

120 years of ocean discovery

As we celebrate GEBCO's 120 years of ocean discovery (1903–2023), we do so in a situation and in an environment that has drastically changed since our last celebration twenty years ago. We are one of the longest-running ocean mapping data collection, compilation, and distribution programmes in history. And yet, even after more than a century of activities, we are still only at the beginning of Earth's last great mapping endeavour.

Recent years have seen a rise in ocean exploration, which has led to the discovery of previously untapped natural resources, new medicines, genomes, and food sources. But how do we manage and use these discoveries fairly and sustainably? The 30×30 Project calls for world leaders to commit to protecting at least 30 % of the world's ocean by 2030 through a network of highly protected marine areas. And yet, ocean and coastal territories must be well-defined so nations can decide how to protect and monitor the region effectively. We cannot manage what we do not know is there. This simple fact will become increasingly important as nations venture further into the ocean to build their blue economies.

The challenge of coordinating global mapping efforts and making available ocean depth data (also known as bathymetry data) to the public has been the primary objective of GEBCO since its genesis.

There are many benefits to having a complete map of our ocean. The shape and depth of the seafloor are foundational knowledge we need to address many ocean issues brought to the world stage by initiatives such as The Paris Agreement, The Sendai Framework for Disaster Risk Reduction (2015–2030), the UN Decade of Ocean Science for Sustainable Development

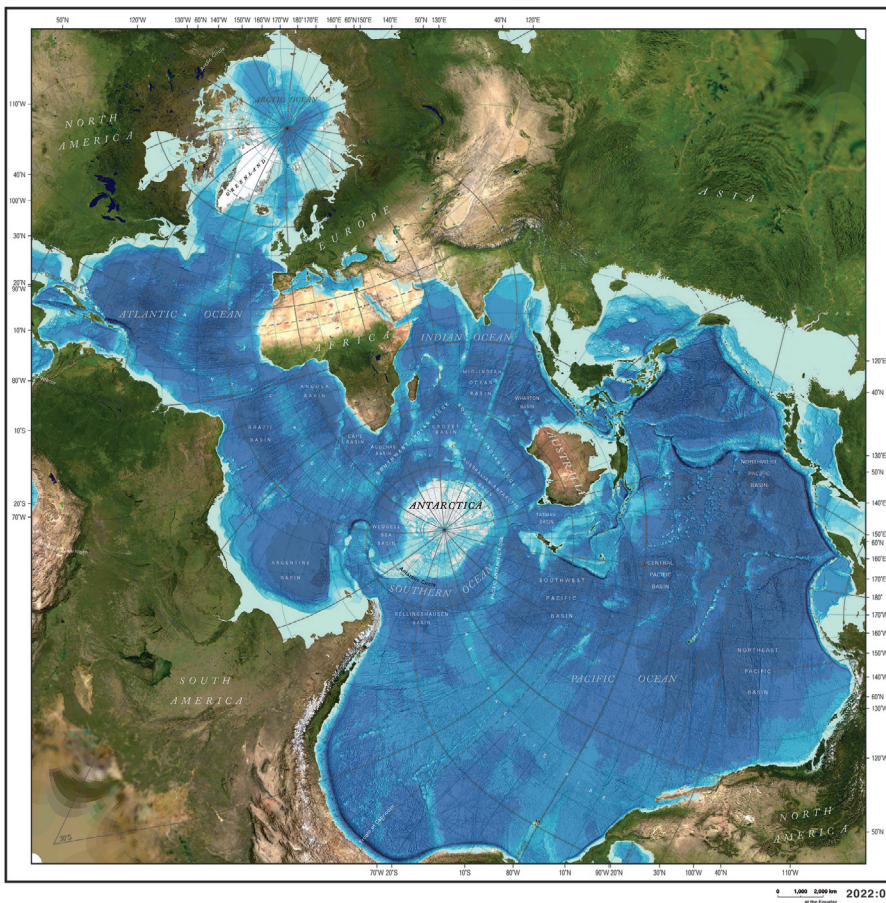


Evert Flier



The origin of GEBCO (Carpine-Lancre et al., 2003, p. 3)¹: His Serene Highness Prince Albert I of Monaco chaired the first meeting of the international Commission, Wiesbaden, 15–16 April 1903. Around this time, HSC Prince Albert I offered to organise and finance *la Carte générale bathymétrique des océans*, the General Bathymetric Chart of the Oceans (GEBCO).

¹ Carpine-Lancre, J., Fisher, R., Harper, B., Hunter, P., Jones, M., Kerr, A., Laughton, A., Ritchie, S., Scott, D. and Whitmarsh, M. (2003). *The History of GEBCO 1903–2003: the 100-year story of the General Bathymetric Chart of the Oceans*. Lemmer, Netherlands. GITC bv, 140pp.



GENERAL BATHYMETRIC CHART OF THE OCEANS (GEBCO) WORLD OCEAN BATHYMETRY

BACKGROUND

The GEBCO community consists of an international group of experts in ocean mapping who work on the development of a range of bathymetric data sets and data products with the aim of providing the most authoritative and/or available bathymetry for the world's oceans. It is intended that bathymetric data from all cruises and expeditions, regardless of their national origin, would be brought together in one series of maps covering the entire world ocean. That intent was realized as oceanographic and hydrographic organizations and institutions, governments, commercial entities and academia have supported the data on which the present editions of GEBCO were produced between 1903 and 1982. The depth contours of the GEBCO Fifth Edition were digitized and set data in the GEBCO Digital Atlas, GEDAT, in 1984. The GEDAT data base was then mirrored as new bathymetric data became available, and new editions of the GEDAT were published in 1997 and 2002.

Recognizing the importance of the availability of gridded bathymetric data sets for applications such as ocean modelling work, GEBCO released its first global bathymetric grid in 2003. Since then, GEBCO has continued to update their global bathymetric grids. This map is based on the GEBCO 2022 grid – a global grid at 15 arc-second intervals. The GEBCO 2022 grid is the fourth data set developed through the Nippon Foundation-GEBCO Seabed 2030 Project (http://seabed2030.org). This is a collaborative project between the Nippon Foundation of Japan and GEBCO which aims to bring together all available bathymetric data to produce the definitive map of the world ocean floor by 2030. This release includes a version of the grid with land on topography information for Greenland and Antarctica. The grid is primarily derived from direct measurements but also includes satellite altimetry data and other data sets with oceanographic content. This combined grid of the World Ocean Bathymetry is the basis for this printed map and the online bathymetry services from the GEBCO datacenter (publication 1-8 (2021)). Further information on GEBCO can be found at www.gebco.net.

MAP PRODUCTION

This printed map, intended as a laboratory working project of the Nippon Foundation-GEBCO Seabed 2030 Project at the Center for Coastal and Ocean Mapping of the University of New Hampshire, USA, is a cartographic representation of the bathymetry of the world ocean floor, based upon the GEBCO 2022 bathymetric grid (15 arc-second resolution) available through www.gebco.net. The bathymetry is portrayed as shaded relief, hypsometrically ordered with 5m boundaries at 200m, 500m, and every 1000m. The basic method of map production were kept to those used for the printable GEBCO world map released in 2012 but new GEBCO grid data in 2022 was used for the bathymetric data and satellite mosaic Blue Marble (NASA).

This map is produced and printed with support from the Korean Hydrographic and Oceanographic Agency (KHGA) and members of the GEBCO Sub-Committee on Communication, Outreach and Public Engagement (SCCOPE) to celebrate the 120-year anniversary of GEBCO. The German Hydrographic Office (DHO) also contributed to the printing of the map.

REFERENCES

General Bathymetric Chart of the Oceans (GEBCO) Compilation Group (2022) GEBCO 2022 Compilation Group (2022) GEBCO 2022 Bathymetric Grid (15 arc-second resolution) available through www.gebco.net.
 Blue Marble satellite mosaic, NASA Earth Observatory, www.nasa.gov/images/content/162486main_blue_marble_20120801_500.jpg.
 World Vector Shoreline, National Geospatial Data Center, <http://www.ngs.noaa.gov/geoportal/lands/wvs.html>.

- JOINT IHO - IHO GEODINAMIC COMMITTEE FOR GEBCO (GGC) 2022**
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 - Mr. Sam Nemei (Secretary)
 - Dr. Paul Beal
- The GGC members information is provided as https://www.gebco.net/gdc_members.html and https://www.gebco.net/gdc_members.html.

Spilhaus Projection
Depths in corrected meters

120
1903-2023

(Depths are in corrected meters below sea level)

GEBCO 1903-2023, Celebrating 120 Years of Ocean Discovery.

GEBCO world map (GEBCO, 2023)²: The GEBCO world map shows the bathymetry of the world's ocean floor in the form of a shaded relief colour map. The map was printed for the 120 year celebration of GEBCO. It is based on the 2022 release of the GEBCO global grid³ and is presented in Spilhaus projection.

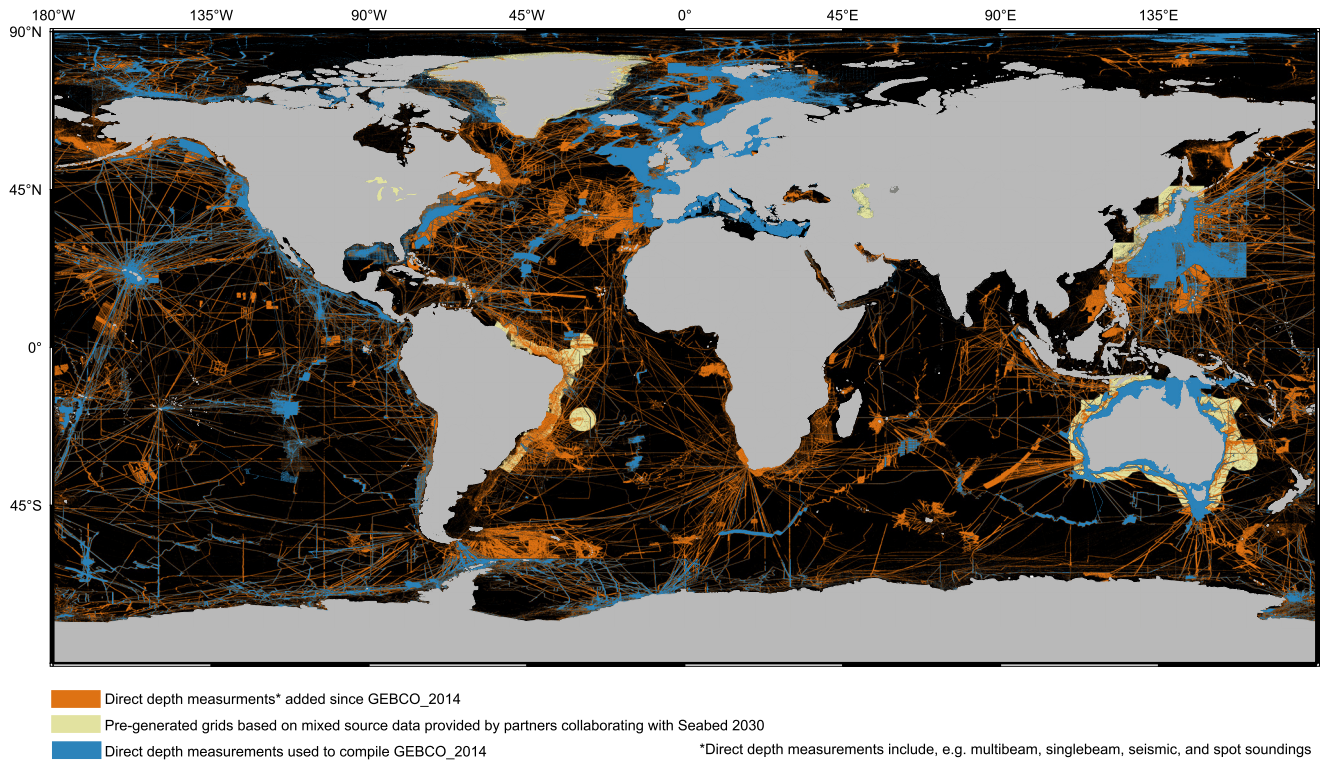
(2021–2030) and, just recently, the historic new UN High Seas Treaty, protecting international waters. Each of these initiatives has highlighted the need for comprehensive global seabed information as a critical component for achieving their objectives. Knowing the shape of the seabed is critical to understanding the circulation of ocean currents and associated effects on climate change, weather systems, tides, and tsunami wave propagation. Improving our knowledge of the seabed will allow us to better prepare for and mitigate possible impacts of a changing climate, and protect marine life.

This combination of the need for a comprehensive seafloor map supporting a sustainable ocean and planet, and the recognition of the profound lack of seabed knowledge, led to another great initiative. In 2017, the Nippon Foundation-GEBCO Seabed 2030 project was established to accelerate GEBCO's mission and complete the mapping of the seafloor by 2030. The vast majority of our seafloor will be considered mapped if one depth sounding exists in an area of 400 by 400 meters. The Seabed 2030 standard requires closer-spaced soundings in shallower waters, though never more than one sounding in an area of 100 by 100 meters. During the project's first five years, data sharing and ocean mapping mobilisation efforts have quadrupled the area covered by directly measured depth soundings. And still, we are only at the beginning, as over 75 % of the seafloor remains unmapped.

Crowdsourced data collection, or citizen science, has long been around in many fields and now contributes to global ocean mapping efforts. Crowdsourced bathymetry is getting more widely accepted and recognised by the established mapping community, including hydro-

² GEBCO (2023). Maps of world ocean bathymetry. GEBCO - The General Bathymetric Chart of the Oceans, British Oceanographic Data Centre (BODC), National Oceanography Centre, United Kingdom. https://gebco.net/data_and_products/printable_maps/ (accessed 7 October 2023).

³ https://gebco.net/data_and_products/historical_data_sets/#gebco_2022 (accessed 7 October 2023).



Schematic representation of the data bases added for the generation of the GEBCO bathymetric raster datasets since 2014. The contributors of the are described in the accompanying information to GEBCO's current gridded bathymetric data set, the GEBCO_2023 Grid (GEBCO Bathymetric Compilation Group 2023, 2023)⁴. Image credit: Martin Jakobsson, Department of Geological Sciences Professor, Stockholm University.

graphic offices, and has the potential to be scaled up many times. The International Hydrographic Organization (IHO) Crowdsourced Bathymetry initiative is gaining momentum and attracting more and more interest from a growing and wider public. While a few years ago, bathymetric data collection was limited to a few established players, we are now seeing a broad range of contributors. Research vessel operators, cruise ship operators, commercial survey ship operators, fishers, super yacht owners, and leisure boat equipment manufacturers are growing more aware that they can contribute to seabed mapping and are increasingly willing to do so.

Seabed mapping sensors are put on autonomous platforms that can operate for longer periods with near zero carbon footprint, without the complexity of carrying a crew, and, once scaled up, at a reduced cost. In addition, green laser systems on airborne platforms, including drones, show improved data quality results in coastal zones and bathymetry derived from satellite imagery is being exploited as a potential source of depth data where water clarity permits.

The global paucity of depth information is stifling 'the science we need for the ocean we want', which means that decision-making by governments and multilateral institutions is without the benefit and consideration of all the evidence required. It is now well-accepted that bathymetric data is essential as a baseline for characterising the ocean environment and its systems. But in addition to scientific and rational justifications, we can ask ourselves the following question:

Do we not have an obligation to humanity to complete the work of our adventurous ancestors, like Leif Eiriksson, Admiral Zheng He, Jean Baret, Marie Tharp and Bruce C. Heezen, to discover the remaining part of our planet? After the 2nd World War, humankind's inquisitive nature and technological advancements shifted towards outer space. But, in the recent words of Bill Gates: 'Space? We have a lot to do here on Earth.'

Only two per cent of the total global research budget is ocean-related. Therefore, getting governments, science, and industry to work together towards improving ocean knowledge and completing the mapping of our planet is the main task of GEBCO.

⁴ GEBCO Bathymetric Compilation Group 2023 (2023). The GEBCO_2023 Grid - a continuous terrain model of the global oceans and land. NERC EDS British Oceanographic Data Centre NOC. <https://doi.org/10.5285/f98b053b-0cbc-6c23-e053-6c86abc0af7b>



Gill Rodrigues (front left), Director of International Relations at The International Seakeepers Society, and Helen Snaith (back right), Head of Seabed 2030's Global Center, join crew members from The Maiden Factor as she sets sail for The Ocean Globe Race 2023. Maiden will be collecting bathymetric information throughout the race and will be contributing the data to Seabed 2030 in partnership with Seakeepers.

GEBCO is unique. It is one of the building blocks needed to improve ocean literacy, understand how our ocean influences life on earth and, vice versa, understand how humankind influences the health of our ocean. GEBCO also invests in the future of our ocean through the GEBCO Training Program, funded by the Nippon Foundation. This highly successful training program is currently in its 19th year, having delivered over 100 students from more than 40 countries, where 90 per cent of them are working in ocean mapping. The GEBCO Guiding Committee recently established a new GEBCO Sub-Committee on Education and Training to coordinate more effectively with the current training program and reach out to other ocean mapping programs so that GEBCO has the interest of and can be managed by future generations.

GEBCO is strongly supported by its two parent organisations, the IHO and the International Oceanographic Commission (IOC), and thus by all the hydrographers and oceanographers of the world.

GEBCO is the only publicly available, authoritative, global, compiled bathymetric dataset that is more and more widely used by a diverse group of users.

But most of all, GEBCO is a network of voluntary, passionate, professional people, ocean scientists, hydrographers, and industry representatives, working towards the same goal, to finish Earth's last great mapping endeavour.

Evert Flier

Chair of the GEBCO Guiding Committee