in-depth
MAPPING THE FLOOR OF OUR OCEANS
Newsletter of The Nippon Foundation-GEBCO Seabed 2030 Project

EDITORIAL

Two Oceans Two Technologies

The return of SEA-KIT's Unmanned Surface Vehicle, USV Maxlimer, to Plymouth last month marked a major step forward in a programme that we have called Two Oceans Two Technologies, and its contribution towards mapping the entire ocean floor by 2030 – The Nippon Foundation-GEBCO Seabed 2030 objective. Our target was data capture in the Atlantic and the second part of the programme will see uncrewed technology complete similar activity in the Pacific in the course of the next few weeks.

For three weeks in July, the USV undertook the Uncrewed Trans-Atlantic Survey (UTAS) project, co-sponsored by the European Space Agency and industry partners. Fitted with a hull-mounted multi-beam echo-sounder, the vessel mapped approximately 1,000 square kilometres whilst being controlled 24/7 in the Atlantic via satellite communications by SEA-KIT from its Remote Operations Centre in Tollesbury, on the east coast of UK.

Quoting from SEA-KIT, UTAS project's overall aim was "to demonstrate the capabilities of current technology to survey unexplored or inadequately surveyed ocean frontiers." As a result, by kind permission of the mission sponsors, our international Alumni from the University of New Hampshire were able to use the system to gather invaluable bathymetry. In addition, we were able to prove that our Alumni team members, operating remotely across eight countries – USA, Brazil, Greece, Ireland, Egypt, St Vincent and the Grenadines, Mauritius and Kenya – and working 24 hour shifts, were able to come together to help plan the mission, monitor the sonar, gather data and then post-process it.

There is a history of The Nippon Foundation collaboration with SEA-KIT. The USV was used by the GEBCO-Nippon Foundation Alumni Team in their winning entry for the Shell Ocean

SEA-KIT's Unmanned Surface Vehicle (USV), Maxlimer

Discovery XPRIZE in May last year. Indeed initial development of the USV was funded by The Nippon Foundation, which also mobilized the Alumni for this latest challenge. Fugro, another Seabed 2030 partner, announced a strategic partnership with SEA-KIT earlier this year and was involved in this successful demonstration project. So we are very proud of SEA-KIT and what it has achieved: what began a few years back as a scientific challenge taken on by the Alumni became an award-winning technology that has now matured into a viable commercial company.

This is exactly the kind of innovative operation that GEBCO and The Nippon Foundation were trying to create when they launched Seabed 2030. We congratulate the SEA-KIT team and our Alumni on their latest achievements and look forward to adding the data collected by them to the GEBCO Grid.

The BBC described USV Maxlimer's voyage as an impressive demonstration of the future of robotic maritime operations. Robotic solutions will be essential if we are to have any chance of closing the knowledge gap, said the BBC – a view to which we at Seabed 2030 wholeheartedly subscribe.

Jamie McMichael-Phillips
Seabed 2030 Project Director

REGIONAL CENTERS

Atlantic and Indian Oceans Regional Center

The team at the Atlantic and Indian Oceans Regional Center continues to work on compiling, assembling and integrating existing data from throughout the region, and gratefully acknowledges the many data contributions that have been made to date. Technical activities have focused on the development of new tools and workflows that will enable coordinated data processing activities by partners. It is envisioned that this effort, a collaboration with the Global Multi-Resolution Topography (GMRT) Project, will accelerate the creation of regional data products.

In addition to data compilation, the team has been working with stakeholders throughout the region to identify additional data that have not yet been shared and to develop a strategy for building collaborations and capacity. Recent highlights include an ongoing series of webinars co-sponsored by the Meso-American and Caribbean Hydrographic Commission (MACHC) and the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE). These webinars are focused on the current status of mapping, demonstrations of online tools for coordination and cooperation, gaining an understanding of the needs of stakeholders, and developing a strategy to work together to map the remainder of the region.

Additional webinars are being planned for the coming months that are intended to build new collaborations with the community of stakeholders. These events will showcase the status of mapping and will provide an opportunity to better understand stakeholder needs and priorities. Information about these events will be posted on the center's web page. Despite the pandemic, the team at the Atlantic and Indian Regional Center remains focused on community and capacity building efforts to accelerate toward our common goals.

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Southern Ocean Regional Center

During the past six months, dealing with COVID-19 effects has been among the key challenges at the Southern Ocean Regional Center. Particularly, the collection of bathymetric data during the upcoming Antarctic season has been of central concern. Fortunately, our chief data manager Laura Hehemann will be able to join a cruise of RV Polarstern in March 2021. This multidisciplinary expedition led by the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research will target the central part of the Weddell Sea addressing oceanographic, biological and paleo-climatic scientific questions. On board, Laura will oversee the collection of bathymetric data during transit and conduct dedicated mapping surveys in this vast ice-covered and mostly uncharted area of the Southern Ocean.

A major task of the Southern Ocean Regional Center has lately been the advanced preparation for the release of the second version of the International Bathymetric Chart of the Southern Ocean (IBCSO). By now, the data integration for IBCSO Version 2.0 has been completed and our data engineers Sacha Viquerat and Fynn Warnke have streamlined workflows so that the ingestion and the handling of large volumes of data have become smooth and efficient. Altogether, the initial iteration of data cleaning has almost been finished and very soon, a surface will be computed providing a first glance at IBCSO v2.0.

IBCSO v2.0 will also be the contribution of the Southern Ocean Regional Center to the next release of the GEBCO grid. The spatial congruence of the area of responsibility of the Seabed 2030 Southern Ocean Regional Center and the GEBCO project IBCSO generates manifold synergies between these closely linked projects, thus helping to create the best possible image of the mysterious and remote waters around Antarctica and advancing the task set out by Seabed 2030 to map the world's oceans.

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Royal Navy Hydrographer Jennifer Whalley is crewing the TS Pelican around Britain for the Darwin 200 Project. The ship is fitted with echo sounders which will contribute data to Seabed 2030.

REGIONAL CENTERS

Arctic and North Pacific Ocean Regional Center

With the recent release of IBCAO 4.0, the newly compiled, 200 x 200 m bathymetric grid of Arctic Ocean bathymetry and the publication of this product in the Nature Journal Scientific Data (Jakobsson, M., Mayer, L.A., Bringensparr, C., Castro, C.F, Mohammad, R., Johnson, P. Ketter, T., et al. The International Bathymetric Chart of the Arctic Ocean Version 4.0. Sci Data 7, 176 [2020]), the focus of the Arctic and North Pacific Regional Data Center has shifted to enhancing the computational environment for the Seabed 2030 project, working on identifying existing data sets still not in the compilation, and identifying possibilities for new data acquisition.

Regular meetings have taken place between the Regional Data Center staff from both Stockholm, the University of New Hampshire and Amazon Web Services. Initial focus has been on moving post-processing and statistical calculations (i.e. global coverage) to the cloud with a long-term goal of having significant Seabed 2030 data stored and processed through a distributed cloud-based process. Data discovery is an ongoing process and several North Pacific and Arctic Ocean data sets have been identified that will be included in the next GEBCO compilation.

Finally, planning is beginning for new proposals that may lead to future data collection in the high-Arctic, and efforts are underway to equip a number of Greenland-based fishing vessels with certified data loggers so that a new source of "crowd-sourced" bathymetry can be continuously fed into the Seabed 2030 Project. More on that in future newsletters.

Center co-Heads: Professor Martin Jakobsson and Professor Larry Mayer
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Scientists conduct near-shore work during the 2019 Ryder Expedition

Credit: Professor Martin Jakobsson

South and West Pacific Ocean Regional Center

The COVID-19 pandemic has forced us all to try new ways of working and the South and West Pacific Regional Data Center is no exception.

We've managed to adapt like everyone else, and shortly after New Zealand ended its nationwide lockdown period in June, we hosted our first virtual Regional Mapping meeting.

We were delighted to welcome 42 people from 10 countries, including 11 of those in person at NIWA's campus in Wellington.

The aims of the workshop were to review progress to date, identify sources of bathymetric data and discuss protocols and methods around data sharing and management. We also wanted to identify areas we need to prioritise in the region and discuss upcoming mapping expeditions.

We all agreed meetings such as this are important to maintain the network of stakeholders within the region.

The South and West Pacific Regional Data Center is continuing to grow and improve the regional bathymetric grid from newly identified data sources which is extremely encouraging. As we move from Phase 1 of the Seabed 2030 project into Phase 2, we are now firmly focused on sourcing new data.

The focus for this year will be on sharing information of new projects, especially priority areas and upcoming voyages. Our region covers extremes in depths and areas and is dominated by deep ocean basins so any data must be shared. The centre is looking at new data that isn't in the GEBCO grid, including single beam.

We are also looking into crowd-sourcing as a solution to collect data around smaller island states unable to fund data collection themselves. Tuna fleets could also make a huge difference in this area as could navies. Building capacity within these smaller nations is also a priority.

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GLOBAL CENTER

The Seabed 2030 Global Center: who are we?

The Seabed 2030 Global Center is hosted by the British Oceanographic Data Centre (BODC) – a core part of the National Oceanography Centre (NOC) in the UK. BODC and NOC both have a very long history with GEBCO, and have provided GEBCO guiding committee members and chairs on many occasions.

BODC have, in particular, had a key role on the development and distribution of GEBCO's digital products – reflected now in their role in the Seabed 2030 project.

The Global Center team consists of three members:

Head of the Global Center: **Helen Snaith**; the Digital Atlas Manager: **Pauline Weatherall**; and our software developer: **Chris Thompson**.

Whilst Helen and Chris have joined the team recently from other areas of science, Pauline has been a part of GEBCO since 1990.

At that time, the digitised contours, coastlines and tracklines from the printed sheets of the fifth edition of the GEBCO charts were used to initialise what became known as the GEBCO Digital Atlas (GDA). The initial challenge for Pauline was to meticulously edge-match these digitised sheets leading to the first seamless, high-quality, digital bathymetric contour chart of the world's oceans.

Pauline using (then) cutting edge software for working with digitised contours.

This provided the base for the regular updating of the GDA where new data could easily be 'stitched in' to maintain a seamless dataset. Since 1994, and up to the Centenary edition in 2003, the bathymetry of about 1/3 of the world's oceans had been revised and submitted to BODC (i.e. to Pauline) for updating the GDA.

Further information about her role at this time can be found in The History of GEBCO 1903-2003 book, published to coincide with the GEBCO Centenary Conference held in 2003. In particular: the complete data set of the digital contours, coastlines and tracklines for the GEBCO 5th Edition was finalised in June 1993, thereby providing a high-quality digital base from which future editions of GEBCO might evolve. The project was a major undertaking requiring years of effort to bring it to a successful conclusion. The success of the project owed much to the painstaking work of two individuals in particular: Denis Toustou at BGI and Pauline Weatherall at BODC.

At this time, GEBCO moved from digitised contour charts to what we know today – gridded digital datasets. Pauline continued her key role of investigating the availability of new data sets and adding them to the GEBCO grid. As better observations became available, with new observational technologies allowing higher resolution mapping, Pauline developed and delivered the increasing resolution GEBCO grid: from the 1-minute grid of 2003 through to the 30 arc-sec GEBCO_08 and GEBCO_2014 grids. She instigated delivery of the data through Web Map Services and adopted new data format standards.

This work is now continued within the Seabed 2030 project, where Pauline coordinates the inputs from the Regional Centers and ensures a single, globally consistent dataset is produced. She works with Chris and the wider BODC software developer team to continue to develop new services for delivery of the data.

She is also the first point of contact for most of the users of the Seabed 2030 datasets. As the number of new users increases, she provides expert support and guidance on how to use the data.

Center Head: Dr Helen Snaith
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NEW PARTNERSHIP

REV Ocean

A rendering of the completed Research Expedition Vessel (REV Ocean)

REV Ocean is a not-for-profit company created with one overarching purpose and ambition: To make the ocean healthy again. The company was established in 2017 and is funded by Norwegian businessman Kjell Inge Røkke. The ocean is a dynamic, interconnected global ecosystem that can recover if the negative pressures currently affecting the oceans are dealt with effectively. To do that, we need to improve our understanding of the ocean, get key stakeholders – decision-makers, researchers, business and civil society – aligned with that understanding and turn that knowledge into concrete solutions.

REV Ocean will launch the world's largest research vessel in 2022 which will be available to researchers, decision-makers, artists, campaigners, businesspeople and philanthropists that share our goal of making the ocean healthy again. The REV Ocean vessel is the most advanced marine research vessel in the world, with extensive sonar systems, laboratories and submersibles onboard. As one of the largest vessels of its kind, it also has extended range and endurance, which allows for global operations.

Taking on the role as ocean trailblazers REV Ocean intends to create positive, measurable impact; provide a pathway for others to follow and motivate the next generation of ocean leaders. REV Ocean will strive to fill critical knowledge gaps, develop innovative solutions, and bridge science, business and policy sectors to achieve positive change. REV Ocean recently signed an MOU with Seabed 2030, as seen in the image below, to work together to advance understanding of the ocean floor. Its programs will be developed to support the UN Ocean agenda, the UN Decade of Ocean Science (2021-2030) and help achieve the UN Sustainable Development Goals (2015-2030).

Find out more about REV Ocean

Seabed 2030 announces new partnership with REV Ocean

Seabed 2030 Project Director Jamie McMichael-Phillips and REV Ocean CEO Nina Jensen at the virtual signing ceremony

NEW PARTNERSHIP

IIC Technologies Ltd is a global provider of geospatial solutions and services. IIC provide consultancy, training, R&D and specialist geospatial services to clients in government, defense, industry and the private sector.

IIC has decades of experience providing innovative services and solutions to the ocean mapping community. IIC clientele include numerous national charting agencies and research institutes for services that include hydrographic surveying, digital chart creation, data storage, data management, dissemination and software development. The IIC Academy provides internationally recognized training and education to the maritime community via a blended learning framework including its internationally recognized hydrographic surveyor and nautical cartographer courses. IIC's Innovation Center provides tailored solutions, optimisation, research and development for clients, ensures IIC remains at the leading edge, and was vital to IIC's success in providing near seamless support to its clients during the recent COVID-19 period.

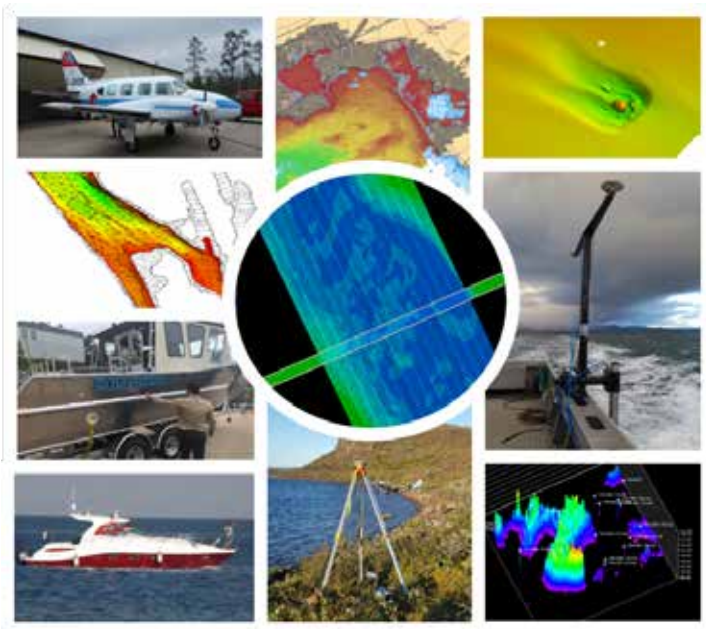
COVID-19 has posed unique and difficult challenges for the ocean mapping community. Continued data management and production created significant problems for many including NOAA's Office of Coast Survey. As stated by Rear Admiral Shepard M. Smith:

"We now have a new reality. The focus going forward needs to be on sustainment... for long term capacity in our operations."

Given IIC's extensive experience with remote data management and charting support, IIC and its employees embedded in the Office of Coast Survey rapidly responded to this call by Rear Admiral Smith, ensuring minimal down time was experienced and continued support was maintained.

This rapid adaptation and relocation of support was reflected across IIC's broad range of services for its global clientele. This resulted in negligible impact on customers operations, development and training, and in some cases innovative resolutions that will continue post-COVID.

With the recently signed MOU with Seabed 2030, IIC is committed to assist Seabed 2030 in its endeavors through IIC's people, capabilities, collaborative networks and ability to develop innovative solutions across the geospatial domain. Whatever the challenge we look forward to working together to overcome it.



Find out more about IIC Technologies

DATA CENTRE FOR DIGITAL BATHYMETRY

Established in 1990, the International Hydrographic Organization Data Centre for Digital Bathymetry (IHO DCDB) stewards the worldwide collection of bathymetric data. Now hosted by NOAA's National Centers for Environmental Information (NCEI), the DCDB archives and shares, freely and without restriction, nearly 60 terabytes (uncompressed) of oceanic depth soundings. The DCDB also serves as the long-term archive for the GEBCO Ocean Mapping Programme and The Nippon Foundation-GEBCO Seabed 2030 project.

A centralized, international archive of bathymetry improves access to and distribution of bathymetric data across the community. The DCDB consists primarily of unedited, single and multibeam bathymetric data contributed by the efforts of governmental, academic, crowdsourced, and industrial hydrographic and oceanic entities. These data are a public resource routinely used to produce improved regional and global bathymetric maps and grids in support of science and exploration. Data provided to the DCDB are available for download from the DCDB website.

Ongoing maintenance and enhancements of the archive enables any user to locate and access data they need, maximizing the value and utility of that data. Comprehensive and standardized metadata registered in catalogues support search and discovery within the DCDB map application, allowing for an intuitive interface that displays, selects, and downloads a diverse range of data. This increase in the world's data accessibility fosters a widely-known objective in the bathymetric community: Map Once, Use Many Times.

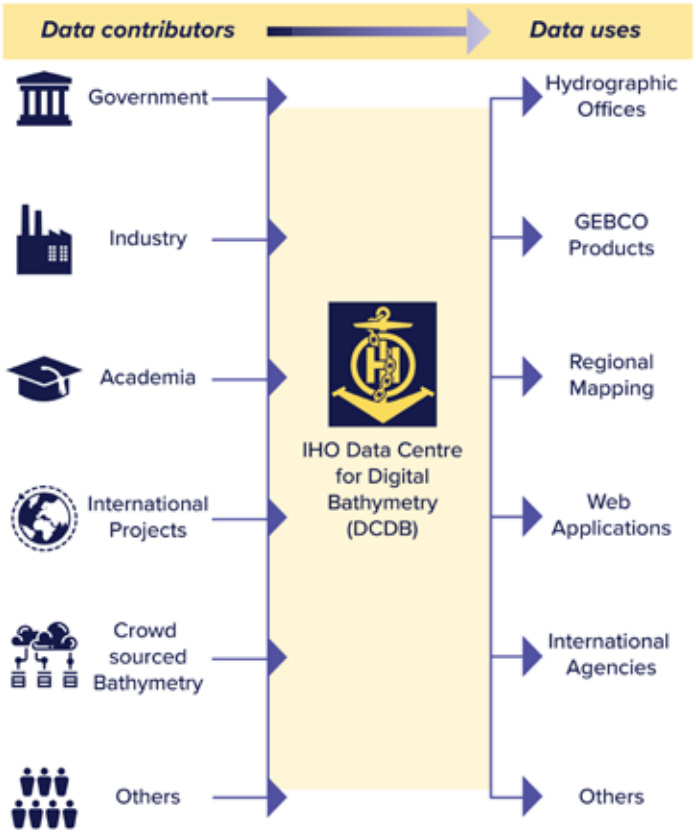
Looking forward, the DCDB is set to take its next technological leap: the migration of data holdings and analysis into a cloud-computing infrastructure. Creating a reliable, documented, and thriving repository for bathymetry data, stationed on the leading edge of the technological curve, benefits users worldwide. Such scientific stewardship positions the IHO DCDB to carry on as the gold standard for international data cooperation for the benefit of all humankind.

Jennifer Jencks
Director, IHO Data Centre for Digital Bathymetry

Christie Reiser
Data Manager, IHO Data Centre for Digital Bathymetry

Access data from the IHO DCDB

Contribute data to Seabed 2030 and the IHO DCDB



The US-based Marine Technological Society has presented the Compass International Award for outstanding contributions to the advancement of marine sciences and technology to Dr Vladimir Ryabinin, Executive Secretary of UNESCO's Intergovernmental Oceanographic Commission (IOC). The IOC, with the IHO (International Hydrographic Organization), is a Seabed 2030 partner.

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