver Spring, MD 20910
Tel: 1-301-427-2089
Fax: 1-301-427-0033
E-mail: mike.johnson@noaa.gov

Jack Kaye
Director
R&A Program, Sun-Earth System Division
NASA HQ, Mail Code YS
Washington, DC 20546
Tel: 202-358-2559
Fax: 202-358-2770
E-mail: Jack.A.Kaye@nasa.gov

Chet Koblinsky
Director, Climate Office
National Oceanic and Atmospheric Administration (NOAA)
1100 Wayne Ave., South 1225
Silver Spring, MD 20910
Tel: 301-427-2089 x136
Fax: 301-427-2032
E-mail: chester.j.koblinsky@noaa.gov

John Lever
CIO
Naval Oceanographic Office
Code 0TI
Stennis Space Center, MS 39522, MS 39522
Tel: 228-688-4248
Fax: 228-688-5287
E-mail: jlever@ms-online.com

Walton H Low
Hydrologist
US Geological Survey (USGS)
12201 Sunrise Valley Dr, MS413
Reston, VA 20192
Tel: 703-648-5707
Fax: 703-648-6693
E-mail: wlow@usgs.gov

Mark Luther
Professor
Marine Science, University of South Florida
140 Seventh Avenue South
St Petersburg, FL 33701
Tel: 727-553-1528
Fax: 727-553-1189
E-mail: luther@marine.usf.edu

Thomas Malone
Executive Director
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0849
Fax: 703-588-0872
E-mail: t.malone@ocean.us

Buzz Martin
State Scientific Support Coordinator
Texas General Land Office
P.O. Box 12873
Austin, TX 78711-2873
Tel: (512) 475-4611
Fax:
E-mail: buzz.martin@glo.state.tx.us

David Martin
Associate Director
Applied Physics Laboratory (APL), University of Washington
1013 NE 40th Street
Seattle, WA 98105-6698
Tel: 206 543 2945
Fax: 206 543-3521
E-mail: dmartin@apl.washington.edu

Robert Mason
Hydrologist
U. S. Geological Survey (USGS)
415 National Center
Reston, VA 20192
Tel: 703-648-5305
Fax: 703-648-5722
E-mail: rrmason@usgs.gov

Molly McCammon
Executive Director
Alaska Ocean Observing System
1007 W. 3rd Avenue, Suite 100
Anchorage, AK 99501
Tel: 907-770-6543
Fax: 907-278-6773
E-mail: mccammon@aoos.org

Blanche Meeson
Education Liaison
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0845
Fax: 703-588-0872
E-mail: b.meeson@ocean.us

Brian Melzian
Oceanographer/Project Officer
U.S. Environmental Protection Agency
(EPA - NHEERL/Atlantic Ecology Division)
27 Tarzwell Drive
Narragansett, RI 02882
Tel: (401) 782-3188
Fax: (401) 782-3030
E-mail: melzian.brian@epa.gov

Simone Metz*
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0844
Fax: 703-588-0872
E-mail: s.metz@ocean.us

Eric Miller
NOAA's Observing Systems Architect
National Oceanic and Atmospheric Administration (NOAA)
1335 East West Hwy SSMC1 Station 5230
Silver Spring, MD 20910
Tel: 301-713-2789 x171
Fax: 301-713-3136
E-mail: eric.miller@noaa.gov

Peter Milne
Director of Ocean Observing
Joint Oceanographic Institutions (JOI)
1201 NewYork Av, Suite 400
Washington, DC 20005
Tel: 202-787-1604
Fax: 202-232-3426
E-mail: pmilne@joiscience.org

Paul Moersdorf
Director
National Data Buoy Center
1100 Balch Blvd.
Stennis Space Center, MS 39529
Tel: 228-688-2805
Fax: 228-688-1364
E-mail: paul.moersdorf@noaa.gov

Mark Moline
Professor
California Polytechnic State University
1 Grand Ave
San Luis Obispo, CA 93407
Tel: 805-756-2948
Fax: 805-756-1419
E-mail: mmoline@calpoly.edu

Jan Newton
Senior Oceanographer
Washington State Dept. of Ecology
PO Box 47710
Olympia, WA 98504-7710
Tel: 360 407 6675
Fax: 360 407 6884
E-mail: newton@ocean.washington.edu

Worth Nowlin
Chairman
Steering Committee, U.S. Global Ocean Observing System
(GOOS)
3146 TAMU, Department of Oceanography
College Station, TX 77843-3146
Tel: 979/845-3900
Fax: 979/847-8879
E-mail: wnowlin@tamu.edu

Chris Parrish
National Oceanic and Atmospheric Administration (NOAA)
1315 East-West Highway
Silver Spring, MD 20910
Tel: 301-713-0609
Fax:
E-mail: chris.parrish@noaa.gov

* Now at the National Science Foundation (smetz@nsf.gov)

Gary Petrae
Deputy Assistant Administrator
National Oceanic and Atmospheric Administration (NOAA),
Program Planning and Integration
1315 East West Hwy., Rm 15752
Silver Spring, MD 20910
Tel: 301-713-1622 x 185
Fax:
E-mail: gary.petrae@noaa.gov

Stephen Piotrowicz
Deputy Director
National Oceanic and Atmospheric Administration
(NOAA/Ocean.US)
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0850
Fax: 703-588-0872
E-mail: s.piotrowicz@ocean.us

Thomas Rayburn
Senior Project Manager, Environmental Quality
Great Lakes Commission
2805 S. Industrial Hwy.
Ann Arbor, MI 48104
Tel: 734-971-9135
Fax: 734-971-9150
E-mail: tray@glc.org

Jeff Reutter
Director
Ohio Sea Grant and Stone Lab
1314 Kinnear Rd.
Columbus, OH 43212
Tel: 614-292-8949
Fax: 6142924364
E-mail: reutter.1@osu.edu

Jeffrey Runge
Research Professor
University of New Hampshire
OPAL, 142 Morse Hall
Durham, NH 03824
Tel: 603-862-3575
Fax: 603-862-0243
E-mail: jrunge@cisunix.unh.edu

Kurt Schnebele
Director, Acting
National Oceanographic Data Center
1315 East West Hwy
Silver Spring, MD 20910
Tel: 301.713.3270
Fax: 301.713.3300
E-mail: Kurt.J.Schnebele@noaa.gov

Paul Scholz
Division Chief
National Oceanic and Atmospheric Administration/Coastal
Services Center (NOAA/CSC)
2234 South Hobson
Charleston, SC 29405
Tel: 843-740-1208
Fax: 843-740-1313
E-mail: Paul.Scholz@noaa.gov

Harvey Seim
Chief Operating Officer, Southeast Atlantic Coastal Ocean
Observing System
University of North Carolina - Chapel Hill
Dept. Marine Sci, CB#3300, 12-7 Venable Hall
Chapel Hill, NC 27599
Tel: 919-962-2083
Fax: 919-962-1254
E-mail: hseim@email.unc.edu

Eileen Shea
Climate Projects Coordinator
East-West Center
1601 East-West Road, Room 2062 John A. Burns Hall
Honolulu, HI 96848-1601
Tel: (808) 944-7253
Fax: (808) 944-7298
E-mail: SheaE@EastWestCenter.org

Linda Sheehan
Director, Pacific Regional Office
The Ocean Conservancy
116 New Montgomery Street, Suite 810
San Francisco, CA 94105
Tel: 415-979-0900, x12
Fax: 415-979-0901
E-mail: lsheehan@oceanconservancyca.org

Joel Slotten
CDR
U.S. Coast Guard
2100 2nd St. SW
Washington, DC 20593
Tel: (202) 267-6127
Fax:
E-mail: jslotten@comdt.uscg.mil

Richard Spinrad
Assistant Administrator
National Oceanic and Atmospheric Administration/National
Ocean Service (NOAA/NOS)
1305 east west highway
silver spring, MD 20910
Tel: 301-713-3074
Fax: 301-713-4269
E-mail: richard.spinrad@noaa.gov

Kristine Stump
Research Associate
Ocean.US
2300 Clarendon Blvd., Suite 1350
Arlington, VA 22201
Tel: 703-588-0853
Fax: 703-588-0872
E-mail: k.stump@ocean.us

Steven Swartz
Ecosystem Goal/EOP Coordinator
National Oceanic and Atmospheric Administration (NOAA Fisheries, S&T)
1315 Eastwest Highway, Rm 12552
Silver Spring, MD 20910
Tel: 301-713-2363 ext 128
Fax:
E-mail: steven.swartz@noaa.gov

Mike Szabados
Director
NOS/CO-OPS
1305 East West Hwy Room 6633
Silver Spring, MD 20910
Tel: 3017132981
Fax: 3017134392
E-mail: mike.szabados@noaa.gov

Eric Terrill
Director, Coastal Observing R & D Center
Southern California Coastal Ocean Observing System (SCCOOS)
Marine Physical Laboratory, Scripps Insitution of Oceanography
La Jolla, CA 92093-0213
Tel: 858 822 3101
Fax: 858 534 7132
E-mail: eterrill@ucsd.edu

Carolyn Thoroughgood
Dean
University of Delaware
College of Marine Studies
Newark, DE 19716
Tel: 302-831-2841
Fax: 302-831-4389
E-mail: ctgood@udel.edu

Chris Vickroy
Technical Fellow
The Boeing Company
13100 Space Center Blvd., US HBS-30
Houston, TX 77059
Tel: 281-226-4388
Fax:
E-mail: stephen.c.vickroy@boeing.com

Roy Watlington
Professor, Acting Coordinator of the Virgin Islands Experimental Program for the Stimulation of Competitive Research (VI-EPSCoR)
University of the Virgin Islands
No.2 John Brewers Bay
St. Thomas, VI 00802
Tel: 340 693-1391
Fax: 340 693-1385
E-mail: rwatlin@uvi.edu

Stephanie Watson
Coordinator
Central and Northern California Observing System (CeNCOOS), Monterey Bay Aquarium Research Institute
7700 Sandholdt Road
Moss Landing, CA 95039-9644
Tel: 831-775-1987
Fax: 831-775-1620
E-mail: swatson@mbari.org

Doug Wilson
Intergovernmental Oceanographic Commission (of UNESCO) Sub-commission for the Caribbean and Adjacent Global Ocean Regions Observing System (IOC-IOCARIBE-GOOS)
410 Severn Ave Suite 107A
Annapolis, MD 21043
Tel: 410 267 5648
Fax: 410 267 5666
E-mail: doug.wilson@noaa.gov

Robert Winokur
Technical Director
Oceanographer of the Navy
2511 Jefferson Davis Hwy
Arlington, VA 22202
Tel: 703-601-1210
Fax: 703-601-1320
E-mail: robert.s.winokur@navy.mil

Don Wright
Fellow for Coastal Research
SURA
SURA, 1201 New York Avenue, NW,Suite 430
Washington, DC 20005
Tel: (202) 408-7872, ext 238
Fax:
E-mail: dwright@sura.org

Jim Yoder
Division Director
Ocean Sciences, National Science Foundation
4201 Wilson Blvd, Suite 725
Arlington, VA 22230
Tel: 703-292-8580
Fax: 703-292-9085
E-mail: jyoder@nsf.gov

APPENDIX II


© Oregon Sea Grant


© Oregon Sea Grant


© Oregon Sea Grant

Integrated Ocean Observing System (IOOS)
First Annual Implementation Conference
31 August - 2 September 2004
Holiday Inn Rosslyn, Arlington, VA

Tuesday, August 31, 2004

0730 – 0830 Continental Breakfast

0800 – 0830 **Registration**

0830 – 1200 Plenary I: Overview, Goals, and Procedures

0830 – 0930 Overview of the IOOS and the preliminary *Development Plan*, conference goals, procedures, and deliverables (Tom Malone)

0930 – 1030 Agency Perspectives (Ocean.US Executive Committee (EXCOM) members, five minutes each) (led by EXCOM Chair or designee)

1030 – 1035 Form small groups (three to four people) to discuss and agree on the following (Dick McCaffery):

(1) Overall, are you comfortable with the preliminary draft of the *First Annual IOOS Development Plan*?
(2) Do you have particular issues or concerns that you would like to have clarified? If so, what are they (maximum of two)?

[This will be a "self organizing" activity, with each group including at least one person from a federal agency and one person from a region. Each group will be asked to report back in plenary on one to two issues. All of these will be recorded for the Conference report.]

1035 – 1045 BREAK/Registration

1045 – 1100 Small group caucuses to address questions (1) and (2) above

1100 – 1200 Brief reports from groups and panel-led[1] discussion to clarify issues related to IOOS development and to determine if there are common themes that can be used to improve the *IOOS Development Plan* and, if appropriate to the topic, can be addressed in subsequent sessions (led by EXCOM Chair or designee)

1200 – 1300 LUNCH

Working lunch for Chairs, Co-Chairs, and Rapporteurs of sessions scheduled on days one and two (Tom Malone and Dick McCaffery)

1300 – 1500 Plenary II: Regional Development

Overview of Regional Association (RA) and Regional Coastal Ocean Observing System (RCOOS) development, including the rationale for federal investment in their establishment and sustained operation; current status of RA and National Federation of Regional Association (NFRA) development, the establishment of RCOOSs, and next steps. (David Martin, Chair NFRA Organizing Committee)

Recommend actions needed to be eligible for certification as an RA and the process for certification with estimated costs (FY 05-06); recommend actions needed to establish the NFRA (Discussion led by Dick McCaffery)

[1] The Ocean.US Executive Committee, Director of Ocean.US, and Chair of the NFRA Organizing Committee will constitute the panel.

1500 – 1530 BREAK

1530 – 1730 Plenary III: Data Management and Communications (DMAC)

Overview of the DMAC Plan, key issues, and opportunities (including recommended next steps for developing DMAC capabilities) (Lee Dantzler and Steve Hankin)

Data management intersects almost all aspects of IOOS. Ocean.US will provide an overview of the DMAC Plan, key issues, and opportunities for moving forward, as well as planned DMAC activities. The goal of the subsequent discussion will be to help ensure that a common view of DMAC considerations is incorporated into the breakout discussions. Recommendations will be solicited from the workshop participants regarding forthcoming IOOS DMAC "best practices" and standards development activities, and to help ensure that the key issues and priorities have been identified.

1800 – 2000 RECEPTION (Vantage Point Restaurant and Lounge, Holiday Inn Rosslyn)

Wednesday, September 1, 2004

0700 – 0800 Continental Breakfast

0800 – 0900 Plenary IV: The Global Ocean-Climate Component

Review of the global plan, the status of implementation, and future developments (Chet Koblinsky)

0900 – 1000 Plenary V: Product-Driven, Prioritized, Phased Implementation

Review charge to Working Groups (WGs) and procedures for formulating a prioritized, phased implementation plan for developing an integrated system that will deliver new or improved products (Tom Malone and Dick McCaffery)

1000 – 1030 BREAK

1030 – 1200 Breakout Session

Five groups work in parallel (each group with co-Chairs from a federal agency and a regional group, and a rapporteur). One WG will work on establishing priorities for coordinated development of the global and coastal components of the IOOS.[2] Four WGs will focus on product-driven implementation plans (see "Guidance for Product-Driven Working Groups") as follows:

(1) Coordinated development of the global and coastal components
(2) Water Level, Surface Current, and Wave Fields
(3) Distribution and Volume of Sea Ice
(4) 3-Dimensional fields of dissolved inorganic nitrogen, chlorophyll-*a*, dissolved O_2, and pCO_2
(5) Spatial extent and condition of essential habitats for living marine resources (e.g., coral reefs, oyster reefs, sea grass beds, kelp beds, tidal marshes, and mangrove forests)

1200 – 1300 LUNCH

1300 – 1500 Breakout Session (continued)

1500 – 1530 BREAK

[2] Discuss the interdependencies of the global and coastal components, and formulate recommendations for coordinated development of an IOOS in which the coastal component meets requirements of the global component and vice versa (FY 05 – 14).

1530 – 1700 Plenary VI: Working Group Results

Reports from WG chairs (short-term and long-term priorities for implementation and development) followed by a comment session for the record.[3]
Rapporteurs deliver completed work sheets from each WG to Kristine Stump no later than 1700.

Thursday, September 2, 2004

Meeting of Federal Agencies with Ocean.US

Given recommendations from days one to two and the preliminary *IOOS Development Plan*, agree on the following:

(1) Potential agency roles and responsibilities for IOOS implementation (for subsequent vetting by the agencies following the conference as described below); and
(2) A 30-day action plan for accepting, rejecting, and prioritizing recommendations for implementing the IOOS during FY 05-06 and FY 07-14.

For the coastal component (backbone, RAs) and coordinated development of global and coastal components, the EXCOM leads the following:

(1) Discuss intersections with or potential linkage of recommendations from days one and two with current and/or planned agency programs;
(2) Identify major problems and inconsistencies in these recommendations; and
(3) Agree on a 30-day schedule for each agency to answer the following questions for **each** set of recommendations in the categories of "national backbone," RAs and global-coastal coordination:

(a) Is the recommendation a high, medium, or low priority for your agency to implement? If high or medium, indicate when implementation should begin (FY 05-06 or FY 07-14).
(b) In terms of the seven IOOS goals in general, should the recommendation be a high, medium, or low priority for IOOS implementation?
(c) For (a) and (b) above, should your agency be the lead agency for implementation? If interagency collaboration is needed, which agencies should be involved and how will this be accomplished?
(d) Given (a), (b), and (c) above, which recommendations (or elements thereof) is your agency willing to commit to and fund? What are your agency's priorities, and which can be committed to in FY 05-06 or FY 07-14? What conditions must be met, and what issues must be addressed for implementation to occur?

Results of days one and two of the workshop and agency responses to these questions will be used by Ocean.US to revise the preliminary *IOOS Development Plan* for public comment. Based on these comments, a final, EXCOM-approved draft will be prepared for transmission to the National Ocean Research Leadership Council (NORLC).

© Blanche Meeson, 2000

© Reg Meeson, 2004

[3] The comment period is intended to give everyone an opportunity to express a point (pro or con) for the record. This may include questions for clarification, issues of concern, statements of support, etc. The purpose is to listen, not to debate.

APPENDIX III

1st Annual IOOS Implementation Conference

Small Group Feedback

On day one of the conference, participants were asked to form small groups of three to four conferees (13 groups) to discuss and agree on the following: (1) Overall, are you comfortable with the preliminary draft of the *First Annual IOOS Development Plan*? (2) Do you have particular issues or concerns that you would like to have clarified? If so, what are they (maximum of two)? Each group reported back in a discussion led by the Ocean.US Executive Committee to clarify issues related to IOOS development and to determine if there are common themes that can be used to help guide preparation of the *First Annual IOOS Development Plan* and, if appropriate to the topic, can be addressed in subsequent sessions. Many of these comments were concerned primarily with the plan itself. A summary of all comments is given below.

Common Themes

1. Users, products, and modeling

1.1 Put into place a system that meets a set of requirements for an end-to-end system.
As the *Development Plan* currently reads, there are no metrics to determine whether or not user needs are met, and these are needed in order to justify additional resources. Performance metrics for near-term successes should be included.

1.2 Correct the lack of specificity in identifying user groups.
The user community is not visible enough. Engage non-traditional users. Convene a user forum to gather direct input on needs.

1.3 Identify, via marketing and socioeconomic analysis, which user groups to engage first, given limited resources.

1.4 Link data providers to data users for success in an end-to-end system.

*1.5 Add a section describing methods to integrate the private sector***.**
The *IOOS Development Plan* is very top-down. Look to the data management and communications (DMAC) Plan as a model for how this recommendation could be accomplished.

1.6 Use model requirements to drive development of observing and DMAC subsystems.

1.7 *Identify what data is being collected, what models exist, and what products are being produced by IOOS.*
It is important to identify products that will keep the observing system sustained and that will maintain the interest of the agencies. Research will also develop new products. Add a section on "Data Products," where they are defined and examples are given.

1.8 *Be more specific in the Executive Summary.*
The Executive Summary is fairly vague and "researchy," with no evidence that IOOS is provided for user groups. There is no discussion of data products, which are of interest to many audiences. The Executive Summary needs objectives/milestones with responsible parties and timelines; otherwise, there is no accountability.

1.9 *Link the eight climate-based elements listed in the Executive Summary to the seven societal goals.*

2. Research to Operations

2.1 The process and description of the transition from research to operations should be more developed.
This section should include mechanisms to facilitate these transitions, especially in the modeling community. The development plan should outline when programs are in each stage.

*2.2 In the context of the transition from research to operations, identify mechanisms for connecting modeling to data collection, and link modelers to data collectors***.**

2.3 *Include regional guidance to federal agencies for the development of the backbone* (e.g., location and density of National Data Buoy Center buoys).

2.4 Delineate mechanisms for transfer of new technology and knowledge between regions (process and funding).

2.5 Describe the roles of user groups other than academic and federal research communities.

3. Priorities and Timelines for Phased Implementation

3.1 *Part II needs more focused objectives and priorities***.**
To set these priorities, identify specific products needed from users. Look to the global community as an example of how do accomplish this task.

3.2 *Use Research to Operations recommendations to create prioritized timelines*.

4. Establishing Regional Associations (RAs)

4.1 Facilitate more dialogue between regional groups and federal headquarters.

4.2 Increase funding level per RA for institutionalizing and capitalizing RAs and Regional Coastal Ocean Observing Systems (RCOOSs).

Explain how the integration of existing systems will occur with regard to funding.

4.3 Clarify the role of RAs in DMAC.

4.4 Ensure that the Development Plan contains accurate representation of RAs, including those that are not adjacent to the coastline of the contiguous U.S., and mechanisms for working with international groups.

5. Other

5.1 Define "integrated" and a measure for achieving it.

5.2 Enhance biological components.

5.3 Strengthen remote sensing recommendations, particularly ocean color.

5.4 Include mechanisms for interagency collaboration at state and local levels.

5.5 Develop priorities for DMAC development.

5.6 Address dissolved oxygen in Part II.

Oxygen is critical to eutrophication/hypoxia issues that are affecting the nation from coast to coast. We have the technology to do this with some limitations, but these are no worse than chlorophyll. Oxygen should be specifically mentioned as a high priority for early implementation of the *Development Plan.*

5.7 *Evaluate the location of the existing* in situ *platforms to ensure that they are best located to meet IOOS needs.*

© Kip Evans

APPENDIX IV

Table A. Summary of DMAC priorities and cost estimates (x $1,000) for FY2005-2006, as recommended in May 2004 DMAC Plan.

DMAC Function	Outcomes	Activities	Cost	
Interoperability Framework			FY 2005	FY 2006
Program Management Activities	Effective system planning and coordination	• Engage services of software engineer to prepare documents • Appoint DMAC Standing Committee • Establish DMAC implementation strategy and oversight function	$36	$72
Metadata/Data Discovery	Interim metadata standards Initial catalog services	• Convene community-based metadata working group	[$335[a]]	$271
	Initial data discovery services	• Convene community-based data discovery working group. • Testbed to develop distributed search capability		
	Applied R&D (enhancement) activity	• Bi-directional linkages between data discovery, data transport, on-line browse		
Data Archive and Access	Framework for cooperation among Archive Centers	• Convene a community-based working group of archive center representatives to id IOOS partner organizations that will provide archive services. • Framework to inventory & assess state of marine data archives	$235	$335
	IOOS Archive Centers demonstrate capability to provide DMAC data discovery and transport services	• NODC pilot projects using DMAC standards for NRT and RT data sets • Pilot projects to modernize access to data sets delivered in real time.		
Data Transport	Semantic data model	• Convene community-based expert working group	$450	$348
	Infrastructure component development for common standards with spatial data (GIS) and biological data provider/user communities	• Convene community-based working group with key expertise in Open GIS Consortium and OBIS		
TOTAL			$721	$1026

a. A proposal has been submitted to NSF and SURA that is likely to be funded, so this amount has been deducted from the total.

Table B. Summary of DMAC guidance to the NOPP Agencies and RAs for FY 05-06, as recommended in the May 2004 DMAC Plan. [a, b]

DMAC Function	Activities
Interoperability framework	
Metadata/Data Discovery	- Create and publish FGDC compliant metadata - Submit metadata to GCMD and NCDDC - Participate in DMAC Metadata Working Group
Archive and Access	- Ensure all irreplaceable data in current/historical holdings have permanent archive - Convene expert working group to determine best methods to enable national archives as "users" of IOOS generated data (see related task under core activities). - Make arrangements for permanent archive of all future IOOS irreplaceable data for which organization is responsible
Data Transport and On-line Data Exploration and Navigation	- Install servers to provide data access using OPeNDAP - Continue enterprise GIS solutions (IOOS will develop gateways). - Participate in DMAC Data Transport Working Group (semantic data modeling) - Install Live Access Server and notify DMAC.
Design and Demonstration	
Interoperability/integration	- Pilot projects to establish interoperability between selected IOOS observing systems, partners, and regional entities.

[a] Data providers should first select an approach for managing IOOS data: either delegate responsibility to another entity (i.e., agreement with NDBC to QC and distribute mooring data in DMAC compliant manner); or manage data internally in DMAC-compliant manner.
[b] Cost estimates are not available for these activities.

Table C. Summary of DMAC program initiation activities and cost estimates (x $1,000) in FY 07 (Year N) as recommended in the May 2004 DMAC Plan.

DMAC Functions	Activities[a]	Cost Estimates Yr N
Interoperability framework		
Program Management Activities		$726
Metadata and Data Discovery	- Determine metadata content and format standards - Develop tools and procedures to support metadata providers - Discovery: Select/develop and maintain catalog and search capability - Discovery: Design discovery Portal - Discovery: Design and implement data location service	$2,480
Data Archive and Access	- Current archive & access assessment - Determine dataset priorities for all IOOS data disciplines - Determine IOOS dataset categorization - Recruit centers for IOOS Archive System and form partnerships - Develop archive critical metadata - Define IOOS archive and access data policy - Establish IOOS data stream developers guidelines - Develop Archive System data discovery interfaces - Receive and provide more data in real time - Broaden base for user services - Establish procedures to document the archive System Metrics - Procedure to resolve data retention issues - Write plan for archive & access security	$1,612

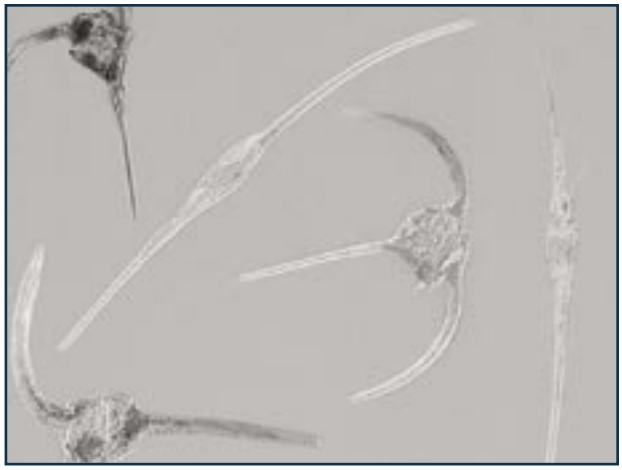
Data Transport	- Develop comprehensive IOOS data model(s) - Deliver time critical (real time) data to Data Assembly and Operation Modeling - Develop DMAC middleware - Make data available using IOOS middleware solution - Develop metric and implement performance monitoring - Implement middleware security - Provide guaranteed geo-temporally-referenced browse for all IOOS data - Aggregation of unstructured data (e.g., vector, point, sequence, profile) - OPeNDAP-GIS client and GIS-OPeNDAP server	$2,234
Subtotal		**$7,052**
Interoperability infrastructure		
Inflation-adjusted costs		
Communication/ Infrastructure	- Includes communications hardware at ~10 sites that contribute to essential DMAC infrastructure (i.e., archive centers and primary data assembly centers) - Communications lease for entire infrastructure	$1,460
Servers at Centers	- Servers at ~10 sites, including hardware and software, and hardware maintenance after year of installation.	$2,400
Engineering/Integration	- Coordinate and manage the total hardware, software, and infrastructure definition, design, procurement, installation, integration, and maintenance. - Oversee Capacity Building, the effort in providing labor and services to data providers to enable them to reach and maintain the level at which they can participate.	$3,000
Subtotal		**$6,860**
Design and Demonstration		
Data Discovery	*Pilot Projects (see DMAC Plan)*	$1,000
Access/Infrastructure		500
Data Transport		1,000
Archive		500
Information Assurance		500
Innovative Architectures		300
Subtotal		**$3,800**
Total		**$17,712[b]**

[a] Note that some of these activities may be initiated in FY2005/2006, and most are multi-year.
[b] This estimate supports first year implementation costs of program initiation activities.

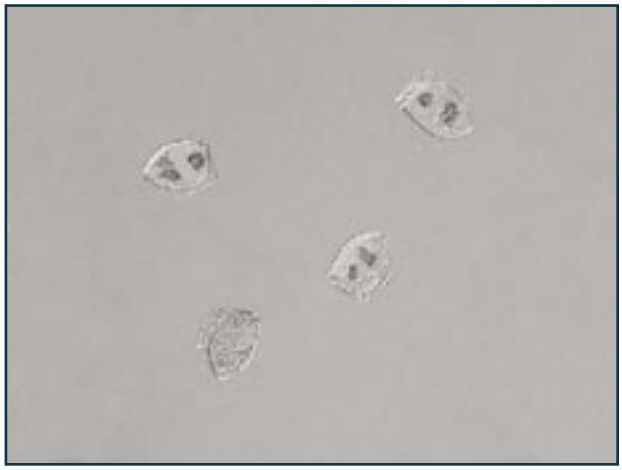
APPENDIX V

Acronyms

ADCP	Acoustic Doppler Current Profiler
AIS	Automated Identification System
AUV	Autonomous Underwater Vehicle
DMAC	Data Management and Communications
EPA	Environmental Protection Agency
EXCOM	Executive Committee
FGDC	Federal Geographic Data Committee
FY	Fiscal Year
GCMD	Global Change Master Directory
GEOSS	Global Earth Observing System of Systems
GIS	Geographical Information Systems
GLOBEC	Global Ocean Ecosystems Dynamics
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GPS	Global Positioning System
HAB	Harmful Algal Bloom
HAZMAT	Hazardous Materials
HFR	High Frequency Radar
IABP	International Artic Buoy Program
IOOS	Integrated Ocean Observing System
IOWG	Implementation Oversight Working Group
IWGEO	Interagency Working Group on Earth Observations
IT	Information Technology
LIDAR	Light Detection and Ranging
LMR	Living Marine Resources
LOICZ	Land-Ocean Interactions in the Coastal Zone
LTER	Long-Term Ecological Research
MMS	Minerals Management Service
NAML	National Association of Marine Laboratories
NASA	National Aeronautics and Space Administration
NCDDC	National Coastal Data Development Center
NDBC	National Data Buoy Center
NERR	National Estuarine Research Reserves
NFRA	National Federation of Regional Associations
NMS	National Marine Sanctuaries
NOAA	National Oceanic and Atmospheric Administration
NODC	National Oceanographic Data Center
NOPP	National Oceanographic Partnership Program
NORLC	National Ocean Research Leadership Council
NRT	Near Real-time
NSF	National Science Foundation
NWLON	National Water Level Observation Network
OBIS	Ocean Biogeographic Information System
OPeNDAP	Open Source Project for 2 Network Data Access Protocol
OSSE	Oriented Scintillation Spectrometer Experiment
PIPS	Polar Ice Prediction System
PORTS®	Physical Oceanographic Real-Time System
QA/QC	Quality Assurance/Quality Control
RA	Regional Association
R&D	Research and Development
RCOOS	Regional Coastal Ocean Observing System
RGPS	Radarsat Geophysical Processing System
RT	Real-time
SAR	Synthetic Aperture Radar
SAR SAT	Synthetic Aperture Radar satellite
SPARROW	Spatially Referenced Regressions on Watershed Attributes
THORPEX	The Observing System Research and Predictability Experiment
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
VOS	Voluntary Observing Ships
WG	Working Group



© Bigelow Laboratory for Ocean Sciences



© Bigelow Laboratory for Ocean Sciences

© Bigelow Laboratory for Ocean Sciences

OCEAN.US

© Courtesy of NASA