Executing a GEBCO Community Vision

for

Improving the Availability, Discoverability & Accessibility of Bathymetric Data

A 3-day working meeting, co-organized and hosted by the GEBCO Technical SubCommittee for Ocean Mapping (TSCOM), the International Hydrographic Organization's Data Center for Digital Bathymetry (IHO-DCDB), and the Regional Center for the Atlantic and Indian Oceans of the Nippon Foundation - GEBCO Seabed 2030 Project, was held 11-13 March 2024. The National Oceanic and Atmospheric Administration National Centers for Environmental Information hosted the meeting in Boulder, Colorado. The goal of the meeting was to further develop topics and progress actions captured in the draft 2023 TSCOM Action Plan and to rework the plan into a more inclusive GEBCO Technical Action Plan**.**

About the organizers: TSCOM provides technical advice towards the maintenance and improvements of GEBCO products and supporting data. The DCDB is the recognized IHO repository for all bathymetric data, with the intention of providing preservation, discovery and access of data. The Nippon Foundation - GEBCO Seabed 2030 Project has the goal of creating a complete map of the world ocean by 2030, and is actively assembling bathymetric data into the publicly available GEBCO world map.

Report written by: Vicki Ferrini and Jennifer Jencks

Executive Summary

This report summarizes the outcomes of the March 2024 working meeting focused on further developing topics and actions described in the draft 2023 TSCOM Action Plan to create an inclusive GEBCO Technical Action Plan. The strategic goals of the workshop were focused on increasing data availability and utility by encouraging transit mapping data collection, enhancing metadata, coalescing around common format standards, and sharing tools and approaches for data stewardship. Workshop participants aimed to foster collaboration, refine objectives, and develop actionable strategies to advance technical initiatives within the GEBCO framework.

By developing actionable strategies to advance technical initiatives within the GEBCO framework this effort aspires to deliver efficiencies, grow the GEBCO community, and achieve goals that are beneficial to all. Adopting proven practices that promote data acquisition and sharing will help increase the availability of critical data that serves the common good. Prioritizing efforts and ensuring a consistent strategy across strategic goals will help target resources more effectively and ensure that the messaging is unified across different stakeholders and initiatives.

The meeting was co-hosted by Jennifer Jencks (Director of the IHO DCDB) and Dr Vicki Ferrini (Head, Atlantic and Indian Oceans Regional Center for the Nippon Foundation GEBCO Seabed 2030 Project and TSCOM member). The list of participants (virtual and in-person) are found in Annex A.

Objectives

At the conclusion of the 2023 Working Meeting at LDEO, there was recognition of the need for clear guidance documents, standards, and targeted communication to drive adoption of the proposed guidance. In preparing for the May 2024 meeting, the two key objectives identified were to:

> Finalize and activate a GEBCO Technical Strategic Plan, in collaboration with GEBCO subcommittee chairs and in line with the draft GEBCO Strategy.
>
> Develop and begin building the Communication Campaigns (audience, comms mechanisms, intended outcomes and timelines) for each Strategic Goal.

Development of a GEBCO Technical Action Plan

The workshop focused on developing a technical action plan for GEBCO in collaboration with GEBCO subcommittee chairs and in line with the GEBCO Strategy. The new GEBCO strategy has a modern, expansive and ambitious perspective including a renewed vision to bring knowledge about the global seabed to the world through free and open datasets; and an expanded mission of enabling and inspiring seabed mapping efforts through international capacity development, education, and collaboration. The GEBCO Technical Action Plan, led by GEBCO's Technical Sub-Committee on Ocean Mapping (TSCOM), aspires to weave the technical recommendations generated with broad community input during the hybrid technical engagement series in 2023 into the broader GEBCO vision while fully engaging GEBCO subcommittees to maximize participation and impact in-line with GEBCO's renewed vision.

The technical plan revolves around improving data collection practices, enhancing metadata, and incentivizing participation and adoption within specific communities, organizations, and sectors. Clear technical guidance, in the form of documents and standards, should be the foundation of targeted communication to drive adoption of the proposed practices. The messaging campaign that supports the technical plan can then build on those documents and promote the culture change necessary.

Acknowledging that cultural differences in data acquisition, processing and sharing practices exist highlights the importance of accommodating diverse approaches. A key aspect of the action plan involves technical enhancements, particularly in metadata and web services which will enrich our ability beyond binary classification of mapped vs unmapped, but help inform decision-making about whether or not existing data are sufficient for different use-cases. To ensure broader adoption and usability of the generic sensor format (GSF), cultural and technical challenges including format restrictions, usability barriers, and compatibility with commercial software must be addressed along with.

Development of Communication Campaigns

Clearly defining target audiences and intended outcomes will be critical to developing messaging strategies for different stakeholders. Articulating incentives, developing clear messaging tailored to various audiences and decision-makers, and addressing fears and concerns that inhibit adoption are critical aspects of the messaging campaign. Leveraging the expertise and efforts of GEBCO subcommittees and other partnerships will help ensure that the messaging campaign is comprehensive and focused.

Throughout the workshop, there was an emphasis on community involvement and ensuring proposals align with broader community interests and usage patterns. Participants also emphasized the importance of iterative planning, continuous refinement, and collaboration.

They discussed strategies for organizing and managing tasks, balancing aspirations with practical feasibility, and adapting their approach based on ongoing feedback and insights.

Strategic Priorities

Strategic priorities developed in 2023 were the primary focus of this workshop. Three strategic priorities are technical, and the fourth is integrative. Prioritizing efforts and ensuring a consistent strategy across all goals will help GEBCO in targeting resources more effectively and ensuring that the messaging is unified across different stakeholders and initiatives.

Strategic Priority #1: Increase data availability: Transit mapping

Increasing data availability can be accomplished through two mechanisms: (1) the contribution of existing data, and (2) the acquisition of new data. This strategic goal addresses both, by focusing on increasing and normalizing opportunistic data acquisition during transits and establishing routine pathways for contributing those data to the IHO DCDB public archive.

> **Vision:** Multibeam-enabled vessels routinely acquire data while transiting throughout the high-seas and contribute the resulting swath-formatted* data to the IHO-DCDB for access and use by the global community.
>
> **swath-formatted = raw swath sonar data or processed swath sonar formatted data in GSF or processed MB-System compatible data (not ascii or raster).*
>
> **Why this is important:** Data are scarce and acquisition is costly, not acquiring transit data is a missed opportunity.

There is agreement that there should be a concerted effort to improve data collection practices, standardization, and incentivization within the discussed community or organization. There is also recognition that the primary effort to move this forward will depend on clear communication, stakeholder engagement, and resource management in achieving these goals.

Discussions highlighted the importance of clarifying roles and responsibilities, addressing technical and regulatory challenges, and improving accessibility and transparency in the data collection approval process. Action items include further exploration of tax incentives, standardizing approval guidelines, and improving accessibility of approval information for stakeholders.

Technical Document(s)

There was a decision to develop a guidance document that would cover topics such as purpose, scope, data collection methods, data quality assessment, and legal considerations with regards to collecting transit data. This would be similar, in layout, to the IHO Publication B-12: IHO Guidance on Crowdsourced Bathymetry.

"Cultural Change" Documents

The importance of conveying the value proposition of transit data to different audiences is key. This will include marketing efforts targeted at various stakeholders to encourage data contribution.

Stakeholder Group	Desired Outcome
Government Decision Makers	Recognize the value of transit data and authorize acquisition/sharing of data. How: Articulate incentive for each sector and showcase success stories. Awareness of tools and protocols for optimizing data quality during transit mapping at lower costs (+ gap filling)
Commercial Survey Companies	
Academic Fleet Managers*+	
Sensor Manufacturers + Tech Support Projects (e.g. MAC)	
Data acquirers	
Science Community	
Vessel Operators	
Research Fleet Managers	

Strategic Priority #2: Enhance metadata and improve web services

Web services have become one of the primary ways users discover, evaluate and assess available bathymetric data and data products. The strategic intent is to define and document the clear steps necessary (e.g. specific data coverage web service modifications) to enhance web services to better meet user needs, and to increase usability and accessibility for downstream geospatial analysis and integration.

The lead developer of the UNH/CCOM Bathy Globe Tool was invited to provide an update of the tool and help identify areas for collaboration. The need for metadata and minimum standards for service functionality were discussed as this is the core of content utilized by Bathy Globe and other data discovery applications. More details of this discussion and next steps can be found in Annex B.

The underlying issue that brought us here was the desire for a DataNoData (DND) layer, a single layer showing us what is mapped or unmapped; facilitating this layer is an end goal of improving web services. There is no single **planning layer** that definitively shows seabed mapping coverage and availability. Evaluating areas left to be mapped for proposal presentations, funding requests, planning, and at-sea opportunistic mapping involves finding and navigating multiple data layers, a task that is overly complex for the majority of users and cumbersome in practice for proficient data users.

> **Vision:** Bathymetric web services are provided in the types of formats and with enough supporting metadata to allow for query, extraction, validation, and integration by downstream users.
>
> **Why this is important:** Web services are a widely used, important way of letting the ocean mapping community and general public know about the work you have been doing. Web services tend to be the most up-to-date representation of what is available in the archives, and allow consumption by an infinite number of applications and the broadest community possible. By providing web services with enhanced capabilities and enriched metadata, we can improve data discovery, facilitate integration (data-no-data layers) and provide an improved what-has-been-mapped base layer for existing and to-be-developed applications and tools. The enriched metadata is the transformation piece that takes us from data to information.

Technical Document(s)

Over the last several years, there has been quite a bit of progress made towards integrating data layers and improving web services. A Guidelines for Bathymetry-Focused Web Services is near finalization and will be a useful tool for many in the community. This will be a living document that will be updated as we obtain more feedback from service providers regarding their experiences and challenges in developing web services.

The need for an "Integrated Metadata Document" has also been discussed for some time. Specifically, integrated and cross-referenced metadata needs that are articulated through GEBCO metadata guidance and are cognizant of the multiple stages in the data stewardship

continuum. The desired outcome involves establishing a master inventory of minimum metadata requirements that meets use-cases across the data continuum.

“Cultural Change” Documents

It will require a collaborative effort to address technical challenges and improve the usability and interoperability of web services for ocean mapping. There was much discussion around encouraging collaboration and partnership with organizations like CCOM to leverage their work in improving web services. The goal is to ensure that the knowledge gained from these efforts benefits the wider community. Documenting issues and challenges faced in developing web services is key as this information will help inform future efforts and support the broader community.

Stakeholder Group	Desired Outcome
Web Service Providers Decision & Policy Makers/Government	Recognize the value of enhanced metadata and services that support data discovery and survey planning
Web Service Providers Decision & Policy Makers/Government	

Strategic Priority #3: Encourage the use of a common generic sensor format for bathymetry

GSF or generic sensor format is a sensor - and software - agnostic format for storing swath bathymetric data that can store processing flags as well as important early-stage processing information such as the applied sound speed information. As we increase the sharing of raw data, to be efficient we must also focus on coordinating data processing efforts.

A strategic approach is required to address the complexities associated with data formats, with a focus on collaboration, communication, and practical solutions to improve interoperability and efficiency in data management and analysis.

> **Vision:** Swath-formatted processed data are routinely archived and the community moves toward the adoption of a proper fully interoperable GSF.
>
> **Why this is important:** As the archive of raw swath sonar data increases, and increasing numbers of people are processing data, we can leverage the value of the data by sharing the next stage of processed swath data to avoid duplication of

those processing efforts. Sharing data in an interoperable processed swath file format enables down-stream users to conduct additional data processing steps without having to revert to raw data. A standard and supported GSF format and tools ensures interoperability and protects the future of the data archived.

Technical Document(s)

There was an identified need to develop tools and translators to facilitate the conversion of data between different formats, particularly between GSF and MB system formats, which are commonly used in the industry.

While a Draft GSF Issue Paper has been written, it was agreed that it should be further adapted and published.

"Cultural Change" Documents

There is an agreed upon need to improve communication and understanding among stakeholders, prioritize efforts effectively, unify messaging to promote the GSF format.

The participants discuss the importance of engaging various stakeholders, including government agencies, software manufacturers, and researchers, in efforts to promote and improve the GSF format. They also touch upon the need for education and training to ensure that users understand how to effectively implement and utilize the format.

Stakeholder Group	Desired Outcome
National Survey and Mapping agencies	Recognize the value of preserving and sharing processed swath data, and authorize/provide GSF data to the archive(s).
Science Community	
Swath data acquisition and processing agencies and companies, and project funders	
Data archives/repositories	
Community Groups (eg: GEOHAB, Hydrographic Societies and Association, Oil and Gas Survey/Producers, Eurofleets)	Promote the value of GSF processed swath data for the community, availability of data archives.

Strategic Priority #4: Unify an approach for disseminating info & outcomes

To accomplish the technical goals that have been identified, there is a need for clear and coordinated messaging, acknowledging that different sectors and regions may require tailored approaches. The stakeholder community is broad and diverse and includes policymakers, regulators, funding agencies, and others who play a role in shaping data policies and decisions as well as research fleet managers, vessel operators, commercial entities, sensor manufacturers, and other amplifiers.

Tailoring the messaging and engagement strategies to the specific context of each region or country was recognized as an important aspect of the communication strategy. This may involve understanding the existing policies, regulations, and initiatives related to the topic at hand, as well as identifying key stakeholders within the government who have influence over decision making in that domain. Flexibility and adaptability in approach will be crucial for effectively reaching and engaging with government decision makers across different jurisdictions. The conversation also touched on the role of companies like Kongsberg in automating data delivery and the potential benefits of leveraging cloud technology to increase data availability.

Overall, there was consensus on the need for a phased approach, with technical document completion marking phase one and broader outreach efforts following thereafter. The group recognized the importance of collaboration, engagement with stakeholders, and effective communication to advance GEBCO's goals. The communication strategy will also need to evolve and be flexible to adapt to challenges and opportunities along the way.

Strategic Priority #5: Develop a larger vision of GEBCO

There was a call by the TSCOM Chair for envisioning the future of GEBCO beyond its current activities. This includes considerations for evolving skill sets, shifting methodologies (e.g., real-time grid generation), and adapting to changing needs in ocean mapping and data management.

An example of the topics from this brainstorming session includes:

1. GEBCO provides hands on capacity building
    a. More than just a document and a webpage; GEBCO to provide in person training and support (eg: supporting organizations in building in-house web services)
    b. Technical training, technical support through GEBCO
    c. Encouraging organizations to want to build their capacity
    d. Supporting training courses (sending people to a variety of courses, including commercial)
    e. Supply of equipment/software

2. GEBCO funds mapping expeditions
3. GEBCO identifies new partnership opportunities and defines how mutually beneficial partnerships can functionally be established
4. GEBCO establishes a functional distributed model of engagement and participation to ensure that groups around the world are empowered and can engage productively and equitably in GEBCO's work ("creates an active mechanism to participate").
5. GEBCO includes staffing. With the exception of SB2030, GEBCO currently relies on volunteers funded elsewhere or not at all. Perhaps the current SB2030 model can help transition GEBCO post-2030.
6. Invest in the data system of the future (technology AND people) that are needed for the use cases of today and tomorrow.

In summary, the conversation underscored the importance of strategic planning, collaboration, and proactive efforts to address challenges in ocean mapping. By developing a clear funding strategy, fostering global cooperation, exploring new funding and resource contribution opportunities, and addressing metadata issues, the group aims to advance its goals and initiatives in ocean exploration and research.

Next Steps

Following the March 2024 Workshop, the draft GEBCO Technical Strategic Plan will be finalized and presented at GGC41 for approval and activation. In the meantime, progress will be continued on the strategic priorities described above.

Annex A: Meeting Attendees

In Person:

1. Jennifer Jencks - Workshop Co-Lead, DCDB Director, TSCOM & SCOPE Member
2. Vicki Ferrini - Workshop Co-Lead, Seabed 2030 Regional Data Center Head, TSCOM Member; Strategic Goal 1 Co-Lead
3. Federica Foglini - TSCOM Vice Chair, GEBCO Metadata WG Chair
4. Lindsay Gee - Strategic Goal 3 Lead
5. Erin Heffron - TSCOM Member, Strategic Goal 2 Lead
6. Shannon Hoy - Strategic Goal 1 Co-Lead
7. Juliet Kinney - Seabed 2030 Data Manager, TSCOM Member
8. Roxy Wigley - SCET Vice Chair

Virtual:

1. Aileen Bohan - SCRUM Chair
2. Tom Butkiewicz - UNH/CCOM (Annex B)
3. Eunmi Chang - SCOPE Vice Chair
4. Sarah Grasty - SCOPE Chair
5. Larry Mayer - Seabed 2030 Regional Data Center Head
6. Geoffroy Lamarche - GEBCO Strategy Author, GGC Member
7. Kim Picard - GEBCO Strategy Author, GGC Member
8. Helen Snaith - Seabed 2030 Global Data Center Head, TSCOM Member
9. George Spoelstra - TSCOM Chair
10. Pauline Weatherall - GEBCO Data Manager, TSCOM & SCOPE Member

Annex B: Summary of Discussion re. Bathy Globe Filler

Bathy Globe was created to address the issue of displaying coverage data sets accurately and at scale. Initially designed as an visualization and outreach tool, it later evolved into Bathy Globe Gap Filler, a desktop application used to plan transits and surveys to fill gaps in data coverage. The Bathy Globe team is now working on a web-based version to improve updating frequency of data coverage layers with a focus on open-source tools and collaboration to enhance efficiency and accessibility for users.

Data coverage layers are sourced from the public GEBCO data set, which is updated annually, and two other sources that are updated on a higher frequency (GMRT, DCDB) to identify existing coverage and inform survey planning based on data quality. The conversation touched upon data quality complexities and the importance of cooperation to streamline data access and improve metadata availability.

The need for metadata and minimum standards for service functionality were discussed as this is the core of content utilized by Bathy Globe and other data discovery applications. The conversation delved into the complexities of data quality assessment and the challenges of creating a unified data layer. There was discussion of the need for an authoritative data coverage layer with clear documentation enabling users to build custom web applications, but this is not something UNH/CCOM is aspiring to do.

The importance of publicly available logic for decision-making and the potential for creating a series of layers that users can toggle on and off was also discussed. Collaboration and the need for clear communication between different stakeholders involved in data integration and service improvement was emphasized.The aim is to ensure the most accurate and equitable access to data for planning surveys and assessing data quality.

The following actions were agreed upon:

Document the Approach: There was an agreement that UNH/CCOM will document the approach used to assemble the coverage layers, including the algorithms and decision-making process involved. This documentation would make the logic transparent, publicly available and repeatable.Emphasis was placed on ensuring that the publicly available data and the decision-making logic behind the coverage layer are transparent and replicable by anyone.

Serve with Caveats: The UNH/CCOM team agreed to serve the coverage layer with appropriate caveats and warnings, acknowledging the limitations and subjective nature of the data quality assessment and their limited ability to serve this information at scale. However, they do not aspire to be an authoritative source.

Variable Decision-Making: Providing controls for users to adjust parameters and criteria for assessing data quality, would allow users to build their own coverage layer based on their preferences and trust levels in different data sources.

Provide Guidance on Web Services: There was a request for guidance on providing web services for data that may not be well-defined or confidently assessed. This would involve incorporating input from the TSCOM group and GEBCO to determine how such data should be served and what metadata should accompany it.