Report of the IHO Data Centre for Digital Bathymetry

Submitted by:	Director of the DCDB
Related documents:	IHO CL23-1990 on Establishment of the DCDB 2023 MOU between NOAA & the IHO To Cooperate on the Data Centre for Digital Bathymetry
Related Projects	IHO CSB Initiative, GEBCO, Nippon Foundation-GEBCO Seabed 2030 Project

1. Meetings Held During Reporting Period

N/A

2. Work Programme

The IHO Data Centre for Digital Bathymetry was established in 1990 to steward the worldwide collection of bathymetric data. The Centre archives and shares, freely and without restrictions, depth data contributed by mariners. Data can be discovered and accessed from the IHO DCDB Data Viewer: *ncei.noaa.gov/maps/iho_dcdb/*

The IHO DCDB is hosted by the U.S. National Oceanic and Atmospheric Administration (NOAA) on behalf of the IHO Member States.

DCDB Data Holdings

Since establishment, the quantity of data archived in the DCDB has grown considerably both in area coverage and data volume, particularly in the last decade with the addition of multibeam echo sounder (MBES) data. Today, the DCDB archives over 66 terabytes (TB) of uncompressed oceanic soundings acquired by hydrographic, oceanographic and other vessels during surveys or while on passage. The archive includes raw and processed multibeam bathymetry data, survey metadata, and in some cases ancillary data and products from over 3,800 surveys spanning 43 years contributed by 58 different data sources.

DCDB data holdings are routinely used for the production of improved and more comprehensive bathymetric maps and grids, particularly in support of the GEBCO Ocean Mapping Programme and the Nippon Foundation-GEBCO Seabed 2030 project. The Seabed 2030 project has created a global drive to search out new datasets to be added to the currently available bathymetry and the IHO DCDB has been identified as the preferred archive.

For the 2023 release of the GEBCO grid, it is estimated that 24.9% of seafloor has been mapped in high resolution and shared with the global community; compared with 23.4% in 2022 and 6% in 2017.

Since June 2022, 127 new multibeam bathymetry surveys have been archived. The largest data providers to the DCDB continue to be the U.S. Academic Research Fleet (ARF) with 60 surveys archived in the last year. Additional significant data contributions to the DCDB in the last year also include:

- NOAA - 51 surveys
- Fugro - 12 surveys
- JAMSTEC - 7 surveys
- Canadian Hydrographic Service - 2 surveys

Over the last year, the DCDB continued to bring in crowdsourced bathymetry (CSB) data from Rosepoint Navigation System, FarSounder Inc, PGS and MacGregor Germany.

New CSB pipelines were finalized with M2Ocean, Great Lakes Observing System (GLOS), Orange Force Marine and GEC Aqua Map.

We are currently hoping to onboard the Interdisciplinary Center for Development in Ocean Mapping (CIDCO) and Seabed 2030 later this year.

It is worth noting that the estimated seafloor mapped for the DCDB Archive holdings was calculated to be ~12%.

DCDB Map Viewer

Once the contributed bathymetric data have been archived, they are made discoverable and accessible through the DCDB web map viewer.

Improvements and updates to the viewer over the last year include:

- Added DEPARTURE/ARRIVAL PORT for multibeam popup
- Updated CSB legend to include additional colors for new data providers
- New CSB vector tile layer created (hosted in ArcGIS Online) which provides a fast-drawing view of the CSB lines.
- Web Services - Updates:
    - Switched to Canada NONNA WMTS
    - Updated to new GEBCO_2022 Basemap & Type Identifier (TID) grid (Bathymetric Coverage Maps).
- Web Services - New:
    - Norway added: MAREANO was moved from under EmodNet to be a standalone.
    - Added IHO Regional Hydrographic Commissions (RHC) boundaries to DCDB viewer (Options)
- "Grid Extract" updates:
    - New options dataset options added: ETOPO_2022 and latest U.S. coastal Continuously Updated Digital Elevation Models (CUDEMs)

CSB-specific Enhancements

An improved CSB data ingest pipeline was deployed allowing for (1) the reprocessing of all data files and the resolution of many previous errors, (2) resolution of known map viewer performance challenges by simplifying geometries and (3) auto population of the S3 bucket (replacing a manual push that had been stalled for over a year).

The development of a new pre-approval portal is currently underway. This will allow coastal states to review data in areas of national jurisdiction when requested in IHO CL 01/2020 & IRCC CL 21/2020 responses.

Planned DCDB Enhancements

In response to the growing data demands from the Seabed 2030 project and IHO CSB initiative, the DCDB commenced a program last year to rebuild its infrastructure and enhance its interface to provide data ingest, archiving, discovery, display and retrieval of global bathymetric data. The new ingest-to-archive data pipelines will allow for improved reliability, greater ease in ingesting new data, greater flexibility in allowed data formats and simplified data delivery.

Over the next year, additional enhancements will focus on:

Multibeam Bathymetry:

- Finalizing the migration of the current (outdated, inflexible) database to the new schema to enable a better system for:
    - Versioning of processed swath files
    - Discovery of ancillary files
    - Improved tracking of complex metadata, including multiple source institutions for surveys.
    - Indicating polygons of extent of coverage

Crowdsourced Bathymetry

- Finalize API that provides a notification and approval process of data for coastal states who have provided positive responses but request pre-approval of data before the public distribution from DCDB.
- Improve the granularity and precision of the CSB geographic mask.
    - Will involve masking only the subset of a given submission which intersects with restricted areas.
    - May also include ability to take different actions with the embargoed data depending on the member state's requirements.
- Improve data visualization
    - Currently experimenting with various ways to display point data

AutoGrid

- The current version of AutoGrid is a web application which accepts the user's area of interest, cell size, and grid format and then asynchronously produces a custom data grid from the multibeam archive. AutoGrid 2.0 will run in the cloud (AWS) and include multibeam and CSB data (with eventual expansion to include singlebeam and possibly lidar).

GEBCO Gazetteer

The DCDB developed and hosts, on behalf of the IHO, the GEBCO Gazetteer, a web tool that allows the public to search for, view, and download information (eg: geographic location, feature dimensions, the discoverer, and the origin of the name) on more than 3800 undersea features. Gazetteer v4.3.7 is live at *ngdc.noaa.gov/gazetteer*. The GEBCO Subcommittee on Undersea Feature Names (SCUFN) is the primary stakeholder for the Gazetteer.

Work over the last year included (1) resolving reported issues or enhancement requests, (2) providing maintenance releases and (3) continuing development on Gazetteer v5.0 which will provide interoperability with the Beta-Gazetteer developed by the Korean Hydrographic and Oceanographic Agency.

Goals for 2023 work include:

- Continue to support the GEBCO Gazetteer and KHOA Beta-Gazetteer interoperation (Gazetteer v5.0.0)
- Update the API, fixing reported bugs and adding requested enhancements
- In-depth testing
- Developing a modern user interface with Vue.js and Google Material Design

3. Progress on IRCC Action Items

Action 15: DCDB to investigate how to report on SPIs 3.2.1 and 3.2.2. in a way that allows the perception on the evolution on the amount of data and number of contributors to DCDB who are not hydrographic offices.

Figures reported to the Secretariat in January 2023, to populate the part of 2022 IHO Annual Report dedicated to the IHO Strategic Plan 2021-2026.

The SPi are
- SPI 3.2.1: figure to be provided by DCDB (no input/indication received so far)
- SPI 3.2.2: figure to be provided by DCDB (no input/indication received so far)

SINGLEBEAM BATHYMETRY

1. In 2022, a total of 177 datasets/surveys were contributed to the DCDB's singlebeam data holdings.
2. Of those 177 datasets/surveys, 10 were contributed by hydrographic offices.
3. HO contributions currently make up 17% of the DCDB's singlebeam data holdings.

MULTIBEAM BATHYMETRY

1. In 2022, a total of 198 datasets/surveys were contributed to the DCDB's multibeam data holdings.
2. Of those 198 datasets/surveys, 0 were contributed by hydrographic offices.
3. HO contributions currently make up 0% of the DCDB's multibeam data holdings.

CROWDSOURCED BATHYMETRY

1. In 2022, four new data providers began contributing data to the DCDB's CSB data holdings.
2. Of those four new data providers, 0 were hydrographic offices.
3. HOs currently make up 0% of the DCDB's CSB data providers.

4. Problems Encountered

N/A

5. Any Other Items of Note

Last year, this report stated the intent of the DCDB in future years would be to produce regional breakdowns of data holdings using RHC limits as part of SPI reporting. This was not accomplished in 2022 but will be a priority in 2023 and 2024.

During the 2023 IHO Assembly, Secretary General Dr. Mathias Jonas announced the signing of a Memorandum of Understanding with the United States' National Oceanic and Atmospheric Administration (NOAA). With the signing of this MoU, both parties are reaffirming their commitment to the international community through this key element of the global data infrastructure.

Dr. Rick Spinrad, NOAA Administrator and Under Secretary of Commerce for Oceans and Atmosphere, and IHO Secretary General Dr. Mathias Jonas signed the MoU. During the IHO Assembly,

the signing of the MoU was recognized by Dr. Jonas and Rear Admiral Benjamin Evans, U.S. National Hydrographer and Director of NOAA's Office of Coast Survey.

6. Conclusions and Recommended Actions

It is highlighted that the DCDB is an IHO Member States' resource that requires additional data to increase the coverage and move towards a comprehensive global bathymetric dataset. Therefore IHO Member States and stakeholders are invited to contribute and encourage the provision of bathymetric data regardless of its origin or reason for gathering.

7. Justification and Impacts

N/A

8. Actions Required of IRCC

The IRCC is invited to:

A. Note the contents of this report;

B. Encourage Member State and stakeholder bathymetric data contributions to the DCDB, regardless of origin;

C. Encourage RHC Chairs to collaborate with the DCDB on developing and highlighting annual regional breakdowns of data holdings as part of SPI reporting.

D. Take any other action it considers appropriate.