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Critical issues relating to the integration of land and marine geospatial information

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Report of the Secretariat

Summary

The present paper contains the report for consideration on critical issues relating to the integration of land and marine geospatial information. At its second session, held in August 2012, the Committee of Experts on Global Geospatial Information Management noted the importance of the world's seas, oceans and coastal waters as a significant global resource that was neither well mapped nor integrated with land geospatial information. The Committee of Experts also noted the lack of harmonized land and marine geospatial data and access policies, and the need for closer working relations between land and marine geospatial data creators in Member States. The report, supported by background papers prepared by the International Hydrographic Organization and the International Federation of Surveyors, describes the importance of hydrographic information as a fundamental prerequisite to the development of successful economic and environmentally sustainable human activities; the need for Governments to place greater emphasis on the mapping of the world's seas, oceans and coastal waters; the lack of harmonized land and marine geospatial data access and policies, and the challenges of integrating land and marine geospatial information; and the common existence of non-matching geospatial data sets (topographic maps and nautical charts), resulting from differing vertical datums, symbologies and generalization issues. The Committee of Experts is invited to take note of the report and to express its views on the way forward in order to facilitate the integration of land and marine geospatial information so that planning, management and solutions can be identified for Member States in a seamless, interoperable and holistic way.

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I. Introduction

1. At its second session, held in August 2012, the Committee of Experts on Global Geospatial Information Management noted the importance of the world's seas, oceans and coastal waters as a significant global resource that was neither well mapped, nor integrated with land geospatial information. The Committee also noted the lack of harmonized land and marine geospatial data and access policies, and the need for closer working relations between land and marine geospatial data creators in Member States. In adopting decision 2/103 (E/2012/46) the Committee welcomed the suggestion for the International Hydrographic Organisation (IHO) and the Committee to collaborate on examining the issues, and report their findings at the third session of the Committee. The IHO and the International Federation of Surveyors (FIG) were invited to submit background papers to inform the issue.

2. It has been recognized that land and marine geospatial data must be interoperable. In November 2005 and February 2007, under the auspices of the International Hydrographic Organisation (IHO), workshops on the integration of land and marine information were held in Germany and Havana respectively. In March 2007 another land and marine information integration workshop was convened in Ireland. The need for land and marine data integration has also been supported by regional geospatial bodies. In 2006, at the 17th United Nations Regional Cartographic Conference for Asia and the Pacific (UNRCC-AP), the inclusion and development of a marine administration component as part of a seamless spatial data infrastructure to "ensure a continuum across the coastal zone" was suggested.

3. This report, supported by two background documents submitted by the International Hydrographic Organization (IHO) and the International Federation of Surveyors (FIG), describes the importance of hydrographic information as a fundamental prerequisite to the development of successful economic and environmentally sustainable human activities; the need for governments to place greater emphasis on the mapping of the world's seas, oceans and coastal waters; the lack of harmonized land and marine geospatial data access and policies, and the challenges of integrating land and marine geospatial information; and the common existence of non-matching geospatial data sets (topographic maps and nautical charts), resulting from differing vertical datums, symbologies and generalization issues. The Committee of Experts is invited to take note of the report and to express its views on the way forward. Points for discussion and decision are provided in paragraph 11.

II. The importance of integrating land and marine geospatial information

4. It is estimated that three billion people live within 200 kilometres of the world's coasts, and that this figure may double by 2025, resulting in serious pressure on the land and marine environment. The coastal zone and the world's seas and oceans constitute one of the most productive resources for many industries including, aquaculture, shipbuilding, telecommunications, defence and security, tourism, transportation, transshipment/port services, offshore oil and gas production, and desalination and water treatment. The consistent and effective management of these very important resource areas is of fundamental importance to Government's globally. An essential requirement therefore, is having access to reliable, comprehensive and accurate geospatial information covering the coasts, oceans and seas. No human activity can take place

beside, in, on or under the sea in a safe, sustainable and cost effective way without the use of hydrographic and land information.

5. The world's coasts, oceans and seas are subjected to the damaging consequences of sea level rise and shoreline erosion, over fishing, pollution, waste disposal and destroyed marine habitats. The increasing use and pressures of commerce and development have necessitated the implementation of protective and conservation measures to maintain and sustain these importance resource areas. The availability of comprehensive coastal and hydrographic geospatial information is indispensable for designing and managing environmental protection measures, supporting economic development activities and the implementation and management of mitigation measures. The integration of land and marine geospatial information is needed so that planning, management and mitigation solutions can be identified along the world's coastlines.

6. The importance of integrating and managing land and marine geospatial information has increasingly become prominent through decisions emanating from regional and international meetings and policy directives of Governments. The increasing pressure from global issues such as climatic, environmental and demographic changes and sectoral activities in the near coastal and coastal areas, which have resulted in severe coastal degradation. These pressures contrast with the need to maintain the high economic value of coastal and marine activities (fishing, tourism, transportation, and telecommunication industries) and the social value of these areas to support the quality of life of millions of people. Central to address all these activities is the need to generate, integrate and have access to, geospatial data sets in both the land and marine sectors. Ideally, this requires an integrated geospatial management framework that incorporates all of the required information for all of the actors. Many countries have a functional land administration system and at least some kind of marine management system. However, these generally operate as separate entities and thus can cause conflict within the coastal zone or the land-sea interface, as they are not interoperable and simply do not communicate with each other.

III. The issues

7. While many Member States, particularly those in Europe, are aware of the problems associated with disconnected land and marine geospatial information, few have committed to resolve them given the complexities and the lack of funding to support the necessary work to be done. The background papers provide by the IHO and FIG argue that there are a multiplicity of technical, policy and institutional issues which have affected the progressive integration of land and marine geospatial datasets. The following issues have been identified:

- (a) There are little or no hydrographic data and high resolution maps and charts for many parts of the world's seas and oceans, particularly in the Caribbean, Indian and Pacific Oceans and Polar regions. The need for current and comprehensive nautical charts become greater in these areas given the increasing presence of deeper draught shipping, larger vessels and the increasing tendency of cruise liners to seek new routes, and anchorages. Some associated issues are the lack of detailed underlying information, data generalisation and conservative depths on nautical charts, which all make their use very limited.
- (b) The infrastructure supporting the creation of nautical maps and charts has been dwindling, particularly in developing States where funding is limited. This has contributed to fewer surveying vessels being operated and existing nautical charts and maps are not being continuously updated or new ones prepared.

- (c) Heterogeneous and non-matching data sets (topography and nautical charts) are an inherent problem due to the 'digital divide' in the marine data framework and across the marine and land data sets. Within the marine data sets, for example, most nautical charts are a data-mosaic of information derived from many sources with various and often wide-ranging differences in quality of position, depth and reliability. Land mapping and nautical charting have developed separately to address different categories of users. Therefore, the integration of geospatial information collected on both sides of the coastline becomes a tedious operation. Differences to be taken into consideration are the definition and delineation of the coastline, incompatibility of data formats, spatial reference systems (horizontal datum, vertical datum and coordinate system), data accuracies, scale of data source, feature or object definition, resolution or data acquisition method, and data modelling. Table 1 provides a comparative list of typical differences across both the land and marine data sets.

Table 1: Examples of elements affecting the integration of land and marine geospatial data

Items	Topographic Map	Nautical Chart
Coastline	Taken from aerial photograph (line at which land and water meet at time of exposure)	High tide water level
Horizontal datum	Indonesian Datum 1974 (for map published prior to 1996) WGS 84 (for map published from 1996 on)	Bessel 1841 WGS 84
Vertical Datum	Mean Sea Level (MSL) for land elevations. - no depth information	Mean Sea Level (MSL) for land elevations. - Chart Datum for depth information (e.g. Low tide water level).
Projection system	Universal Transverse Mercator (UTM).	Mercator
Digital Storage Format	Various format (DWG, ARC, SHP)	S57 files
Scale	Systematically (1 to 10K, 25K, 50K, 100K, 250K).	Not Systematically (range from large scale to small scale)

- (d) A lack of implementation of existing international standards and guidance for terrestrial geospatial data and metadata makes it cumbersome to easily harmonise land-based and maritime geospatial datasets.
- (e) In many countries the national organizations or institutions (mapping agency, land management, hydrographic office, etc.) are separate entities, creating geospatial data for their own individual purposes and using their own technical specifications without considering that the data may be shared or distributed to wider communities. This results in independent silos of information and information cultures which work against sharing of multi-disciplinary geospatial information. A great volume of coastal/marine data is therefore collected by a

plethora of government and private agencies which are not readily shared or made accessible.

- (f) A lack of harmonized geospatial marine data access policies within Government and across nations. In countries with strong 'freedom of information' cultures, such as the USA, some public sector marine information is not disclosed due to fear of liability actions against the data providers.
- (g) The need to clearly identify fundamental geospatial data sets to support the management of the coast and marine environments. The IHO Marine Spatial Data Infrastructure Working Group has identified the following marine data sets that are typically needed to support geospatial information management of the world's coasts, seas and oceans: seabed topography, geology, marine infrastructure (bathymetry, wrecks, offshore installations, salinity, waves, water quality, pipelines and cables), administrative and legal boundaries, areas of conservation, marine habitats and oceanography. Consideration must also be given to the fact that the marine environment is temporal and dynamic, the third dimension is used more widely in marine than on land, and abstractions are relied upon more so than on land (e.g. predictions of tides).

IV. Recommendations

8. Both background papers identify that global action is needed to substantively address the challenges of integrating land and marine geospatial information. There is a clear need to effectively manage the coastal zone as well as the need for integration of data between the land, coast and marine environment. This will require a new generation of management and knowledge-based system that incorporates many facets. The technical issues are being worked through by Member States and international bodies. This has been made possible through advances in the number, types and capacities of platforms and sensors together with volunteered geospatial information. However, there remains the challenge of standardization of data collection and management practices in the coast and marine environment. Special note has been made of the fact that policy-willingness and people-readiness are needed to ensure that institutions and jurisdictions collaborate to consider, develop and build interoperable standards, frameworks and infrastructures for the integration of land and marine geospatial information.

9. The following is a compilation of the recommendations tendered by the IHO and FIG to address the issues surrounding the integration of land and marine geospatial information:

- (a) Create and implement coastal and marine geospatial standards at the national level. This will ensure that the responsible organizations create geospatial data in the same manner and will ease the integration as well as the sharing and exchange of geospatial data from various sources;
- (b) Encourage the rapid development of stop-gap technologies and measures such as satellite-derived bathymetry and crowd-sourced data, the facilitation of access to data collected by scientific cruises and the consideration of projects aimed at improving ocean mapping with focused priorities. These could all provide significant contributions to the marine component in the development of the global map for sustainable development initiative under the umbrella of the Committee of Experts;
- (c) Regional cooperation organizations should be invited to engage with the relevant Regional Hydrographic Commissions to assess, develop, fund, and

implement capacity building plans in partnership with donor nations and agencies and with industry;

- (d) Coastal States should also ensure that systematic procedures are in place for the transmission of relevant survey data, collected by third parties in waters under their national jurisdiction, to the concerned mapping or charting authority. Diplomatic clearances for surveying and scientific ships, or contracting documents with private companies, should include such requirements. These measures will greatly assist in the updating and improvement of nautical charts, publications and mapping of the oceans and seas more generally;
- (e) Enhance land and marine institutional coordination arrangements and stakeholder collaborations; and
- (f) Strengthen legal frameworks to provide the institutional structure for marine geospatial data sharing, discovery, and access.

10. The Committee of Experts may wish to consider, in collaboration with the IHO, FIG and other international actors, evaluating the need to prepare a standardized and coordinated approach to the integration of land and marine geospatial information inclusive of identifying, sharing and promoting the use of best practices.

V. Points for discussion

11. The Committee is invited to:

- (a) Take note of the report and work done by the IHO and FIG; and**
- (b) Express its views on the way forward in order to facilitate the integration of land and marine geospatial information so that planning, management and solutions can be identified for Member States in a seamless, interoperable and holistic way.**