LAMONT-DOHERTY EARTH OBSERVATORY
COLUMBIA CLIMATE SCHOOL

Mapping the Gaps with Academic Research Fleet Vessels

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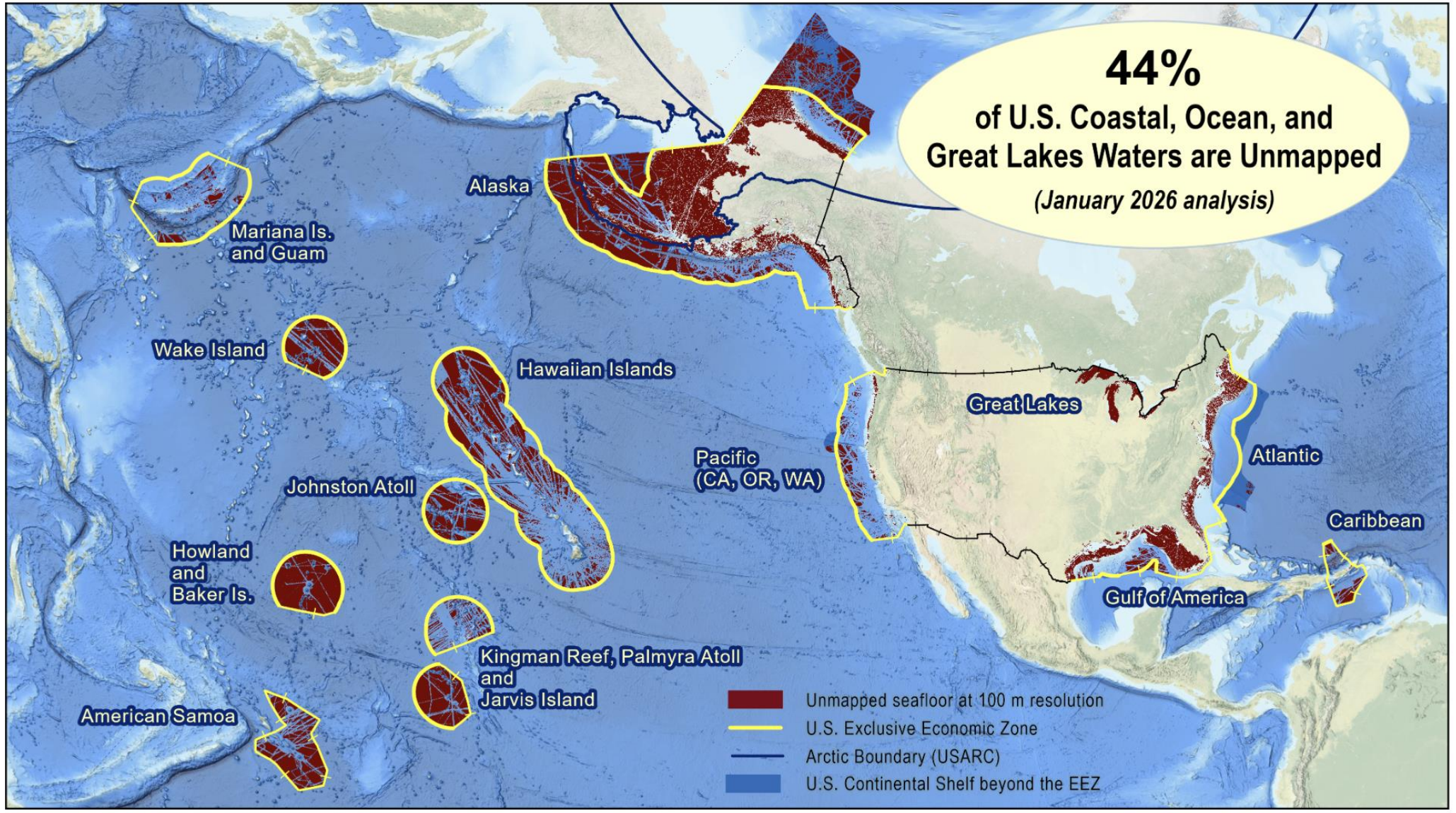
MULTIBEAM ADVISORY COMMITTEE
MGDS MARINE GEOSCIENCE DATA SYSTEM
GMRT
GeoMapApp
THE NIPPON FOUNDATION-GEBCO SEABED 2030

US Bathymetry Gap Analysis



https://iocm.noaa.gov/seabed-2030-status.html

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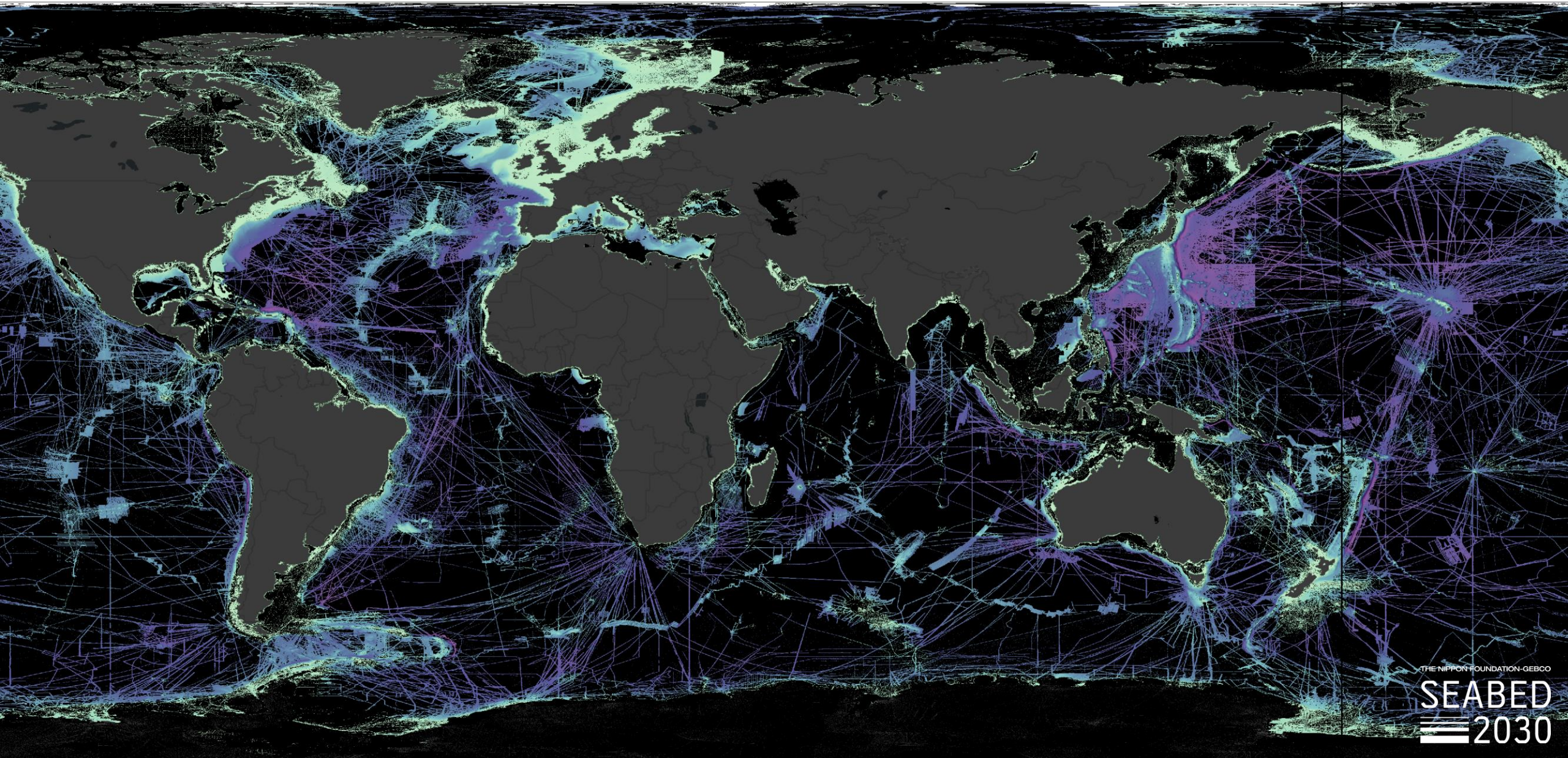
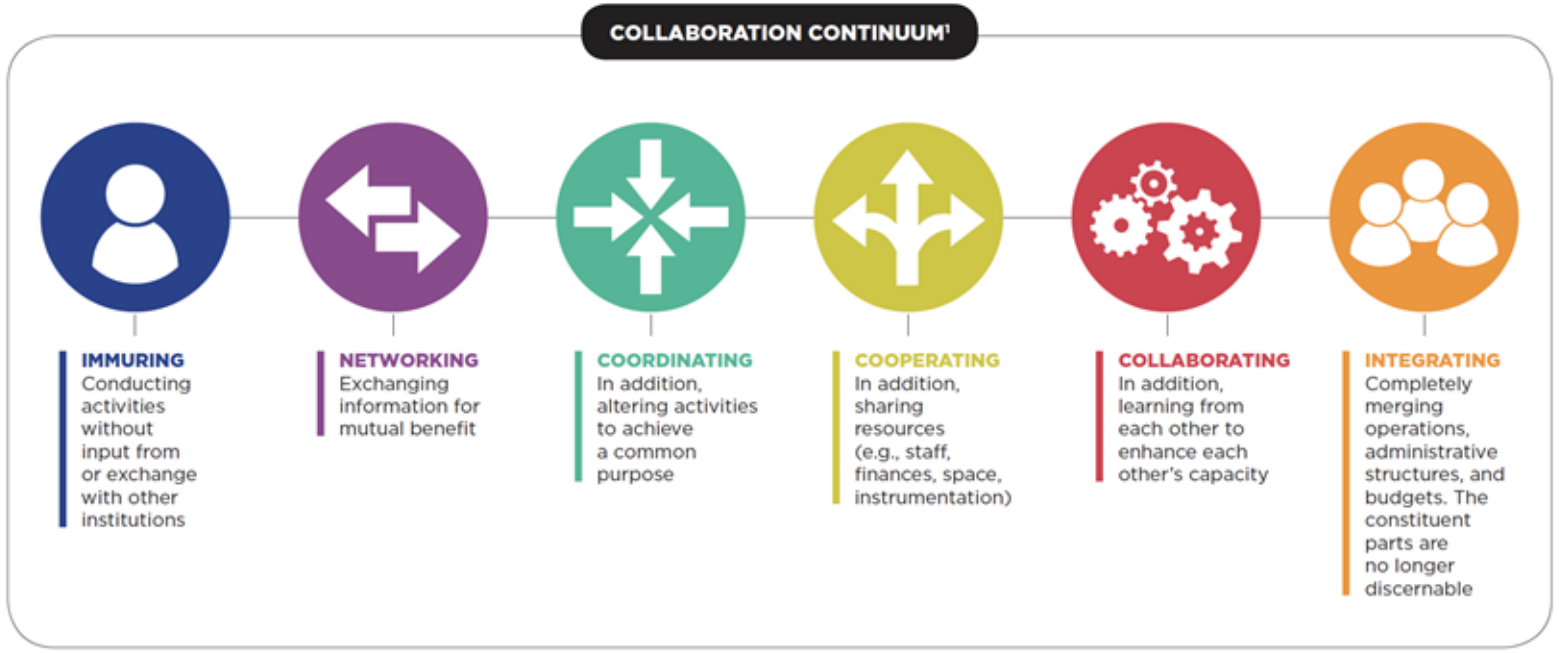
GEBCO 2026: 28.7% world ocean mapped



How will we map the gaps?

- Collaboration/Coordination
  - Knowledge sharing
  - Data sharing
  - Global movement
- Technical Innovation
  - Acquisition
  - Data Processing & Integration
- **Transit Mapping**



[1] The original Collaboration Continuum, which included Networking, Coordinating, Cooperating, and Collaborating, comes from Arthur T. Himmelman, *Collaboration for a Change: Definitions, Decision-making Models, Roles, and Collaboration Process Guide*. January 2002, Himmelman Consulting, Minneapolis, MN.

FEMME EDINBURGH | 2023

Barrie

- T
- R
- C
- Inertia

Technical

Resource

Cultural

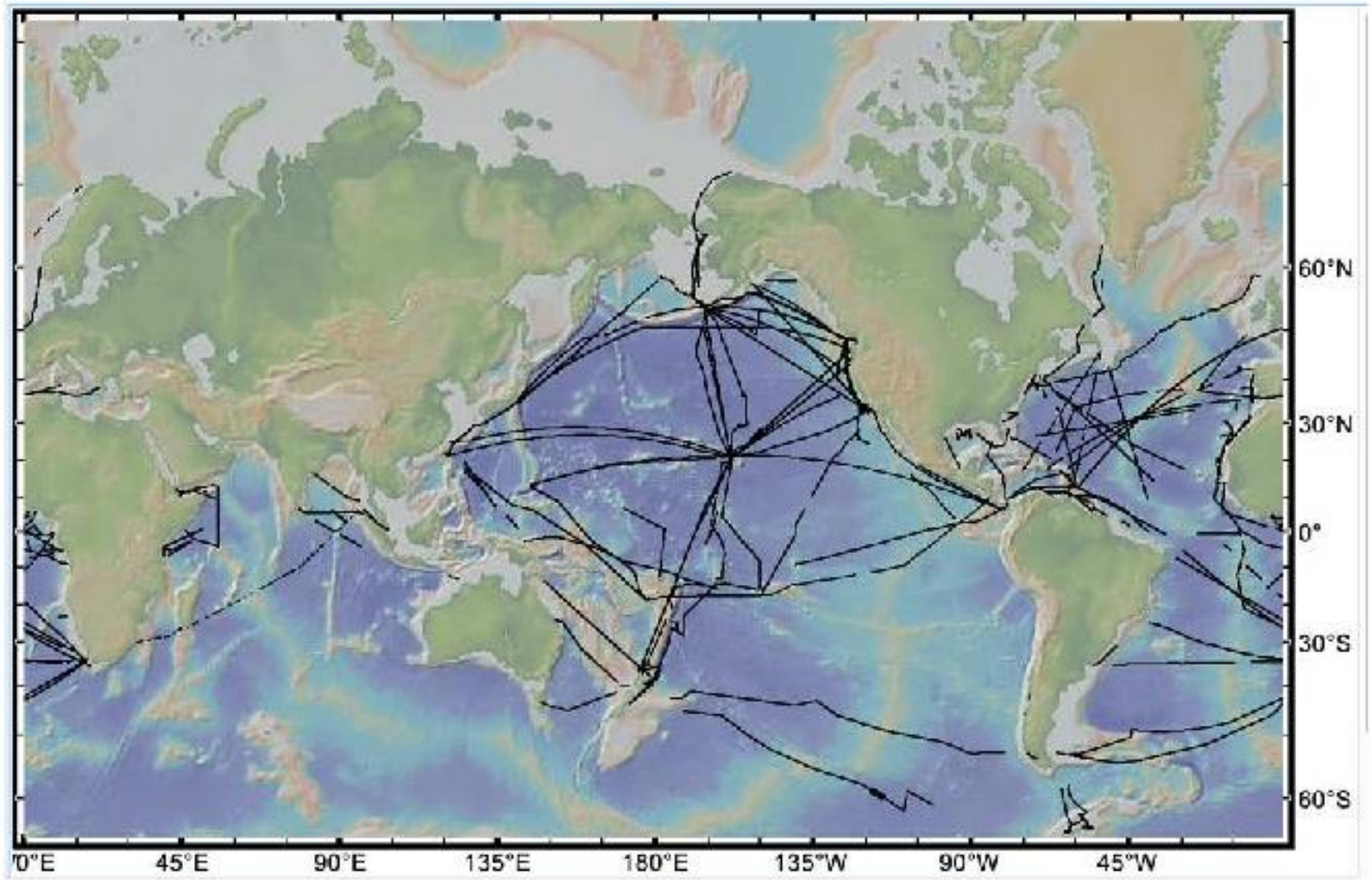
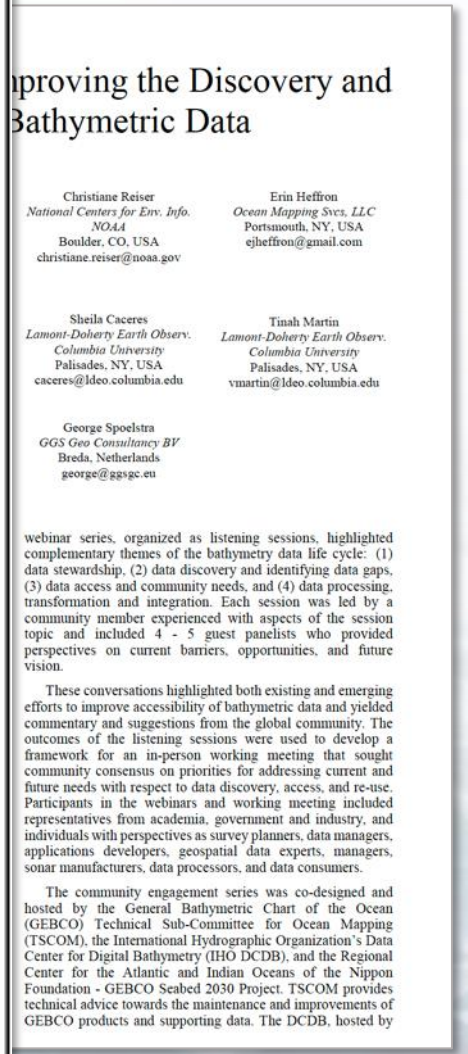


Fig. 3. An example of multibeam data coverage acquired during transit legs of research vessels in the US Academic Research Fleet (ARF). In addition to this coverage, the ARF routinely acquires data during transits to research



proving the Discovery and
Bathymetric Data

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webinar series, organized as listening sessions, highlighted complementary themes of the bathymetry data life cycle: (1) data stewardship, (2) data discovery and identifying data gaps, (3) data access and community needs, and (4) data processing, transformation and integration. Each session was led by a community member experienced with aspects of the session topic and included 4 - 5 guest panelists who provided perspectives on current barriers, opportunities, and future vision.

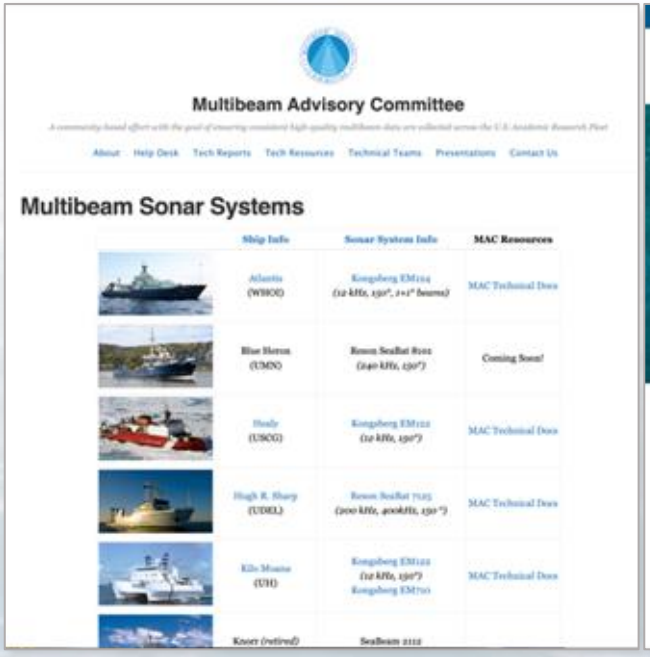
These conversations highlighted both existing and emerging efforts to improve accessibility of bathymetric data and yielded commentary and suggestions from the global community. The outcomes of the listening sessions were used to develop a framework for an in-person working meeting that sought community consensus on priorities for addressing current and future needs with respect to data discovery, access, and re-use. Participants in the webinars and working meeting included representatives from academia, government and industry, and individuals with perspectives as survey planners, data managers, applications developers, geospatial data experts, managers, sonar manufacturers, data processors, and data consumers.

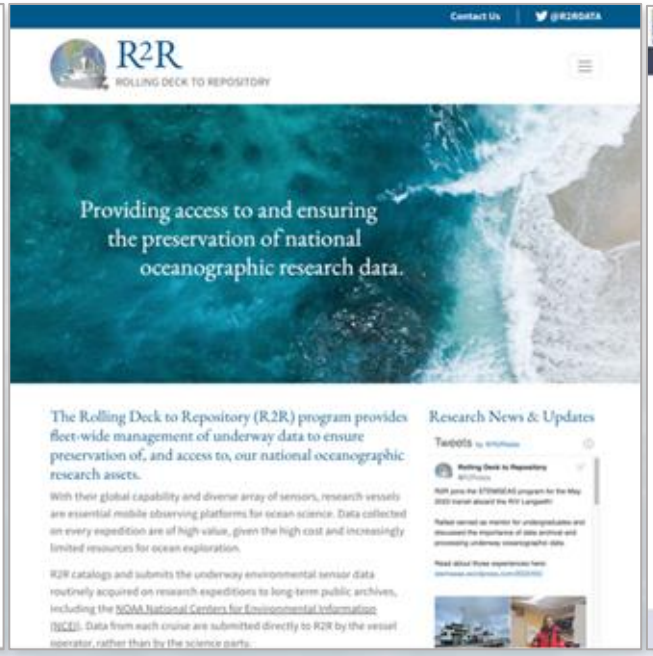
The community engagement series was co-designed and hosted by the General Bathymetric Chart of the Ocean (GEBCO) Technical Sub-Committee for Ocean Mapping (TSCOM), the International Hydrographic Organization's Data Center for Digital Bathymetry (IHO DCDB), and the Regional Center for the Atlantic and Indian Oceans of the Nippon Foundation - GEBCO Seabed 2030 Project. TSCOM provides technical advice towards the maintenance and improvements of GEBCO products and supporting data. The DCDB, hosted by

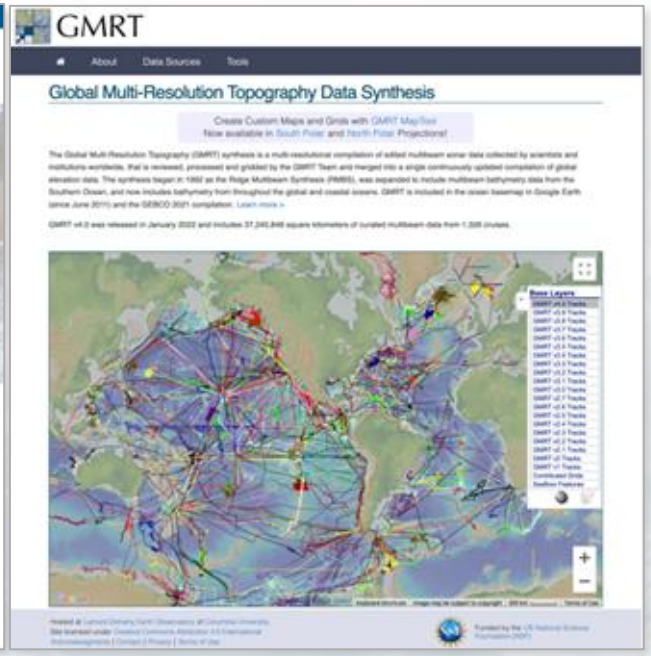
Ferrini et al., 2023
DOI: 10.23919/OCEANS52994.2023.10337031

Multibeam Data in the US Academic Research Fleet

- Complementary data stewardship projects that address technical, resource and cultural limitations
- Promote routine acquisition and preservation of high-quality bathymetry data
- Deliver openly available tools, data and best practices
- Increases return on investment in MBES capabilities







Acquisition | Preservation | Synthesis & Integration | Preservation, Provenance & Access

Growth of raw MB source data in NOAA Archive

National Centers for Environmental Information
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

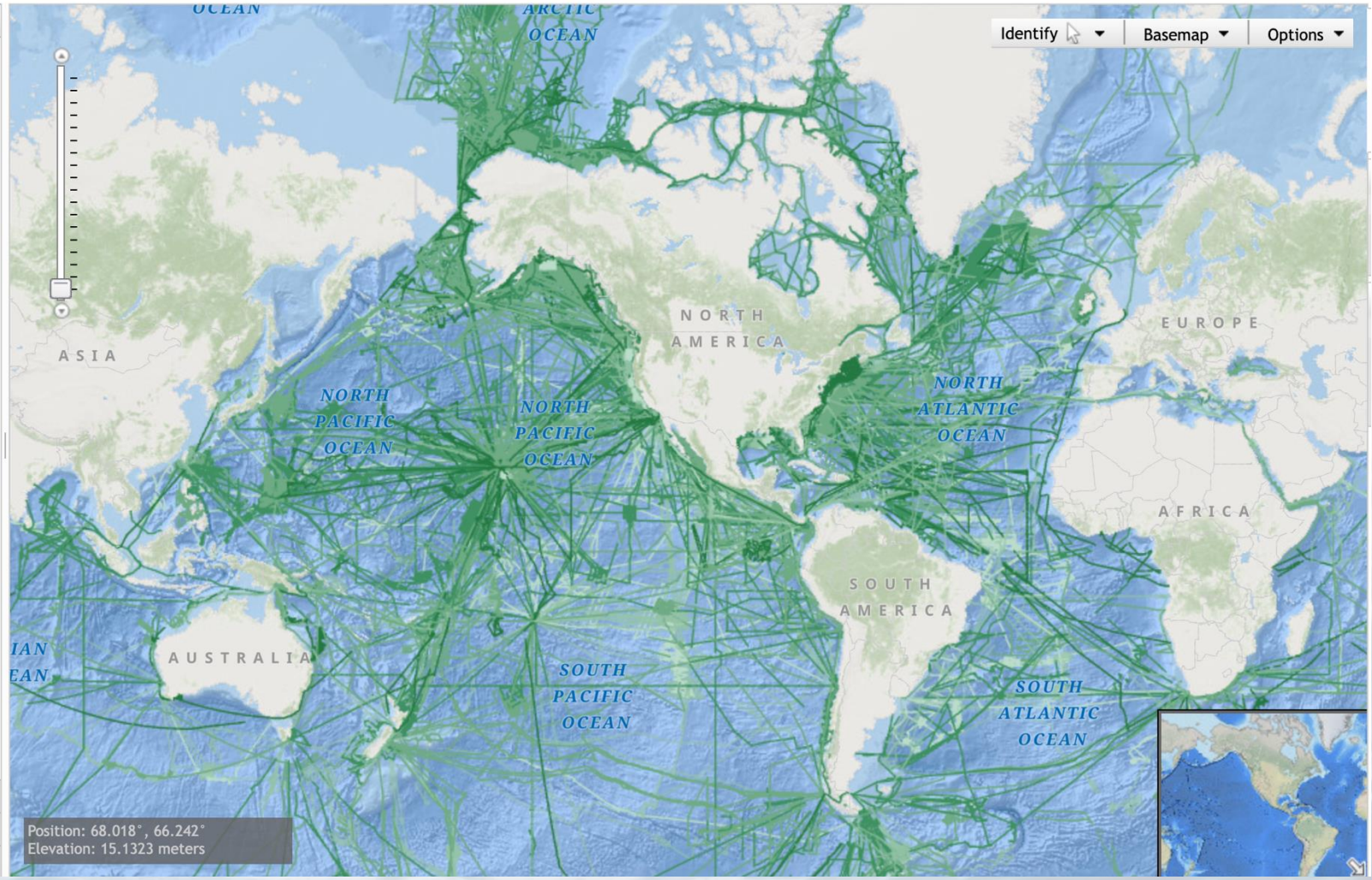
Bathymetric Data Viewer

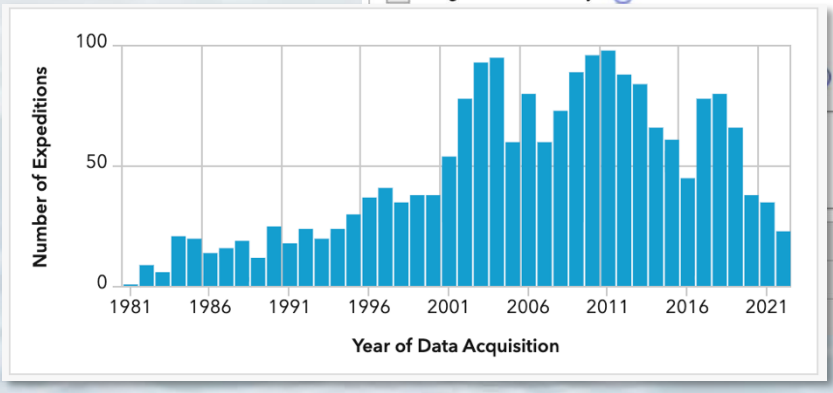
https://www.ncei.noaa.gov/maps/bathymetry/

NOAA / NESDIS / NCEI / Maps / Seafloor Mapping

Layers

- Bathymetric Surveys and Products
  - [x] Multibeam Dataset Tracklines
    - ( ) All Multibeam Datasets
    - (•) Multibeam Raw
    - ( ) Multibeam Processed
    - ( ) Multibeam Products
  - [ ] Multibeam Survey Footprints
  - [ ] Multibeam Bathymetry Mosaic
- NOAA NOS Hydrographic Data and Products
  - [ ] Hydrographic Survey Outlines:
    - (•) All Surveys with Digital Data
    - ( ) Surveys with Bathymetric Attributed Grids (BAGs)
    - ( ) Surveys without Digital Data
  - [ ] BAG Color Shaded Relief
  - [ ] U.S. Bathymetry Coverage and Gap Analysis
  - [ ] BlueTopo
- [ ] Single-Beam Surveys





Multibeam Bathymetry Database (MBBDB) at NCEI

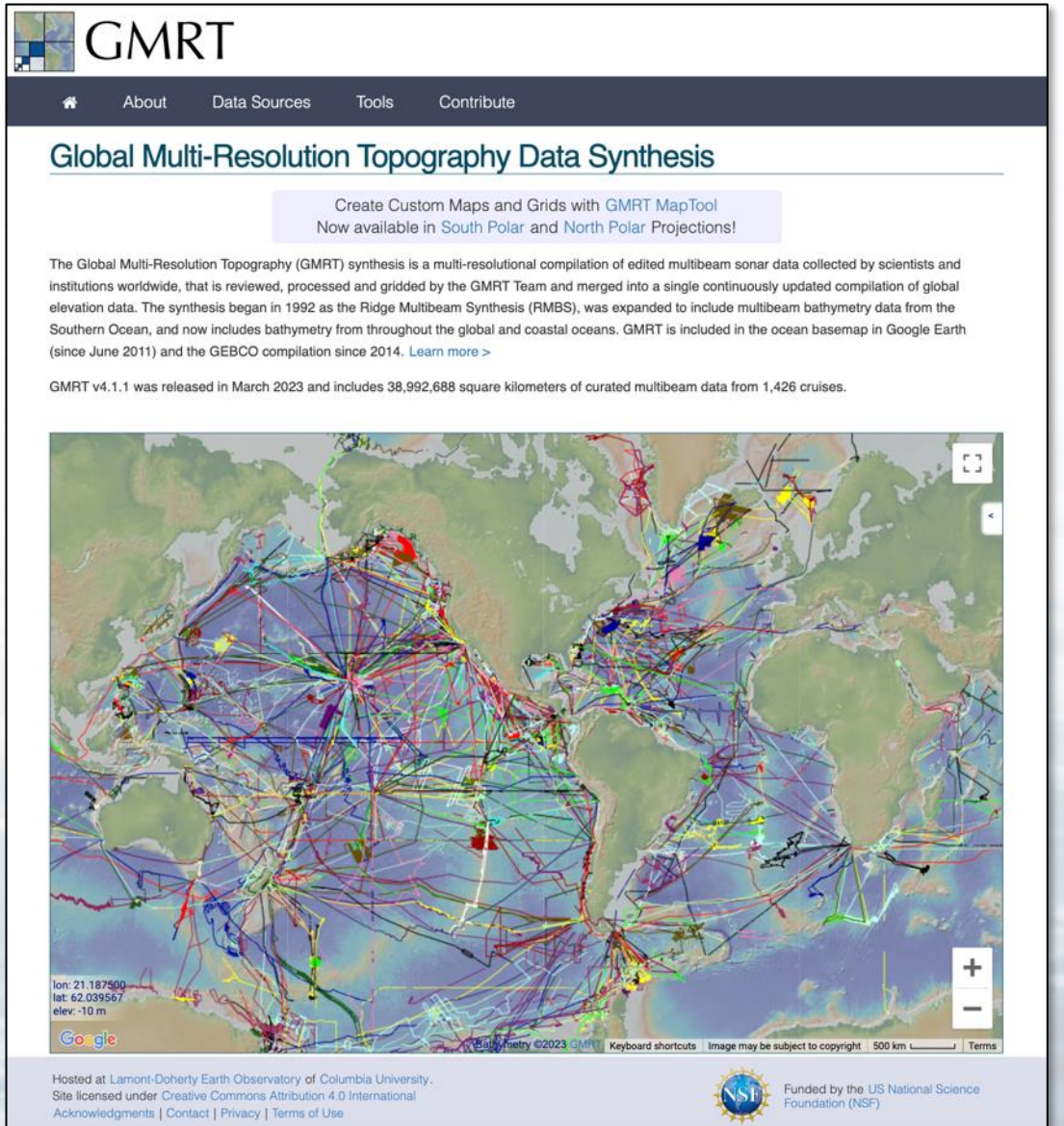
GMRT: Global Multi-Resolution Topography

- Provide users with access to **seamlessly integrated bathymetry** and land elevation data at the best resolution available for a particular area of interest

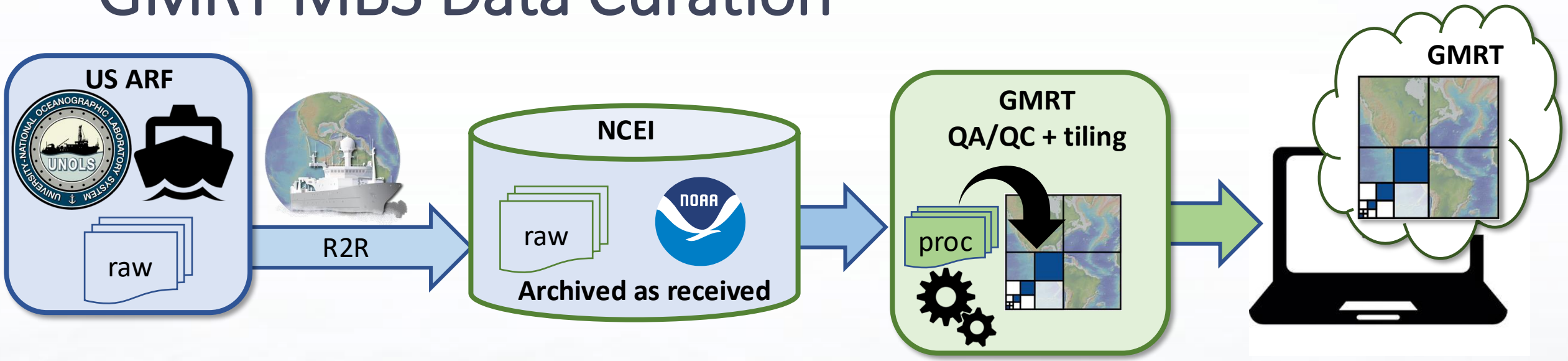
- Support broad **accessibility** by **specialists and non-specialists** alike through multiple user interfaces, services, and output formats
  - Web services, web app, desktop app

- Continuously **expand bathymetry coverage** by integrating new data and highlighting data gaps

- Strive for scalability and efficiency in all aspects of data stewardship continuum

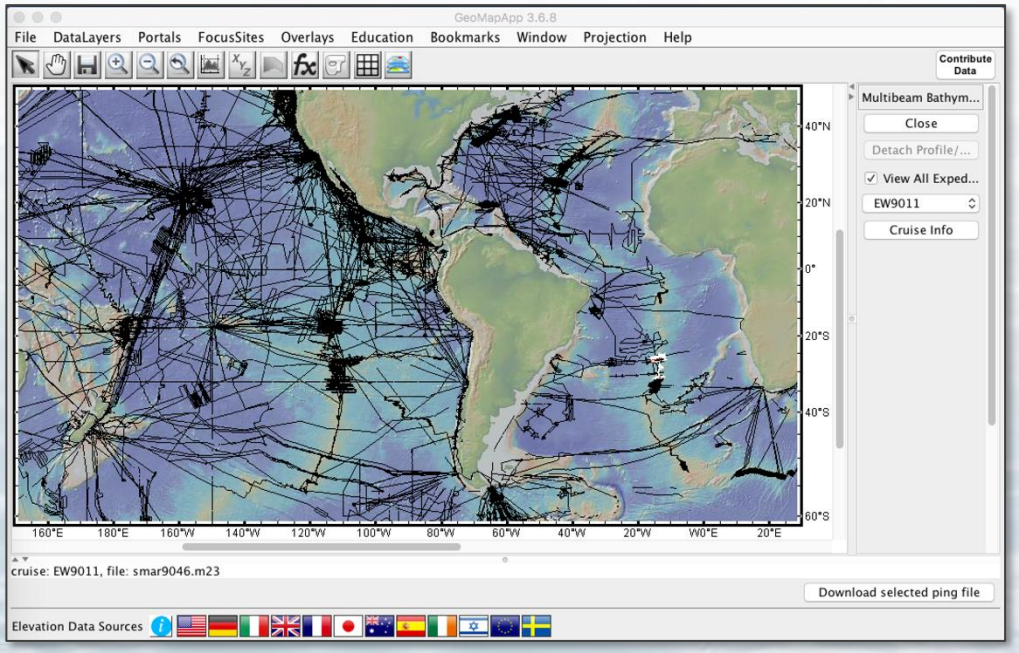


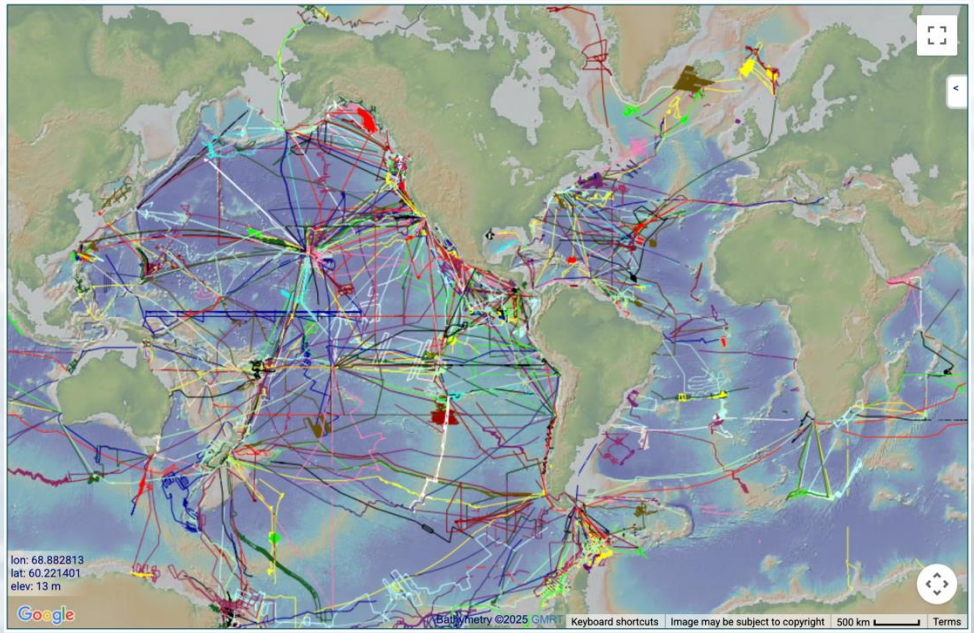
GMRT MBS Data Curation



Java

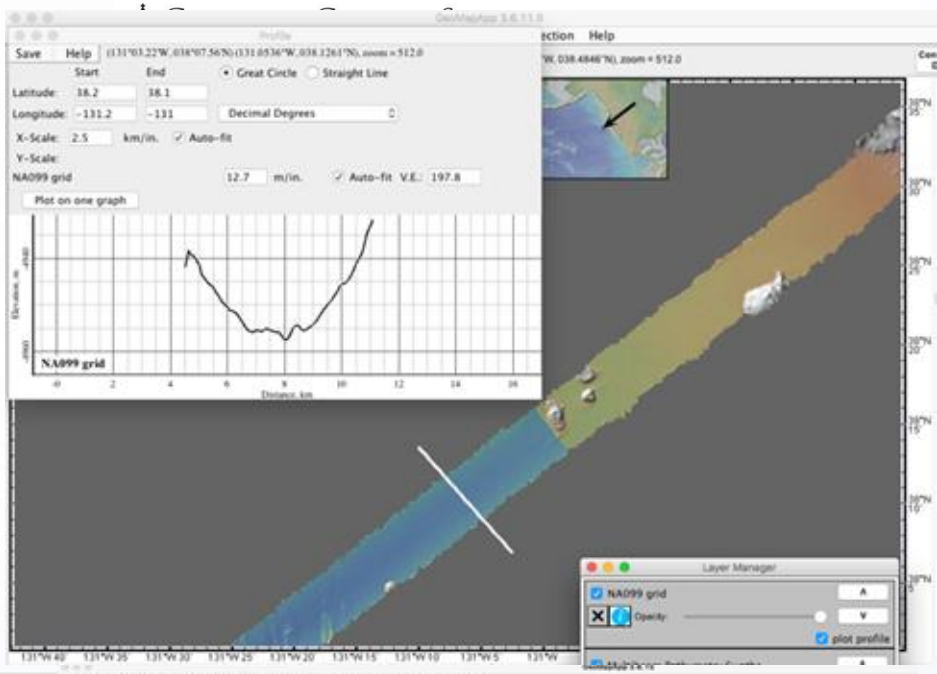
MB SYSTEM

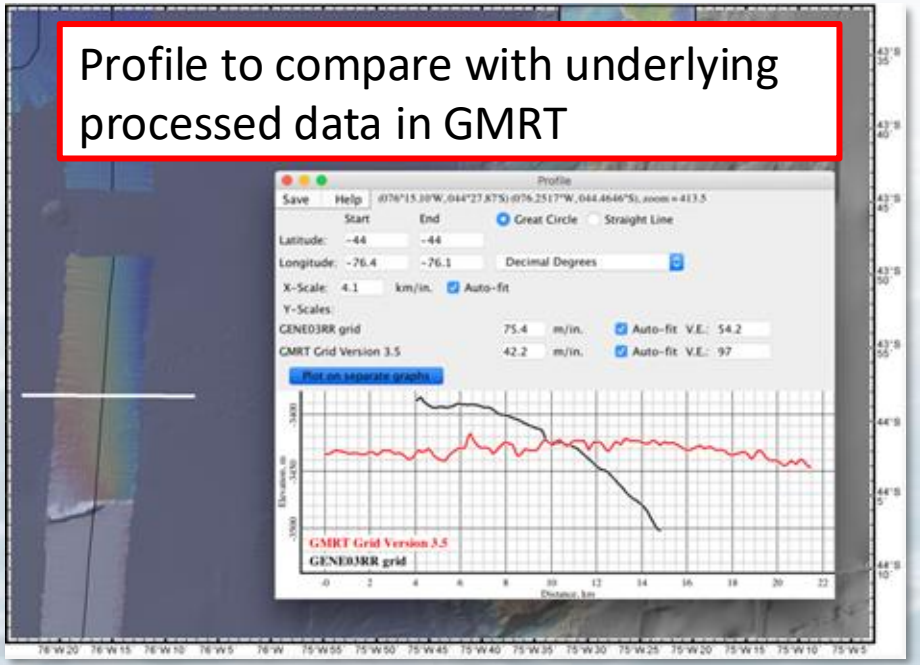


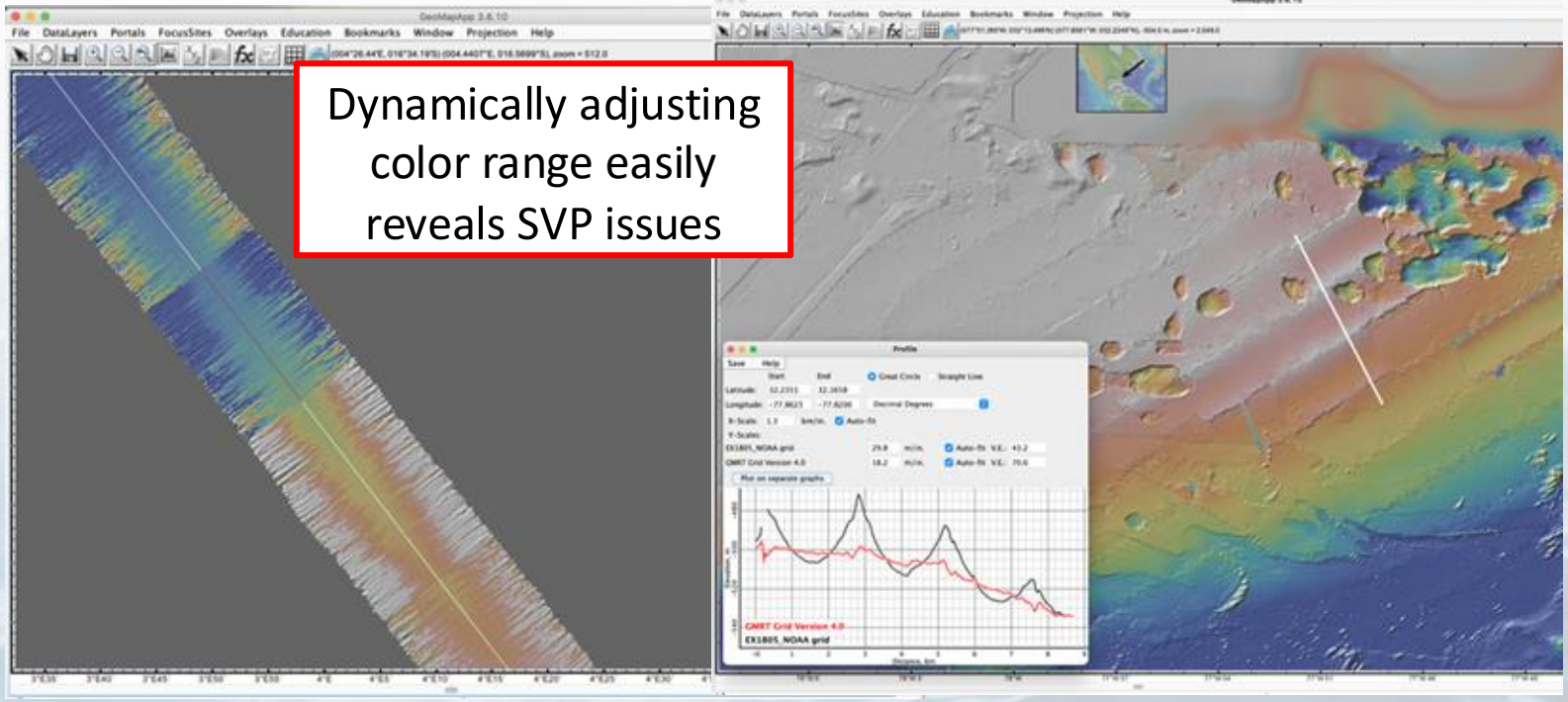


GMRT: MBES Data Curation

- Create tiled rasters from swath files
  - Review rasters & compare with underlying GMRT data
- Identify and address data quality issues
  - Ping edits, SSP issues
- Ensure that processed data are fit-for-purpose and can be seamlessly integrated with other data







GMRT MBS Data Stewardship

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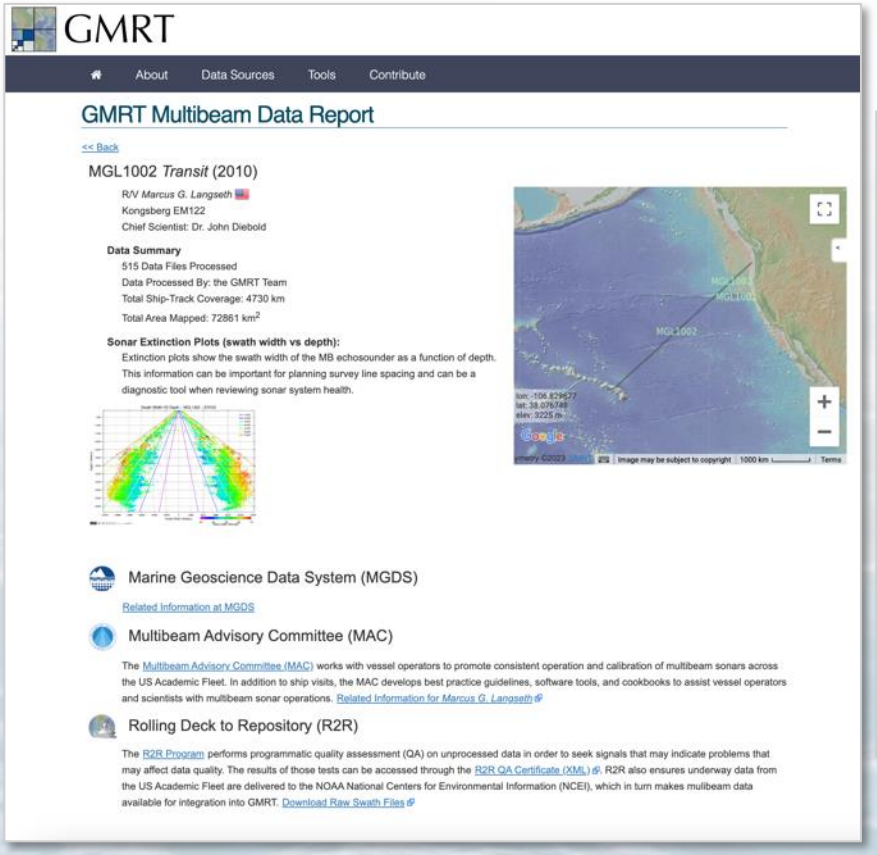
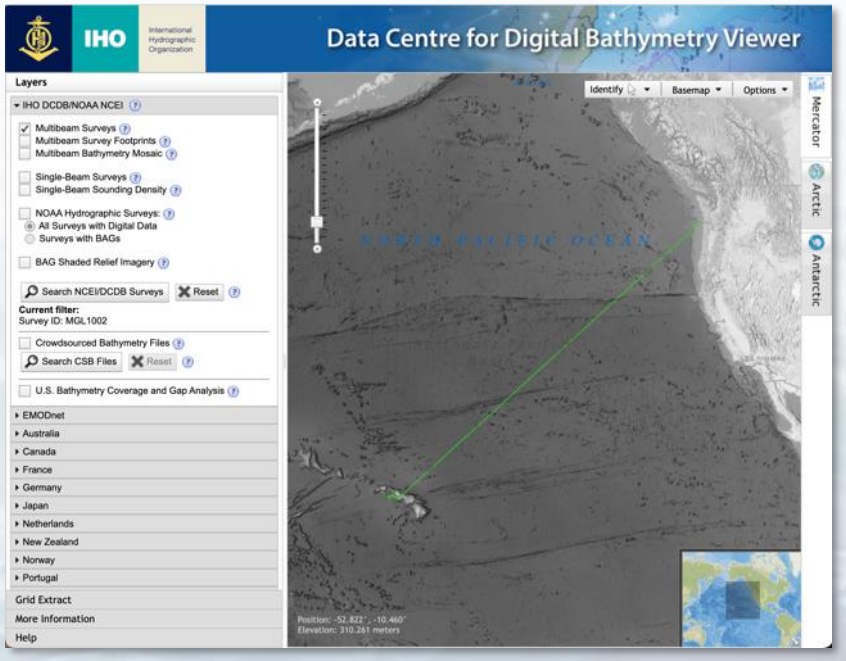
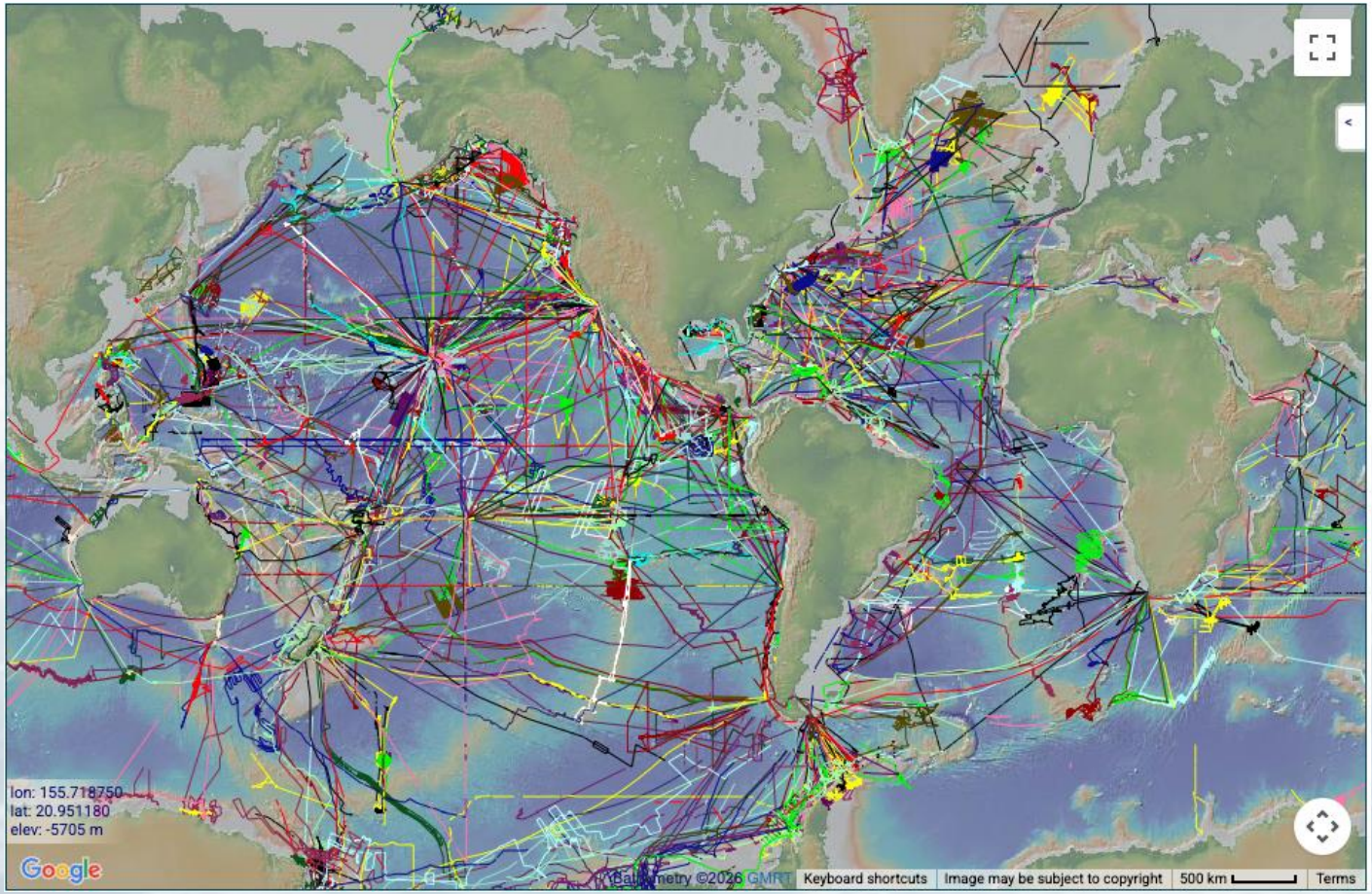
- Processed data accessible through integrated synthesis (grids + images)
- Processed swath files preserved, available & citable with full attribution to data collectors and data processors





GMRT: MBES Data Sources

- Data Processing Priority: US Academic Research Fleet
- Data acquired during surveys and transits

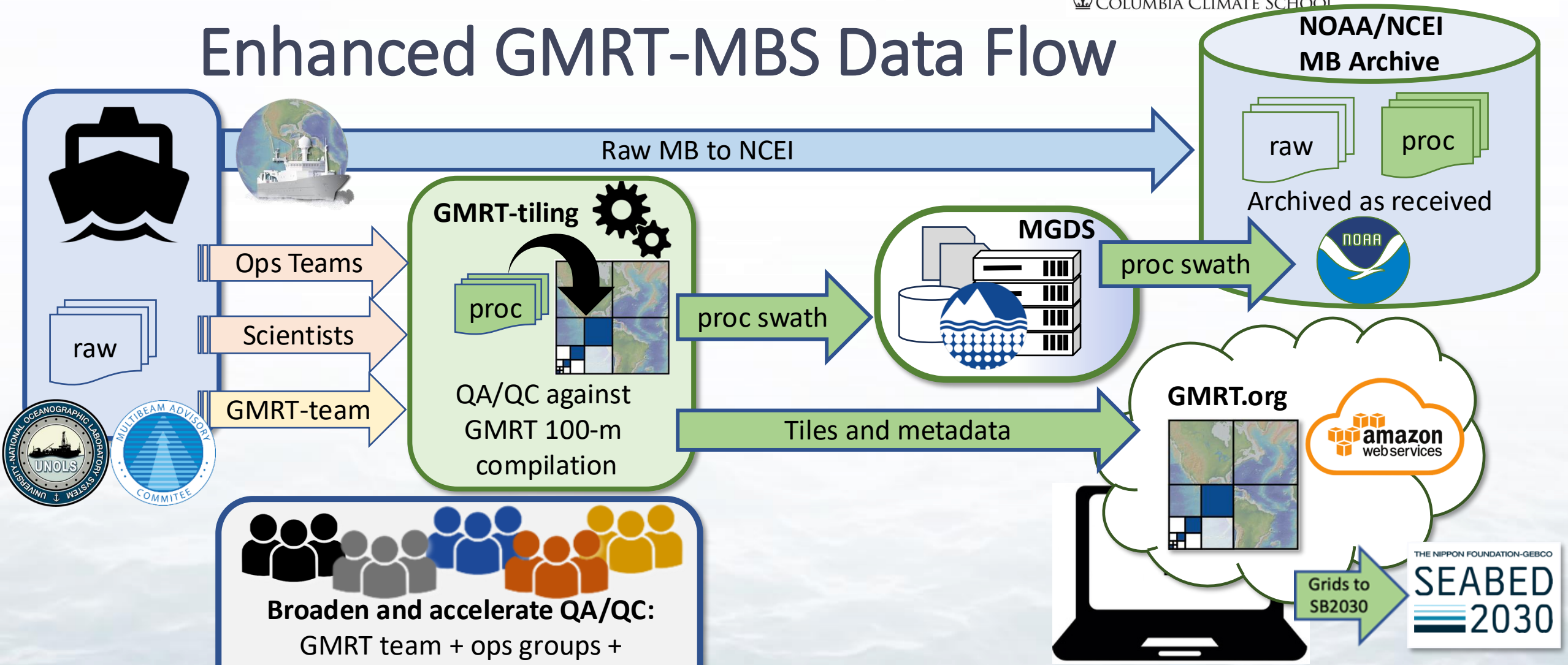


GMRT V 4.4.1 Curated Multibeam Stats	
Expeditions	1,621*
Multibeam Devices	24
Ships	54
Ship Operators	40
Chief Scientists	636
Total Swath Files	311,244
Total Area Mapped (km^2)	44,116,654
Total Area Mapped (%)	12.19%
“Transit” Cruises (%)	13%

https://www.gmrt.org/ https://www.geomapapp.org/

**70% USARF expeditions,*
75% processed from raw by GMRT Team

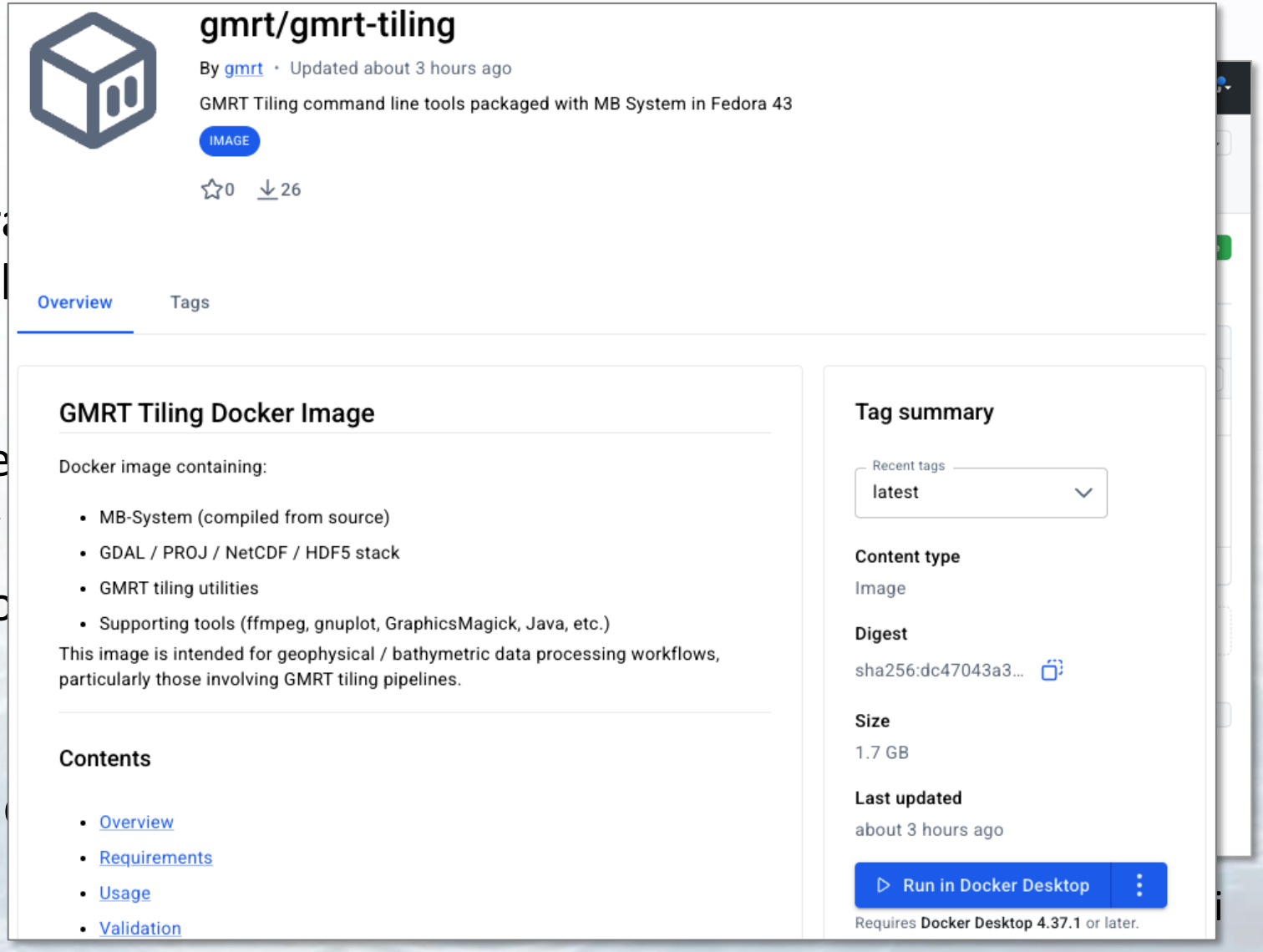
Enhanced GMRT-MBS Data Flow



- Accelerate processing and increase efficiency
- Common lens to ensure fit-for-purpose standard
- Optimize data quality in processed data archives

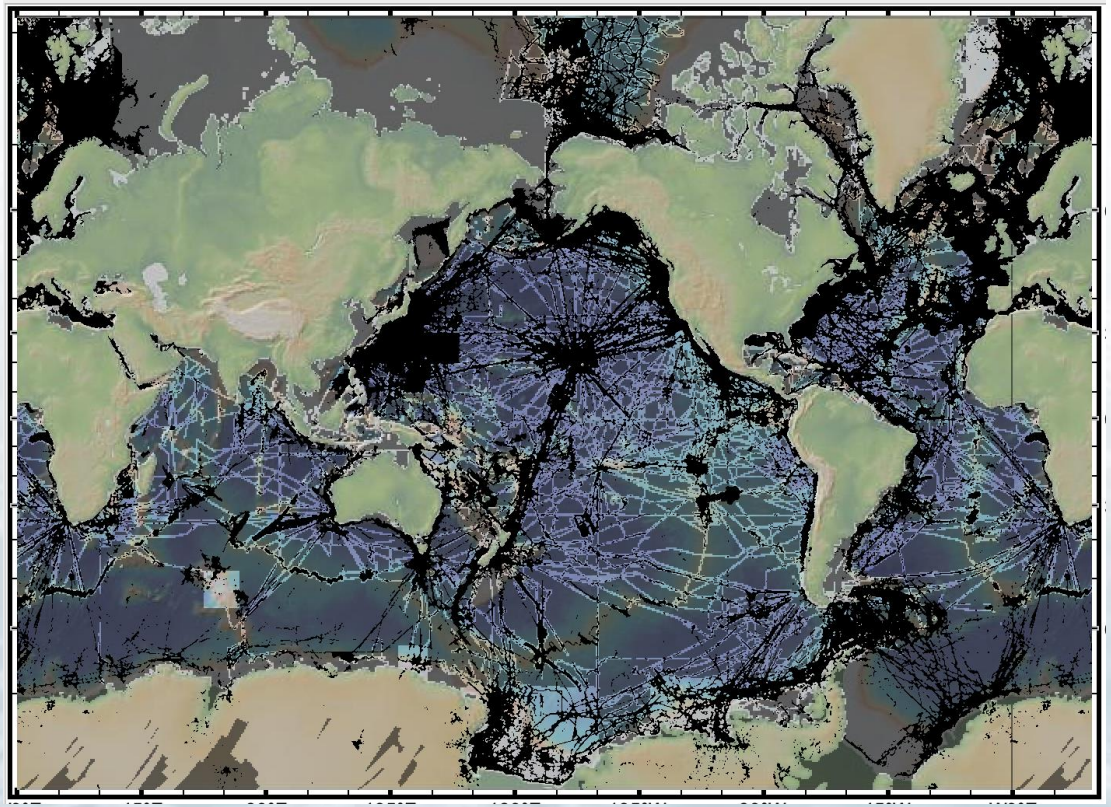
GMRT: Distributable Data Processing and Curation

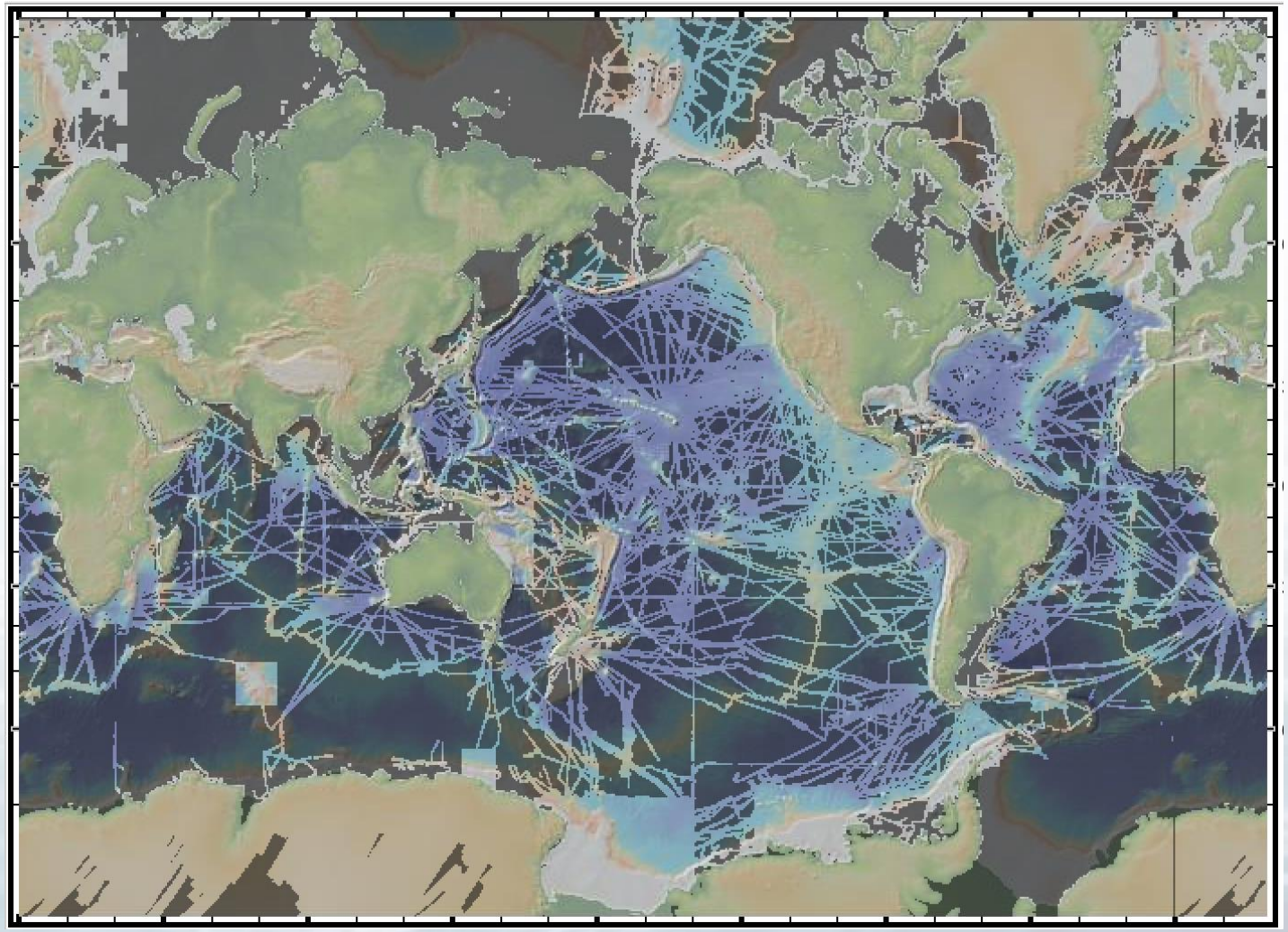
- Goals
  - Establish common fit-for-integra
  - Improve quality of publicly avail swath files
  - Minimize need reprocessing
  - Accelerate the pace of data inte
- Successfully deployed in multi
  - Physical and virtual machines (c
  - Personal computers
  - At-sea
- Code and instructions available



Identifying Data Gaps with GMRT

- GMRT Mask
- GEBCO Type Identifier
- NCEI MB Data Holdings





GeoMapApp

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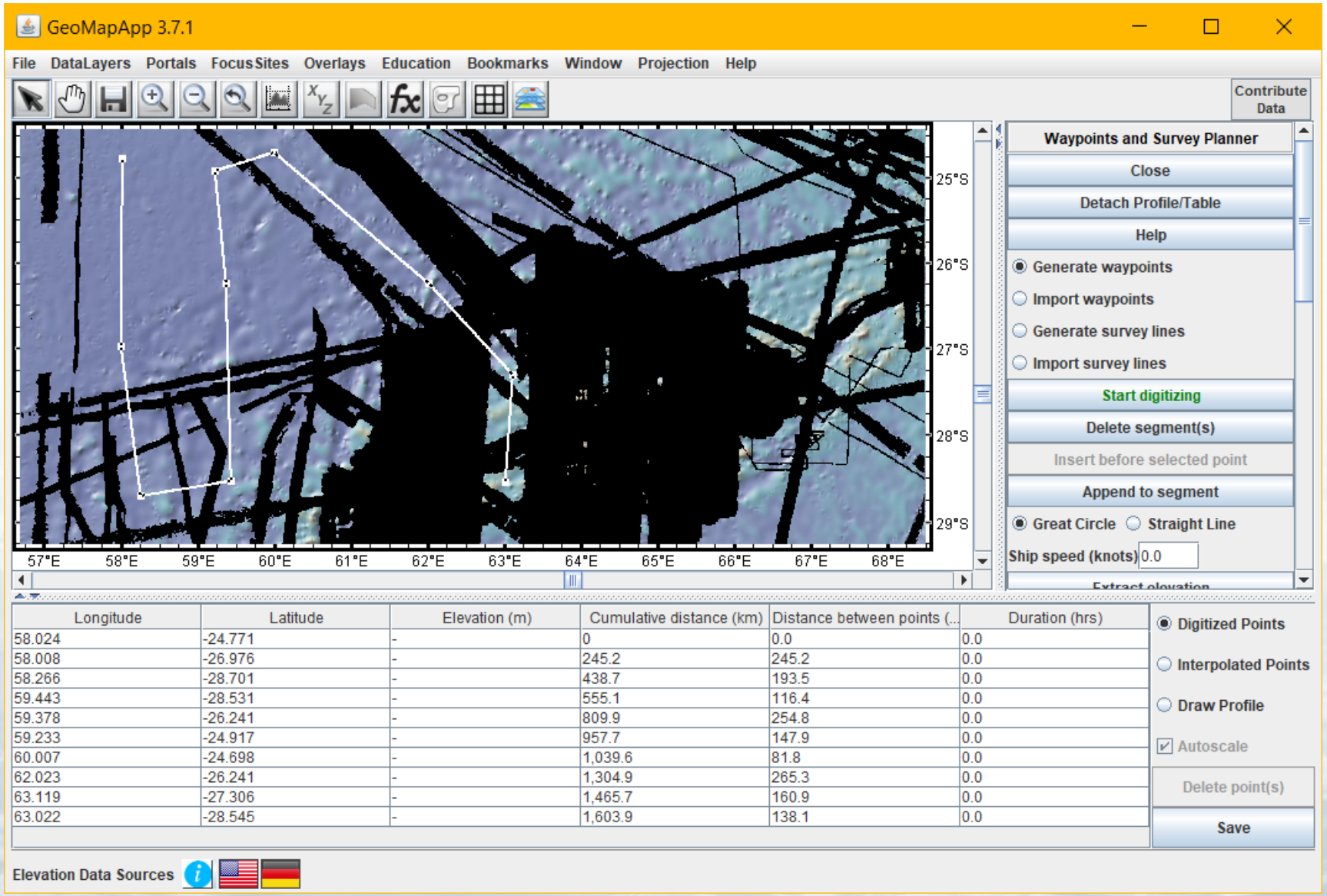
Identifying Data Gaps with GMRT & GeoMapApp



Longitude	Latitude	Elevation (m)	Cumulative distance (km)	Distance between points (...	Duration (hrs)
58.024	-24.771	-	0	0.0	0.0
58.008	-26.976	-	245.2	245.2	0.0
58.266	-28.701	-	438.7	193.5	0.0
59.443	-28.531	-	555.1	116.4	0.0
59.378	-26.241	-	809.9	254.8	0.0
59.233	-24.917	-	957.7	147.9	0.0
60.007	-24.698	-	1,039.6	81.8	0.0
62.023	-26.241	-	1,304.9	265.3	0.0
63.119	-27.306	-	1,465.7	160.9	0.0
63.022	-28.545	-	1,603.9	138.1	0.0

GMRT in Third-Party Tools

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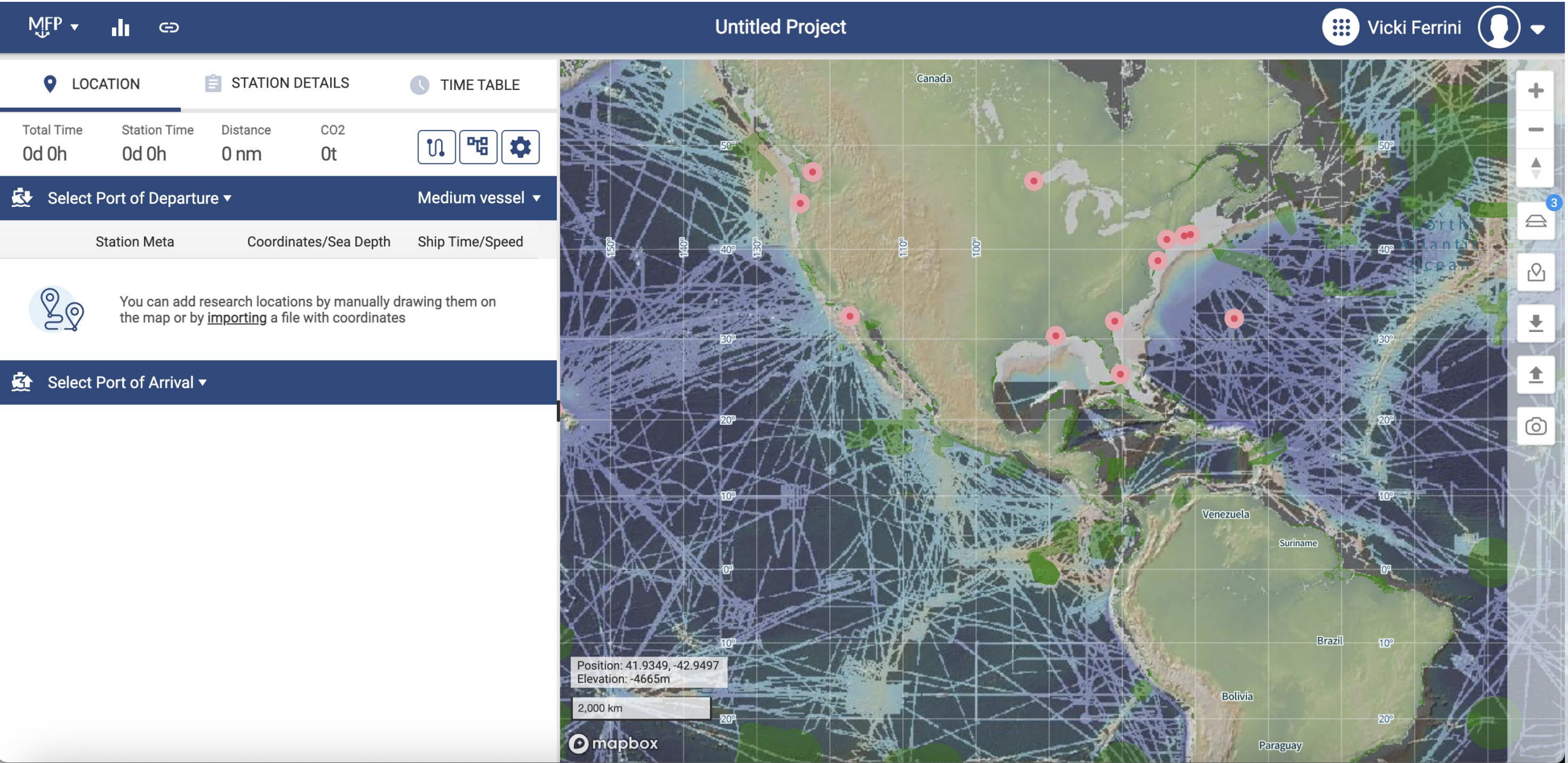
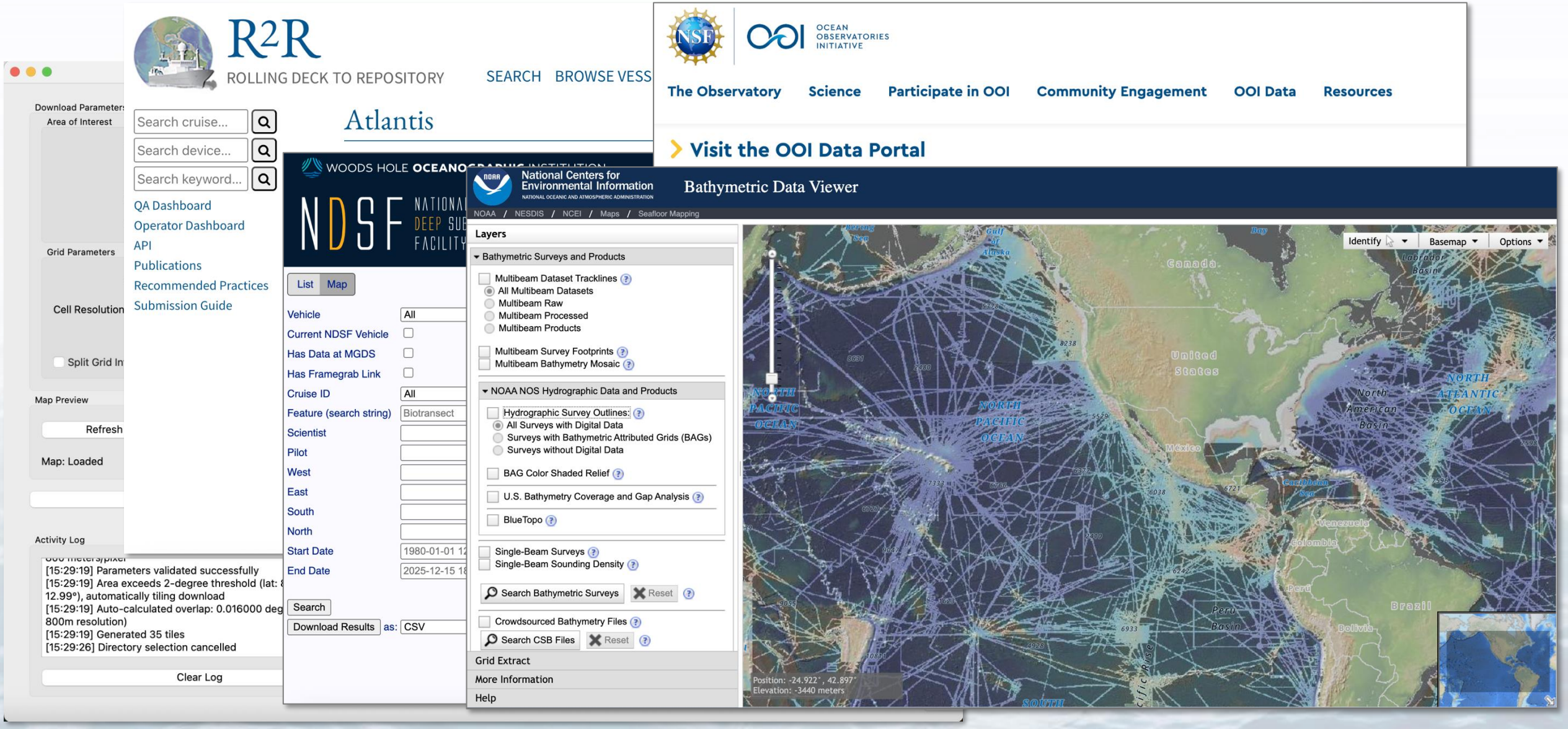


GMRT in Third-Party Tools



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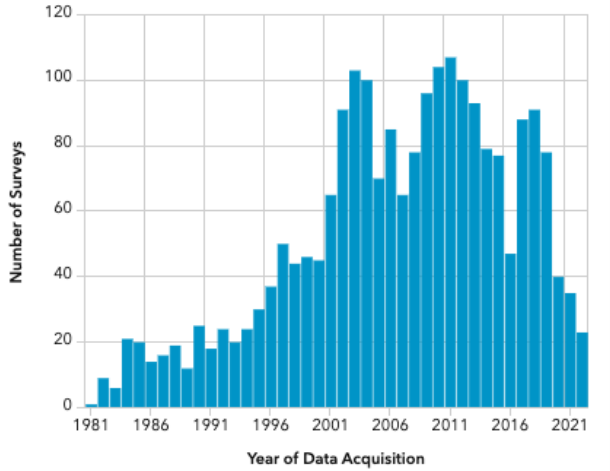
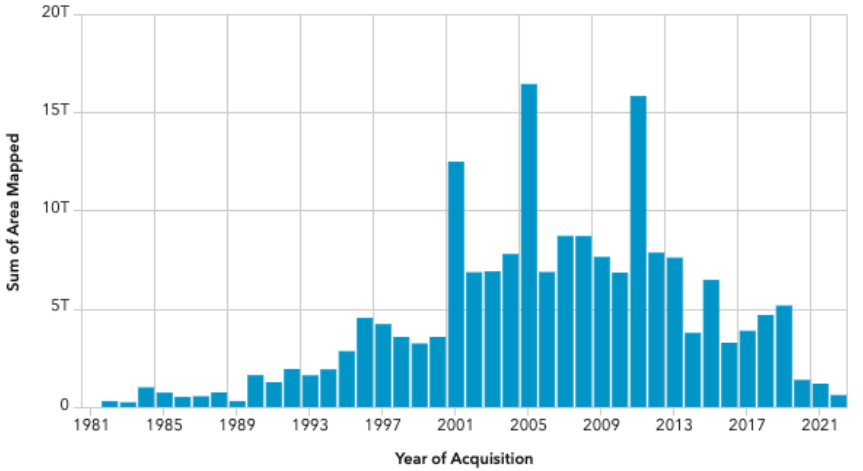
ARF MB Coverage Dashboard (Under Development)

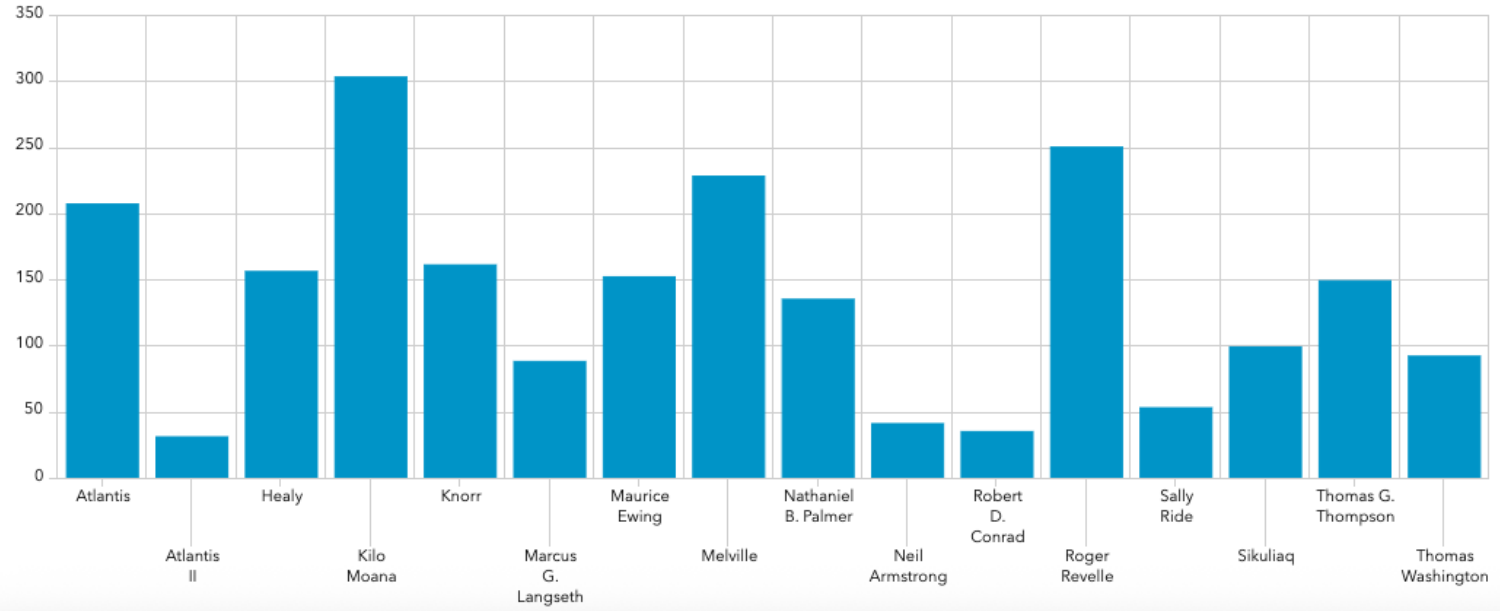
ARF-MBCoverage Dashboard

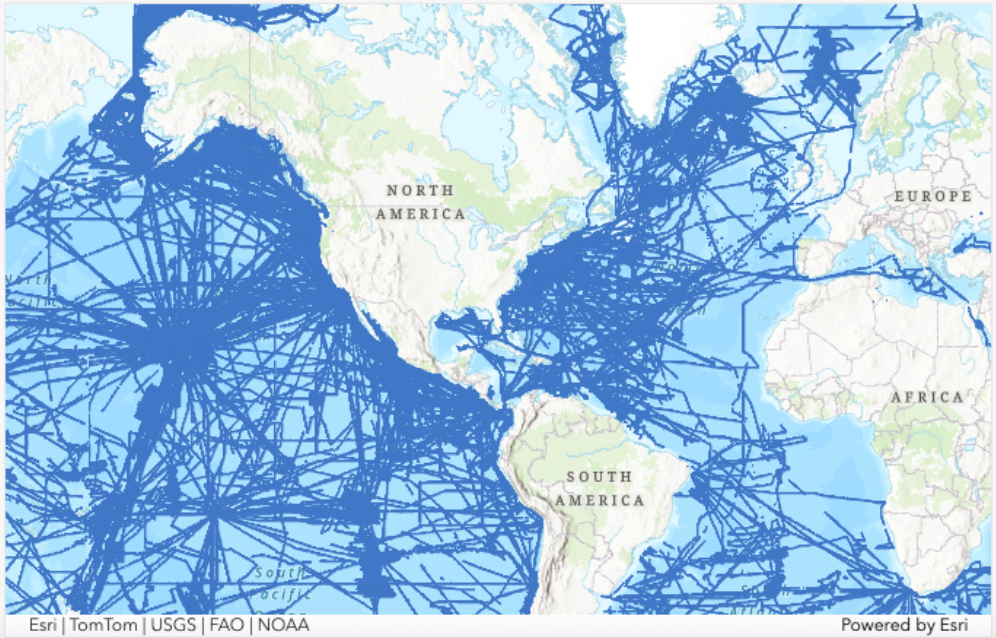
Vicki Ferrini
vlf2102_columbia





PLATFORM	NUMBER OF SURVEYS (INCL TRANSITS)
Kilo Moana	304
Roger Revelle	251
Melville	229
Atlantis	208
NOAA Ship OKEANOS EXPLORER (R337)	188
Knorr	162
Healy	157
Maurice Ewing	153





Main Take-Aways

- USARF delivers significant amounts of data to national and global mapping efforts through surveys & transit mapping
- Multiple tools to identify data gaps (GMRT, GeoMapApp + more)
- Community of experts ready to process data (GMRT + Seabed 2030)
- Distributable tools available to help ensure data are fit for integration (GMRT)
- New tools on the horizon to enhance opportunistic and continuous data acquisition (MAC + GMRT)
- Dashboard highlighting ARF impact under development
- Contact us – we're here to help!