

2ND IOOS IMPLEMENTATION CONFERENCE
ARLINGTON, VIRGINIA
MAY 3-4, 2005

PROCEEDINGS

SECOND IOOS IMPLEMENTATION CONFERENCE:
MULTI-HAZARD FORECASTING



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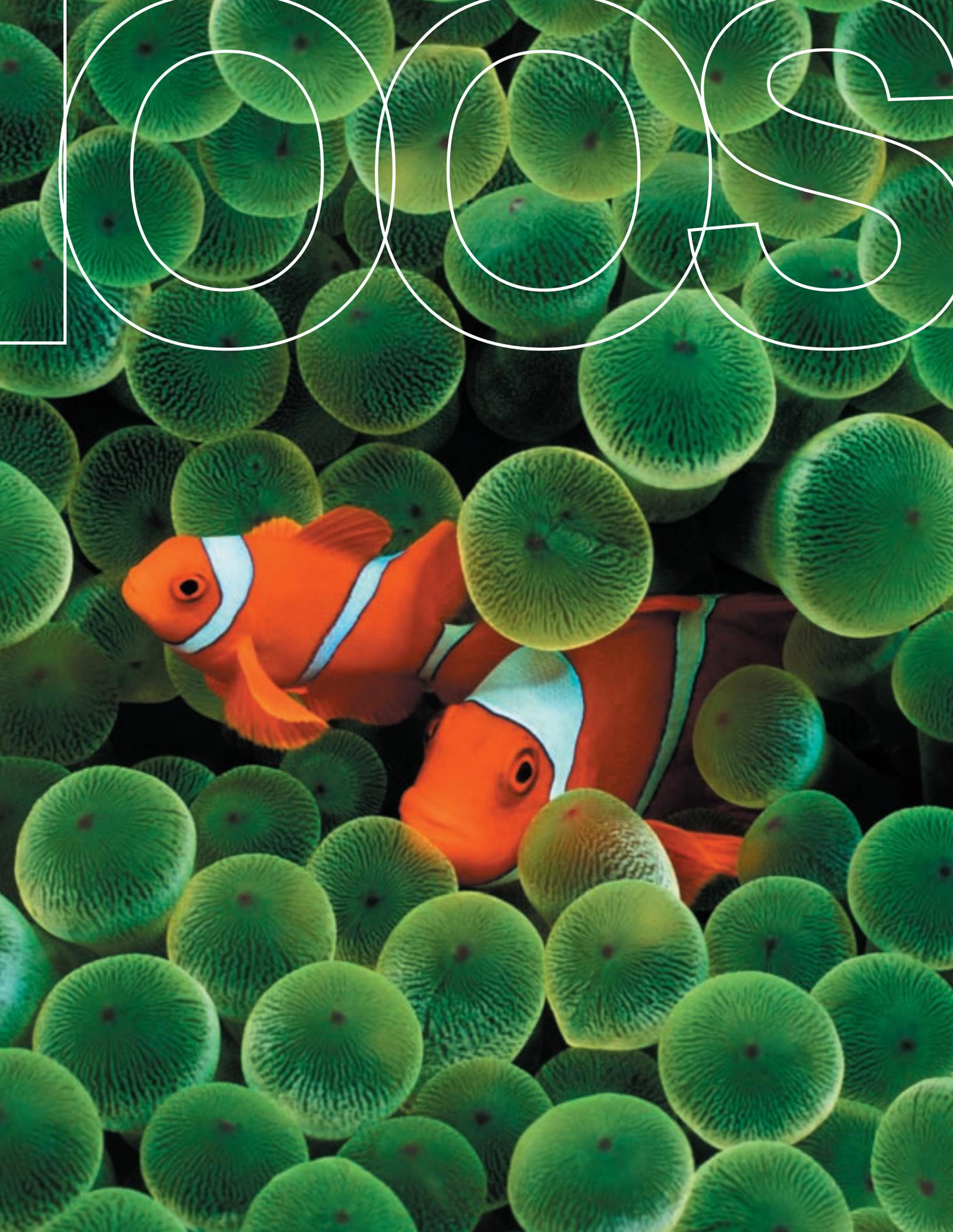
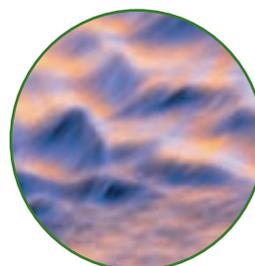


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Executive Summary



Ocean.US, in collaboration with the federal agencies and nascent Regional Associations (RAs), conducted the Second Integrated Ocean Observing System (IOOS) Implementation Conference on May 3-5, 2005. Recognizing that the IOOS must address data and information needs on global, national, and regional scales, the conference provides a forum for leaders involved in IOOS development on all three scales to work together in establishing priorities for IOOS development. As a step toward completing the *Second IOOS Development Plan* by the end of the 2005 fiscal year, consensus recommendations from the conference will be used to update and improve the *First IOOS Development Plan*.¹

In contrast with the First IOOS Implementation Conference, which was broad in scope, objectives of the Second IOOS Implementation Conference were more focused as follows:

- Address one of the seven societal goals (natural hazards that cause coastal flooding) that cross-cuts requirements for meteorological, physical, biogeochemical, and ecological data on oceanic and coastal systems;
- Develop data management and communications capabilities needed for multiple applications (mitigating the effects of coastal flooding on coastal communities, ecosystems, and natural resources); and
- Address formation of an education network to facilitate the use of ocean data for the public good, and identify priority activities for this education network that will create an informed public that knows how to avoid and respond to natural disasters, etc.

Given this focus, conferees from several areas of expertise were invited: natural hazards (forecasting tsunamis, hurricanes, and nor'easters), coastal flooding, data management and communications, education, and ocean and Great Lakes observing systems. Although most of the conferees were new to IOOS planning and implementation activities, recommendations that emerged from the working group sessions reinforced those of the First IOOS Implementation Conference as follows:

- Continue to implement and strengthen current plans for the global ocean component of the IOOS;
- Immediately begin to implement the Data Management and Communications (DMAC) Plan;
- Establish and adequately fund RAs and the National Federation of Regional Associations;
- Implement coastal ocean data assimilation experiments as pilot projects to facilitate coordinated development of the coastal and global components;
- Sustain existing elements of the observing subsystem recommended for the backbone in the *First IOOS Development Plan* and integrate these into an interoperable system; and
- Sustain the current investment in coastal ocean observing systems.

Given the objectives of the Second IOOS Implementation Conference, consensus recommendations were more targeted than in the first conference as summarized below.

¹ First Integrated Ocean Observing System (IOOS) Development Plan, January 2005 <<http://www.ocean.us/ioosplan.jsp>>

Observations

- (1) Repeat measurements and timely post-inundation updates of near shore coastal bathymetry-topography and benthic-land cover/use, especially in high risk areas.
- (2) Increase density of rainfall, atmospheric moisture profiles and soil moisture measurements.
- (3) Increase stream gauge (continuous, real-time telemetry) coverage in the coastal zone.
- (4) Increase real-time spatial and temporal resolution wind fields over water, surface current fields, directional wave fields, and sea surface salinity distributions, especially in the Nation's Exclusive Economic Zone and Great Lakes.
- (5) Optimize the tide gauge network to increase density of real-time measurements in high risk areas.
- (6) Increase spatial resolution of real-time bottom pressure, sea surface height, and upper ocean measurements (ocean basin scale).

Data Management and Communications

- (1) Fully implement the DMAC standards identification oversight process as recommended by the DMAC Steering Team and outlined in the IOOS and DMAC Plans.
- (2) Implement key supporting elements of the process recommended by the DMAC Steering Team to establish community-based DMAC Expert Technical teams (Expert Teams).
- (3) Form Community Engagement Caucuses to provide needed outreach and feedback mechanisms to key constituency groups with whom IOOS DMAC must engage.
- (4) Correct the present under-investment in technical support services for the DMAC Standards Oversight Process to enable timely identification, review, and publication of IOOS DMAC interoperability standards.
- (5) Support IOOS DMAC investment in the emerging IOOS RAs.
- (6) Complete the ongoing IOOS Systems Engineering analysis, especially those aspects that address interoperability among the federal backbone, RAs, U.S. Integrated Earth Observation System, Global Ocean Observing System, and Global Earth Observation System of Systems components.

Modeling

- (1) Using the emerging management structure for the Ocean.US DMAC initiative as a model, establish a Steering Team for the development of operational models and an interagency body to enable and oversee implementation.
- (2) Establish an inundation modeling test bed for improving existing and developing new models with more rigorous calibration and validation procedures.

Education

- (1) Establish an IOOS education and public awareness network with a Central Coordinating Site and regional sites allied with the RAs to facilitate sharing among regions and other networks.
- (2) Participate in the Governance of IOOS at both national and regional levels.
- (3) Participate in planning activities including development of an annual Action Plan and key messages and themes, and audience research for the workforce and the public's knowledge of the ocean. Research using pilot projects to develop and refine effective education practices using data is a new addition.
- (4) Design learning materials to meet regional needs within the national IOOS framework, and target learning materials to specific audiences.
- (5) Formalize interagency collaboration for implementing an ocean education strategy.

1. Introduction

The Integrated Ocean Observing System (IOOS) is the coastal and ocean component of the U.S. Integrated Earth Observing System (IEOS), as well as 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 IOOS Development Plan* was completed in December 2004 following the First IOOS Implementation Conference. The Plan marked an important step toward the implementation of a fully integrated IOOS, and its recommendations are being used by federal agencies to help establish priorities for contributing to the implementation, operation, and improvement of the initial IOOS. The Second IOOS Implementation Conference builds upon this Plan and a sequence of workshops and conferences initiated by Ocean.US under the auspices of the National Oceanographic Partnership Program (NOPP). Reports of these activities can be found on the Ocean.US web site at <http://www.ocean.us>.

A Steering Committee (Appendix I) was formed to determine conference goals, objectives and deliverables, identify conference participants (Appendix II), and prepare the agenda (Appendix III).

1.1 Goals and Rationale

The *First IOOS Development Plan* recommends programs to be incorporated into the initial IOOS, but does not specify priorities or requirements for observations, data management and communications (DMAC), modeling, and education. Priorities and requirements for observations have been specified for the global component. The Second IOOS Implementation Conference began this process for coastal observations and for DMAC. The conference also began to address linking IOOS development to the needs of the education community. Therefore, the conference focused on four related goals in three categories:

- Identify actions needed to improve IOOS capabilities for more effective **(1)** warnings of coastal inundation caused by natural hazards and **(2)** mitigating and managing impacts of coastal inundation on coastal communities, coastal marine and estuarine ecosystems, and living marine resources;
- Initiate procedures that will ensure **(3)** coordinated development of regional coastal ocean observing systems (RCOOSs) and a national backbone that are interoperable nationwide in terms of data management and communications (implement DMAC); and

- Initiate procedures for **(4)** developing mechanisms that will link IOOS data and information to an emerging national network of educators, with the intent of enhancing science education and training and improving public awareness and stewardship of the oceans (implement the Ocean.US plan for engaging the education community as users of IOOS data and information).

Background information on coastal inundations, DMAC, and education is given in Appendices IV, V, and VI respectively.

These goals were identified by the Steering Committee for three main reasons:

- A fully integrated system that addresses all seven societal goals of the IOOS will not be implemented overnight. Implementation must be phased based on current and projected operational capabilities and research priorities for improving and developing new operational capabilities.
- Observing subsystem assets needed to achieve these goals are among those recommended for the backbone in the *First IOOS Development Plan*.¹ Technologies and models required to improve forecasts and warnings of coastal inundation, through the development of more integrated approaches to data management and communications, are in use or available now.
- Improving forecasts of natural hazards and the provision of data and information required to more effectively manage and mitigate their effects are high priorities of the IOOS (**Goals 1 and 2** of the conference).

In terms of susceptibility to natural disasters, the recent tsunami in South Asia clearly demonstrated that habitat loss and modification (e.g., loss of tidal wetlands, coral reefs, and seagrass beds) increase the susceptibility of coastal communities to coastal inundation. Furthermore, natural hazards and increases in susceptibility to natural hazards due to land use impact public health risks and the capacity of ecosystems to support biodiversity and natural resources. Thus, in addition to more accurate and timely forecasts, improved mitigation of the effects of natural hazards and the development of ecosystem-based management practices depend on timely detection and prediction of environmental changes that are or will affect the susceptibility of coastal communities to natural hazards. In short, the data and information required to achieve conference **Goals 1 and 2** (e.g., surface current and wave fields, water level, shoreline erosion and position, wetland loss, and land-based inputs [point and non-point sources of pollution and pathogens]) are also

required for ecosystem-based management of water quality and living resources, managing public health risks, and safe and efficient marine operations.

Interoperability among RCOOSs, among RCOOSs and other elements of the IOOS, and between IOOS and U.S. IEOS is a key to achieving conference **Goals 1 and 2**. The World Meteorological Organization (WMO) has identified the “Future WMO Information System” (FWIS) as the global data distribution mechanism for GEOSS. As a step toward FWIS development, the DMAC plan for the IOOS is being used by the WMO as an early model for developing standards and protocols. Thus, achieving conference **Goal 3** will help to advance both the IOOS and U.S. IEOS.

Finally, as so clearly demonstrated by the recent tsunami disaster, rapid detection and timely forecasts are insufficient in themselves. Decision makers and the public must know how to interpret the information and act accordingly. Therefore, high priority is placed on education, training, and public awareness (conference **Goal 4**).

1.2 Objectives

There is an immediate need to provide greatly improved information products for high profile applications and to ensure that local decision makers and the public understand how to interpret these products and respond appropriately. Therefore, the Second IOOS Implementation Conference focused on four related objectives and associated deliverables as described below.

1.2.1 Forecasting of Natural Hazards

Objective 1: Reach agreement on the challenges and specific high priority steps that should be taken to develop an IOOS that will improve the accuracy and effectiveness of forecasts and early warnings of coastal inundation. “Effectiveness” here includes the timely delivery of appropriate data and information as well as the impact of the information on the public and decision makers.

More specifically provide the following deliverables:

- (1a)** As a starting point for discussion, evaluate the IOOS demonstration project² for hurricanes in the southeastern U.S. in terms of its usefulness to decision makers and educators. Recommend specific actions that will improve the usefulness of the product as a demonstration of IOOS capabilities.¹
- (1b)** Identify and prioritize enhancements to the IOOS that are likely to improve models and observations

² The NOAA COTS/ONR Working Group Reports, including the report for the IOOS Demonstration Testbed, provide a framework for this activity. <http://www.ocean.us/documents/docs/cots_onr_workplans.pdf>

required for nowcasts and forecasts of coastal inundation. Use models to help specify data requirements (variables to be measured, sensors and platforms [both remote and *in situ* sensing], spatial resolution of observations, accuracy and precision of measurements). Formulate time lines and cost estimates for implementing these enhancements.

1.2.2 Mitigating and Managing the Effects of Natural Hazards

Objective 2: Provide more accurate forecasts of the impacts of coastal inundation (from coastal erosion and habitat modification/loss to public health and fisheries) and improve capabilities to assess vulnerability to coastal inundation (e.g., maps showing levels of risk) and the effects of human uses on vulnerability (e.g., wetland loss, coastal erosion, increases in population density in susceptible places).

More specifically provide the following deliverable:

(2a) Identify products (new products or improvements in existing products) that will be most useful to decision makers responsible for managing and mitigating the effects of coastal inundation on coastal communities, ecosystems, and natural resources. Specifically address requirements for observations and modeling needed to improve maps of 100-year coastal inundation and projections of coastal inundation risk based on realistic scenarios of rates of sea level rise and subsidence, coastal erosion, and habitat modification/loss (e.g., loss of tidal wetlands). Describe modeling and monitoring requirements for providing these products, e.g., (model types, variables that must be measured, time-space scales of measurements, real-time or delayed mode data transmission).

1.2.3 Data Management and Communications

Objective 3: Using the DMAC Plan³ as a starting point, reach agreement on updated guidelines and priorities for data providers as a means to assist nascent RAs with: (1) initial management of data streams, (2) ensuring compatibility as the IOOS matures, and (3) identifying critical gaps. The near-term focus will be on interoperability among the data and information providers required to achieve objective 1.

More specifically, provide the following deliverable:

(3a) A consensus two-year action plan, endorsed by participants, for coordinated regional-federal development of DMAC functions nationwide (interoperability) that includes:

- An update of the “Concrete Guidance for Data Providers”⁴ presented in the DMAC Plan to coordinate RAs in their initial steps towards data interoperability within the IOOS framework;
- Identification of critical gaps (pressing questions not addressed by the concrete guidance) in DMAC activities requiring immediate attention;
- Proposed mechanisms, key organizations, and individuals to coordinate regional development with the Ocean.US DMAC Plan and with future DMAC developments at the federal level; and
- Proposed time line, milestones, estimated costs, and performance measures for addressing these gaps/questions.

This plan will initiate a process that will ensure coordination between regional development of DMAC capabilities and DMAC implementation at the federal level. Part of the process will include reaching agreement on mechanisms for involving regional DMAC experts in addressing national-level, technical issues of interoperability (beyond the short-term guidance above). This longer-term process will involve technically-skilled individuals from regional groups, industry, and federal agencies in a pro-active, engineering-oriented effort.

1.2.4 Using IOOS Data and Information for Education, Capacity Building, and Outreach

Objective 4: Reach agreement on (1) education and public awareness priority initiatives (outlined in the *IOOS Development Plan*) and an approach to their implementation that enables use of data and information to address detection, local government reaction, and appropriate public response to hazards assessed in Objective 1; and (2) a stepwise approach to develop a national Education and Public Awareness Network (outlined in the *First IOOS Development Plan*) that supports and implements priority initiatives and ensures coordination among regions.

More specifically provide the following deliverable:

(4a) A consensus two-year action plan for coordinating regional development of a nationwide Education and Public Awareness Network that includes the following:

³ Data Management and Communications Plan for Research and Operational Integrated Ocean Observing Systems: I. Interoperable Data Discovery, Access, and Archive, March 2005 <http://dmac.ocean.us/dacsc/imp_plan.jsp>

⁴ “Concrete Guidance for Data Providers” <<http://dmac.ocean.us/dasc/guidance02.jsp>>

- Identification of groups that will participate in the network, description of the roles and responsibilities of regional sites and coordinating office, actions required to establish the network, and mechanisms to ensure coordination among the IOOS sectors (global, coastal, regional, local);
- Specific initiatives to be implemented via the education network that will enable use of IOOS data and information and shape future network-based efforts (i.e., needs assessment and analysis for formal, informal, and workforce education);
- First order success measures; and
- A timetable with milestones and order of magnitude financial estimates to implement the action plan.

1.3 Participants

Representatives from federal agencies, nascent RAs, the National Ocean Research Leadership Council (NORLC) Interagency Working Group (IWG), the U.S. GOOS Steering Committee, the Ocean.US enterprise (Ocean.US staff and Executive Committee), and technical experts on coastal inundation (observations, modeling, and risk), DMAC, education, and coastal ocean observing systems from both public and private organizations were invited to participate in the conference (Appendix I). Technical experts accounted for about 70% of conference participants.

1.4 Procedure

The conference agenda is given in Appendix III. Day 1 began with a series of plenary reports that provided an overview of conference goals, objectives, deliverables, and procedures; framed the conference in terms of regional and federal commitments to IOOS development, challenges that have been faced, and progress to date; and briefed conferees on issues relevant to achieving conference goals (development of operational capabilities, data requirements for improved forecasting and mitigation, DMAC and Education Plans). A panel consisting of the Chair of the Ocean.US Executive Committee, Director of Ocean.US, and the Chair of the NFRA Governing Committee answered questions concerning the clarification of goals, procedures, and deliverables.



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Two breakout sessions were organized, one to address Objectives 1 and 2 on the afternoon of Day 1 and one to address Objectives 3 and 4 on Day 2. Within the framework of the *First IOOS Development Plan*¹, DMAC Plan for Research and Operational Ocean Observing Systems³, and proceedings of the 2004 Education workshop⁵, results from the first breakout sessions (Objectives 1 and 2) were used to help guide deliberations of working groups during the second breakout session (Objectives 3 and 4). Following each breakout session, the Chairs of the working groups reported their results in plenary for discussion. Working group reports are given in Appendix VII.

Following the conference, participating federal agencies met to discuss and respond to the consensus recommendations of the working groups. This led to a formal resolution (section 3) concerning federal commitments to IOOS development.

1.5 Conference Evaluation

Conferees were given an evaluation form to fill out at the end of the conference. Most respondents (about 25% of all participants) were pleased with the conference and rated it a “B” (Table 1). In their written responses, most indicated that their expectations were met or exceeded.

Table 1. Conference ratings on a scale of 1 (lowest) to 5 (highest).

TOPIC	AVERAGE
Organization	3.9
Day 1	3.8
Day 2	3.6
Plenary Sessions	4.0
Presentations	4.0
Breakout Sessions	3.5
Conference Venue	4.1
Catering Services	4.0
Hotel Room	4.1

⁵ The IOOS and COOS Education Workshop Report, Promoting Lifelong Education – Using the Integrated Ocean Observing System (IOOS) to Shape Tomorrow’s Earth Stewards and the Science and Technology Workforce, March 2005. Figure 2 in the report lists the specific recommendations. <<http://www.ocean.us/documents/workshop.jsp>>

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

Recognizing that plans are in place for implementing the global ocean component and that implementation has begun, the conferees emphasized the importance of continued development and strengthening of the global ocean component. They also focused on implementing and improving the coastal component and on coordinated development of the coastal and global components.

2.1 Coastal Inundation

Conferees were divided into two parallel working groups, one for Objective 1 (forecasting natural hazards) and one for Objective 2 (mitigating the effects of natural hazards). Each working group was divided into three subgroups (one each for tsunamis, tropical storms, and extra-tropical storms) to address each objective. All six groups were asked to address upland flooding. The IOOS demonstration project for hurricanes was presented at the beginning of the breakout session on forecasting natural hazards.²

The recommendations below are those made by all or most of the subgroups. It was generally agreed that all observations should be made openly accessible in a manner consistent with IOOS DMAC guidelines, with minimal delay, and within a timeframe consistent with their use in forecasting, mitigation, and planning activities. Those recommendations that are new and not articulated in the *First IOOS Development Plan* are indicated by “(NEW).”

2.1.1 Observations

- (1) Repeat measurements and timely post-inundation updates of near shore coastal bathymetry-topography (including shoreline position) and benthic-land cover habitats (e.g., sea grass beds, tidal wetlands, forests, grassland) and use (e.g., dredging, bottom trawling, infrastructure, impervious surfaces), (in one to five years), especially in high risk areas.
- (2) Increase density of rainfall measurements, atmospheric moisture profiles, and soil moisture measurements (NEW).
- (3) Increase stream gauge (continuous, real-time telemetry) coverage in the coastal zone, including near head and mouth of rivers for more accurate estimates of land-based inputs (run-out) of freshwater, sediments, nutrients, and pollutants on seasonal scales and during post-storm runoff.
- (4) Increase real-time spatial and temporal resolution wind fields over water, surface current fields, directional wave fields, and sea surface salinity distributions (Exclusive Economic Zone, or EEZ).

- (5) Optimize the tide gauge network to increase density of real-time measurements in high risk areas.
- (6) Deploy Deep-ocean Assessment and Reporting of Tsunamis (DART) buoys for all coasts and to record a directional tsunami (higher spatial resolution of real-time, bottom pressure and upper ocean measurements on an ocean basin scale).
- (7) Augment the DART buoy array with improved near surface technologies for open ocean wave height measurements (e.g. Real Time Kinematic (RTK) GPS Systems) (NEW).

2.1.2 Modeling

Establish an inundation modeling test bed for improving existing and developing new models with an emphasis on:

- (1) Coupled wind, tide, river flow, rainfall, surface current, wave, and water level models with data assimilation for more accurate forecasts of impacts (surge, time-space magnitude of inundation, run out/runoff; transport of debris, sediments, nutrients, and pollutants); and
- (2) More rigorous calibration and validation procedures.

To achieve these goals, the following recommendation was also made:

- (3) Using the emerging management (planning and implementation) structure for the Ocean.US DMAC initiative as a model, establish a Modeling Steering Team for the development of operational models and an Interagency Body to enable and oversee implementation.

2.1.3 Products

Maintain up-to-date coastal inundation maps for emergency planning (including shoreline position and near shore [e.g. – 30 m to + 30 m] bathy-topographic maps); toolbox of products available to managers; and user-oriented products (including product training and performance feedback, daily forecasts updated hourly, and real-time transmission of surge and inundation maps to managers).



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2.2 DMAC

On Day 2, participants were divided into two parallel working group sessions: one to address IOOS DMAC, and the other to focus on Education.

The DMAC session was organized into three parallel subgroups to assess and modify as needed the following: (a) the DMAC standards process as recommended by the inter-agency, community-based DMAC Steering Team and outlined in the DMAC Plan; (b) proposed updates to the short-term guidance regarding standards for IOOS data providers, presented in the DMAC Plan and updated by the DMAC Steering Team; and (c) proposed near-term recommendations for improving access to data required for development of a multi-hazard forecasting and mitigation system (section 2.1).

The DMAC subgroups expressed a clear understanding of: (a) the need for broad community involvement in the DMAC standards process, (b) the underlying complexities of the challenges faced in establishing a fully interoperable, distributed DMAC Subsystem, and (c) the increasing urgency for moving DMAC forward. This renewed sense of urgency was driven by the conferees' recognition that, despite strong endorsement of the DMAC Plan at the First IOOS Implementation Conference, the disparity between the volume and diversity of data on ocean and coasts and the capacity to manage these data for the purposes of the IOOS is growing rapidly, i.e., investments in making measurements are increasing relative to investments in developing capacity to analyze these data effectively via an integrated approach to DMAC. The recommendations below reflect this sense of urgency. They are organized into the categories used in the DMAC and IOOS Plans and proposed cost estimates, namely:

- DMAC Interoperability Framework (Standards Oversight process);
- DMAC Interoperability Infrastructure;
- DMAC Test Beds.

2.2.1 DMAC Interoperability Framework (Standards Oversight Process)

The DMAC Interoperability Framework includes the assessment, identification, and recommendation of IOOS DMAC standards. The underlying philosophy for this process is to adopt existing standards where appropriate; where not appropriate, examine existing standards and best practices and identify whether they may be adapted to meet IOOS needs. If the preceding options are not available, work with ongoing programs and/or define new program initiatives to address the gaps in standards. The Conferees recommended full implementation of the DMAC standards identification oversight process as recommended by the DMAC Steering Team in April 2005, and outlined in the IOOS and DMAC Plans. In addition,

the following specific recommendations were endorsed by consensus at the Conference (Those that are expansions of earlier recommendations articulated in the *First IOOS Development Plan* or the DMAC Plan are indicated by "NEW"):

- (1) Implement the DMAC standards identification process recommended by the DMAC Steering Team to establish community-based Technical Expert Teams (Expert Teams) in key DMAC areas. The process should include user-group oriented forums to engage the expanding IOOS community (NEW). The following specific Expert Teams were endorsed:
 - DMAC Standards Process - to improve the sharing and feedback of information regarding the status of current DMAC standards, ongoing activities, lessons learned, and proposed new standards (NEW);
 - Metadata and Data Discovery;
 - Data Transport and Access;
 - Archive;
 - IOOS and DMAC Systems Engineering (NEW);
 - IT Security (NEW); and
 - Quality Assurance/Quality Control (NEW).
- (2) Implement the DMAC Community Engagement Caucuses to provide needed outreach and feedback mechanisms to key constituency groups with whom IOOS DMAC must engage. To this end, the following specific Community Engagement Caucuses were endorsed:
 - Private Sector Caucus - to enfranchise the private sector within IOOS, especially with regard to interoperable standards and improved access to IOOS data that might support development of value-added products by the private sector (NEW);
 - International Caucus - to fully engage those international programs and activities within which IOOS will operate (e.g., WMO-Intergovernmental Oceanographic Commission Joint Technical Commission for Oceanography and Marine Meteorology, GEOSS, etc.) (NEW); and
 - Modeling Caucus - to improve access and distribution of model products (NEW).
- (3) Correct the present under-investment in technical support services for the DMAC Standards Process to enable timely identification, review, and publication of IOOS DMAC interoperability standards (including the necessary technical documentation) that are necessary to support the expanding regional observing systems (NEW).

2.2.2 DMAC Interoperability Infrastructure

The DMAC Interoperability Infrastructure includes the underlying physical and IT infrastructure within which IOOS

is being implemented. The Conferees recommended fully implementing the DMAC Interoperability Infrastructure as recommended by the DMAC Steering Team and outlined in the IOOS and DMAC Plans. These investments are targeted to augment current federal program activities and address regional infrastructure needs. The investments focus on the acquisition or updating of hardware and software to enable interoperability, network capacity building, systems implementation, and national-level systems integration. In addition, the following recommendations were highlighted at the Conference:

- Complete the ongoing preliminary IOOS Systems Engineering analysis, especially those aspects that address interoperability among the federal backbone, RAs, U.S. IEOS, GOOS, and GEOSS components. Support a continuing IOOS Systems Engineering effort to help ensure coordinated integrated planning, development, implementation, and modernization of IOOS DMAC components (NEW); and
- Support investment in the IOOS DMAC components of emerging IOOS RAs.

2.2.3 DMAC Test Beds

Conferees recognized the intrinsic value of testing and evaluating proposed DMAC solutions in realistic environments. The Conferees recommended that the DMAC Test Beds recommended by the DMAC Steering Team and outlined in the IOOS and DMAC Plans be fully implemented. These investments will support efforts 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, geographic areas, and organizations. In addition, the following recommendations was highlighted at the Conference:

- DMAC Test Beds should be established to enable successful identification, testing, and community acceptance of IOOS DMAC standards. This approach enables an incremental process for standards identification, supports both long-term and short-term needs for DMAC standards, and fosters community-building.

2.2.4 Regional Development

Conferees agreed that regional and national DMAC development must be coordinated and made the following recommendation:

- Support a regional counterpart to the DMAC-Steering Team to enhance coordination between the national and regional efforts.

2.3 Education

Three subgroups convened to establish (1) priorities for education, capacity building, and public awareness initiatives presented in the *First IOOS Development Plan*; and to recommend (2) a stepwise approach to develop a national education, capacity building and public awareness network that supports and implements the priority initiatives. Although each subgroup considered different topics, several recommendations were made by more than one group and are, therefore, considered to be the highest priorities. These are given below in priority order.

2.3.1 National Coordinating Office for Education

Conferees outlined a process for establishing, operating and sustaining a national network of educators⁶ coordinated via a Central Coordinating Site with regional sites allied with the RAs. Consistent with IOOS design principles, the Central Coordinating Site and the regional sites should be built from the best existing education networks⁷ and capabilities. Networks and participants may vary from region to region, with the resulting nationwide network-of-networks embracing more networks than any single region. Assembly of the network-of-networks should be via a coordinated bottom-up and top-down effort: bottom-up to ensure locally relevant regional development and top-down to ensure national coordination. The end result is the transparent linkage of multiple sites within a region and linkage of those regions to form a national network. Therefore, the COSEE, NEERS (education and coastal training program), and SeaGrant (education and extension) networks should be the initial partners in this network-of-networks. As these network linkages near completion, the National Marine Sanctuary Program (NMSP), Global Learning and Observations to Benefit the Environment (GLOBE) program, and EPA National Estuary Program (NEP) education networks should be incorporated. Over the long-term, other Earth system science and environmental education networks would be linked-in using the best available practices.

⁶ Educators refers to practitioners in many disciplines and venues including classroom teachers and education administrators in kindergarten through grade 12, faculty members active in grades 13-18 at two and four-year colleges, professionals of continuing education, professionals of adult-basic and adult-secondary education, and education program and exhibit staff at natural and cultural history sites (parks, sanctuaries, reserves, seashores) and informal learning centers (aquariums, museums, coastal learning centers, science and technology centers), leaders and trainers of youth group personnel, science writers, filmmakers, etc.

⁷ An education network is any organized collection of educators, defined as in footnote 1, whose members are active in formal, informal or non-formal education. These members engage in a wide range of activities and possess many different titles, e.g., teacher, faculty members, youth leader, extension agent, interpreter, community liaison, instructor, continuing education specialist, media specialist, science writer, exhibit designer, etc.

The responsibility and function of the Central Coordinating Site, broadly stated, is to facilitate sharing between regions and with other networks of educators. Specifically, the Central Coordinating Site should, at a minimum, be responsible for:

- Community building among educators and between educators and the data management community;
- Formalization of linkages among networks to form the network-of-networks to encourage and enable collaboration and community building among partners;
- Compilation and maintenance of an inventory of education efforts;
- Implementation of research to identify effective educational practices especially in the area of learning products, development of those products, and education services that leads to a suite of education *best practices*⁸ associated with ocean observing systems; and
- Development and retention of test beds for developing assessment and evaluation strategies and for the design and testing of products for education at all levels.

The responsibility and function of the regional education sites allied with the RAs is to forge alliances at the regional level resulting in a network of local educators that use ocean observing system information (e.g., original data and information products created using individual and multiple data streams) in their education programs and materials. In each region, staff with expertise in applying IOOS data products to the major education application areas is needed (e.g., k-12 classrooms, museums, youth programs, extension and capacity building, and communications). Since an individual rarely possesses the unique skills and abilities required for more than one or two of these areas, multiple individuals will be needed in each region.

Community building is required to create a functional national IOOS educator network-of-networks with educators and information managers working together to ensure that IOOS information management provides data useable by educators. Building community will require encouragement and support from within constituent education networks and the information management community, face-to-face workshops, and co-location of personnel. Recommended actions to strengthen community include temporary assignments of regional staff to the Central Coordinating Site, participation of educators in DMAC planning, and data managers in education planning. New investments in coordination and integration at national and regional levels, including travel support and personnel, will be required to achieve success.

The nascent RA for the Gulf of Mexico is forming a Gulf of Mexico Coastal Ocean Observing System (GCOOS) Education and Outreach Council that will be comprised of individuals representing a wide variety of education networks and coastal and aquatic education efforts within the region. Membership is being sought from the following networks and organizations: COSEE, SeaGrant institutions, NERRS, EPA-NEP, NASA centers, Department of Defense facilities, marine laboratories, NMSP, science museums and aquaria, and industry.

2.3.2 Governance of IOOS Education

Conferees endorsed the recommendations from the 2004 Education Workshop⁵ and the companion actions layout in the *First IOOS Development Plan* as follows: (1) the education community should be full partners in IOOS governance; (2) education should be represented on the NFRA and each RA; and (3) education should be part of the initial development of the RA and, therefore, included in the business plan. Conferees also recommended that each region form a *regional education council*⁹ of local education experts to provide guidance to each region. At the national level, two bodies were recommended: 1) a *national IOOS education council* comprised of RA and national experts in education (formal and informal), capacity building, extension and communications to help guide Ocean.US national planning; and 2) a multi-agency *IOOS Education Implementation Oversight Working Group* of appropriate federal program managers to work with Ocean.US to implement the IOOS education plan.

2.3.3 IOOS Education Planning

Consistent with earlier recommendations and the *First IOOS Development Plan*, participants reaffirmed that the education community and specifically the forming education network-of-networks allied with IOOS, should engage in IOOS education planning and provide an education perspective to data management planning. As requested, the participants enriched prior recommendations by specifying individual high priority actions in four areas.

⁸ Best practices are those that have been shown through quantitative research studies to be highly effective at achieving the desired learning result for a target audience.

⁹ The name of this group may vary from region-to-region. In all regional associations, there is at least one group that represents the interests of the education, extension and communications community.

2.3.3.1 Education Strategy and Implementation Planning

- The IOOS national education strategy^{1,5} should be updated about every five years.
- An IOOS Education Action Plan based on the national education strategy should be created and updated annually to reflect adjustments in priorities and funds. The action plan should be published in the yearly IOOS development plan.
- A formal evaluation and assessment plan should be included in the action plan and funded. It should be carried out to formally assess the effectiveness of the entire education program and individual elements of the program, and it should assess long-term impact of the education program.

2.3.3.2 Key Educational Messages and Themes

Conferees considered development of key IOOS educational messages and themes within the context of GEOSS. They recommended that:

- Key national IOOS-wide messages and themes should center on the seven IOOS societal goals;
- Region-specific education messages are adapted to the needs of each audience;
- Region-specific education messages and themes nest within the national ones, thereby linking regional themes to national ones and vice versa (Figure 1); and
- Regional IOOS allied *education products* link regional themes and content to national themes.

Several examples of regional themes were discussed (Figure 1) in the context of regional education needs and audiences. The end result is a regional focus for individual education materials and programs that produce a nationally coherent voice for IOOS allied education.



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Figure 1: IOOS Societal Goals (Themes) and Regional Versions

- **Improve predictions of climate change and weather and their effects on coastal communities and the nation; (national theme)**
- **Improve the safety and efficiency of maritime operations;**
 - **safe navigation of harbors and coasts (regional theme)**
- **More effectively mitigate the effects of natural hazards;**
- **Improve national and homeland security;**
 - **Safe navigation of harbors and coasts**
- **Reduce public health risks;**
 - § **water quality**
 - § **non-point source pollution of coasts and estuaries**
 - § **nutrient enrichment**
- **More effectively protect and restore healthy coastal ecosystems;**
 - § **water quality**
 - § **nutrient enrichment**
 - § **non-point source pollution of coastal and estuarine waters**
 - § **sustaining recreational fishing**
- **Enable the sustained use of ocean and coastal resources.**
 - § **nutrient enrichment**
 - § **sustaining recreational fishing**

2.3.3.3 Audience Research and Pilot Projects

Audience research and *pilot projects* should be used to inform education planning and implementation. Understanding the needs and current knowledge of an audience is a powerful tool for planning and implementation. Research is critically needed in two areas:

- Current and future ocean science and operational workforce^{1,5} needs, skills, and education and training sources; and
- Extent and depth of the public's understanding of the ocean's role in their lives (via the seven IOOS societal goals).

The results of these studies, in conjunction with results from more narrowly focused existing research results carried out by specific programs, should be used to identify gaps in capability and knowledge. Workforce and public awareness implementation efforts should then focus on these gaps. Periodic repetition of this research should be carried out to determine long-term (longitudinal) effectiveness of the education efforts implemented in response to these studies.

Pilot projects complement audience research and can inform implementation when *best practices* are not known (NEW). They can be used to identify highly effective (best) practices, refine existing practices, and to develop cost effective mechanisms to transition highly effective practices to common usage. Design of *learning materials*, especially those *containing data* and *assessment strategies*, was identified as areas that need improved practices. Currently, we lack protocols and practices for effective education material development and deployment. Participants recommended that IOOS education planning efforts incorporate a research component that advances our understanding in this area. To highlight the immediate need for these protocols, conferees created the following incomplete list of practices:

- Address a specific audience need;
- Incorporate practices of the target audience;
- Strive for materials that are broadly useful (i.e., useful to most members of the target audience and some members of other audiences);
- Consider multi-cultural needs and concerns; and
- Use *effective practices* established through education research to guide learning material development.

2.3.4 Learning Material Design

Conferees discussed regional needs for education products and provided the following insight and recommendations:

- All example education products described by conferees applied to one or more of the IOOS goals (national themes, Figure 1). Conferees recommended that regional education products contain regional themes nested under the seven IOOS societal goals.
- Conferees considered the potential for multiple regionalized education products that address a topic, different audiences, and the unique environment of each region. Conferees recommended that regional education products target the needs of specific regional audiences, be linked to national IOOS themes, and be closely aligned with IOOS efforts in a region.
- Conferees were concerned that the operational data collection priorities of a region be aligned with the needs of the education community. Available data and information products and their timeliness were an issue of special concern. Conferees recommended that 1) initial education efforts focus on audiences whose education needs match the existing operational priorities of a region, and 2) synergy increase as IOOS develops.

- Conferees recognized that duplicate education product development efforts and rediscovery of education practices among the regions were highly likely given the number of national IOOS themes (seven), the number of regions (11), and the many similar audiences in the different regions. Conferees recommended that national coordination would minimize duplication by:

- Improving communication;
- stimulating regions to collaborate on learning materials where there are common themes and messages;
- Encouraging alignment with the developing ocean literacy guidelines; and
- Fostering reuse and repurposing of regional materials by a) forming a nationally recognized collection of learning materials, b) structuring learning materials for ready adaptation to other regions, and c) structuring data and information products (e.g., visualizations, example data subsets, graphs, illustrations, animations) for use in multiple venues.

Collectively, these recommendations reaffirmed recommendations from prior efforts and added a new emphasis on regional themes, messages, and products, all under the umbrella of the seven IOOS societal goals.

2.3.5 Formalize Interagency Collaboration Beyond IOOS

The recommendations in this section are new, respond to the *U.S. Ocean Action Plan*¹⁰, and address the need for interagency planning, coordination, and collaboration



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¹⁰ U.S. Ocean Action Plan: The Bush Administration's Response to the Commission on Ocean Policy <<http://ocean.ceq.gov/actionplan.pdf>>

for ocean education beyond that associated with IOOS as called for in the NOPP Strategic Plan and the U.S. Commission on Ocean Policy. Conferees recommended formalizing interagency collaboration for all ocean science education under the developing ocean policy framework in the Office of Science and Technology Policy (OSTP), and linking IOOS education to that collaboration. They also recommended formation of an interagency ocean education program office to support this forming framework.

3. Federal Response to Recommendations of the Conferees

Representatives of Federal Agencies that are signatories to the MOA creating the Ocean.US Office (NOAA, Navy, NASA, NSF, EPA, USACE, USGS, MMS, USCG) considered recommendations for implementing a multi-hazard forecasting system for improved mitigation of the impacts of tropical storms, tsunamis and extra-tropical storms in general and for IOOS DMAC and Education in particular. As a body, the following declaration was agreed to:

We appreciate the work of the participants in the Second IOOS Implementation Conference to formulate a clear set of consensus priorities for FY 05-08 IOOS implementation. We view the priorities in the context of both maintaining current IOOS activities (including observing systems, data systems, and product generating-delivery systems) and improving IOOS capabilities consistent with the IOOS Development Plan, the Strategic Action Plan for the U.S. Integrated Earth Observing System (IEOS), and the U.S. Ocean Action Plan.

- (1) *We acknowledge the U.S. IOOS as the ocean and coasts contribution to the Global Ocean Observing System (GOOS), the U.S. IEOS and the Global Earth Observing System of Systems (GEOSS).*
- (2) *To facilitate implementation of the priorities given below, we recommend that agencies initiate discussions to establish an IOOS interagency programming mechanism as an important step toward facilitating implementation of the IOOS Development Plan.*
- (3) *We reaffirm our 2004 support for the following priorities articulated in the First IOOS Development Plan:*
 - *Develop Regional Associations (RAs) and the National Federation of Regional Federations;*
 - *Implement the DMAC plan nationally and regionally; and*
 - *Implement regional pilot projects.*
- (4) *We are committed to using the following consensus recommendations from the Second IOOS Implementation Conference to guide the FY05 - FY08, Federal contribution (in terms of both supporting*

and operating) to IOOS Development, especially as related to coastal inundation resulting from storms, and tsunamis:

- *Implement the DMAC standards process as the first step toward facilitating data exchange and access within and among RAs and participating Federal Agencies;*
- *Support the completion of the ongoing Systems Engineering analysis as critical for the successful implementation of the IOOS; and*
- *Implement the recommendations for establishing an IOOS Education Network as prioritized by conferees at the Second IOOS Implementation Conference through close coordination with the Joint JSOST-SIMOR Education Task Force, once it is established.*

Although participating Federal Agencies may focus on selected priorities and actions given above, the interagency consensus is to accept the priorities as a whole.



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Appendices

APPENDIX I Conference Steering Committee

Second IOOS Implementation Conference Steering Committee Membership and Its Charge

The Steering Committee for the Conference consisted of the following members:

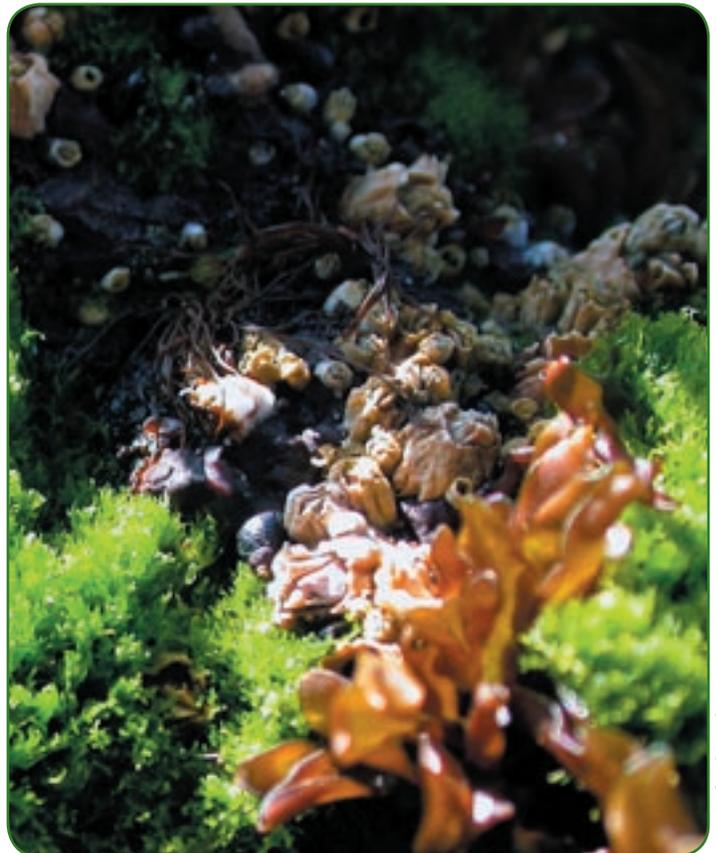
- Ocean.US: Tom Malone (Chair), Lee Dantzer, Blanche Meeson, Mike Hemsley, Andy Clark, Steve Piotrowicz, Bob Houtman
- EXCOM: John Haines, Bill Birkemeier
- Regional Representatives: David Martin (Co-Chair), Rick Devoe, Josie Quintrell, Molly McCammon, Stephanie Watson
- SURA: Don Wright (Co-Chair)
- NOAA CSC: Paul Scholz

The Committee was charged with the following:

- Finalize the Conference prospectus and prepare a provisional agenda;
- Identify products that can be used to help achieve

Objectives 1 and 2;

- Select experts to be invited;
- Select plenary topics and speakers; and
- Oversee information gathering in preparation for the conference.



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APPENDIX II Conference Participants

David Atkinson
International Arctic Research Center
University of Alaska Fairbanks
930 Koyukuk Drive
P.O. Box 757340
Fairbanks, AK 99775-7340
datkinson@iarc.uaf.edu

Jerad Bales
U.S. Geological Survey
3916 Sunset Ridge Road
Raleigh, NC 27607
jdbales@usgs.gov

Eric Bayler
NOAA Science Center
Room 601
5200 Auth Road
Camp Springs, MD 20746
eric.bayler@noaa.gov

Sandy Bernard
Southeast Coastal Ocean Observing Regional
Association
113 Calhoun Street
Charleston, SC 29401
sandy.bernard@scseagrant.org

Bill Birkemeier
U.S. Army Corps of Engineers
Coastal & Hydraulics Laboratory
1261 Duck Road
Duck, NC 27949
birkemw@wes.army.mil

Julie Bosch
NOAA
Building 1100
Room 101
Stennis Space Center, MS 39529
julie.bosch@noaa.gov

Darrell Brown
EPA
1200 Pennsylvania Avenue NW
4504T
Washington, DC 20460
brown.darrell@epa.gov

Larry Atkinson
Old Dominion University
Oceanography
Norfolk, VA 23529
latkinso@odu.edu

Richard Balza
The Boeing Company
PO Box 3707
MC 8R-77
Seattle, WA 98124-2207
richard.m.balza@boeing.com

Jon Berkson
U.S. Coast Guard
2100 2nd Street SW
Washington, DC 20593
JBerkson@comdt.uscg.mil

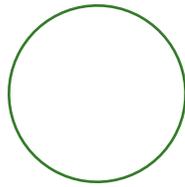
Joanne Bintz
SURA
1201 New York Avenue, NW
Suite 430
Washington, DC 20005
bintz@sura.org

Philip Bogden
Gulf of Maine Ocean Observing System
PO Box 4919
Portland, ME 04112
bogden@gomoos.org

Mel Briscoe
Office of Naval Research
800 North Quincy Street
Code 322
Room 407-1
Arlington, VA 22217
melbourne_briscoe@onr.navy.mil

Michael Bruno
Stevens Institute of Technology
Castle Point on Hudson
Davidson Labs D-200
Hoboken, NJ 07030
mbruno@stevens.edu

Barry Burgan
EPA
1200 Pennsylvania Avenue NW
Washington, DC 20460
burgan.barry@epa.gov



Sarah Carr
EPA
11 2nd Street NW
Apt. 301
Washington, DC 20002
carr.sarah@epa.gov

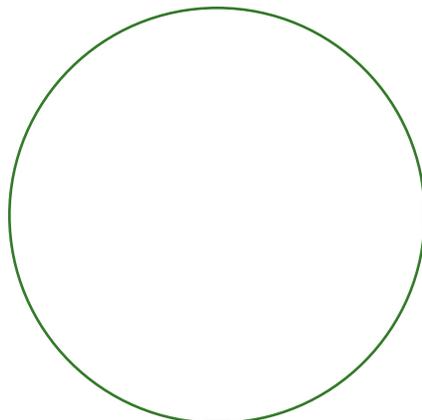
David Chapman
Delaware Sea Grant
Marine Advisory Service Marine Policy Program
Graduate College of Marine Studies - University of
Delaware
700 Pilottown Road
Lewes, DE 19958
dchapman@udel.edu

Paula Coble
NASA
300 E Street SW
5L79
Washington, DC 20546
pcoble@hq.nasa.gov

Susan Cook
Consortium for Oceanographic Research & Education
1201 New York Avenue, NW
Suite 420
Washington, DC 20005
scook@coreocean.org

Jorge Corredor
University of Puerto Rico
Department of Marine Sciences
PO Box 908
Lajas, PR 00667-908
j_corredor@cima.uprm.edu

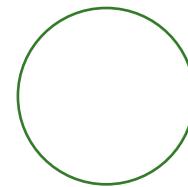
Lee Dantzer
Ocean.US
538 Joyner Drive
Havelock, NC 28532
dantzerl@uncw.edu



Janet Campbell
University of New Hampshire
Institute for the Study of Earth, Ocean and Space
Morse Hall
Room 142
Durham, NH 03824-3525
janet.campbell@unh.edu

Tina Chang
NOAA NMFS
1315 East West Highway
Silver Spring, MD 20910
tina.chang@noaa.gov

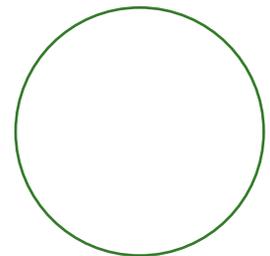
Andy Clark
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
a.clark@ocean.us



Roz Cohen
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
rosalind.e.cohen@noaa.gov

Peter Cornillion
University of Rhode Island
South Ferry Road
Narragansett, RI 02882
pcornillon@gso.uri.edu

William Curry
Navy
2511 Jefferson Davis Hwy
Arlington, VA 22202
william.curry@navy.mil

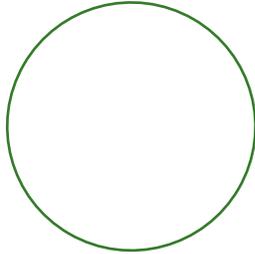


Margaret Davidson
NOAA CSC
2234 South Hobson Avenue
Charleston, SC 29405
margaret.davidson@noaa.gov



Annette DeCharon
Bigelow Laboratory for Ocean Sciences
180 McKown Point
P.O. Box 475
West Boothbay Harbor, ME 04575-0475
adecharon@bigelow.org

Ben Domenico
Unidata Program Center
UCAR FL4
3300 Mitchell Lane
Room 1208
Boulder, CO 80301
ben@unidata.ucar.edu



Brian Dushaw
University of Washington
Applied Physics Laboratory
1013 N.E. 40th Street
Seattle, WA 98105-6698
dushaw@apl.washington.edu

Jean Ellis
NASA
Science Mission Directorate
Earth-Sun Division
300 E Street SW, Mail Suite 5H79
Washington, DC 20546
jellis@mail.hq.nasa.gov

Lesley Ewing
California Coastal Commission
45 Fremont Street
Suite 2000
San Francisco, CA 94105
lewing@coastal.ca.gov

Gary Fisher
U.S. Geological Survey
Maryland-Delaware-D.C. Water Science Center
8987 Yellow Brick Road
Baltimore, MD 21237
gtfisher@usgs.gov

Madilyn Fletcher
University of South Carolina
Baruch Institute for Marine & Coastal Sciences
Columbia, SC 29208
fletcher@sc.edu

Rick DeVoe
Sea Grant Consortium
287 Meeting Street
Charleston, SC 29401
rick.devoe@scseagrant.org

Debbie Duckworth
Southern California Coastal Ocean
Observing System, SIO
291 Rosecrans
San Diego, CA 97106
dduckworth@ucsd.edu

James Eckman
Office of Naval Research
NOPP, Code 322
Ocean Optics & Biology Program, Code 322
800 N. Quincy Street
Arlington, VA 22217
James_Eckman@onr.navy.mil

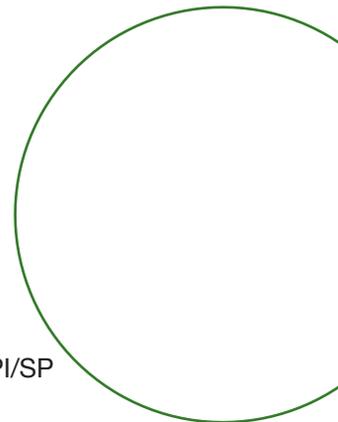
David Eslinger
NOAA
2234 South Hobson Avenue
Charleston, SC 29405
dave.eslinger@noaa.gov

Peter Fippinger
Consortium for Oceanographic
Research and Education
Suite 420
1201 New York Avenue, NW
Washington, DC 20005
pfippinger@coreocean.org



Pierre Flament
NSF
4201 Wilson Boulevard
Room 725
Arlington, VA 22230
pflament@nsf.gov

Mike Ford
NOAA
Program Planning and Integration PPI/SP
SSMC3 #15640
1315 East-West Highway
Silver Spring, MD 20910
michael.ford@noaa.gov



Carl Friedrichs
Virginia Institute of Marine Science
Box 1346
Gloucester Point, VA 23062
cfried@vims.edu

Carl Gouldman
NOAA
1305 East-West Highway
SSMC4
Room 13632
Silver Spring, MD 20910
carl.gouldman@noaa.gov

David Halpern
Executive Office of the President
Office of Science and Technology
725 17th Street NW
Room 5218-4
Washington, DC 20502
dhalpern@ostp.eop.gov

Susan Heinz
Raytheon Information Solutions
324 N. Canyon Blvd.
Monrovia, CA 91016
Susan_Heinz@Raytheon.com

Dan Henderson
NOAA
National Data Buoy Center
Stennis Space Center, MS 39529
dan.henderson@noaa.gov

Emily Hirsch
FEMA
Mitigation Directorate
500 C Street SW
Washington, DC 20472
emily.hirsch@dhs.gov

Amy Holt-Cline
University of New Hampshire
Ocean Process Analysis Lab
Morse Hall Rm 151
Durham, NH 03824
acline@unh.edu

Roger Gauthier
Great Lakes Commission
Eisenhower Corporate Park
2805 South Industrial Highway
Suite 100
Ann Arbor, MI 48104-6791
gauthier@glc.org

John Haines
U.S. Geological Survey
MS 915-B
12201 Sunrise Valley Drive
Reston, VA 20192
jhaines@usgs.gov

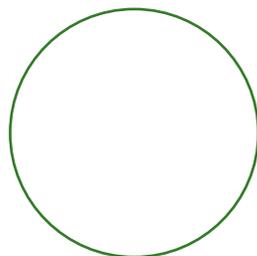
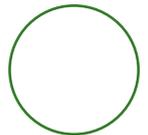
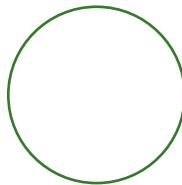
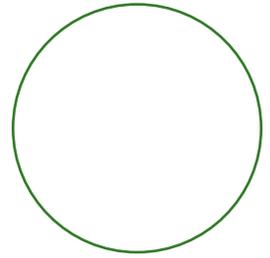
Steve Hankin
NOAA
7600 Sand Point Way NE
Seattle, WA 98115-0070
steven.c.hankin@noaa.gov

Mike Hemsley
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
m.hemsley@ocean.us

Debra Hernandez
SCDHEC
1362 McMillan Avenue
Ste. 400
Charleston, SC 29405
hernandl@dhec.sc.gov

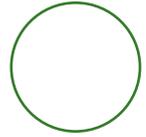
Kris Holderied
Consortium for Oceanographic
Research and Education
Suite 420
1201 New York Avenue NW
Washington, DC 20005
kholderied@coreocean.org

Bob Houtman
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
b.houtman@ocean.us



Matthew Howard
Texas A&M University
Dept. of Oceanography
College Station, TX 77843-3146
mkhoward@tamu.edu

Eoin Howlett
Applied Science Associates
70 Dean Knauss Dr.
Narragansett, RI 02882
ehowlett@appsci.com



Gary Hufford
NOAA
National Weather Service Alaska Region
Box 23
222 W 7th Avenue
Anchorage, AL 99513
gary.hufford@noaa.gov

Atziri Ibanez
NOAA
National Estuarine Research Reserve System
1305 East West Highway
NORM 5
Silver Spring, MD 20190
atziri.ibanez@noaa.gov

Alex Isern
NSF
4201 Wilson Boulevard
Room 725
Arlington, VA 22230
aisern@nsf.gov

Donald Jackson
Florida Sea Grant Extension
P.O. Box 110405
Gainesville, FL 32611
djackson@ifas.ufl.edu

Rick Jahnke
Skidaway Institute of Oceanography
10 Ocean Science Circle
Savannah, GA 31411
crahnke@att.net

Bob Jensen
U.S. Army Corps of Engineers
3909 Halls Ferry Road
Vicksburg, MS 39180-6199
robert.e.jensen@erd.usace.army.mil

Harry Jenter
U.S. Geological Survey
12201 Sunrise Valley Drive
Mailstop 432
National Center
Reston, VA 20192
hjenter@usgs.gov

Ann Jochens
Texas A&M University
Dept. of Oceanography
3146 TAMU
College Station, TX 77843-3146
ajochens@tamu.edu

Mark Johnson
University of Alaska Fairbanks
IMS/SFOS
Fairbanks, AK 99775-7220
johnson@ims.uaf.edu

Walter Johnson
Minerals Management Service
381 Elden Street
Herndon, VA 20170
walter.johnson@mms.gov

Mike Johnson
NOAA
1100 Wayne Avenue
Suite 1202
Silver Spring, MD 20910
mike.johnson@noaa.gov

George Kaminsky
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
gkam461@ecy.wa.gov

Marlene Kaplan
NOAA
Office of Education and Sustainable Development
14th and Constitution NW
Room 6869
Washington, DC 20230
marlene.kaplan@noaa.gov

Darryl Keith
EPA
27 Tarzwell Drive
Narragansett, RI 02881
keith.darryl@epa.gov

Kenneth Lanfear
U.S. Geological Survey
12201 Sunrise Valley Drive
Mail Stop 405
Reston, VA 20192
lanfear@usgs.gov

Nancy Laurson
EPA
1200 Pennsylvania Avenue, NW
EPA West, Room 7214
Mailcode 4504T
Washington, DC 20460
laurson.nancy@epa.gov

Lynn Leonard
University of North Carolina Wilmington
Coastal Ocean Research Monitoring Program
5600 Marvin K. Moss Lane
Wilmington, NC 28409
lynnl@uncw.edu

Eric Lindstrom
NASA
Headquarters
Mail Stop 5H79
Washington, DC 20546
elindstr@hq.nasa.gov

Stephen Lord
NOAA
5200 Auth Road
Room 207
Camp Springs, MD 20746
stephen.lord@noaa.gov

Thomas Karl
NOAA
151 Patton Avenue
Asheville, NC 28801
thomas.r.karl@noaa.gov

Fred Klein
Mitretek Systems Inc.
3150 Fairview Park Drive South
Falls Church, VA 22042
fred.klein@mitretek.org

Nicole Larrain
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
n.larrain@ocean.us

Anthony LaVoi
NOAA CSC
2234 South Hobson Avenue
Charleston, SC 29405-2413
tony.lavoi@noaa.gov

Murray Levine
Oregon State University
104 Ocean Admin Building
Corvallis, OR 97331
levine@coas.oregonstate.edu

Dan Lohaus
Northrop Grumman Mission Systems
1406 Fort Crook Rd So.
Bellevue, NE 68005
dan.lohaus@ngc.com

Rick Luettich
UNC Institute of Marine Sciences
3431 Arendell Street
Morehead City, NC 28557
rick_luettich@unc.edu

Tom Malone
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
t.malone@ocean.us

Robert Mason
U.S. Geological Survey
415 National Center
Reston, VA 20192
rrmason@usgs.gov

Richard McCaffrey
McCaffrey and Associates
2001 North Adams
Suite 126
Arlington, VA 22201
info@mccaffery.net

Janice McDonnell
Institute of Marine & Coastal Sciences
Rutgers University
71 Dudley Road
New Brunswick, NJ 08901
mcdonnel@imcs.rutgers.edu

Blanche Meeson
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
b.meeson@ocean.us

Brian Melzian
EPA
U.S. EPA (Atlantic Ecology Division)
27 Tarzwell Drive
Narragansett, RI 02882
melzian.brian@epamail.epa.gov

Steve Moran
Raytheon Company
1100 Wilson Boulevard
Arlington, VA 22209
sgmoran@raytheon.com

David Martin
Applied Physics Laboratory - Univ. of Washington
1013 NE 40th St.
Seattle, WA 98105
dmartin@apl.washington.edu

Mark Mauriello
New Jersey Dept. of Environmental Protection
Land Use Regulation Program
P.O. Box 439
Trenton, NJ 08625-0439
mark.mauriello@dep.state.nj.us

Molly McCammon
Alaska Ocean Observing System
1007 West Third Avenue
Suite 100
Anchorage, AK 99501
mccammon@aocs.org

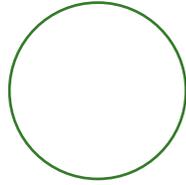
Carrie McDougall
NOAA
Office of Education and Sustainable Development
U.S. Department of Commerce
14th St. and Constitution Ave. NW #6863
Washington, DC 20230
carrie.mcdougall@noaa.gov

Christain Meinig
NOAA
7600 Sand PT Way NE
Seattle, WA 98115
christian.meinig@noaa.gov

Eric Miller
NOAA
NESDIS E/OSD1
SSMC1 #5230
1335 East-West Highway
Silver Spring, MD 20910
eric.miller@noaa.gov

Julio Morell
University of Puerto Rico-Mayaguez
PO Box 908
Lajas, PR 00667-908
j.morell@cima.uprm.edu

Marvin Moss
University of North Carolina Wilmington
Center for Marine Science
5600 Marvin K Moss Lane
Wilmington, NC 28409
mross@uncw.edu

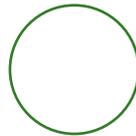


Jan Newton
University of Washington
1013 NE 40th Street
Seattle, WA 98105-6698
newton@apl.washington.edu

Tom Passin
Mitretek Systems
3150 Fairview Park Drive
Falls Church, VA 22042
tpassin@mitretek.org

Cheryl Peach
Scripps Institution of Oceanography/UCSD
9500 Gilman Drive
La Jolla, CA 92093
cpeach@ucsd.edu

Jim Potemra
IPRC/SOEST
University of Hawaii
1680 East West Road
POST Bldg. 4th Floor
Honolulu, HI 96822
jimp@hawaii.edu



J. Scott Rainey
American Pilots' Association
499 South Capitol Street SW
Suite 409
Washington, DC 20003
scott.rainey@americanpilots.org

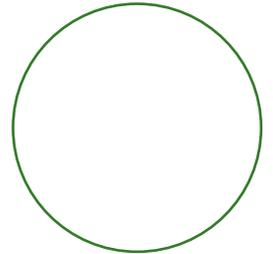
Evan Richert
Gulf of Maine Ocean Observing System
PO Box 4919
Portland, ME 04122-4919
erichert@usm.maine.edu

Laura Murray
University of Maryland
PO Box 775
Cambridge, MD 21613
murray@hpl.umces.edu

Worth Nowlin
Texas A&M University
3146 TAMU
College Station, TX 77843-3146
wnowlin@tamu.edu

Arthur Paterson
NOAA
1315 East-West Highway
SSMC3, Room 5637
Silver Spring, MD 20910
arthur.e.paterson@noaa.gov

Dwayne Porter
Baruch Institute
School of Public Health, USC
Columbia, SC 29208
porter@sc.edu



Josie Quintrell
Gulf of Maine Ocean Observing System
350 Commercial Street
Portland, ME 04112-4919
josie@gomoos.org

D.B. Rao
NOAA NCEP
5200 Auth Road
Room 209
Camp Springs, MD 20746
desiraju.b.rao@noaa.gov

Lisa Rom
NSF
4201 Wilson Boulevard
Room 725
Arlington, VA 22230
erom@nsf.gov

Timothy Rulon
NOAA
National Weather Service
1325 East-West Highway
Silver Spring, MD 20910
timothy.rulon@noaa.gov

Steven Rumrill
South Slough National Estuarine Research Reserve
P.O. Box 5417
Charleston, OR 97420
steve.rumrill@state.or.us

Gregg Schmidt
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
g.schmidt@ocean.us

Kurt Schnebele
NOAA NODC
1315 East-West Highway
SSMC3
Silver Spring, MD 20910
kurt.j.schnebele@noaa.gov

Paul Scholz
NOAA
Weather and Water
2234 S. Hobson Avenue
Charleston, SC 29405-2413
paul.scholz@noaa.gov

Sam Schuchat
State Coastal Conservancy
1330 Broadway
11th Floor
Oakland, CA 94612
sschuchat@scc.ca.gov

Harvey Seim
University of North Carolina Chapel Hill
Marine Sciences Department
CB#3300
12-7 Venable Hall
Chapel Hill, NC 27599
harvey_seim@unc.edu

Peter Sheng
University of Florida
Coastal & Oceanographic Eng.
365 Weil Hall
Gainesville, FL 32611-6580
pete@coastal.ufl.edu

Noriko Shoji
NOAA East-West Center
1601 East-West Road
John A. Burns Hall (JAB 2051)
Honolulu, HI 96848-1601
noriko.shoji@noaa.gov

Suzanne Skelley
NOAA
14th and Constitution Avenue NW
Washington, DC 20230
suzanne.skelley@noaa.gov

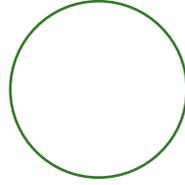
Lundie Spence
COSEE SE
287 Meeting St
Charleston, SC 29401
lundie.spence@scseagrant.org

Richard Spinrad
NOAA NOS
SSMC4 Room 13632
1305 East West Highway
Silver Spring, MD 20910
richard.spinrad@noaa.gov

Fritz Stahr
Ocean Inquiry Project
2852 NW 62nd St
Seattle, WA 98107
stahr@oceaninquiry.org

Steve Stewart
Michigan Sea Grant
21885 Dunham Road
Suite 12
Clinton Township, MI 48036
stew@msu.edu

Kristine Stump
Ocean.US
2300 Clarendon Boulevard
Suite 1350
Arlington, VA 22201
k.stump@ocean.us

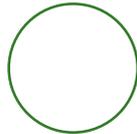


Michael Szabados
NOAA
1305 East-West Highway
N/COP42, Room 6623
SSMC4
Silver Spring, MD 20910
mike.szabados@noaa.gov

Julie Thomas
Scripps Institution of Oceanography, Integ. Ocean Div.
Mail Code 0214
La Jolla, CA 92037
jthomas@ucsd.edu

Ray Toll
SAIC
1 Enterprise Parkway
Hampton, VA 23666
raymond.f.toll.jr@saic.com

Paul Turner
OHSU-OGI-CCALMR
20000 NW Walker Rd.
Beaverton, OR 97006
pturner@ccalmr.ogi.edu



Bob Vorthman
Mitretek Systems
3150 Fairview Park Dr
Falls Church, VA 22042
vorthman@mitretek.org

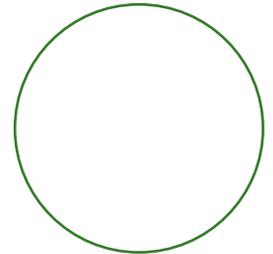
Timothy Walsh
Washington Department of Natural Resources
Division of Geology and Earth Resources
P.O. Box 47007
Olympia, WA 98504-7007
tim.walsh@wadnr.gov

Deidre Sullivan
Marine Advanced Technology Education Center
Monterey Peninsula College
980 Fremont Street
Monterey, CA 93490
dsullivan@mpc.edu

Eric Terrill
Scripps Institution of Oceanography/UCSD
Marine Physical Laboratory
9500 Gilman Drive, Mail Code 0205
La Jolla, CA 92093-0205
eterill@ucsd.edu

Terry Thompson
Kachemak Bay National Estuarine Research Reserve
95 Sterling Highway
Suite 2
Homer, AK 99603
terry_thompson@fishgame.state.ak.us

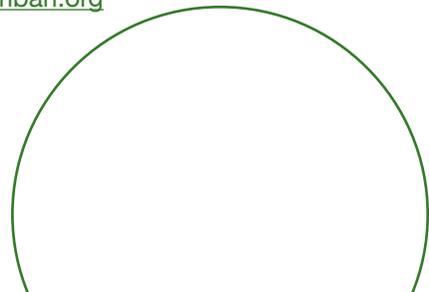
Neil Trenaman
RD Instruments
9855 Businesspark Avenue
San Diego, CA 92131-1101
ntrenaman@rdinstruments.com



Jorge Vasquez
Jet Propulsion Laboratory/Caltech
300/323 4800 Oak Grove Dr.
Pasadena, CA 91101
jorge.vazquez@jpl.nasa.gov

Sharon Walker
J.L. Scott Marine Education Center and Aquarium
703 East Beach Drive
Ocean Springs, MS 39564
sharon.walker@usm.edu

Stephanie Watson
Central and Northern California
Ocean Observing System
Monterey Bay Aquarium Research Institute
7700 Sandholdt Road
Moss Landing, CA 95039-9644
swatson@mbari.org



Marcia Weaks
NOAA
1305 East-West Highway
SSMC4, Room 12134
Silver Spring, MD 20910
marcia.weaks@noaa.gov

Patrick Welsh
University of North Florida
4567 St Johns Bluff Road South
Jacksonville, FL 32224
pwelsh@unf.edu

Doug Wilson
NOAA
410 Severn Avenue
Annapolis, MD 21043
doug.wilson@noaa.gov

Robert Winokur
Navy
2511 Jefferson Davis Hwy
Arlington, VA 22202
robert.s.winokur@navy.mil

Steve Worley
National Center for Atmospheric Research
PO Box 3000
Boulder, CO 80307-3000
worley@ucar.edu

Don Wright
SURA
1201 New York Avenue NW
Suite 430
Washington, DC 20005
wright@vims.edu

David Zilkoski
NOAA
1305 East-West Highway
SSMC 4, 13868
Silver Spring, MD 13088
dave.zilkoski@noaa.gov

Daniel Zimble
Environmental Science Research Institute
8620 Westwood Center Dr.
Vienna, VA 22182
dzimble@esri.com



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APPENDIX III

Agenda

2nd IOOS Implementation Conference
3-4 May, 2005
Provisional Agenda

Monday, 2 May

1900 – 2100 Dinner for Chairs and Rapporteurs of Breakout Groups and Ocean.US Staff, Crystal City Sheraton

Tuesday, 3 May

0700 – 0800 Registration and Continental Breakfast

0800 – 1200 Plenary Session I (Grand Ballroom C)

Opening (Richard Spinrad, Ocean.US Executive Committee) – 5 min

- (1) Workshop Goals, Objectives, Deliverables and Process (Tom Malone, Director, Ocean.US) – 20 min
- (2) The Regional Commitment and Challenges to IOOS Development (David Martin, APL, University of Washington, Chair NFRA Governing Committee) – 20 min
- (3) The Federal Commitment and Challenges to IOOS Development (Spinrad) – 20 min
- (4) Open Comments on Progress to Date and Clarification of Conference Objectives and Process (led by Dick McCaffrey with a Panel of Spinrad, Martin and Malone to provide clarifications) – 60 min

1000 – 1030 BREAK (Continue Registration)

- (5) Development and operational implementation of real-time ocean forecast systems for dissemination of coastal and basin-scale products and services (Steve Lord, NCEP) – 20 min
- (6) Data and Information Required to Improve U.S. Capabilities to Assess the Risk of Coastal Hazards (Tom Karl, NOAA) – 20 min
- (7) Harmonizing Near-Term and Long-Term DMAC Requirements (Lee Dantzler, NOAA, Ocean.US) – 20 min
- (8) Implementing the IOOS Education Initiative (Blanche Meeson, NASA, Ocean.US) – 20 min
- (9) Review Afternoon Session (Malone) – 10 min

1200 – 1300 LUNCH (Complete Registration) (Grand Ballroom B)

1300 – 1730 Breakout Session I (WGs may subdivide)(Coffee service available 1500-1530)

Working Group 1: Early Warnings and Timely Forecasts: Improving Current Capabilities
(See WG assignments for location)

Working Group 2: Mitigating and Managing the Effects of Natural Hazards
(See WG assignments for location)

1730 – 1930 Reception with Congressman Curt Weldon (Grand Ballroom B)

Wednesday, 4 May

0700 – 0800 Continental Breakfast
(0730 – WGs 1 and 2 Chairs and Rapporteurs submit reports to Kristine Stump)

0800 – 1000 Plenary Session II: WG Chairs Report Results for Discussion & Finalization
(deliverables) (Grand Ballroom C)

1000 – 1015 Working Group IV Meeting (Grand Ballroom C)

1000 – 1030 BREAK

1015 – 1045 Working Group III Meeting (Grand Ballroom C)

1015 – 1200 Breakout Session II

Working Group 3: Near-Term DMAC Guidelines
(See WG assignments for location)

Working Group 4: Implementing the National Education Network
(See WG assignments for location)

1200 – 1300 LUNCH (Grand Ballroom C)

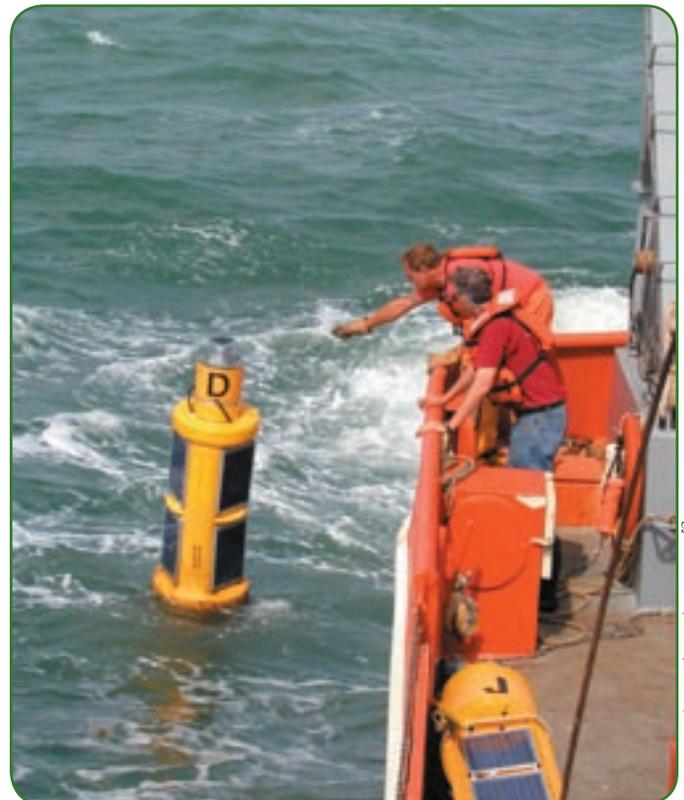
Luncheon Speaker: Kathie Olsen, Ph.D., Associate Director for Science, Office of Science and Technology Policy (OSTP) (Tentative Title: Implementing the Ocean Action Plan)

1300 – 1430 Breakout Session II continued

1430 – 1500 BREAK (Chairs and Rapporteurs prepare reports and submit to Kristine Stump)

1500 – 1630 Plenary Session III: WG Chairs Report Results for Discussion & Finalization
(deliverables) (Grand Ballroom C)

1630 – 1700 Plenary Session V: Next Steps (Malone) (Grand Ballroom C)



APPENDIX IV

Coastal Inundation Background for Goals 1 and 2

Disaster Reduction

A more direct link between IOOS development (an enterprise of the NORLC) and Committee on Environment and Natural Resources (CENR) of the National Science and Technology Council (NSTC) is needed in anticipation of the federal response to the Ocean Action Plan. The NSTC recently released its report on disaster reduction* which provides a framework for sustained Federal investments in science and technology to address six “Grand Challenges”:

- 1) *Develop an all-hazards information source* – A comprehensive and current hazards database must be readily available to and useable by emergency managers, individuals, first responders, and policy makers. Improving and developing observation tools are essential to populating the database with pertinent, comprehensive and timely information for planning.
- 2) *Enhance hazard understanding* – To improve forecasting and assessments, data are needed from our social and natural environments. Data must be incorporated into advanced and validated models that support an improved understanding of underlying social and environmental system processes and enhance assessments of impacts.
- 3) *Develop mitigation technologies and strategies* – Design and build structures and infrastructures that are inherently hazard resilient. This includes developing and implementing mitigation measures that aid post-recovery improvement. All structural mitigation must be supported by appropriate non-structural measures including land use and zoning regulations.
- 4) *Protect critical infrastructure systems* – Identify and address complex responses and the interdependencies of these lifelines at a systems level (e.g., communications, electricity, financial, gas, sewage, transportation, and water). Using integrated models of interdependent systems, additional vulnerabilities can be identified and addressed.
- 5) *Assess disaster resilience* – Federal agencies must work with universities, local governments, and the private sector to identify effective standards and metrics for assessing disaster resilience, and maintain community “report cards” that accurately assess the community’s disaster resilience. Validated models, standards, and metrics are needed for estimating cumulative losses, projecting the impact of changes in technology and policies, and monitoring the overall estimated economic loss avoidance of planned actions.



- 6) *Promote “risk-wise” behavior* – Enhance communications, trust, and understanding within the community by promoting risk-wise behavior. To be effective, hazard information (forecasts and warnings) must be communicated to a population that understands, trusts, and effectively responds to the impending hazard event.

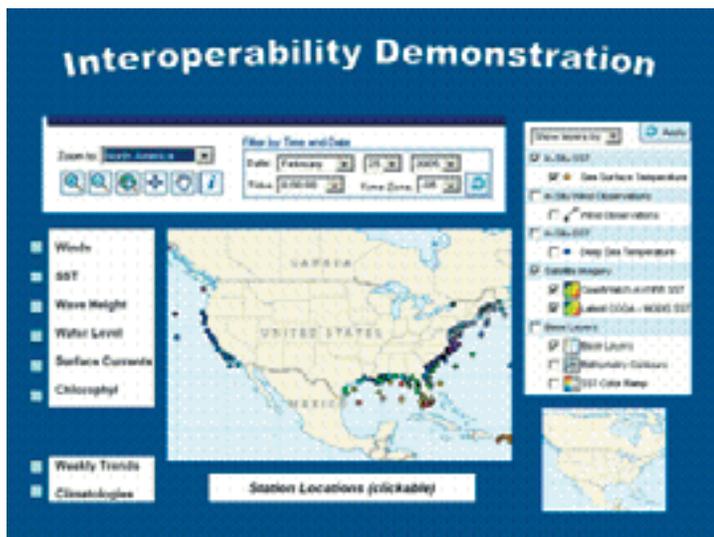
NOAA COTS/ONR IOOS Demonstration Testbed

Grand Challenges 1 and 2 are addressed by a recently initiated IOOS Demonstration Testbed. The goal is to serve as a distributed forum for developing, sharing, and testing key components of IOOS interoperability. The long-term vision is the establishment of operational regional nowcast systems for coastal and ocean variables. As we strive toward that vision, there are two key elements that must be addressed simultaneously: (1) development of applications that demonstrate the utility of IOOS-enabled data to address coastal issues and (2) data interoperability (the ability to search for, obtain, and integrate appropriate data regardless of source location or providing system). More specifically, the IOOS demonstration will illustrate a value-added educational “product line” derived from IOOS interoperability in the context of high profile coastal hazard events.

For the purpose of this project, the term “hazards” is used to include effects of episodic natural hazards such as hurricanes, tsunamis, nor’easters and bio-chemical hazards such as toxic algal blooms and oil spills. The goal is to demonstrate the use of real and near real time ocean observing data from disparate sources to forecast and mitigate the effects of natural hazards and to use this to help guide the development of DMAC. Essential to the success of the demonstration is the identification and implementation of standards for core data variables that are priorities for hazards applications.

Core Variables Interoperability

Target variables are sea surface temperature, vector winds, water level, directional waves, surface current, and chlorophyll concentration. Initial priorities for demonstrating the impact of interoperability are sea surface temperature and winds. This will expand over time to include the full set of targeted variables. This effort will serve as a test-bed for DMAC by focusing on the development of metadata, QA/QC standards, and data assimilation and display guidelines for these variables.



Hazards Application Demonstrations

Subject hazards include hurricanes, nor'easters, tsunamis, oil spills, harmful algal blooms, rip currents, and ice floes. The demonstrations will develop a number of regional/local applications that utilize, as needed, the core variables discussed above (along with other variables as appropriate) to demonstrate the utility of ocean observing data in addressing a range of coastal hazards. As the interoperability standards are adopted, the demonstrations will increasingly provide integrated data and model output in real or near-real time. In the short-term, the effort will build on the 2004 hurricane retrospective (www.openioos.org) to deliver relevant timely data for variables relevant to hurricane impacts (due July 2005).

IOOS data and information for improved forecasting and mitigation of natural hazards will also serve as a test-bed for IOOS education and communications by presenting ocean observing data in the context of high-profile events that are of significant interest to the general public and education audiences. The objective is to develop case studies or retrospectives that utilize IOOS data for predicting and mitigating natural hazards.

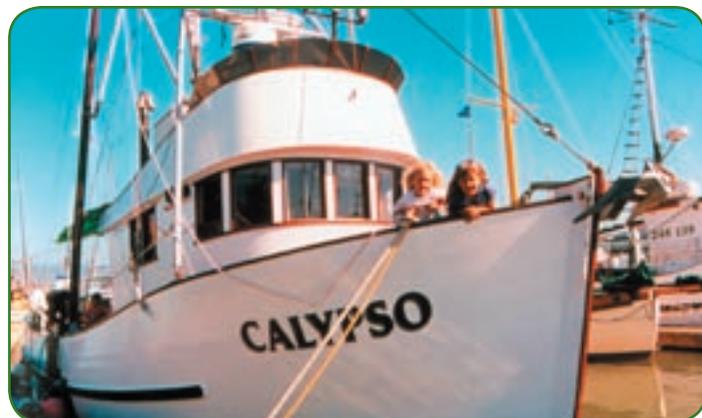


An example of a hazards demonstration for hurricanes is shown below. The demonstration includes case studies for observed hurricanes during the 2004 hurricane season. It combines *in situ* observations with remote sensing and model predictions to demonstrate how the hazard phenomenon interacts with the ocean environment and how those interactions are reflected in the observations. For educational purposes it provides a specific context for incorporating ocean observation data into classroom activities. For outreach purposes it provides an opportunity to expose numerous audiences to the uses of ocean observations related to high-profile events. These applications can begin to provide more concrete examples of the relationship between ocean observations and several of the societal goals embraced by IOOS.

Getting It Done

Seven working groups have been established to conduct the demonstrations:

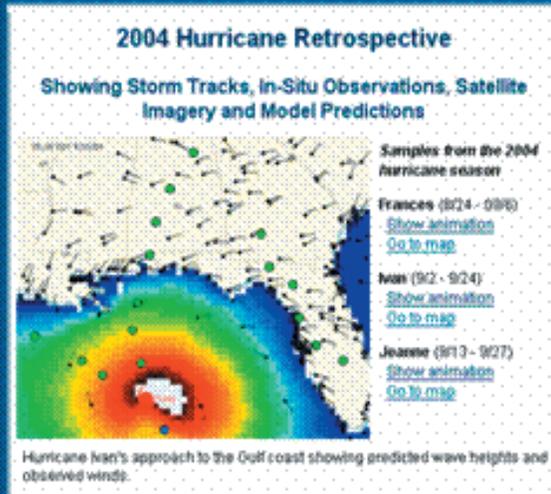
- Data Aggregation
- Metadata
- QA/QC
- Common Interface
- Communications
- Goal Focus
- Steering Committee made up of leaders from the various working groups.



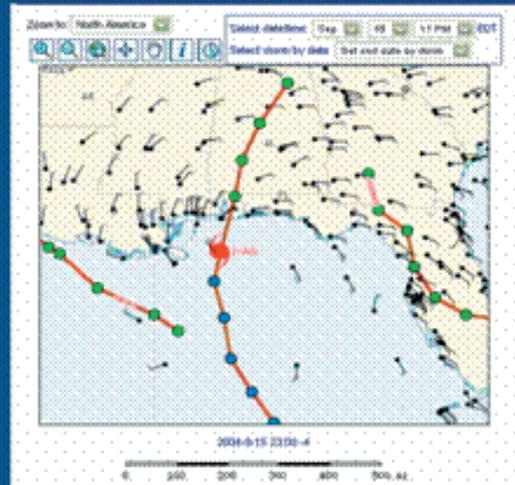


HURRICANE CASE STUDIES EXAMPLE

Hurricane Frances
Hurricane Ivan
Hurricane Jeanne



Retrospective Animation



Interactive Mapping

The Data Aggregation, Metadata, and QA/QC groups will work together to identify, develop and adopt standards that facilitate interoperability among data sources. Concurrently, the Common Interface, Communications, and Goal Focus groups will focus on relevant applications and communication among interested partners in the effort. The Steering Committee, representing these groups and the Ocean.US DMAC Steering Team, will guide the completion of the hazards applications portion of the demonstration.

The “pilot” demonstration is for hurricanes in the southeastern United States. This pilot will be implemented by July 2005 and will serve as a template for building additional demonstrations that focus on priorities of other regions. As we continue to construct regional demonstrations, we will continue to advance the standards and protocols needed to achieve interoperability in conjunction with the work of the DMAC Steering Team.

Storm Surges: Needs Assessment

Assumptions

- NOAA has expertise and effort focused on elements of storm surge.
- There are also expertise and resources in state agencies, academia, and the private sector that need to be entrained in working out the solutions to these issues.
- There is a need for interagency coordination on development and implementation of a storm surge forecast and decision-support capability.

Objectives

- Complete a comprehensive assessment of users and user needs.
- Explore outside R&D activities relative to a community storm surge model.
- Identify issues, challenges, and opportunities and a plan for NOAA for implementation of a comprehensive storm surge forecast, including the associated observational requirements, capabilities, and opportunities.

Groups – Responsibilities

Leadership Group

- Responsible for overall guidance and direction for all work.
- Identify programmatic gaps and ensure that existing efforts are complementary and not duplicative, or make corrective recommendations.
- Ensure inter- and intra-agency coordination is occurring.

Needs Assessment – Virginia Lee (Chair) – Rhode Island Sea Grant

- Responsible for identifying the users and determining their requirements, needs, and wants. Should include an interagency component. Has conducted an internet-based survey run by the University of Rhode Island, and focus groups in New England, the Gulf, and southeast.

Modeling R&D – Frank Aikman (Chair), Phil Bogden (member)

- Responsible for ensuring that all entities with interests in surge modeling are engaged actively and part of developing the plan for resolution. Group will answer how we structure a strategic modeling construct in a consistent way regardless of the model developer or operator.

Forecast and Decision Support Tool Development – Doug Marcy (Chair), Rick Devoe (member)

- Responsible for integrating all information into a storm surge forecast, and for assisting in graphically depicting the information in an easily understandable format. Should engage all sectors – public, private, NGO, and academic – in developing the overall plan and approach.

Coastal Inundation: Linking Observations and Models

The following summary of current operational capabilities for modeling and observations is not meant to be inclusive, but to illustrate the current operational capabilities for predicting (hindcasting, nowcasting, and/or forecasting) coastal inundation.

Models

(1) Inundation from Storm Surge and High Tides

The purpose of the “Sea, Lake, and Overland Surges from Hurricanes” (SLOSH) model is to estimate storm surge heights resulting from historical, hypothetical, or predicted hurricanes (hindcasting, forecasting, and mitigation) and to provide information needed to perform comprehensive evacuation studies and implement evacuation plans derived from such studies (mitigation). The model is operational (run every six hours) and requires the following data in real-time: atmospheric pressure; water level; hurricane diameter, intensity, and track; near-shore bathymetry and topography; roads, levees, and other physical features that can modify flow patterns; and hurricane landfall locations (hindcasting only). The model does not assimilate data on precipitations, river flow, or wind waves. Additional observations useful to forecasters include wind speed and direction and wave height, period, and direction.

Operational storm surge forecasts are also made for the east coast, Gulf of Mexico, Northwest coast, Bering Sea, and Arctic Ocean by the Meteorological Development Laboratory Extratropical Storm Surge Model (run every six hours). Data requirements are vector winds, atmospheric pressure (both obtained from the Global Forecast System), bathymetry, and water level. The model does not assimilate topography, precipitation, river flow, or wind waves. Additional observations useful to forecasters include wind speed and direction and wave height, period, and direction.

Operational models for forecasting water level have been developed for New York/New Jersey, Chesapeake Bay, and Houston/Galveston (and are in development for St. Johns River, FL, Lake Michigan, and Lake Erie). The required data are water level (measured), vector winds (measured and NWS forecast models), atmospheric pressure (measured and NWS forecast models), stream flows (measured), and bathymetry (measured).

(2) Inundation from Tsunami Waves

The Method of Splitting Tsunami (MOST) model is used by Tsunami Warning Centers to issue warnings and by Washington and Oregon for hazard assessment (mitigation). MOST is operational and required data on near-shore bathymetry and topography; earthquake location and magnitude (warnings/forecasts); tsunami wave height, period, and direction (warnings/forecasts); and “credible worst case” and/or probabilistic suite of scenarios for the time-space extent of inundation (hazard assessment/mitigation).

(3) Inundation from Upland Flooding

The National Weather Service River Forecast System (NWSRFS) is used to issue warnings and forecasts of inundation due to river flooding. It is an operational model that can be run at one to six hour intervals. Required data are stream flows, water level (tidal and non-tidal), air temperature, vector winds, and cross channel bathymetry.

The National Flood Frequency (NFF) Program provides estimates of flood-peak discharges (mitigation) and requires data on drainage basin area, slope, precipitation, and land-use practices (developmental characteristics).

Observational Assets

Sensor systems for the provision of required data include the following: NDBC Buoys and C-MAN stations (meteorological data), NWLON (tides), stream gauges, near-shore bathymetry and topography, and satellite based remote sensing (Geostationary Operational Environmental Satellite, Polar Operational Environmental Satellite, QuickSCAT, TOPEX/Poseidon, Jason-1, Ocean Surface Topography Mission, SeaWiFS, Moderate Resolution Imaging Spectroradiometer).

Surface Current Mapping Initiative

Real-time data on surface currents in coastal waters could be used to improve models of coastal inundation. Surface current mapping of U.S. coastal waters (the EEZ) and oceanic waters are a high priority for the IOOS. Surface currents can be measured using a variety of direct and remote sensing techniques. Ocean.US has begun a surface current mapping initiative focusing specifically on high frequency (HF) radar technology for measuring surface currents in coastal waters. Currently, most of the ninety plus HF radar installations along the U.S. coastline

are owned and operated by university research groups. The goal of the Ocean.US initiative is to facilitate creation of a nationwide network for the national backbone based on the diverse regional and local systems that exist.

Workshops

Two workshops have been held to address technical, data management, and governance issues: September 11, 2003 (http://www.ocean.us/documents/docs/scmi_report.pdf) and March 14 - 16, 2004 (<http://act.marine.usf.edu/>). The most recent workshop (October 21, 2004, Washington, D.C.) focused on how surface current maps of coastal waters would help federal agencies better meet their missions.

Status of Systems

The network of HF radar systems around the U.S. is expanding. The largest expansion is occurring in California as a result of a bond issue that will permit purchase of new radars which, at buildout, will provide complete coverage of the California coastline using 40 radar sites. The Alliance for Coastal Technologies website (<http://act.marine.usf.edu/>) gives the latest information on HF radar sites. Development of a national HF radar data server has been funded by an IOOS earmark which is managed by a NOAA NOS/NWS partnership. Standards for quality assurance and quality control are also being developed under this same earmark.

Financial Support

The funding profile for HF radar systems is still essentially all research. NOPP, via NOAA NOS Center for Operational Oceanographic Products and Services and MMS, is supporting a HF radar research project in Alaska. The first workshop noted above gives information on funding requirements and governance scenarios, and those recommendations are still valid. Increasingly, earmarks are being used to support these systems.

Economic Benefits

Economic benefits that may accrue from surface current measurements need to be determined and published. This technology appears to be very promising, but demonstration or pre-operational projects are needed, such as the recent search and rescue projects supported by the U.S. Coast Guard.



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APPENDIX V

DMAC Activities Relevant to Goal 3

1. DMAC-ST Background

Ocean.US has established a DMAC Steering Team (DMAC-ST) to serve as a community-based resource to help guide the identification of appropriate data management and communications standards, best practices, and proposed technical solutions that will enable IOOS interoperability. These standards help provide common system-to-system interfaces among IOOS data providers and users within a targeted Web Services-based architecture that better enables application-to-application communications and interoperability. The focus is primarily on external system interfaces - existing internal system specifications and practices now employed that do not impact external interoperability (e.g., internal syntax, transport, etc.) lie outside the scope of DMAC-ST deliberations. Our goal is to make maximum use of standards, standards development, and evaluation efforts already in place or in process. The Steering Team and its associated activities provide a mechanism to identify and evaluate existing capabilities and programs relevant to IOOS DMAC, and formulate recommendations for the IOOS community.

The DMAC standards process, outlined in the recently-completed **Data Management and Communications Plan for Research and Operational Integrated Ocean Observing Systems** (<http://dmac.ocean.us/index.jsp> - March 2005), embraces a philosophy that can be summarized succinctly by the following over-arching principles:

- a. Expand access to data and information;
- b. Increase the ease and efficiency of data provider and user interactions through shared standards and protocols;
- c. Maximize the use of existing open community standards and activities supporting standards development – adopt, adapt, and only if necessary develop.
- d. Do not interfere with existing communications pathways or processes in place between data providers and their users.

Ocean.US tasked the DMAC-ST to re-visit the initial concrete standards guidance outlined in the DMAC

Plan, and where possible identify updates to those recommendations. Where updates were not possible and key gaps were identified (either in the standards themselves or in the standards process), the Steering Team was further tasked with recommending appropriate corrective actions. The DMAC-ST completed these tasks at its April 5-7, 2005 meeting. A summary of the key recommendations from this review is provided in sections 3 and 4. More details are included in Section 9.1 of the Conference pre-brief materials.

2. DMAC-Steering Team Membership

The DMAC-ST members are listed in the following table. An asterisk (*) is used to identify the official federal agency representatives to the Steering Team.

Lee Dantzler, Ocean.US (Chair)	Roz Cohen, Ocean.US	Steve Hankin, Ocean.US	Landry Bernard, NOAA-NDBC
Nancy Byler, Army Corps of Engineers*	Phillip Bogden, GoMOOS-SURA	Peter Cornillon, URI	Ben Domenico, (Russ Rew – alt.) UNIDATA
Daphne Fautin, CoML / UKan (Peter Fippinger - alt. CORE)	Pierre Flament, National Science Foundation*	Steve Hale, Environmental Protection Agency*	Carroll Hood, Raytheon Corp.
Matt Howard, NFRA, TxA&M	Walter Johnson, MMS*	Bob Keeley, Canada MEDS Director	Ken Lanfear, US Geological Service*
Tony Lavoij, NOAA CSC*	John Lever, Navy CNMOC*	Roy Mendelsohn NOAA-Fisheries	Peter Milne, JOI / ORION
John Orcutt, UCSD / ORION	Jorge Vasquez, NASA*	Stephanie Watson, CeNCOOS Regional Association	Steve Worley, NCAR

3. Meeting Outcome

- a. The DMAC-ST reached consensus on how it will operate as a community-based process for identification and recommendations regarding DMAC standards. This agreement is reflected in the DMAC-ST Terms of Reference.
- b. The DMAC-ST identified key critical standards areas that must be addressed both in the short-term as well as long-term if IOOS is to achieve its “interoperability” goal. For these areas, the DMAC-ST reviewed present guidance provided in the DMAC Plan, identified gaps in existing guidance, and where possible provided updates and/or specific recommendations for:
 - i. The DMAC Standards Process – a community resource;
 - ii. Metadata – content and vocabulary appropriate to marine data;
 - iii. Transport and Access – a suite of protocols enabling Web Services;
 - iv. Archive – Engaging the major existing infrastructure;

- v. IT Security – Appropriate to diverse IOOS community; and
 - vi. QA/QC – An unaddressed Ocean.US gap.
- c. A sustained effort is needed to move forward in the above areas. The Steering Team therefore recommended that Expert Teams be formed to guide standards identification/recommendations for the first four of the above areas. Provisional Expert Team Chairs were identified during the meeting.
- d. A discussion was held on the new IOOS Systems Engineering contract (with Mitretek), and the underlying need for high-level systems engineering to support deployment of the distributed IOOS enterprise and its integration within GEOSS.
- e. The DMAC-ST strongly endorsed an IOOS-DMAC standards approach that embraces an “adopt, adapt, and only if necessary develop” philosophy.
- f. The Steering Team further recognized the complex and rapidly-evolving (often immature) technologies necessary for IOOS participants to become interoperable, as well as the significant gaps in available information that have not yet been addressed by the marine data community. Community involvement through existing programs, supplementing existing programs with resources to address IOOS needs, and sustaining the community vetting process of proposed standards will all be critical to success.
- g. The next meeting of the DMAC-ST will be held in the October 2005 timeframe. Subject to funding availability, it is expected that initial report-outs from several of the Expert Teams will be available at that time.

4. Recommendations on Updated Short-Term DMAC Guidance

DMAC Standards Process

- a. Data providers should report to Ocean.US any standards or standards processes presently in use. This step is considered a key element.
- b. Data providers should participate in Ocean.US DMAC Expert Team forums to enable diverse contributions to the standards process.
- c. The Steering Team recommends that immediate attention be given by Ocean.US to implementing a community-oriented, standards-related resource that would create a collaborative Web site environment (location to be determined) to:
 - i. Support consensus-building, and provide an opportunity for feedback;
 - ii. Provide information on DMAC data standards;
 - iii. Provide technical assistance resources in key evolving standards areas such as XML schema, NetCDF conventions, and other emerging topics; and
 - iv. Help share relevant existing information available through federal agency programs.
- d. The Steering Team recommends that an Expert Team on DMAC Standards Process be established,

and that data providers participate to ensure that their requirements for different types of data are met.

Metadata

- a. Guidance applies to both present data sources, and legacy data holdings and inventories.
- b. All metadata should be created in an XML-schema with an XML style sheet.
- c. Metadata should be created that are compliant with the Federal Geographic Data Committee (FGDC). If FGDC extensions are not available for the specific type of data in question, use an alternative, community-accepted standard and document standard used.
- d. Data providers should be alert to their metadata needs, and should identify gaps so that their needs can be addressed through the Steering Team.
- e. Submit metadata to one of the National Spatial Data Infrastructure nodes where they will be widely available to the community.
- f. Metadata providers should document the data dictionary used.
- g. There are other substantial efforts already in place to address IOOS marine metadata needs from which the DMAC Metadata Expert Team will be drawing, including: the FGDC Subcommittee on Marine Metadata, the NSF-sponsored Marine Metadata Interoperability Initiative, the collaborative Office of Naval Research-NOAA COTS Working Groups, and SURA.
- h. The Steering Team recommends that an IOOS DMAC Expert Team on Metadata be formed, and that data providers participate in this team to ensure that their requirements for all types of data are met.

Data Transport and Access

- a. Depending upon the nature of the data to be provided, it is recommended that providers of:
 - i. *Gridded data* -- install servers providing access to their data through OPeNDAP data access protocol.
 - ii. *Complex data collections in a relational data base (SQL)* -- make data accessible to DMAC by participating in data transport pilot activities to either (i) use OPeNDAP relational data base server or (ii) use enterprise GIS protocols. Full operational support for complex data collections in relational databases will be developed early in the evolution of DMAC.
 - iii. *Large collections of individual files that comprise a single (logical) data set* -- if OPeNDAP servers exist for the file types install these servers to provide access to the individual files.
- b. Data providers should participate in pilot and/or test-bed activities to develop “aggregation” capabilities that will provide a higher level (more ordered) view of the collections.

- c. It is recommended that all data providers:
 - i. Participate in the DMAC Transport (Semantic Data Model) Working Group (see Ocean.US DMAC Plan, Part II, Section 2, Data Transport, Activity 1) to ensure that the special characteristics of their data (if any) will be thoroughly considered during the formulation of DMAC data transport standards.
- d. Data providers can assume that future DMAC-compatible interfaces will be SOAP-enabled.
- e. Gateway services (protocol conversion resources) must be addressed immediately in order to respond to many types of users (e.g., Register UDDI users).
- f. The Steering Team recommends that an IOOS DMAC Expert Team on Data Transport and Access be formed, and that data providers participate on this team to ensure that their requirements for different data types are met.

collection/operations center that has responsibility for those kinds of forecasts/warnings, and has implemented certified IT security safeguards. NDBC is the designated data collection center for marine buoy observations.

- c. IOOS participants not otherwise guided by formal IT security guidelines above (e.g., forecasts and warnings) shall use prudent, community-accepted “best practices” regarding IT security until specific IOOS security guidelines are produced.
- d. In the meantime, federal agencies should be polled to identify IT security resources that can be shared with IOOS data providers (e.g., NOAA NDBC’s IT security safeguard documents).
- e. The Steering Team recommends that an IOOS DMAC Expert Team on IT Security be formed, and that data providers participate to ensure that their requirements for different types of data are met.

Archive

- a. Data Providers should review their current data holdings to ensure that irreplaceable data are archived at a responsible entity.
- b. Existing federal Archive Centers should maintain the archive processes now in place.
- c. Existing Archive Centers should begin to structure their collections so that they are accessible and searchable under the current plan, i.e., collections documented and registered to DMAC metadata standards.
- d. The Steering Team reaffirms present guidance that Regional Data Centers, Modeling Centers, and other data providers should begin negotiations with the Archive Centers for data management. This discussion ensures the subsequent transport of their data into the related national archive holdings. For example, marine buoy data provided via NOAA’s NDBC will also be delivered to the NODC for archiving.
- e. The Steering Team further notes the strong connection between the Data Transport and Access processes and that of Archive, and therefore these efforts should be closely coordinated.
- f. The Steering Team recommends that an IOOS DMAC Expert Team on Archive is established, and that data providers and existing and emerging Archive Center representatives participate to ensure that their requirements for different types of data are met.

Data Management – Quality Control (Qc) & Assurance (Qa)

- a. The Steering Team reaffirms present guidance with respect to delegating data management and QA/QC for marine buoy and mooring data to NOAA NDBC.
- b. Although QA/QC is outside DMAC scope, data providers may find additional guidance elsewhere, including QARTOD’s recommendations and expertise for QA/QC Guidelines, and other ongoing international QA/QC activities.

IT Security

- a. The Steering Team believes that a better understanding is needed of the different security roles, challenges, and constraints of the DMAC data providers, DMAC service providers, and data users.
- b. Until specific IOOS data and network security guidelines are defined, IOOS participants providing data (including model output) that will be used in the production of official forecasts and/or warning should negotiate for their use with the federal data



APPENDIX VI

Education Background to Goal 4

In 2004, participants at the *IOOS-COOS and Education Workshop* developed recommendations and a strategic implementation plan for education and communications allied with the Integrated Ocean Observing System (IOOS). The plan builds on existing activities and programs and positions IOOS education and communications efforts as one component of a larger national education effort that promotes lifelong ocean education within the context of Earth and space system education.

The value of ocean education within the context of the Earth system and of science and technology education cannot be overstated. The oceans are fundamental to our very existence - most of the oxygen we breathe comes from the oceans - yet most citizens do not know it. Our nation's economic prosperity depends on an adequate supply of innovative science and technology professionals which we as a nation must develop and sustain. The allure of the oceans as captured by ocean observing systems can be used to successfully address both of these issues. The overarching goals of IOOS education and communications address these issues by 1) developing and sustaining a community of educators engaged in informal, formal, work force and postsecondary education that uses IOOS information (e.g., data, careers, societal uses) to achieve their education objectives, and 2) creating the work force needed to develop and sustain the IOOS and to produce the allied information products, services, and tools.

The education plan, like other aspects of IOOS, embraces IOOS design principles.

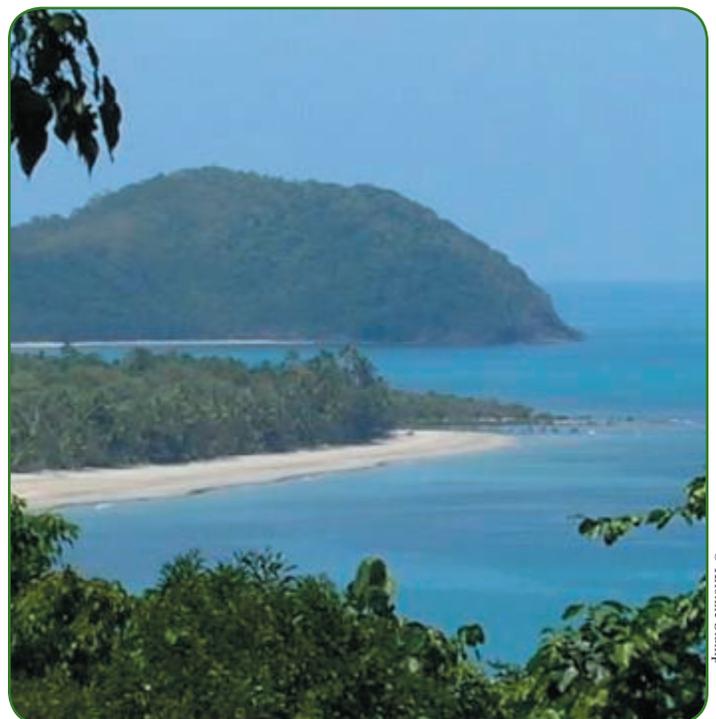
- Build on the best of what is already in place;
- Pay special attention to quality, sustainability, and scalability of efforts; and
- Use partnerships across federal, state, and local government, academia, industry, professional societies, and nonprofit organizations.

The Education Workshop Report outlines an education plan that supports local education leadership and provides lifelong learning using the unique information and facilities of IOOS. Citizens of all ages, ethnicities, and locales are encouraged to participate in lifelong ocean science learning. The plan supports learning by youth in formal classroom settings (kindergarten through grade 16); ongoing learning by adults and children through engagement in informal self-directed learning environments found in museums, sanctuaries, youth programs, and multiple media; and learning by adults in preparation for careers in the work force allied with ocean observing systems.

In each education area (informal, formal, and work force and postsecondary education), the plan addresses key national education issues that affect local communities and influence the production and supply of science and technology professionals. The major issues addressed in the plan are (1) expanding the diversity of the ocean science work force to reject the rapidly changing demographics of the population, (2) aligning formal education learning materials to each state's implementation of the National Science Education Standards, and (3) obtaining active participation of industry and professional organizations in the work force and postsecondary education efforts.

The plan also recognizes and capitalizes on the inherent relationships that exist between informal, formal, and work force and postsecondary education. It recognizes the commonalities between these different education areas and the benefits that accrue from them. These commonalities serve to unite the education program both across education areas and within an area and they align along five functional categories:

- (1) Building a community of educators and users;
- (2) Using information technology to support education and communications;
- (3) Planning based on a thorough assessment of user needs and capabilities;
- (4) Developing and using common messages and themes throughout all education and communications activities; and
- (5) Ensuring that all citizens have ample opportunity to engage in ocean careers.



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Collectively, these commonalities provide coherence to the education program, foster coordination and continuity of education efforts between education areas and within an area, and improve program effectiveness and efficiency.

Finally, the plan addresses development of structural and organizational elements that provide the mechanisms for coordination and collaboration, enable sustainability, and foster efficiency. The principal structural element is a national network of regional education offices with a central coordinating office. This national network is embedded within the larger Earth and space science education network as a way to extend the reach of the ocean science education network. Within this structure, each regional office develops a regional network of ocean science and technology educator-leaders with expertise in informal, formal, and workforce and postsecondary education that act locally to develop the professional expertise of their colleagues and to influence local education improvement efforts.

Initial actions to form this network were taken at the workshop. Participants signed a resolution to participate in its formation. Structurally the network of regional offices participates in the governance of IOOS both at the national level and at the regional level. The network also supports a data translation and story development facility that provides expertise and services to the entire education network. This facility translates IOOS scientific and applied content into stories of interest to informal, formal, and work force and postsecondary educators, creates powerful companion visuals derived from IOOS data, and packages them so that stories and visuals are usable by education and communication professionals. The end result of this plan when implemented is a coordinated and coherent education effort that

- (1) Enhances the supply of science and technology professionals essential to our Nation's economic prosperity;
- (2) Enhances lifelong science and technology learning with an improved understanding of the ocean's role in our life support system; and
- (3) Provides the educated and skilled work force allied with ocean observing systems.



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APPENDIX VII

Working Group Reports

Working groups were established as follows:

BREAKOUT SESSION I

- Working Group 1: Forecasting of Natural Hazards (Subgroups on tsunamis, hurricanes, and extra-tropical storms)
- Working Group 2: Mitigating and Managing the Effects of Natural Hazards (Subgroups on storm surge inundation caused by tsunamis, hurricanes, and extra-tropical storms)

BREAKOUT SESSION II

- Working Group 3: Data Management and Communications
- Working Group 4: Using IOOS Data and Information for Education, Capacity Building, and Outreach

WORKING GROUP 1: Subgroup on forecasting tsunami inundation results

- What are the existing models?
 - One operational model – Method of Splitting Tsunamis (MOST) run by NOAA’s Pacific Marine Environmental Laboratory (PMEL)
 - Open water wave height, seismic wave height, bathymetry knowledge required for MOST to give tsunami wave height and propagation time lines.
- Data Requirements
 - Bathymetry
 - Real-time seismic info
 - Real-time deep ocean wave height
 - Sea-level information
 - Knowledge of shoreline topography
- Distant vs. Nearshore Detection
 - Distant Detection
 - Seismic networks
 - Tsunami wave height detection at sea
 - Nearshore Detection
 - Water level network
 - Future high frequency radar and other technology
- Describe challenges/obstacles
 - High resolution shallow water bathymetry
 - Frequent bathymetry updates to 200 meters
 - Access to shallow water bathymetry (classified data from the Navy); national security issues
 - Site specific bathymetry data
 - Survival of tide station during a tsunami
 - Assure reliable communications with adequate band width capabilities.
- Priorities for Enhancement
 - Increase deep water wave height measurements
 - Enhance nearshore water level measurements
 - Optimize seismic sensors network
 - Improve modeling with enhanced bathymetry and landforms
 - Develop an Atlantic MOST model
- Evolving tsunami detection technologies
 - GPS Real Time Kinetic techniques
 - Satellite altimeter
 - Infrasound
 - Dry sensor technique
- Discussion Points
 - Is optimizing the seismic sensor network more important than the nearshore water level network?
 - If additional pressure sensors are installed, where can they be located strategically to also improve the RA’s RCOOS needs?
- RAs vs Federal Role
 - Warnings are responsibility of the Federal Government; they are not an Ocean Observing System.
 - Should RAs be involved in funding and operating water level instruments?
 - Possibly if same quality and accuracy as national network
- Future Funding
 - This group understands that there is a President’s plan to partially accomplish enhancements to the warning system at a level of approximately \$24 million over the next two years. Is this adequate?



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WORKING GROUP 1: Subgroup on forecasting hurricane surge inundation results

Priorities for improved Hurricane Storm Surge Warnings and Forecasts

The near consensus of the working group was that improved warnings and forecasts of Hurricane Storm Surge were possible in the immediate future (less than one year). Current SLOSH model forecast does not include wave effects on hurricane storm surge; a significant improvement would be to move to a model to which this can be added. In order to achieve improved warnings and forecasts, coupling to an atmospheric model and a coastal ocean wave model with improved winds is required. Additional observations to obtain data on the ocean mixed layer heat content available to the hurricane are also required. This data could be obtained 48 to 72 hours before landfall in and near the forecast landfall area. These ocean observations could be tasked to Navy P-3, S-3 and even SH-60 aircraft capable of dropping AXBT instruments, etc. to supplement NOAA P-3 and G-4 aircraft. These additional aircraft would not be at risk from the storm as it would be hundreds of miles distant, but the information provided, particularly along the Southeast Atlantic and Gulf Coast would substantially improve hurricane storm surge modeling by improved sampling of ocean mixed layer heat capacity. It is also noted that the group endorsed the U.S. Weather Research Program (USWRP) recommendations for surface weather observations and buoy spacing (Dabberdt et al 2005, in press). Other improvements include a modeling testbed linking the research and operational communities to improve forecasts in the near-term future, and the long term improvements to bathymetry, topographic and shoreline data.

Priorities Based on Time Horizon:

Immediate (less than one year)

Improved ocean wind field

Current SLOSH model forecast does not include wave effects on hurricane storm surge, and current wind and ocean heat content observations are too sparse in time and space. Fund improved model based on coupled atmosphere/coastal wave interaction; improved ocean heat content observations from aircraft.

Timeline: very short; model development underway (research models exist; capability could exist for this season), NCEP expects to go fully operational with closely coupled model within a few years [NOTE: other development efforts are also afoot]. Existing aircraft fleet, both NOAA and Navy (G-4, P-3, S-3, SH-60) could provide coordinated targeted observations with AXBT along SE Coast. This is feasible now. Enhance coastal wind observations following USWRP guidelines for coastal wind observations and buoy spacing improvements (Dabberdt et al. 2005, in press).

Funding: Fund coupled research model using WRF atmospheric model and SWAN coastal wave model, with

dynamic ocean forecast model for SE Atlantic coast (~ \$1 M). Targeted observations NOAA/Navy (~\$1M).

Near Term (1-3 years)

Establish Joint NCEP/IOOS inundation modeling testbed and verification system as an extension of the SURA testbed.

To enable transition of new models to operations. Start with inundation modeling, but will serve to spin up similar efforts in other atmospheric and ocean modeling areas. It was noted that existing research models could be coupled in less time (<1 year) than the NOAA NCEP next generation coupled model will take; though these models are not hardened for full 24/7 operational capability. Establishing the Joint NCEP/IOOS testbed could accelerate and streamline model development efforts along the line of the UKMET model development methodology, where University/Research community efforts are integrated into the operational (NOAA NCEP) forecast system more effectively. Additional offshore buoys for verification will be required.

Timeline: Results 1-4 years after initiation

Funding: ~\$10 M per year

Long Term

Improved bathy/topo/shoreline:

While all agreed this is the highest priority, there are existing and prioritized programs at multiple levels with existing relationships that have been worked out locally, regionally and nationally. We therefore support and endorse the national program(s): FEMA map modernization; JALBTCX, USACE-led effort focusing on beachface; VDATUM nationally. We also endorse the need for this data along the beach backslope for overwash and barrier island breaching, and timely post-storm surveys.

Timeline: ongoing long term project(s), National, Regional and locally; need timely post-storm updates; backshore regime is needed in addition to the beachface.

Funding: (Unknown, \$100s M Possibly)

WORKING GROUP 1: Subgroup on forecasting extra-tropical storm surge inundation results

As a philosophy, recognize that observation needs and problems vary regionally and involve regional association expertise and action.

Highest priorities (general assessment of relative cost/time requirements):

1. Provide methods for assimilation of existing real-time local data (e.g, radar-derived precipitation, local weather observations, high resolution sea-surface temperatures, satellite observations) in an interactive manner.–low costs/near term
2. Complete DMAC: Integrate real-time observations into models and provide model grid outputs in data layers. – low costs/near term.

3. Develop high-resolution topography with relevant/consistent datum (and critical infrastructure).
- high costs/near term.
4. Identify highest priority observational needs and fill priority gaps.
-unknown costs/long term.
5. Add coupled air/land/water interface
-high costs/long term.
6. Leverage the work of CODAE to address common problems.
7. Conduct Observational Simulation Science Experiments (OSSE) for existing models and determine costs/benefits -- short term/low costs.
8. Verification and metrics for models.
9. Make increased use of existing satellite data.
10. Improve end-user education and assessment to make maximum use of products and data services.

General Impediments

1. Lack of common modeling framework –Work with ESMF to identify framework.
2. Lack of cross-cultural communications and linkages among modelers and with network operators.
3. Lack model and data interoperability.
4. Partnership with ESIP.
5. Evolve Ocean.US to include a modeling “team”.
6. Lack computational resources to run ensemble forecasts.
7. Poor communications between model centers and forecasters (users).
8. Lack sufficient understanding of local winds/waves and lack model for forecasting.
9. Need validation and verification.
10. Lack topographic information on anthropogenic and drainage infrastructure.

Summary of Models

Model	Model Type	User	Status	Output Format	Coverage Scope	Owner/Maintainer
GFS –Global Forecasting	A	Prof	OP	GriB	Global	Agencies
NoGAPS	A	Prof	OP	GriB	Regional	Agencies Individuals
ETA/NAM	A	Prof	OP	GriB	Regional	Agencies Individuals
WRF-Weather Research Forecast	A	Prof	OP	GriB	Regional	Agencies Individuals
COAMPS –Coupled Ocean Atmosphere Mesoscale Prediction System	A/O	Prof	OP	GriB	Regional	Agencies Individuals
MM5	A	Prof	OP	GriB	Regional	Agencies Individuals
HyComp	O	Prof	PreOP	NetCDF Curvilinear Coordinates	Regional	Agencies Individuals
WaveWatch	O	Prof	OP	GriB	Global/ Regional	Agencies
SLOSH	O	Prof	OP	GriB	Regional	Agencies
Princeton Ocean Model	O	Prof	OP	NetCDF/GriB	Regional	Agencies Individuals
PORTS	O	Prof/ Decision Maker	OP	NetCDF	Local/ Estuary	Agencies Individuals
Extra-Tropical Storm Surge	O	Prof/ Decision Maker	OP	GriB	Regional	Agencies Individuals
GLFS –Great Lakes Forecasting System	O	Prof Decision Maker	PreOp	NetCDF	Local Estuary	Agencies Individuals ³
3-D unstructured grid models UnTrim, AdCic, Caro-Coops	O	Prof	PreOp	NetCDF	Local Estuary	Agencies Individuals
AHAPS	A/H	Prof	Op		Regional	NWS

WORKING GROUP 2: Subgroup on mitigating and managing the effects of tsunamis

Houston and Garcia maps – FEMA Inundation Maps

100 year and 500 year inundation maps do not have updated bathy or topo information.

Not sure about modeling used to develop maps.

Do not include longer term events, such as Cascadia, that are expected to be major Pacific North West tsunami concerns.

These are far-field events – provide at least 5 hours of warning.

Models did not include inundation depths; with LIDAR it is now possible to get better information on inundation depths.

Only thing available now for east coast.

MOST -- Method of Splitting Tsunamis (Oregon, Washington and California)

Some work by Geist and Geffenbaum to predict sediment transport in Willapa Bay

Washington is doing inundation maps with depth zones (ARCVIEW platform) – from TIME Center

Alaskan Inundation Model (Alaska) –

Source dependent;

Need to redo model or check quality of bathymetry since there are broad areas where there is not bathy at all;

Data outputs now can be misinterpreted (eg. Homer, AK)

Hawaii – also doing modeling (some 1-D; some 2-D; some 3-D – for operational uses, people only want to use proven technologies)

Have large amount of empirical data.

From an island perspective, it is also topo.

In Hawaii, a lot of evacuation will be vertical, so must know what buildings will survive

The maps in the phone books are for far-field events;

They do not consider near-field events

East Coast: Dr. Philip Lui has a long-wave/tsunami model that may have application to the east coast; east coast also has the barrier island system that needs to be considered in tsunami inundation mapping

HAZUS? Is this a useful model? The inventory may tie into identification of resources that are at risk.

Useful to think in terms of extreme events.

BATHYMETRY

Need to know bathymetry to calibrate the model regardless of model and what you are modeling; need to know the shoreline; where the islands actually exist; many of the Pacific Islands are not in great shape vis-à-vis data and mapping

What types of bathymetry do we need – Nearshore?

Offshore?

Should these be at same resolution?

What time cycles should be considered for remapping or updating bathymetry and what regions or locations need more frequent updates?

TOPOGRAPHY

The shoreline changes.

Need to have inundation maps prepared for various tidal and riverine conditions.

Do inundation maps ever take into consideration the fact that topography may change if the tsunami is generated by a near-field event – incorporating the earthquake consequences or the topographic changes from the first or second wave of the tsunami?

RUN-DOWN/RUN-OUT

Run-down/run-out is very important to tsunamis for search and rescue and identification of areas to be impacted by pollutants, etc. Need to better model hydrodynamics of run-out.

DETECTION SYSTEMS

DART Buoy system – 7 buoys now operational; work now to make as intense enough grid to record a directional tsunami. Require maintenance. Some consideration for adding other sensors onto DART Buoys.

There are no DART Buoys between Cascadia Subduction Zone and Oregon/Washington Coast. But you have to go out-board of the subduction zone to detect the tsunami.

Tide gauges can work in concert with DART Buoys.

MODELING NEEDS

Add into modeling something to anticipate where currents will carry things – where to do recovery and where there will be concentrations of debris?

Do models predict anything about the aftermath of a tsunami for either built or natural systems?

Run-off models – patterns where water goes after run-up. What areas will be exposed to significant inland components (pollutions, nutrients, oil, hog farm gunk, etc.) Tsunamis cause lots of erosion and we need models that show new deposition locations.

What can be added to existing products that will help put probabilities onto various inundation events?

What can be added to existing products to help predict post-event impacts (changes to salinity, for example)?

Where will velocities be the highest – how will water move?

Local very high resolution modeling.
Need better ecological maps to identify resources that can be at risk.
Stream gauging, tidal elevations, hydraulic modeling.

DETECTION/WARNING/ALERT NEEDS

Can or should warning system be totally automated?
What role do people have in this process? What systems are needed to get warning information to the people who need it? NOAA Weather Radio system is used. Hawaii has a siren system, but people need to know what the sirens mean. San Francisco has a siren system that also has a voice command element to provide directions concerning the hazard.

Possibly use pressure gauges for locally generated event warnings – gauges can be sited close to shore, in bays and harbors.

Warning issues: NWS got away from the evacuate/do not evacuate system many years ago. Shouldn't tsunamis get away from that? However, for storm systems, we have a lot of real-time data to support these NWS warnings for storms and we do not have the same level of experience or input. Also, there are no off-shore seismometers.

Sirens
AHAB – All Hazard Alert Broadcast

CODES AND STANDARDS NEEDS

If buildings will be used for vertical evacuation, how do we know they will survive?

DATA NEEDS

What resolution do we need for data –bathy and topo?
Vasily found that a 50m grid cell was about as detailed as they can use and work with
How frequently could data be acquired?

Steve Worley's three classes of data:

1. Static Data (or data that can be good for several years) – like deep-water bathymetry.
Is it available?
2. Dynamic data. Where does real time data come from? Can we do real-time modeling for tsunamis? If not, when will we be able to do this? Should data be made available so modelers can start playing what if scenarios? SIFT (Short-term inundation Forecast Test) and run-off information. Model input is the earthquake. It takes at least 12 minutes now to model the tsunami after the earthquake happens.
3. Information to the public – how do they get warnings, what does it say, how do they use it?
The inundation map and the signs are ways to first

inform the public concerning tsunamis. Separate information for utilities or other special users

PRODUCTS for DECISION MAKERS

Decision-makers, at times, need different information than do the public

PRIORITY OF ENHANCEMENTS

Emergency management

1. Federal (National) Reponse Plan needs to include tsunamis -- NOAA and FEMA need to talk about tsunamis.
2. National need for critical areas, such as LA/Long Beach Ports, oil facilities, significant business entities, etc. to do tsunami plan and response.
3. Develop adequate inundation (FEMA maps should be replaced by tsunami inundation) maps for all coastal, at-risk communities, to be used for evacuation, planning and resource management.

Education

1. Getting people to safe locations (off beaches, out of rivers and low-lying areas)
 - A. Education, such as tsunami drills
 - B. Tourists need something different from students – AHAB is the only thing that works now for tourists
2. Improve community outreach (tsunami ready) programs

Data Modeling and Forecasting

1. Acquire real-time data for validating tsunami modeling and forecasts
2. Reassess better bathymetry, topography, ecological resources and land use
3. Endorse establishment an end-to-end performance metric for tsunami warnings
4. Promulgate enhancements to building codes/ guidance for construction to address tsunamis (some question whether this is an IOOS issue)
5. Model capabilities should be expanded to provide inundation velocities as well as run-out characteristics

WORKING GROUP 2: Subgroup on mitigating and managing the effects of hurricanes

Question: What products will be most useful to decision makers responsible for managing and mitigating the effects of coastal inundation on coastal communities, ecosystems and natural resources?

Mitigation & Management Responsibilities

- Beach Nourishment
- Infrastructure Relocation
- Building Codes
- Engineering Improvements
- Land Use Planning

- Coastal Evacuation
- Public Warnings
- Education
- Shoreline Change
- Flood Insurance
- Emergency Dune Restoration
- Drainage System Maintenance

1) Coastal Evacuation

Priority Enhancements

- Need products that compile data or toolbox of capabilities for management uses. (e.g. hurrivac) based on an “official” forecast
- Everything necessary to improve hurricane forecasts & minimize uncertainty (improved models and increased observations to feed models) [Reduce the cone]
- Coupling wave/surge/precipitation and increased observations for better forecasting of impacts (flooding and surge)
- Education – pre and post. Ensuring the full range of public education necessary to make the entire evacuation process work.

Challenges

- Big uncertainties with cause and effect of intensification, storm track, and speed
- Public education challenges significant given transient populations, experiences with prior storms and uncertainties, etc.
- Developing products that are user-oriented, including product training and performance feedback loops
- How to get better information into the products – including transitioning research efforts to operational outcomes and obtaining “official” status
- Developing partnerships to improve coordination in data collection and sharing. This issue also applies to maximizing education opportunities.

2) 100-Year Floodplain Map (One percent annual chance)

Priority Enhancements

- Improve/resolve datum issues
- Better statistical models of wind fields/including actual information from more recent hurricanes
- Improve topo/bathy mapping and institute operational update/maintenance program and standards – link to interagency efforts with USGS/USACE
- Improve land use/land cover resolution/coverage
- Education – pre and post. Ensuring the full range of public education necessary to make the entire evacuation process work.

Challenges/Constraints

- Cost
- Shifting agency priorities
- Dynamic Environment – maintenance

3) Shoreline Change (sediment budget)

Priority Enhancements

- Develop operational capabilities (coupled wave/surge/sediment transport)
- Increase data – specifically topo/bathy, bottom characteristics, waves

Challenges

- Lack current understanding of natural processes and interactions AND impacts of structures
- Source of materials for nourishment
- Money
- Localized and research specific (improved coordination among agencies)
- Nourishment policy changing in terms of who pays
- Recurring need for renourishment

WORKING GROUP 2: Subgroup on mitigating and managing the effects of extra-tropical storms

100-yr FLOOD MAPS DO NOT

- Contain effect of wave set-up
- Sea level rise
- Subsidence / Rebound
- Wetting / Drying
- Effects of sediment transport
- Riverine Inflow

100-yr FLOOD MAPS ARE NOT

- Applicable to future conditions
 - Projection of land use
 - Impervious cover
- Back bay re-flooding toward the sea due to Nor’Easters
- Low pressure bombs-rapid developing and movement (coupled atmospheric problem)

Improvements to Meet Deficiencies

- Better elevation data
- More tide gauges to fill gaps/verification
- Directional wave measurements nearshore
- Survey monuments and add where applicable
- Data Bases of
 - Who does what
 - Who has what
- Use of telemetry to transmit real time data to the users

Improvements to Meet Deficiencies

- Mechanism for inter-model comparison
 - Consistency versus divergence
 - Competition good for technological advancements
 - Standardized Test Bed

- For evaluation of improvements
- Performance metrics

Biological / Environmental Needs

- Estimates of toxins
 - Riverine
 - From the Sea
- Chemical / Biological sensors (underway)
- Rapid response testing – Beach Closure
- Models can estimate the wind generated circulation, they can estimate where the toxins (chemical, biological) go

Great Lakes Needs

- Need more measurements
 - Winds CMAN stations along land/sea boundary
 - Directional wave measurements
- Loss of buoys in late fall –early spring
 - Impacts wind field generation
 - Need for HF, Doppler Radars, QuickSCAT
- Issues of ice and its effect
 - On flooding, erosion and inundation
- River inflow, lake in/outflows

General

- Better use of satellite remote sensing
 - High water marks,
 - Water mass differences
 - SAR used for wind estimates
 - Satellite data to determine datums
- Where do 100-year maps work?
 - Under what conditions
 - Where are they deficient

General

- IOOS value added
 - Understanding the value of IOOS
 - Importance of the products
 - Translate to economic value
 - Demonstration projects highlight IOOS importance
 - Business model (e.g. NWS to Weather Channel)
- EXCOM: needs to facilitate interaction of program work groups to establish priorities for all agencies

Education

- Common vocabulary explanation to increase general understanding
- Visual aids that show storm surge inundation using real events that people can relate to
- Who are the users of IOOS and what are the needs of the users
- Forum or other mechanisms to interact with agencies involved gathering / using data

WORKING GROUP 3: Data Management and Communications Summary Presentation

Conference Outcome – DMAC

- Endorsed DMAC process, updated short-term guidance, and priorities
- Participants exhibited clear understanding of
 - Need for broad community involvement
 - Underlying complexities AND complementarities
 - Challenges in facilitating “communications” across communities still evolving
 - Urgency, given expanding investments in observing systems

Conference Outcome – DMAC

- Recommendations map consistently onto IOOS Development Plan . . . Some expansion & emphasis
- DMAC Interoperability Standards Oversight
- DMAC Interoperability Infrastructure
- DMAC Test-bed Activities

Conference Outcome – DMAC

o DMAC Interoperability Standards Oversight ... Endorsed

- DMAC Steering Team continuation and approach
 - Adopt, Adapt then Develop, also “Do no harm”
- o Need for DMAC Expert Teams for
 - Standards process communications facilitation
 - An “urgent” cross-cutting need
 - Metadata and discovery
 - Transport and access
 - Archive
 - Systems Engineering
 - Security
 - QA/QC
- o Need for DMAC Community Engagement Caucuses
 - Enfranchising private sector
 - International
 - Modeling
- o Need for improved technical support services
 - Technical documentation and guides – especially for RAs
 - Sample test and implementation verification cases

Conference Outcome – DMAC

o DMAC Interoperability Standards Oversight (cont'd)

- Need for investment in DMAC within RAs
- Need RA DMAC counterpart with Ocean.US DMAC Steering Team
- o **DMAC Interoperability Infrastructure**
 - Emphasis on need for professional systems engineering services to enable integration among
 - IOOS – Federal backbone as well as RCOOS’s
 - RA’s
 - IEOS
 - GEOSS

- o **DMAC Test Beds**
 - Enables incremental approach
 - Support both short-term and long-term standards evolution
 - Helps build the “community”
 - Opportunities for private industry
 - Multi-hazard interoperability test-bed (Open-IOOS like?)

Conclusion

- o Need counterpart for evolving DMAC “governance structure” with
 - IOOS Observing Subsystem Component (absent)
 - IOOS Modeling Subsystem Component (absent)
- o Implications to evolving Ocean.US office organizational structure

WORKING GROUP 3: Subgroup 1

1. DMAC-Steering Team Background

- o **Clarifications**
 - Will DMAC provide software, reference implementations, hardware gateways, etc.?
- o **Gaps or “showstoppers”**
 - Implementation may prove difficult due to breadth of scope
- o **Endorsement**
 - Inclusive process – monumental task
 - Do not ‘reinvent the wheel’ – keep as is
 - Approach endorsed by group

2. DMAC ST Membership

- o **Clarifications**
 - RAs form DMAC working group and appoint chair to serve on DMAC ST
 - Rotate ST membership amongst RAs
 - Coordination with larger/international efforts
 - How do Expert Teams interact with each other?
- o **Gaps or “showstoppers”**
 - Ensure private industry role in process
- o **Endorsement**
 - Recommend not altering current DMAC ST membership distribution

3. Meeting Outcome

- o **Clarifications**
 - Role of data discovery within DMAC
 - How does ST influence plans/activities of ET?
- o **Gaps or “showstoppers”**
 - No apparent milestones or timelines - strong recommendation to include
 - DMAC provide list of timelines and milestones
 - ET take feedback from others to develop/alter timelines
- o **Endorsement**
 - Unanimous agreement that meeting was held!

4. Short Term Guidance - Standards Process

- o **Clarifications**
 - Bullet d - “...process be established, based on other organization-based processes that DMAC can adopt...”
 - NASA SEEDS, FGDC, ISO, IEEE as examples
- o **Gaps or “showstoppers”**
 - Need more detail on actual DMAC standards process
 - First task of ET should be to develop DMAC standards process, timelines, and milestones
- o **Endorsement**
 - Endorsement with additional clarification and gaps addressed

4. Short Term Guidance - Metadata

- o **Clarifications**
 - Clarification on submission of metadata to NSDI nodes (more IOOS-relevant sites that should be considered also?)
 - Additional metadata guidance needed for data providers, including archive centers (online resource; step-by-step tutorials)
 - Metadata approaches need to be flexible to accommodate future changes
 - Clarification on FGDC standards role
- o **Gaps or “showstoppers”**
 - “All metadata” - meaning instance or format? Clarification needed
 - Suggestion in bullet b - change ‘created’ to ‘shared in an XML format’ (or revise bullet b entirely to say what DMAC ST means)
 - Establish timelines and milestones - critical need [high priority]
 - Devote funding targeted to metadata
- o **Endorsement**
 - Endorsement with additional clarification and gaps addressed

4. Short Term Guidance - Data Transport and Access

- o **Clarifications**
 - Attention needed to ‘push’ technologies (LDM, Lead ITR project, Navy TEDS)
 - General Web services as opposed to SOAP-specific recommendation
- o **Gaps or “showstoppers”**
 - No mention of Open Geospatial Consortium role
 - Address unstructured grids
- o **Endorsement**
 - Endorsement with additional clarification and gaps addressed

4. Short Term Guidance - Archive

- o **Clarifications**
 - Agree DMAC needs to promote best practices and protocols for data collection access and searching
 - Will all archive centers be required to provide data access - to both new and/or historic archives?

- Will each region have centralized archive centers?
- Terminology and capitalization of ‘data centers’ needs clarification to enhance understanding of various centers within system
- o **Gaps or “showstoppers”**
 - Model results and digital video, if included in archives, will add significant additional storage requirements (potentially orders of magnitude)
- o **Endorsement**
 - Endorsement with additional clarification and gaps addressed

DMAC Challenges

Many of these are outside the bounds of DMAC but connections need to be made to the groups addressing these topics

- Nuts-and-Bolts --- electricity, telemetry, communication network (bandwidth, reliability), disk storage, maintenance
- How do these elements relate to DMAC?
- How does RTO process factor into these elements?
- Providing real-time access to data
- Data redundancy needs to be compliant with DMAC
- Integrating disparate data types (support data assimilation)
- Developing real-time products to drive decision support tools and processes
- Need to develop liaisons/expert team/community engagement caucuses to work with IOOS clients - focus on product development, model development, education, outreach

WORKING GROUP 3: Subgroup 2

1. DMAC-ST Background

- Clarifications
- Gaps or “showstoppers”
- Endorsement

2. DMAC ST Membership

- CONCERN Regional Associations need representation on DMAC-ST. Possible separate RA DMAC Steering functions.
- Endorsement

3. Meeting Outcome

- Endorsement

4. Short Term Guidance - Standards Process

- DMAC must query RAs about what their policies/standards are. Ocean.US web site for standards should be organized by variable.
- Endorsement

4. Short Term Guidance - Metadata

- All metadata should be available in an XML-schema with an XML style sheet.
- Submit metadata to one of the National Spatial Data Infrastructure nodes, e.g. Geospatial One-Stop, where they will be widely available to the community.
- The RA's can register with Geospatial One-Stop. The “federation” of sources then cross-reference.
- Endorsement

4. Short Term Guidance - Data Transport and Access

- *Continued compelling need for other protocols ---* Examples include OBIS and times series datasets.
- Data distributor may be different than the data author/compiler. This is in the XML dist-info metadata fields. The metadata may also be provided by a separate distributor. FGDC standards may not be complete on these issues.
- Imperative to develop interactions with modelers, automated metadata and NetCDF.

4. Short Term Guidance - Archive

- Streamline the development of data ingestion to the Federal Archive Centers.
- NDBC has incomplete solutions for data types at the moment. NDBC is commended for its efforts.
- Requests for data from Archives are not working well.
- DMAC Archives might include non-federal repositories.

4. Short Term Guidance - IT Security

- Endorse IT Security Expert Team
- Variation of security policies among the sources.

4. Short Term Guidance - Data Management – QA/QC

- QA/QC protocols are conducted by the data authors
- Partnerships must be established.
- Metadata is one location for QA/QC.
- Endorsement.

Other Recommendations

- Modelers should be included in each of the Expert Teams.
- Recommend pilot projects of end-to-end data handling, example in HF Radar, moored current meters, etc.
- National security issues regarding datasets needs to be addressed.
- Active development should be undertaken by the Data Transport Expert Team.

DMAC Activities that Address Coastal Inundation Issues

- o What are the key data streams?
- o For each data stream:
 - Who owns (or is responsible for) it?
 - What priority should be attached to it?
 - Identify obstacles (challenges) to using it.
 - Key data streams:
 - (2) Bottom Pressure at offshore and nearshore sites.
 - (1) High resolution topography and nearshore bathymetry. Improved deepwater bathymetry.
 - (3) In situ coastal inundation.
 - (2) Wind (model output, buoys, CMAN, remote sensing) (measured at 10m) (need better resolution)
 - (2) Directional Waves
 - (3) River stage and discharge
 - (2) Barometric Pressure
 - (3) Tide gauge, sea level
 - Land use / land cover
 - (2) Upper ocean heat content/heat flux (AXB, etc.)
 - Sediment Budgets

- Habitat Characterizations
- Optimized seismic sensors.
- For data stream: Topography and bathymetry.
- Who owns coastal mapping? NOAA, USACE, USGS, states, Navy.
- What priority should be attached to it? High
- Identify obstacles (challenges) to using it. New data required, large quantities, data formats, data discovery, restricted access
- For data stream: Model Wind Products.
- Who owns it? NCEP, Navy.
- What priority should be attached to it? High
- Identify obstacles (challenges) to using it. Real-time data available for NCEP, 24-hour delay for Navy, large quantities, data formats, restricted access

- Meeting Outcome (10 minutes)
 - Clarifications?
- Expert Team on systems engineering? – instead an Integrated Product Team for systems engineering
 - Gaps?
 - Endorsement OK?

- **Recommendations on Updated DMAC Guidance (20-30 minutes)**
 - Clarifications? Gaps? Endorsement OK?
 - Standards Process
 - Is there recommendation of specific standards? Some overlap in scope between standards process and other sections. A; no process outlined by which particular standards are developed. Need more review
 - How would the review be accomplished? ET for Standards Process will identify successful scenarios and other ETs will review the proposal
 - Standards process can be resource-intensive. Need Ocean.US or other entity to do this on behalf of IOOS. High priority to have both an identification of the process and resources to implement the process. Lots of agreement on the need for resources, including staff.

WORKING GROUP 3: Subgroup 3

- o **Review/Discuss:** *Summary of Recommendations from DMAC-ST [section H]*
- o **Purpose: Get community (your) endorsement for the path forward**
 - Are adjustments necessary?
- o **DMAC-ST Background (10 minutes)**
 - Clarifications?
 - Gaps?
 - Endorsement OK?
 - No discussion
- o **DMAC-ST Membership (10 minutes)**
 - Clarifications?
 - Gaps?
 - Propose addition of member representing operational satellite data (e.g., NOAA NESDIS) – lg. volumes. already have expertise on the ST from the satellite domain (Peter and Jorge); expertise we need is how we transition to the operational environment.
 - Similar need for representation from the Tsunami warning centers.
 - Representation from RAs on ST or ETs? More discussion with NFRA
 - Endorsement OK?
 - Question on the role of the Steering Team – who certifies a process or standard? A: Likely to be via ST via Expert Teams; ST may also certify the process.
 - How functional is a Large Steering Team? TOR recommend 25 or below. How do we involve more people where expertise is needed – via Expert Teams and Caucuses.
 - How does team actually function? Outlined this in TOR – 2 meetings/yr. with email. STs monitoring ETs, where much of the work is accomplished.
 - Need for liaison function to link to other programs/standards bodies
 - How to get industry involved? May need to actively pursue industry participation throughout DMAC teams and processes. One rep. on ST is from Raytheon with architecture/engineering expertise. Are there consortia or trade unions that could be approached.



- Suggestion to adopt a pre-existing standards process and use existing resources
- B. iii is a big task and is it correct to centralize this at Ocean.US. Centralization not necessary, can point at existing groups
- Existing data clearinghouses (e.g., NCDDC, NESDIS) – provide extra resources for this additional responsibility. Intent to leverage existing efforts (agreement)
- Summary: resource requirements to achieve the implementation of the Standards process not well-recognized and will need to be addressed by the ET
- For consensus-building, who will be adjudicating?
- Standards process section doesn't include link to other ETs agreement
- Requirements based analysis – standards process tied to architecture
- Once standards set, need guidance for data users readily available
- Adapt, adopt, develop – three different standards processes. Most will be “adopt” – WHO adopts?
- ET to set minimum criteria for standards considered for adoption. “Adapt” will be accomplished with existing entity
- Some standards we must adopt (e.g., FGDC)
- Role of the ET to vote to adopt, etc.? With appropriate representation on ET
- May be implications per Ocean.US future
- Ex: vertical data reqs. For storm surge. Fed. Agencies use diff. standards (even within agencies) for legal requirements. How to address these issues? Difficult for ET. Will need to identify an approach.
- FGDC metadata can identify the different standard used
- ETs should be formed on a task-specific basis. Additional responsibility for enforcement once standard identified.

• **Recommendations on DMAC Guidance**

- Clarifications? Gaps? Endorsement OK?
- Metadata
- ET interconnections (and w/ST) critical
- Clarify c. “work toward developing an extension” and still recognize other community standards.
- Lots of review comments on DMAC vs. FGDC too restrictive
- Role of ET is to review other standards, as well
- Controlled vocabularies and ontologies included? Under f (emphasize the importance of this – identify and examine existing data dictionaries, as a first priority of the metadata ET)
- FGDC needs tools – read dataset and have tool to develop metadata for you. Tools exist.
- FGDC even in XML doesn't address semantics (machine-to-machine readability). Groups working on this.

• **Recommendations on DMAC Guidance**

- Clarifications? Gaps? Endorsement OK?
- Data Transport and Access
- ETs and ST need strong interconnections
- Emphasize importance of e.
- IOOS needs ability to flexibly move between approaches (this applies to transport, metadata, other sections)
- OPeNDAP, other options should be included: FTP, NDBC MODEM kit. Some discussion - concern that this is not actually making a recommendation. Add another service that all can see. FTP doesn't allow machine-to-machine interoperability. MODEM kit provides standardization. Add layers of technology with advances and capability development. Ensure this flexibility.
- OPeNDAP is challenging to install and not well-supported. If this is a purported standard, there need to be additional resources allocated for use.
- Suggest to change from “providers” to providers or others that work on their behalf.
- Add “http” with SOAP – d.
- Need a gateway from all the ways of making data accessible to a consistent form for interoperability.
- This is evolving short term guidance
- System engineers as enforcing things – clarification that they design, support, as well.

• **Recommendations on DMAC Guidance**

- Clarifications? Gaps? Endorsement OK?
- Archive
- Satellite data in large quantities – need to be cognizant of this. Any DMAC recommendations for modifications to formats, may be addressed through NOAA (otherwise contract)...archiving and near-real time data distribution. Decide upon a specific format, e.g., HDF, NetCDF

• **Recommendations on DMAC Guidance**

- Clarifications? Gaps? Endorsement OK?
- IT Security
- How much effort at looking at other fields for solutions? E.g., biomedical community (applies to transport and security, etc.). Also commercial support.

• **Recommendations on DMAC Guidance**

- Clarifications? Gaps? Endorsement OK?
- Data Management – QA/QC

WORKING GROUP 4 (Using IOOS Data and Information for Education, Capacity Building, and Outreach): Sub-Group—Network Formation

Charge: Design and develop an implementation strategy for an IOOS collaborative ocean education/communication network with distributed regional offices and a national coordinating office

1. *Provide guidance on structure and function of the network infrastructure.*

- a) What should the IOOS education network look like?
- Evolving; it must be flexible
 - Need facilitation to enable sharing of education ideas between RA and other networks in the *rainforest*¹
 - Important not to REINVENT the WHEEL
 - Different regions have different local resources (NERRS, COSEE, informal learning centers (aquaria, science centers, museums), etc.) and needs, so education partnership might be different from region-to-region.
 - Utilize the Regional Association structure, while enabling sharing between regions and other education networks
 - Example: GCOOS has an Education and Outreach Council and an education coordinator for the Regional Association
- b) How should the IOOS network be linked to other networks?
- Connections between networks should be formalized to encourage collaborations
 - Network should be linked to “JSOST & SIMOR” level coordination within the OSTP (President’s Ocean Action Plan)
 - Educators should be co-located with other marine educators when possible
 - Workshops should be held to build *community* among network personnel
- c) What other networks would be helpful as collaborative partners?
- * = Recommended first partners
- NSF: COSEE*, GLOBE, LTER
 - NOAA: NERRS*, NMSP, SeaGrant*, OE
 - NASA: ESSE, ESSEA, Explorer Schools, GLOBE
 - EPA: NEP Network, Regional Laboratories
 - NPS
 - USCG
- d) What can IOOS learn from them about effective network design?
- MODEL:

- o Tie to RA structure, point persons in each Regional Association to do education, extension, and communications
 - o Education council at each Regional Association to support and advise; connection between Regional Associations and other national networks is via the National Coordinating Office.
- e) What should the roles of various elements (regional sites, national office, other entities) be?
- Regional Sites
 - o Do not put PR/media function on educational personnel better to do education
 - o Local learning material development; possible template distribution nationally
 - o Focus on IOOS data, and look for ways to integrate with other types of observation and monitoring data.
 - National Coordinating Office
 - o Compile and maintain an inventory of ocean observing education efforts
 - o Participate in/oversee research that addresses effectiveness of educational products/services; compiles lessons learned; determines what is effective?
 - o Coordinate test beds for assessment strategies, product design, educational research, etc.
- f) Who decides what?
- Regional representation at National Coordinating Office level; “Bottom-up management” & national coordination/integration

Timeline:

- 1) Education should be part of initial development of Regional Association; it should be addressed in the business plan
- 2) 18 months – 2 years for fully functional network

Approximate cost (Ideal):

- 1) Regional:
 - a) Minimum of 2 FTE’s per Regional Association
 - b) Program and travel funding for Regional Association education/extension/communications staff
- 2) National:
 - a) Competitive solicitation to develop showcase “multi-media”
 - b) Coordinator FTE
 - c) Council steering board
 - d) Travel funding to promote community building

¹ Rainforest here serves as an analog to emphasize the importance of interaction and interconnectivity between networks. There are multitudes of symbiotic and complex links between organisms in a rainforest from fungi that connect different species of trees to entwining vines that structurally link the forest floor with the canopy.

Performance metrics:

- 1) Structure of a network/functioning network in place within 18 months
 - 2) Each Regional Association has incorporated an educational strategy and they have staffed positions (i.e., FTE's)
2. *Guidance on how to create, support and sustain a community of users across various educational partners and different audiences*
- a) Hard for one person to do both kindergarten through grade 16 formal education and *extension* type, non-formal education
 - Probably need at least two different people to do this
 - Model: Great Lakes SeaGrant network – each state has an allocation for *education* and for *outreach/extension*
 - b) Important to identify user groups and audiences
 - c) Need to engage local educators in each region; address their interests
 - d) Three stages:
 - Create – work with existing regional networks/ workshops
 - Support – funding & dedicated personnel
 - Sustain – Continual outreach & interaction

Timeline:

- 1) Audience needs assessment should be determined by each Regional Association in first year.
3. *Formation of Steering committees at regional and national levels*
- a) Education should be represented in the NFRA and Regional Association governance.
 - b) Every region should have an education steering group with stakeholders represented – and other network representatives where appropriate.
 - c) Series of small workshops to get educators together with DMAC to coordinate
4. *Formation of a education working group on data and technology to interface with DMAC on standards and protocols for data products useful in education*
- a) Process: Members of the education council are board members or DMAC members

Timeline: Immediate; next three months



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APPENDIX VIII

Acronyms

ADCP	Acoustic Doppler Current Profiler
AIS	Automated Identification System
AUV	Autonomous Underwater Vehicle
DMAC	Data management and communications
EPA	Environmental Protection Agency
EXCOM	Ocean.US Executive Committee
FY	Fiscal Year
GEOSS	Global Earth Observing System of Systems
GODAE	Global Ocean Data Assimilation Experiment
GOOS	Global Ocean Observing System
GLOBEC	Global Ocean Ecosystems Dynamics
GPS	Global Positioning System
HAB	Harmful Algal Bloom
HAZMAT	Hazardous Materials
HFR	High Frequency Radar
IABP	International Arctic Buoy Program
IOOS	Integrated Ocean Observing System
IOWG	DMAC 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
NAML	National Association of Marine Laboratories
NASA	National Aeronautics and Space Administration
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
NOPP	National Oceanographic Partnership Program
NORLC	National Ocean Research Leadership Council
NSF	National Science Foundation
NWLON	National Water Level Observation Network
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
SAR	Synthetic Aperture Radiation
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



¹ The NOAA COTS/ONR Working Group reports, including the report for the IOOS Demonstration Testbed, provide a framework for this activity (http://www.ocean.us/documents/docs/cots_onr_workplans.pdf).





