

ENABLING OCEAN ENTERPRISE DEVELOPMENT THROUGH IOOS:

Building on Foundational Mid-Atlantic IOOS Support With
Focused Partnerships, Leveraging, and Innovation

Gerhard F. Kuska
MARACOOS
Newark, Delaware, USA
kuska@maracoos.org

Carolyn A. Thoroughgood
University of Delaware
College of Earth, Ocean, and Environment
Newark, Delaware, USA
ctgood@maracoos.org

Abstract— Discussions surrounding the development of an Ocean Enterprise have continued since the 1980s. While interest and engagement in ocean science and application have increased over the years—particularly as technologies have advanced—actual development of the Ocean Enterprise has not advanced significantly. Fundamentally a gap in the needed partnerships persists, preventing greater benefit to our economy and society as a whole. The U.S. Integrated Ocean Observing System (IOOS), through its national and regional components, represents a bridge to cross the gap and enable the development of an ocean enterprise. The Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS or Mid-Atlantic IOOS) would be an excellent test bed for developing the partnerships and innovation necessary to develop the ocean enterprise. MARACOOS partners have experienced important successes in serving the various stakeholder communities since its establishment in 2005. However, a greater focus is needed on new, innovative partnerships that draw in private sector partners and further leverage resources for technology test beds, as well as the development of information products tailored to specific users by the private sector with the support of IOOS regional associations, like MARACOOS, and their broad cross-section of partners from government, academic, and non-profit sectors. MARACOOS will launch an enhanced focus on these public-private partnerships through a new Innovation Council and adaptive framework for focused opportunity response. This effort will seek broader recognition of IOOS across the government, strengthen existing and create new strategic partnerships with private sector firms, and grow the abilities and reach of MARACOOS/IOOS partners in their areas of expertise. These partnerships will address specific challenges and opportunities in the broad areas of inundation, flooding, resiliency, and weather-related issues, water quality and public health related issues, maritime safety, fisheries and ecological decision support tools, and energy-related challenges—all with an eye on developing an ocean enterprise that advances technology, develops a stronger economy, and facilitates society's ability to manage and benefit from its ocean and coastal resources. The lessons learned in the Mid-Atlantic can serve as a model for transfer to and scalability in other regions.

Index—observing, ocean observing, coastal ocean observations, forecasting, IOOS, ocean, coastal, MARACOOS, integrated ocean observing system, Ocean Enterprise, Mid-Atlantic, regional association, stakeholder, user, end user, product development, research to operations, applied research, physical oceanographic data, applied data.

I. INTRODUCTION

Discussions surrounding the development of an Ocean Enterprise or the New Blue Economy, as it is now sometimes called, have continued since the 1980s (Ross et al 1989, Spinrad 2014). This continued dialog has been fostered by the very positive anticipated outcomes that include:

- (1) generation of economic benefits, both through creation of new revenue streams and cost avoidance in existing activities;
- (2) creation of new jobs;
- (3) development of new technologies and equipment;
- (4) conservation of developed resources and ocean environments;
- (5) reduction of public risk through enhanced prediction capabilities, and increased national security (Ross et al 1989).

While interest and engagement in ocean science and application have increased over the years—particularly as technologies have advanced—actual practical development and use of ocean resources as envisioned by the Ocean Enterprise Concept have not advanced significantly. Fundamentally a gap in the needed and engaged partnerships persists, preventing greater benefit to our economy and society as a whole. The U.S. Integrated Ocean Observing System (IOOS), through its national and regional components, represents a bridge to cross the gap and enable the development of an ocean enterprise.

II. REGIONAL IOOS IDEALLY SUITED

The development of an Integrated Ocean Observing System was recognized as a critical action by the U.S. Commission on Ocean Policy, and as a key component of our nation's ability to provide sound science for decision making by the Administrations of President George W. Bush and President Barack Obama (USCOP 2004, White House 2004, White House 2010). It is through IOOS that the research to operations translation from ocean data to ocean data products, tools, and support to decisions and actions is facilitated (Spinrad, 2014). It is through IOOS that transitioning what

some have called the “Valley of Death” is transformed into the “Valley of Opportunity”.

The Mid-Atlantic Regional Association Coastal Ocean Observing System (MARACOOS or Mid-Atlantic IOOS) represents the next generation in ocean observing and forecasting for a changing Mid-Atlantic region. With more than 60 partners from academic, government, non-profit, and the private sectors, MARACOOS partners engage, coordinate, and integrate state-of-the-art, basic and applied research, that include observations, data management and presentation, modeling and predictions, tailored information product development, outreach, and education (Cicin-Sain et al 2015). It is the applied science aspect that has resulted in practical solutions to some of the society’s most pressing challenges.

The U.S. Mid-Atlantic region would be an excellent test bed for developing the partnerships and innovation necessary to develop the ocean enterprise. The U.S. Mid-Atlantic region extends 1,000 kilometers from Cape Cod to Cape Hatteras, encompasses ten states (Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and North Carolina) and the District of Columbia, five major urban ports and estuaries (including the largest estuary in the United States—the Chesapeake Bay), and supports 76 million inhabitants (about one quarter of the U.S. population), one quarter of U.S. maritime commerce, the largest naval base in the world (located at Naval Station Norfolk), and both commercial and recreational fisheries. It also faces challenges from a century of industrialization, a growing coastal population, ongoing threats from tropical storms and nor’easters, climatic-scale warming trends, and growing demands on the nation’s most congested electrical power grid. The challenges and potential in the Mid-Atlantic region are numerous and representative of challenges around the nation. The lessons learned in the Mid-Atlantic can serve as a model for transfer to and scalability in other IOOS regions.

III. SOME SUCCESSES HAVE BEEN ACHIEVED

MARACOOS partners have experienced important successes in serving the various stakeholder communities since its establishment in 2005. Examples include: the provision of surface current data and modeling support to the U.S. Coast Guard and its Search and Rescue Optimal Planning System (SAROPS) to enhance safety of life and property at sea; provision of surface current data into NOAA PORTS® for assimilation into products for maritime transportation; provision of surface current data into National Weather Service forecasting programs (AWIPS II) for enhanced coastal forecasting by Weather Forecast Offices (WFOs); collaborative work with the fishing community for improved data and information products that have resulted in bycatch avoidance, as well as the re-establishment of commercial quotas previously restricted; developing data and modeling products to assist water quality and beach managers with

pollution and spill response, as well as support for modeling of pathogens (such as *Vibrio vulnificus*); advancing the understanding and application of storm surge and hurricane intensity modeling to assist forecasters and emergency managers; and initial development of data and information support to state and private sector entities interested in developing offshore wind energy, as well as sea breeze wind information for power companies to determine of community power demands (MARACOOS 2015).

MARACOOS has a network of some of the world’s leading scientists and business leaders who are poised to expand their efforts to address priority regional user needs. Other federal agencies have recognized the combination of scientific expertise and operational capabilities in the Mid-Atlantic with their investments in this region. The NSF Ocean Observing Initiative (OOI) has chosen the MAB for its first 5-year deployment of the Pioneer Array. The OOI Cyber-Infrastructure Implementing Organization (CI IO) chose MARACOOS as its first test bed. DHS formed a Center of Excellence for Port Security in the MAB to test new technologies for deployment around the country, while the Navy is using the MAB to test new technologies for forward deployed non-collaborative environments worldwide. The lessons learned are being translated to other regions in the U.S. and other countries around the world. The procedures developed by the MAB HF Radar network to reach operational status in USCG SAROPS are now being expanded nationally as part of the developing National HF Radar Network. The web portals, Google Earth visualization interfaces, and the virtual community blog space developed to support Glider missions in the Mid-Atlantic have been used to coordinate the national IOOS response to the Deepwater Horizon Oil Spill in the Gulf of Mexico. Now, the MAB Region is serving as an international model for cooperative research and application partnerships, especially in Europe and the Asia (Kuska et al 2012).

IV. LESSONS LEARNED

The successes to date have identified some basic principles underpinning effectiveness in attending to stakeholder needs. Lesson 1: It is important to be tasked by the end-user who is really a customer. With the need clearly defined, data products can be targeted to meet specific needs. Working closely with the end user allows immediate feedback and evaluation of cost/benefit. Failure of all parties to interact throughout the development process can result in wasted human and financial resources as well as missed alternative solutions. Also, end-user involvement increases final “buy-in”.

Lesson 2: There must be alignment between the project and the end-user expectation. This alignment is facilitated by continuous end-user interaction and ensures that the end-user can inform the project/product development throughout. Such engagement also enhances the prospect that the final product will actually be used.

Lesson 3. There must be flexibility during the project execution, as initial approaches may fail and alternatives must

be found. It is important that critical decision points be identified to avoid wasted resources as well as customer dissatisfaction.

V. EVOLVING THROUGH INNOVATION

In 2012, MARACOOS established a stakeholder engagement approach to drive product development through an improved execution of the Research to Operations continuum. The stakeholder engagement approach included:

- Identify stakeholders / operational end users
- Assess operational or other applied needs
- Establish linkages with respective experts and support the needs translation process
- Support joint identify of information products
- Support joint assessment of timelines, feasibility, resource needs, and relative priority
- Represent operational communities with the research community during product creation
- Serve as support during beta testing, operations launch, and post-operational evaluation
- The conduct and management of this stakeholder engagement approach requires a multi-tiered structure, including:

1. Stakeholder Liaison Service → product development corps of individuals to reach out to the end user communities, bringing the needs (and the communities) together with the research communities to ensure consistent communication of needs and translation to meaningful products;

2. User Council / thematic working groups → “tentacles” into the communities to oversee linkages between the research communities within the regional associations and the end user communities, providing advice on trends and focal areas;

3. Leveraged partnerships (i.e. Sea Grant extension) → extending reach to the end user communities through existing networks, providing efficient connections with benefits for multiple organizations with overlapping missions;

4. Integrated approach that includes private sector and academia in product development → minimizing risks associated with the valley of death and shortening R2O timelines by utilizing existing and new infrastructure to focus early on specific needs and meaningful products from the end users’ point of view;

5. Close collaboration among adjacent regional associations → maximizing impact by combining efforts across regional jurisdictional lines (for example for offshore wind energy along the U.S. east coast); and,

6. Information sharing among all regional associations → sharing and supporting the network through a regular information sharing venue (such as NFRA or supporting structures within the NFRA structure) (Kuska et al 2012).

Focus was placed on the stakeholders, with particular focus on the user community, including decision makers at all levels of

government, as well as maritime users in the private and non-government sectors and the public.

VI. CHANGING DYNAMIC

Despite the needs for more and better information and decision tools in the communities of ocean and coastal users and decision makers, funding levels have remained generally level.

Leveraging of existing funding streams and promoting operational efficiencies continue, but are unable to allow for full development of the needed systems in the Mid-Atlantic and across the nation. Additional sources of funding are needed, in combination with enhanced partnerships to grow the application of ocean observing data and the development of user-relevant products.

To progress toward achieving the potential inherent in MARACOOS, a greater focus is needed on new, innovative partnerships, as these relationships are critical to the provision of a robust response to stakeholder needs. The potential for new partnerships that share the MARACOOS mandate to address real needs for real people is enormous. Going forward, MARACOOS will re-double its efforts to draw in private sector partners, and further leverage resources for technology test beds, and develop information products tailored to specific users. MARACOOS will facilitate and integrate the services provided by the private sector with the support of IOOS regional associations, like MARACOOS, and their broad cross-section of partners from government, academic, and non-profit sectors.

VII. TYPES OF PARTNERS

Industry or private sector partners can be categorized in several ways. For purposes of ocean observing activities in the Mid-Atlantic, MARACOOS identifies three types of partnerships: 1) Providers of instrumentation and services; 2) Users of data and products; and 3) Intermediaries who develop products from IOOS data.

Providers of instrumentation and services are an important partnership for the technology aspect of ocean observing, offering the latest instrumentation to improve real-time ocean observations as well as the data management aspects of the regional associations portfolio. Companies like CODAR Ocean Sensors, Teledyne Webb, and Applied Science Associates provide on-the-ground assets (high-frequency radar antennas, gliders, and data management services, respectively) to help form the backbone of the observatory. Users of data and products are the consumers of the applied solutions that IOOS creates. Consumers such as various pilot associations access the data products to support their business decision making. Finally, intermediaries take the data products from MARACOOS and add value to create tailored products for the user community. Companies such as Weatherflow and

Roffer's Fishing Service use IOOS data to create products that are marketed to the public and a variety of entities. Although these are only a few examples of industry engaged in the ocean observing arena, each of these types of private sector firms can benefit through enhanced products and services to their clients as well as increased revenue to their individual business units by partnering with regional IOOS. Ultimately, it is these partnerships and services that will bring about the development and expansion of an ocean enterprise.

VIII. BUILDING ON THE INNOVATION STRENGTH OF IOOS

One of the key features of IOOS in the regions is the platform for bringing together experts from differing fields in order to address critical issues in our ocean and coastal environment. By establishing teams to identify issues, scoping out and prioritizing solutions, and leveraging expertise and resources, regional IOOS embodies the "I" for Integration in IOOS.

To build on this strength, MARACOOS will launch an enhanced focus on these public-private partnerships through a new Innovation Council and adaptive framework for focused opportunity response. This effort will seek broader recognition of IOOS across governmental entities at the federal, state, and local levels, strengthen existing and create new strategic partnerships with private sector firms, and grow the abilities and reach of MARACOOS/IOOS partners in their areas of expertise. These partnerships will address specific challenges and opportunities in the broad areas of inundation, flooding, resiliency, and weather-related issues, water quality and public health related issues, maritime safety, fisheries and ecological decision support tools, and energy-related challenges—all with an eye on developing an ocean enterprise that advances technology, develops a stronger economy, and facilitates society's ability to manage and benefit from its ocean and coastal resources.

These partnerships will focus on broad regional priorities that are as yet unfunded through existing federal funds, as well as focused sub-regional efforts across the Mid-Atlantic.

The MARACOOS Innovation Council will discuss, analyze and help implement strategies to accomplish high priority stakeholder defined projects. The mission of this council is to evaluate opportunities that build upon the MARACOOS RA and coastal ocean observing infrastructure in one of the five theme areas of (1) Maritime safety, (2) Ecological decision support (3) Water quality, (4) Inundation, and (5) Energy. Working groups for selected projects will be comprised of partners willing to collaborate both in project definition and the acquisition of funding.

The Innovation Council will oversee the individual working group efforts and provide strategic advice to the Board of Directors on where, when and how MARACOOS should pursue growth.

Some of the duties and responsibilities of the Innovation Council will include: 1) Development: provide information regarding trends and initiatives in government, academia, and the private sector related to MARACOOS high priority areas; 2) Facilitate relationships between staff and subject matter experts to support new initiatives; 3) Implementation: Assist in delivering information on and funding for quality ocean observation/ stakeholder engagement initiatives by actively participating in identification, planning, and advancing key opportunities; 4) Identify projects or programs that will enhance ocean observation data collection and assimilation, development of data products, and stakeholder engagement; 5) Identify new models of innovation and expert leaders who will provide guidance and information on new initiatives; and 6) Oversee activities of theme-oriented working groups.

IX. CONCLUSION

A future ocean enterprise is dependent on the development of marketable products and services that hinge on proactive partnerships with the private sector through the Integrated Ocean Observing System. These partnerships will also support implementation of the IOOS 10-year Regional Build Out Plans and the long-term viability of these systems.

There are many societal demands for government resources leading to the long-term outlook for a resource-limited environment; new and innovative partnerships become increasingly vital to sustaining existing products and services and provide the only reliable means for future growth.

The IOOS regional associations are ideally placed to form strategic alliances and develop an engaged network of partners committed to generating unique and adaptive solutions to stakeholder needs. Through this integrative approach, relevant issues will be addressed that have a profound and positive impact in capturing the extraordinary potential of the ocean enterprise.

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