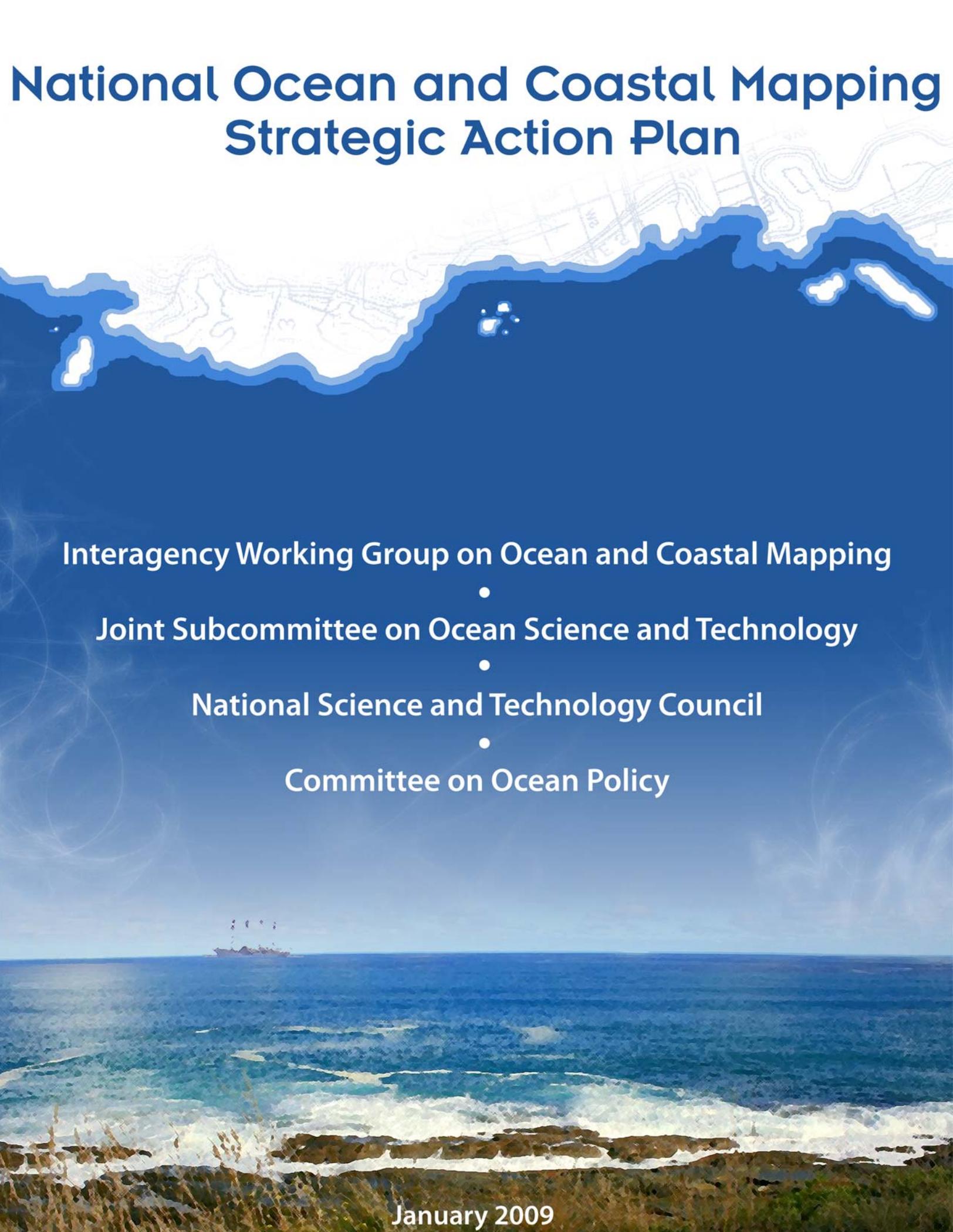


National Ocean and Coastal Mapping Strategic Action Plan



Interagency Working Group on Ocean and Coastal Mapping

•
Joint Subcommittee on Ocean Science and Technology

•
National Science and Technology Council

•
Committee on Ocean Policy

January 2009

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

Interagency Working Group on Ocean and Coastal Mapping
Joint Subcommittee on Ocean Science and Technology
National Science and Technology Council
Committee on Ocean Policy

The Importance of Ocean and Coastal Mapping

The *National Ocean and Coastal Mapping Strategic Action Plan* lays out a context for action and guides a common direction to address the needs of the ocean and coastal mapping community. It is based on coordination, communication, and partnerships, and is designed to be a catalyst for collaboration with the power to transform attitudes, policies and services. The Strategic Action Plan also recognizes the need of the ocean and coastal mapping community to communicate and demonstrate the value of its products and services beyond the current user and supplier communities.

An estimated 160 million people live within 50 miles (80 kilometers) of the coast. The combined property value of coastal land approaches \$3 trillion (Heinz Center, 2002). The rapid development of coastal land over the last 50 years has greatly increased the risk from natural disasters and their associated economic impact. Accurate ocean and coastal data and map products are essential for assessing and managing this dynamic and economically critical coastal zone.

Weather-related economic losses in coastal areas between 1980 and 2008, for example, totaled over \$430 billion (Pielke et al. 2008). If climate change model predictions are correct, inundation directly associated with sea level rise and more and stronger weather-related events will exacerbate both economic and environmental impacts (IPCC, 2007). Also, the most recent assessment of marine transportation reports that cargo moving through U.S. coastal water contributes annually over \$742 billion in gross domestic product and 13 million jobs. This assessment reports that over \$111 billion is contributed to the U.S. economy from recreational and commercial fishing activities. In 1996, nearly 78 million people participated in recreational boating activities that used as many as 16 million boats. These recreational boating activities were valued at about \$19 billion (U.S. DOT, 1999).

Each year, oil and gas resources from the U.S. Outer Continental Shelf (OCS) contribute to the Nation's economy. In fiscal year 2007, oil and gas revenues (including bonuses, rents and royalties) from the OCS reported from private industry was \$7.0 billion, including \$67.7 million that was distributed to coastal states by the federal government. Approximately 43 million acres are leased to private industry for oil and gas development. Production from these leases account for almost 30 percent of the Nation's domestic production of crude oil and 23 percent of its natural gas.

Ocean and coastal data and map products provide the essential framework and information required for assessing and managing this dynamic coastal zone, ensuring safe coastal and ocean operations, and better understanding of the interactions and impacts of human activities and coastal ecosystems. They also support recovery operations and help identify ways to enhance the

resilience of coastal ecosystems and human communities to extreme weather events, destructive human activities, and damaging natural processes.

In order to understand and manage the environmentally and economically important coastal zone, agencies at all governmental levels and the private sector collect and map many types of geospatial information. These data are required and collected using a wide variety of specifications, at many different spatial and temporal scales. With such a large and varied user community our ability to know, share and potentially leverage like mapping activities and products is severely challenged.

Many institutional, technical, and logistical obstacles impede our ability to produce coastal and ocean data and map products in a timely manner to support management and operational decisions, sometimes leading to duplicative data collections or use of less than ideal data. In response to the U.S. Ocean Action Plan, the Joint Subcommittee on Ocean Science and Technology established the Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM) to help the national ocean and coastal mapping community address these issues. This National Strategic Action Plan has been developed through the efforts and leadership of the IWG-OCM.

Working Together

Insufficient communication, standardization, and understanding along with numerous technical issues have resulted in inefficiencies and duplicative data collection and map production efforts. These shortcomings have also resulted in use of inappropriate data for critical decisions, acceptance of dated information on which to base decisions, and a host of other compromises in the coastal zone by government agencies and private sector organizations. A critical need exists for establishing a coordinated, cost effective, integrated ocean and coastal zone data collection and mapping network. There is also a need to ensure that the geospatial data being collected are, as much as possible, accessible to the public.

Integrated ocean and coastal mapping is defined as the practice of planning, acquiring, integrating, and disseminating ocean and coastal geospatial data and derivative products in a manner that permits easy access and use by the greatest range of users. This concept requires intra- and inter-agency Federal, State, local, private sector, and academic institution coordination and collaboration with a focus on improving efficiencies, streamlining operations, reducing redundancies, developing common standards, data documentation (metadata), sharing best practices, and stimulating innovation and technological development. Successful implementation will allow each organization to more effectively meet its specific mission objectives while providing the broadest possible benefits to the nation as a whole.

Integrated Mapping

Effective development and application of geospatial information requires integration of diverse data types and knowledge-based interpretation to serve a user community with varied interests, needs, and responsibilities. The

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

requirement for map products to meet pressing national needs, and the substantial resources required to map our extensive, diverse, and challenging coastal and marine settings, provide a compelling argument for a coordinated effort spanning the entire mapping community. Coordinated planning and prioritization of data collection, standardized data management processes and integration, and design and provision of tools for timely product generation and decision support are all essential elements of an effective and comprehensive program. Such an approach will encourage collaboration and resource leveraging, minimize duplication of effort, and ensure that geospatial data and products are developed and applied to achieve the maximum value to the nation.

At least 15 Federal government agencies are involved in the collection and production of geospatial data and maps of U.S. coastal and marine areas (NRC, 2004). Every coastal state, many universities, and private and public organizations collect geospatial data and produce maps. In recent years, the Federal government has begun to lead efforts at coordinating and standardizing mapping activities nationwide. For example, the Federal Geographic Data Committee, an interagency committee established to promote the coordinated development, uses, shares, and disseminates geospatial data and standards. The National Research Council Committee (NRC) on National Needs for Coastal Mapping and Charting (2004) developed a series of coastal zone mapping and infrastructure-related recommendations with the goal of strengthening the nation's ocean and coastal mapping infrastructure. States have their own geospatial data coordinating councils that attempt to leverage Federal programs, with varying requirements, deadlines, and restrictions.

Better Coordination

In 2004, the President released the U.S. Ocean Action Plan. The Plan established a cabinet-level Committee on Ocean Policy to coordinate the activities of executive departments and agencies regarding ocean-related matters in an integrated and effective manner. Through the Committee on Ocean Policy, the National Science and Technology Council Joint Subcommittee on Ocean Science and Technology (JSOST) was formed and tasked with numerous responsibilities, including identifying national ocean science and technology priorities; facilitating the coordination of disciplinary and interdisciplinary ocean research, ocean technology and infrastructure development, and national ocean observation programs; and facilitating the application of knowledge for prediction and forecasting of ocean phenomena. Under JSOST governance, several interagency working groups were formed to address high priority issues, including ocean and coastal mapping.

In June 2006, JSOST established the Interagency Working Group on Ocean and Coastal Mapping. The goal of this working group is to facilitate the coordination of ocean and coastal mapping activities and avoid duplicating mapping activities across the Federal sector as well as with State, industry, academic and non-governmental (NGO) mapping interests.

Activities of the IWG-OCM include:

- Inventory Federal, Federally-funded, and non-Federal governmental ocean and coastal mapping and charting programs and operations.

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

- Identify common mapping needs and coordinated programs.
- Coordinate Federal, industry, academic, NGO, and non-Federal government mapping programs and leverage available resource and technology assets.
- Set priorities for standards development and promote use of standards for data acquisition and management, metadata, and tool and product development.
- Identify technological research and development needs for geospatial data collection, processing, and delivery.

The Mission

The Interagency Working Group on Ocean and Coastal Mapping was established to engage the national mapping community, including providers and users, to promote the efficient and effective development and application of ocean and coastal mapping to support informed decision making.

A Strategic Action Plan

This document describes the *National Ocean and Coastal Mapping Strategic Action Plan* that was developed by the IWG-OCM in coordination with the national mapping community. This action plan was developed to promote efficient and effective acquisition, processing, and application of ocean and coastal geospatial data and maps.

Getting Started

The broad objectives of the IWG-OCM charter served as a starting point for development of a community strategic action plan. The elements of this plan, informed by the substantial efforts of the NRC, the U.S. Commission on Ocean Policy, the Ocean Action Plan, and the IWG-OCM, were developed at a community workshop held in Ft. Lauderdale, Florida in February 2008. Attendees represented a wide range of Federal agencies, state agencies, the private sector and academic institutions as well as providers and users of mapping data and services. Workshop participants brought to the process substantial experience in promoting, planning, and implementing collaborative mapping programs as well as operational use of ocean and coastal geospatial data and products. The discussion was thus informed by a wealth of attendee experience and knowledge of best practices and successes that underpin the recommendations resulting from the workshop that are the basis of the Strategy.

The national ocean and coastal mapping community believes that:

- Enhanced and readily available geospatial data and products are essential to effective management and protection of our coastal and marine environments, economies, and communities.
- The broadest and most critical needs for coastal and marine geospatial data and services can be effectively met only through coordinated and collaborative planning and implementation with providers and users reflecting diverse interests.

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

The IWG-OCM is committed to supporting an effective, active, and inclusive national ocean and coastal mapping community as a powerful force advancing national coastal and ocean mapping interests. Such a community is deemed both necessary and achievable.

The members of this national mapping community vary in their specific interests, capabilities, and responsibilities. However, the shared commitment to collaborative development of the foundational geospatial products and tools unites them in this effort. This Strategic Action Plan is to be used as a guide for advancing integrated OCM. It is intended to provide context for all participants and stakeholders engaged in a collaborative effort that spans the entire range of mapping activities from planning through implementation and application.

This Strategic Action Plan is built on a shared foundation and shared principles that will guide a sustained and effective effort to advance integrated OCM. This plan also identifies priority strategic objectives for collaborative implementation over the next three to five years. The Plan will be revisited periodically and updated and revised as ocean and coastal mapping needs dictate.

Shared Principles

Three principles will enable and enhance an effective integrated ocean and coastal mapping effort both now and in the future. These principles require a persistent and substantial commitment by the national mapping community to advance integrated OCM.

1. **Coordination** – Most existing mapping programs focus on meeting the specific objectives for which they were designed. However, interests, needs, and objectives overlap and better coordination will reduce duplication, expand annual coverage, increase efficiency, facilitate sharing of best practices, and help ensure that the products of individual mapping programs are effectively applied beyond their original objectives.
2. **Collaboration** – Existing mapping programs cannot individually meet all the user communities' requirements for data collection and integration, map production, and tool and technology application. A sustained effort to advance the OCM mission requires collaboration in planning, development, execution, and dissemination.
3. **Communication** – Ensuring effective development and application of mapping resources requires persistent communication within the mapping communities, with other users of geospatial data and products, and with the public at large.

Principles for Community Involvement

The national mapping community must be committed to supporting an effective, active, and inclusive national ocean and coastal mapping effort. This Strategic Action Plan provides the impetus for each organization's commitment to support a shared development of the OCM vision so that coordinated, collaborative efforts will lead to more effective and responsive mapping programs for the nation.

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

- Each organization is dedicated to its own mission and the work to achieve that mission. A successful effort requires all participants to understand, support and advance those individual missions.
- Each organization is committed to ensuring that its mapping resources are used as effectively as possible and will work within the community to leverage resources, share expertise, avoid duplication, and improve results.
- Each organization understands that the value of investment in geospatial data, maps, and mapping services must be measured in terms of responsiveness to user needs leading to effective application.
- Each organization supports community development and application of new technologies and fosters new applications of existing technologies to increase the effectiveness of mapping programs.
- Each organization recognizes its data have undiscovered or unrealized value that can be revealed through broader application, interoperability, and integration across the OCM community.
- Each organization agrees to share OCM program and data acquisition information, and geospatial applications in regional or national forums.

Involvement Outcomes

The implementation of this Strategic Action Plan will result in improvements in the collection, sharing, data use, and products to meet national, regional, and local coastal and ocean policy, conservation, and management needs. This Plan also will provide a framework for defining agency-specific efforts and collaborative partnerships necessary to meet shared short-term and long-term objectives and planning for the future. The IWG-OCM and the agencies it represents pledge to advance the objectives and outcomes of this strategic plan.

The benefits of implementation are:

- Better stewardship of our coastal and marine environments leading to healthy ecosystems, enhanced recreational and commercial navigation safety, and sustained economic development.
- Long-term sustainable mapping programs that effectively support scientific, regulatory and management programs at all levels.
- Enhanced recognition of the value of mapping services to effective policy and decision making.
- Enhanced discovery, access, and application of data and services through use of Geospatial “One-stop” or “clearinghouse” tools.
- Application of data to multiple uses to ensure maximum value from investments in data collection - “Map Once, Use Many Times.”
- Increased sharing of data, knowledge, tools, and practices throughout the national mapping community.
- Increased pace and efficiency of coastal and ocean mapping through cooperation and partnerships that meet public needs.

Challenges

A sustained integrated OCM effort requires long-term institutional commitment that extends past agency reorganization and turnover. In spite of the overall principles and commitments of this Strategic Action Plan, some daunting challenges remain. Each agency must recognize the value of supporting other agency programs, and building capability and capacity through collaboration rather than building duplicative mapping capabilities within agency walls. Individual agency missions must be advanced, while also advancing a broad perspective on the value of mapping programs. Given the number and diversity of mapping programs, the challenge of communication and coordination is daunting but not insurmountable. Differences in organizational culture, language, and mission should not mask the substantial common ground. The national mapping community must invest time and effort in communicating and coordinating effectively and inclusively to maximize the value of individual projects and persistent programs.

Strategic Objectives

To assuage some of the challenges associated with implementing integrated OCM, this Strategic Action Plan will initiate three short-term objectives that will, over the next 3-5 years, focus on building communication, coordination, and collaboration within the national mapping community. These objectives will evolve as the community builds and evolves.

1. Build a National OCM Community

This objective focuses on increasing awareness; building advocacy, shared priorities and practices; and supporting implementation of integrated ocean and coastal mapping throughout the national ocean and coastal mapping community. At national and regional levels community efforts are needed to define shared needs, identify priorities and opportunities, and communicate the actions, impacts and potential of the national OCM community.

2. Provide the Tools and Expertise to Promote an Effective National OCM Community

This objective focuses on providing the national ocean and coastal mapping community with critical geospatial data, mapping tools, and expertise to promote the efficient and effective advancement and application of OCM to support informed decision making. The range of tools includes those needed for collaborative planning, integration, implementation, and application of integrated ocean and coastal mapping activities.

3. Demonstrate and Build Upon Success

This objective focuses on developing and promulgating models for effective collaborative development and implementation of mapping programs, and on communicating the value and impact of successful collaborative OCM activities. Lessons learned and best practices from new and past collaborative efforts will provide models for future activities and demonstrate the effectiveness of coordinated efforts toward meeting the goals of integrated OCM at a variety of partnership and geographic scales.

Description of the Short-term Objectives

1. Build a National OCM Community

Growing interest in the sustainable management of the oceans and coasts has led to increased demand for geospatial data at all levels and across all disciplines of the public sector. Duplicative mapping over areas in which more than one group has an interest is an occasional occurrence. More frequently, resources are spent in many groups to develop similar data delivery mechanisms or data manipulation and integration tools. Communication among all stakeholders that have an interest in ocean and coastal mapping data is key to avoiding duplication and to leveraging assets to the greatest advantage of the data user. However, the group of stakeholders is very large and diverse, with widely varying technical language, so there is no easy route through which to relay mapping plans and research and development that would benefit the entire community. Three priority activities are envisioned that will immediately foster community building among the stakeholders.

Activity 1: Establish an outreach team that will:

- Develop a succinct message that describes the importance of this Strategic Action Plan and integrated OCM to the national mapping community for various newsletters and other outreach efforts to build awareness.
- Develop fact sheets that clearly articulate a common message for stakeholders to encourage participation and advocacy.
- Describe and define how the IWG-OCM works with other national groups.
- Link outreach to other regional and national efforts (e.g., Gulf of Mexico Alliance outreach).
- Use the “Spider” approach for outreach. Go through multiple networks to distribute the OCM message, goals, and objectives.

Activity 2: Identify the members of the national mapping community involved in OCM through existing networks, ocean and coastal mapping agencies, and other sources. Develop an education and outreach strategy that will begin the process of building, reaching out, and informing the ocean and coastal mapping community.

Activity 3: Identify national, regional, Federal, and other forums, where this Strategic Action Plan and OCM can be presented, discussed and expanded to reflect regional needs and priorities.

2. Provide the Tools to Promote an Effective National OCM Community

A variety of tools are required to effectively and efficiently support the efforts of the OCM community. The successful integration of these tools will be determined by their ability to facilitate informed decision making, and by their usability among technical and non-technical customers. Towards this objective, specific activities and tools have been identified that will support mapping efforts in the field and in the office.

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

Activity 1: Develop and implement tools for data dissemination through “Geospatial One-Stop (GOS).” The decision to use GOS as the web portal for communication and dissemination of OCM data requires that additional tools within the site be developed. Suggested tools include:

- A registry, inventory, or catalog of desired, proposed, planned, and completed ocean and coastal mapping data collection activities.
- A formal mechanism for user input and feedback.

Activity 2: Develop a “Tool Blog.” The ability to communicate frequently with the ocean and coastal mapping community regarding tools can be facilitated through a web blog, located on GOS and linked through the OCM web site. The blog will provide a forum to communicate common needs for tool development and usage, assist in establishing the inventory of existing tools and resources, and identify opportunities for leveraging resources.

Activity 3: Design and develop tools that perform seamless vertical datum transformation and seamless multiple resolution horizontal grid integration. The use and sharing of basic map foundation data, such as bathymetric and topographic data, will be greatly aided by tools that perform these two essential functions.

Activity 4: Develop new tools and enhance existing tools for primary map layer generation. The following data sets are considered typical, but not all inclusive, of layers used by ocean and coastal managers and decisions makers:

- | | |
|---------------|----------------------|
| • Bathymetry | • Salinity |
| • Topography | • Wetlands |
| • Land use | • Cultural resources |
| • Currents | • Habitat |
| • Temperature | • Cadastre |
| • Shoreline | • Geology |

These data sets have historically been collected and generated through a variety of methods, sometimes resulting in incompatible formats. The development of a tool or tools that can collect and integrate these layers in a common format would facilitate their wider use and be of great advantage to the ocean and coastal mapping community.

Activity 5: Develop and enhance tools for linking the classification systems for ocean and coastal environments, resulting in primary class and sub-class map layers. The following classification systems are often used for ocean and coastal mapping:

- Land classification
- Seafloor classification, including rugosity (seafloor roughness)

Development of tools that provide a link between the land and seafloor classification systems and include content and format from the many agencies that maintain systems will benefit the ocean and coastal mapping community and further advance techniques to visualize change in the ocean environment.

Activity 6: Develop tools for decision-making products. The following products have been extremely helpful to decision makers:

- Species-specific habitat maps
- Sediment budgets and transport paths
- Inundation models
- Risk vulnerability maps
- Erosion and accretion maps
- Wetland change maps
- Ocean and coastal jurisdiction (cadastral) data and maps
- Flood insurance rate maps

Development of tools that integrate and manipulate these maps and data will identify and highlight high interest areas of the ocean and coastal environment.

Activity 7: Develop tools and methodologies for mapping in shallow water. The accurate sensing of very shallow water areas (~0-10 meter) is a challenge with the current state of technology. New tools and new ways of using existing tools need to be developed for future applications.

Tools for Decision Makers

The Vertical Datum Transformation Tool (VDatum) is a tool for transforming elevation data from one vertical datum into another and for blending bathymetric and topographic data sets into a digital elevation model (DEM). Such transformations are necessary when data from diverse sources need to be combined or compared. The goal is to develop a seamless nationwide VDatum utility to facilitate more effective sharing of vertical data through national elevation and shoreline databases. This also is the first step toward developing a "national shoreline." VDatum will improve efficiency, reduce duplication of effort, and better meet the needs of Federal, State, and county agencies using these data products.

The Multipurpose Marine Cadastre (MMC) is a multi-year, inter-agency effort to build a GIS-based marine information system for the outer continental shelf and state waters that will provide the necessary data and supporting information to inform decision making on a range of issues. At its core, the MMC will contain marine cadastral data encompassing the spatial extent, usage, rights, restrictions, and responsibilities of marine areas, as well as other regionally-specific data needed to support planning, management, and conservation of submerged lands and marine spaces. The combination of marine cadastral and issue-specific data will provide users with the spatial context needed to address issues such as alternative energy sites, aquaculture, submerged lands leasing, and marine conservation. To achieve this vision for the nation, the Federal Geographic Data Committee Marine Boundary Working Group (MBWG) has begun organizing the underlying framework data and forming key partnerships with stakeholder groups. The MBWG's responsibility in this project will be to provide the

authoritative marine boundary data, internet mapping tools, and supporting cadastral information. The utility of the MMC will be explored through key partnerships and case studies. The MMC Data Viewer is now available for use.

3. Demonstrate and Build Upon Success

The national OCM community has demonstrated its flexibility, capability, and commitment to collaborate in a number of different projects. The benefits to the partners are clear in every case. Leveraging existing mapping efforts reduces the financial burden for any single partner. The broad technological and scientific backgrounds of the partners yield improved data products. Local partnerships ensure a broad user base is incorporated in both planning for data collection and in specifying products that inform local decision-making processes. Each success demonstrates the value of integrated OCM and adds to the list of lessons learned that aid future endeavors.

Two priority activities will help formalize this process so that OCM best practices are developed and propagated through the community with each successful implementation.

Activity 1: Develop a scalable, collaborative, project-oriented best practice model that demonstrates the benefits of an integrated approach to ocean and coastal mapping.

- Identify existing OCM successes.
- Glean best practices and incorporate into a conceptual OCM model.
- Select projects that can test the model (see Activity 2 below).
- Determine effective outreach techniques to other agencies.
- Create fact sheets that describe the process to inform other potential projects.

Activity 2: Implement integrated ocean and coastal mapping projects.

- Identify mapping initiatives with momentum and involvement by multiple agencies.
- Recruit additional partners and promote participation from other agencies.
- Create a project fact sheet to communicate goals.
- Develop ways to leverage resources (funds, personnel, programs).
- Determine costs and metrics for projects.
- Populate registries and inventories.
- Identify existing tools that could be applied to or developed for the project.
- Perform “beltway” and regional advocacy.
- Provide feedback to conceptual model (Activity 1 above).

The desired outcomes of these activities are a model for collaboration and practical successes that together address the challenges faced by both federal and non-federal partners in implementing an integrated ocean and coastal mapping effort. These challenges include: mechanisms for leveraging funding, personnel, equipment, and programs; broadcasting the effort to potential federal and local partners; using existing registries and inventories; identifying existing tools and techniques to apply during project execution; timely access to data; data management, standards, and integration; and partner communication throughout the process.

Success of this objective will rely on communication and leveraging between partners, flexibility of partners, state and federal champions, and timely and easy access to resulting data.

The implementation of integrated OCM nationwide, as described in this Strategic Action Plan, is a major step toward ensuring better management of and long-term sustainability of our Nation's coastal zone. The tremendous economic value and environmental importance of our Nation's coastal and marine ecosystems require that we invest in and ensure progress on integrated ocean and coastal mapping.

Demonstrations of Success

The Joint Airborne Lidar Bathymetry Technical Center of Expertise: *The Joint Airborne Lidar Bathymetry Technical Center of Expertise is a partnership in airborne coastal mapping and charting among the U.S. Army Corps of Engineers (USACE), Naval Meteorology and Oceanography Command and Naval Oceanographic Office (NAVOCEANO), and the National Oceanic and Atmospheric Administration (NOAA). Its mission is to conduct operations, evolve airborne coastal mapping and charting technology, and facilitate industry investment and commercialization of the technology. The Center, celebrating its 10-year anniversary in 2008, completes its mission through a community of government, industry, and academic collaborations.*

The Center's operational missions include surveys around the globe in support of Navy nautical charting requirements and within the U.S. supporting Corps of Engineers' coastal management requirements through its National Coastal Mapping Program. Navy requirements are driven by international priorities and Corps of Engineers' surveys are planned and coordinated through regional efforts that include Federal, State, and local participation, typically in the form of a workshop held the beginning of each calendar year. These surveys include the continental U.S., covering a mile-wide swath along the coast. Products, widely available and used by the coastal management community and public, include topographic and bathymetric elevations, spectral imagery and land use classifications, shoreline position and classification, bottom reflectance, and high resolution imagery, with new products under development.

Airborne coastal mapping and charting technology evolution is achieved using government research laboratories, such as the Naval Research Lab, NOAA's National Geodetic Survey, and the Corps' Engineering Research and Development Center, with industry and academic institutions. Research covers a wide range of topics such as regional geomorphology and sediment management, quantifying the engineering, environmental, and economic impacts of storms, data fusion techniques bringing lidar and spectral imagery together, and next generation system development through industry/academia/government collaborations. These and related topics are presented at an annual technical workshop sponsored by the Joint Center.

A number of informal collaborations have developed through the Joint Center, one example being coastal monitoring in the wake of storms, to assess damage and support recovery. The Joint Center has covered much of the U.S. over the past few years and will continue to work around the country on a recurring basis, covering the entire coast every five years. Coordination

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

and collaboration has developed with the USGS and its program to study episodic events. In 2004, this collaboration and data were used to restore a number of shore protection projects in Florida resulting in over \$200M in reconstruction costs.

The California Seafloor Mapping Program: *The California Ocean Protection Council (OPC) and the State Coastal Conservancy (SCC) have set out to create a comprehensive marine geologic and habitat base map series for all California state waters to support the establishment and management of a network of marine protected areas mandated by the State's Marine Life Protection Act. Until recently, the only information available to manage and protect seafloor habitats was in the form of nautical charts. Much of their underlying bathymetry and seafloor characterization data were acquired in the early 20th century and are inadequate for the task at hand. Realizing that the prospects of surveying all of the State's 14,500 km² of coastal seafloor to modern standards and producing the required base maps with only State resources were daunting, SCC set out to create a multi-agency, multi-year partnership to address these challenges.*

The OPC initiated this effort in 2005 by organizing a marine mapping strategic planning workshop to set mapping priorities for California. The workshop called together key stakeholders who identified data gaps, set standards and protocols for future data collection efforts, and listed priority data products needed by State and Federal government. The partnership that was formed to support the implementation of this plan, the California Seafloor Mapping Program (CSMP), brings together State (SCC, California State University Monterey Bay Seafloor Mapping Lab, California Geological Survey and the Department of Fish and Game), Federal (U.S. Geological Survey, U.S. Army Corps of Engineers and National Oceanic and Atmospheric Administration) and private-sector mapping capabilities, to conduct high-resolution surveys along the California coast and produce the required map series.

Through the initial development of CSMP, it was recognized early that if the seafloor data (high-resolution bathymetry, acoustic backscatter, and geological and biological ground-truthing) were acquired to internationally accepted standards using rigorous protocols and stringent data-management processes, then these data could be utilized by a wide range of ocean and coastal decision makers for broader purposes – map once, use many times. The agreement to leverage the combined resources and capabilities of this State/Federal/private-sector confederation will result in data that will be used for supporting the designation of marine reserves and protected areas; understanding coastal sediment transport and sand delivery; identifying geologic fault dynamics and hazards; describing tsunami potential and developing seamless topographic/bathymetric digital elevation models; characterizing National Marine Sanctuary resources; supporting wave, current and oil spill prediction models; supporting ecosystem-based management decisions; and updating nautical charts. All resulting data and products will be made publically accessible.

Massachusetts CZM/USGS Partnership: *the U.S. Geological Survey (USGS), the Massachusetts Office of Coastal Zone Management (CZM), and the National Oceanic and Atmospheric Administration National Ocean Service (NOAA-NOS) initiated geologic mapping of the Massachusetts inner continental shelf as a cooperative effort in 2003. The overall goal of this cooperative is to determine the geologic framework of the seafloor inside the 3-mile limit of State*

National Ocean and Coastal Mapping Strategic Action Plan
Version 1.0, November 2008

waters, using high-resolution geophysical techniques, sediment sampling, and seafloor photography. The products and knowledge developed by this project have broad applicability to scientific, resource-management, and navigational issues in the region. The seabed characterization maps and geospatial data help USGS scientists understand the processes that have shaped the coast and how it has evolved over time, and thereby help evaluate the vulnerability of coastal environments to storms, sea-level rise, and long-term climate change. CZM staff gains a firm science foundation of the marine geologic environment through the collection of high-resolution bathymetry, backscatter intensity and sub-bottom data, which is important for management of marine habitat and to address offshore development proposals (e.g., sand mining, pipelines, energy projects). Through collaborative funding, planning and implementation, State and Federal mission requirements are more effectively advanced.

This collaborative project has strengthened the USGS relationship with CZM, which co-funds the project, and NOAA-NOS, which have provided data from their navigational charting activities. Demonstrating the wider application of the resulting data and products, CZM is responding to ongoing and emerging resource management needs such as developing a framework to classify and map marine habitats. The high-resolution bathymetric and surficial geology data, in combination with underwater photographs and video, are fundamental to classify and map the physical nature of the seafloor environment. Furthermore, the Massachusetts Division of Marine Fisheries (DMF) is using the mapping products to monitor habitat recovery following offshore construction activities and to design new ecosystem-based management practices for coastal fisheries. CZM has staff located at the USGS Woods Hole Science Center and CZM, DMF and USGS frequently meet to help coordinate research activities. This has been enormously helpful in growing this State-Federal cooperative effort. To date, maps covering nearly 1450 km² of the shallow seafloor have been published or are in preparation for state waters extending from the MA/NH border to Cape Cod Bay. Beginning in 2009, additional mapping is planned for areas south of Cape Co (i.e., Buzzards Bay and Vineyard Sound)d, which will also incorporate charting data from NOAA in areas of shared interest. A larger role for DMF in the project is also planned as efforts move toward incorporating fisheries/biological data to further characterize and classify the seafloor in terms of habitat. The success demonstrated to date has provided a focal point for more collaborative projects to include additional State, Federal, and academic partners in regional efforts to better coordinate survey plans, better define mission-critical requirements, and assess regional capabilities.

Summary

This *National Ocean and Coastal Mapping Strategic Action Plan* lays out a context for action and guides a common direction to address the needs of the ocean and coastal mapping community. This Strategic Action Plan emphasizes the need of the ocean and coastal mapping community to communicate and demonstrate the value of its products and services beyond the current user and supplier communities. Based on coordination, communication, and partnerships, the plan serves as a catalyst for collaboration with the power to transform attitudes, policies and services

References

Heinz Center, 2002. *Human Links to Coastal Disasters*. Island Press. Washington, D.C. 139 pp.

IPCC, 2007: *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

NRC, 2004. *A Geospatial Framework for the Coastal Zone: National Needs for Coastal Mapping and Charting*. Committee on National Needs for Coastal Mapping and Charting, Mapping Science Committee, National Research Council, Washington, D.C., 149 pp.

Peilke, Roger A. et al, February 2008. *Natural Hazards Review* © ACSE: Normalized Hurricane Damage in the United States: 1900–2005, 14 pp.

U.S. DOT, 1999. *An Assessment of the U.S. Marine Transportation System: A Report to Congress*. U.S. Department of Transportation, Washington, D.C., 122 pp.

U.S. Ocean Action Plan, 2004. *The Bush Administration's Response to the U.S. Commission on Ocean Policy* (available at <http://www.oceans.ceq.gov>).

U.S. Ocean Action Plan Update, 2007. Prepared by The Committee on Ocean Policy (available at <http://www.oceans.ceq.gov>).

The MMC Data Viewer can be accessed via the MBWG website:
<http://www.csc.noaa.gov/mbwg/htm/multipurpose.html>

The California Seafloor Mapping Program workshop website:
<http://seafloor.csusb.edu/StrategicMappingWorkshop.htm>

The Vertical Datum Transformation Tool can be accessed at:
<http://vdatum.noaa.gov/>