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Implementation and adoption of standards for the global geospatial information community

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Note by the Secretariat

Summary

The present paper contains the report prepared jointly by the International Hydrographic Organization, technical committee 211 of the International Organization for Standardization (ISO) and the Open Geospatial Consortium on the implementation and adoption of standards for the global geospatial information community for consideration by the Committee of Experts on Global Geospatial Information Management.

At its fourteenth session, held from 7 to 9 August 2024, the Committee of Experts adopted decision 14/113, in which it welcomed the report of the three standards development organizations and their work with the Committee of Experts. The Committee welcomed the numerous examples of the ongoing standards development activities for data access and interoperability while also encouraging Member States to set policy that starts with open standards as a default for geospatial and location information programmes towards the implementation of standards-based solutions that ensure interoperability, data-sharing and flexibility to adapt to changing data sources and technologies, and to support actual real use cases for the integration of geospatial information and statistics, for the reporting of the Sustainable Development Goals, the implementation of the United Nations Integrated Geospatial Information Framework and the use and application of artificial intelligence.

The Committee also urged Member States to collaborate with and participate in the maintenance, advancement and capacity development of geospatial standards, together with the standards development organizations.

In the report, the International Hydrographic Organization provides information on its continuing efforts to advance the S-100 Universal Hydrographic Data Model to support the creation and maintenance of interoperable maritime data product services that are compliant with the ISO 19100 series of geographic information standards. In 2024, the organization reported that edition 5.2.0 of S-100 had been released. Based on edition 5.2.0 of S-100, the organization has released a number of Phase 1 S-100 product specifications as operational editions, including S-101 Electronic Navigational Chart, S-102 Bathymetric Surface, S-104 Water Level Information for Surface Navigation and S-111 Surface Currents.

* [E/C.20/2025/1](#).

Several additional S-100-based product specifications are being developed and implemented in collaboration with several international organizations, including entities of the United Nations system and partners such as the International Organization for Marine Aids to Navigation and the World Meteorological Organization. The International Hydrographic Organization also reports that it has established a freely available training resource on maritime spatial data infrastructure to assist its members in aligning their country-level work to the United Nations Integrated Geospatial Information Framework and the Operational Framework for Integrated Marine Geospatial Information Management.

Technical committee 211 of ISO, in the report, provides information on its activities with entities of the United Nations system and partners, including supporting the modernization of the geodetic infrastructure as a partner of the United Nations Global Geodetic Centre of Excellence; continued progress in the development of the ISO 19152 Land Administration Domain Model, of which parts 1 and 3 have been published and parts 2, 4 and 5 should be published by August – allowing better integration of land and sea boundaries and supporting the Framework for Effective Land Administration; ISO 19144 on land cover and land use, in conjunction with the Food and Agriculture Organization of the United Nations, of which parts 1, 2 and 3 have been published and part 4 is under development with the Open Geospatial Consortium.

In the report, the Open Geospatial Consortium discusses its focus on developing and testing open geospatial application programming interface standards via pilots, projects and testbeds under its collaborative solutions and innovation programme, covering several areas including climate services, disasters, the marine environment, digital twins and the built environment. Over the past year, the Consortium has focused on a range of topics relevant to Sustainable Development Goals, including a multi-year continued focus on improved support for disaster response, increased coordination within the marine domain and innovation related to climate services. The Consortium emphasizes the integration of geospatial information with statistics and other data under the findable, accessible, interoperable and reusable data principles. The Consortium further reports that it continues to enhance interoperability with its standards, as well as the International Hydrographic Organization and ISO standards, thereby ensuring a cohesive framework for geospatial data utilization and standardization, in support of the global geospatial information agenda.

I. Introduction

1. The International Hydrographic Organization (IHO), the Technical Committee 211 of the International Organization for Standardization (ISO/TC 211), and the Open Geospatial Consortium (OGC) work in partnership to leverage their respective missions, and membership expertise to advance Findable, Accessible, Interoperable and Reusable (F.A.I.R.) principles and Standards to meet the goals and objectives of the Committee of Experts. The standards development organizations continued to increase cooperation through formal liaison agreements and joint program initiatives to produce standards and good practice recommendations that could not be fully achieved by working in isolation. The goal is to ensure Member States take a high-level policy decision globally to ensure that open standards are the default starting point for all geospatial and location requirements.
2. The Committee of Experts is invited to take note of the present report and to express its views on the activities and plans of the three Standards Development Organizations (SDOs) and their contribution to the development, implementation, and adoption of open standards for the global geospatial information community. Points for discussion and decision are provided in paragraph 39.

II. Update from the Open Geospatial Consortium (OGC)

Introduction

3. The Open Geospatial Consortium (OGC) and its more than 450 members from across the private, public and academic and research sectors have guided the advancement of open Standards and associated practices to make geospatial information broadly accessible to support global requirements. For 2025, OGC focused on the Integrity, Provenance, and Trust of data.
4. Through its member meetings, workshops, forums, summit events, and practical results demonstrated via its 18 ongoing Collaborative Solutions and Innovation (COSI) initiatives covering a broad range of topics, OGC is addressing an expanding range of geospatial interoperability challenges facing the international community. As noted above, OGC's 2025 focused on developing Standards and supporting materials to establish an IPT framework. This work is in response to the increasing use of data produced by suppliers, and not by data custodians themselves as well as known instances of data falsification or even synthetic ("deep fake") imagery. Over the past year, OGC has focused on a range of topics relevant to SDGs including a multi-year continued focus on improved support to disaster response, increased coordination within the Marine domain, and innovation related to climate services.

Adoption and Implementation of OGC General Purpose Geospatial Standards

5. OGC is continuing with its advancement of an open API Standards suite - a modernization and expansion of OGC's Web Services Standards. This work on the OGC API Standards is now expanding the capabilities of the core Standards and beginning to offer new functionality, such as APIs for Moving Features and Discrete Global Grid Systems.
6. OGC has a process to endorse externally developed specifications as Community Standards. The Spatio-Temporal Asset Catalog (STAC), built on top of OGC API – Features, is moving through this process.
7. OGC is nearing completion on the Features and Geometries JSON (JSON-FG) Standard. This Standard extends GeoJSON (a widely used Standard from the Internet Engineering Task Force (IETF)) to support Coordinate Reference Systems

(CRSs) and complex geometric representations of data. GeoJSON files are in wide use and will be fully valid instances of the JSON-FG Standard.

Adoption and Implementation of OGC Domain-Specific Standards

8. With the rapid rise in use of Artificial Intelligence (AI) in geospatial data processing and analysis, there is often a lack in confidence by those working with mission-critical data that cannot be wrong. OGC is adopting a staged approach to increase trust in AI processes, initially by adopting the Training Data Markup Language (TDML) for AI that provides a consistent metadata model to describe the source, provenance, and suitability of training and validation data for AI systems. Next in this effort will be a model description Standard to help users understand which sets of training and associated models are suitable for their own use cases.

Engagement with Regional Committees and other International Bodies

9. Beyond coordination with ISO/TC 211 and IHO, OGC works with a number of other Standards-setting or domain-focused organizations to ensure that common principles are in place for the use of location information. OGC recently worked with ISO/TC 204 (Intelligent Transport Systems) to charter a new Transportation and Mobility Domain Working Group (DWG). This DWG considers all modes of transportation and methods of mobility, including land, sea, and air.

Compliance Testing Resources

10. As part of OGC's compliance [testing and certification program](#), OGC continues to publish compliance tests for Standards, often soon after the Standards are published. These tests are open-source software and permissively licensed to permit developers to test their own work before creating software. OGC also offers a certification program using the tests and OGC evaluation of test results to formally mark software that is proven to properly implement OGC Standards.

Innovation and Standards Development

11. Unique to OGC is the Collaborative Solutions and Innovation (COSI) program, which brings sponsors and participants together to collectively work on solving common problems across multiple domains. The COSI program uses real-world scenarios and demonstrations of results and is closely connected to the standards program. Testing OGC (and IHO and ISO) standards using practical use cases results in improvements based on implementations and shortens the adoption cycle of new and existing standards.

12. During the intersessional period, and carrying on into 2025, OGC led or participated in the following initiatives:

- (a) All Data for Green Deal - Man-made climate change is the great challenge of our time. The All Data for Green Deal (AD4GD) project defines the European Commission Climate Data Space and explores how FAIR approaches can help integrate data better to make more profound decisions at the regional and national level to mitigate climate change. This project is co-funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101061001.
- (b) CHEK -The goal of CHEK is to facilitate digital building permit procedures for municipalities. CHEK explores how to integrate geodata with Building Information Model (BIM) data. The CHEK model contains all information about the building's components, materials and properties as well as its location and orientation. By applying the latest semantic web research, CHEK enables automated

digital building permits using standards-based processing pipelines. (This project has received funding from the European Union's Horizon Europe programme under Grant Agreement No.101058559).

- (c) Climate and Disaster Resilience Pilot - designed to accelerate our collective readiness for accessing, fusing, and analyzing data from the climate change services and modeling communities with earth observation and social science data to contribute to the global push for achieving climate resilience. The pilot project explores how climate data, heat island data, and other important data can be used most effectively. The pilot project applies generative AI to respond to natural language questions.
- (d) CLIMOS - The CLIMOS project aims to help mitigate the emergence, transmission, and spread of pathogens (sand fly focus). The project develops guidelines and best practices on how data from various sources can be linked together most efficiently. This project is co-funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101057690
- (e) FOCAL - The FOCAL project (eEfficient explORation of Climate data locALLY) tackles some of the most urgent challenges faced today in adapting to and mitigating the impacts of climate change. It connects local realities with regional and global ambitions, transforming data into actionable insights that empower decision-makers to build resilient cities and sustainable forests. FOCAL puts powerful tools in the hands of local planners and foresters, ensuring they can confidently tackle climate risks. By piloting cutting-edge AI and high-performance computing solutions, FOCAL positions Europe as a leader in climate science, setting an example for the world to follow.
- (f) iGuide - OGC is involved in this National Science Foundation (NSF)-funded project to explore how High-Performance Computing Platforms can be used in data infrastructures most efficiently.
- (g) IHO-OGC Federated Marine Spatial Data Infrastructure Pilot (FMSDI) - The Federated Marine SDI Demonstration (FMSDI) pilot explores the integration of the land-perspective with the sea-perspective. As such, it brings together two distinct domains in one of the regions most sensitive to climate change: The land-sea interface. The pilot continues into 2025 with more focus on feature type catalogs and knowledge graphs to explore linked data potentials and challenges.
- (h) ILIAD – Digital Twin of the Ocean - Over 50 Partners are building the solutions and infrastructure to monitor the marine environment with their own and public datasets and services. OGC is involved in several areas focusing on Social Science and Digital Twin of the Ocean APIs. Standards-based methods to discover, access, and process data of various types and in an appropriate variety of formats will enable open ecosystem integrations and the market of applications. These will be built on the OGC APIs linked to the multimodal semantic layer provided by the OGC Definition Server. This project is co-funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101037643.

- (i) InCASE - Earth observation data and measurement results must be discoverable and well documented. To do so, they must comply with relevant standards to ensure compatibility between different data sources. Compliance with such standards significantly improves the value of the data. Users can thus develop different services and monitor policy objectives. The InCASE project is investigating how these principles can be applied specifically to data measurements from sensors, etc., in the field. This project is funded by the European Environment Agency and OGC's main contribution to GEO and GEOSS.
- (j) OGC Sprints -OGC Sprints are collaborative events driven by rapid code development to implement and test specific capabilities of a technical approach or standard. Most OGC API Standards are refined and tested via these Sprints so that each final Standard is proven to be implementable and useful.
- (k) OGC Testbed-20 - The 2024 testbed addresses Interoperability, Provenance, and Trust, Geodatacubes, High-Performance Computing, and new imagery formats for better information storage and exchange.
- (l) OGC Testbed-21 – TEstbed-21 is in final planning stages at the time of this publication. The primary focus will be on Geodatacubes and Integrity, Provenance, and Trust.
- (m) Open Science Persistent Demonstrator - This pilot makes interoperability more tangible. The pilot explores how data and services can be used across cloud platforms in single workflows.
- (n) SEADOTs - The SEADOTs project (Social-Ecological Ocean Management Applications using Digital Ocean Twins) is an EU-funded initiative dedicated to revolutionizing ocean management by integrating socio-ecological data with Digital Ocean Twins (DOTs). By combining advanced ocean data with socio-ecological and socio-economic models, SEADOTs aims to empower policymakers and stakeholders to make informed, data-driven decisions for sustainable ocean use.
- (o) Urban Digital Twins Interoperability Pilot - Urban Digital Twins will be developed, but no single city can be expressed within a single twin. This project explores how multiple digital twins can be integrated using several smart city challenges.
- (p) USAGE -The Horizon Europe project USAGE (Urban Data Space for Green Deal) develops solutions and mechanisms to make city-level environmental and climate data available to citizens. This project is co-funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101059950
- (q) NSDI 2.0 - The Next Generation National Spatial Data Infrastructure research brings existing SDIs to the next level. Addressing previously underrepresented topics such as governance, customer-targeting design, knowledge infrastructure and geospatial ecosystem perspectives lead to the development of new best practices and guidelines for more efficient SDIs.
- (r) National and municipal spatial data solutions - the pilots in this context are closely aligned with the NSDI research. In these pilots,

the OGC explores how municipalities and national governments can optimize the handling of geospatial data for phases of planning, managing, monitoring, and evaluation.

III. Update from Technical Committee 211 of the International Organization for Standardization (ISO/TC 211)

13. [ISO/TC 211 Geographic information/Geomatics](#) manages ISO's geospatial standards, with the vision to support a sustainably prosperous future by providing, in cooperation with other organizations, a set of standards that enable better management of geographic information through collaboration, harmonization, and outreach. The specific focuses of ISO/TC 211 are on metadata and data quality in support of the FAIR Principles - that data should be findable, accessible, interoperable and reusable. The work with other standards bodies focuses on ensuring they can make best use of geographic information.

14. ISO/TC 211 works with United Nations (UN) agencies and others, including supporting modernization of the global geodesy supply chain (with the newly established UN-GGCE); continued progress in the development of ISO 19152 LADM, of which Part 1 has been published and Part 2 will be published by August - allowing better integration of land and sea boundaries, and supporting UN Framework for Effective Land Administration (UN FELA); ISO 19144 on land cover and land use, in conjunction with the Food and Agriculture Organization of the United Nations (FAO), of which Parts 1 & 2 have been published and Part 3 should be published by August.

15. ISO/TC 211 has been working with the Expert Group in the Integration of Statistical and Geospatial Information (ISGI) of the Committee of Experts on the revision of the Global Statistical Geospatial Framework (GSGF) and has been updating ISO 19157 Data quality and this year hope is to launch an online register of data quality measures, with machine readable definitions. The ISO Registration Authority for this is the Open Geospatial Consortium.

16. ISO/TC 211 now consists of 39 Participating and 34 Observing members which are national standards bodies. ISO/TC 211 collaborates with numerous liaisons, including ISO committees and external organizations. Key internal ISO liaisons include integrated transport, digital twins, smart cities, smart farming, climate change and ESG (environmental, social, governance). For more information, the Strategic Business Plan is available on the ISO/TC 211 website. Freely available resources such as UML models and XML schemas for supporting standards implementations are also found on ISO/TC 211 website. The committee remains active in the ISO work towards machine readable standards and the ISO online standards development tool pilot.

17. ISO as a whole is now more focused on sustainability, particularly climate change in support of the United Nations Call for Action on Adaptation and Resilience. The focus is on standards in energy production, transport, and construction. The ISO Climate Change Coordination Committee recognizes the value of geospatial information and standards in planning and monitoring sustainability, and ISO/TC 211 is working with them to improve its portfolio.

Sustainable Development Goals (SDGs)

18. Geospatial standards support the broader objectives of the 2030 Agenda for Sustainable Development: general purpose geospatial standards that are important for industry and infrastructure, and those standards in direct support of the UN-GGIM, specifically in the areas of Geodetic Referencing, Land Administration, Land Cover and Land Use, and Addressing. For example, the UN Convention on

Combating Desertification uses ISO 19144 to integrate land cover information; the standard was prepared and revised jointly with FAO. ISO provides [tools](#) to help technical committees to map their projects to the SDGs. ISO/TC 211 collects user stories showing how our standards have helped countries work towards specific SDGs; see <https://committee.iso.org/sites/tc211/home/standards-in-action/united-nations.html>.

General purpose geospatial standards and aligning with the business environment

19. Several geospatial standards are so basic that users are not always aware of them being implemented. Standards that describe data in a uniform way (specifications, metadata and quality, and geographic point location by coordinates) are widely used. Other examples of these hidden standards cover the process of relating national coordinate reference systems to global geodetic reference systems (so that two or three numbers can represent a place on the earth), and the calibration of remote sensing devices. As geospatial technology becomes mainstream, some of the “specialist” standards are implemented in more mainstream software, such as the common implementation of spatial technology in relational databases. As the information technology environment changes, geospatial standards need to change; for example, ISO/TC 211 has begun its first project looking at a JSON encoding. Working with the European Commission, a [report](#) was published on using existing geospatial standards to publish data into generic “data spaces”.

Participation in standardization and advancing implementation

20. The requirements for standardization are identified by the user community and therefore stakeholder participation is critical. In many cases, international organizations develop domain specifications based on the ISO/TC 211 and OGC standards, for example FAO, IHO, World Meteorological Organization (WMO), and the Defence Geospatial Information Working Group (DGIWG). Our biannual Standards in Action seminars generally contain a dozen presentations with speakers from various countries and the June 2024 seminar included the Global Environmental Data Strategy of UNEP, UK, Saudi Arabia, and India. Presentations are available on the ISO/TC 211 website.

Coordinate Reference Systems

21. ISO/TC 211 supports the implementation of the Global Geodetic Reference Frame (GGRF) by developing standards, including:

- (a) ISO 19111 “Referencing by coordinates”, which describes coordinate reference systems and transformations between them - how to represent a location in numbers.
- (b) ISO 19161-1 “International terrestrial reference system (ITRS)”, which adopts the work of the International Union of Geodesy and Geophysics (IUGG), the International Association of Geodesy (IAG) and the International Astronomical Union (IAU) to show how to “realize” national and regional coordinate reference systems in alignment with the worldwide ones, such as GNSS.
- (c) By the time of the meeting, work should have started on ISO 19161-2 Geodetic references — Part 2: Unique identification of geodetic ground stations in collaboration with the International association of geodesy (IAG) and the International Earth Rotation and Reference Systems Service (IERS), this will extend and modernize the way that ground geodetic stations are identified. They form a key part of the GGRF.

- (d) ISO 19127 “Geodetic Register”, which specifies the [ISO Geodetic Register](#) (ISOGR) and its associated Control Body. The Control Body consists of convenors nominated by the International Association of Geodesy (IAG) and of international geodetic experts. The register contains official parameters and transformations for national and regional coordinate reference systems and is freely available online.

22. ISO/TC 211 is a recognized partner of both the UN-GGIM Subcommittee on Geodesy (SCoG) and the United Nations Global Geodetic Centre of Excellence (UN-GGCE) and continues to work with SCoG and UN-GGCE towards a sustainable Geodetic Register. Many geospatial users today are familiar with the EPSG Dataset and Registry managed by the International Association of Oil & Gas Producers (IOGP) and the OGC CRS registry. ISO/TC 211, OGC, and the IOGP have published a description of the different purposes of these registers and the interactions between them.

Land Administration

23. Having engaged OGC, IHO, International Federation of Surveyors (FIG), United Nations Office of Legal Affairs’ Division for Ocean Affairs and Law of the Sea (DOALOS), the World Bank, FAO, and UN-Habitat, ISO/TC 211 is running an extensive revision of ISO 19152:2012 “Land Administration Domain Model (LADM)” with confidence that the proposed new parts to this standard will cover the organizational requirements. The result of this revision is creating a multi-part standard: 1) General Conceptual Model (published in January 2024); 2) Land Registration; 3) Marine Georegulation (likely to be published before the fifteenth session of the Committee of Experts); 4) Valuation Information; 5) Spatial Planning; and 6) Implementations. Parts 2, 4 and 5 should be published in 2025. Parts 2, 4, and 5 should be available for public comment (ISO Enquiry Stage) by the time of the meeting. A proposal for Part 6 is under preparation. ISO LADM supports the UN Framework for Effective Land Administration (FELA) and the Social Tenure Domain Model, while it is not expected that countries with well-developed land administration systems will adopt it.

Land Cover and Land Use (LCLU)

24. LCLU is an essential and fundamental data themes used by millions of professional users globally across a wide variety of applications. While the explosion of Location Intelligence tied to these essential data layers continues at a pace, the growing need for an agreed upon LCLU meta language is more urgent than ever, to facilitate international analysis. ISO 19144-2:2012 “Geographic information - Classification systems - Part 2: Land Cover Meta Language (LCML)” was developed under the leadership of FAO, who is also leading the revision, including developing ISO 19144-3, a similar meta language standard for Land Use. The revised ISO 19144-2 was published in December 2023. ISO 19144-3 should be published by the time of the fifteenth session. A part 4 is planned to establish a register of land cover and land use classifications.

Addressing

25. An address provides structured information for the unambiguous determination of an object, such as a house or apartment building. Addresses are essential for the management of cities, for governance and public administration generally, for service delivery in the public and private sector, and they can give people status or (legal) identity in society. ISO 19160-2 supports the Universal Postal Union’s initiative, “Addressing the World – An Address for Everyone”, which promotes the establishment of national addressing infrastructures to the benefit of all. The multi-part ISO 19160, Addressing, provides the standards required for a country’s addressing infrastructure, such as a conceptual data model;

terminology; good practices for assigning and maintaining addresses; how to measure the quality of address data; and international postal addressing, the latter jointly developed with the Universal Postal Union (UPU).

26. ISO 19160-2 Addressing - Part 2: Assigning and maintaining addresses for objects in the physical world was published in November 2023. ISO 19160-2 specifies how to plan, implement, and maintain addresses and corresponding address data to gain maximum benefits for governance and society in the long run. It is a tool against which Governments could measure the objectives, principles, and goals conformance of their address policies for a good practice and governance framework. This standard supports the first goal of United Nations Integrated Geospatial Information Framework (UN-IGIF), namely, enabling geospatial (address) information governance, policy and institutional arrangements that ensure effective geospatial (address) information management, accommodate individual organizational requirements and arrangements, and that are aligned to national and global policy frameworks. The standard is also useful for those involved in slum upgrading, as addresses are often assigned when housing conditions in settlements are being improved.

IV. Update from the International Hydrographic Organization (IHO)

Marine Geospatial Framework

27. IHO continued to work on its S-100 Universal Hydrographic Data Model framework to support the creation and maintenance of interoperable maritime data product specifications compliant with the ISO-19100 series of geographic information standards. The S-100 infrastructure which includes the [Geospatial Information Registry](#). The Feature Catalogue and Portrayal Catalogue builders have been developed and are now embedded into the process of the development and maintenance of data product specification. S-100 based product specifications assigned to IHO, the International Association of Light Authorities (IALA), the Intergovernmental Oceanographic Commission (IOC), the Inland ENC Harmonization Group (IEHG), the World Meteorological Organization (WMO), the International Electrotechnical Commission (IEC) and NATO are being maintained on the [IHO website](#). Edition 5.2.0 of S-100, released in June 2024, represents the culmination of experiences of the past years in testing and development against S-100. This edition incorporates key extensions aimed at enhancing standards to better meet stakeholder requirements for safety and efficiency in the digital maritime domain. These enhancements include support for real-time data integration (e.g., water levels), streaming service delivery, improved data portrayal mechanism, and strengthened encryption to support data authentication and cybersecurity.

28. IHO S-100 Roadmap serves as the strategic foundation for the implementation of the Electronic Chart Display and Information System (ECDIS) performance standards adopted by International Maritime Organization (IMO), based on the S-100 framework. It outlines the phased development, testing and deployment of S-100 based products, ensuring alignment with the IMO's regulatory timelines – beginning in 2026 and leading to mandatory carriage after 2029. This alignment ensures that both technical and regulatory elements are in place to enable a safe, efficient, and interoperable digital navigation environment.

Product standards development

29. S-100 based product specifications have been developed and tested according to the S-100 Implementation Decade (2020-2030) roadmap. The Phase 1 product specifications – S-101 Electronic Navigational Chart, S-102 Bathymetric Surface, S-104 Water Level Information for Surface Navigation, S-111 Surface

Currents – have successfully published their operational Edition 2.0.0 between December 2024 and January 2025. S-121 Maritime Limits and Boundaries and S-130 Polygonal Demarcations of Global Sea Area are also under development. Following the release of their initial trial versions (Edition 1.0.0), their specifications are currently undergoing testing and validation to support the development of their operational editions. IHO has also made substantial progress on the S-122 Marine Protected Areas and intends to eventually have an online system to display protected areas on the high seas.

Testbed and Innovation Program

30. IHO operates a project named S1OOP - S-100 Open Online Platform that is aimed to be the foundation for a digital ocean and accelerate the wide adoption of the S-100 hydrographic framework by jointly developing and making available the technical requirements needed to overcome any S-100 implementation barriers. The project installed four themes, Theme 1 - Online viewer, Theme 2 – Data Production and Protection, Theme 3 – Open-source management, and Theme 4 – Knowledge and Capacity. The Joint IHO-Singapore Innovation and Technology Laboratory (IHO Lab) established in Singapore in October 2021 is aimed to accelerate innovation in the field of hydrography through sandbox implementation of new S-100 standards under construction.

31. The IHO Infrastructure Centre will be established as a centralized hub to support the development and maintenance of S-100-based systems. In October 2024, the IHO Council approved its provisional operation in the Republic of Korea starting in 2025, with the final decision on its formal establishment to be made at the IHO Assembly in April 2026. The Centre will also serve as a platform for innovation, testing, and collaboration within the global hydrographic community.

Marine Spatial Data Infrastructure

32. Marine Spatial Data Infrastructure (MSDI) has been highlighted as an important component of the future development of hydrographic offices. The IHO has established basic MSDI training material for the IHO Member States and Regional Hydrographic Commissions to conduct basic MSDI education/training. The MSDI training material is now freely available on the IHO web page <https://iho.int/en/body-of-knowledge>. An MSDI e-learning program has also been developed to enable people to access MSDI teaching externally and even receive the teaching online. The MSDI teaching material is available on the IHO's website for free and the e-learning interactive material can be downloaded and accessed on YouTube.

33. The FAIR Data Principles (Findable, Accessible, Interoperable, Re-usable) are used widely in the geospatial community, promoting, and supporting knowledge discovery and innovation as well as data and knowledge integration, and sharing and reuse of data. The FAIR principles do not strictly define how to achieve a state of "FAIRness". Rather they describe a continuum of features, attributes, and behaviors that will move a digital resource closer to that goal. The principles help data and metadata to be 'machine readable', supporting new discoveries through the harvest and analysis of multiple datasets. To have a Hydrographic Offices approach to the FAIR Data Principles IHO has provided best practices on how IHO MS can use the FAIR principles in their work with their national and regional MSDI, the IHO is also working to establish FAIR principles checklist to guide implementation.

34. The continued improvement of the alignment between UN-IGIF and UN-IGIF-Hydro is important as this will ensure a unified approach to data management between land and sea. IHO document C-17 should also be further aligned with, if not merged with, the UN-IGIF Hydro. The focus of IHO C-17 is on how Hydrographic Offices can act in response to UN-IGIF and UN-IGIF-Hydro and the

broader global perspective and some of the working issues, like data consistency, data quality, multiple-use best practices, business models, the FAIR principles, maritime digital twins etc. leaving UN-IGIF and UN-IGIF-Hydro to define broader use cases. The Edition 3.0 of C-17 is available on IHO publication at <https://iho.int/en/capacity-building-publications>.

Global coverage of seabed topography

35. To improve the incomplete image of the ocean's seabed topography from all available data resources, IHO has continued to develop its "Crowdsourced Bathymetry campaign" and its supporting guidance document (IHO B-12). In addition, significant developments have been undertaken to the IHO's Data Centre for Digital Bathymetry (DCDB) to enhance uploading, data viewing and download functionality. The resulting General Bathymetric Chart of the Oceans (GEBCO) grid of global ocean seabed topography is publicly available under open data policy terms for download and re-use. The grid is now updated on an annual basis, having grown from 6% in 2017 to 24.9% in 2024.

V. Support to the implementation of the UN-IGIF

36. After the 3rd edition of the standards guide from the United Nations Integrated Geospatial Information Framework (UN-IGIF) was endorsed at the Eleventh session of the Committee of Experts, the SDOs made it available as a [web publication](#), open for continuous feedback.

VI. Geospatial Standards in Measuring and Monitoring the SDGs

37. The SDOs continue to maintain and advance a framework of geospatial standards and good practices that support the mapping, visualization, analysis and forecasting related to the 17 SDG topics. The SDO general purpose geospatial standards continue to be adopted by technology suppliers worldwide to make it easier for the user community to implement F.A.I.R. solutions that are broadly compatible for collaboration and data sharing. The SDO domain specific standards are helping to address specific SDGs on addressing hunger, health, and sustainable communities.

38. Some specific examples of SDOs support to SDGs over this past year include:

- (a) Goal 2 Zero Hunger: ISO/TC 211 Land Cover/Land Use;
- (b) Goal 3 Good Health and Well Being: OGC Health Spatial Data Infrastructure Data Model;
- (c) Goal 9 Industry, Innovation and Infrastructure: All SDOs general purpose standards apply;
- (d) Goal 11 Sustainable Cities and Communities: implementation of OGC CityGML, OGC Indoor Mapping Data Format Community Standard;
- (e) Goal 13 Climate Action: SDO General Purpose Standards, OGC Open API: Environmental Data Retrieval; and
- (f) Goal 14 Life Below Water: S-101 - IHO Electronic Navigational Chart, S-102 – Bathymetric Surface, S-111 – Surface Currents, and S-129 – Under Keel Clearance.

VII. Points for Discussion

39. The Committee of Experts is invited to:

- (a) Take note of this present report of the SDOs and express its views on their progress, work and plans;**
- (b) Take note of and express its views on the need to work with the UN Global Geodetic Centre of Excellence to support a sustainable ISO Geodetic Register;**
- (c) Encourage broad use of the Standards Guide to support implementation of standards-based solutions that ensure interoperability, data sharing, and flexibility to adapt to changing data sources and technologies;**
- (d) Encourage Member States and other relevant United Nations system entities to participate, through membership and resource contribution, in the international geospatial standards development processes and meetings of the OGC, ISO/TC 211, and IHO to follow and provide input into standards as they are developed, finalized and approved; and**
- (e) Encourage Member States to set policy that starts with open standards as a default for geospatial and location information programmes, and the broad use of geospatial standards.**