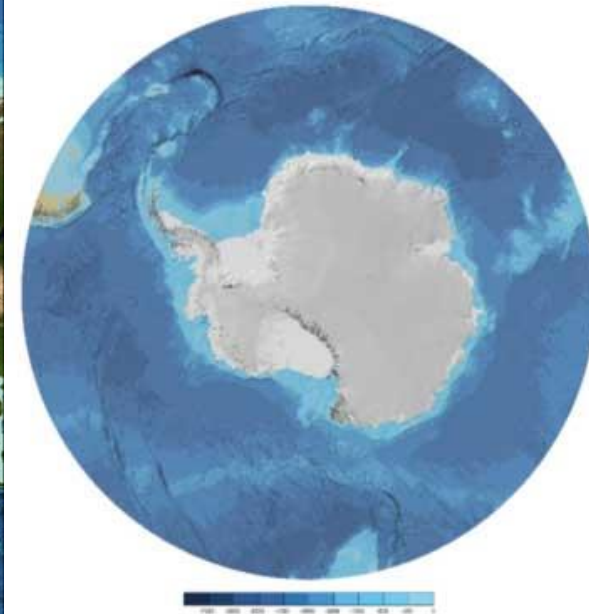
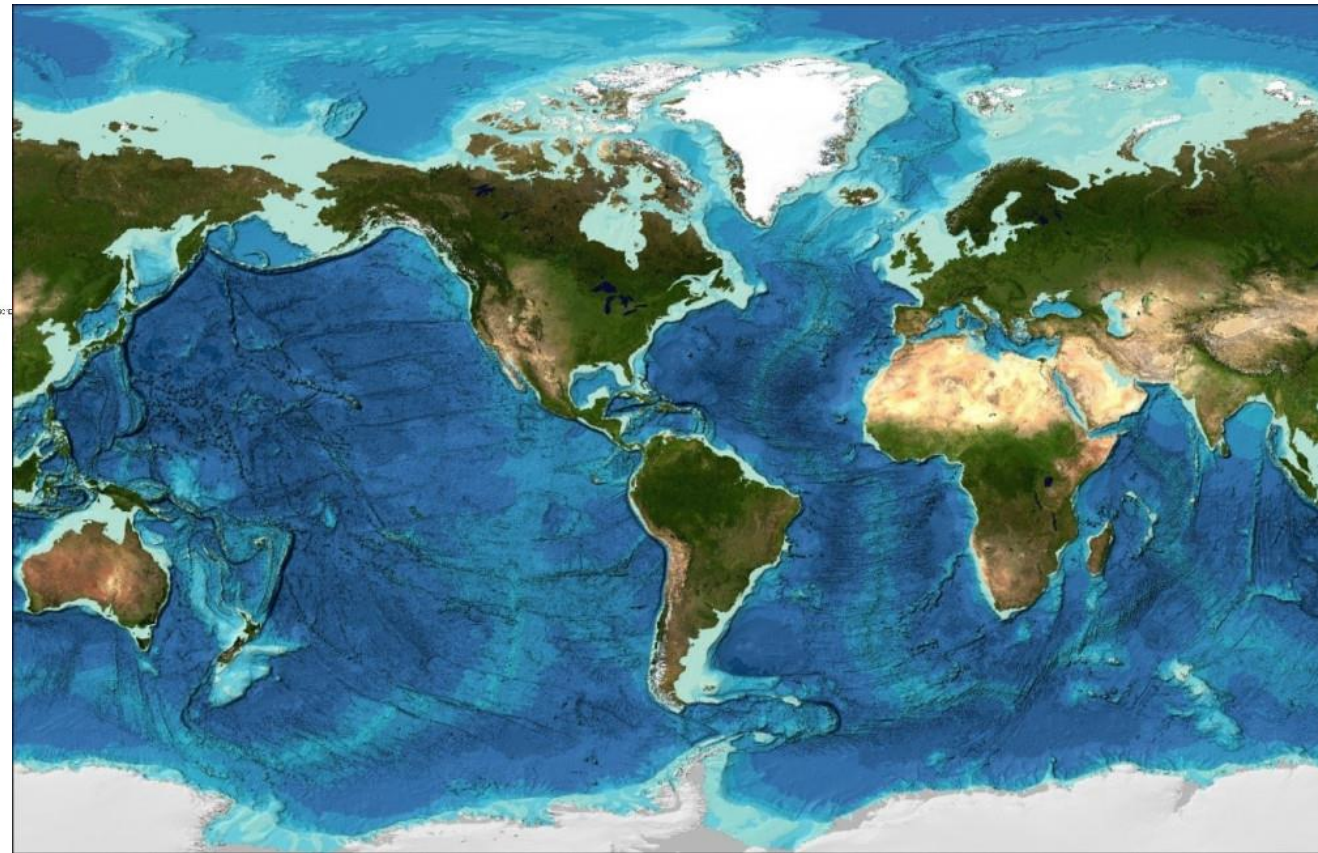
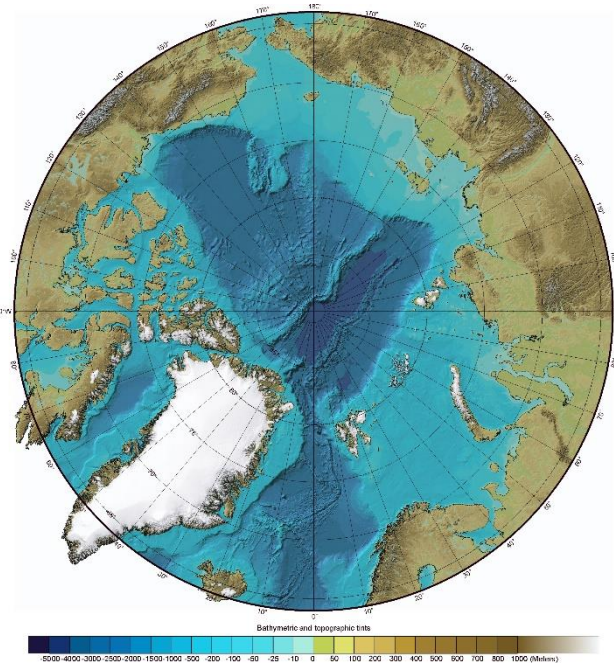


# The last great mapping endeavor of our planet

NSHC35, 5-6 April 2022, Reykjavik  
Evert Flier, Chair GEBCO Guiding Committee



# GEBCO, building partnerships for ocean mapping





GEBCO aims to provide the most authoritative, publicly available bathymetry data sets for the world's oceans.

[Download GEBCO's global grid](#)

[Download polar grids](#)

[Contribute data](#)



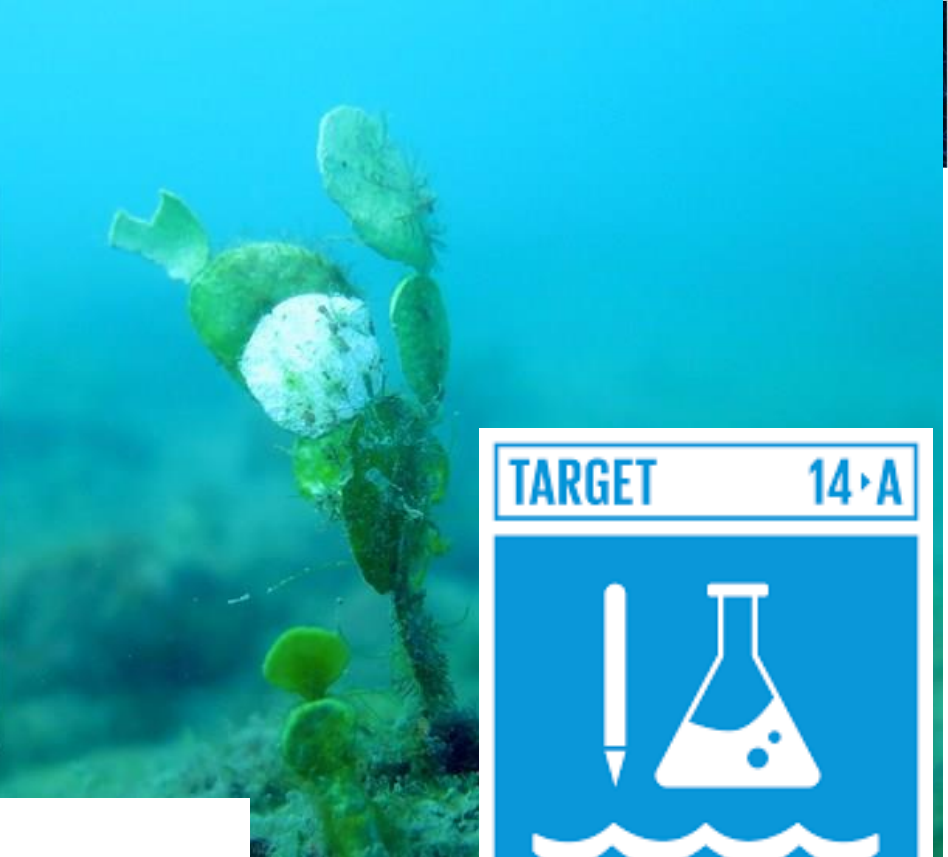
Sustainable Development Goals



14 LIFE BELOW WATER

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Source: [www.saveoursea.social/oceansdg](http://www.saveoursea.social/oceansdg)



TARGET 14-A



INCREASE SCIENTIFIC KNOWLEDGE, RESEARCH AND TECHNOLOGY FOR OCEAN HEALTH

# The Science We Need for the Ocean We Want



#OCEANDECADE



2021-2030 United Nations Decade of Ocean Science for Sustainable Development





Canada



Norway



USA



Mexico



Portugal



Japan



Jamaica



Kenya

Palau



Fiji



Chile



Ghana



Indonesia

Australia



Namibia



HIGH LEVEL PANEL for  
**A SUSTAINABLE  
OCEAN ECONOMY**

#OceanPanel #COP26



GEBCO



IHO

International  
Hydrographic  
Organization



United Nations  
Educational, Scientific and  
Cultural Organization

Intergovernmental  
Oceanographic  
Commission



**UNDER THE SEA**

**RARE & MASSIVE CORAL REEF DISCOVERED DEEP IN OCEAN'S "TWILIGHT ZONE"**

Evert Flier | Norwegian Mapping Authority



THE NIPPON FOUNDATION-GEBCO

SEABED

2030

Seabed 2030 Project Update



## ***Project Update***

### **Update by Project Work Packages:**

**WP1 – Data**

**WP2 – Systems & Tools**

**WP3 – Technology Innovation**

**WP4 – Mapping Activities**

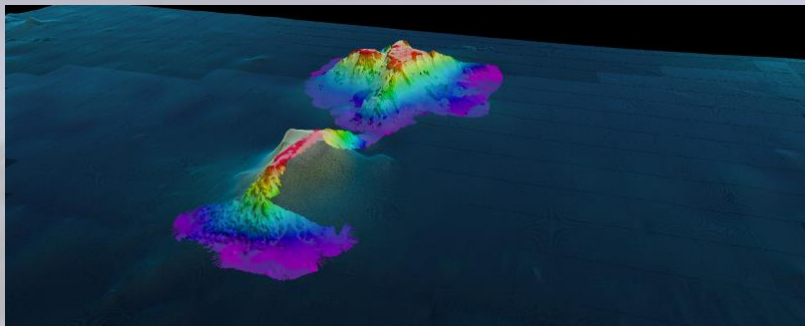
**WP5 – Management**





## WP1 – Data

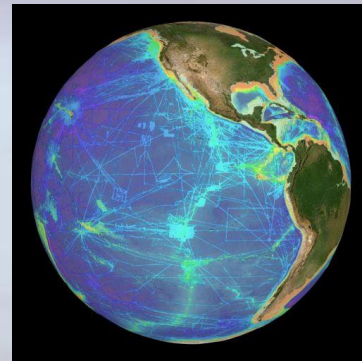
- **GEBCO 2021 Grid released – 20.6% mapped**
- **IBCAO 4.1 published for Arctic Ocean**
- **IBCSO 2.0 published for Southern Ocean**
- **Data ingestion via:**
  - **Extensive engagement with data donor organisations**
  - **Data mining with counties/entities**



*E/V Nautilus – Mercury & Loudoun Seamounts (Pacific)*

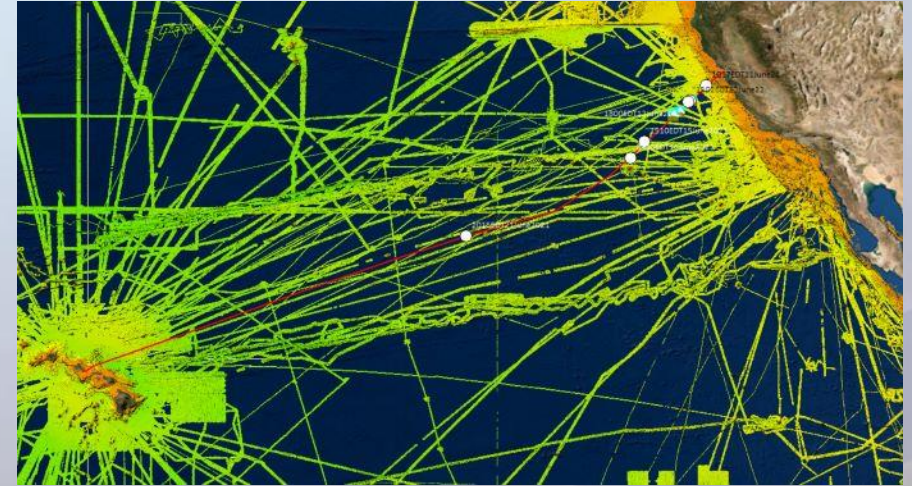
## WP2 – Systems & Tools

- Process improvements at Centers
- Surveying System Bathy Data Uploader
  - Collaboration with Kongsberg Maritime
  - Beta version developed
- Statistics routines developed on AWS
- Collaboration with Scripps on SRTM+ base grid improvements
- UNH Web App visualization refined



## WP3 – Tech Innovation

- **Gridding Statistics improvements**
- **UNH work on new-gen CSB loggers**
- **UKHO/Teledyne Caris GAM**
  - *Generalised Additive Model bathy cleansing*
- **Proved viability of autonomous data gathering on Saildrone's Pacific crossing**
  - *Two Oceans Two Technologies initiative*
- **SeaKoMap** cloud-based processing via
- **Kongsberg Maritime Blue Insight**
- **IHO-CSB Trusted Node – Global Center**



*Saildrone – San Francisco to Hawaii transit*

# WP4 – Mapping Activities

- Data from wider Ocean Frontier activities:
  - IB Oden in Arctic
  - EV Nautilus & DSSV Pressure Drop in Pacific
  - USCGC Healy in NW Passage
  - RV Polarstern in Atlantic & Southern Ocean
- Ocean Frontier Mapping Project
  - Funded mapper onboard DSSV Pressure Drop
- Satellite Derived Bathy (SDB)
  - Mauritius
  - Federated States of Micronesia
  - Maldives
- IHO-CSB -South Africa/Greenland/Palau/SWPac
- Fugro transit bathy - 2 million sq km milestone



Figure 2: Location of data derived from Sentinel-2 imagery (white) and Landsat-8 imagery (green)

**IHO Crowdsourced Bathymetry Initiative**

**Crowdsourced bathymetry (CSB)** is the collection of depth measurements from vessels, using standard navigation instruments, while engaged in routine maritime operations. CSB can be used to supplement the more rigorous and scientific bathymetric coverage done by hydrographic offices, industry, and researchers around the world.

In 2014, the IHO recognized that traditional survey vessels alone could not be relied upon to solve data deficiency issues and agreed there was a need to encourage and support all mariners in an effort to "map the gaps." An initiative was established to support and enable mariners and professionally manned vessels to collect CSB. This approach leverages underway x, y, z, 1 data already being collected on vessels with common commercial echo sounders and Global Navigation Satellite System receivers.

**Contributing CSB Data to the DCDB**

The DCDB accepts CSB contributions through a network of "Trusted Nodes," which may be organizations, companies or universities serving as data liaisons between mariners (data collectors) and the DCDB. Trusted Nodes may supply data logging equipment, provide technical support to vessels, download data from data loggers, and be responsible for data transfer directly to the DCDB.

CSB data must be provided in either CSV or GeoJSON, and capture the minimum required information (XYZ, timestamp). Examples of both data formats can be found in our [ingest API documentation](#). As a trusted node, you will be asked to provide additional information about yourself (provider contact point/organization name, provider email, and unique ID).

Those interested in contributing data or becoming a Trusted Node should contact the DCDB at [bathydata@iho.int](mailto:bathydata@iho.int).

# WP5 – Management

- **Flagship Programme of the Ocean Decade (June 2021)**
- **Endorsed by the 2021 Paris Peace Forum (July 2021)**
- **Wind-in-the-Sails Survey & global prioritisation work ongoing**
  - Workshops in 2022 Q1/2
- **MOU and supporters growing:**
  - MOUs – 26 to date
  - MOU with governments of NZ & UK



## WP5 – Management (cont'd)

- Much engagement with wider community
  - Mostly virtual presence
  - Significant events:
    - One Ocean Summit
    - COP26 (*in person*)
    - Paris Peace Forum
    - Royal Society of Naval Sciences (Sweden)
    - Global Maritime Forum
    - Ocean Business (*in person*)
    - NZ Marine Sciences Society Conference
    - Southern Ocean Decade & Polar Forum
    - UNESCAP CSB Conference
    - SEAIGNEP (Africa)
    - Map the Gaps GEBCO Symposium

.... and many more.



# Thank you for your support!





# Crowdsourced Bathymetry

Evert Flier

*for Patrick Westfeld*

NSHC CSB/Seabed 2030 Coordinator  
CSBWG Member





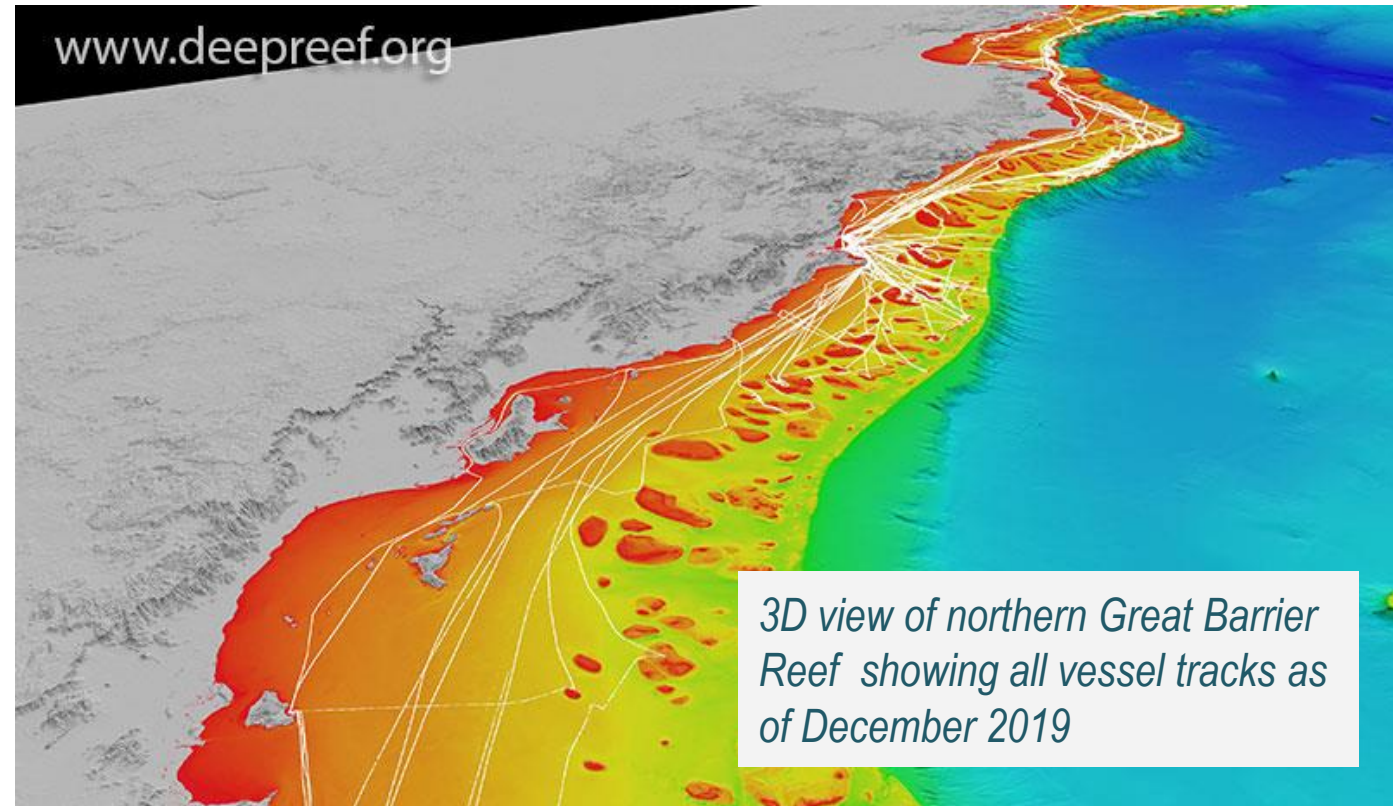
# IHO Crowdsourced Bathymetry Initiative

*Crowdsourced bathymetry (CSB) is the collection and sharing of depth measurements from vessels, using standard navigation instruments, while engaged in routine maritime operations.*



# The Value of CSB Data

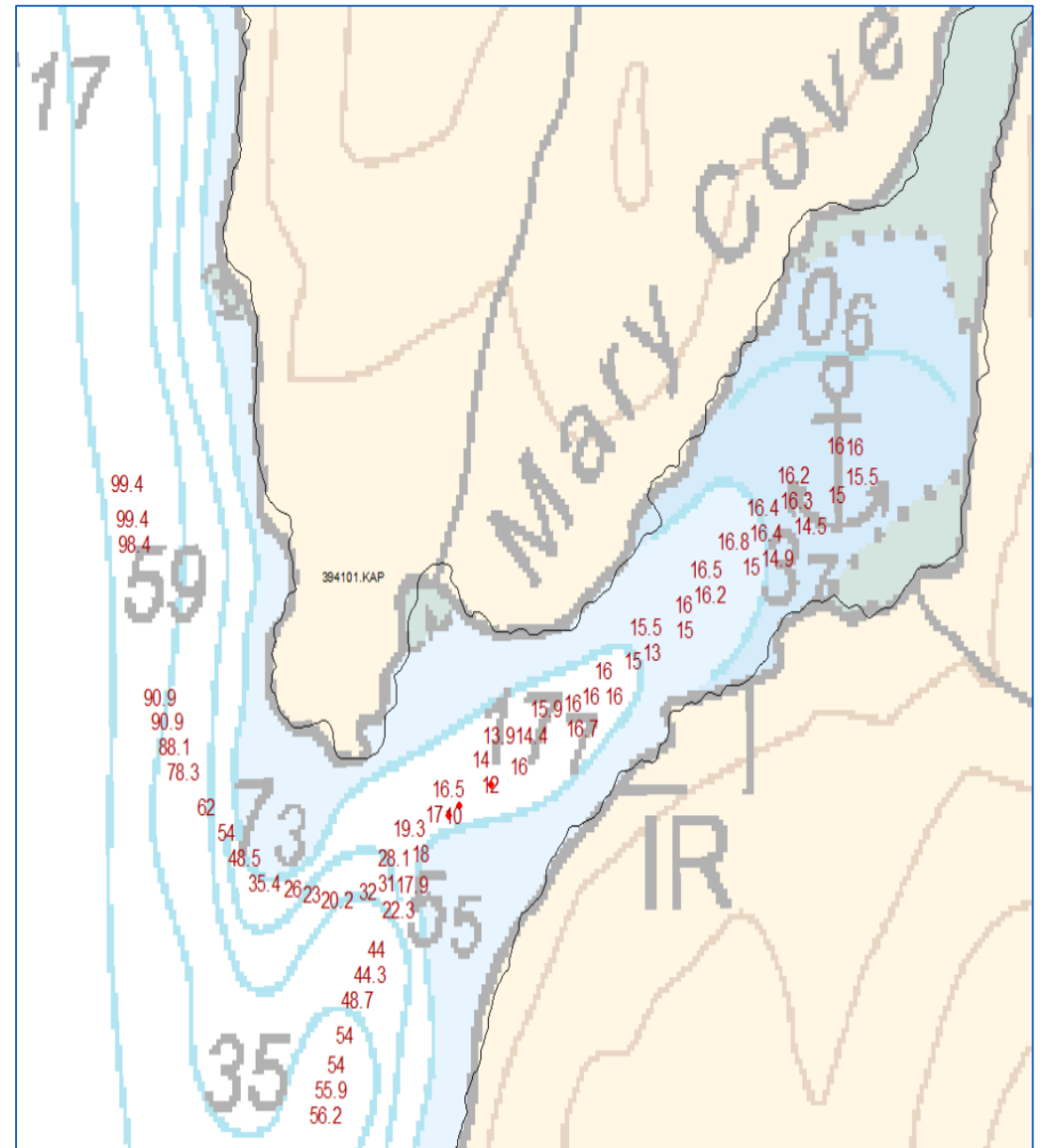
- Data with scientific, commercial & research value at no cost to the public sector
- Fill gaps where data is scarce (eg: Arctic, Small Island Developing States)
- Useful along shallow, complex coastlines
- Identify uncharted features
- Assist in verifying charted information
- Confirm whether charts are appropriate for the latest traffic patterns.



*...but only if vessels collect and donate depth information while on passage*

# The Value of CSB Data

- CHS has used CSB to update several Inside Passage charts along coastal routes.
- A systematic comparison of charted depths < 10 m yielded improved charted channel depths, data density and improved chart compilation in areas that were surveyed with singlebeam.
- CSB helped prioritize survey areas for the following survey season
- CSB has initiated the publication of Notices to Mariners.



CSB revealed some chart compilation problems.

***Don't use the chart to figure out how much anchor chain you need!***



# IHO CL 01/2020 & IRCC CL 21/2020\*

- All coastal States are requested to indicate their position on the ***provision of CSB data*** from ships within waters subject to their jurisdiction into the public domain
- To date, 30 coastal States (**green**) have replied positively\*\* (***Belgium, Denmark, Germany, Iceland, Netherlands, Norway, Sweden***)
- The DCDB implemented a geographic filter to reflect current coastal State positions.



[\\*iho.int/uploads/user/circular\\_letters/eng\\_2020/CL21\\_2020\\_EN\\_v1.pdf](https://iho.int/uploads/user/circular_letters/eng_2020/CL21_2020_EN_v1.pdf)

[\\*\\*iho.int/uploads/user/Inter-Regional%20Coordination/CSBWG/MISC/B-12\\_2020\\_EN\\_Acceptance\\_of\\_CSB\\_Data\\_in\\_NWJ\\_v3.0.pdf](https://iho.int/uploads/user/Inter-Regional%20Coordination/CSBWG/MISC/B-12_2020_EN_Acceptance_of_CSB_Data_in_NWJ_v3.0.pdf)

# CL Questionnaire asks:

- Do you support or object to the CSB data provision for depth measurements from the internal waters, territorial sea, or EEZ of your country?
- Do you wish to be informed when such information is received by the IHO DCDB?
- Do you wish to review such information before its ingestion into the IHO DCDB?
- Do you wish for the opportunity to put caveats on the further dissemination of such data?

**CROWDSOURCED BATHYMETRY DATA PROVISION – COASTAL STATE POSITION  
FOR WATERS SUBJECT TO THEIR NATIONAL JURISDICTION**

**TEMPLATE FORM**

(to be returned to the IHO Secretariat **no later than 4 September 2020**)

E-mail: [cl-ic@iho.int](mailto:cl-ic@iho.int) - Fax: +377 93 10 81 40)

**IHO clarification on Crowdsourced Bathymetry Activity**

For the purpose of this Circular Letter, the following terms have the specified meanings:

Bathymetry is the determination of ocean, coastal, and inland water depths. The general configuration of sea floor as determined by profile analysis of depth data.

Crowdsourcing is a process by which people and/or groups voluntarily submit observations, data, or information to accomplish a task or goal.

Crowdsourced bathymetry is defined by the IHO as the collection of depth measurements from vessels, using standard navigation instruments, while engaged in routine maritime operations.

Crowdsourced bathymetry data provision is the transmission to the IHO Data Centre for Digital Bathymetry for ingestion, aggregation, categorization, and public dissemination of depth measurements made by vessels, using standard navigation instruments, while engaged in routine maritime operations.

IHO Data Centre for Digital Bathymetry (DCDB) was established in 1990 to steward the worldwide repository of bathymetric data. The Centre archives and shares, freely and without restrictions, depth data contributed by mariners. The IHO DCDB is an IHO resource that is hosted by the U.S. National Oceanic and Atmospheric Administration (NOAA) on behalf of IHO Member States.

Internal Waters, Territorial Sea, and Exclusive Economic Zone have the same meanings as are given those terms under the 1982 UN Convention on the Law of the Sea.

Questions:

- 1) Do you support or object to the crowdsourced bathymetry data provision for depth measurements from the internal waters of your country?

SUPPORT

OBJECT

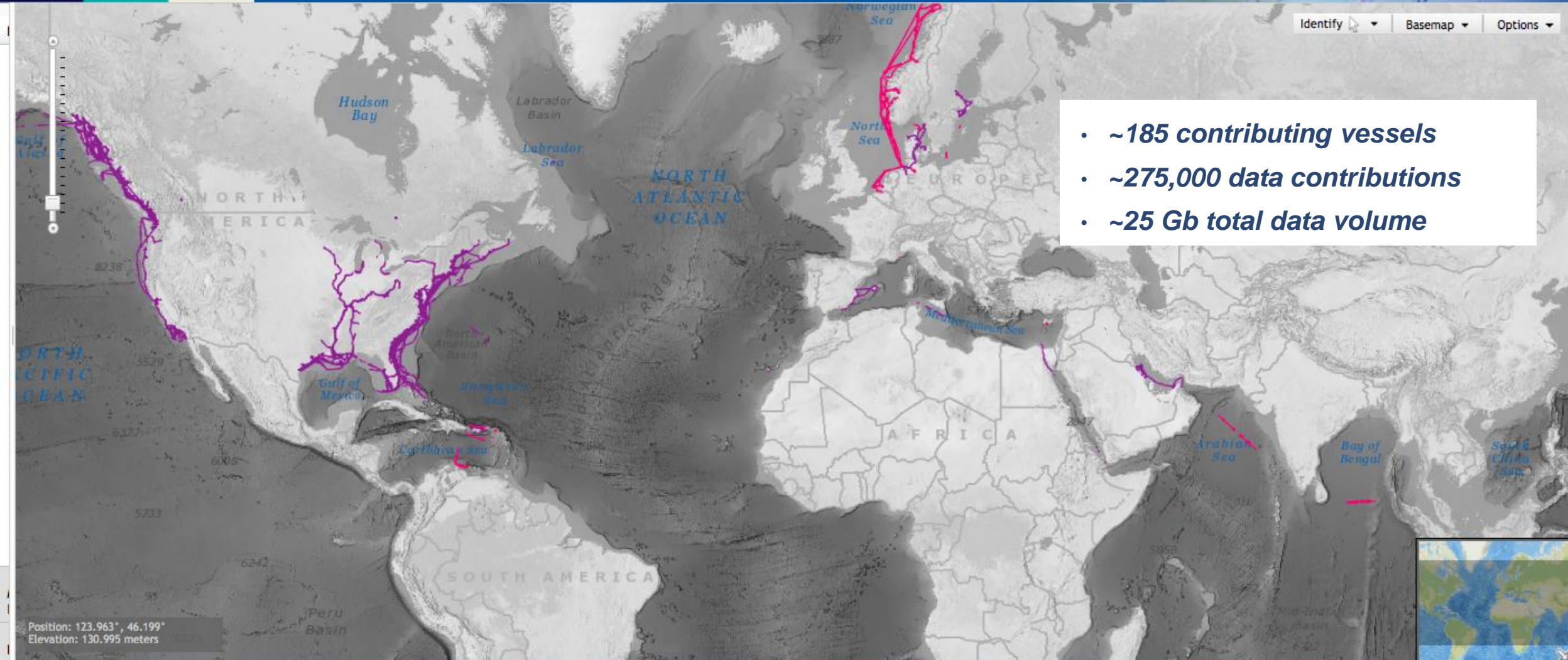
CAVEAT:





IHO

International  
Hydrographic  
Organization



- **~185 contributing vessels**
- **~275,000 data contributions**
- **~25 Gb total data volume**



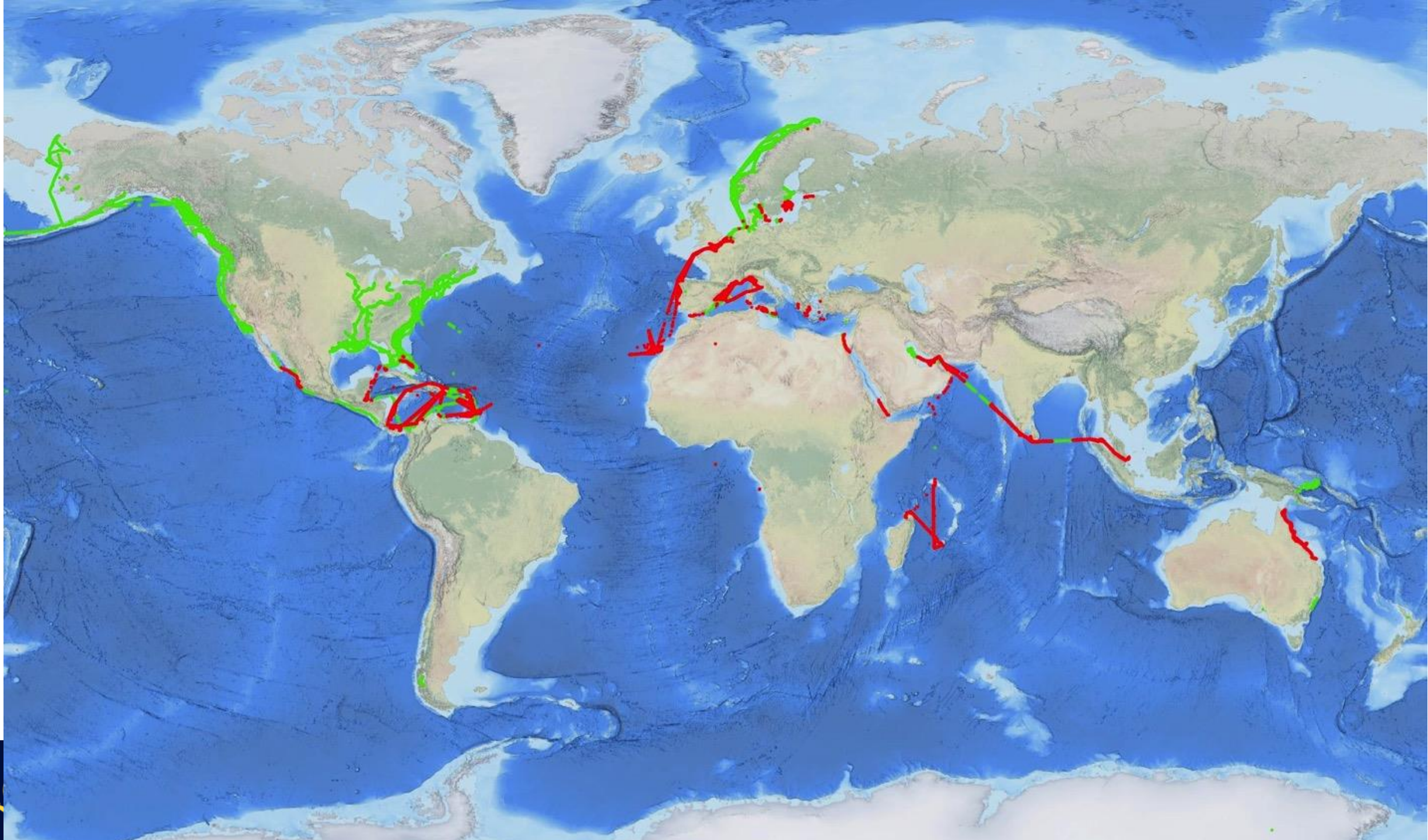


IHO

International  
Hydrographic  
Organization

# Data Centre for Digital Bathymetry Viewer







# How to Contribute CSB Data

The DCDB accepts CSB contributions through a network of "**Trusted Nodes**"

- Eg: organizations, companies or universities serving as data liaisons between mariners (data collectors) and the DCDB.
- Trusted Nodes may supply data logging equipment, provide technical support to vessels, download data from data loggers, and be responsible for data transfer directly to the DCDB.



*Those interested in contributing data or becoming a Trusted Node should contact the DCDB at [bathydata@iho.int](mailto:bathydata@iho.int).*

# CSB Trusted Nodes - *Current*

## Rose Point Navigation System

- Mariners can enable their electronic charting system log file to record position, depth, and time.

## MacGregor/Carnival Cruise Line

- Data provided by Voyage Data Recorders (VDR) logging depth sounding data for IMO mandated shipborne single beam devices.

## FarSounder

- Manufactures 3D Forward Looking Sonar; some clients have agreed to ALSO collect/contribute CSB

## Petroleum Geo-Services (PGS)

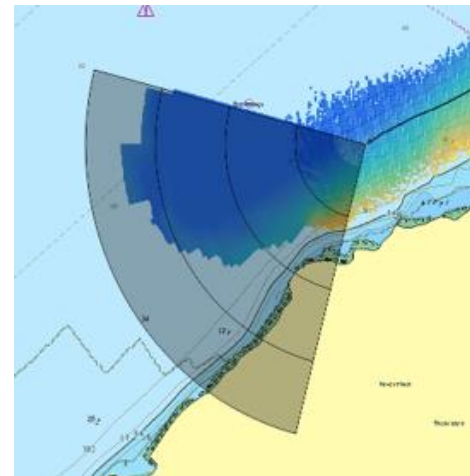
- Implemented a data feed from PGS vessels to the DCDB



[www.rosepointnav.com](http://www.rosepointnav.com)



Voyage  
Data  
Recorder



*a major overhaul of the CSB pipeline is currently underway*



# CSB Trusted Nodes - *In process*

## James Cook University

- Data submitted to the DCDB; Awaiting Australia's response to IHO CL

## Navico C-MAP

- Recently established a new bathymetric feed b/w DCDB & navigation software company

## Great Lakes Observing System

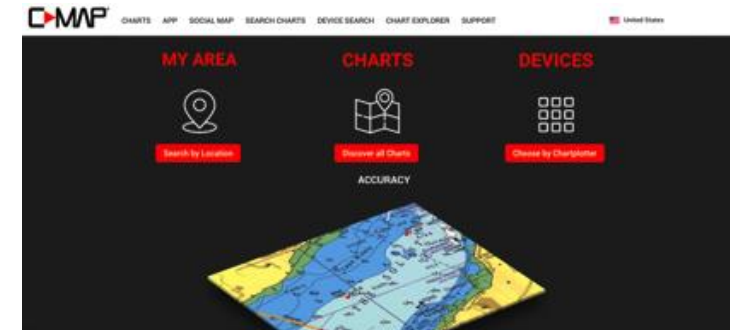
- Awaiting test submissions, initial checks complete

## M2Ocean

- Finalizing metadata content and testing data submissions with data collected by Hydroballs (small autonomous bathymetric buoys)



SmartLog USB  
data logger



# Seabed 2030-funded CSB Field Trials

## Objective:

1. Facilitate field trials that will accelerate CSB activity
2. Collect data in data scarce areas
3. Grow excitement about the CSB initiative
4. Develop a repeatable regional CSB mapping project strategy

## In return, a potential program must guarantee the provision of staff to:

1. Hand out data loggers to the community
2. Assist local mariners in set up
3. Act as a data assembly center
4. Provide a copy of these data to the IHO DCDB to be



*Support includes provision of data loggers (NMEA0183 and NMEA2000) and installation support (where needed).*



# Seabed 2030-funded CSB Field Trials

## Greenland Institute of Natural Resources

- Phase 1: aim to engage approximately 50 vessels of various sizes- 30 data loggers deployed so far.

## The Institute For Maritime Technology & The South African Navy HO

- 100 data loggers deployed to SANHO/IMT.
- Planning of trials: identification of stakeholders, establish relationships, feasibility studies, regular communication via various channels.

## Bureau of Marine Transportation - Palau

- 100 data loggers received (NMEA0183 and NMEA2000)
- Coordinating with South & West Pacific Seabed 2030 Data Center
- Will receive support from U.S. Navy for logger installation and setup in 2022.



*"Sea Lab 1", IMT – trial deployment (Credit: CDR Christoff Theunissen)*



# Other CSB Field Trials in Progress

- **Tall Ship Pelican of London:** testing in UK waters complete, further data collection 2022 and beyond.
- **Lisa Blair Sails the World:** Antarctica 2022 and future voyages.
- **Bernhard Schulte Ship Management (BSM):** Discussions currently underway; potential to roll out to 400+ vessels.
- **New Zealand:** Several test cases currently underway via S&WPac Regional Center.



*Top, left: Data collection onboard EV Nautilus (credit: Ocean Exploration Trust). Bottom, left: Scientists onboard RV Falkor (credit: Schmidt Ocean Institute).*



# IHO CSB Working Group

- 12 meetings; 1 Industry workshop
- Chair (Jennifer Jencks, USA) & Vice-Chair (Pete Wills, CA)
- Active Member State Participation:
  - Canada, China, Denmark, France, Germany, India, Italy, Lebanon, Mexico, Netherlands, New Zealand, Norway, Portugal, South Africa, Sweden, UK, Uruguay, USA
- Observers and expert contributors:
  - CCOM-JHC, CIDCO, Da Gamma Maritime Ltd, Dongseo U, ECC AS, ESRI, FarSounder, FLIR Systems AB, Fugro, GMATEK, Inc., James Cook U, JAMSTEC, Navico/C-Map, ONE Data Tech Co., Olex, PYA, Seabed 2030, Sea-ID, SevenCs/ChartWorld, TeamSurv, Teledyne CARIS, World Maritime University, and WOC
- IHO: Assistant Director Sam Harper
- NSHC CSB/Seabed 2030 Coordinator: Patrick Westfield



CSBWG 9: 30 Jun-02 Jul 2020



CSBWG 10: 30 Mar -01 Apr 2021



# IHO CSB Working Group - Outreach

## CSB Outreach Flyers:

- Super yacht & leisure community
- Survey
- Geophysical & Submarine Cable industry
- Fisheries
- Cruise Line industry
- Software/hardware industry
- Hydrographic Offices
- Academic/Scientific Research

**CITIZEN SOURCED DATA**  
**HELP REVEAL THE DEEP AND SHARE YOUR DATA**

**CROWDSOURCED DEPTH INFORMATION**  
Commercially owned ships can participate in increasing our knowledge of the ocean by sharing depth measurements from navigation instruments while out at sea. Known as Crowdsourced Bathymetry (CSB), this information can help identify uncharted features such as seamounts and canyons, verify charted information, and help fill the gaps where no data exists.

**CRUISE SHIPS**  
Many expedition cruise ships explore the world's oceans, often in areas where data is sparse, non-existent, or of poor quality. These are exactly the places where contributions to global seafloor mapping efforts can have the greatest impact.

To minimise effort on the part of the ship's crew, data collection and contribution of data can occur by using either built-in navigation software systems that are participating in the CSB initiative, or through a small hardware data logger that can be interfaced to the ship's NMEA data bus. Routinely measured parameters such as under keel depth and position, can then be stored, uploaded and contributed to local and global mapping initiatives. These contributions can also benefit navigational safety, detect unknown hazards, and aid other mariners and ocean scientists.

By contributing data, cruise ships can help avoid accidents, environmental damage and make the oceans a safer place for all. Additionally, participation in this global effort can be included in the cruise line's marketing materials highlighting the various ways they contribute to scientific endeavors.



**DR. MATHIAS JONAS**  
**IHO SECRETARY-GENERAL**  
"Getting to know the ocean is the greatest mapping adventure of our times. Many underwater mountain ranges, volcanoes, canyons have yet to be discovered and named."

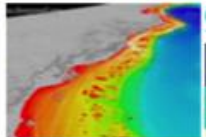
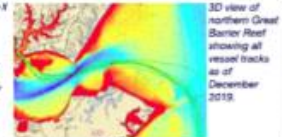

**BECOMING A 'TRUSTED NODE'**  
The IHO's Data Centre for Digital Bathymetry (DCDB) accepts CSB data contributions through organizations, companies or universities that serve as data aggregators and / or liaisons between mariners (data collectors) and the DCDB. These "trusted nodes" help the CSB effort in a variety of ways ranging from supplying data logging equipment or software, providing technical support to vessels, downloading data from data loggers, aggregating collected data and facilitating data transfer. The IHO DCDB will help identify the best-suited "trusted node" type for you.

Contributed data should include depth, position and time stamp. While additional information is encouraged, data does not need to include vessel name, IMO number or anything else with the vessel identification prior to uploading to the IHO DCDB database. By contributing data to the IHO DCDB, the provider will not be held liable for the data submitted.

**FIND OUT MORE**  
Further information about collecting or contributing data can be found at the IHO DCDB website ([ngdc.noaa.gov/iho/](http://ngdc.noaa.gov/iho/)) or by contacting representatives of the IHO Crowdsourced Bathymetry Working Group at [bathydata@iho.int](mailto:bathydata@iho.int).  
Visit [seabed2030.org](http://seabed2030.org) to learn more about the Nippon Foundation-GEBCO Seabed 2030 project, which aims to bring together all available bathymetric data to produce the definitive map of the world ocean floor by 2030.

NOAA's Be Hydro! crowdsourced bathymetry test tracks in green overlaid on multibeam survey data demonstrates how changes can be detected.

3D view of northern Great Barrier Reef showing all vessel tracks as of December 2019.



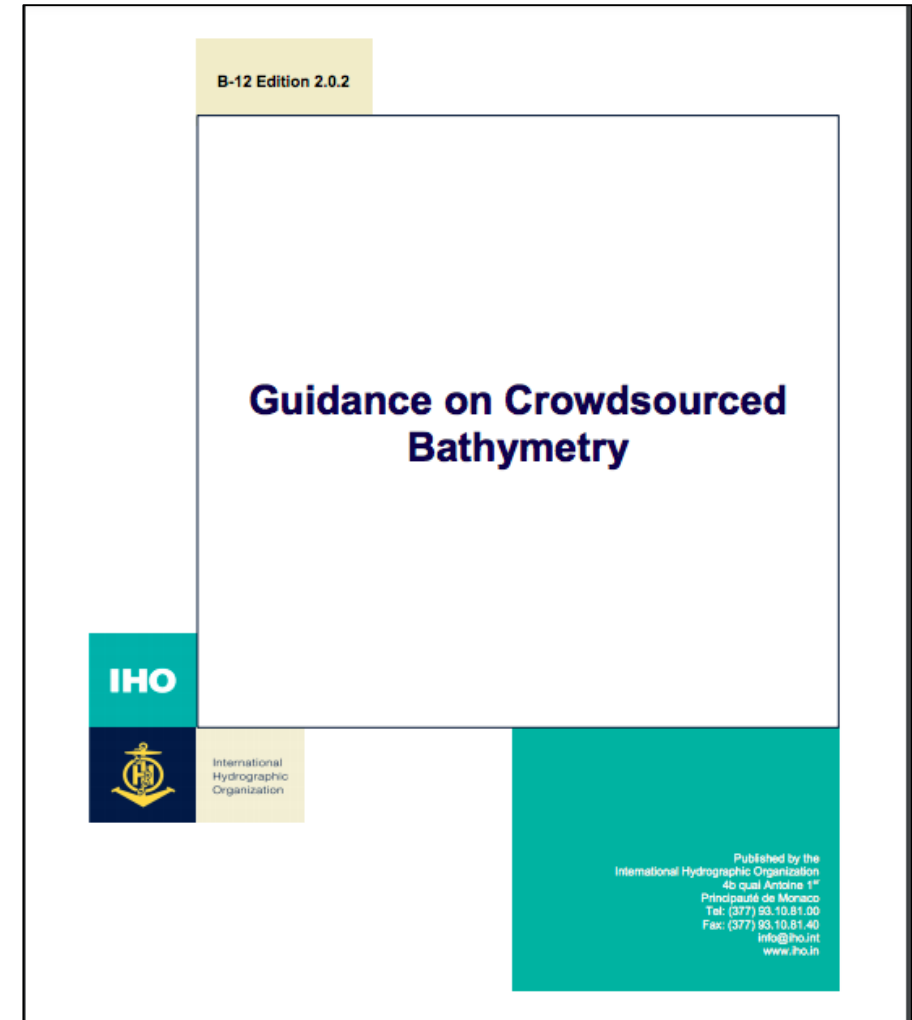


# IHO CSB Working Group 12

CSBWG12 held 8-11 March 2022.

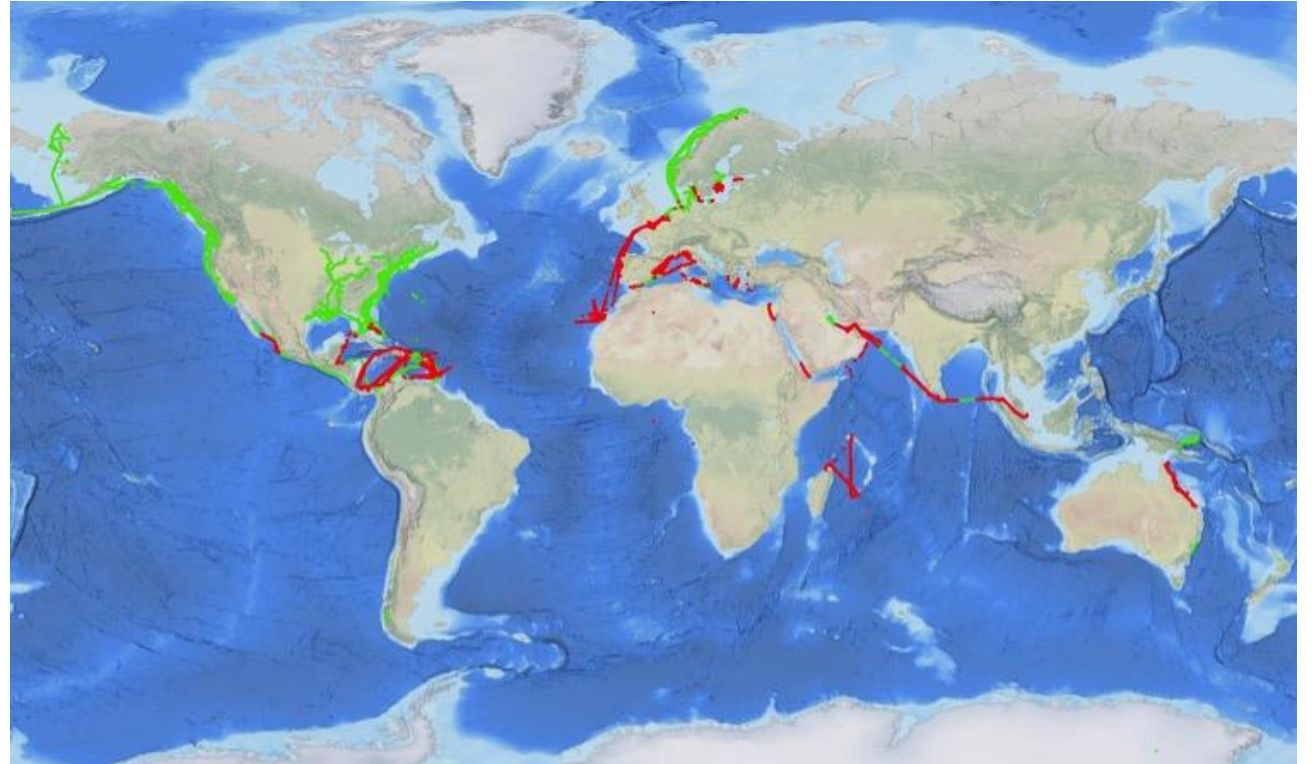
FOCUS: To finalize the review and update of IHO Publication B-12: CSB Guidance Document.

*B-12 has now been in circulation for over 2 years and, apart from including feedback from operational use and experience, there is a strong desire to make the document more "equipment agnostic" with the intent of soliciting data from ALL sources, not just single beam echo sounders.*



# How can HOs become involved?

- Offer a positive response to the IHO or IRCC Circular Letters
- Consider joining and/or attending the CSBWG - it is open to all!
- Encourage local participation in CSB collection and sharing.
- Volunteer to become the next Seabed 2030-funded CSB Program!



# Thank you!

[Evert.flier@kartverket.no](mailto:Evert.flier@kartverket.no)



GEBCO

