

The Nippon Foundation-GEBCO

Seabed 2030 Project

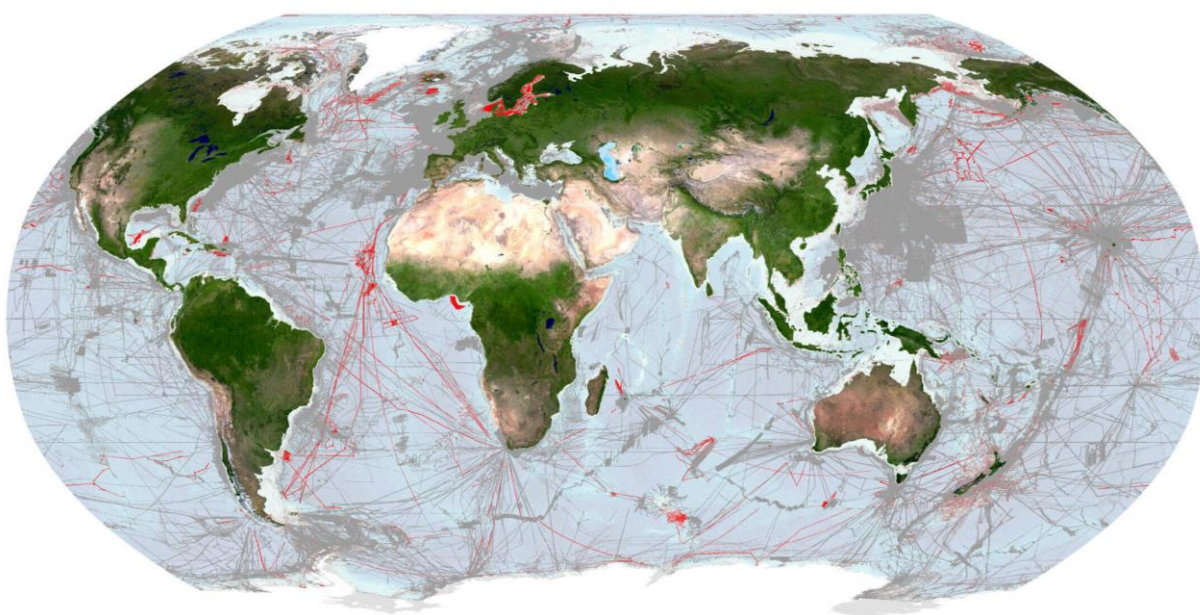
100% of the ocean floor mapped by 2030

YEAR 7 ANNUAL REPORT

1 August 2023 – 31 July 2024

Authors: Seabed 2030 Project Team

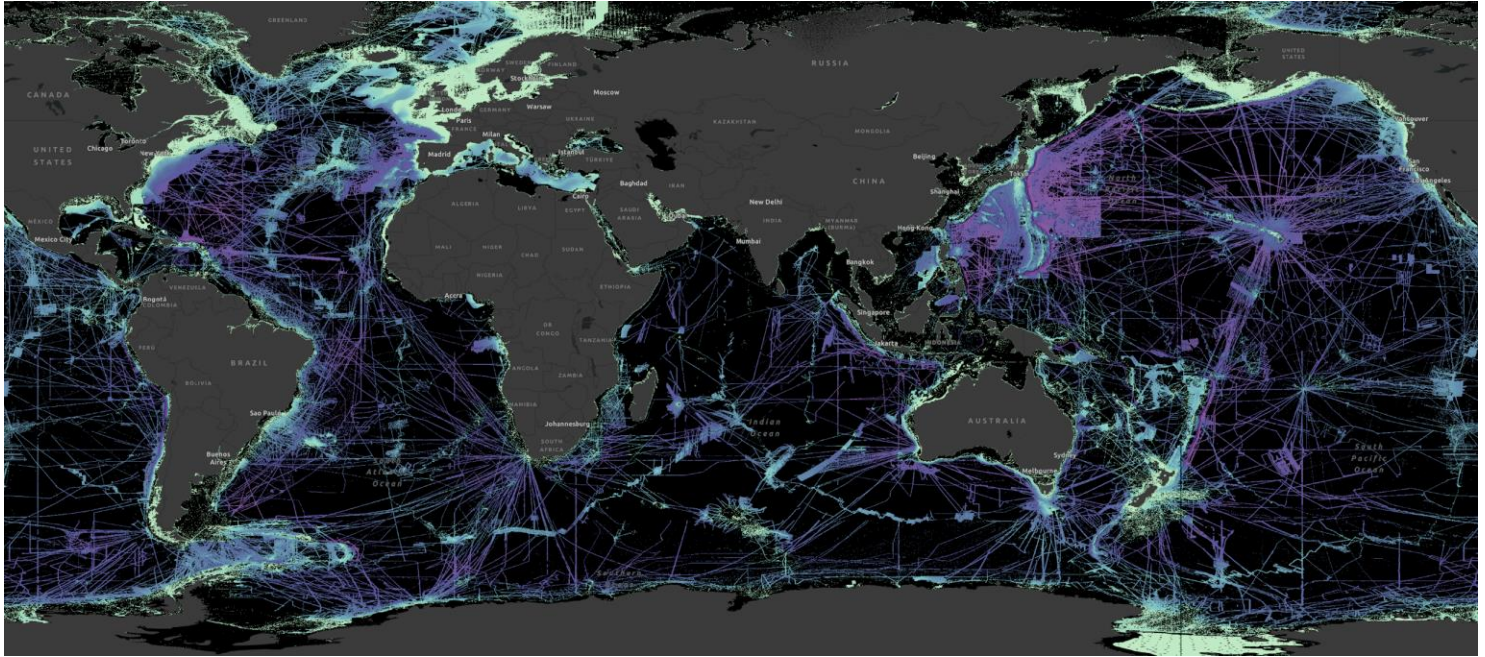
Jamie McMichael-Phillips, Martin Jakobsson, Helen Snaith, Vicki Ferrini, Boris Dorschel, Kevin Mackay, Larry Mayer, Jennifer Cheveaux, Shereen Sharma, Steve Hall, Pauline Weatherall, Pegah Sourì.



***GEBCO Grid 2024 (red) v 2023 (dark grey) coverage comparison.
courtesy: National Oceanography Centre.***

Contents

Seabed 2030 Vision	3
Executive Summary	4
Appendices	6
Introduction	7
Year 7 Finance Report (Main Budget)	8
Finance Report (Ocean Frontier Mapping)	8
Center Information	9
Seabed 2030 Center Reports	10
Southern Ocean Regional Center	10
Pacific Ocean Regional Center	15
Atlantic and Indian Oceans Regional Center	23
Arctic and North Pacific Oceans Regional Center	45
Global Center	70
IHO Data Center for Digital Bathymetry	75
Management updates	78
Engagement and Development	78
Partnerships	84
Media and Communications	85
Project Update by work stream	86
WP1: Data	86
WP2: System and tools	87
WP3: Technology Innovation	89
WP4: Mapping Activities	90
WP5 Management	91



Unmapped Ocean v2024 GEBCO_2024 (courtesy: Lamont-Doherty Earth Observatory).

Seabed 2030 Vision

By 2030, the World's oceans are fully mapped and the freely available GEBCO Grid is a complete map of the global ocean bathymetry.

ACCELERATING OCEAN MAPPING

Executive Summary

Year 7 has been a high tempo year for The Nippon Foundation–GEBCO Seabed 2030 Project which has seen significant activity across a broad range of work areas.

The most noteworthy milestone was the June 2024 announcement of 26.1% of the world ocean mapped. Some 4.34 million km² of new data, equating to an area broadly that of the EU, was added to the GEBCO Grid. This could not have been achieved without the generous support of a wide variety of data contributors across government, philanthropic, industry, academic and citizen-science sectors.

There has been sustained effort across all of our Seabed 2030 Centers in the areas of gridding, innovation, regional networking and working with the various GEBCO Sub Committees. There has been a blend of activity funded within the Seabed 2030 Grant combined with that undertaken as part of wider programmes funded separately within the research institutions that host the Centers, all of which has greatly benefitted the Project and the wider GEBCO Programme. New versions of IBCAO (5.0) and GMRT (4.2.1) have been released, and advanced preparations are underway for the 2024 release of IBCSO later in Year 8. Significant improvements have been made for the storing and handling of metadata, not only for the Arctic region, but also for global data sets used during statistical calculations. The latter is now derived from a fully automated algorithm at Amazon Web Services. There has been refinement of the viewer and hosting facility for the GEBCO Grid; a Web Map Service (WMS) has been developed to deliver imagery based on the GEBCO_2024 release, and work is progressing on delivery of the multi-resolution grid.

One of our Center hosts has been deeply engaged in the DriX uncrewed vessel trials and upgrade, with a compact midwater MBES. In conjunction with the E/V Nautilus, successful field mapping was achieved. The improvement of existing and development of new GEBCO web services and applications for the user community continued across the Centers. Work also included the creation of the “Understanding TID” Story Map available on the GEBCO website in both English and Spanish. Again, a blend of Seabed 2030 and other agency funding applies and the benefit to the wider ocean mapping community is clear. Applications included:

- GEBCO 2024 Globe Web App
- GEBCO Global 15 arc-second & multi-resolution Web App (in draft)
- GapFiller (transit & survey planning)
- Meso-American & Caribbean Hydrographic Commission Web App
- Regional Gap Analysis Web App
- Regional Unmapped Ocean Web App
- WIOBathy Web App (see below)

We have continued to host the Seabed 2030 Crowdsourced Bathymetry (CSB) Trusted Node at the Global Center, processing incoming crowd sourced data, providing support and feedback to Regional Centers and data collectors, and liaising closely with IHO’s DCDB on data submission.

As always, we continue to receive stalwart support from the DCDB Director and her team. This extends beyond data repository core business, which of course is crucial to the ocean mapping effort; and embraces wider leadership, outreach, and support for GEBCO and Seabed 2030; including hosting of, and participation in, workshops, discussion panels and other key technical fora.

Engagement with the Nippon Foundation-GEBCO alumni has continued throughout the year. Two individuals kindly offer their time to us on an on-call remote basis to provide technical support to CSB volunteers. We have also been associated with two alumni-led projects:

- WIOBathy: Collation and compilation of Multi-Scale and Multi-Resolution Bathymetric Data in the Western Indian Ocean.

- MARUM: Sharing MARUM bathymetric data and open-source processing software (MB-System) workflows.

These projects are funded separately by The Nippon Foundation but directly support Seabed 2030 and the population of the GEBCO Grid.

Year 7 saw a continued rise in our global media coverage, increased collaboration with strategic partners, and expansion of the Project's presence across multiple digital platforms. Mid-year revision of the Seabed 2030 Communications Strategy focused on a highly targeted engagement programme alongside a multimedia profile raising campaign. Regular updates, live event coverage, and collaborative content with partners has helped to drive interaction. Some 495 media hits were recorded during Year 7, and there was sustained engagement and growth across traditional and social media.

The *Wind in the Sails* activity delivered to us the compendium of 12 Use Cases for ocean mapping. These are designed to be high-level readable documents for senior decision makers within the wide ocean community but also have utility for a much wider group of users/readers. Proof reading was underway at the end of Year 7, prior to publication early in Year 8.

An improved level of administrative resilience was introduced within the project. Following the withdrawal of the CEH/NOC Wiki site, a replacement shared area for storage and maintenance of project documents has been established, including a full historical archive of the old Wiki site documentation.

We extended our reach across an increasing number of stakeholders during the year. A significant 14 new MOUs were added to the portfolio, bringing the total number at the end of Year 7 to 63. Whilst every MOU is important to us, the very notable, and arguably the most complex signing in Year 7 was with the 5 Member States of the Nordic Hydrographic Commission: progress here was facilitated greatly by the GGC Chair. Again this year, we represented Seabed 2030 at a broad range of gatherings, both in-person and through virtual attendance. Noteworthy international events include: the Alumni Seminar (Japan); the International Research Ship Operators Meeting (Belgium); The Ocean Collective Summit (Singapore); COP28 (UAE); AGU Annual Meeting (USA); Our Ocean Conference (Greece); Canadian Hydrographic Conference; Hydrospace Conference (Australia); WESTPAC International Mariner Science Conference (Thailand); and PNMS Science & Monitoring Strategy Workshop (Palau).

In addition to regular, ongoing engagement with the Ocean Decade Corporate Data Group, the Seabed 2030 Team also attended a number of IHO and IOC events during Year 7, including: South East Pacific Hydrographic Commission (Chile); South West Pacific Hydrographic Commission (Fiji); Hydrographic Commission on Antarctica (Italy); 2nd Ocean Decade Regional Conference (Thailand); Indian Ocean Regional Decade Conference (India); Ocean Decade Challenger 150 Atlantic Scientific Regional Working Groups Meeting (Spain); and the 1st Ocean Decade Conference (Spain).

Our Centers have supported a number of lab visits, predominantly focused on capacity sharing and development. We ran a Cross-Regional Seabed 2030 Workshop in Colombia; supported the WIOBathy Data Workshop in Madagascar; and held our 5th Arctic-Antarctic and North Pacific Mapping Meeting in Germany.

Overall, Year 7 has been busy and fruitful year for Seabed 2030. This was achieved through strong collaboration across the Project Team and the enduring staunch support of our parent organizations—The Nippon Foundation, GEBCO, IHO, and IOC. Lastly but by no means least, we have been greatly supported by our growing stakeholder community. To all, we again extend our sincere gratitude in helping to accelerate the mapping of our Ocean.

Appendices

The following appendices support the main body of this report:

Document name
Appendix 1 - Year 7 Programme of Work (v1.2 FINAL)
Appendix 2 - Year 8 Bid Submission (v1.3 FINAL)
Appendix 3 - Year 8 Work Plan (v1.2 FINAL as approved by NF Board)
Appendix 4 - Year 8 Grant Agreement
Appendix 5 – Year 7 Finance Report
Appendix 6 – The Nippon Foundation-GEBCO Alumni Projects: 6a – WIOBathy Project Inception Report 6b – MARUM Project Progress Report
Appendix 7 - Year 7 Media Coverage
Appendix 8 – Greenland CSB Progress Report (as of end Year 7)
Appendix 9 – Satellite Derived Bathymetry Dominican Republic Project Report
Appendix 10 – Wind in the Sails (WITS) Project: 10a – Use Case Compendium 10b – Work Plan for Year 8 (Phase 3, Objective 9)
Appendix 11 – Communications Strategy
Appendix 12 – Record of MOU Partners, and Supporters to end of Year 7
Appendix 13 – Year 7 Social Media Report (Meridian)
Appendix 14 - Year 7 key events attended

Introduction

This report details activities and progress achieved within the Year 7 period of 1 August 2023 to 31 July 2024 and fulfils annual reporting obligations for The Nippon Foundation grant award and the GEBCO Guiding Committee (GGC).

Having just entered its eighth year of activity, The Nippon Foundation – GEBCO Seabed 2030 Project (Seabed 2030) is a collaborative project between The Nippon Foundation and GEBCO to inspire the complete mapping of the world's ocean by 2030 and to compile all bathymetric data into the freely-available GEBCO Ocean Map.

Working under the auspices of the International Hydrographic Office (IHO) and UNESCO- Intergovernmental Oceanographic Commission (IOC), GEBCO, as of 2023, has a 120-year history of ocean floor mapping. Seabed 2030 was launched at the United Nations Ocean Conference in 2017 and is continuing to build a global community of ocean mappers, hydrographers, scientists, industry and the public to discover and publish all existing bathymetric data. Seabed 2030 also advocates for new mapping expeditions to fill the gaps in our knowledge of the seafloor and provide the world with the definitive map of the world's bathymetry.

Seabed 2030 is built on a global network of four Regional Centers *[sic]* and one Global Center *[sic]*, in association with the IHO Data Center for Digital Bathymetry (DCDB). Management of the project is the responsibility of the Project Team, consisting of; the Project Director, the Head of Engagement & Development, the Head of Partnerships, the Project Administrator and the Heads of the Seabed 2030 Centers.

Year 7 Finance Report (Main Budget)

The full finance report covering the 7th operational year of The Nippon Foundation-GEBCO Seabed 2030 Project from 1st August 2023 – 31st July 2024 is enclosed (as Appendix 5). Expenditure summary:

TOTAL	3,200,001.00	3,200,001.00	3,196,641.14
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Surplus (Budget-Expenditure)	3,359.86
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Finance Report (Ocean Frontier Mapping)

The Ocea Frontier Mapping programme is currently on hold pending further guidance from The Nippon Foundation.

Center Information

Seabed 2030 Center	Location	Lead
Southern Ocean Regional Center	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany	Dr Boris Dorschel
South and West Pacific Ocean Regional Center	National Institute of Water and Atmospheric Research, Wellington, New Zealand	Mr Kevin Mackay
Atlantic and Indian Oceans Regional Center	Lamont-Doherty Earth Observatory, Columbia University, United States of America	Dr Vicki Ferrini
Arctic and North Pacific Oceans Regional Center	Joint Center: <ul style="list-style-type: none"> Department of Geological Sciences, Stockholm University (SU), Sweden Center for Coastal and Ocean Mapping, University of New Hampshire (UNH), USA 	Co-Leads: Prof Martin Jakobsson (SU) & Prof Larry Mayer (UNH)
Global Center	British Oceanographic Data Centre, National Oceanography Centre, United Kingdom.	Dr Helen Snaith
IHO Data Center for Digital Bathymetry	National Oceanic and Atmospheric Administration's National Centers for Environmental Information in Boulder, Colorado, US	Jennifer Jencks

The project works on an annual work plan and budget approved by The Nippon Foundation as the funding agent. As a project of an IHO working group, Seabed 2030 reports to the GEBCO Guiding Committee (GGC) on the delivery of the annual work plan. The GGC also endorses the annual work plan and the annual report from the previous year.

The work plan is structured across five work packages:

- WP1: Data.
- WP2: Systems and tools.
- WP3: Technology Innovation.
- WP4: Mapping Activities.
- WP5: Management:
 - WP5.1: Operational Management
 - WP5.2: Strategic direction
 - WP5.3: Communication
 - WP5.4: Capacity Development

Further details of the project can be found on the [Seabed 2030 website](#)

This report continues with reports from each Center's activities in Year 7 and is followed by progress reports on each work package.

Seabed 2030 Center Reports

Southern Ocean Regional Center

Location: Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research.

Center Lead: Boris Dorschel.

Summary

Year 7 activities of the Seabed 2030 Southern Ocean Regional Centre (SO-RC) mainly focused on data acquisition with *RV Polarstern* and the preparation of the IBCSO 2024 annual release. Overall, for the SO-RC, Year 7 was a phase of intense mapping activities during the Antarctic season 2023/24. The major outreach activity was hosting the fifth Arctic Antarctic and North Pacific Mapping Meeting in Bremen, Germany in November 2023.

Center Staff

- Boris Dorschel, Head of the Bathymetry Working Group
- Sacha Viquerat, Data Manager, Programmer
- Patrick Schwarzbach, Data Manager, Outreach
- Natalie Cornish, Data Manager, GIS technician, and Outreach
- Tea Isler, PhD Student
- Laura Höppner, Student Assistant updating the metadata database
- Fynn Warnke, Data Manager, Programmer
- Simon Dreutter, Hydrographer, Cartographer, Data Manager
- Yvonne Schulze Tenberge, Metadata Database

Funds provided by The Nippon Foundation for Year 7 supported 3 Full Time Equivalent (FTE) positions. F. Warnke provide continued support to Seabed 2030 in the form of a mini-job in total 0.1 FTE. T. Isler is part of the SO-RC team pursuing a PhD. L. Höppner supported the team as a Student Assistant throughout Year 7. Additional 0.5 FTE B. Dorschel, 0.3 FTE S. Dreutter, and 0.2 FTE by Y Schulze Tenberge (all AWI) were provided to the Seabed 2030 Project.

Regional Mapping progress

Year 7 was characterised by intense mapping activities. The SO-RC participated in four *RV Polarstern* expeditions collecting almost half a million square kilometres (459,780 km²) of bathymetric data of almost entirely uncharted seabed of the Southern Ocean (PS140 [111,290 km²] Fig. 1 and PS141 [144,810 km²] Fig. 2) and the Atlantic (PS139 [56,100 km²] and PS142 [91,480 km²] Fig. 3). Subsequently, all data will be provided to Seabed 2030. In parallel, data acquisition, integration and cleaning continued. Furthermore, a long-term proposal was submitted to secure the default collection of bathymetric data with *RV Polarstern* during research

and transit expeditions.

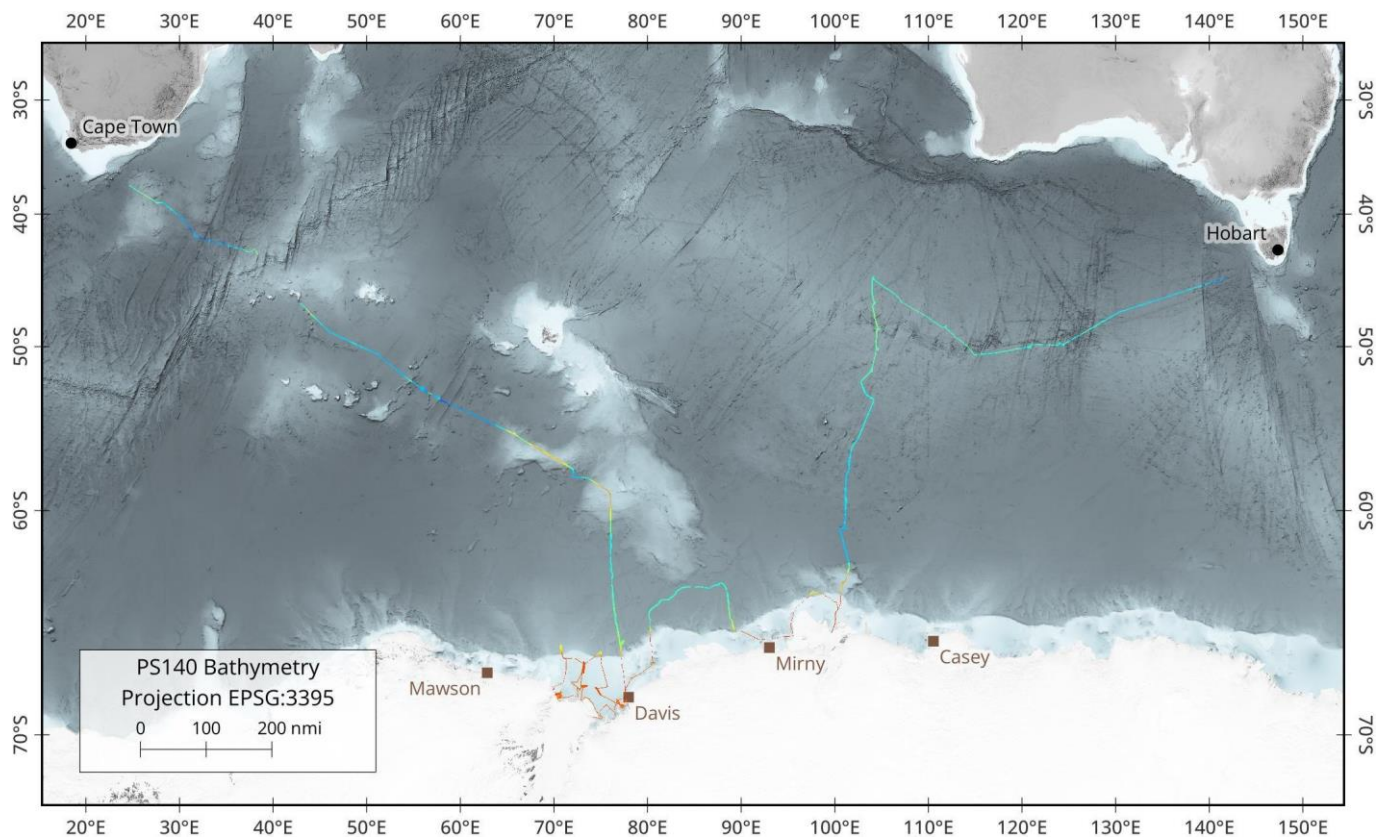


Figure 1) Bathymetric data collected with RV Polarstern during PS140.

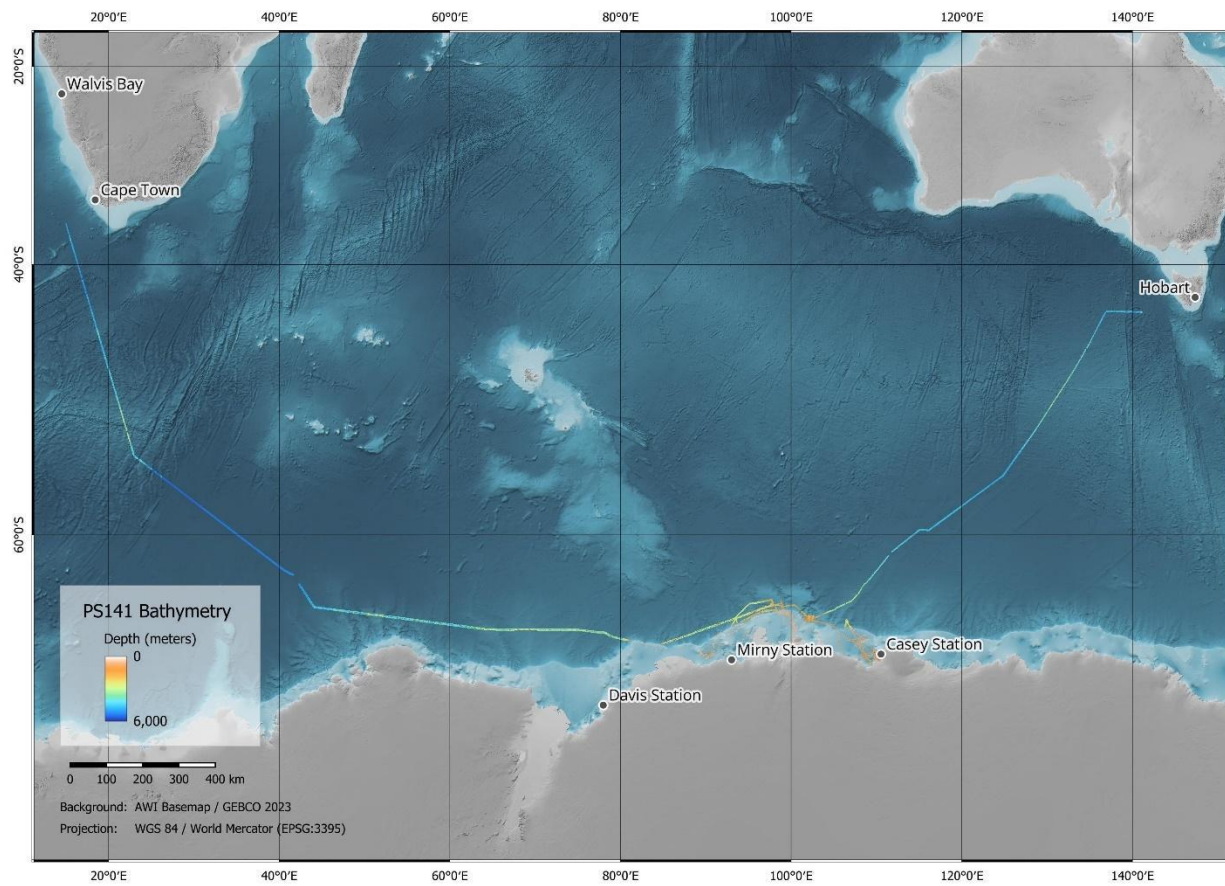


Figure 2) Bathymetric data collected with RV Polarstern during PS141.

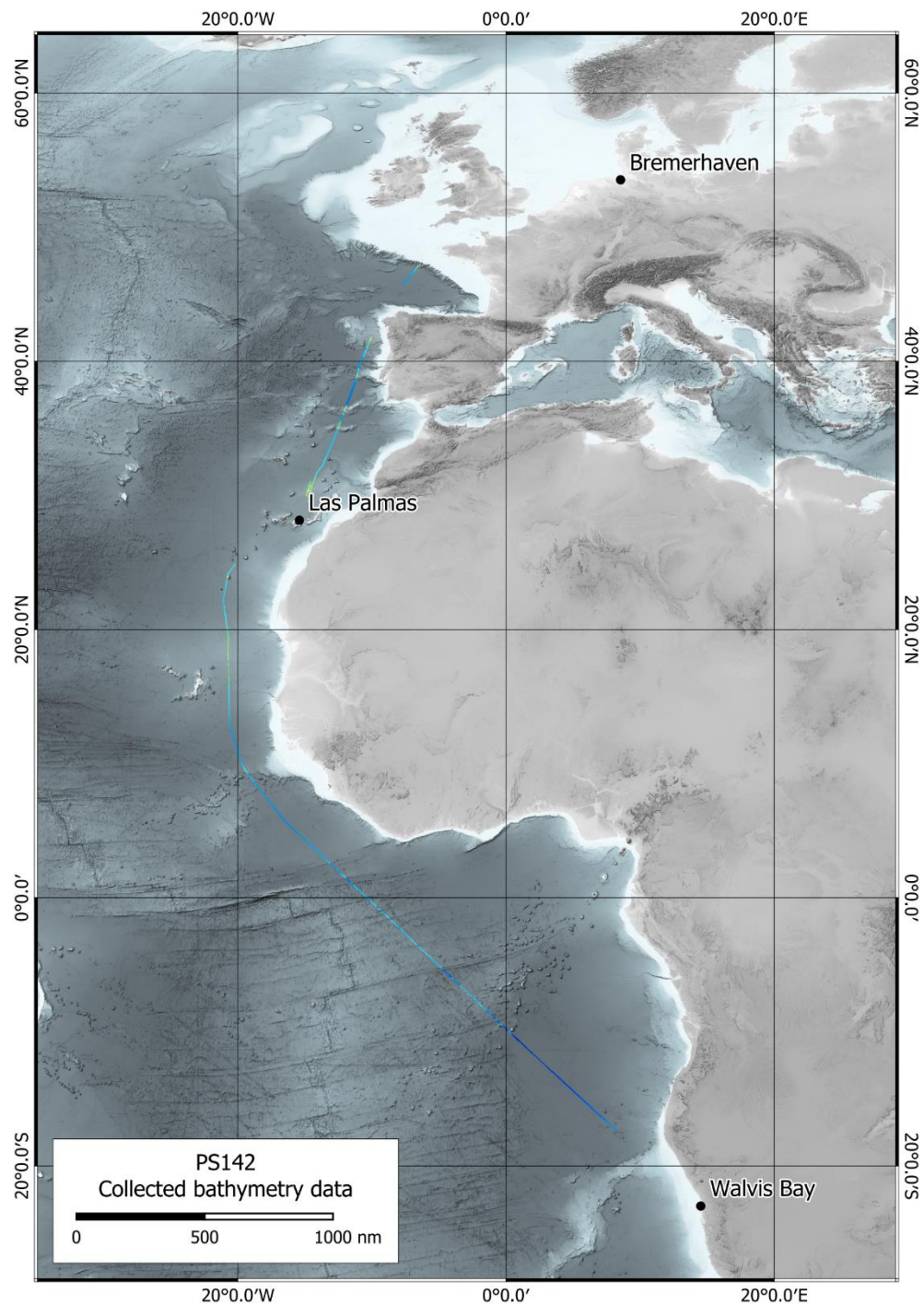


Figure 3) Bathymetric data collected with RV Polarstern during PS142.

Major data and grid contributions

Over the course of Year 7, new data sets were integrated continuously in the SO-RC and IBCSO database. *Table 1* highlights all datasets larger than 100 Mb. The resulting backlog of data was reduced, and all datasets will be integrated in the next GEBCO submission.

Table 1. Data contributions in Year 7.

Dataset	Contributing Organisation
PS140.xyz	Alfred Wegener Institute for Polar and Marine Research
ColAntExpX_GerlacheStrait.xyz	Center for Oceanographic and Hydrographic Research
ColAntExpX_TwoHummockIsland.xyz	Center for Oceanographic and Hydrographic Research
PS141.xyz	National Institute of Polar Research (NiPR)

Other activities

After the migration of data workflow SEAHORSE to AWI's new high-performance computer 'Albedo' in Year 6, optimisations were programmed to utilise the full capabilities of the new hpc system in Year 7.

Report of status of regional mapping committee

The Antarctic and IBCSO mapping communities receive irregular updates of the status of IBCSO. The first IBCSO annual release was prepared.

Stakeholder Engagement and Outreach

- Map the Gaps Symposium & Crowdsourced Bathymetry Spotlight, Monaco, 7-8 November 2023.
- Meeting of the GEBCO Guiding Committee (GGC40) IHO Secretariat, Monaco, 9-10 November 2023.
- The Fifth Arctic, Antarctic and North pacific mapping Meeting, Bremen Germany, 27-29 November 2023.
- Member of the UN Group of Experts preparing a publication on marine geospatial information management.
- 19th Hydrographic Commission on Antarctica (HCA) Conference, Venice Italy, 15-18 April 2024.

Financial report

All Year 7 funds were allocated for staff and data acquisition. For large parts of the year, one student was employed for 80 hours per month for data cleaning. In addition, funds were used to support bathymetric data collection during Expedition PS139, PS140, 141, and 142 with *RV Polarstern*.

Pacific Ocean Regional Center

Location: National Institute of Water and Atmospheric Research, Wellington, New Zealand.

Center Lead: Kevin Mackay.

Summary

The main achievements of the Pacific Center (PaC) during Year 7 (1 August 2023 - 31 July 2024) were:

1. Gathering, processing, assembling, and gridding of bathymetric data collected in the SW Pacific region.
2. Submission of the 15-arc sec resolution sparse grid to be integrated into the GEBCO_2024 grid release; initial delivery to GDACC was done on the 29th February 2024, with a follow-up revised delivery on the 5th May 2024.
3. Preparation of the regional inventory of bathymetric data, and identification of unmapped areas. This included:
 - Continued development of ArcGIS Online viewers to visualize the coverage of bathymetric data holdings of the PaC and other institutes conducting ocean mapping in the SW Pacific region.
 - Identification of potential sources to be explored and data holders to be contacted.
4. Promotion of the Seabed 2030 project and PaC: multiple research conferences, meeting with stakeholders.
5. The data center has been renamed from the South and West Pacific Regional Center (SaWPaC) to the Pacific Ocean Regional Center (PaC). This change has been made to address some confusion about the geographic extent of the center, especially with respect to the inclusion of East Asia and South America in the area of responsibility of the PaC.
6. Communication and outreach:
 - Promotion of the Seabed 2030 project and PaC through multiple international conferences, seminars, individual meeting with stakeholders, and media interviews. A total of 27 presentations were made at various events.
7. Networking and education:

PaC has been engaged various regional organisations and stakeholders throughout the last year in Australia, New Zealand, Peru, Ecuador, Colombia, Chile, Japan, Indonesia, Fiji, New Caledonia, South Korea, Philippines, and Malaysia.

Center Staff

The Centre is based at NIWA Wellington and is led by Mr. Kevin Mackay (NIWA Programme Leader: Environmental Information Management). The Centre Lead is supported in his task by Ms Belen Jimenez Baron in the role of Seabed 2030 PaC Data Manager and a Technical Management Committee (TMC).

Technical Management Committee (TMC)

The PaC TMC includes representatives of NIWA, [GNS Science](#) (Institute of Geological and Nuclear Sciences) and Toitū Te Whenua Land Information New Zealand (LINZ) - which is the New Zealand Hydrographic Authority):

- Dr Sally Watson, Marine Geologist, NIWA
- Dr Vaughan Stagpoole, Geophysicist, GNS Science.
- Dr Brook Tozer; Geophysicist, GNS Science
- Dr Jenny Black, IBCSO editorial member; Data Technician, GNS Science.
- Mr. Adam Greenland, New Zealand National Hydrographer; Former Chair of the IHO South West Pacific Regional Hydrographic Commission; LINZ.
- Mr Stuart Caie, CSB-GEBCO-Seabed 2030 Regional Coordinator for the IHO South West Pacific Regional Hydrographic Commission; New Zealand Hydrographic Authority, LINZ.
- Dr Anna Meissner, Senior Marine Geospatial Specialist, New Zealand Hydrographic Authority, LINZ.

TMC meetings were held monthly in an on-line forum. Records of the agendas and minutes of the TMC meetings are kept at NIWA. These TMC meetings aim:

- to follow up on the progress of the PaC technical and administrative work,
- to provide updates on participation in meetings/conferences aiming to promote Seabed 2030 and seek bathymetric data,
- to identify upcoming actions.

Students

The PaC welcomed two new students this year:

- Callum Mackay joined PaC from Victoria University of Wellington, starting in February 2024, and has been processing and cleaning data given to Seabed 2030 from KOPRI and OGS.
- Juliette Dael joined PaC from the ISEN marine engineering school in Brest, France. Starting in May 2023, Juliette is based in the NIWA Wellington campus and is tasked with processing and cleaning bathymetric data downloaded from the CI National Environment Service.

Regional Mapping progress

PaC 2023/2024 delivery (direct measurements only) that was integrated into the GEBCO_2024 release covers ca. 36% of the GEBCO_2024 cells (15 arc sec grid cell size) for the PaC regional extent.

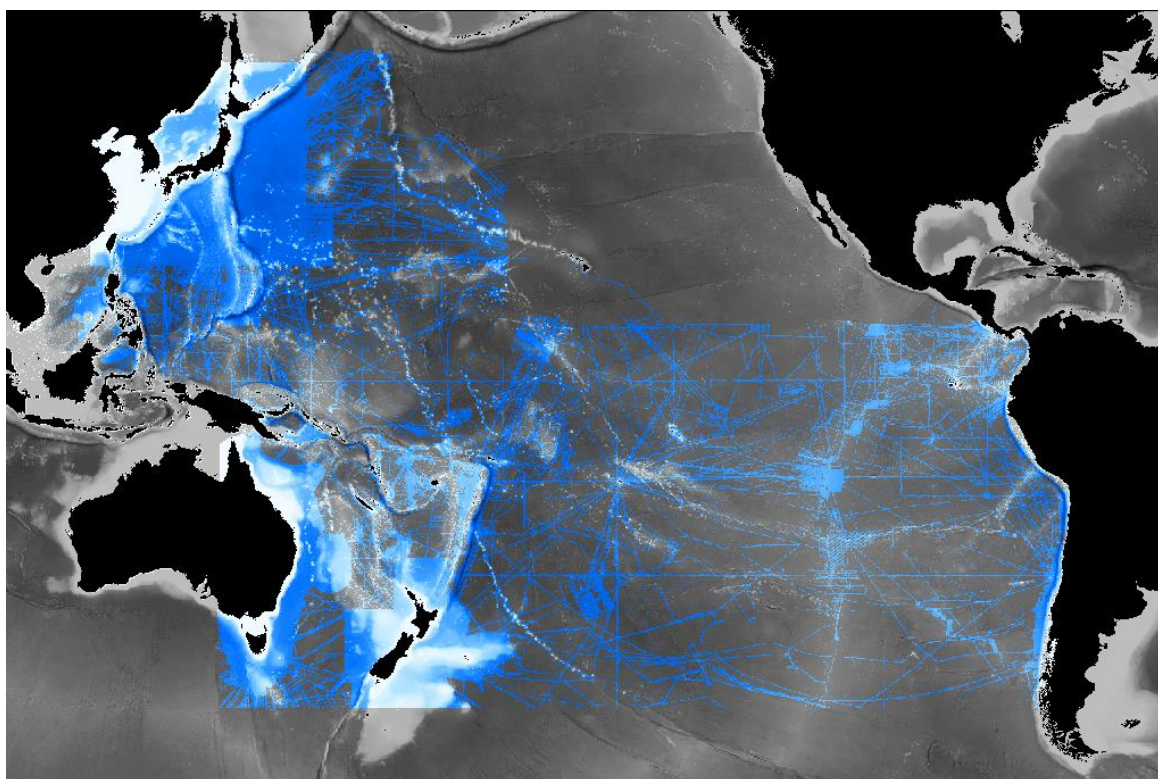


Figure 1. SaWPaC delivery 2023/2024 - bathymetric data layer, 15 arc sec sparse grid- overlain on the GEBCO_2024 gridded bathymetry.

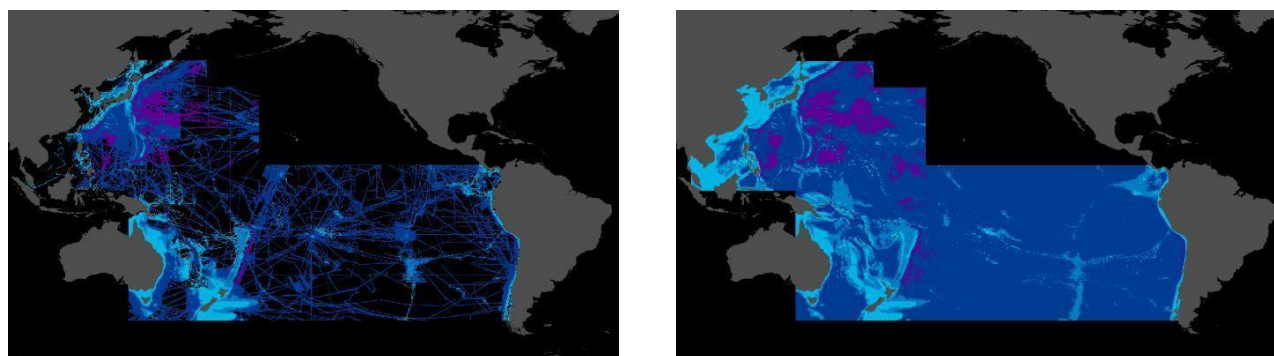


Figure 2. PaC delivery 2023/2024 (left) and target Seabed 2030 - GEBCO coverage for the south and west Pacific (right). Depths are coloured according to the ranges defined by the Seabed 2030 target grid resolution.

To enable the community to visualize the data delivered in 2024 and current bathymetric data holdings, PaC keeps an updated webmap app using [ArcGIS online viewer](#). More advanced ArcGIS users can access and download different open source layers through the [NIWA open data page](#).

Stakeholder Engagement and Outreach

Members of the PaC Technical Management Committee presented the Seabed 2030 Project at various regional conferences, workshops and seminars, as listed below.

The Centre activities were also presented at IOC/IHO meetings in the region, including the 21st Meeting of the

South West Pacific Regional Hydrographic Commission, the 10th East Asia Hydrographic Commission meeting, the 2nd UN Ocean Decade Regional Conference and, for the first time, the South East Pacific Regional Hydrographic Commission.

Conference/workshop presentations

Jimenez, B. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. Australasian Hydrographic Society Seminar, 30 August 2023, Dunedin, New Zealand.

Jimenez, B. (2023) Seminar on The Nippon Foundation – GEBCO Seabed 2030 progress. Otago University School of Surveying, 7 September, Dunedin, New Zealand.

Mackay, K. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. Marine Geophysics Symposium, 11-12 September, Wellington, New Zealand.

Jimenez, B. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. 1st Pacific Islands Conference on Ocean Science and Ocean Management, 11-15 September 2022, Nadi, Fiji.

Jimenez, B. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. Fiji Hydrographic Service, 18 September, Suva, New Zealand.

Jimenez, B. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. SPC Maritime Boundary Expert and Pacific Data Hub Architect, 19 September, Suva, Fiji.

Mackay, K. (2022) TESMaP. FEMME 2023 Kongsberg Multibeam Users Conference, 25-27 September, Edinburgh, UK.

Mackay, K. (2022) TESMaP. Scottish Oceans Institute, St Andrews University, 29 September, St Andrews, UK.

Mackay, K. (2022) TESMaP. Scottish Association for Marine Science (SAMS), 4 October, Oban, UK.

Jimenez, B. (2023) The Nippon Foundation – GEBCO Seabed 2030 project. Ecuador Navy Head of Hydrographic Division, 10 October 2023, virtual meeting in conjunction with the Atlantic and Indian Ocean Data Center.

Jimenez, B. (2023) Collaboration with GEBCO Guiding committee member Yerinelys Santos and SCRUM vice-chair Hugo Montoro for coordinated strategy in the Latin American Region. Virtual meeting in conjunction with the Atlantic and Indian Ocean Data Center

Jimenez, B. (2023) Collaboration between IHO-DCDB, CSBWG and Seabed 2030 coordinated strategy towards the Hydrographic Commission meetings. Special emphasis on SEPHC, as its first time Seabed 2030 is invited, virtual meetings.

Jimenez, B. (2023) Peruvian Navy requested support for planning of the next campaign for surveying in the Marine Protected area around the Nazca Area, 31 October

2023, virtual meeting.

Caie, S. (2023) The Nippon Foundation – GEBCO Seabed 2030 project, SWPHC MSDI Working Group Meeting, 2 November, virtual meeting.

Jimenez, B (2023) The Nippon Foundation – GEBCO Seabed 2030 project. SPC Marine Data Hub, 3 November, virtual meeting.

Caie, S. (2023) The Nippon Foundation – GEBCO Seabed 2030 project, New Zealand Coastal Society Conference, 22-23 November, Wellington, New Zealand.

Jimenez, B (2023) The Nippon Foundation – GEBCO Seabed 2030, IHO-South East Pacific Hydrographic Commission, 27-29 November, Valparaiso, Chile.

Jimenez, B (2023) The Nippon Foundation – GEBCO Seabed 2030 project. Pontificia Universidad Catololica de Valparaiso, 21 June 2022, Noumea, New Caledonia.

Jimenez, B (2023) The Nippon Foundation – GEBCO Seabed 2030 project, Seminar at DIMAR, 7 December, Cartagena, Colombia.

Mackay, K. (2023) The Nippon Foundation – GEBCO Seabed 2030 progress. The Pacific Geospatial and Surveying Council, 4-7 December, virtual meeting.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 progress. 10th East Asia Hydrographic Commission, 6-8 March, Bali, Indonesia.

Jimenez, B and Caie, S (2024) The Nippon Foundation – GEBCO Seabed 2030 progress, 21st South West Pacific Regional Hydrographic Commission, 28 February – 1 March, Nadi, Fiji.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 progress. AusSeabed Steering Group meeting, 7-8 April, Hobart, Australia.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 progress. Hydrospatial 2024 conference, 9-12 April, Hobart, Australia.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 progress. IOC 2nd UN Ocean Decade Regional Conference & 11th WESTPAC International Mariner Science Conference, 22-25 April, Bangkok, Thailand.

Mackay, K. and Caie, S. (2024) The Nippon Foundation – GEBCO Seabed 2030 progress. NZ Marine Geospatial workshop, 3 May, Wellington, New Zealand.

Watson, S. (2024) Seafloor mapping in the New Zealand region. GEOHAB, 6-11 May, Arendal, Norway.

Jimenez, B., Dael, J. and Caie, S. (2024) The Nippon Foundation – GEBCO Seabed 2030

progress. Australasian Hydrographic Society. World Hydro Day seminar, 11 June, Auckland, New Zealand.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 project. University of the Sea Seminar, 21 June, virtual meeting.

Mackay, K. (2024) The Nippon Foundation – GEBCO Seabed 2030 project. Australasia Community Briefings for the S-5B Students, 7 July, virtual meeting.

Report of status of regional mapping committee

The sixth Regional Mapping Committee Meeting will be held by PaC as a hybrid in-person/on-line meeting, on 4-6 November 2024. The meeting will be held with the support of the Fijian Hydrographic Office. The 41st GEBCO Guiding Committee (GGC41) will be held in conjunction with this meeting at the same venue on the 4-9 November.

The objectives of this meeting will be to:

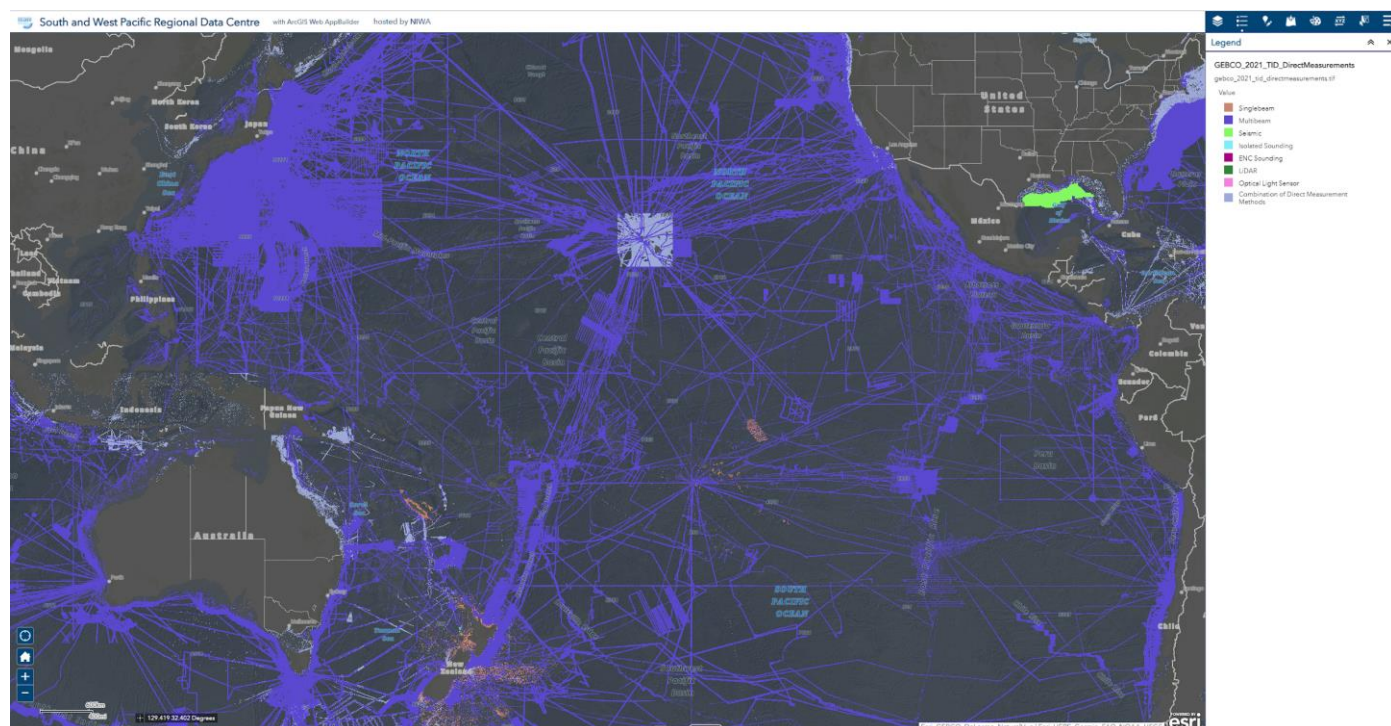
- Catch up with the Regional Mapping Committee with representatives from relevant organizations,
- Identify sources of bathymetric data in the SW Pacific region,
- Discuss methods and protocols of data sharing and management,
- Identify area of regional priority and upcoming mapping expeditions.

About sixty delegates are expected to attend in-person. An additional sixty to attend on-line.

Major data and grid contributions

During Year 7, the PaC regional inventory of bathymetric data was updated.

The major data contributors are NIWA, LINZ, JAMSTEC, AusSeabed, Inkfish, BSH. IHO DCDB and GMRT (LDEO).



Compilations and gridded contributions

Organizations that contributed data to the South and West Pacific Ocean regional data compilation as of GEBCO 2024:

Australian Hydrographic Office (AHO)
Bundesamt für Seeschifffahrt und Hydrographie (BSH)
AusSeabed, Australia
CSIRO, Australia
Geoscience Australia
Inkfish
Japan Agency for Marine- Earth Science and Technology (JAMSTEC)
Lamont-Doherty Earth Observatory, Columbia University (GMRT)
Toitu Te Whenua Land Information New Zealand (LINZ)
National Institute of Water and Atmospheric Research (NIWA)
National Ocean and Atmospheric Administration (NOAA)
PANGAEA
Royal New Zealand Navy (RNZN)
Scottish Association for Marine Science (SAMS)
Servicio Hidrográfico y Oceanográfico de la Armada (SHOA)
TCarta
University of Hawaii
UNOLS R2R

Financial report

All funds were allocated to seabed mapping activities.

Atlantic and Indian Oceans Regional Center

Location: Lamont-Doherty Earth Observatory, Columbia University, United States of America.

Center Lead: Vicki Ferrini.

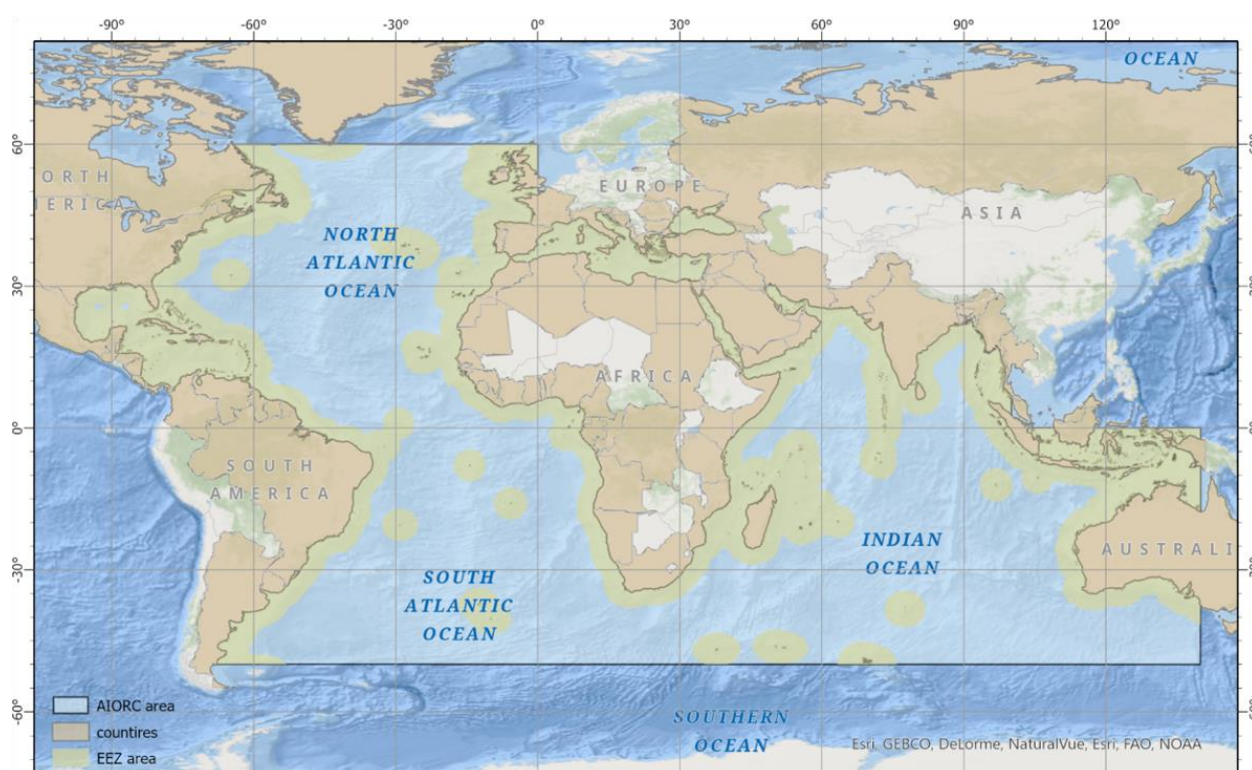


Figure 1: The extent of the Atlantic and Indian Oceans Region for the Seabed 2030 Project.

Overview

The Atlantic and Indian Ocean Regional Center (AIORC) focuses on the Atlantic and Indian Oceans from the Americas to Australia (Fig. 1). This regional also includes the Mediterranean Sea, Black Sea, Red Sea, and Persian Gulf. The extent of the Atlantic and Indian Ocean region covers an area of ~140.7 million km², which represents ~39% of the global ocean (361.9 million km²). The region is bounded by 117 countries on six continents, with approximately 53.9 million km² (38%) of the region falling within EEZs.

The AIORC is fortunate to have many national and international efforts focused on seabed mapping within the region, which are significant sources of high-quality data compilations (e.g. EMODnet, GMRT, AusSeabed, Seamap2030). There are many Regional Hydrographic Commissions that fall within or intersect the AIORC region, and strong relationships have been established with many of them. There are also GEBCO subcommittee members located within the region, as well as more than 60 Alumni of the Nippon Foundation - GEBCO Training Program from more than 30 countries that form the backbone of our community of stakeholders.

Significant portions of the Atlantic and Indian Ocean region that are actively being mapped and stewarded by partners through national and regionally-focused international efforts. Many large data sets are produced by these efforts and they are increasingly being shared for inclusion in the GEBCO grid. As we engage with more stakeholders throughout the region, we recognize that many are resource-limited, and developing strong

collaborative relationships with them is of high priority to our regional strategy. The long-term plan to increase data coverage in the region remains focused on stakeholder engagement to promote data sharing, and coordination to fill gaps. The increasing use of emerging technologies, the promotion of crowdsourced bathymetry and transit mapping, and working with stakeholders to identify and encourage the contribution of existing bathymetric data are central to our efforts. Our capacity building strategy focuses both on the engagement of organizations and groups with demonstrated mapping capacity and the sharing of tools, data, and knowledge to build bridges with underserved areas within the region.

The AIORC team is based at the Lamont-Doherty Earth Observatory of Columbia University in New York, and includes a diverse, multinational group of experts (*Fig. 2*). Led by Dr. Vicki Ferrini (US), the team includes Ms. Hayley Drennon (US), Ms. Tinah Martin (Nippon Foundation-GEBCO Alumnus, Madagascar), Ms. Sheila Cáceres (Dominican Republic), Dr. Frank Nitsche (Germany/US), and Mr. John Morton (US), with administrative support provided by Ms. Angela Martin (US) and IT support from Dr. Gilles Guerin (France/US).



Figure 2: The Atlantic and Indian Oceans Regional Center Team.

Year 7 Highlights

The AIORC has continued its focused efforts on data discovery and assembly of a high-quality data compilation for the region. This year, the team made significant progress in expanding data coverage, with 24.92% of the region now mapped with direct measurements (*Fig. 3*). This corresponds to 9.66% of the global ocean and reflects the success of local initiatives and continuous regional stakeholder engagement to extend the community of stakeholders and increase data contributions across the Atlantic and Indian Oceans.

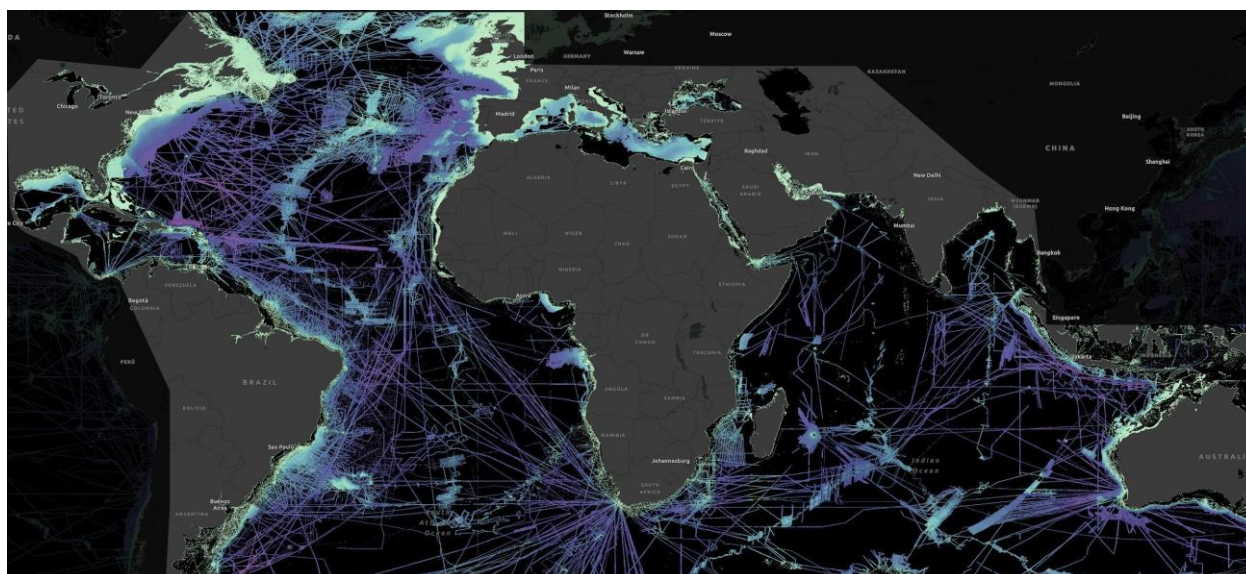


Figure 3: The extent of direct measurement coverage across the Atlantic and Indian Oceans region is highlighted as areas of the ocean represented by blues and purples. Black areas indicate regions where no direct measurement data have yet been integrated into the regional grid.

As described below, the team engaged in significant efforts to engage stakeholders across the region. This year, the Center also welcomed three of the seven participants of the 2023-2024 Nippon Foundation-GEBCO Training Program for lab visits. Lab visits further support their development as early-career professionals in ocean mapping and are the basis of professional relationships that serve as the foundation of future collaboration. During their visit, Muadh Al-Harrasi (Oman), Ximena Boza Noriega (Panama), and Matthew-Dane Henry (Jamaica) gained firsthand experience in processing and reviewing bathymetric data by using the tools and workflows implemented by the AIORC Team. Data processed as part of their visit will be included in the GEBCO 2025 grid. Ongoing engagement includes providing slides and information they can share among their professional networks to further advance the mission of Seabed 2030. Working closely with Alumni of the Nippon Foundation-GEBCO Training Program is a key aspect of our stakeholder engagement strategy.

In addition, the AIORC Team continued its successful Summer Apprentice Program, hosting two undergraduate students from The City College of New York supported by external funding. This included JK Goongoon, an Environmental Engineering student, and Juniagay Patterson, an Earth and Atmospheric System Sciences student.

Regional Mapping progress

The AIORC continues to increase data coverage, with 24.92% of its region mapped as of GEBCO 2024 (Figs. 4 and 5). This represents a roughly 10% increase in coverage over the last three years. The vast majority of the data in the region is multibeam, which continues to increase thanks to the ongoing efforts of stakeholders leading local initiatives. Recent recategorization has decreased the percentage of mixed direct measurements (TID 17) and increased multibeam (TID 11) and single beam (TID 10) percentages.

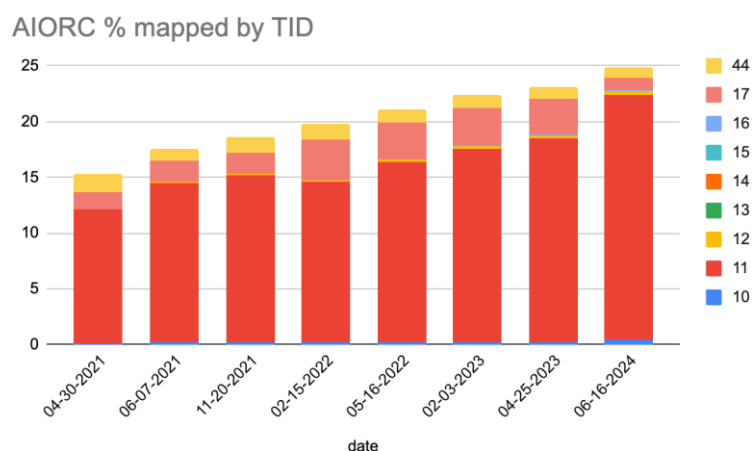
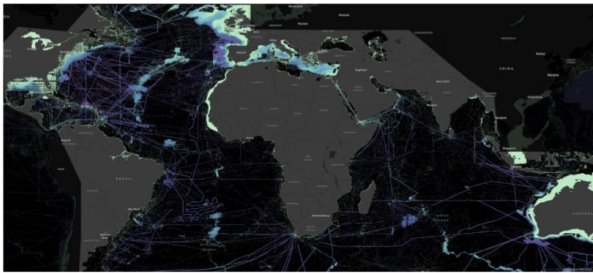
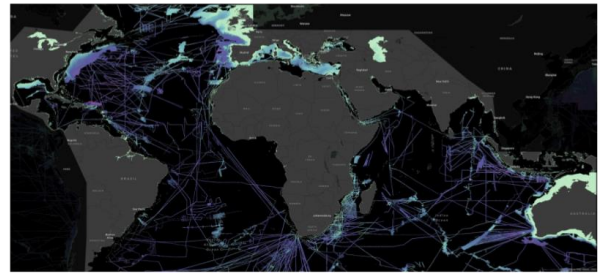


Figure 4: Bar graph showing the growth of data coverage within the Atlantic and Indian regions, broken down by Type Identifier (TID) from when statistics tracking began in April 2021.

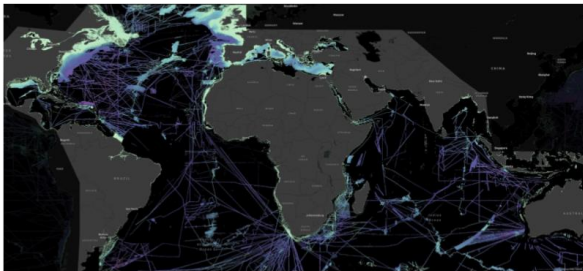
(a) GEBCO 2014



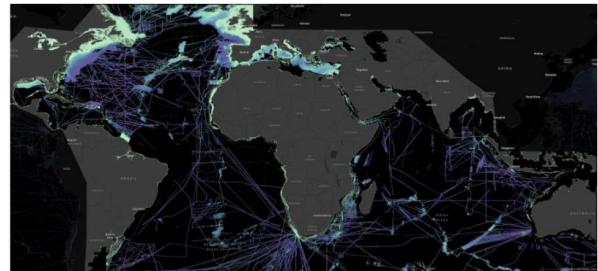
(b) GEBCO 2019



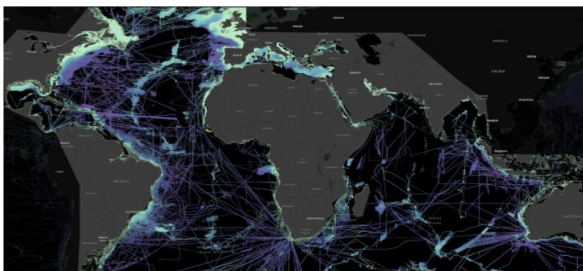
(c) GEBCO 2020



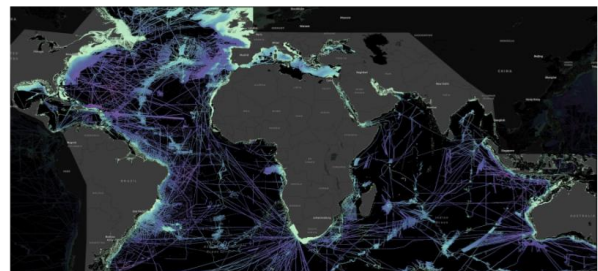
(d) GEBCO 2021



(e) GEBCO 2022



(f) GEBCO 2023



(g) GEBCO 2024

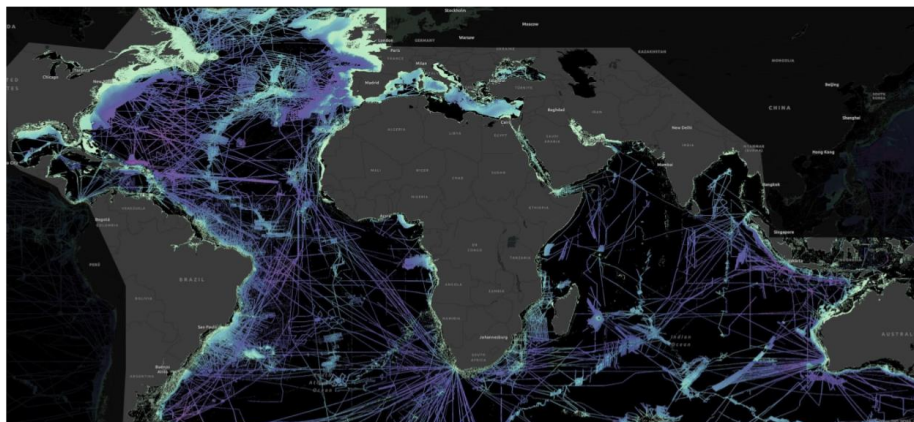


Figure 5: Progression of data coverage throughout the region with each release of the GEBCO grid. Areas considered “unmapped” are shown in black. Some large areas that were considered “mapped” in GEBCO2014 and GEBCO2019 were later characterized as “unmapped” (e.g. around Australia) as constraints on the type identifier (TID) were improved. GEBCO 2024 shows the most extensive data coverage for the Atlantic and Indian Oceans corresponding to 24.92% of the region now mapped.

Technical Development Highlights

Understanding TID Story Map

To address the many questions surrounding the GEBCO Type Identifier (TID), the [“Understanding TID” Story Map](#) (Fig. 6) was developed to explain what the GEBCO TID is, why it exists, and how it is used. Available on the GEBCO website in both English and Spanish, the StoryMap is being widely distributed within the Seabed 2030 network and has already been well-received by the community. By providing stakeholders with a clearer understanding of the concept of TID and its importance, we expect to improve our ability to accurately distinguish mapped from unmapped areas with future data contributions and to increase the ease of data integration.

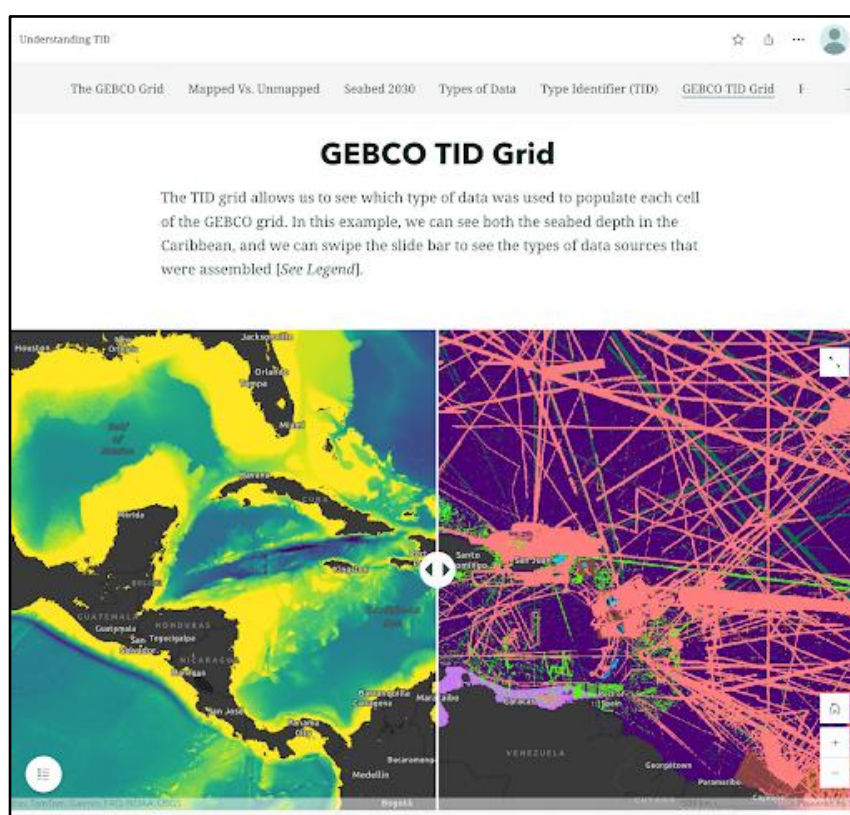


Figure 6: “Understanding TID” Story Map describing the concept and relevance of the GEBCO TID Grid.

Meso-American and Caribbean Hydrographic Commission (MACHC) Web Application

The first web application developed by the team for a specific community of stakeholders is the Meso-American and Caribbean Hydrographic Commission (MACHC) web application that was developed in 2020. This application was an integral part of the virtual webinar series convened in 2020 in collaboration with the IHO and IOC leadership within the region. Changes made to this web application over the past year included a review and refreshment of web services and an update of data coverage layers. The custom [MACHC web application](#) continues to be highlighted on the Regional Hydrographic Commission’s web page and is a useful tool for regional coordination.

Regional Gap Analysis Web Application

This custom [Regional Gap Analysis web application](#) (Fig. 7) was developed to support the team’s efforts to identify newly-available data that can be reviewed for integration into the Atlantic and Indian Ocean Regional Compilation. By integrating data footprints from multiple Web Feature Services (IHO DCDB, EMODnet, Pangaea, and NONNA) with our own direct measured footprints into a unified web application, we can more effectively discover and identify new data sources for inclusion in our compilation. This consolidated approach enhances data visibility and streamlines the process of identifying gaps for further integration.

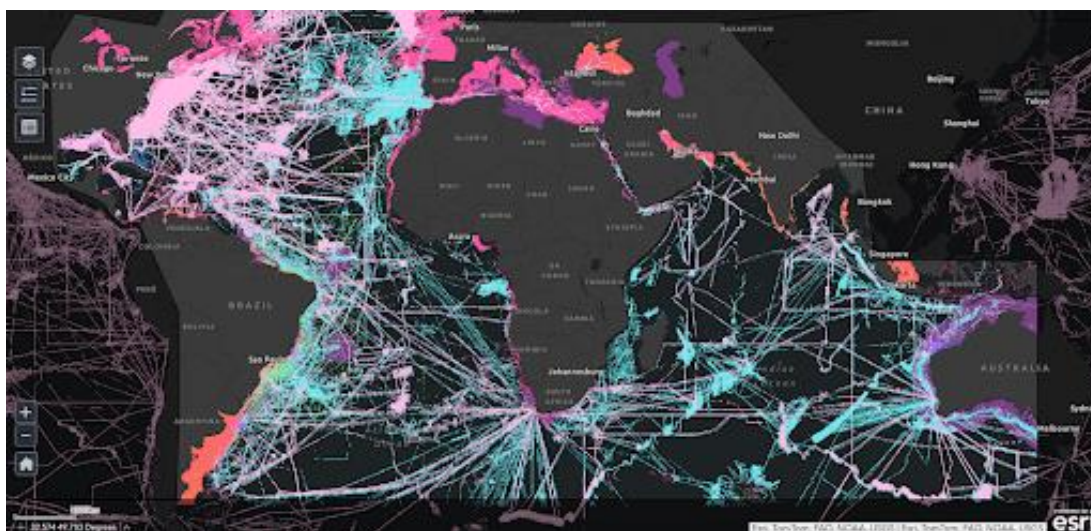


Figure 7: Regional Gap Analysis Web Application.

Regional *Unmapped Ocean* Web Application

In order to quickly visualize what is considered mapped and unmapped for stakeholders, the AIORC team generated a simple [Regional Unmapped Ocean web application](#) which is used to visualize the regional Digital Elevation Model (DEM), Typhoid Identifier (TID), and the geospatial extent of direct measurements within the region.

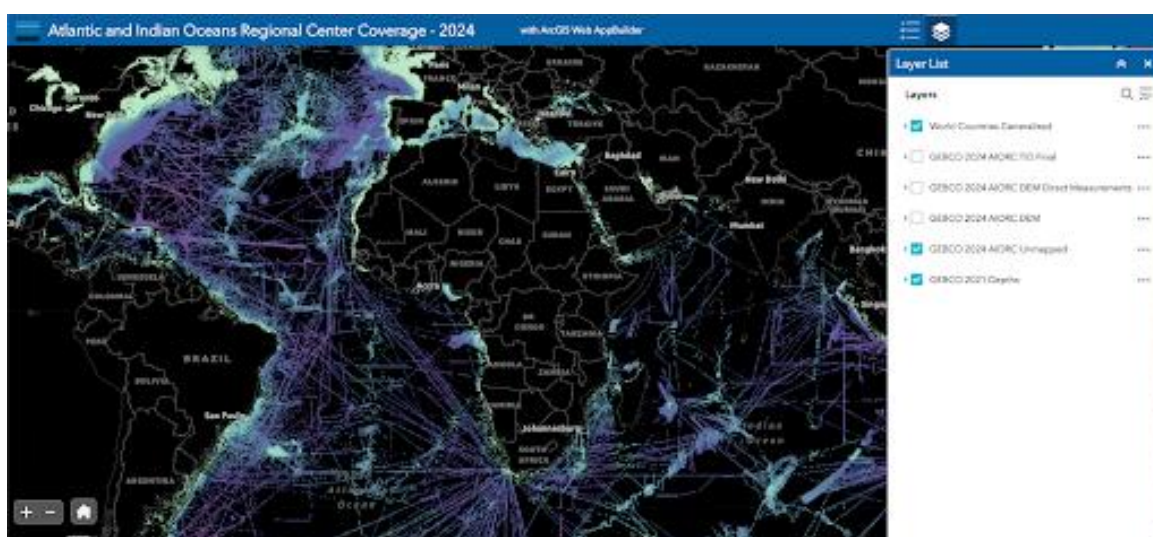


Figure 8: Regional "Unmapped Ocean" Web Application.

WIOBathy Web Application

In support of the WIOBathy Alumni Project, a WIOBathy web application was developed (Fig. 9). This helps participants in the project visualize the data currently integrated into the GEBCO grid in the project's region of interest, and to explore the extent of data that have been contributed as part of the WIOBathy project. This is an important tool for collaboratively reviewing and confirming data as it is contributed for assessment by the AIORC Team. [\[Link\]](#)

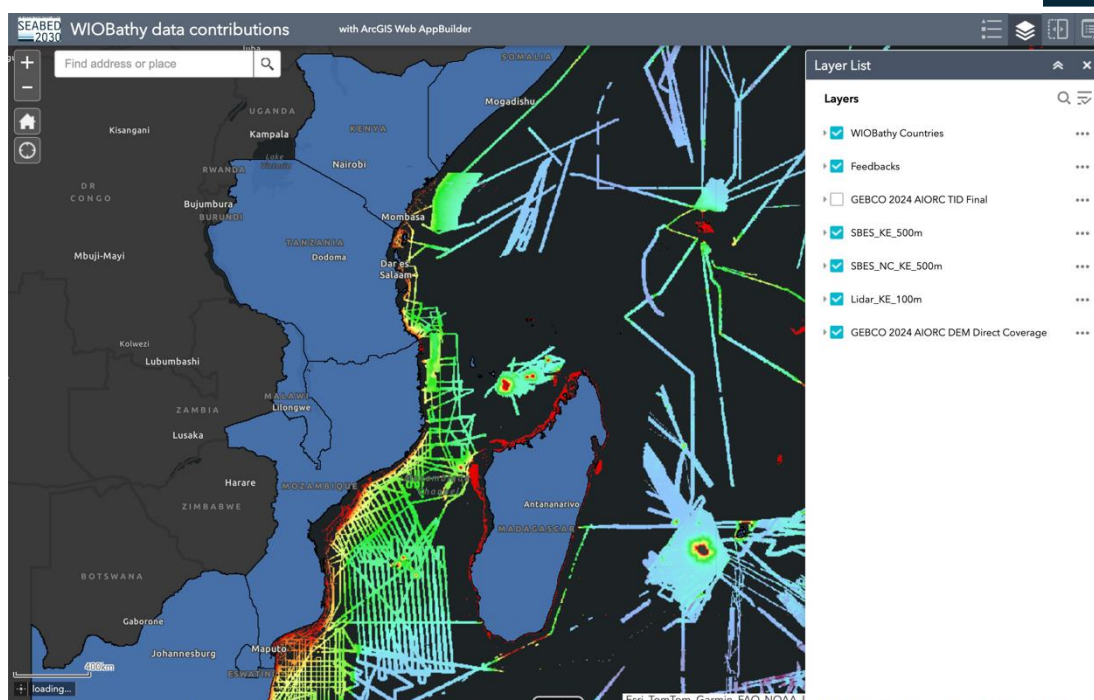


Figure 9: WIOBathy Custom Web Application.

Stakeholder Engagement Highlights

The AIORC team has actively engaged with stakeholders over the past year by participating in workshops, conferences, training sessions, and other meetings and events. The team has fostered cross-sector partnerships and promoted Seabed 2030 through industry forums, academic workshops, international delegations, and early career talks. Engagements have resulted in white paper publications in IEEE and a manuscript submitted for publication in the Limnology and Oceanography Bulletin. Training sessions with TCarta in Jamaica and the Dominican Republic have further strengthened regional capacity with respect to Satellite Derived Bathymetry (SDB). Additionally, participation in key conferences and industry forums have provided platforms to showcase the project's progress and encourage new data contributions. AIORC team members have also expanded engagement efforts in Latin America and Africa, collaborating with Ecuador, Colombia, and Uruguay, as well as IOCAFRICA to support regional data-sharing initiatives. With growing partnerships through these cross-sector events, and coordination with international delegations, the Center continues to build a diverse and inclusive global network in support of the project.

Training Sessions & Workshops Organized

Seabed 2030 Workshop in Colombia (December 2023).

Sheila Cáceres participated in a workshop at DIMAR (Colombian Maritime Authority) as part of a joint strategy with the Pacific Center to establish formal engagement with and contributions from Colombia. During the workshop, the Seabed 2030 Project was introduced, and Cáceres presented various publicly available tools and resources for bathymetric data discovery and use.

Girl Talk Program (January 2024).

In January 2024, the Girl Talk Program was launched to empower women and gender non-conforming individuals in ocean science, inspired by Marie Tharp's legacy. The program brought together nearly 30 participants from the New York City area through virtual sessions on ocean mapping and career stories, and panel discussions addressing gender diversity challenges. Virtual speakers included many members of the GEBCO community including Dawn Wright, Christie Reiser, Erin Heffron, and Shannon Hoy as well as all of the

women in the AIORC Team. A two-day in-person workshop provided hands-on experience with bathymetry data and fostered mentorship. Participants contributed data to The Nippon Foundation - GEBCO Seabed 2030 project, advancing global ocean floor mapping. Girl Talk aims to break stereotypes and build a supportive network for future ocean science professionals.



Figure 10: Participants in the Girl Talk in-person event during which multibeam data from the IHO DCDB public archive were processed and contributed to Seabed 2030.

GEBCO Technical Workshop (March 2024).

In collaboration with TSCOM and the Director of the IHO DCDB, Ferrini contributed to the planning and execution of a 3-day hybrid workshop held in Boulder, Colorado. This was a follow-up to the co-designed technical workshops held in 2023, and focused on the refinement of GEBCO technical strategic priorities that will advance and contribute to the completion of the global ocean map. The three strategic priorities included transit data acquisition, enhancements of metadata and web services, and the promotion of a common generic sensor format to optimize data sharing and integration. This event was attended by members of multiple Regional Centers, leadership of all GEBCO Sub-Committees and other technical experts.



Figure 11: In-person participants in the March 2024 GEBCO Technical Workshop.

Seabed 2030 - TCarta Jamaica Training (March 2024).

Through a collaboration between Seabed 2030 and TCarta, an SDB training event with the National Land Agency of Jamaica took place in March 2024. This resulted in a complete SDB product of Jamaica's national

waters produced for Jamaicans by Jamaicans, and a data delivery of 13,538.9 km² that was made to the Regional Center.

WIOBathy Data Workshop (April 2024).

The AIORC Team organized a workshop to describe approaches for different data types and formats, and to share tools, resources, workflows and knowledge with the WIOBathy group. The workshop covered topics from project goals to data preparation and how to submit data. Discussions from this workshop also helped the team refine its resources and workflows to make them more accessible to stakeholders.

Seabed 2030 - TCarta Dominican Republic Training (July 2024).

A second training event was conducted in the Dominican Republic with The Directorate of Hydrographic and Oceanographic Services of the Navy in July 2024. This allowed Navy members to be part of SDB data processing for their national waters. Training was co-designed with TCarta, Esri and the AIORC Team. Sheila Cáceres attended and facilitated the event in person. With the support of Seabed 2030 and in collaboration with Esri, TCarta provided the training, technology, tools and instructors necessary for the event to take place. Data delivery of 7,053.89 km² was made available to the Regional Center by TCarta.



Figure 12: In-person participants in the July Seabed 2030 -TCARTA SDB Workshop in the Dominican Republic.

Nippon-Foundation GEBCO Training Program Lab Visit (July 2024).

The AIORC Team hosted three Nippon Foundation - GEBCO Training participants (Yr 20) from Panama, Jamaica and Oman, all countries within the AIORC region. The students were given presentations on the groups' various projects as well as instruction on open source tools for visualizing, processing, and analyzing data.

Workshops Attended

Ocean InfoHub Workshop (August 2023).

The Ocean InfoHub project is focused on sharing marine data in Africa. Tinah Martin participated in a workshop entitled "Towards Transparent and sustainable access and Sharing of Marine Data in Africa" that took place in August 2023. Presenting on Seabed 2030's activities, Ms. Martin highlighted the GEBCO map as our main publicly available data product and encouraged both use of the product and the contribution of new data. This engagement furthers the connection between Seabed 2030 and Ocean InfoHub, which is interested in including Seabed 2030 as a node in their ocean information and data discovery platform.

Deep Ocean Observing Strategy (DOOS) Workshop (October 2023).

Tinah Martin and Hayley Drennon collaborated with the Deep Ocean Observing Strategy (DOOS) Group to develop a comprehensive white paper outlining key tasks for the UN Decade community. Leading up to this, Tinah Martin participated in the DOOS workshop in October 2023, engaging with multiple institutions and representing the importance of seafloor mapping to the multidisciplinary objectives of the DOOS community. The outcomes from this workshop helped shape the "Deepening the Decade" session at the UN Decade for Ocean Science Conference, where Drennon represented Seabed 2030 as a panelist. Additionally, they organized a collaborative booth and side events for the 2024 UN Decade Ocean Conference in Barcelona, Spain (April 2024). Both Martin and Drennon also attended the DOOS Annual Meeting, which followed up on the discussions initiated during the UN Decade event.

Arctic-Antarctic Regional Mapping Meeting (November 2023).

Frank Nitsche participated virtually in the Seabed 2030 5th Arctic-Antarctic Regional mapping Meeting.

UN Decade Challenger 150 Atlantic Scientific Regional Working Group Meeting (March 2024).

Vicki Ferrini was invited to attend this meeting to discuss bathymetry data availability, and the needs and future work of this project that is focused on benthic habitats. This engagement furthers connections with an international group of experts who are committed to helping deliver more bathymetry data to Seabed 2030. Stakeholders from North and South America, Europe and Africa attended this in-person event in Portugal. Soon after this event, an MOU was established between the Challenger 150 Program and Seabed 2030 at the UN Decade Conference in Barcelona.

IHO DCDB - NOAA - TSCOM Metadata Workshop (March 2024).

Vicki Ferrini participated in a 2-day metadata workshop organized by NOAA, the IHO DCDB, and TSCOM Metadata Working Group. During this meeting, she and other participants reviewed the GEBCO/Seabed 2030 metadata in the context of other schemas to ensure consistency. Several recommendations were made as a result of this workshop that are anticipated to simplify and standardize the GEBCO metadata schema and make it more compatible with other complementary metadata schemas including those of EMODnet, GMRT, DCDB, and NOAA.

Conferences Attended

Kongsberg FEMME Conference (September 2023).

The 17th Forum for the Exchange of Mutual Multibeam Experiences (FEMME) was held in Edinburgh, Scotland in September 2023. This is an international meeting that happens every few years and brings multibeam experts from around the world to talk about technical and applied aspects of multibeam mapping. In this first FEMME event since the pandemic, more than 200 people attended. Vicki Ferrini presented an invited talk at this event focused on transit mapping - showcasing successes, tools and encouraging more transit mapping and the contribution of data to Seabed 2030.

Oceans 2023 - Gulf Coast (September 2023).

An IEEE Conference Paper (Ferrini et al., 2023) was published as an outcome of the 2023 TSCOM - Seabed 2030 Webinar and Workshop Series: Developing a Vision for Improving the Discovery and Accessibility of Bathymetric Data. Hayley Drennon attended and presented on the importance of improving global bathymetry data discovery and accessibility by addressing the needs of diverse users, including data creators, managers, and consumers. The presentation emphasized the necessity of comprehensive metadata for data access and

use, and the value of sharing tools and knowledge for data management to boost efficiency. The presentation also highlighted the need to gather community input on metadata, formats, and use-cases to optimize accessibility, noting that engagement events had been held to identify barriers to data sharing and opportunities for collaboration, as well as community priorities for bathymetry data acquisition and use.

COP28 & Side Event (December 2023).

Vicki Ferrini attended COP28 in Dubai to represent the project and support Project Director Jamie McMichael-Philips during a presentation at the Ocean Pavilion. She also presented a talk at a side event, hosted by the Society for Underwater Technology (SUT) Middle East, to promote the project and encourage industry data contributions.

American Geophysical Union (AGU) Annual Meeting (December 2023).

Vicki Ferrini and Frank Nitsche attended along with summer student Memphis Washington who delivered a presentation about equitable approaches to mapping prioritization. Ferrini also led a session at the Data Help Desk highlighting Seabed 2030 and other seafloor data resources.

UN Decade for Ocean Science Conference (April 2024).

Hayley Drennon represented the Atlantic and Indian Ocean Team at the meeting and spoke as a panelist on the *Deepening the Decade* side event about how seafloor mapping and the Seabed 2030 project is foundational to further the Deep Ocean Actions for a Sustainable Ocean outlined in the DOOS white paper.

Other Meetings and Events

Lamont-Doherty Earth Observatory Open House (October 2024).

The AIORC was offered an informational exhibit about Seabed 2030 at the Lamont-Doherty Earth Observatory Open House, which was attended by over 2,000 individuals from around the NYC metropolitan area. The team was joined by Nippon Foundation-GEBCO Training Program Alumnus Daina Mathia (Kenya).



Figure 12: Seabed 2030 exhibit table at the 2023 LDEO Open House.

Seabed 2030 presentation Dominican Republic Navy (February 2024)

Sheila Cáceres introduced the Seabed 2030 Project to the Directorate of Hydrographic and Oceanographic Services of the Navy in the Dominican Republic.

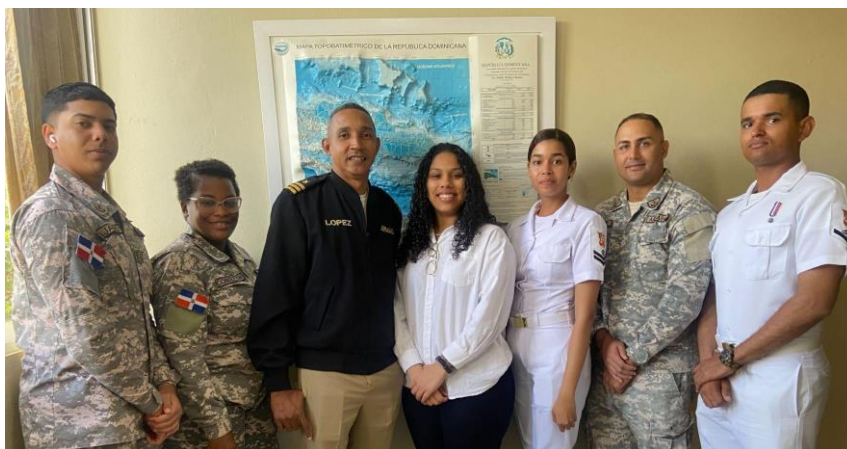


Figure 13: Cáceres visits the Dominican Republic Navy to promote Seabed 2030.

Coordination Meeting: National Administration of Fuels, Alcohols and Portland of Uruguay (February 2024).

Cáceres and Ferrini engaged in initial virtual conversations with Uruguay researchers focused on reciprocal data sharing and collaborative product development. This led to the submission of additional data to the Regional Center that will enable higher resolution product integration into the GEBCO grid.

Meeting with the Asia Foundation's Pacific Women Climate Fellows (April 2024).

The Columbia Climate School hosted the Asia Foundation's Pacific Women Climate Fellows at the Columbia University campus to discuss topics of common interest. Ferrini was invited to attend and to discuss the Seabed 2030 Project and how it may relate to the work and interests of the Fellows who are from Tonga, Fiji and Papua New Guinea. The leadership of the Asia Foundation was also in attendance. The event raised awareness about the project and planted seeds for future collaborations with the Fellows and the Asia Foundation.

UN Kenyan Delegation visit (June 2024).

The team hosted visiting UN delegates from Kenya, developing closer relationships, promoting the project, and establishing connections for future collaborations.



Figure 14: Kenyan delegation to the UN visits LDEO.

Peace Boat (June 2024)

Vicki Ferrini spoke about Seabed 2030 onboard the Peace Boat's ship, the *MV Pacific World*, during the celebration for the United Nations World Oceans Day, as part of "Sailing for Blue Innovation and the SDGs." This invitation-only event provided an opportunity to promote the project and its goals and for coordinating with the Executive Director of Peace Boat, US regarding a collaboration to use the vessel for crowdsourced bathymetry data acquisition.



Figure 15: Ferrini participating in a ceremonial toast alongside UN representatives and Founder of Peace Boat, Yoshioka Tatsuya, during the Peace Boat event in New York City.

Capitol Hill Ocean Week (June 2024).

Ferrini participated in Capitol Hill Ocean Week events in Washington DC, promoting Seabed 2030 among multiple stakeholders.

Regional Hydrographic Commission Coordination and Participation

SAIHC.

Provided slides and talking points to CSB/SB2030 Coordinator in August 2023 for the Southern Africa and Islands Hydrographic Commission (SAIHC) meeting.

MBSHC.

Provided slides and talking points to CSB/SB2030 Coordinator in June 2024 for the Mediterranean and Black Sea Hydrographic Commission (MBSHC) meeting.

MACHC.

Prepared and supplied slides and talking points for the annual meeting of the MesoAmerican and Caribbean Hydrographic Commission (MACHC) held in December 2023. Held multiple virtual meetings with the CSB/SB2030 Coordinator in conjunction with the Director of the IHO DCDB.

SWAtHC.

Provided slides and talking points for them to use at the South-West Atlantic Hydrographic Commission (SWAtHC) meeting in April 2024. Held multiple virtual meetings with the CSB/SB2030 Coordinator in conjunction with the Director of the IHO DCDB.

NIOHC.

Vicki Ferrini attended the North Indian Ocean Hydrographic Commission (NIOHC) meeting in Thailand in May 2024. This allowed her to engage directly with stakeholders and provide a presentation on behalf of the Project. She also met in person with the CSB/SB2030 Coordinator for the NIOHC.

IOC Regional Coordination

Ongoing engagement with IOCARIBE and IOCAFRICA through community meetings. Primary effort over the past year has been focused on IOCAFRICA and planning for workshops to be held in September 2024 in Kenya.

GEBCO Sub-Committee Engagement

Ferrini is an active member of the Technical Sub-Committee on Ocean Mapping (TSCOM). As described above, she contributed to the planning and execution of the TSCOM technical meeting in March 2024. This meeting involved the leadership of all GEBCO Sub-Committees and was an opportunity to develop cross-subcommittee coordination related to strategic technical priorities of GEBCO. Ferrini continues to coordinate closely with TSCOM leadership and members to help advance technical strategic priorities for GEBCO. In addition, the Center hosted the TSCOM Chair for a visit to Lamont-Doherty Earth Observatory in July 2024.

Data Acquisition Highlights

Participation in *R/V Falkor (too)* Cruise FKt230812 (August 2023).

Mapping plays a crucial role in exploring hydrothermal vent ecosystems, as demonstrated by the research cruise aboard *RV Falkor (too)* at the Galápagos Spreading Center. Ferrini and Drennon were part of an interdisciplinary team targeting unmapped areas and discovering new hydrothermal vent sites (Sendero del Cangrejo). By aligning efforts with the 2023 GEBCO footprints, they were able to also fill critical gaps in seabed knowledge and enhance our understanding of underwater environments. While participation in this cruise was independent of Seabed 2030 project funding, the effort significantly contributed to multiple global initiatives including Seabed 2030, advancing hydrothermal vent exploration and aiding discoveries of unexplored regions.

[\[Link\]](#)

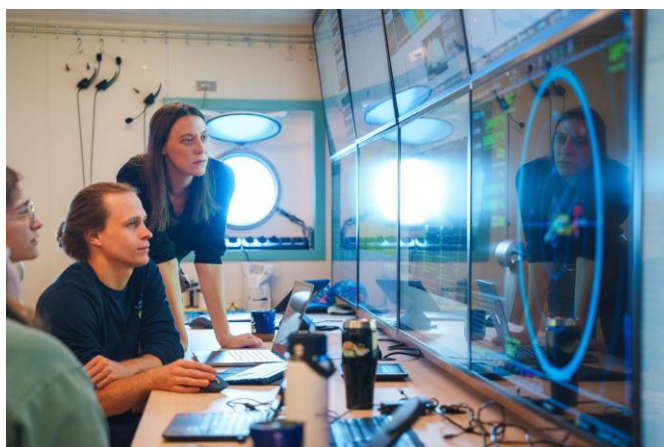


Figure 16: Drennon guiding mapping operations during Falkor(too) cruise FKt230812.

Participation in Ecuadorian Navy Cruise (November 2023).

Sheila Cáceres participated in a 21 day cruise aboard INOCAR's Hydrographic Vessel Orion as part of a joint strategy with the Pacific Center to establish formal engagement with and contributions from Ecuador.

Participation in E/V Nautilus Cruise NA158 (November - December 2023).

Hayley Drennon supported data acquisition to fill data gaps using the 2023 GEBCO footprints. In addition, Drennon presented the Seabed 2030 project to scientists aboard, as well as during engagements with various classrooms during outreach events.

Participation in R/V Falkor (too) Cruise FKt240524 (May 2024).

Vicki Ferrini and Hayley Drennon provided shore-based support for members of the science party based at Stockton University to help identify existing bathymetric data and highlight data gaps that could be filled during the expedition off the coast of Chile. [\[Link\]](#)

Transit Data Acquisition during R/V Langseth Cruise MGL2406 (May 2024).

Coordinated with operators of the Lamont-Doherty Earth Observatory research vessel *Langseth* which acquired transit data from South Africa to New York City. Route planning was facilitated by the use of GEBCO data coverage footprints in GeoMapApp. Data are currently being processed for integration into GEBCO 2025.

Press Coverage

"Otherworldly mini-Yellowstone found in the deep sea"

Researchers discovered Sendero del Cangrejo, a hydrothermal vent field in the Western Galápagos Spreading Center. This area is rich with life and unique geological features, resembling a mini Yellowstone beneath the ocean. The team mapped and sampled the never-before-seen site, basing their search on bathymetric maps and chemical signals. These findings, along with decades of research, contribute to our understanding of hydrothermal vents, which could hold clues to life's origins on Earth and other planets. Their work offers insights into ocean chemistry, biology, and planetary evolution. [\[Link\]](#)

"Girl Talk Is Making Waves"

In recognition of International Women's Day, the Columbia Climate School featured the "Girl Talk" program, led by Vicki Ferrini. The program engages women and gender non-conforming individuals in ocean sciences by teaching ocean mapping and geospatial visualization. Participants processed data from research cruises,

contributing to Seabed 2030's goal of mapping the ocean floor by 2030. The program also emphasizes inclusivity and empowerment, drawing on the legacy of Marie Tharp to inspire diverse participants to explore science careers. The workshop is part of broader efforts to decentralize and diversify the field of ocean mapping. [\[Link\]](#)

“City Tech Students Contribute to Global Ocean Mapping Effort “

City Tech students recently joined a diverse group of women at Columbia University's Climate School to learn about ocean mapping and contribute to the creation of a complete map of the ocean floor. [\[Link\]](#)

“Armada Dominicana recibe apoyo internacional para el entrenamiento TCarta”

In-person capacity development on the production of Satellite Derived Bathymetry (SDB) data for the Hydrographic Service of the Navy in the Dominican Republic. [\[Link\]](#)

Note: This article was also published by 24 other digital local newspapers and news websites in the Dominican Republic.

Publications, Articles and Podcasts

- V. Ferrini, J. Jencks, C. Reiser, E. Heffron, A. Bastos, H. Drennon, S. Caceres, T. Martin, F. Foglini, G. Spoelstra, 2023. "Developing a Vision for Improving the Discovery and Accessibility of Bathymetric Data," *OCEANS 2023 - MTS/IEEE U.S. Gulf Coast*, Biloxi, MS, USA, 2023, pp. 1-4, doi: 10.23919/OCEANS52994.2023.10337031. [\[Link\]](#)
- M. Washington, V. Ferrini, H. Drennon and T. Martin, “A GIS Approach for Equitably Prioritizing Ocean Mapping Efforts” *American Geophysical Union December 2023*, San Francisco, CA, USA, 2023.
- V. Ferrini, “Beyond Open Access Data: Committing to Data Accessibility” *ECO Magazine*, Deep Dive II, Marine Environmental Research. [\[Link\]](#)
- S. Caceres, “Global ocean mapping, stronger together” *ONBOARD Magazine*, Spring 2024 Issue, Page 5. [\[Link\]](#)
- Revealing Hidden Depths - the Seabed 2030 Podcast, Episode 6 - Dr. Vicki Ferrini, Head of the Seabed 2030 Atlantic & Indian Ocean Center, Feb 2024. [\[Link\]](#)

Complimentary Activities at LDEO that Support Seabed 2030

This section describes additional activities that take place at Lamont-Doherty Earth Observatory that are funded outside of the Seabed 2030 Project but contribute to the mission of Seabed 2030. All activities listed below are led by Ferrini and some members of the AIORC Team are also engaged in these projects.

GeoMapApp (GMA)

Developed and maintained by Lamont-Doherty Earth Observatory, GeoMapApp is a powerful, interactive mapping tool that allows users to visualize, explore, and analyze geospatial data, with a focus on global bathymetry and Earth science datasets. It provides access to a wide array of publicly available data, enabling custom map creation, multi-layer data integration, and in-depth analyses for research and education. [\[Link\]](#)

Supporting the Seabed 2030 mission, GeoMapApp offers an accessible platform for visualizing and analyzing global bathymetric data. It integrates the GEBCO grid into its default GMRT basemap, fostering transparency and interaction with ocean floor data, crucial for advancing Seabed 2030's goals. A key feature is the inclusion of layers showing the geospatial extent of GEBCO direct measurement footprints and IHO DCDB data holdings, which, when used with the GeoMapApp Survey Planner tool, helps to fill data gaps. This functionality was effectively demonstrated by Drennon to technicians and scientists during her work aboard the *Falkor (too)*.

By integrating diverse geospatial datasets, GeoMapApp enhances global collaboration and data sharing, playing a critical role in Seabed 2030's mission to map the world's oceans. It is essential for both disseminating data and driving engagement in ocean mapping efforts.

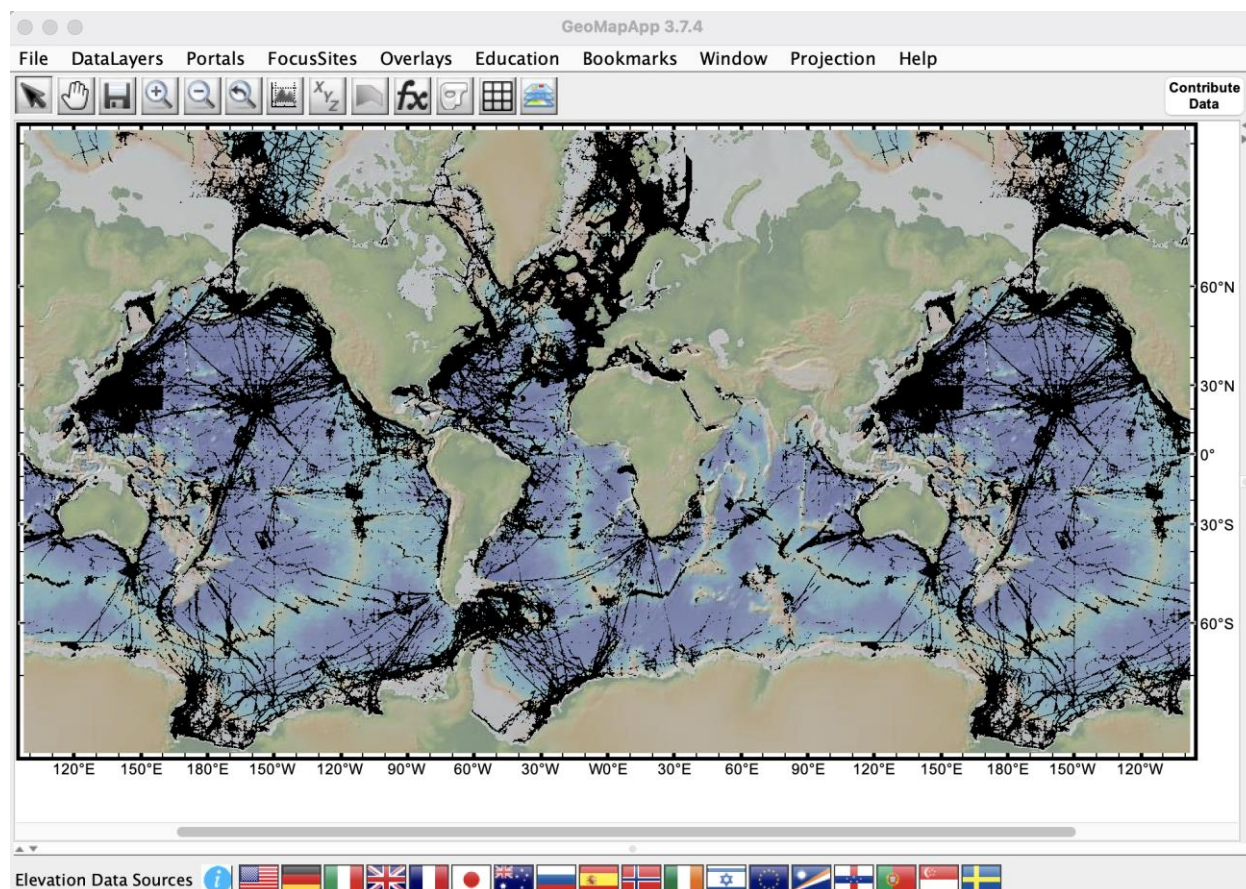


Figure 17: GeoMapApp with the layers that show the extent of direct data coverage in the GEBCO grid (based on TID), and the extent of data holdings in the DCDB. This combined perspective helps reveal data gaps that can inform data acquisition during opportunistic and transit mapping activities.

The Girl Talk Program

Launched in January 2024 with funding from the Every Page Foundation, Girl Talk seeks to empower and encourage women in ocean mapping. Inspired by Ocean Mapping Pioneer Marie Tharp, from Lamont-Doherty Earth Observatory, the Girl Talk Program was created to provide foundational knowledge about ocean mapping, an overview of related career opportunities, and direct connections to the growing network and culture of women-inspiring-women in ocean mapping. The program provides girls, women and gender non-conforming individuals with tools to navigate STEAM career paths related to ocean sciences by gathering a multi-generational community around the topics of mapping and geospatial visualization. As a result of this program, conversations were initiated with the World Maritime University (WMU)-Sasakawa Global Ocean Institute about common interests related to empowering women for the United Nations Decade of Ocean Science for Sustainable Development. [\[Link\]](#)

Global Multi-Resolution Topography (GMRT)

The Global Multi-Resolution Topography (GMRT) Synthesis provides global coverage of integrated ship-based multibeam swath bathymetry data at roughly 100-m resolution. Data from primarily US Academic research cruises are assessed, cleaned, processed and curated by the GMRT Team. Processed swath files are made publicly available, and the integrated multibeam compilation is routinely contributed to the Seabed 2030

Project. Version 4.2.0 was released in November 2023 with the inclusion of the GEBCO 2023 grid. The current version (v4.2.1) was released in May 2024 and includes data from 1,490 cruises covering more than 40 million km² of the global ocean. [\[Link\]](#)

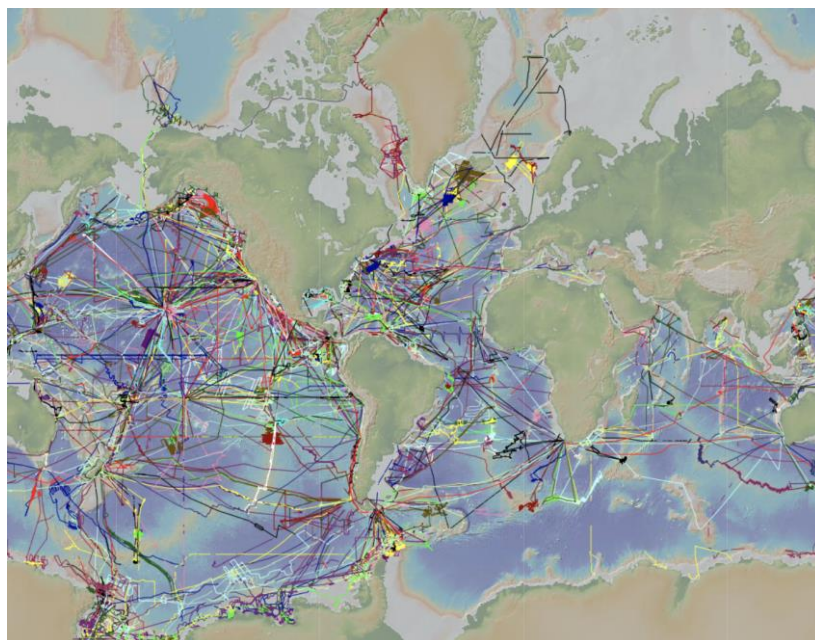


Figure 18: Global extent of curated multibeam data in GMRT v4.2.1 that was contributed to Seabed 2030 for inclusion in the GEBCO grid.

Marine Geoscience Data System (MGDS).

The Marine Geoscience Data System (MGDS) is a trusted data repository offering free public access to a curated collection of marine geophysical data and metadata related to the formation and evolution of the seafloor and sub-seafloor. It serves as a source of data for the GEBCO community and is where processed swath files generated both by GMRT and the AIORC are deposited with full metadata and attribution information. Data within MGDS are issued Digital Object Identifiers (DOIs) and are cross checked to the IHO DCDB for long-term preservation and access. [\[Link\]](#)

Multibeam Advisory Committee (MAC).

The Multibeam Advisory Committee (MAC), co-led by Ferrini in collaboration with Paul Johnson at UNH-CCOM, supports the Seabed 2030 project by promoting high-quality multibeam data acquisition across the U.S. Academic Research Fleet. With a focus on the open exchange of technical knowledge, the MAC promotes best practices and system optimization with the goal of enhancing data quality. The resources, tools and reports generated by the MAC, as well as the Ocean Mapping Community Wiki it maintains, are public resources that benefit the international mapping community. [\[Link\]](#)

Regional Data Contributions

The Center received multiple data contributions over the past year, resulting in 118 new grids integrated into the regional compilation. Roughly two thirds of these grids were from the government sector and one third from the academic sector. Of the 35 contributing organizations over the past year, 26% are new contributors; of the 15 contributing countries over the last year, 13% are new contributors. The total data contributions for the Atlantic and Indian Oceans region now come from 193 organizations across 42 countries.

List of 2024 Contributor Organizations (*New to 2024)

- Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research
- ARGANS
- Australian Hydrographic Office
- Canadian Hydrographic Service
- Centre for Marine Environmental Sciences, University of Bremen
- Directorate of Hydrography and Navigation, Brazilian Navy
- Eomap
- Federal Institute for Geosciences and Natural Resources
- Federal Maritime and Hydrographic Agency of Germany
- French Research Institute for Exploitation of the Sea
- GEOMAR Helmholtz Centre for Ocean Research Kiel
- Geoscience Australia
- Global Multi-Resolution Topography Synthesis
- Hydrographic Institute, Portuguese Navy
- Hydrographic Service for the Navy, Ministry of the Defence of Argentina
- Kiel University
- Marine Geoscience Data System
- *National Administration of Fuels, Alcohols and Portland
- National Geospatial-Intelligence Agency
- *National Land Agency of Jamaica
- National Oceanic and Atmospheric Administration, National Centers for Environmental Information
- National Oceanography Centre
- *Nigerian Navy
- *Ocean Ledger
- *Ocean Maps GmbH
- *OceanX
- TCarta
- *U.S. Geological Survey
- United Kingdom Hydrographic Office
- University of Bristol
- University of Hamburg
- *University of Tasmania
- *University of Tokyo, Atmosphere and Ocean Research Institute
- Wreckless Marine

Table 1: All contributing organizations as of the GEBCO 2024 Compilation:

Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Germany
ARGANS	UK
AusSeabed	Australia
Australian Hydrographic Office	Australia
British Antarctic Survey	UK
British Oceanographic Data Centre (National Oceanography Centre)	UK

Canadian Hydrographic Service	Canada
Centre for Marine Environmental Sciences, University of Bremen	Germany
Council of Scientific and Industrial Research-National Institute of Oceanography	India
Directorate of Hydrography and Navigation of the Venezuelan Navy	Venezuela
Directorate of Hydrography and Navigation, Brazilian Navy	Brazil
EOMAP	Austria
European Marine Observation and Data Network	International
Federal Institute for Geosciences and Natural Resources	Germany
Federal Maritime and Hydrographic Agency of Germany	Germany
French National Centre for Scientific Research	France
French Research Institute for Exploitation of the Sea	France
Geological Institute, Russian Academy of Sciences	Russia
Geological Survey of Spain	Spain
GEOMAR Helmholtz Centre for Ocean Research Kiel	Germany
Geoscience Australia	Australia
Global Multi-Resolution Topography Synthesis	USA
Hydrographic and Oceanographic Service of the French Navy	France
Hydrographic Institute, Portuguese Navy	Portugal
Hydrographic Service for the Navy, Ministry of the Defence of Argentina	Argentina
Hydrographic Service, Royal Netherlands Navy	Netherlands
Hydrographic Survey Directorate of Survey and Land Registration Bureau	Bahrain
Indian Naval Hydrographic Department	India
Institute of Marine Sciences	Italy
International Hydrographic Organization Data Centre for Digital Bathymetry	International
Israel Oceanographic and Limnological Research	Israel
Japan Agency for Marine-Earth Science and Technology	Japan
Kiel University	Germany
Laboratoire de Géologie de l'ENS	France
Laboratory of Space Geophysical and Oceanographic Studies	France
Marine Geoscience Data System	USA
Maritime and Port Authority of Singapore	Singapore
National Administration of Fuels, Alcohols and Portland	Uruguay
National Geospatial-Intelligence Agency	USA
National Land Agency of Jamaica	Jamaica
National Oceanic and Atmospheric Administration	USA

National Oceanic and Atmospheric Administration, National Centers for Environmental Information	USA
National Oceanic and Atmospheric Administration, Office for Coastal Management	USA
National Oceanography Centre	UK
Nigerian Navy	Nigeria
Nippon Foundation GEBCO Seabed2030 Project	International
Ocean Ledger	UK
Ocean Maps GmbH	Austria
Oceanography, Hydrography and Meteorology Service of the Uruguayan Navy	Uruguay
OceanX	USA
Olex AS	Norway
Paris Institute of Earth Physics	France
Royal Navy	UK
Russian Academy of Sciences	Russia
SEA-KIT	UK
Societe des Explorations de Monaco	Monaco
South African National Biodiversity Institute	South Africa
South African Navy Hydrographic Office	South Africa
Spanish National Research Council	Spain
State Hydrographic Service of Ukraine	Ukraine
Swansea University	UK
TCarta	USA
U.S. Geological Survey	USA
United Kingdom Hydrographic Office	UK
University College Cork	Ireland
University of Bristol	UK
University of Cape Town	South Africa
University of Hamburg	Germany
University of New Hampshire, Center for Coastal and Ocean Mapping, Joint Hydrographic Center	USA
University of Tasmania	Australia
University of Tokyo, Atmosphere and Ocean Research Institute	Japan
University of Vale do Itajai	Brazil
University of Wisconsin-Madison	USA
US Department of the Interior, Bureau of Ocean Energy Management, Bureau of Ocean Energy Management	USA
Wreckless Marine	South Africa

XPRIZE	USA
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Figure 19: Map identifying all countries that have contributed to the Atlantic/Indian Regional Data Compilation for the Seabed 2030 Project.

Financial report

All funds were allocated to seabed mapping activities.

Arctic and North Pacific Oceans Regional Center

Locations: Department of Geological Sciences, Stockholm University (SU), Sweden/Center for Coastal and Ocean Mapping, University of New Hampshire (UNH), USA.

Center co-Leads: Martin Jakobsson (SU) & Larry Mayer (UNH)

Center Staff

Stockholm University

- Dr Rezwann Mohammad, Scientific Programmer
- Mr Björn Eriksson, System Administrator
- Mr Marcus Karlsson, Data Manager/Analyst/Programmer
- Dr Silvia Salas Romero, Data Manager/Analyst (finished during the end of Year 7)
- Mr Florian Vacek, Data Analyst (began during the start of and left halfway through Year 7)
- Mr Florian Heinze, Data Analyst (began during the end of Year 7)
- Ms Celine Golda, Data Analyst (began and left during the end of Year 7)

Center for Coastal and Ocean Mapping, University of New Hampshire

- Paul Johnson, Data Manager
- Juliet Kinney, Data Manager and Analyst
- Sara Cardigos, Data Processing Technician
- Michael Bogonko, Spatial Analyst
- Daina Mathai (lab visitor September – October 2023)
- Ahmed Borghini (lab visitor July 2024 – present)

Regional Mapping Progress

Summary: Arctic Ocean Region

The team at Stockholm University uses a gridding workflow that has been developed in-house over the course of the Seabed 2030 Project to compile the GEBCO grid each year for the Arctic region. This workflow currently operates on the National Supercomputer Centre in Sweden (NSC) and Amazon Web Services (AWS). Our gridding method generates grids on a polar stereographic projection, with the specific projection parameters used for the International Bathymetric Chart of the Arctic Ocean (IBCAO), and also calculates coverage statistics and compiles an Arctic geographic grid for the GEBCO grid.

The workflow is primarily written in Python, calls for some GMT (Generic Mapping Tools) routines, and now delivers grids at multiple resolutions. Additionally, further developments have been made over the last year to allow it to run only on AWS, significantly reducing the timespan each gridding takes and allowing for “incremental” gridding procedures rather than requiring full grids to be generated each time. The vision is that

after uploading new data, the grids should be updated more or less directly. We are getting closer to this goal by utilizing GPUs (Graphic Processing Units) rather than CPUs (Central Processing Units) for the computations, however, not all the components of the gridding algorithm we developed are yet implemented on GPUs.

During Year 7, we have also made significant improvements to the storing and handling of metadata for all datasets used in the Arctic region and the whole world during statistical calculations. All metadata is now harmonized to a single table located on AWS, with automated systems in place to allow users to easily upload and update metadata, view previous versions - this simplifies our statistical calculations by ensuring that metadata is correctly entered. As of the previous year, the SU team has run the statistical coverage calculation for all Centres using a fully automated algorithm at AWS.

During Year 7 of the Seabed 2030 Project, more than 190 bathymetric datasets already present in the Arctic region were updated, more than 60 new datasets were added to the grid, and almost 50 new datasets are due to be added during the start of Year 8. These datasets are further specified in Tables in this report.

Furthermore, the SU team completed the latest version of the IBCAO grid, Version 5.0, during Year 7, which was sent in for submission to the Nature journals Scientific Data. The IBCAO 5.0 grid is currently available on the GEBCO website and minor new versions are planned for the start of Year 8. A few select areas which have received significant updates in IBCAO Version 5.0 compared to Version 4.0 can be seen in *Figure A* below.

The SU team has actively participated in multibeam mapping efforts during Arctic icebreaker expeditions. In particular, operators were onboard the Swedish icebreaker *Oden* during its journey from Sweden to Pituffik (and back), ensuring high-quality data acquisition during the transit to and from the GEOEO24 North of Greenland Expedition 2024. The operators involved were NF Alumni. The North of Greenland Expedition 2024, led by SU team members (although falling into Year 8), mapped previously unexplored areas along the Northern Greenland coast.

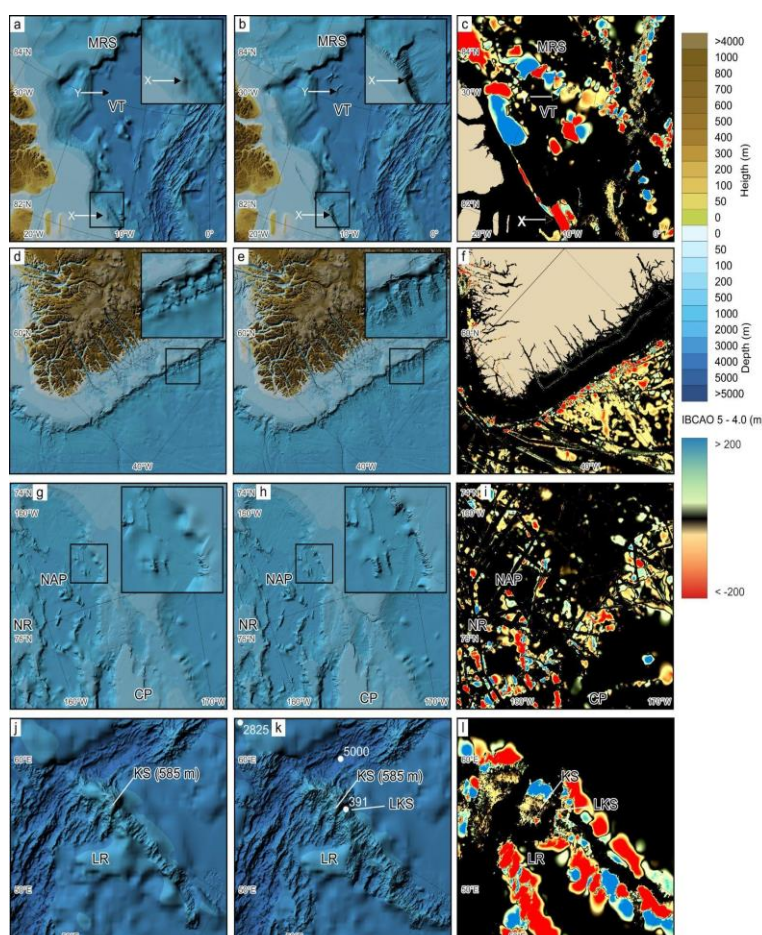


Figure A: Comparison between IBCAO 4.0 and 5.0 in four selected areas (from the submitted IBCAO 5.0 article). The left column depicts IBCAO 4.0, the middle column shows IBCAO 5.0, and the right column displays the depth difference between the two (IBCAO 5.0 - 4.0). Colours toward blue indicate that IBCAO 5 is shallower than IBCAO 4.0, while colours towards red show the opposite.

Summary: North Pacific Region

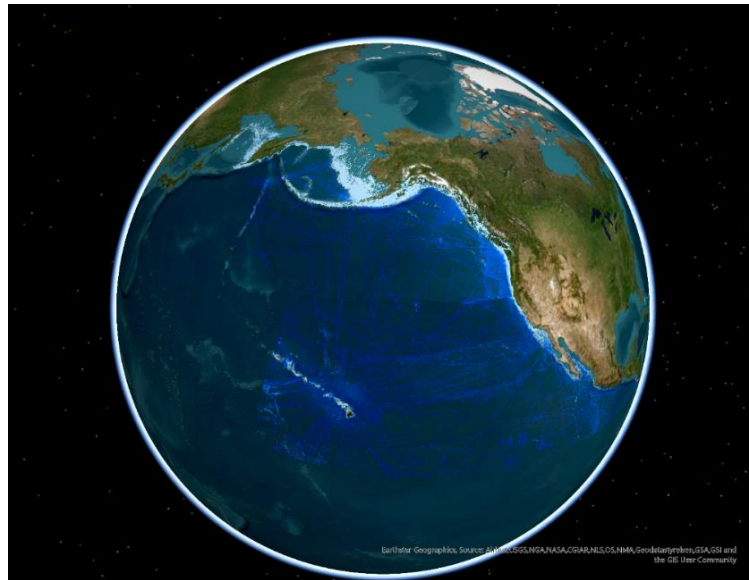


Figure 1. North Pacific Final Bathymetry Grid 2024.

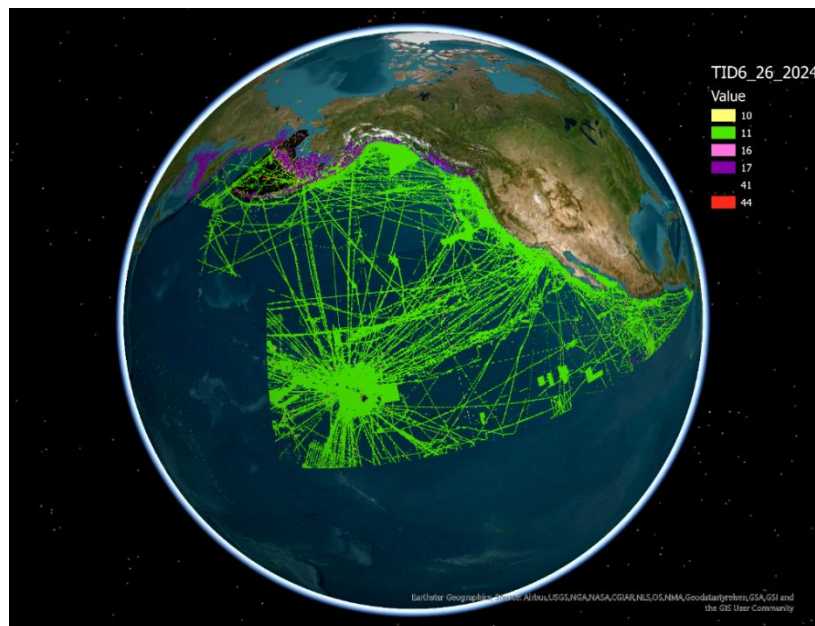


Figure 2. North Pacific TID for Final Grid 2024.

Year 7 Highlights:

- Final Bathymetry Grid & TID for 2024 submitted to GDACC.
- Draft 2024 Grid submission, revisions.
- Upload of bathymetry to Stockholm for coverage statistics.
- Continued processing of NCEI multibeam datasets.

- GEBCO lab visiting student Ahmed Borgini reviewed, revised and cleaned grids in 2024 final GEBCO grid.
- Daina Mathai gathered USGS Alaska bathymetry for the 2024 grid during her GEBCO lab visit.
- Continued data discovery, processing, and compilation using the ESRI BIS.
- Preparation of Multiresolution Grid Mosaic drafts for (.001, .002, .004 degrees) test area near Hawaii.
- Gap Filler Updates were made, including a publication on its updated implementation.
- The Center was responsible for the Viewer & Hosting for the Final 2024 Global Grid.
- The team was involved in several presentations and workshops regarding the project.
- Drix field mapping in collaboration with the *E/V Nautilus* in September and October 2023.
- Sara Cardigos participated in SHOM Empowering Women in Hydrography.

Major data and grid contributions

Data from the Arctic Region:

The new and updated data in the Arctic region during Year 7 are listed here in a set of tables.

Revisited and edited data included in previous gridded Seabed 2030 compilations:

Dataset	Contributing Organization	Data Category
Pelagia 64PE263; 64PE400	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Alaska Margin	Mixed sources, Healy surveys	Multibeam
Amundsen OMG 2003	Canadian Hydrographic Service	Multibeam
Neil Armstrong AR30-01; AR30-02; AR30-04; AR30-05; AR30-06; AR35-01; AR35-02; AR45; AR46	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Araon ARA02B; ARA03B; ARA04B; ARA05B; ARA05C; ARA07C; ARA08C; ARA09C; ARA10C; ARA12C; ARA13C	Korea Polar Research Institute	Multibeam
Ardem 2.0 Grid	University of Alaska Fairbanks	Pre-generated grid
Ardem SB 2019	University of Alaska Fairbanks	Singlebeam
Argo Groundings	Commonwealth Scientific and Industrial Research Organisation	Isolated Soundings
Atlantis AT30-01; AT30-02	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
BedMachine V5	University of California Irvine Department of Earth System Science	Pre-generated grid
Bell01	Bell Geospace Inc.	
CHS NONNA Multibeam	Canadian Hydrographic Service	Multibeam
CHS NONNA Singlebeam	Canadian Hydrographic Service	Singlebeam
CHS NONNA Optical	Canadian Hydrographic Service	Optical
CHS NONNA Satellite	Canadian Hydrographic Service	Satellite
CHS NONNA Mixed	Canadian Hydrographic Service	Mixed
CHS NONNA Unknown	Canadian Hydrographic Service	Unknown
Discovery 2016 SB	Scottish Association For Marine Science	Singlebeam
Electra 17	Stockholm University, Department of Geological Sciences	Multibeam
EMODnet 2022	European Marine Observation and Data Network	Combination of direct measurement methods
EMODnet 2022 Interpolated	European Marine Observation and Data Network	Interpolated based on a computer algorithm
Ewing 0205; 0409; 0607	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
FD170001	Fugro	Multibeam
Fugro Searcher 201108	Fugro	Multibeam
Hawkbill 99 LR	United States Navy	Multibeam

HDNO 2001	Head Department of Navigation and Oceanography	Digital bathymetric contours from charts
HDNO Digitized Contours	Head Department of Navigation and Oceanography	Digital bathymetric contours from charts
Healy HLY030; 0405; 0503; 0602; 0703; 0804; 0806; 1001; 1002; 1003; 1102; 1103; 1104; 1202; 1302; 1303; 13TC; 1502; 1602; 17TC; 1803; 18TC; 18TD	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Helmer Hansen 2014	The University Centre in Svalbard	Multibeam
High North 2020; 2021; Molloy Hole	Italian Hydrographic Institute	Multibeam
James Clark Ross 20040813; 20130713; 2018SB; 2019SB; 17006; 210; 75	British Antarctic Survey	Multibeam, Singlebeam
Kilo Moana 0309	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Knorr 154; 156; 187L01; 187L02; 192-02; 196-02; 196-03; 199-02; 203-04; 213-02; 213-03; 221-02; 221-03; 147L2; 151L2; 158L4; 166L3; 195-10; 216-03; 221-01; 221-04	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Laura Bassi 2021 Iridya	National Institute of Oceanography and Applied Geophysics	Multibeam
Marcus G. Langseth 0814; 1310	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Maria S. Merian 28; 43; 66 EM122; 66 EM712; 67; 68; 76	GEOMAR Helmholtz Centre for Ocean Research Kiel	Multibeam
MGLN45MV	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Oden ASCOS 2008	Stockholm University, Department of Geological Sciences	Multibeam
Oden EAGER 2011C	Stockholm University, Department of Geological Sciences	Multibeam
Oden LOMROG 2007 EGR; MJR	Stockholm University, Department of Geological Sciences	Multibeam
Oden SAS 2021; Transit 1; Transit 2	Stockholm University, Department of Geological Sciences	Multibeam
Olex IBCAO 2019	Olex AS	Combination of direct measurement methods
Sonne 264; 276 EM122; 276 EM710; 286	GEOMAR Helmholtz Centre for Ocean Research Kiel	Multibeam
SCICEX 2011 Connecticut; 2011 New Hampshire; 2012 Topeka 1; 2012 Topeka 2; 2014 Hampton; 2014 New Mexico; 2016 Hampton; 93-99	United States Navy	Singlebeam
Polarstern 101-3; 105; 109-4; 115-2; 115-1; 122-1; 131; 17-1; 17-3; 19-3; 51-1a; 70-1a; 70-1b; 70-1c; 70-2; 78-3; 80-3; 87-4	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Sikulialq SKQ201503t; 201504t; 201505s; 201507t; 201509t; 201510s; 201511s; 201512s; 201611t; 201612s; 201708t; 201709s; 201710t; 201711t; 201712s; 201714t; 201809t; 201813s; 201816s; 201817t; 201819s; 201820t; 201822s; 201915s; 201916s; 202002s; 202006s; 202010s; 202012s; 202014s; 202105t; 202106s;	University of Alaska Fairbanks	Multibeam

202107s; 202112t; 202113s; 201713s; 201818s; 201923s		
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New data that have been acquired over Year 7:

Dataset	Contributing Organization	Data Category
Healy HLY1901; HLY1902; HLY19TB; HLY19TC; HLY21TC; HLY21TD; HLY1001; HLY1104; HLY1502; HLY18TD; HLY2202	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Marcus G. Langseth MGL1111; MGL1309; MGL1903; MGL1110; MGL0814; MGL1310	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Knorr KN203-04	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Sonne 093 EM122	GEOMAR Helmholtz Centre for Ocean Research Kiel	Multibeam
Araon ARA14C	Korea Polar Research Institute	Multibeam
Tarajok West Greenland 2023 P1; P2	Greenland Institute of Natural Resources	Multibeam
Tarajok West Greenland 2022	Greenland Institute of Natural Resources	Multibeam
Tarajok Fylla Canyon 2022	Greenland Institute of Natural Resources	Multibeam
Sanna Sisimiut 2019	Greenland Institute of Natural Resources	Multibeam
Go-Marie Devon 2023 P1; P2; P3; P4	Ocean Research Project Inc.	Multibeam
Go-Marie Croker 2023	Ocean Research Project Inc.	Multibeam
Neil Armstrong AR35-04	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Greenland Coastline	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Land
GSHHS Coastline L1; L2, L3; L4; L5; L6	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Land
Russian Nautical Chart Soundings	East View Geospatial	Isolated soundings
Sarmiento de Gamboa 2023	Barcelona University, Department of Earth and Ocean Dynamics	Multibeam
Inbis Channel 2008-2017	Barcelona University, Department of Earth and Ocean Dynamics	Multibeam
Kilo Moana KM0514	University of California Irvine Department of Earth System Science	Multibeam
Emodnet 2022 Multibeam	European Marine Observation and Data Network	Multibeam
Emodnet 2022 Singlebeam	European Marine Observation and Data Network	Singlebeam
Emodnet 2022 LIDAR	European Marine Observation and Data Network	LIDAR
Emodnet 2022 Combination	European Marine Observation and Data Network	Combination of direct measurement methods
Chauché Lille 1 & 2	University of California Irvine Department of Earth System Science	Pre-generated grid / Multibeam
Chauché Silarlleq	University of California Irvine Department of Earth System Science	Singlebeam
Fiamma 2	University of California Irvine Department of Earth System Science	Isolated sounding
Gravimetry 2015-2017	University of California Irvine Department of Earth System Science	Pre-generated grid
Holland 2007	University of California Irvine Department of Earth System Science	Isolated sounding
JCR 2004	National Science Foundation; Woods Hole Oceanographic Institution	Singlebeam
Motyka 1985-2014	University of California Irvine Department of Earth System Science	Isolated sounding
Rignot 2012-2013	University of California Irvine Department of Earth System Science	Singlebeam
Rysgaard	University of California Irvine Department of Earth System Science	Multibeam
Rysgaard 2000-2001	University of California Irvine Department of Earth System Science	Singlebeam

Stevens 2015	National Science Foundation; Woods Hole Oceanographic Institution	Singlebeam
Sugiyama 2013	Japanese Ministry of Education, Culture, Sports, Science and Technology	Singlebeam
Bendtsen 2015	University of California Irvine Department of Earth System Science	Pre-generated grid
Fugro Searcher 201108 Transit	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Thomas G. Thompson TN249	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Maria S. Merian MSM28; MSM43	University of Bremen, Institute of Environmental Physics	Multibeam

New data that are not yet included or which have been included after the end of Project Year 7, Q4.

Dataset	Contributing Organization	Data Category
Central Gulf of Alaska Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Western Gulf of Alaska Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Norton Sound Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Cook Inlet Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Beaufort Sea Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Combination of direct measurement methods
Aleutians Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Eastern Bering Sea Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
Bering Strait Smooth Sheet	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Alaska Fisheries Science Center	Pre-generated grid
OGs Explora Panorama 1 & 2	Federal Institute for Geosciences and Natural Resources	Multibeam
LK19-Bios	Aarhus University; Geological Survey of Denmark and Greenland	Multibeam
Polarstern 94-3 / ARK-XXIX-3	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 88-1	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 99-1	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 100-2 / ARK XXX-2	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 116	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 137	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Polarstern 139-1	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Maria S. Merian 65 EM712	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Maria S. Merian 95	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam

Maria S. Merian 65 EM122	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Maria S. Merian 108 EM122	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
Maria S. Merian 108 EM712	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	Multibeam
James Clark Ross JR51	British Antarctic Survey	Multibeam
Knorr KN166L11	Woods Hole Oceanographic Institution	Multibeam
Sikuliah SKQ201914S	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202004T	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202013S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202013S EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202014S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202115S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202115S EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202310S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202310S EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202002S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202002S EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202014S EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202105T	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202106S	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202107S	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202112 EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202112 EM710	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202113S EM302	University of Alaska Fairbanks	Multibeam
Sikuliah SKQ202113S EM710	University of Alaska Fairbanks	Multibeam
Marcus G. Langseth MGL1907	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Healy HLY0102	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Healy HLY0103	National Oceanic and Atmospheric Administration, National Centers for Environmental Information	Multibeam
Arctic Dem Digital Surface Model	Polar Geospatial Center	Land

Data from the Pacific Region:

Over 200 new multibeam echosounder surveys were incorporated into the 2024 North Pacific grid (*Figures 1-4*). The new datasets comprise both composite sets and individual surveys. Composite datasets include the Northwest Hawaiian Island grids from the NOAA Coral Program and J.R. Smith at SOEST, University of Hawaii, including satellite derived bathymetry. The other major composite dataset was from Zimmerman et al. for Cook Inlet, and the Western Gulf of Alaska and the Central Gulf of Alaska (this data set without TID separation). Final grids were merged with the global compilation GMRT 4.2 using ESRI BIS for the 2024 grid. This year the merging required some methodology refinement and improvement of workflows for areas in Alaska where large discrepancies between SMRT and direct observations occurred. The team put substantial effort into revising metadata and reviewing grids with noise in the 2023 grid to produce a cleaner 2024 combined grid. The 2024 grid compilation continued to use ESRI BIS system in WGS84 using a script- based approach.

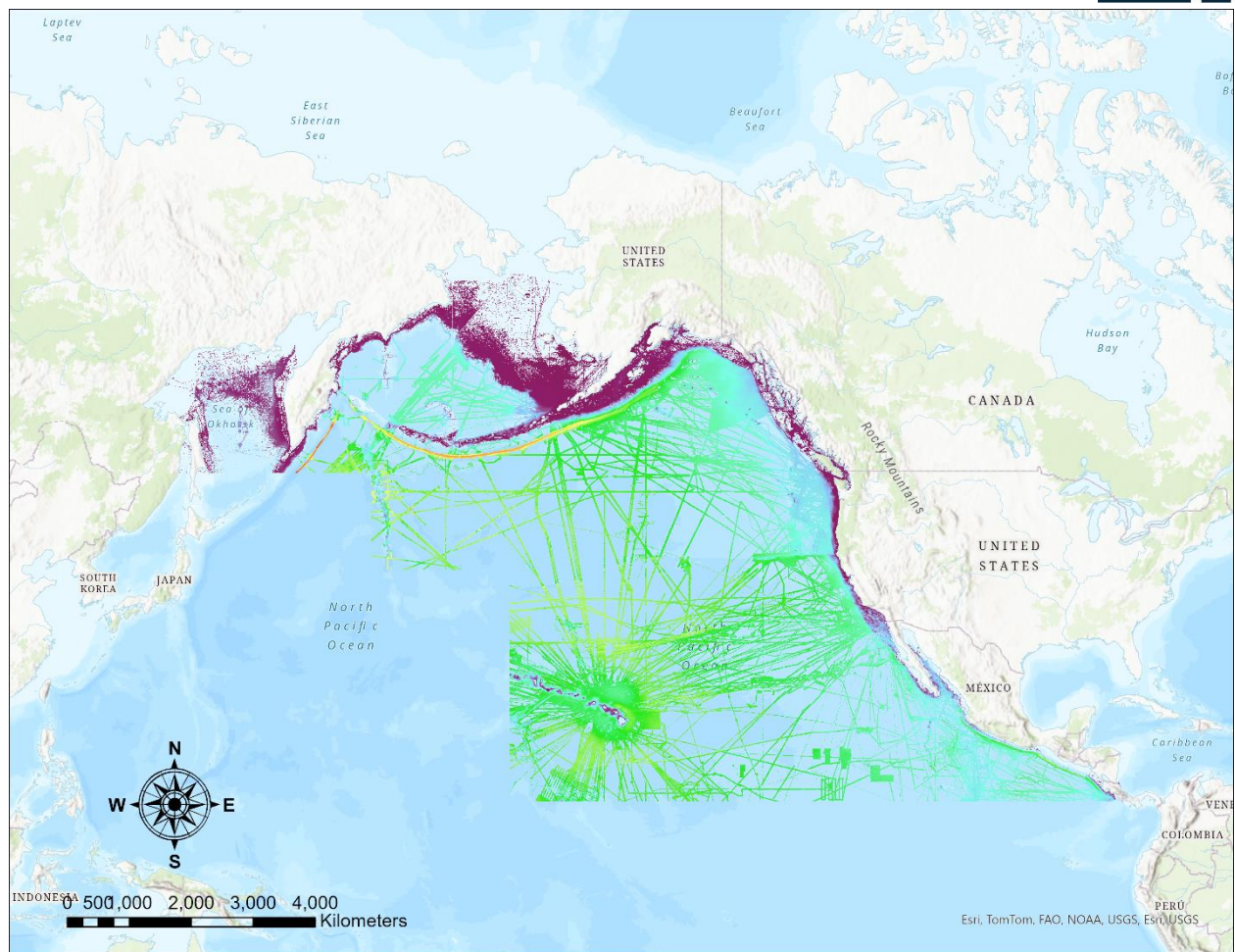


Figure 3. Map Final 2024 North Pacific Bathymetry.



Figure 4. Pink/Purple represents new coverage contributions in the 2024 Grid. Does not show new data in areas where the Zimmerman interpolated grid was used in 2023.

New contributions in the North Pacific for 2024.

In the North Pacific, **200** new multibeam echosounder surveys (each represented by 1 or more grids) were integrated into the 2024 GEBCO grid (Figure 5):

SOURCE	VESSEL	MBES SURVEYS
Inkfish	<i>R/V Dragon</i>	6 surveys
Ocean Exploration Trust	<i>R/V Nautilus</i>	11 surveys (35 grids)
NCEI	Various	60 surveys
Jamstec	Various	3 surveys
Germany	<i>Sonne</i>	2 surveys
NODC	<i>James Cook</i>	1 survey
NOAA OER	<i>Okeanos Explorer</i>	12 surveys
NOAA Fisheries		1 survey
NOAA OCS	Various	100 surveys
USGS	Various	4 surveys/2 SBES

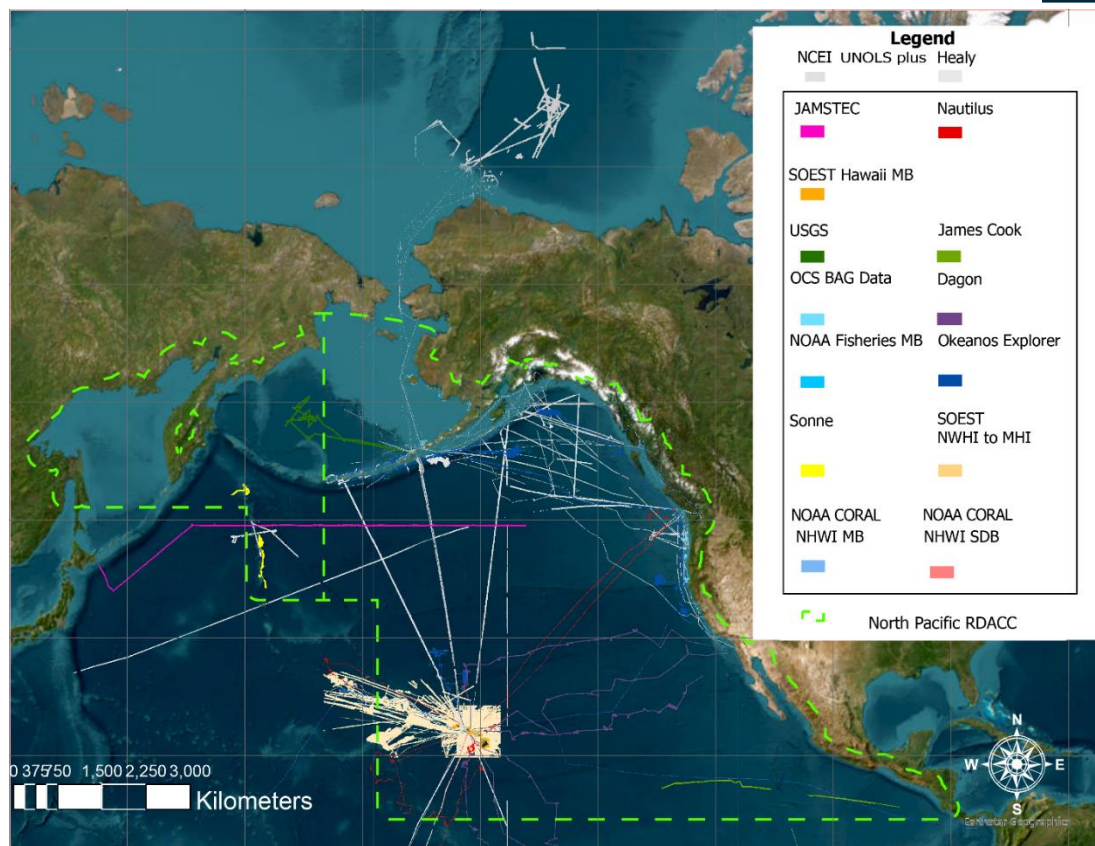


Figure 5. New Contributing Sources to 2024 Grid: (NCEI UNOLS in grey).

2023 Daina Mathai Lab Visit: USGS Data in Alaska:

Daina Mathai has been doing part of a GEBCO training program lab visit split 50/50 between LDEO and CCOM. Daina found published USGS bathymetry data in Alaska and created maps of this coverage as part of her internship/lab visit. Metadata creation and quality evaluations were also done. Daina determined which surveys are already in the GEBCO grid, and which have yet to be incorporated (Figure 6).

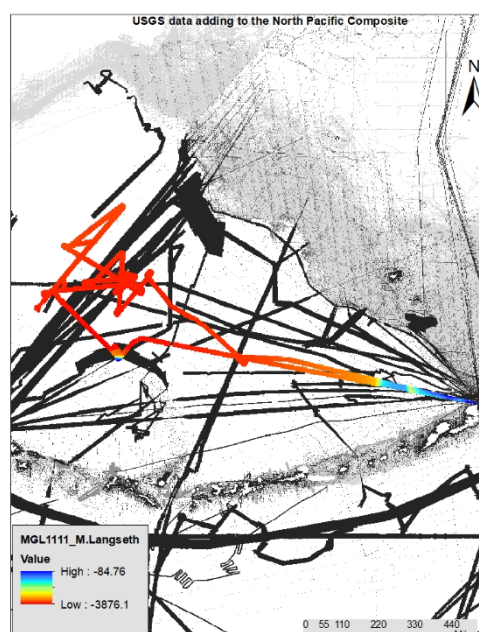


Figure 6. Example of MGL1111 USGS survey published cleaned grid that was not in NCEI holdings at the time of Daina

Mathai's visit.

July 2024 Ahmed Borghini Lab Visit:

Ahmed Borgini of Tunisia spent his required Lab Visit at CCOM/UNH where he re-cleaned 19 grids with known issues after the 2024 final grid submission. This data cleaning was also part of the preparation for a multi-resolution grid and for improving the 2025 grid. Ahmed also began a search for new data at NCEI. Ahmed cross referenced the new NCEI data with existing data in the North Pacific grid and with GMRT team holdings.

Workflow modifications for 2024 grid.

Internal processing and grid preparation workflows continued to be refined and improved over the course of this year. Two issues were found in the May 2024 grid submission that were addressed by working with Pauline Weatherall at the Global Center and submitting updates in June:

- 1) Significant noise in Cook Inlet was identified and partially resolved with the inclusion of Zimmerman data.
- 2) Our mosaicking of the Zimmerman interpolated grid with other data in areas of sparse input data tended to generate offsets. We had noted that SRTM was significantly different in places from the actual observations, sometimes on the order of 1,000m. The Zimmerman interpolation values, especially near parts of the Aleutian Trench, were closer to direct observation and thus we utilized this data in our submission grid. However, even using this data, we still ended up with offset artifacts in the data gridded product.

Steps taken to resolve noise:

Zimmerman Cook Inlet and Western Gulf of Alaska Grids were separated by TID and included in the updated Grid.

Steps taken to resolve offsets:

Working with Pauline Weatherall at the Global Center it was determined that a simple remove restore would not work adequately with the subset area. It was necessary to put the SRTM observed data into the grid first, and then provide Pauline with the Aleutian/Bering Zimmerman gridded area to use in the remove-restore step.

Multiresolution grid preparation.

Michael Bogonko created 30 decimal degree polygons to divide up the globe for testing the use of higher resolution data sets on a global scale. We then cropped data to our regional boundaries. We decided to focus on the region near Hawaii for our subset area (*Figures 7 and 8*), as this area has a lot of highly cleaned data in it, and work done by many groups that we were able to update for 2024.

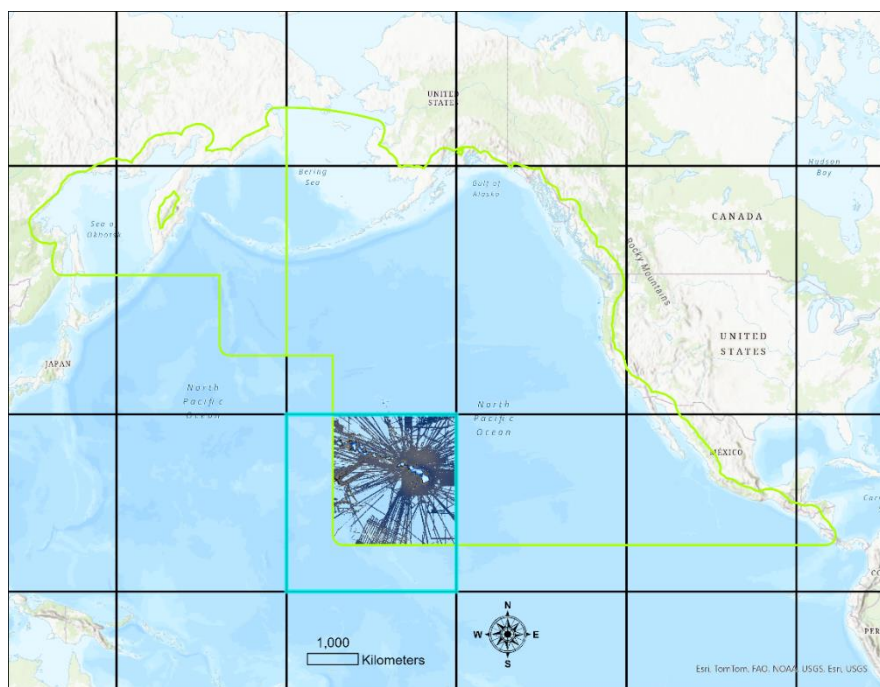


Figure 7. Hawaii test Region for multi-resolution grids.

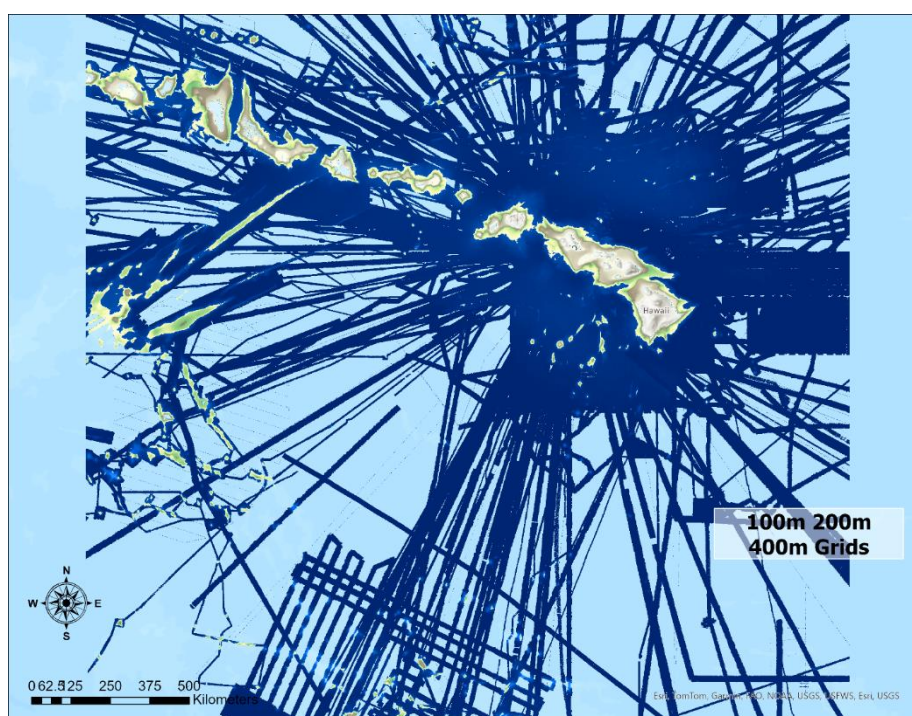


Figure 8. Hawaii multi-resolution subset region. Grids shown above are the: 100m (.001°) beige 0-1,500m, 200m (.002°) green 0-3,000m, and 400m (.004°) deep blue areas.

Systems and Tools

North Pacific Center

Multibeam Advisory Committee Initiatives

The Multibeam Advisory Committee (funded by NSF) has developed a number of tools and services that serve the entire seafloor mapping community and are relevant to Seabed 2030. The Multibeam Test Site database

has been further expanded since the previous report. An updated web GIS interface has been developed, new test sites have been added to the database, and the regional bathymetry layer has been updated to show the GEBCO 2024 grid since the last release (Figure 9).

<https://gis.ccom.unh.edu/portal/apps/instant/sidebar/index.html?appid=fe407a56250b4de8b0b9ac3c1a0d3dd6>

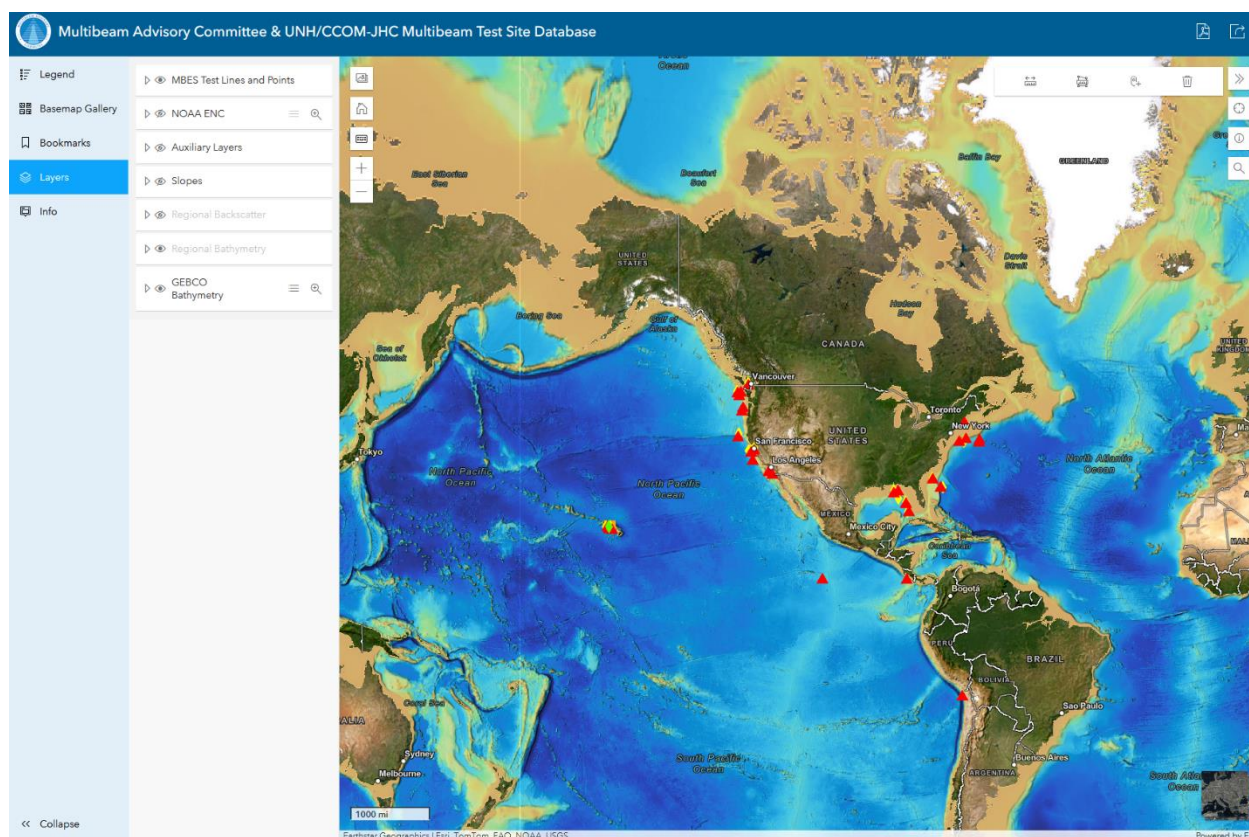


Figure 9. New Multibeam Test Site Web Application.

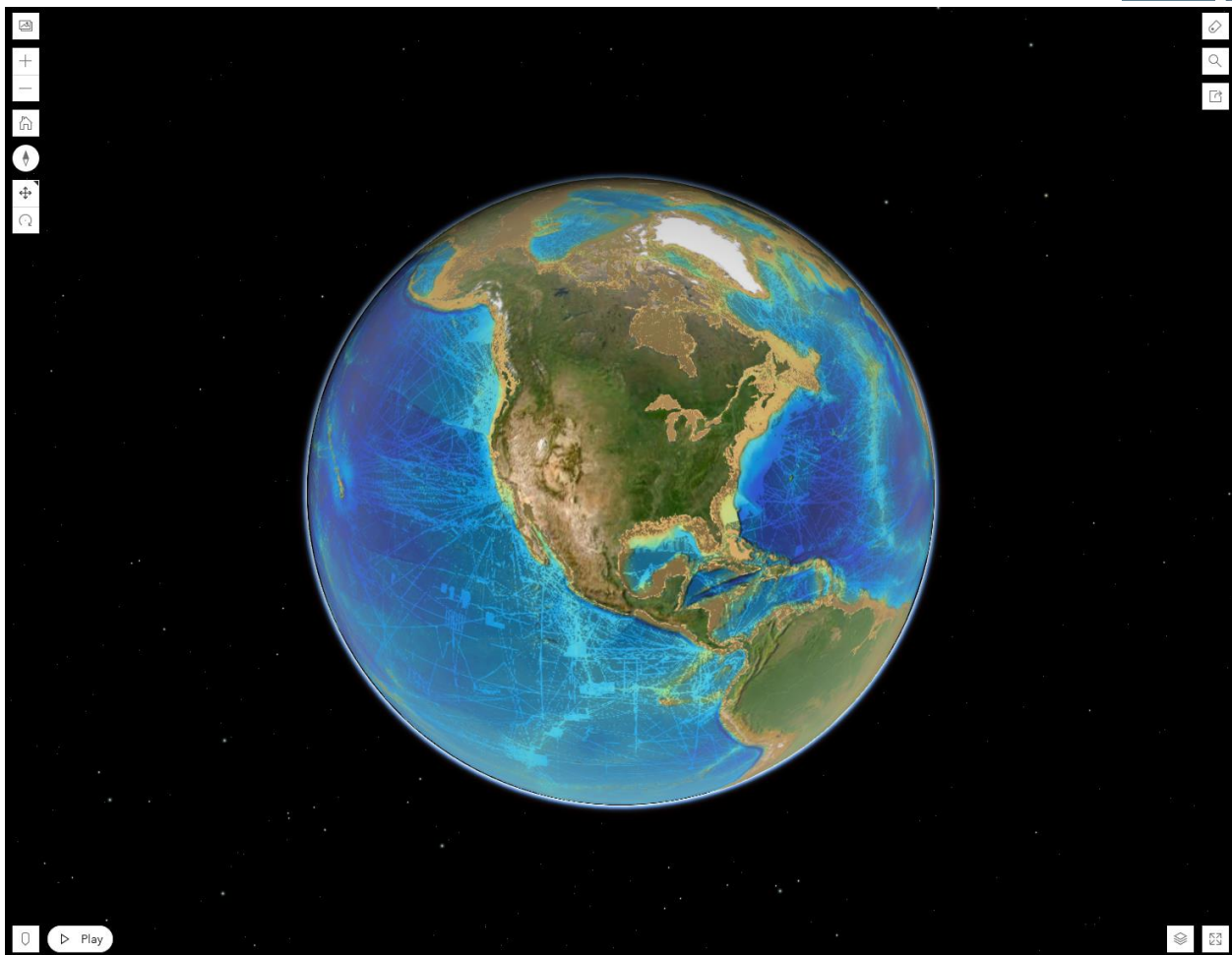
2024 Additional GEBCO Web Services

A new version of the GEBCO globe was published with all services (bathymetry, elevation, TID (revised during the fall), and indirect mask) to serve the 2024 datasets. CCOM (Paul Johnson) has updated all of the existing web apps to use the GEBCO 2024 layers (Figure 10). This includes the Blue/Green GEBCO globe available through:

<https://gis.ccom.unh.edu/portal/apps/instant/3dviewer/index.html?appid=01e75d22b08445669a7e510ace3b36a5>

and the rainbow-colored version available through:

<https://gis.ccom.unh.edu/portal/apps/instant/3dviewer/index.html?appid=639555324ccf41f6a9ec6061a62a0440>



*Figure 10. GEBCO 2024 Globe Web Application.
Mollweide projection visualizing the change in survey coverage from 2019 to 2023.*

The visualization for the change in coverage for the GEBCO globe first implemented in Year 7, Q1 (2023), was also updated to include the 2024 data (*Figure 11*). This webapp allows users to interactively visualize the change in GEBCO survey coverage from 2014 to 2024, available at:

<https://gis.ccom.unh.edu/portal/apps/instant/media/index.html?appid=81acf5572fa645538be190b0a56bbc62>,

A Decade of Seafloor Mapping - GEBCO 2024 (Left) VS GEBCO 2014 (Right)

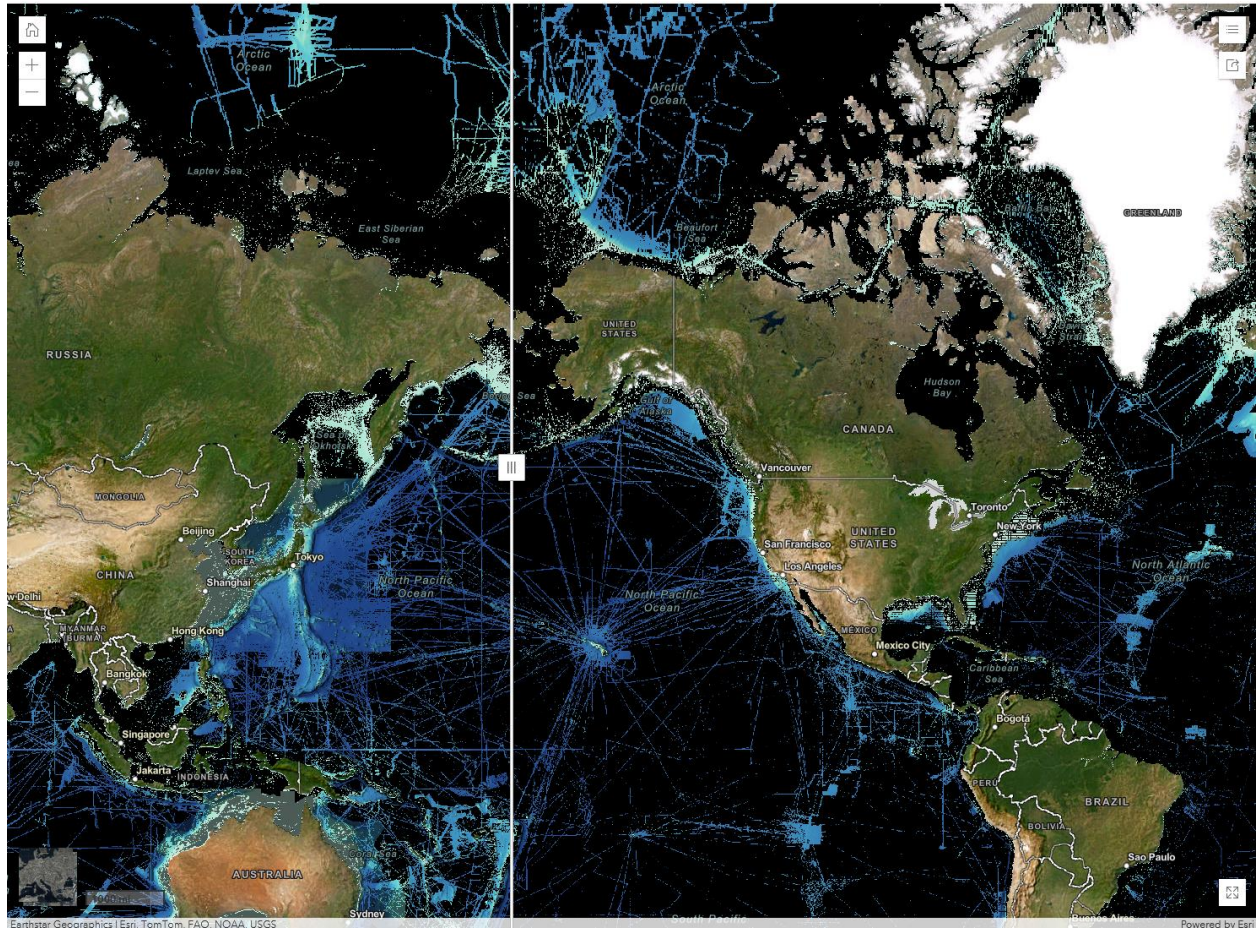


Figure 11. Visualization of the change in survey coverage from 2014 to 2024.

2024 Global Draft Grid Viewer:

A web viewer for the draft global grid for 2024 was put together by Paul Johnson. Once again, this tool was hosted by CCOM. The tool allows users to draw polygons with notes about areas that need addressing (*Figure 12*). This year Pauline Weatherall also provided the TID for SMRT in the draft, and this was very helpful in distinguishing the source of problems.

<https://gis.ccom.unh.edu/portal/apps/instant/sidebar/index.html?appid=f6e2532577a6469baf00e721f38833a4>

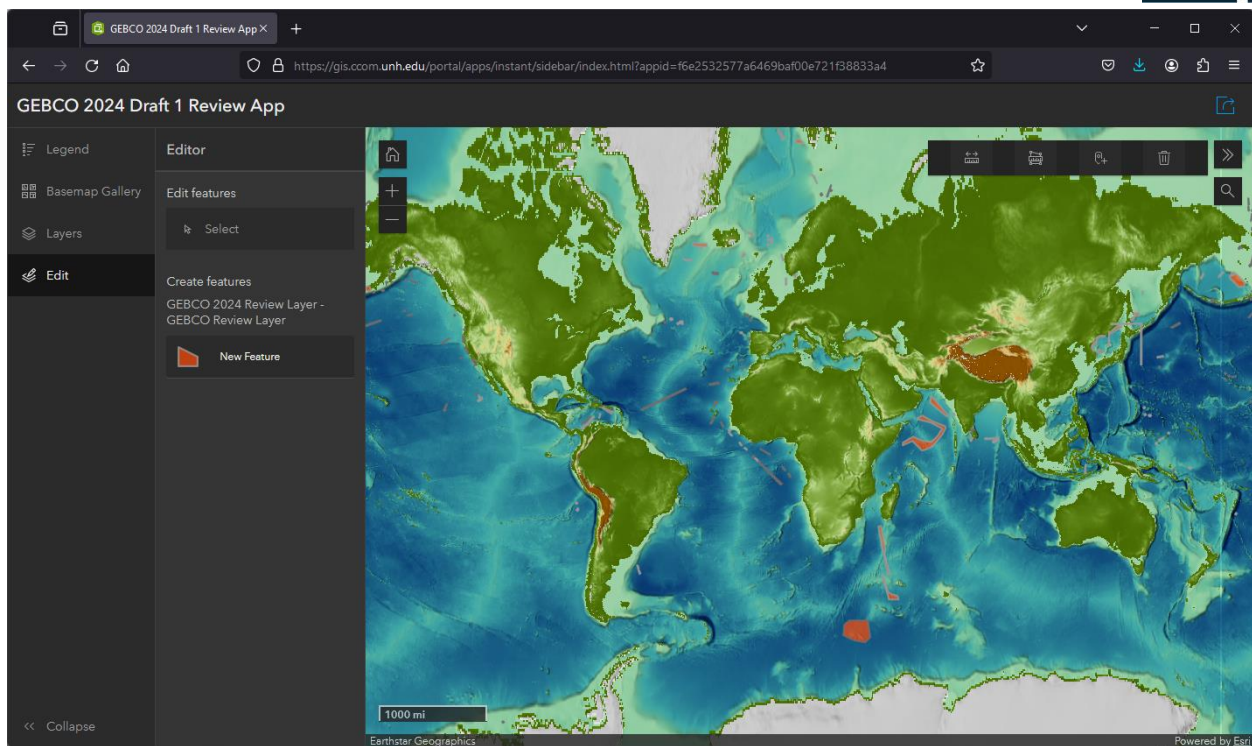


Figure 12. Web App Viewer for Reviewing 2024 Draft Global Grid.

2024 Final Global Grid Visualization:

A full list of all of the GEBCO grid visualizations web viewer for the final 2024 global grid for was put together by Paul Johnson and is available through CCOM's GIS portal (Figure 13) at: <https://gis.ccom.unh.edu>.

Systems and Tools

North Pacific Center

GEBCO Visualizations



Figure 13. GEBCO 2024 Visualizations landing page on (<https://gis.ccom.unh.edu>)

Comparison app:

<https://gis.ccom.unh.edu/portal/apps/instant/media/index.html?appid=81acf5572fa645538be190b0a56bbc62>

Mollweide Atlantic app:

<https://gis.ccom.unh.edu/portal/apps/instant/basic/index.html?appid=2cd9ce9dd37c48bf9036d102b6f32485>

Mollweide Pacific app:

<https://gis.ccom.unh.edu/portal/apps/instant/basic/index.html?appid=2ad51c800d744772834270d470d62ab36a563>

GEBCO Globe app:

<https://gis.ccom.unh.edu/portal/apps/instant/3dviewer/index.html?appid=01e75d22b08445669a7e510ace3b36a5b36a5>

Spillhaus app:

<https://gis.ccom.unh.edu/portal/apps/instant/slider/index.html?appid=47bc4e96590b45de880bc98c4f09570b0b>

REpresentational State Transfer (REST) Services:

CCOM maintains a full REST (REpresentational State Transfer) interface to each published data source from the Center's GIS Portal. This interface, which can be found at

<https://gis.ccom.unh.edu/server/rest/services/GEBCO> allows users to easily add any of the GEBCO services to a GIS platform or web application.

GapFiller

GapFiller is an application for planning transits and surveys while optimizing coverage on unmapped areas developed specifically to support Seabed 2030 (developed by Dr. Colin Ware) with stand-alone still being distributed. Ilya Atkin, under the supervision of Dr. Tom Butkiewicz, has continued the development of a web-based version of the application. The updated link is at: <https://gapfiller.unh.edu>.

GapFiller continues to be developed and improved, including allowing the planning of multiple surveys within a large survey area and the addition of several other features including a measuring tool (*Figure 14*).

George Spoelstra and Erin Heffron of TSCOM visited CCOM and discussed ways to further improve GapFiller and what role it may play in community needs. The TSCOM visit also focused on the development of plans for automating the process of pulling data from other repositories and coming up with different definitions of what constitutes "mapped" to different groups/stakeholders, so that we can compile different GapFiller maps for various user bases or needs.

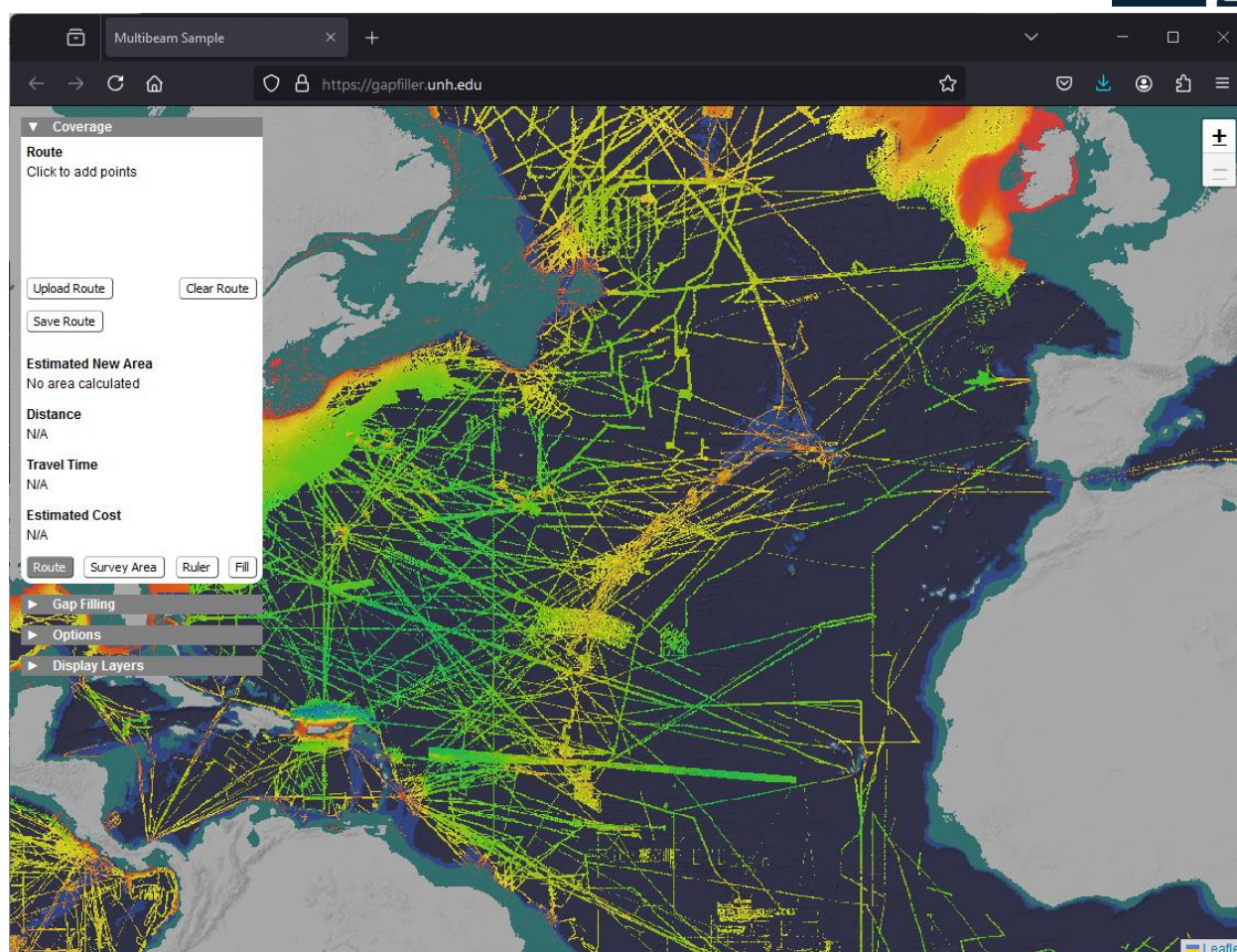


Figure 14. Online GapFiller demo page <https://gapfiller.unh.edu>.

Technological Innovation

North Pacific Center

DriX: The DriX uncrewed vehicle continues to be upgraded including the installation of the first of its kind, compact Kongsberg EM712 – midwater multibeam sonar (to approximately 3000 m depth) that is compact enough to fit on a small autonomous vessel. The prototype was installed on the DriX for its first trials in April 2024 and produced excellent results. The first field mapping use of the system took place on the *E/V Nautilus* in September and October of 2023 (Figure 15).

Center Field Programs

North Pacific Center

NA-155 – The *E/V Nautilus* spent 3 weeks in the region of the Geologist Seamounts. During that time, 4477 sq km of new EM302 multibeam sonar data were collected from the NAUTILUS while 476 sq km of new EM712 data were collected from the DriX:

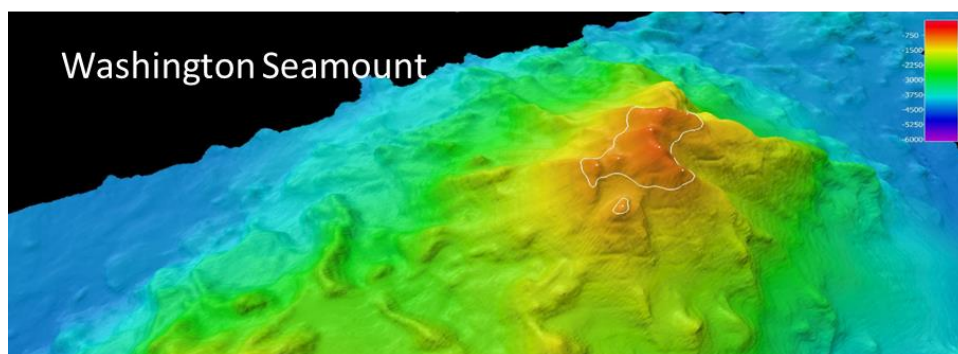
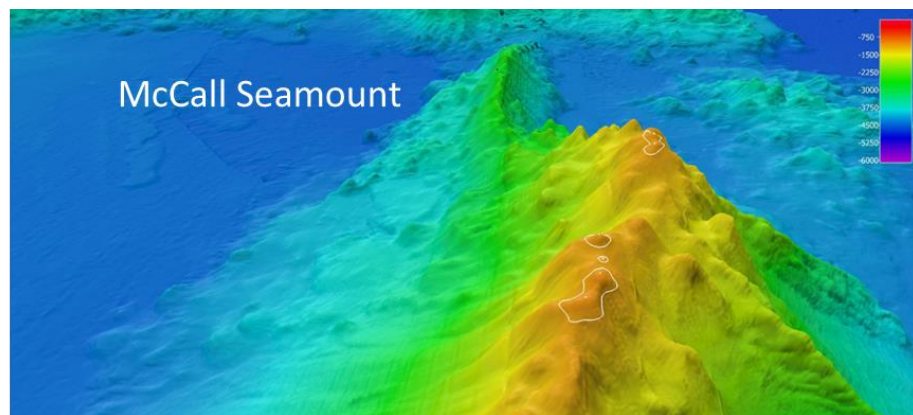


Figure 15. Combined EM712 and EM302 data collected during NA155 on McCall and Washington Seamounts, part of the Geologists Seamount Chain.

Sara Cardigos Participation in the Empowering Women in Hydrography Project (EWH'), with the French Navy SHOM (France), aboard one of their vessels *RV Beautemps-Beaupré* (Figure 16). The cruise happened from the 18 – 31 March 2024, from Amsterdam (Netherlands) and arrived in Brest (France). Sara gave a presentation on Seabed 2030 to the crew on the ship and wrote up a summary of her trip.



Figure 16. Sara Caridigos on SHOM Empowering Women in Hydrography with crew of RV Beautemps-Beaupré.

Other activities

Arctic Center

Seabed 2030 Bathymetry Contribution Form

During previous years, the Stockholm University team developed a bathymetry contribution service using a web form where users may upload new bathymetry data or update previously entered datasets. Two separate pages currently exist; a public page accessible to anyone with a web browser and a standard internet connection, and an internal page only accessible to approved members affiliated with the Seabed project. An example of these pages is shown in *Figure B*.

The data contribution form has a slightly different appearance depending on whether the public or internal page is used. Public users may only upload one dataset at a time, and the metadata information for that dataset is entered directly into the webpage. Once all the metadata information and the file have been uploaded, an analyst at Stockholm University will retrieve it and upload it manually to our servers and metadata table. Updates to previously existing datasets cannot be made here and must instead be manually requested.

For the internal page, there is no direct limit to how many datasets can be added or changed in a single upload, though there is a small risk of an upload failure if several hundred are tried at once. More than 1200 datasets were successfully uploaded to Amazon Web Services on one occasion, however. This makes it possible for all Seabed 2030 Centres to share all their data using the form in order to calculate the coverage statistics. On this page, users are instead requested to upload a tab-separated text file which contains the metadata of all new or existing datasets that should be changed. Here, each column in the text file will represent a metadata field and each row a dataset. Users may upload several new datasets at once, alter the metadata of several old datasets at once, or both upload and change simultaneously.

Regardless of which page is used, users must permit the SU team to use their files, ensuring that they are the owners or have themselves been permitted to distribute the data. Data and metadata are directly uploaded to Amazon Web Services where they are stored and can be accessed using their web interface by anyone with permission and by the statistical computation system that the SU team has developed at AWS.

The harmonization of the metadata table, described further below, has allowed us to store a large number of metadata fields entered into the contribution page for several versions of each dataset.

Additional changes are currently being planned for the contribution page to allow for even greater ease of use and for further customized ways to upload data. As much of the data upload as possible should be automatically handled by the contribution page, avoiding issues that require manual attention. It will also be made easier for users to request access to datasets they would normally not have access to, allowing the public to download data that is considered unrestricted.

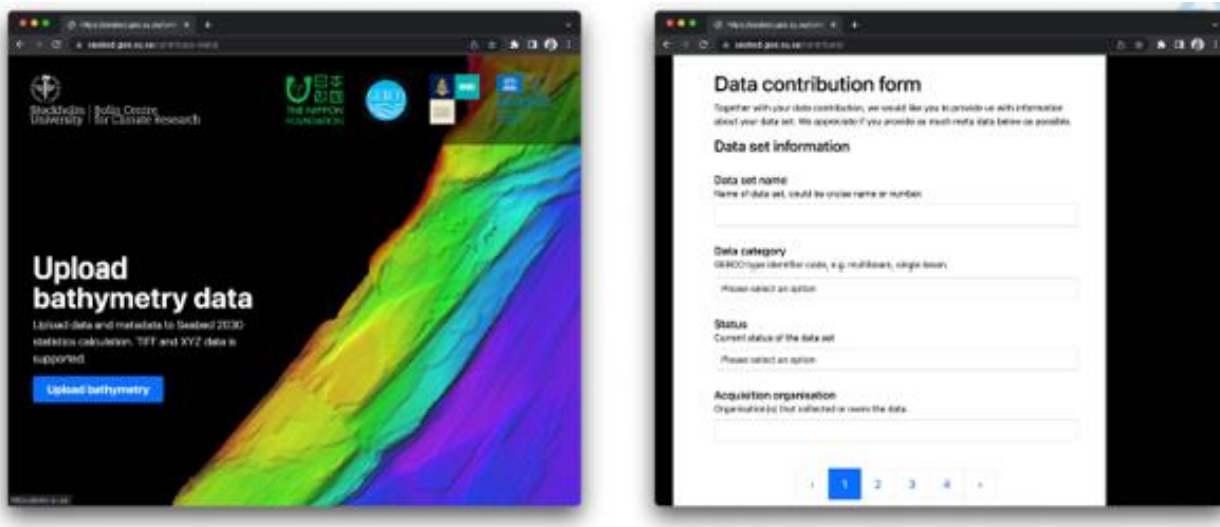


Figure B: Seabed 2030 bathymetry contribution form.

Development of a data processing system at Amazon Web Services

The SU team has continued the development of a data processing system at Amazon Web Services after completing an early version at the start of Year 7. Since last year, we have run the statistical coverage calculation at AWS. The team has also continued the work for automating the grid generation using the same computational framework and environment as the statistical coverage calculation, utilizing Python cloud computing technologies, distributed computing, and vectorized computing. The new methods are considerably faster than the old gridding method using Generic Mapping Tools (GMT).

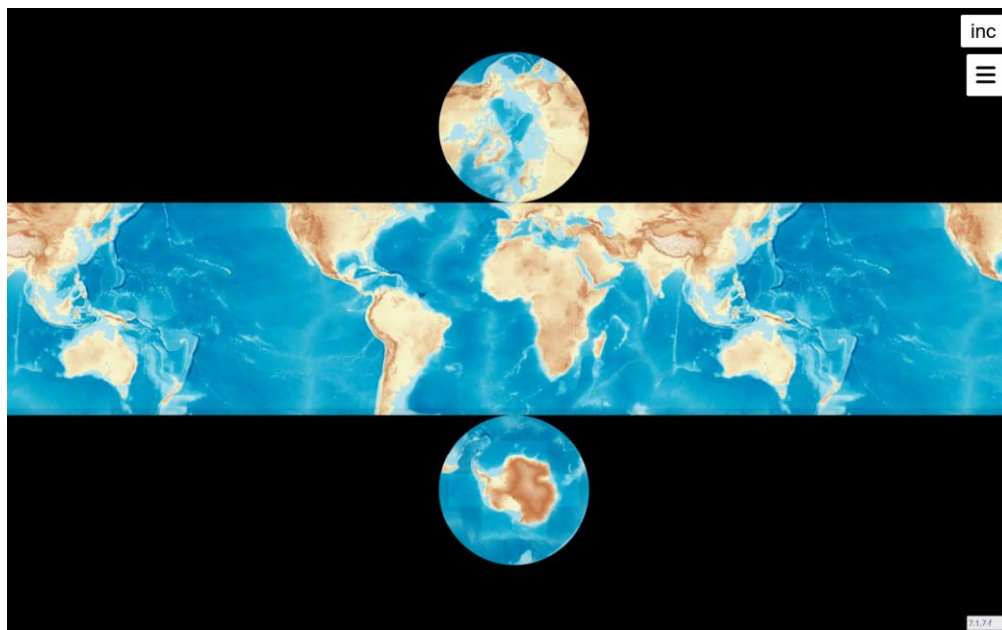


Figure C: Seabed 2030 generated grid.

While each Centre uses its own gridding algorithm and there is no decision to not continuing doing so, tests of gridding the entire World oceans using our developed gridding algorithm on AWS and all data contributed for the statistical coverage calculation have been made (Figure C). Our algorithm proved to be capable of handling the global coverage of data.

We are slowly approaching the vision of a fully automated processing system without any manual interaction using a 100 % open-source software stack with the following steps:

1. a web interface for data contribution submitted to Amazon Web Services.
2. a simple structure of data and metadata stored in repositories at Amazon Web Services.
3. statistical coverage calculation using the data and metadata, at the target Seabed 2030 resolutions 100, 200, 400 and 800 metres, performed at Amazon Web Services, using python, producing a raster map (in GeoTIFF data format) and data tables (in JSON data format), presented in a simple web page.
4. grid generation using the same data and metadata, in variable resolutions at the target Seabed 2030 resolutions 100, 200, 400 and 800 metres, performed at Amazon Web Services, using python, producing raster maps (in GeoTIFF data format).
5. present the grid in a simple web map.
6. develop an update mode to speed up the calculation by only processing the modified data and regions since the previous calculation, to present a result nearly immediately after data contribution.

The first three items in the list above are currently operational and item four is currently functional but needs some major adjustments to give satisfactory results. One important adjustment is to change the projection from Cylindrical Equal-Area projection, used in the coverage calculation, to possibly spherical Mercator projection and stereographic projections for the polar regions.

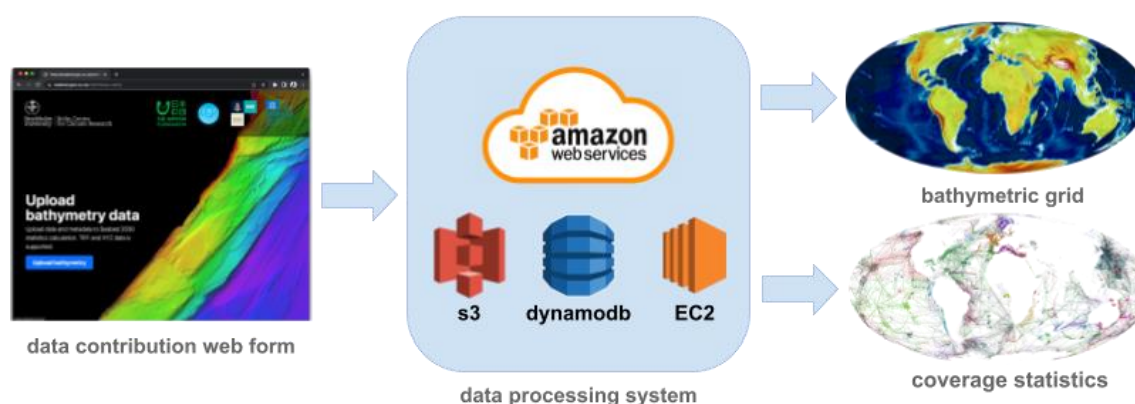


Figure D: Scheme of Seabed 2030 fully automated system.

Harmonization and standardization of metadata and refining contribution of bathymetry data

During Year 7, the process to harmonize all metadata from our various sources and systems was finished. Now, all metadata collected by our Centre is stored in a single table with all information for each dataset and all previous versions of those datasets. This includes information for our datasets in the Arctic Ocean previously stored on local servers, all information sent for each quarterly statistical calculation performed at our Centre, and all metadata for the other Centres' datasets that have been sent to us.

The harmonized metadata table is now stored on AWS, where all datasets have been given a unique SID (Source Identification) number, which relates a dataset to a metadata page, and a version number which indicates how many times a dataset entry has been edited. Now, whenever a new dataset is uploaded, it is given the highest currently used SID number incremented by one, and when an existing dataset is edited, the version number is instead incremented. SID and version numbers are now automatically updated whenever uploads and updates to the contribution page are made.

The harmonized table stored on AWS has been almost completed, with all vital information fields being transferred from previously stored metadata. Some information is still missing, such as original upload times

and dates, which are planned to be tracked down and added to the system during Year 8.

Currently, the completely public uploader at the contribution webpage is not linked to the harmonized table, meaning if the public uploads data to the page, an analyst at our Centre still needs to manually add it to the harmonized table. Implementing a link between these is also planned for the upcoming first quarter of the next year.

In addition to harmonizing all metadata, plans to standardize all metadata submissions are also currently being written to implement as soon as possible. At the moment, no standardization exists for how members of the Arctic and other Centers should format the metadata being submitted, which can occasionally lead to issues when attempting to locate previous entries and during statistical calculations. Examples of such issues are when datasets have minimal metadata and no information is given in the title of the entry or the name of the file. If a dataset, for example, has the title “mb_bathymetry” and filename “mb_data.xyz”, it will be almost impossible to categorize, analyze for quality, or attribute to its correct source. Attempts over the previous Project year have been made to address such issues, though some still remain. and official guidelines should be written to aid when uploading datasets.

In addition, previously we have not required any standardized spelling for fields such as originator, meaning the metadata could contain datasets from the same originator but with different spellings. When performing a statistical calculation this can result in their being separate values for how much an originator has contributed, when the actual value should be combined to be higher. This issue has been corrected and the upload page now requires the users to follow a specific given spelling for each originator. Some other fields still do not have a spelling guide, however, which will be assessed over the next year. Our next goal with the harmonization process is that all Centers should follow similar standardization procedures such that all dataset entries contain as much metadata as possible and that they are written in the same manner. We will write guidelines for important fields such as name, filename, originator, provider, priority, status, updates, comments, etc., over the next year.

Another major improvement that can be made to the metadata table is through the prioritization system. All datasets are given a priority value in order for the statistical calculation to determine which datasets should be counted before other ones, though there are currently no guidelines for what priority each Center should use when uploading data. This has led to each Centre currently having vastly different ideas of what is considered a high-priority and a low-priority value to enter. Guidelines will be written and displayed on the submission page to give users a general idea of what values should be used when entering a priority number. A meeting will hopefully be held with the other Seabed 2030 Centres sometime during the next quarter to discuss the metadata system and all planned changes to it, in order to receive feedback and discuss how many changes are necessary or not. We would like the other Centers to add as much metadata with their submissions as possible, though it may not be possible to include too many fields. However, datasets from the other Centers currently have practically no metadata beyond the obligatory fields of originator, data category, priority, and coordinate system, and there are a few additional ones which we believe would be very useful to store in our metadata system. We would also like to plan a meeting with Global Center colleagues to discuss the sharing of metadata since we believe GEBCO have a lot of metadata relating to the other Centers which we have not stored in our harmonized table at AWS.

Meetings & workshops where Seabed 2030 activities were presented:

North Pacific Center

Cardigos, Sara, "Enhancing the Ocean Mapping Network", Lightning talk in the panel “Why is Ocean Floor Exploration Critical” Tuesday, Nov 7, 2023, at 3 pm. At the Map the Gaps Symposium in Monte Carlo, Monaco in November, 2023.

Fifth Arctic-Antarctic and North Pacific Mapping Meeting, Bremen, 27 to 29 November 2023. Juliet Kinney,

Paul Johnson, Larry Mayer. (*Sara Cardigos attended as a GEBCO alumni as she was between contracts).



Figure 17. Group Photo of the Fifth Arctic-Antarctic and North Pacific Mapping Meeting, Bremen, Germany, 27 to 29 November 2023: Photo by Patrick Schwarzbach.

Juliet Kinney and Rochelle Wigley attended the TSCOM workshop in Boulder, CO. Larry Mayer and Sara Cardigos participated virtually. Larry Mayer and Tom Butkiewicz gave an update on GapFiller. The workshop was hosted at NCEI Boulder, Colorado March 11-13 2024 as a follow up to last May's LDEO Workshop.

The GEBCO Technical Subcommittee on Ocean Mapping (TSCOM) and the IHO Data Center for Digital Bathymetry (DCDB) hosted the workshop: *Executing a GEBCO Community Vision for Improving the Availability, Discoverability & Accessibility of Bathymetric Data Working Meeting* to further develop topics captured in the [Proposed Action Plan 2023-2026: Prepared for the GEBCO Technical Sub-Committee for Ocean Mapping \(TSCOM\)](#).

NOAA 13th NOAA Enterprise Data Management Workshop: Virtual Presentation by Juliet Kinney. “How is data re-used? Are DOI’s useful in tracking examples of new data in Alaska to GEBCO grid, regional grid citations, re-use metrics” Juliet Kinney presented at the 2024 EDM Workshop. The talk was part of the Measuring Mapping, Exploration, and Characterization Progress in Alaska session. This session was held on Tuesday, May 14th, 2024, from 11:45am to 1:15pm ET.

Publications

North Pacific Center

C. Ware, Mayer, L. A., and Johnson, P., “[BathyGlobe GapFiller: A Planning Tool to Help Fill the Gaps in World Bathymetry](#)”, *The International Hydrographic Review*, vol. 29(2). International Hydrographic Organization, pp. 16-27, 2023.

Financial Report

All funds have been apportioned to Seabed 2030 activities at Stockholm University and University of New Hampshire.

Global Center

Location: British Oceanographic Data Centre, National Oceanography Centre, United Kingdom.

Center Lead: Helen Snaith.

Summary

The Global Center has continued to update, maintain and deliver the GEBCO global bathymetric grid and support users of the data set. The Center has also continued its work as the 'Seabed 2030 Trusted Node' for Crowdsourced Bathymetry (CSB) data by submitting data sets to the IHO DCDB and providing feedback to contributors of CSB data. Further development of the application to deliver multi-resolution versions of GEBCO's grids has been done.

Publication of the GEBCO_2024 Grid

The GEBCO_2024 Grid and accompanying Type Identifier (TID) Grid were published in July 2024. A Digital Object Identifier (DOI) was also minted for the data set (doi:10.5285/1c44ce99-0a0d-5f4f-e063-7086abc0ea0f).

The data set is made available to download as a global data set or for user-defined areas, via the GEBCO grid download app (<https://download.gebco.net/>) in a number of formats. Versions of the grid are made available with and without ice surface elevation information for Greenland and Antarctica. During Year 7, there have been over 269,000 downloads of the global GEBCO grid and downloads of data for user-defined areas. Imagery, based on the GEBCO grid, can also be generated and downloaded, as shaded relief or coloured for bathymetric depth.

A Web Map Service (WMS) has been developed to delivery imagery based on the GEBCO_2024 Grid.

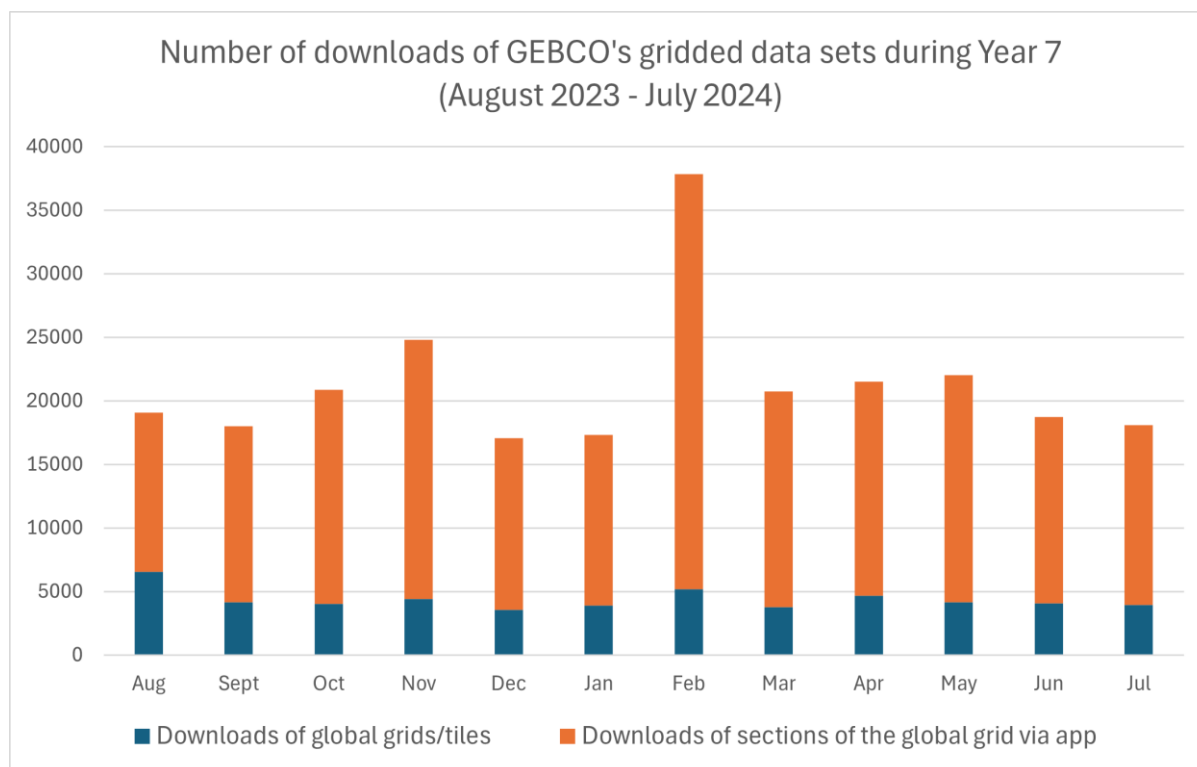


Figure 1: Number of downloads per month for Year 7 of the global GEBCO grid and data from the grid for user-defined areas.

Gridded data sets in polar projection co-ordinates are also made available for access via the download app.

As with previous compilations of the GEBCO grid, through the Seabed 2030 Framework, the generation of the GEBCO_2024 Grid was a collaborative effort between the Regional Centers and the Global Center.

Work on the compilation of the global grid began in February 2024 with the generation of a draft global grid based on data sets provided by the Regional Centers and base grid (SRTM15_plus v2.6) provided by David Sandwell and colleagues at Scripps Institution of Oceanography (SIO).

The draft global grid was made available for review by the Seabed 2030 Technical Team, GEBCO Technical and Regional Mapping groups and the SRTM15_plus team. The results from the review process were passed to the Regional Centers and SRTM15_plus Grid Developers for investigation and revised grids were produced. A final gridded product was then developed at the Global Center from the revised grids along with accompanying dataset documentation. The framework for access to the data set via GEBCO's web site and download app was also updated.

Crowdsourced bathymetry (CSB) work

The Global Center acts as a Trusted Node for CSB data sets – i.e. acting as focal point for some contributors of CSB data with the aim that the data are assessed and processed into a form for submission to the IHO Data Center for Digital Bathymetry (IHO DCDB) and are then made generally available.

During the year, two CSB data sets have been processed and submitted to the IHO DCDB. The Center also processed CSB data sets received by the Seabed 2030 Pacific Ocean Regional Center and provided feedback to the Center on these data sets.

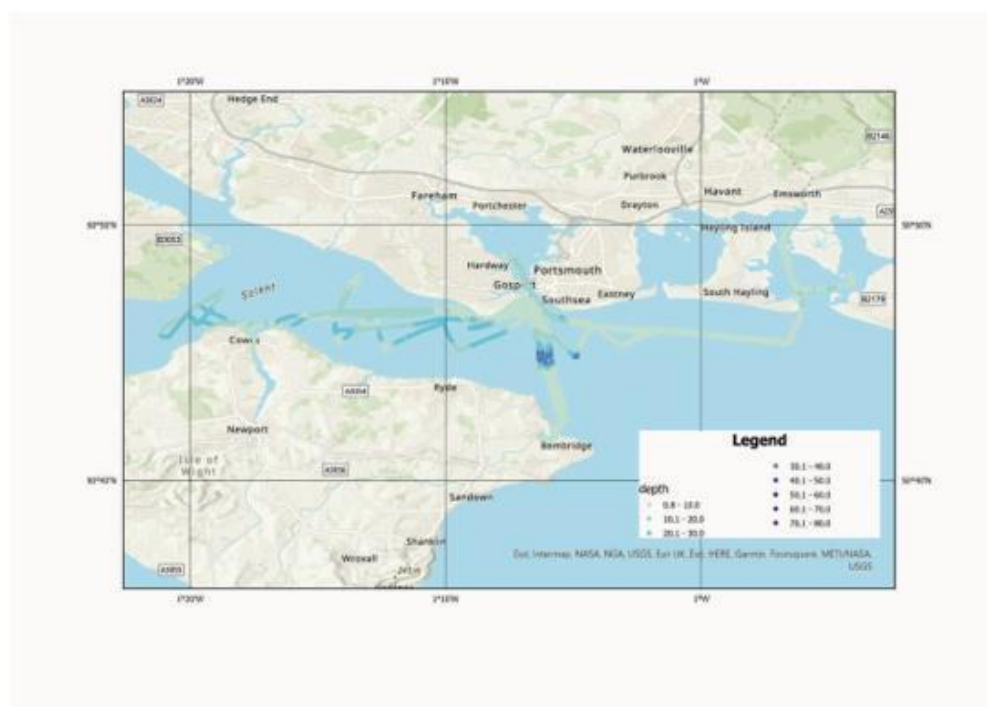


Figure 2: Sample coverage of a processed CSB data set

Development of an application to deliver multi-resolution grids

The GEBCO grid is currently made available as a global 15 arc-second interval grid. However, in some regions, it is based on data at higher resolutions. To accommodate users who want access to higher resolution data, where it exists, a multi-resolution grid product is being developed:

- The grids will be ‘sparse populated’ – i.e. only grid cells that are based on measured data are populated.
- The range of depth values in the grids depends on the grid interval.
- The grids will be delivered in geographic co-ordinates.
- The 15 arc-second interval grid will also continue to be delivered as a global fully-populated grid.

The table below shows the depth range and grid resolution for the various multi-resolution grids.

Depth range (meters)	Grid resolution (degrees)	Approximate grid resolution (meters)
0–1,500	0.001	100
0 - 3,000	0.002	200
0 - 11,000	0.004	400

A draft application has been developed to provide access to both the global 15 arc-second interval grid and the multi-resolution grid product.

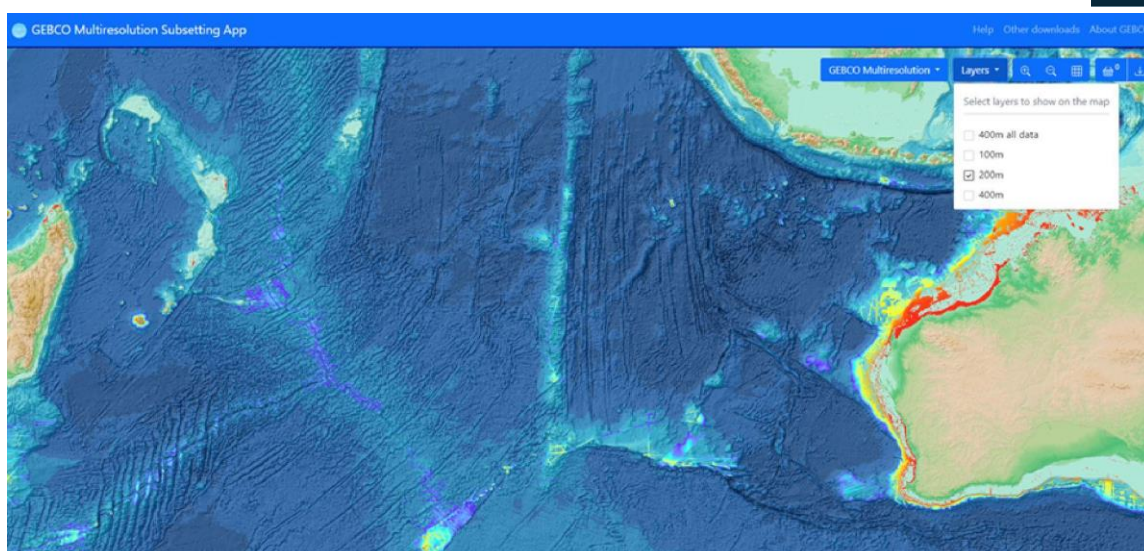


Figure 2. Imagery from the draft multi-resolution grid delivery application - the 'rainbow colours' show areas of multi-resolution data plotted on the 15 arc-second GEBCO grid (areas of blue shaded-relief).

Other activities

Filling data gaps - provided access to bathymetry data sets held in BODC's archive

The Center has been working to provide information about datasets held at BODC that can be used to update the GEBCO grid.

We have provided raw multibeam bathymetry data from two cruises in the Atlantic Ocean to the Atlantic and Indian Ocean Regional Center. One cruise of raw multibeam data has been provided to the North Pacific Regional Center for inclusion in the GEBCO grid.

Project support work

The Global Center continues to act as the point of contact for users of GEBCO's products and services. During Year 7, 35 direct enquiries related to the GEBCO grid or source bathymetric data sets were answered. The Center also hosts and maintains the internal project communications tools. Center staff have continued to contribute to Seabed 2030's newsletters.

Miscellaneous

As part of the GEBCO/Seabed 2030 contribution to the UNESCO State of the Oceans Report 2024, the GDACC provided text and imagery to be included in the document.

Publications

The GDACC presented a poster about the work of GEBCO and Seabed 2030 at the International Conference on Marine Data and Information Systems (IMDIS) 2024. <https://imdis.seadatanet.org/Posters/Session-PRODUCTS>.

Attended events

Center staff attended:

- Crowdsourced Bathymetry (CSB) Working Group 14, August 2023, Stavanger, Norway

- GEBCO TSCOM, SCRUM and SCOPE meetings and 40th Joint IHO-IOC Guiding Committee for GEBCO meetings November 2023, Monaco.
- Executing a GEBCO Community Vision Working Meeting, March 2024, attended via Zoom
- GEBCO Guiding Committee Intersessional meeting, April 2024, attended via Zoom
- UN Ocean Decade Conference, April 2024, Barcelona, Spain
- Crowdsourced Bathymetry (CSB) Working Group 15, April 2024, attended via Zoom

Center Staff

The Global Center has a full staff complement, with three staff working regularly on the Seabed 2030 Project (Helen Snaith, Pauline Weatherall and Chris Thompson). During Year 7, additional work has been provided by the BODC software development team and system administrators as part of an agile software development framework.

Financial report

All funds were allocated to seabed mapping activities.

IHO Data Center for Digital Bathymetry

Location: National Oceanic and Atmospheric Administration's National Centers for Environmental Information (NOAA NCEI) in Boulder, Colorado, USA.

DCDB Director: Jennifer Jencks

DCDB Data Managers: Jess Nation, Christie Reiser, Georgie Zelenak

Summary

The IHO Data Center for Digital Bathymetry (DCDB) is the recognized IHO repository for all deep ocean bathymetric data collected by hydrographic, oceanographic and other vessels. Since 1990, NOAA's NCEI (formally NGDC) has hosted the DCDB. In support of the IHO Crowdsourced Bathymetry (CSB) Initiative, the DCDB built and supports a data pipeline that also allows for the ingest, discovery and access of CSB data.

In addition to data archiving, the bathymetry team focused much of their Year 7 effort continuing their work with the NOAA NCEI Software Development Team on enhancement and implementation of new end-to-end data pipelines for both CSB and multibeam bathymetry that will ultimately allow for a much more flexible inclusion of data.

The DCDB Director also continued to focus on outreach efforts within the IHO Regional Hydrographic Commissions (RHC) by either presenting directly or providing regionally specific presentation materials to the Regional Coordinators covering the importance of data sharing and the CSB effort.

DCDB Data Managers also attended (virtually or in person) all Seabed 2030 Regional Center meetings.

The main activities of the DCDB for Year 7 include:

DCDB Infrastructure Enhancements

- Transition from current (outdated, inflexible) multibeam bathymetry database to new schema is 80% complete. The new schema will enable a better system for versioning processed swath files, discovery of backscatter and ancillary files, efficient tracking of metadata for more complex datasets, and management of products associated with multiple surveys.
- Completed build out of a new end-to-end multibeam archiving system. The system will feature increased automation (more efficient archiving times), improve error handling and notifications and include flexible options for future file readers and plugins. Enhancements will enable the ability to handle new multibeam data formats, new platforms (eg: uncrewed systems), processed data, and products.
- Deployed to operational a new crowdsourced bathymetry pre-approval application. This app will allow coastal states to review data in areas of national jurisdiction when requested in IHO CL 01/2020 & IRCC CL 21/2020 responses.
- Once the contributed bathymetric data have been archived, they are made discoverable and accessible through the DCDB web map viewer (ncei.noaa.gov/maps/iho_dcdb/). Improvements and updates to the viewer over the last year include:

Updates:

- Simplified and revised AusSeabed and EMODnet layers.
- AusSeabed: only footprints for bathymetry acquisitions and compilations are displayed.
- EMODnet: multibeam and singlebeam now combined; issue addressed with identify popup.

- Updated UKHO web services.
- Updated to ArcGIS jsapi 3.45.

Additions:

- Cape Verde grids.
- Seabed 2030 Regional Centers layer (under "Options").
- new ETOPO Hillshade basemap.
- EMODnet and Germany layers (PANGAEA and AWI) to the Arctic and Antarctic views.
- Canada layers (NRCan surveys/hillshades and NONNA-10/NONNA-100) to the Arctic view.

Data submission

The DCDB has archived over 1.7 TB uncompressed (1.08 TB compressed) multibeam bathymetry data from 70 surveys and 5 sources. This includes:

- 40 surveys from 9 vessels contributed by Rolling Deck to Repository (R2R).
- 27 surveys from 4 vessels contributed by National Oceanic and Atmospheric Administration (NOAA); including 5 surveys from 1 vessel contributed by NOAA Ocean Exploration and Research (OE).
- 2 surveys from 1 vessel contributed by Inkfish.
- 1 survey from 1 vessel contributed by the Maine Coastal Mapping Initiative (MCMi).

Over the last year, the DCDB continued to bring in (CSB) data from Rosepoint Navigation System, FarSounder Inc, PGS, MacGregor Germany, M2Ocean, Great Lakes Observing System (GLOS), Orange Force Marine and GEC Aqua Map. New CSB data ingest pipelines were finalized with the Interdisciplinary Center for Development in Ocean Mapping (CIDCO), Seabed 2030, International Seakeepers Society, and the Center for Ocean Mapping and Innovative Technologies (COMIT). We are currently in the process of onboarding Alcatel Submarine Network and Docktech.

36.2 GB of CSB data, contributed from 433 vessels, are publicly accessible. In April, the DCDB exceeded 1 billion data points (1,058,335,732 as of June 2024).

Crowdsourced Bathymetry Initiative

- The Director of the IHO DCDB continues to serve as the Chair of the IHO Crowdsourced Bathymetry Working Group (CSBWG).
- Two working group meetings were held in Year 7. The 14th meeting (hybrid), from 16-18 August 2023, was hosted by the Norwegian Mapping Authority Hydrographic Service in Stavanger, Norway and attended by ~60 participants (25 in person). A 3 hour intersessional meeting was held virtually on 13 December 2023. The 15th meeting (hybrid), from 23 – 25 April 2024, was hosted by the IHO Secretariat in Monaco and attended by ~80 participants (20 in person). The meeting provided an opportunity to report on progress being made on each of the eleven work items detailed in the CSBWG work plan.
- The DCDB Director meets monthly with both the Seabed 2030 Director and the Head of the Global Center. These meetings allow for communication and coordination on several ongoing Seabed 2030-funded CSB activities. Through partnership with and funding by the Seabed 2030 Project, a supply of generic data loggers has been purchased and distributed to numerous CSB projects. The intent is for this to be a great way to (1) collect data in underserved areas, (2) grow excitement about the CSB initiative, (3) develop a repeatable regional CSB mapping project strategy.

Other Seabed 2030-related activities

- Jess Nation, DCDB Data Manager, attended the Lakebed 2030 Conference (in-person; September 2023) and presented on a project that implemented mapping coordination and data stewardship practices into Northwestern Michigan College's Marine Technology Capstone curriculum. This project resulted in the first multibeam survey from the Great Lakes region to be archived and published at the DCDB.
- Christie Reiser, DCDB Data Manager, attended the FEMME Kongsberg Conference in Edinburgh, Scotland.
- Map The Gaps Symposium 2023
 - Jennifer Jencks, DCDB Director, presented on *Our Unmapped Ocean One Problem. More than One Solution* and introduced a panel discussion on CSB.
 - Jess Nation, DCDB Data Manager, participated in a panel discussion on Ocean Mapping Programs.
- Georgie Zelenak, DCDB Data Manager, attended the 5th Seabed 2030 Arctic-Antarctic and North Pacific Mapping Meeting in Bremen, Germany (November 27–29) to provide an update on the DCDB and CSB.
- Jennifer Jencks co-hosted with Dr. Vicki Ferrini, (Head, Atlantic & Indian Ocean Center) a GEBCO Technical Working Meeting on Improving the Availability, Discoverability & Accessibility of Bathymetric Data in Boulder, Colorado (11-13 March).
- Jess Nation, co-hosted a GEBCO Metadata Workshop in Boulder, Colorado (14 March).
- The IHO DCDB & NOAA NCEI hosted seven students enrolled in the Nippon Foundation/GEBCO Postgraduate Certificate in Ocean Bathymetry training program, May 15-16. GEBCO scholars have been visiting the Data Center annually for over 15 years. The students spent 1.5 days learning about data management best practices, marine geophysical data holdings and stewardship, web delivery services, and digital elevation model development.

Management updates

Engagement and Development

The Nippon Foundation-GEBCO Alumni Projects

Following the success of the XPRIIZE, The Nippon Foundation allocated a significant portion of the prize money to support alumni-led projects in the broader field of ocean mapping. A questionnaire distributed to the alumni revealed that 42.5% of respondents were interested in developing new regionally scaled projects, while 39.7% expressed a desire to engage in global-scale initiatives. Additionally, 66% of alumni indicated interest in joining ongoing projects, representing the highest level of feedback received, highlighting a strong eagerness to contribute to project work. A request for proposals was sent to alumni network.

The submitted proposals had to address any of the goals listed below;

- To map an unmapped portion of the seafloor and provide open access bathymetric data to be included in relevant databases and GEBCO products.
- To develop a new technology or provide a significant development to the existing technology useful at any stage of bathymetric data collection, data processing, product creation or product delivery.
- To provide an innovative use of the technology useful at any stage of bathymetric data collection, data processing, product creation or product delivery.
- Data mining (collating high-resolution data that has already been collected, but is not publicly available).

Two alumni projects were selected by a panel of judges, *‘Collation and compilation of Multi-Scale and Multi-Resolution Bathymetric Data in the Western Indian Ocean,’* and *Sharing MARUM bathymetric data and open-source processing software (MB-System) workflows’* (see Appendix 6a and Appendix 6b).

The Seabed 2030 Head of Engagement and Development (HED) is responsible for overseeing and managing the alumni projects, ensuring their progress and success. Additionally, she provides regular reports to stakeholders, keeping them informed of key developments and outcomes.

Collation and compilation of Multi-Scale and Multi-Resolution Bathymetric Data in the Western Indian Ocean

The WIOBathy project is a collaborative project, spearheaded by Alumni of the Nippon Foundation/GEBCO training program in the WIO region. It is a collaborative project among alumni and institutions from Kenya, Tanzania, Mauritius, Madagascar, Mozambique, and South Africa. Its main purpose is to compile and collate available bathymetry data in the region and contribute to the Seabed2030 global initiative seeking to have a definitive seafloor map of the global ocean by 2030. The project will also contribute to the GEBCO grid by submitting new data.

Project Progress

Kenya, Madagascar, Mozambique and Tanzania have successfully completed their respective in-country stakeholder workshops. In-country workshops played a vital role in this initiative, serving as platforms to bring together stakeholders and the mapping community to compile and share bathymetric data. These workshops acted as a significant catalyst in advancing the consolidation of regional bathymetric data.



Image 1: Participants at the Kenya In-country Stakeholder workshop [10th – 16th January 2024 at the Coast Development Authority in Kilifi, Kenya].



Image 2: Participants at the Mozambique In-country stakeholder workshop [20th – 24th May 2024 [21st – 23rd May 2024 at the University of Eduardo Mondlane, Maputo, Mozambique].



Image 3: Participants at the Tanzania In-country Stakeholder workshop [12th – 14th August 2024 at the White Sands Hotel & Conference Centre, Dar es Salaam].



Image 4: Participants at the Madagascar In-country Stakeholder workshop [9th – 11th September 2024 at the Le Pave Hotel, Antananarivo].

A virtual WIOBathy Data Workshop was organized by the project management unit together with The Nippon Foundation - GEBCO Seabed 2030 Project Atlantic and Indian Oceans Regional Center (AIORC). The training encompassed various key topics, including data preparation and quality assurance/quality control (QA/QC) processes. This included discussions on data compilation at AIORC, the tools used for QA/QC, and an overview of bathymetry workflows, covering QA/QC for gridded data products, sparse data, and swath-formatted survey data (both raw and processed). Additionally, the training addressed metadata requirements and the process for data submission via the GEBCO submission form.

The project team benefited from the valuable opportunity to present the initiative at 2nd Aquatic Resources & Blue Economy Conference and the Southern African and Islands Hydrographic Commission (SAIHC20), where it garnered significant interest from attendees. These presentations helped raise awareness and generate enthusiasm for the project's objectives and potential impact.

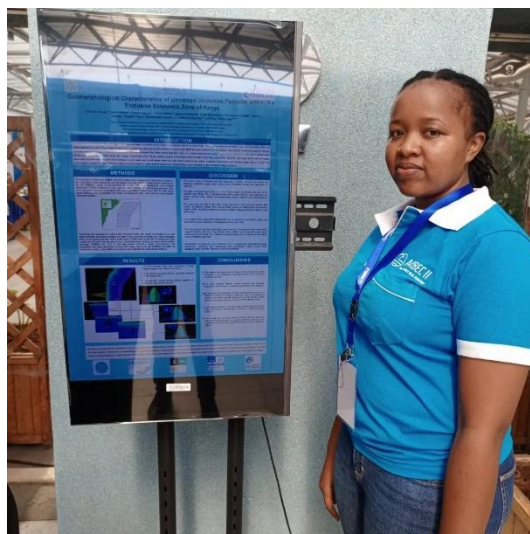


Image 5: Ms. Mathai presenting a poster on seabed features found within Kenyan EEZ.



Image 6: Dr Amon Kimeli and Ms. Victoria Obura during SAIHC Raising Hydrographic Awareness Seminar as part of the 20th Meeting of the Southern African and Islands Hydrographic Commission (SAIHC20) [16-19 September 2024, The Acacia Premier Hotel - Kisumu, Kenya].

Sharing MARUM bathymetric data and open-source processing software (MB-System) workflows

This project is led by Dr. Evgenia Bazhenova at MARUM (Centre for Marine Environmental Sciences), University of Bremen. This project seeks to submit PANGAEA datasets and focus on development of the open-source MB-System software and documentation.

MB-System documentation will include the following:

- revision of the existing MB-System documents and tutorials developed at MARUM for processing of bathymetric data collected by AUV and surface vessels.
- adoption of the data processing workflows for a larger and broader ocean mapping community.
- publication of data processing workflows as Stand Operating Procedures (SOP), e.g. on the ZENODO portal.
- integration of data processing workflows into the GEBCO Cookbook, subject to confirmation with the editorial working group.
- preparation of YouTube videos/webinars for visualization of the data workflows.

The MARUM sea-floor mapping group works in close cooperation with the Southern Ocean Regional Centre of The Nippon Foundation - GEBCO Seabed 2030 Project, hosted by the Alfred-Wegener-Institute for Polar and Marine Research (AWI Bremerhaven, Germany). MARUM also welcomes visits of alumni of the Nippon Foundation – GEBCO training program of the University of New Hampshire (“lab visits”), subject to the availability of additional support.

Project Progress

A comprehensive review of MARUM cruises that collected bathymetry data has been conducted, focusing on the period since the establishment of MARUM in 2003. Between 2003 and 2023, approximately 350 cruises with MARUM participation took place. Bathymetry data for 37 of these cruises, previously missing from the PANGAEA database, were successfully retrieved from the servers.

A metadata template has been created for the data submissions, which will be completed for 37 cruises. This preparation is a key step in organizing and ensuring the accuracy of the data before submission.

A streamlined data processing workflow has been adopted, including the development of a simple script for plotting both raw and processed data. In addition, updated manuals are being prepared and will be published on the MBARI GitHub page, providing clear guidance for users on utilizing the new workflows effectively.

A new subchapter on MB-System has been proposed for inclusion in the GEBCO Cookbook, under Section Fundamentals, Chapter 4.0: Software Overview. The proposal is currently awaiting approval from the Editorial Board, with the primary contact from NOAA NCEI.

SeaKoMap solution

Seabed 2030 previously collaborated with Kongsberg Maritime (KM) to develop and deliver the SeaKoMaP solution, with the unified goal of optimizing the processing of bathymetric data. SeaKoMaP, an acronym which stands for Seabed 2030 Kongsberg Maritime Cloud Processing, will allow Seabed 2030 to leverage its extensive alumni network as a means of simplifying some of the many valid processes, from data collection to the publishing of seafloor maps. SeaKoMap solution is managed by the HED and is currently on hold awaiting further funding opportunities.

Ocean Frontier Mapping

This initiative is currently on hold awaiting further advice from The Nippon Foundation.

IOC Working Group on User Requirements and Contributions to General Bathymetric Chart of the Oceans (GEBCO) Products

With reference to IOC Circular Letter No 2989, *Subject: Ocean Mapping Stakeholder Survey in the framework of the IOC Working Group on User Requirements and Contributions to General Bathymetric Chart of the Oceans (GEBCO) Products*, the HED engaged with colleagues at the Intergovernmental Oceanographic Commission (IOC) to conduct an online survey and compile a comprehensive report on the findings for the working group.

The report was subsequently presented at the IOC Executive Council in June 2024.

Partnership and engagement

The HED visited the Seabed 2030 Pacific Ocean Regional Data Center in June 2024. The primary objective of the visit was to evaluate the requirements and necessary efforts for engaging and collaborating with countries within the region. This assessment aimed to identify key areas for cooperation and establish the groundwork for effective partnerships moving forward. The HED also visited Land Information New Zealand (LINZ) and GNS Science to initiate cooperative dialogue and establish a shared vision for future engagements in the region. These discussions aimed to strengthen collaboration and identify opportunities for joint efforts in advancing regional objectives.

Similar engagements and visits are planned for Asia and the rest of the Pacific, with the aim of fostering collaborative partnerships and establishing a unified approach for future initiatives. These upcoming interactions will focus on exploring opportunities for regional cooperation, ensuring alignment with the broader objectives of enhancing scientific research and data sharing across these regions.

Partnerships

The Head of Partnerships (HoP) is tasked with a broad range of duties in support of Seabed 2030, including facilitating new relationships, developing agreements with potential data providers, maintaining strong links with existing partners, and gaining the support of oceanic Professional Bodies and Learned Societies. As of the end of Year 7, 63 MOU agreements were in place, and 288 organizations had pledged support to Seabed 2030 in some way (Appendix 12).

Where appropriate, and where we can see benefit for Seabed 2030, data providers and facilitators are encouraged to become formal Seabed 2030 Partners by signing a Memorandum of Understanding or Letter of Intent, and they are featured on the Seabed 2030 website after having signed an agreement. These partnerships are intended to increase the amount of mapping data that Seabed 2030 receives from entities that conduct seabed mapping, or who provide the technology, platforms and staff who gather and process data. This includes partners in industry, government, and academia from all over the world. The HoP's remit involves meeting with senior leaders from the global mapping community, and builds on relationships established throughout the history of Seabed 2030, and on the links established by parent organizations International Hydrographic Organisation (IHO) and Intergovernmental Oceanographic Commission of UNESCO (IOC).

Records are currently managed using shared online spreadsheets by the Project Administrator and Head of Partnerships; in Year 8, a new contact management system called 'Pipedrive' will be introduced to better manage the partnerships workflow (with back-end support from Meridian). Preparatory work for this project commenced during Year 7.

A highlight of Year 7 included working directly with the UN Ocean Decade Corporate Data Group, who represent corporate holders of ocean data and liaise with the IOC UNESCO Ocean Decade Coordination Unit in Paris. The HoP established regular meetings with the group in September 2023, and the release of large datasets that were originally gathered by companies working in offshore energy, pipeline and cable laying is being negotiated for Year 8.

Working with the Head of Engagement and Development (HED), during Year 7, the HoP was invited to coordinate input to the GEBCO user needs survey that was later reported to the IOC Executive Council in June 2024.

In addition to attending a wide range of conferences, meetings and events (see Appendix 14), the HoP has also taken part in outreach activities throughout the year and has conducted a number of interviews with the media. Other outreach activities included the production of a new podcast for the global ocean community that since September 2023 has featured interviews with the Seabed 2030 Director, the Head of the Atlantic-Indian Ocean Regional Center, Fugro, Orange Force Marine, EMODnet, Saildrone and the IOC Decade Coordination Unit. Further interviews are planned for Year 8 and beyond.

Looking ahead to Year 8, the HoP will continue to position Seabed 2030 globally and grow its network of partners with a view to increasing data contributions. The HoP will work closely with the HED, who will be assisting with partnership work by focusing on the Pacific Ocean region.

Media and Communications

Building on the progress of previous years, Year 7 marked a continued period of growth and outreach for Seabed 2030. This year saw a continued rise in global media coverage, enhanced collaboration with strategic partners, and a notable expansion of the project's presence across multiple digital platforms. A total of 495 media hits were recorded throughout Year 7, marking an increase from the previous year (see Appendix 7).

One of the standout media moments of the year was an interview between Cleo Abram, a popular YouTube creator, and Seabed 2030's Head of Partnerships, Steve Hall. Abram's channel is known for breaking down complex scientific topics for a wide audience. Her video, which highlighted the importance of ocean mapping and included the interview with Hall, was viewed by over 2.5 million people. This exposure – aided by Abram's 3.98M subscribers – introduced Seabed 2030 to a much broader demographic, raising awareness and potentially fostering new supporters from varied sectors, including education and technology.

Another notable interview was that of Project Director Jamie McMichael-Phillips with Al Jazeera – one of the world's largest news networks. With a reach of over 150 countries, this opportunity allowed Seabed 2030 to engage audiences in the Middle East, Africa, and beyond.

Seabed 2030 also received an in-depth feature in BBC Future, a highly respected platform for innovative and forward-looking science stories. As with previous years, the project also once again benefitted from the support of the BBC's outgoing science correspondent, Jonathan Amos, who shared an update on the project's latest grid figure to his 54K followers on X. His tweet garnered 13.3K views.

Continuing its focus on partnerships, Seabed 2030 co-authored a scholarly article with its long-standing partner Saildrone, which was published in the *Journal of Ocean Technology*. This article outlined the cutting-edge technologies and collaborative strategies that are essential to the success of seabed mapping. With a strong reach across academic and scientific communities, the piece enhanced the project's profile among researchers, marine experts, and innovators.

In addition to traditional media, Seabed 2030 also saw sustained engagement and growth across its digital platforms in Year 7. Regular updates, live event coverage, and collaborative content with partners helped drive interaction and expand Seabed 2030's digital presence.

This digital growth continues to be a vital aspect of the project's communications strategy, facilitating direct engagement with stakeholders ranging from the scientific community to policymakers, educators, and the general public.

Seabed 2030's social media campaign focusing on its key partnerships was also a success. Videos featuring collaborations with partners including Fugro, Esri, Saildrone, Schmidt Ocean Institute, SEA-KIT, and explorer Victor Vescovo collectively garnered thousands of views, further strengthening the project's reach and engagement.

All of Seabed 2030's social media channels have experienced significant growth and engagement in Year 7 (see Appendix 13). This in turn has resulted in higher brand awareness, trust, and opportunities to highlight partners.

Project Update by work stream

The endorsed Year 7 Work Plan is at Appendix 1.

Work Package	Description
WP1	Data
WP2	Systems and tools
WP3	Technology Innovation
WP4	Mapping Activities
WP5	Management
WP5.1	<ul style="list-style-type: none"> Operational Management
WP5.2	<ul style="list-style-type: none"> Strategic direction
WP5.3	<ul style="list-style-type: none"> Communication
WP5.4	<ul style="list-style-type: none"> Capacity Development

WP1: Data

Task 1.1. Secure data contributions from different communities

D1.1.1 – Increased data contributions from different organizations.

Work has continued on data processing pipelines to increase efficiency and improve quality of products; new contributions submitted online are monitored through Google forms (22 entries in year 7). New metadata standards have been agreed with GEBCO TSCOM to improve reporting on contributions, and metadata was collected for all contributions included in the 2024 grid. Work has taken place with the Head of Partnerships to increase collaborations leading to new contributions.

Task 1.2 Data Product – Update IBCAO and publish v6.0

D1.2.1 – To be published by Spring 2024.

IBCAO 5.0 was completed during Spring 2024 and a scientific article was submitted to Nature Scientific Data. The article has 70 co-authors spread across the world who all contributed to the piece.

Task 1.3 Data Product – IBCSO 2023 and initiation of IBCSO 2024

D1.3.1 – To be published by Summer 2023.

IBCSO 2023 was cancelled due to necessary updates to the SEAHORSE workflow. The IBCSO 2024 annual release is expected in September 2024.

Task 1.4 Publish Data Product – GEBCO 2024 and updated polar region grids

D1.4.1 – GEBCO 2024 and updated polar region grids to be published by 21 June 2024.

The GEBCO_2024 Grid was published in July 2024, along with the Southern Ocean area grid in polar projection co-ordinates. Work is in progress to make the Arctic area grid available in polar projection co-ordinates. Web Map Services have been developed based on the GEBCO_2024 grid. IBCAO v5 grid was published via GEBCO's web site.

Task 1.5 BedMachine Collaboration

D1.5.1 – Ingestion of under-iceshelf topography into IBCAO and IBSCO.

Initial contact has been made with BedMachine to begin discussions.

WP2: System and tools

Task 2.1 Further development of mapping statistics system

D2.1.1 – System that can deliver statistics regularly based on input data from RDACCs.

The statistics algorithm has been further improved during Year 7 and is fully automated. It runs in the AWS cloud.

Task 2.2. Process automation

D2.2.1 – Research into automated updating of regional grids.

Incremental gridding has been implemented, meaning that only the portions around where there is new data are updated in order to improve performance. Furthermore, gridding using Graphic Processor Units has been implemented for several routines, but some more work is required.

Task 2.3 Further development of UNH GapFiller tool

D2.3.1 – Extend capabilities of GapFiller tool for planning expeditions whilst optimizing

filling of mapping gaps. Make GapFiller available as both a stand-alone tool and web-based.

GapFiller has evolved and new capabilities have been added, including scraping of multiple data sources, multiple survey segments and others, as requested by TSCOM.

Task 2.4 Refresh map based on an initial list of Seabed 2030 Priority Areas

D2.4.1 – Based on further WITS activity. Tools to support dynamic planning by external data contributors for ship transits and science missions.

WITS Project work towards a Seabed 2030 global prioritization tool continues, as detailed under D5.2.1

Visualizations of existing data through Bathyglobe and links to tools added to Seabed 2030 website to support transit planning. Team working with TSCOM and CCOM to extend planning tool availability.

Task 2.5 Deliver the next generation GEBCO product

D2.5.1 – Publish a multi-resolution GEBCO product.

A draft application has been developed to provide access to both the global 15 arc-second interval grid and the multi-resolution grid product.

Task 2.6 Maintain GDACC as a Crowdsourced Bathymetry (CSB) Trusted Node

D2.6.1 – Based on IHO standards and guidance, maintain Trusted Node. Engage with contributors and deliver data to IHO-DCDB.

During Year 7, two CSB datasets have been processed by the Global Center and submitted to the IHO DCDB. CSB datasets received by the Seabed 2030 Pacific Ocean Regional Center were also processed and feedback was provided to the Center on these data.

Task 2.7 Grid quality improvement

D2.7.1 – Based on collaboration with Scripps Ocean Institute for SRTM15+ updates.

The GDACC has continued to engage with colleagues at Scripps Institution of Oceanography regarding the use of the SRTM15_plus dataset, which is used as a base grid for the GEBCO global grid. Feedback for the GEBCO grid review process was passed to Scripps and this information was used by them to provide a revised SRTM15_plus base grid for use in generating the GEBCO_2024 Grid. Scripps also provide feedback on the draft version of the GEBCO_2024 Grid which was useful to help improve the final product.

Task 2.8 Web Services for Visualization

D2.8.1 – Continue support of web services for visualization of SB2030/GEBCO data sets, particularly for QC and planning. Investigate use of Esri products in the delivery of web services and develop a web coverage service for the GEBCO global grid.

Web Map Services based on the GEBCO_2024 grid have been developed and made available. An Esri service was provisioned, but costs of provision were excessive. Alternatives are now under development for API and coverage services.

Task 2.9 Visualization of the coverage/origin of source data sets used in the generation of the GEBCO Grid.

D2.9.1 – Development of a web map to allow the visualization of the coverage of the source data included in the GEBCO Grid.

Centers are continuing to support and improve the performance of Web Map Services that support GEBCO/Seabed 2030 products. A Work Plan has been developed with TSCOM for further enhancements of Bathyglobe and specification of services.

WP3: Technology Innovation

Task 3.1. Data Uploader

D3.1.1 – Collaborate with Teledyne Caris on a Data Uploader Tool

An initial prototype as developed by CARIS. The work is currently paused. Action is needed on metadata deliverables.

Task 3.2. Data Uploader

D3.2.1 – Collaborate on refining KM Data Uploader Tool.

Brief discussions have been undertaken with Kongsberg Maritime, but the work on the Uploader has been temporarily paused for the time being.

Task 3.3. Data Uploader

D3.3.1 – Refine Seabed 2030 Data Uploader Tool.

The Uploader has been further refined and developed during Year 7.

Task 3.4. Cloud-Based Processing (SeaKoMap)

D3.4.1 – Operationalize SeaKoMap capability.

The SeaKoMap solution is managed by the Seabed 2030 Head of Engagement and Development and is currently on hold pending future funding opportunities.

Task 3.5. Support Innovative Mapping Technology

D3.5.1 – Continue efforts to develop and support Project NEMO floats. Conduct first deployments of floats in deep Pacific.

A first deployment of NEMO floats has taken place - processes are being reviewed and data analyzed to determine what, if any, improvements need to be put into production models.

Task 3.6. Support Innovative Mapping Technology

D3.6.1 – Collaboration and development activity on autonomous data collection.

The DriX uncrewed vehicle continues to be upgraded including the installation of the first of its kind, compact Kongsberg EM712 – midwater multibeam sonar (to approximately 3000 m depth) that is compact enough to fit on a small autonomous vessel. The prototype was installed on the DriX for its first trials in April 2024 and produced excellent results.

Task 3.7. Support Crowdsourced Bathymetry (CSB) Technology

D3.7.1 – Basic technical support for volunteers and support for new generation loggers.

Two technical advisors are now in place to provide remote technical support for the installation and operation of CSB data loggers (both the new generation loggers once available and the existing NMEA2000/0183 versions).

WP4: Mapping Activities

Task 4.1 Progress Mapping the Ocean Frontiers

D4.1.1 – Identify expeditions to be supported and acquire new data.

The Ocean Frontier Mapping program is currently on hold pending further funding opportunities.

Task 4.2 Greenland Crowd Source Project

D4.2.1 – Continue to oversee Greenland Crowd Source Initiative.

The ‘Collaborative Mapping Greenland’ Project is ongoing, and vessels continue to be fitted with data loggers as part of the pilot. Processes and results of the Project have been presented at scientific meetings both in Greenland and internationally. Leaflets have been disseminated in both Danish and Greenlandic locally in an effort to recruit more participants, and technical assistance has been provided at quayside and onboard vessels, where required (see Progress Report at Appendix 8).

Data collected as part of the pilot will continue to be delivered to Seabed 2030 and DCDB, although the Project is temporarily on hold during Year 8 due to other commitments/staffing shortages at the Greenland Institute of Natural Resources.

Task 4.3 Continue to accelerate Crowd Sourcing activity

D4.3.1 – In liaison with IHO CSBWG, significantly increase crowd sourced data submissions.

Crowd Sourced Bathymetry (CSB) activity in Palau, New Zealand and Greenland is ongoing. After a period of inactivity in South Africa due to a changeover in staffing, contact was reestablished late in Year 7 and activity is to resume shortly. The CSB Representative for Jamaica (Alumni member) is currently drafting a costed project proposal for expanding activity in the Caribbean region, with an update expected later in 2024.

Roll out of the UNH-SEA-ID low-cost data loggers (NEMO-30) has been further delayed due to supply chain issues and ongoing development of hardware/software components. A dispatch list of recipients is being maintained in anticipation of the loggers’ readiness for release, which includes the Nigerian Navy who have several interested participants lined up.

The International Seakeepers Society continues to provide excellent support for CSB activities and has

been dispatching NMEA data loggers to its global membership while also promoting Seabed 2030 at events and conferences. Seakeepers now incorporate 'orphan' vessels (those that don't already belong to a Trusted Node and would previously have been directed to Seabed 2030) into their global CSB program. The initial purpose behind this arrangement was to provide participants with a more streamlined, guided approach through the CSB onboarding process, but it has also helped to ease Seabed 2030 capacity concerns. Following support from the Global Center and DCDB, Seakeepers is now established as a CSB Trusted Node.

The Director and Project Administrator continue to represent Seabed 2030 on the IHO CSB Working Group, and both attended the 14th meeting in Stavanger, Norway in August 2023 (CSBWG14). Neither were able to attend the 15th meeting in Monaco (CSBWG15) in April 2024 but were kept informed on developments by colleagues. The Project Administrator has contributed to the work of the Sub-Working Group responsible for producing a CSB 'Incentives and Recognition Strategy'. Routine meetings with the CSBWG Chair/Director DCDB are scheduled monthly.

Task 4.4 Satellite Derived Bathymetry

D4.4.1 – Encouragement of 3rd party involvement whilst also deriving meaningful data products for use in the GEBCO Grid.

The second year of TCARTA - Memorial University SDB Internship program took place during Year 7, which delivered new data from Somalia, Nicaragua, Lesser Antilles, and Galapagos.

Engagement was initiated with Greenwater to discuss delivering future additional SDB to the project.

Task 4.5 Satellite Derived Bathymetry

D4.5.1 – Data ingest activity Jamaica and Haiti

Two SDB training events were conducted in collaboration with TCarta in Jamaica and the Dominican Republic. Both resulted in new data delivery to the project and capacity development within Hydrographic Offices (see DR Project Report at Appendix 9). The Jamaican data was included in GEBCO 2024 and the DR data will be included in GEBCO 2025.

Task 4.6 Satellite Derived Bathymetry

D4.6.1 – Wave Kinematic Bathymetry – development for Seabed 2030

Wave Kinematic SDB delivered by TCarta from the coast of Suriname was included in GEBCO 2024. This provides coverage that would be difficult and very costly to acquire with standard survey methods and proves the value of WKB as an alternative where water clarity is insufficient for traditional SDB methods.

WP5 Management

WP5.1 Operational

Management Task 5.1.1 Secure Year

8 funding

D5.1.1 – Year 8 Work Plan and Budget approved.

Following engagement with The Nippon Foundation, GGC Chair and Chairs of TSCOM and SCRUM, the Year 8 Budget and Work Plan bids were submitted (Appendix 2 and Appendix 3, attached). The Nippon Foundation Board generously approved a Grant of \$3,200,000 (Appendix 4, attached).

Task 5.1.2 Year 7 Financial Management

D5.1.2 – Year 7 finance ledger is accurate and Project run to budget.

Year 7 accounts were reconciled within 3 months of year end. Surplus funds will be returned to The Nippon Foundation in November 2024 in accordance with the Grant conditions.

Task 5.1.3 Annual Project Reporting to GGC

D5.1.3 – Year 7 Annual Report submitted to GGC.

The Year 7 Annual Report will be presented at GGC41, 4-8 November 2024.

Task 5.1.4 Quarterly reporting to The Nippon Foundation and GGC

D5.1.4 – Quarterly reports presented to The Nippon Foundation and GGC.

Quarterly reports have been submitted to The Nippon Foundation in writing and via verbal brief and to GGC via the GEBCO Secretary throughout Year 7.

Task 5.1.5 Periodic Project Reporting to Sponsors

D5.1.5 – Sponsors meetings held as required by Sponsors.

In addition to the quarterly reporting cycle, Sponsors meetings are held twice each Project year, or additionally as required. At the request of participants, meetings are scheduled approximately 6 months in advance. The last meeting was held in June 2024. The next meeting is scheduled for January 2025 (Year 8).

Task 5.1.6 Engage with the GEBCO community

D5.1.6 – Diary of Year 7 engagement demonstrating GEBCO contribution to Seabed 2030.

Records are maintained of all GEBCO Sub-Committee work by the Chair of each group.

WP5.2 Strategic Direction

Task 5.2.1 Engage with user community

D5.2.1 – Robust use case evidence documented (via WITS work) and GEBCO product users active in Seabed 2030.

Review of Year 7 activity (Phase 2, Objective 7)

- Proposed a Seabed 2030 mapping prioritization tool user needs/requirements document and validated with Project representatives (workshop and interviews).

- Reviewed GEBSCO SCRUM prioritization web app and AusSeabed prioritization tool and conducted gap analysis.
- Presented architecture/design and implementation plan prioritization for consideration.
- Produced a workflow document for implementation of prioritization tool.
- Final delivery of the Use Case Compendium was taken in Year 7 - originally part of the Year 6 Work Plan but has been through several rounds of revision and design amendments as considered a key Deliverable (Appendix 10a).

Planned activity for Year 8 – (Phase 3, Objective 9)

- Prioritization assessment of ocean areas with evidence-based reporting.
- Conduct a strategic assessment analysis and visualization of global ocean areas to enable a baseline 'Prioritization Grid Scoring, document. (Objective 9 Work Plan at Appendix 10b).
- Objective 9 outputs include:
 - Global Grid score (baseline) seabed mapping prioritization reference map prototype.
 - Seabed 2030 seabed mapping strategic intelligence report prototype.
 - Seabed mapping prioritization area assessment baseline justification case document.
 - Seabed mapping prioritization toolkit model II Implementation Plan document.
 - An article for Seabed 2030 to use to promote its mission and WITS activities.

Task 5.2.2 Solicit external strategic advice/input

D5.2.2 – Improve Seabed 2030 strategy through external advice.

There has been ongoing engagement across a wide field of advisers including Sponsors, the GEBSCO community and other stakeholders interested in Seabed 2030 work. The external Strategic Advisory Group continues to meet virtually as required, with the next in-person meeting scheduled for Tokyo in March 2025.

Task 5.2.3 Position Seabed 2030 globally

D5.2.3 – Seabed 2030 acknowledged as key global initiative.

Seabed 2030 is increasingly recognized on a global level as a key initiative and continues to position itself in a strong position to achieve its mission by:

- Working alongside The Nippon Foundation, the GEBSCO community, IHO and IOC to advance project growth.
- Adopting a key position within the UN Decade of Ocean Science as a flagship programme.
- Increasing data submissions by engaging with regional activities.
- Building an expanding network of partners and stakeholders.
- Attending key events and conferences.
-and more.

Task 5.2.4 Build strong partnerships

D5.2.4 – Partners make significant contribution to Seabed 2030 success.

Currently there are 288 organizations that have pledged support to Seabed 2030 in some way (see Appendix 12). Groups are broadly defined as follows:

Partners: Organizations making a significant and ongoing contribution to Seabed 2030 through an agreed plan of action as defined in a formal MOU or sponsorship license (usually for software).

Data Contributors: Organizations contributing data to Seabed 2030. No formal MOU exists.

Supporters: Organizations or individuals who, whilst having no data to contribute, wish to provide strong support to the Seabed 2030 mission. No formal MOU exists.

As of the end of Year 7, 63 MOU agreements were in place as well as a renewed software agreement with QPS.

Task 5.2.5 Engage with widest possible community

D5.2.5 – Attendance at key events and promotion within networks.

Regional Centers continue to organize successful regional mapping meetings, with some having adopted a partial hybrid model to increase attendance and improve accessibility. Regional engagement in other events, conferences and activities is helping to increase the network of Seabed 2030 stakeholders, partners and data contributors and is monitored centrally to ensure maximum global coverage.

Task 5.2.6 Engage with Decadal Programmes and Projects

D5.2.6 – Participation at key events and promotion within networks.

Seabed 2030 continues to work alongside the UN Decade team and other global initiatives. There is ongoing engagement with the Decade Coordination Unit and the newly established IOC Corporate Data Group.

The Seabed 2030 team played a pivotal role at the 2024 Ocean Decade Conference in Barcelona, sharing a booth that was co-designed with the Intergovernmental Oceanographic Commission's Decade Coordination Unit team and representatives of fellow decade flagship programmes to host an 'ocean data sharing helpdesk' with regular presentations about our work to delegates and members of the public. In addition, the team helped to staff the 'Deep Ocean Decade Booth' hosted by the Deep Ocean Stewardship initiative.

Before the main conference started, Seabed personnel contributed to the Ocean Data Strategy session on 'Implementing a Federated Global Ocean Data Information System,' and the 'How to Harness Private Sector Data to Boost Ocean Science and Drive a Sustainable Blue Economy' event. Seabed 2030 brochures were printed in English, Spanish and French, and as the main conference proceeded, we contributed to the IHO 'Seabed Data we Need for the Ocean We Want' session held in the main auditorium, an industry data sharing event with the UN Global Impact programme. Contributions were also made to the session on 'Science & Solutions for a Sustainable and Resilient Ocean Economy' moderated by Claire Jolly of OECD, the session 'Science & Solutions for a Safe & predicted Ocean' moderated by Marc Heine, CEO of MOU partner Fugro, and in the session 'Resources and Partnerships for the Ocean Decade' which featured Hide Sakaguchi from the Ocean Policy Research Institute of the Sasakawa Peace Foundation.

MOUs with Challenger 150, The Marine Technology Society, and GEOMAR were signed in person at the event, and the team networked and started building new relationships with other future partners.

The Head of Partnerships continues to act as the coordinator for two Seabed 2030 Decade projects; 1) Kenya Marine and Fisheries Research - "High resolution seabed mapping in the western Indian Ocean" and 2) NOAA - "Seascope Alaska - a regional & coastal mapping campaign."

WP5.3

Communication Task 5.3.1 Media Strategy

D5.3.1 - Deliver against published Media Strategy.

Ongoing external engagement with Shearwater Global, ENP Media and Meridian in relation to delivering outputs against the Seabed 2030 Communications Strategy, including but not limited to:

- content creation for social and mainstream media.
- publication of newsletters.
- submission of material to external publications.
- media monitoring, event support.
- press releases and announcements.
- creation of social media campaign and partner videos.

The Meridian team brings social media expertise to the Project's media activities. The drafting of a new Communications Strategy during Year 7 utilized externally facilitated team workshops to bring a more strategic approach to online partner engagement, expanding virtual networking, promoting the work of the project via different channels and driving traffic to the Seabed 2030 and GEBCO websites.

Task 5.3.2 Seabed 2030 media content across all channels

D5.3.2 – Ongoing process to deliver new content.

Meridian's Year 7 Social Media Report is presented at Appendix 13 and shows growth and increased engagement across all channels. In collaboration with Shearwater Global, Meridian creates and publishes new, highly relevant content across the Project's platforms: Facebook, LinkedIn, X, Instagram and Threads. A monthly KPI Report is provided (to be provided quarterly from Year 8), and ongoing advice on how to best nurture the Project's growing social media community is offered.

Task 5.3.3 Promote Seabed 2030 at external events and meetings

D5.3.3 – Catalogue of events and meetings attended.

A list of Year 7 events and presentations is at Appendix 13. Ongoing attendance at key events and participation in meetings, both virtually and in person, raises awareness of Seabed 2030 and increases the network of potential stakeholders, MOU partners and data contributors.

Task 5.3.4 Acknowledge partner contributions

D5.3.4 – Seabed 2030 website.

The Global Center has updated the list of organizations who have contributed data to the GEBCO Grid. The list is made available via GEBCO's web site. The Seabed 2030 website is jointly administered by the Global Center and the Project Administrator, with support from Shearwater Global.

WP5.4 Capacity Development

Task 5.4.1 Engage Alumni in Seabed 2030 activities

D5.4.1 – Manage Alumni coordination across appropriate Seabed 2030 activities.

As part of CSB mapping activities, two alumni provided remote technical expertise throughout Year 7 and will continue to act in this capacity throughout Year 8. Their involvement encompassed providing technical assistance for data loggers during expeditionary operations.

The two alumni projects as detailed in the Head of Engagement and Development section have a direct and significant impact on achieving the Seabed 2030 mission. The WIOBathy project is a pioneering initiative led by Alumni of the Western Indian Ocean (WIO) region. This collaborative effort unites institutions and experts from Kenya, Tanzania, Mauritius, Madagascar, Mozambique, and South Africa. The project's primary goal is to compile, collate, and contribute bathymetry data to Seabed 2030.

The second Alumni project focuses on enhancing the open-source MB-System software and documentation for bathymetric data processing. The project aims to submit datasets to PANGAEA and develop standardized data processing workflows for the broader ocean mapping community. YouTube videos and webinars will be created to visualize data workflows, increasing accessibility and visibility of data processing methods. By achieving these objectives, the project will improve MB-System software and documentation, facilitating more efficient and standardized ocean mapping practices.