# Marine geospatial information management

2024

United Nations

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# FOREWORD

In the summary of *The Second World Ocean Assessment*, it is noted that:

> The ocean covers more than 70 per cent of the surface of the planet and forms 95 per cent of the biosphere. Changes in the ocean drive weather systems that influence both land and marine ecosystems. The ocean and its ecosystems also provide significant benefits to the global community, including climate regulation, coastal protection, food, employment, recreation and cultural well-being. Those benefits depend, to a great extent, on the maintenance of ocean processes, marine biological diversity and related ecosystem services.[1]

The United Nations Convention on the Law of the Sea was adopted in 1982 after almost a decade of negotiations and entered into force in 1994. It is often referred to as a "constitution for the oceans". By providing legal certainty, including through the establishment of clear maritime zones, rules for boundary delimitation and a comprehensive dispute settlement system, the Convention has done much to guarantee the peaceful uses of the ocean. Through its provisions on the conservation and management of living and non-living resources, the protection and preservation of the marine environment and the establishment of a regime for the exploration and exploitation of the deep seabed as the common heritage of humankind, it has promoted the equitable, sustainable and efficient utilization of the ocean. In addition, the Convention touches on various aspects of what is now encompassed in the 2030 Agenda for Sustainable Development and its Sustainable Development Goals.

Marine geospatial data and information play a critical role in the implementation of the Convention and support informed decision-making, aimed at the maintenance of ocean processes, marine biological diversity and related ecosystem services.

Marine geospatial data and information underpin the definition of all marine spaces and the regulation of a range of diverse activities carried out at sea and regulated pursuant to the Convention, including: traffic separation schemes

- Submarine pipelines
- Artificial islands, installations and structures
- Living resources, such as fish stocks, marine mammals and sedentary species
- Non-living resources, such as oil, gas and other mineral resources
- Reports on publicly relevant events that occur at sea
- Environmental impact assessments and activities related to the prevention, reduction and control of pollution of the marine environment
- Marine scientific research

Although notable progress has been made in the management of marine geospatial data and information over the past two decades, more work remains to be done to address considerable gaps related to various aspects of marine geospatial data and information globally. The gaps

1 A/75/232/Rev.1.

were identified in *The Second World Ocean Assessment*[2,3] which was an update to the first such assessment, *The First Global Integrated Marine Assessment*,[4] and was focused on the developments and changes known to have occurred since 2015.

Annex I to the present publication contains a summary of the marine geospatial and temporal data gaps that have been identified.

Recognizing the importance of marine geospatial information management, the General Assembly, in paragraph 388 of its resolution 77/248 of 30 December 2022, requested the Secretary-General to prepare a publication on marine geospatial information management.

The goal of the present publication is to promote a better understanding of the role that well-structured, integrated marine geospatial information management, including its infrastructure and systems, populated with reliable, timely and good-quality marine geospatial data, which are standardized, interoperable, integrated and available and accessible for cross-sectoral and multidisciplinary research, policy-development, decision-making and strategic actions, plays in improving the understanding of the challenges related to the sustainable future of the ocean and the planet, and in developing proper risk mitigation strategies.

I would like to express my thanks to Australia, Ecuador, Egypt, France, Greece, Italy, Nigeria, Singapore, Türkiye, the United States of America and the European Union for contributing to this publication, providing examples of marine geospatial data and information management projects (see annex II).

I would also like to express my gratitude to the following intergovernmental organizations that provided contributions (see annex III): the secretariats of the Convention for the Protection of the Marine Environment of the North-East Atlantic, Convention on Biological Diversity, Food and Agriculture Organization of the United Nations, Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization, International Hydrographic Organization, International Seabed Authority, Pacific Community and United Nations Development Programme.

2 *The Second World Ocean Assessment: World Ocean Assessment II* (United Nations publication, 2021).

3 Concerned by the declining state of the ocean, States Members of the United Nations, through the General Assembly, established the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects. The aim of the Regular Process is to provide an evaluation of the state of the global ocean, the services that it provides and the human activities that influence its state. The Regular Process is in its third cycle (2021–2025), with the first and second World Ocean Assessments published in 2016 and 2021, respectively. For more information, see www.un.org/regularprocess/.

4 Group of Experts of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socioeconomic Aspects, *The First Global Integrated Marine Assessment: World Ocean Assessment I* (New York, United Nations, 2016).

João Miguel Ferreira de Serpa Soares
Under-Secretary-General for Legal Affairs and United Nations Legal Counsel
Office of Legal Affairs

# ACKNOWLEDGEMENT

In January 2023, in a letter to States Members of the United Nations and intergovernmental organizations, the Office of Legal Affairs drew attention to paragraph 388 of General Assembly resolution 77/248 of 30 December 2022 on oceans and the law of the sea, requesting the Secretary-General to issue a publication on marine geospatial information management. Member States and intergovernmental organizations were invited to nominate experts to assist the Secretary-General in drafting the publication.

In response, Member States nominated the following experts:

| *Expert* | *Nominating State* |
|---|---|
| María Dolores Alvarez (Vice-Chair) | Argentina |
| Mark Alcock (Chair) | Australia |
| Nsengiyunva Nadine | Burundi |
| Juan Pablo Benavides Monsalve | Chile |
| Andrea Baquerizo Torres | Ecuador |
| Julien Smeeckaert | France |
| Gabin Sogorb (alternate) | France |
| Boris Dorschel | Germany |
| Christina Pandermaraki | Greece |
| Dimitris Sakellariou (alternate) | Greece |
| Stellamaris Muthike (Vice-Chair) | Kenya |
| Hemanaden Runghen | Mauritius |
| Kamil Rybka | Poland |
| Nataly Kolchina (alternate) | Russian Federation |
| Alexey Shapoval | Russian Federation |

The intergovernmental organizations nominated the following experts:

| *Expert* | *Nominating intergovernmental organization* |
|---|---|
| Chee Hai Teo | Department of Economic and Social Affairs, United Nations |
| Emmanuel Blondel | Food and Agriculture Organization of the United Nations |
| Yong Baek | International Hydrographic Organization |
| Kioshi Mishiro | International Seabed Authority |
| Peter Pissierssens | Intergovernmental Oceanographic Commission, United Nations Educational, Scientific and Cultural Organization |
| Chris Moulton | OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic |
| Malakai Vakautawale | Pacific Community |

The group of experts held 16 online meetings and one in-person meeting, which was held in New York from 13 to 17 November 2023. The following experts attended the in-person meeting:

| *Expert* | *Nominating intergovernmental organization* |
|---|---|
| Mark Alcock (Chair) | Australia |
| Gabin Sogorb (alternate) | France |
| Boris Dorschel | Germany |
| Hemanaden Runghen | Mauritius |
| Kamil Rybka | Poland |
| Chee Hai Teo | Department of Economic and Social Affairs, United Nations |
| Emmanuel Blondel | Food and Agriculture Organization of the United Nations |
| Kioshi Mishiro | International Seabed Authority |
| Chris Moulton | OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic |

In addition, the following staff members of the Division for Ocean Affairs and the Law of the Sea of the Office of Legal Affairs participated in the drafting of the publication: Robert Sandev, Senior Geospatial Information Officer and project coordinator; Luigi Santosuosso, Senior Legal Officer; Michael Shewchuk, Legal Officer; Shawn Stanley, Geospatial Information Officer; Emily Cikamatana, Geospatial Information Officer; Catherine Harwood, Legal Officer; Snježana Žaric, Geospatial Information Officer; Michael Moffat, Associate Legal Officer; Christine Nabwire, Library Assistant; Akanksha Pandey, Geospatial Information Assistant; Farah Ouirghimmie, intern; and Elizabeth Nwarueze, intern.

# I. INTRODUCTION TO GEOSPATIAL INFORMATION MANAGEMENT

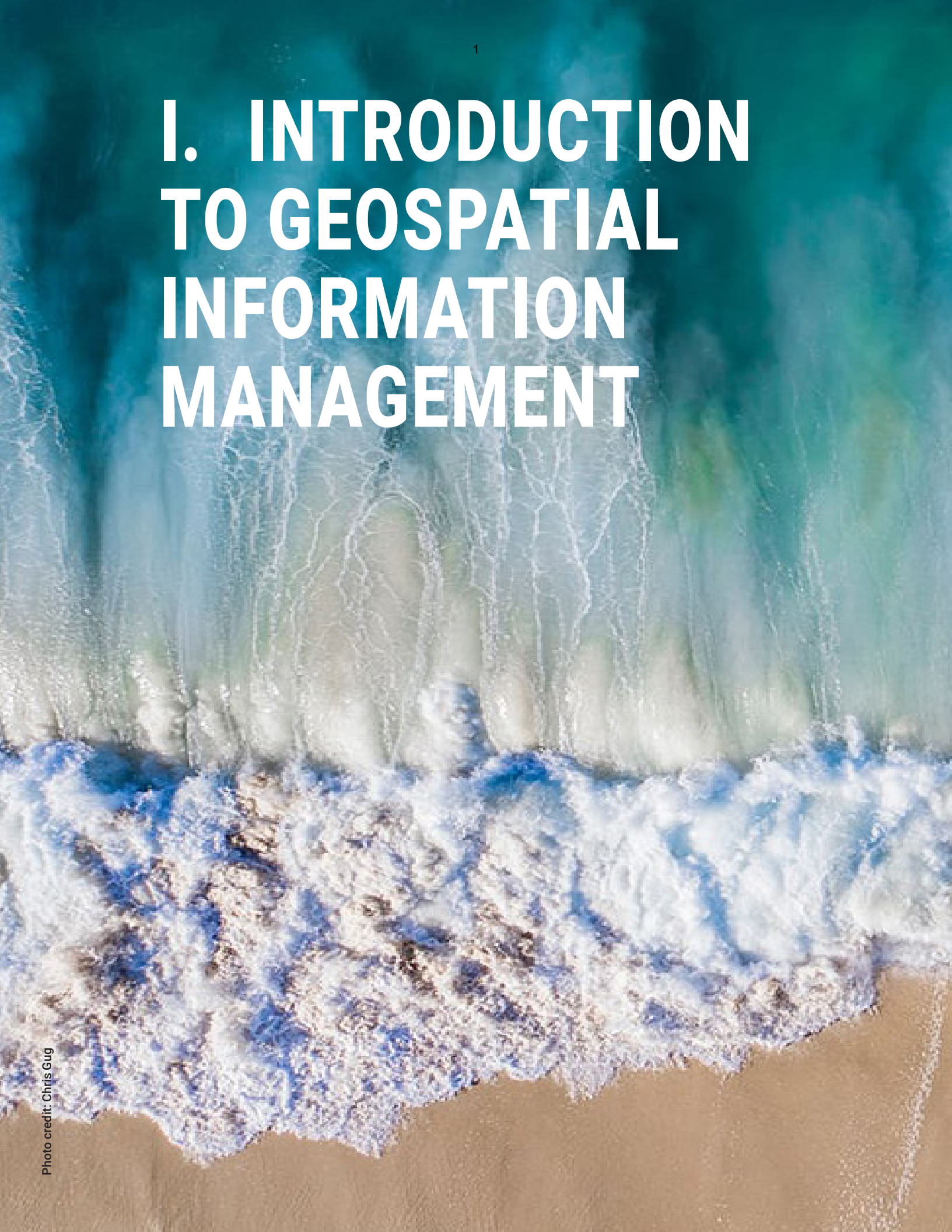


Photo credit: Chris Gug

# A. What are marine geospatial data and information?

All human activities, environmental, biological and geological processes and the reality of ecosystems on Earth, including what is on, above and below the surface of the sea, land and the atmosphere above them, exist at a place and time. The term "geospatial information" describes the recording by humans of that information in order to understand the world and the consequences of human actions and to inform decisions on the sustainable use of its resources. Although it is possible to capture such information in many forms, the present publication is focused on marine geospatial data and information that can be used in electronic forms, in particular within geographic information systems.

Noting that there are various perspectives and definitions of geospatial data and information and following the practice of the United Nations Integrated Geospatial Information Framework, the terms "geospatial data" and "geospatial information" are used interchangeably in general contexts. In specific instances, "geospatial data" refers to observations or measurements; "geospatial information" refers to data that have been processed, organized, structured and presented.

# B. Why are marine geospatial data and information important?

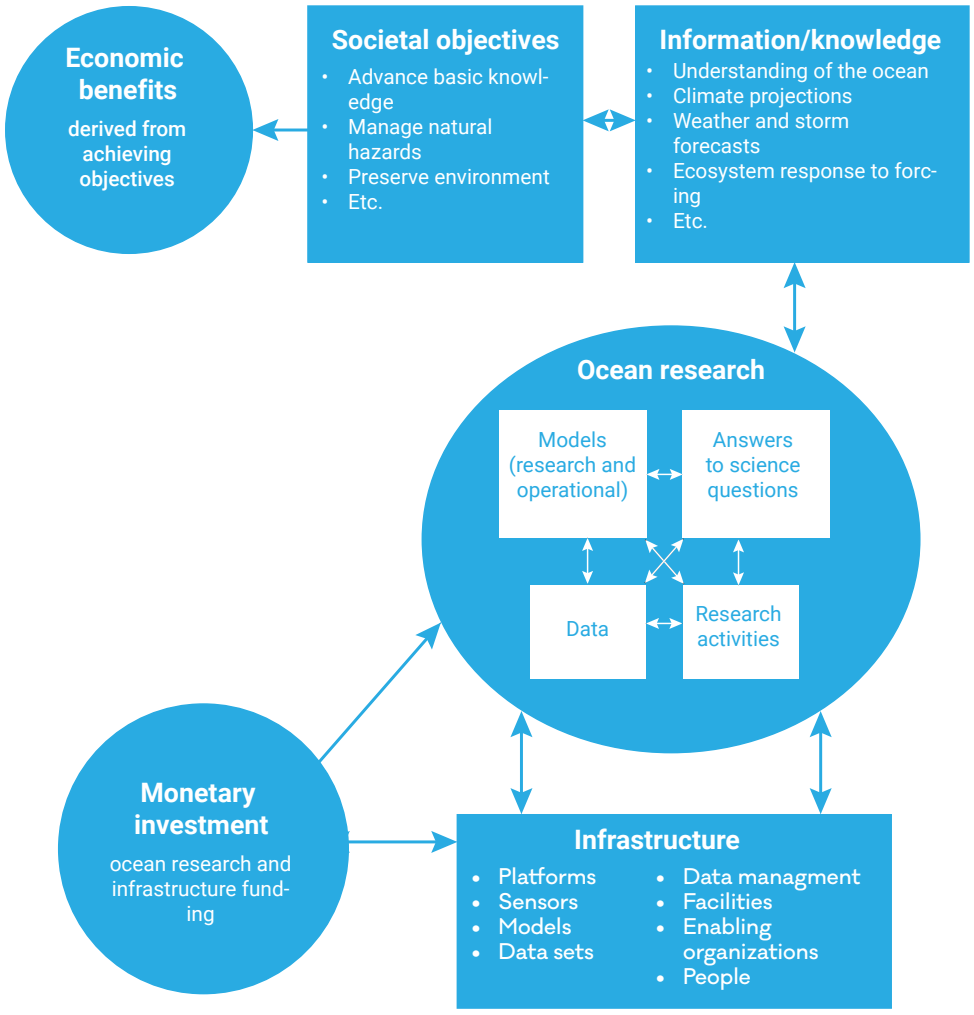
Geospatial data and information are crucial for informed decision-making around the three pillars of sustainable development: society, the economy and the environment. Links among ocean infrastructure, scientific research and relevant societal objectives and their associated benefits are illustrated in figure I.

To be able to respond to current challenges, decision makers must have access to reliable, high-quality and timely geospatial information. Having that information benefits society, given that it

enables the efficient allocation of resources and contributes to achieving the 2030 Agenda for Sustainable Development and its Sustainable Development Goals.

Figure I

**Links among ocean infrastructure, scientific research and relevant societal objectives and their associated benefits**




*Source:* National Research Council, *Critical Infrastructure for Ocean Research and Societal Needs in 2030* (Washington, D.C., National Academies Press, 2011).

## C. What is marine geospatial data and information management?

The mass use of geospatial data and information in a digital format requires proper management to optimize their use and exchange. Geospatial data and information management encompasses the leadership, resources, structures, partnerships and practices required for the successful operation of geographic information systems within an entity, nationally, regionally or globally. Those elements are important to the expression of regulatory and planning processes. From the maritime perspective, leadership in geospatial information management drives a transformative approach that makes it possible to harmonize information collected from land and sea, inland waters and other water areas or surfaces.

Technological advances have been driven by the widespread use of marine geospatial data and information in recent years, promoting automation in the capture and management of information through geographic databases driving efficiencies in mapping, modelling and marine governance.

Strategic pathway 4 of the United Nations Integrated Geospatial Information Framework – with its four focus areas of data themes; custodianship, acquisition and management; data supply chains; and data curation and delivery – helps to establish guidelines and best practices for the collection and management of integrated geospatial information.[1] The objective is to encourage geospatial data custodians to comply with standards on the management, exchange and reuse of geospatial information, and encourage users to organize, plan, acquire, integrate, curate, publish and archive the data. Those good geospatial information management practices should be aligned with standards that facilitate data and technology interoperability, and thus provide integrated information for various geographic information systems.

## D. Data principles in the context of marine geospatial data and information management

The principles that data are findable, accessible, interoperable and reusable – known as the FAIR guiding principles[2] were developed to improve the management and stewardship of scientific data and are generally applicable to marine geospatial data and information, and thus support the improved and rigorous management of that data and information. Adhering to those principles can be considered necessary for the proper

1 For more information on the strategic pathways, see https://ggim.un.org/UN-IGIF/part2.cshtml.

2 For more information, see Mark D. Wilkinson and others, "The FAIR guiding principles for scientific data management and stewardship", Scientific Data (March 2016). Available at https://doi.org/10.1038/sdata.2016.18.

Photo credit: Simon Lorenz

management of marine geospatial data and information. Knowing that it is desirable but rare for data to be entirely findable, accessible, interoperable and reusable, a stepwise improvement starts with making data more findable. The increased findability of data will significantly improve marine geospatial data and information management.

Principles concerning collective data benefit, authority to control, responsibility to control and ethics – known as the CARE Principles for Indigenous Data Governance[3] – were drafted in response to the current movement towards open data and open science, which is not fully aligned with the rights and interests of indigenous peoples. Existing principles within the open data movement, such as the FAIR guiding principles, are primarily focused on the characteristics of data that will facilitate increased data-sharing among entities and do not give consideration to power differentials and historical contexts. The emphasis on greater data-sharing alone creates tensions for indigenous peoples who are asserting greater control over the application and use of indigenous data and knowledge for collective benefit.[4] For many indigenous communities, the oceans are central to their culture. Communities in and around the Pacific Ocean, in particular, are demanding greater consideration of their interests in decisions about the use of the oceans.

The CARE Principles are a framework that is relevant not only to indigenous peoples but, more broadly, to any initiatives that involve bringing data from the local to the global levels, which demands that consideration be given to the interests of the data creators, whether they are local communities or national entities in developing States. Setting aside the ethical aspects of the CARE Principles, such consideration should be treated as an overarching principle, given that data aggregation almost always requires an investment from the creator. Without considering mutual benefit, no system of global data access can be successful.

3 For more information, see the web page on the CARE Principles for Indigenous Data Governance, of the Global Indigenous Data Alliance. Available at www.gida-global.org/care.

4 For more information, see the flyer on CARE Principles for Indigenous Data Governance. Available at www.gida-global.org/s/CAREPrinciples_OnePagersFINAL_Oct_17_2019.pdf.

# E. Importance of standards and standardization bodies

Standards help producers, custodians and users of geospatial data and information to use the same formats and best practices for the acquisition, stewardship, content interoperability and distribution of marine geospatial data. The success of a global geospatial data and information system relies on the implementation of standardized practices and formats.

There are many benefits to standardization. Some examples of organizations and their contributions to the implementation of the FAIR guiding principles are as follows:

(a) Findability: the International Organization for Standardization and its standard 19115, on geographic information metadata, which helps to improve the findability, or discoverability, of data;
(b) Accessibility: the Open Geospatial Consortium, for data exchange on the Internet, facilitates accessibility of data through the technologies that support online mapping applications;
(c) Interoperability: the World Meteorological Organization (WMO) and its standards for the collection and codification of weather observations support the compilation of global weather predictions in real time;
(d) Reusability: the Society of Exploration Geophysicists and its standards for data acquisition and encoding allow for the preservation and reuse of field and processed marine geophysical data.

The success of standardization depends on coordination bodies that create, implement and promote the standards. The bodies can be regional, national or international organizations, such as the International Organization for Standardization, they can be industry-based, such as the Open Geospatial Consortium, or they can be thematically based, such as the World Register of Marine Species.

Examples of bodies and initiatives that successfully develop and promote standards for marine geospatial data and information are:

(a) International Organization for Standardization, which has introduced standards ISO 19115, on geographic information metadata, and ISO 19152, on land administration domain model, in particular part 3 on marine georegulation, and its technical committee ISO/TC 211, on geographic information and geomatics;
(b) Food and Agriculture Organization of the United Nations (FAO), which coordinates standards for fisheries;

(c) International Hydrographic Organization, which has a principal aim to ensure that all the seas, oceans and navigable waters of the world are surveyed and charted, thereby supporting the safety of navigation and the protection of the marine environment, and its Maritime Limits and Boundaries Product Specification (S-121) (version 1.0.0), developed in response to General Assembly resolution 59/24.[5]

(d) WMO, the international standardization organization in the fields of meteorology, hydrology, climatology and related environmental disciplines;

(e) Intergovernmental Oceanographic Commission, through its International Oceanographic Data and Information Exchange programme, has been cooperating with WMO on an ocean data standards project, disseminating and promoting best practices and standards;

(f) Ocean Biodiversity Information System, a global open-access data and information clearing house for marine biodiversity for science, conservation and sustainable development;

(g) Darwin Core, a standard maintained by the Darwin Core Maintenance Interest Group, which includes a glossary of terms intended to facilitate the sharing of information about biological diversity by providing identifiers, labels and definitions and is primarily based on taxa and their occurrence in nature, as documented by observations, specimens, samples and related information;

(h) World Register of Marine Species, which provides an authoritative and comprehensive list of names of marine organisms, including information on synonymy, according the highest priority to valid names, although other names in use are included, in order that the register can serve as a guide for interpreting taxonomic literature led by taxonomic and thematic experts;

5 In paragraph 6 of the resolution, the Secretary-General was requested to improve the existing geographic information system for the deposit by States of charts and geographical coordinates concerning maritime zones, including lines of delimitation, in particular by implementing, in cooperation with relevant international organizations, the technical standards for the collection, storage and dissemination of the information deposited, in order to ensure compatibility among the geographic information system, electronic nautical charts and other systems developed by those organizations. Version 1 of the product specification was finalized for testing in December 2018. Subsequently, in paragraph 6 of its resolution 74/19, of 10 December 2019, the General Assembly noted the ongoing cooperation and progress achieved in the development by the International Hydrographic Organization, in cooperation with the Division for Ocean Affairs and the Law of the Sea, of the technical standards for the collection, storage and dissemination of the information deposited, which are not legally binding, in order to ensure compatibility among geographic information systems, electronic nautical charts and other systems, and re-emphasized the importance of the completion of those efforts through wide participation and reviews by Member States. Although no State is required to use S-121 in whole or in part, the submission of deposited material in a widely shared and recognized standardized format is highly desirable, in order to achieve the objective outlined in General Assembly resolution 59/24. Standard 19152, on land administration domain model, is the International Organization for Standardization counterpart to S-121 and reflects the knowledge obtained by the development of S-121, resulting in a generic model that allows for the extension of S-121 to be applied to all maritime limits and boundaries, including fisheries, marine protected areas, offshore renewables and petroleum. The development of those standards could support the electronic declaration and deposit of maritime limits and boundaries information and the seamless administration of land and sea through a combined land and marine land cadastre. Both standards are under testing.

(i) Open Geospatial Consortium, a group of experts committed to improving access to geospatial or location information and connecting people, communities and technology to solve global challenges and address everyday needs;
(j) Society of Exploration Geophysicists, a technical standards committee serving as a forum for the discussion of geophysical developments in relation to which standards for the acquisition and processing of geophysical data must be identified or improved;
(k) Infrastructure for Spatial Information in the European Community directive and its themes “sea regions” and “oceanographic geographical features”.

# II. GOING FROM LOCAL TO GLOBAL

Photo credit: Andrea Marandino

Marine geospatial data and information play a pivotal role in understanding and managing the oceans. As such, States have been collecting marine geospatial data and creating information to meet their national needs and address more specific, or localized, environmental, social and economic issues. The oceans, however, are interconnected, and to address regional and global challenges, a holistic view is required. Although it seems logical to use marine geospatial data and information at a broader level, the seamless sharing of marine geospatial data and information from a local to a global level poses significant challenges. The concept of "local to global" encompasses activities, phenomena or perspectives that occur at local, national, regional and global scales.

The fisheries sector is a good example of the wide range of activities that relate to marine geospatial data collection, management and end products. From national fisheries authorities to regional fisheries management organizations and global coordinating agencies, such as FAO, each level has its own role, data format requirements and specific products. The needs and challenges concerning data-sharing across the spectrum, from local to global, are explored in the present section.

# A. Why is there a need to share marine geospatial data and information from the local to the global level?

To tackle regional and global issues, relevant marine geospatial data and information must be available. When coordination is missing at any level of data management, initiatives will serve only the originating level; local data serve local purposes only, and national data serve mainly national purposes. Access to local marine geospatial data and information is critical for national, regional and global decision-making, given that local data and information are usually more detailed, up-to-date and granular than data at any other level.

To use local marine geospatial data and information at the national, regional or global levels, additional data management work is usually needed at all levels to make the data usable. There are obvious benefits in doing that work, including:

(a) Data are available, duplication is prevented and the cost of data collection can be avoided;
(b) Data have multiple uses;
(c) Data collection at the local level is carried out by those with significant local knowledge and is usually of higher granularity;
(d) Data spatial and temporal scope are expanded.

The data flow can be reversed, and data gathered at a higher level can serve national and local purposes.

# B. Challenges of going from local to global

Most of the challenges of going from the local level to the global level can be vastly reduced by partnerships and cooperation on data-sharing (starting at the national level) and by using internationally recognized standards. The list below builds on the report of the Working Group on Marine Geospatial Information of the United NationsCommittee of Experts on Global Geospatial Information Management [6] to summarize the primary challenges to sharing, using and reusing marine geospatial data and information across and between levels, from local to global.

6 Working Group on Marine Geospatial Information, United Nations Committee of Experts on Global Geospatial Information Management, "White paper on readily available and accessible (open) marine geospatial information" (New York, 2020). Available at https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/E-C.20-2020-31-Add_2-White-paper-on-readily-available-and-accessible-marine-geospatial-information-23Jul.pdf.

# 1. KNOWLEDGE OF THE STATUS OF DATA AND INFORMATION

To foster effective collaboration and enhance decision-making among diverse groups of stakeholders across different levels, the status of data and information must be known. Unlocking the wealth of existing marine geospatial data and information at the local, national, regional and global levels relies on two critical components: awareness of and access to available marine geospatial data and information.

With such constraints as mandates, funding and technical expertise, many organizations do not prioritize making known the existence of available geospatial data and information. To complicate matters, with multiple agencies and non-governmental organizations collecting, managing and curating marine geospatial data and information, it is sometimes unclear which entity to contact to access data. The risks of duplication of effort, economic loss, missed economic opportunities and ineffective policy decisions highlight the need for coordination and awareness across all levels. In some circumstances, a legal framework on geospatial data and information management could be a solution. The Infrastructure for Spatial Information in the European Community Directive is an example of such a legal framework established by the European Union.

Accessing data presents distinct challenges across various levels. Regional and global entities typically present marine geospatial data and information online. Sharing such data and information, however, can be challenging for some local or national agencies that have little or no Internet access. Solving the issue will require significant investment to expand information technology infrastructure.

Acquiring marine geospatial data and sharing the data and information come at a cost. To offset the cost, access to marine geospatial data and information can be subject to a fee.

Sharing marine geospatial data and information, in particular with external stakeholders, requires mutual trust among all parties involved. Concerns around such issues as national security, data misuse, intellectual property and economic, cultural and environmental sensitivities can be a barrier to data-sharing and information-sharing initiatives. Chapter IV of the present publication includes a more in-depth analysis of restrictions on access to data and information.

Photo credit: Taryn Schulz

## 2. IMPLEMENTATION OF STANDARDIZATION

A standard is a documented agreement between providers and consumers, established by consensus, that provides rules, guidelines or characteristics for ensuring that materials, products and services are fit for purpose. Standards related to marine geospatial data and information usually cover the characteristics of the data or information described but can include data quality and the methods for creating, managing and exchanging data or the descriptions of equipment used to undertake those tasks. Examples of standards bodies are listed in chapter I, section E. Marine geospatial information management standards could address:

(a) Data semantics (e.g. taxonomy);
(b) Language differences;
(c) Data formats;
(d) Quality issues;
(e) Coordination of reference systems and vertical datum differences;
(f) Accuracy of data requirements;
(g) Access to data, including ways of sharing geospatial data, such as metadata standards;
(h) Chains of reporting and reporting obligations for different bodies.

A further discussion of this topic can be found in the study entitled "A guide to the role of standards in geospatial information management".[7]

7 Open Geospatial Consortium, International Organization for Standardization Technical Committee 211 Geographic Information and Geomatics and International Hydrographic Organization, "A Guide to the Role of Standards in Geospatial Information Management" (n.p., 2015). Available at https://ggim.un.org/documents/Standards%20Guide%20for%20UNGGIM%20-%20Final.pdf.

Photo credit: Alvaro Herrero

## 3. TECHNOLOGY

The task of collecting and managing marine geospatial data and information and the resources needed to do so are inherently connected with technology. The technological challenge is complicated by the fact that technology is constantly evolving. There is an obvious disparity in access to up-to-date equipment and software, owing to varying levels of funding.

The challenges of technological evolution and change are cross-cutting. All stakeholders are affected by growing volumes of data and the need to keep infrastructure and software up-to-date as a result of technological evolution. New or modernized information technology infrastructure and new procedures to archive securely large volumes of data can be used, but continuous investment in infrastructure, capabilities and standards are required.

Predicted future trends in geospatial information management are described in *Future Trends in Geospatial Information Management: the Five to Ten Year Vision* of the United Nations Committee of Experts on Global Geospatial Information Management.[8]

Strategic pathway 5[9] of the United Nations Integrated Geospatial Information Framework is focused on innovation and its potential, cost-effective technologies and process improvements, as well as opportunities to leapfrog.

8 Christin Walter, Ordnance Survey of Great Britain, *Future Trends in Geospatial Information Management: the Five to Ten Year Vision*, 3rd ed. (New York, United Nations Committee of Experts on Global Geospatial Information Management, 2020). Available at https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/Future_Trends_Report_THIRD_EDITION_digital_accessible.pdf.

9 See https://ggim.un.org/UN-IGIF/documents/SP5%20-%20Innovation%204Jul2020%20GLOBAL%20CONSULTATION.pdf.

## 4. CAPACITY DEVELOPMENT

Capacity development empowers individuals and entities with the right skill sets to:

(a) Recognize the relevance and potential applications of marine geospatial data and information;
(b) Collect, manage, process and share necessary marine geospatial data and information;
(c) Ensure compliance with directives, legislation and guidelines;
(d) Liaise with stakeholders.

Strategic pathway 8[10] of the United Nations Integrated Geospatial Information Framework concerns the need for capacity development and education programmes for all levels of government, organizations and communities. Continuous updates on the latest advances in marine geospatial technology, information technology solutions and data-collection methods would ensure an efficient use and reuse of data and information and help the stakeholders involved to adapt to the needs of one another across different levels.

In its "White paper on readily available and accessible (open) marine geospatial information",[8] the Working Group on Marine Geospatial Information of the United Nations Committee of Experts on Global Geospatial Information Management, called for the following:

(a) Development of data-sharing partnerships to facilitate the timely sharing of data among States, government agencies, the research and academic community, private data providers and other users and stakeholders;

10 See https://ggim.un.org/UN-IGIF/documents/SP8-Capacity_and_Education_19May2020_GLOBAL_CONSULTATION.pdf.

11 Working Group on Marine Geospatial Information, "White paper". Available at https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/E-C.20-2020-31-Add_2-White-paper-on-readily-available-and-accessible-marine-geospatial-information-23Jul.pdf.

(b) Implementation of internationally agreed standards, such as those of the International Organization for Standardization, the International Hydrographic Organization and the Open Geospatial Consortium, including standards for metadata, to make data-sharing easier and more discoverable;

(c) Collection and management of marine geospatial data with multi-use purposes in mind, and greater stakeholder awareness of the types and locations of information that are available;

(d) Participation in capacity-development opportunities when resources allow, and the active transfer of knowledge, tools and techniques that facilitate the collection, management and sharing of marine geospatial data in developing counterparts.

Photo credit: Patrick Webster

# III. ROLE OF INTERGOVERNMENTAL ORGANIZATIONS IN MARINE GEOSPATIAL INFORMATION MANAGEMENT

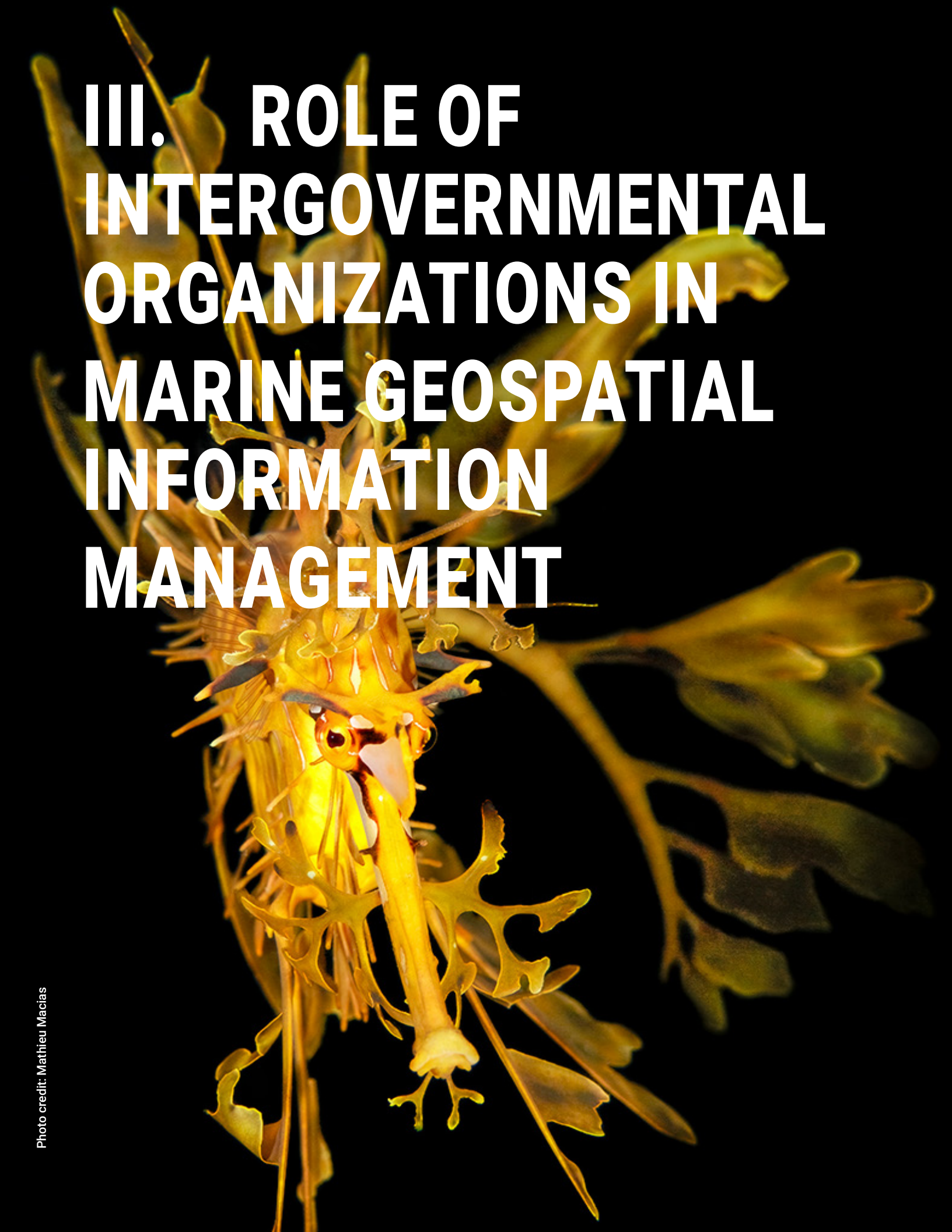


Photo credit: Mathieu Macias

Photo credit: Romeo Bodolai

# A. Collective objectives and supporting actions and activities

Intergovernmental organizations provide a forum in which States coordinate and work collaboratively towards the achievement of common goals. By nature, their role is varied, covering an enormous range of objectives (as demonstrated by the breadth of information presented in annex III). Coordinating efforts, in particular in the marine environment, is critical, given that marine environments span geopolitical boundaries and that transboundary cooperation is the only way to ensure that the Sustainable Development Goals and their targets are reached.

The Goals are a major focus of action and activity for intergovernmental organizations. Such organizations that are concerned with the marine environment refer to Goal 14, on life below water, and its associated targets and indicators, the overall aim of which is to conserve and sustainably use the oceans, seas and marine resources for sustainable development.

Goal 14, target 14.c, is aimed at enhancing the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of General Assembly resolution 66/288, entitled “The future we want”, of 27 July 2012. That legal framework needs reliable and robust

marine geospatial data and information to enable the enhancement of conservation and sustainable use.

The United Nations Decade of Ocean Science for Sustainable Development (2021–2030)[12] is an initiative to stimulate ocean science and knowledge generation in order to reverse the decline of the state of the ocean system and create new opportunities for the sustainable development of the massive marine ecosystem. It promotes the attainment of the targets of Goal 14 by raising awareness and recognizing efforts to achieve the Goal overall.

Intergovernmental organizations coordinate the establishment of standards and their implementation, for example to ensure effective and sustainable data exchange in a timely fashion, which can lead to increased demand for the submission of scientific data and information in a digital, georeferenced format that is compatible with multiple organizations. Intergovernmental organizations will respond to that demand by:

(a) Facilitating common approaches (harmonization);
(b) Promoting standardization, encompassing the inception of new standards, encouraging the development of data descriptions (metadata), fostering data-sharing opportunities and providing implementation guidelines;
(c) Supporting capacity-building;
(d) Providing tools in support of cross-domain and ecosystem approaches to geospatial data and information management.

Such mechanisms help intergovernmental organizations to collate data effectively, from the local to the regional levels, facilitate data exchange, foster collaboration and coordination to address environmental challenges and identify possible knowledge gaps, supporting a multidisciplinary approach for the implementation of effective solutions to achieve transboundary objectives.

In addition, marine geospatial data and information can be provided without any restrictions. More use could be made of the digital public goods initiative,[13] to which the Secretary-General referred in the road map for digital cooperation,[14] his report on the implementation of the recommendations of the High-level Panel on Digital Cooperation.[15] Intergovernmental organizations can help to contribute to sharing without barriers by providing content and encouraging its provision using open data principles. In some circumstances, however, access management will be required, in particular when the organizations are responsible for sensitive data and information (see chapter IV), and in those cases open data access may not be appropriate.

12 See https://oceandecade.org/.

13 See www.un.org/techenvoy/content/digital-public-goods.

14 See www.un.org/en/content/digital-cooperation-roadmap/.

15 A/74/821 para. 78.

Infrastructure for Spatial Information in the European Community and other directives, such as the European Union marine strategy framework directive,[16] provide legal frameworks to encourage the sharing of environmental spatial information among organizations and facilitate better policymaking across boundaries and data domains by promoting the role of intergovernmental organizations in executing those critical functions. For example, the thirteenth preambular paragraph of the marine strategy framework directive provides that: "Where practical and appropriate, existing institutional structures established in marine regions or subregions, in particular Regional Sea Conventions, should be used to ensure such coordination".

## B. Facilitating common approaches

Agreement on common scientific approaches and methodologies forms the foundation of any collective effort. To advance the implementation, development and achievement of agreed objectives, consensus must be reached on technical details, including standards.

Intergovernmental organizations provide the foundation for ensuring that geospatial data and information can be gathered and prepared across the entire area of interest. Standardized approaches should form the basis of efforts, within the mandate of the organizations. The agreed approaches should be made available with a view to promoting transparency and fostering broader adoption. Furthermore, mechanisms should be established for the continuous monitoring and evaluation of the implementation of the agreed approaches to ensure their effectiveness. The harmonization of approaches and methodologies requires a collaborative and inclusive process that reflects the diverse needs and perspectives of all stakeholders involved.

Examples of such harmonization and related actions in practice include:

(a) FAO fisheries management regional data-collection reference frameworks, such as that of the Western Central Atlantic Fishery Commission;[17]

(b) Collective contribution of the International Hydrographic Organization and the Intergovernmental Oceanographic Commission of high-resolution mapping of the international seabed area, including for the General Bathymetric Chart of the Oceans;[18]

(c) Standard reporting and metadata templates of the International Seabed Authority to guide contractors in reporting on deep-sea exploration, including mid-waters, in line with regulations;[19]

16 European Parliament and Council of the European Union, directive 2008/56/EC. Available at https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive_en.

17 See www.fao.org/wecafc/data/dcrf.

18 See www.gebco.net/about_us/seabed2030_project/.

19 See www.isa.org.jm/exploration-contracts/reporting-templates/.

Photo credit: Edwar Herreno Para

(d) Coordinated Environment Monitoring Programme of the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Agreement 2016-01).[20]

## C. Promoting standardization

Leveraging the important role of intergovernmental organizations in promoting the inception, adoption and implementation of standards to their members and partners results in overall "standardization". In marine geospatial data and information management, standardization is driven by several main sources: the International Organization for Standardization, the Open Geospatial Consortium and the International Hydrographic Organization. The International Organization for Standardization and the Open Geospatial Consortium provide the backbone of geographic information standards and are widely used in the United Nations system, by intergovernmental organizations in general and across marine domains. In marine fisheries,

20 See www.ospar.org/documents?v=32943.

standards of those two organizations have been recommended for use by the Coordinating Working Party on Fishery Statistics.[21]

## 1. BUILDING NEW STANDARDS

Standardization is an important tool in the exchange of geospatial data. Building upon the harmonization of methodologies, intergovernmental organizations have a role in coordinating the response to gaps in standards by augmenting existing or creating new standards and promoting their implementation. Standards can include technical specifications for marine geospatial data and products.

Technical specifications have been produced by intergovernmental organizations to address the standardization of marine geospatial information and its exchange, examples of which include, a standard for maritime limits and boundaries of the International Hydrographic Organization (S-121), the United Nations Fisheries Language for Universal Exchange[22] and specifications for the exchange of fisheries geospatial data produced by the Coordinating Working Party on Fishery Statistics.[23]

The publication of available standard reference marine geospatial information products will be central to achieving global objectives, such as the Sustainable Development Goals, and the coordinating role of intergovernmental organizations in that process is crucial in establishing close partnerships and collaborative arrangements with institutions at the national, regional and global levels.

Examples of the successful development by intergovernmental organizations of global geospatial information standardized products, include:

(a) On physical features, the General Bathymetric Chart of the Oceans, operating under the auspices of the International Hydrographic Organization and the Intergovernmental Oceanographic Commission of UNESCO, and the Atlas of Geomorphic Features, of GRID-Arendal and the United Nations Environment Programme (UNEP);
(b) On marine protected areas, the Protected Planet data set[24] of the UNEP World Conservation Monitoring Centre and the International Union for Conservation of Nature;
(c) On other effective area-based conservation measures, the Vulnerable Marine Ecosystems database[25] of FAO, a global inventory of fisheries measures to protect vulnerable marine ecosystems.

21 For more information, see FAO, "Recommended GIS standards". Available at www.fao.org/cwp-on-fishery-statistics/sharing-practices/gis-recommended-standards.

22 See https://unece.org/trade/uncefact/unflux.

23 See www.fao.org/3/cc6734en/cc6734en.pdf.

24 See www.unep-wcmc.org/en/protected-planet.

25 See www.fao.org/in-action/vulnerable-marine-ecosystems/vme-database/en/vme.html.

Building global data sets often implies a custodian role for intergovernmental organizations in pulling data and information from either national or regional sources. Depending on the nature of the data, and their evolution across time, data collation may become challenging and eventually compromise the long-term sustainability of the data sets. Intergovernmental organizations that are custodians of the information must, therefore, play an important coordinating role to ensure that global data sets are maintained into the future.

Some global geospatial marine information products are likely to be crucial for the achievement of the Sustainable Development Goals but are unavailable within the United Nations system or from intergovernmental organizations. For example, there is an absence of a comprehensive global geospatial database on maritime jurisdictions, established to be consistent with the United Nations Convention on the Law of the Sea, including the high seas and the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction.

Among intergovernmental organizations, there is a growing need to use marine geospatial data and information at the global level for the purposes of achieving the Sustainable Development Goals, including, for example, the identification of marine fisheries and stocks for Goal 14. Recently, there has been discussion within FAO through the Fisheries and Resources Monitoring System and the Coordinating Working Party on Fisheries Statistics of the ways to address such needs and to connect to existing standardization initiatives on water jurisdiction areas.

In the long term, the standard for maritime limits and boundaries of the International Hydrographic Organization (S-121) is aimed at addressing those needs by providing specifications for the electronic deposit and exchange of maritime limits and boundaries defined under the United Nations Convention on the Law of the Sea. In the short term, however, intergovernmental organizations and all marine geospatial data and information users must find alternative solutions to manage geospatial domain information without necessarily referring to the Convention.

Digital data on maritime jurisdictions are often needed by fisheries experts to identify and characterize the geographic coverage of stocks and fisheries in the FAO Global Record of Stocks and Fisheries.[26] Separately, a global inventory of reference fishery areas is being developed to support the identification of fisheries. The standard for maritime limits and boundaries of the International Hydrographic Organization is extendable and, therefore, provides an opportunity to draw a path for further standardization of digital information on marine fishing zones. Intergovernmental organizations could play a growing role in marine geospatial information standardization through active

26 See https://i-marine.d4science.org/web/grsf/data-catalogue.

Photo credit: Michael Sswat

and joint participation in international standardization bodies and technical committees, such as technical committee ISO/TC 211 of the International Organization for Standardization and the Open Geospatial Consortium, to prepare the next generation of geographic information standards, in response to community needs. Building profiles, for example for fisheries, under ISO 19115, is one area of work in which intergovernmental organizations may involve themselves.

Intergovernmental organizations must approach standardization in a cross-domain way. Marine geospatial information may be combined with other domains, such as statistical or taxonomic information. For example, the standardization of georeferenced multidimensional catch and effort time series in marine fisheries should take into account geospatial, statistical, taxonomic, fisheries and other domain standards. Standardization of the geospatial information should then be carried out in an open manner to connect with other domains for which different standards apply.

## 2. ENCOURAGING DATA DESCRIPTION (METADATA)

Data set descriptions, known as metadata, are gathered alongside data to aid discovery and to ensure that the usefulness of the data is maximized. Metadata are critical supplementary information describing the data. The principal geographic information metadata standard is standard 19115 of the International Organization for Standardization, which provides schemas to describe geospatial data sets, including their content, identification, distribution, spatial and temporal data coverage, quality and provenance. Best practice requires that metadata be recorded in parallel with the data management steps, from data collection through to dissemination.

Photo credit: Sina Ritter Sina Ritter

Standardized metadata resources can be read by computer systems, which means that the data comply with the FAIR guiding principles.

Although metadata are crucial in describing data, the complexity of geographic information standards makes metadata production difficult for those who are not experts and constitutes a barrier to describing data. Intergovernmental organizations can play a role in introducing simplified information models, with a view to creating minimum requirements that can guarantee that data are described sufficiently. The provision of data with associated metadata with required content allows experts and others to understand the information and ensure the long-term usefulness of the data for the promotion of marine scientific research. The Dublin Core Metadata Element Set[27] is an example of a reference backbone that can be used to implement templates on the basis of such models.

Metadata supports the FAIR guiding principles by providing controlled vocabularies, known as data dictionaries or registers. Intergovernmental organizations have a key role in building a consensus to establish controlled vocabularies. An example of that process is the Fisheries Data Interoperability ad hoc working group[28] initiative, promoted through the Coordinating Working Party on Fishery Statistics and led by the Fisheries and Aquaculture Resources Use and Conservation Division of FAO. In that initiative, reference fisheries digital data sets are developed by multiple intergovernmental organizations, such as regional fisheries management organizations, working together to develop

27 See www.dublincore.org/specifications/dublin-core/dces/.

28 See https://github.com/fdiwg.

geospatial-enabled regional and global fisheries databases, such as the Fisheries and Resources Monitoring System Global Tuna Atlas.29

## 3. FOSTERING DATA EXCHANGE AND DISSEMINATION

Intergovernmental organizations develop standards for data exchange by establishing content and presentation. Managing the presentation of information is especially important for informing non-expert audiences and facilitating consistent decision-making. Effective presentation bridges the gaps between scientific experts, scientific disciplines, decision makers and the public. An initiative that illustrates this process is the FAO Database on Vulnerable Marine Ecosystems,[30] which is based on the geographic and temporal extent of deep-sea fisheries management measures taken by regional fisheries management organizations.

The release and exchange of geospatial marine data and information can be sensitive issues. Intergovernmental organizations play an important role in improving access by negotiating with data owners. The report of the Secretary-General on the road map for digital cooperation provides a pathway for intergovernmental organizations to improve access to high-quality data and information products.[31] Success stories in that regard are presented in annex III to the present publication and include but are not limited to the Global Ocean Observing System,[32] the Array for Real-time Geostrophic Oceanography,[33] launched by the Intergovernmental Oceanographic Consortium and WMO, the International Oceanographic Data and Information Exchange, the close cooperation between the Committee of Experts on Global Geospatial Information Management and the marine spatial data infrastructures working group of the International Hydrographic Organization, and the maritime limits portal of France.[34]

Once data have been collected and assessed and have produced reliable information outputs, with clearly defined data-sharing paths, the data and information can be reused for multiple purposes. Data reuse fosters capacity-building and increases the financial and scientific value of the data, making it possible for others, such as regional organizations, to access and build upon the original work.

Agreeing upon objectives, collecting and assessing data and reaching consensual conclusions on the assessed outcomes require a significant amount of collective work

29 See www.fao.org/3/cc4342en/cc4342en.pdf.

30 See www.fao.org/in-action/vulnerable-marine-ecosystems/vme-database/en/vme.html.

31 A/74/821.

32 See www.goosocean.org/.

33 See https://argo.ucsd.edu/.

34 See https://maritimelimits.gouv.fr/.

and investment, but the rewards that follow extend beyond the level of intergovernmental organizations to include the global community.

## 4. SUPPORTING CAPACITY-BUILDING

Intergovernmental organizations play a critical role in capacity-building programmes and projects through their support for the deployment of marine geospatial information management standardization. The provision of implementation guidelines alongside digital public goods is aimed at facilitating efficient and sustainable capacity-building. Fostering such sustainable capacity-building can encourage the support of national data managers for the development of national marine geospatial data strategies and management plans.

An example of support from an intergovernmental organization for capacity-building is the International Seabed Authority hosting experts from African States selected as part of the Africa Deep Seabed Resources[35] project within the secretariat of the Authority. The project is implemented by the Authority in partnership with the African Union and the Norwegian Agency for Development Cooperation following a joint voluntary commitment registered at the 2017 United Nations Ocean Conference by the Authority and the African Mineral Development Centre of the Economic Commission for Africa (since transferred to the African Union) in support of the sustainable development of Africa's Blue Economy. Secondments build on existing capacity-building initiatives to provide national experts with technical skills on matters related to the deep seabed and help the secretariat of the Authority to benefit from the contribution of those experts to advance specific tasks identified in partnership with the Legal and Technical Commission of the Authority.

The Intergovernmental Oceanographic Commission of UNESCO is another example of support and is aimed at increasing the institutional and professional capacity of States to manage marine research and observation data and information as part of the Ocean Teacher Global Academy[36] of the Commission.

## 5. COORDINATING A CROSS-DOMAIN OR KNOWLEDGE ECOSYSTEM APPROACH

Standardization enables intergovernmental organizations to coordinate across domains and establish a knowledge ecosystem approach, examples of which include:

35 See www.isa.org.jm/capacity-development-training-and-technical-assistance/adsr-experts/.

36 See https://classroom.oceanteacher.org/.

(a) Data catalogues, such as the Ocean Biodiversity Information System,[37] to which intergovernmental organizations, including the International Seabed Authority, contribute, and the Fisheries GeoNetwork Platform[38] of FAO;

(b) Tools for exploring data through specific geospatial data portals, facilitating the discovery and reuse of, and access to, data, such as the GeoInfo[39] map viewer of the Fisheries and Aquaculture Resources Use and Conservation Division of FAO, the OSPAR Data & Information Management System[40] of the OSPAR Commission, the Map and data service of the Baltic Marine Environment Protection Commission[41] and the protected areas impact maps of FAO and UNEP;

(c) Information hubs, which are aimed at presenting generalized marine information, including geospatial information, such as the Ocean InfoHub Project[42] established by the International Oceanographic Data and Information Exchange of UNESCO.

37 See https://obis.org/2021/06/10/isa.

38 See www.fao.org/fishery/geonetwork/.

39 See www.fao.org/fishery/geoserver/geoinfo/.

40 See https://odims.ospar.org/.

41 See https://helcom.fi/baltic-sea-trends/data-maps/.

42 See https://oceaninfohub.org/.

# IV. MANAGING RESTRICTIONS TO DATA ACCESS

Photo credit: Tom St George

# A. Restrictions on access to marine geospatial information and related consequences

Access to information enables its reuse, providing far-reaching benefits for the wider community and often benefiting areas of work beyond those for which the data were initially collected. Although open access to marine geospatial data and information provides the greatest economic and reuse potential, there are legitimate reasons for data to be placed under restricted access. In those cases, the sensitivities of the data owners must be respected, but access under the least restrictive terms should be encouraged. Areas under which legitimate barriers to access may remain are described below.

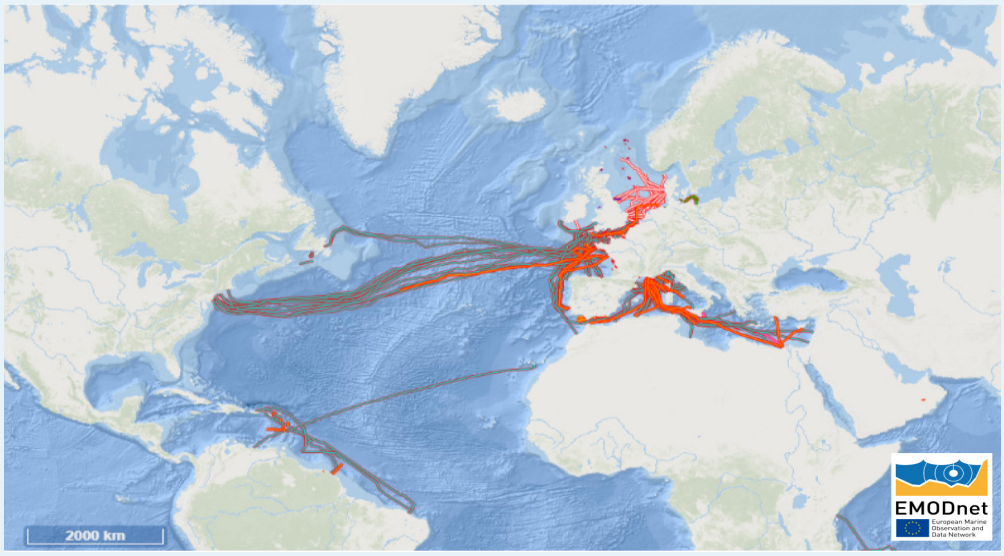
## 1. SECURITY

The release of detailed information on matters that are considered by a State to be sensitive for reasons of national security will likely have some access constraints. Sensitive data and information could include information related to military facilities and activities and critical infrastructure, such as submarine cables and pipelines. Bathymetry and detailed hydrographic soundings are considered to be sensitive by many States.

For critical infrastructure, such as submarine cables, there will often be a need to find a balance between keeping its location confidential and protecting it from unintentional damage by those who have a legitimate interest in working near it. An example of where this issue has been addressed is the legal obligation under the United Nations Convention on the Law of the Sea, which governs future exploitation of seabed minerals in the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction, and which provides an obligation to protect submarine cables on the seafloor. For the regulator and miners to be adequately protected and to prevent any unintended interference with the infrastructure, the cable operators must share information about the position of submarine cables with the regulator. The onus to exchange information has been enshrined in a memorandum of understanding between the International Cable Protection Committee and the International Seabed Authority.[43] An example of a map showing the approximate positions of telecommunications cables is provided in figure II.

43 See www.isa.org.jm/wp-content/uploads/2022/04/MOU-ICPC.pdf.

Figure II
**Map of telecommunications cables limited to approximate positions**

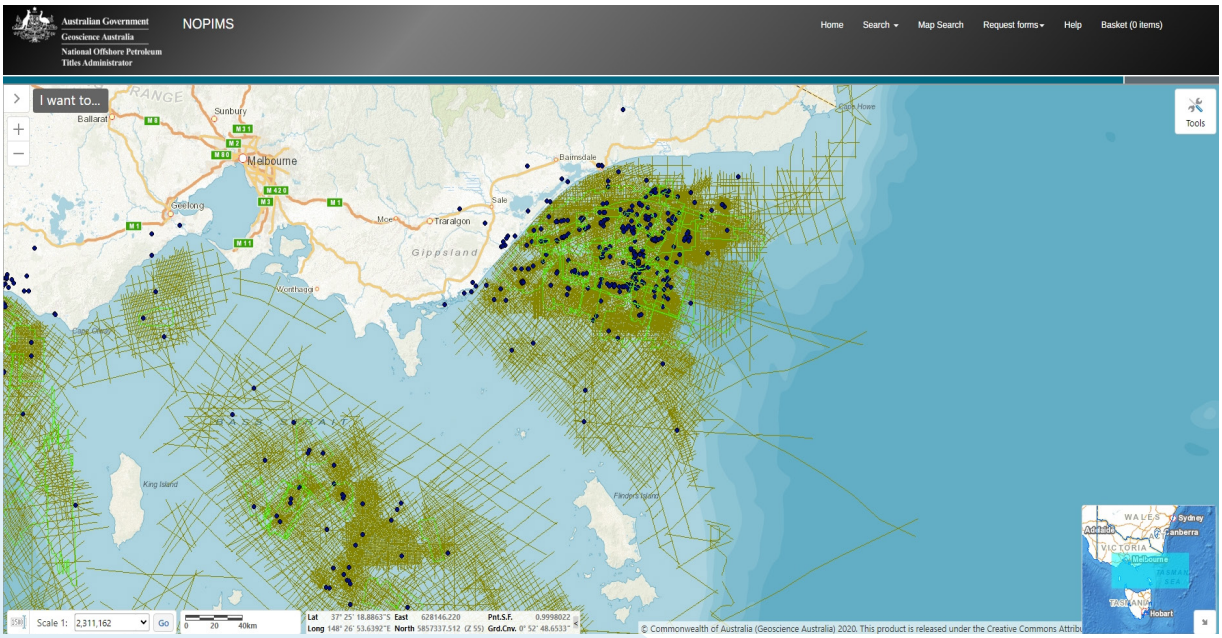



*Source*: European Marine Observation Data Network Map Viewer. Available at https://emodnet.ec.europa.eu/geoviewer/.

## 2. ECONOMY

Data collected by private companies may have value for purposes other than that for which they were originally collected, including for safe navigation, marine environment protection and other public goods. In almost all cases, the data will be protected by intellectual property rights requiring the consent of and, in some cases, financial compensation to their owner for access. Surveys by oil companies often include information that is valuable for safe navigation or may be valuable for the management or economic development of marine resources beyond the original exploration goals. Several models for providing access to these data have been developed, each dependent on applicable national legal frameworks. In some cases, a secondary industry may be developed to obtain commercial value from the resale of the data; in others, it may be necessary to provide exploration data to the State for public release after a statutory embargo period, such as in Australia for offshore petroleum data, where seismic and well data that are out of embargo are accessible through the National Offshore Petroleum Information System, as shown in figure III.

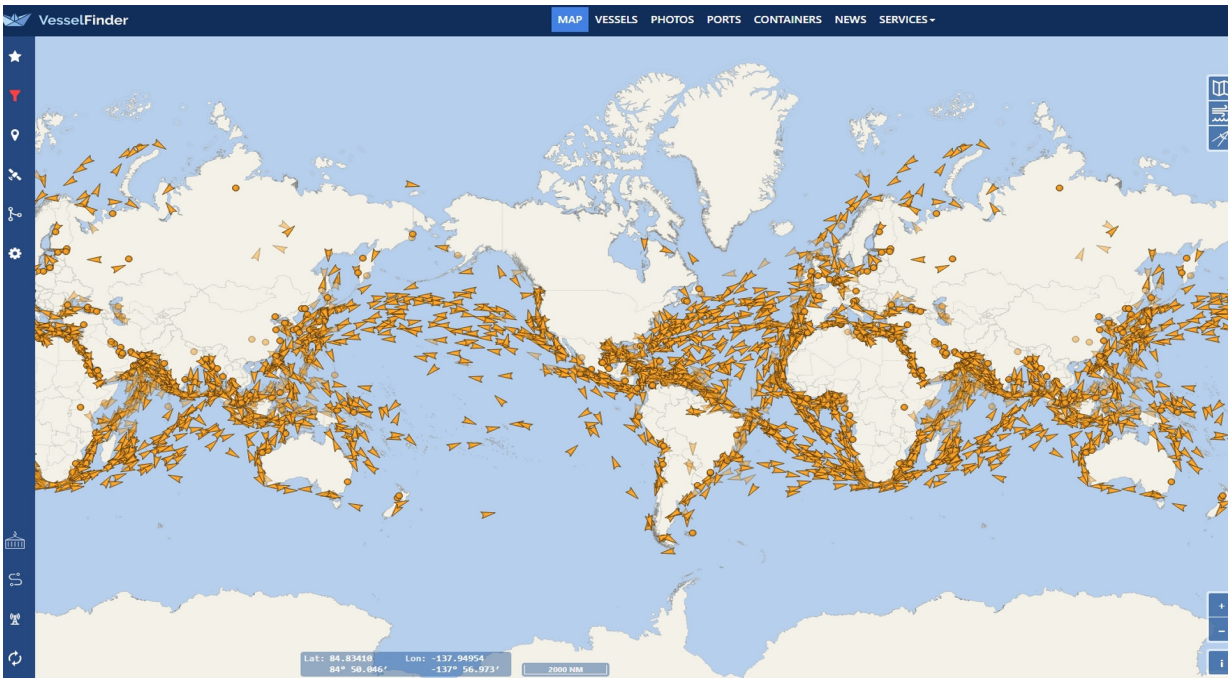
Figure III
**Extract from the National Offshore Petroleum Information System portal**




*Source:* Geoscience Australia, Australia, National Offshore Petroleum Information Management System NOPIMS. Available at www.ga.gov.au/nopims.

Shipping data, including ship positions and associated information, such as those reported through the automated identification system or the vessel monitoring system, are usually collected to monitor shipping and fishing activities in real time. The data continue to have value for marine planning and environmental management. Often the data are made fully available under a subscription service or are limited, through aggregation or anonymity, as shown in figure IV.

Figure IV
**Example of a vessel tracking tool offering some services for free and others with paid subscription**




*Source:* VesselFinder. Available at www.vesselfinder.com.

## 3. CULTURE

Wreck locations and underwater cultural heritage sites are other types of geospatial information for which the precise location cannot be publicized, owing to their cultural and environmental sensitivity. The exact locations of such sites cannot be released for fear of looting or excessive visitation, which could lead to the damage or destruction of the sites. An example of an online shipwreck database is provided in figure V.

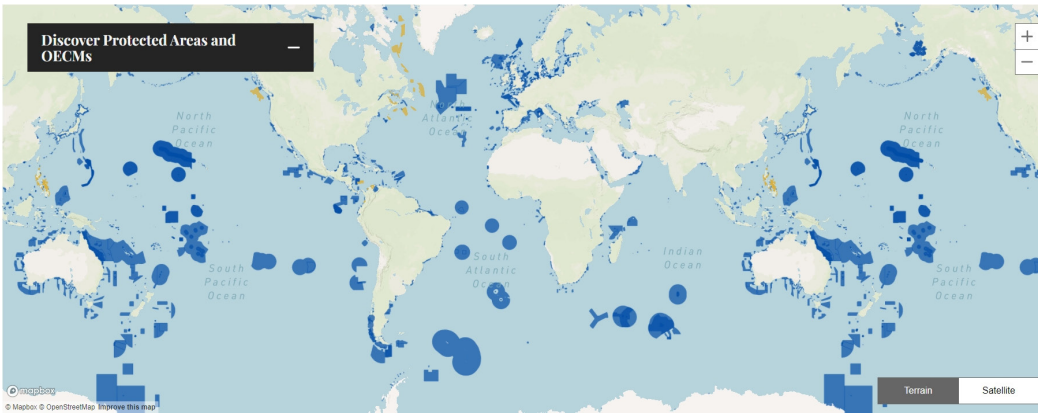
Figure V
**Example of an online shipwreck database**


*Source*: The Wrecksite. Available at www.wrecksite.eu/wreck-search.aspx.

# 4. ENVIRONMENT

The exact locations and underlying designation information for marine protected areas can be difficult to access because they are managed by multiple organizations and individual States. The World Database on Protected Areas is a joint venture between UNEP and the International Union for Conservation of Nature, managed by the UNEP World Conservation Monitoring Centre. An example of an online protected areas database is provided in figure VI.

Figure VI
**Example of an online protected areas database**




*Source*: Protected Planet, "Discover protected areas and OECMS". Available at www.protectedplanet.net/en.

At the single point of access provided by Protected Planet, data from governments, non-governmental organizations, landowners and communities are brought together with monthly updates using standardized methodologies for processing and presentation. It is an example of the power of overcoming data and information restrictions for the reuse of content. It provides the basis for monitoring and reporting on progress towards achieving international environmental targets, such as the Aichi Biodiversity Targets and the Sustainable Development Goals, which would otherwise be restrictive and time-consuming to achieve.

The consequences of placing excessive restrictions on information access can be very high. Within a single project, there are risks associated with outdated marine data sets, costs are incurred for the acquisition of more accurate or higher-resolution data and more time is needed to find and then process information that is not standardized. If marine geospatial data and information are not centralized, some marine environment themes can be overlooked.

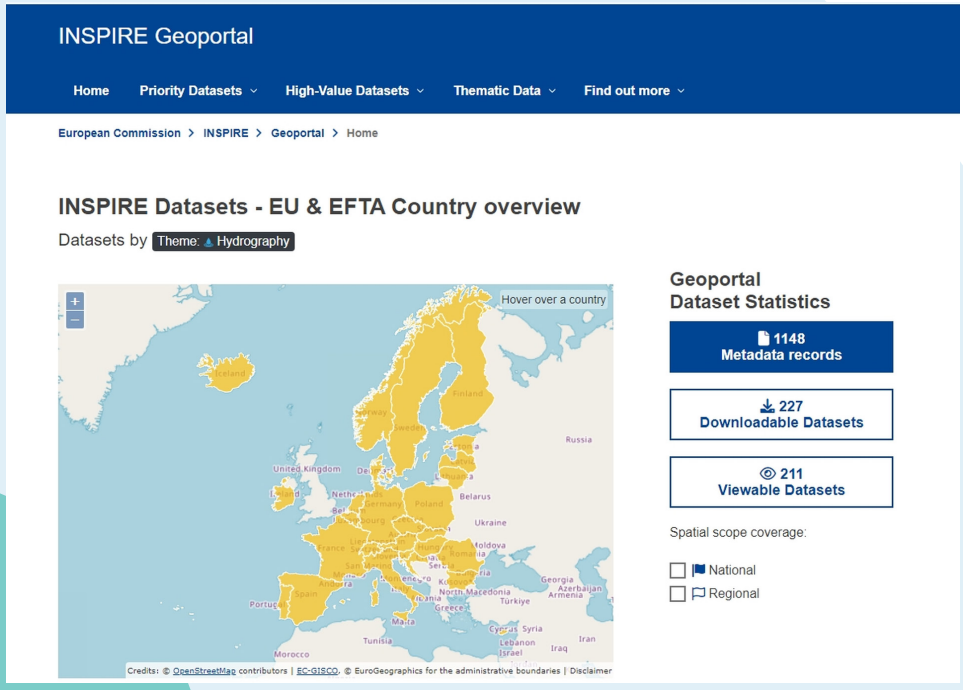
# B. Managing restricted marine geospatial data and information and paths to access

In recent years there has been an concerted push worldwide to increase accessibility to geospatial data and information, including marine geospatial data and information, irrespective of the area of work and inclusive of the maritime environment. Some examples follow.

## 1. INFRASTRUCTURE FOR SPATIAL INFORMATION IN THE EUROPEAN COMMUNITY

The directive on Infrastructure for Spatial Information in the European Community, often known as INSPIRE, has been established to reduce the barriers to freely accessible online environmental data, in general, and marine geospatial data, in particular, in the European Union, and has delivered efficiency for all stakeholders working in a marine-related field. An extract from the INSPIRE geoportal is shown in figure VII.

Figure VII
**Extract from the INSPIRE geoportal for hydrography**

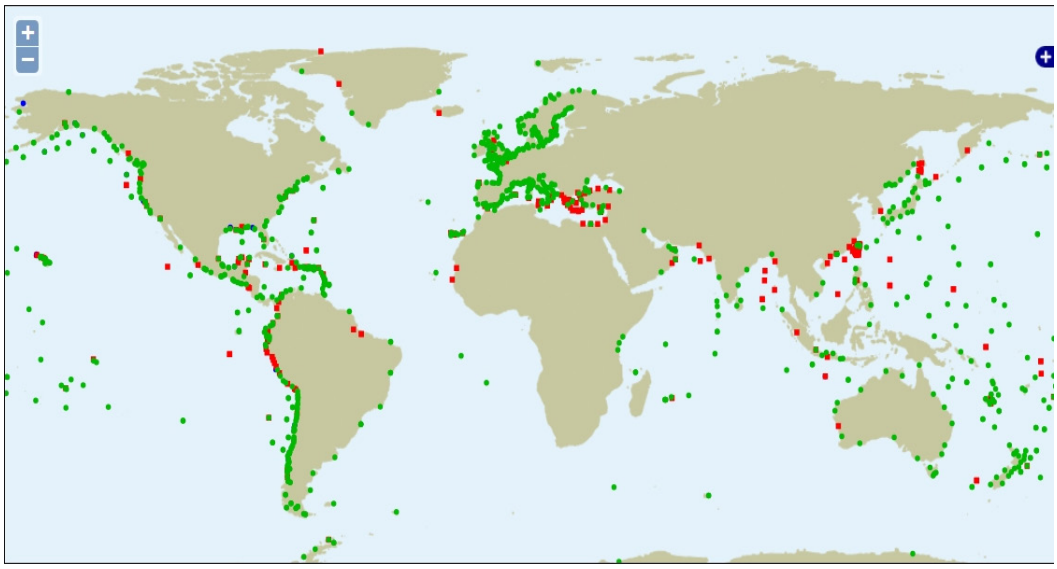



*Source*: European Commission, "Hydrography", INSPIRE Datasets – EU & EFTA Country overview. Available at https://inspire-geoportal.ec.europa.eu/srv/eng/catalog.search#/overview?view=themeOverview&theme=hy

## 2. SEA LEVEL STATION MONITORING FACILITY

The Sea Level Station Monitoring Facility, an extract of which is shown in figure VIII, provides information about the operational status of global and regional networks of sea level stations in real time and a display service for quick inspection of the raw data stream from individual stations.

Figure VIII
**Extract from the Sea Level Station Monitoring Facility**



*Source*: Flanders Marine Institute and Intergovernmental Oceanographic Commission, Sea Level Station Monitoring Facility. Available at www.ioc-sealevelmonitoring.org.

# C. Licensing templates

Under strategic pathway 2[44] of the United Nations Integrated Geospatial Information Framework, a policy and legal framework has been established that is essential for instituting the effective, efficient and secure management and exchange of geospatial information. In that context, a policy and legal resource kit[45] has been developed. It includes such model legal instruments as an agreement, a policy and legislation that States and private entities can refer to and, where appropriate, adapt to their specific circumstances when implementing the Integrated Geospatial Information Framework, with a view to improving data-sharing and exchange at the national level.

44 See https://ggim.un.org/UN-IGIF/documents/SP2-Policy-and-Legal-23Feb2020-GLOBAL-CONSULTATION.pdf.

45 See Working Group on Policy and Legal Frameworks for Geospatial Information Management, Committee of Experts on Global Geospatial Information Management, *United Nations Integrated Geospatial Information Framework Policy and Legal Resource Kit* (New York, 2022). ). Available at https://ggim.un.org/documents/UN-IGIF-Policy-and-%20Legal-Resource-Kit-Aug2022.pdf.

# V. NEXT STEPS FOR MARINE GEOSPATIAL INFORMATION MANAGEMENT

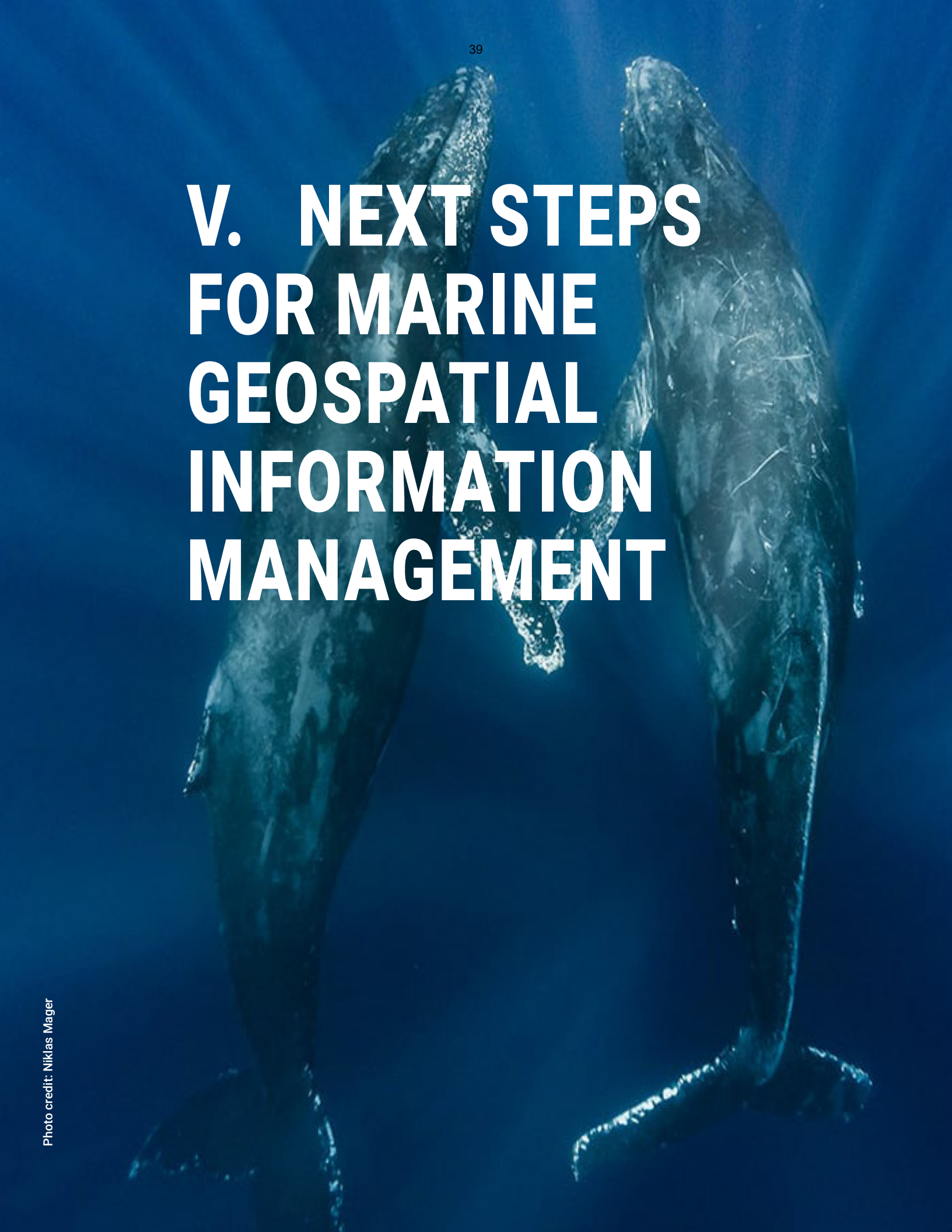


Photo credit: Niklas Mager

# A. Initiatives to date

Initiatives in the past decade have demonstrated the benefits of open access to marine geospatial data and information. Improved access has led to increased demand and has driven innovation in marine geospatial data and information management, and intergovernmental organizations have successfully taken up the challenge of promoting and implementing the FAIR guiding principles. In addition, there is a growing archive of accessible reference standards that can be applied by all end users to define and structure their content. Global marine geospatial databases and access mechanisms are being developed, and international organizations are working together across domains to build synergies. As a result, there is greater presentation, functionality, interoperability and reuse of information, which helps to extract additional value on initial investments.

Although much progress has been made, there remains much work to be done, and it is important to maintain and build upon the momentum that has been achieved. Future challenges in responding to the increased pressures on the oceans will drive a need for greater volumes and variety of data. Consequently, continuous investment in infrastructure and tools for analysis will be required to create the products that are needed for decision makers to act.

The present publication, including the input of all information providers, has highlighted the critical conditions and some obvious next steps in the process of maintaining the momentum in the development of marine geospatial data and information management.

# B. Availability

There is now greater acknowledgement of the importance of marine geospatial data and information availability, the findability of the data and information and associated access requirements that can minimize barriers to their reuse, including in areas outside the area of original collection.

As the desire to be able to share data and information widely continues to grow, the positive implications of findable marine geospatial data and information that have clear access rules, including licensing, are now starting to be reaped by a wider community.

As the barriers to sharing marine geospatial data and information continue to be reduced and, as a result, the presentation, use and associated added value of the information beyond the purposes for which the data were originally collected continue to be developed, the prevention of duplicative collection, processing and reporting continues to be refined. This is an area of marine geospatial data and information

management that can be further developed in order to increase efficiency and maximize the use of the data and information.

A positive first step towards building a wider understanding of the scope of marine geospatial data and information lies in users being able to find data, even if they cannot immediately be accessed. The knowledge and understanding of exactly which marine geospatial data and information are present in the marine world will drive other steps forward by association; for example, unlocked marine geospatial data and information will allow the development of long-term trend-based assessments of features by extending or further reinforcing and refining existing baselines. Furthermore, the risk of duplicated effort is reduced.

The challenge of implementing an entire system of principles, in particular for large and complex existing data sets, for which retrospective work can be daunting, expensive and time-consuming, should not prevent a stepwise approach in the presentation of the data sets as part of a larger and longer-term ongoing strategic process. Ensuring that marine geospatial data and information are findable is itself a significant step towards increased data interoperability that can be achieved without unreasonable effort.

Photo: Evans Boudin

# C. Dependency

The importance of and the reliance on marine geospatial data and information for decision-making will only continue to grow. More and more marine geospatial data and information are deemed to be needed, but the means to store them and the capacity for handling, processing and disseminating them need to be developed simultaneously. The prioritization and use of existing frameworks and strategies is the first step towards responding to that need.

There will always be a need for marine geospatial data and information that have not yet been recorded or acquired, for data and information that are better, often in terms of resolution and the ability to detect and identify smaller features, or that cover a different or wider geographic or temporal scope. That need stems from marine geospatial data and information being critical for decision-making, underpinning considerations and decisions made in the marine environment, and from accelerating technological developments and the increased availability of such marine geospatial data and information.

The extensive network of frameworks and strategies in the supply chain of marine geospatial data and information needs to be exploited further in order to maximize capacity at each level and share the requirements that those frameworks and strategies provide for. In that regard, the first task that can be undertaken is the identification and recording of all marine geospatial data and information that are currently available and being prepared, in order to create a marine geospatial information knowledge baseline that can be used for strategic decision-making.

## D. Communication

Communication, within and among entities, from the local to the global levels, has been highlighted as an area for further improvement. When content is recorded and shared, an archive of marine geospatial data and information is created that can help to ensure the availability of records. The development and resulting integration of the data supply chain presents a huge opportunity to operators and users at all levels.

The increased awareness of the existing marine geospatial data is an initial expected output that can feed directly into the strategic response process of decision makers, resulting in a feedback loop in the consideration of data product development. As a result, the creation of data products on the basis of the interpreted expectations of users is minimized and direct communication is established. That process further reinforces the importance of the initial collection of marine geospatial data and helps to maximize their reuse and overall value.

## E. Longevity

The longevity of marine geospatial data and information has justified their archiving, in order that future efforts can build upon historic, foundational work. Longevity safeguards content that is required for existing frameworks that would otherwise have a data expiry date, which helps to address data sustainability. Intergovernmental organizations can play a crucial role by offering data sustainability functions as a part of their data plans to preserve marine geospatial data and information.

## F. Strategic investment

Broader deliverables include the more focused use of continually stretched resources through strategic investment. To achieve greater oversight and improve the use of resources, consideration should be given to data flows as an entire life cycle and the ways in which education and training directly feed into implementation activities. Further identification of common issues and responses by developing and sharing openly community tools can maximize the use of vital marine geospatial data and information management practices across the globe.

## G. Sovereignty

It is helpful to ensure that marine geospatial data and information custodianship remains guided by those who have sovereignty and simultaneously ensure presentation for the collective benefit, taking into account the CARE Principles for Indigenous Data Governance. That approach is directly connected with maximizing capacity at each step of the process and the identification of the step that can benefit the most from strategic

investment. Owners of marine geospatial data and information should be proponents of their own data from their own area and the associated increase in value to the community, both financially and from a knowledge perspective. They should curate the data and information, paying attention to the needs of and feedback from their immediate and wider audiences, which may use, and therefore increase the value of, the data and information. It should be emphasized that, although the sovereignty of marine geospatial data and information is important, data-sharing has often proved beneficial for all parties in the past.

## H. Overall development

The developments in the management of marine geospatial data and information have demonstrated the potential ways in which good practices can increase the efficient use of resources at all levels, with intergovernmental organizations playing a central role. That trend is very encouraging, but it highlights the continued need to further develop marine geospatial data and information management in order to keep up with technological advances, to be fit to tackle future challenges and to provide the best base for decision-making at all levels.

## I. Recommended action

The future of sustainable ocean governance will rely heavily on marine geospatial data and information to guide integrated planning and the achievement of marine-related goals. Three initiatives to consider when aiming to establish and maintain standardized geospatial data and information management practices that are compatible and interoperable with other data management systems globally and within and across organizations are as follows:

(a) Schedule of detailed publications on thematic topics, the first in a series of which could be on the physical geography, characteristics and processes of the ocean, with the topics for subsequent publications to be determined through the analysis of the results deriving from the implementation of the following two recommended actions;
(b) Catalogue of the marine geospatial data and information landscape, and the responsibilities of intergovernmental organizations, which will contribute significantly to responding to the knowledge gaps identified in the World Ocean Assessment and the implementation of the Agreement under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction;
(c) Survey of intergovernmental organizations to document the maturity of existing marine geospatial data and information management initiatives and to seek the identification of thematic areas for priority action.

# Marine geospatial information management

## Annex 1

2024

United Nations

## Disclaimer

The designations employed and the presentation of materials in the present publication, including geographical names, citations, maps and the bibliography, do not imply official endorsement, acceptance or the expression of any opinion whatsoever on the part of the United Nations concerning the names and legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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# ANNEX I: MARINE GEOSPATIAL INFORMATION AND DATA TOPICS IN *THE SECOND WORLD OCEAN ASSESSMENT*

In its resolution 57/141, the General Assembly decided to establish a regular process under the United Nations for the global reporting and assessment of the state of the marine environment, including socioeconomic aspects, both current and foreseeable, building on existing regional assessments. The goal was to ensure a comprehensive overview of the ocean and the relationships between the ocean and humans, covering all environmental, social and economic aspects. *The First Global Integrated Marine Assessment* was published in 2016. It helped to establish a baseline and its conclusion was that many parts of the ocean had been seriously degraded and that, if the problems were not addressed, they would produce a destructive cycle of degradation in which the ocean could no longer provide many of the benefits on which humans rely. *The Second World Ocean Assessment* was published in 2021. Its scope was extended to the evaluation of trends and the identification of gaps. Among its conclusions was that the ability to measure and, therefore, understand the changes of the principal components of the marine environment is not equal across the planet. Spatial and temporal data gaps were identified in almost all components of the marine environment that were considered. The following is a summary of the spatial and temporal data gaps for each component of the marine environment included in *The Second World Ocean Assessment*.

# I. State of the marine environment

## A. Physical and chemical state of the ocean

The analysis in this section is based on chapter 5 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* contains an analysis of the current physical state of the oceans through seven climate change indicators: sea level, ocean circulation, sea temperature and ocean heat content, salinity, ocean acidification, dissolved oxygen and sea ice.

### 2. RELEVANCE

Monitoring those indicators over time and following their global patterns would provide valuable information on the impact of climate change and on the physical and chemical state of the ocean. The changes are closely related to trends in the state of biodiversity and marine habitats and spatial and temporal patterns of extreme climate events.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

#### (a) Sea level

Currently, global mean and regional sea levels are well documented, mainly by satellites measuring the topography of the sea surface, known as satellite altimetry missions. That is not the case for coastal sea levels, which are highly undersampled by tide gauges. In addition, coastal zones are not surveyed by conventional satellite altimetry missions because the proximity of the land adversely affects the accuracy of the measurements obtained by the satellites. Investing in reprocessing of the data acquired by conventional

satellite altimetry missions and the systematic use of new synthetic aperture radar technology will facilitate the estimation of sea level changes very close to the coast.

**(b) Ocean circulation**

Although the overall current ocean observation network provides a large amount of spatial and temporal data on ocean circulation globally, data are not as readily available for coastal regions, marginal seas and deep ocean regions below 2,000 m. In addition, uncertainties about ocean circulation arise from the short timespan of direct, continuous measurements. Consequently, there is a need to design an observation system that incorporates a mixture of observation technologies adapted to the various operating environments.

**(c) Sea temperature and ocean heat content**

As is the case with ocean circulation measurements, the understanding of sea temperature and ocean heat content could be improved with longer, direct, continuous measurements. To achieve that goal, investment is needed in the development of a global long-term surface energy flux observation system.

**(d) Salinity**

Temporal and spatial coverage with modern observations, dating back to 2008, inevitably allowed for a better understanding of salinity change. The short timespan of modern data availability, however, affects the long-term historical assessment and modelling of changes in salinity. Maintaining and upgrading the existing observation systems and expanding the observed geographical area, with a view to improving the current understanding of salinity change and the related impacts on marine ecosystems, should, therefore, be the goal in the future.

**(e) Ocean acidification**

National and international monitoring of carbonate chemistry over the past decade contributed to a better understanding of the status and impact of ocean acidification from the local to the global level. The variability of carbonate chemistry across various depths, distance from continents, owing to land influence, upwelling regimes, freshwater and nutrient input and latitude, and the time of emergence of the signal varying from 8 to 15 years for open ocean sites and from 16 to 41 years for coastal sites, however, require a commitment to global long-term observational records, especially in the coastal zone, where most commercially and culturally important marine resources are found.

**(f) Dissolved oxygen**

Dissolved oxygen has been observed with sufficient accuracy since the early 1900s globally. It is noted in *The Second World Ocean Assessment* (vol I, p.331), however, that there is a need to monitor environmental variables, including dissolved oxygen, in areas near the edge of coral species niches, near the aragonite saturation horizon, in basins where temperatures are high, such as the deep Mediterranean, and where cold water coral ecosystems are threatened by the cumulative stressors of human activities.

**(g) Sea ice**

Although monitoring of the geophysical parameters of sea ice by satellite is improving, local observations to validate those of satellites are lacking, both in the Arctic and in the Antarctic. There is a need to improve local measurements of snow on sea ice and the thickness of sea ice to improve the understanding of the physical processes in the polar regions.

# II. Biodiversity of the main taxa of marine biota

## A. Plankton (phytoplankton, zooplankton, microbes and viruses)

The analysis in this section is based on chapter 6A of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Single-celled organisms are immensely significant as a fundamental component of marine life. They collectively contribute to approximately 50 per cent of primary production on Earth, making them essential for sustaining ocean biodiversity and regulating the planetary carbon cycle. Among the planktonic community, marine phytoplankton, including diatoms and picoplankton (less than 2 µm in size), play a critical role in marine primary production, driving marine food webs and supporting various marine species.

### 2. RELEVANCE

Understanding the dynamics of plankton diversity and productivity is crucial for comprehending the functioning of marine ecosystems and their services. Plankton not only support marine biodiversity but also sustain fisheries by forming the foundation of food chains. Moreover, the biological pump facilitated by plankton assists in sequestering atmospheric carbon dioxide, helping to mitigate the impact of climate change. A better understanding of the health and abundance of the microscopic organisms will provide valuable insight into the state of marine ecosystems, enabling informed conservation efforts and sustainable management of marine resources in the face of ongoing environmental changes.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Despite the vital role of plankton in marine ecosystems, the current status of global ocean observation lacks dedicated monitoring mechanisms for plankton diversity. That deficiency highlights the necessity for an international, integrated observation system that is focused on ocean life, in particular plankton, as part of the broader Global Earth Observation System of Systems. Presently, such challenges as undersampling and the discovery of cryptic species through metagenomics hinder the accurate assessment and understanding of plankton diversity. Overcoming the challenges and improving global ocean observations are crucial steps in effectively monitoring plankton diversity and productivity.

## B. Marine invertebrates

The analysis in this section is based on chapter 6B of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Marine invertebrates constitute a vital component of marine ecosystems, serving as integral food sources and contributing to ecological balance. The organisms face multiple threats, such as climate change, pollution and overexploitation.

### 2. RELEVANCE

Marine invertebrates serve as a crucial food source for various marine species, supporting global fisheries and food security for coastal communities. In addition, their presence or decline has a great impact on marine biodiversity, influencing the health of coral reefs and other critical ecosystems. Safeguarding marine invertebrates is, therefore, essential for ensuring resilient marine ecosystems and the well-being of coastal communities.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

In recent years, efforts have been made to enhance the understanding of marine invertebrates, but challenges persist. From 2012 to 2019, 10,777 new marine benthic invertebrate species were described, primarily in the Mollusca and Arthropoda phyla. Notably, the North Atlantic Ocean and South Pacific Ocean, including the Coral Sea, were home to the highest number of recorded species. Despite that progress, knowledge gaps remain, in particular in tropical regions, hindering a comprehensive assessment of global marine invertebrate diversity. Data collection is further complicated by the various factors affecting marine invertebrates. Climate warming has led to distribution shifts, affecting marine communities of the Arctic, North Atlantic and Pacific Oceans. The introduction of invasive species disrupts ecosystems and poses additional threats to native invertebrates. Furthermore, pollution from diverse sources contributes to low oxygen conditions, diminishing species diversity in affected areas. To address those challenges, data-collection efforts must be improved. Long-term monitoring of marine areas, in particular in vulnerable habitats, is essential for understanding population trends and assessing the effectiveness of conservation measures. Prioritizing taxonomic identification and baseline biodiversity studies will help to bridge knowledge gaps, leading to more informed conservation strategies.

## C. Fishes

The analysis in this section is based on chapter 6C of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Fish biodiversity is a fundamental component of oceans: it contributes to the overall health and stability of marine ecosystems and directly affects human communities and economies that rely on fisheries and related industries.

### 2. RELEVANCE

The collection of marine fish biodiversity data is highly relevant for environmental monitoring, fisheries management, conservation and economic decision-making. Biodiversity data are essential for effective fisheries management. Sustainable fisheries rely on the knowledge of fish species abundance, migration patterns and habitat preferences. With adequate data, stakeholders can implement appropriate measures to prevent overfishing and ensure the long-term viability of fish stocks. Protecting vulnerable fish species is crucial not only for their survival but also for maintaining the ecological balance of marine ecosystems.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Significant progress has been made in the collection of marine fish biodiversity data. Taxonomic studies have led to the discovery and description of numerous new fish species, contributing to a more comprehensive understanding of fish diversity. In addition, advances in phylogenetic studies have improved knowledge of the evolutionary relationships among fish species. The availability of global databases, such as the Ocean Biodiversity Information System, has revolutionized the study of fish occurrence and distribution. Vast amounts of occurrence records from various sources are compiled in the databases, enabling researchers to study species distribution and biogeography on a global scale. Many marine fish species have been assessed for their conservation status, providing valuable insights into which species require urgent protection measures. Moreover, technological innovations have significantly enhanced data collection in challenging marine environments. Sampling technologies, such as remotely operated vehicles and autonomous underwater vehicles, have enabled researchers to explore deep-sea habitats and collect valuable data on previously inaccessible species. Satellite tagging has provided insights into fish migration patterns and behaviour.

Despite those advances, however, critical gaps in data collection persist. Taxonomy and systematics remain ongoing challenges, given that there are likely many undiscovered fish species, in particular in remote and deep-sea regions. Consequently, taxonomic efforts must continue to ensure a comprehensive understanding of marine fish diversity. Furthermore, to address complex ecological questions, more integrated research efforts are necessary. Combining data from multiple sources, such as genetics, oceanography and ecology, will enable scientists to predict the responses of fish species to multiple stressors, including climate change and human activities.

## D. Marine mammals

The analysis in this section is based on chapter 6D of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

There are 132 known surviving species of marine mammals, including cetaceans, pinnipeds, sirenians, otters and the polar bear. They have varied habits, ranging from those with multiple

discrete local populations, as is the case for some dolphin species, to those that are endemic to a specific ecoregion, such as freshwater dolphins. Marine mammal populations face numerous threats, such as by-catch in fisheries, habitat alteration, pollution, anthropogenic noise and climate change. Understanding the threats and their impact on marine mammals is crucial for devising appropriate conservation strategies.

#### 2. RELEVANCE

Data collection is of utmost importance in marine mammal conservation. It aids in understanding population dynamics, threats and ecological interactions, leading to effective management and policy development.

#### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Better data-collection and management efforts have led to improved conservation of marine mammal populations. The impact of climate change on marine mammal populations and their habitats, however, requires ongoing research and data collection to inform future conservation strategies. Furthermore, data collection plays a critical role in understanding the consequences of changes in marine mammal populations on ocean processes, including in the spatial transfer of nutrients and carbon, human communities and the economy. Continued efforts in cooperative data collection and related research are essential for ensuring the long-term survival and well-being of marine mammal species and the ecosystems that they inhabit.

### E. Marine reptiles

The analysis in this section is based on chapter 6E of *The Second World Ocean Assessment*.

#### 1. INTRODUCTION

The *World Ocean Assessment* is focused on assessing the conservation status of marine turtles, sea snakes and marine iguanas. Marine reptiles face numerous threats, including by-catch, targeted harvesting, marine pollution, habitat loss, coastal development, disease and climate change.

#### 2. RELEVANCE

Understanding the reproductive biology, foraging habitats, demographics, disease pathogenesis, geographical distribution, movements, habitats, resilience to disturbances and responses to threats of marine reptiles is crucial. Marine reptiles face threats from by-catch, pollution, habitat loss, coastal development, disease and climate change, and, therefore, a well-informed approach is necessary in order to strike a balance between, on the one hand, economic growth through tourism, and on the other, conservation efforts, and to safeguard these unique species and their ecosystems.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Advances in data-collection efforts and related research have led to significant changes since the first World Ocean Assessment in the status of marine reptiles on the IUCN Red List of Threatened Species, such as the shift of the loggerhead turtle from “endangered” to “vulnerable” and the reclassification of two sea snake species from “critically endangered” to “data deficient”. Despite the advances, there are still significant knowledge gaps, in particular in relation to the effect of known threats, that hinder effective conservation efforts. Building capacity and implementing long-term monitoring initiatives are paramount to address the gaps and inform conservation strategies.

## F. Seabirds

The analysis in this section is based on chapter 6F of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Seabirds, defined as bird species heavily reliant on the marine environment for part of the year, play a crucial role in marine ecosystems as top predators. They consume biomass comparable to all fisheries combined. Seabirds inhabit various oceanic regions, connecting various marine systems and ocean basins. There are 359 identified species of seabirds, categorized into six orders and 12 families. They are relatively well studied compared with other marine taxa, with several assessments documenting their status and trends over the years.

### 2. RELEVANCE

The global conservation status of seabirds has deteriorated since the first *World Ocean Assessment* was published in 2016. By 2020, 31 per cent of species were threatened with extinction, up from 28 per cent in 2010. Fishing-related pressures, such as by-catch and prey depletion, have increased the number of affected species, although pollution is affecting fewer species. Invasive alien species and climate change continue to threaten seabird populations, similar to the situation in 2010.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

There has been a comprehensive review of the threats affecting seabird species, leading to changes in their conservation status. Some species have experienced a worsening outlook and are now categorized at a higher risk, while others are considered to be at a lower risk, owing to greater knowledge rather than genuine improvements in their status. Data-collection efforts have improved the understanding of the impacts of such threats as fishery by-catch and prey depletion by fishing, and of the decrease in marine pollution due to reduced oil spills. Emerging threats, however, including marine plastics and the complex consequences of climate change on seabird populations, require further study. To address those challenges and make informed decisions, the remaining knowledge gaps in the demography, distribution and population trends of seabirds, in particular smaller species, must be bridged. To achieve that

goal, a greater focus on capacity-building efforts for monitoring, research and assessment will be crucial.

### G. Marine plants and macroalgae

The analysis in this section is based on chapter 6G of *The Second World Ocean Assessment*.

#### 1. INTRODUCTION

Mangroves, salt marsh plants, seagrasses and macroalgae (seaweeds) are vital forms of vegetation and components of coastal ecosystems, providing numerous ecological services and supporting marine biodiversity.

#### 2. RELEVANCE

Mangroves, salt marshes and seagrasses act as critical nursery habitats for marine organisms, enhance water quality and protect coastlines from erosion and storms. Macroalgae form extensive and productive coastal habitats, supporting numerous marine species and providing food for various organisms, including humans. The loss of marine plant species can have severe impacts on human communities and economies.

#### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Despite advances in genomics, taxonomic and systematic studies of marine plants are lacking in many regions. Enhancing human and infrastructure capacities is vital for monitoring and conserving marine biodiversity, in particular in small island States and archipelagic countries. Further research is needed to assess the impact of human activities and climate change on marine plant populations and ecosystems.

## III. State of biodiversity in marine habitats

### A. Intertidal zone

The analysis in this section is based on chapter 7A of *The Second World Ocean Assessment*.

#### 1. INTRODUCTION

The intertidal zone, located where the land meets the sea, encompasses a diverse range of habitats along coastlines worldwide. The unique zone experiences regular exposure and immersion, owing to tides, making it a crucial interface between terrestrial and marine ecosystems. Rocky shores, sandy beaches, mangroves, coral reefs and tidal flats are among the various environments found in the intertidal zone. Due to its accessibility, the zone plays a pivotal role in human activities

and interactions, making it of particular importance for subsistence and small-scale fisheries and harvesting.

### 2. RELEVANCE

The significance of the intertidal zone extends beyond its ecological role. It is located at the forefront of human influence on the oceans. Human activities, such as deforestation and coastal modification, have a direct impact on the intertidal zone, and climate change indirectly affects it. Coastal development and urbanization alter intertidal habitats, posing risks to coastal communities and marine species. As sea levels rise, intertidal habitats face the threats of reduction and coastal squeeze, affecting both ecosystems and human well-being.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Despite the importance of the intertidal zone, there are still significant knowledge gaps and limited taxonomic infrastructure, in particular in developing countries. Baseline data on intertidal ecosystems require improvement through comprehensive studies and enhanced data-collection efforts. Understanding the impact of human activities and climate change on intertidal habitats requires accurate and comprehensive data, which can be challenging to obtain in less developed regions. Addressing the limitations in data collection is crucial for the effective conservation and sustainable management of intertidal ecosystems and their long-term health and resilience.

## B. Biogenic reefs and sandy, muddy and rocky shore substrates

The analysis in this section is based on chapter 7B of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Biogenic reefs and sandy, muddy and rocky shores are indispensable components of coastal ecosystems, supporting biodiversity and providing vital ecosystem services. The habitats exist on coastlines worldwide and are interconnected with diverse ecosystems, including coral reefs, estuaries, mangroves and salt marshes.

### 2. RELEVANCE

Biogenic reefs and sandy, muddy and rocky shores are of immense significance in coastal environments, owing to their rich biodiversity and the essential ecosystem services that they provide. The habitats perform critical functions, such as water filtration, nutrient cycling and coastline protection, which have a direct impact on human well-being and support livelihoods. With over 60 per cent of the global population living in coastal areas, such environments are economically relevant, facilitating tourism, recreational activities and artisanal and commercial fishing and serving as aesthetically pleasing destinations. They are increasingly vulnerable to various stressors, however, including pollution, coastal urbanization and the adverse effects of climate change, posing significant challenges to their health and functioning.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Although biogenic reefs and sandy, muddy and rocky shores are recognized for their ecological importance, there are still notable knowledge gaps, in particular in less developed regions. Not enough spatial and temporal data and information are available to anticipate medium-term or long-term scenarios with accuracy. Data are particularly scarce across some regions, such as the South Atlantic, the wider Caribbean and the western Pacific.

## C. Atoll and island lagoons

The analysis in this section is based on chapter 7C of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Low-lying tropical coral reef and atoll islands and their associated lagoon systems are geologically young features, shaped by fluctuations of the sea level, biological sediment production and oceanic and atmospheric conditions. With their low-lying nature, small extent and exposure to marine conditions, the islands are vital for subsistence communities which are heavily reliant on the surrounding reefs for daily food security.

### 2. RELEVANCE

The relevance of atoll islands lies in their susceptibility to diverse environmental threats and the impact of the resulting changes on human communities. Urban atoll islands are increasingly dependent on engineering solutions to mitigate environmental risks, and rural island communities rely on the health and productivity of surrounding marine and coastal ecosystems. Major challenges include climate change, rising sea levels, erosion, storms, reef degradation and lagoon pollution, all of which significantly affect the islands and their inhabitants.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

There is little information on the way reef processes respond to changes in individual and compounded climate drivers as they change. Geographical variability in shoreline erosion and inundation is observed, but the causes of those spatial patterns are poorly understood, which largely precludes any forecasting of the behaviour of particular locations.

## D. Tropical and subtropical coral reefs

The analysis in this section is based on chapter 7D of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* provides an update on the status of tropical and subtropical coral reefs in several regions, and contains a description of their steady degradation, including widespread mortality of corals from global marine heatwave events and declines in biodiversity.

### 2. RELEVANCE

Tropical and subtropical coral reefs are vital ecosystems that support diverse marine species and play a crucial role in coastal protection. They are important sources of income, including in the fishing and tourism industries, and are a basis for sociocultural identity. Despite their ecological and economic significance, reefs face severe threats, primarily from climate change and anthropogenic activities. With coral reefs projected to face functional extinction by 2050 if current trends persist, the loss of coral reefs will affect the ability to achieve any of the Sustainable Development Goals. The monitoring of reef health and the effectiveness of management tools are crucial to informing efforts to improve reef resilience and combating their degradation.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Progress has been made in addressing significant knowledge gaps that were reported in *The First Integrated Marine Assessment*, including understanding the responses of corals and coral-dependent species to climate change and the spatial extent of mesophotic coral reefs. Currently, there are knowledge gaps around the responses of reef communities to climate change; the socioeconomic value of coral reefs; the effectiveness of management tools to improve reef resilience; and the distribution, biodiversity and ecological function of mesophotic coral reefs. Although new technologies have been developed to monitor coral reef systems, there is limited local capability to use them.

## E. Cold water corals

The analysis in this section is based on chapter 7E of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Cold water corals are globally distributed and play a vital role in supporting diverse marine habitats. Their ecosystems are intricately connected with the open ocean through benthic-pelagic coupling, contributing to the deep-sea food web and nutrient cycling.

### 2. RELEVANCE

Cold water coral ecosystems are relevant to marine biodiversity, sustainable fisheries, carbon sequestration and human well-being. They serve as habitats and nurseries for commercially exploited fish stocks, contributing to sustainable fishing practices. In addition, cold water corals offer valuable marine genetic resources and act as carbon sinks, sequestering carbon from the atmosphere and mitigating the impacts of climate change. Their conservation is vital for protecting

vulnerable marine ecosystems and achieving Sustainable Development Goals related to marine conservation, food security and economic benefits for countries relying on marine resources.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The data-collection efforts relating to cold water corals are steadily improving, but substantial knowledge gaps persist. Recent advances in predictive habitat modelling have led to new discoveries, identifying populations of cold water corals in various regions, such as the Antarctic continental shelf, North Pacific low pH waters and the Moroccan Atlantic continental margin. The use of long-term observatories has enhanced the understanding of cold water coral habitats at local and regional scales, emphasizing the importance of sustained ocean monitoring. Despite progress, several challenges hinder data collection and research on cold water corals. The remoteness and complexity of the deep-sea environment make data-gathering time-consuming and expensive. Standardizing data-collection protocols and increasing cross-sectoral collaboration could improve data comparability and efforts to bring use of data to scale.

## F. Estuaries and deltas

The analysis in this section is based on chapter 7F of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Estuaries and deltas are unique habitats for diverse marine and coastal organisms. They hold great importance for human populations, offering resources for recreation, food provisioning and water supply.

### 2. RELEVANCE

Estuaries and deltas are highly productive systems, with variable gradients in salinity, nutrients and other factors, influenced by natural events and human-driven activities. Despite human perturbations, the environments support biodiversity and various ecosystems, such as mangroves, salt marshes, seagrass meadows and intertidal zones. They play a crucial role in sustaining commercial and subsistence fisheries, tourism and recreation, contributing significantly to the global economy (estimated at over $6.1 trillion in 2014). The mouths of rivers act as conduits for freshwater, nutrients, sediments and pollutants, making them essential for marine and coastal ecosystems.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Advances have been made in observation systems, such as satellites, global observation networks and buoys, designed to capture rapid changes in the environmental conditions of estuary and delta environments. There remain challenges in managing land use in estuaries and deltas, in particular in predicting future extreme events and the effects of rapid human interventions. More data are needed to understand coastal wetland conservation in areas where it can be most beneficial or might alleviate the need for engineered protection works. Improving monitoring and investing

in scientific research will enhance the understanding of changing ecosystem services and their implications for human well-being.

## G. Seagrass meadows

The analysis in this section is based on chapter 7G of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Seagrasses are marine flowering plants that inhabit coastal waters. Seagrass meadows have experienced alarming declines, primarily from coastal development, land reclamation, deforestation, pollution and overfishing.

### 2. RELEVANCE

Many socioecological systems rely on healthy seagrass meadows to support a multitude of important ecosystem services. The decline and loss of seagrass meadows pose significant challenges, leading to the degradation of fishing grounds, nursery areas and erosion control, with coastal communities facing adverse effects of storm surges, erosion and flooding. In addition, seagrass ecosystems make important contributions to marine carbon sequestration, holding promise as a vital tool for mitigating the impacts of climate change. Further understanding of the biology, ecosystem function, threats, rehabilitation, and restoration, monitoring and management tools for seagrass meadows is essential for their effective management and to realize their potential to provide diverse ecosystem services.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Although the general awareness of seagrass and the important ecosystem services it offers is improving, there is a lack of spatial and temporal data for many areas. Seagrass distribution maps must be more detailed, and there is currently no repository to share information at ecologically relevant scales. In addition, there are knowledge gaps in sociocultural and socioeconomic research. Technological advances, such as remote sensing and modelling, together with interdisciplinary approaches, will broaden the understanding of the complex interactions among seagrasses and their environment and encourage the identification of potential solutions to prevent further loss.

## H. Mangroves

The analysis in this section is based on chapter 7H of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Mangroves are found across tropical and subtropical regions, are important ecosystems at the interface of sea and land, and are home to 73 recorded species and hybrids.

### 2. RELEVANCE

Mangroves provide valuable goods and services, such as seafood, timber, shoreline protection, carbon sequestration and waste bioremediation, and hold cultural significance for local communities. They face significant threats, making them one of the most endangered ecosystems globally. Human activities have led to the disappearance of over a quarter of the original mangrove cover. Certain conservation initiatives, rehabilitation efforts, natural regeneration and climate-induced expansion, however, have shown positive results in some areas. Further research on the sustainability and interrelationships of habitats and between mangroves and catches of marine fishing resources will increase the capabilities of coastal managers and empower local communities to conserve mangroves more effectively.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Various technological advances have improved mangrove distribution data on the global scale, with satellite data being a primary approach for assessment. Cloud computing platforms have made it possible to estimate more reliably local, regional and global mangrove cover and changes over time. There remains, however, a lack of reliable surveys on the status of mangroves at the global and regional scales, and of standardization of methods for assessing mangroves. Further research and capacity-building are necessary in order to standardize assessment methods and understand the interconnectivity between mangroves and adjacent coastal environments.

## I. Salt marshes

The analysis in this section is based on chapter 7I of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Salt marshes, which are dynamic intertidal coastal systems that are regularly flooded with salt or brackish water, thrive on every continent except Antarctica. These habitats are dominated by salt-tolerant plants adapted to tidal immersion.

### 2. RELEVANCE

Found more commonly in temperate climates than subtropical or tropical regions with mangrove forests, salt marshes play a pivotal role in providing critical ecosystem services. They safeguard coastlines, prevent erosion, recycle nutrients and offer vital habitats for numerous species, including birds, fishes, molluscs and crustaceans. Their ability to sequester carbon dioxide as blue carbon sinks renders them crucial players in mitigating the impact of climate change.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Remote sensing techniques and surface elevation tables have been used in recent studies to monitor marsh accretion and loss rates. Knowledge gaps persist, however, necessitating increased spatial and temporal data-collection and capacity-building efforts to safeguard these vital coastal ecosystems.

## J. Continental slopes and submarine canyons

The analysis in this section is based on chapter 7J of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Continental slopes are regions where the seafloor gradually deepens from the shelf edge to the upper limit of the continental rise. Steep-walled canyons are often found in these areas, contributing to habitat heterogeneity and biodiversity.

### 2. RELEVANCE

Slopes and canyons offer essential ecosystem services, such as carbon sequestration, nutrient recycling, fisheries and waste disposal. In addition, interest is growing in mining non-renewable resources from these areas. Furthermore, the sediment records found in the continental slope serve as a unique paleoecological archive, providing insights into historical deep-sea biodiversity dynamics.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Deep-sea environments remain poorly explored: most canyons and slopes remain uninvestigated, in particular those on the margins of developing countries. Some 66 per cent of the continental slope seabed bathymetry from 200 to 1,000 m and 72 per cent from 1,000 to 3,000 m remain unmapped, and an even larger area of the seafloor has never been surveyed for biology. Furthermore, there is a notable disparity in knowledge and technology across different regions.

## K. High-latitude ice

The analysis in this section is based on chapter 7K of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

In the *World Ocean Assessment* "high-latitude ice" is used as a generic term for a variety of critically important high-latitude marine habitats, which include ice shelves, pack ice, sea ice and the highly mobile ice edge. High-latitude ice habitats are characterized by high, but geographically variable, declines in the extent of sea ice resulting from climate change. In *The Second World Ocean Assessment* the coverage of high-latitude sea ice environments was extended to include habitats associated with icebergs and ice shelves.

### 2. RELEVANCE

Ice shelf and iceberg habitats provide unique marine signatures and have an impact on the surrounding ocean that is different from that of sea ice. Melting icebergs input nutrients and trace elements, creating productive ecosystems. Ice shelf decay and iceberg grounding have negative impacts on the environment, affecting coastal benthic ecosystems and marine organisms. In addition, the decreasing amounts of sea ice will reduce local community access to subsistence hunting opportunities. At the same time, the decreasing sea ice extent in the

Arctic provides increased opportunities for human activities, such as fishing, navigation and hydrocarbon exploration.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The inaccessibility of the high latitudes means that the ice habitat remains relatively poorly understood, with limited understanding of the three-dimensional nature of ice habitats, the range and number of species within them and their spatial and temporal variability. Much analysis has been derived from remote sensing, with new satellite systems promising further knowledge. Ensuring universal access to new data produced by observation platforms will be vital to addressing knowledge and capacity gaps.

## L. Seamounts and pinnacles

The analysis in this section is based on chapter 7L of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Seamounts, submerged volcanoes rising above the seafloor, cover up to 20 per cent of the deep seafloor and have a unique topography and physical structure.

### 2. RELEVANCE

Seamounts are hotspots of biodiversity and endemic species, providing significant ecosystem services. They support rich benthic communities and commercial fisheries. Limited sampling, however, hinders the understanding of their ecological importance and vulnerability to threats.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Recent research programmes have helped to improve knowledge of seamount ecosystems, including their effects on circulation, primary productivity and species distribution. Given that few seamounts have been surveyed globally, however, there are major gaps in the understanding of biodiversity scales and patterns on seamounts and their resilience to climate change and human activities. More comprehensive data-collection efforts are needed to fill knowledge gaps.

## M. Abyssal plains

The analysis in this section is based on chapter 7M, of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

The abyssal plains, located at a water depth of 3–6 km, cover about 58 per cent of the surface of the Earth. They mainly comprise vast areas of seafloor plains and are covered in generally fine sediments, punctuated by sporadic hard substrate at topographic highs in the form of knolls, seamounts, mid-ocean ridges and island arcs, and by lows in the form of valleys and deeper

trenches. They are characterized by cold temperatures, high hydrostatic pressure and limited food availability.

### 2. RELEVANCE

Abyssal environments mainly support the processes that drive deep-sea and global ecosystems and the global climate system. They serve as a biological pump, transferring carbon and nutrients from surface waters to the deep sea. Few abyssal services could directly benefit humans, but the most significant are mineral resources.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Data-collection efforts in abyssal ecosystems have improved in recent years, but significant knowledge gaps still exist. Large areas of the abyssal plains remain unsampled. Where they have been sampled, taxonomic and biodiversity information remains limited, hindering environmental impact monitoring and the development of effective conservation measures. Data and information about the spatial and temporal distribution and patterns of species and their resilience to climate and human stressors in the abyssal plains are limited. The lack of data is further compounded by the fact that this vast expanse is almost entirely located in areas beyond national jurisdiction.

## N. Open ocean

The analysis in this section is based on chapter 7N of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

The open ocean, or the pelagic zone, consists of the epipelagic zone (down to a depth of 200 m), the mesopelagic or twilight zone (at 200–1,000 m depth), the bathypelagic zone (at 1,000–4,000 m), which comprises almost 75 per cent of the ocean volume, the abyssopelagic zone (at 4,000–6,000 m) and the hadalpelagic zone (deeper than 6,000 m).

### 2. RELEVANCE

The open ocean is essential for marine ecosystem goods and services and has great potential for mineral energy and living resources.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Although the epipelagic zone has been extensively studied, and spatial and temporal data on mesopelagic ecosystems are improving, very little is known about organisms from the deeper zones. The deeper pelagic ocean is significantly underobserved and undersampled. The main knowledge gaps relate to the open ocean ecosystems and the impact of physical drivers on the biodiversity found in them and the vertical migration of organisms between the deeper and upper ocean. More basic information, such as traditional taxonomy, must be collected about species that live in those environments.

## O. Ridges, plateaux and trenches

The analysis in this section is based on chapter 7O of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Mid-ocean ridges comprise a system that is 75,000 km in length, formed when tectonic plates move apart and new crust forms. Plateaux are geologically not as well defined or as extensive as ridges but comprise relatively less steep and shallower features separated from continental shelves by deep channels. They usually are located nearer to land and are considered richer in terms of harvestable resources than oceanic ridges. Trenches are long, narrow depressions of the seafloor and are often very deep and asymmetrical, with relatively steep sides. They have flat floors with accumulated fine sediments. Trenches are formed when oceanic plates collide with continental plates; the heavier oceanic plates are subducted, creating a trench.

### 2. RELEVANCE

Deep-sea features must be assessed, owing to the increasing levels of human activity and potential threats to these ecologically sensitive areas. Understanding the significance and vulnerability of the features helps to develop conservation and management strategies to preserve marine biodiversity.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Bearing in mind that 66 per cent of the seabed from 200 to 1,000 m in depth, 72 per cent from 1,000 to 3,000 m in depth and 93 per cent of the seabed deeper than 3,000 m remains unmapped, and a large area of the seafloor has never been surveyed for biology, the deep ocean remains a black box in global model simulations. For ridges, plateaux and trenches, major data gaps include basic aspects of biodiversity, ecological and environmental data, critical to addressing ecosystem responses to disturbance. Access to the deep ocean is constrained to a few developed countries, mainly for financial and technical reasons. Collaborative and interdisciplinary research networks have been suggested as an effective way to bridge that gap, given that a vast portion of the deep ocean is within the exclusive economic zones of developing countries and the high seas.

## P. Hydrothermal vents and cold seeps

The analysis in this section is based on chapter 7P of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Hydrothermal vents are features on the seabed from which heated seawater is discharged. Cold seeps are submarine springs where hydrocarbon-rich fluids emanate from the seabed, originating from buried organic matter, fossil fuel reservoirs or methane hydrates.

#### 2. RELEVANCE

Hydrothermal vents and cold seeps are important to local biodiversity and biogeography and to the flux of greenhouse gases to the atmosphere, with long-distance effects on both the seabed and the water column. They serve as ecological models for understanding adaptation and resilience in extreme conditions and offer potential for biotechnological and biomedical innovation. In addition, they are important in mineral resources exploration.

#### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Hydrothermal vents and cold seeps are generally features of the deep sea. Consequently, data gaps identified with other deep-sea features, namely basic aspects of biodiversity, ecological and environmental data, critical to addressing ecosystem responses to disturbance, are applicable in connection with hydrothermal vents and cold seeps.

# IV. State of human society in relation to the ocean

The analysis in this section is based on chapter 8 of *The Second World Ocean Assessment*.

## A. Introduction

*The Second World Ocean Assessment* includes an analysis of coastal communities and various maritime industries, including the harvesting of food, shipping, seabed mining, offshore hydrocarbon exploration and exploitation, tourism and recreation, use of marine genetic resources, marine renewable energy, production of fresh water by desalinization, and salt production. In addition, it contains an examination of the relationship between human health and the ocean through the lens of the health risks and benefits associated with living in proximity to the sea, including the exposure to contaminated seawater and problems caused by food from the sea.

## B. Relevance

About 40 per cent of the global population lives within 100 km of the coast, with coastal communities playing a vital role in supporting all components of the ocean economy, a range of social and cultural values and coastal and marine management and governance. The various economic activities are steadily growing in scale. Shipping is fundamental to the global economy by carrying about 90 per cent by volume of international trade. Coastal tourism represents a substantial proportion of overall economic activity for many countries, in particular small island developing States and archipelagic States.

The benefits to human health from living near the sea include enhanced air quality, exercise opportunities, novel marine-derived pharmaceuticals and ready access to healthy seafood. Risks are posed by tsunamis, storms and tropical cyclones, sea level rise, contaminated food from the sea, chemical contaminants, harmful algal blooms and pathogens, and novel pollutants, such as antibiotics, hormones, nanomaterials and microplastics. Increased knowledge of the links

between the ocean and human health will help to improve interventions to protect human health from threats and to increase the health benefits derived by humans from the sea.

## C. Current data-collection coverage status

### 1. COASTAL COMMUNITIES AND MARITIME INDUSTRIES

#### (a) Coastal communities (geodemographics)

Regular monitoring and assessment of changes in the size of coastal populations have largely occurred at the national or regional level. Little has been published about the total global coastal population since the early 2000s, with studies concentrating mainly on low-elevation coastal zones, owing to their significance in the context of sea level rise. Better information on the state of coastal communities, the threats they face and their economic and social situation is needed, in particular for communities of indigenous peoples, given the crucial roles that they play in maritime industries, in social and cultural aspects and in ocean conservation.

#### (b) Capture fisheries, shellfish harvesting and aquaculture

The *World Ocean Assessment* includes values of total production and information on the fishing fleet and levels of employment in the industry, including by gender. There have been no recent surveys of death and injuries in the fishing industry, but surveys have previously showed significantly higher levels of such incidents compared with other industries.

#### (c) Shipping

The shipping sector seems comparatively well-documented with data. With respect to cargo traffic, the *World Ocean Assessment* includes information on the extent of international seaborne trade by commodity type, container shipping routes and lines, fleets and capacities, registries, ownership and control of shipping, and the construction and demolition of ships. Regarding passenger traffic, the *Assessment* is focused mainly on the pattern and level of cruise ship activities, including the global distribution of cruising, number and size of cruise ships, and number and supply countries of passengers. The reported numbers and supply countries for seafarers were based on estimates from 2015 with another survey planned for 2020. In the context of piracy, the total number of attempted and actual cases of piracy and armed robbery against ships by area are reported. Better information is needed on social considerations, such as the rates of injury and death of seafarers and other aspects of their welfare.

#### (d) Seabed mining

No overview of the economics of seabed mining is available, and there have been no surveys of employment, the occurrence of death and injury to workers or pay across the field.

**(e) Offshore hydrocarbons**

*The Second World Ocean Assessment* provides the share of offshore hydrocarbon production as a percentage of global production and information on the main offshore producers and the estimated annual global investment capital expenditure. In addition, it is stated in the *Assessment* that the survey of social aspects of the offshore hydrocarbon industry that was presented in *The First Global Integrated Marine Assessment* remains accurate, with employment numbers fluctuating significantly with changing crude oil prices.

**(f) Tourism and recreation**

*The Second World Ocean Assessment* includes data on inbound international tourism by global region and related tourism expenditure. Only limited information is available, however, on the scale of coastal and marine tourism and their growth, as compared with tourism generally, or the importance of domestic coastal tourism. Furthermore, there is a lack of global information on the social and economic aspects of coastal and marine tourism, in particular the extent of the benefits for host countries, and on the status of employment in those industries. The *Assessment* provides limited data on the extent of certain coastal tourist activities, such as scuba diving, whale watching and recreational boating.

**(g) Marine genetic resources**

To provide an idea of the scale of activity in the sector, which is concentrated in a comparatively small number of countries, the Assessment provides the numbers of clinical trials, regulatory approvals and marketed cosmeceutical ingredients.

**(h) Marine renewable energy**

The *Assessment* provides an estimate of the total employment levels in the offshore wind energy sector, with an estimate by gender provided only for the onshore and offshore wind energy sector as a whole.

**(i) Desalinization**

The *Assessment* provides an overview of installed capacity for desalinization at the global level and for the main regions, including disaggregation by processing type. Global statistics for employment in desalinization operations are not available, but an estimate is included in the *Assessment*. Further investigations may be needed on the relationships among discharge designs and impacts on the marine environment.

**(j) Salt production**

Salt production from the evaporation of seawater is still a significant source of salt around the world. Comprehensive statistics at the global level, however, remain unavailable, although reports are available for some regions. The size of the workforce involved in sea salt production is unknown.

### 2. HUMAN HEALTH AS AFFECTED BY THE OCEAN

**(a) General aspects of the relationship between human health and the ocean**

Since the assessment and management of impacts on human health resulting from pressures on the ocean have largely been undertaken separately with little or no collaborative interaction, the need for an interdisciplinary approach and new multinational, interdisciplinary projects in that regard are highlighted in the Assessment.

**(b) Health of coastal communities**

Studies comparing the health of coastal and inland communities have largely been confined to developed countries.

**(c) Effects of exposure to contaminated seawater**

Studies in many places have quantified the scale of the risk to human health from contact with seawater containing pathogens. The global impact of poor water quality was examined in a study by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection and the World Health Organization, on the basis of estimates of the number of tourists who swim and of the relative risks at various levels of contamination. More needs to be done to determine the scale and location of illness from swimming in contaminated water. To improve public health, the monitoring of bathing-water quality against developed standards will need to be accompanied by standardized ways of publicizing the results.

**(d) Problems for human health posed by food from the sea**

Shellfish are the major vector of illnesses caused by pathogens discharged to the sea. Although surveys confirm shellfish-borne viral outbreaks, there is no global database on the scale and location of outbreaks of illness of that kind. With respect to toxic algal blooms, effective monitoring and management programmes are in place in some at-risk regions, with a view to preventing such toxins from entering commercial seafood. Gaps remain related to the extent of contamination of fish and shellfish.

# V. Pressures on the marine environment

## A. Natural hazards and extreme climate events

The analysis in this section is based on chapter 9 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes an analysis of three types of ocean-related extreme climate events, namely marine heatwaves, tropical cyclones and extreme El Niño/Southern Oscillation events, and provides information on the impact of sea level rise.

## 2. RELEVANCE

Marine heatwaves, tropical cyclones and extreme El Niño/Southern Oscillation events, and the severity of their impact on nature and human societies, are projected to increase in the future, requiring climate change mitigation efforts to reduce such increases. In addition, coastal cities are more and more susceptible to erosion and flooding, owing to sea level rise, increased storminess and coastal urbanization, which amplifies the need for substantial investment in hard engineered coastal defence measures and nature-based solutions, such as the restoration of natural barriers.

## 3. CURRENT DATA-COLLECTION COVERAGE STATUS

(a) Marine heatwaves

Satellite observations have shown that marine heatwaves doubled in frequency from 1982 to 2016 and have increased in duration, spatial extent and intensity, largely as a result of increases in mean ocean temperature due to human activity-induced climate change. Early warning systems capable of forecasting marine heatwaves can contribute to reducing vulnerabilities in fishing, tourism and conservation, but are yet unproven on a large scale.

**(b) Tropical cyclones**

While changes in the frequency and spatial distribution of tropical cyclones are hard to detect in observational records, studies of individual cyclones have shown an influence of anthropogenic climate change on their intensity, in particular associated rainfall, winds and extreme sea level events, and a potential influence on their spatial occurrence, with an observed poleward migration of maximum tropical cyclone intensity in the western North Pacific.

**(c) Extreme El Niño/Southern Oscillation events**

The El Niño/Southern Oscillation is a coupled atmosphere-ocean phenomenon in the tropical eastern Pacific. It occurs on timescales that range from two to seven years had has wide-ranging climatic effects in many parts of the world, owing to global teleconnections. It is often measured by the surface pressure anomaly difference between Tahiti, French Polynesia, and Darwin, Australia, or the sea surface temperatures in the central and eastern equatorial Pacific. Sustained long-term monitoring and existing forecasting systems may be employed in risk management and adaptation associated with human health, agriculture, fisheries, coral reefs, aquaculture, wildfire, drought and flood management.

**(d) Effects of sea level rise**

Coastal, archipelagic and small island cities, in particular in low-lying areas, are becoming increasingly susceptible to erosion and sea level rise. As a result, it is likely that many hard engineered structures built to protect the land from the sea will need to be adapted, upgraded or combined with nature-based solutions to keep pace with rising sea levels, which could prove challenging for developing countries.

## B. Ocean physical and chemical properties

The analysis in this section is based on chapter 9 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

The accelerated increase of anthropogenic carbon dioxide in the atmosphere leads to an increase in the acidification and deoxygenation of the ocean. Such change, combined with changes in ocean temperature and salinity induced by climate change and human activities, are having an impact on marine ecosystems by altering the distribution of marine species, decreasing the ecological value of coastal ecosystems and changing marine primary production.

### 2. RELEVANCE

Ocean acidification may affect all marine life, for example, through changes in gene expression, physiology, reproduction and behaviour.[1] Ocean acidification affects ecosystem properties, functions and services. It reduces reef resilience on a global scale and exacerbates reef destruction. Some groups of organisms do well in acidified conditions, but many taxa do not.[2] Damage from ocean acidification results in less coastal protection and less habitat for biodiversity and fisheries.[3]

Oxygen is fundamental to life in the oceans: it exerts strong control over biological and biogeochemical processes in the open ocean and coastal waters. The threshold of oxygen concentration or saturation at which life processes diminish varies considerably among species, processes and habitats and is affected by temperature.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Advances in ocean observation systems are required in order to attribute ecosystem impacts to changing ocean chemistry. Global initiatives in ocean research, such as Biogeochemical Argo, the Global Ocean Acidification Observing Network and the Global Ocean Oxygen Network, of the Intergovernmental Oceanographic Commission, are reducing barriers and building capacity through collaboration and partnerships, mentoring and training, and support for the creation of regional hubs. Observation and research efforts on ocean acidification and deoxygenation are concentrated in a small number of countries, leaving significant knowledge and capacity gaps, in particular in the southern hemisphere, small island developing States and least developed countries. Higher capacity to collect complex data and deliver better observations across the globe is required, given that it will improve the predictive power of experiments and ecosystem models replicating real-world scenarios across the world.

1 Ulf Riebsell and Jean-Pierre Gattuso, "Lessons learned from ocean acidification research", *Nature Climate Change*, vol. 5, No. 1 (January 2015), p. 12; and Intergovernmental Panel on Climate Change, *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate* (2019).

2 Sylvain Agostini and others, "Ocean acidification drives community shifts towards simplified non-calcified habitats in a subtropical temperate transition zone", Scientific Reports, vol. 8 (July 2018).

3 Jason M. Hall-Spencer and Ben P. Harvey, "Ocean acidification impacts on coastal ecosystem services due to habitat degradation", *Emerging Topics in Life Sciences*, vol. 3, No. 2 (May 2019).

## C. Nutrient inputs to the marine environment

The analysis in this section is based on chapter 10 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Inputs of nitrogen and phosphorus into coastal ecosystems through river discharges and atmospheric depositions rapidly increased during the twentieth century, primarily as a result of anthropogenic inputs derived from the use of synthetic fertilizers, burning of fossil fuel, cultivation of legumes, production of manure from livestock and municipal waste.

### 2. RELEVANCE

Excessive inputs of nitrogen and phosphorus led to a global increase in the extent of hypoxia zones, sometimes called dead zones, ocean acidification and toxic algae events, posing a serious threat to the health of coastal ecosystems and their capacity to provide valuable services to society. Toxic algae events lead to the production of toxins, which can cause mass mortalities of fishes and shellfish and harm to the health of people who consume contaminated fish and shellfish or are exposed to the toxins through direct contact.[4] Climate-driven acceleration of the global water cycle, including rises in the magnitude and frequency of major rainfall events, will increase nutrient inputs into coastal waters.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Many large marine ecosystems are hotspots of anthropogenic nutrient-loading in both developed and developing countries. A global watershed model has been developed to provide regional and global perspectives on changing nutrient inputs into coastal systems that connects human activities and natural processes in watersheds with nutrient inputs into coastal systems globally.[5] The lack of data on coastal ecosystems in the southern hemisphere is a critical contributing factor to the gaps in the current understanding of the impacts of anthropogenic nutrient inputs into coastal oceans.

## D. Liquid and atmospheric inputs to the marine environment from land, including through groundwater, ships and offshore installations

The analysis in this section is based on chapter 11 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes an analysis of the situation concerning a number of hazardous substances in the ocean from water and airborne inputs to the marine environment

4 Patricia M. Gilbert and others, "The global, complex phenomena of harmful algal blooms" *Oceanography*, vol. 18, No. 2 (June 2005).

5 S.P. Seitzinger and others, "Sources and delivery of carbon, nitrogen, and phosphorus to the coastal zone: an overview of Global Nutrient Export from Watersheds (NEWS) models and their application", *Global Biogeochemical Cycles*, vol. 19, No. 4 (December 2005); and Rosalynn Y. Lee, Sybil Seitzinger and Emilio Mayorga, "Land-based nutrient loading to LMEs: a global watershed perspective on magnitudes and sources", *Environmental Development*, vol. 17 (January 2016).

from land, including groundwater, ships and offshore installations. The hazardous substances analysed are: persistent organic pollutants, metals, radioactive substances, pharmaceuticals and personal care products, hydrocarbons, rare earth elements and airborne inputs of nitrogen and sulfur oxides.

### 2. RELEVANCE

Hazardous substances in the ocean have a direct negative impact on human health and indirectly affect human health when marine plants and animals that contain hazardous substances are used as food sources. In addition, they affect the marine environment itself, such as through ocean acidification or eutrophication, potentially making it inimical to ocean life. A greater understanding of the cumulative impacts of multiple hazardous substances on marine biota is needed.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Clear comparisons between the environmental quality of various ocean areas remains a problem because of the use of different measuring techniques and very different ranges of the varieties of chemicals being observed.

In addition, obtaining information on the atmospheric deposition of various pollutants is dependent on the modelling approaches used to increase the spatial coverage. To be able to model the deposition, high-quality data on emissions and deposition is strongly needed. The availability of such data is limited for a large part of the ocean.

## E. Inputs and distribution of solid waste, other than dredged material

The analysis in this section is based on chapter 12 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* provides an analysis of the situation concerning activities resulting in marine litter, including plastics, abandoned fishing gear, microparticles and nanoparticles, and estimates of its sources from land, ships and offshore installations; and dumping at sea, including garbage from ships and sewage sludge.

### 2. RELEVANCE

Marine litter is most apparent on shorelines, where it accumulates as a result of water currents, wave and wind action and river outflows. The accumulation of plastics, predominantly, occurs, however, on the ocean surface in ocean gyres, in the ocean column and seafloor and within marine life, to which it can cause direct harm and, when it is consumed, harm higher trophic level species, including humans. In addition, marine litter affects other uses of the marine environment, including navigation, tourism, aquaculture and fisheries. The deliberate disposal of waste or other materials in the sea affects marine ecosystems and creates environmental challenges.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The adoption of the United Nations Convention on the Law of the Sea and the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and its 1996 Protocol led to the introduction of regulations for solid waste disposal at sea by coastal States and significant progress in this domain. Substantial underreporting and a lack of published data, however, makes it difficult to track implementation and understand the current extent of the challenge that exists. Some of the contributing factors leading to such knowledge gaps are: a lack of standardization of methods for data collection and analysis and of counts or levels of marine litter between locations, a lack of adequate national or regional monitoring of the quantities and impact of marine litter and a lack of standardized methods for the quantification of microplastics in the marine environment.

## F. Changes in erosion and sedimentation

The analysis in this section is based on chapter 13 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* provides information on the patterns of erosion and sedimentation through the dynamics that have been observed historically of the shoreline and sediment.

### 2. RELEVANCE

Coastal erosion and changes in sedimentation pose severe risks to coastal infrastructure, property, economic activities and ecological systems. Monitoring the coastal trends and changes that accelerate erosion, sedimentation and geomorphological change in coastal ecological systems would improve the ability to model and forecast their dynamics and identify potentially severe impacts.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Increased availability of satellite images and advanced image processing analysis techniques and computing resources have improved the capacity for the global assessment of the changes in coastal erosion and sedimentation. In many regions, however, in particular in developing States, the available data remain insufficient for local and regional decision-making, with many data sets requiring substantial further interpretation and better worldwide spatial resolution.

## G. Coastal and marine infrastructure

The analysis in this section is based on chapter 14 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes information on the changes in coastal and marine infrastructure, their effect on the coastal community and the potential damage to habitats and ecological systems, including their extent, structures and functions. The changes include coastal

offshore land reclamation, coastal development structures, ports, harbours, power cables and submarine communications cables.

#### 2. RELEVANCE

Understanding the correlation between the changes in coastal and marine infrastructure and their potential impacts on the marine environment could improve marine spatial planning and functional analysis and the use of blue infrastructure, resulting in fewer negative effects.

#### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

In general, at the global level, not enough is known about the extent of coastal and marine infrastructure changes and their ecological and socioeconomic impacts. The problems are especially serious for developing countries, mainly owing to the lack of investment in coastal and marine scientific research, including data collection.

### H. Capture fisheries and harvesting of wild marine invertebrates

The analysis in this section is based on chapter 15 of *The Second World Ocean Assessment*.

#### 1. INTRODUCTION

*The Second World Ocean Assessment* contains an analysis of the status of capture fisheries and harvesting of wild marine invertebrates, including by-catch, post-harvest fish losses, marine protein and oils in agriculture and aquaculture, and illegal, unreported and unregulated fishing.

#### 2. RELEVANCE

Capture fisheries remain a crucial source of nutrition and employment, with 4.3 billion people dependent upon fisheries for protein and 120 million people involved in capture fisheries, more than 90 per cent of whom are estimated to be involved in small-scale fisheries.

#### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Several knowledge gaps and a lack of related data are identified in *The Second World Ocean Assessment*: an understanding of the impact of climate change on capture fisheries, of the ecological significance of unexploited stocks in deep-sea environments and of the ability of recovered ecosystems to assume their former roles.

### I. Aquaculture

The analysis in this section is based on chapter 16 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Aquaculture broadly concerns the cultivation of aquatic organisms in controlled aquatic environments for any commercial, recreational or public purpose. An analysis of the status of the aquaculture sector is set out in *The Second World Ocean Assessment*.

### 2. RELEVANCE

Aquaculture contributes to human nutrition and improves it for the rural poor, in particular mothers and young children. It supports livelihoods across the world. Aquaculture is growing at a faster rate than other major food production sectors and it produces food that is high in protein, contains essential micronutrients and, sometimes, contains essential fatty acids that cannot be substituted by other foods.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The rapid growth of intensive aquaculture is a relatively new phenomenon. As a result, there are significant knowledge gaps and a lack of related data for the proper assessment of its consequences for the environment, human health and social issues, and for a thorough understanding of the impact of climate change on aquaculture and the correct management of seeds, feeds and health.

## J. Seaweed harvesting and use

The analysis in this section is based on chapter 17 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes an analysis of the current state of seaweed farming and harvesting through several topics, including the uses by humans and economic system services.

### 2. RELEVANCE

Seaweed is used for human consumption, as food and prebiotics in aquaculture, in food processing, as an animal feed additive, as fertilizers, in water purification and in industrial, cosmetic and medical applications. Collecting data and information on the socioeconomic and environmental impact of seaweed farming and wild harvesting would provide valuable information on their benefits and environmental impact, in particular with regard to climate change mitigation and adaptation.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Seaweed production has been steadily rising to meet the market demand. Such growth has been followed by emerging knowledge gaps and an absence of data on the biology of many seaweed species, including species that are already being farmed and harvested, and the effect on climate change mitigation and adaptation. Addressing those gaps would help to create

appropriate economic and financial models, safeguarding the future of the global seaweed aquaculture industry.

## K. Seabed mining

The analysis in this section is based on chapter 18 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

In *The Second World Ocean Assessment* seabed mining is classified into marine aggregate mining (placer diamonds, placer tin, irons and deposits and phosphorite deposits) and deepwater seabed mining (polymetallic nodules, sea floor massive sulfides, or polymetallic sulfides, and cobalt-rich ferromanganese crusts). In addition, the need for data to improve the understanding of the environmental, social and economic aspects of seabed mining sector is highlighted in the Assessment.

### 2. RELEVANCE

Marine aggregate mining is a major activity that has huge negative impacts on coastal zones, in particular with regard to coastal vulnerability and resilience to flooding, storm surges, tsunamis and rising sea levels. As a result, there is a growing interest in extracting offshore aggregate.

Although there are currently no commercially developed deep-sea mining operations, the legal framework and the technology to enable exploitation activities are steadily progressing, as a result of growing interest.

Various mineral resources are located in multiple geological and oceanographic settings that host a range of communities and habitat types. Understanding the potential effects of seabed mining on those habitats will contribute to avoiding, reducing and mitigating negative impacts.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

As the interest in seabed mining rises and the technologies to make seabed mining possible steadily develop, the focus shifts to understanding the impact on deep-sea ecosystems and deep-sea species. As a result, it has become evident that the collection of baseline data must be expanded, in particular in respect of the characterization of ecosystems and their components, and the natural variations of environmental baselines, including in the shallow-water continental shelf and the deep sea. Baseline ecological information is needed for predicting the ways in which biodiversity, species connectivity and ecosystem functions and services will respond to change.

## L. Offshore hydrocarbon exploration, production and decommissioning

The analysis in this section is based on chapter 19 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Offshore hydrocarbon exploration and production are highly capital-intensive activities and employ workers at above-average wage levels. Exploration is maturing in many regions. As major hydrocarbon reservoirs deplete beyond recovery, the industry expects to spend around $100 billion at the global level over the next decade on decommissioning activities.[6] That trend has the potential to create significant employment opportunities, some of which can offset the reduction in jobs in exploration and production.

### 2. RELEVANCE

The offshore oil and gas sectors have continued to expand globally, in particular in deep and ultradeep waters. Understanding the correlation among exploration and production trends, social and economic aspects, emerging technologies and potential future trends with possible environmental impacts is vital to minimizing the effect on the environment.

Hydrocarbon resources, accumulated under impermeable rock formations, are identified by analysing geological and geophysical data that are collected during surveys. Geological and geophysical data are used to provide an assessment of marine mineral, archaeological and benthic resources. Data compiled during the long-term monitoring of oil and gas exploration and development are used as a baseline to determine trends and establish mitigation strategies.

Studies have shown that offshore platforms contribute hard engineering structures to the marine environment and, in the process, provide food sources and complex physical habitats for a variety of organisms. In an attempt to minimize the detrimental effect on those habitats, stakeholders are evaluating the alternatives to the physical removal of offshore installations.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The short-term impacts of oil and gas exploration, development and decommissioning on the marine environment have been studied extensively. Understanding the long-term effects at the global level, however, requires the development of monitoring programmes for the systematic measurement of important environmental, social and economic indicators over time, which will help with the design and implementation of effective policies and mitigation measures to ensure that resources are developed in an environmentally responsible manner.

## M. Anthropogenic noise

The analysis in this section is based on chapter 20 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

The past few decades have been characterized by an increased awareness of the importance of sound to marine life and a greater understanding of the potential impact of anthropogenic

6 The UK Oil and Gas Industry Association Limited, *Decommissioning Insight* 2018 (2018).

noise on such life. *The Second World Ocean Assessment* includes a description of the sources and primary drivers of anthropogenic noise and its regional variations, including areas where it is expected to increase, its impacts and the current state of knowledge of it, including gaps in knowledge and capacity-building.

## 2. RELEVANCE

Population growth, migration to coastal areas, increased industrialization and tourism, and other developments are expected to result in an increase in activities that contribute to anthropogenic noise, unless they are accompanied by mitigation efforts, which are being initiated. The adequate protection of the marine environment is not possible without a consensus on a global approach to filling knowledge gaps related to the impact of anthropogenic noise. States have been encouraged to study anthropogenic noise in order to develop guidelines and conduct mitigation efforts.

## 3. CURRENT DATA-COLLECTION COVERAGE STATUS

As part of regional and national initiatives, States are developing ocean noise-targeted projects, including noise registers or databases with specifications on impulsive noise activity, that are expected to result in an increased ability to map variability in sound levels and efforts to standardize data collection and measurements.

The global recognition of sound as an essential ocean and cross-disciplinary variable and the incorporation of observation systems into new initiatives were expected to contribute to an increase in the monitoring of anthropogenic noise and a better understanding of its contributions to ambient sound and possible changes in soundscapes over time.

Fundamental challenges in evaluating the relative increases and possible impacts of anthropogenic noise in the ocean include a lack of knowledge and related data on baseline ocean ambient noise and of understanding of the impacts of noise on marine ecosystems. Most work to date has been focused on the impact of a single stressor on a particular species. Difficulties of studying the impacts of anthropogenic noise on population levels, in combination with other stressors and on multiple species, was acknowledged in the Assessment. The ability to integrate effects and impacts across different scales and sources must be expanded, in order to allow for a realistic assessment of the impact of anthropogenic noise on marine animals. In the meantime, a precautionary approach is being followed in regulations on the basis of insufficient data. Substantial efforts are needed to standardize monitoring approaches, measurements and archival frameworks or systems for acoustic recording approaches and associated collected data.

## N. Renewable energy sources

The analysis in this section is based on chapter 21 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes an analysis of the advances in knowledge of and capacity for various types of marine renewable energy at the global level, including offshore wind energy, tidal and ocean current energy, wave energy, ocean thermal energy, osmotic power, marine biomass energy and offshore solar and geothermal energy.

### 2. RELEVANCE

The sharing of data and information is an important driver of cost reduction, which must be addressed in order for marine renewable energy technologies to be commercially viable. Knowledge-generation is also important for fostering the integration of marine renewable energy into national policies. Monitoring advances in knowledge of and capacity for marine renewable energy is relevant to its potential role as a major contributor to the achievement of renewable energy production targets.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Some data are available regarding developments in marine renewable energy, including energy capacity increases, in particular for offshore wind as the leading example of technology in the sector. Although some data are available regarding the environmental effects of offshore wind projects, the environmental impacts of other marine renewable energy devices have not been studied in detail, owing to the scarcity of operating wave energy converters and tidal and ocean current turbines. More data and coordinated studies are needed to gain a full picture of the environmental impacts of various types of marine renewable energy devices.

Data collection will be important for environmental monitoring and mitigation measures. Establishing environmental baselines and monitoring biotic elements are necessary to addressing any adverse impact on biodiversity of marine renewable energy activities. Standards must be defined for analysing environmental monitoring data for marine renewable energy development sites and for identifying the area over which biological effects may occur, in order to inform baseline data collection. The marine renewable energy technologies used and the stressors introduced in the marine environment should be considered when designing monitoring procedures. Predictive models can be a supplementary tool, ideally when combined with localized observations. Oceanographic and meteorological data can be obtained from on-site measurements, outputs from numerical models and remote sensing instruments. Long-term data are required for the preliminary estimation of the available marine renewable energy resource and the oceanographic and meteorological climate characteristics in the area of the installation. In addition, short-term and medium-term forecasting of oceanographic and meteorological conditions is important for operational planning activities. During operations, reliable short-term forecasts of expected power production are required for large-scale power integration.

## O. Invasive species

The analysis in this section is based on chapter 22 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

*The Second World Ocean Assessment* includes an analysis of invasions by marine non-indigenous species, in particular with a view to documenting their baseline status, changes and consequences for human communities, economies and well-being, with a focus on several regional aspects.

### 2. RELEVANCE

Most non-indigenous species have triggered negative ecological, socioeconomic or human health consequences. Trade and climate change are likely to increase further biological invasions and associated biosecurity and biodiversity risks.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Although data have been collected on some species, areas or effects at particular times, no surveys on a larger scale, covering a broad range of species and impacts, have yet been performed. Similarly, the means through which invasions occur, such as through ballast water, biofouling, canals, aquaculture, trade or debris, have not been sufficiently understood and comprehensive monitoring to detect invasion does not occur. Better data are needed to understand the species, areas, time frames and means associated with invasions. Such data could support good ocean governance and help to address risks associated with invasive species, including with a view to ending poverty and hunger and improving health, access to water and economic growth.

To appreciate the problem better at the global level, by improving the understanding of the locations of species and the ways that they arrived there, accessible and searchable databases, including detailed, validated and georeferenced inventories, are needed. An improved geospatial and temporal understanding of the means of invasion is essential to informing policy and management decisions within and beyond areas of national jurisdiction.

## P. Exploration for and use of marine genetic resources

The analysis in this section is based on chapter 23 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

The exploration for and use of marine genetic resources refers to the discovery, analysis and application of genetic materials derived from marine organisms. Such resources encompass a wide range of organisms, including microorganisms, algae, invertebrates and fish, and hold significant potential for various industries, including pharmaceuticals, cosmetics and biotechnology. The exploration and use of marine genetic resources have gained considerable attention in recent years, owing to their biological and chemical diversity and their potential economic and environmental benefits.

### 2. RELEVANCE

Marine organisms are known to produce unique and bioactive compounds that have the potential to be developed into new drugs and therapies. Many marine-derived drugs have already been approved for medical use, in particular in the field of anticancer chemotherapy. In addition, marine organisms provide a rich source of bioactive compounds for the development of cosmetic products that have added therapeutic benefits. Furthermore, marine genetic resources have implications for biotechnology. Advances in that field, such as genetic engineering and synthetic biology, have opened up new avenues for harnessing the potential of marine genetic resources. Such resources can be used for the production of valuable enzymes, biomaterials and biofuels, among other applications. The exploration and use of marine genetic resources can contribute to the development of sustainable and environmentally friendly technologies.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

The collection and documentation of data related to marine genetic resources are crucial for understanding diversity and potential applications of the resources. Efforts have been made to enhance data-collection coverage through various initiatives and projects. Despite those efforts, gaps remain in data-collection coverage, in particular in underexplored regions, such as the deep sea and polar regions. To ensure comprehensive coverage of marine genetic resources, ongoing efforts are needed to expand sampling in those underrepresented areas. Collaboration among researchers, institutions and governments is crucial for collecting and sharing data and knowledge.

## Q. Marine hydrates

The analysis in this section is based on chapter 24 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Marine hydrates are crystalline compounds which exist primarily on continental slopes in areas with large quantities of methane gas, where the temperature is sufficiently low and the pressure is sufficiently high for their formation and maintenance. Methane hydrate is the most common marine hydrate. *The Second World Ocean Assessment* includes a fuller assessment of the abundance of marine hydrates, their potential as a source of energy and the associated risks for the atmosphere and in seabed stability.

### 2. RELEVANCE

As a source of natural gas, marine hydrates have the potential to be a future energy source where they exist in large deposits. Methane, however, is a greenhouse gas that is estimated to be 25 times more consequential for the climate than carbon dioxide. Some research indicates that there might be a connection between global warming and methane release into the atmosphere, given that the stability of gas hydrates depends on temperature and pressure.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Research programmes on the use of marine hydrates as a source of natural gas have been established in some States, and exploration activities have identified promising deposits in some regions. Knowledge gaps remain, however, in relation to the global distribution and size of methane hydrate deposits. Many assessments of those deposits are largely based on extrapolation rather than direct observation and on estimates of the volume of the methane hydrate stability zone, regardless of evidence of the presence of gas. In addition, there are gaps in understanding marine hydrates, such as their behaviour in changing circumstances, in particular changes in ocean temperature, their potential dissociation and the behaviour of any methane that is released, their impact on climate and slope stability, and their contribution to ocean acidification. The knowledge gaps may be significant in relation to the release of oceanic methane into the atmosphere and its potential function as a greenhouse gas.

# VI. Management approaches to the marine environment

## A. Marine spatial planning

The analysis in this section is based on chapter 26 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Marine spatial planning is aimed at resolving increasing conflicts related to the growing scale of human activities and their associated impact on the marine environment.

### 2. RELEVANCE

Defining and analysing existing and future conditions are essential in the process of marine spatial planning. Potential conflicts and compatibilities among existing human activities and between those activities and the protection and preservation of the marine environment can thus be identified.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Marine spatial planning is defined as the public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process. Consequently, the availability of spatial and temporal data and information about the ecological, environmental and oceanographic conditions of the targeted sea area is an essential basis for effective marine spatial planning. As a result, more effective marine spatial planning is generally present where greater coverage of related spatial and temporal data exist.

## B. Management approaches

The analysis in this section is based on chapter 27 of *The Second World Ocean Assessment*.

### 1. INTRODUCTION

Marine ecosystem management, comprising decision-making processes and management tools, is a critical part of safeguarding the health of the ocean and its resources. It is generally agreed that the ecosystem approach provides an effective framing of ocean management. Implementing the ecosystem approach, however, faces challenges, owing to regional disparities in skills, financial capacity and resources.

### 2. RELEVANCE

Managing marine ecosystems is essential to addressing increasing marine environmental challenges. Notably, marine protected areas have rapidly increased in number and size, largely in response to internationally agreed targets under the Convention on Biological Diversity and the 2030 Agenda. Many other types of area-based management tools have been implemented. Regions with limited capacity, however, struggle to implement the ecosystem approach, leading to decades of degradation in marine and coastal areas, with effective management remaining hindered by inadequate plans and enforcement measures. Climate change has emerged as a significant driver for the prioritization of restoration efforts to protect communities and marine habitats worldwide.

### 3. CURRENT DATA-COLLECTION COVERAGE STATUS

Data collection for marine management is often set back by a lack of information of appropriate quality and quantity. Although big data methods and innovative data use show promise, understanding ecological causes and effects related to socioeconomic priorities remains limited in many regions. Knowledge-sharing and open access to information across sectors are crucial to improving data availability. Citizen science programmes are gaining importance as a valuable source of monitoring data. Effective marine ecosystem management requires regional disparities to be addressed, data availability to be expanded and the diverse values associated with the marine environment to be understood. Timely action and collaboration are vital to ensuring a sustainable future for the ocean.

# ANNEX II: MARINE GEOSPATIAL INFORMATION MANAGEMENT – SUCCESS STORIES AT NATIONAL AND REGIONAL LEVELS

Annex II is available at www.un.org/Depts/los/doalos_publications/publicationstexts/annex2.pdf

# ANNEX III: MARINE GEOSPATIAL INFORMATION MANAGEMENT – INTERGOVERNMENTAL ORGANIZATIONS

Annex III is available at www.un.org/Depts/los/doalos_publications/publicationstexts/annex3.pdf.

# Marine geospatial information management

## Annex II

2024

United Nations

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# ANNEX II: MARINE GEOSPATIAL INFORMATION MANAGEMENT – SUCCESS STORIES AT NATIONAL AND REGIONAL LEVELS

# AUSTRALIA

## AUSTRALIA'S OCEANS

Australia is an island continent with a vast marine estate. Australia's cultural identity and lifestyle is based on a connection to our maritime environment, with more than 85 per cent of Australia's population living within 50 kilometres of the coast.

We have the third largest maritime jurisdiction in the world, straddling three oceans: the Southern, Pacific and Indian. Our ocean estate is larger than our land mass, with 70% of Australia's jurisdiction beneath the ocean's surface. Our search and rescue region covers one-tenth of the Earth's surface.

Sea country is an important part of First Nations culture. Sea country encompasses the flora and fauna, beliefs and cultural practices of the many Indigenous groups that care for these areas and indicates a strong connection between First Nations people, land, sea and resources over time.

Our oceans host some of the most important marine areas on the planet, including the Great Barrier Reef, the world's largest and extensive fringing and rocky reef system. A quarter of our World Heritage listed sites – inscribed because they are some of the most remarkable places on earth – are ocean locations.

Australia's ocean ecosystems are some of the most biodiverse in the world. Our ocean is home to over 33,000 recorded marine species, and many animals migrate through or over Australian waters during their annual migrations. Australia is custodian of the third largest area of mangroves globally, and 50 per cent of the world's seagrass species. Our oceans and coasts provide essential ecosystem services, such as carbon dioxide absorption, nutrient cycling and coastal protection.

## *ECONOMY*

Ocean industries contribute AUD $118.5 billion and 462,000 jobs to Australia's economy each year, and this continues to grow rapidly. Our ocean economy generates income from industries such as energy exploration and production, fisheries, coastal and marine tourism, shipping and transport. Australia's ocean also hosts a vast array of recreational activities such as fishing, boating, and surfing which provide significant social and economic benefits for communities.

It is estimated that Australia's coasts and ocean provide AUD$25 billion worth of ecosystems services.

An increase in demand for sustainable energy is expected to drive growth in ocean-based renewable energy. It is estimated that renewable ocean-based energy will contribute up to 11 per cent of Australia's total electricity generation by 2050, supporting Australia's transition to net zero emissions.

## *PRESSURES*

The ocean is under pressure. We need to take action to prevent ocean degradation, which will impact our marine industries and the health and wellbeing of Australians.

*Climate Change*

Climate change is one of the greatest threats to our ocean and will fundamentally change ocean ecosystems. The ocean absorbs about 25 per cent of annual global carbon dioxide emissions and about 90 per cent of the heat generated from rising global emissions. This is leading to warmer seas, rising sea levels, unprecedented marine heat waves, and increasing acidification.

*Microplastics*

It is estimated 75 per cent of marine debris comes from land-based sources and two-thirds of coastal debris in Australia is plastic. Microplastics have been found in fish, tap water, and are present in all water samples collected world-wide.

*Biodiversity Decline*

Australian waters provide critical habitat for many species. Threats such as climate change and variability, marine pollution, ocean noise, habitat loss or degradation, fisheries bycatch, entanglement, poorly regulated tourism, invasive or pest species, and disease are leading to their decline.

*Cumulative Impacts*

A key challenge for the sustainable management of our ocean is the complex interaction between many human induced pressures. Future management of the Oceans will need to take into account the complex interactions between climate and other human activities as a whole rather than in isolation to build a sustainable ocean ecosystem and economy.

## *OCEAN MANAGEMENT*

In Australia, management of our ocean is complex and interconnected across all three levels of government, First Nations people and industry. Under the Offshore Constitutional Settlement, state and territory governments have responsibility from the coastline to 3 nautical miles and the Commonwealth is responsible for 3 nautical miles to the outer boundary of Australia's exclusive economic zone (200 nautical miles), plus areas of extended continental shelf. Local governments play an important role in community engagement, planning and management in the coastal zone.

In some areas, native title rights and other rights granted to First Nations provides governance rights to of varying degrees. In the Northern Territory, access rights have been conferred to Traditional Owners for almost 90 per cent of the coastline.

We have established one of the world's largest networks of marine parks, covering 4.3 million square kilometres or 48 per cent of our ocean.

As an island nation, our ocean connects us to our region and the rest of the world. Australia is taking a leadership role in multiple regional and international forums to promote a healthy and resilient ocean, including the High-level Panel for a Sustainable Ocean Economy.


Australia is committed to the 2030 Agenda for Sustainable Development and the 17 Sustainable Development Goals. SDG14 Life Below Water is the official ocean goal and aims to conserve and sustainably use the ocean and marine resources for sustainable development. However, the ocean is linked to all 17 goals and plays a role in addressing global challenges including ending poverty and hunger, gender equality for women and girls and combatting climate change. Australia is making good progress in implementing SDG14 through actions such as committing to reduce marine pollution through transitioning to a circular economy and implementing several initiatives to reduce plastic pollution; exceeding the target to conserve at least 10 per cent of our coastal and marine areas; and active engagement in our region and globally to combat illegal, unreported and unregulated fishing.

## *MARINE GEOSPATIAL DATA AND INFORMATION*

Underpinning and supporting the existing and future management of Australia's oceans will be the provision marine geospatial data. The breadth of information required to support Australia's goals is diverse and growing. Successfully delivering this information will require maintaining investment and innovation in data collection, custodianship and visualisation by all levels of government.

All levels of Australian governments, scientific organisations and accademia have demonstrated that we are capable of coming together for a common purpose to deliver national outcomes that maximise the nations' investment in marine geospatial data collection and provide visibility of Australia's offshore planning and regulatory frameworks. This submission will provide visibility for several representative initiatives undertaken by Australia to build coordination within sectors and manage geospatial data and information that support whole of jurisdiction decision making in our oceans and coasts. These are:

For the publication of Australia's maritime limits and boundaries and information for coordination and marine planning, the Australian Marine Spatial Information System (AMSIS)

For nationally coordinated access to marine geology and geophysics collected by the Petrolium Industry, the National Offshore Petroleum Information System (NOPIMS)

For improved coordination in the collection, custodianship and distribution of bathymetric data AusSeabed and the commitment by the Australian Government to hydrographic surveying, the HydroScheme Industry Partnership Program (HIPP)

The collection and publication of biodiversity data -The Atlas of Living Australia

The acquisition, custodianship and publishing of ocean observation data, including oceanography - The Integrated Marine Observing System (IMOS) and the Australian Ocean Data Network (AODN)

An example of marine geospatial data access at a State Government level the Victorian Department of Energy, Environment and Climate Action (DEECA) Coastkit

# *THE AUSTRALIAN MARINE INFORMATION SYSTEM*


## Mission

The Australian Marine Spatial Information System (AMSIS) is a web based interactive mapping and decision support system that improves access to integrated government and non-government information in the Australian Marine Jurisdiction. AMSIS is the primary mechanism for visualising Australia's international maritime boundaries and limits established under various treaties and the Seas and Submerged Lands Act 1973 and the domestic limits established under the Coastal Waters (State Powers) Act 1980 and the Offshore Petroleum and Greenhouse Gas Storage Act 2000

AMSIS is a decision support tool maintained by Geoscience Australia that brings together information required by Government, industry and private individuals with an interest in the regulation, geography and uses of Australia's Marine Jurisdiction. AMSIS provides a mechanism to visualise competing interests in the marine space, using curated data from across Government, State, and academia to expose competing use, and enable discussion with the multi-sectoral users to better plan and manage the Jurisdiction.

The goal of AMSIS is to provide visibility of all offshore zones managed by the national government as well as all information required for whole of jurisdiction planning. AMSIS contains information on Australia's Maritime Boundaries, Petroleum and Minerals, Fisheries, Environment and Heritage, Native Title and Physical Geography.

AMSIS is managed by Geoscience Australia as a whole of Australian Government initiative. Information in AMSIS is provided by the relevant Department or Entity and is delivered as web services either by the competent Department or by Geoscience Australia depending on the technical capacity of the Agency.

AMSIS is built on the model of a multipurpose marine cadastre. It is being developed to support two main use cases:

- A digital marine cadastre for the legal declaration and distribution of maritime limits
- The primary portal for whole of jurisdiction planning in Australia

The geographic coverage of AMSIS is the Australian maritime Jurisdiction.

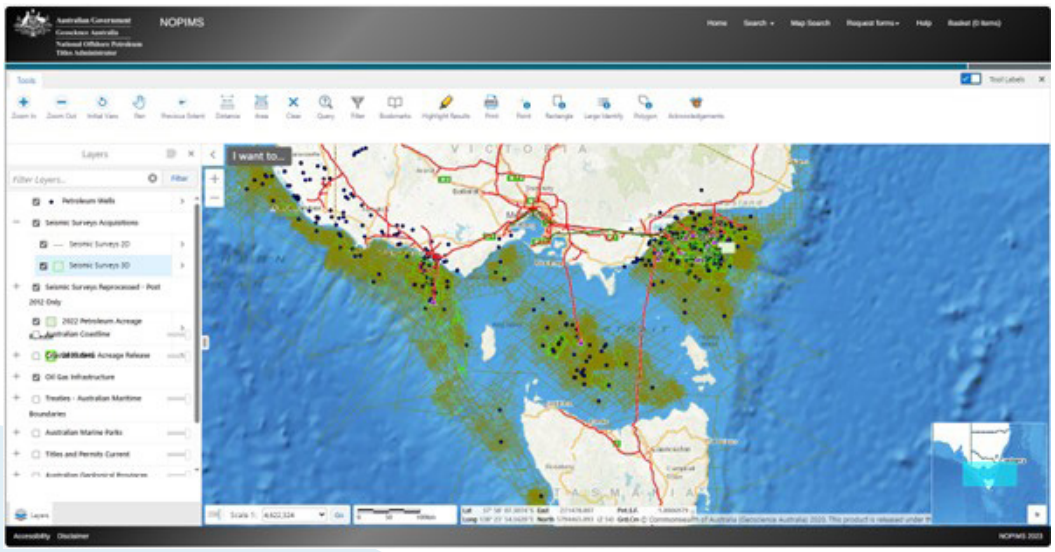
AMSIS is published at the following URL Australian Marine Spatial Information System (AMSIS) (arcgis.com)

AMSIS applies OGC standards and is the testbed in Australia for deploying IHO-121 *maritime limits and boundaries* or ISO-19152 part 3 marine *georegulation* standards in the context of a marine cadastre.

Link

S-121 product specification

# *NATIONAL OFFSHORE PETROLEUM INFORMATION MANAGEMENT SYSTEM*




The National Offshore Petroleum Information Management System (NOPIMS) has been developed as a collaborative initiative by Western Australia Department of Mines Industry Regulation and Safety, Geoscience Australia and the National Offshore Petroleum Titles Administrator (NOPTA) to provide access to technical data related to offshore wells and surveys.

Apart from hydrographic surveying, NOPIMS is the longest standing Australian Government initiative to formally capture and make available marine geospatial data. The functions of data collection and rules for data access are established by regulations under the Offshore petroleum and Greenhouse gas Storage Act 2006

NOPIMS contains all offshore petroleum exploration data collected over the last 50 years. No registration is required to view data listings or download data. The system is compatible with all major browsers and includes an intuitive interface, predictive search boxes and HTML 5 Map, which means that the map can be accessed on all platforms including tablets and mobiles.

NOPIMS supports data discovery, access and delivery by providing direct user access to metadata listings and, for the majority of open file digital data items, the ability to download data directly from the web portal via cloud-enabled web services. NOPIMS is progressively updated as new activities occur.

Geoscience Australia's Client Services team responds to requests for any items not directly downloadable, more bespoke data requests and provide support and advice regarding the collections. Requests can be submitted either via NOPIMS or via email to ausgeodata@ga.gov.au. Fees are charged to cover the cost of copying data and delivery.

The geographic coverage of NOPIMS is all seabed to the limit of the continental shelf of Australia established under UNCLOS.

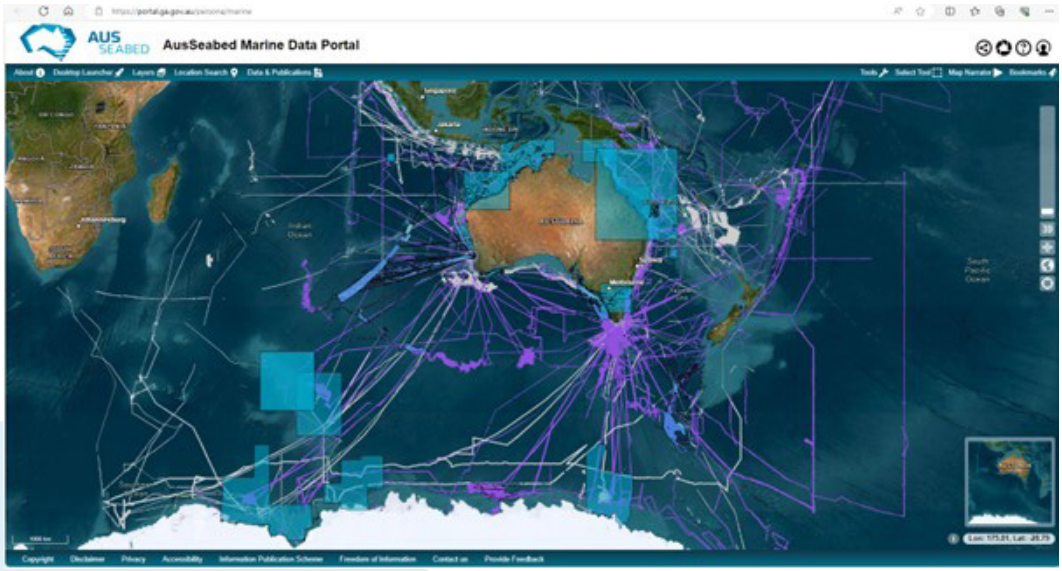
NOPIMS is published at the following URL https://www.ga.gov.au/nopims

The text based database search page is located at https://nopims.dmp.wa.gov.au/nopims

Its online map application is published at https://nopims.dmp.wa.gov.au/Nopims/GISMap/Map

All data contained in NOPIMS follows petroleum industry standards.

# *BATHYMETRY: AUSSEABED, NEW AUSBATHYTOPO NATIONAL AND REGIONAL BATHYMETRY SURFACES AND THE HYDROSCHEME INDUSTRY PARTNERSHIP*




## INTRODUCTION

Bathymetry is one of the highest value marine geospatial data sets.  It influences all ocean physical and ecological processes. Historically, access to bathymetric products suitable to support the management of the oceans has been impeded by access restrictions to data and the inherent complexity of the data. One of the more recent achievements in Australia has been the establishment of several complimentary initiatives that have transformed how we as a country and community plan, collect and provide access to bathymetry data. These initiatives are: AusSeabed, the new AusBathyTopo series of regional and national bathymetry surfaces, and the Hydroscheme Industry Partnership Program.

These initiatives are facilitating new opportunities for managing Australia's jurisdiction.  For instance, improved access to bathymetric data in new AusBathyTopo surfaces has allowed unprecedented detail to be achieved in these foundation products. These products have already been used to improve ocean modelling, and will underpin a new national geomorphic classification based upon a recently completed two part scheme (part 1 and part 2) developed to support area planning in the marine jurisdiction.

# AUSSEABED

Home | AusSeabed

AusSeabed Marine Data Portal (ga.gov.au)

AusSeabed, a collaborative national seabed mapping initiative led by Geoscience Australia, is central to the Australian seabed information ecosystem. It was established in 2018 and focuses on delivering publicly accessible seabed mapping data and coordinating efforts to map the gaps across the Australian maritime region of responsibility. The program is governed by a cross-sector Steering Committee and Executive Board. The AusSeabed Strategy and Roadmap guides the direction of the program, to achieve three key goals.


*AusSeabed has three key goals: products, coverage and awareness.*

## AusSeabed Vision

The Australian seabed information ecosystem delivers maximum benefits to Australian Governments and users, supporting sustainable use of the marine environment, a resilient society and the growth of the Blue Economy.

## AusSeabed Mission

Improve the awareness, coverage, quality, accessibility and usability of seabed mapping products in the Australian region through coordination, collaboration, and innovation.

## AusSeabed Role

AusSeabed plays a pivotal role within the Australian seabed information ecosystem by:

- Connecting stakeholders across all sectors and encourage collaboration
- Liberating seabed data and products for users
- Guiding the sector towards quality standards and consistency
- Raising awareness of the importance of seabed mapping in the wider community

## Program Outcomes

- Sustainable and supported federated platform adopted by users
- Coordinated activities across Australian Governments and the seabed mapping community
- Improved quality of data acquisition through adoption of common standards and tools
- Seabed mapping products support improved decision making within Australian Governments and the broader users

# *HYDROSCHEME INDUSTRY PARTNERSHIP*

Australian Hydrographic Office - HIPP

Storymaps showing progress on the hydroscheme

HydroScheme 2021 (arcgis.com)

HydroScheme 2022 (arcgis.com)

### HYDROSCHEME 2023 (ARCGIS.COM)

The HydroScheme Industry Partnership Program is the commercial acquisition program that undertakes focused hydrographic survey activities to contribute to national charting priorities. The vision for HIPP is to undertake an efficient, effective and sustainable hydrographic survey, oceanographic and marine geophysical data collection program through a partnership with Industry to deliver a true nation-building effort.

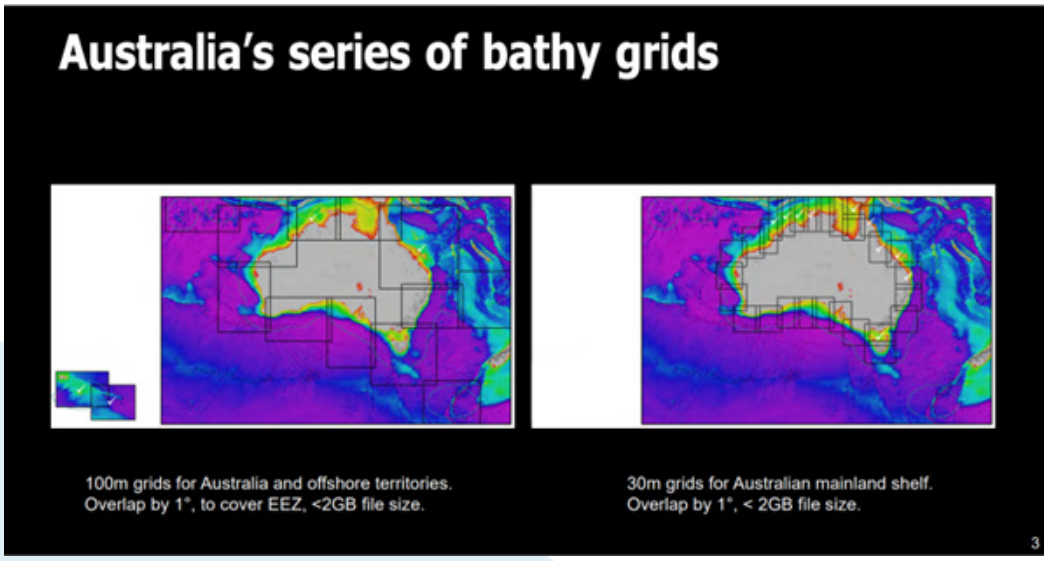
### STRATEGIC OBJECTIVES:

- To obtain full, high quality bathymetric coverage of Australia's Exclusive Economic Zone by 2050
- To link the Australian Chart Datum to the National ellipsoid through the development of the AusHydroid by 2030
- To integrate all HIPP activities into the National Plan for Multibeam Data Acquisition
- Provide environmental data that contributes to national efforts in establishing a baseline dataset of Australia's marine estate through data acquisition for safety of navigation
- To support hydrographic, meteorological and oceanographic survey in remote locations
- To support the development of an academic program to deliver an organic tertiary hydrographic qualification
- To support capacity building programs in the region
- To adhere to the Australian Government's Data Availability and Use

## *NEW AUSBATHYTOPO SERIES*

Presentation on 250m grid production (James Cook University)

Data Access all AusBathyToposurfaces via AusSeabed Data Portal

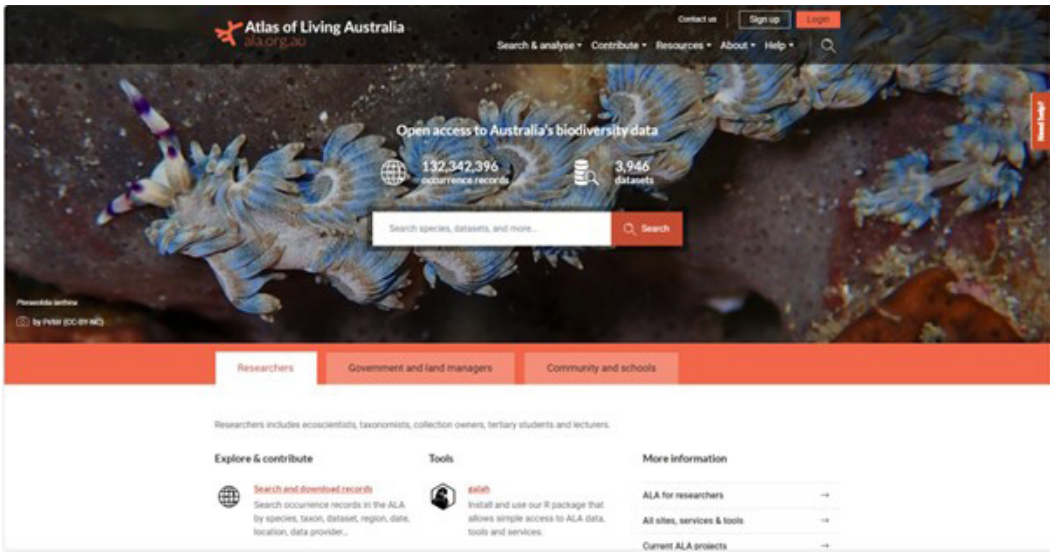



Over a period of 10 years, a collaboration between Geoscience Australia, the Australian Hydrographic Office and James Cook University has developed a series of integrated land and bathymetry topographic surfaces for Australia.

These surfaces:

- Have benefited from improved availability of bathymetric LIDAR collected by state and national government entities.
- Included the use of new Earth Observation processing techniques to improve coastline control, provided elevation data across the entire intertidal zone and incorporated shallow water bathymetry using satellite-derived bathymetry where no bathymetric LIDAR exists.
- Expose the geography of the Australian continental shelf in unprecedented detail, in particular, for the first time, Australia has a 30m elevation model for the entire Great barrier Reef and Torres Strait, including the adjacent land areas. This will facilitate integrated management of the world's largest reef ecosystem, including the modelling of terrestrial impacts on the reef ecology.

# *THE ATLAS OF LIVING AUSTRALIA*




The Atlas of Living Australia (ALA) is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources, making it accessible and reusable.

The ALA helps to create a more detailed picture of Australia's biodiversity for scientists, policy makers, environmental planners and land managers, industry and the general public, and enables them to work more efficiently.

The ALA is the Australian node and a full voting member of GBIF – the Global Biodiversity Information Facility – an international network and data infrastructure funded by the world's governments and aimed at providing anyone, anywhere, open access to data about all types of life on Earth.

## VISION

To deliver trusted biodiversity data services for Australia supporting world-class research and decision-making.

## INTERNATIONAL LEADERSHIP

The ALA plays an important role in developing and maintaining international biodiversity data standards. The ALA has membership roles on the Biodiversity Data Standards (TDWG) Executive Committee, Humboldt Core Task Group, Audubon Core Interest Group, Taxon Names and Concepts Interest Group, and the Machine Observations Interest Group.

## ALA USERS

The ALA is an essential resource for:

- Researchers in the fields of ecology, new species discoveries, systematics (relationships between living things), taxonomy (naming and classification), and digitisation of biological collections
- Researchers and practitioners in biodiversity conservation and environmental monitoring, sustainable ecosystem development
- Government agencies and land managers responsible for natural resource management and environmental impact assessments
- Community and education groups involved in ecoscience education and citizen science activities.

## DATA STANDARDS

The ALA uses the Darwin Core set of standards to mobilise and deliver biodiversity data. Darwin Core is the internationally agreed data standard to facilitate the sharing of information about biological diversity.

## GOVERNANCE

Learn about the ALA advisory board, executive and contributors on the Governance page.

## FUNDING

The ALA receives support from the Australian Government through the National Collaborative Research Infrastructure Strategy (NCRIS) and is hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

## LINKS

The Atlas of Living Australia Strategy 2020-2025

# *THE INTEGRATED MARINE OBSERVATIONS SYSTEM (IMOS) AND AUSTRALIAN OCEAN DATA NETWORK (AODN)*

Australia's Integrated Marine Observing System (IMOS) has been operating a wide range of observing equipment throughout Australia's coastal and open oceans since 2006. IMOS makes all of its data openly and freely accessible to the marine and climate science community, other stakeholders and users, and international collaborators.

Australia's Integrated Marine Observing System (IMOS) is enabled by the National Collaborative Research Infrastructure Strategy (NCRIS). It is operated by a consortium of institutions as an unincorporated joint venture, with the University of Tasmania as Lead Agent.

## PRINCIPAL PARTICIPANTS

University of Tasmania (Lead Agent) Australian Institute of Marine Science Bureau of Meteorology CSIRO Sydney Institute of Marine Science (encompassing the University of New South Wales, The University of Sydney, Macquarie University and University of Technology Sydney) University of Western Australia South Australian Research and Development Institute

## ASSOCIATE PARTICIPANTS

Curtin University Deakin University Australian Antarctic Division The University of Melbourne

## HOW DOES IMOS WORK?

IMOS is designed to be a fully-integrated, national system, observing at ocean-basin and regional scales, and covering physical, chemical and biological variables.

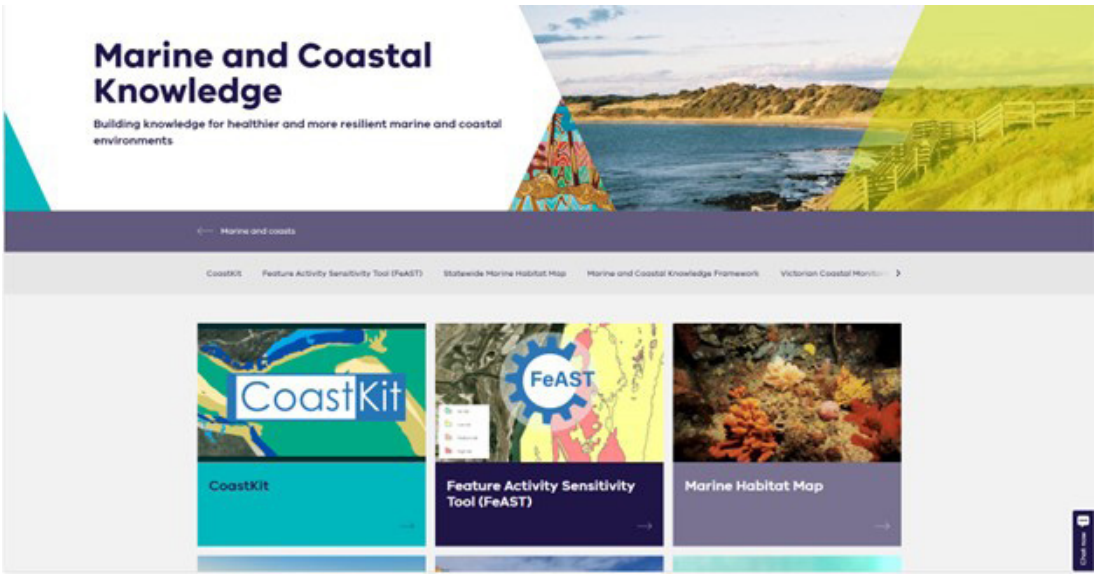
IMOS Facilities, operated by eight different institutions within the National Innovation System, are funded to deploy equipment and deliver data streams for use by the entire Australian marine and climate science community and its international collaborators.

IMOS observations are guided by science planning undertaken collaboratively across the Nodes of the Australian marine and climate science community with input from government, industry and other stakeholders. There are five major research themes that unify IMOS science plans and related observations: Long-term ocean change Climate variability & extremes Boundary currents Continental shelf & coastal processes Ecosystem responses

## DATA ACCESS

IMOS observations are turned into data that can be discovered, accessed, downloaded, used and reused in perpetuity through the IMOS data facility: the Australian Ocean Data Network.

# MARINE AND COASTAL KNOWLEDGE (VICTORIA)




In Australia, Under the Offshore Constitutional Settlement, State and Territory governments have responsibility from the coastline to the first 3 nautical miles of the surrounding oceans.

All States and Territories have systems in place to manage geospatial data and information relevant to the discharging their responsibilities.

An example of the kinds of capabilities is represented by the information and online mapping portals supported by the Victorian Department of Energy, Environment and Climate Action. The marine and Coastal Knowledge web portals which provides access to data and tools for managing the waters over which Victoria is responsible.

## COASTKIT

This portal provides access to a range of functionality, including CoastKit, an online web mapping portal which provides a central repository for marine and coastal data with intelligent in-built tools. In CoastKit you can zoom, explore and overlay maps, identify features, generate reports, download and create printable maps and images. The portal is frequently updated, using the best available information and promotes standardised data classification for collection, reporting, monitoring, assessment and evaluation.

You can find all CoastKit datasets in the Victoria Spatial Data Library aligning with FAIR data sharing standards.

## MARINE AND COASTAL KNOWLEDGE FRAMEWORK

Victoria's coasts and oceans are important in our natural world. The marine ecosystem is closely linked to our land and the people that use these environments.

To make better decisions about how to manage our marine and coastal environments, we need knowledge on how they operate and respond to changes.

The Marine and Coastal Knowledge Framework (MACKF) includes standards for data collection, management, and analysis to inform decision making.

Marine & Coastal Knowledge Framework Strategic Directions 2020-22 (PDF, 4.6 MB).
Marine & Coastal Knowledge Framework Strategic Directions 2020-22 (DOCX, 16.1 MB).

The MACKF has 3 core themes:

- Drivers: the legal and policy setting which is guided by international scientific and management principles.
- Outputs: the Knowledge Management System which pulls on scientific and socioeconomic data from research programs and data modelling.
- Applications: the components that apply the data and information products to support management and planning decisions and their evaluation.

### EXAMPLES OF OTHER STATE INITIATIVES

New South Wales fisheries data portal
Queensland Government Open data Portal
Government of Western Australia Department of Transport coastal data and charts

# ECUADOR

# PUBLICACIÓN SOBRE LA GESTIÓN DE LA INFORMACIÓN GEOESPACIAL MARINA

La base de la publicación sobre la gestión de la información geoespacial marina debe brindar orientación estratégica y recomendaciones a sus miembros sobre temas prioritarios como:

- Estandarización de datos
- Manejo de información geoespacial
- Desarrollo de infraestructura tecnológica: Catálogo de datos geoespaciales (Publicación de servicios OGC, manejo de aplicativos geográficos, descarga de información pública y seguridad de la información.

## ESTANDARIZACIÓN DE DATOS

Se empleará estándares internacionales y compatibles con los datos hidrográficos, oceanográficos, geológicos, geofísicos, biológicos, meteorológicos, climáticos, terrestres, costeros, gobernanza marítima y actividades relacionadas con el ser humano. Dentro de las normas internacionales sugeridas, se encuentran las siguiente:

- ISO 19126:2021 - Información geográfica — Registros y diccionarios de conceptos de características y su aplicación (DGIWG Feature Data dictionary – DFDD 2014)
- ISO/TS 19110-Geographic Information – Metodology for Feature Cataloguing;
- ISO 19115: GeographicInformation- Metadata;
- S-100 (Modelo Universal de Datos Hidrográficos): comprende quince partes relacionadas que brindan al usuario las herramientas y el marco apropiados para desarrollar y mantener datos, productos y registros relacionados con la hidrografía.
- S-121 (MaritimeLimits and Boundaries): La Especificación de Producto de Límites Marítimos está destinada a la codificación e intercambio de información digital de límites marítimos; incluidos los límites marítimos, las zonas y los límites descritos en la Convención de las Naciones Unidas sobre el Derecho del Mar (UNCLOS).
- S-126: Esta especificación de producto describe la topografía marina y terrestre; corrientes predominantes, estacionales y peligrosas; mareas; clima; y otras condiciones ambientales. La información del entorno físico puede considerarse información adicional complementaria que complementa la S-101 ENC.
- S-101: La especificación de producto (PS) de la ENC de la S-101 especifica el contenido, la estructura, la codificación de datos y los metadatos necesarios para compilar los datos de la ENC de la S-101. La Especificación también incluye los requisitos de representación para su uso dentro de un ECDIS. El S-101 PS reemplazará al S-57 ENC PS.

Estos estándaresabstractos para información geográfica definidos por la Organización Internacional de Normalización ( ISO TC/211 ) como los estándares de la Organización Hidrográfica internacional (OHI) permiten **catalogar los objetos geográficos, sus atributos, dominios** de información hidrográfica y relacionada, métodos y herramientas para la gestión, procesamiento, análisis, acceso, presentación y

transferencia de dichos datos en forma digital/electrónica entre diferentes usuarios, sistemas y ubicaciones. Al seguir este conjunto de estándares geoespaciales se permite la provisión de soluciones para que el levantamiento y manejo de información a fin de garantizar la compatibilidad entre los sistemas de información geográfica, las cartas náuticas electrónicas y otros sistemas.

## MANEJO DE INFORMACIÓN GEOESPACIAL

La forma más optima del manejo de información espacial son las bases de datos geográficas administrados dentro de un GIS (GeographicInformationSystem). El diseño de la base de datos geográfica debe realizarse en base al trabajo realizado en la estandarización mencionada donde se toma en cuenta:

- Organización de los datos de acuerdo con las categorías y subcategorías de acuerdo con el grupo de información geoespacial y a la normativa de la OHI- FeatureDatasets.
- Identificación de los objetos geográficos a través de una identificación única – Featureclass.
- Identificación de representaciones espaciales: Punto, línea, polígono, raster.
- Identificación de un sistema de referencia
- Identificación de los atributos mandatorios y opcionales de los objetos geográficos.
- Identificación de los elementos administrativos mandatorios y opcionales (ISO 19115) a través del manejo de metadatos.

El manejo de la información geoespacial marina estandarizada, garantizael buen orden, uso, interoperabilidad y calidad de la información que será empleada en el desarrollo de los estudios técnicos científicos de los países miembros teniendo en cuenta una guia establecida. De forma paralela, se debe contar con un sistema documental para garantizar el manejo de la documentación de respaldo de los objetos geográficos de manera eficiente, y que guarde relación con la estructura de la base de datos geográfica. (**ANEXO A**)

## SISTEMAS DE REFERENCIA GEOGRÁFICA

Establecer el formato de un Sistema de referencia de presentación  para la visualización de la información espacial marina, de esa manera el depósito por los Estados de cartas y coordenadas geográficas relativas a las zonas marítimas, incluidas las líneas de delimitación, presentadas de conformidad con la Convención, y darles la publicidad debida, sea compatible cos organizaciones internacionales pertinentes, como la Organización Hidrográfica Internacional, así como el almacenamiento y la difusión de la información depositada, para garantizar la compatibilidad entre el Sistema de Información Geográfica, las cartas náuticas electrónicas y otros sistemas desarrollados por estas organizaciones. (**ANEXO B**)

## DESARROLLO DE INFRAESTRUCTURA TECNOLÓGICA

Los literales a), b) y c) del artículo 268 de la CONVEMAR establecen que:

*Artículo 268:*
*Los Estados, directamente o por conducto de las organizaciones internacionales competentes, fomentarán...*

> *a) La adquisición, evaluación y difusión de conocimientos de tecnología marina y facilitarán el acceso a esos datos e informaciones;*
> *b) El desarrollo de tecnología marina apropiada;*
> *c) El desarrollo de la infraestructura tecnológica necesaria para facilitar la transmisión de tecnología marina;*

En función de ello, implementar una Infraestructura de datos espaciales (IDE) administrada por la DOALOS, la cual tendría como objetivo publicar información geográfica recopilada por los países miembros, mediante herramientas tecnológicas como:

**Catálogo de datos:** permita acceder a datos marinos libres de descarga, metadatos y servicios web para facilitar la búsqueda de información espacial e integrar la investigación delos países miembros y la comunidad científica a través de la información geográfica marina.

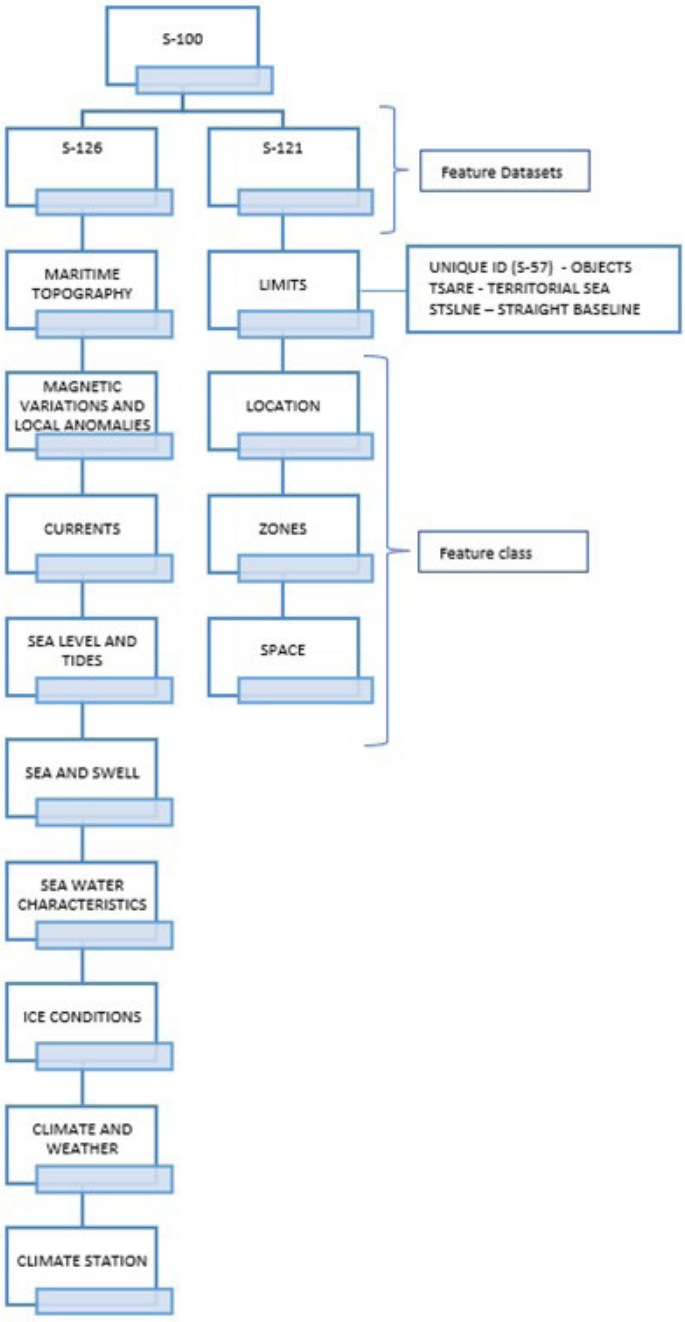
**Manejo de aplicativos webs** que permita navegar sobre datos publicados por la DOALOS a través de visores geográficos. Esto permitirá a los usuarios visualizar, consultar y explorar la información geográfica generada por los países miembro mediante servicios. Para garantizar la funcionalidad del visor y la interoperabilidad se debe seguir los estándares (WMS, WFS y otros servicios estándar de la OGC) establecido para la visualización de datos.

**Descarga de información pública** que permite el manejo de cartografía náutica libre y acceso a páginas globales que proporcionan información de la superficie marítima. Adicional al componente de descarga de información geoespacial es necesario vincularlo con la documentación para que la infraestructura tecnológica cumpla con su objetivo de búsqueda.

**Seguridad de la información:**La administración de los usuarios es fundamental para la gestión efectiva de la información espacial; por lo que es importante establecer un control sobre los roles de usuarios, los privilegios y restricciones a los cuales están asociados cada usuario. Una vez gestionado los niveles de acceso a los diferentes componentes de la infraestructura tecnológica se puede identificar los permisos necesarios para ingresar, descargar y visualizar la información de acuerdo con su restricción.

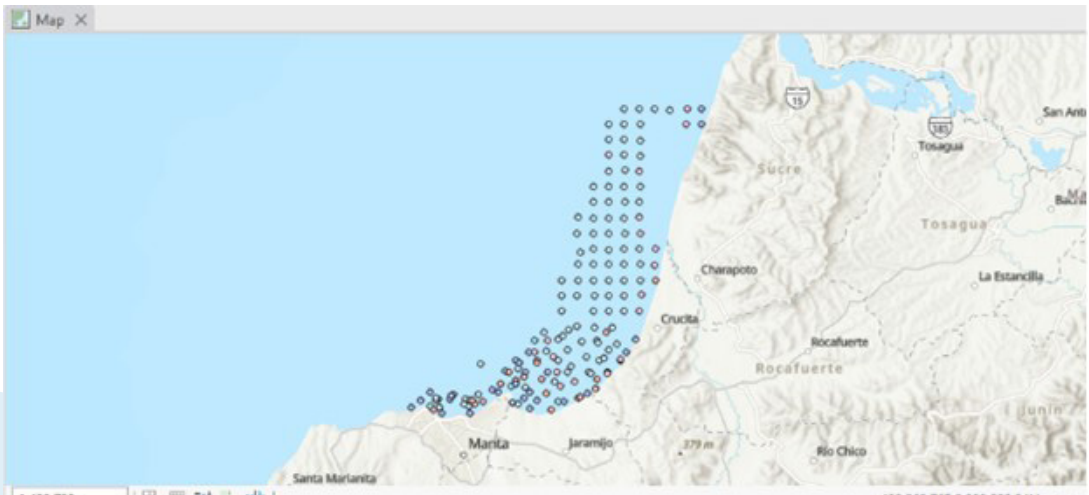
# ANEXO A

## CATEGORÍAS, SUBCATEGORÍAS Y OBJETOS - OHI S-100



# ANEXO B

## ATRIBUTOS DEL OBJETO SBDARE (MUESTRAS DE FONDO)




SBDARE

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| | FID | NUM_MUESTR | SERIE_CART | LATITUD | LONGITUD | ABREVIATUR | NAT_FONDO | FUENTE | COLOUR | NATQUA_1 | NATSUR | WATLEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1102 | 9322 | 107 | 02-08-10S | 79-51-17W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 2 | 1103 | 9323 | 107 | 02-08-10S | 79-50-50W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 3 | 1104 | 9324 | 107 | 02-08-11S | 79-50-25W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 4 | 1105 | 9325 | 107 | 02-08-58S | 79-50-35W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 5 | 1106 | 9326 | 107 | 02-08-58S | 79-50-57W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 6 | 1107 | 9327 | 107 | 02-08-58S | 79-51-19W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 7 | 1108 | 9328 | 107 | 02-09-35S | 79-51-45W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 8 | 1109 | 9329 | 107 | 02-09-36S | 79-51-21W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 9 | 1110 | 9330 | 107 | 02-09-36S | 79-50-54W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 10 | 1111 | 9331 | 107 | 02-10-11S | 79-51-27W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 11 | 1112 | 9332 | 107 | 02-10-11S | 79-51-53W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 12 | 1113 | 9333 | 107 | 02-10-11S | 79-52-21W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |

# PUBLICATION ON MARINE GEOSPATIAL INFORMATION MANAGEMENT

The basis of the publication on marine geospatial information management should provide strategic guidance and recommendations to its members on priority topics such as:

- Data standardization
- Geospatial information management
- Development of technological infrastructure: Catalogue of geospatial data (Publication of OGC services), Management of geographical applications, download of public information Information and security

## DATA STANDARDIZATION

These standards must be international and compatible with hydrographic, oceanographic, geological, geophysical, biological, meteorological, climatic, terrestrial, coastal, maritime governance and human-related activities. Suggested international standards include:

- ISO 19126:2021 - Geographical information - Feature concept dictionaries and registers
- and their application (DGIWG Feature Data dictionary - DFDD 2014)
- ISO/TS 19110-Geographic Information - Metodology for Feature Cataloguing;
- ISO 19115: GeographicInformation- Metadata;
- S-100 ( IHO Universal Hydrographic Data Model) comprises fifteen related parts that give the user the appropriate tools and framework to develop and maintain hydrographic related data;
- S-121 (Maritime Limits and Boundaries) The Maritime Boundary Product Specification is intended for the encoding and exchange of digital maritime boundary information; including maritime limits, zones and boundaries as described under the United Nations Convention on the Law of the Sea (UNCLOS);
- S-126: This Product Specification describes marine and terrestrial topography; prevailing, seasonal and hazardous currents; tides; weather; and other environmental conditions. Physical environment information may be considered supplementary additional information that complements the S-101 ENC.
- S-101: The S-101 ENC Product Specification (PS) specifies the content, structure, data encoding and metadata required for compiling S-101 ENC data. The Specification also includes the portrayal requirements for use within an ECDIS. The S-101 PS willsupersedethe S-57 ENC PS.

These abstract standards for geographical information defined by the International Organization for Standardization ( ISO TC/211 ) as the standards of the International Hydrographic Organization (IHO) allow **the cataloguing of geographical objects, its attributes, hydrographic and related information domains,** methods and tools for the management, processing, analysis, access, presentation and transfer of such data in digital/electronic form between different users, systems and locations. By following this set of geospatial standards is allowed the provision of solutions for the survey and handling of information to ensure compatibility between geographic information systems, electronic nautical charts and other systems

## MANAGEMENT OF GEOSPATIAL INFORMATION

The most optimal form of spatial information management is the geographic databases managed within a GIS (Geographic Information System). The design of the geographical database should be based on the work done in the aforementioned standardization where it is taken into account:

- Data organization according to categories and subcategories according to geospatial information group and IHO regulations- Feature Datasets.
- Unique Coding of geographical objects for the creation of feature classes.
- Identification of spatial representations: Point, line, polygon, raster.
- Identification of a reference system.
- Identification of mandatory and optional attributes of geographical objects.
- Identification of mandatory and optional administrative elements (ISO 19115) through the management of metadata.

The management of standardized marine geospatial information ensures the good order, use, interoperability and quality of the information that will be used in the development of the scientific technical studies of the member countries taking into account an established guide. In parallel, a documentary system should be in place to ensure the efficient handling of the supporting documentation of geographical objects and related to the structure of the geographical database. (**ANNEX A**)

## GEOGRAPHICAL REFERENCE SYSTEMS

Establish the format of a Presentation Reference System for the display of marine spatial information, thereby depositing by States charts and geographical coordinates relating to maritime areas, including delimitation lines, submitted in accordance with the Convention, and given due publicity to them, be compatible with relevant international organizations, such as the International Hydrographic Organization, as well as the storage and dissemination of deposited information, to ensure compatibility between the GIS, electronic nautical charts and other systems developed by these organisations. (**ANNEX B**)

## DEVELOPMENT OF TECHNOLOGICAL INFRASTRUCTURE

*Article 268:*
*States, directly or through competent international organizations, shallpromote:*

> *(a) the acquisition, evaluation and dissemination of marine technological knowledge and facilitate access to such informationand data;*
> *(b) the development of appropriate marine technology;*
> *(c) the development of the necessary technological infrastructure to facilitate the transfer of marine technology;*

On its basis, implementing a Spatial Data Infrastructure (SDI) ) managed by DOALOS, which would aim to publish geographic information collected by member countries, using technological tools such as:

**Data catalogue**: Provide access to free marine download data, metadata and web services to facilitate the search for spatial information and integrate research from member countries and the scientific community through marine geographic information.

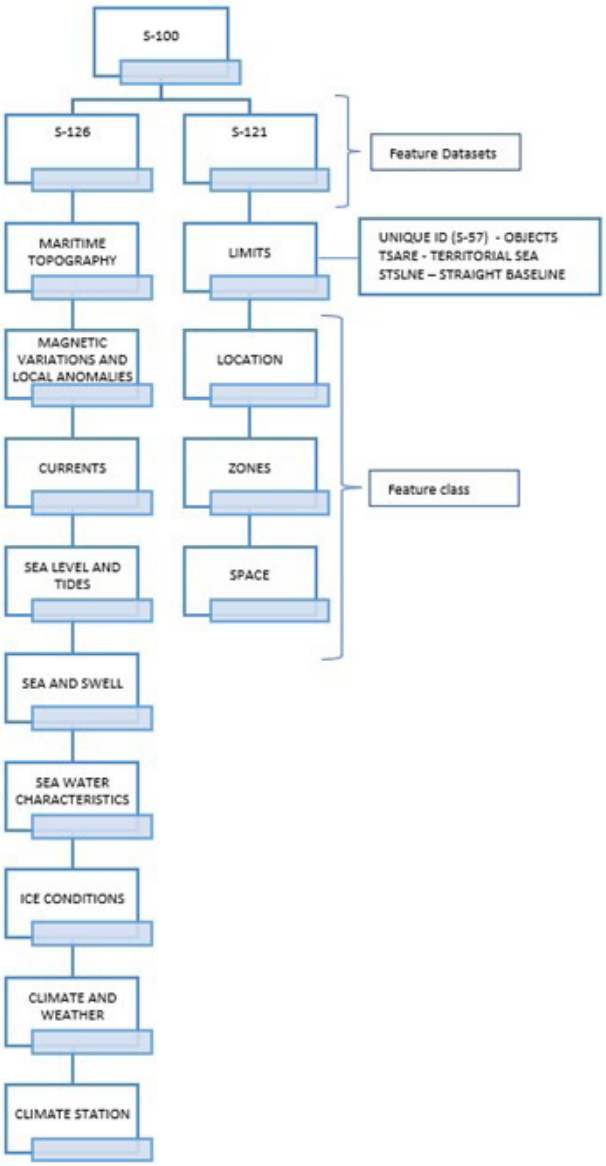
**Management of web applications** that allow navigation on data published by the DOALOS through geographic viewers. This will allow users to view, consult and explore geographic information generated by member countries through services. To ensure viewfinder functionality and interoperability must follow the standards (WMS, WFS and other standard OGC services) set for data visualization.

**Download public information** that allows the management of free nautical cartography and access to global pages that provide information of the maritime surface. Additional to the geospatial information download component it is necessary to link it to the documentation for the technological infrastructure to meet its search objective.

**Information security**: User administration is fundamental to the effective management of spatial information; therefore, it is important to establish control over user roles, privileges and restrictions to which each user is associated. Once the levels of access to the different components of the technological infrastructure are managed, the necessary permissions can be identified to enter, download and view the information according to its restriction.

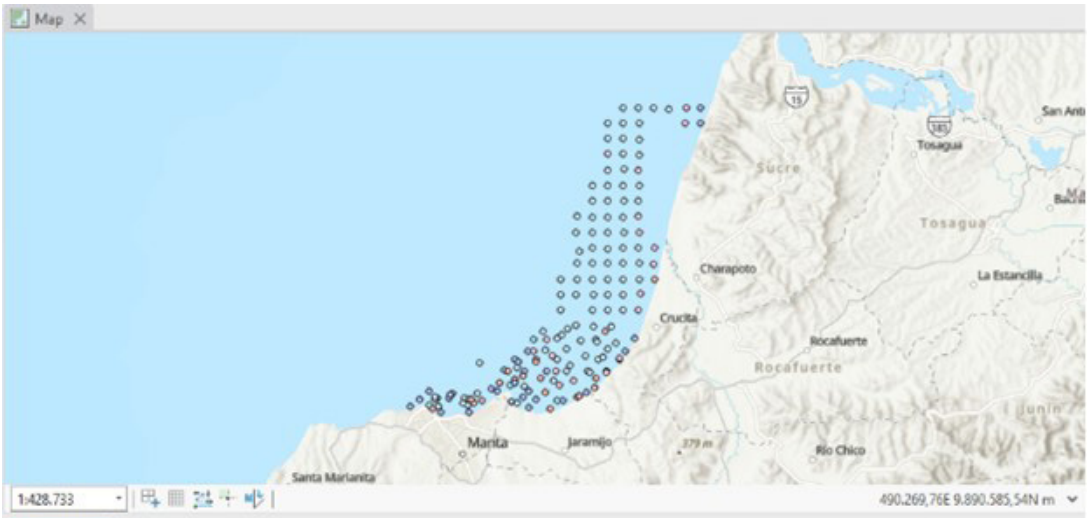
# ANNEX A

## CATEGORIES, SUBCATEGORIES AND OBJECTS - IHO S-100



# ANNEX B

## BDARE OBJECT ATTRIBUTES (BOTTOM CHARACTERISTICS)




SBDARE

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| | FID | NUM_MUESTR | SERIE_CART | LATITUD | LONGITUD | ABREVIATUR | NAT_FONDO | FUENTE | COLOUR | NATQUA_1 | NATSUR | WATLEV |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1102 | 9322 | 107 | 02-08-10S | 79-51-17W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 2 | 1103 | 9323 | 107 | 02-08-10S | 79-50-50W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
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| 4 | 1105 | 9325 | 107 | 02-08-58S | 79-50-35W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 5 | 1106 | 9326 | 107 | 02-08-58S | 79-50-57W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 6 | 1107 | 9327 | 107 | 02-08-58S | 79-51-19W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 7 | 1108 | 9328 | 107 | 02-09-35S | 79-51-45W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 8 | 1109 | 9329 | 107 | 02-09-36S | 79-51-21W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 9 | 1110 | 9330 | 107 | 02-09-36S | 79-50-54W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 10 | 1111 | 9331 | 107 | 02-10-11S | 79-51-27W | soS | ARENA | BITACORA | 7 | 6 | 4 | 3 |
| 11 | 1112 | 9332 | 107 | 02-10-11S | 79-51-53W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |
| 12 | 1113 | 9333 | 107 | 02-10-11S | 79-52-21W | soSi,S | LIMO ARENOSO | BITACORA | 7 | 6 | 3,4 | 3 |

# EGYPT

# Implementation of the National Marine Spatial Data Infrastructure of Egypt

## EG-NMSDI

Since 2016, the Egyptian Navy Hydrographic Department ENHD, in its capacity as the official representative of Egypt to the International Hydrographic Organization IHO, has started developing a strategic implementation plan (SIP) for the development of the thematic National Marine Spatial Data Infrastructure of Egypt (NMSDI), with a view of improving resource management and supporting decision making. NMSDI also aims at facilitating the transformation from traditional hydrographic to a modern Hydrospatial agency.
So far, ENHD has identified 12 critical steps to implement the aforementioned plan, tackling several aspects, including:

- Stakeholder engagement;
- Resource allocation;
- Data theme definition and prioritization;
- Standards to be used in data and metadata;
- Technology selection;
- Monitoring and evaluation.

Furthermore, ENHD has developed a Planning Support Concept (PSC), aimed at providing a structured approach to ensure that all currently identified 12 steps in the SIP can be executed in a prioritized, effective, and timely manner. As a first step, ENHD developed a Project Management Framework to support the execution of the SIP and contracted Esri Company to begin using its technology to develop and implement the NMSDI of Egypt.

# EUROPEAN UNION

# Input of the European Union and its Member States on the 2023 DOALOS publication on 'marine geospatial information management'

## EUROPEAN UNION

Input of the European Union (EU) on the 2023 DOALOS publication on 'marine geospatial information management'.

### IMPORTANCE OF MARINE GEOSPATIAL INFORMATION MANAGEMENT

The management of marine geospatial information is a subject of crucial importance as it enables the effective use marine knowledge for conservation and management of the marine environment. The foundation for marine knowledge is the availability of marine geospatial data/information of different resolution, in space and in time. Public and private organisations around the globe are collecting marine geospatial data/information on hundreds of parameters, regarding the geophysical and chemical attributes of the seas and oceans, marine biodiversity, geology and composition of marine habitats, information on the distribution, intensity and impact of human activity. The availability of coherent, quality, detailed marine geospatial information is important for the assessment of the current and future state of the marine environment and its resources, through analysis and through the use of simulation models.

### EU WORK ON MARINE GEOSPATIAL INFORMATION MANAGEMENT

The first step in the EU towards the management of geospatial data and information was taken through the entry into force in 2007 of the 'INSPIRE' Directive [1], establishing an infrastructure for spatial information in Europe to support EU environmental policies, and policies or activities which may have an impact on the environment. It is based on the infrastructures for spatial information established and operated by the EU Member States. This Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. To ensure that the geospatial data infrastructures of the EU Member States are compatible and usable in an EU and transboundary context, the Directive requires that common Implementing Rules (IR) are adopted in a number of specific areas: Metadata, Data Specifications, Network Services, Data and Service Sharing, and Monitoring and Reporting.

Regarding the marine domain specifically, the EU has established a robust foundation for the management of geospatial data/information. Marine geospatial data/information is essential for efficient, effective and safe operations of economic activity at sea and for measuring and reducing impacts on the environment, including with a view to their reduction. Management of such data/information is consequently undertaken by different organisations responsible for activities such as research, fisheries management, environmental monitoring, safe navigation, coastal protection or licensing new offshore or coastal activities. EU Member States are collecting marine geospatial data/information to be able to assess the environmental status of their waters, adopt adequate management measures and fulfil their obligations under relevant EU

1 For further information, see: https://inspire.ec.europa.eu/

legislation (e.g. Marine Strategy Framework Directive, Water Framework Directive, the Habitats and Birds Directive, the Nitrates Directive and other environmental policies). Although the collection and use of marine data is not always specified in detail, the total spending amounts to a minimum of €100 million annually, which highlights the need for coherent management of such geospatial data/information at the European level.

The EU's management of marine geospatial data/information covers data collected both in-situ (in the field) and from satellites. The management of marine geospatial information collected through satellites is easier, as the sources are consolidated and it is straightforward to organise coherent standards and metadata. In Europe, the marine geospatial information coming from space is managed by the Copernicus Marine Service . The Copernicus Marine Service[2] (or Copernicus Marine Environment Monitoring Service) is the marine component of the EU's Copernicus Programme. It provides free, regular and systematic authoritative information on the state of the Blue (physical), White (sea ice) and Green (biogeochemical) ocean, on a global and regional scale. It is designed to serve EU policies and international legal commitments related to Ocean Governance, to cater to the needs of society at large for global ocean knowledge, and to boost the Blue Economy across all maritime sectors by providing free-of-charge state-of-the-art ocean data and information. It provides key inputs that support major EU and international policies and initiatives and can contribute to: combating pollution, marine protection, maritime safety and routing, sustainable use of ocean resources, developing renewable marine energy resources, supporting blue growth, climate monitoring, forecasting, and more. It also aims to increase awareness amongst the general public by providing European and global citizens with marine geospatial data and information about ocean-related issues.

Marine geospatial information collected in the field (in-situ) is more challenging to manage. The number of organisations collecting this data, the number of parameters collected, the different temporal and spatial resolutions of these collection activities, makes its management complicated and expensive. To ensure that the in-situ ocean observation collected through different sources [3] is consolidated, the EU has invested in the creation of the European Marine Observation and Data Network (EMODnet)[4]. EMODnet brings together more than 120 organisations, to aggregate the existing in-situ marine observation and data in the European seas, process them according to international standards, harmonise them and make them openly available as interoperable data layers and data products.

EMODnet provides access to European marine geospatial data and data products across seven disciplinary areas: bathymetry; geology; seabed habitats; chemistry; biology; physics and human activities. It is a best-practice example of the benefits of efficient networking: the different

2 For further information, see: https://marine.copernicus.eu/.

3 Except for data collected through the Data Collection Framework, which are considered proprietary and are made available in a consolidated format or under request.

4 For further information, see: https://emodnet.ec.europa.eu/en.

organisations brought together are collaborating to provide free access to marine data belonging to different data owners around Europe, while they invest in the creation of high-level, harmonised data products, which provide a detailed and integrated overview of the state of Europe's seas. One key example is the Bathymetry Digital Terrain Model, which provides the highest resolution of bathymetrical data available in Europe and is widely used for scientific and industrial purposes. These include hydrodynamic and climatic modelling, extraction of resources, and planning and development of renewable energy facilities. Another key example is the harmonisation of EU Member States' data regarding marine litter around the European coasts and seas. In addition to the thematic data services, EMODnet also provides a Data Ingestion service, through which organisations, businesses and other stakeholders can bring forward their marine data and make them openly available. The biggest added value of EMODnet is the development of standards to make marine geospatial data findable, accessible, interoperable and reusable (also referred to as 'FAIR').

The EU has accordingly invested a lot of efforts in in-situ marine geospatial data harmonisation, standardisation and management. Apart from the EMODnet, the SeaDataNet [5] and the International Council for the Exploration of the Seas (ICES) [6] are main channels for accessing marine geospatial data on hundreds of variables at a pan-European level, including biological resources, marine litter and human activities. Additionally, a lot of work has taken place in creating common data and metadata standards and common vocabularies, to achieve sharing of data between EU Member States.

A number of other European initiatives are also highly relevant. One is the Marine Research Infrastructures Database (RID), which was created in 2014 by EurOcean. It is a unique comprehensive public repository of information (technical, scientific and operational) about European marine science and technology research infrastructures, which collects marine geospatial information in-situ. [7] It contributes to EU policy support (e.g. Next Generation Research Vessels), to the European Atlas of the Sea (European Commission), to the Ocean Info Hub (IOC UNESCO), and hence to the UN Decade for Ocean Science and Sustainable Development. Another is the European Sustainable Blue Economy Partnership, co-funded by 25 countries among which EU Member States and Associated Countries (under the coordination of Italy) and by the European Commission, which will support the coordination of the observing system also with the aim to sustain the Digital Twin of the Ocean. [8]

The EU and its Member States are also working actively at the international level to support progress in relation to the management of marine geospatial data/information, either by developing bilateral collaboration to increase the use of common international standards for marine geospatial data sharing or by funding and participating in large scale international research collaboration efforts that include the management of marine geospatial data. One example is the All-Atlantic Research

5 For further information, see: https://www.seadatanet.org/

6 For further information, see: https://www.ices.dk/Pages/default.aspx

7 For further information, see: https://rid.eurocean.org/

8 For further information, see: https://bluepartnership.eu/

Alliance. [9] Another example is the Atlantic International Research Centre (AIR Centre), which is a long-term consultation and dialogue platform. [10]

## CHALLENGES IN MARINE GEOSPATIAL INFORMATION MANAGEMENT

At the European and international level, the discussions around marine geospatial data management and sharing attract a lot of attention. Specific focus is being put on aspects of data interoperability, data sharing, data ingestion, standards, data policies, metadata, data portals and tools to visualise the data.

Experts agree on the great challenges that (marine) geospatial data management is bringing forward at the technical level. Interoperability of data is an issue that gains more and more attention, not only related to marine geospatial data, but in general. The rise of integrated modelling approaches and the development of Digital Twins is creating a growing demand for interoperable, multidisciplinary marine geospatial data. Interoperability of marine geospatial data/information remains a time-consuming and resource-demanding task to perform, requiring coordination in national and international levels.

Other important challenges of marine geospatial data management relate to ownership of data and of access to data, which may be restricted or challenging due to bureaucratic barriers, security barriers and more. Cultural and political impediments may restrict access to data and of course there are many categories of marine geospatial data, especially related to human activities, which may be considered of proprietary nature. There is wide consensus among experts on the need for a standardised and common approach towards marine data management, coming from a body with the relevant authority, which is currently lacking.

## INTERNATIONAL INITIATIVES AND POTENTIAL FOR (FURTHER) INTERNATIONAL COLLABORATION ON MARINE GEOSPATIAL INFORMATION MANAGEMENT

Creating the structures that will allow collaboration on marine geospatial data management at the international level, is an ambitious goal that is harboured under the UN Decade of Ocean Science for Sustainable Development. Many States and the EU have made high political commitments on taking action towards climate knowledge as well as the sustainability of the ocean and its resources, and such collaborations can contribute towards the fulfilment of these commitments.

The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) has a Working Group on Marine Geospatial Information, which collaborates closely with the International Hydrographic Organisation and its Marine Spatial Data Infrastructures Working Group (MSDIWG). The UN Ocean Decade has established a Data Coordination Group. Within this group, a dedicated Data Exchange Work Programme can support more efficient data sharing activities and can facilitate the connection with global actors, including the UNESCO IOC International Oceanographic

9 For further information, see: https://allatlanticocean.org/

10 For further information, see: https://www.aircentre.org/.

Data and Information Exchange (IODE) [11] and the United Nations Environment Programme (UNEP) [12], so that any progress and insights can contribute further to global progress. The establishment of structured collaborations on marine geospatial data management and interoperability can create momentum participating in and following good practices. Nevertheless, it is very important to create the appropriate international framework to harbour these collaborations.

The EU is currently represented in the Ocean Decade Data Coordination Group, aiming to identify opportunities for collaboration, to exchange of good practices and to achieve substantial progress in the interoperability and open sharing of ocean observation and marine geospatial data at the global level. The EU is also participating in the G7 Future of our Seas and Oceans Initiative (FSOI), where all of the priority areas are related to better coordination and sharing of Ocean Observation, from networks, to infrastructure and advancement of technologies. In both aforementioned international fora, the need for more coordinated action regarding these issues is considered as fundamental.

It is critical to encourage an open and large international cooperation on marine geospatial information management, given the scarcity of biological observations and the progressive development of ecosystem models at operational scale (as required by increased policy development in relation to biodiversity protection, restoration and sustainable use, climate change and its impact on marine biodiversity and ecosystems). Such international collaboration should focus on structuring the collection, harmonization and sharing of marine biological geospatial information, whatever their sources and types, with an appropriate governance, fostering open and free data policies as well as data preservation.

An initial mapping exercise at the international level is necessary, to identify existing collaborations on marine geospatial data management and marine knowledge already taking place. Another exercise that is deemed necessary to frame any collaboration efforts at the international level, is the more analytical mapping of the respective data services. This should include information on aspects such as the use of marine geospatial standards, metadata development, storage, accessibility and sharing practices. International collaborations could focus on the establishment of common vocabularies for marine geospatial data and metadata, but also common narratives around the importance of marine geospatial data, for policy, for science and for society.

Another area of data management with potential for collaboration is that of Findable, Accessible, Interoperable and Reusable (FAIR) marine geospatial data. FAIR data principles are implemented but this does not ensure quality control of data, in particular for some categories of data, as are the ones coming from citizen-science. There is global interest in working on marine geospatial data exchange and Quality Control and Quality Assurance mechanism and procedures. Credibility and transparency are very important as well as the development of coherent metadata that are properly prepared. Educating data providers as well as users is therefore key to breaching the gap and this could be another where international collaboration focus could be put. International collaboration could also contribute to reducing data fragmentation, data harmonisation, implementing and

11 For further information, see: https://www.iode.org/

12 For further information, see: https://www.unep.org/technical-highlight/gems-ocean-programme-officially-endorsed-un-ocean-decade

monitoring the progress of implementing FAIR data principles as well as the developments of modes to analyse and visualize data. Some of the aforementioned European and international organisations, initiatives and networks could support such collaboration.

## FOCUS OF THE DOALOS PUBLICATION

The main objective in marine geospatial data management is to extend access to marine data, metadata and data products through cooperation between expert organisations. The 2023 DOALOS publication could cover the priorities of international marine geospatial data management, including:

- Development of protocols to ensure access to data held by institutions using common international FAIR (Findable, Accessible, Interoperable, Reusable) principles, based on the international experience.
- Identification of main geographic and thematic gaps in global marine knowledge and the development of structured action to target these gaps. For example, it is well recognised that both the availability and management of marine geospatial data and information in developing countries are challenging. Targeted actions should be developed to exchange capacity and to create information management systems providing access to this information. Additionally, the availability of geospatial information collected through satellites or automated systems (as is data related to the physical and geochemical attributes of the ocean) are better managed at the international level and thus more available at the global level. In contrast, marine geospatial data/information on marine biodiversity and seabed habitats is more challenging to collect and to manage. In this area, the need for development of more detailed standards for the management of data is currently very crucial and related with multiple political priorities.
- Development of international contributions to the collaboration frameworks set through international agreements and to the outcomes of the UN Decade of Ocean Science for Sustainable Development, especially towards achieving the outcome of “an accessible ocean with open and equitable access to data, information and technology and innovation”.
- Identification of the marine spatial data infrastructure (MSDI) international stakeholders and regional initiatives in order to provide a non-exhaustive but comprehensive overview of possible examples or partners for readers of the publication who may wish to initiate an MSDI project at the local level.

# France

# Publication sur la gestion de l'information géospatiale marine

## Contribution de la France

Pour la France, il est important de cadrer au préalable le champ d'application de la publication de DOALOS sur la gestion de l'information géospatiale marine. Il ne semble pas opportun de rédiger une publication centrée sur les aspects techniques, au risque d'être redondant avec les publications du groupe de travail de l'OHI sur les infrastructures de données spatiales marines (MSDIWG) ou de l'UN-GGIM. De même, la présentation d'exemples nationaux ou régionaux, même s'ils sont instructifs, ne peut fournir une vision complète des enjeux et des points de vigilance de tels projets.

Sur la base des travaux du MSDIWG de l'OHI, la France propose de définir les enjeux, les défis, les prérequis et les points clés de la gestion d'informations géospatiales marines dans la publication autour de quatre domaines clés :

- Politique et Gouvernance (mécanismes de coordination et de suivi, accords sur le partage, l'accès et l'utilisation des données et des produits...) ;
- Technologie ;
- Normes techniques (données spatiales et services) ;
- Données et métadonnées.

Une cartographie des acteurs internationaux de la géomatique et plus spécifiquement de la gestion des informations géospatiales marines (MSDI) pourrait être établie à la fin de la publication. Des exemples d'initiatives nationales ou régionales liées aux initiatives MSDI pourraient également être inclus dans l'annexe afin d'illustrer les principes énoncés dans la publication.

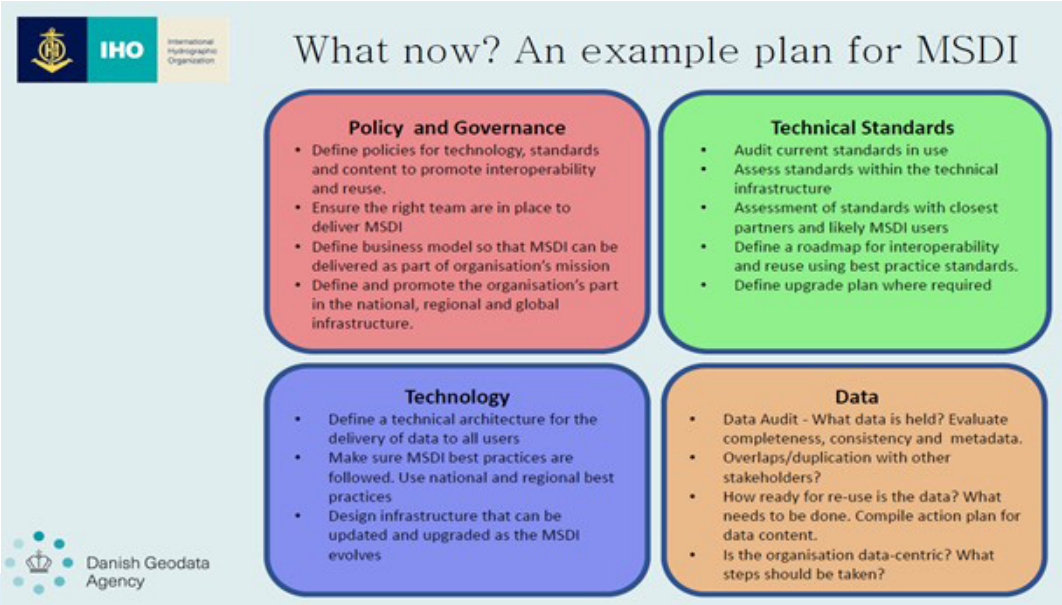



*Schéma d'un projet MSDI, extrait du support de formation du MSDIWG de l'OHI*

## Présentation de la directive européenne sur l'infrastructure d'informations spatiales en Europe (INSPIRE) et des enseignements qui en ont été tirés

La directive INSPIRE vise à établir une infrastructure de données spatiales (IDS) à l'échelle européenne afin de garantir l'interopérabilité entre les bases de données et de faciliter la diffusion, la disponibilité, l'utilisation et la réutilisation des informations spatiales en Europe.

La directive est entrée en vigueur le 15 mai 2007 et doit être pleinement mise en œuvre par les États membres de l'UE à partir de 2021.

La directive INSPIRE établit les principes suivants :

- Les données ne devraient être collectées qu'une seule fois et conservées là où elles peuvent être maintenues le plus efficacement possible ;
- Il devrait être possible de combiner des informations spatiales homogènes provenant de différentes sources à travers l'Europe et de les partager avec de nombreux utilisateurs et applications ;
- Les informations collectées à un niveau/échelle devraient pouvoir être partagées avec tous les niveaux/échelles : détaillées pour les enquêtes approfondies et générales à des fins stratégiques ;
- L'information géographique nécessaire à la bonne gouvernance à tous les niveaux doit être disponible facilement et de manière transparente ;
- Il est facile de trouver les informations géographiques disponibles, de savoir comment les utiliser pour répondre à un besoin particulier et dans quelles conditions elles peuvent être acquises et utilisées.

La conformité à la directive INSPIRE repose sur trois points essentiels :

1. Les données sont diffusées par le biais de services standardisés (normes OGC) ;
2. Les données spatiales répondent aux spécifications INSPIRE (basées sur les normes ISO) ;
3. Les données et les services spatiaux sont décrits par des métadonnées normalisées (normes ISO).

La directive INSPIRE concerne 34 données spatiales liées à l'environnement, classées en 3 catégories.

### Enseignements tirés de la mise en œuvre d'INSPIRE par les États membres :

Aspects positifs :

- Mise en œuvre de métadonnées (format xml) documentant les séries de données spatiales ;
- Réflexion sur la qualité des données spatiales ;
- Interopérabilité des services d'OGC (WxS) - communication entre les producteurs.

Points perfectibles :

- Architecture obsolète (par exemple, le type WxS de l'OGC est remplacé par l'API de l'OGC ; le flux SOS est remplacé par les "choses capteurs") ;
- Spécifications de données parfois trop théoriques (éloignées de la réalité) ;
- Manque de réflexion sur la substance des données spatiales (par exemple, les limites maritimes ou le niveau des mers n'utilisent pas la même référence d'un État à l'autre) ;
- Mise en œuvre hétérogène de la directive INSPIRE à l'échelle européenne.

### En conclusion :

Succès dans la mise en œuvre des métadonnées, mais les objectifs d'interopérabilité ne sont pas toujours atteints (au sein des États membres ou entre eux).

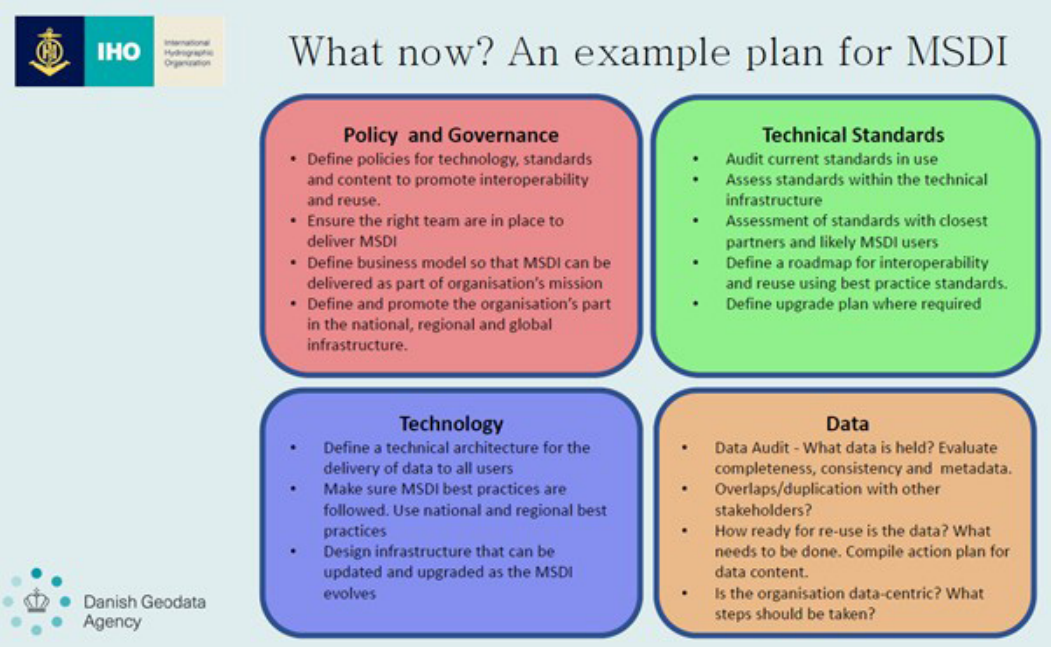
**Publication on marine geospatial information management**
**Contribution of France**

In France's view, it is important to first frame the scope of the DOALOS publication on marine geospatial information management. It does not seem appropriate to draft a publication focusing on technical aspects, at the risk of being redundant with the publications of the IHO Working Group on Marine Spatial Data Infrastructures (IHO MSDIWG) or UN-GGIM. In the same way, the presentation of national or regional examples, even if instructive, cannot provide a complete vision of the challenges and points of vigilance of such projects.

Based on the work of the IHO MSDIWG, France proposes to define the issues, challenges, prerequisites and key points of MSDI within the publication around four key areas:

- **Policy and Governance** (coordination and monitoring mechanisms, agreements on data and products sharing, access and use …);
- **Technology**;
- **Technical standards** (spatial data and services);
- **Data and metadata.**

A mapping of international stakeholders in geomatics and more specifically in MSDI could be drawn up at the end of the publication. Examples of national or regional initiatives related to MSDI could also be included in the annex to illustrate the principles set out in the publication.




*Plan for MSDI project, extracted from training material of the IHO MSDIWG*

## Presentation of, and lessons learned from, the European Directive on infrastructure for spatial information in Europe (INSPIRE)

The INSPIRE directive aims to establish a Europe-wide spatial data infrastructure (SDI) to ensure interoperability between databases and facilitate the dissemination, availability, use and re-use of spatial information in Europe.

The directive came into force on 15 May 2007 and is supposed to be fully implemented by EU member states since 2021.

The INSPIRE directive lays down the following principles:

- Data should be collected only once and kept where it can be maintained most effectively;
- It should be possible to combine seamless spatial information from different sources across Europe and share it with many users and applications;

- It should be possible for information collected at one level/scale to be shared with all levels/scales; detailed for thorough investigations, general for strategic purposes;
- Geographic information needed for good governance at all levels should be readily and transparently available;
- Easy to find what geographic information is available, how it can be used to meet a particular need, and under which conditions it can be acquired and used.
- It addresses 34 spatial data themes needed for environmental applications divided in 3 areas:

Compliancy to INSPIRE is based on 3 key points:

1. Data is disseminated through standardized services (OGC standards)
2. Spatial data meets the INSPIRE specifications (based on ISO standards)
3. Spatial data and services are described by standardized metadata (ISO standards)

INSPIRE addresses 34 spatial data related to environment categorized in 3 areas.

Lessons learned from the INSPIRE implementation by Member States:

Positive aspects:

- Implementation of metadata (xml format) documenting spatial datasets
- Reflection on the spatial data quality
- OGC Service Interoperability (WxS) – communication between producers

However:

- Obsolete architecture (e.g. OGC WxS-type replaced by OGC API; SOS flow replaced by “sensor things”)
- Data specifications sometimes too theoretical (far from reality)
- Lack of reflection on the substance about spatial data (e.g. maritime limits or sea levels do not use the same reference across states)
- Heterogeneous implementation of the INSPIRE directive at the European scale.

### In conclusion :

Success in the implementation of metadata, but Interoperability objectives are not always met (within or between member states).

# The Netherlands

*Input regarding the preferences as to the focus of the publication of DOALOS on marine geospatial information management*

In the Netherlands, an important institution for finding and sharing North Sea geospatial information is the Marine Information and Data Centre (IHM). IHM is a collaborative venture between Rijkswaterstaat Ministry of Infrastructure and Water Management, the Ministry of Agriculture, Nature and Food Quality and the Ministry of Defence (The Hydrographic Service of the Royal Netherlands Navy).

The IHM recommends to refer to the Integrated Geospatial Information Framework (IGIF) and the IGIF-Hydro (containing specific marine considerations based on the Framework) in the publication. (Part One of IGIF-Hydro is already available. Part Two will be available after the 13th UN-GGIM meeting in August 2023 at the website of the Working Group on Marine Geospatial Information.)

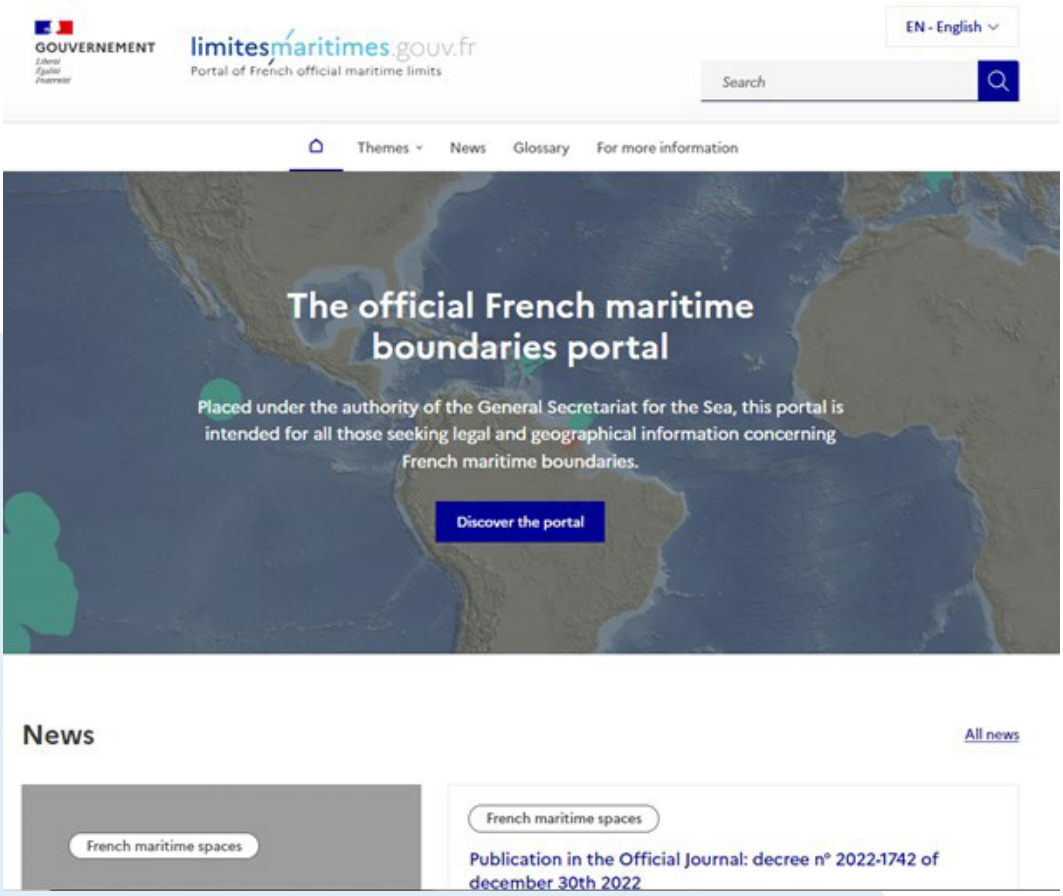
From our national experience we learned that the guidance this framework brings is useful in different ways:

- It is helpful in aligning efforts between partners (crossing organizational boundaries) to meet the SDGs.
- It accelerates the speed of the three simultaneous transitions at the North Sea (concerning food, nature and energy). We use the IGIF approach to connect (expensive) marine observations and measurements by different types of organizations (government, research and industry) along the information flows with policy and decision-making, monitoring of environmental status and increasing marine knowledge, providing societal value. In this way the framework helps to overcome fragmentation in information management and data collection.
- (Apart from the SDGs as shared community goals) as a reference architecture for information management including geospatial, hydrographic, oceanographic and statistical information, addressing the specific aspects of the marine domain (in IGIF-Hydro).

# FRANCE

# The French maritime limits portal

The French maritime limits governmental portal https://maritimelimits.gouv.fr informs about and provides access to official French maritime limits.




*French maritime limits homepage https://maritimelimits.gouv.fr/ (upper part)*

## Legal basis and governance

Put into service in June 2018, the portal is legally founded by Order No. 2016-1687 dated 8 December 2016, with the aim of disseminating official information used to delimit maritime areas under the sovereignty or jurisdiction of the French Republic (governed by the Montego Bay Convention), in particular legal references and digital geospatial data.

Decree No. 2017-821 dated 5 May 2017 entrusted its design and implementation to Shom, the national hydrographic service.

A steering committee chaired by General Secretariat for the Sea (SGMer) with representatives from the Ministries of Europe and Foreign Affairs (MEAE), the Armed Forces (MINARM), Overseas France (MOM),

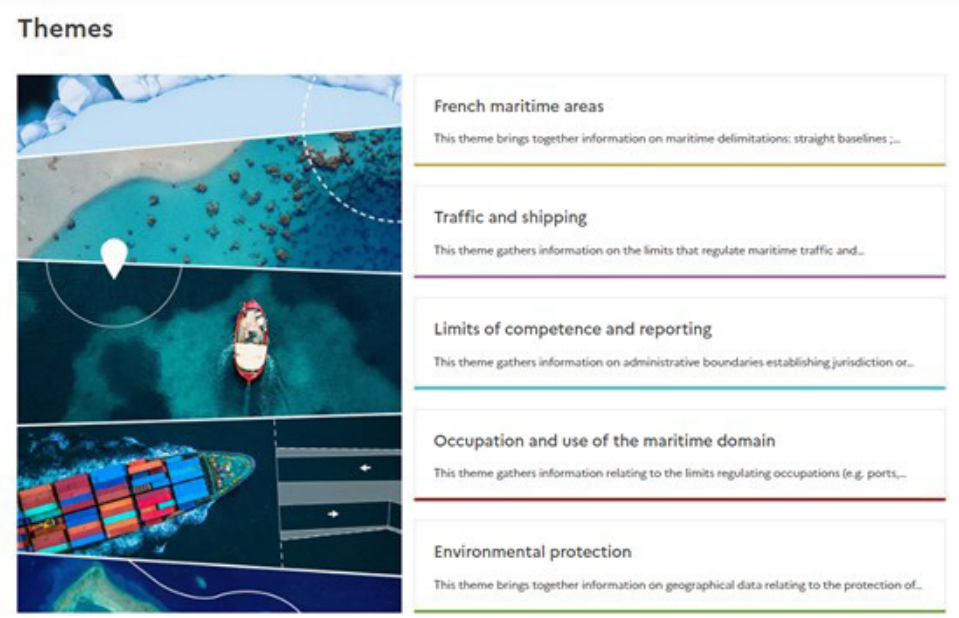
and Ecological Transition (MTE), as well as the Directorate General for Maritime Affairs, Fisheries and Aquaculture (DGAMPA) and the Shom set the guidelines for the portal.

## Latest developments

After its launching in 2018, in accordance with the guidelines of the steering committee, the portal was progressively enriched from 2019 to 2021 with national regulatory maritime limits (e. g. not governed by the Montego Bay Convention) such as: boundaries relating to fishing zones, archaeological fees, traffic separation schemes, etc.

The steering committee scope therefore decided in 2022 to extend the scope of the portal beyond the initial theme of maritime delimitations and sea boundaries to all national regulatory maritime limits and to include four additional themes (or categories): traffic & navigation, occupation & use of the maritime domain, environment, jurisdiction & reporting on the maritime domain.

A new version of the portal structured along five themes (see below) was released in March 2023.

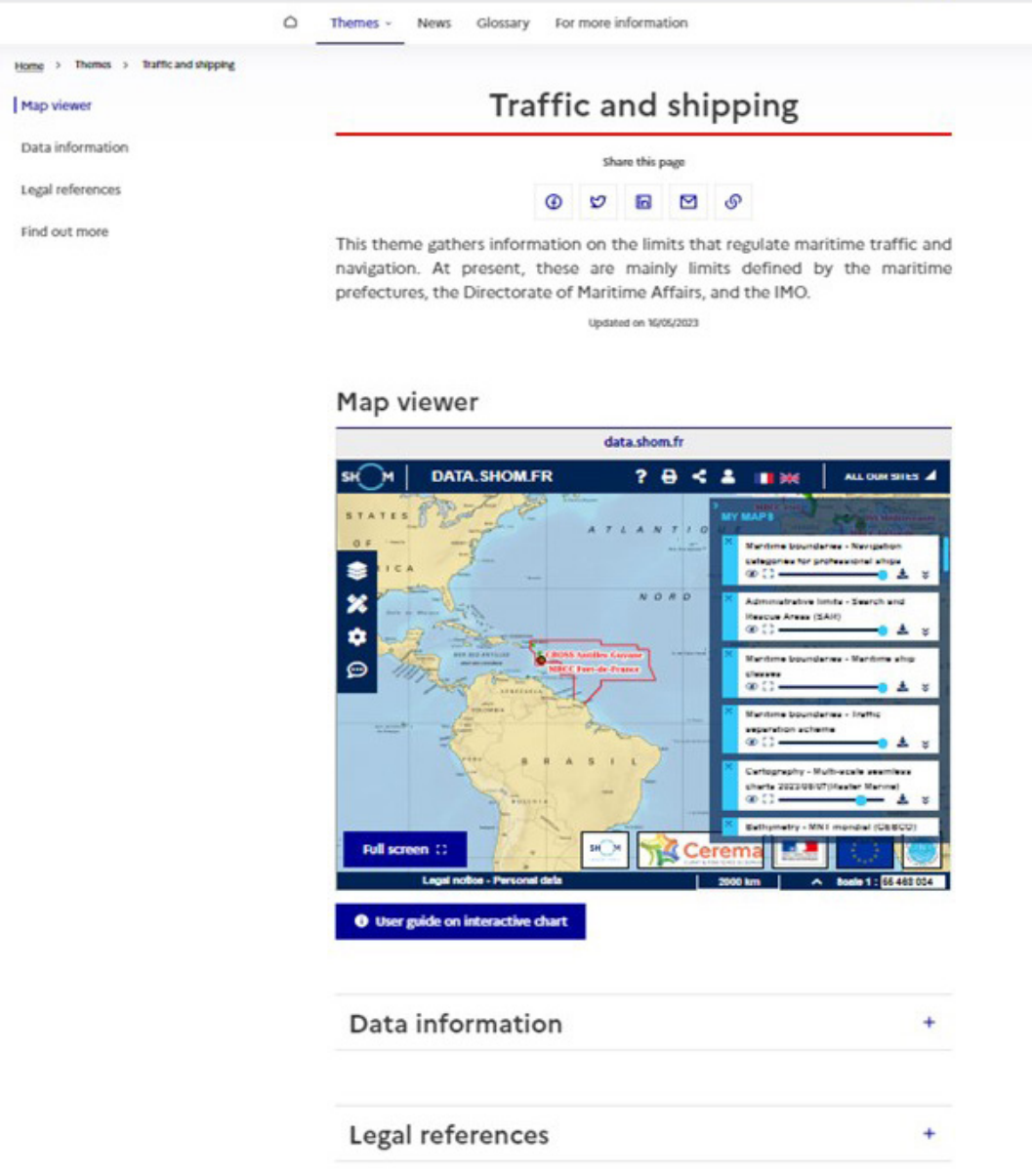



*French maritime limits homepage presenting the 5 themes*
https://maritimelimits.gouv.fr/ *(lower part)*

## Principles related to geospatial information access

Each theme is structured similarily with a map viewer enabling visualization of the various datasets related to the theme, data information, legal references and related information of interest (“find out more”).

The basic principle underpinning the portal is to NOT duplicate existing data of reference which are already available on an SDI. The maritime limits portal is not a SDI but a website providing information about data (legal reference and how to access to geodata) as well as a visualization through the map viewer.




*Example of portal structure the theme "Traffic and shipping"*
*https://maritimelimits.gouv.fr/themes/traffic-and-shipping*

Vizualisation through the map viewer is mostly based on data.shom.fr (Shom SDI). This does not mean, however, that all the data on this portal are produced by Shom or disseminated by data.shom.fr. Geospatial data produced by other organisations are also accessible, but data disseminated thought other SDIs are used and vizualised through data.shom.fr (e.g. marine protected areas in the "environment" theme, which are produced by the Office Français de la Biodiversité-OFB and disseminated through the OFB infrastructure).

For a given theme, each data layer (or maritime limit dataset) described in the “Data information” section, the following information are provided:

- the reference authority for the limit (the legal reference text),
- the producer of the digital geographic dataset (from the legal reference text)
- the data provider (or SDI disseminating the data)
- Geo services (URL)
- downloadind (URL)
- limitations related to the reuse of data

The “Legal references” section provides access to the legal sources (texts) defining the maritime datasets.

# GREECE

In Greece the main entities in Marine geospatial information and data are the Hellenic Navy Hydrographic Service (HNHS) and the Hellenic Centre of Marine Research (HCMR). Moreover there are several Universities and Research Institutes which explore the marine environment focusing mainly in biodiversity. HNHS and HCMR have the principal role in acquiring and managing Marine geospatial information and data in Greece, which are the main, national, public, research institutions that implement multidisciplinary marine research, own and operate the research fleet and produce and manage the vast majority of the marine geospatial information. HCMR operates under the supervision of the General Secretariat for Research an Innovation (GSRI) of the Ministry of Development. HNHS is a founding member of IHO and falls under the Ministry of Defence, where its Director holds a vast amount of responsibilities both of national and international nature.

The Director of HNHS attends high level discussions taken place in IHO and fora, while at the same time participates at the formation of the decisions made by both Ministers of Foreign affairs and Defence at a geopolitical level. HNHS is also strengthening its scientific role and international/national presence by leading or participating in several research programmes. Due to its bilateral agreements signed, HNHS holds a strong leverage in the geospatial environment. Having as key stronghold national legislation HNHS is the responsible entity to request, gather, manage and exploit all geospatial data that result from domestic and international governmental agents, research institutes and universities exploration in the Hellenic Continental shelf.

Through HCMR, marine data and geospatial information are managed at national and European Union (EU) level in the framework of the EU directives and initiatives. Greece and all EU Member States are collecting marine geospatial data/information to be able to assess the environmental status of their waters, adopt adequate management measures and fulfill their obligations under relevant EU legislation (**e.g. Marine Strategy Framework Directive, Water Framework Directive, the Habitats and Birds Directive, the Nitrates Directive** and other environmental policies)**. The EU Marine Strategy Framework Directive (MSFD)** was put in place to protect the marine ecosystem and biodiversity. To help EU countries achieve a good environmental status (GES), the directive sets out 11 illustrative qualitative descriptors. The joint communication on international ocean governance proposes concrete measures at international level, for example to address environmental, fisheries and climate issues.

One of their main purposes of HNHS and HCMR is to support policy and decision makers at national, regional and EU level regarding marine policies and regulations, especially considering societal and economic issues. More precisely, HNHS and HCMR provide support to the Ministries of Defense, Maritime Activities, Civil Protection and Climate Change, Environment and Energy and many other national and European authorities. , HCMR is the main public research organization implementing the monitoring programmes for the Water Framework (WFD, 2000/60/EC) and the Marine Strategy Framework (MSFD, 2008/56/EC) Directives in Greece.

The operational monitoring networks of the EU directives such as WFD (2018-2023) and MSFD (2018-2023) are implemented in 6-year cycles. Monitoring frequency and techniques are strictly depending on the elements (biological, physicochemical, hydrological and pressures components i.e. contaminants, noise, plastics) monitored and following the protocols and frequencies established by Greece (more details on the WFD, MSFD official monitoring programmes are available at EEA-EIONET). The extension of the WFD and MSFD monitoring networks covers the whole country. In WFD are monitored 246 coastal water bodies covering an area of ~36500 km2 (area within 1nm from coastline including gulfs where the area extended

up to the territorial waters 6/12nm); 32 transitional water bodies (~1100 km2); and in MSFD several stations and platforms are monitored to cover the official Hellenic Republic marine waters ~480000 km2Marine geospatial data/information covers data collected in the field and from satellites. In Europe, the marine geospatial information coming from space is managed by the **Copernicus Marine Service.**

Acquisition of geospatial data and information in the field is being implemented by many organizations across the EU Member States. To ensure that the in-situ ocean observation collected through different sources is consolidated, the EU has invested in the creation of the **European Marine Observation and Data Network (EMODnet)**. EMODnet brings together more than 120 organisations, to aggregate the existing in-situ marine observation and data in the European seas, process them according to international standards, harmonise them and make them openly available as interoperable data layers and data products.

Apart from the EMODnet, the **SeaDataNet** and the International Council for the Exploration of the Seas (ICES) are main channels for accessing marine geospatial data on hundreds of variables at a pan-European level, including biological resources, marine litter and human activities.

Greece participates in all above listed EU directives and initiatives. A long list of marine geospatial information that has been produced at national level and exploited at EU level is given below. Most of them are open access.

**European Marine Observation Data Network (EMODNET), https://emodnet.ec.europa.eu/geoviewer/**

Bathymetry
Satellite Derived Coastlines (LAT, MSL, MHW)
Seabed Substrate (Folk 16, Folk 7, Folk 5)
Sedimentation Rates
Quaternary tectonics (250k)
Landslides Susceptibility
Submarine Landslides (250k)
Submarine Volcanoes (250k)
Geomorphology: Seamounts, canyons etc.
Submerged Landscapes / LGM Palaeocoastlines
Biozones (infralittoral - circalittoral - bathyal – abyssal)
Habitats
Biogenic Substrate
Coralligenous and other calcareaous bioconcretions
Seagrass cover

**Marine Strategy Framework Directive (MSFD), https://msfd-portal.hcmr.gr/**
Assessment of the Marine Reporting Units of the Hellenic Republic Marine Waters:

- Environmental Status related to 41 MSFD Criteria and the corresponding criteria elements (Ministerial Decision - MSFD Monitoring_Gov_Gaz_325_1-2-22)

- Addition products related to MSFD descriptors such as
    - Annual Fisheries Production per fishing gear, 1990-2019. Source: National Statistical Service of Greece Annual Fisheries Production per Species, 1990-2019. Source: National Statistical Service of Greece
    - Etc

**Other products via https://msfd-portal.hcmr.gr/**

Seagrass meadows extend in the Greek Seas (Panayotidis et al. 2022 Spatial dataset available on: https://www.seanoe.org/data/00765/87740/ )
Probability of coralligenous habitats (View via Web Map Service-WMS)
Probability of maerl habitat (View via WMS)
Probability of Posidonia Oceanica meadows (View via WMS)

**Water Framework Directive (WFD), https://msfd-portal.hcmr.gr/**

Assessment of Coastal Network and Coastal Water Bodies:

- Integrated Ecological StatusBenthic MacroInvertebrates - BMI (related to MSFD: D2C1, D5C8, D6C3, D6C5)MacroalgaeAngiosperms (related to MSFD: D2C1, D6C3, D6C5)Chlorophyl-a (related to MSFD: D4C2, D5C2)PhysicoChemical Quality Index (related to MSFD: D5C1, D5C4, D5C5)Chemical Status (related to MSFD: D4C2, D8C1)

**Hellenic Centre for Marine Research (HCMR) / SEADATANET**

Distribution of NO3 in space and time: 10-year mean seasonal distribution of nitrates in the Greek Seas for the period 1960 – 2013

Distribution of pH: 10-year mean seasonal distribution of pH in the Greek Seas, at various depths, for the period 1950 – 2015

Distribution of salinity in space and time: Mean annual and seasonal distribution of salinity, at various depths, in the Greek Seas for the period 1959 – 2014

Distribution of Clorophyl-a in space and time: 6-year mean seasonal distribution of Clorophyl-a, at various depths in the Greek Seas for the period 2012 – 2017

Distribution of PO4 in space and time: 6-year mean seasonal distribution of Clorophyl-a, at various depths in the Greek Seas for the period 2011 – 2016

Water Temperature: Mean annual and seasonal temperature distribution at various depths, in the Greek Seas for the period 1950 – 2015

Temperature: Climatic indexes of temperature change – thermal content of Greek Seas and East Mediterranean (https://doi.org/10.5281/zenodo.1408832,

https://doi.org/10.5281/zenodo.1408929, https://doi.org/10.5281/zenodo.1408917, https://doi.org/10.5281/zenodo.1411398, https://doi.org/10.5281/zenodo.1408903)

Hellenic Navy Hydrographic Service (HNHS) makes public the following sets of geospatial data:

- Greek coastline at scale 1:90000 ,(https://www.hnhs.gr/index.php/en/?option=com_opencart&Itemid=268&route=product/category&path=86)
- Digital Terrain Model (DTM) of the Greek Seas at a resolution of 15" of the degree (463 m.) (https://www.hnhs.gr/index.php/en/?option=com_opencart&Itemid=268&route=product/category&path=86)
- Sea Level Statistics from the Greek Tide Gauge Network
- (https://www.hnhs.gr/en/?option=com_opencart&Itemid=268&route=product/product&path=86&product_id=247)

Hellenic Navy Hydrographic Service(HNHS)/ Datasets

HNHS is safe-keeping and updating the following marine geospatial data in the sense of datasets:

- Different scales of coastline depiction
- Layer for shallow water and reefs
- Layer of tide gauges of HNHS network
- Layer depicting submarine cables and pipelines
- Layer of lights
- Layer of Wrecks
- Layer of mooring buoys
- Geographical Names/Submarine geomorphological Names (UNGEGN)
- Maritime limits and zones (existing legislation, treaties, UNCLOS)
- Natura 2000 layer - marine protected areas
- Regional Units/ Municipalities Units
- Bathymetric data layer
- Topography data layer
- Layer of population data per island
- Layer of human-related activities
- Layer of archeological entitie

# ITALY

# Input no. 1

**Organization**: Italian Navy Hydrographic Institute / University of Milano-Bicocca

**Initiative**: Atlas of Maritime Limits and Boundaries in Central Mediterranean: Legal Texts and Illustrative Maps, edited by Ilaria Tani (University of Milano-Bicocca), Stefano Ferrero and Nicola Marco Pizzeghello (Italian Navy Hydrographic Institute), Genoa, 2020

## 1. Key information

Mission. The mission of the collaboration between the Italian Navy Hydrographic Institute and University of Milano-Bicocca is to combine two different experiences – cartographic and legal – with a view to providing the users of the Atlas with the visual representations (i.e., maps) of maritime limits and boundaries in a given area, according to national legislations, international treaties, and decisions of international courts and tribunals. The maps aim at merely reflecting legislations, treaties, and judicial decisions, and do not imply the position of the editors of the Atlas on whether the limits and boundaries are drawn in compliance with the applicable rules of international law. For the same reason, no assumption is made in the Atlas on where maritime boundaries that have not yet been agreed upon by the concerned States should be drawn (in fact, they are not represented).

Geospatial data are at the center of the system: the study of the relevant geographical area and the construction of geographical coordinates of points of the maritime limits and boundaries of States based on legal rules represent a common endeavor of cartographers, hydrographers, geographers, as well as legal professionals including lawyers, legal advisers, negotiators, judges, arbitrators, public administrators, and legislators. Geographical coordinates of points that are listed in national legislations, bilateral maritime boundary agreements between opposite or adjacent States, or decisions of international courts or tribunals settling a maritime boundary dispute identify lines at sea that become the foundational “grid” or “layer” for any other spatial construction regulating the use of maritime spaces (navigation, fishing, construction of artificial islands, installations and structures, resource development of the seabed and subsoil, marine scientific research). Lawyers could not understand legal instruments referring to segments joining a number of points defined by geographical coordinates without having a cartographic representation of the resulting lines and the geographical context in which they are located. At the same time, cartographers cannot provide technical support for the drawing of maritime limits and boundaries without a clear knowledge of the applicable rules of international law, in particular those enshrined in the United Nations Convention on the Law of the Sea (Montego Bay, 1982). Membership. The Italian Navy Hydrographic Institute and University of Milano-Bicocca approved and financed the initiative. Captain Nicola Marco Pizzeghello (Italian Navy Hydrographic Institute) and Dr. Ilaria Tani (University of Milano-Bicocca) take care of the project and edit the Atlas with regards to the cartographic and legal aspects, respectively.

Geographic scope. The purpose of the project is to cover the whole Mediterranean basin. The first volume of the Atlas is dedicated to the Central Mediterranean, deferring the rest to the next future. The global picture of maritime limits and boundaries in Central Mediterranean is complex, considering the different types of coastal zones and maritime boundaries that have been established (or have not been established yet) by and

between the fourteen coastal States involved, namely: Albania, Algeria, Bosnia and Herzegovina, Croatia, France, Greece (western front), Italy, Libya, Malta, Monaco, Montenegro, Slovenia, Spain (eastern front), and Tunisia. URL. https://www.istitutoidrografico.it/it/shop-488/altra-documentazione-nauticaaltre-pubblicazioni-varie/atlas-of-maritime-limits-and-boundaries

## 2. Administrative framework

The collaboration is undertaken in the context of a Framework Agreement between the Italian Navy and University of Milano-Bicocca.

## 3. Institutional arrangement

The initiative does not foresee a specific institutional arrangement, but direct cooperation between the experts of the two institutions involved. The IIM acts as the editor of the *Atlas*.

## 4. Marine geospatial data

Geographical coordinates of points describing the maritime limits and boundaries of Central Mediterranean coastal States are collected from the relevant legal texts and stored in a spatial database shared between the two institutions involved.

## 5. Technology and standards implemented

Maps are extracted from layers of an MSDI populated by data, attributes, and metadata, in compliance with the Universal Hydrographic Data Model (IHO S 100).

## 6. Relevant links

Italian Navy Hydrographic Institute: https://www.marina.difesa.it/noi-siamo-lamarina/pilastro-logistico/scientifici/idrografico/Pagine/home.aspx
Contact: nicolam.pizzeghello@marina.difesa.it
University of Milano-Bicocca: https://en.unimib.it/
Contact: ilaria.tani@unimib.it

# Input no. 2

**Organization**: Italian Navy Hydrographic Institute

**Initiative**: Geoportal Management system for nautical information

## 1. Key information

Mission. The web interface, created in 2022 under a European Union-funded project, is designed to speed up and simplify the official exchange of nautical information between public and private entities and the Italian Navy Hydrographic Institute. The method of exchange expedites the updating process of official nautical documentation, complying with the necessary legal constraints. Moreover, the platform allows releasing standard web services to facilitate the availability and accessibility of marine geospatial information. This system aims at representing an example of reusable information exchange tool for different uses for a broader audience. Information can be shared and extended to other States or organizations. Through the quick collection and exchange of information, its centralized and massive storage, the punctual and certified updating of nautical charts, and its immediate availability, the geoportal aims at providing a better and faster marine information to stakeholders and decision-makers. It could represent the basis for the development of an interface that collects different open marine datasets, which are often complete and updated but not collected to one another. Membership. The geoportal has been developed by the Italian Navy Hydrographic Institute in collaboration with Abruzzo (one of the twenty Italian regions) in the context of the European Union project Interreg named Med Osmosis. Access to the geoportal is allowed, permanently or temporarily, through the release of credentials to those who request it. The account is nominative, and the authorization levels are defined on the basis of the specific needs of the user. Coast Guard officers, public authorities (ministerial offices, research institutions, local authorities), private companies, concessionaries, individuals with a specific interest in maritime activities may enter and use the portal with different levels of interactions. All registered users are able to transfer authoritative marine information quickly and in a simple way: equipped with an efficient system of graphic tools for the planning of initiatives, they can submit information for the technical cartographic check by the hydrographic office. The latter can automate the process of entering new features or updating products, streamlining the interactions with the Coast Guard and local maritime authorities. Geographic scope. The Italian Hydrographic service area of responsibility. URL. https://geo.istitutoidrografico.it/en/#/it/home

## 2. Administrative framework

The web portal follows the Italian marine geospatial information legal and administrative framework.

## 3. Institutional arrangement

The initiative is developed under the European Union project Interreg named Med Osmosis. The portal is designed to be authoritative and replace the traditional exchange of documents on the web. It does not foresee an institutional seat besides the IIM.

## 4. Marine geospatial data

Geographical coordinated of points describing the extent of functional areas (such as marine protected areas, fisheries restricted areas, anchor areas, etc.) and the position of aids to navigation, lighthouses, buoys, traffic schemes, underwater features, etc.

## 5. Technology and standards implemented

Data, attributes, and metadata of the web portal comply with the IHO Transfer Standard for Digital Hydrographic Data.

## 6. Relevant links

Italian Navy Hydrographic Institute: https://www.marina.difesa.it/noi-siamo-lamarina/ pilastro-logistico/scientifici/idrografico/Pagine/home.aspx Contact: maridrografico.genova@marina.difesa.it

# NIGERIA

DISTRIBUTION OF FISH SPECIES IN NIGERIAN WATERS

The Fisheries Resources Division (now Department) had been in existent since the establishment of NIOMR. The department had conducted research into the abundance, distribution, management and conservation of fisheries and other biological marine resources in the brackish, and marine waters and beyond. The research activities spanned over many years to date and had covered the entire Nigerian marine water space from the coast to the outer limits of the EEZ.

Among the fisheries resources, there are two main categories: the Demersal and the Pelagics. Available information on the spatial distribution of species or groups indicates that the predominant category are the demersal resources, and these resources are distributed or delineated along depth zones. Information on the coordinates or positions of these resources can not be easily provided but may be obtained using a well gridded bathymetric paper or electronic chats.

Seven communities of fish species had been identified and described and the composition of each community had not changed over time except with the addition of more species identified in recent surveys. The following are the major communities of marine fishes in Nigerian waters and their distribution ranges:

Table 1: Distribution of fish communities in Nigerian marine waters

| S/N | Communities | Species | Depth Range |
|---|---|---|---|
| 1 | Sciaenid Community | Big-eye grunts, threadfins, Croakers, Sea catfishes, Sting rays, Barracudas, Puffer fishes, Tongue soles, Atlantic bumpers | 0 -50m |
| 2 | Sparid Community | Atlantic Big-eye, Goatfishes, Groupers, Flying fishes, Electric rays, Black croakers, Sea breams, | 50 -100m |
| 3 | Eurybathic Community | Cutlass fishes Milk Sharks | |
| 4 | Lutjanid Community | Snappers and other related species | 40 – 80m |
| 5 | Sparid Community | Sea breams, Balistes spp, Pagrus sp, Flying fishes | 60 – 100m |
| 6 | Deep Shelf Community | Ariommas, Chlorophthalmus spp, Antigonia spp, | 100 – 200m |
| 7 | Continental Slope Community | Moridae, Diabrachus spp, Gonostomatidae, Merluccius spp | > 200 m |

Some of the species within some of the fish communities above are found to migrate between communities and depth ranges while some are strictly restricted to the specific depth ranges specified.

Research surveys confirming the distribution of the above-mentioned species groups covered the entire Nigerian marine waters up to the EEZ hence the coordinate positions of each species or group cannot be specifically provided but the boundaries of the Nigeria marine waters (including some bathymetric contours) is as shown in Figure 1 while the coordinates of the extremes (A – H) of the area is as presented in Table 1.

**Figure 2: The extents of the Nigerian Marine Waters including the Joint Development Zone (JDZ) between Nigeria and Sao Tome**

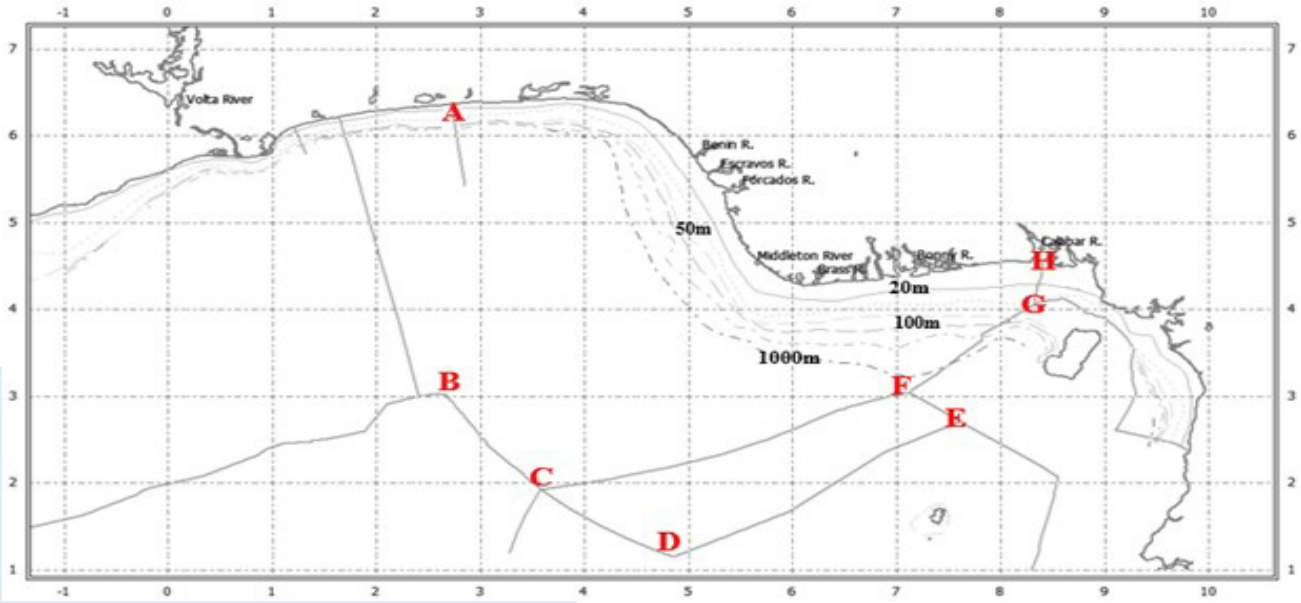



**Table 2: Coordinates of the extents Nigerian Marine Waters**

| POINTS | LATITUDE | LONGITUDE |
|---|---|---|
| A | 6.36955 | 3.2.75611 |
| B | 3.04165 | 2.66766 |
| C | 1.93603 | 3.59638 |
| D | 1.17316 | 4.88995 |
| E | 2.72102 | 7.60976 |
| F | 3.05271 | 7.12329 |
| G | 4.06987 | 8.37264 |
| H | 4.68902 | 8.50531 |

In addition, many of the fish species are known to migrate to the brackish water areas along the entire coast for breeding and nursing of their young. The brackish water areas include the lagoons in southwest and the estuaries or river mouths in the Niger Delta area. The coordinates of some of the lagoons and some estuaries or river mouths are presented in Table 3.

**Table 3: Coordinates of some estuarine water or areas of Nigeria**

| AREAS | LATITUDE | LONGITUDE |
|---|---|---|
| Lagos Lagoon | 6.48656 | 3.46770 |
| Lekki Lagoon | 6.50960 | 4.14335 |
| Benin River | 5.76484 | 5.07238 |
| Escravos River | 5.57289 | 5.17219 |
| Forcados River | 5.38095 | 5.31039 |
| Ramos River | 5.13216 | 5.36629 |
| Pennington River | 4.54406 | 5.64822 |
| Num River | 4.26951 | 6.06896 |
| Brass river | 4.27533 | 6.23941 |
| St. Nicholas Rivers | 4.30003 | 6.43494 |
| St. Bartholomew | 4.32933 | 6.71848 |
| Bonny River | 4.36747 | 7.09166 |
| Imo River | 4.44475 | 7.60132 |
| Calabar River | 4.55941 | 8.38154 |

There are several fishing communities that are situated along the entire coastline of Nigeria for easy access to the fishing areas. Many are situated along and around the lagoon and major rivers presented in Table 3.

The pelagic resources are species that are found within the water column and their distribution is based on the distance from the shore. This category is classified into three subgroups; small pelagics, large pelagics and the mesopelagic. The small pelagics are usually found within the nearshore or coastal waters (< 15nm) while the large pelagics are found farther in deeper waters and are usually highly migratory beyond national boarders. Examples of the small pelagics include the Bonga, Sardinellas, Anchovy, some Carangidae to mention a few while the large pelagics includes the tunas and tuna-like fishes. The mesopelagic are the

ones that reside within the middle layer of the ocean and are also found mostly in the deeper waters. The most common and predominant species are the lantern fishes (Mychtophidae).

# FISHING TECHNOLOGY AND SAFETY DEPARTMENT MARINE GEOSPATIAL AREAS

There are about three distinct categories that cover the mapping of fishing grounds and the distribution of fish species in terms of depths. Identifying fishing gears that interact with marine mammals and sea turtles, resulting in an accidental capture of species that are endangered, as well as the regions where such gears are used.

The work done in industrial fisheries is on mapping of fishing grounds regularly used by Nigerian Industrial Shrimp Trawlers utilizing Trawl Net equipped with Turtle Excluder Device (TED) to test the effectiveness of the devices deployed. The trawler operates between N 5.64895° 4.88908° and 4.19822° 8.29929° at depths ranging from 20 to 40 meters; the operation is centered in the country's Niger Delta region below 50 meters. The devices were effective since no endangered sea turtles were landed throughout the monitoring period, and the concentration of trawlers in the area suggested shrimp richness in the Niger Delta. Fish captured at varying depths included 59 species from 28 families. Sciaenidae leads the captures, accounting for 25% of total landings, followed by Haemulidae (21%), Trichiuridae (13%), and others (less than 10%). Pseudotolithus senegalensis was the dominating species (16.10%), followed by Brachydeuterus auritus (14.35%), Trichiurus lepturus (13.47%), Drepane africana (6.28%), Pomadasys perotaei (6.13%), and Ilisha africana (5.70%), with the remaining species contributing less than 5% each.

The work done in artisanal fisheries is divided into two categories: monitoring of interactions of fishing gear with protected living marine resources (PLMR), which are endangered marine mammals and sea turtles, and geo-referencing bycatch of these endangered species. The survey area includes three states: Lagos, Ogun, and Ondo, with coordinates of 06°24.607', 004° 05.700' and 06°26.306', 003° 52.859' (Lagos), 06°23.005´, 004°15.782´ and 06°22.860´, 004°17.416´ (Ogun) and 06°16.949', 004°36.664' and 06° 19.780', 004° 28.503' (Ondo). According to the survey, an estimated 43,059 sea turtles are caught as bycatches by artisanal fisheries each year. Despite the fact that no marine mammal was spotted in any community, unlike the sea turtle, an interview-based report indicated that around 10,890 were collected as bycatch in three types of fishing nets, namely gillnet, stow net, and purse seine.

Survey of fishing gear, craft and operational methods was carried out on 6 fishing communities along Lagos East and West coast between Lekki coastline 6°26'19.32"N and 3°50'32.88"E and 6°26'3.30"N and 3°56'1.62"E (East) and Badagry coastline, these include: Kplagada (New Site, 06° 23' 34.8" and E002° 5' 47.7" ), Yovoyan (N06° 23' 39.7" and E002° 53' 28.8"), Gberefu-Ilaje (N06° 23' 38.7" and E002° 53' 29.5") and Aivoji (N06° 23 ' 38.7" and E002° 53' 29.8") (West). A total of 862 fishermen recorded in the East used Monofilament gill net which constituting 64% followed by Purse Seine 23%, Beach Seine was 5% while other gear constitute less than 5%. On the West, Kpalagada and Aivoji fishing communities monofilament gill net is the major fishing gear used as well, seine net at Yovoyan while multifilament, stow-net and the mini-trawl nets are the major fishing gear used at Ilaje - Gberefun.

Supplementary Details

## Coordinate of different areas operated by the Industrial Shrimp Trawlers during 2013 and 2014

| 2013 | | | | | 2014 | | | |
|---|---|---|---|---|---|---|---|---|
| Months | Map Station ID | Coordinates | | Depth | Map Station ID | Coordinates | | Depth |
| | | North | East | | | North | East | |
| January | 9 | 4.24590° | 5.78539° | 30 | 13 | 4.03137° | 6.94155° | 30 |
| February | | | | | 14 | 4.01540° | 7.26911° | 35 |
| March | 12 | 4.05435° | 6.59851° | 25 | 12 | 4.05435° | 6.59851° | 25 |
| April | 11 | 4.04824° | 6.19580° | 20 | 11 | 4.04824° | 6.19580° | 20 |
| May | | No Catch Pirate Attack | | Nil | 5 | 5.64895° | 4.88908° | 40 |
| June | 7 | 4.87552° | 5.25983° | 20 | 16 | 4.34138° | 7.65210° | 35 |
| July | 8 | 4.54631° | 5.35577° | 25 | 8 | 4.54631° | 5.35577° | 25 |
| August | 17 | 4.25245° | 7.94501° | 35 | 17 | 4.25243° | 7.94501° | 35 |
| September | 15 | 4.11589° | 7.51714° | 30 | 8 | 4.54631° | 5.35577° | 25 |
| October | 18 | 4.24875° | 8.14359° | 35 | 19 | 4.19822° | 8.29929° | 40 |
| November | 6 | 5.31444° | 5.12037° | 40 | 6 | 5.31444° | 5.12037° | 40 |
| December | 10 | 4.12172° | 5.91694° | 20 | 13 | 4.03137° | 6.94155° | 30 |

Artisanal Survey for fishing gears interaction with protected living marine resources

| Community | GPS.N | GPS.E |
|---|---|---|
| Okun Ajah | 06°25.470’ | 003° 35.064’ |
| Akodo | 06°26.103’ | 003° 56.029’ |
| Olomowewe | 06°24.925’ | 004° 03.806’ |
| Okun Tiye | 06°25.928’ | 003° 57.448’ |
| Magbon Alade | 06°26.306’ | 003° 52.859’ |
| Osoroko | 06°24.712’ | 004° 05.154’ |
| Lekki | 06°24.607’ | 004° 05.700’ |
| Apakin | 06°24.213’ | 004° 07.805’ |
| Oyanmi | 06°23.486´ | 002°30.563´ |
| Gberefu | 06°23.622´ | 002°53.530´ |
| Yovoyan | 06°23.593´ | 002°52.273´ |
| Okunlape | 06°23.005´ | 004°15.782´ |
| Akede Bolorunduro | 06°21.144´ | 004°25.161´ |
| Igboser | 06°21.697´ | 004°23.840´ |
| Okun Mosan | 06°22.860´ | 004°17.416´ |
| Ode Etikan | 06°16.949’ | 004°36.664’ |
| Abe Oroyo | 06°13.729’ | 004°38.951’ |
| Abe Alala | 06°12.700’ | 004°40.126’ |
| Ebijimi | 06°03.917’ | 004°49.360’ |
| Remoye | 05°58.883’ | 004°54.414’ |
| Ilepete | 06° 02.257’ | 004° 51.168’ |
| Ojumole | 05° 58.333’ | 004° 54.888’ |
| Ubale | 05° 52.948’ | 004° 59.484’ |
| Ogungbeje | 05° 51.739’ | 005° 00.390’ |
| Beku | 05° 51.739’ | 005° 00.390’ |
| Ayetoro | 06° 06.345’ | 004° 46.649’ |
| Asisa | 06° 09.847’ | 004° 42.802’ |
| Gbabijo | 06° 10.347’ | 004° 42.155’ |
| Araromi | 06° 19.499’ | 004° 27.129’ |
| Holy Centre | 06° 19.780’ | 004° 28.503’ |

# DEPARTMENT OF BIOLOGICAL OCEANOGRAPHY

**Contribution to Marine Geospatial Information Management and the Publications of the Law of the Sea Bulletin**

Department of Biological Oceanography has specific mandate of monitoring Environmental factors and physiological mechanisms; Productivity and Biodiversity in Nigeria's marine and territorial waters. Studies were carried out within Nigerian stretch of the Gulf of Guinea specifically at the following locations:

1. N06.1608333 - N06.2513667: E003.3333333 - E003.7500000
2. N06. 01358 – N06.13897: E004.07172 – E004.34339
3. 040 00'N - 040 40'N: 070 20'E - 080 20'E

Specific Research focus areas are as follows:

Study of Physico-chemical parameters (including the nutrients)
Study of distributions and succession pattern of phytoplankton and zooplankton.
Study of Distributions of Benthic fauna
Study of Microbiological characteristics and status.
Study of levels and distributions of major critical contaminants/xenobiotics (such as Heavy metals and Persistent Organic Pollutants).

Although some ecological variables indicated undesirable impacts of human activities in some locations, generally, desirable physico-chemical and microbiological conditions as well as highly abundant and diverse phytoplankton, zooplankton and benthic macro-fauna were recorded in Nigeria's territorial/coastal waters within the Gulf of Guinea. Levels of critical contaminants such as heavy metals and persistent organic pollutants as well as the estimated values for various eco-toxicological and health risk assessment indices reveal low levels of contamination in the nearshore and offshore Nigeria axis of Gulf of Guinea. The studies also showed that consumption of demersal fishes from the water bodies does not pose health risk to humans.

Some major achievements from the monitoring activities and their implications for national development include:

- Acquisition of data on spatio-temporal distributions of Physico-chemical parameters, Biological characteristics and productivity. These are very vital for effective management of fisheries and other marine resources as well as development of sustainable Mari-culture
- Establishment of the sources, distribution and biological effects of inorganic and organic xenobiotics and pathogenic microbes. The data pool generated useful in evaluating the safety of sea foods for human consumption as well as assessing the adequacy of and compliance with appropriate legislations and standards as issued by the relevant authorities.

## *MARINE GEOLOGY/GEOPHYSICS DEPARTMENT*
## *MARINE GEOSPATIAL INFORMATION*

The Department of Marine Geology/Geophysics has the mandate to conduct research into the topography and geological features of the seabed and the territorial waters of Nigeria and high seas beyond. The research areas include:

- Geological and Geophysical survey
- Coastal erosion and ocean dynamics
- Sea level rise monitoring and climate change studies
- Geochemistry etc.

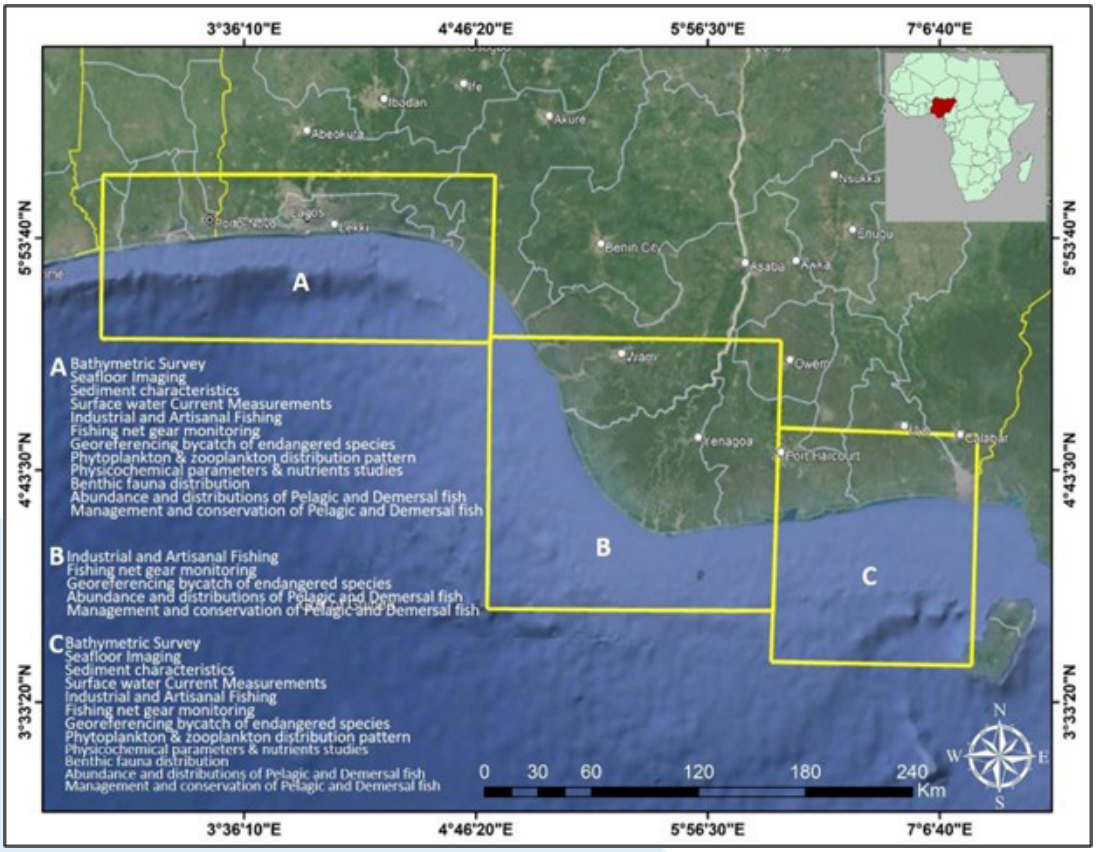
The team comprise of Marine Geologists, Geophysics, Geochemists, Sedimentologists, Micropaleontologists, Paleoceanographers etc.

The coastal erosion team has regularly been surveying Lagos coastline from Seme beach that lies between longitudes 3°0' and 3°45' E and between latitudes 6°25' and 6°30' N to Orimedu beach which lies between longitudes 03° 53' 46.3"E and 03° 54' 53.6"E and between latitudes 06° 26' 12.6"N and 06° 26'16.3"N. The coastline is low-lying and prone to erosion. Anthropogenic activities are massive and negatively impact on the beaches.

The Department has acquired surface and sub-surface sediment samples offshore Nigeria territorial water that covers two segments of Gulf of Guinea. The first segment is offshore Lagos with latitude coordinates 6°18'34.72"N and 6°1'21.48"N and longitudes 3°24'24 43.43"E and 4°34'20.34"E. Second segment is offshore Cross river with latitude coordinates 4°13'14.82"N and 4°4'26.88"N and longitudes 7°37'13.08"E and 8°0'15.00"E at a minimum water depth of 20 meters and maximum of 320 meters.

The sediments were collected using Van-Veen grab and subsurface samples using gravity corer. Heavy minerals, grain size distribution and XRD were performed on the samples in order to determine the spatial variation in sediment also distribution and provenance.

Current and bathymetry surveys were conducted along the nearshore waters using the Acoustic Doppler Current Profiler and Echo Sounder. Data were analyzed to determine the variation in depths, morphology and flow velocity along the Nigeria coastal waters.


3°36'10"E
4°46'20"E
5°56'30"E
7°6'40"E
5°53'40"N
4°43'30"N
3°33'20"N
Ibadan
Ife
Akure
Abeokuta
Lagos
Ikeja
Benin City
Asaba
Awka
Enugu
Nsukka
Warri
Owerri
Yenagoa
Port Harcourt
Calabar
A
B
C
A Bathymetric Survey
Seafloor Imaging
Sediment characteristics
Surface water Current Measurements
Industrial and Artisanal Fishing
Fishing net gear monitoring
Georeferencing bycatch of endangered species
Phytoplankton & zooplankton distribution pattern
Physicochemical parameters & nutrients studies
Benthic fauna distribution
Abundance and distributions of Pelagic and Demersal fish
Management and conservation of Pelagic and Demersal fish
B Industrial and Artisanal Fishing
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Benthic fauna distribution
Abundance and distributions of Pelagic and Demersal fish
Management and conservation of Pelagic and Demersal fish
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# SINGAPORE

# SINGAPORE'S MARINE GEOSPATIAL JOURNEY

## 1. KEY INFORMATION ABOUT GEOSPACE-SEA

Singapore's marine space serves as a crucial and shared resource for various sectors, including shipping, fisheries, desalination plants, marine parks, and submarine cables/pipelines. The Maritime and Port Authority of Singapore (MPA), responsible for regulating the port and maritime activities, collaborates with numerous agencies and institutions to effectively plan, develop, and monitor marine activities. MPA also actively coordinates with different agencies to address emergency marine incidents such as oil spills, search and rescue operations, and salvage operations.

With its strong support and involvement from 11 participating agencies, MPA has spearheaded an initiative known as GeoSpace-Sea. This collaborative effort ensures optimal and sustainable utilisation of the marine space, considering the diverse demands placed upon it.


GeoSpace-Sea has established itself as a collaborative national-level Maritime Spatial Data Infrastructure (MSDI), which facilitates data discovery, enables easy access, evaluation, and reliable utilisation of marine geospatial data. By harnessing geospatial information and technologies, GeoSpace-Sea integrates marine environment, utilities, social, and economic data across space and time. This integration opens possibilities for effective planning, monitoring, assessment, and change detection, ultimately leading to informed and improved decision-making processes.

## 2. LEGISLATIVE ADMINISTRATIVE AND POLICY FRAMEWORK MANDATING THE MARINE GEOSPATIAL INFORMATION COLLECTION, COORDINATION, STANDARDISATION MANAGEMENT AND/OR DISSEMINATION ACTIVITIES

The GeoSpace-Sea framework comprises a comprehensive set of policies, standards, procedures, and programs that promote collaboration between organisations and technologies to enhance the efficient utilisation, management, and generation of marine geospatial data.

MPA regulates the conduct of hydrographic surveys within Singapore's Port limit. The data collected adheres to the Hydrographic Survey, S-57, and Geospatial Singapore data standards.

Furthermore, GeoSpace-Sea is actively collaborating with agencies and Institutes of Higher Learning (IHLs) to establish a guide to ensure standards and compliance in the submission of marine science and marine environmental data.

## 3. INSTITUTIONAL ARRANGEMENT

The Chief Executive of the MPA leads the GeoSpace-Sea Steering Committee in collaboration with other Singapore government agencies and Singapore marine research community. The committee's objectives are to:

a. Develop and evaluate policies, standards, and guidelines for the Marine Spatial Data Infrastructure (MSDI) within GeoSpace-Sea;
b. Define, review, and monitor the implementation and upkeep of GeoSpace-Sea;
c. Facilitate the discoverability, access, and distribution of marine geospatial and coastal data to government agencies, industry, and IHLs; and
d. Promote the utilisation of marine and coastal geospatial data by sharing use cases and metadata.

Apart from the works under the GeoSpace-Sea Committee, MPA is also an active member of various other inter-agency working groups and committees that:

a. Develop, monitor, and enhance policies for geospatial data management, accessibility, and application;
b. Drive geospatial technology integration for improved policy decisions and service delivery; and
c. Promote adoption of geospatial systems for optimal resource usage.

## 4. MARINE GEOSPATIAL DATA

GeoSpace-Sea organises its geospatial datasets into various relevant data themes, including Basemaps, Administrative, Physical, Ecological, and Human. Since its launch, GeoSpace-Sea has witnessed significant growth in the number of datasets, leading to the realisation that the current data themes may no longer suffice. Consequently, GeoSpace-Sea is currently reassessing its data themes and considering the inclusion of additional ones, such as marine tourism, recreation, marine biology, and scientific research.

A significant portion of the datasets found in GeoSpace-Sea originates from the MPA Hydrographic Office and other participating agencies. Recently, the IHLs have also contributed their marine science datasets to GeoSpace-Sea, facilitating studies conducted by various agencies on subjects such as marine biodiversity, the impact of climate change on the marine environment, and sea-level rise.

## 5. MARINE GEOSPATIAL INFORMATION MANAGEMENT TECHNOLOGY AND STANDARDS IMPLEMENTED

In November 2021, GeoSpace-Sea was launched as an initiative to provide marine and coastal geospatial data to Singapore government agencies. It marked the first phase of the initiative, enabling these agencies to access data from a unified source. While the system is already functional, efforts are unneigderway to enhance its capabilities and expand its scope. The second phase, launched in August 2022, extended data access to the public, including educational institutions and research entities, through a designated link (https://sg-mdh.mpa.gov.sg/geospace-sea-datasets). This phased approach ensures adaptability and responsiveness to evolving needs.

GeoSpace-Sea consists of various modules to facilitate data discovery, consumption, visualisation, and management. The front-end catalogue module allows users to search for specific datasets and retrieve metadata, while the front-end consumption module enables visualisation tailored to different user groups. The back-end module manages data content from multiple agencies and providers, while external interface modules facilitate distributed services.

In designing the system, GeoSpace-Sea adopted the principles of Findability, Accessibility, Interoperability, and Reusability (FAIR). This means that users could easily search for desired datasets and consume them through open standard web services, specifically those provided by the Open Geospatial Consortium (OGC) such as Web Map Service (WMS), Web Feature Service (WFS), and Web Coverage Service (WCS). Additionally, datasets could be downloaded in open formats such as comma-separated values (CSV) and shapefiles.

Initial stages of GeoSpace-Sea were focused on building and improving the data repository to enable the sharing of marine geospatial data using open standards. As it enters the Growth phase, the focus shifts to expanding GeoSpace-Sea's capabilities and extending its reach. Currently, GeoSpace-Sea supports a variety of MPA operations, from marine spatial planning and climate change studies to recreational safety advisories and tidal stream predictions for contractors.

GeoSpace-Sea is committed to support the Singapore Geospatial Master Plan and its future plans, which seek to leverage on geospatial information for the benefit of Singapore's economy and society. GeoSpace-Sea also participates in regional and international forums to promote the use of International Hydrographic Organization (IHO) standards and Marine Spatial Data Infrastructure (MSDI).

GeoSpace-Sea remains committed to sharing its data in open standards and building a common MSDI metadata standard to ensure full interoperability. Furthermore, GeoSpace-Sea is exploring the use of common open Application Programming Interfaces (APIs) to maximise searchability and simplify the development of applications. GeoSpace-Sea intends to evolve itself from a Marine Geospatial Data Infrastructure into a Marine Geospatial Knowledge Hub, serving the needs of diverse domains.

# TÜRKIYE

# SPATIAL DATA INFRASTRUCTURE IN TÜRKİYE

The activities of Türkiye's establishment of spatial data infrastructure are carried out in order to solve a number of problems such as the challenges of integrating information systems of public institutions and organizations, duplicate and conflictive data, and lack of a common language in information systems and unknown data ownership.

Regarding spatial data and spatial data infrastructure, the Presidential Decree No. 49 on Geographic Information Systems was published in the Official Gazette No. 30941 dated 7 November 2019, and entered into force. The purpose of this Presidential Decree is to ensure coordination between public institutions and organizations, to establish targets and strategies regarding the National Geographic Information System and related infrastructure, to determine the procedures, principles and standards for the production, updating, management, use, access, security and distribution of geographical information within the scope of geographical data themes and to determine the duty, authority and responsibility of the public institutions and organizations, natural and legal entities and the boards established under this Presidential Decree.

Since 2012, the Directorate General of Geographic Information Systems of the Ministry of Environment, Urbanisation and Climate Change (MoEUCC) has been carrying out activities related to the development of National Spatial Data Infrastructure, in line with the national (TSE) and international standards (ISO, OGC) and the national legislation. INSPIRE Directive and the documents published within this scope were taken as a guide in the activities carried out on the development of spatial data infrastructure in Türkiye. By the end of 2020, the following documents have been prepared and published:

- Data specification documents for 32 spatial data themes (Addresses, Administrative units, Cadastral parcels, Coordinate reference systems and Geographical grid systems, Geographical names, Hydrography, Protected sites, Transport networks, Elevation, Geology, Land cover, Orthoimagery, Agricultural and aquaculture facilities, Area management/restriction/regulation zones & reporting units, Atmospheric conditions, Bio-geographical regions, Buildings, Energy Resources, Environmental monitoring facilities, Habitats and biotopes, Human health and safety, Land use, Meteorological geographical features, Mineral resources, Natural risk zones, Population distribution and demography, Production and industrial facilities, Sea regions, Soil, Species distribution, Statistical units, Utility and governmental services)
- Consolidated UML Model,
- Generic Conceptual Model,
- Implementation Rules,
- Data Dictionary,
- Feature Catalogue,
- Basic Types and Models,
- Technical and organizational guidelines for Interoperability Procedures and Principles,
- Template Document for data producer organizations during data sharing between them and network services.

Data specification documents for 20 themes were published in the Official Gazette No. 31180 (bis.) dated 09 July 2020 by the Turkish Geographic Information System Executive Board Decision No.1 dated 27 February 2020. Data specification documents for 12 themes and Metadata Definition Document were published in the

Official Gazette No. 31248 (bis.) dated 18 September 2020 by the Turkish Geographic Information System Executive Board Decision No.3 dated 20 August 2020. Efforts are underway to harmonize the spatial data and metadata owned by the institutions in accordance with the published Data Specification Documents.

According to the Article 108 of the Presidential Decree No. 1 which was published in the Official Gazette No. 30474 dated 10 July 2018, the Directorate General of Geographic Information Systems of the MoEUCC was held responsible for "setting standards, policies and strategies for the production, quality and sharing of spatial data and information at the national level and preparing the necessary legislation". In this context, the Geographical Information Strategy and Action Plan was prepared by the Directorate General of Geographic Information Systems, and completed at the end of 2018.

The Geographical Information Strategy and Action Plan was published in the Official Gazette No. 31171 dated 30 June 2020 by the Turkish Geographic Information System Board Decision No. 2020/1 dated 11 June 2020, following the revisions made in line with the opinions of the relevant institutions. Within the scope of Geographical Information Strategy and Action Plan, a Geospatial Maturity Model was prepared to measure the maturity level of institutions of Türkiye in terms of legal infrastructure, organizational structure, human resources, technical infrastructure, geospatial data and finance criteria.

Within the scope of the Presidential Decree No. 49 on Geographical Information Systems, a Committee and an Executive Board have been established. Turkish Geographic Information Systems Committee and Executive Board holds periodic meetings to carry out coordination activities.

The National Geographical Data Responsibility Matrix was published in the Official Gazette No. 31171 dated 30 June 2020 by the Turkish Geographic Information System Board Decision No. 2020/1 dated 11 June 2020. The aim of this matrix is to define information such as the degree of confidentiality, with whom and in which environment the data will be shared regarding the geographic data provided by the responsible institutions.

With the decision of the Board of Turkish Geographic Information System dated 24.08.2022 and numbered 2022/1, the "National Geographic Data Responsibility Matrix (Revision)", "National Geographic Data Sharing Matrix", "Procedures and Principles for Access, Sharing and Use of Geographic Data" and "Geographic Data Production and Sharing Procedures and Principles for Disaster and Emergency Situations" were published in the Official Gazette in accordance with the 6th paragraph of the 8th article of the Presidential Decree No. 49 on Geographic Information Systems (Decision No: 2022/1, Decision Date: 24.08.2022).

In addition, six data themes (Buildings, Geology, Environmental Monitoring Facilities, Transport Networks, Area Management/Restriction/Regulation Zones & Reporting Units, Utility & Governmental Services) were extended and updated with the work of the Thematic Working Groups.

## MINISTRY OF INTERIOR OF THE REPUBLIC OF TÜRKİYE DIRECTORATE GENERAL OF PROVINCIAL ADMINISTRATION

Geographic Information Systems are of critical importance for planning, implementing and monitoring activities related to economic, social and community development. Today, in line with this purpose, countries develop various work plans, create systems and provide the necessary infrastructures in order to ensure the supply, implementation and updating of geographical data. The work in this context continues for Türkiye as

well, and comprehensive studies are being carried out to create Türkiye's National Geographical Information Systems (TUCBS). In this respect, the "Project for Updating and Digitization of Civil Administrative Boundaries" (MIDAS) by the Directorate General of Provincial Administration, which aims to digitize the geographical data on the civil administrative boundaries of Türkiye in accordance with international data standards, has been included in the Investment Program, carried out under the responsibility of the Directorate General since 01.11.2022.

In terms of central administration, Türkiye is divided into provinces, and provinces into districts according to geographical conditions, economic circumstances and the necessity of public services. The administrative boundary constitutes the external framework established by law of the areas of authority and responsibility of these units. From past to present, the fact that not all of the administrative boundaries of our country are in digital environment or those in digital environment are not always up-to-date, causes some problems between institutions and organizations and leads to duplicate data to be produced due to local studies. As a result of the "Project for Updating and Digitization of Civil Administrative Boundaries" (MIDAS), initiated in order to eliminate these problems, the country border, coastal edge line, provincial border, district border, municipality, village, neighbourhood boundaries will be digitized and integrated with geographical information systems in a database based on geographical information systems, in a way to include many attribute information such as "hududname" (documents regarding the boundaries of villages), decree, sketch, "mazbata" (minutes kept to determine the boundaries between villages and their neighbouring villages) in the relevant regions. In this way, duplicate data generation by institutions and organizations will be prevented, civil administrative borders will be standardized and singularized, healthy and updatable digital civil administrative borders of our country will be established.

# UNITED STATES OF AMERICA

# NATIONAL STRATEGY FOR MAPPING, EXPLORING, AND CHARACTERIZING THE UNITED STATES EXCLUSIVE ECONOMIC ZONE

*Prepared by the*

OCEAN SCIENCE AND TECHNOLOGY SUBCOMMITTEE

*of the*

OCEAN POLICY COMMITTEE

June 2020

**About the Ocean Policy Committee**

The Ocean Policy Committee was established in 2018 by Executive Order 13840, "Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States," to coordinate Federal actions on ocean-related matters and is co-chaired by the Director of the Office of Science and Technology Policy (OSTP) and the Chairman of the Council on Environmental Quality (CEQ). The Executive Order directed the Ocean Policy Committee to engage and collaborate with the ocean community on ocean-related matters, identify priority ocean research and technology needs, and leverage resources and expertise to maximize the effectiveness of Federal investments in ocean research. For more information about the work of the Ocean Policy Committee, please see the Ocean Policy page on the CEQ website: https://www.whitehouse.gov/ceq/.

**About the Ocean Science and Technology Subcommittee**

The Ocean Policy Committee established the Ocean Science and Technology Subcommittee (OST) pursuant to Section 4(b) of Executive Order 13840 to address ocean science and technology issues across agencies. This includes identifying priority ocean research and technology needs, participating as appropriate in the work of the National Oceanographic Partnership Program (NOPP), and supporting research and technology collaboration among the agencies and departments represented on the Ocean Policy Committee.

**About this Document**

Pursuant to Section 2 of the Presidential Memorandum of November 19, 2019, on "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska," this document sets forth a national strategy for mapping, exploring, and characterizing the United States Exclusive Economic Zone (EEZ), and for enhancing opportunities for collaboration among interagency and non-United States Government entities with respect to those activities. These proposed actions are subject to the availability of appropriations.

**Copyright Information**

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**Beth Wenstrom**, BOEM
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## Abbreviations and Acronyms

| | |
|---|---|
| AUV | Autonomous Underwater Vehicle |
| BOEM | Bureau of Ocean Energy Management |
| CEQ | Council on Environmental Quality |
| CRADA | Cooperative Research and Development Agreement |
| DOE | Department of Energy |
| DOI | Department of the Interior |
| DOT | Department of Transportation |
| eDNA | Environmental DNA |
| EEZ | Exclusive Economic Zone |
| EPA | Environmental Protection Agency |
| FDA | Food and Drug Administration |
| FGDC | Federal Geographic Data Committee |
| FWS | Fish and Wildlife Service |
| IWG-OCM | Interagency Working Group on Ocean and Coastal Mapping |
| LIDAR Light | Detection and Ranging |
| MMC | Marine Mammal Commission |
| NASA | National Aeronautics and Space Administration |
| NCEI | National Centers for Environmental Information |
| NGA | National Geospatial-Intelligence Agency |
| NIH | National Institutes of Health |
| NMIO | National Maritime Intelligence-Integration Office |
| NOAA | National Oceanic and Atmospheric Administration |
| NOPP | National Oceanographic Partnership Program |
| NPS | National Park Service |
| NSF | National Science Foundation |
| OCS | Outer Continental Shelf |
| ODNI | Office of Director of National Intelligence |
| OMB | Office of Management and Budget |
| ONR | Office of Naval Research |
| OPC | Ocean Policy Committee |
| OSTP | Office of Science and Technology Policy |
| ROV | Remotely Operated Vehicle |
| S&T | Science and Technology |
| USACE | United States Army Corps of Engineers |
| USARC | United States Arctic Research Council |
| USCG | United States Coast Guard |
| USDA | United States Department of Agriculture |
| USGS | United States Geological Survey |
| USN | United States Navy |

## Table of Contents

**Executive Summary**

The ocean, coasts, and the Great Lakes are among the most treasured resources in the United States. They are an integral part of our national identity and our Nation's future. A comprehensive understanding of our oceans is fundamental to advancing science, building ocean-related industries, informing decisions that balance ocean use and conservation, and enhancing the Nation's prosperity and security. While technologies and understanding continually improve, the United States currently lacks critical information regarding many foundational characteristics of our Nation's oceans. To develop the knowledge and information necessary to address these gaps, improve our Nation's understanding of our vast ocean resources, and advance the economic, security, and environmental interests of the United States, President Trump signed a Presidential Memorandum1 on November 19, 2019, titled "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska." This Presidential Memorandum[1] directs the Ocean Policy Committee to "coordinate the development of a national strategy for mapping, exploring, and characterizing the United States EEZ, and for enhancing opportunities for collaboration among interagency and non-United States Government entities with respect to those activities." [2]

Pursuant to the Presidential Memorandum, this document presents a strategy to map the United States EEZ, identify priority areas within the United States EEZ, and explore and characterize these priority areas, leveraging the expertise and resources of multi-sector partnerships. Deploying new and emerging science and technologies at scale, and doing so in partnership with private industry, academia, and non-governmental organizations, are essential components of the strategy.

While this document provides important guidance to Federal agencies on ocean science and technology (S&T) priorities and informs the policy development process, implementation of this plan is dependent on available resources and will vary year to year. This effort is a phased-strategy approach meant to address near-term priorities within the next 3 years. This Strategy will be updated in 2023, and may be similarly revised thereafter, to reflect advancements in S&T, partnerships, and the operational sophistication of the mapping, exploration, and characterization enterprise.

The Strategy advances five goals, each supported by strategic objectives that incorporate high-level actions, to accomplish the task of mapping, exploring, and characterizing the United States EEZ. An immediate action under the Strategy will be the development of an Implementation Plan that will characterize and direct specific actions to implement the Strategy.

1 The Presidential Memorandum is available at: https://www.whitehouse.gov/presidential-actions/memorandum-ocean-mapping-united-states-exclusive-economic-zone-shoreline-nearshore-alaska/

2 The United States Exclusive Economic Zone (EEZ) extends no more than 200 nautical miles from the territorial sea baseline and is adjacent to the 12 nautical mile territorial sea of the United States, including the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Commonwealth of the Northern Mariana Islands, and any other territory or possession over which the United States exercises sovereignty.

**Goal 1: Coordinate Interagency Efforts and Resources to Map, Explore, and Characterize the United States EEZ:** Federal agencies will align priorities in efforts to map, explore, and characterize the resources of the United States EEZ.

**Goal 2: Map the United States EEZ:** Federal agencies will coordinate mapping efforts to compile a complete map of deep water by 2030 and nearshore waters by 2040. Completing this goal will give the United States unprecedented detailed information about the depth, shape, and composition of the seafloor of the United States EEZ.

**Goal 3: Explore and Characterize Priority Areas of the United States EEZ:** Federal agencies will identify priority areas of interest for exploration and characterization, and coordinate interagency and cross-sector efforts to explore the ocean, make new discoveries, and characterize the ocean resources of the United States.

**Goal 4: Develop and Mature New and Emerging Science and Technologies to Map, Explore, and Characterize the United States EEZ:** New and emerging S&T is key to making ocean mapping, exploration, and characterization more efficient and effective. Federal agencies will coordinate efforts to promote and advance new technologies to support this effort.

**Goal 5: Build Public and Private Partnerships to Map, Explore, and Characterize the United States EEZ:** Fully mapping, exploring, and characterizing the United States EEZ will require efforts not only from Federal agencies but from State governments, private industry, academia, and non-governmental organizations. Federal agencies will participate in and support these partnerships in order to ensure all goals are completed by their target dates.

This Strategy is a call to action for Federal agencies and non-Federal partners to build a national enterprise to map, explore, and characterize the United States EEZ. Meeting this challenge will require coordinated action and collaborative efforts that join scientific inquiry, entrepreneurial enterprise, philanthropic endeavor and public and private investment. It will also require a broadly defined but common direction to help guide our actions and ocean stewardship. In doing so, we will dramatically increase our knowledge of the Nation's ocean resources, and enhance our economic competitiveness, strengthen our national security, protect our environment, and preserve continued prosperity.

## Introduction

The ocean covers 71 percent of the Earth's surface and supports global prosperity.[3] The United States Exclusive Economic Zone (EEZ) extends 200 nautical miles (NM) from shore and is larger than the land area of all 50 States combined, and is one of the largest in the world (Figure 1). Despite its vast expanse, most of this area is still unmapped, unobserved, and unexplored.[4] Mapping, exploring, and characterizing the ocean and coastal shoreline advances scientific understanding, safeguards the Nation's economic prosperity, and promotes the health and security of our people. This knowledge is essential to advancing America's understanding of the marine environment and addressing sustainable ocean resource management.

The United States has economic, security, and environmental interests in exploring and understanding its EEZ. In 2016, the National Oceanic and Atmospheric Administration (NOAA) estimated that the ocean economy produced more than $300 billion in goods and services and that there were approximately 154,000 ocean-dependent businesses, which employed more than 3 million people and paid $129 billion in wages.5 Given the size of the United States EEZ and coastline, the energy, critical minerals, living resources, and ecosystems it encompasses may be worth many billions if not trillions of dollars.[5] The ocean science and technology (S&T) enterprise can provide the foundational knowledge needed to address many complex ocean-related challenges and inform decision-making that will ultimately strengthen our Nation and its communities.

In November 2019, President Trump signed a Presidential Memorandum on "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska," (Presidential Memorandum) recognizing the value of mapping, exploration, and characterization to enhance our future prosperity, health, and national security. The Presidential Memorandum includes three directives which provide an interagency framework for how this effort will be implemented and executed: Section 2 directs a national strategy for mapping, exploring, and characterizing the United States EEZ; Section 3 directs a strategy for mapping the Arctic and Sub-Arctic Shoreline and Nearshore of Alaska; and Section 4 directs a strategy for efficient permitting of mapping, exploration, and characterization activities.

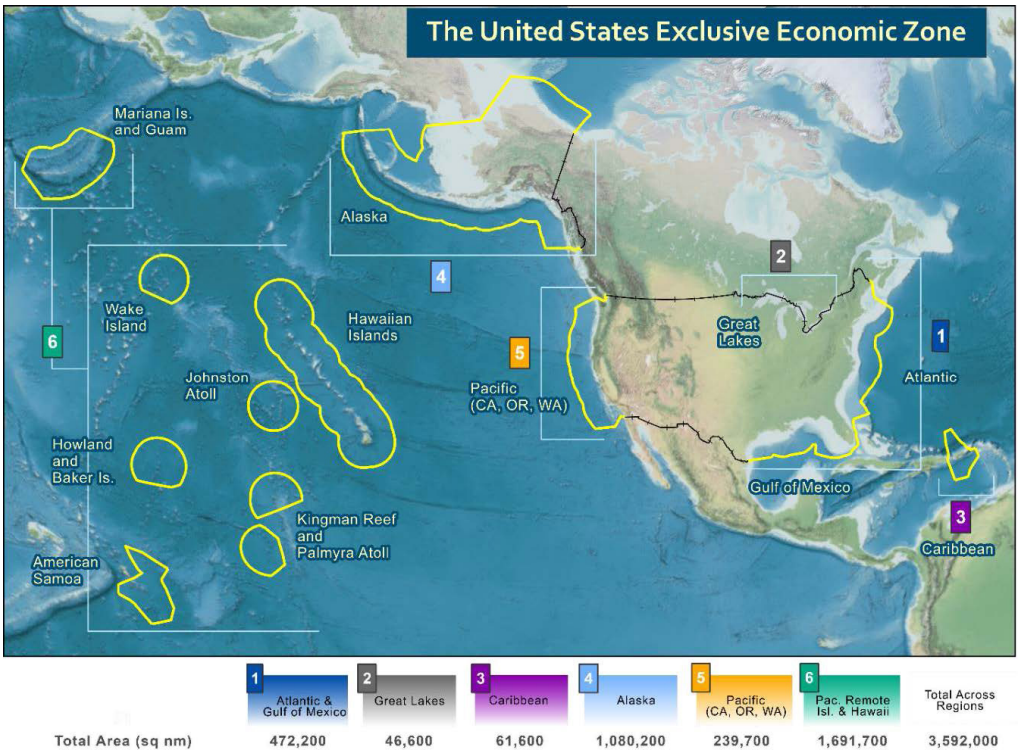
This document presents the *National Strategy for Mapping, Exploring, and Characterizing the United States EEZ (Strategy)*. As directed under Section 2 of the Presidential Memorandum, the Strategy is a product of the Ocean Policy Committee (OPC), through its Ocean Science and Technology (OST) Subcommittee.

3 More information on ocean and coastal resources is available at: https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources

4 This strategy may apply to areas beyond the 200 NM limit in some circumstances, in particular to the United States extended continental shelf (ECS). Consistent with international law, the United States has sovereign rights and jurisdiction, including with respect to natural resources, over its ECS. More information on the United States ECS is available at: https://www.state.gov/about-the-u-s-extended-continental-shelf-project/

5 National Oceanic and Atmospheric Administration (NOAA). 2019. NOAA Report on the United States Ocean and Great Lakes Economy. https://coast.noaa.gov/data/digitalcoast/pdf/econ-report.pdf

***Figure 1. The United States Exclusive Economic Zone. (Image credit:NOAA)***




Mapping, exploring, and characterizing the United States EEZ will require, and the Strategy strongly supports, the use of new and emerging S&T and the expertise and resources of non-Federal partners. New technologies will increase the scope, pace, and efficiency of mapping and sampling over an extremely large area. Similarly, partnerships with non-Federal entities engaged in ocean resource data collection will more efficiently accomplish these efforts, leverage common interests, and avoid duplication of effort.

For the purposes of this document:

- *Ocean mapping* provides comprehensive data and information needed to understand sea-floor characteristics such as depth, topography, bottom type, sediment composition and distribution, and underlying geologic structure.
- *Ocean exploration* provides a multidisciplinary first look at an unknown or poorly under-stood area of the seafloor, sub-bottom, and/or water column and an initial assessment of an area's physical, chemical, and biological characteristics.
- *Ocean characterization* provides comprehensive data and interpretations for a specific area of interest of the seafloor, sub-bottom, and/or water column, in direct support of specific research, resource management, policymaking, or applied mission objectives.

The Strategy was informed by public comments provided in response to a request for information. The OST received a total of 23 public comments from Federal agencies, marine industries, academia, non-governmental organizations, and private individuals. Comments highlighted current technological capabilities, identified opportunities to incorporate S&T in mapping, exploration, and characterization, recommended considerations for identifying priority areas, and proposed community engagement strategies. All comments received helped shape the Strategy's goals, objectives, and actions.

This Strategy establishes five overarching goals for mapping, exploring, and characterizing the United States EEZ:

**Goal 1: Coordinate Interagency Efforts and Resources to Map, Explore, and Characterize the United States EEZ**

**Goal 2: Map the United States EEZ**

**Goal 3: Explore and Characterize Priority Areas of the United States EEZ**

**Goal 4: Develop and Mature New and Emerging Science and Technologies to Map, Explore, and Characterize the United States EEZ**

**Goal 5: Build Public and Private Partnerships beyond Federal agencies to Map, Explore, and Characterize the United States EEZ**

Each Goal is supported by strategic objectives that incorporate high-level actions. The objectives identify responsible agencies, and include either specific or ongoing timelines for completion. The designation of responsible agencies identifies primary responsibility for implementation but does not exclude or limit the participation of additional agencies, who will participate as appropriate. An immediate action under the Strategy will be the development of an Implementation Plan that will characterize and direct specific actions to implement the Strategy.

The Strategy recognizes that developing and implementing a new, more fully integrated and collaborative approach to mapping, exploring and characterizing the United States EEZ will require a period of transition as agencies, partners, and stakeholders establish priorities, adopt new S&T, and develop new practices. For example, technologies currently deployed at pilot scale are likely in the next several years to be deployed at scale, significantly increasing the ability to cost-effectively gather far more information than is currently possible. However, the practical details of how that will occur are not yet known. And at the same time, previously directed and authorized ocean research activities of all kinds are, and will continue to be, ongoing.

Therefore, this Strategy focuses initially on developing the capacity of, and relationships among, Federal agencies and non-Federal partners to accomplish the President's direction to map, explore, and characterize the United States EEZ, while also supporting ongoing and new work in the field. The Strategy will be updated in 2023, and may similarly be revised thereafter, to reflect continuing advancements in the implementation of S&T, the effectiveness of partnerships, and the operational sophistication of the collaborative mapping, exploration, and characterization enterprise.

## Goal 1: Coordinate Interagency Efforts and Resources to Map, Explore, and Characterize the United States EEZ

Agencies across the Federal Government play a role, directly or indirectly, in mapping, exploring, and characterizing the ocean. These agencies also require the information derived from those activities to fulfill their missions and support non-government sectors that advance the economic, security, and environmental interests of the United States. Although aspects of mapping, exploration, and characterization activities are addressed by intragovernmental bodies or government participation with public advisory committees, informal consortia, or other means, there is no mechanism or process for strategically coordinating these activities as an integrated pursuit.[6] Therefore, the first goal of this Strategy is to promote efficient and effective coordination across the Federal government to better leverage and strategically align agency efforts to map, explore, and characterize the United States EEZ. The objective of this goal is to establish an interagency body that can accomplish the needed level of coordination across agencies and between agencies and non-government partners.

### 1.1 Establish a National Ocean Mapping, Exploration, and Characterization Council.

In June 2018, President Trump signed Executive Order 13840, titled "Ocean Policy to Advance the Economic, Security, and Environmental Interests of the United States." The Executive Order established the OPC to serve as a high-level body charged with coordinating Federal ocean-related matters[7] and directed it, in part, to advance ocean S&T, engage and collaborate with the ocean community, and leverage resources and expertise across sectors to maximize the effectiveness of Federal investments in ocean research.[8]

To coordinate agency policy and actions needed to advance ocean mapping, exploration, and characterization, and to support collaboration with non-government partners and stakeholders, the National Ocean Mapping, Exploration, and Characterization Task Force will be transitioned to a standing body, the National Ocean Mapping, Exploration, and Characterization Council (Council). The Council will develop and implement multi-disciplinary, collaborative, and coordinated approaches to mapping, exploring, and characterizing the United States EEZ. The Council will report to the OST, which will provide support and guidance for the Council's work as appropriate. The OPC will provide strategic direction and facilitate interagency resolution of policy issues as appropriate. (See **Figure 2.**)

The Council will oversee two working groups: the existing National Science and Technology Council (NSTC) Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM)[9] will focus primarily on ocean mapping. A new Interagency Working Group on Ocean Exploration and Characterization (IWG-OEC) will be established to focus on ocean exploration and characterization. These two bodies will report to the Council, which will coordinate mapping, exploration, and characterization activities.

6 This Strategy does not eliminate any resources or funds from other agencies and does not conflict with legislative authorities.

7 Executive Order 13840 defined "ocean-related matters" as those "involving the ocean, coastal, and Great Lakes waters of the United States (including its territories and possessions), and related seabed, subsoil, waters superadjacent to the seabed, and natural resources."

8 The OPC is comprised of senior representatives of over twenty Federal agencies and offices within the Executive Office of the President, and is co-chaired by the Director of the Office of Science and Technology Policy (OSTP) and the Chairman of the Council on Environmental Quality (CEQ). The OPC is supported by two interagency subcommittees, including the OST Subcommittee and the Ocean Resource Management (ORM) Subcommittee, that address ocean science and technology, and regulatory and policy coordination, respectively, across the agencies.

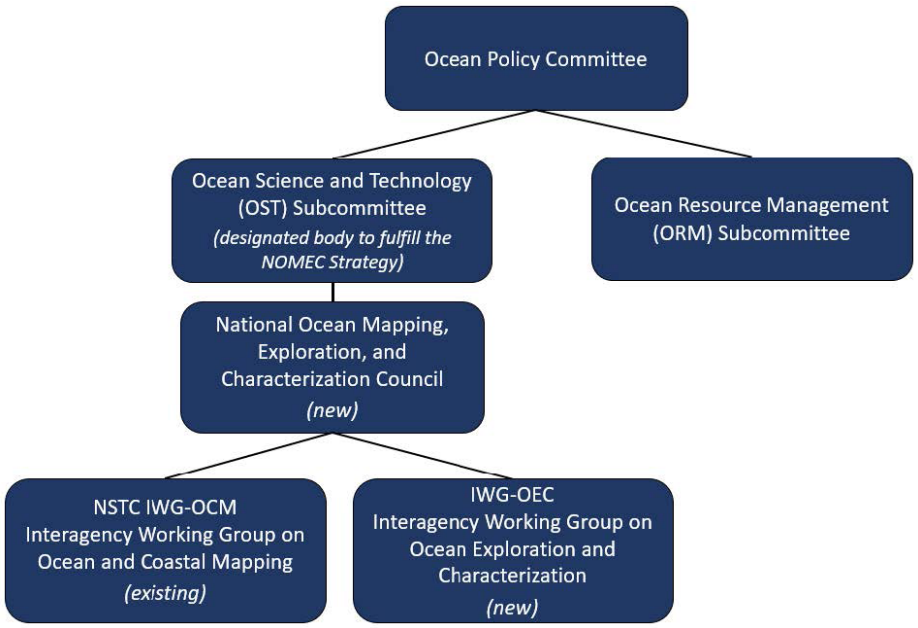



***Figure 2. National Strategy Coordination Structure. (Image credit: OST)***

Figure 2 depicts the proposed structure of the interagency coordinating Council and working groups in the context of the OPC, OST, and ORM. The Council will be co-chaired by Senior Executive Service members or General or Flag Officers of Federal agencies with primary mapping, exploration, and characterization responsibilities and authorities. Membership of the Council and working groups will represent Federal agencies which have programmatic responsibilities and resources needed to implement the Strategy. [Timeline: 90-days. Responsibility: OPC]

*1.2 Develop an Implementation Plan for the National Strategy.*

While this document provides strategic direction and identifies high-level actions, implementation of the Strategy will require the Council to develop a detailed approach to accomplishing the goals and objectives described below. Therefore, as an immediate action under the Strategy, the Council and subordinate bodies will develop an Implementation Plan that will characterize and direct specific actions to implementthe Strategy. The Implementation Plan will identify specific actions that describe how the goals, objectives, and associated timelines presented in this Strategy will be accomplished. Key issues to be addressed in the Implementation Plan include:

- Establish the processes for identifying national ocean mapping, exploration, and characterization priorities;
- Ensure effective coordination of mapping, exploration, and characterization activities with members of the national security and intelligence communities;
- Facilitate non-Federal input into national ocean mapping, exploration, and characterization priority-setting processes;

9 The IWG-OCM reports to the Subcommittee on Ocean and Science Technology (SOST) under NSTC. The IWG-OCM was established in 2006 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 mapping interests" (National Ocean and Coastal Mapping Strategic Action Plan 2009)

- Serve as a coordinating mechanism for all Federal and federally-funded programs conducting or supporting ocean mapping, exploration, and characterization activities under existing Federal agency programs and statutory authorities;
- Identify opportunities for combining multiple agencies' overlapping or complementary needs, activities and/or resources, and propose specific recommendations and solutions;
- Promote protocols for accepting data, equipment, or other resources that support national ocean mapping, exploration, and characterization priorities; and
- Promote partnerships among Federal and State agencies, private industry, academia, and non-governmental organizations to conduct or support ocean mapping, exploration, and characterization activities and technology development needs.

The Council will solicit public comment on the components of a draft Implementation Plan through workshops (such as the National Ocean Exploration Forum described in Section 5.2), requests for information, or other mechanisms, and will present a final draft to the OPC for its review and approval. [Timeline: 180 days. Responsibility: Council]

**Goal 2: Map the United States EEZ**

The United StatesEEZ is larger than the combined land area of all 50 states, spanning over 13,000 miles of coastline and containing 3.4 million square nautical miles (SQNM) of ocean.[10] Mapping the seafloor will increase our understanding of natural and cultural resources, physical hazards, and ocean-related processes related to climate, earthquakes, tsunamis, weather forecasting, ocean habitats, fisheries, and biodiversity.

For the purposes of this goal, mapping is defined as the comprehensive data and information needed to understand seafloor characteristics such as depth, topography, bottom type, sediment composition and distribution, and underlying geologic structure. In particular, bathymetry (measurement of water depth and seafloor shape) is a foundational mapping element for many activities, including nautical charting, sand and gravel assessments, habitat restoration, and wind energy siting. Collecting bathymetry is the first step in exploration and characterization activities and can help to identify promising sites for further investigation.

10 More information on the United States EEZ is available at: https://www.gc.noaa.gov/documents/2011/012711_gcil_maritime_eez_map.pdf

In shallow, clear waters, bathymetry can be efficiently measured from aircraft and satellites using light detection and ranging (LIDAR)[11] and imagery. However, current estimates indicate that this technique can be used in less than 1 percent of United States waters. In deeper and murkier waters, the current best available technology for bathymetric seabed mapping is swath sonar,[12] which maps a strip of the seafloor on each pass. These modern mapping systems can also measure the acoustic properties of the seabed, from which seabed composition can be inferred, as well as backscatter from the water column. Additional sonars and sensors can be operated simultaneously during mapping operations to map the sediment layers beneath the seabed, as well as biological, physical, and chemical properties of the seawater. An effectively integrated ocean and coastal mapping approach seeks to simultaneously acquire multiple data types during continuous underway operations.

The Strategy addresses mapping United States waters based on ocean depth. The initial goal will focus on mapping water 40 meters and below, representing 90 percent of the United States EEZ, but only about one-third of the total level of effort. Currently, sonar-equipped ships and unmanned maritime vehicles are best suited for hydrographic data collection of deep ocean applications because they can capture a large area with minimal effort and therefore will be the initial focus of this Strategy. This goal to map the deep water can be met by 2030.[13]

In shallower waters, the level of effort for seabed mapping increases dramatically as sonar swath width decreases[14] and the value of new technology in LIDAR and unmanned maritime increases. Shallow water mapping work will continue at current rates through 2030 in support of existing agency mandates. In the second decade, the pace of mapping will accelerate as the deep water mapping efforts are completed and advancements in technology are deployed at scale. This higher difficulty region will benefit from airborne and satellite system measurements, along with future technology improvements in unmanned systems, communications, artificial intelligence, and sensors. Specific Federal agency strategies for developing new S&T and leveraging unmanned systems and artificial intelligence will also directly contribute to this Strategy. Mapping the waters less than 40 meters, nearshore waters, can be completed by 2040.

11 LIDAR is a remote sensing method used to examine surfaces of the Earth. More information on LIDAR is available at: https://oceanservice.noaa.gov/facts/lidar.html

12 More information on sonar for seabed mapping is available at: https://oceanexplorer.noaa.gov/technology/tools/sonar/sonar.html

13 All timelines are based on current projected appropriations and current predicted vessel deployment schedule.

14 Several national coastal strategies, including the Alaska Coastal Mapping Strategy (Section 3 of the Presidential Memorandum) and the National Coastal Mapping Strategy developed by the IWG-OCM address the particular challenges of mapping shallow waters with airborne and satellite technologies.

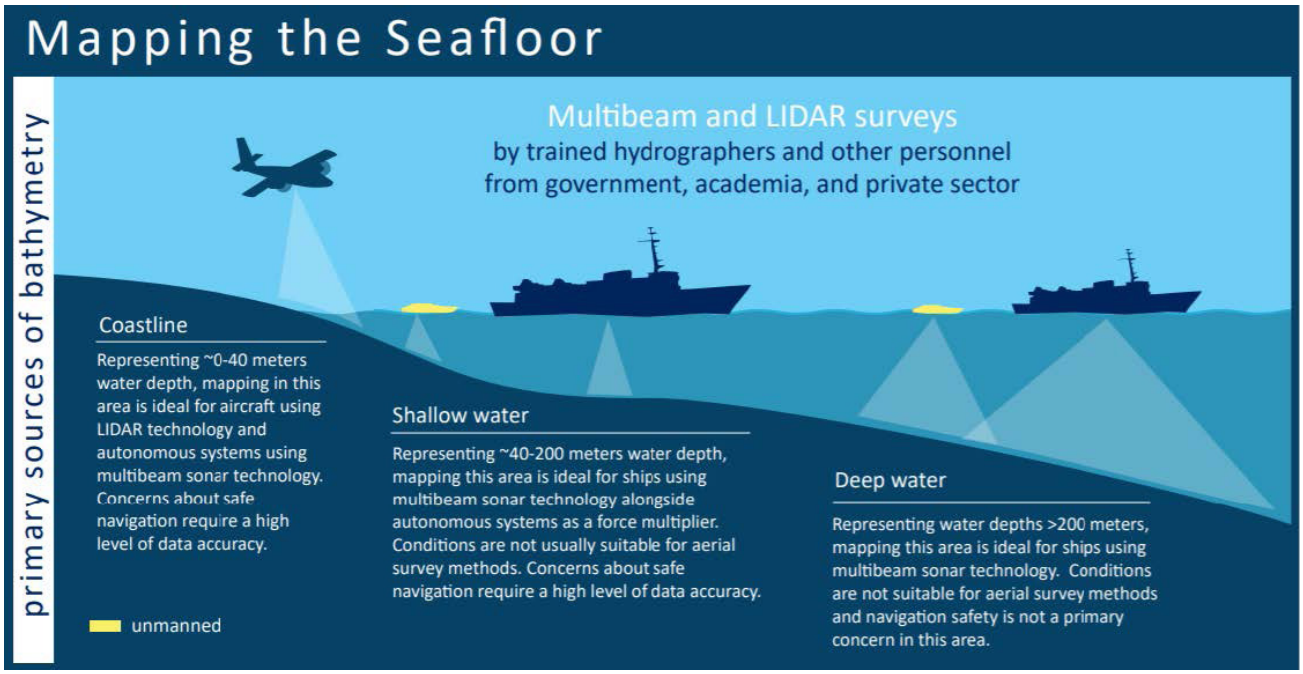



***Figure 3. Primary sources of bathymetry for coastline, shallow, and deep water mapping. (Image credit: NOAA)***

### *2.1 Establish a Standard Ocean Mapping Protocol.*

Ocean mapping programs share many requirements, but the differences in sensors, calibrations, and corrections may make the data from one program less usable by others. In order to ensure that mapping conducted in support of this Strategy will be broadly applicable, a standardized collection protocol will be developed. This protocol will guide all the participants in data acquisitions and processing to ensure the widest access to and use of the data, minimize duplication of effort, and efficiently collect, process, and publish as much data as possible into archives and databases. National data standards and best practices will be used, as required by the Geospatial Data Act of 2018.[15] This protocol will include the following features:

- Specifications for bathymetry data;
- Specifications for seabed backscatter acoustic imagery;
- Specifications for water column backscatter;
- Specifications for sub-bottom profiling; and
- Timelines and protocols for data management and availability.

The IWG-OCM will develop and circulate this protocol for interagency review and seek public comment. This protocol will be reviewed and updated as necessary by the IWG-OCM every 5 years to take advantage of new technologies as they mature. [Timeline: 2-years. Responsibility: Council]

15 More information on the Geospatial Data Act of 2018 is available at: https://www.fgdc.gov/gda

***2.2 Coordinate and Execute Campaigns to Map the United States EEZ.***

Under the direction of the Council, the IWG-OCM and partner groups will coordinate and execute the comprehensive mapping of the United States EEZ. Executing this objective will require:

- Cataloging and analyzing existing ocean data, using the United States Bathymetric Gap Analysis, to identify mapping gaps and seek out additional existing data from Federal agencies, industry, and other sources. Broader mapping analyses, such as the 3D Nation Requirements and Benefits Study[16] will also be used to inform mapping gaps;
- Aggregating agency input on mapping priorities by ocean region. Resulting maps will highlight both areas of common interests and important but potentially isolated places in need of study. These priorities will then be shared publicly to inform mapping campaign sequencing;
- Designing a sequenced set of regional ocean mapping campaigns in manageable segments over time, and track and report on the progress of these campaigns. Clear delineation of agency priorities, plans, and performance will enable Federal and external partners to collaborate most effectively to address individual requirements; and
- Executing regional ocean campaigns, allowing for flexibility to move among annual planned areas as needed based on weather, equipment, and scientific cruise schedules. Agency geospatial contract vehicles, Federal/private/academic platforms, grants, and agreements can be assets to utilize in implementation.

The Council and the IWG-OCM will periodically review and deconflict, as needed, interagency mapping plans. [Timeline: 2-years. Responsibility: Council]

***2.3 Make Data Usable and Available.***

Consistent with and subject to national security considerations and any applicable law, Federal agencies and their partners will collect and archive data in standardized formats wherever possible. NOAA's National Centers for Environmental Information (NCEI) is responsible for hosting and providing access to comprehensive oceanic, atmospheric, and geophysical data. NCEI is also the national archive of the United States for multi-beam bathymetric data and will serve in that capacity as this Strategy is implemented. NCEI will provide discovery-level metadata to allow expert users to download and use data and information such as bathymetry, seabed backscatter, water column backscatter, and sub-bottom profiles in their original and processed forms. Other archives may also provide these services in a federated arrangement.

NOAA developed the National Bathymetric Source, a national database of bathymetry that operationally combines data from multiple repositories and contributes to NCEI. The bathymetry data and resulting services are updated daily and are available in a variety of forms suitable for different applications. This system will provide ready access to bathymetric services as a core part of the service delivery model for the bathymetry part of this Strategy. Similar curated services may be developed for other parameters. [Timeline: Ongoing. Responsibility: OPC agencies]

16 More information on the 3D Nation Requirements and Benefits Study is available at: https://my.usgs.gov/confluence/display/3DNationStudy/3D+Nation+Requirements+and+Benefits+Study

***Goal 3: Explore and Characterize Priority Areas of the United States EEZ***

Just as mapping the seafloor at high resolution will reveal the characteristics of the ocean bottom, fine-scale exploration and characterization, combining direct visual observations and environmental sampling, are needed to discover and inventory the ocean's resources. This will enable scientists and resource managers to establish connections among the resources, to answer basic research questions, and to support our efforts to sustainably manage and use valuable resources.

Initial exploration and characterization will use seafloor and sub-seafloor maps and acquire the samples and/or sensor-based data that are purposely intended to provide a multidisciplinary first-look at an unknown or poorly understood area. This will provide insight into characteristics of the seafloor, sub-bottom, and/or water column, and an initial assessment of an area's physical, chemical, and biological environments. Observations may include a combination of multiple tools that identify the structure, processes, and components of the system of interest. This will facilitate discovery and provide an initial indication that a site or feature warrants further investigation. Once areas of interest are identified, additional information will be collected to more fully characterize or assess a location to support specific research and mission objectives, which could include hazard and resource assessment, habitat delineation, and a better understanding of the Earth system processes. Exploration and characterization may also include the use of Earth system and ecosystem models and remotely sensed data to support campaign and mission planning and serve as management decision support tools.

The tools available to explore and characterize the ocean will be matched to the bathymetric and physical, geological, chemical, and biological oceanographic environments of a given area. Exploring the water column requires a different approach than exploring a high-temperature hydrothermal vent situated in the high-relief bathymetry of a seafloor spreading center. Similarly, sampling delicate marine organisms for species identification and characterization of their biopharmaceutical potential requires a different approach than sampling hard substrates to gain information about the potential value of seafloor mineral deposits.

The following objectives will guide and support the exploration and characterization of priority ocean areas.

***3.1 Identify Strategic Priorities.***

Clear and focused strategic priorities for ocean exploration and characterization will guide decisions and actions that implement the President's direction to identify, explore, and characterize "priority areas" within the United States EEZ. To identify strategic priorities and priority areas, the Council will consider statutory requirements, Federal agency missions, strategic national issues, Administration policy priorities, and stakeholder perspectives. The Council will coordinate agency or Council-sponsored workshops (such as the National Ocean Exploration Forum described in Section 5.2), requests for information, and other mechanisms to engage partners and stakeholders in this process. Examples of potential strategic priorities include but are not limited to areas with features and resources subject to agency resource management and stewardship responsibilities, areas with potential for offshore energy, critical minerals, or biopharmaceutical resources, and areas or systems that may provide key insights into understanding ocean and Earth systems. Specific geographic areas that are consistent with strategic priorities will be identified on a mission and campaign-based basis through the process described above.

This process will be repeated periodically to account for improvements in understanding and advancements in technology, to increase stakeholder participation, and to allow for stakeholders to better coordinate their exploration and characterization efforts. [Timeline: 12-months. Responsibility: Council]

***3.2 Establish Exploration and Characterization Standards and Protocols.***

Common standards for the collection, storage, and control of data and information collected in exploration and characterization activites are needed in order to maximize the benefit of such data. Yet, there is no single suite of measurements, standards, or protocols that can address all identified priorities. For example, the measurements needed to consider an ocean area explored may only be a subset of and at a lower resolution to those needed to characterize that same area. Similarly, the standards and protocols needed to characterize an ocean area in support of living marine resource management are different from those needed to understand the critical mineral potential, and both are different than those needed to assess offshore energy or biopharmaceutical potential. In recognition of these issues, the Council will lead interagency efforts to establish a suite of standards and protocols for exploration and characterization that will meet the information needs of agency requirements.

In all cases, the standards and protocols will seek to maximize commonality, taking advantage of existing efforts to identify standards and protocols within the ocean science community, leveraging existing repositories for housing data and samples, and promoting consistency with standards and protocols of the Federal Geographic Data Committee, and other similar bodies and international efforts to standardize oceanographic data. Similar to the prioritization process identified in the previous section, established exploration and characterization standards and protocols may be periodically revisited to allow for improvements in understanding, advancements in S&T, and increases in or changes to stakeholder input. [Timeline: 2-years. Responsibility: Council]

***3.3 Explore and Characterize Priority Areas.***

Identified priority areas should be explored and characterized to inventory, observe, study, and assess living and non-living marine resources, ecosystems, and ocean processes. In some instances, priorities may be able to be addressed through a single at-sea mission supported by an individual agency or partner. However, full implementation of this Strategy will require the development of multi-mission ocean exploration and characterization campaigns executed and supported by a multitude of partners encompassing one or more years of effort and an assemblage of ships and other at-sea vehicles and technologies.

Once a campaign is defined by a broad geographic region and/or thematic discipline, a phased approach will identify campaign partners and participants, further refine specific exploration and characterization information needs, identify and secure required resources, including funding and seagoing assets needed to complete the campaign, target discrete campaign operating areas and individual mission objectives, establish data and sample delivery timelines, and develop strategies for participation and public engagement. In this phased approach, reports from recent workshops hosted by relevant communities will be consulted and the ocean science and stakeholder communities will be solicited to inform campaign objectives. Where necessary, workshops to establish campaign-specific goals and partner responsibilities will be conducted and will include a wide diversity of partners and stakeholders to understand the specific information needs.

To facilitate campaign planning and execution, the Council will collect information from Federal agencies about their planned exploration and characterization missions, as well as those of their non-Federal partners, in order to identify opportunities for collaboration, coordinating resources, and efficiency. Where appropriate, the National Oceanographic Partnership Program (NOPP)[17] and other similarinteragency and non-Federal coordinating bodies will be used to execute the campaign. [Timeline: Ongoing. Responsibility: Council]

17 The NOPP facilitates partnerships between Federal agencies, private industry, and academia to advance ocean science research and education. Through this collaboration, Federal agencies can leverage resources to invest in priorities that fall between agency missions or are too large for any single agency to support. More information is available at: https://www.nopp.org/

***3.4 Make Exploration and Characterization Data Usable and Available.***

Ocean exploration and characterization missions will typically collect very large amounts of data. While much of these data are used in real-time to inform and further refine at-sea mission operations, it is through the transformation of these data into useful information that the full value of these efforts will be realized. The more people who have access to the data, the richer the opportunities are for interpretation and transformation into information that is useful to a wider variety of stakeholders, from scientists to educators to policymakers to business owners.

Consistent with and subject to national security considerations and unless otherwise prevented by law, all data, including images and access to samples resulting from publicly supported, dedicated civilian exploration and characterization expeditions will be made widely available at little or no additional cost and in real-time or as soon as appropriate quality assurances have been completed. For ease of use, the data will conform to the standards developed in Section 3.2 and be in a form consistent with Federal Geographic Data Committee standards. Where practicable, ocean exploration and characterization data will reside within established data and sample repositories and their existence made widely known. Routine synthesis of the data and sample collections may be used to identify exploration and characterization gaps and refine future priorities. [Timeline: Ongoing. Responsibility: OPC agencies]

***Goal 4: Develop and Mature New and Emerging Science and Technologies to Map, Explore, and Characterize the United States EEZ***

The United States EEZ is vast and poses unique challenges to operations. Weather and other factors can create risk for the vessels and the people aboard, limiting the operating windows. Current sampling techniques often generate a limited picture of the biological, chemical, geological, and physical features of the ocean. Comprehensive mapping, exploration, and characterization of the marine landscape and water column require more detailed and efficient data collection and processing than has been used in the past. As such, more frequent and ambitious mapping, exploration, and characterization campaigns must include new ships, analytics, technologies, and other platforms capable of measuring, sampling, and imaging both yet-to-be-mapped, explored, and characterized areas, and those with insufficient data.

Several cutting-edge methodologies and enabling technologies in unmanned systems, high bandwidth communications, and artificial intelligence will contribute to a step-change in capabilities. To advance these efforts, new and emerging methodologies and technologies must be identified, adapted, and adopted by the greater ocean mapping, exploration, and characterization communities and integrated into the missions and campaigns envisioned in this Strategy. Specifically, the rapid advancement of autonomous tools, platforms, and technologies may provide for a more cost-effective and efficient acquisition of hydrographic mapping data. Often, efforts center on leveraging partner expertise in marine technology development, where private industry, academia, and non-governmental organizations are major contributors. As marine scientific and technology markets continue to grow, opportunities for contributions from and support to these partners will increase. priorities that fall between agency missions or are too large for any single agency to support. More information is available at: https://www.nopp.org/.

Emerging technologies allow us to investigate the ocean at unprecedented time and space scales that often yield fundamental scientific discoveries. For example, initial studies of the midwater section of the water column known as the twilight zone, enabled by new technologies, suggest that the biomass of fish in the twilight zone may be more than in all the rest of the ocean combined. The dark and cold ocean twilight zone is one of the least understood environments on the planet despite its importance to ecosystem services, including supporting ocean food webs and commercial fisheries, and transferring carbon dioxide to the deep ocean. Advancing scientific campaigns to answer questions about underexplored areas such as the twilight zone will propel ocean S&T into the next frontier.

Managing ocean S&T innovation is a long-term pursuit that requires both collaboration and the development of new methodologies and technologies. There is, however, a need for balancing short-term research efforts to address immediate needs or potential concerns, with long-term research and development efforts to understand the fundamental ocean system and inform major challenges and decision-making. As technologies advance and research priorities shift, it is important to ensure that a balanced approach is taken between longer-term goals and areas of immediate opportunities, such as deep water mapping.

***4.1 Identify Science and Technology Needs in Mapping, Exploration, and Characterization.***

The development of ocean mapping, exploration, and characterization standards and protocols will characterize the current state of the art for ocean technologies, and define the need for specific technologies and their application. New and emerging technologies may also be able to support the acquisition of additional kinds of information, and significantly improve current standards for accuracy and resolution. In addition, new technologies may provide opportunities to efficiently acquire data that have value beyond the immediate objectives of current mapping, exploration, and characterization activities.

For example, autonomous systems are continuously becoming smaller, more affordable and reliable, more energy independent,[18] and deployable for longer missions. Additionally, computing power is being applied to inform expedition planning, make real-time mission decisions, and analyze and visualize data; artificial intelligence and machine learning are being incorporated into autonomous vehicles and big data applications.[19] Identifying information needs and the technologies capable of addressing them will assist the government, private industry, academia, non-governmental organizations, and other stakeholders in guiding investments into new and emerging technologies.

The Council will develop and maintain a portfolio of S&T advancements that would improve the efficiency or performance of ocean observations and describe their potential applications. This portfolio can be used to guide and inform prioritizing investments in technology by the Federal Government and non-government partners. The Council will ensure that technical challenges are communicated across the government and to the broader public as they arise. The Council will produce the initial portfolio outlining S&T needs within 1 year and provide periodic reevaluations. [Timeline: Ongoing. Responsibility: Council]

18 An initiative by the Department of Energy (DOE) called "Powering the Blue Economy" looks at opportunities for marine renewable energy in maritime More information is available at: https://www.energy.gov/eere/water/powering-blue-economy-exploring-opportunities-marine-renewable-energy-maritime-markets

19 For example, NOAA recently released four new S&T strategies on unmanned systems, artificial intelligence, 'omics, and cloud computing to guide transformative advancements in the quality and timeliness of NOAA's services. More information is available at: https://nrc.noaa.gov/NOAA-Science-Technology-Focus-Areas

***4.2 Support Development, Testing, Deployment, and Use of New Technologies.***

Performance testing and evaluation is a proven and essential process that necessarily precedes operational use to clarify and validate design specifications. This includes calibration of key instruments or sensors, evaluation of alternative configurations and payloads, and field trials to monitor overall vehicle-plus-sensor system performance. This process may also include simultaneous testing of multiple platforms in combination with traditional data collection methodologies, such as ships, to compare results, and may be conducted in partnership with other Federal agencies or non-Federal partners and stakeholders.

Through traditional contract and grant mechanisms, including those focused on small business and innovation, Federal agencies will support the development and transition of emerging marine observing technologies and applications. Agencies may also consider offering prizes or proposing challenges that will engage the private sector and the general public in the development of new technologies to solve ocean mapping, exploration, and characterization challenges. Past examples have led to significant improvements in mapping without the use of ships and current examples seek to integrate marine renewable energy with ocean observation platforms to allow for a longer duration or sustained data collection.

Agencies may use frameworks, proving grounds, and testbeds to conduct testing of advanced operations, services, and S&T capabilities that address the needs of users across the ocean community. Where appropriate, Federal agencies can enter into cooperative research and development agreements with non-Federal entities to support at-sea testing of existing technologies or those under development to assess operational readiness and provide mission-focused feedback to external partners. Incorporation and use of these new or emerging technologies during ocean mapping, exploration, and characterization activities may enhance the overall objectives of the campaign, accelerate private sector innovation, spur further innovation and discovery, and create a market for commercially developed technology applications. [Timeline: Ongoing. Responsibility: OPC agencies]

***4.3 Support Partnerships with Organizations that are Promoting, Investing in, or Developing Ocean Methodologies, Technology, and Applications.***

The United States has a robust ocean S&T industry that is organized into thematic and regional groups, supported by numerous professional societies and coordinated through local, regional, and national alliances. In all cases, these groups seek to promote awareness of the United States and international development in marine S&T, support information sharing, and facilitate cross-sectoral dialog among leaders of government and non-governmental institutions and their members. Engagement with these groups is essential to the success of this Strategy and will be used to address the methodology, technology, and application development on the needs identified in Section 4.1. Agencies will regularly engage in and support these groups to better understand the landscape of domestic and international methodology and technology developments, improve communication and coordination across sectors, and encourage partnerships aimed at advancing the methodologies and technologies required to map, explore, and characterize the United States EEZ, and to maximize the use of the resulting data. [Timeline: Ongoing. Responsibility: OPC agencies]

### *Goal 5: Build Public and Private Partnerships to Map, Explore, and Characterize the United States EEZ*

Developing a comprehensive understanding of the United States EEZ is a national goal, and it will require a national effort to accomplish. Under this Strategy, Federal agencies will support and motivate the mapping, exploration, and characterization enterprise to advance economic, and environmental, and national security objectives, consistent with agency missions. However, the coordinated and sustained participation of non-Federal partners is critical to accomplishing this goal.

Building and maintaining partnerships in ocean S&T is a national priority, as articulated in Executive Order 13840, the Administration's ocean S&T priorities report,[20] and the Presidential Memorandum. In November, 2019, OSTP and the CEQ hosted The White House Summit on Partnerships in Ocean Science and Technology.[21] The Summit brought together over 100 leaders from the Federal government, the private sector, academia, and philanthropy to discuss opportunities for partnerships and how to collaboratively apply S&T for the conservation, management, and balanced use of America's oceans. The Presidential Memorandum underscored the importance of that discussion by stating, "to ensure that these [ocean mapping, exploration, and characterization] activities produce the broadest possible benefits and provide the greatest return on investment of Federal resources, it is the policy of the United States to support these activities, when appropriate, in collaboration with non-United States Government entities."[22]

#### *5.1 Maximize Opportunities for Non-Federal Participation.*

This Strategy provides a framework for coordinated efforts among Federal and State agencies and private industry, academia, and non-governmental organizations. There are a variety of mechanisms that will be used to enhance the planning, coordination, and successful implementation of mapping, exploration, and characterization activities within the United States EEZ. These include:

- *Cross-agency partnerships*: Interagency committees and working groups, such as the IWG-OCM, IWG-OEC, and the NOPP, support coordinated ocean and coastal mapping, exploration, and characterization activities as well as associated technology development across the Federal government.
- *Utilization of Federal platforms*: Federal vessels, including those from National Science Foundation (NSF)-funded research vessel fleet, the NOAA fleet, the United States Coast Guard (USCG) ice breakers, United States Navy oceanographic ships, the United StatesAcademic Research Fleet and industry partners, have the capabilities for mapping, exploration, and characterization and have successfully completed these missions. The NOAA Ship Okeanos Explorer is the only federally owned and operated vessel dedicated to ocean exploration. Dedicated platforms may also include current and planned satellites from NOAA, the United States Geological Survey (USGS), and the National Aeronatics and Space Administration (NASA), as well as from international and commercial satellite providers.
- *Multi-sector Partnerships*: Academic and non-profit institutions and cooperative institutes provide the expertise for ocean and coastal mapping, exploration, and characterization. These partnerships provide access to a wealth of ocean exploration resources, including ships, autonomous and remotely operated vehicles, expertise, and opportunities for technology testing and development.

20 Science and Technology for America's Oceans: A Decadal Vision, Subcommittee on Ocean Science and Technology, National Science and Technology Council, November 2018.
21 Ocean Policy Committee. 2019. Summary of the 2019 White House Summit on Partnerships in Ocean Science & Technology. https://www.whitehouse.gov/wp-content/uploads/2019/11/Ocean-ST-Summit-Readout-Final.pdf
22 See Presidential Memorandum of November 19, 2019 on "Ocean Mapping of the United States Exclusive Economic Zone and the Shoreline and Nearshore of Alaska," Sec. 1.

Multi-agency and multi-sector partnerships can be employed through existing mechanisms such as Federal contracts, competitive grants, and cooperative research and development agreements (CRADAs). Agencies will increase their use of commercial ocean mapping contracts and encourage close engagement with the NOPP and other partnership mechanisms. [Timeline: Ongoing. Responsibility: OPC agencies]

***5.2 Foster Cross-Sector Engagement.***

The Council will convene an annual ocean mapping and exploration forum among Federal agencies, State, territorial, tribal, private industry, academic, non-governmental organizations, and private constituents with diverse backgrounds, sectors, and interests. The forum will strengthen existing relationships, encourage new partnerships, and promote better communication and sharing of expertise and knowledge. As appropriate, the Council will also engage with the ocean community at regional settings across the country such as convening Town Hall sessions at relevant societies, conferences, and scientific and technical gatherings. Interaction is a critical component of maintaining an open dialogue with stakeholders and relevant sectors in advancing ocean mapping, exploration, and characterization.

Partnerships provide an opportunity for multiple sectors to align the strengths of their respective agency or organization to achieve results that cannot be accomplished individually. To be successful, partners require a platform to communicate and strengthen the understanding of each other's interests and capacities. The Council will provide direction for enterprise partnerships among Federal agencies and private industry, academia, and non-governmental organizations. Executing this objective will require the Council to:

- Promote mechanisms to strengthen collaboration between Federal and non-Federal stakeholders;
- Conduct interdisciplinary exploration activities to meet national priorities efficiently, expeditiously, and cost-effectively;
- Advance and make available new exploration technologies, techniques, and approaches that may benefit the national community;
- Accelerate the private or non-Federal development and use of assets, infrastructure, platforms, and innovative approaches to complement existing assets and capabilities of Federal agencies;
- Advance processes for ocean exploration data management, access, synthesis, and visualization that all sectors can benefit from; and

Support the use of NCEI as a primary, centralized repository for ocean exploration data obtained through publicly funded activities, and the use of the Smithsonian Institution and other publicly accessible repositories for biological and geological samples.

[Timeline: 2-years. Responsibility: OPC]

***5.3 Inspire and Involve the Public.***

An inclusive science, technology, education, and mathematics (STEM)-literate and ocean-literate workforce that is prepared for the future is fundamental to ocean innovation and for the Nation to best harness the potential benefits gained from this Strategy.

The expected increase in mapping, exploration, and characterization activity in support of this Strategy will also support job growth in many supporting sectors. New technology will not be useful without trained operators and technicians. Agencies should take every opportunity to communicate the importance of ocean S&T and the potential for STEM careers in this field. Agencies should support educational outreach programs and grants that encourage the advancement and participation of underrepresented groups in ocean S&T. Community and technical colleges can help expose a more diverse body of students to job opportunities in the blue workforce. Special degree programs geared toward ocean work, hands-on experience, and professional development offered through these institutions can prepare students for marine occupations, including marine forecasters, ocean instrument technicians, scholars, and underwater remotely operated vehicle (ROV) developers. Continued investments in outreach and STEM-education is critical for ensuring United States leadership and that the next generation of Americans remains competitive in the growing international field of ocean S&T.

Federal agencies will take action to expand the reach of existing ocean mapping, exploration, and characterization partnerships focused on disseminating results to all sectors and communities. Agencies will also promote and strengthen educational and professional development communities of practice relevant to ocean mapping, exploration, and characterization. Agencies will increase opportunities for individuals from under-represented groups, undergraduate and graduate students, and early career professionals to participate in Federal and non-Federal ocean exploration activities. Special consideration will be given to Alaska Native Organizations[23] in order to minimize potential conflicts with subsistence and cultural activities. For example, mapping, exploration, and characterization activities will avoid bowhead whale migration and other important subsistence time periods. [Timeline: Ongoing. Responsibility: All Federal agencies]

**Conclusion**

The United States EEZ represents one of the largest ocean and coastal shorelines in the world, and the knowledge gathered from mapping, exploring, and characterizing our EEZ is essential to advancing America's economic, security, and environmental interests. This Strategy provides a roadmap for Federal agencies, in partnership with other sectors and the ocean community broadly, to comprehensively map, explore, and characterize the United States EEZ, and identifies five goals and supporting objectives that will guide the Nation's efforts to do so.

These goals and objectives were designed to advance global leadership of the United States in ocean S&T, unleash discovery and innovation within the ocean S&T enterprise, and support stewardship of our oceans to advance the Nation's economic, security, and environmental interests. The success of this national Strategy requires an engaged, informed, and coordinated ocean community pursuing a concerted effort to advance ocean S&T and improve the application of that understanding for the benefit of the Nation. The information gathered through this collaborative effort will expand the Nation's ocean S&T enterprise, build ocean industries, and bolster conservation efforts.

Successful implementation of this Strategy depends on two key factors: the development of new and emerging S&T that will allow us to accelerate ocean data collection, and partnerships with non-Federal entities who will contribute their efforts to this important national goal. Without both of these factors,

23 For the purposes of the Strategy, "Alaska Native Organizations" includes Alaska Tribes, Alaska Native Corporations, Alaska Native Consortia, and Alaska Native Co-Management Organizations.

it may not be possible to accomplish mapping of the entire United States EEZ and the exploration and characterization of priority areas within a reasonable timeframe

Accordingly, it is critical that Federal agencies and non-Federal partners prioritize the development of new and emerging technologies to accelerate data collection and pursue partnerships to achieve the Strategy's objectives. The successful implementation of this Strategy requires coordination and collaboration among mapping, exploration, and characterization efforts across Federal agencies and among private industry, academia, and non-governmental organizations.

By implementing this Strategy, the United States will dramatically increase our understanding of the Nation's EEZ and ocean resources, enhance our economic competitiveness, strengthen our national security, protect our environment, and preserve continued prosperity.

# Marine geospatial information management

## Annex III

2024

United Nations

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# ANNEX III: MARINE GEOSPATIAL INFORMATION MANAGEMENT – INTERGOVERNMENTAL ORGANIZATIONS

# CONVENTION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE NORTH-EAST ATLANTIC (OSPAR COMMISSION)

**Authored by**: Eleanor Dening and Chris Moulton, OSPAR Commission Secretariat Data Department

The Commission for the Protection of the North-East Atlantic (OSPAR Commission ("OS" for Oslo and "PAR" for Paris)) is the mechanism by which 15 Governments and the European Union cooperate to protect the marine environment of the North-East Atlantic.

In addition to the 15 Governments[1] and the EU, OSPAR has a number of Observer Organisations which include other intergovernmental organisations working in similar fields, and international non-governmental organisations. The non-governmental observer organisations are environmental protection and nature conservation organisations, industry and trade organisations and organisations of regional and local authorities.

The geographic scope of interest of the organisation is the North-East Atlantic which OSPAR divides into the following five Regions; Region I Arctic Waters, Region II Greater North Sea, Region III Celtic Seas, Region IV Bay of Biscay and Iberian Coast and Region V Wider Atlantic. The Maritime Area means the internal waters and the territorial seas of the Contracting Parties, the sea beyond and adjacent to the territorial sea under the jurisdiction of the coastal state to the extent recognised by international law, and the high seas, including the bed of all those waters and its sub-soil, situated within the following limits:

1. those parts of the Atlantic and Arctic Oceans and their dependent seas which lie north of 36° north latitude and between 42° west longitude and 51° east longitude, but excluding:

    a. the Baltic Sea and the Belts lying to the south and east of lines drawn from Hasenore Head to Gniben Point, from Korshage to Spodsbjerg and from Gilbjerg Head to Kullen,

    b. the Mediterranean Sea and its dependent seas as far as the point of intersection of the parallel of 36° north latitude and the meridian of 5° 36' west longitude;

2. that part of the Atlantic Ocean north of 59° north latitude and between 44° west longitude and 42° west longitude.

https://www.ospar.org

https://odims.ospar.org/en/

https://oap.ospar.org/

1 Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') was opened for signature at the Ministerial Meeting of the Oslo and Paris Commissions in Paris on 22 September 1992. It was adopted together with a Final Declaration and an Action Plan. In this decade, the Convention will be implemented through OSPAR's North-East Atlantic Environment Strategy 2030. It is according to the Strategy that allows the legislative administrative and policy framework mandating the marine geospatial information collection, coordination, standardization management and/or dissemination activities. Specifically, Part I Section 5;

> *We will ensure that data collection and assessment programmes are kept under continuous review, so they are up to date and fit for purpose as both technology and our understanding of the marine environment develop. Monitoring and assessment of the marine environment require the effective use and management of data and information to support the production of robust assessments. This will be achieved through the OSPAR Data and Information Management System (ODIMS) and the OSPAR Assessment Portal (OAP), allowing links to be made with other providers and consumers of OSPAR data and information. We are committed to ensuring that the data we use are findable, accessible, interoperable, reusable and reproduceable.*

OSPAR's Joint Assessment & Monitoring Programme (JAMP) provides the strategic direction to the preparation of assessments of the implementation of the North-East Atlantic Environment Strategy.

The OSPAR JAMP sets out that, "The monitoring data and information generated by OSPAR through its coordinated environmental monitoring activities form the basis for assessment of the state of the OSPAR Maritime Area". These include the Intermediate Assessment 2017 and the Quality Status Report. Such data and information should be "gathered in accordance with agreed OSPAR guidelines and procedures" and thus be "comparable across the breadth of the OSPAR Maritime Area".

The questions identified in the JAMP are addressed in coherent assessments that are developed by using OSPAR's Coordinated Environmental Monitoring Programme (CEMP). The aim of the CEMP is to deliver comparable data from across the OSPAR Maritime Area through providing a coordinated approach to monitoring, data collection and assessment activities. The CEMP Appendices set out details of the agreed monitoring and assessment approaches for each component of the themes including the approaches to be applied to realise coordination of monitoring and assessment.

The work of the OSPAR Commission is formally governed by the Rules of Procedure of the OSPAR Commission.

Work to implement the OSPAR Convention and its Strategy is taken forward through the adoption of Decisions, which are legally binding on the Contracting Parties, Recommendations and Agreements. Decisions and Recommendations set out

actions to be taken by the Contracting Parties. These measures are complemented by Agreements setting out:

- issues of importance;
- agreed programmes of monitoring, information collection or other work which the Contracting Parties commit to carry out;
- guidelines or guidance setting out the way that any programme or measure should be implemented;
- actions to be taken by the OSPAR Commission on behalf of the Contracting Parties.

The OSPAR Commission also issues publications comprising background documents, data reports and the results of evaluations and assessments of data reported to OSPAR by its Contracting Parties.

The OSPAR Commission is supported by the Coordination Group (CoG), Biodiversity Committee (BDC), Environmental Impacts of Human Activities Committee (EIHA), Hazardous Substances and Eutrophication Committee (HASEC), Offshore Industry Committee (OIC) and Radioactive Substances Committee (RSC). These bodies are in turn supported by Intersessional Correspondence Groups and Working Groups.

The Heads of the Delegations of the Contracting Parties meet regularly to prepare the meetings of the Commission, to advise on management and to oversee the development and implementation of the agreements made by the Commission. The Commission is also supported by meetings of the Group of Jurists and Linguists and the Committee of Chairs and Vice-Chairs.

Currently OSPAR is divided into the following work areas reflecting the different issues that OSPAR is addressing under its strategic and operational objectives under the NEAES 2030 and within each work area are Datastreams that Contracting Parties are obligated to report towards:

Biological Diversity and Ecosystems

- Abundance and Distribution of Cetaceans, Food webs, Habitats in the North-East Atlantic, Marine Birds, Marine Protected Areas Network, Non-Indigenous Species, Other Effective Area-Based Conservation Measures, Pelagic Habitats, Recovery of sensitive fish species and Vulnerable Marine Ecosystems.

Cross-cutting

- Quality Status Report, Marine Strategy Framework Directive, Joint Assessment & Monitoring Programme, Coordinated Environmental Monitoring Programme, Climate Change and Ocean Acidification, Economic and Social Analysis, Cumulative Effects Assessment, Ecosystem Approach, OSPAR Measures and Actions Programme, Science Needs Agenda, Environmental Protection of the Arctic, and Cross-sectoral Cooperation and International Engagement.

Environmental Impacts of Human Activities

- Dumping and Placement of Wastes or Other Matter at Sea, Encounters with Dumped Chemical and Conventional Munitions, Extraction of Marine Sediments, Fishing for Litter, Litter ingested by Sea Turtles, Marine Litter Beach Monitoring, Noise, Offshore Renewable Energy, Plastic Particles in the Stomachs of Seabirds and Seabed Litter.

Hazardous Substances and Eutrophication

- Eutrophication Status, Inputs of Heavy Metals, Inputs of Nutrients, Levels and Trends in Marine Contaminants and their Biological Effects and Riverine Inputs and direct Discharges (RID).

Offshore Industry

- Discharges, Spills and Emissions from Offshore Oil and Gas Installations and Inventory of Offshore Installations

Radioactive Substances

- Discharges of Radionuclides from the Non-Nuclear Sectors, Environmental Monitoring of Radioactive Substances and Liquid Discharges from Nuclear Installations.

The annual meeting of each Committee agrees to circulate data calls for Contracting Parties to report data on each Datastream before the next Committee meeting.

Contracting Parties implement the monitoring of components, according to CEMP Guidelines, through ongoing or specific national programmes coordinated within that country, national programmes coordinated on a regional or Convention-wide basis and programmes carried out by one or more supplier/contractor on behalf of the OSPAR Commission and paid for by Contracting Parties (including one-off surveys).

Contracting Parties report data either to the OSPAR Secretariat or to the relevant Data Manager, depending on the Datastream, the Data Manager could for example be an external organisation or Contracting Party. The data are reported according to reporting formats that are tailored to each Datastream (and published as OSPAR Agreements). The OSPAR Secretariat Data Team compile Contracting Parties' submissions or collaborate with the external data managers to ensure the data adheres to the relevant reporting format. This ensures the data are ready for sign off by the relevant Committee meeting then the data can be forwarded to the OSPAR Commission meeting to be agreed for publication via ODIMS.

The data agreed by the annual Commission meeting are published in ODIMS. Each submission in ODIMS usually comprises a Shapefile that is styled and presented as an interactive map in the portal. A submission could also be a spreadsheet or other data format. Supplementary INSPIRE compliant metadata is created for each submission. The OSPAR Secretariat collaborates with external data managers to ensure that data are interoperable within the OSPAR data environment as well as findable via the central data management system, utilising webservices insofar as possible (examples include the OSPAR Marine Protected Area database, and Impulsive Underwater Noise Registry). Leveraging the functionality provided by webservices, ODIMS has the

capacity to seamlessly display externally managed data directly in ODIMS allowing all content to be presented in parallel, ensuring users are receiving the most accurate data.

There is an abundance of international cooperation required through the exchange of OSPAR data. This applies throughout the data lifecycle: from the submission through to the reuse of data. The data OSPAR produces and presents via ODIMS feeds directly into other international mechanisms, for example the International Atomic Energy Agency Marine Radioactivity Information System (MaRIS), EMODnet data portals, and a multiude of other tools, systems, and reports, made possible as OSPAR data are licensed according to Creative Commons Zero.

In line with the NEAES, OSPAR Data follows the FAIR principles, ensuring that the data are findable, accessible, interoperable and reusable.

ODIMS is an online tool which provides a single point of access to all the data and information gathered through OSPAR's Joint Assessment and Monitoring Programme. The data is uploaded, amended and managed in an administrative interface by the OSPAR Secretariat.

All the code that runs ODIMS is based on Django and Python, with REST API. Geoserver and Geoportal provide the OGC mapping and metadata webservices respectively.

AWS is used to store the uploaded files in ODIMS.

OSPAR Commission website - https://www.ospar.org/

OSPAR Data and Information Management System - https://odims.ospar.org/en/

OSPAR Assessment Portal - https://oap.ospar.org

# OSPAR Assessment Portal and OSPAR Data and Information Management System's role in delivery of the OSPAR Quality Status Report 2023

1.1.1 https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/

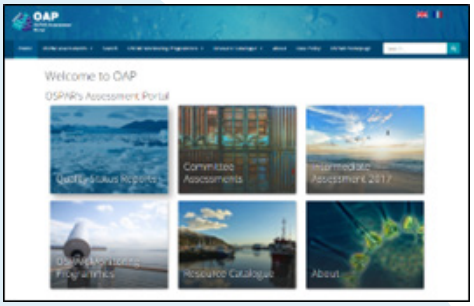
1.1.2 https://odims.ospar.org/

1.1.3 https://oap.ospar.org/

The OSPAR Assessment Portal (OAP) and the OSPAR Data and Information Management System (ODIMS) are two key tools in the dissemination and management of OSPAR data and information. The tools played a critical role in the delivery of the OSPAR Quality Status Report 2023 (QSR 2023).

OSPAR's Quality Status Report 2023 is a comprehensive assessment of the environmental health and status of the North-East Atlantic Ocean and of human activities interacting with it.






The report is made up of more than 120 assessments and covers various aspects, including, biodiversity, habitats, and human activities that impact the marine environment. It examines the presence of contaminants and pollutants in the water, such as chemicals and microplastics, and assesses their potential effects on marine life and ecosystems.

Additionally, the report evaluates the status of different marine species, from fish and seabirds to mammals and plants. It looks at population, distribution, and trends, identifying any changes or threats to these species. This information helps scientists and policymakers understand the overall health and resilience of the oceanic ecosystem.

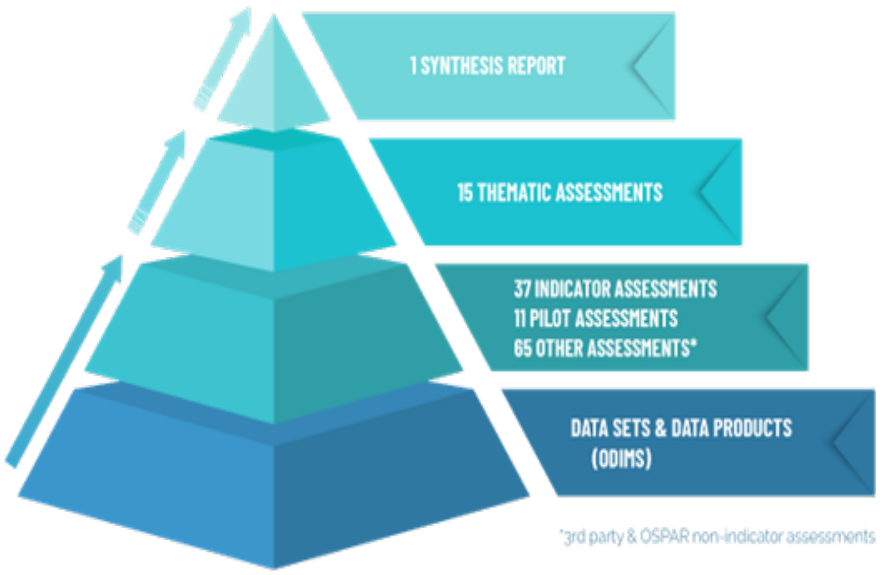
Another crucial aspect addressed in the QSR 2023 is the impact of climate change and ocean acidification on the marine environment. It examines the changes in ocean

temperature, acidity, and sea-level rise, among other factors, and assesses their effects on marine life and ecosystems.

Overall, the QSR 2023 serves as an important tool for scientists, policymakers, and the public to understand the current state of the North-East Atlantic Ocean, the challenges it faces, and the measures needed to ensure its long-term health and sustainability.

Underpinning the Quality Status Report 2023 is a huge amount of data, shown at the base of the pyramid below:

These data are the result of years of work from a huge number of people, to define, collect, administer, prepare and analyse. The data are hosted in the OSPAR Data and Information Management System (ODIMS) https://odims.ospar.org/ and made available in accordance with the OSPAR Rules of Procedure which states:




> *"OSPAR is committed to making as much information as possible publicly available, consistent with achieving other similarly important goals of public policy. The framework for this is set out in Article 9 of the OSPAR Convention."*

Following this, OSPAR data made available for download via ODIMS, are licensed according to Creative Commons Zero, https://creativecommons.org/publicdomain/zero/1.0/. Further information is available via the OSPAR Data Policy, https://odims.ospar.org/en/data_policy/

The information presented via the OSPAR Assessment Portal (OAP) is also made available in accordance with the OSPAR Rules of Procedure. Following this, information

presented in OAP are licensed according to Creative Commons BY-4.0, https://creativecommons.org/licenses/by/4.0/.

### 1.1.4 Background: The Role of ODIMS and OAP in OSPAR's work

The OSPAR Data and Information Management System was developed as an online tool providing a single point of access to all the data gathered through OSPAR's Joint Assessment and Monitoring Programme (JAMP) as well as being critical in delivering the Monitoring and Assessment element of the North-East Atlantic Environment Strategy 2030 (NEAES, https://www.ospar.org/convention/strategy).

The JAMP describes the strategy, themes and products that OSPAR Contracting Parties are committed to deliver, through collaborative efforts in OSPAR, across the different thematic work areas of the Convention.

With an increasing level of detail on the actions and process, underneath the JAMP is the Coordinated Environmental Monitoring Programme (CEMP). The CEMP details the overall aims and concepts of delivering comparable data from across the OSPAR Maritime Area, which can be used in assessments to address the specific products raised in the JAMP.

Each element of the CEMP should also have a CEMP Guideline providing detailed documentation of agreed monitoring and assessment methods. In order to collect data to align with the monitoring and fulfil the assessment methods, detailed reporting formats and associated guidance documentation are also drafted that are utilised by Contracting Parties in responding to OSPAR Data Calls.

At the end of this process, data sets and associated assessment products are published via ODIMS and OAP. Having the NEAES Strategy, JAMP, CEMP, CEMP Guidelines and reporting formats as underpinning information allows for the creation of a transparent, robust and reliable monitoring and assessment process. This background structure enables assessments of extended geographic areas and timescales, such as the QSR 2023, to be completed.

To date, ODIMS contains over 900 individual data submissions, from 42 data streams (https://odims.ospar.org/en/datastreams/). Data are from the full complement of OSPAR thematic areas; including, data on environmental pressures, environmental status, area-based management, and measures. Not all data are managed by the Secretariat and ODIMS allows for connection to external data managers via compliant webservices. All spatial data can be overlaid by the user to create individual custom maps.

Another benefit is the reuse of the data and information. As the collection and structure methods are detailed, the content can be widely and reliably reused. An example of this is the integration of QSR2023 assessments in Member State reporting under European Directive 2008/56/EC - Marine Strategy Framework Directive (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32008L0056).

# CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

## ANNEX

### Contribution from the Secretariat of the Convention on Biological Diversity to DOALOS publication on marine geospatial information management May 2023

*Executive Summary*

This note summarizes recent work under the Convention on Biological Diversity (CBD) relevant to marine geospatial information management, focusing on the process for describing ecologically or biologically significant marine areas (EBSAs).

The CBD Secretariat coordinates the global process to facilitate the description of EBSAs. Since 2011, the Secretariat has coordinated a series of regional workshops to facilitate the description of EBSAs. As a result of these 15 workshops, 338 areas meeting the EBSA criteria have thus far been entered into the EBSA repository and transmitted to the UN General Assembly and its relevant processes. The Parties to the CBD continue to consider potential modalities for the modification of the description of existing EBSAs and for the description of new EBSAs. In the meantime, the Secretariat continues to support Parties, Other Governments and competent organizations in using EBSA information and working to enhance the capacity of Parties to describe EBSAs and use them to inform planning and management.

*Background on the EBSA process*

The term "ecologically or biologically significant marine area" or "EBSA" first appeared in the context of the Convention on Biological Diversity (CBD) in 2006, when the Conference of the Parties (COP) to the CBD decided to convene a scientific expert workshop to:

> "refine and develop a consolidated set of scientific criteria for identifying ecologically or biologically significant marine areas in need of protection, in open ocean waters and deep sea habitats, building upon existing sets of criteria used nationally, regionally and globally" (para 44b, decision VIII/24).

The Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection was convened the following year (2007) in the Azores, Portugal. Experts considered more than 20 different sets of national and

international criteria, including those of the FAO and IMO. Distilling common elements from various existing criteria sets and experiences in biogeographical and ecological classification systems, the workshop drafted a set of proposed CBD scientific criteria for identifying EBSAs: https://www.cbd.int/doc/meetings/mar/cbwsoi-wafr-01/other/cbwsoi-wafr-01-azores-brochure-en.pdf.

*The Scientific Criteria for Identifying Ecologically or Biologically Significant Marine Areas in Need of Protection in Open-Ocean Waters and Deep-Sea Habitats*, which have come to be known as the "EBSA criteria", were adopted by the Conference of the Parties at its ninth meeting, in 2008 (decision IX/20). The CBD EBSA criteria are as follows:

1. Uniqueness or rarity
2. Special importance for life history of species
3. Importance for threatened, endangered or declining species and/or habitats
4. Vulnerability, fragility, sensitivity, slow recovery
5. Biological productivity
6. Biological diversity
7. Naturalness

More information on the criteria, including a definition, rationale, examples and guidance on how they should be applied, is available in the annex to decision IX/20.

At its next meeting, in decision X/29 (2010), the COP noted that the application of the EBSA criteria is a scientific and technical exercise, that areas found to meet the criteria may require enhanced conservation and management measures, and that this can be achieved through a variety of means, including marine protected areas and impact assessments. The COP also emphasized that the identification of EBSAs and the selection of conservation and management measures is a matter for States and competent intergovernmental organizations, in accordance with international law, including the United Nations Convention on the Law of the Sea.

To support Parties in their efforts to identify EBSAs, the COP, in the same decision, requested the CBD Secretariat to organize a series of regional workshops, in collaboration with Parties and other Governments as well as competent organizations and regional initiatives, such as regional seas conventions and action plans and regional fisheries management organizations.

This inclusive, science-driven process has led to the identification and description of areas of the ocean that are among the most crucial to the healthy functioning of the global marine ecosystem. As a result of the regional 15 workshops held between 2011 and 2019, 338 areas have been identified as EBSAs in regions covering nearly the entire global ocean. These EBSAs incorporate every type of marine ecosystem and cross all ocean basins, except for the Southern Ocean and Antarctic ecosystems.

The regions covered appear below chronologically, together with some selected examples of the features described for each, for illustrative purposes only (further information is available in the corresponding workshop reports, available at www.cbd.int/ebsa):

- **Western South Pacific Ocean:** Equatorial high-productivity zone, with high primary production over a large area; high aragonite saturation zone (special biological and ecological value under conditions of ocean acidification); submarine canyons, seamounts, ridges, trenches, archipelagos; important

coral reefs; seabirds; important whale migration corridors; endemic fish species; cold-water corals and deep-sea species; biodiversity hotspots;

- **Wider Caribbean & Western Mid-Atlantic Ocean**: high diversity of corals and fish of the Mesoamerican Barrier Reef; pelagic and benthic ecosystems of the Sargasso Sea; high productivity of the Amazonian – Orinoco influence zone; major oceanographic and seafloor features of the Atlantic Equatorial fracture zone;
- **Southern Indian Ocean**: high productivity and high pelagic and benthic habitat heterogeneity of the Agulhas Current ecoregion; unique oceanographic features of the Mozambique Channel, producing a highly productive, highly biodiverse ecosystem, including many threatened and endangered; "East African Coral Triangle", second in biodiversity to the Coral Triangle
- **Eastern Tropical & Temperate Pacific Ocean**: areas containing endemic species, such as the Galapagos Archipelago, offshore aggregation area of great white sharks ("White Shark Café"); nutrient-rich, highly productive upwelling systems, including the Costa Rica Thermal Dome; equatorial high productivity zone;
- **North Pacific Ocean**: high productivity of the North Pacific Transition Zone; seamounts; hydrothermal vent fields; high productivity and biodiversity of the West Kamchatka shelf; polynya system along the Chukotka coast; upwelling systems in the Sea of Okhotsk and off the Alijos and Coronado islands (California Current);
- **South-Eastern Atlantic Ocean**: three large marine ecosystems: Benguela current, Guinea current and Canary current, giving rise to such areas as Benguela Upwelling System and Guinea-Canary currents convergence area; Subtropical Convergence Zone; Mid-Atlantic Ridge; Walvis Ridge (seamounts); Namaqua Fossil Forest;
- **Arctic Ocean**: The marginal ice zone and the seasonal sea-ice habitat for endemic and vulnerable species; dynamic multiyear ice; high productivity and high benthic biomass of the Barents Sea large marine ecosystem, including key habitat for walrus; critical seabird habitats and wintering areas; polynyas;
- **North-West Atlantic Ocean:** seamount chains; hydrothermal vents; the Southeast Shoal / Flemish Cap, Flemish Pass and Orphan Knoll; Labrador Sea deep convection area; transition zone front; seabird foraging areas; deepwater canyons;
- **Mediterranean Sea:** Coastal seagrass meadows, trenches and seamounts, diverse benthic and pelagic habitats, underwater caves, spawning and nursery zone for important demersal and pelagic resources (e.g., bluefin tuna); upwellings, cold-water coral and deep-sea sponges; red coral; important habitats for megafauna and deep-sea species; abundant marine mammals due to high primary productivity; endangered migratory seabirds (e.g., Balearic shearwater), sharks and endemic fish (Maltese skate);
- **North-East Indian Ocean:** Bay of Bengal Large Marine Ecosystem, including shallow shelf, slope, deep abyssal and offshore ridge system and unique biophysical conditions, as well as a highly productive marine ecological system containing a wide range of highly valuable, species-rich and diverse ecological systems; mangrove forests, shallow and deep-sea coral, high diversity of seagrass beds; canyon systems; small- and medium-sized pelagic fishes; diverse range of marine animals, including groups of endangered species (e.g., cetaceans, including

non-migratory blue whales, seabirds, sea turtles, sea snakes, fish, dugongs, whale sharks, manta rays, gastropods, sea cucumbers, sponges, sea fans and corals);

- **North-West Indian Ocean and Adjacent Gulf Areas:** diverse deep-sea and shallow-water coral beds; large population of dugongs; endemic subspecies of avifauna; hawksbill nesting sites; resident population of Indo-pacific humpback dolphin; highly biodiverse mangrove communities; seagrass and algal beds; high seabird and fish diversity; significant feeding, breeding and nursery grounds for sea turtles, waterbirds, dolphins, reef fishes, sharks, rays and skates; feeding areas for marine megafauna (e.g., baleen whales, whale shark, mobulids and sunfish); unique ecology of the Arabian Sea Oxygen Minimum Zone; highly productive areas, including an upwelling region resulting from "the Great Whirl" and associated eddies and gyres;
- **East Asian Seas:** Network of 20 sites in a flyway of 100+ migratory waterbird species; extremely high biodiversity and endemism of Sulu-Sulawesi Marine Ecoregion—in the centre of the world's highest concentrations of marine biodiversity (Coral Triangle); areas of high biological productivity and diversity (e.g., seagrass, kelp); globally high levels of fish biodiversity; major spawning area for bluefin tuna; unique set of 2400 limestone islands and islets with very high habitat and ecosystem diversity; only known spawning area of the Pacific bluefin tuna; turtle nesting areas; high coastal productivity from the warm Kuroshio Current; complex and unique convection zone where it mixes with the cold Oyashio Current, creating one of largest fishing grounds in the world; trenches, troughs and seamounts with hydrothermal vents and hydrocarbon seeps hosting endemic, very rare, vulnerable species;
- **Black and Caspian Seas**: globally unique habitats created by river deltas; habitat for endangered Black Sea cetaceans (e.g., bottlenose dolphin, harbour porpoise); Caspian seal (the only marine mammal in the Caspian Sea); regionally rare red algae (Phyllophora crispa); globally threatened seabird species; Important Bird and Biodiversity Areas; important nursery and feeding areas for sturgeon species, critically endangered globally; phyllophora fields, which support more than 110 species of invertebrates and 47 species of fish; seagrass beds;
- **Baltic Sea**: high diversity of endemic and endangered aquatic plants; complex archipelago area, with islands and skerries, and different types of waters (enclosed lagoons to large open-sea areas); deep, oxygenated trenches; habitat of endangered Baltic ringed seal (sea ice) and critically endangered harbour porpoise; highly productive waters in lagoons, inlets and bays with high numbers of macrophytes, invertebrates, waterfowl and fish; habitats important for various life-history stages of fish, invertebrates and birds (e.g., coastal lagoons, large shallow inlets and bays, estuaries, wetlands, Boreal Baltic narrow inlets, outer skerries and sea ice);
- **North-East Atlantic and Adjacent Areas**: structurally complex seabed habitats; hydrothermal vent fields, seamount complexes and large submarine canyons; Charlie-Gibbs Fracture Zone (unique geomorphological feature to the region); Mid-Atlantic Ridge; globally significant deep-water, cold-water corals; rich communities of unique and endemic fauna; fragile cold-water corals, sponge aggregations

and deep-water vulnerable fish; upwellings with high pelagic productivity; pelagic-feeding bird species; "bubbling reefs"; areas of complex hydrology; persistent presence of cetacean populations; seasonal migratory pathway for large migratory pelagic species; Mid-North-Atlantic Frontal System;

***How shapefiles are created during the workshop***

The COP emphasized that the application of the EBSA criteria is a scientific and technical exercise and that it should use the best available scientific and technical information, integrating the traditional, scientific, technical and technological knowledge of indigenous and local communities. In order to do so, these regional workshops have engaged a range of experts from governments, global and regional organizations, academia and civil society, catalyzing partnerships and building capacity.

The data on which the EBSA process relies is made available by:

- **A technical team**: Each regional workshop conducted to date has been supported by a technical team from either the Commonwealth Scientific and Industrial Research Organisation (Australia) or Duke University Marine Geospatial Ecology Lab (United States of America). The technical teams have used a consistent approach: prior to each regional EBSA workshop, they develop a detailed data report synthesizing regional ocean data and identifying strengths and gaps in the knowledge base. These data reports compile three general types of data:
    - **Biogeographic data** (major biogeographic classification systems)
    - **Biological data** (data and statistical indices compiled by the Ocean Biogeographic Information System)
    - **Physical data** (bathymetric and physical substrate data, oceanographic features and remotely sensed data) that can be used as surrogates; this includes seamounts, vents and seeps, geology, climatologies, remotely observed data and derived oceanographic products,

These datasets, which include 70 to 100 GIS layers, are generally sourced from internationally accessible sites. The data tend to be large-scale: global or regional in nature, providing a consistent core of base environmental conditions across the workshops.

- **CBD Parties and relevant organizations**: A call for information to support the objectives of the workshops is also sent out to all CBD Parties and relevant global and regional organizations/initiatives prior to the workshop, in the hope that they can identify critical regional data sets and analyses that can supplement the larger-scale efforts of the technical team. This can be ecological and biological data and/

or traditional knowledge on marine ecosystems, habitats and species, and/or physical/oceanographic/geological data and/or traditional knowledge. This information is often integrated into the data report compiled and made available by the technical team (see above).

- **Experts attending the workshop**: Workshop participants include experts nominated by governments, intergovernmental organizations (including regional organizations), non-governmental organizations, academia, research institutions, and indigenous peoples and local communities (IPLCs). They are selected based on their scientific knowledge of the given region and their access to relevant ecological and biological data on marine ecosystems, habitats and species, and/or physical, oceanographic and geological data. They often bring scientific data/literature to the workshops to supplement the data brought by the technical team. In many cases, the scientific and technical information they provide is at a local level, as opposed to a global/regional level, with a finer level of detail than that provided by the technical team. These experts are also asked to fill in an EBSA template to describe in detail any area they believe meets the EBSA criteria. They may send in these templates prior to the workshop or complete them during the workshop.

The process for describing areas meeting the EBSAs criteria is based on expert knowledge available at the workshop, as well as data compiled prior to the workshop. Many of the workshops have benefitted from the participation of an expert nominated by IPLCs, with a view to integrate their traditional knowledge in the EBSA description process. The approach is therefore based on available data and expert knowledge rather than a comprehensive process – this is unavoidable due to constraints related to data availability at multiple spatial scales.

At the workshop, the participants break into smaller groups and, with the support of the technical team, begin by drawing approximate boundaries of areas that may meet the EBSA criteria on a central map, noting opportunities to extend or merge these areas and to identify areas yet to be considered. Through this process, experts increase their understanding of the data available. At a plenary discussion, workshop participants review the areas proposed and consider them for inclusion on the final list of areas described.

At the end of each workshop, participants build on the process by identifying, through open plenary discussion, gaps and needs for further elaboration in describing EBSAs, including the need for the development of scientific capacity and future scientific collaboration.

***How the information is shared through the EBSA repository***

The proposed EBSAs from the regional workshops are submitted for consideration and review by the CBD Subsidiary Body on Science, Technology, Technological Advice

(SBSTTA), and the Conference of the Parties. Upon the decision of the COP, they are considered formal CBD EBSAs and their descriptions and shapefiles, are included in the EBSA repository (https://www.cbd.int/ebsa/ebsas) and transmitted to the United Nations General Assembly and its relevant processes.

This EBSA website (available at: www.cbd.int/ebsa) hosts the EBSA repository and also acts as an information sharing-mechanism on EBSAs, providing access to the reports of the EBSA regional workshops and other EBSA-related resource materials, such as EBSA booklets, brochures, video, training materials or other publications; weblinks to relevant global processes (e.g., FAO's work on vulnerable marine ecosystems, IMO's work on Particularly Sensitive Sea Areas); and the schedule of EBSA meetings.

***Status of negotiations on EBSA modalities***

The EBSA process has been extremely valuable to improving our understanding of the ecological and biological significance of various components of the ocean, and providing a solid scientific basis for States and competent intergovernmental authorities to select, as appropriate, adequate measures to plan and implement conservation and sustainable use of marine biodiversity. EBSAs provide information that is not only useful for management planning, but also provide a focus for research and monitoring of various features in the ocean. Furthermore, the EBSA regional workshop process has facilitated scientific collaboration, networking and capacity-building at various scales around the world.

Notwithstanding the success of the EBSA process, the COP has been considering ways to improve it since 2014 (COP XII), when the COP requested the Executive Secretary to develop practical options to further enhance scientific methodologies and approaches to describe areas meeting the EBSA criteria, ensuring that the best available scientific and technical information and traditional knowledge of various users of marine resources are used and that the products are scientifically sound and up-to-date.

Discussions on this issue thus far have brought forth valuable insights on means to improve the EBSA process and the use of EBSA information. However, the COP has unfortunately not yet been able to find consensus on all elements of this issue. Important elements of these discussions include: (a) Modalities to modify the description of areas described as meeting the EBSA criteria, considered by the Conference of the Parties and included into the repository; (b) Modalities to describe new areas meeting the EBSA criteria; and (c) Actors who can propose the modification of EBSAs and the description of new EBSAs.

# DIVISION FOR OCEAN AFFAIRS AND THE LAW OF THE SEA OFFICE OF LEGAL AFFAIRS UNITED NATIONS

## Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations

Under the 1982 United Nations Convention on the Law of the Sea (UNCLOS), States Parties are required to deposit with the United Nations Secretary-General charts or the lists of geographical coordinates of points, specifying the geodetic datum, in relation to straight baselines and archipelagic baselines as well as the outer limits of the territorial sea, the exclusive economic zone and the continental shelf.

Following the entry into force of the on 16 November 1994, the United Nations General Assembly, in its resolutions on the law of the sea and, later, on oceans and the law[2] of the sea , requested the Secretary-General to first establish, and subsequently develop and update, the infrastructure and activities to discharge the depositary functions.

The Division for Ocean Affairs and the Law of the Sea (DOALOS) of the Office of Legal Affairs (OLA) is mandated to discharge the responsibilities entrusted to the Secretary-General under UNCLOS, including:

2 GA resolutions 49/28 of 1994, 52/26 of 1997, 59/24 of 2004, 60/30 of 2005, 67/78 of 2012, 74/19 of 2019, 75/239 of 2021; 76/72 of 2022; 77/248 of 2023 and Secretary-General's bulletin ST/SGB/2021/1 paragraphs 9.2 (b) and (e)

a) Establishing appropriate facilities, as required under UNCLOS, for the deposit by States of maps, charts and geographic coordinates concerning national maritime zones and establishing a system for their recording and publicity as part of an integrated programme on the law of the sea and ocean affairs, distinct from the usual depositary functions of the Secretary-General;
b) Developing and maintaining the appropriate facilities for the deposit by States of charts and geographical coordinates concerning maritime zones, including lines of delimitation, and giving due publicity thereto;
c) Improving the existing geographic information system for the deposit by States of charts and geographical coordinates concerning maritime zones, including lines of delimitation, submitted in compliance with the Convention, and giving due publicity thereto, in particular by implementing, in cooperation with relevant international organizations, such as the International Hydrographic Organization, the technical standards for the collection, storage and dissemination of the information deposited, in order to ensure compatibility among the geographic information system, electronic nautical charts and other systems developed by these organizations.

These depositary functions do not involve any determination concerning the conformity of the deposited material with the relevant provisions of UNCLOS. The receipt of and publicity given to deposited charts and/or lists do not imply the expression of any opinion whatsoever on the part of the Secretariat concerning the designations employed therein, the presentation thereof, or the legal status

of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. In addition, due publicity given by the Secretary-General to the deposited charts and/or lists in the context of these depositary functions does not imply recognition by the United Nations of the validity of the related actions and decisions of the respective coastal States.

Websites:

www.un.org/depts/los

https://oceans.un.org/ (access provided upon request through the State's Permanent Mission to the United Nations)

# FOOD AND AGRICULTURE ORGANIZATION (FAO)

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Food and Agriculture Organization of the United Nations (UN-FAO) – Fisheries & Aquaculture Division

The Food and Agriculture Organization (FAO) is a specialized agency of the United Nations that leads international efforts to defeat hunger. The goal is to achieve food

security for all and make sure that people have regular access to enough high-quality food to lead active, healthy lives.

The FAO Fisheries and Aquaculture Division (NFI) works with Members and partners to transform aquatic systems and promote the responsible and sustainable management of aquatic food systems, for better production, better nutrition, a better environment, and a better life. Leaving no one behind.

- Membership of the organization :

With 195 members - 194 countries and the European Union, FAO works in over 130 countries worldwide.

- Geographic scope of interest of the organization: National/Regional/Global

- URL: https://www.fao.org/fishery-aquaculture/en

**Corporate FAO data standards**

FAO data management and dissemination activities are generally governed under a corporate policy framework which includes a Data Protection and Policy Notice, and by FAO Statistics and Data Quality Assurance Framework. This framework is the overarching FAO framework that guides the Organization in ensuring the availability of high-quality international statistics on food and agriculture for decision-making. It consists in a series of principles to adhere to at the institutional, statistical process and statistical output level, in order to ensure the quality of FAO data and statistics. The quality of data and statistics itself is defined in the framework, through various quality dimensions, in order to guarantee common understanding of what it is to achieve. Under this general framework, specific standards were recently developed: a Standard on the acquisition and use of non-statistical data sources (including Big data) for statistical purpose; a standard on metadata dissemination for statistics; and soon will follow a standard on metadata dissemination of geospatially referenced datasets.

**Best practices and FAO Geonetwork legacy**

The marine geospatial information management has been set based on the legacy of FAO to build on open geospatial standards, such as with the GeoNetwork metadata catalogue (created by FAO). The promotion of geospatial standards in the field of fisheries, aquaculture and related marine information has been carried out by the Fisheries & Aquaculture division through its leading role in FAO in developing and operating marine Spatial Data Infrastructures (SDI) and related web portals through the Fisheries Global Information System (FIGIS), essentially based on tools promoted through the Open Source Geospatial foundation (OsGeo).

**Promotion of marine geospatial information existing standards**

In the recent years, geographic information standards have been progressively introduced through the Coordinating Working Party (CWP) on fishery statistics. The CWP provides a mechanism to coordinate the statistical programmes conducted by regional fishery bodies and other intergovernmental organizations with a remit for fishery statistics; The CWP is composed of experts nominated by intergovernmental organizations with an expertise in fishery statistics. There are currently 19 participating IGOs in the CWP. UN-FAO, by means of its Fisheries & Aquaculture division, acts as CWP Secretariat.

As of today, the CWP has recommended several geographic information standards as part of its handbook including:

- General concepts and related standards such as Spatial Reference Systems, Geographic coordinates, Geographic Systems and Main Water Areas
- GIS recommended standards, covering both geographic data and metadata, and related formats and protocols

Most of the core GIS standards recommended by the CWP are inherited from the ISO/TC211 standardization technical committee on Geographic Information/Geomatics and the Open Geospatial Consortium (OGC).

In the previous years, ad hoc task groups have been created to foster reference harmonization and standardization, particularly for fisheries geo-referenced data exchange and dissemination. This includes various activities including the dissemination of reference harmonization digital resources (fisheries and geospatial domain reference datasets) and the design of data exchange format specifications for geo-referenced fisheries datasets applicable at various scales (national, regional, global).

FAO directly puts in practice internationally recognized geospatial information standards that are recommended by the CWP and adopted as FAO corporate standards, through two main information pillars:

- the FAO fisheries & aquaculture knowledge base (FishInfo): a portal that provides access to the breadth of FAO Fisheries and Aquaculture technical knowledge and products. The databases, geospatial platforms, software, glossaries that this portal gives access to will help researchers, media, students, decision makers and Ocean enthusiasts with up-to-date information to support their work.
- the Fisheries and Resources Monitoring System (FIRMS) which primary aim is to provide access to a wide range of high-quality information on the global monitoring and management of fishery marine resources.

Geospatial aggregated information is collated by the FAO Fisheries & Aquaculture division who acts as custodian of the information. Such collation of data is done through networking, governance models and related arrangements.

The Regional Fishery Body Secretariats' Network (RSN) was established to facilitate information exchange among Secretariats of the different Regional Fishery Bodies (RFB) and Regional Fisheries Management Organizations (RFMO). FAO disseminates RFB fact sheets as well the RFB map viewer to visualize the RFB areas of competence.

The Fishery and Resources Monitoring System (FIRMS) relies on apartnership made of IGO members (Regional Fishery Bodies), collaborative institutions, and observers. Arrangements are in place to set the rights and obligations of the Partners and the rules driving the partnership, as well as for collaboration (for collaborative institutions). A governance model is in place with a Steering Committee (FIRMS SC), the Secretariat (provided by FAO) and the Technical Working Group (FIRMS TWG). Currently, the FIRMS Technical working group includes three separate working groups:

- The working on the Global Record of Stocks and Fisheries (GRSF TWG)
- The Global Tuna Atlas working group (GTA TWG) gathering the five Tuna Regional Fisheries Management Organizations, FAO and the French National Research Institute for Sustainable Development (IRD – as collaborative institution)
- The working group on terminology, that includes terms and definitions pertaining to geospatial

Through these working groups, FIRMS contributes to the development of geospatial standards, which then may be proposed to CWP for endorsement as geospatial data standards recommended for use in fisheries statistical data collection.

• **Implemented standards**

FAO implements core ISO/OGC standards as recommended by the CWP including:

- Standards for Spatial Reference Systems and Geographic coordinates
- GIS recommended standard formats and protocols for data and metadata

• **Standards under development**

*Water Jurisdiction Areas geospatial standard*

With the growing need to characterize spatially information domain objects (e.g. fisheries, stocks) based on reference water areas, the CWP has started to work on a coding system (and associated geographic boundaries) to better categorize and represent marine water jurisdiction areas (covering national jurisdiction areas – NJA – vs. Areas beyond national jurisdiction – ABNJ) based on the UNCLOS area type definitions, and existing research material development on marine regions (e.g. VLIZ Flanders Marine Institute Marine Regions portal). Preliminary results of this work were

presented at CWP Intersessional meeting (London – UK, June 2023) In a next phase, CWP looks forward to consolidating this work with partners beyond the CWP, such as UN DOALOS, UN Geospatial, and VLIZ.

Global Record of Stocks and Fisheries – Areas database

In the context of the FIRMS Global Record of Stocks and Fisheries, a global database of reference areas is under development to help characterizing spatially stocks and fisheries.

**Geospatial information system description**

These two pillars are technically supported by a common Spatial Data Infrastructure (SDI) made of ISO/OGC compliant components, including:

- software components to store and serve geospatial data and metadata: spatial database/file systems, geographic server (GeoServer), metadata catalogue (GeoNetwork),
- middleware components (geospatial processing workflows)
- fact sheet embedded maps (through GIS web-mapping widgets)
- thematic GIS portals/ map viewers to browse geospatial information

Thematic portals include:

- For the FAO FAO fisheries & aquaculture knowledge base (FishInfo)

o The GeoInfo map viewer, to browse all geospatial content from the FAO Fisheries & aquaculture knowledge, based on the FAO Fisheries & Aquaculture GeoNetwork

o Collection-specific map viewers:

- The aquatic species distribution map viewer
- The RFB map viewer
- The Vulnerable Marine Ecosystems database

- For Fishery Resources Monitoring System (FIRMS)

o The Stocks & Fisheries map viewer
o The Global Tuna Atlas (GTA)
o The Global Record of Stocks and Fisheries map viewer (GRSF) [Pilot version disseminated via the iMarine platform]
o Regional data bases (under development as pilot use cases – WECAFC DCRF and Regional Commission for Fisheries, RECOFI), with regional map viewers

At FAO organization level, the Fisheries & Aquaculture Spatial Data Infrastructure (SDI) is then harvested by a geospatial platform launched as part of the FAO Hand-In-Hand initiative. Similar harvesting mechanisms are in place for external data infrastructures (including national SDI) that need to access FAO fisheries & aquaculture geospatial data through ISO/OGC protocols for interoperability

# INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO (IOC)

# INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION OF UNESCO (IOC)

**Author:** Peter Pissierssens, Head IOC Project Office for IODE

The Intergovernmental Oceanographic Commission of UNESCO (IOC/UNESCO) promotes international cooperation in marine sciences to improve management of the ocean, coasts and marine resources. The IOC enables its 150 Member States to work together by coordinating programmes in capacity development, ocean observations and services, ocean science, tsunami warning and ocean literacy. The work of the IOC contributes to the mission of UNESCO to promote the advancement of science and its applications to develop knowledge and capacity, key to economic and social progress, the basis of peace and sustainable development. The IOC is in charge of coordinating the United Nations Decade of Ocean Science for Sustainable Development 2021-2030, the "Ocean Decade".

IOC has a membership of 150 countries.

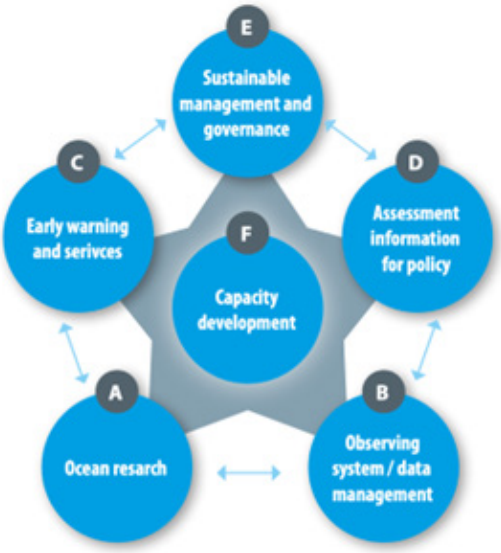
**IOC's High Level Objectives**

The IOC is working to achieve its Vision through the following High-Level Objectives:

- Healthy ocean and sustained ocean ecosystem services;
- Effective warning systems and preparedness for tsunamis and other ocean-related hazards;
- Resilience to climate change and contribution to its mitigation;
- Scientifically-founded services for the sustainable ocean economy;
- Foresight on emerging ocean science issues.

**The value chain of IOC**

IOC generates value through interaction of all its functions. In order to maximize the value, the IOC should work as an end-to-end system, in which observations and research enable various services and assessments, leading to informed decisions and guidance to policy and culminating in multiple societal and economic uses. Feedback from various functions in the system should lead to evolving and, generally, increasingly more and more demanding requirements for observations, science and




services. The capacity development will act as the catalyst of the whole system, working both at the cutting edge and leaving no one behind.

The IOC functions will be realised through the continuously developing programmes, acting globally, regionally, nationally and locally, through activities of regional subsidiary bodies, and by undertaking shorter-term project activities. In reality, all the programmes, constituencies and projects act as co-design and coordination mechanisms, while the true groundwork is done in and by Member States.

The Decade will provide an opportunity to mainstream IOC programmes and activities internationally and within Member States. The work will be directed towards achieving IOC High-Level Objectives.

Within IOC data management is coordinated by the International Oceanographic Data and Information Exchange Programme (IODE) (https://www.iode.org). IODE was established in 1961. Its purpose is to enhance marine research, exploitation and development, by facilitating the exchange of oceanographic data and information between participating Member States, and by meeting the needs of users for data and information products.

The main objectives of the IODE Programme are:

> (i) To facilitate and promote the discovery, exchange of, and access to, marine data and information including metadata, products and information in real-time, near real time and delayed mode, through the use of international standards, and in compliance with the IOC Oceanographic Data Exchange Policy for the ocean research and observation community and other stakeholders;
> (ii) To encourage the long term archival, preservation, documentation, management and services of all marine data, data products, and information;

(iii) To develop or use existing best practices for the discovery, management, exchange of, and access to marine data and information, including international standards, quality control and appropriate information technology;
(iv) To assist Member States to acquire the necessary capacity to manage marine research and observation data and information and become partners in the IODE network;
(v) To support international scientific and operational marine programmes, including the Framework for Ocean Observing for the benefit of a wide range of users.

Since 1961 IODE has built a network of over 100 National Oceanographic Data Centres (NODC), Associate Data Units (ADU) and Associate Information Units (AIU) in 68 Member States.

Member States oversee the work of the IOC through two Governing Bodies, the Assembly and the Executive Council.

**The IOC Assembly** meets once per biennium. The purpose of the Assembly is to review the work of the Commission, including the work of the Member States and the Secretariat, and formulate a common work plan for the coming two years.

**The Executive Council** meets every year and reviews issues and items from on-going work plans, and makes preparations for the Assemblies. The Executive Council consists of up to 40 Member States, including the six Member States represented by the Chairperson and the five Vice-Chairpersons. The Executive Council meets every year to review issues and items from on-going work plans, and make preparations for the IOC Assembly.

Representation in the IOC Executive Council Electoral Group I can consist of up to 10 seats; Group II of up to 3 seats; Group III of up to 9 seats; Group IV of up to 9 seats; and Group V of up to 9 seats.

Both the IOC Assembly and the Executive Council are prepared, supported and run by the six IOC Officers, under the leadership of the IOC Chair, in close alignment with the IOC Secretariat, under the leadership of the Executive Secretary.

IOC Data Policy and Terms of Use (https://www.iode.org/policy)

IOC adopted its IOC Data Policy and Terms of Use during the 32nd Session of the IOC Assembly (June 2023) through IOC Decision A-32/4.4 (IOC Data Policy and Terms of Use (2023)). The preamble states “The timely, open and unrestricted international sharing, in both real-time and delayed mode of ocean metadata, data and products is essential for a wide variety of purposes and benefits including scientific research, innovation and decision making, the prediction of weather and climate, the operational forecasting of the marine environment, the preservation of

life, economic welfare, safety and security of society, the mitigation of human-induced changes in the marine and coastal environment, as well as for the advancement of scientific understanding that makes this possible. Innovation of specialised products can be stimulated and encouraged by timely, open and unrestricted access to metadata and data. Metadata, data and products should be accessible, interoperable and openly shared with minimum delay and minimum restrictions."

It has 10 sections focusing on Purpose, FAIR and CARE principles, Conditions of Use, Data Repositories and the IOC ocean data and information system (ODIS), Secure long-term data archives, Access restrictions, Data sharing policies of Member States, and Data and metadata sharing guidelines. The full policy can be found on https://www.iode.org/policy

**IOC/IODE Manuals and Guides** (https://oceanexpert.org/doclist/9)

IODE has published a number of Manuals and Guides related to ocean data and information management and exchange (https://oceanexpert.org/doclist/9) providing guidance to national data centres and other stakeholders on procedures to manage data and information.

**IODE/GOOS Ocean Best Practices System** (https://www.oceanbestpractices.org)

In addition, IODE and GOOS have jointly created the "Ocean Best Practices System". The OBPS is a global, sustained system comprising technological solutions and community approaches to enhance management of methods as well as support the development of ocean best practices. A best practice is a methodology that has repeatedly produced superior results relative to other methodologies with the same objective; to be fully elevated to a best practice, a promising method will have been adopted and employed by multiple organizations. The repository now contains over 2000 documents and is available on https://search.oceanbestpractices.org/

**Ocean Biodiversity Information System (OBIS)** (https://www.obis.org)

OBIS aims to be the most comprehensive gateway to the world's ocean biodiversity and biogeographic data and information required to address pressing coastal and world ocean concerns. Its mission is to build and maintain a global alliance that collaborates with scientific communities to facilitate free and open access to, and application of, biodiversity and biogeographic data and information on marine life.

More than 20 OBIS nodes around the world connect 500 institutions from 56 countries. Collectively, they have provided over 45 million observations of nearly 120 000 marine species, from Bacteria to Whales, from the surface to 10 900 meters depth, and from the Tropics to the Poles. The datasets are integrated so you can search and map them all seamlessly by species name, higher taxonomic level, geographic area, depth, time and environmental parameters. OBIS emanates from the Census of Marine Life (2000-2010)

and was adopted as a project under IOC-UNESCO's International Oceanographic Data and Information (IODE) programme in 2009.

**Objectives**

- Provide world's largest scientific knowledge base on the diversity, distribution and abundance of all marine organisms in an integrated and standardized format (as a contribution to Aichi biodiversity target 19)
- Facilitate the integration of biogeographic information with physical and chemical environmental data, to facilitate climate change studies
- Contribute to a concerted global approach to marine biodiversity and ecosystem monitoring, through guidelines on standards and best practices, including globally agreed Essential Ocean Variables, observing plans, and indicators in collaboration with other IOC programs
- Support the assessment of the state of marine biological diversity to better inform policy makers, and respond to the needs of regional and global processes such as the UN World Ocean Assessment (WOA) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES)
- Provide data, information and tools to support the identification of biologically important marine and coastal habitats for the development of marine spatial plans and other area-based management plans (e.g. for the identification of Ecologically or Biologically Significant marine Areas (EBSAs) under the Convention on Biological Diversity.
- Increase the institutional and professional capacity in marine biodiversity and ecosystem data collection, management, analysis and reporting tools, as part of IOC's Ocean Teacher Global Academy (OTGA)
- Provide information and guidance on the use of biodiversity data for education and research and provide state of the art services to society including decision makers
- Provide a global platform for international collaboration between national and regional marine biodiversity and ecosystem monitoring programmes, enhancing Member States and global contributions to inter alia, the Global Ocean Observing System (GOOS) and the Global Earth Observing System of Systems (GEOSS)

**World Ocean Database (WOD)** (https://www.iode.org/wod)

The World Ocean Database represents the world's largest collection of vertical profile data of ocean characteristics available internationally without restriction. The World Ocean Database was first released in 1994 and updates have been released approximately every four years, 1998, 2001, and 2005. The most recent World Ocean Database series, WOD09, was released in September 2009. The WOD09 has more than 9 million temperature profiles and 3.6 million salinity profiles.

The World Ocean Database is hosted and managed by the World Data Center Oceanography in Silver Spring, USA. It can be accessed through http://www.nodc.noaa.gov/OC5/SELECT/dbsearch/dbsearch.html

The WOD Project is closely related to the Global Archaeology and Rescue (GODAR) Project.

In addition to WOD, IODE is coordinating a number of other specialized data projects such as GTSPP (https://www.iode.org/gtspp) and IQuOD (https://www.iquod.org),

**Ocean Data and Information System (ODIS)**

The UNESCO/IOC Project Office for IODE has documented over 3100 online repositories of ocean data and information, which shows the highly complex online environment, and challenge of finding the right information from the right source (ODISCat 2023-10; https://catalogue.odis.org). This prompted IOC and its IODE to proceed with the Ocean Data and Information System (ODIS).

The Ocean Data and Information System (ODIS) provides an interoperability layer and supporting technology to allow existing and emerging ocean data and information systems, from any stakeholder, to interoperate with one another.

ODIS links these distributed, independent, systems through a decentralized interoperability architecture (ODIS-Architecture), to form a digital ecosystem. As with natural ecosystems, ODIS will be resilient to the gain or loss of parts, and accommodate a high diversity of products and services, while maintaining its core functions. In this way, ODIS will provide a comprehensive and global e-environment where users can discover data, data products, data services, information, information products and services provided by Member States, projects and other partners.

The Ocean Data and Information System (ODIS) Architecture currently links over 32 nodes from 25 partners. This is demonstrated through three regional portals and a global search portal that can now be searched to find Oceans related data and information from multiple sources (https://oceaninfohub.org).

The global portal currently contains over 100,000 content items in 8 content categories: (i) Experts (26,000); (ii) Institutions (15,000; (iii) Documents (42,000); (iv) Training (1,900); (v) Vessels (238); (vi) Projects (3,600); (vii) Datasets (17,000); and (viii) Spatial search (8,700).

The overarching goal of the Ocean Data and Information System (ODIS) in the long term, is to provide a sustainable and responsive digital ecosystem where users can discover data, data products, data services, information, information products and services provided by IOC Member States, independent projects, private sector partners, and other partners associated with the UN Decade of Ocean Science for Sustainable Development.

**AquaDocs** (https://www.aquadocs.org)

Within the value chain published knowledge and reporting is the next step after data management and an important content type/knowledge element. AquaDocs is the joint open access repository of the UNESCO/IOC International Oceanographic Data and Information Exchange (IODE)and the International Association of Aquatic and Marine Science Libraries and Information Centers (IAMSLIC) with support from the FAO Aquatic Sciences and Fisheries Abstracts. It is a thematic repository covering the natural marine, coastal, estuarine /brackish and fresh water environments and includes all aspects of the science, technology, management and conservation of these environments, their organisms and resources, and the economic, sociological and legal aspects.

**OceanExpert** (https://www.oceanexpert.org)

Closely related to published papers is information about publication authors, other experts who are members of our various communities of practice, as well as information on their instututions and organizations. The OceanExpert database currently contains information on over 25000 individual experts and over 8000 institutions.

**International Coastal Atlas Network (ICAN)** (https://ican.iode.org)

ICAN is a community of practice of organisations who have been meeting since 2006 to scope and implement data interoperability approaches to coastal web atlases (CWAs). In 2013 ICAN became a project of UNESCO IOC´s International Oceanographic Data and Information Exchange (IODE) Programme.

The mission/strategic aim of the IODE ICAN project is to share experiences and to find common solutions to CWA development (e.g., user and developer guides, handbooks and articles on best practices, information on standards and web services, expertise and technical support directories, education, outreach, and funding opportunities, etc.), while ensuring maximum relevance and added value for the end users.

ICAN members seek to play a leadership role in forging international collaborations of value to the participating nations, thereby optimizing regional governance in coastal zone management. A major goal is to help build a functioning digital atlas of the worldwide coast based on the principle of shared distributed information. The long-term view is for global-level operational interoperability which will evolve as the ICAN project members strive to increase awareness of the opportunities that exist for increased coastal and marine data sharing among policy makers and resource managers as strategic users of a CWA.

The long-term strategic goal of the IODE ICAN project is to encourage and help facilitate the development of digital atlases of the global coast based on the principle of distributed, high-quality data and information. These atlases can be local, regional, national and international in scale. This can be achieved by sharing knowledge and experience among atlas developers in order to find common solutions for coastal web

atlas development whilst ensuring maximum relevance and added value for the users. In some cases users may be significantly involved in atlas development itself. In order to reach this goal ICAN has the following objectives:

- Ensure that ICAN has representation from coastal web atlas development and user groups from across the world.
- Develop technical and policy guidelines to assist coastal web atlas developers in acquiring data and engaging with data providers. Accordingly, collate and publish a set of best-practise guidelines for the development of coastal web atlases.
- Highlight the benefits of interoperability and standards based systems to the coastal atlas developer communities.
- Develop collaborative projects for the sharing of know-how, implementation of technical solutions and demonstration of atlas benefits to users.
- Align the atlas efforts of the Network partners in order that interoperability can be facilitated.
- Engage with other relevant international IODE projects and developments as well as relevant activites outside of IODE.
- Involve representatives of the relevant user communities to help in tailoring coastal web atlases to their needs.
- To further these objectives ICAN has identified a range of activities in the areas of technical implementation, atlas assessment, outreach, training, and participation in scholarly communities, and strategic planning and funding.

IODE covers all ocean physical, chemical and biological data (including biodiversity) as collected by IOC Member States and managed by their national data centres and/or global databases such as those described above.

**ODIS (Ocean Data and Information System)**

ODIS works with many types of spatial geometries in order to be as inclusive as possible. The ODIS-architecture documentation covers guidelines for Spatial Geometry:

https://book.oceaninfohub.org/thematics/spatial/index.html

Guidance is also given for describing Maps as a subtype of Document in schema.org:

https://book.oceaninfohub.org/thematics/docs/maps.html

**OBIS (Ocean Biodiversity Information System)**

From the very beginning, OBIS has championed the use of international standards for biogeographic data. Without agreement on the application of standards and protocols, OBIS would not have been able to build a large central database. OBIS uses the following standards:

- Darwin Core: https://manual.obis.org/darwin_core.html

- Ecological Metadata Language: https://manual.obis.org/eml.html
- Darwin Core Archive and dataset structure: https://manual.obis.org/data_format.html

More information is available on https://manual.obis.org

**AquaDocs**

The AquaDocs repository uses extended Dublin Core metadata standard.

# INTERNATIONAL HYDROGRAPHIC ORGANIZATION

# International Hydrographic Organization

The International Hydrographic Organization (IHO) is an intergovernmental organization that works to ensure all the world's seas, oceans and navigable waters are surveyed and charted. Established in 1921, it coordinates the activities of national hydrographic offices and promotes uniformity in nautical charts and documents. It issues survey best practices, provides guidelines to maximize the use of hydrographic survey data and develops hydrographic capabilities in Member States.

IHO Member States are represented within the IHO by the respective national authority responsible for the provision of hydrographic and nautical charting services in each Member State.

The IHO's scope of interest is global. Hydrography is the basis for all activities involving the sea: Safety of navigation, Tourism, Protection and management of the marine environment, Use of marine resources: minerals, oil & gas, renewable energy, Maritime trade, Coastal zone management, Maritime boundaries and policing, Marine science, Tsunami flood and inundation modelling, and Marine spatial data infrastructure.

The Convention on the International Hydrographic Organization defines the Organization's mandate to be the authoritative worldwide hydrographic body which actively engages all coastal and interested States to advance maritime safety and efficiency and which supports the protection and sustainable use of the marine environment. The Convention presents the IHO's mission to create a global environment in which States provide adequate and timely hydrographic data, products and services and ensure their widest possible use.

As an Intergovernmental Organization, the IHO is comprised of 99 Member States as of November 2023 which governs the Organization through triennial Assembly and subsidiary organizational entities.

The Secretary-General and Directors, together with international experts in hydrography and nautical cartography as well as locally-recruited administrative support staff make up the IHO Secretariat in Monaco. The Secretariat coordinates and promotes the IHO's work programmes and provides advice and assistance to Member States and relevant third parties.

The organization shall comprise the Assembly, Council, Finance Committee, Secretariat, and two subsidiary organs, which are Hydrographic Service and Standard Committee (HSSC) developing and maintaining global hydrographic standards and Inter-Regional Coordination Committee (IRCC) to coordinate and promotes cooperation with other international and regional organizations.

IHO Marine Geospatial Information is categorized into geographic data that delineates the spatial characteristics of the ocean. This spatial information is collaboratively developed with IHO member states, as well as relevant international organizations and communities. The key global marine spatial information services provided by IHO as outlined below:

- Global coverage of International Charts and Electronic Navigational Charts
- Global quality and coverage of survey data
- Global Automatic Identification System (AIS) indicated ships traffic
- Gazetteer of Under Sea Feature Names
- Layout of Marine Safety Information for NAVAREA
- Global Bathymetry data

There components represent the comprehensive range of marine geospatial information offered by the IHO, reflecting collaborative efforts with IHO Member States and International entities.

The IHO Services and Standards Programme focuses on the implementation and strategic direction of developing, improving, promulgating and promoting clear, uniform, global hydrographic standards to enhance safety of navigation at sea, protection of the marine environment, maritime security and economic development".

The main elements are:

- Programme Coordination
- Foundational Nautical Cartography Framework
- Universal Hydrographic Data Model (S-100 Framework) - Nautical Charting (S-57 / S-52 Framework)
- Supporting the implementation of e-navigation and Marine Spatial Data Infrastructures (MSDI)
- Hydrographic Surveying
- Hydrographic aspects of UNCLOS
- Other technical standards, specifications, guidelines and tools

The noted data repositories are hosted by the IHO and are accessible via the links listed below:

IHO Main website: https://iho.int/

IHO Geospatial Information Registry: https://registry.iho.int

IHO Web Catalogue for International Charts and ENCs: https//chart.iho.int

IHO Data Centre for Digital Bathymetry: https://ngdc.noaa.gov/iho/

IHO-IOC General Bathymetry Chart of the Oceans: https://www.gebco.net/

# UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

The United Nations Development Programme (UNDP) is a United Nations agency tasked with helping countries eliminate poverty and achieve sustainable economic growth and human development. The UNDP emphasizes developing local capacity towards long-term self-sufficiency and prosperity. UNDP works in more than 170 developing countries and territories spanning multiple continents and regions.

www.undp.org

UNDP has been actively involved in supporting communities located in coastal and marine environments but does not have a specific mandate on marine geospatial information collection, standardization, or dissemination activities.

UNDP has started a series of initiatives on geospatial data collection and marine geospatial data is among the main data themes. In general, the UNDP geos data repository contains geospatial marine layers in three forms: 1) acquired and curated from open sources, 2) acquired and curated by remote sensing technologies, and 3) as links to public big raw geospatial data archives hosted by the major cloud vendors. The data are hosted in a cloud environment and disseminated through universal world-wide web technologies and open geospatial dissemination standards.

UNDP is currently developing GeoHub a cloud based geospatial platform designed to: 1) organize and host data in one central location, 2) support advanced geo visualization, and 3) support advanced geospatial analytics. The main goal of the platform is to support UNDP policy makers making informed decisions by leveraging geospatial data and analytics in the context of SDGs.

https://geohub.data.undp.org/

# INTERNATIONAL SEABED AUTHORITY

MARINE GEOSPATIAL INFORMATION MANAGEMENT

# International Seabed Authority (ISA)

**Authors (contributors):**

Sheldon Carter, Noemie Wouters, Ulrich Schwarz Schampera, Kioshi Mishiro

## 1. KEY INFORMATION ABOUT THE ORGANIZATION

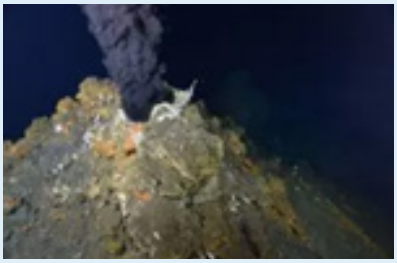
In accordance with the UN Convention on the Law of the Sea ("the Convention") and 1994 Agreement relating to the implementation of Part XI of the convention ("1994 Agreement), the International Seabed Authority (ISA) is the organization through which the States Parties to the Convention organize and control mineral exploration and exploitation activities in the Area beyond the national jurisdiction (the Area), particularly with a view to administer the mineral resources of the Area, for the benefit of mankind as a whole. At the core of this mandate is the responsibility for ISA to take the necessary measures to ensure the effective protection of the marine environment from potential harmful effects caused by seabed activities. UNCLOS also requires ISA to promote and encourage the conduct of marine scientific research in the Area and coordinate and disseminate the results of such research.

The Convention defines "the Area" as "the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction". The establishment of the exact geographic limits of the Area depends on the establishment by States of the outer limits of the continental shelf, including the delineation of the outer limits of the continental shelf, where it extends beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, in accordance with the Convention. Pursuant to Article 84, paragraph 2 of the Convention, coastal States are obliged to give due publicity to charts or lists of geographical coordinates of points and, in the case of those indicating the outer limit lines of the continental shelf, to deposit a copy of such charts or lists with the Secretary-General of the Authority.

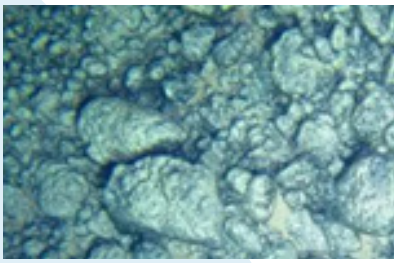
## 2. LEGISLATIVE ADMINISTRATIVE AND POLICY FRAMEWORK MANDATING THE MARINE GEOSPATIAL INFORMATION COLLECTION, COORDINATION, STANDARDIZATION MANAGEMENT AND/OR DISSEMINATION ACTIVITIES

With the entry into force of UNCLOS in 1982 and the establishment of ISA in 1994, exploration activities for mineral resources in the Area began to be regulated under exploration contracts. Originally, exploration activities were predominantly undertaken by mining consortia in the 1960s and 1970s to identify potential deposits and invest in research and development of technology for mining and processing nodules. These studies were carried out by four multinational consortia composed of companies from the United States, Canada, the United Kingdom, West Germany, Belgium, the Netherlands, Italy, Japan, and two groups of private companies and agencies from France and Japan. There were also three publicly sponsored entities from the Soviet Union, India and China. National agencies followed up with the decrease in commodity prices and enhanced resource supplies until 2010, when private companies restarted activities to invest in what may develop into a polymetallic-nodule-mining industry.

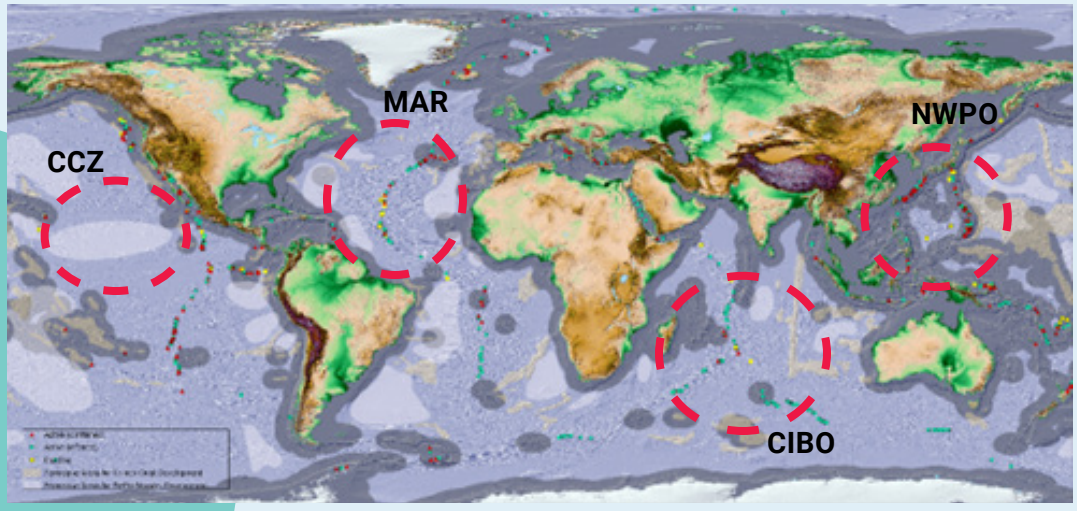
Polymetallic Nodules



Polymetallic Sulphides



Cobalt-rich Ferromanganese Crusts



## 2.1 Active Contract Areas[3]

As of 11 July 2024, the ISA has entered into 30 contracts with 21 contractors for the exploration of polymetallic nodules, polymetallic sulphides and cobalt-rich ferromanganese crusts in the Clarion Clipperton Fracture Zone (CCZ), the Northwest Pacific Ocean (NPO), the Central Indian Ocean Basin (CIOB), and the Mid-Atlantic Ridge (MAR).

**Polymetallic Nodules:**

The entitled exploration area allocated to each contractor does not exceed 75,000 sq. km after the completion of 50 per cent relinquishment of the original area allocated (not exceeding 150,000 sq. km) by the end of eight years from the date of the contract.

**Polymetallic Sulphides:**

The total area allocated to the contractor under the contract is limited to 2,500 sq. km after the completion of 75 per cent relinquishment of the original exploration contract area (not exceeding 10,000 sq. km) by the end of the eighth year from the date of the contract.

**Cobalt-rich Ferromanganese Crusts:**

The total area allocated to the contractor under the contract is not exceeding 1,000 sq. km after the completion of the relinquishment of 2,000 sq. km of the original exploration area (not exceeding 3,000 sq. km) by the end of the tenth year from the date of the contract.

## 2.2 Deepsea Data Collection

It is required that the contractors undertake profound mineral exploration work, and also gather environmental data and conduct environmental baseline studies, taking into account any recommendations issued by the agreed contract and the Legal and Technical Commission (LTC). Environmental baseline studies assess the likely effects on the marine environment of any activities under the plan of work for exploration, thus to monitor and report.

The LTC recommendations provide guidance to contractors in relation to the content, format and structure of the annual reports, that include general requirements and specific guidance for reporting on the exploration activities under contract for mineral resources (i.e. polymetallic nodules, polymetallic sulphides, cobalt-rich ferromanganese crusts). (ISBA/21/LTC/15 )[4]

3 https://www.isa.org.jm/exploration-contracts/maps/

4 ISBA/21/LTC/15: Recommendations for the guidance of contractors on the content, format and structure of annual reports

In the requirements of the submissions of the data, ISA provides standard templates (i.e. reporting and metadata templates) to be used by contractors for reporting geological, and environmental data and associated digital files. (ISBA/21/LTC/15)

### 2.3 Confidentiality and Non-Confidentiality

The data and information related to the protection and preservation of the marine environment contained in the reports, in particular the data from environmental monitoring programmes, shall not be considered confidential. (ISBA/19/C/17: Regulation 36 and 37)

The resource-related data and information, including high-resolution bathymetric data, is confidential. No such data and information shall be released until the contractor has been accorded a reasonable opportunity to exhaust the judicial remedies available. (ISBA/19/C/17: Regulation 36 and 37)

## 3. INSTITUTIONAL ARRANGEMENT – GOVERNANCE MODEL – LEADERSHIP INSTITUTIONAL STRUCTURE – INSTITUTIONAL STRUCTURE

In accordance with the UNCLOS, all State Parties to UNCLOS are members of ISA. The ISA has 169 Members, including 168 Member States and the European Union. The institutional structure of the ISA is similar to most international organizations, and consisting of Legal and Technical Commission (41 members) as an advisory body, and the Finance Committee (15 members); the Assembly; the Council (36 members); the Secretariat (i.e. Executive Office of the Secretary-General, Office of Legal Affairs, Office of Environmental Management and Mineral Resources, Office of Administrative Services)

**Legal and Technical Commission**: Technical, scientific and legal reviews for exploration or mining activities, development of environmental management plans, assessment of the environmental implications of activities in the Area, and recommendations to the Council.

**Finance Committee**: Central role in the administration of ISA's financial and budgetary arrangements.

**Council**: Central, executive organ of the ISA, that supports the work of the plenary body. The council can exercise policy-making, and supervisory competencies, including the power to specific policies within the competencies of the ISA.

**Assembly**: the plenary body of the ISA, that has the power to establish, in collaboration with the Council, general policies on all matters within the competence of the ISA.

## 4. MARINE GEOSPATIAL DATA – DATA THEMES

The contractors are required to submit the metadata and results of their sample analysis from exploration and baseline surveys in contract areas, using the digital reporting templates recommended by the Legal and Technical Commission. (ISBA/21/LTC/15/CORR.1[5] )

Building on ISA's long-term efforts to develop a central repository of data being submitted by contractors from their exploration activities, the ISA launched, in July 2019, its new comprehensive database called "ISA Deep Seabed and Ocean Database" (DeepData) (http://data.isa.org.jm). DeepData is an integrated database system designed to serve as a geospatial data management system.

The environmental data in DeepData, including the data themes; biological, oceanographic and geochemical parameters of the marine ecosystems, are accessible to the public. The geological data relating to mineral resource assessment are formally identified as confidential by the regulations on prospecting and exploration of mineral resources, and are made accessible only to authorized users of ISA organs and contractors. (ISBA/19/A/9, ISBA/19/C/17, ISBA/16/A/12/ Rev.1, and ISBA/18/A/11).

The contractors are required to produce Geographic Information System regional maps with high resolution bathymetry showing major geological and geomorphological features to reflect the heterogeneity of the environment, at a scale appropriate to the resource and habitat variability (ISBA/25/LTC/6/Rev.1). The collected and processed bathymetric data are being submitted as digital 'xyz' files in the American standard code for information interchange (ASCII) format or a common geographic information system (GIS) format. The processing sequence must be fully described (ISBA/21/LTC/15/CORR.1).

## 5. MARINE GEOSPATIAL INFORMATION MANAGEMENT TECHNOLOGY AND STANDARDS IMPLEMENTED

In 2015, the Legal and Technical Commission (the Commission) requested ISA to evaluate the current methods of managing seabed exploration data and make recommendations for a strategy to address identified gaps and inadequacies, and recommended that ISA proceed with the implementation of its Data Management Strategy in June 2016 (ISBA/22/LTC/15). The strategy establishment and development provide effective ways to reviewing, monitoring and evaluation of contractors' activities (environmental, geological and technological integration) by ISA.

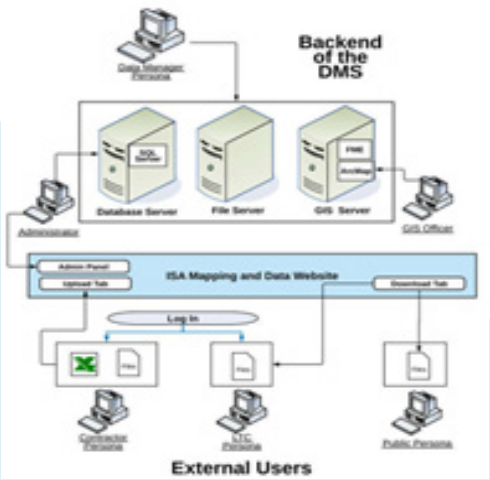
The ISA Secretariat launched the DeepData website (https://data.isa.org.jm/isa/map/ ) in July 2019 and fulfilled the initial objectives set out in ISBA/22/LTC/1.

DeepData has been designed to serve as a spatial, internet-based data management system; the main function is to host all data related to deep-seabed activities and sharing environmental data.

5 ISBA/21/LTC/15/CORR.1: Reporting Template: https://www.isa.org.jm/reporting-templates

After the launch of DeepData, the Secretariat focused on developing a revised version of the reporting templates that could support the extraction, transformation and loading (ETL) procedures associated with incorporating new data with the master data inventory (Figure)

**Figure.** *Generalized workflow diagram showing interaction between personas and ISA DeepData database.*




In 2022, the revised reporting templates underwent the implementation of several quality assurance and control mechanisms to improve the overall quality of data collected by the Authority. The revised reporting templates were accompanied by a newly developed metadata template that has aided in the cataloguing and storage of associated data (https://www.isa.org.jm/exploration-contracts/reporting-templates/ ).

The ISA data management aims to provide different functions, i.e., promoting and encouraging Marine Scientific Research (MSR) in the Area and coordinating and disseminating the results of such research as the core of ISA's mission. ISA further developed an Action Plan on the MSR (ISBA/26/A/17) in support of the United Nations Decade of Ocean Science for Sustainable Development. ISA DeepData database serves as the global repository of all deep-seabed-related data that are submitted by ISA's contractors. This contains, among mineral exploration data, physical and geochemical oceanographic and biological, parameters of the marine ecosystems from the seafloor to the ocean surface as well as maps, photographs, videos from contractors. The Secretariat also established several partnerships and collaborations with other UN (e.g. OBIS, WoRMS) and national agencies (e.g. ADSR project[6] ) and members of the scientific community to expand the outreach and ensure interoperability with other international databases based on the F.A.I.R principles.

Three best practice examples described below illustrate how marine geospatial management informs effective science policy and regulatory frameworks:

6 Africa Deep Seabed Resources (ADSR) project funded through Norwegian Agency for Development Cooperation (NORAD)

## 5.1 Regional Environmental Management Plans (REMPs)

REMPs are an essential tool for ISA to ensure the protection of the marine environment, that aims to:

- provide the relevant organs of ISA, as well as contractors and their sponsoring States, with proactive area-based and other management tools to support informed decision-making processes that balance resource development with conservation;
- provide ISA with a clear and consistent mechanism to identify particular areas thought to be representative of the full range of habitats, biodiversity and ecosystem structures and functions within the relevant management area;
- provide those areas with appropriate levels of protection; and
- help ISA meet globally agreed goals and targets, such as those set out by the 2030 Agenda and in particular Sustainable Development Goal 14 (Life below water).

## 5.2 Area 2030

Area 2030 is a collective contribution of high-resolution mapping of the international seabed area by contractors in support of the effective implementation of UNCLOS, the 2030 Agenda and the UN Decade of Ocean Science for Sustainable Development. The high-resolution bathymetric data provided by contractors is confidential information as it concerns resource-related data; however, ISA facilitated the submission by ten contractors of the bathymetric data through the International Hydrographic Organization (IHO) as part of the ISA Area 2030 initiative (as of September 13). It will contribute to improve the geological model, identify deep-sea habitats, including inferring possible mineral occurrences based on artificial intelligence techniques, and increase the scientific knowledge of the global oceans and support global oceans' governance by mapping.

## 5.3 Sustainable Seabed Knowledge Initiative (SSKI)

SSKI, funded by the European Commission, aims to transform our understanding of the planet's largest ecosystem in the deep-sea. Launched at the 2022 UN Ocean Conference, SSKI aims at the description of over one thousand new species from the regions of the Area that are currently being explored for mineral resources and may be targeted for future exploitation. As such SSKI will strengthen the scientific foundation for effective identification, characterization, protection and management of the deep-sea in the Area, in collaboration with other UN entities. This includes sharing of taxonomic data with the Ocean Biodiversity Information System (OBIS), to increase the dissemination and

visibility of such data to the public. The Authority also entered partnerships with the World Register of Marine Species (WoRMS) as an additional quality control mechanism to improve taxonomic data quality. This initiative and the new knowledge it will generate will enable scientists to create maps of life on the seafloor and help to understand and manage the potential effects of anthropogenic activities on deep-sea ecosystems.

# PACIFIC COMMUNITY

# Response to the request for information Annex 1 Marine Geospatial Information-Intergovernmental

The Pacific Community presents its compliments to the Division for Oceans and Law of the Sea and has the honour to refer to the letter of 20 June 2023, in which the Division invited contributions from Intergovernmental organisations to describe their missions in the collection and dissemination of marine geospatial data and Information.

The Pacific Community (SPC) is the principal scientific and technical organisation supporting development in the Pacific region since 1947. SPC is proud to be applying collective capabilities in science, knowledge and innovation to serve the people of the Pacific in reaching their sustainable development goals and aspirations. By placing Pacific people at the centre of our approaches, and with our deep understanding of Blue Pacific contexts and worldviews, SPC embark on the journey to implement the Strategic Plan 2022 – 2031 that encompasses the insights and foresight of our 27 member countries and territories, staff and key stakeholders. It builds on learning from our previous plans and aligns with the 2050 Strategy for the Blue Pacific Continent.

SPC has a strong comparative advantage in being able to bring a multi-disciplinary approach to addressing some of the region's most complex development challenges, resilience and climate action, natural resources and biodiversity, food systems, equity, education and social development, sustainable economies and livelihoods, planetary health and transforming institutional effectiveness.

SPC holds itself accountable to the Pacific values enshrined in the Strategic Plan and to serving our Blue Pacific region in progressing our four development goals:

- Goal 1: All Pacific people benefit from sustainable development
- Goal 2: All Pacific communities and cultures are empowered and resilient
- Goal 3: All Pacific people reach their full potential and live long and healthy lives
- Goal 4: One SPC delivers integrated programmes through streamlined services

As a member-owned organisation, SPC commits to transforming and adapting as an institution to respond to our members' unique and evolving priorities.. In doing so, we draw on the strength of our diversity, including the vast interdisciplinary expertise and multi-cultural backgrounds of our 700+ staff located across the region.

## 1. MISSION

*"To progress all Pacific peoples' rights and well-being through science and knowledge, guided by our deep understanding of Blue Pacific contexts and cultures."*

## 2. MEMBERSHIP OF THE ORGANISATION

The Pacific Community consists of the Following States and Territories

American Samoa, Australia, Cook Islands, Federated States of Micronesia, Fiji, France, French Polynesia, Guam, Kiribati , Marshal islands, Nauru, New Caledonia, New Zealand, Niue, Northern Mariana Islands, Palau, Papua New Guinea, Pitcairn Islands, Samoa, Solomons Islands, Tokelau, Tonga, Tuvalu, United Kingdom, United States of America, Vanuatu, Wallis and Futuna

## 3. URL

www.spc.int and https://gem.spc.int/

## 4. LEGISLATIVE AND POLICY FRAMEWORK

Details of the institutional arrangements for SPC are found The Pacific Community Governance Compendium

Our work in the oceans is guided by the needs of the people of the Blue Pacific Continent and the decisions of our leaders as expressed in the 2010 Framework for a Pacific Oceanscapes, the 2021 Pacific Islands Forum Leaders Ocean Statement, the 2050 Strategy for a Blue Pacific Continent and the Pacific Island Forum Leaders Declaration on Preserving Maritime Zones in the Face of Climate Change-related Sea-Level Rise

## 5. INSTITUTIONAL ARRANGEMENTS

SPC delivers its programs through 9 work areas

- Climate Change and Environmental Sustainability
- Educational Quality and Assessment
- Fisheries Aquaculture and marine Ecosystems
- Geoscience Energy and maritime
- Human Rights and Social Development
- Land Resources
- Public Health
- Statistics for Development
- Integrated programs

# 6. MARINE GEOSPATIAL DATA

SPC manages data relating to fisheries, the marine environment, oceanography, marine geology, maritime transport, and earth and ocean observation data. The relevant programmes and initiatives are summarised below.

## 6.1 Pacific Community Center for Ocean Science (PCCOS)

The Pacific Community (SPC), as the region's hub for science, technology and innovation for sustainable development, is also home to the Pacific Community Centre for Ocean Science, or the PCCOS.

PCCOS aims to help Pacific Island governments and communities easily access the ocean science and expertise they need to make informed decisions and to protect and sustainably manage ocean resources.

Whilst accurate ocean science, data, and information are critical tools, SPC recognises that actors on the ground in our member countries need advice and services tailored to their needs. PCCOS delivers integrated scientific services supporting Ocean management, Ocean governance, Ocean observations; and facilitating, and coordinating and transforming Ocean science into services for SPC members.

The Pacific Community Centre for Ocean Science website is https://pccos.spc.int/

## 6.2 SPC – Climate and Oceans Support Program in the Pacific (COSPPac)

Pacific Island countries are some of the most vulnerable to climate change in the world. The aim of the programme is to measure and deliver useful and usable climate change and Ocean information services in partnership with priority stakeholders, including affected communities and marginalised groups, such that Pacific Island stakeholders are using climate and Ocean information to enable all Pacific peoples to remain resilient to the impacts of climate change and disasters so that they are able to lead safe, secure and prosperous lives. The primary stakeholders in COSPPac are the Pacific Island National Hydrological Meteorological Services (NHMSs) and the Lands and Survey Departments (LSDs).

In relation to the marine geospatial information, SPC works with Pacific Island counterparts to build tools to forecast and report on climate, tides, sea level and ocean conditions, including the modernisation of geodetic reference frames. At the same time, we work with them to determine how best to communicate this information to communities, businesses and governments to improve preparedness and decision-making.

SPC – COSPPac - https://gem.spc.int/projects/cosppac

## 6.3 SPC - Digital Earth Pacific

Globally, the effects of climate change are already being observed through increases in drought, forest fires, sea level rise, and flooding. Given the vulnerability of Pacific Island countries and territories (PICTs) in this respect, the Pacific region faces unique challenges in managing natural resources and biodiversity, securing economies and livelihoods and ensuring sustainable food systems. Digital Earth Pacific (DEP) delivers an operational earth and marine observation system that takes decades of satellite data and makes it easier to access and use, empowering decision-makers across the Pacific. This includes changes to landcover and land use to better target humanitarian assistance after disasters, mapping of changing coastlines caused by climate change or storm events, and understanding how mangrove growth has changed without having to map this manually.

DEP will allow Pacific Community (SPC) SPC member states to make more informed decisions based on timely information. It is a free and open digital public infrastructure helps the region understand the changes in our environment quickly and at a fraction of the cost of previous data systems, at scale.

Digital Earth Pacific helps the Pacific to achieve our 2050 Leaders vision for our Blue Pacific Continent and underpins the progress being made towards the Paris Agreement and our Sustainable Development Goals.

SPC – Digital Earth Pacific website - https://digitalearthpacific.org/

## 6.4 SPC – Pacific Maritime Boundaries Interactive Dashboard

For Pacific Island countries and territories (PICTs), as with all coastal States, maritime boundaries function as national borders. They are critical for governance, security, law enforcement, and natural resource management within a coastal State. A State's maritime boundary can lie adjacent to the high seas or be shared with another country. The UN Convention on the Law of the Sea (UNCLOS) is the international agreement that codifies all coastal State's rights to a marine jurisdiction. Where countries' entitlements to maritime zones overlap, they need to negotiate a shared boundary.

The Pacific Regional Maritime Boundaries project with the Pacific Community (SPC) works with Pacific countries to deliver certainty and publcity on the limits of their maritime zones. The project is supported by a consortium of partners, and overall coordination has been led by the Pacific Community (SPC) since 2001.

This project has developed the Pacific Maritime Boundaries Dashboard, which is hosted on the Pacific Data Hub (PDH, pacificdata.org). The dashboard is an interactive visual presentation of the progress by Pacific countries on Maritime Boundaries tasks. The landing page has an interactive map, depicting the status of boundaries for each country,

and linking to pages that summarise regional progress and provide associated publicly available datasets in formats that can be easily consumed by end users.

SPC - Maritime boundaries dashboard website - https://pacificdata.org/dashboard/maritime-boundaries

## 6.5 Pacific Geospatial and Surveying Council (PGSC)

*Established by the Pacific Region, for the Pacific Region*

Geospatial information underpins the majority of economic and sustainable development activities in the world today. The services provided by Pacific Island geospatial scientists and surveyors contribute to the security and well-being of Pacific people, supporting numerous industries and sectors. These include natural resource management, civil engineering, climate change adaptation, disaster risk reduction, transport, land ownership, health, and agriculture to name a few.

In November 2014, a group of Pacific regional surveying and geospatial experts met in the margins of the annual Pacific Geospatial Information Systems and Remote Sensing (GIS/RS) User Conference in Suva, Fiji. It was at this meeting that the Pacific Geospatial and Surveying Council (PGSC) was first envisaged and a charter governing its mission and objectives was developed.

Today PGSC is an independent regional advisory body with a strategic plan and a partnership desk at the SPC providing Secretariat support, providing a forum for Pacific Island geospatial information and survey authorities to discuss and address regional challenges. The vision is "sustainable development in the Pacific enabled by world-class geospatial information and surveying services." Core members of PGSC are national geospatial, hydrographic, and surveying authorities of Pacific Island countries and territories.

PGSC website - http://pgsc.gem.spc.int/

## 6.6 Pacific Regional Navigational Initiative (PRNI)

Observing international standards is vital to raising regional maritime safety and security. SPC works in the region through projects that are interconnected to achieve similar outcomes. Funded by the New Zealand Foreign Affairs & Trade Aid Programme, the Pacific Regional Navigational Initiative, or PRNI is one project that is taking steps to meet this demand, and to strengthen the efficiency and value of the Pacific region's maritime industry.

Safe and reliable passage through Pacific waters is essential to protect fragile ocean environments and allow Pacific island countries' economies to develop. Up-to-date navigation charts based on modern, accurate surveys are critical transport infrastructure the ocean equivalent of well-constructed roads. Hydrography is highly specialised. Few Pacific countries have the technical capability or systems needed to undertake hydrographic surveys or update their own navigational charts. This new regional programme aims to ensure Pacific navigation charts meet international standards and support maritime safety and economic growth. The initiative contributes to sustainable development in selected Pacific SIDS through supporting:- improved transport and infrastructure management

services as a key enabler of growth. For every $1 spent on hydrography, there is an estimated $91 return in ongoing economic activity.- safe, reliable and affordable transport services that connect people to markets and services.

Pacific regional navigational initiative website - https://sdgs.un.org/partnerships/pacific-regional-navigation-initiative

## 7. RELEVANT LINKS

- Tuvalu coastal adaptation dashboard - https://opm.gem.spc.int/tcap/home
- Republic of Marshal Islands strengthening early warning preparedness dashboard -https://opm.gem.spc.int/prep/home
- Pacific Ocean portal - https://oceanportal.spc.int/portal/ocean.html
- Pacific Regional Navigation Initiative (PRNI) - https://gem.spc.int/videos/pacific-regional-navigational-initiative-prni
- Why maritime zones matter: https://youtu.be/y3p5DUvRhzY
- Exchange of maritime boundaries data to boost fisheries monitoring, control and surveillance in region: https://peump.dev/news/exchange-maritime-boundaries-data-boost-fisheries-monitoring-control-and-surveillance-region
- The Tuna Fisheries Data Management system: Tufman 2 - is a cloud-hosted, web database developed for Pacific Island Countries to manage their tuna fishery data https://fame1.spc.int/resources/tools/tufman2
- Ikasavea: is a smartphone and tablet application that allows fisheries surveyors to collect market, landing and socio-economic survey data offline https://fame1.spc.int/resources/tools/ikasavea
- Tails: is a smartphone and tablet application that allows coastal fisheries staff to easily collect tuna and reef fish catch information from small-scale fishers in remote locations https://fame1.spc.int/resources/tools/tails
- OLLO: is an Android app developed by SPC for observers monitoring longline vessels operating in the southern albacore fisheries https://fame1.spc.int/data-management-tools/ollo
- OnBoard application: app is one of the SPC-developed E-Reporting tools suite https://fame1.spc.int/data-management-tools/onboard-application
- OnShore application: is one of the tablet applications of the SPC-developed suite of E-reporting tools https://fame1.spc.int/data-management-tools/onshore-application
- MULTIFAN-CL: is a computer program that implements a statistical, length-based, age-structured model for use in fisheries stock assessment https://fame1.spc.int/resources/tools/multifan-cl
- PacFishID: is an application for the general public to learn to recognise fishes of commercial interest of the Pacific region https://fame1.spc.int/resources/tools/pacfishid
- REEFLEX: This tool is designed to allow users access to and compare laws and policies on coastal fisheries and aquaculture management in 23 Pacific Island countries and territories (22 SPC member countries and Timor Leste) https://fame1.spc.int/resources/tools/reeflex

- SEAPODYM Data Query System: SEAPODYM is a numerical model initially developed for investigating physical-biological interaction between tuna populations and the pelagic ecosystem of the Pacific Ocean https://fame1.spc.int/resources/tools/seapodym
- Pacific Marine Specimen Bank: Collecting samples of Pacific pelagic species to understand their biology and ecology https://fame1.spc.int/resources/tools/pacificmarinespecimenbank
- Web Tagging Data System: The Web Tagging Data System is a portal that gives access to tagging data collected by SPC and its partners since 2005 https://fame1.spc.int/resources/tools/web-tagging
- Bycatch Management Information System (BMIS): The Bycatch Management Information System (BMIS) focuses on bycatch mitigation and management in oceanic tuna and billfish fisheries https://fame1.spc.int/resources/tools/bycatch-mitigation