The Multibeam Advisory Committee and Ocean Mapping Community Wiki

FEMME 2023 - Edinburgh
28 September 2023

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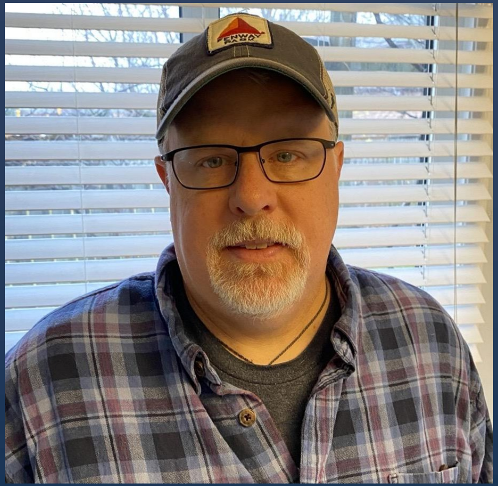
Paul Johnson
Vicki Ferrini
Hayley Drennon

MAC supported under NSF grant 1933720

https://mac.unols.org

mac-help@unols.org



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CCOM research, MAC field support

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Sr. Research Assistant
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GMRT, MGDS, GEBCO
Seabed 2030

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The Multibeam Advisory Committee (MAC)

- Established 2011 with funding from NSF to ensure the consistent collection of high-quality multibeam data across the U.S. Academic Research Fleet (USARF)
  - ***Standardize*** *system performance testing*
  - ***Publish*** *performance and share best practices*
  - ***On-board & remote support*** *for ships*
- Technical Reports & Resources
  - Sea Acceptance / Quality Assurance / RX Noise
  - Host Non-USARF reports
  - Assessment tools, survey guidance

Website: mac.unols.org

Help desk: mac-help@unols.org

Wiki: github.com/oceanmapping/community/wiki

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Mapping Systems in the U.S. Academic Research Fleet

- **12 Vessels with MBES**
  - 11 Research Vessels
  - 1 USCG Icebreaker
  - 10 Kongsberg EM-equipped
- **16 Deep water EM systems**
  - EM710 / EM712 (40-100 kHz)
  - EM302 (30 kHz)
  - EM122 / EM124 (12 kHz)
- **2 Shallow water systems**
  - Reson
  - EM2040 (soon)
- **3 RCRVs (6 MBES) in 2023+**
  - EM304s & EM2040s











MULTIBEAM ADVISORY COMMITEE

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Kongsberg Systems in the U.S. Academic Research Fleet

Ship	System(s)	Arrays	Life Cycle	MAC Visits (Recent)	2024 Plans
Atlantis	**EM124 (g)**	2021	Early	SAT* (2021), QAT* (2022)	QAT
Healy	*EM122*	2010 / 2023 RX	Late	ANT, QAT/SAT* (2022-23)	QAT
Kilo Moana	EM122 / EM710	2012	Late	ANT, QAT* (2023)	QAT
Marcus G. Langseth	EM122 (g)	2007 TX / 2010 RX	Late	ANT, QAT (2023)	QAT
Nathaniel B. Palmer	EM122	2015	Mid	SAT, ANT, QAT (2015)	TBD
Neil Armstrong	*EM122 / EM710*	2016	Mid	SAT, QAT* (2020)	EM124 / 712
Roger Revelle	EM124 / EM712 (g)	2020	Early	SAT*, QAT* (2023)	QAT
Sikuliaq	*EM302* / EM710	2014	Mid	SAT, QAT* (2023)	EM304 MKII
Sally Ride	**EM124** / EM712	2016	Mid	SAT (2021), QAT* (2023)	QAT
Thomas G. Thompson	*EM302*	2018	Mid	SAT, QAT* (2023)	TBD

(g) indicates gondola installation
*Indicates remote support
Underline = recent install (2021)

Italic = pending replacement (2023+)
Green = visited in last two years

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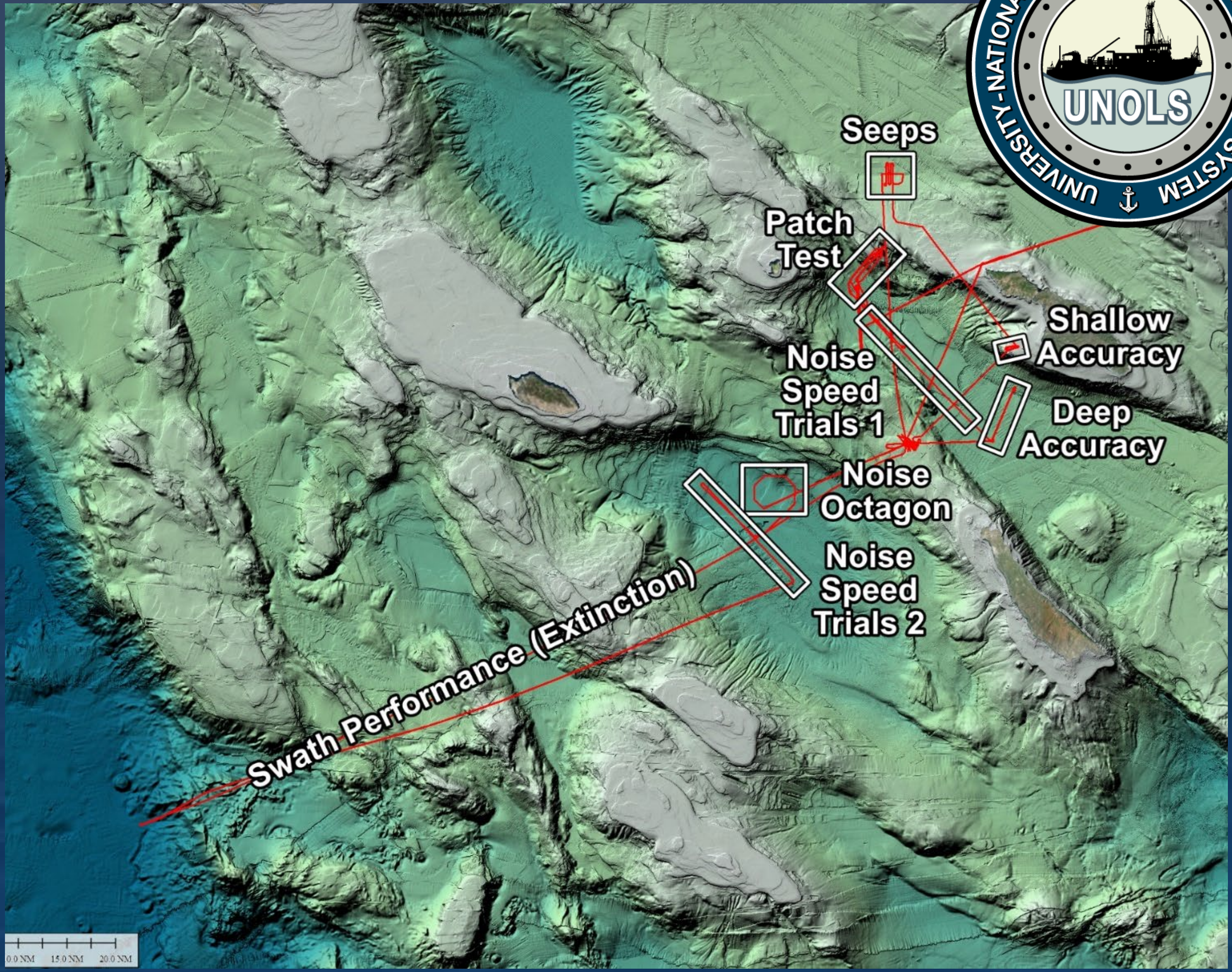
System Performance Testing

SAT and QAT procedures

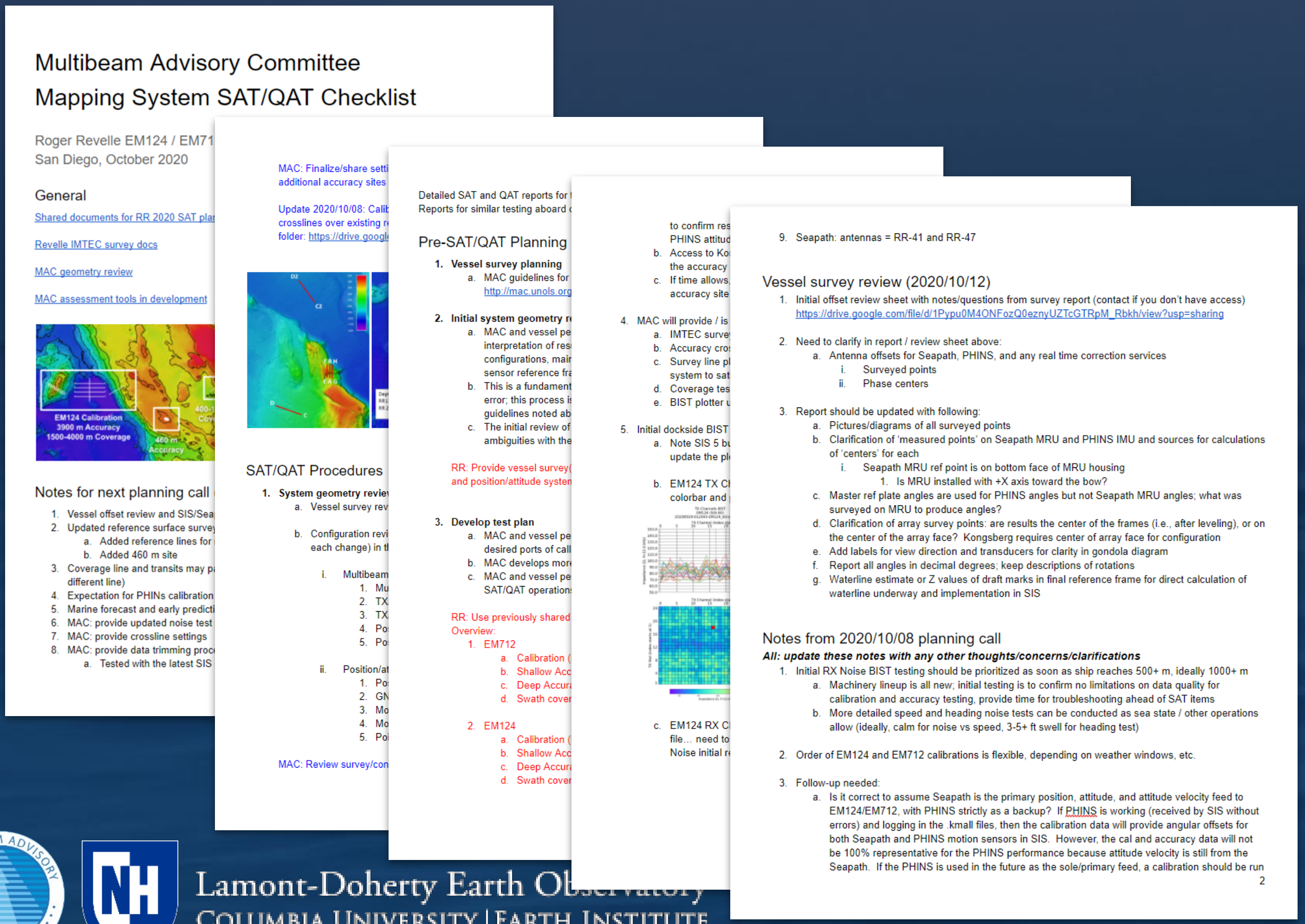
1. Hardware health (impedance)
2. Geometry / config. review
3. Calibration ('patch test')
4. RX noise vs. speed/seas
5. Swath coverage (extinction)
6. Swath accuracy
7. Water column evaluation
8. Backscatter normalization
9. Public reporting (MAC website)

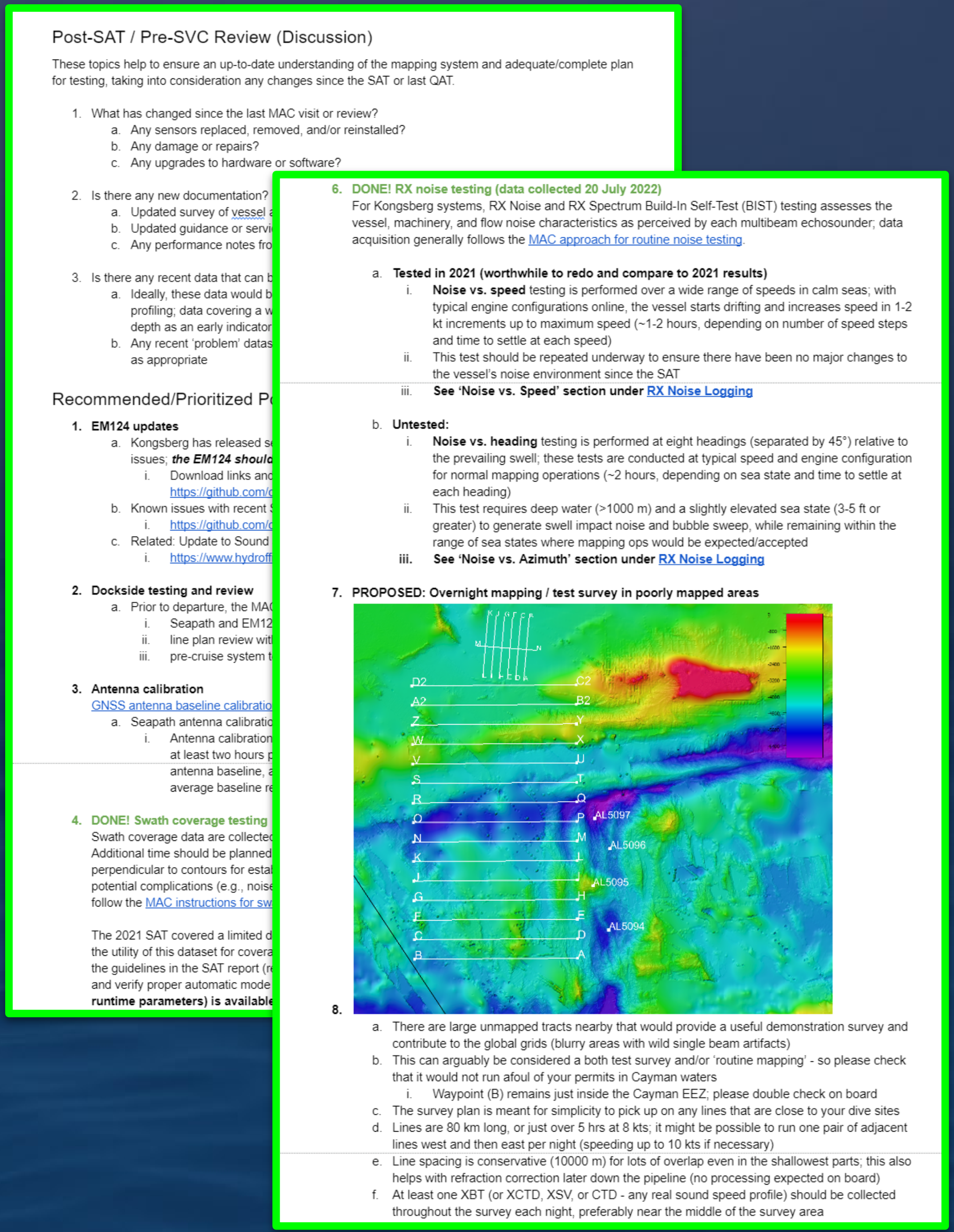


SAT / QAT Checklist

Standardized (but flexible!) procedures in order of priority

Collaborative planning → data collection → follow-up





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Recent MAC and Related Activities

MAC field support in last year

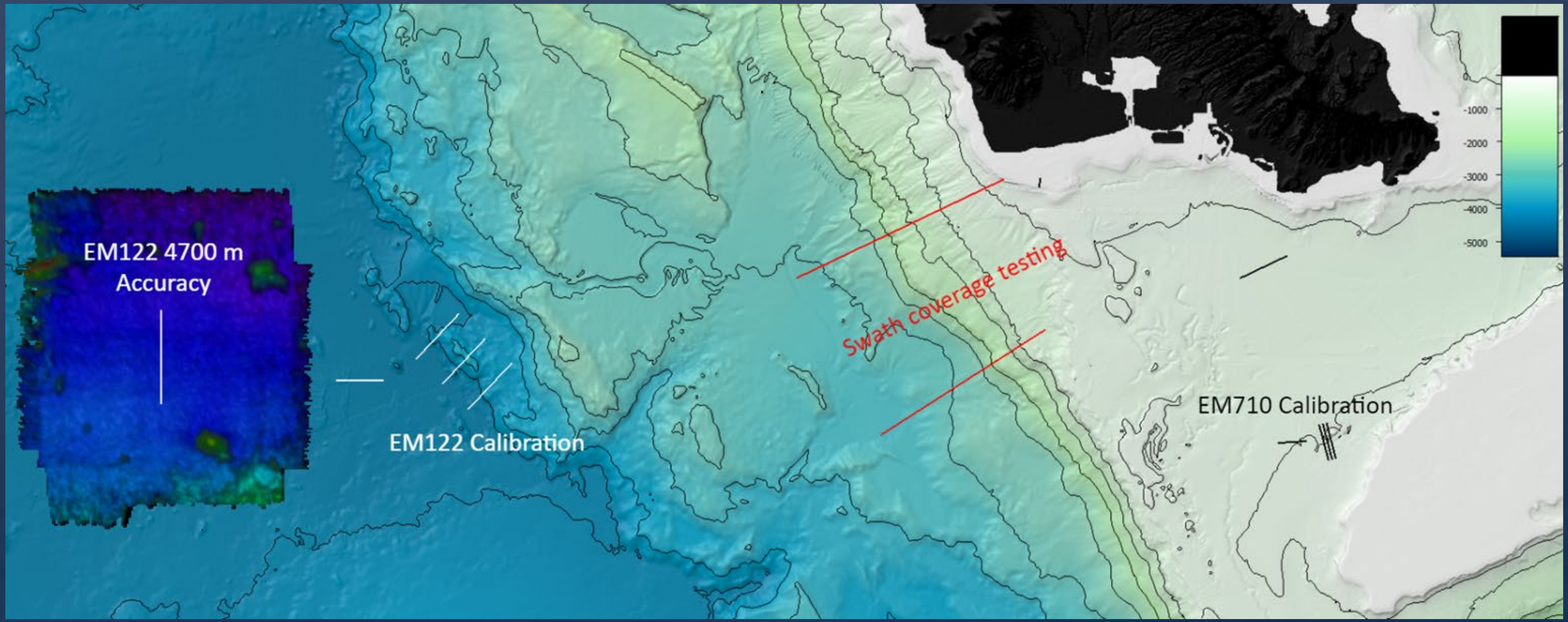
- 8 of 10 EM-equipped ships

MAC-related projects

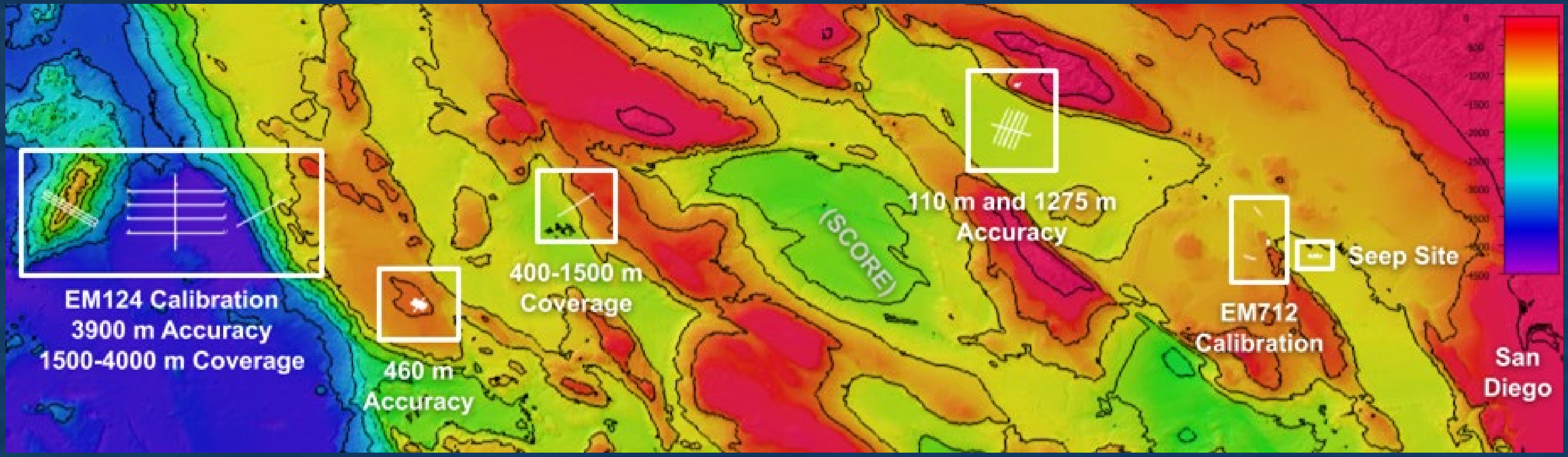
- Sound Speed Manager
- MAC Assessment Tools
- SAT/QAT site database
- GMRT tiling package

<u>Non-MAC</u> testing / field work

- *Nautilus* (QAT)
- *Falkor (too)* (SAT)
- *OceanXplorer* (QAT)
- *Okeanos Explorer* (various)
- Saildrone *Surveyor* (various)
- iXBlue *DriX* (NA142, EM712 SAT)



THANK YOU to technicians and managers for making remote support possible!



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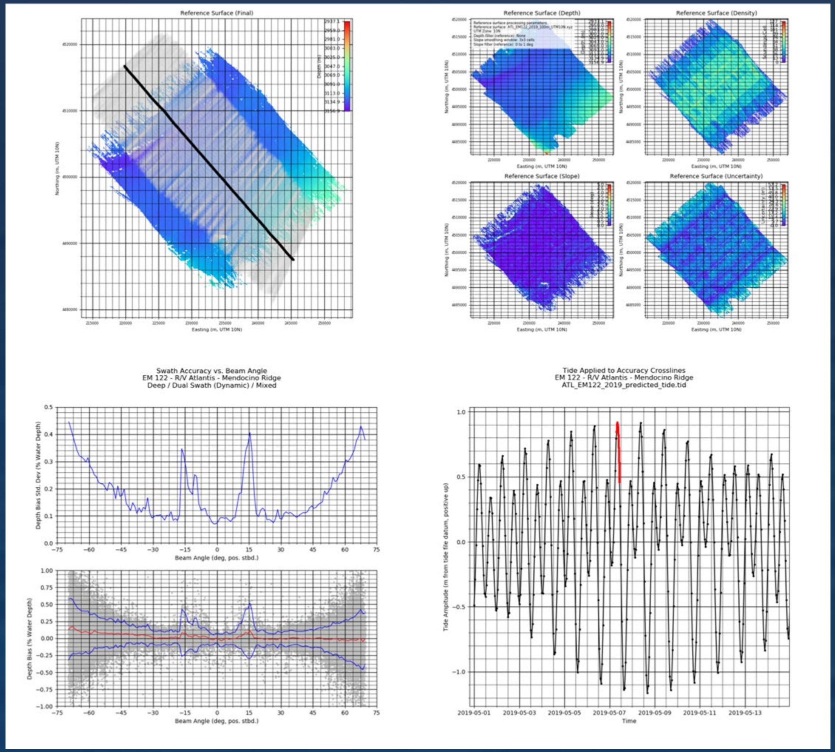
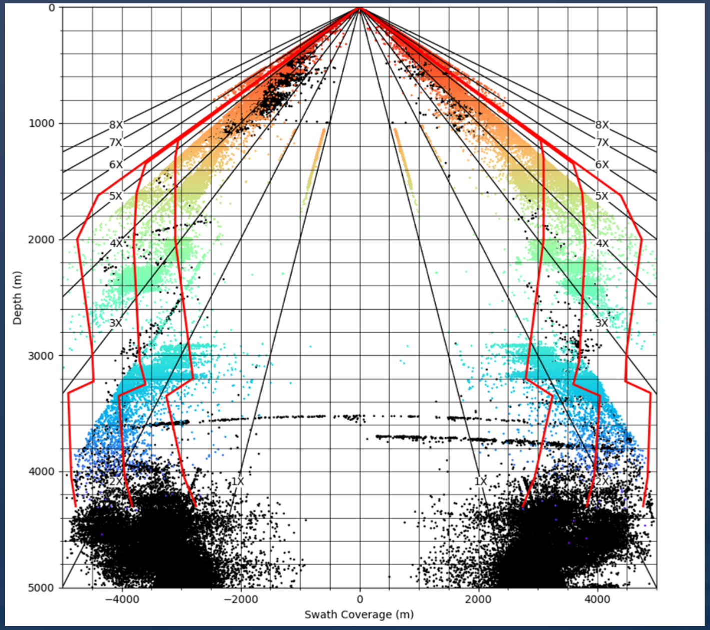
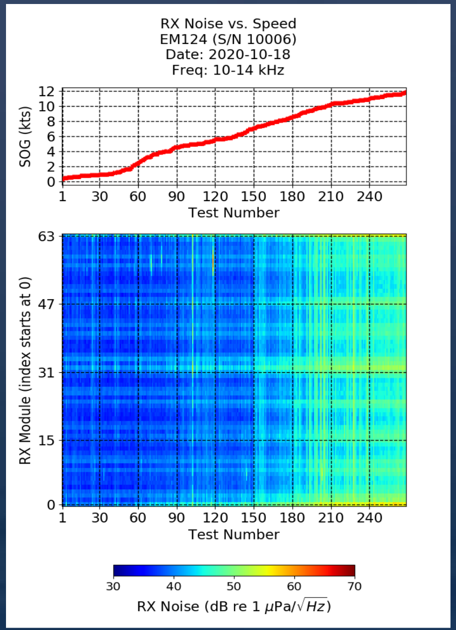
Assessment Tools

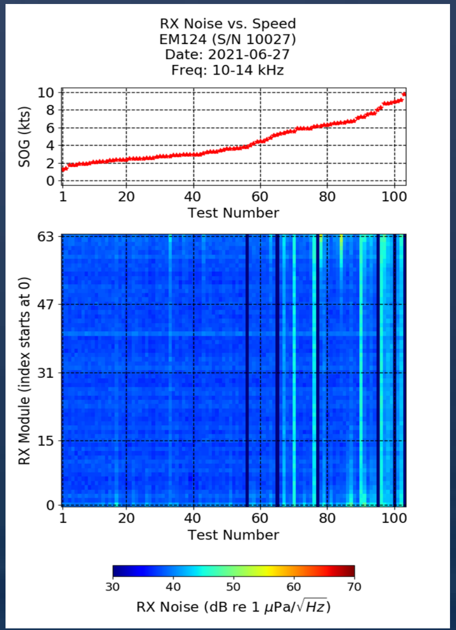
github.com/oceanmapping/community/wiki/Assessment-Tools

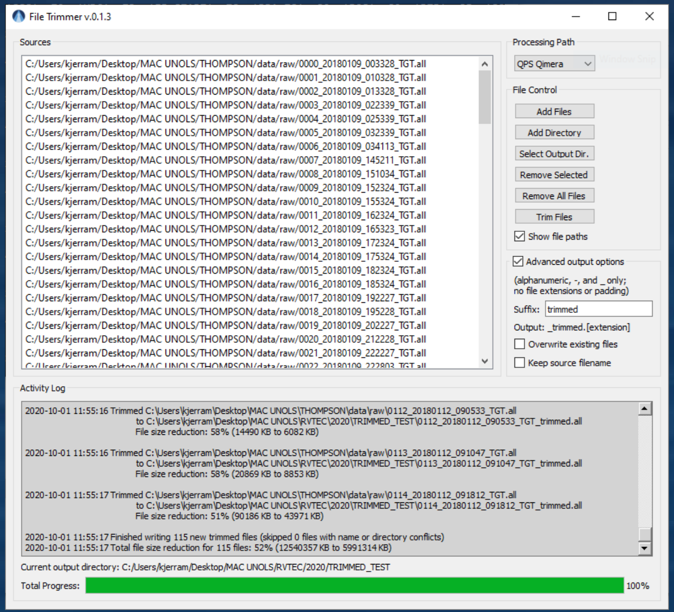
1. File Trimmer
2. BIST Plotter
3. Swath Coverage Plotter
4. Swath Accuracy Plotter
5. ECDIS Converter

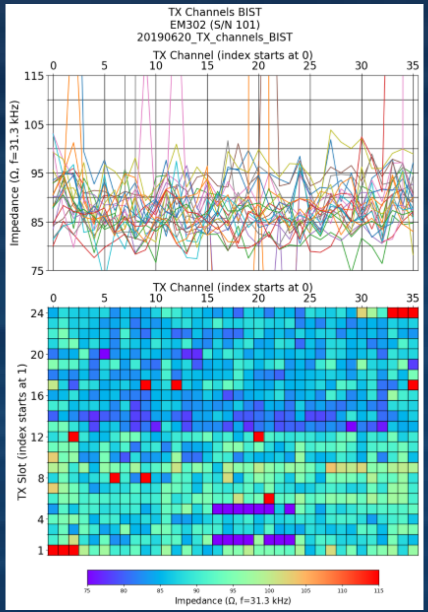


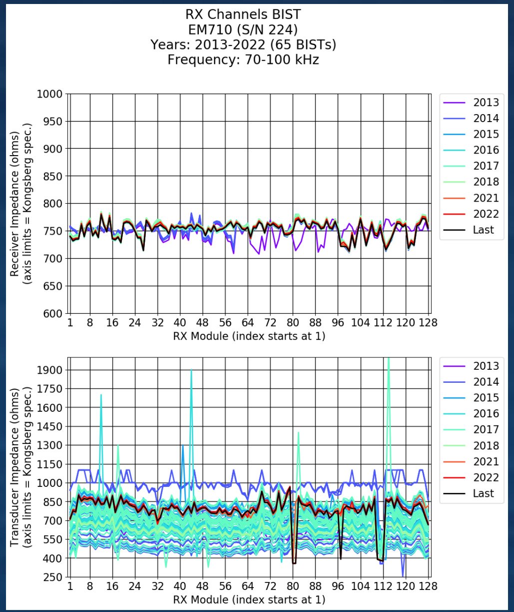












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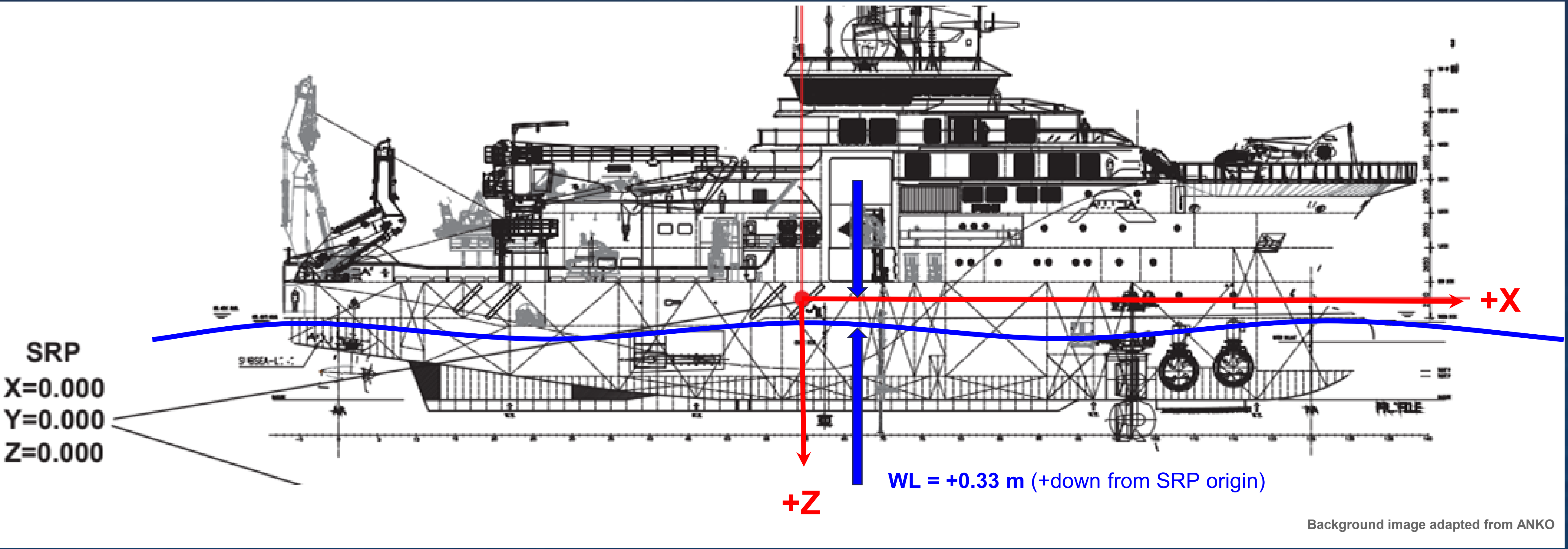
Examples from the Field: System Geometry

- Even the **best** survey reports can still be **interpreted incorrectly**
- **Waterline** remains a window of opportunity for large and persistent errors
- Affects 'starting point' in sound speed profile and final Z adjustment to surface



Vessel Offset Survey Reports

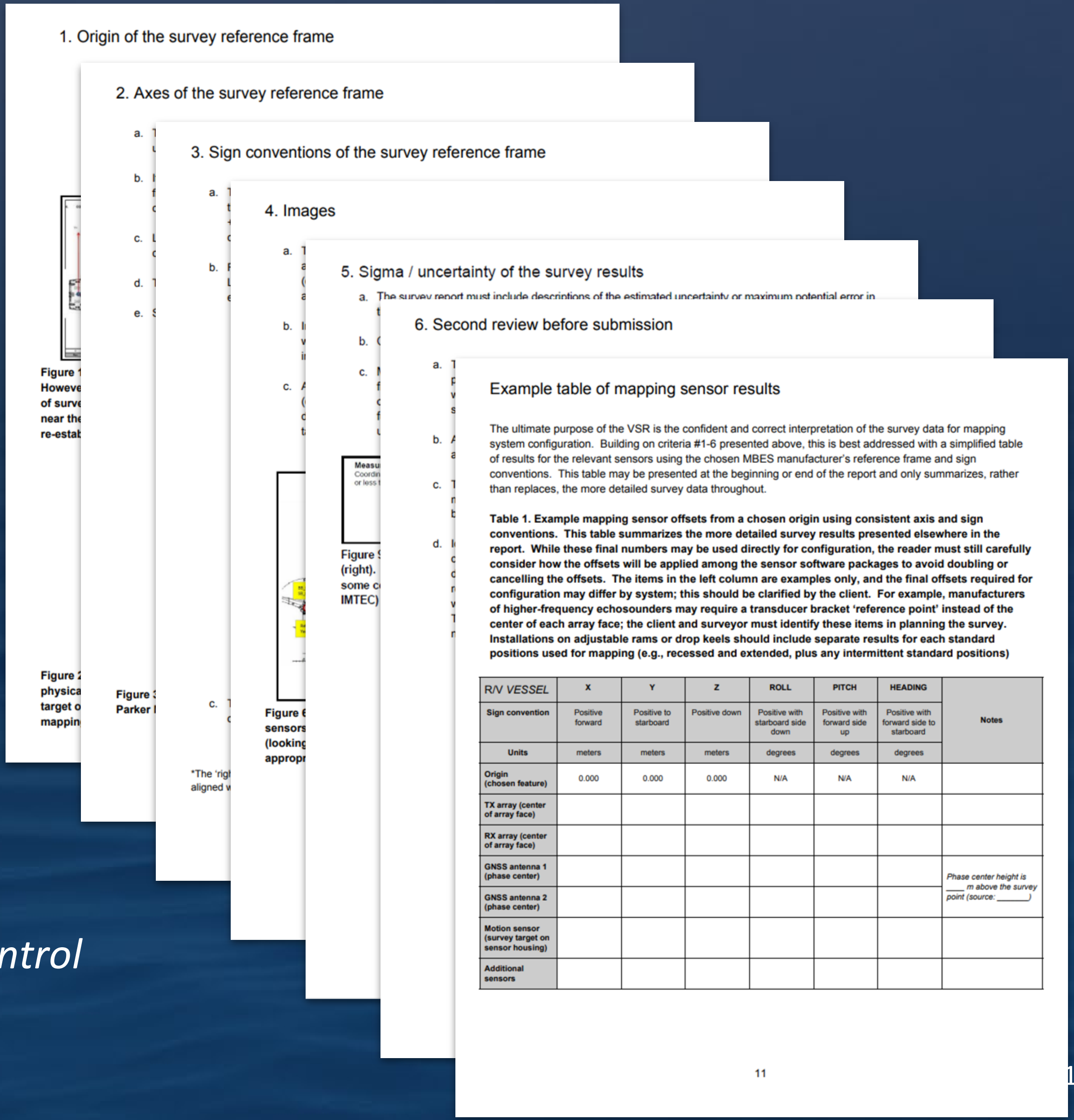
Recommendations for Reporting Vessel Geometry and Multibeam Echosounder System Offsets

Survey reports directly impact data quality for years

Vessel and sensor offsets must be clearly documented

Vessel / sensor offset survey reports **MUST** include:

1. **Origin** of survey reference frame
2. **Axes** of survey reference frame
3. **Sign conventions** of survey results
4. **Images** of surveyed points and sensors
5. **Sigma** / standard deviation or uncertainty
6. **Second review** before submission


1. Origin of the survey reference frame

2. Axes of the survey reference frame

3. Sign conventions of the survey reference frame

4. Images

5. Sigma / uncertainty of the survey results

6. Second review before submission

Example table of mapping sensor results

The ultimate purpose of the VSR is the confident and correct interpretation of the survey data for mapping system configuration. Building on criteria #1-6 presented above, this is best addressed with a simplified table of results for the relevant sensors using the chosen MBES manufacturer's reference frame and sign conventions. This table may be presented at the beginning or end of the report and only summarizes, rather than replaces, the more detailed survey data throughout.

Table 1. Example mapping sensor offsets from a chosen origin using consistent axis and sign conventions. This table summarizes the more detailed survey results presented elsewhere in the report. While these final numbers may be used directly for configuration, the reader must still carefully consider how the offsets will be applied among the sensor software packages to avoid doubling or cancelling the offsets. The items in the left column are examples only, and the final offsets required for configuration may differ by system; this should be clarified by the client. For example, manufacturers of higher-frequency echosounders may require a transducer bracket 'reference point' instead of the center of each array face; the client and surveyor must identify these items in planning the survey. Installations on adjustable rams or drop keels should include separate results for each standard positions used for mapping (e.g., recessed and extended, plus any intermittent standard positions)

R/V VESSEL	X	Y	Z	ROLL	PITCH	HEADING	Notes
Sign convention	Positive forward	Positive to starboard	Positive down	Positive with starboard side down	Positive with forward side up	Positive with forward side to starboard	
Units	meters	meters	meters	degrees	degrees	degrees	
Origin (chosen feature)	0.000	0.000	0.000	N/A	N/A	N/A	
TX array (center of array face)							
RX array (center of array face)							
GNSS antenna 1 (phase center)							*Phase center height is ____ m above the survey point (source: _______)*
GNSS antenna 2 (phase center)							
Motion sensor (survey target on sensor housing)							
Additional sensors							

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github.com/oceanmapping/community/wiki/Dimensional-Control

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Vessel Offset Survey Reports

Recommendations for Reporting Vessel Geometry and Multibeam Echosounder System Offsets

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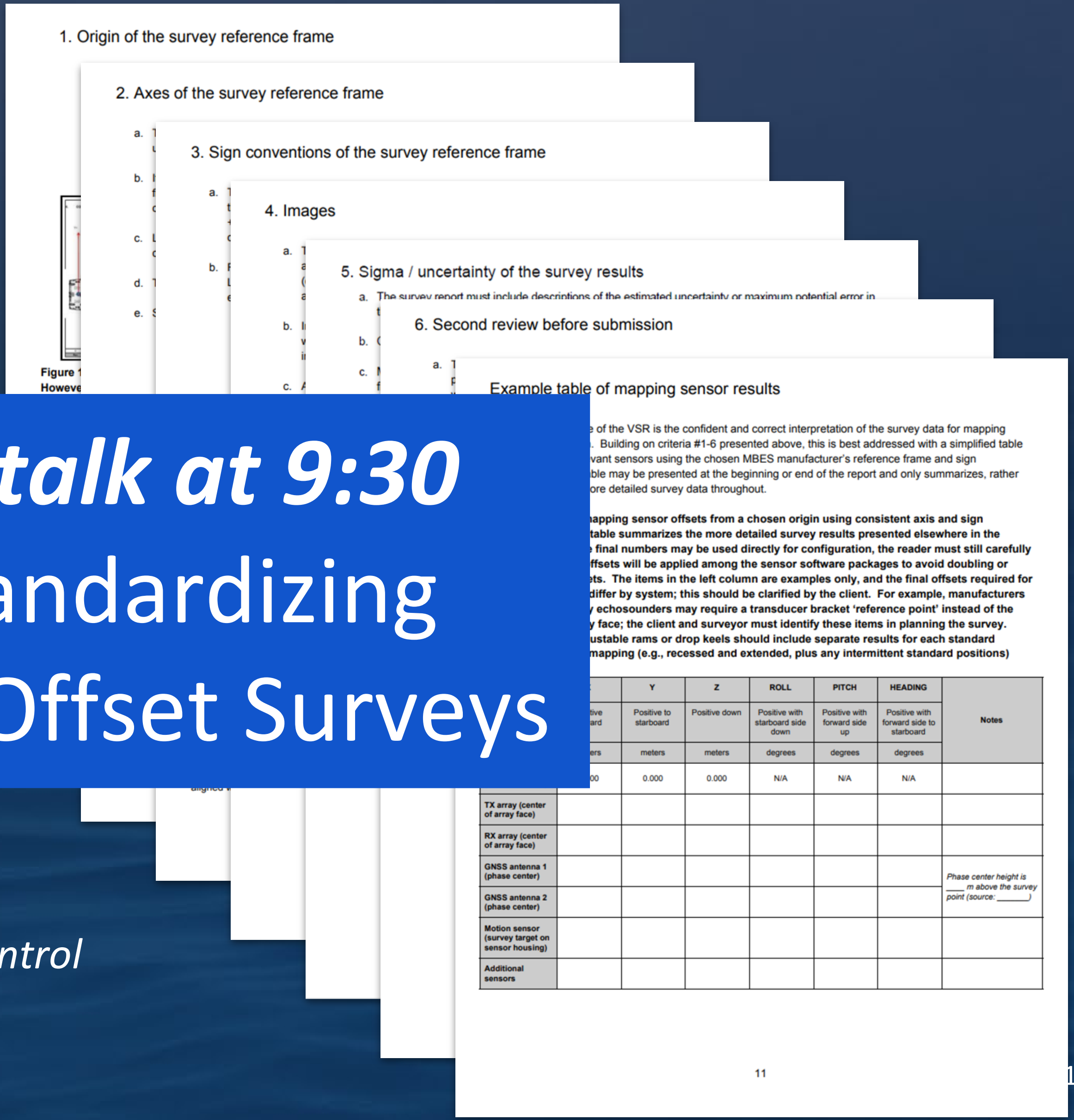

See Anand Hiroji's talk at 9:30

A Step Towards Standardizing Hydrographic Vessel Offset Surveys

github.com/oceanmapping/community/wiki/Dimensional-Control

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Waterline Worksheet

Multibeam Advisory Committee
Kongsberg Waterline Worksheet

Working draft; please contact mac-help@unols.org with feedback

Purpose / Warning

This worksheet (in development) is intended to help translate draft readings into the 'Waterline' parameter required by SIS.
Waterline is the vertical offset from the mapping system reference frame to the sea surface in normal trim.
The Waterline parameter is entered in meters, positive DOWN from the mapping system origin.
If the sea surface is above the origin, then the Waterline parameter is negative.
Errors in waterline directly affect reported depths as well as refraction correction (e.g., starting depth in sound speed profile)
More information at https://github.com/oceanmapping/community/wiki/Dimensional-Control#waterline

Instructions

All cells are protected, aside from those requiring input. Please contact mac-help@unols.org with any feedback.

Green sections: enter ship information	Enter data based on your vessel / sensor offset survey and interpretation of the mapping system reference frame. Ensure correct units are applied.
Yellow cells: extra attention needed	Review your vessel survey and mapping system configuration carefully!
Blue cells: waterline for SIS config	Waterline value for SIS configuration (meters, positive DOWN from the mapping system origin)

Step 1: Consider how draft readings are taken and the current mapping system reference frame. Select the locations for draft reference and mapping system origin.

Reference for vessel draft readings	Keel	This is the reference used for draft readings (e.g., typically the keel or other deepest part of the hull, but not always!)
Mapping system origin (where Z=0)	Motion sensor	This is the origin of the mapping system reference frame as configured (e.g., not necessarily the "vessel survey" reference frame)
Origin height different from draft ref.?	Yes. Review the mapping system ref. frame carefully. Enter the mapping system origin height ABOVE the draft ref. and add alongship position in Step 2.	

Step 2: Enter the mapping system origin height above the draft reference (not waterline!) and alongship distance from stern.

Mapping system origin offsets from draft ref.	Height above draft ref. (decimal feet or m)	Distance from stern (alongship feet or m)	Units (select 'none' if not applicable)	Scale factor to meters	X	Z
Mapping system origin	9.55	38.78	m	1	38.7800	9.5500

Step 3: Enter draft readings and alongship distances from stern. Draft is estimated at mapping system origin.

Draft readings in normal trim (average Port/Stbd readings at each location to estimate draft at CL)	Draft reading (decimal feet or m)	Distance from stern (alongship feet or m)	Units (select 'none' if not applicable)	Scale factor to meters	X (m) +FWD from stern	Z (m) +UP from draft ref
BOW draft reading	5.10	62.38	m	1	62.3750	5.1000
STERN draft reading	6.00	0.00	m	1	0.0000	6.0000
ESTIMATED draft reading at origin	5.44	38.78	m	1	38.7800	5.4404

Step 4: Calculate waterline at origin

Waterline in mapping system reference frame	Waterline (SIS)	X (m) +FWD from origin	Z (m) +DOWN from origin
BOW draft reading in mapping frame		23.60	4.45
STERN draft reading in mapping frame		-38.78	3.55
Waterline for SIS (m, +DOWN at origin)	4.11	0.00	4.11

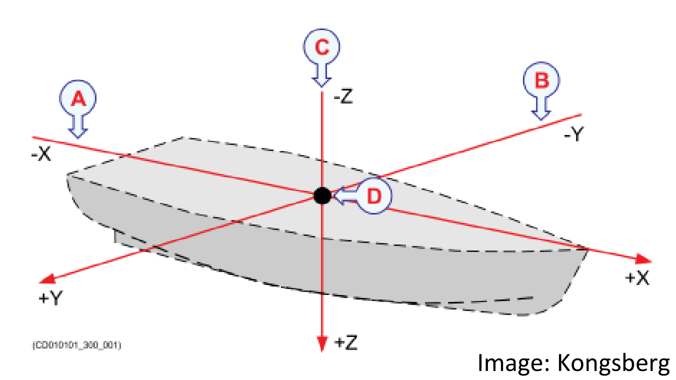


Image: Kongsberg

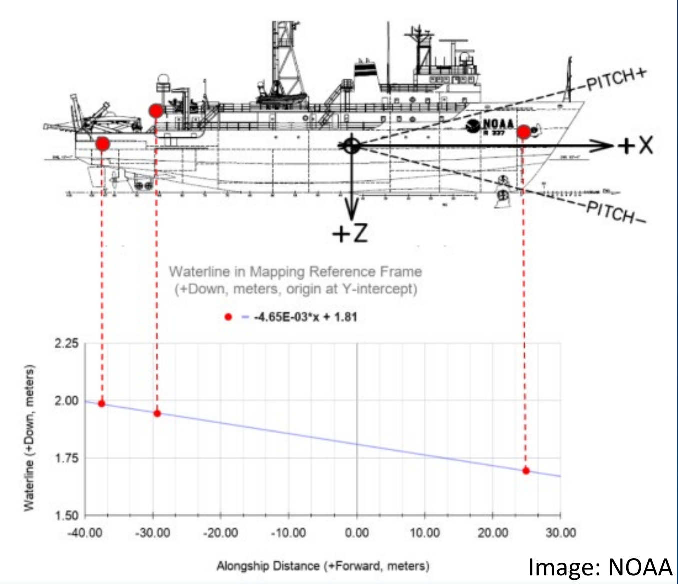
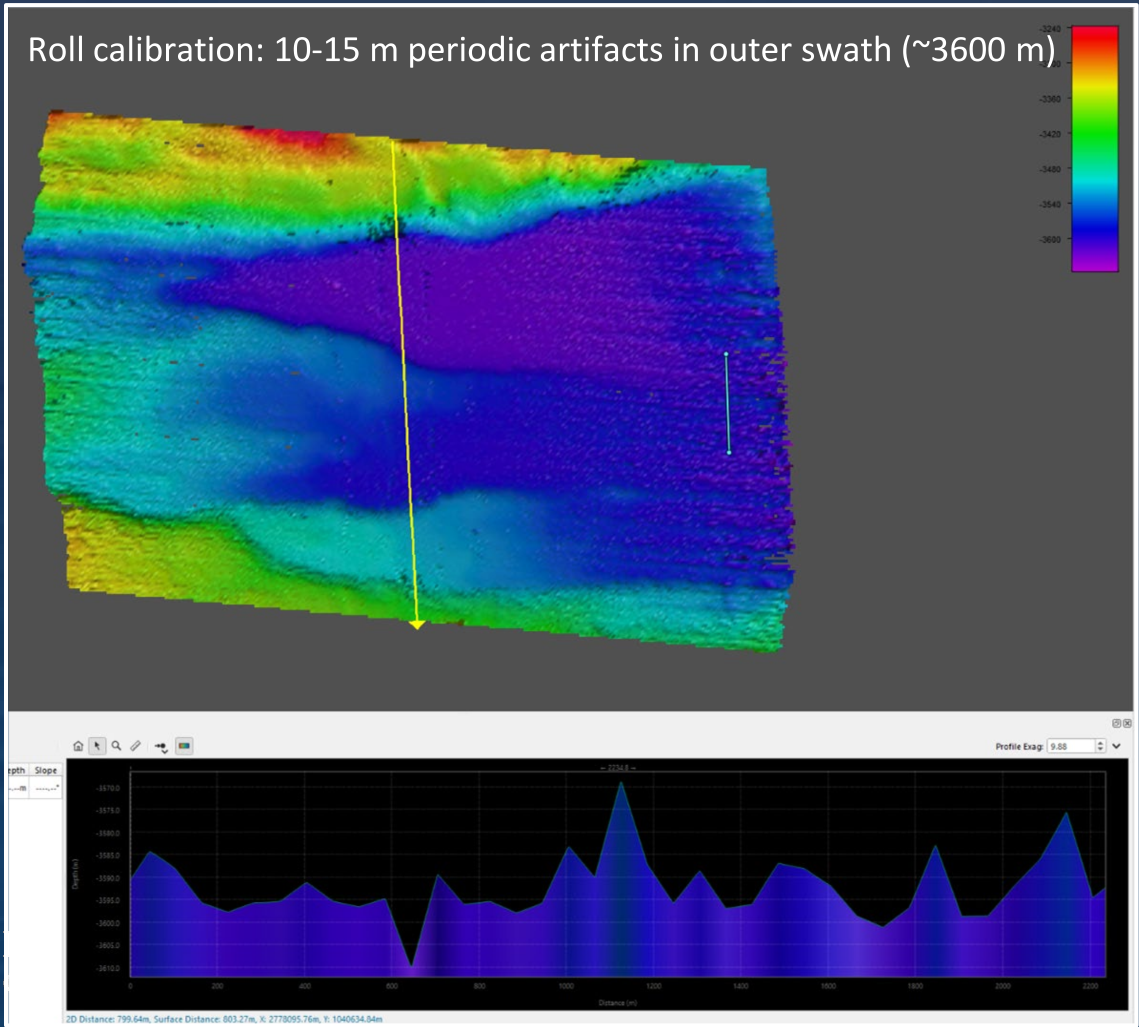


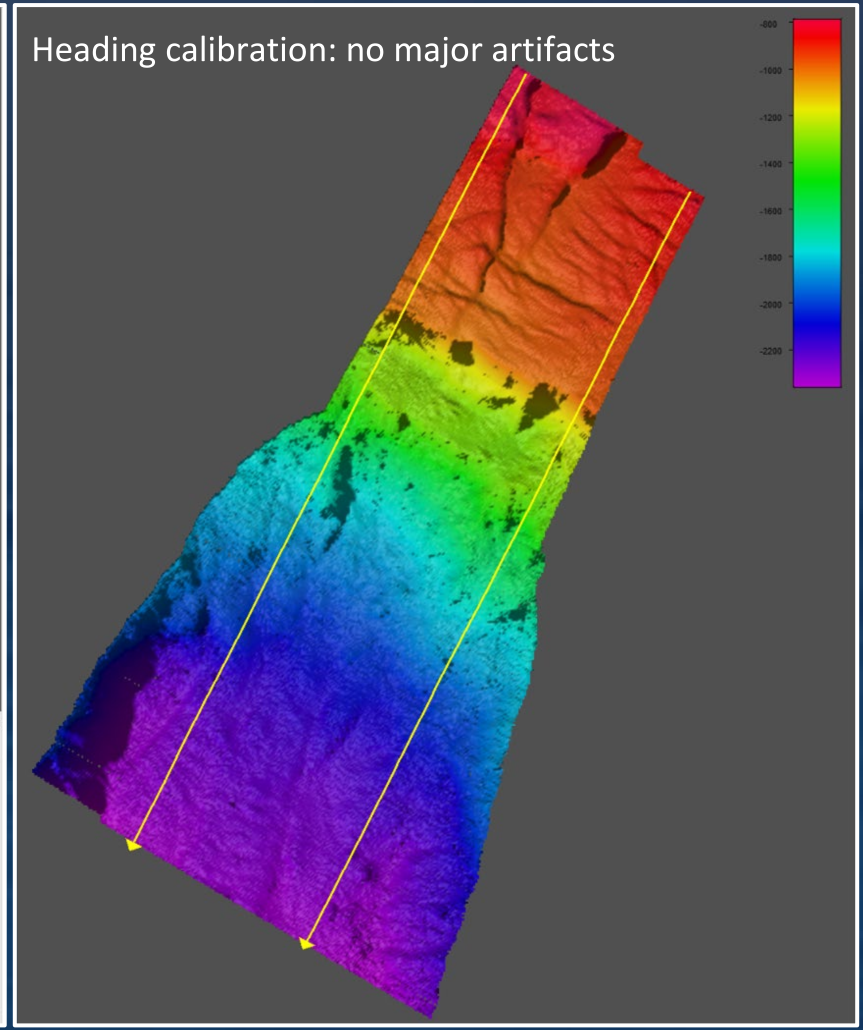
Image: NOAA

github.com/oceanmapping/community/wiki/Dimensional-Control

Examples from the Field: Swath Wobbles

1. Multibeam systems up to date with total geometry review, calibrations, noise testing
2. ‘Wobbles’ in some data (left) but not all (right) during calibration

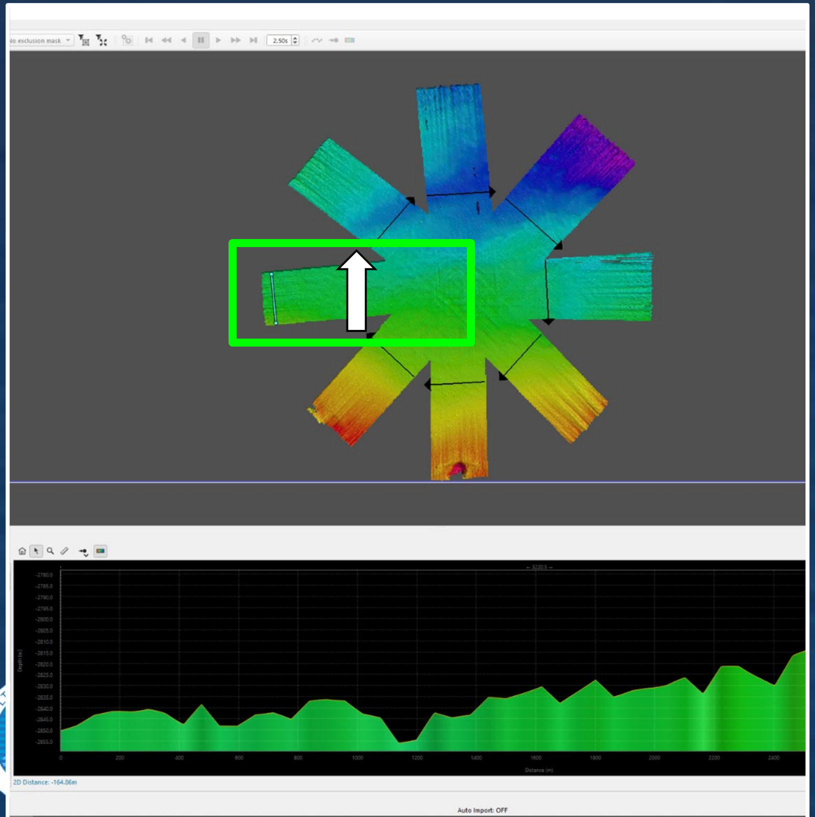




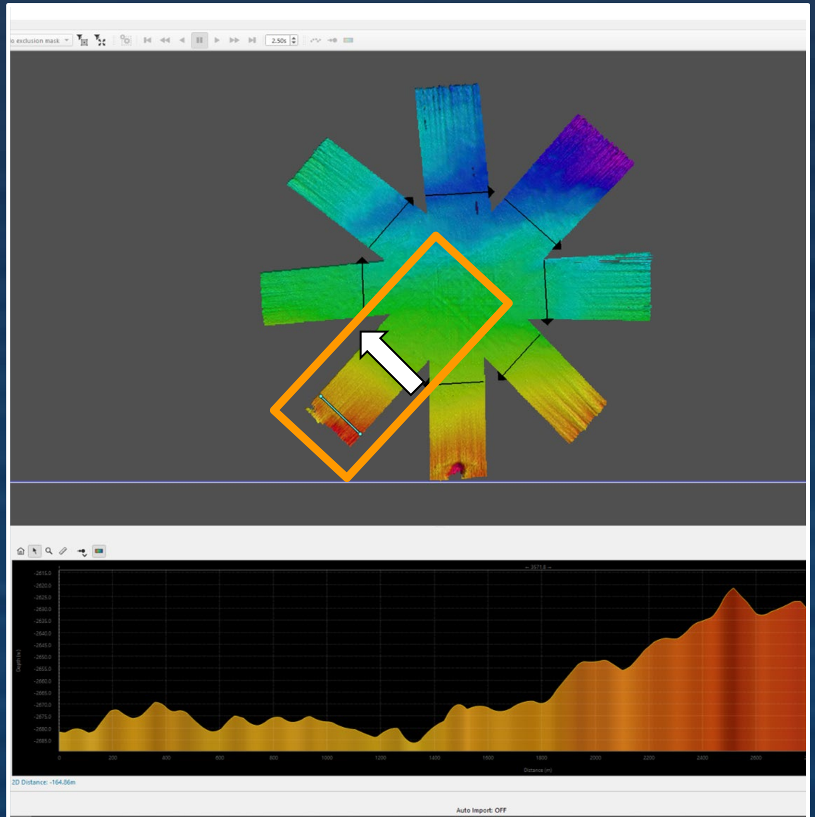
Examples from the Field: Swath Wobbles

1. Mapping ‘octagon’ with 10-15 minutes on eight headings (2650-2850 m)
2. Changes in swath behavior with orientation to potential internal wave field
3. Consistent attitude (1-3° roll and pitch) and surface sound speed on all headings

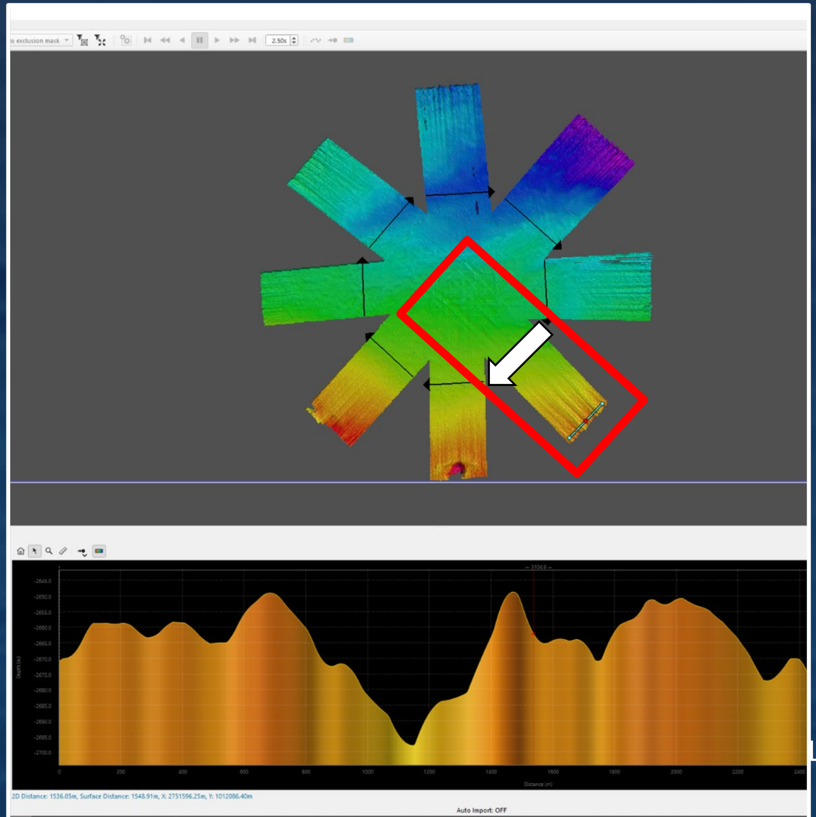
‘Best’ case: ~5 m ripples (N)



‘Middle’ case: ~20 m waves (NW)

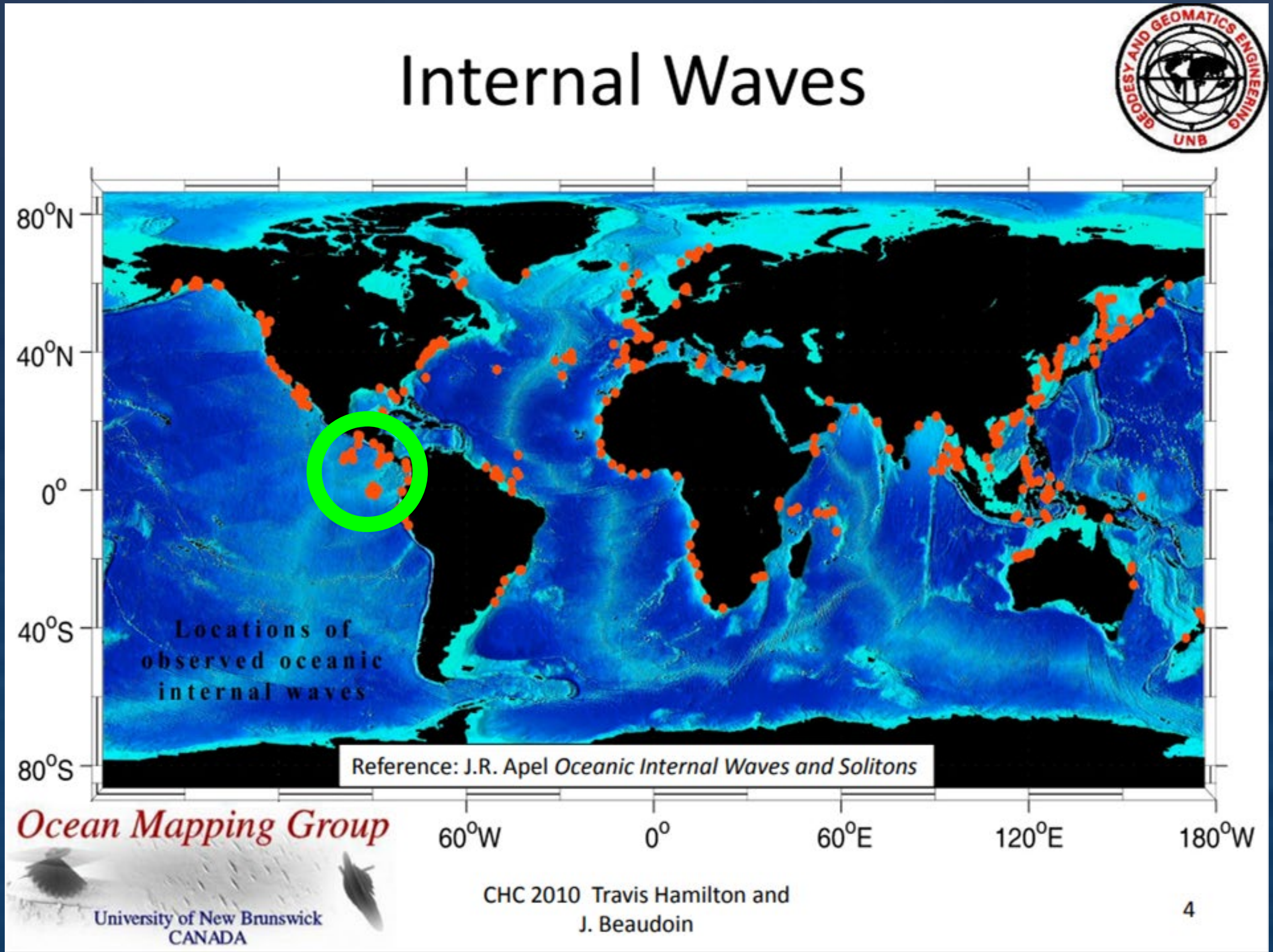


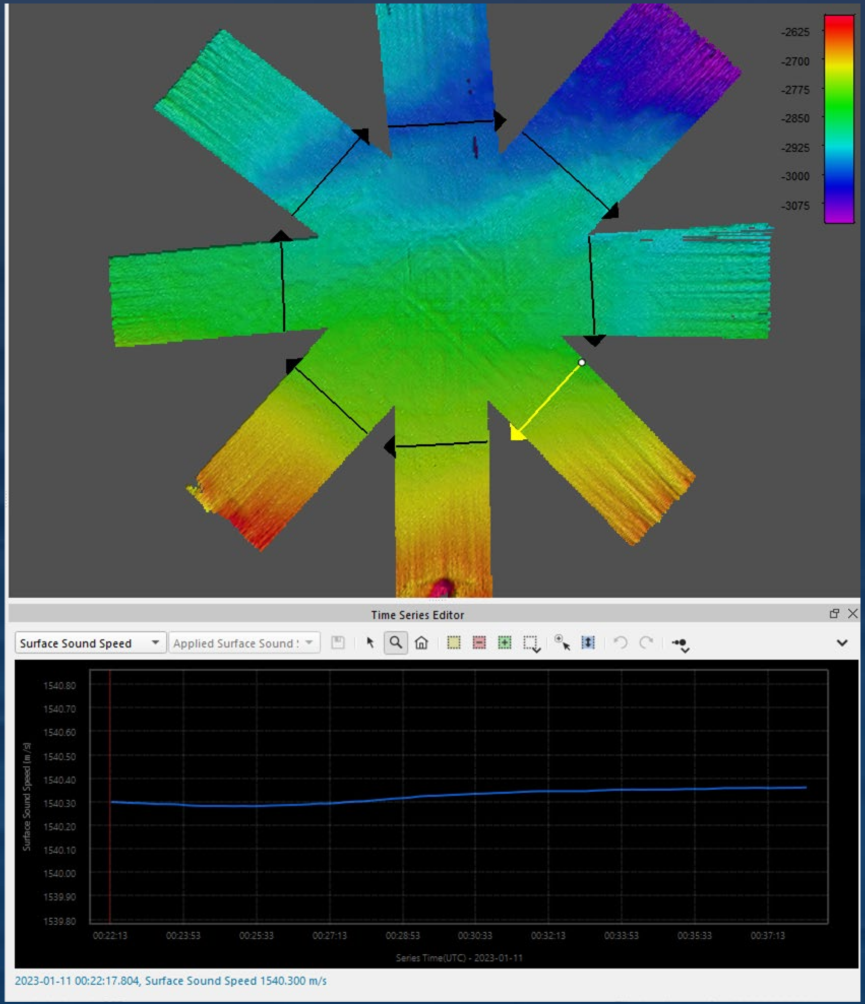
‘Worst’ case: ~50 m wobbles (SW)



Examples from the Field: Swath Wobbles

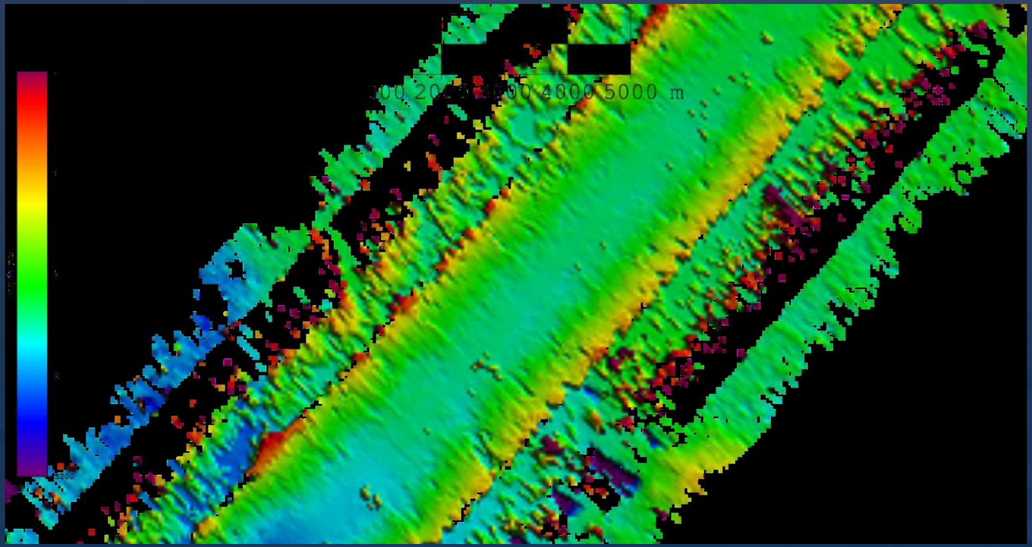
1. Oceanography: Internal waves?
2. Flow-through TSG: Intake depth? Temperature change? Lag time?

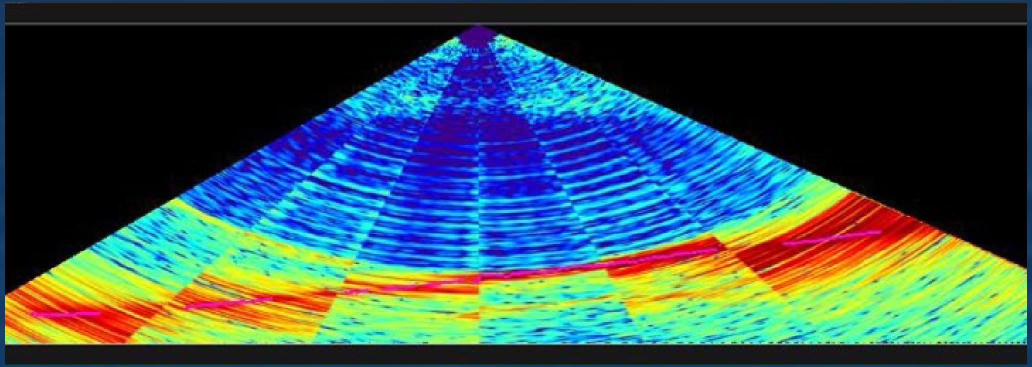


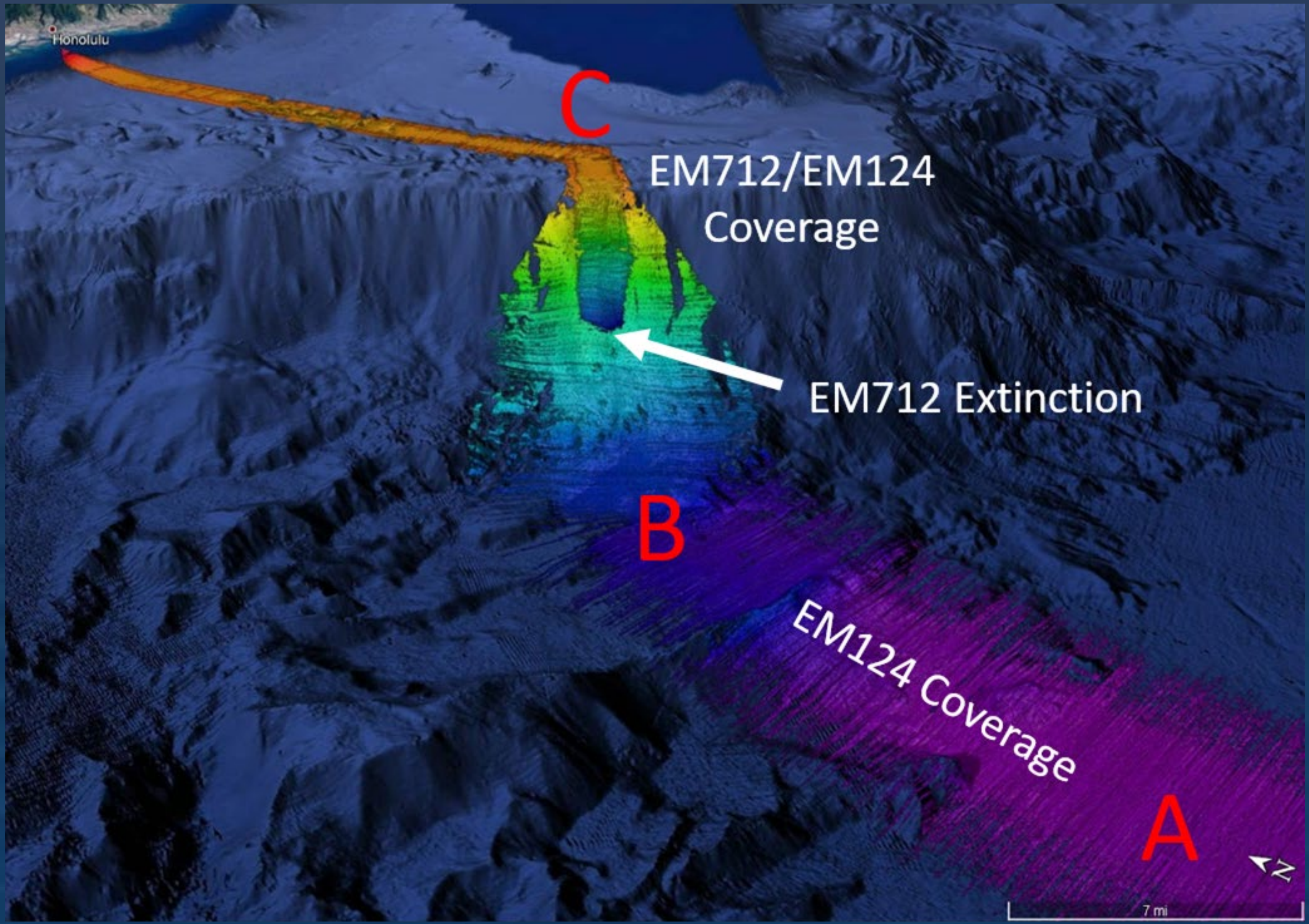


Examples from the Field: Transit Mapping

System performance testing **before** ‘real’ mapping cruises







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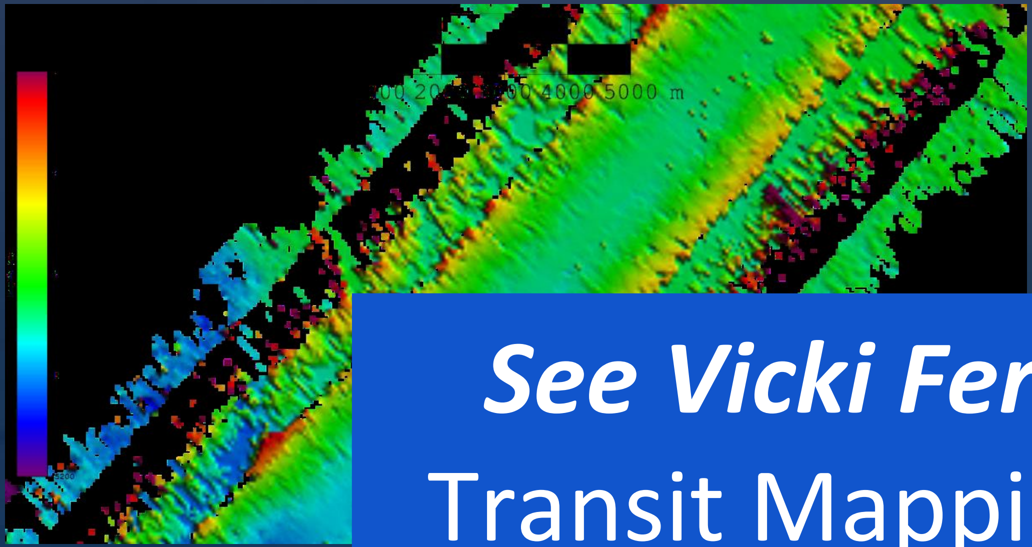

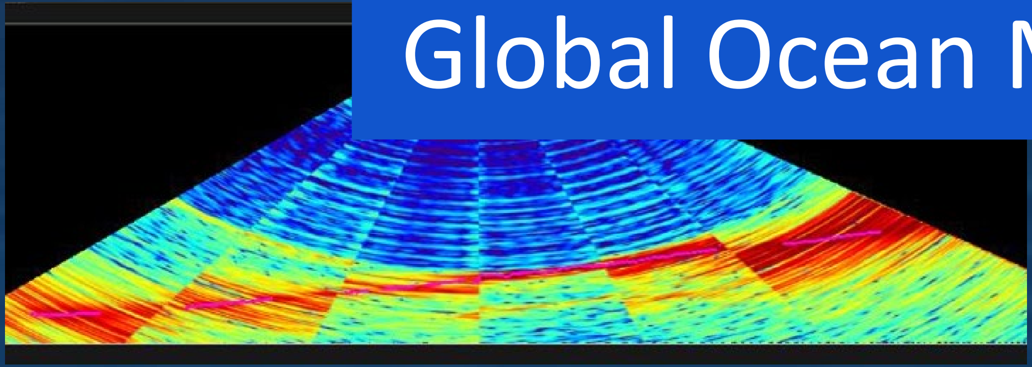

See Vicki Ferrini’s talk at 10:00

Transit Mapping in Support of the Global Ocean Mapping Community

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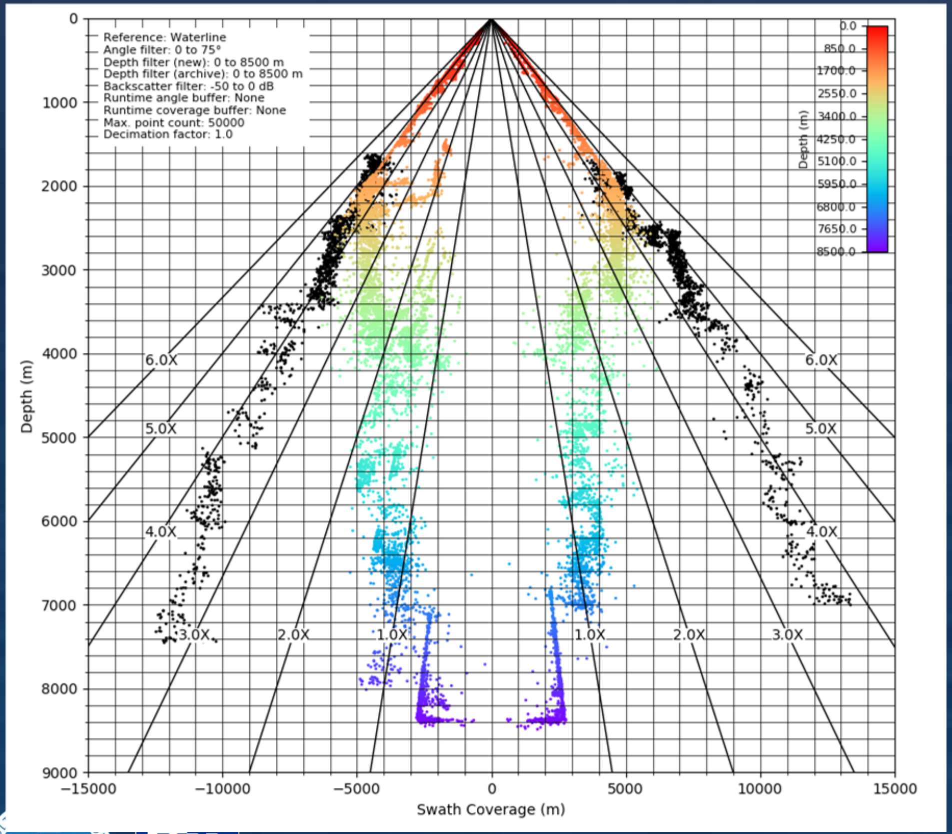
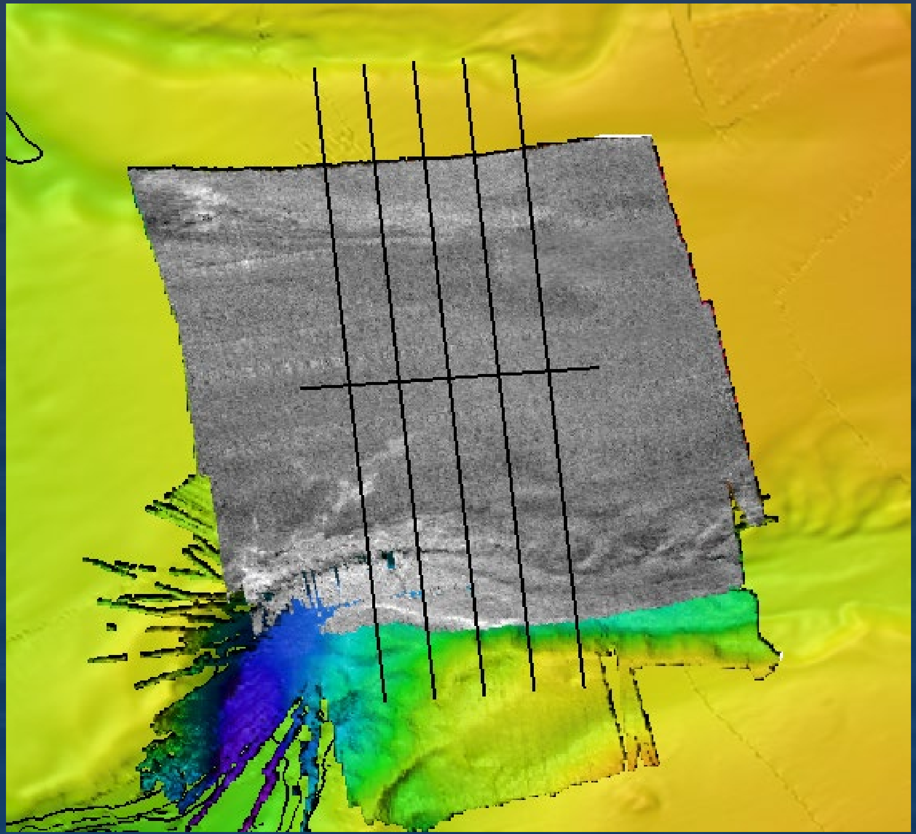
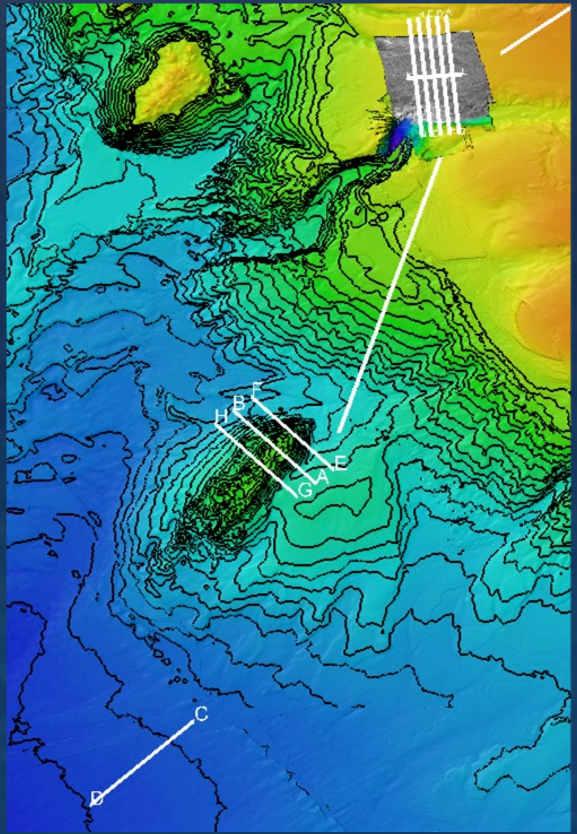
Examples from the Field: Reusing proven test sites

- Common test areas = routine assessments and meaningful comparisons
- SAT/QAT steps can be flexible (with limits) and worked around other activities
- **Advance planning with proven sites means efficient use of ship time and personnel**







Multibeam Test Sites Database – Why is it needed?

Where can I run a test ?

- Depth, slope, seafloor type
- Proximity to other operations
- Exclusion zones / restrictions

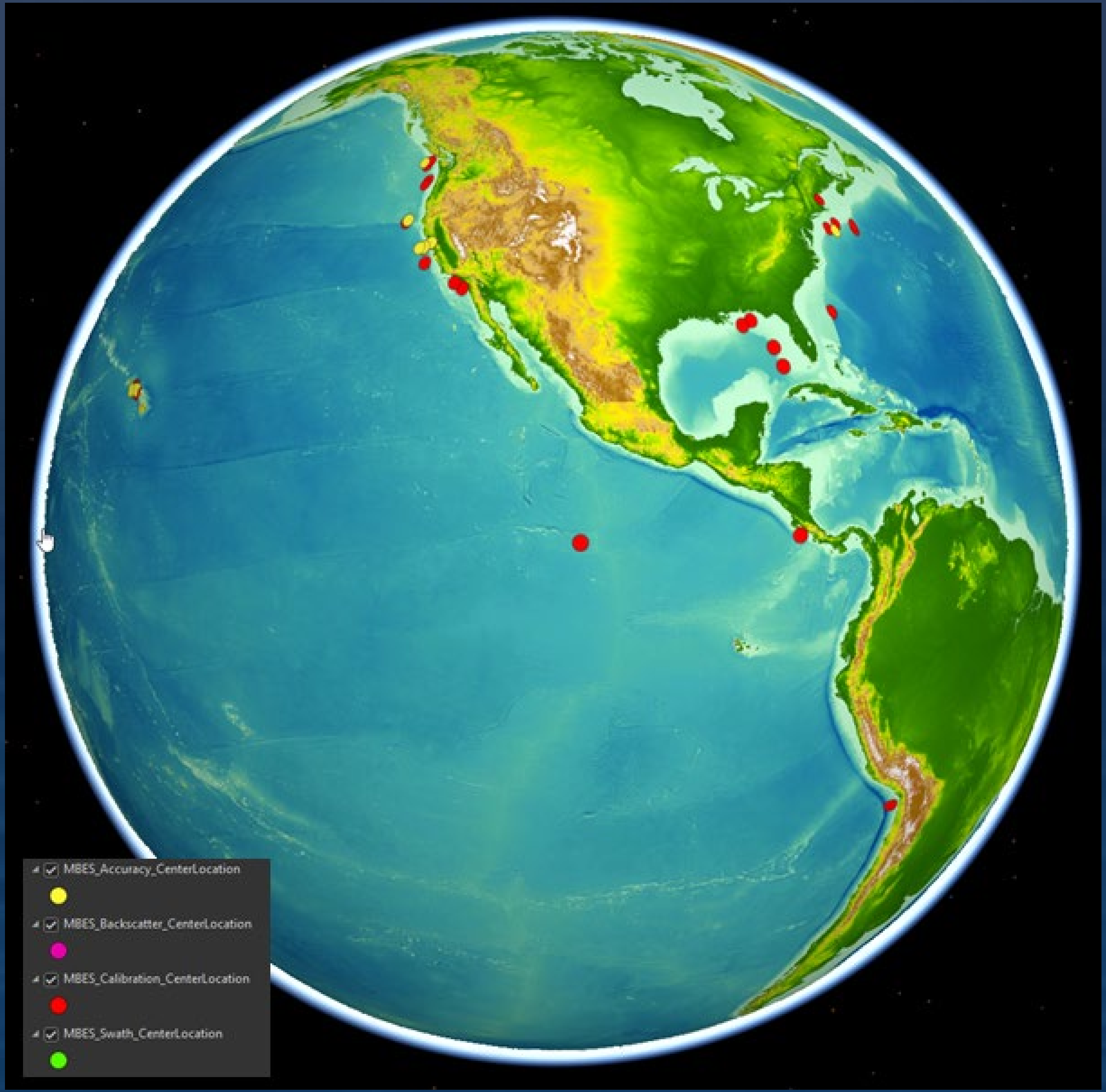
More appropriate sites and comparisons

- Ship to ship / system to system

Opportunistic testing on transits

Significant time savings (ref. surfaces)

Regional planning data can be wrong



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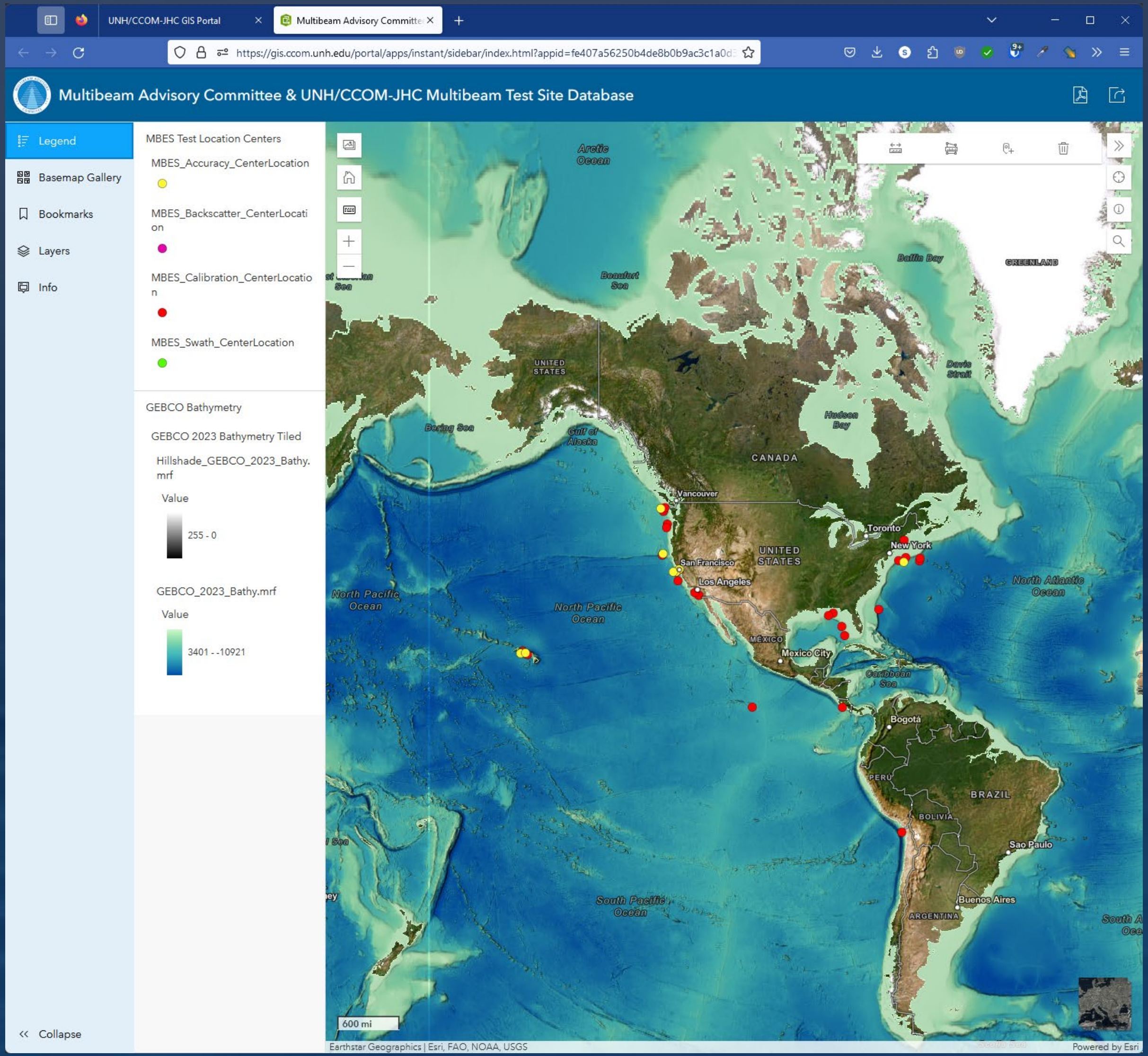
Multibeam Test Sites Database – Prototype WebApp

https://ccom.unh.edu/gis/maps/TestSites



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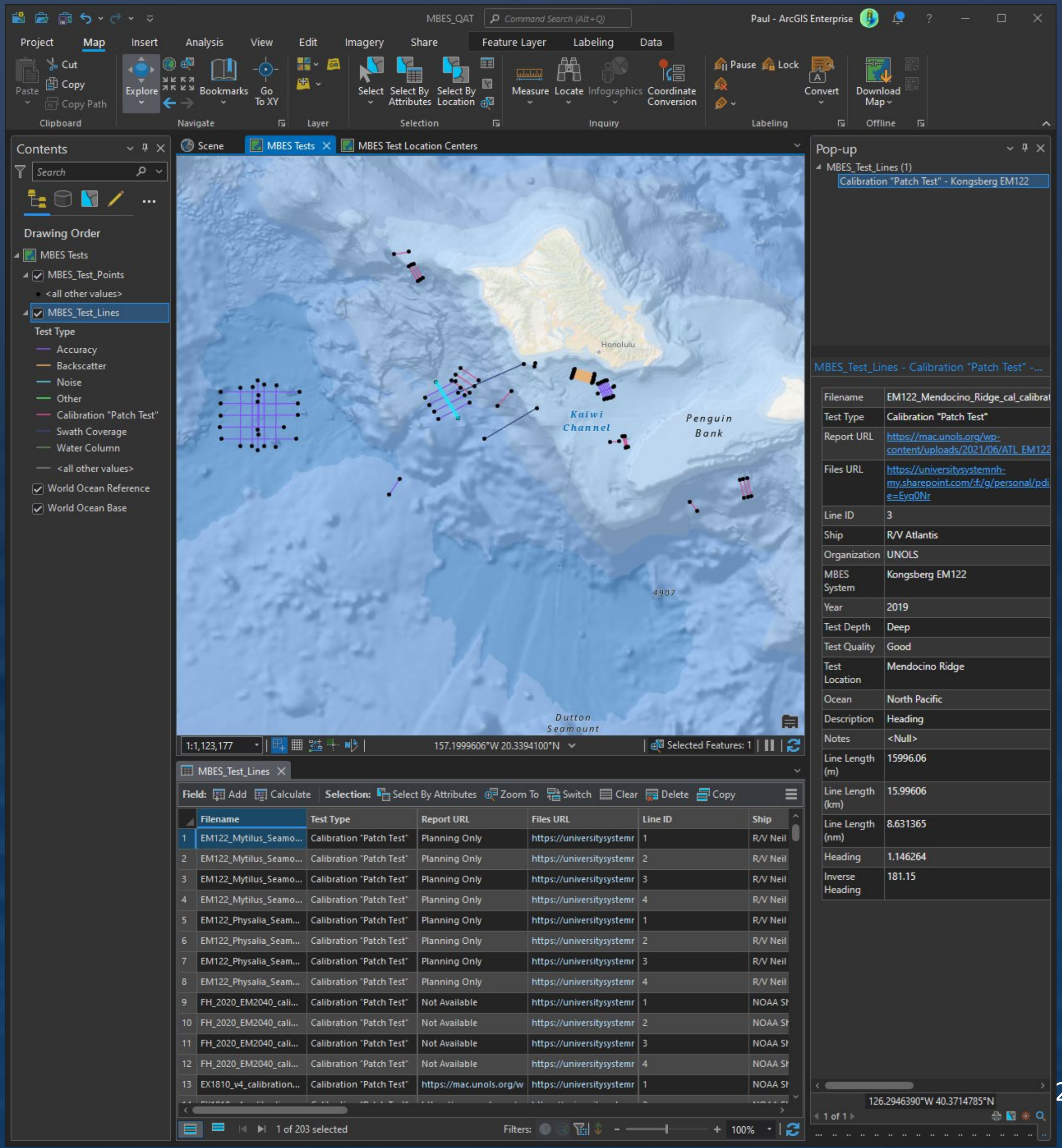
Multibeam Test Sites Database – Site Info

Types of MBES test sites:

- Calibration (Patch Test)
- Swath coverage
- Swath accuracy
- Backscatter normalization
- Water column evaluation

Site info includes:

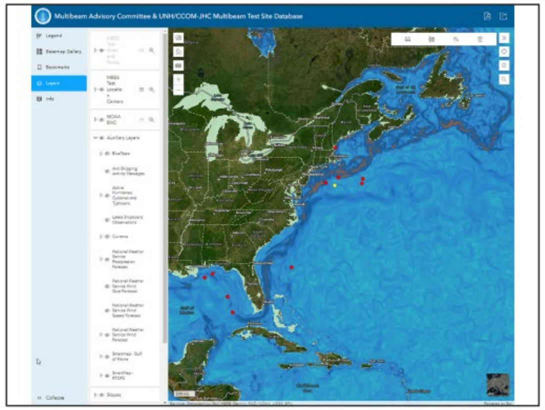
- Test type
- System type
- Location / line plans / settings
- Links to supporting files
- Quality / notes from users



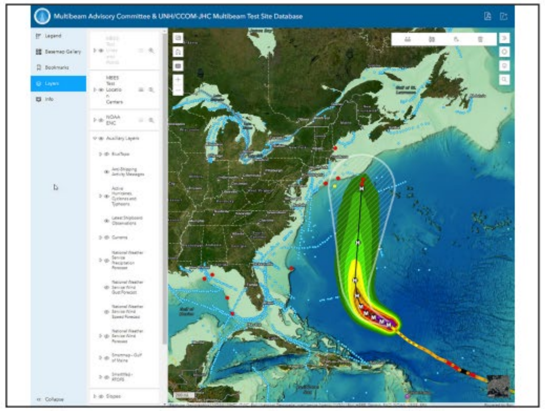
https://gis.ccom.unh.edu

Multibeam Test Sites Database – Planning Layers

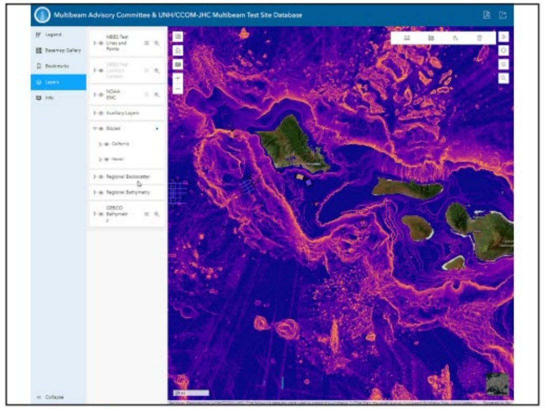
Planning Information



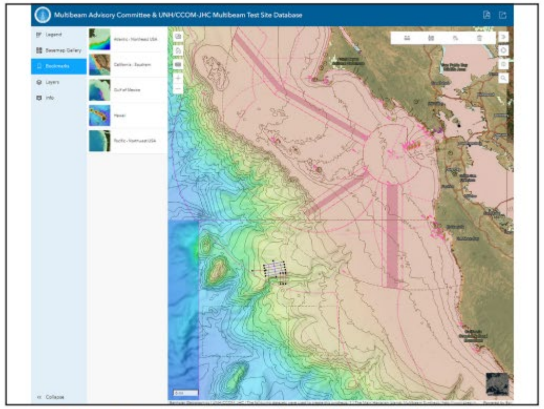
SmartMap Ocean Complexity



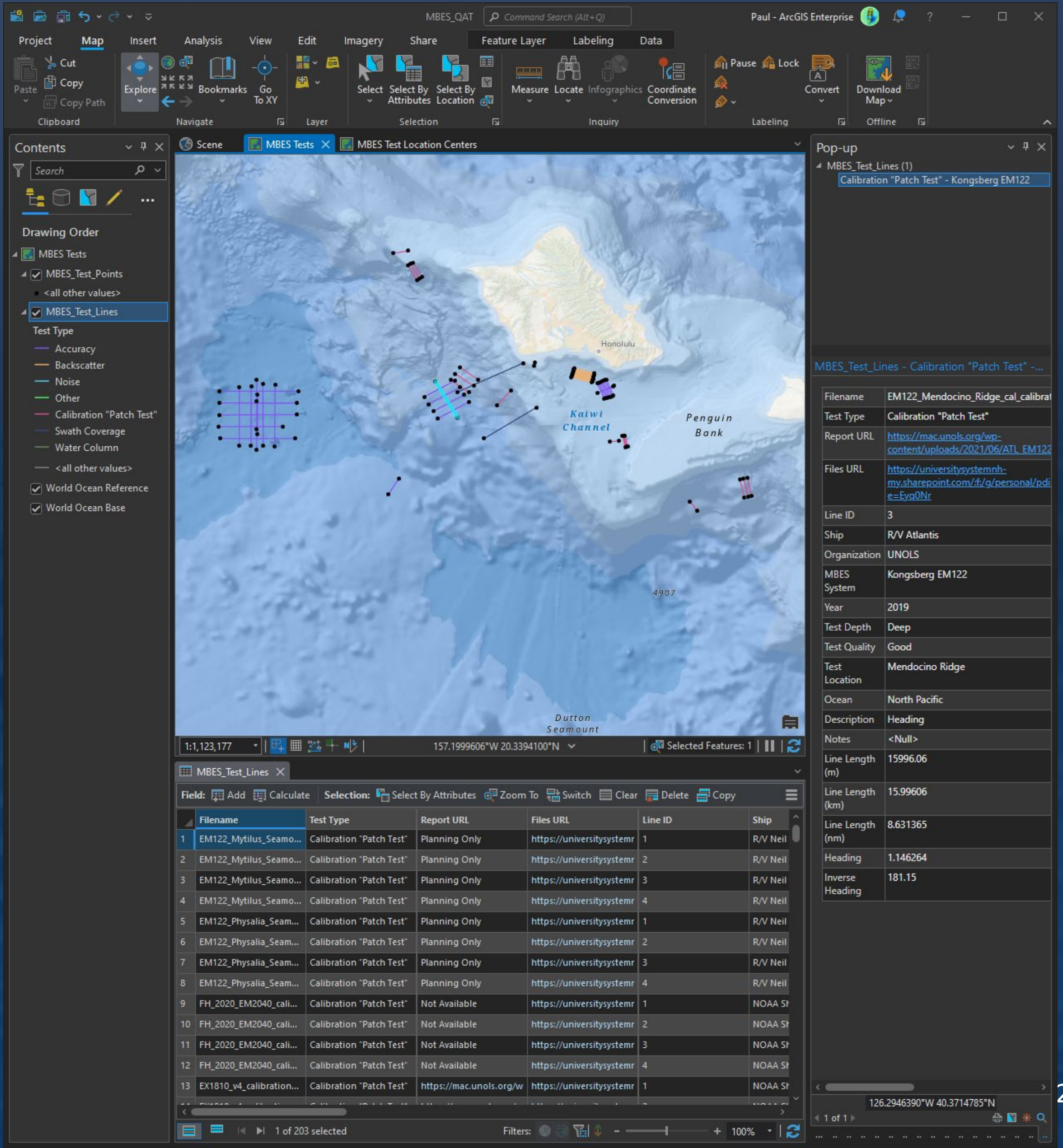
Ocean & Weather Conditions



Regional Bathymetry & Slope



Electronic Navigation Charts

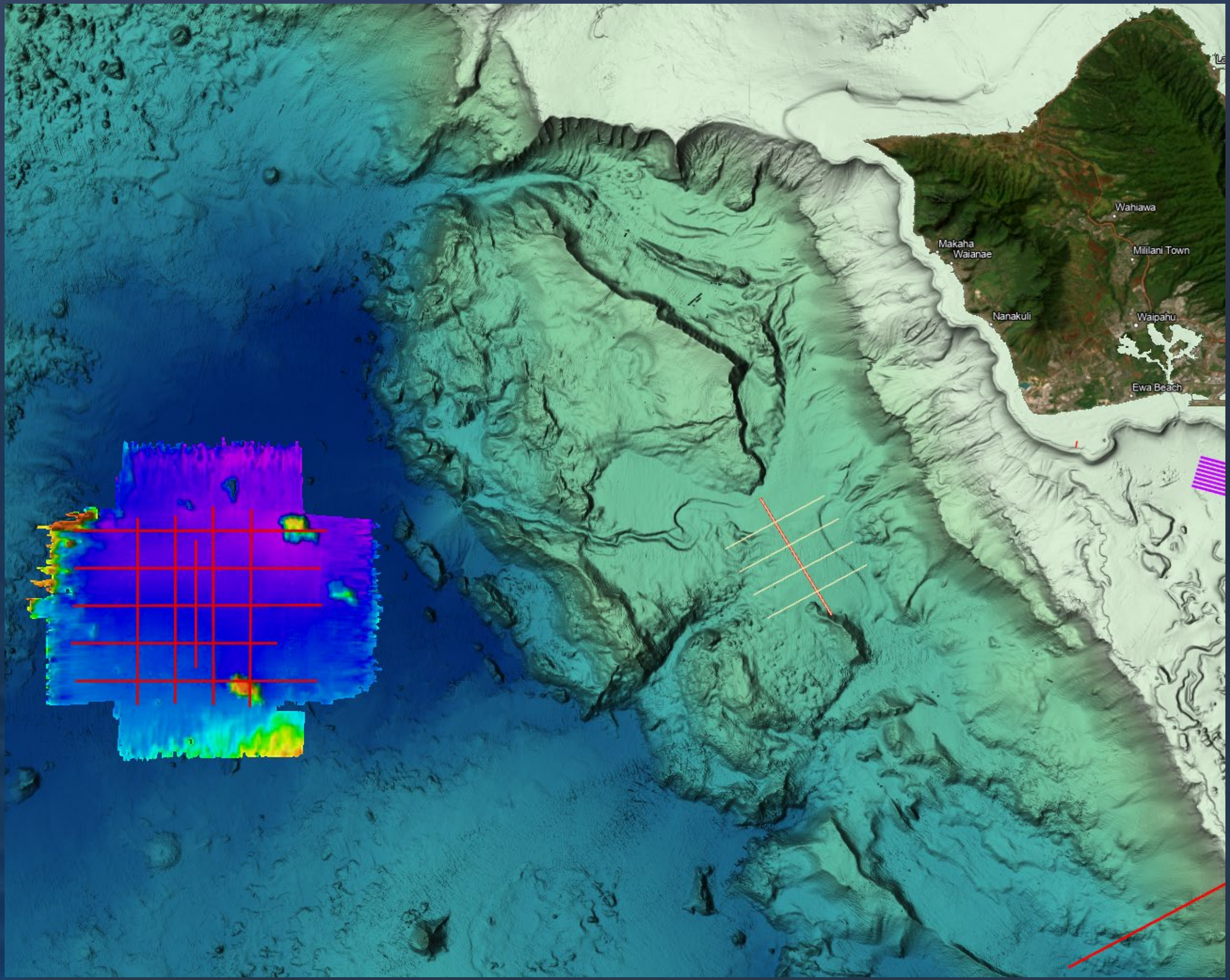


https://gis.ccom.unh.edu

Multibeam Test Sites Database – Recent Example

Hawaii 4700 m reference surface

- 2005 - R/V *Kilo Moana* EM120 (12 kHz)
- Very dense soundings for surface
- **36 hours needed for data collection**



Ships collect accuracy cross lines only

- 2-3 hours per mode

Reused recently by four vessels

- System comparison across ships

NOTE: suitable for stable areas

https://gis.ccom.unh.edu

Multibeam Test Sites Database – Future Work

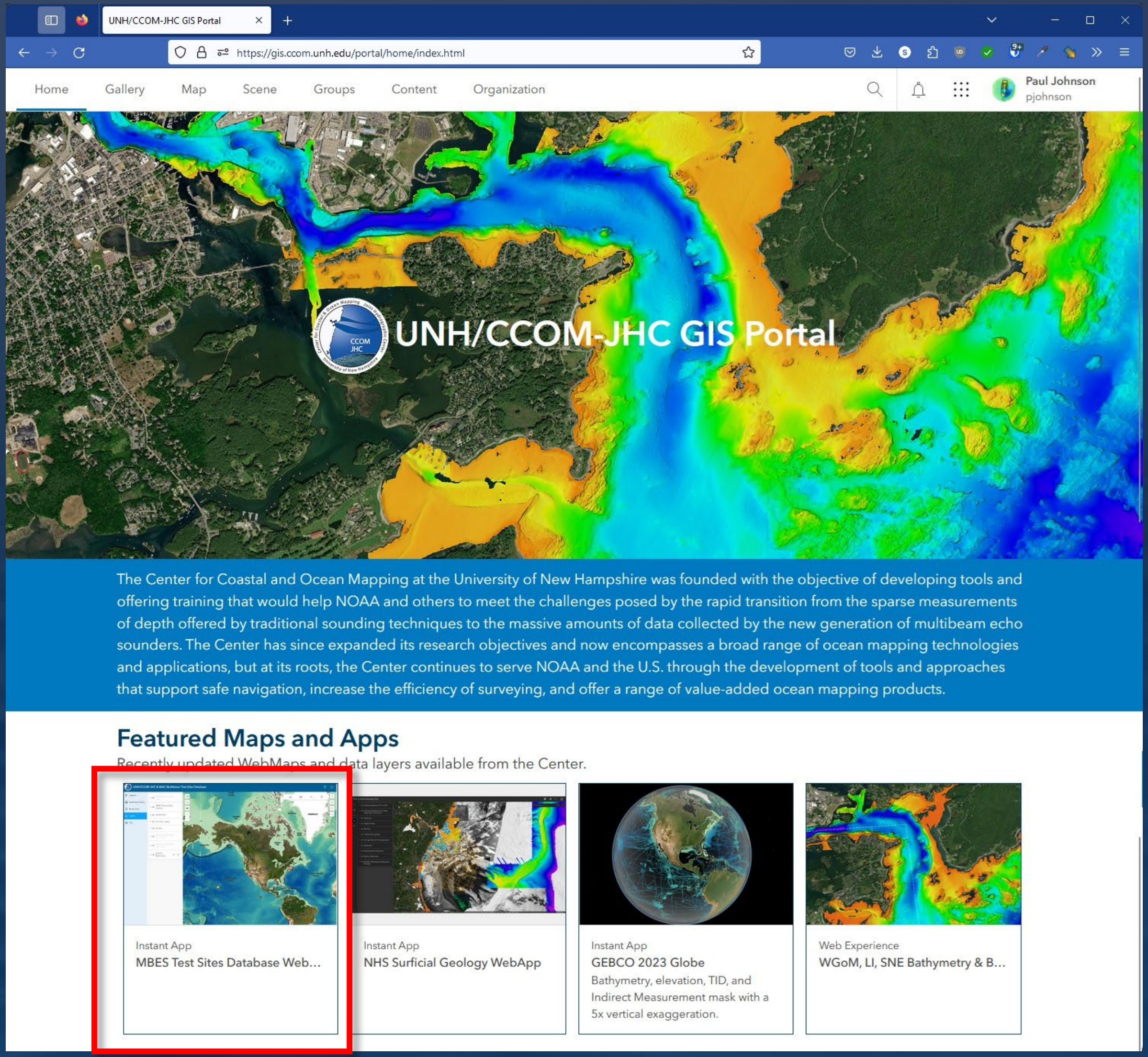
Add new test sites

- NOAA, UNOLS and industry partners
- More sites from FEMME community!
- Reach out at mac-help@unols.org

Standards for file submission

- Line files
- Bathymetry grids
- Operational parameters

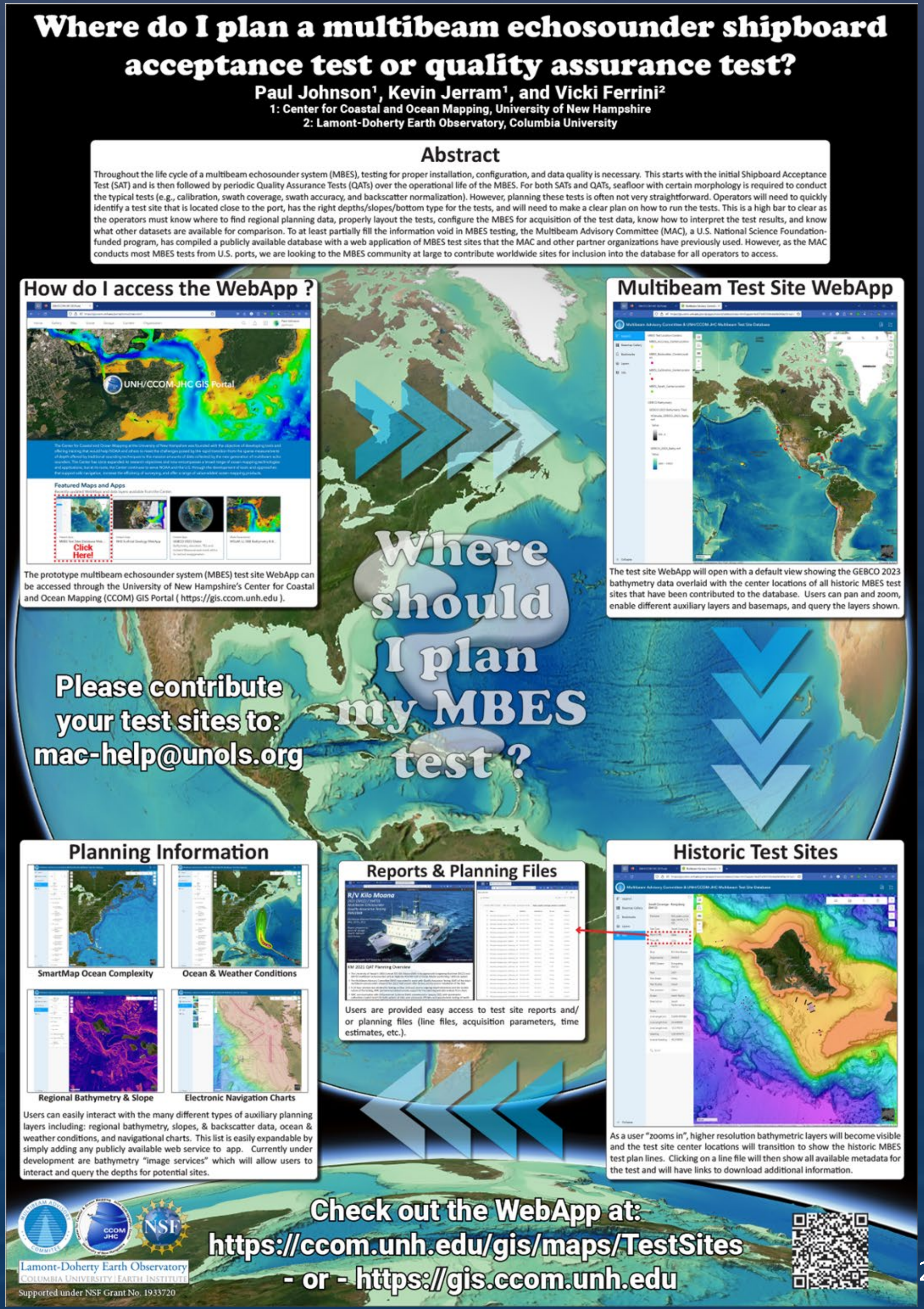
Speed up the WebApp



https://gis.ccom.unh.edu

Multibeam Test Sites Database

Check out the poster and webapp!



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Ocean Mapping Community Wiki

github.com/oceanmapping/community/wiki

What it aims to be:

1. Public resource with context and references
2. Easily updated and expanded
3. Platform for discussion / troubleshooting
4. Welcoming, accessible, and respectful
   a. Admins from MAC, NOAA, and industry

What it will not be:

1. SOP repository (see **Ocean Best Practices**!)
2. Replacement for manufacturer guidance
3. Promotional, preferential, or judgemental

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The **Ocean Mapping Community Wiki** is hosted by the Multibeam Advisory Committee (MAC). This is a collaborative space to share resources and expertise from the global ocean mapping community, with the aim of improving data quality for all.

The value of this wiki depends on community involvement. Your helpful resources, best practices, and 'lessons learned' are welcome! Get involved by becoming a contributor or joining the public discussions and troubleshooting forums.

Announcements

Check out the Community Announcements and Awareness section for non-commercial news from around the ocean mapping community.

Contributing

We hope you'll add your expertise to the conversation and provide feedback.

See the Contribution Guidelines to see who is contributing and how we are moderating the site content.

Recently updated

1. Help out your navigators with the ECDIS Converter for survey line plans
2. Share non-commercial news under the Community Announcements and Awareness section
3. Concatenate files in the File Trimmer (e.g., for patch test processing)
4. Sound Speed Manager now supports World Ocean Atlas 2018!
5. The Swath Coverage Plotter now tracks changes in multibeam settings and offsets
6. Added a Wishlist for priority topics - chime in!
7. Started a Software Updates page to easily find the latest versions of common mapping software
8. Added an informal list of Top 10 Multibeam Issues to highlight common complications (and solutions)
9. Made a new page for Sea Acceptance Testing (and Quality Assurance Testing) to discuss approaches and expectations

Note: Force-refresh your browser cache (e.g., F5) if links appear misdirected.

Multibeam topics

A wide variety of topics have been suggested by partners in academia, government, and industry.

This list is **under development**; suggestions are welcome!

1. Dimensional control - sensor offsets and survey info required for system performance
2. Calibration - resources for calibrating multibeam sonars
3. SAT/QAT approaches - sea acceptance trials (SAT) and quality assurance testing (QAT)
4. Sound speed - recommendations for incorporating sound speed into survey operations
5. Data acquisition - key requirements and recommendations during acquisition
6. Data processing - available software and resources for processing
7. Backscatter processing - guidance for improving backscatter imagery
8. Backscatter normalization - steps for correcting hardware-level biases
9. Assessment tools - tools to help assess multibeam data quality and performance
10. Transit mapping - route planning to **map the gaps** and verify system performance
11. Troubleshooting - common symptoms and solutions to augment manufacturer support

Other mapping topics

Resources for other systems, from the surface through the sediments.

Mapping basics

Pages 17

Find a page...

- Home
  - Announcements
  - Contributing
    - Recently updated
  - Multibeam topics
  - Other mapping topics
    - Mapping basics
    - ADCP resources
    - Midwater mapping
    - Subbottom profiling
    - Positioning
      - Helpful links
  - Resources
    - Open-source data tools
    - Best practices
    - Helpful presentations and papers
    - Why map the ocean?
    - Multibeam Advisory Committee
  - Contact us
- Assessment Tools
- Backscatter Normalization
- Backscatter Processing
- Calibration (Patch Test)
- Contributing
- Data Acquisition
- Dimensional Control
- Hardware Health
- Multibeam Data Processing
- Sea Acceptance Testing
- Software Updates
- Sound Speed
- Top 10 multibeam issues
- Transit Mapping

Show 2 more pages...

+ Add a custom sidebar

Clone this wiki locally

https://github.com/oceanmapping/co

Ocean Mapping Community Wiki

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

All mappers and managers are invited to contribute

oceanmapping / community

Type / to search

Code | Issues 8 | Pull requests | Discussions | Actions | Projects | Wiki | Security | Insights

Filters | is:issue is:open | Labels 45 | Milestones 0 | New issue

8 Open ✓ 21 Closed — Author | Label | Projects | Milestones | Assignee | Sort

- CBMF 1: Timed out waiting for samples — 1
  #45 opened 3 weeks ago by kvonkrusenstiernOX
- Real-time coverage grid stops updating in Kongsberg SIS [gridding] [kongsberg] [sis4] [sis5] — 3
  #39 opened on Jun 13 by ejheffron
- Inmarsat C interference with POS MV GNSS antennas [applanix] [dropout] [gnss] [hardware] [inmarsat] [pos mv] — 1
  #38 opened on May 25 by kjerram
- GSF issues/limitations [data processing] [em304] [gsf] [qimera] — 5
  #37 opened on Apr 12 by ejheffron
- Helmsman Tool does not work in UTM Projection
  #36 opened on Apr 6 by shoy-NOAA
- ALL USERS: Become a collaborator on GitHub for Issue tagging and notification options
  #32 opened on Mar 27 by kjerram
- Qimera distances are always grid distances [bug] [data processing] [qimera]
  #31 opened on Mar 24 by lindsaymbc
- ALL USERS: Clear the search bar to see ALL ISSUES! [doh!] [wontfix]
  #21 opened on Oct 19, 2022 by kjerram

Welcome

Welcome to the Ocean Mapping Community Wiki!

Thank you for contributing your expertise and experience.

As with the rest of the wiki, these Contribution Guidelines are in development to help establish a high degree of relevance and ease-of-use.

In all cases, we seek to follow the Code of Conduct and GitHub Community Guidelines

Scope

It is important to consider the scope of the wiki so its content is relevant and easily maintained. Suggested topics for multibeam and other systems have been added by the first contributors, highlighting some areas of common interest.

The intent is to point users, new and expert, toward the most helpful and up-to-date resources so they can make informed decisions about installation, operation, and processing. It is not meant to be prescriptive for any particular system or insist on any 'one size fits all' approach.

Content should:

1. **Apply broadly** for mapping operations
2. **Highlight examples** of successful use cases
   i. Show us how you did it!
3. **Discuss limitations** or caveats of an approach
4. **Protect** IT security and sensitive information
5. **Respect** the expertise of others and differences among programs

Troubleshooting steps are also of interest for solving common issues.

Adding and editing content

Through GitHub

Please contact us to be added as a GitHub collaborator.

1. Review the existing topics to see where your content fits.
2. Whenever possible, expand on existing topics and add sub-topics to existing pages.
   i. As the site grows, we will reorganize as necessary to improve clarity or context.
3. Add or edit content directly with the GitHub wiki editing features
   i. Check out GitHub's quick guides for adding or editing wiki pages and basic syntax to get started
4. Images require URLs; upload images from your computer to the wiki repository (Code --> Add file) to generate a URL
5. Wherever possible, link to resources (e.g., SOPs) hosted by others rather than uploading separate copies to the repository
   i. This will simplify updates as new versions of these documents are released

Remember this is new for many of us and we are excited for your contributions!

Contact us

You don't have join GitHub to contribute. Please reach out to any of the wiki managers with the content or updates you'd like to see.

Support

Helpful resources from GitHub and others:

1. Writing on GitHub
2. Using wikis
3. Markdown cheatsheet
4. Using GitHub Issues for troubleshooting
5. Resizing images in articles
6. Add other resources you like!

- Home
  - Contributing
    - Contribution Guidelines
  - Multibeam topics
  - Other mapping topics
    - Mapping basics
    - ADCP resources
    - Midwater mapping
    - Subbottom profiling
    - Positioning
      - Helpful links
  - Resources
    - Open-source data tools
    - Best practices
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- Contributing
- Data Acquisition
- Dimensional Control
- Multibeam Data Processing
- Sound Speed
- Transit Mapping
- Troubleshooting
- Water Column Mapping

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Assessment Tools

kjerram edited this page on Apr 6 · 40 revisions

Overview

Multibeam assessment tools described here include:

1. Swath Coverage Plotter v0.2.3
2. Swath Accuracy Plotter v0.1.0
3. BIST Plotter v0.2.2
4. File Trimmer v0.1.5
5. ECDIS Converter v0.0.3

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.
3. **Python folks**: source code is available in the multibeam_tools repository.

Using the tools

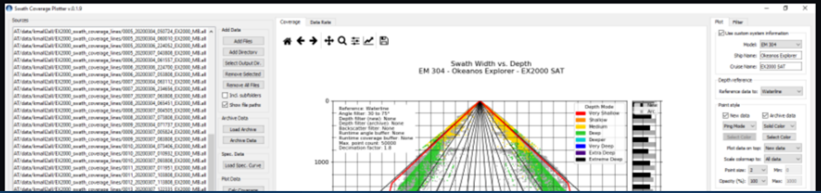
These tools are intended to give users the same plotting and reporting functions used by the MAC for routine performance testing (e.g., sea acceptance trials and quality assurance testing). Currently, only Kongsberg data formats are supported.

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.



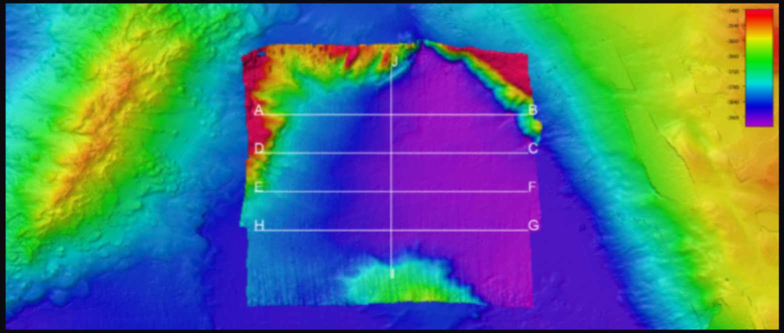
Reference survey acquisition

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.

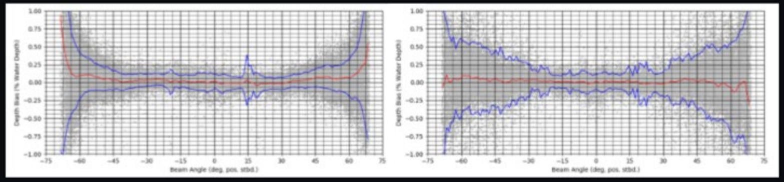


Crossline data acquisition

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.

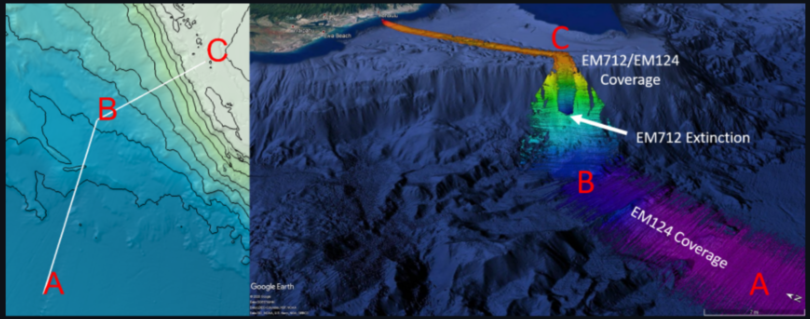
Crosslines are typically run in 'pairs' on opposite headings for each mode to assess any heading-dependent impacts, such as sea state (example below shows accuracy heading with seas and into seas shown on top and bottom, respectively). When seas are calm, this approach also supports deep roll verification 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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github.com/oceanmapping/community/wiki

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

Sensors

Manufacturers define sensor reference points that must be interpreted correctly when configuring that sensor's software.

As with axis and sign conventions, misinterpretation of these definitions will cause data quality issues that cannot always be addressed in post-processing.

Reference points are presented below for several common sensors (alphabetical order). All units are meters unless otherwise noted.

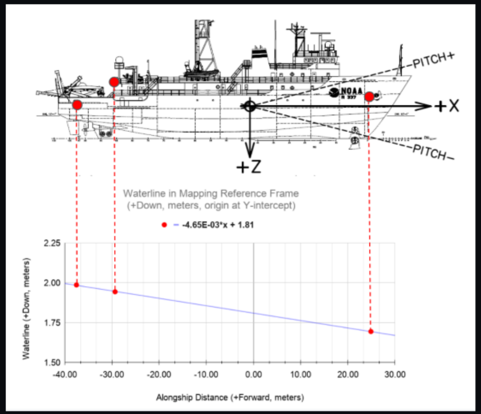
TABLE IN DEVELOPMENT; GitHub-flavored Markdown experts welcome!

It is always recommended to confirm these conventions with the most recent manufacturer documentation. Sources are linked if publicly available; otherwise, please consult the manufacturer.

Transducer	**Reference Point**	**Source**
Kongsberg TX/RX arrays	Center of array face[1]	Kongsberg manual
Kongsberg EM2040 portable	[Pending review][2]	Kongsberg manual
Norbit		
Reson T20/T50	Sonar ref. point (see manual)[3]	Reson T-Series manual
Reson 7125		
Reson 7160	Sonar ref. point (see manual)[3]	Reson 7160 manual
R2Sonic	Acoustic centers of TX (horiz.) / RX (vert.)	R2Sonic knowledgebase
Simrad EK80	Center of array face	Simrad manual (?)
Motion Sensor	**Reference Point**	**Source**
Applanix IMU	Target on housing	Applanix manual[4]
iXBlue PHINS IMU	Sensing center	
Seapath MRU 5+	Target on housing	Seapath manual[5]
Antenna	**Reference Point**	**Source**
AeroAntenna	Notch 1.90 inch above base	Antenna 'notch' specification
Trimble (AeroAntenna) AT1675-540-TS	Phase center 57.75 mm above base	Antenna specification
Trimble GA830	Phase center 88.8 mm above base	Antenna specification
NovAtel GNSS-850	Phase center 51.7 mm above base	Antenna diagram[6]
NovAtel GPS-702-GG	Phase center 66.0 mm (L1) above base	NovAtel GPS-702/701 User Guide
NovAtel GPS-702-GGG	Phase center 65.0 mm above base	
NovAtel GPS-713-GGG-N	Phase center 61.5 mm (L1) above base	Antenna specification
Waterline	**Reference Point**	**Source**
Kongsberg	WL from origin **meters positive down**	Kongsberg manual
PPS Output	**Edge Configuration**	**Source**
Applanix POS MV	Falling edge	Applanix manual
Seapath	Rising edge	Seapath 320 manual

1. For all EM models, including most EM2040 (narrow beamwidths / large arrays); need to verify for arrays with ice protection
2. Need to verify whether all EM2040 models use separate array offsets or if some use a bracket location

Waterline



If survey data are to be referenced to the water level (regardless of later tide correction), then the waterline on the vessel must be measured and configured appropriately in the mapping system reference frame.

The conventions for measuring and configuring waterline vary, and waterline naturally changes with loading and location around the hull. For many applications, it is sufficient to estimate waterline using draft marks or sight tubes and converting these into a 'best-fit' water level around the vessel; this yields the waterline offset at the location required by the mapping system.

For instance, Kongsberg requires the Waterline parameter in meters, positive down from the origin. The example shows a best-fit line through water level measurements taken from surveyed benchmarks around the hull, yielding the waterline offset of +1.80 m at the mapping system origin.

The approach outlined above, translating water levels measured from benchmarks into the mapping system frame, is typically sufficient for deepwater mapping referenced to the water level. However, shallow water configurations may require more detailed waterline estimates with consideration for dynamic draft (if not referenced to the ellipsoid).

Survey reports

It is common for a single survey report to be referenced routinely for the entire service life of a multibeam mapping system. When sensors are moved or replaced, the original survey is used to re-establish the vessel frame and tie in new equipment.

Keeping this in mind, the costs of a high-quality initial survey and clear report are relatively small compared to the ship (and human) time spent acquiring and processing reduced-quality data. In some cases, the vessel must be dry-docked to repeat the survey for proper mapping system configuration.

Recommendations

The MAC developed a set of recommendations for mapping vessel survey reports based on a wide array of experiences interpreting these documents. This guide is intended to help the surveyor ensure that their final report can be easily and correctly interpreted by the vessel operator to reduce windows of opportunity for error in translation, as well as serve as a clear foundation for future vessel surveys in the years ahead.

The recommendations address a few common pitfalls:

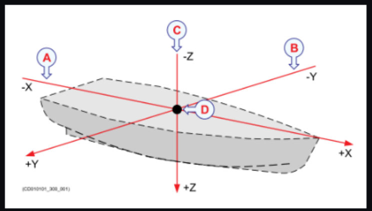
1. even 'good' survey results (meeting the manufacturer's requirements) are reported with ambiguous, inconsistent, or incorrect axis and sign conventions;
2. the mapping system reference frame and sensor reference points are not clearly identified;
3. the report lacks photos or diagrams of the measured locations, leading to errors in interpretation;
4. mapping systems are sometimes configured using 'draft' reports before errors are discovered (e.g., when a final report is not available before sea acceptance trials).

The MAC welcomes other user experiences and recommendations related to mapping system survey reports.

Axis and Sign Conventions

Manufacturers define axis and sign conventions that *must be applied correctly* when interpreting survey reports and configuring software. Misinterpretation of these conventions will cause data quality issues that cannot always be addressed in post-processing.

For example, the Kongsberg reference frame convention is presented below.



Axis and sign conventions are presented below for several hardware manufacturers (alphabetical order). All units are meters and degrees unless otherwise noted.

It is always recommended to confirm these conventions with the most recent manufacturer documentation. Sources are linked if publicly available; otherwise, please consult the manufacturer.

System	**+X**	**+Y**	**+Z**	**+Roll**	**+Pitch**	**+Heading**	**+Heave**	**+Waterline**	**Source**
Applanix	FWD	STBD	DOWN	PORT UP	BOW UP	COMPASS	DOWN	N/A	POS MV V5 Guide (Rev. 4) secs. 2-31, 5-8
iXBlue[1]	FWD	PORT	UP	PORT UP	BOW DOWN	COMPASS	N/A[4]	N/A	PHINS Manual (Rev. Q) pp. 42-45
Kongsberg	FWD	STBD	DOWN	PORT UP	BOW UP	COMPASS	N/A[4]	DOWN[5]	EM Installation Manual p. 140
Reson[2]	STBD	FWD	UP	PORT UP	BOW UP	COMPASS	N/A[4]	UP[6]	Teledyne PDS p. 117, Calibration p. 20
Seapath	FWD	STBD	DOWN	PORT UP	BOW UP	COMPASS	DOWN	N/A	MRU 5+ Installation Manual (Rev. 8) pp. 33, 146
Simrad[3]	FWD	STBD	DOWN	PORT UP	BOW UP	COMPASS	N/A[4]	DOWN[7]	EK80 Manual, Transducer Installation
Software	**+X**	**+Y**	**+Z**	**+Roll**	**+Pitch**	**+Heading**	**+Heave**	**+Waterline**	**Source**
Caris HIPS/SIPS	STBD	FWD	DOWN	PORT UP	BOW UP	COMPASS	(needed)	(needed)	Caris HIPS/SIPS v8.1 manual
QPS Qimera	FWD	STBD	UP	PORT UP	BOW UP	COMPASS	DOWN	Draft and HADR[8]	Qimera v2.5 manual

1. iXBlue alongship (X), athwartship (Y), and vertical (Z) axes are named '1', '2', and '3', respectively.
2. Reson conventions may differ between models and documents (e.g., T50 dual-head drawings are +X forward, +Y starboard, Z+ down)
3. Simrad rotations are assumed to follow the right-hand rule (as do Seapath and other Kongsberg products)

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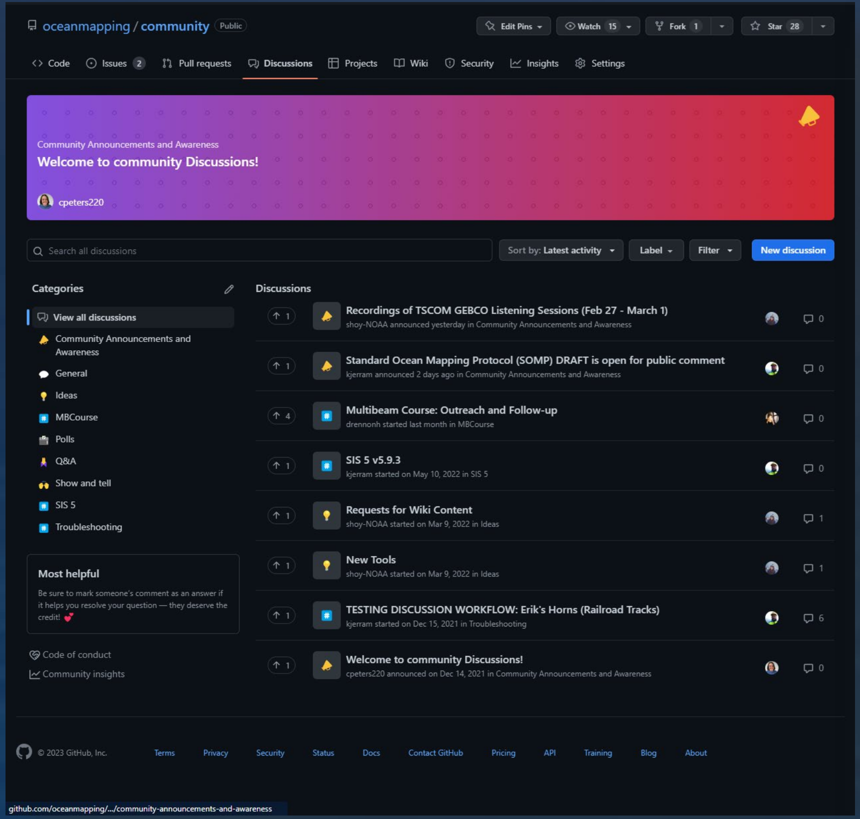
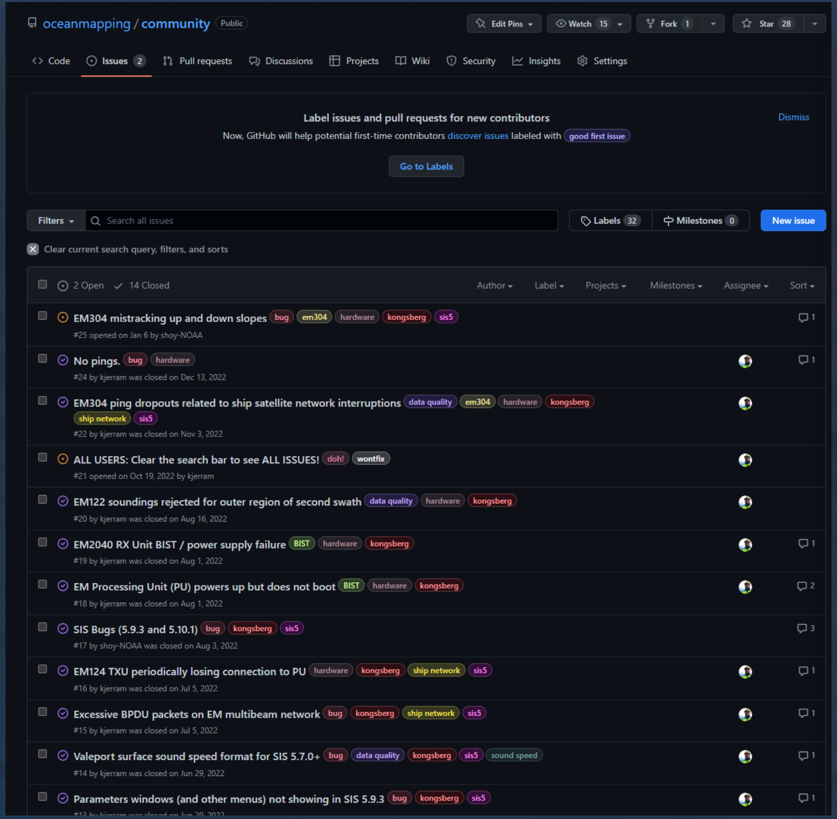
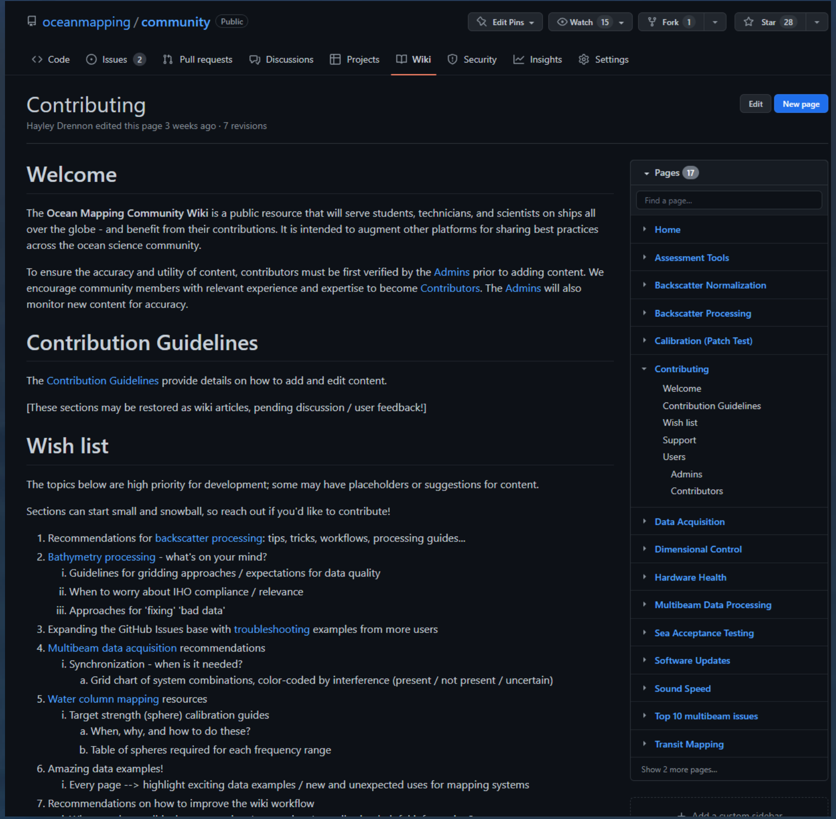
Discussions



Troubleshooting



Contributing



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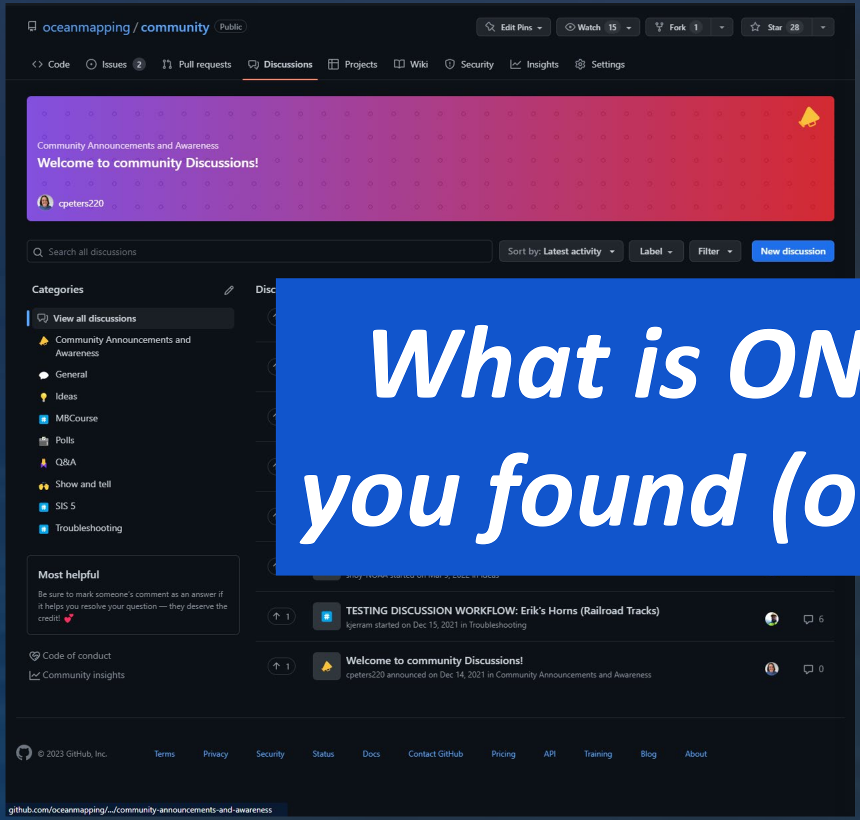

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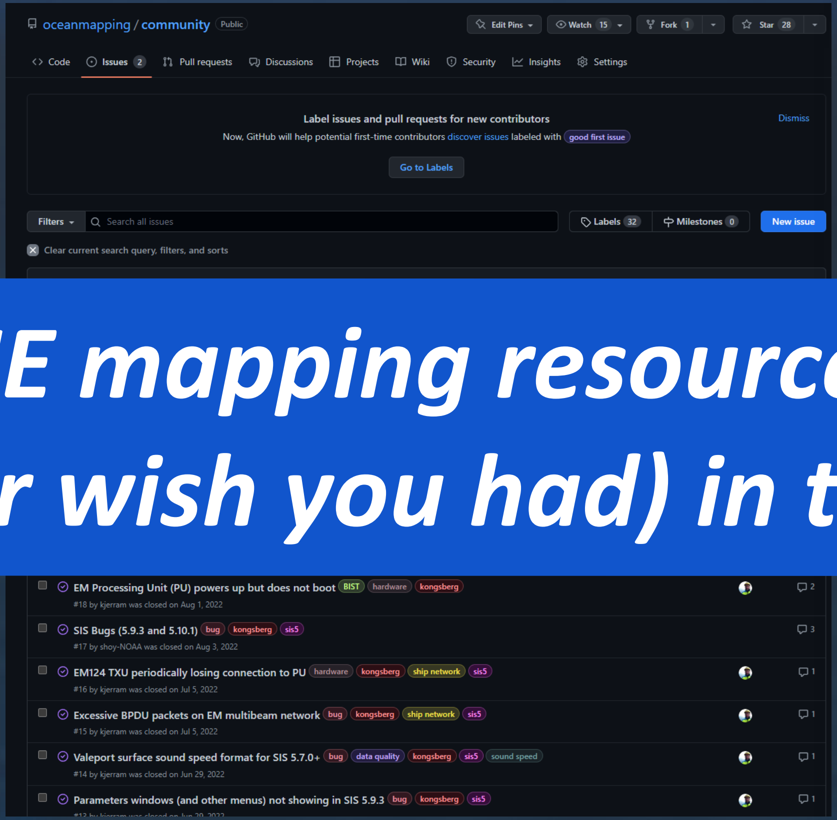
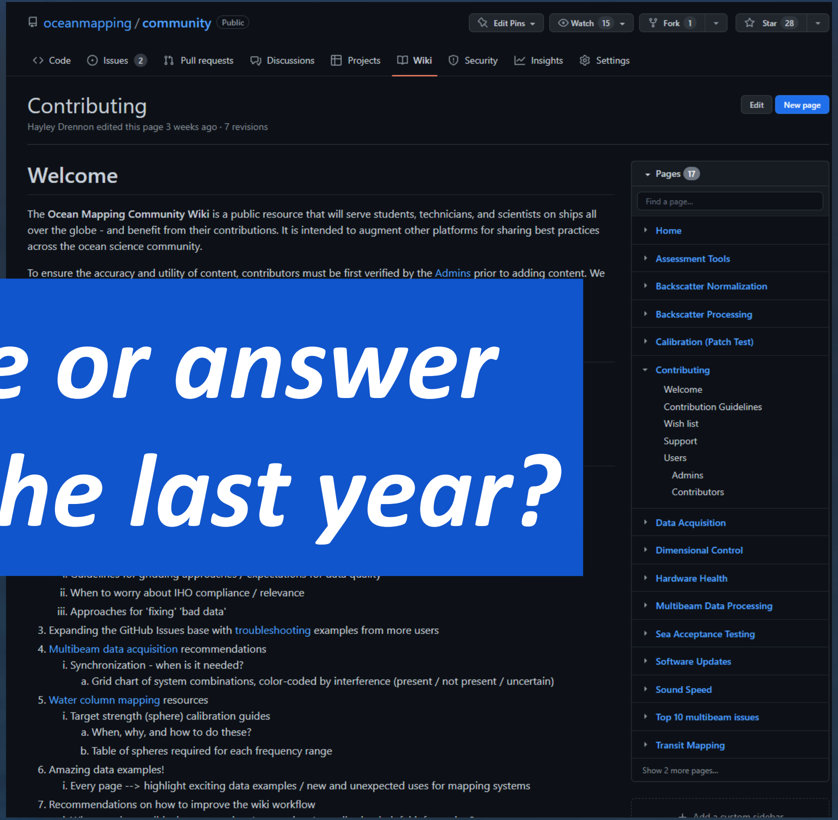


Contributing



What is ONE mapping resource or answer you found (or wish you had) in the last year?

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Example from the Wiki: EM304 Dropouts

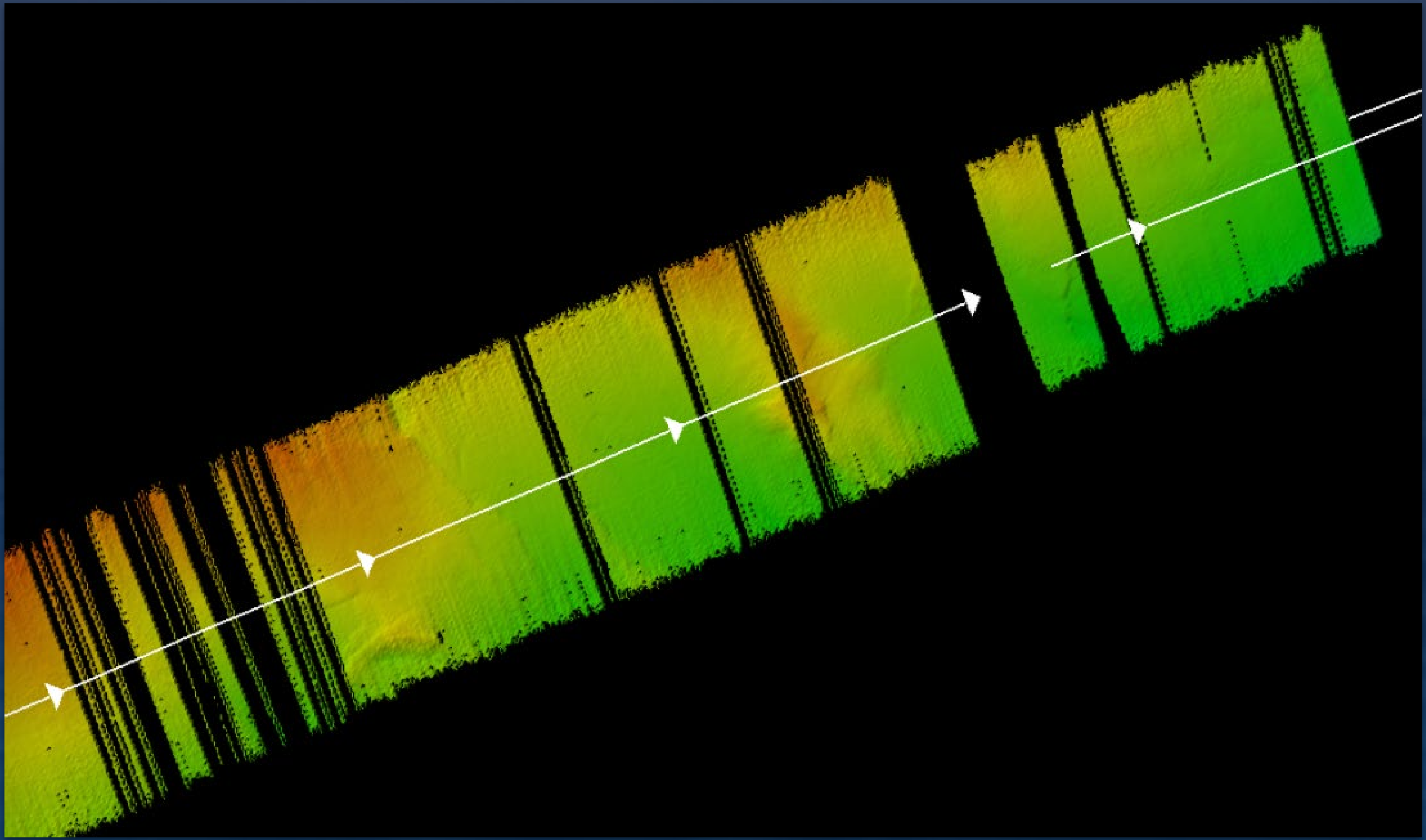

Image: NOAA

Example from the Wiki: EM304 Dropouts

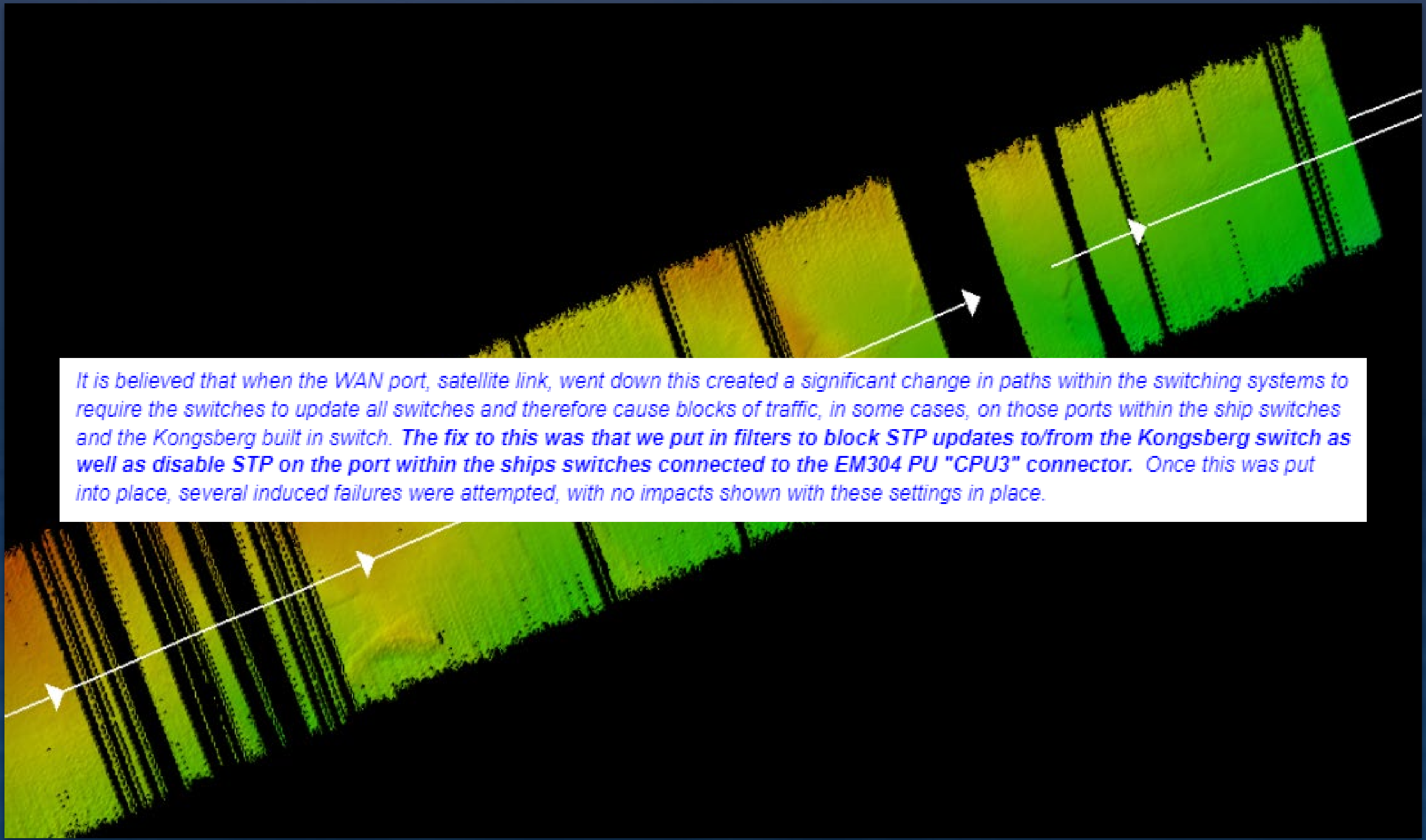

Image: NOAA

Example from the Wiki: EM304 Dropouts

oceanmapping / community Public

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Code · Issues 1 · Pull requests · Discussions · Projects · Wiki · Security · Insights · Settings

EM304 ping dropouts related to ship satellite network interruptions #22

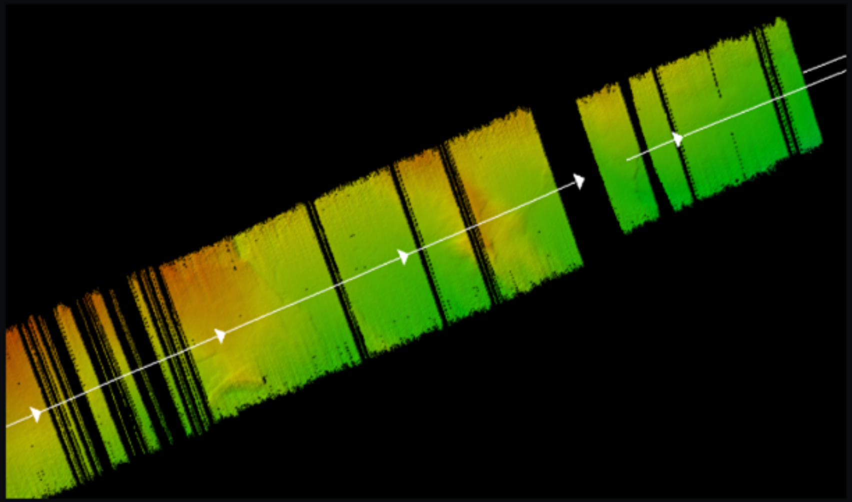
Closed · kjerram opened this issue 6 minutes ago · 0 comments

Edit · New issue

kjerram commented 6 minutes ago • edited · Member

Context:
NOAA Ship Okeanos Explorer with EM304 MKII and POS MV/Seapath navigation inputs.

Symptoms:
The EM304 intermittently and unpredictably stops pinging / tracking seafloor, leaving large data gaps of variable duration. Logging continues as normal (no file increment).



Troubleshooting:
Extensive troubleshooting was conducted by the EX team on board in communication with Kongsberg support in Norway.

Multiple software and firmware updates were applied with no improvement.

The PU ethernet switch firmware was updated to v1.40 to address an issue with excessive BPDU packets (#15)

EM dropouts were found to correlate with brief VSAT satellite internet outages, suggesting a broader ship network interruption impacting the EM network.

Solution:
The relationship between VSAT interruptions and EM network dropouts was traced to the on-board network's spanning tree protocol (STP).

Assignees
kjerram

Labels
data quality · em304 · hardware · kongsbe · ship network · sis5

Projects
None yet

Milestone
No milestone

Development
Create a branch for this issue or link a pull request.

Notifications · Custo
Unsubscribe
You're receiving notifications because you're watch this repository.

1 participant

Lock conversat
Pi
Transfer issue
Convert to discussion
Delete issue

Excessive BPDU packets on EM multibeam network #15

Closed · kjerram opened this issue on Jul 5, 2022 · 1 comment

kjerram commented on Jul 5, 2022 · Member

Information provided by Mary Huey (SIO).

Context / symptoms:

1. The ship's networks experienced excessive traffic of BPDU packets originating from the CPU3 port on the PU (EM124 on Sally Ride).

kjerram added bug · kongsberg · sis5 · ship network labels on Jul 5, 2022

kjerram self-assigned this on Jul 5, 2022

kjerram commented on Jul 5, 2022 · Member · Author

Solution provided by Mary Huey (SIO) after discussion with Kongsberg technical support.

1. Make sure EM switches have latest firmware (vtWss-1.40). Earlier versions may have a bug that allows settings to be wiped.
2. Go to C:\Program Files\Kongsberg Maritime\EMSystem\K-Controller\PU\EM124\Update\Support\Vada_Tech and follow the setup guide for CP219.

Kongsberg technical support can provide a PDF of how switches should be set up.

kjerram closed this as completed on Jul 5, 2022

kjerram mentioned this issue on Nov 3, 2022

EM304 ping dropouts related to ship satellite network interruptions #22 · Closed

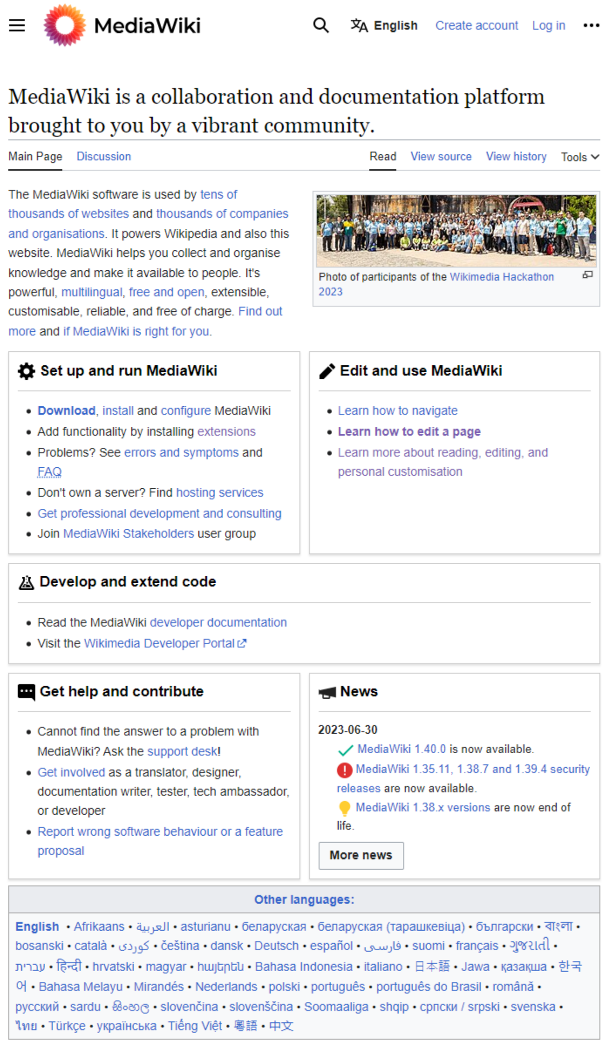
Ocean Mapping Community Wiki

COMING SOON... a better wiki framework!

Testing MediaWiki with new URL

1. Widely adopted (e.g., Wikipedia)
2. Free and open-source
3. Designed for broad user base
4. Easy transfer of GitHub content

Seeking MediaWiki / WikiForge pros and suggestions for wiki software

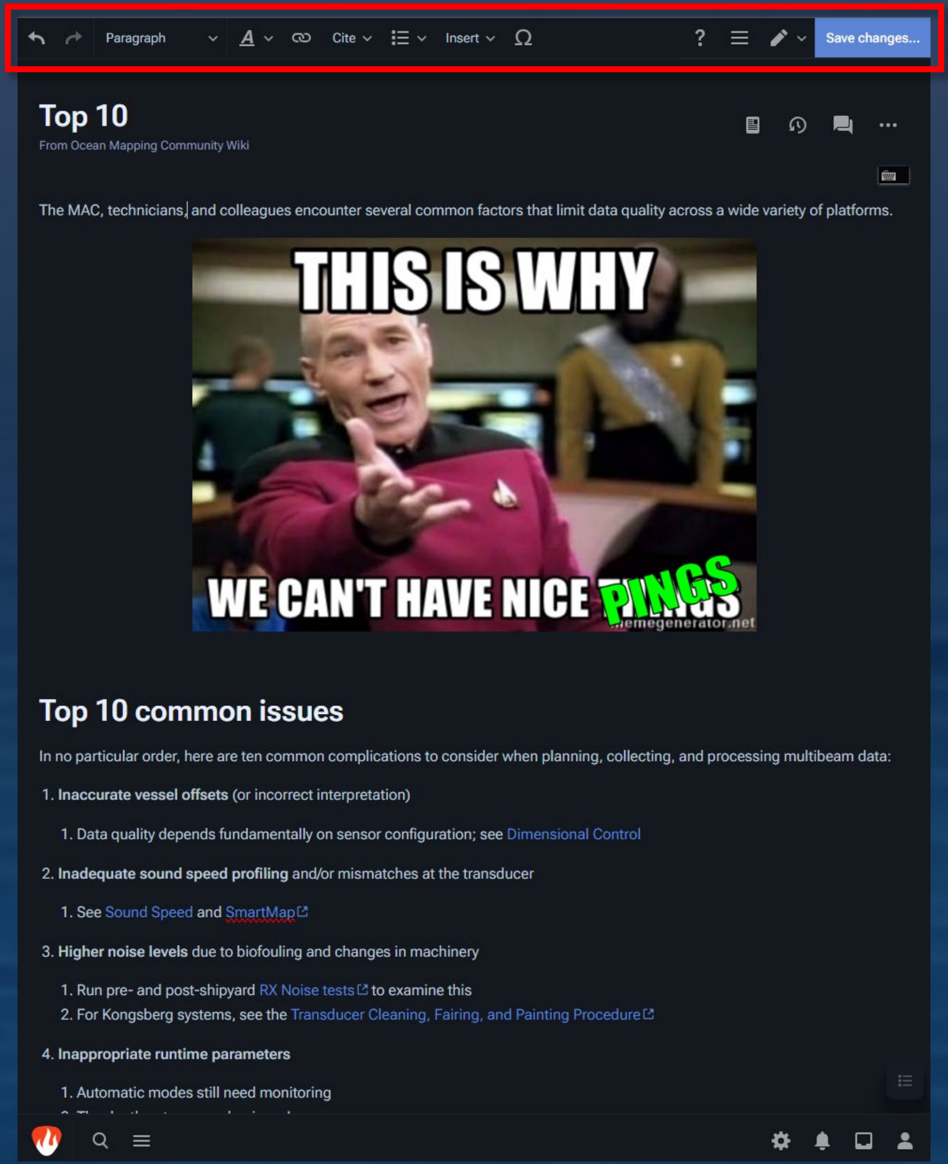


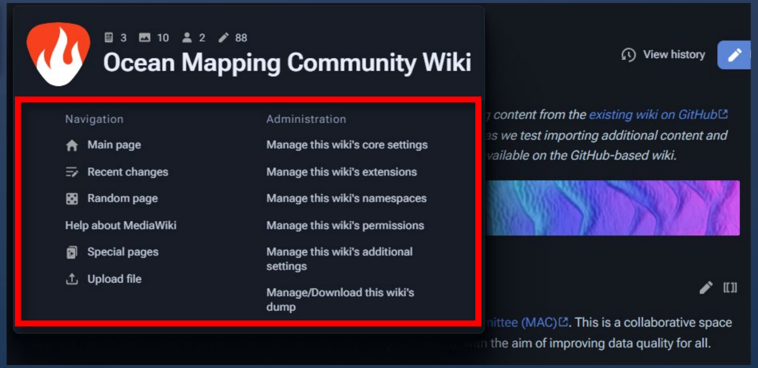
Ocean Mapping Community Wiki

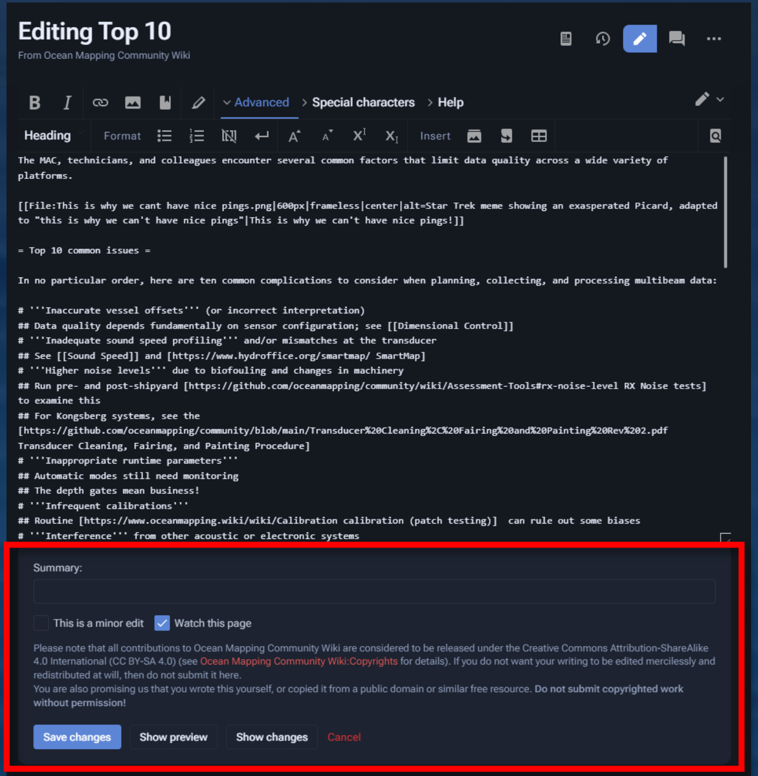
Testing MediaWiki and Wiki Forge platforms

Major advantages so far…

1. Easy login and attribution
2. **Intuitive editors** and previews
    a. Visual and wikitext
3. Broad admin settings / options
4. Multi-user editing support
5. Avoids GitHub ‘barrier to entry’







Next steps…

1. Issue tracking setup
2. Converting content from GitHub
3. Announcing new web address

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Questions? Answers? Reach out!

Ocean Mapping Community Wiki

github.com/oceanmapping/community

omcadmin@ccom.unh.edu

Multibeam Advisory Committee

mac.unols.org

mac-help@unols.org

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