Multibeam Advisory Committee

RVTEC - UNH - Durham, NH

2024 Oct 23

Kevin Jerram
Paul Johnson
Vicki Ferrini

Breakout Session: Assessment Tools

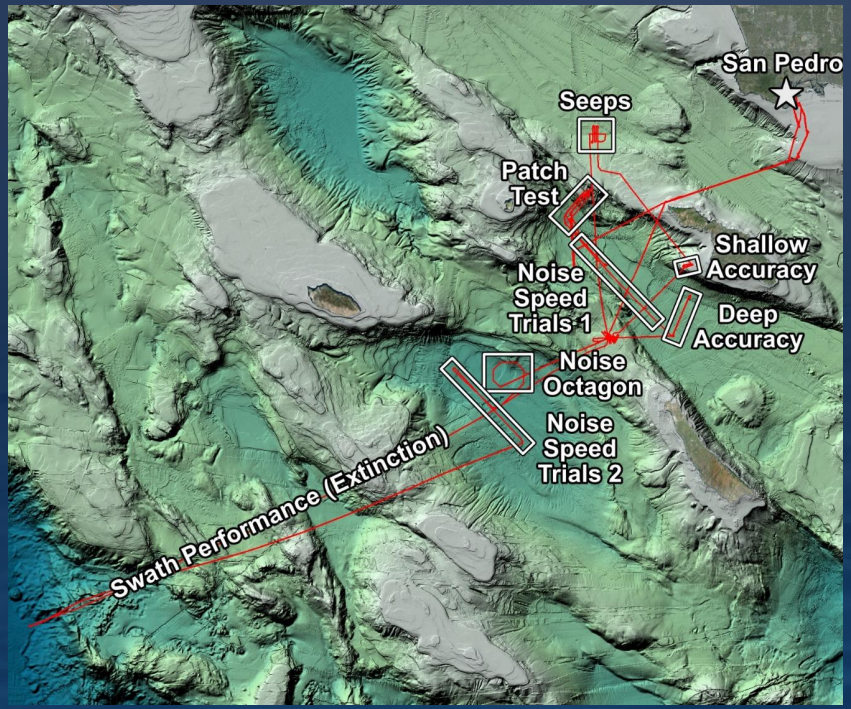
mac.unols.org
mac-help@unols.org

MAC supported under NSF grant 1933720

Test Planning Timeline

MAC supported under NSF grant 1933720

System Performance Testing



Early as possible

Planning

1. Review of recent data, issues, etc.
2. Vessel + sensor offset survey (as needed)
3. Site selection + scheduling
4. Software + firmware updates

1-2 days

Dockside

5. Configuration + offset review
6. Hardware health check
7. Test plan review with bridge (ongoing)

1-10 days

At Sea

8. GNSS antenna calibration
9. Multibeam calibration ('patch test')
10. RX noise vs. speed / seas
11. Swath coverage (extinction)
12. Swath accuracy
13. Water column evaluation
14. Backscatter normalization

1-2 mos.

Follow-Up

15. Data and configuration backup
16. Public reporting (MAC website)
17. Opportunistic testing

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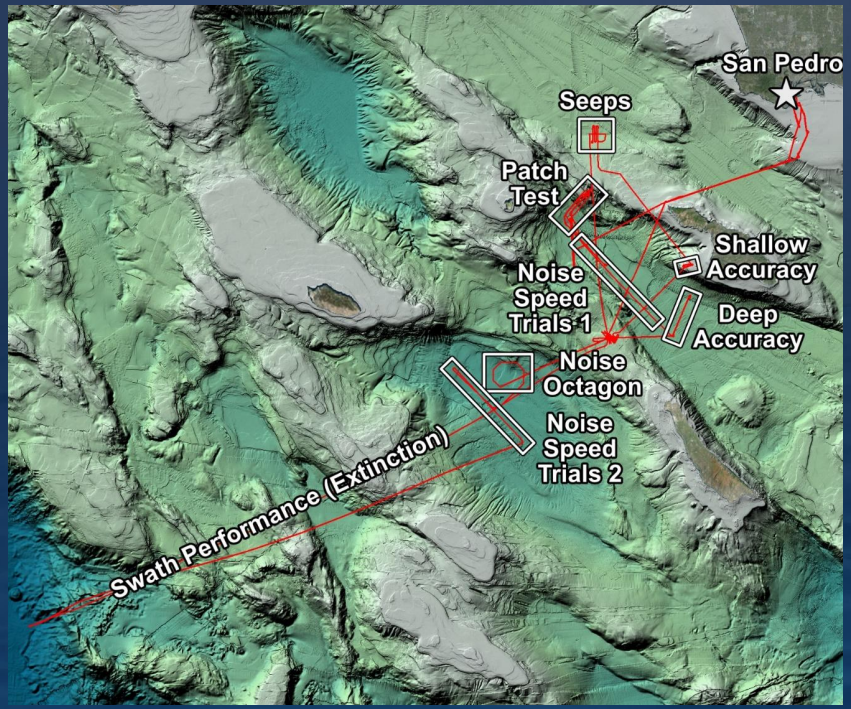

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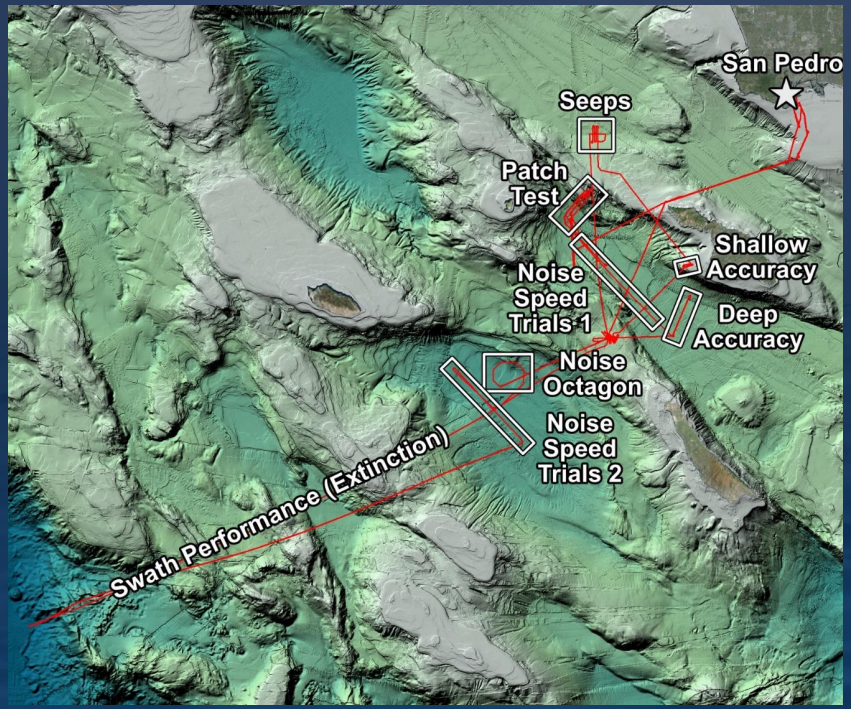

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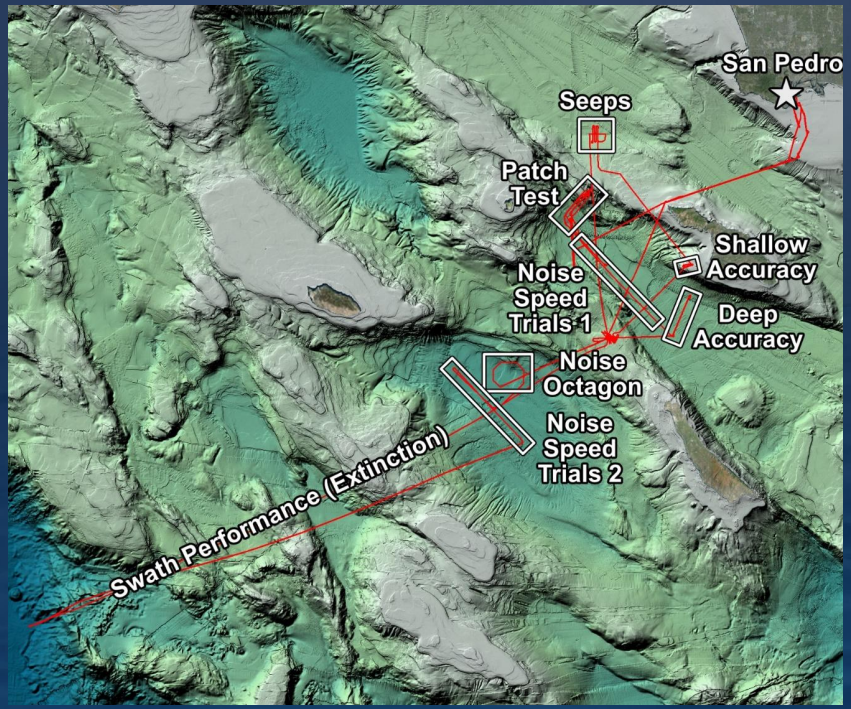

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Test Planning Resources

MAC supported under NSF grant 1933720

MAC (and other) Test Reports

~80 reports on MAC website to provide context, comparison, etc.

- **Standardized** system testing workflows
  - Sea Acceptance, Quality Assurance, Noise
- **On-board & remote support**
  - Flexible scheduling by ship request
- **Public reporting**
  - Technical reports and resources
  - Assessment tools, survey guidance
  - Non-USARF references

Website: mac.unols.org

Helpdesk: mac-help@unols.org

Wiki: github.com/oceanmapping/community/wiki

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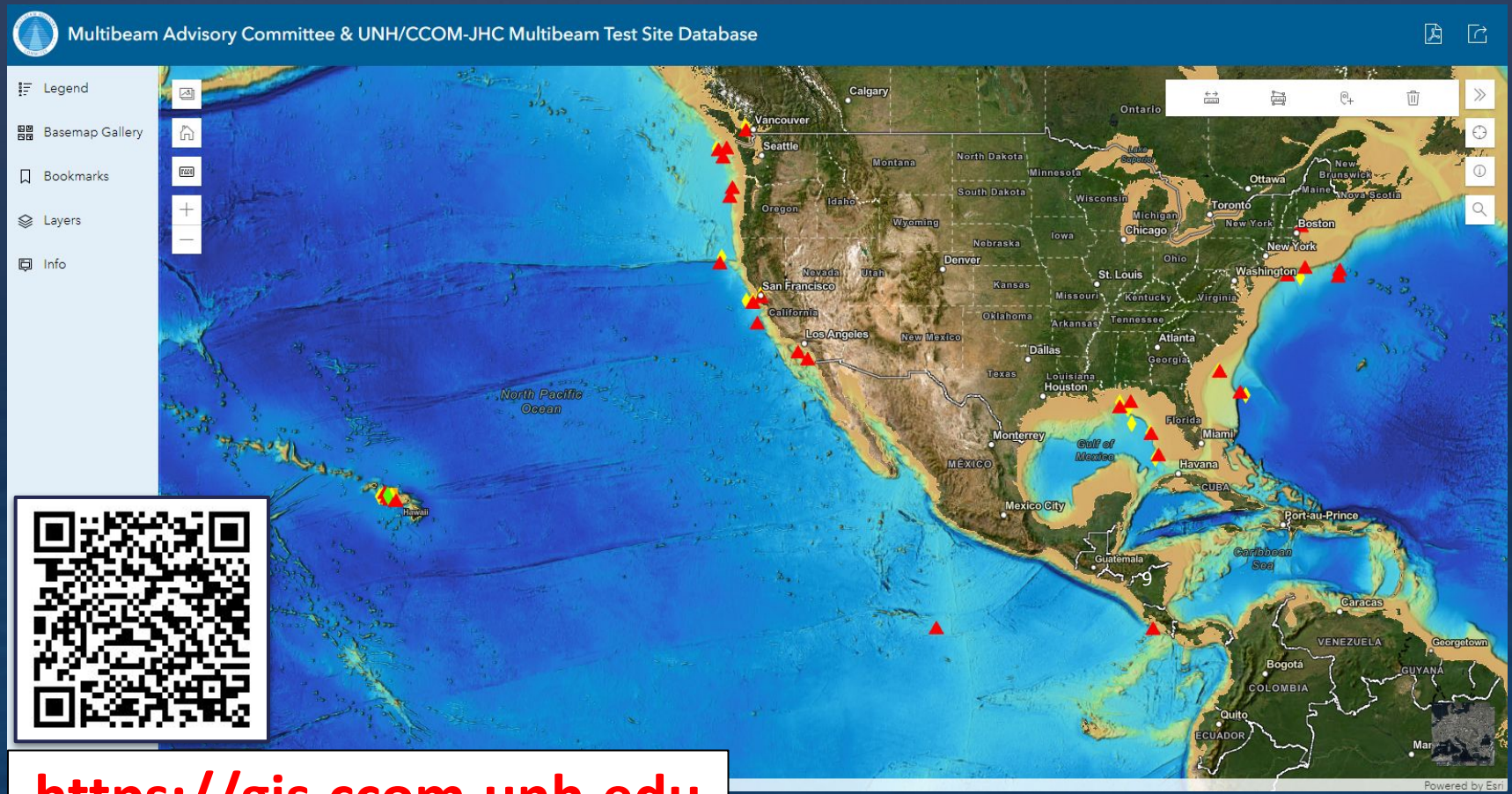
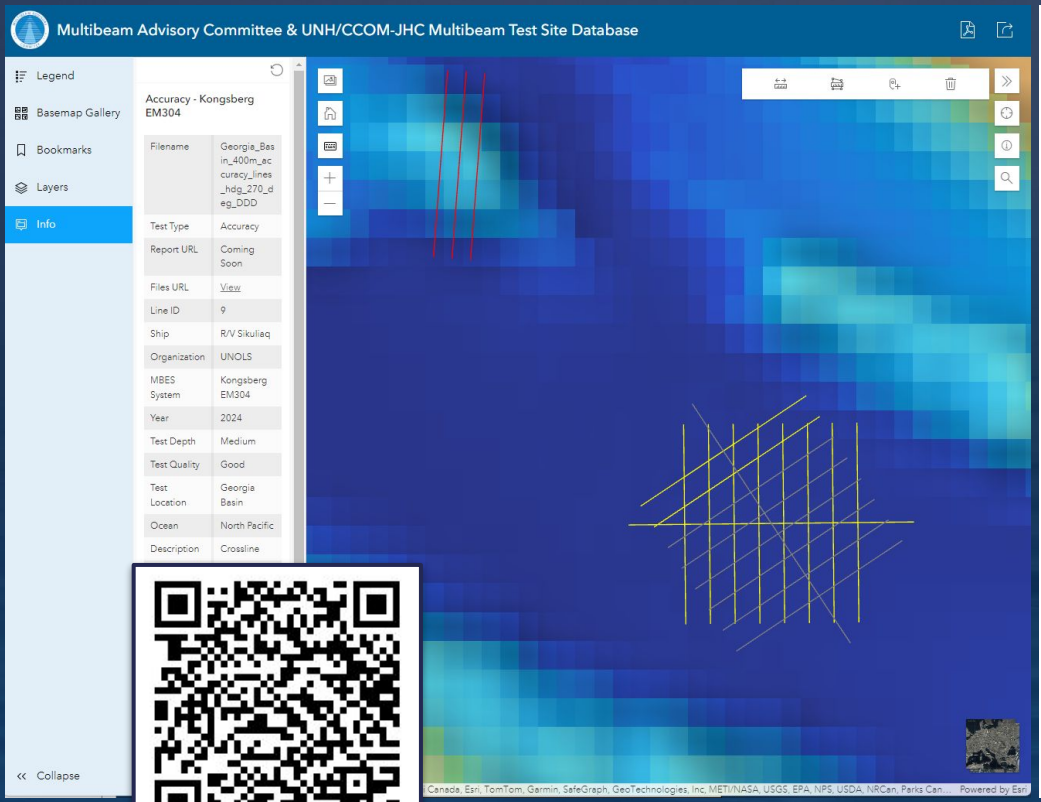
Test Site Database – Work in Progress

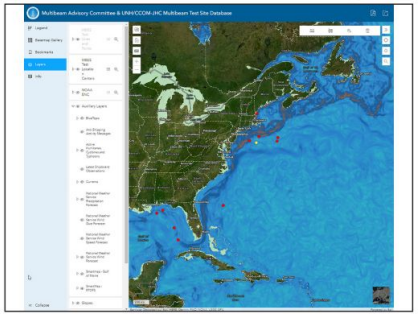


https://gis.ccom.unh.edu

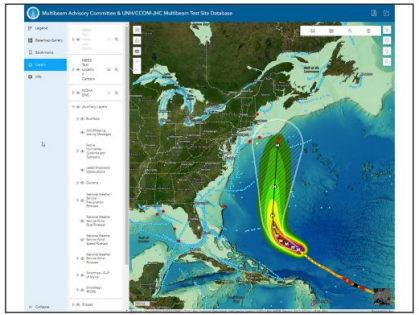
Test Site Database – Planning Layers



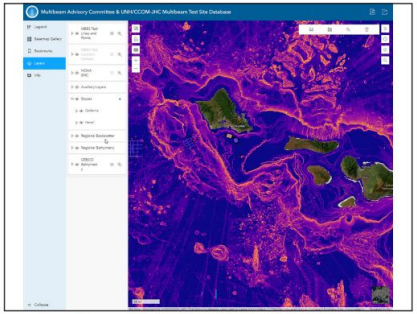
Planning Information



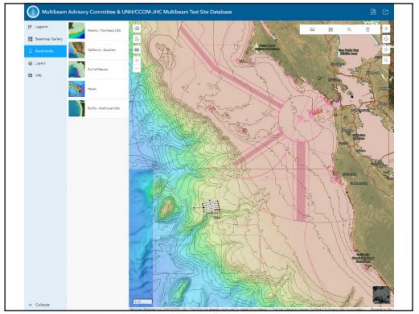
SmartMap Ocean Complexity



Ocean & Weather Conditions



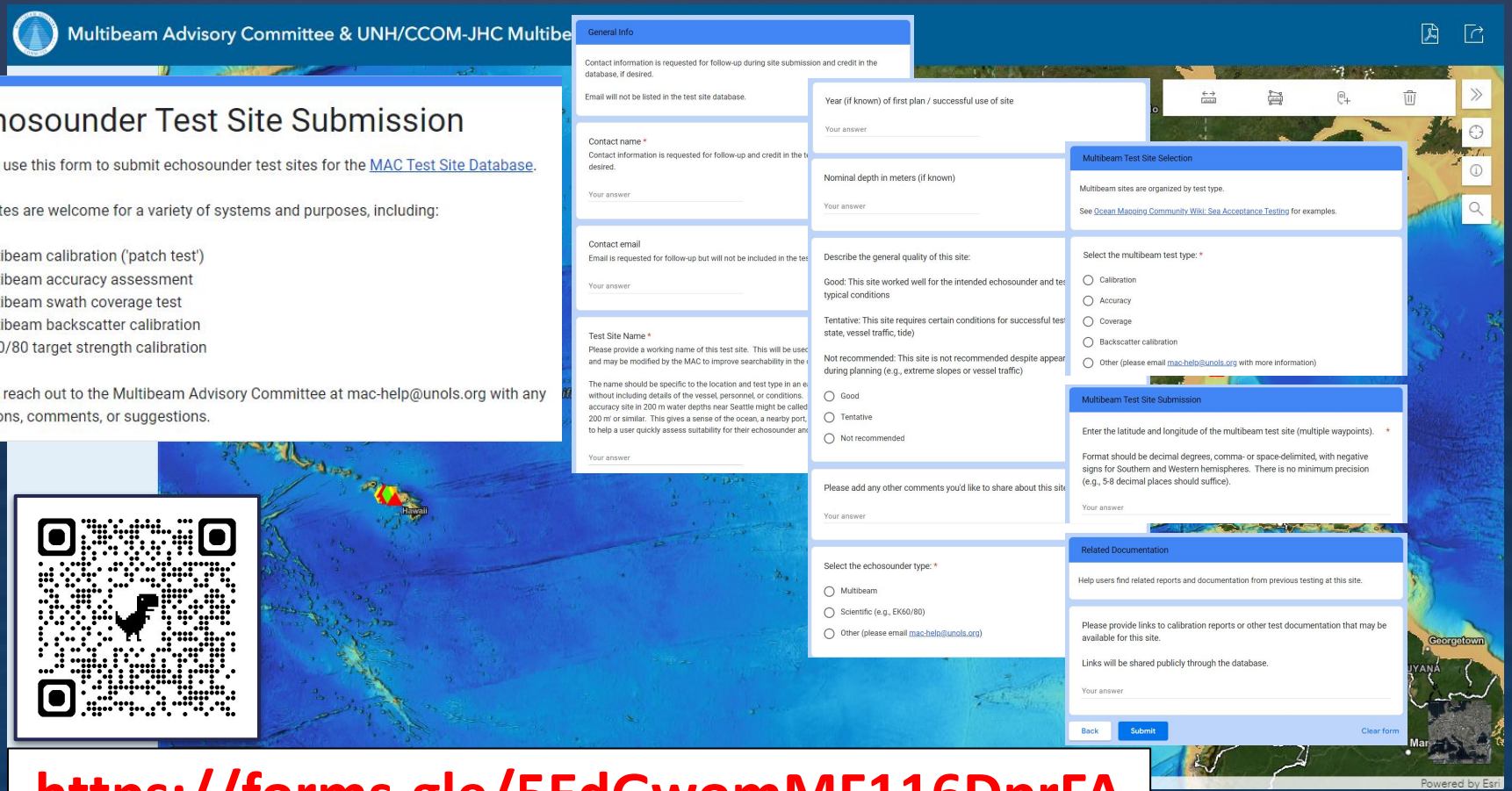
Regional Bathymetry & Slope



Electronic Navigation Charts

https://gis.ccom.unh.edu

Test Site Database – Submission Form



https://forms.gle/5EdGwomMF116DprFA

Ocean Mapping Community Wiki

github.com/oceanmapping/community/wiki

omcadmin@ccom.unh.edu or mac-help@unols.org

Assessment Tools

kjerram edited this page 2 weeks ago · 49 revisions

Edit | New page

Overview

Multibeam assessment tools described here include:

1. Swath Coverage Plotter v0.2.3
2. Swath Accuracy Plotter v0.1.2
3. BIST Plotter v0.2.3
4. File Trimmer v0.1.5
5. ECDIS Converter v0.0.4

Distribution

The standalone Python apps are available through several avenues for different users:

1. **Typical users:** each app is packaged with all libraries and zipped for easy download on Google Drive (with version notes).
   i. Just download, unzip, and run the .exe (similar to Sound Speed Manager).
   ii. The zipped packages are not available through GitHub due to file size limits.
2. **GitHub users:** apps and libraries are packaged in the multibeam_tools_distribution repository.
   i. Due to GitHub's file size limits, these are not zipped and may be more cumbersome to download for normal use. Versions may be lagging behind the Google Drive distribution due to (user) errors working with GitHub.
3. **Python folks:** source code is available in the multibeam_tools repository.

Using the tools

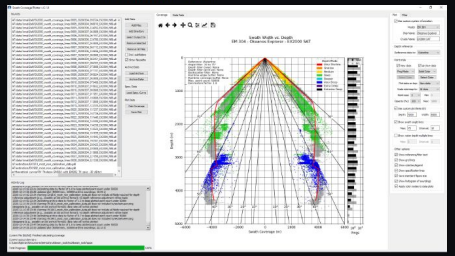
These tools are intended to give users the same plotting and reporting functions used by the MAC for routine performance testing (e.g., sea acceptance trials and quality assurance testing). Currently, only Kongsberg data formats are supported.

Hint: Most of the app features include tooltips; just hover over a button, list, or checkbox to get more information!

Instructions for data acquisition and processing are presented in the following sections. Suggestions are welcome for improving the workflow in each application.

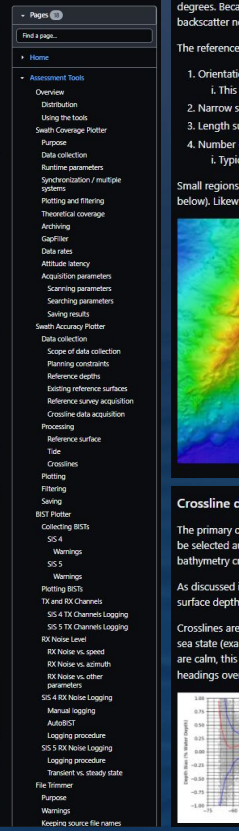
Swath Coverage Plotter

The swath coverage plotter extracts the outermost soundings (flagged 'valid') and plots these with a variety of filtering and plotting options. Currently only .all and .kmall are supported.



Purpose

Swath coverage testing is intended to illustrate the maximum coverage achieved by a given multibeam system over a wide range of depths. The depth range of interest spans from the shallowest typical operating depth for the vessel down to the practical swath extinction limit (e.g., where the system may no longer track the seafloor, generally governed by attenuation of the transmitted signal, noise levels perceived by the multibeam, and reflectivity of the seafloor).



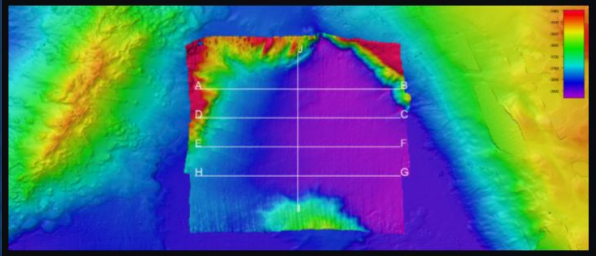
Reference survey acquisition

The reference survey should be planned over relatively flat, benign, homogenous seafloor with slopes no greater than a few degrees. Because the selected depths will likely be used for testing several different modes, the area may also be suitable for backscatter normalization across those modes [wiki development: add link to BS normalization section when complete].

The reference survey lines are planned with a few key considerations:

1. Orientation orthogonal to the crossline (or as a 'grid' if time allows)
   i. This reduces alignment of any swath biases in the reference grid with the crosslines
2. Narrow spacing (e.g., 1 WD) to achieve very high sounding density
3. Length sufficient to cover the full crossline swath width (e.g., 6-8 WD, with buffer for ship handling)
4. Number of reference lines to accommodate desired crossline length
   i. Typically 6-10 reference lines at 1 WD spacing, depending on depth, to yield several hundred crossline pings

Small regions of steeper slopes may be filtered during processing, if present (e.g., the 3900 m reference site off San Diego, below). Likewise, the number of lines may be adjusted to fit the terrain and the schedule.

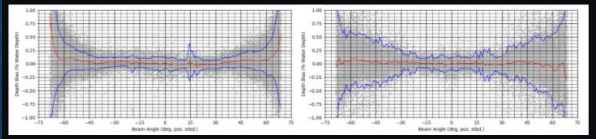


Crossline data acquisition

The primary crossline setting of interest should be the same used for the reference survey; ideally, this is a setting that would be selected automatically by the multibeam system for this depth. This provides a consistent comparison between the 'trusted' bathymetry created from a dense survey and the single-pass crossline(s) for the mode that is intended for this terrain.

As discussed in the planning constraints, there may be several modes of interest that have been grouped for this reference surface depth. Additional crosslines are added as needed and allowed by the ship schedule.

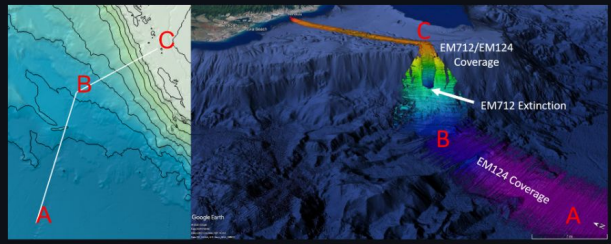
Crosslines are typically run in 'pairs' on opposite headings for each mode to assess any heading-dependent impacts, such as sea state (example below shows accuracy heading with seas and into seas shown on top and bottom, respectively). When seas are calm, this approach also supports deep roll verification using pairs of lines with the same mode and settings on opposite headings over the flat terrain.



Data collection

Ideally, swath coverage test data is collected under vessel operating parameters (e.g., speed, engine lineup, active sensors) that reflects 'typical' mapping configurations. For example, transit data collected at 12 kts with additional engines or generators online may not reflect the flow and machinery noise environment present at a typical mapping speed of 8 kts. Additional acoustic sensors (e.g., a bridge Doppler speed log) may cause interference and outliers in the coverage data that do not represent the standard mapping configuration with those sensors secured. Likewise, highly elevated sea state may not represent suitable mapping conditions.

The MAC recommends acquiring coverage test data at typical mapping speeds (e.g., 8-10 kts) and crossing contours at perpendicular angles wherever possible. Maintaining the ship heading directly up and down the slope is important for reducing coverage biases on either side of the swath that may result from the slope facing toward or away from the system. A coverage test line off HI for the R/V *Roger Revelle* EM124 / EM712 SAT is shown as an example of transiting 'up' and 'down' the major seafloor slopes in order to reduce port / starboard coverage biases across a wide depth range (~100-4000 m). In this example, the transit from waypoint A toward port was routed through waypoints B and C to cross contours more perpendicularly; this small amount of additional transit time produced much more useful data for coverage assessment.



Runtime parameters

The purpose of testing is to let the multibeam system achieve its maximum coverage under the mode it selects automatically for the given depth.

The following settings are generally recommended for Kongsberg EM systems to best illustrate 'automatic' system performance. Vessels that use different parameters during routine mapping should apply those settings where appropriate, aside from the maximum angle, coverage, and depth gates that may inadvertently limit the coverage test data.

Parameter	Recommended	Notes
Depth mode	Automatic	
Dual swath	Dynamic	
FM Transmission	Enabled	Read checkbox carefully [1]
Max angles	75°/75°	70°/70° for some systems
Max coverage	Maximum	Varies by model
Depth limits	As needed	Adjust as needed[2]
TX power	Maximum	0 dB

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Instructions for data acquisition and processing are presented in the following sections. Suggestions are welcome for improving the workflow in each application.

Examples and use cases for these assessment tools have been presented at various workshops, including the 2023 INMARTECH MAC workshop and 2024 RVTEC MAC breakout session (demonstration, slides pending).

Purpose

Swath coverage testing is intended to illustrate the maximum coverage achieved by a given multibeam system over a wide range of depths. The depth range of interest spans from the shallowest typical operating depth for the vessel down to the practical swath extinction limit (e.g., where the system may no longer track the seafloor, generally governed by attenuation of the transmitted signal, noise levels perceived by the multibeam, and reflectivity of the seafloor).

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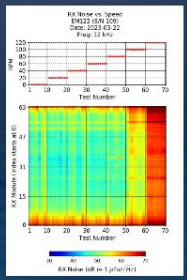
Example from the Field: RX Noise Tracking

Diver inspection showing biofouling on/near arrays (April 2023)

March 2023



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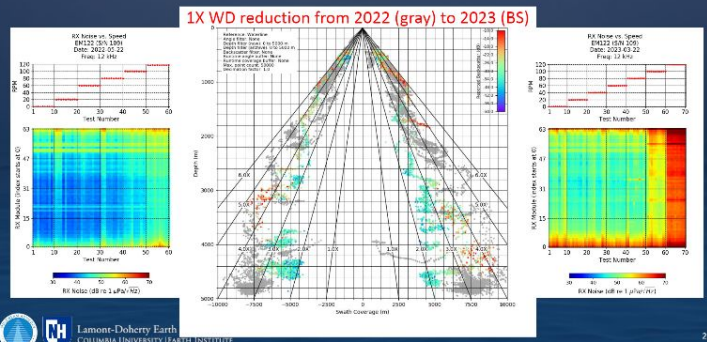
Example from the Field: RX Noise and Swath Coverage

1X WD reduction from 2022 (gray) to 2023 (BS)



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Assessment Tool Demos

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Questions? Answers? Reach out!

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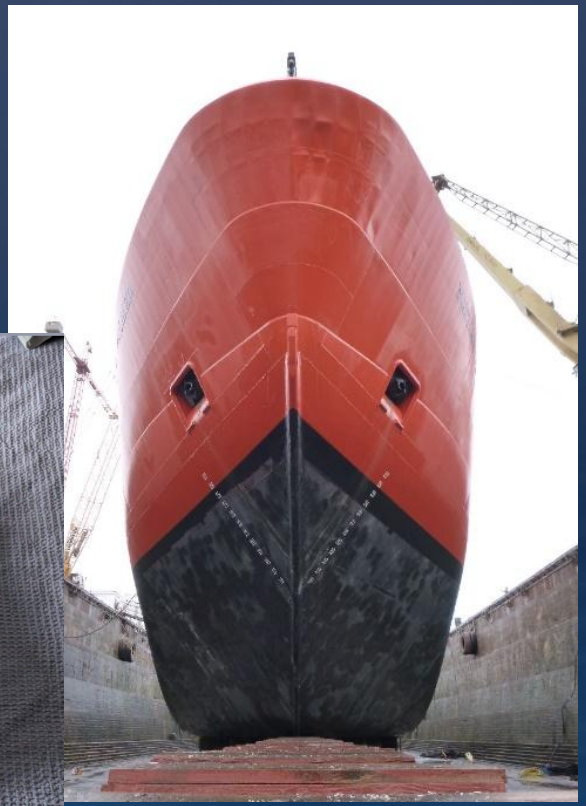

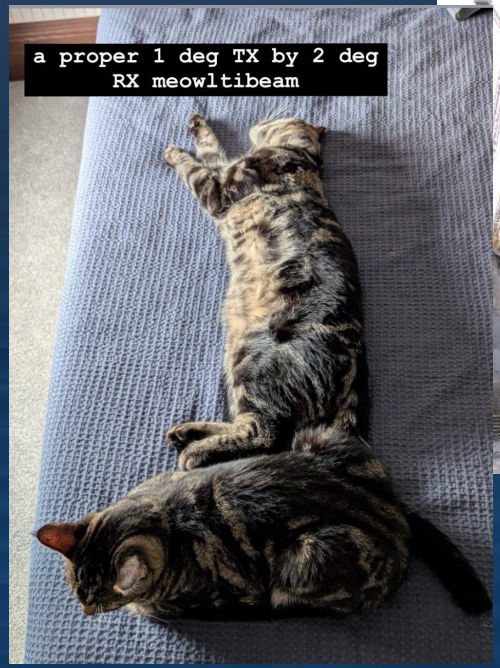

Kate von Krusenstiern

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