

A world map with a blue and green color scheme, showing continents and oceans. Overlaid on the map is the title 'IHO Data Centre for Digital Bathymetry' in large blue font. Below the title, the name 'Jennifer Jencks' is displayed in bold blue font, followed by her email address 'jennifer.jencks@noaa.gov' in a smaller blue font. Below the email, her title 'Director, IHO DCDB' is shown in bold blue font. This is followed by the text 'Hosted by NOAA's National Centers for Environmental Information (NCEI)' and 'Boulder, CO, USA' in bold blue font. At the bottom, the text 'Joint Meeting of TSCOM/SCRUM' is shown in bold blue font, followed by 'Durham, New Hampshire' and 'November 4-5, 2019' in bold blue font.

IHO Data Centre for Digital Bathymetry

Jennifer Jencks
jennifer.jencks@noaa.gov
Director, IHO DCDB
Hosted by NOAA's National Centers for
Environmental Information (NCEI)
Boulder, CO, USA

Joint Meeting of TSCOM/SCRUM
Durham, New Hampshire
November 4-5, 2019

IHO Data Centre for Digital Bathymetry (DCDB)

The **IHO DCDB** is the recognized IHO repository for all ocean bathymetric data.

NOAA's NCEI (formally NGDC) has hosted the DCDB since 1990.

Data are sent to the IHO DCDB, where we provide long term archive and data management.

Pages currently under development

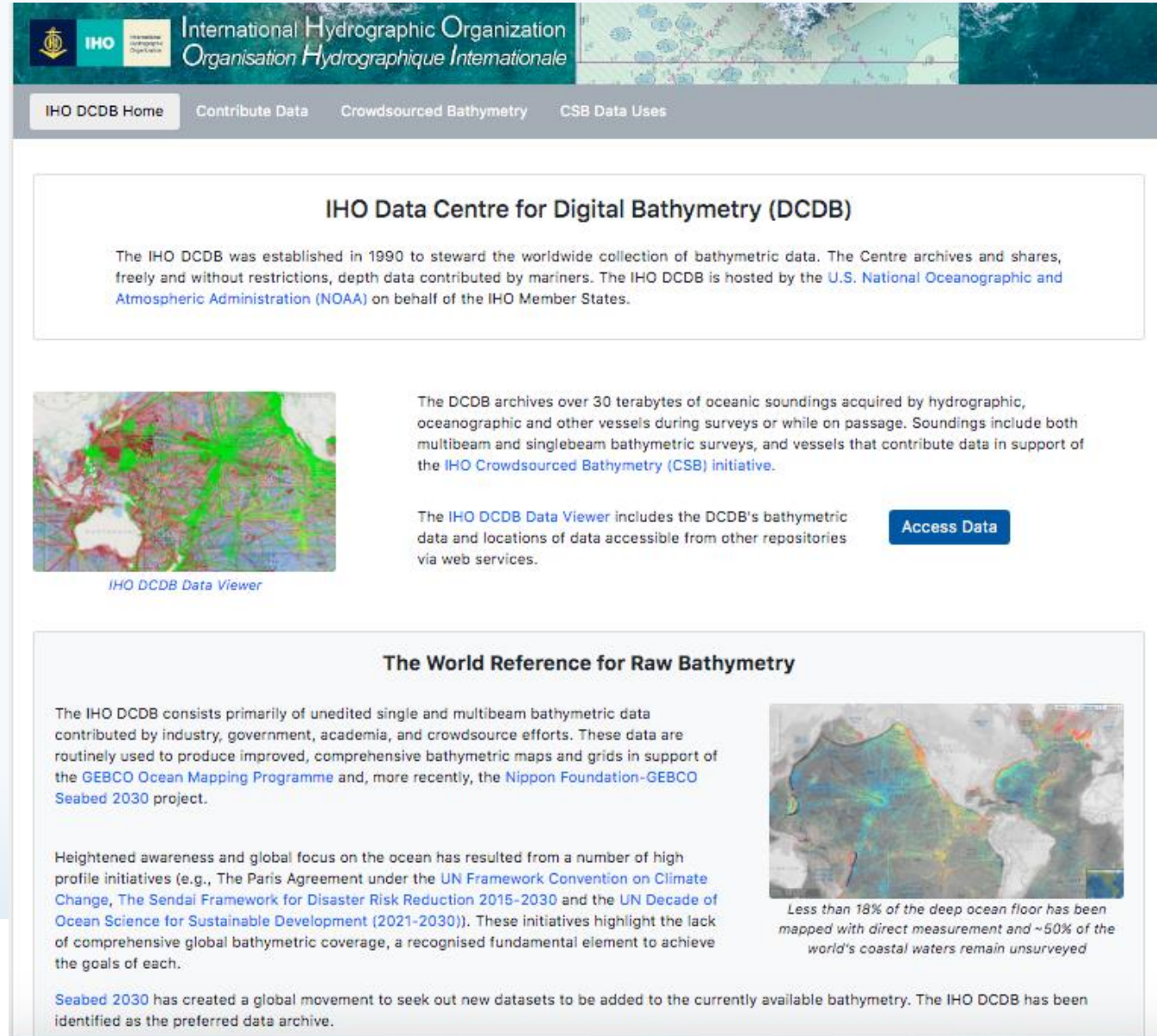
www.ngdc.noaa.gov/iho/

test pages:

<https://www.ngdc.noaa.gov/iho/test/>



International Hydrographic Organization
Organisation Hydrographique Internationale



The screenshot shows the IHO DCDB website. At the top is the IHO logo and the text 'International Hydrographic Organization / Organisation Hydrographique Internationale'. Below this is a navigation bar with links: 'IHO DCDB Home', 'Contribute Data', 'Crowdsourced Bathymetry', and 'CSB Data Uses'. The main heading is 'IHO Data Centre for Digital Bathymetry (DCDB)'. A paragraph states: 'The IHO DCDB 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. The IHO DCDB is hosted by the U.S. National Oceanographic and Atmospheric Administration (NOAA) on behalf of the IHO Member States.' Below this is a section titled 'IHO DCDB Data Viewer' with a thumbnail image of a bathymetric map and a description: 'The DCDB archives over 30 terabytes of oceanic soundings acquired by hydrographic, oceanographic and other vessels during surveys or while on passage. Soundings include both multibeam and singlebeam bathymetric surveys, and vessels that contribute data in support of the IHO Crowdsourced Bathymetry (CSB) initiative.' To the right of this is a button labeled 'Access Data'. Below that is a section titled 'The World Reference for Raw Bathymetry'. It contains text about the data sources and the GEBCO Ocean Mapping Programme. To the right is a thumbnail image of a world map showing bathymetric data. Below the map is a caption: 'Less than 18% of the deep ocean floor has been mapped with direct measurement and ~50% of the world's coastal waters remain unsurveyed'. At the bottom, it mentions 'Seabed 2030' and its goal to create a global movement to seek out new datasets.

DCDB Team



Georgie Zelenak

georgiana.zelenak@noaa.gov

Bathymetry Data Manager

Start Date: Sept 1



Jennifer Jencks

jennifer.jencks@noaa.gov

Director, IHO DCDB

Chair, IHO CSBWG

Cecilia Jencks

up.all.night@baby.com

Director, Jencks Household

Start Date: Oct 7



Christie Reiser

christiane.reiser@noaa.gov

Bathymetry Data Manager

Start Date: Nov 12



Contributing data to the DCDB

Submitting Marine Geospatial Data to NOAA's National Center for Environmental Information & the co-located IHO Data Center for Digital Bathymetry

Introduction

This document describes procedures for submitting water column sonar data, and supporting metadata, to the National Center for Environmental Information (NCEI) and the Data Center for Digital Bathymetry (DCDB).

File Formats

1. Multibeam Bathymetry

General Information:

The multibeam bathymetry database is the instrument's vendor specific format. Data submitted in unsupported formats (sound speed profiles, tides, vessel offsets) are also accepted. Data are documented using metadata.

MB Data File Formats:

NCEI can accept bathymetric data from most systems. The multibeam bathymetry source software suite, MB-System, is the preferred format. Data submitted in unsupported formats can be converted to MB-System using web services provided at NCEI (e.g., <http://www.ncddc.noaa.gov/mb-system/>). The archive upon request to mb.info@noaa.gov.

Processed data (if submitted) need not be in a proprietary format. The majority of processed MB-System, XYZ, or GSF format data are accepted.

If your data are not in one of the supported formats, they are not available at NCEI for your data.

2. Singlebeam/Subbottom

General Information:

The [trackline](#) geophysical database contains processed data files in SEGY format documented using metadata.

SB Data File Formats:

NCEI encourages data providers to use the [singlebeam](#) or [subbottom](#) data management pipeline necessary to generate tracklines through the [Viewer](#). Data submitted in unsupported formats through the web services provided at NCEI (e.g., <http://www.ncddc.noaa.gov/trackline/>) are accepted upon request to trackline.info@noaa.gov.

3. Water Column Sonar Data

General Information:

The water column sonar database contains instrument's vendor specific format data. NCEI has developed a [data packaging tool](#) to facilitate data submission and accompanying metadata.

WCSD Data File Formats:

NCEI can accept files from most instruments. Supported instruments include Kongsberg EM3002, EM710, Reson SeaBat 712, and EK60, EK500, EK60, ES60, EK80).

Metadata:

Proper metadata are very important for the means of long-term preservation of each cruise/dataset. NCEI uses and maintains a metadata table. If you are not familiar with metadata, please visit <http://www.ncddc.noaa.gov/metadata/>. Metadata at the level (multibeam, singlebeam/subbottom) are provided with this document.

If cruise level metadata have not been provided, they are listed in the following table. A request for submission can be requested from mb.info@noaa.gov.

Data File Structure:

The data may be delivered in one archived file (e.g., tar or zip) or in a well-defined directory structure. Please include an MD5 checksum with the delivery so NCEI can verify the integrity of the files and the completeness of the data transfer. For questions regarding MD5 checksums, contact mb.info@noaa.gov.

A preferred data structure would be the following:

```
<ship name>
  <cruise ID>
    cruise/
      o metadata – cruise level
      o cruise report/documentation
    multibeam/
      o version1/
        ▪ data/ – include raw (as collected) data files
        ▪ metadata/ – dataset level
        ▪ ancillary/ – include SSP, nav, tracklines, etc.
      o version2/
        ▪ data/ – include processed data files
        ▪ metadata/ – metadata to include processing steps
        ▪ ancillary/ – include SSP, nav, tracklines, etc.
        ▪ products/ – include grids, images or other derived products
    subbottom/
      o data/ – include all segy files
      o metadata/ – dataset level
    wcscd/
      o data/ – include all raw files
      o metadata/ – dataset level
```

Data Submission:

Email mb.info@noaa.gov to alert the multibeam data manager of incoming data (multibeam, subbottom, wcscd), set up your data submission, or ask any questions.

Data can be delivered to NCEI via (1) shipping external hard drives, (2) uploading to NCEI's FTP server, or (3) data copy using [rsync](#) through a secure shell login ([linux](#)).

1. External hard drives containing a data submission can be shipped to the following address
Evan Robertson
NOAA NCEI
325 Broadway E/NE42
Boulder, CO 80305
2. NCEI maintains a number of public FTP servers. All the FTP servers allow anonymous ftp



Contributing data to the DCDB

One tool to pack it all...

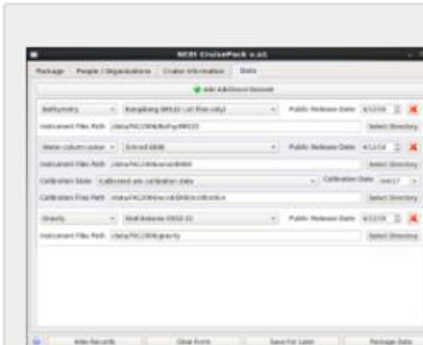
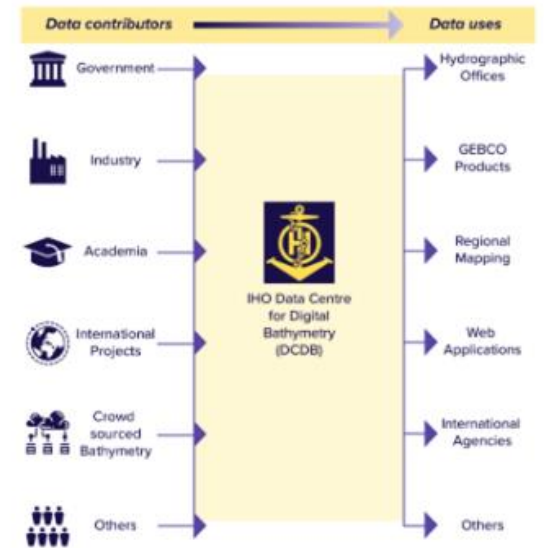
- Stand-alone packager for cruise-based data.
- Additional data types and instruments can be added with little or no modifications to code.
- Simple user interface with pulldown menus and controlled vocabularies
- Creates consistent BagIt format data packages complete with md5 checksum manifest files.
- Generates cruise-level and series level metadata files

Governments, organizations, academia, industry and individuals are encouraged to contribute data to the IHO DCDB. Bathymetric data and metadata can be submitted via File Transfer Protocol (FTP), email, or mail (hard drive) in the formats listed below. Other formats will be considered on a case-by-case basis.

- **Raw sonar data:** MGD77T or the original manufacturer's format
- **Processed data:** BAG, NetCDF, tiff, xyz, sd, asc, etc.
- **Metadata:** XML or text

Learn more about contributing [crowdsourced bathymetry](#).

IHO Member States are invited ([IHO Circular Letter 36/2006](#)) to provide low density shallow water bathymetry for their coastal areas. A tool, developed and distributed with [CL 36/2006](#), and [available upon request](#), will facilitate the extraction of soundings and contours from Electronic Navigational Charts (ENC) cells. Only data from ENCs in navigational purpose bands 2 and 3 are requested.



CruisePack Software

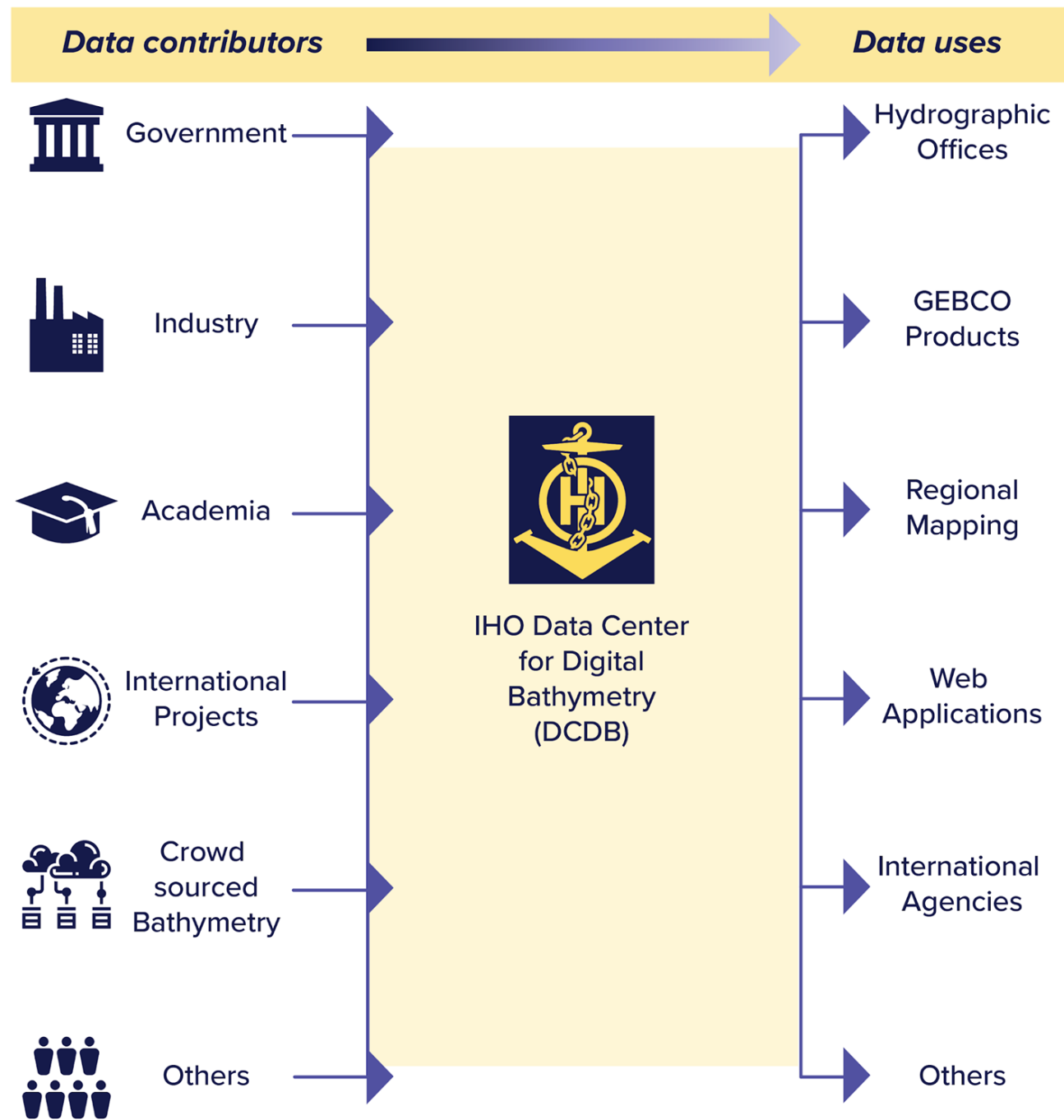
NOAA NCEI is developing and testing *CruisePack*, a data packaging and metadata gathering software tool that simplifies how a data provider collects and submits cruise-based data. *CruisePack* features a simple user interface to control packager operation and facilitate metadata entry. Once the user completes metadata entry, data packaging is automatic. *CruisePack* copies the data, generates machine-parseable JSON metadata records and creates a checksum manifest file; all contained in a structured data package conforming to the Bagit specification.

CruisePack aims to meet a growing community need to submit geophysical data efficiently and in a consistent format. This software is available upon request (mb.info@noaa.gov).



International Hydrographic Organization
Organisation Hydrographique Internationale

Aims to meet a growing need from the community to submit geophysical data to the archive efficiently, easily, and in a consistent format



Recent Data Contributions - *currently in the backlog*

UNOLS Fleet, NOAA Fleet: Routine data contributions

Fugro: 16 new surveys (19 available online)

Five Deeps Expedition - Puerto Rican Trench expedition; data delivered by IHO SG

Brazilian Navy - 10 surveys (data corresponding to Brazilian undersea features accepted at SCUFN 32)

Swiss Polar Institute - 2016 Antarctic survey

Geological Survey of Ireland - 23 surveys

Hydrographic Institute of Italian Navy - Arctic missions High North 2017 - 2018



Contributing data - *IHO Crowdsourced Bathymetry Initiative*

CSB is the collection of depth measurements from vessels, using standard navigation instruments, while engaged in routine maritime operations.

A Working Group was formed and tasked to develop an IHO publication (*B-12 IHO Guidance on Crowdsourced Bathymetry*) that states the IHO's policy towards, and best practices for, the collection and contribution of CSB.





B-12 Edition 2.0.2

https://www.iho.int/iho_pubs/bathy/B_12_Ed2.0.2_2019.pdf



International Hydrographic Organization
Organisation Hydrographique Internationale

B-12 Edition 2.0.2

Guidance on Crowdsourced Bathymetry

IHO

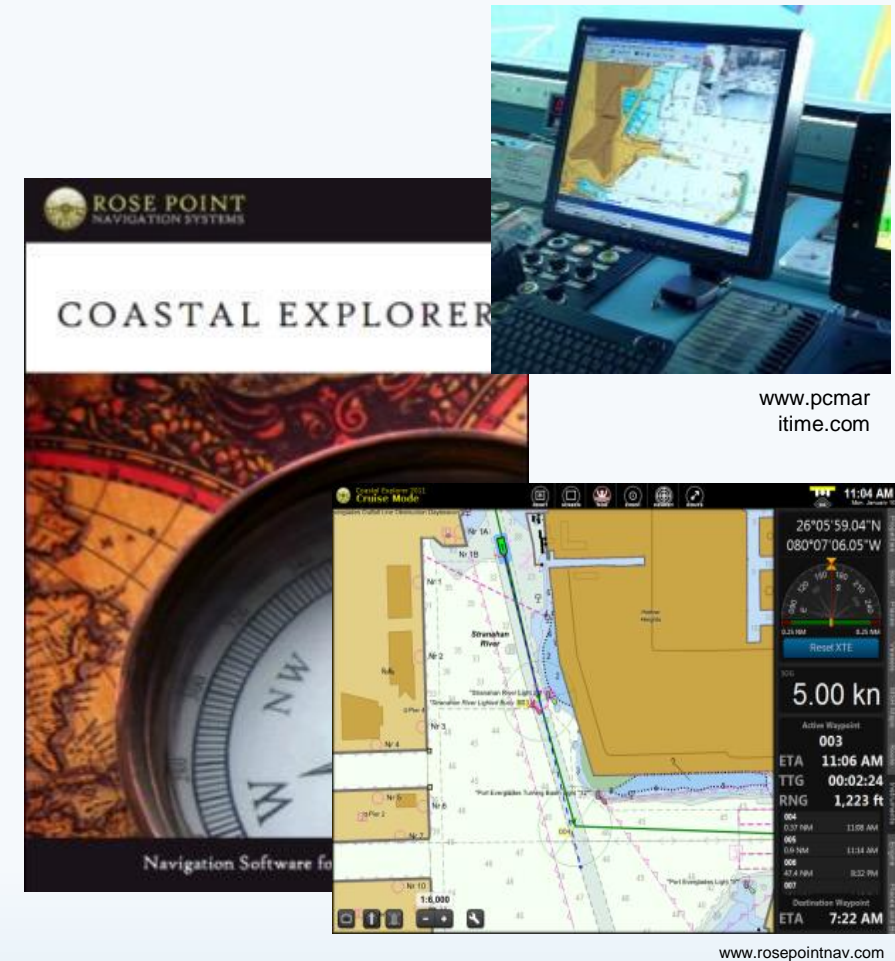


International
Hydrographic
Organization

Published by the
International Hydrographic Organization
4b quai Antoine 1^{er}
Principauté de Monaco
Tel: (377) 93.10.81.00
Fax: (377) 93.10.81.40
info@iho.int
www.iho.int

CSB contributing data - *Rosepoint*

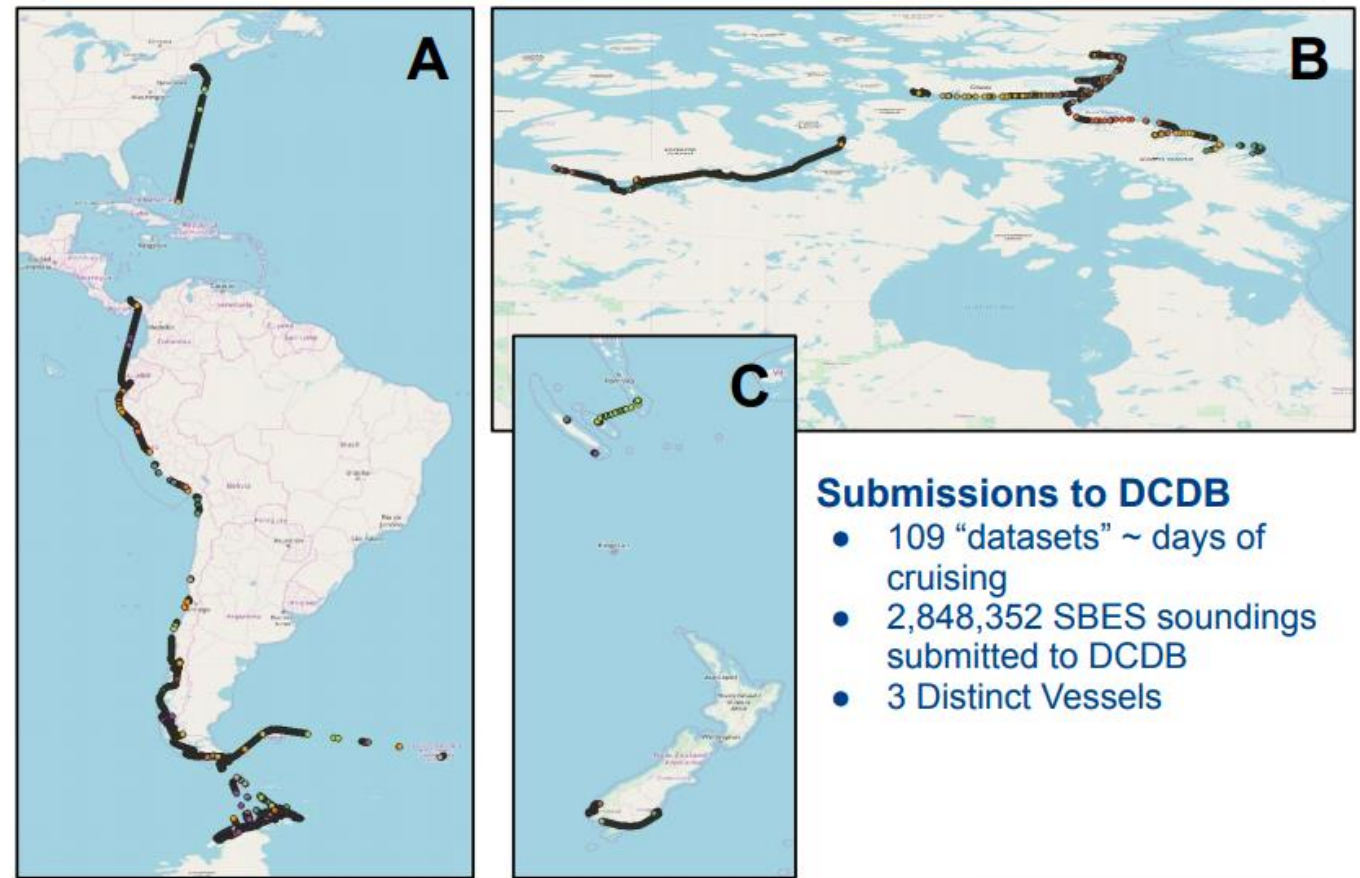
- IHO DCDB and NOAA teamed up with Rose Point Navigation Systems
- Using their navigational system software, mariners can enable a modified electronic charting system log file to ***record position, depth and time.***
- Mariners can capture metadata about vessel and equipment.
- Whenever the mariner updates the software or chart catalog, the data is sent to Rosepoint who then transmits the data to the DCDB via HTTPS post.
- ***154 million soundings; 168 contributing vessels; 6585 data deliveries***



CSB Next Steps: *More data contributors!*

- FarSounder
- Macgregor/Carnival
- James Cook University
- CIDCO

Overview of Data Submitted



Submissions to DCDB

- 109 “datasets” ~ days of cruising
- 2,848,352 SBES soundings submitted to DCDB
- 3 Distinct Vessels

FarSounder, Inc.

www.farsounder.com

2019 Company Proprietary



CSB Data Flow (in a perfect world)

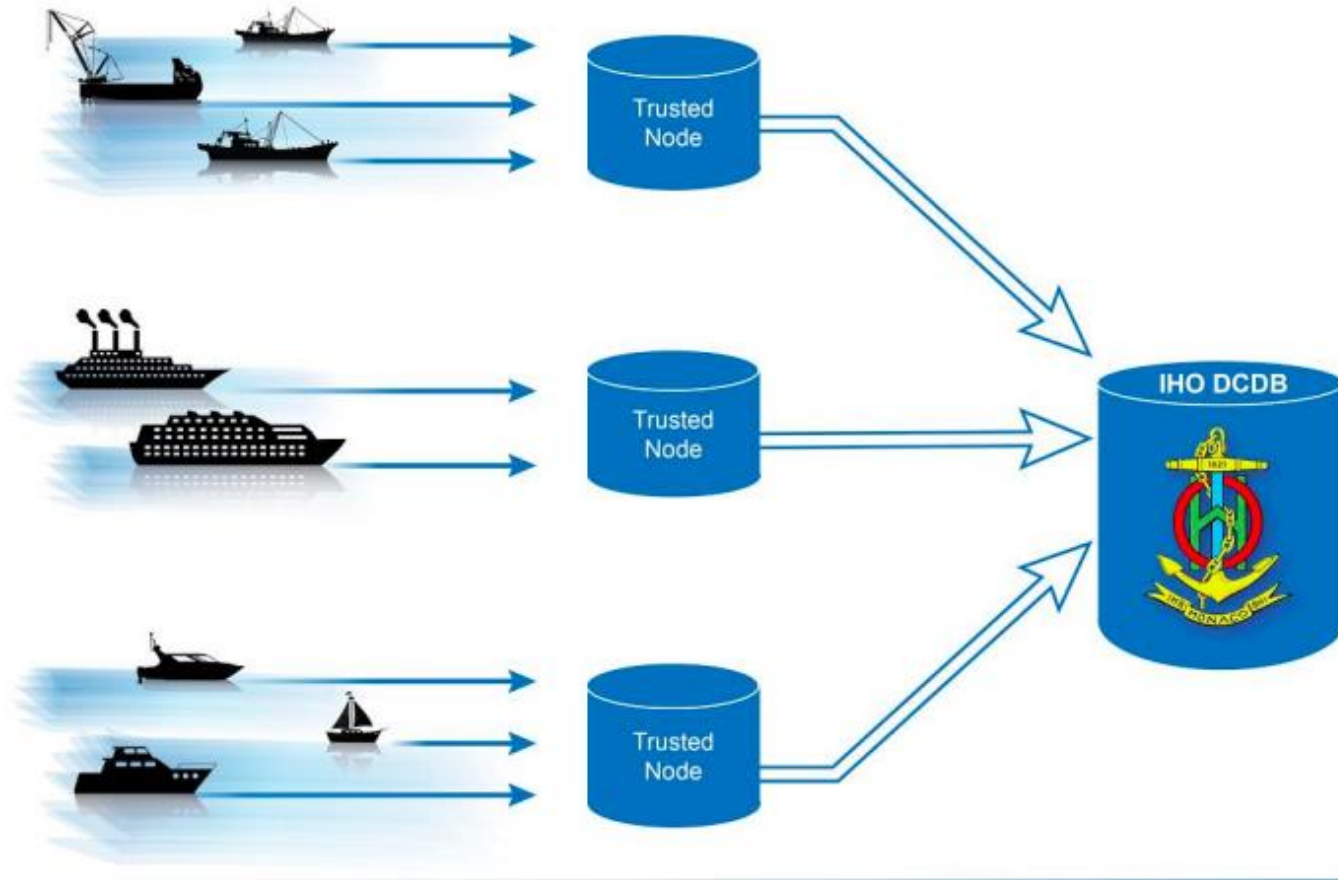
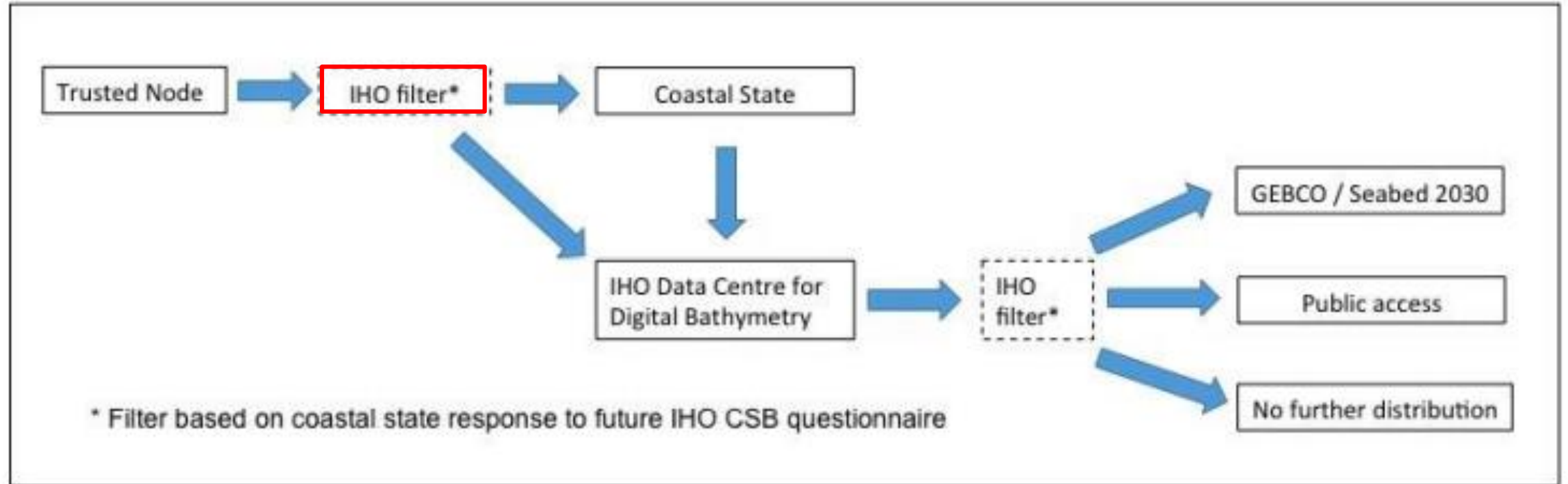


Figure 1. Data flow from vessels, through Trusted Nodes, to the DCDB.



CSB Data Flow (in today's world)



Currently working to apply a set of topologically correct polygons for each EEZ & TS where each polygon is attributed with flags indicating the restriction(s) - YES/NO



Geographic Filtering

Summary analysis of positive responses

1. Based on the comments received to the questionnaire in Annex B to IHO CL 11/2019, the following table will be published as the Positive List to guide potential data gathering activities undertaken by the wider maritime community in waters of national jurisdiction:

Member State	Area	Specific actions required
Argentina	EEZ only	Provide copy of dataset to Hydrographic Office
Brazil	EEZ only	Provide copy of dataset to Hydrographic Office

- The DCDB will filter out CSB data collected from the waters of **all coastal countries not included on the positive list of 13***. This includes:

Most CSB data coming in to the DCDB, that is not in U.S. waters, will not be made available to the public or Seabed 2030.

- Since CSB is stored as files (and NOT points), if any part of a file falls on or within a non-YES country's EEZ, it will not be made available.
- In most cases: 1 survey = 1 file

**** Canada recently submitted a positive response***

Germany	All waters	Inform Hydrographic Office of new dataset
Monaco	All waters	Provide copy of dataset to Hydrographic Office
Netherlands	All waters	Inform Hydrographic Office of new dataset
New Zealand	All waters	Inform Hydrographic Office of new dataset
Norway	All waters – no multibeam activity without prior permission	Inform Hydrographic Office of new dataset
Philippines	Shipping routes and transit passages only	None
South Africa	EEZ only	Provide copy of dataset to Hydrographic Office
Sweden	EEZ only	Inform Hydrographic Office of new dataset
USA	All waters	None



Accessing data from the DCDB

The DCDB utilizes NCEI's standard web services for promoting data access - both the *discovery and delivery of data and metadata*.

The DCDB archives over 30 terabytes of oceanic soundings acquired by hydrographic, oceanographic and other vessels during surveys or while on passage. Soundings include both multibeam and singlebeam bathymetric surveys, and vessels that contribute data in support of the [IHO Crowdsourced Bathymetry \(CSB\) initiative](#).

The [IHO DCDB Data Viewer](#) includes the DCDB's bathymetric data and locations of data accessible from other repositories via web services.

[Access Data](#)

The World Reference for Raw Bathymetry

...rily of unedited single and multibeam bathymetric data nment, academia, and crowdsourcing efforts. These data are roved, comprehensive bathymetric maps and grids in support of ogramme and, more recently, the [Nippon Foundation-GEBCO](#)

...bal focus on the ocean has resulted from a number of high is Agreement under the [UN Framework Convention on Climate k for Disaster Risk Reduction 2015-2030](#) and the [UN Decade of Development \(2021-2030\)](#). These initiatives highlight the lack

of comprehensive global bathymetric coverage, a recognised fundamental element to achieve the goals of each.

[Seabed 2030](#) has created a global movement to seek out new datasets to be added to the currently available bathymetry. The IHO DCDB has been

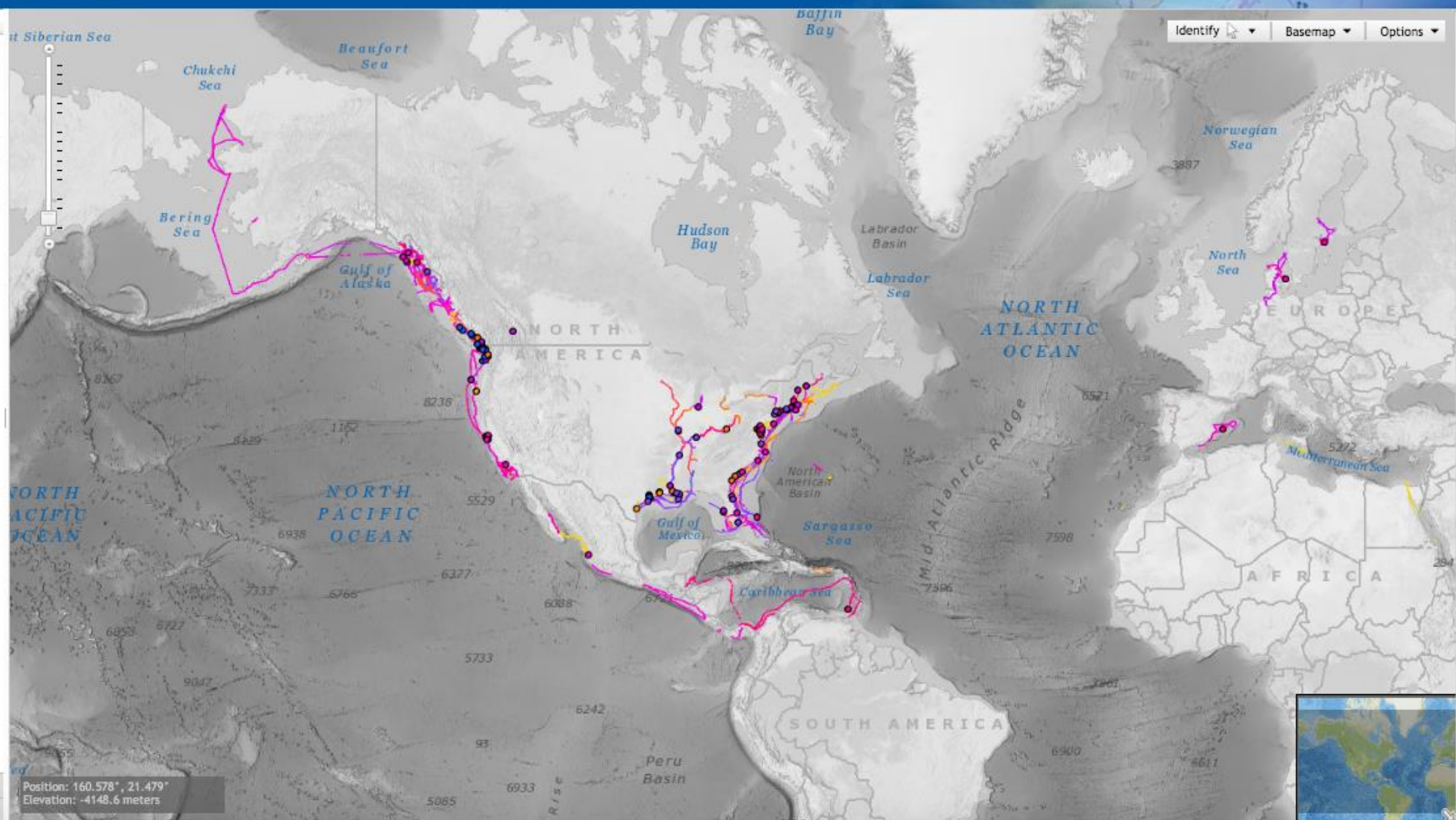
Less than 18% of the deep ocean floor has been mapped with direct measurement and ~50% of the world's coastal waters remain unsurveyed

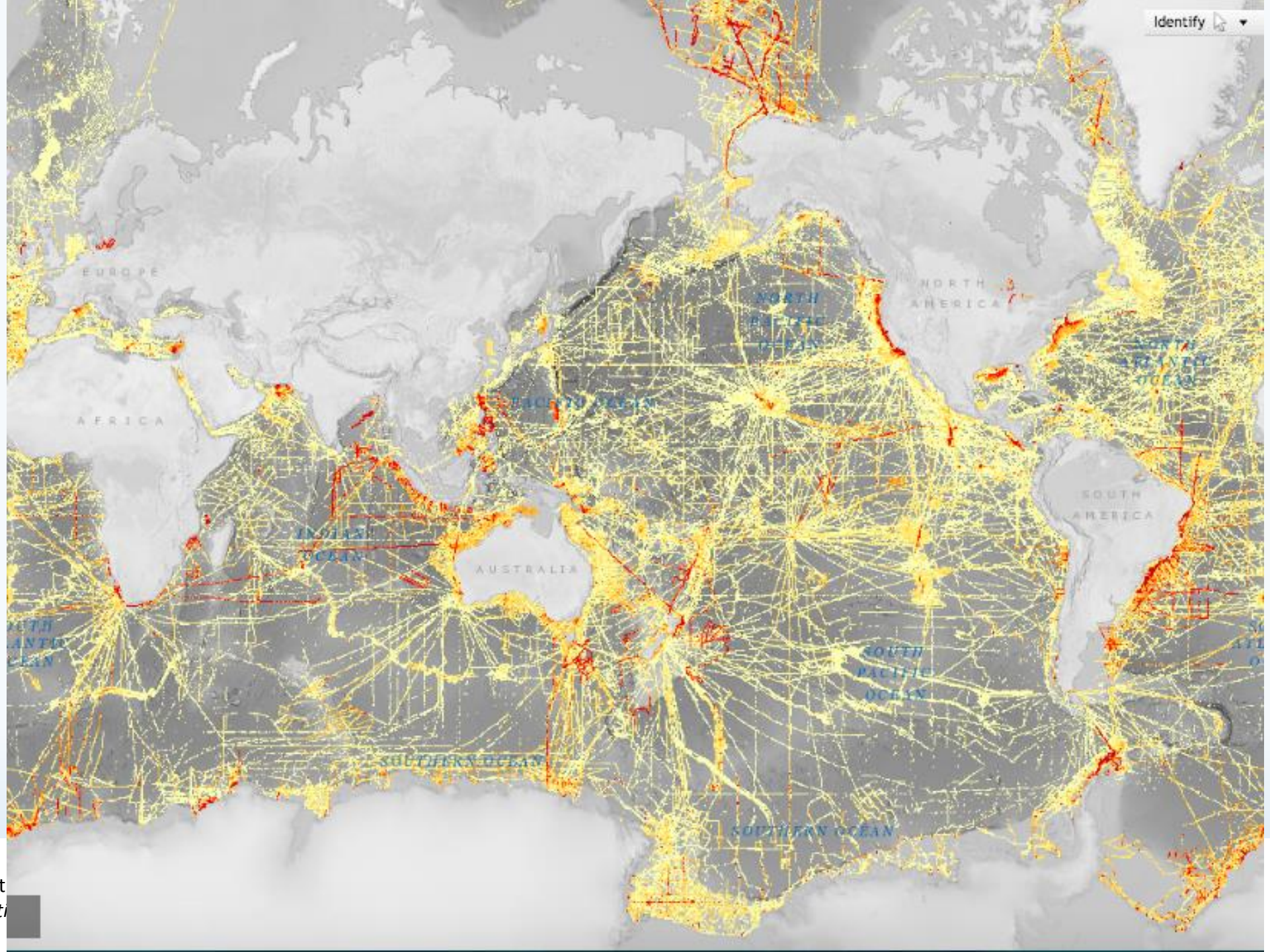


- ▶ IHO DCDB/NOAA NCEI
- ▶ EMODnet
- ▶ Australia
- ▶ Canada
- ▶ France
- ▶ Netherlands
- ▶ Bathymetric Coverage Maps

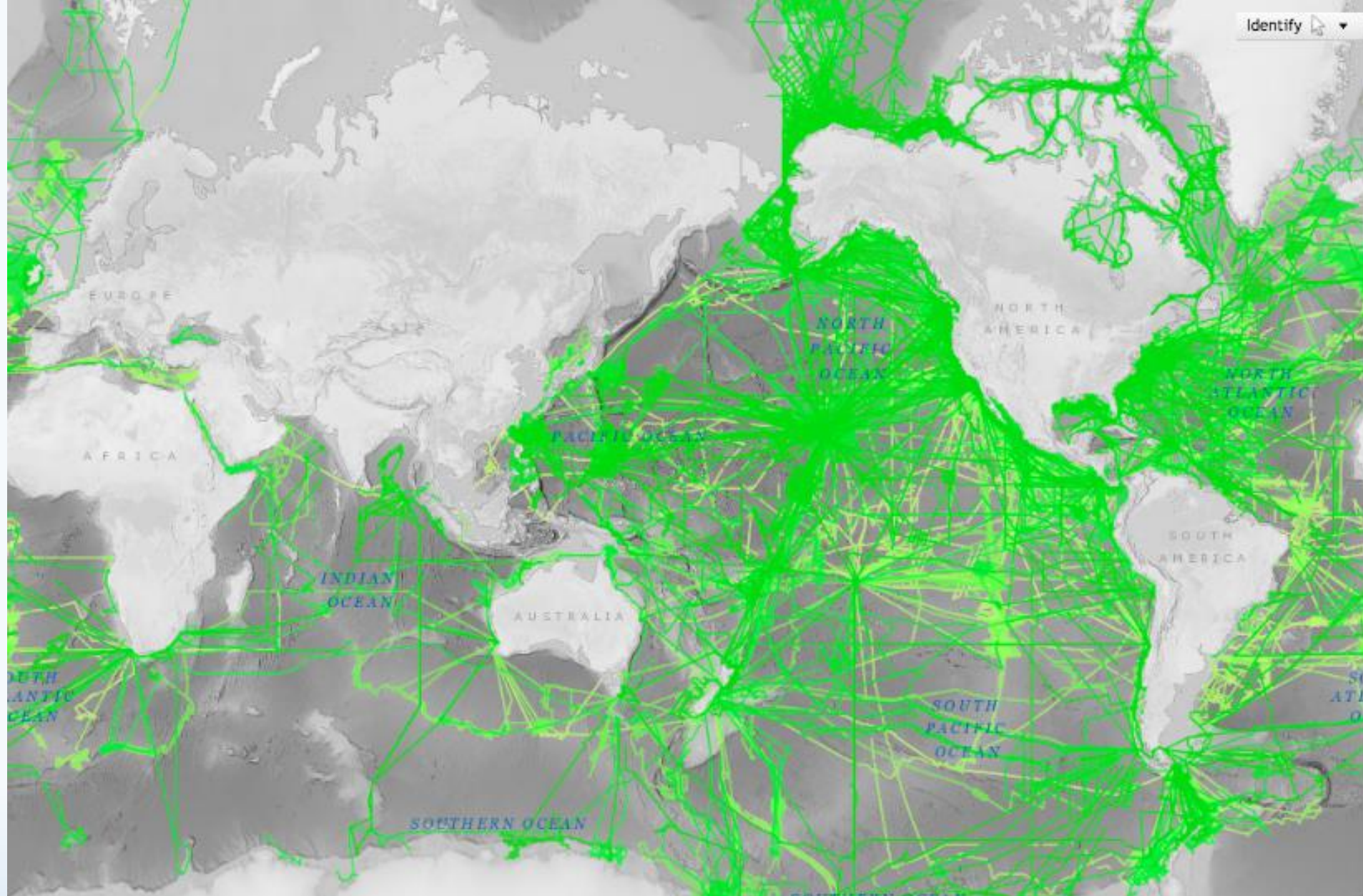
More Information

Help





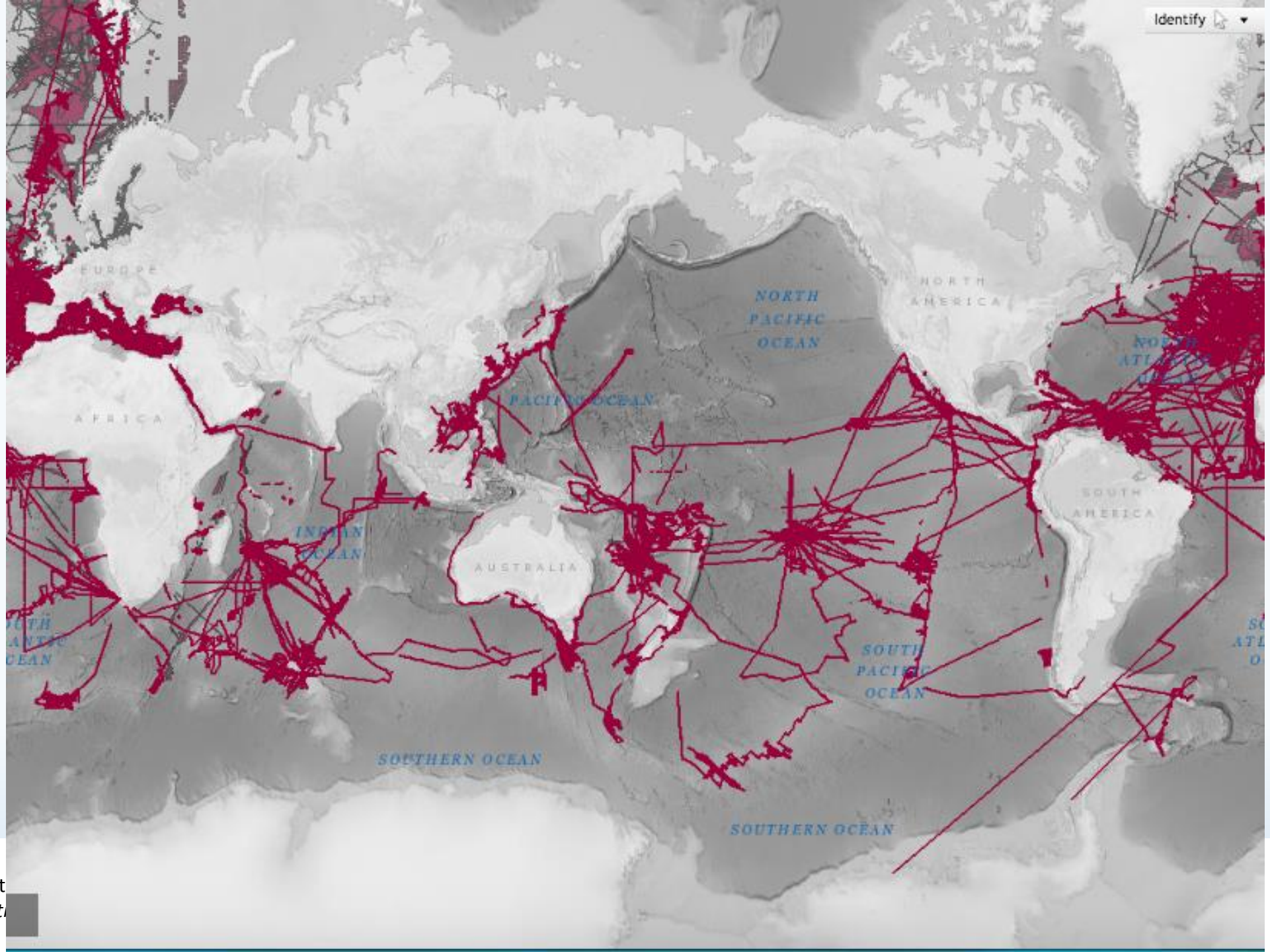
Internat
Organisati



IHO DCDB = World Reference for Raw Bathymetry



Internat
Organisati



Internat
Organisat



Internat
Organisat



Layers

- ☒ IHO DCDB/NOAA NCEI ?
- ☒ EMODnet
- ☒ Australia
- ☒ Canada
- ☒ France
- ☒ Netherlands
- ☒ Bathymetric Coverage Maps



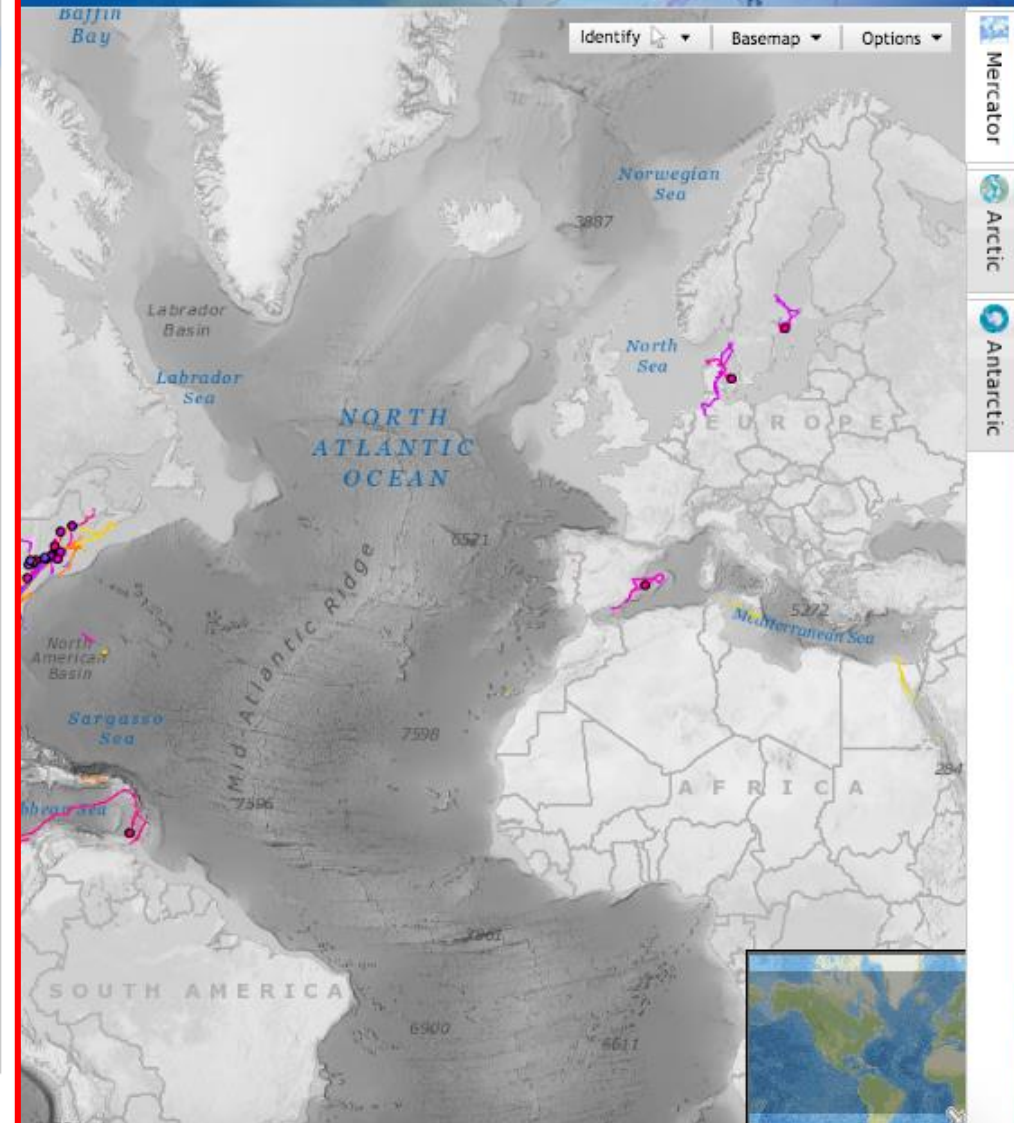
More Information
Help

Layers

- ☒ IHO DCDB/NOAA NCEI ?
- ☒ EMODnet
 - ☐ EMODnet Multibeam Surveys ?
 - ☐ MAREANO Multibeam Surveys ?
 - ☐ MAREANO Multibeam Shaded Relief ?
 - ☐ EMODnet Single-Beam Surveys ?
 - ☐ MAREANO Single-Beam Surveys ?
 - ☐ EMODnet Digital Terrain Model (DTM) ?
- ☒ Australia
 - ☐ AusSeabed Bathymetry Holdings ?
 - ☐ AusSeabed 50m Multibeam 2018 ?
 - ☐ AusSeabed MH370 Phase 1 Data 150m ?
- ☒ Canada
 - ☐ NRCan Multibeam Surveys ?
 - ☐ NRCan Multibeam Shaded Relief ?
 - ☐ Canadian Hydrographic Service NONNA-100 ?
 - ☐ Fisheries and Oceans Canada 500m Bathymetry Compilation ?
- ☒ France
 - ☐ SHOM Bathymetric Grids ?
- ☒ Netherlands
 - ☐ Netherlands Caribbean Grids ?
- ☒ Bathymetric Coverage Maps

More Information
Help

Data Centre for Digital Bathymetry Viewer



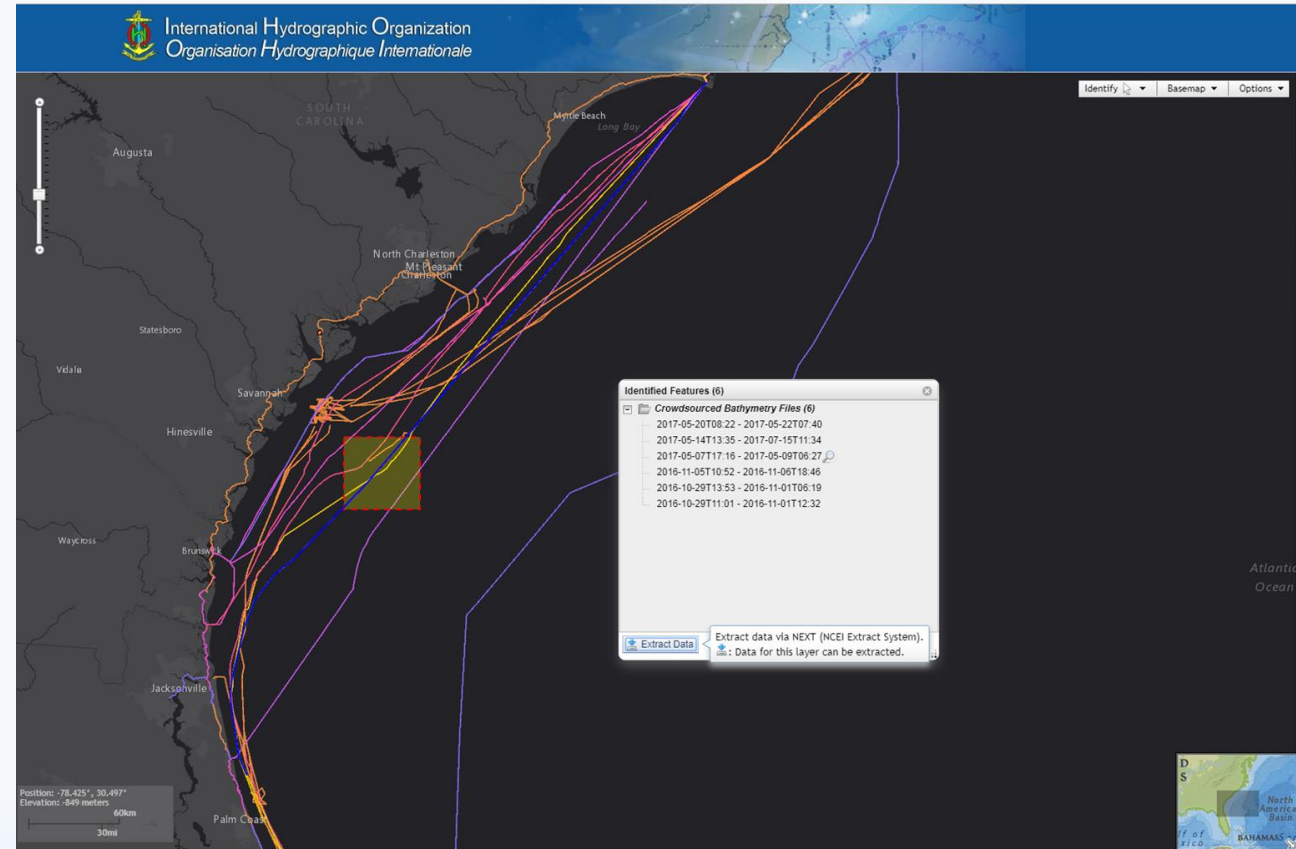
Current & Next Steps - *Data Pipeline*

- Enhance current data ingest pipeline to accept ENC point data
- 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.
- Migrate current (outdated, inflexible) database to a new schema to enable a better system for:
 - Versioning of processed swath files
 - Discovery of backscatter and ancillary files
 - Indicating polygons of extent of coverage



Current & Next Steps - *Data Pipeline*

- Continue to ingest, archive, create tracklines of where data was collected to visualize on map, and provide individual file-based delivery of data.
- Limitations:
 - Data aggregation, processing, and grid generation remains the responsibility of the end user.
 - Data coverage can only be represented as a track...not a polygon



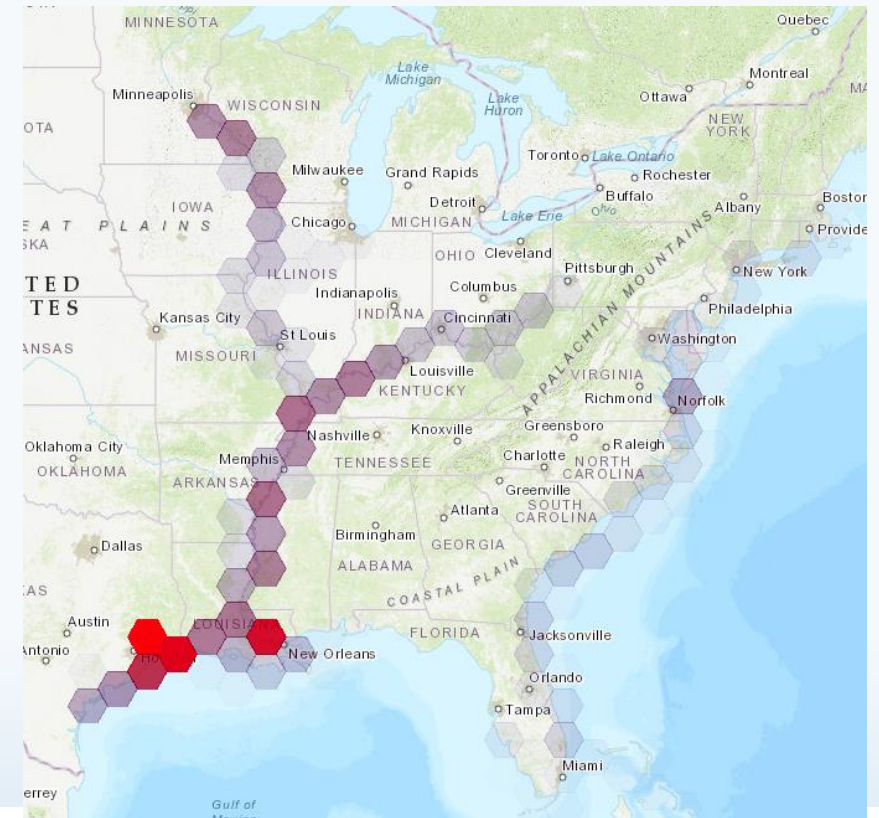
Current & Next Steps - *Point Store*

Implement point storage technology to better handle and store bathymetric data as a seamless collection of points.

DCDB could then provide services to:

- Generate bathy grids of a given area using user-specified resolution
- Show the data density, guiding future data collection efforts
- Query the data collection, providing statistics on the bathymetric measurements surrounding the given location
- Allow the user to extract the raw data from a given area and download in a user-specified format

A point store of this size and capability is currently not feasible to implement on premise.



Current & Next Steps - *ESRI-DCDB Cloud Pilot*

Esri agreed to partner with NCEI/DCDB on a limited-time, cloud-hosted pilot project for no charge.

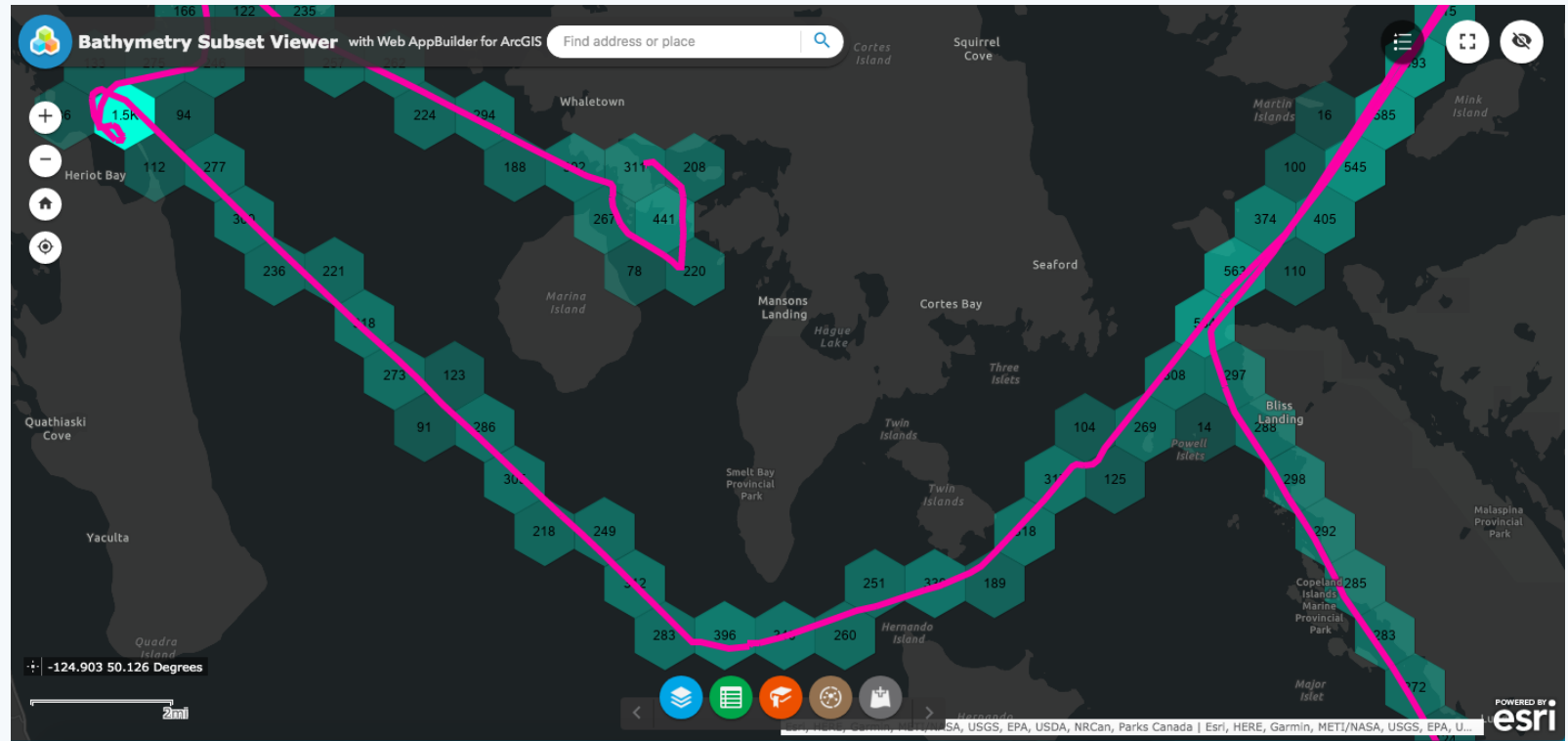
Objectives:

- Evaluate the suitability of the ArcGIS Enterprise software suite for meeting the CSB data discovery, visualization, and data delivery requirements.
- Provide insight as to the cloud requirements to support the Esri software for this purpose, including predictors for future growth.



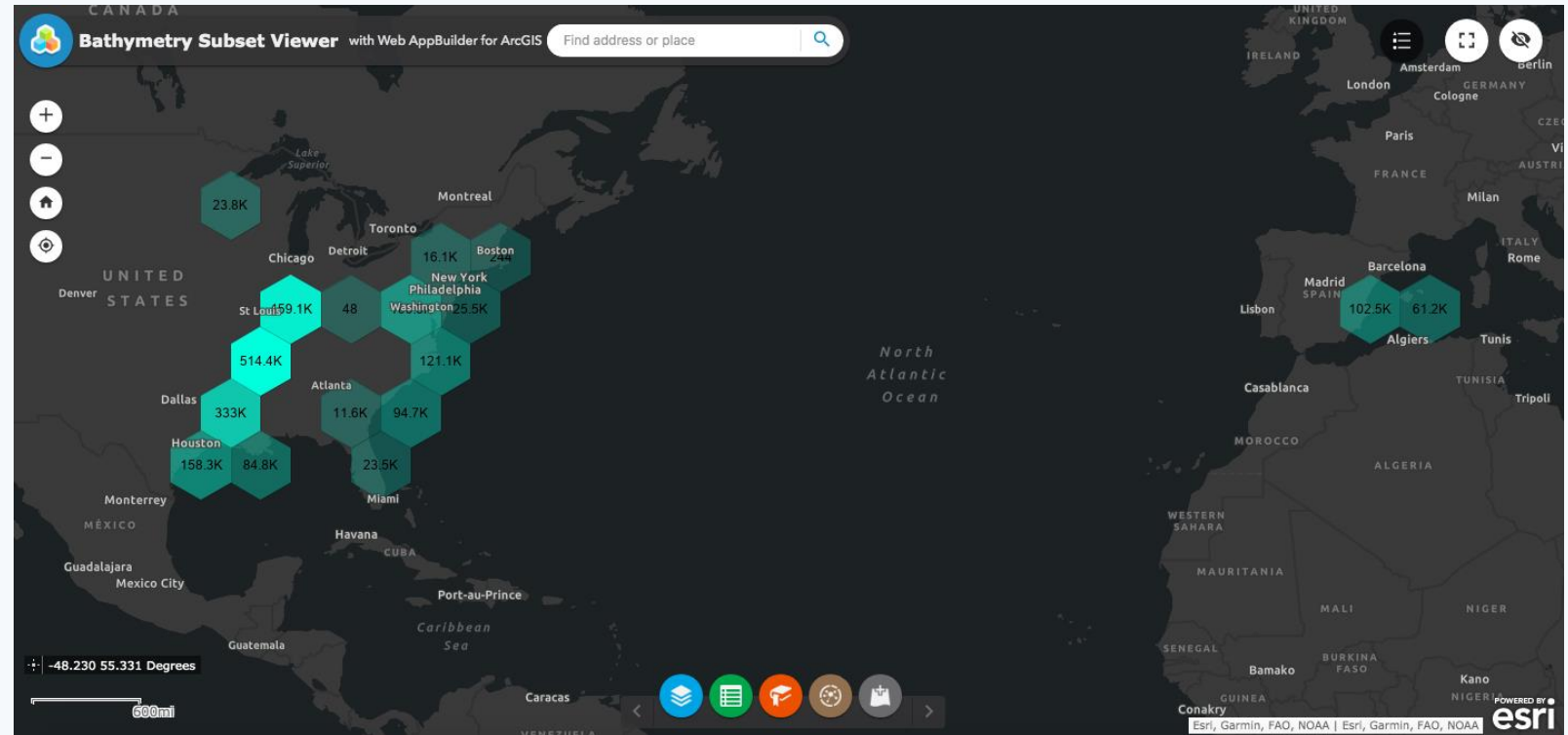
Current & Next Steps - *ESRI-DCDB Cloud Pilot*

- Esri stood up the ArcGIS Enterprise components within their AWS environment.
- DCDB delivered a snapshot of ~152M CSB points and Esri ingested the data.
- Esri is experimenting with re-constructing tracklines from the points using their GeoAnalytics Server



Current & Next Steps - *ESRI-DCDB Cloud Pilot*

- DCDB will create map services using cloud-hosted ArcGIS Enterprise and evaluate performance
- DCDB will create simple demo web applications that consume these services and make the data accessible to stakeholders
- Confirm whether these will meet NOAA, CSBWG, and Seabed 2030 stakeholder requirements



Current & Next Steps - *Point Store*

- The point store would need to be operationalized
- Finding a cloud provider to host
 - NOAA
 - IHO
 - GEBCO/Seabed 2030
 - Commercial or academic partner
- Integrate with DCDB's data ingest and extract systems
- Scale out to include ALL bathymetry data in the DCDB archive



Finally...

1. Develop data flow processes between data contributors, the RDACC/GDACC and the DCDB
2. Identify additional map services to be ingested in to the DCDB Viewer
3. Have CSB and DCDB presence at all future RHC and Seabed 2030 meetings



**The Nippon Foundation-GEBCO
Seabed 2030 Project**



Thank you.

jennifer.jencks@noaa.gov
georgianna.zelenak@noaa.gov