May 2010

The Hydrographic and Oceanographic Dimension to Marine Spatial Data Infrastructure Development: "Developing the capability"

WHITE PAPER

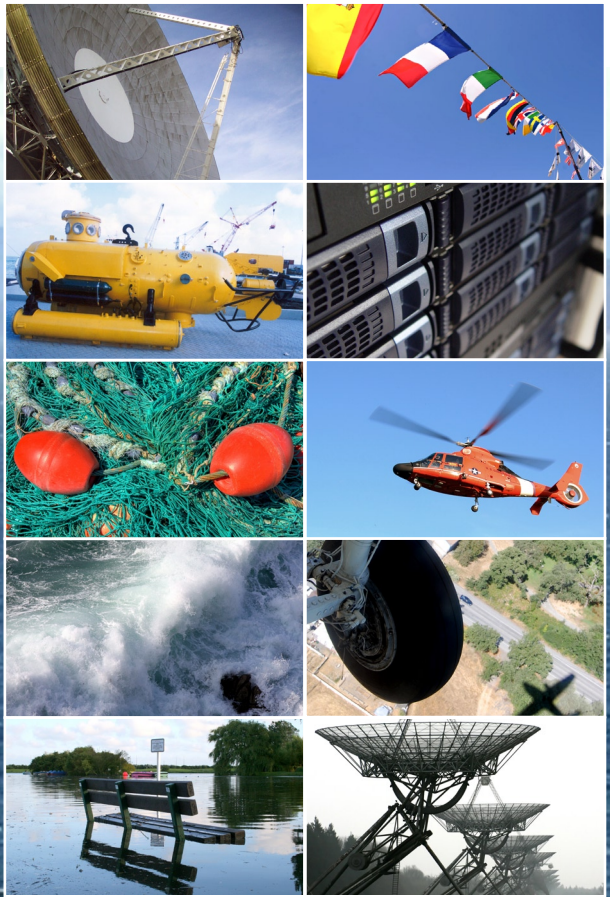
Introduction

The marine and coastal zones of the world host a growing number of overlapping and at times competing uses and activities, including commercial, recreational, cultural, energy, scientific, conservation, defense and security interests.

The quality of life on earth is determined in large part by an incomplete understanding of the interacting system that operates in the world's oceans and coastal areas. The system controls our climate in that it influences rainfall and sea level, it controls access to major resources and raw materials and holds vast amounts of energy potential whilst supporting an explosion of population growth. Increased understanding and control of this system can be accomplished through development of a robust and active program of real time observations, data capture and evaluation, data management, data sharing, exchange and improved access to information to underpin modeling and visualization of the underwater and coastal environment – in short the development of a Marine Spatial Data Infrastructure (MSDI).

This paper discusses the relevance of MSDI to the development of a framework for coastal and marine spatial planning programs at the subnational, national and/or regional levels. It provides an approach to introduce and inform how MSDI inter reacts as a component framework within a National Spatial Data Infrastructure (NSDI) through the development and delivery of a series of global workshops. The workshops will utilize a panel of recognized leaders and experts in the various components of MSDI development as well expertise and experience in developing NSDI.

Stakeholders are strongly urged to endorse this innovative approach to MSDI which will act as the catalyst for the development of capability and capacity to deliver an integrated approach to the management of the coastal zone, oceans and seas. Such development can only be achieved through a partnership approach involving decision makers, planners, scientists, technologists and users and that is designed to drive real efficiencies in operations and activities and so deliver cost savings and other significant benefits to government, commerce and the citizen at large.



What is a Spatial Data Infrastructure?

To explain MSDI it is necessary to put it in the context of Spatial Data Infrastructure. The term Spatial Data Infrastructure (SDI) is often used to denote the relevant base collection of technologies, policies and institutional arrangements that facilitate the availability of and access to spatial data. An SDI is a framework comprised of the following components:

Policy: The defining of the requirement to create interoperable information.

Organizations: Identification of which organizations are willing or mandated to practice cooperation in the sharing and exchange information and to make such information readily available as a means of implementing national (or federal) policy and support "spatially enabled government".

Standards: The foundation of the data collection, management, updating and distribution efforts. Some International standards (e.g. ISO/OGC) include those for geographic information, technology infrastructure to enable data discovery and delivery, and metadata for cataloguing, discovery and retrieval.

Standard Content: A common reference or coordinate system on which key "core" reference content can be registered is essential. Without this SDI is of little use to anyone.

What is Marine Spatial Data Infrastructure?

As the marine component of an SDI the Marine Spatial Data Infrastructure (MSDI) encompasses all marine geographic and business information. For MSDI to be successful, it must be based on clear, broad-based goals that define the desired outcomes to be achieved.

Typical data content includes marine boundaries and limits, conservation and preservation areas, marine habitats, oceanography, bathymetry, hydrography, geology, marine infrastructure, wrecks, offshore installations, pipelines, and cables.

Along the coastlines, currently accepted data on climate change indicates sea level change; incidence of storm events (which are becoming more violent and frequent); higher wave energy and surges that have an impact on fixed structures, and significant beach erosion and flooding inundation. Controllable and equitable use of coastal resources for urban planning, renewable energy, tourism, conservation, preservation of natural habitat, and offshore,

near shore, and inland navigation will be made possible within an MSDI developed framework.

Marine Spatial Data Infrastructure themes common and applicable to most coastal states include:

Maritime Baseline: The line from which maritime zones and limits are measured and monitored internationally.

Offshore Cadastre: The land management system extending from the baseline to the extent of national jurisdiction.

Climate: The modeled and observed spatial and temporal data characteristics of the atmosphere, hydrosphere and land surface system.

Bathymetric Elevation (the "skin of the earth" of which there is only one!)**:** The datum[1] to which sea level is measured and maintained to support nautical charting, engineering and construction projects and to model the seabed.

Seabed Character and Bedform: The complexion of the seabed in terms of its surface geology and sediment composition.

1 Datums vary dependent on use. LAT is used for charting but MSL is used for engineering, construction and conservation.

Land ownership: Information and descriptions of property including title, estate or interest of the federal government (or other owner) in a parcel of real and mineral property.

Flood Hazards: National Flood Insurance Programs maintain flood hazard information around a nation.

Maritime Boundaries: Sovereign sea beds defined by specific legislation and/or usage.

Offshore Minerals: Minerals and hydrocarbons occurring on or under the seabed.

Shoreline or Coastline: The mean position of the incidence of mean high water and land as observed and measured over many tidal cycles.

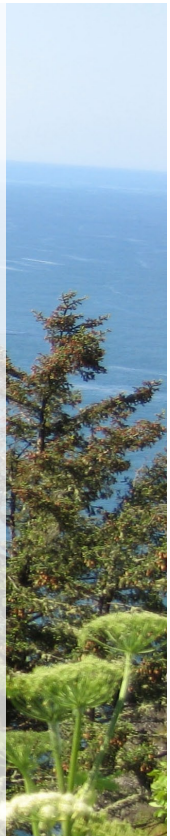
Marine Transportation: Commercial, Defense, and Recreational in terms of surface navigation aids controlling where vessels might traverse.

Obstructions: those features that exist on the seabed (e.g. wrecks, well-heads).

Physical Oceanographic features: Those temporal elements in the water column that describe the condition of the oceans (e.g. salinity, light attenuation, currents, waves).

Common MSDI Themes

Horizontal and vertical datum
Maritime Baseline
Offshore Cadastre
Climate
Bathymetric Elevation
Seabed Character
Land ownership
Flood Hazards
Marine Boundaries
Offshore Minerals
Shoreline
Seabed infrastructure
Oceanographic features
Gazetteer



Gazetteer: A geographical dictionary or directory and reference for information about places and place names.

Within this basic framework MSDI provides a basis for spatial data discovery, evaluation, retrieval, and application for users and providers within all levels of government, the commercial sector, the non-profit sector, academia and by citizens in general.

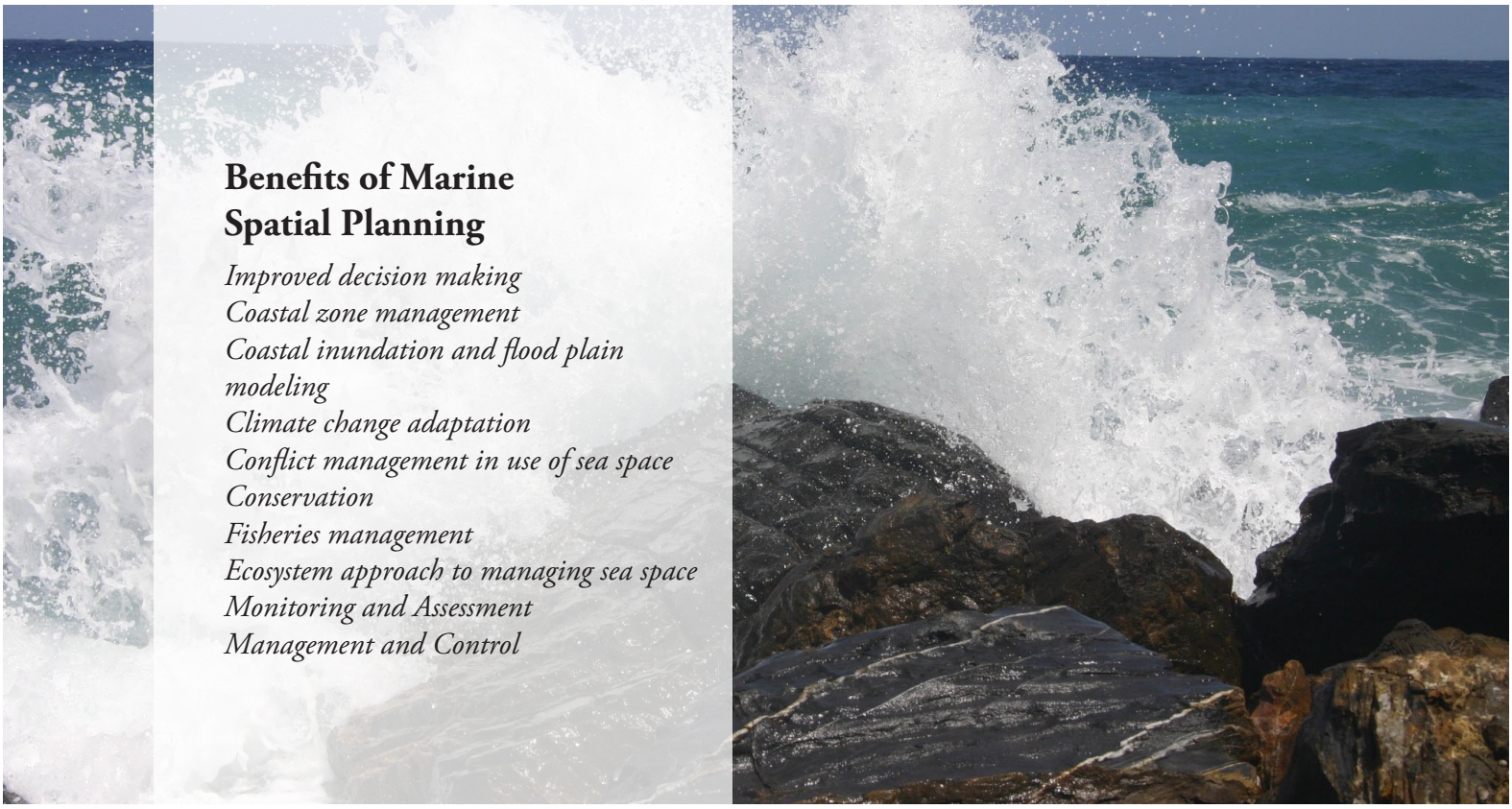
What is Marine Spatial Planning?

Marine Spatial Planning is an adaptive, integrated, ecosystem-based transparent spatial planning process based on sound science. It is being developed for analyzing current and anticipated use of off shore, near shore and coastal "space". MSDI is the framework of information and processes which informs MSP decision making. In doing so, it provides the evidence to support plans for development in the most suitable sites for a range or class of activities. It provides the information that will reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, and preserve critical ecosystems to meet economic, environmental, security, and social objectives. In practical terms, MSP provides a public policy process for society to better determine how the ocean and coasts are sustainably exploited and protected now and for future generations.

Governance and statecraft for marine, maritime, ocean and coastal policies are key components of MSP but cannot be delivered effectively without the underlying MSDI. UNCLOS Article 76 defines the different maritime zones and regulates marine sovereignty rights and rights of use in the establishment of extended EEZ, Marine Protected Areas, SOLAS navigation issues, fisheries maintenance, economic value in the coastal system and the identification and monitoring of threats to coastal sustainability.

What are the Constraints to MSDI Development?

Bringing land and sea data together as one continuous surface requires new tools, new data collection, standardization of data specifications, improved data management and dissemination, and education (with a view to ensuring a sustainable outcome). One key area is datum's; because land based mapping and marine based charting use different vertical datum's, a seamless geodetic framework across the littoral zone is difficult to calculate. This presents a significant challenge. However, many other major gaps in knowledge and information exist because of:



Benefits of Marine Spatial Planning

Improved decision making
Coastal zone management
Coastal inundation and flood plain modeling
Climate change adaptation
Conflict management in use of sea space
Conservation
Fisheries management
Ecosystem approach to managing sea space
Monitoring and Assessment
Management and Control

1. Lack of complete, up to date or accurate data
2. No processes to access data
3. Benefits to be gained from MSDI are not understood in many areas of the world
4. Eroding national or organizational technical infrastructures
5. Inadequate data integration and interoperability
6. Lack of relevant processing systems to transform data into useful information
7. Uncertainty over continuity of observations
8. Inadequate user involvement preventing value and benefit being articulated
9. Lack of political will to make it happen
10. Lack of funding and resources
11. Poor cross organizational cooperation

Who should be Interested?

In May 2007 the 17th International Hydrographic Conference directed the establishment of a Marine Spatial Data Infrastructure (MSDI) working group to identify the hydrographic community inputs to National Spatial Data Infrastructures (NSDI). By October 2009 this working group had developed a procedural guide to establishing the role of a national hydrographic authority in MSDI. At the 1st meeting of the Hydrographic Services and Standards Committee in Singapore October 2009; *Spatial Data Infrastructures: "The Marine Dimension" – Guidance for Hydrographic Offices IHO Publication C-17 was approved.*

National Hydrographic Offices are often the national de facto provider of resources to carry out data collection and support required to populate data sets. This is provided through the provision of vessels, oceanographic and bathymetric equipment, marine geodesy capabilities, and qualified personnel. As such, HO's are well placed to provide a key supporting role in the development of MSDI and will lead to the hydrographic office creating opportunities for national engagement by making hydrographic, bathymetric, and coastal zone data available to other national stakeholders who have a mandate that is wider or different than safety of navigation.

This will lead to an increased appreciation of the value in HO information across the wider marine data community and will stimulate a more joined-up approach at the national or regional level with the outcome that the HO will be in the mainstream of spatial data decision making; something many are not at this time. As a result, hydrographic data themes will enjoy wider appreciation and use.

All marine science will benefit from an MSDI as processes that are observed directly will be available to all through data management.

Benefits of this Approach

The success of a strong national or regional MSDI model will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata, and products.

In this sense we are proposing a global approach to promoting MSDI involving the International Hydrographic Organization (IHO), Regional Hydrographic Commissions (RHC's), Intergovernmental Oceanographic Commission (IOC), Global Earth Observation System of Systems (GEOSS), Ocean Observing Initiatives, Integrated Ocean Observing System, the International Federation of Surveyors (FIG) Commission 4 on Hydrography, UN Environment Program (UNEP), Private Industry, and regional maritime stakeholders.

This global workshop approach will assemble domain experts from separate elements of MSDI in one place for the first time to advise on:

1. Support for sustainable, safe, secure, efficient, and productive uses of the ocean, our coasts, including those that contribute to the economy, commerce, recreation, conservation, homeland and national security, emergency response and disaster mitigation, human health, safety, and welfare;
2. Protecting, maintaining, restoring and preserving a nation's ocean, coastal resources and ensure resilient ecosystems and their ability to provide sustained delivery of ecosystem services;
3. Providing for and maintaining public access to the ocean and coasts;
4. Promoting compatibility among uses and reduce user conflicts and environmental impacts;
5. Streamlining and improving the rigor, coherence, and consistency of decision-making and regulatory processes;
6. Increasing certainty and predictability in planning;
7. Enhancing inter-agency, intergovernmental, and international communication and collaboration.
8. Stimulating public education and outreach.
9. Providing practical knowledge in the GIS tools needed to allow a nation to take a more proactive role in the development of an MSDI.
10. Assisting the organizations listed above to realize the vision for the marine environment – clean, healthy, safe, productive and biologically diverse oceans and seas. It is underpinned by the principles of sustainable

development, integrated management, the conservation of biological diversity, robust science, the precautionary principle and stakeholder involvement.

Getting started!

There are **five basic steps** required for establishing a robust MSDI:

1. **National MSDI Stakeholder Workshop**
   The first step towards a constructive process for creating an MSDI is to engage in a forum which creates a common vision, identifies challenges, and enhances capacity for its implementation.
2. **Establish National MSDI Planning Coordination**
   Gain national support through the development of an inclusive and comprehensive national MSDI planning body to establish national objectives and define the programme.
3. **Establish a National Data Information Management System**
   Standardised core reference data sets are key components to the establishment of the MSDI element of the national spatial data infrastructure (NSDI). They must be publicly available, easily accessible and can be shared and exchanged with MSDI stakeholders.
4. **Public Outreach and Engagement with Stakeholders**
   Informing and communicating with the user community and public are critical to effective implementation. This achieves the development of knowledge, skills and understanding of the value and benefits of MSDI.
5. **Sustainability**
   Making sure that the MSDI is delivered in a sustainable manner and that progress and development is monitored and reported against key targets.

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