

Improving hydrographic data quality with MAC assessment tools and the HydrOffice suite

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HydrOffice under NOAA grant NA20NOS4000196



A photograph of a sunset over the ocean, taken from the perspective of someone on a ship. The sun is low on the horizon, casting a bright golden glow across the sky and reflecting on the water. The sky is filled with scattered clouds, some of which are illuminated by the setting sun. The ocean is dark blue with small, choppy waves. In the foreground, the white railing of the ship is visible on the right side. The text "MAC Assessment Tools" and "(Workshop this afternoon)" is overlaid in white, bold, sans-serif font in the center of the image.

MAC Assessment Tools

(Workshop this afternoon)

Ocean Mapping Community Wiki

github.com/oceanmapping/community/wiki
omcadmin@ccom.unh.edu or mac-help@unols.org

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 .kml are supported.



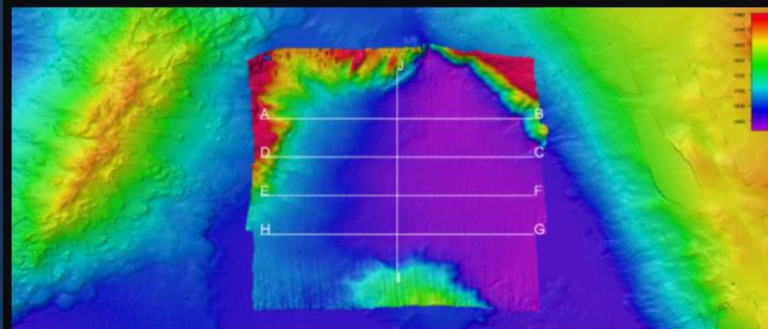
Reference survey acquisition

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.

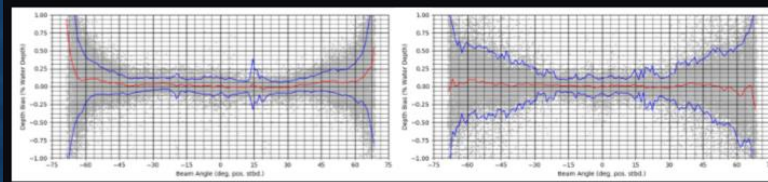


Crossline data acquisition

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.

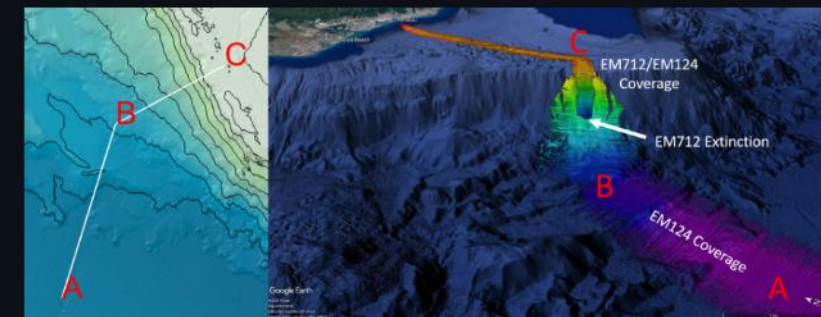
Crosslines are typically run in 'pairs' on opposite headings for each mode to assess any heading-dependent impacts, such as sea state (example below shows accuracy heading with seas and into seas shown on top and bottom, respectively). When seas are calm, this approach also supports deep roll verification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

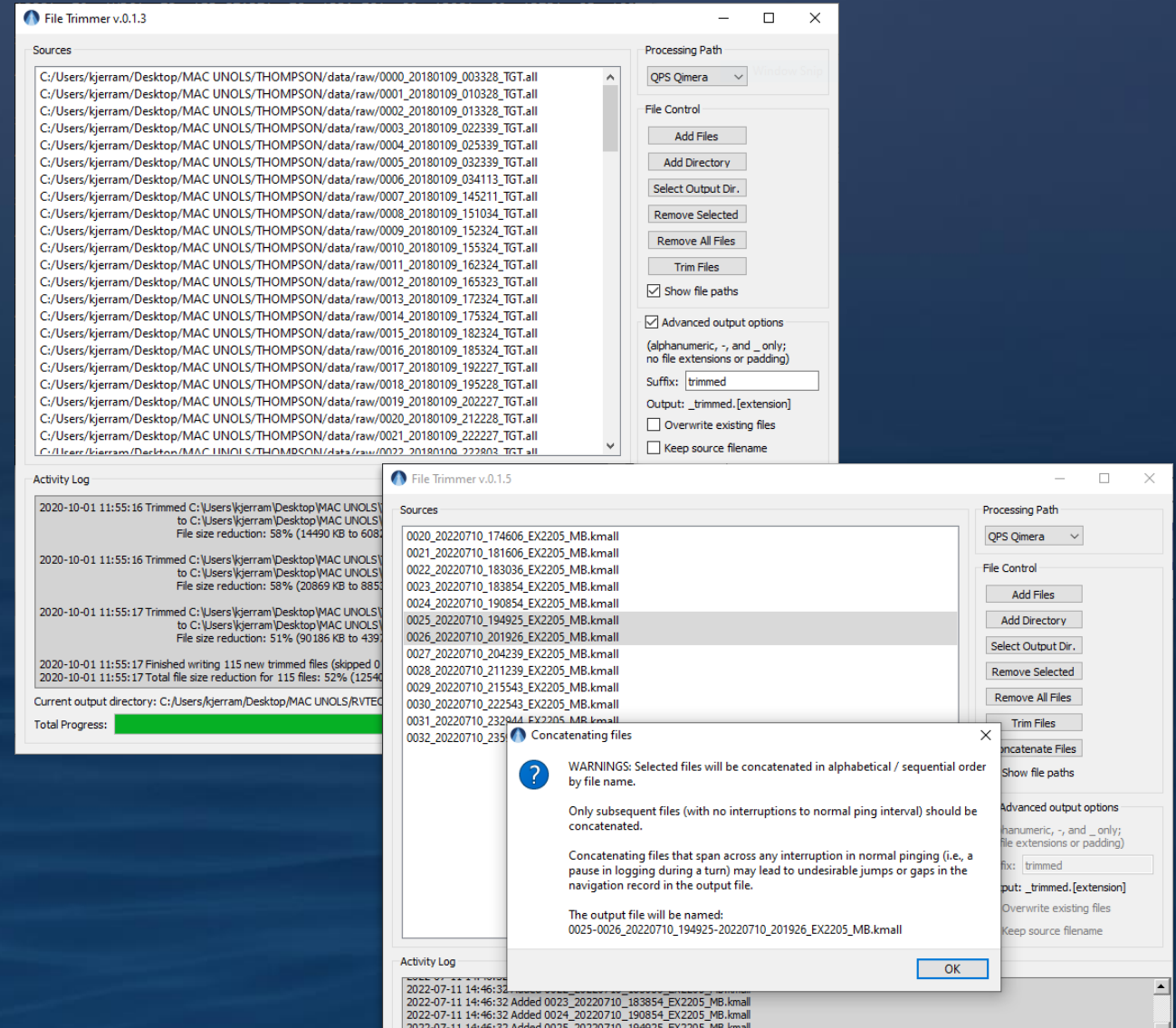
The following settings are generally recommended for Kongsberg EM systems to best illustrate 'automatic' system performance. Vessels that use different parameters during routine mapping should apply those settings where appropriate, aside from the maximum angle, coverage, and depth gates that may inadvertently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

File Trimmer

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

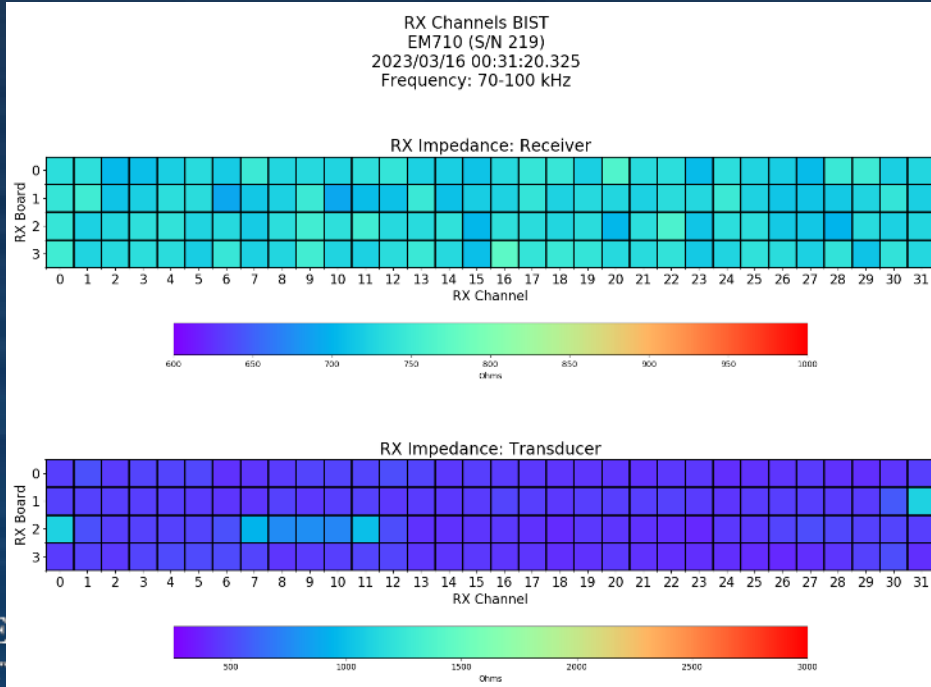
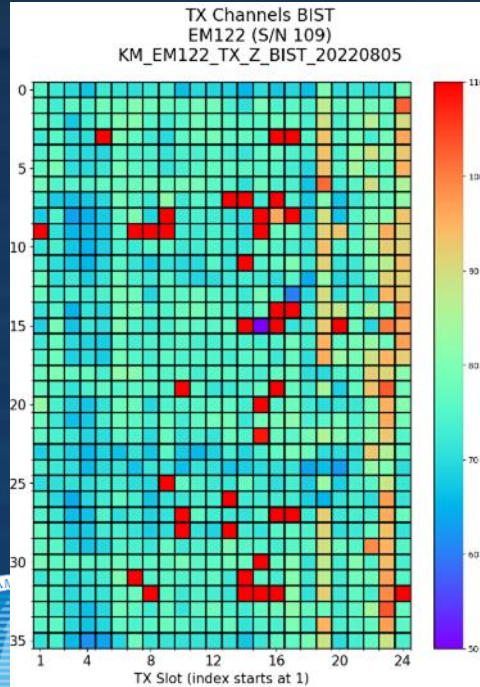
1. Reduce file size for transfer to shore
2. Concatenate files for special processing
3. Protections for raw files and directories
4. Up to 90% reductions for low ping rates
5. .all format only at present
6. Soon to be unnecessary?!



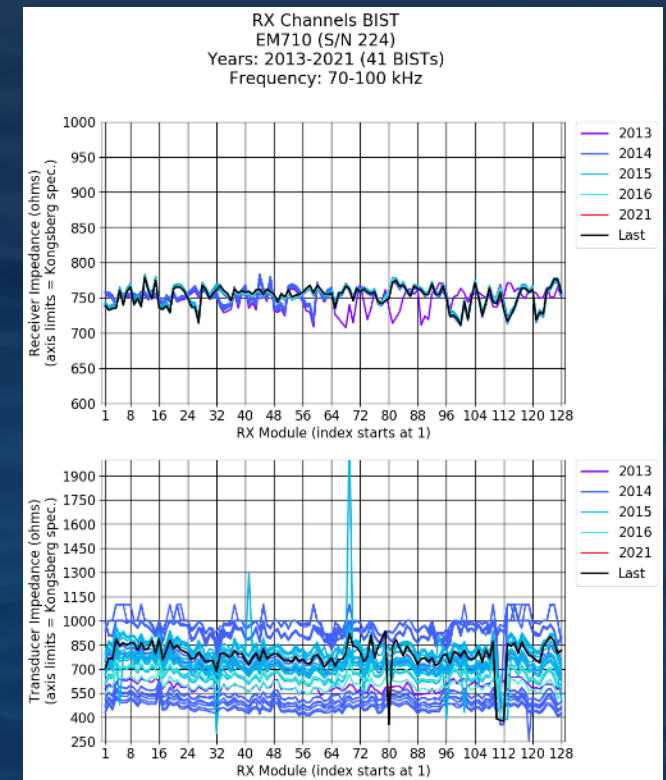
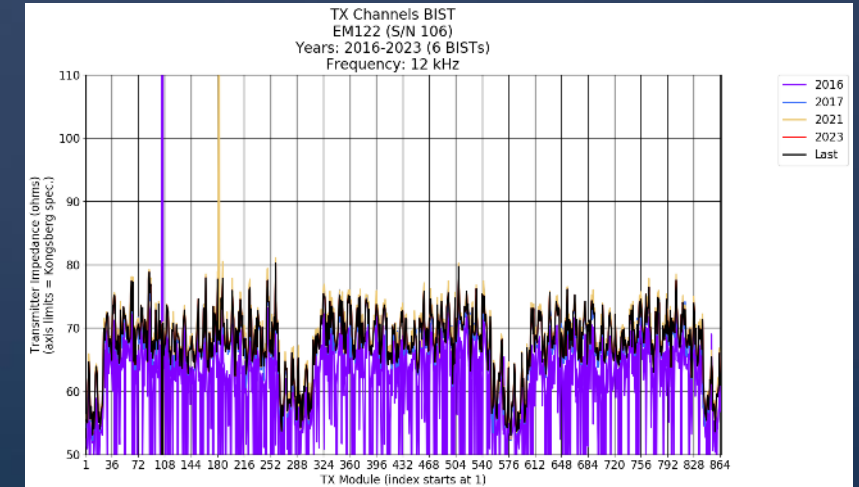
BIST Plotter: TX and RX Channels

1. Verify all channels pass during SAT
2. Track failures of individual channels
3. Monitor general trends across arrays
4. Plan direct impedance measurements

Single TX and RX Channels BISTs



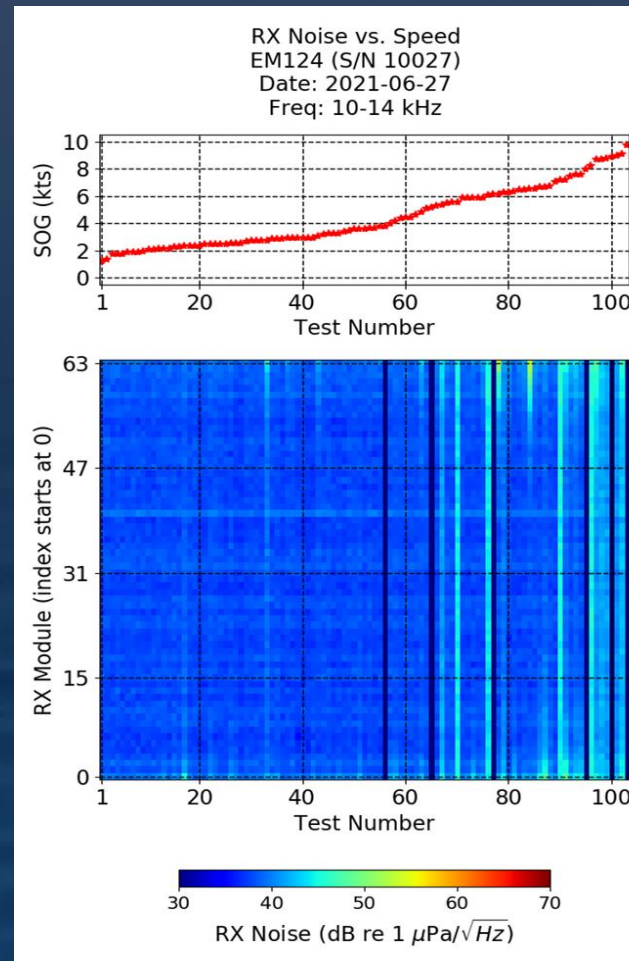
TX and RX Channels history



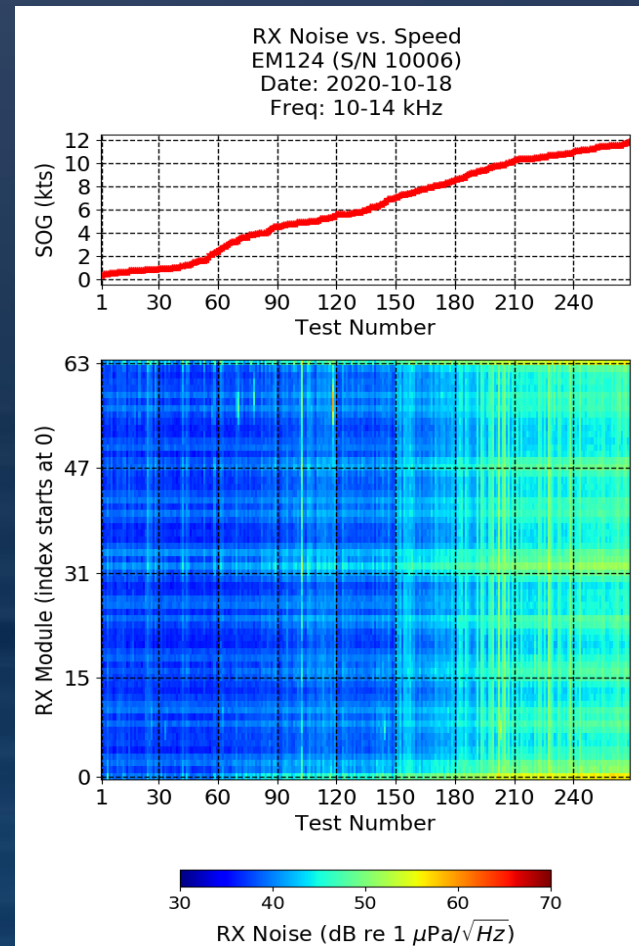
BIST Plotter: RX Noise vs. Speed

1. Evaluate noise trends in **calm** seas
2. Pre- and post-shipyard noise check
3. Plot noise versus:
 - a. SOG / STW
 - b. Engine / shaft speed
 - c. Pitch / thrust %
 - d. Machinery

Vessel 1



Vessel 2



Vertical stripe = swell impact (all channels)

Horizontal stripe = noisy channel (all tests)

BIST Plotter: RX Noise vs. Swell Direction

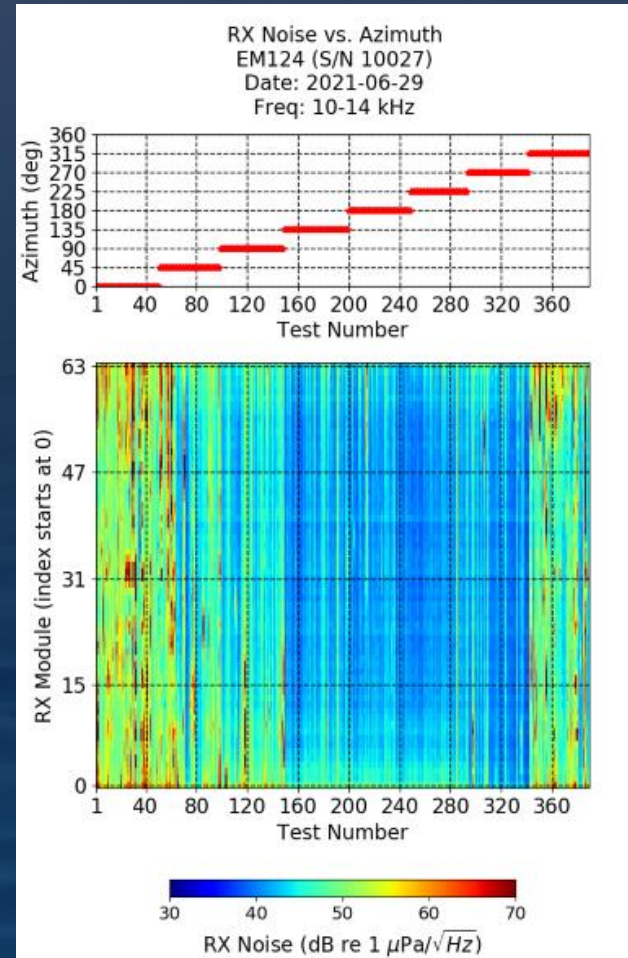
1. Evaluate noise trends in **elevated** seas
2. Identify quietest survey orientations
3. Assess bubble sweep, gondola, etc.
4. Highly vessel-dependent

Azimuth 0° = heading into swell

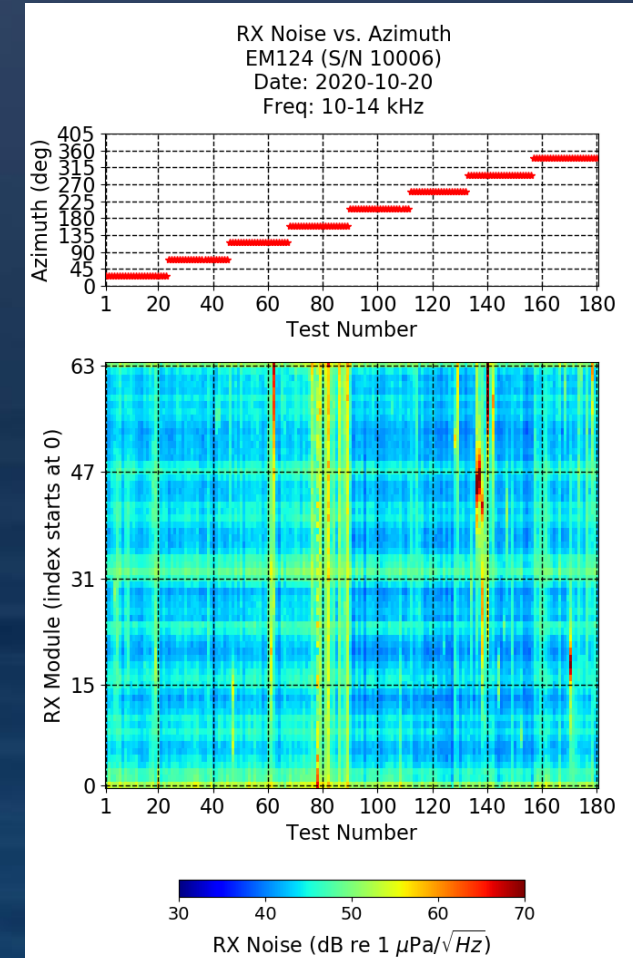
Vertical stripe = swell impact (all channels)

Horizontal stripe = noisy channel (all tests)

Vessel 1



Vessel 2



BIST Plotter: Info on the Wiki

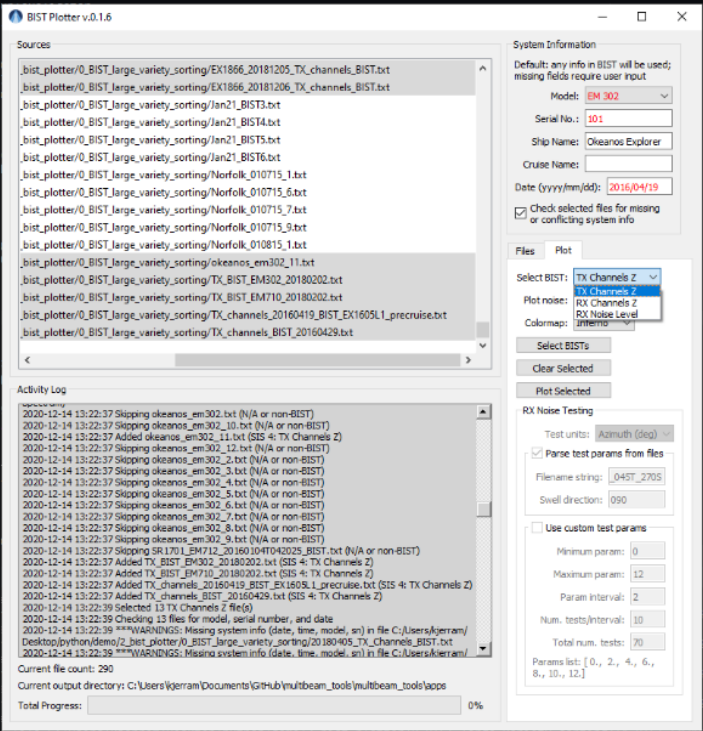
BIST Plotter

The Built-In Self-Test (BIST) plotter currently supports three types of testing:

- 1. TX Channels
- 2. RX Channels
- 3. RX Noise Level

Collecting BISTs describes BIST logging in general, whereas specific acquisition steps for each test type are detailed in their respective sections.

Likewise, Plotting BISTs provides an overview of plotting steps; the individual test sections include more details.



Collecting BISTs

The BIST menu is accessed through the Installation Parameters.



Plotting BISTs

The BIST Plotter offers a few approaches for visualizing BIST data:

1. TX and RX Channels BISTs
 - i. Individual tests (e.g., from a SAT or pre-cruise check)*
 - ii. BIST histories (e.g., from batches of BISTs)
2. RX Noise versus speed, azimuth, or other test parameters

*Note: v0.2.2 can support multiple RX Channels development; in the meantime, if the plotter fails to process files for processing.

Hint: Most features in the MAC Assessment Tool are available!

1. Select Files
 - i. Under the Files tab, use the Add Files button
 - ii. The Add Directory option will include all files in the directory
 - iii. The Activity Log will show which BIST files are processed
 - iv. Non-BIST text files (e.g., PU Parameter files)
2. Select Test Type
 - i. Under the Plot tab, select the desired test type
 - a. TX Channels
 - b. RX Channels
 - c. RX Noise Level
 - a. See RX Noise test parameter
 - ii. Click Select BISTs to automatically review test type
 - a. if none of the loaded files include the test type, note that no files are available for that test type
 - b. Test files can be manually selected
3. Update Parameters
 - i. Check the EM model and serial number
 - ii. System Information fields will turn red if they are not set
 - iii. Some BIST formats may not include the test type
 - iv. Vessel name and cruise are not logged
4. Plot and Save
 - i. Choose the output directory with Select Directory
 - ii. Click Plot Selected
5. Please contact us with BISTs that do not plot

Be aware of certain features / limitations when acquiring.

1. When collecting BISTs for plotting, save the results to text files
2. BISTs can be run individually or in batches
3. Save the results to text files
 - i. Tests are usually saved to a file
 - a. There may be multiple files

SIS 4 supports one test at a time.

For RX Noise testing, it is often recommended to run a test button for each run, after which saving the text file to avoid appearing in the log.

[For collecting repeat series of 10 tests]

Warnings

SIS 4 does not log TX Channels in the BIST collection describes

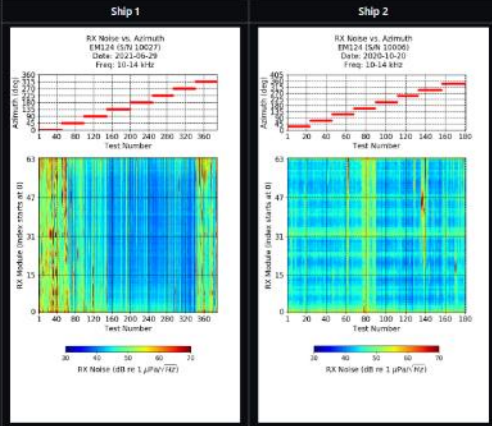
SIS 5

SIS 5 provides a "continuous test" option.

This option is not typically used for BISTs.

Warnings

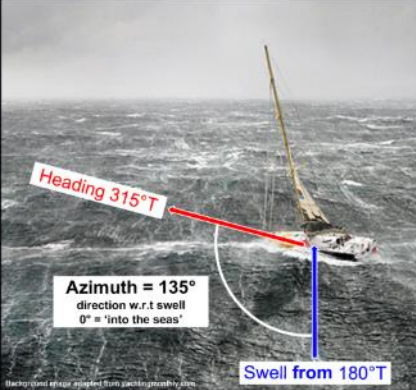
Prolonged continuous logging will freeze the system.



Because the swell can come from any direction, the true heading is irrelevant for assessing hull-specific behaviors in different orientations and sea states.

For this assessment, orientation is presented as hull azimuth relative to the prevailing swell, following the same compass direction used for heading. Azimuth is 0 when the swell is on the bow ('into the seas'), 45 with swell arriving on the port bow, 90 with swell arriving on the port side, etc.

For instance, the prevailing seas are arriving on the port quarter of the vessel shown below; this would correspond to an azimuth of 135° for the purposes of measuring RX Noise versus swell direction.



RX Noise vs. other parameters

RX Noise data can be collected to assess other parameters, and the BIST Plotter provides some support for standard test

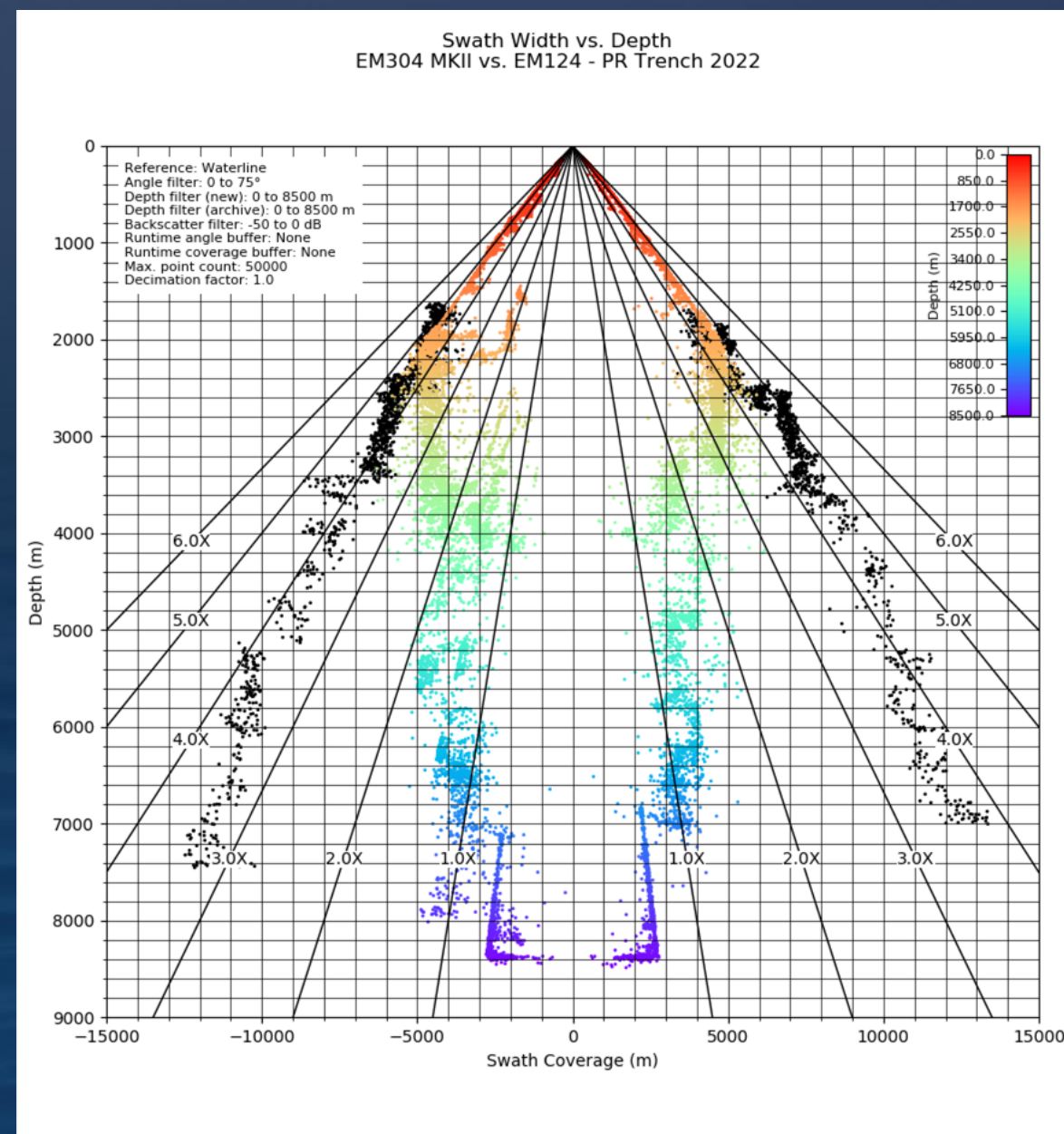


Lamont-Doherty Earth Observatory
COLUMBIA UNIVERSITY | EARTH INSTITUTE

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

Swath Coverage Plotter: Coverage vs. Depth

1. Swath coverage can be limited by many factors
2. Establish baseline coverage trends during SAT
3. Track coverage trends during routine QATs
4. Opportunistic data collection on transits
 - a. **Early detection** of limiting factors
5. 'Real world' survey planning



Swath Coverage Plotter: Parameter Tracking / Search

1. Scan large batches of files for changes to acquisition parameters:
 - a. **Installation Parameters (IP)** → system geometry based on SAT/QAT
 - b. **Runtime Parameters (RTP)** → sonar modes/filters selected by user
2. Query settings by thresholds ($>$ $<$ $=$) and ANY or ALL combinations

The screenshot displays the 'Parameters' tab of the Swath Coverage Plotter. The 'Runtime Parameter Log' shows search results for parameters matching 'ANY parameter matches'. A red box highlights the value '4.42' in the log, with a red arrow pointing to it and the text '>2 m CHANGE IN WATERLINE' overlaid. The search filters on the right include 'Search Acquisition Parameters', 'Show when ANY parameter matches', and various mode and parameter settings like Depth Mode, Swath Mode, Pulse Form, Swath Angle, Swath Cover, and Frequency. Installation Parameters like Waterline, Array Offsets, and Pos. Offsets are also checked.

Runtime Parameter Log

```
***NEW SEARCH*** Initial settings and times of changes that satisfy ANY of the following parameters:  
ping_mode == All, swath_mode == All, pulse_form == All, max_port_deg All 65, max_stbd_deg All 65, max_port_m All 20000, max_stbd_m All 20000, frequency == All, wl_z_m == All, TX  
[XYZRPH] == All, RX [XYZRPH] == All, POS. [(#)XYZ] == All  
2017-04-28 05:34:37.300: Very Deep, FM, Single, 44.0/44.0, 5000.0/5000.0, 30 kHz, 4.42, [6.147,1.822,6.796,0.0,0.0,359.98], [2.497,2.481,6.79,0.0,0.0,0.03], [(1)0.0,0.0,0.0]  
2018-10-06 17:24:28.915: Deep, Mixed, Dual, 75.0/75.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2019-05-13 03:43:44.330: Deep, Mixed, Dual, 70.0/70.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:23:23.526: Deep, Mixed, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:23:55.102: Very Deep, FM, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:24:33.410: Deep, Mixed, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:25:20.845: Very Deep, FM, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:25:54.299: Deep, Mixed, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-05 20:36:50.885: Very Deep, FM, Dual, 50.0/50.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2020-03-07 04:31:26.740: Very Deep, FM, Dual, 70.0/70.0, 5000.0/5000.0, 30 kHz, 2.2, [6.194,1.803,6.864,0.128,-0.392,359.88], [2.457,2.47,6.814,-0.015,0.092,359.98], [(1)0.0,0.0,0.0]  
2021-05-04 19:15:40.146: Very Deep (Manual), FM, Dual, 70.0/70.0, 5000.0/5000.0, 30 kHz, 1.8, [6.167,1.814,6.797,0.21,-0.007,359.945], [2.506,2.485,6.792,-0.134,0.712,359.962], [(-1)0.0,0.0]  
End of search results...
```

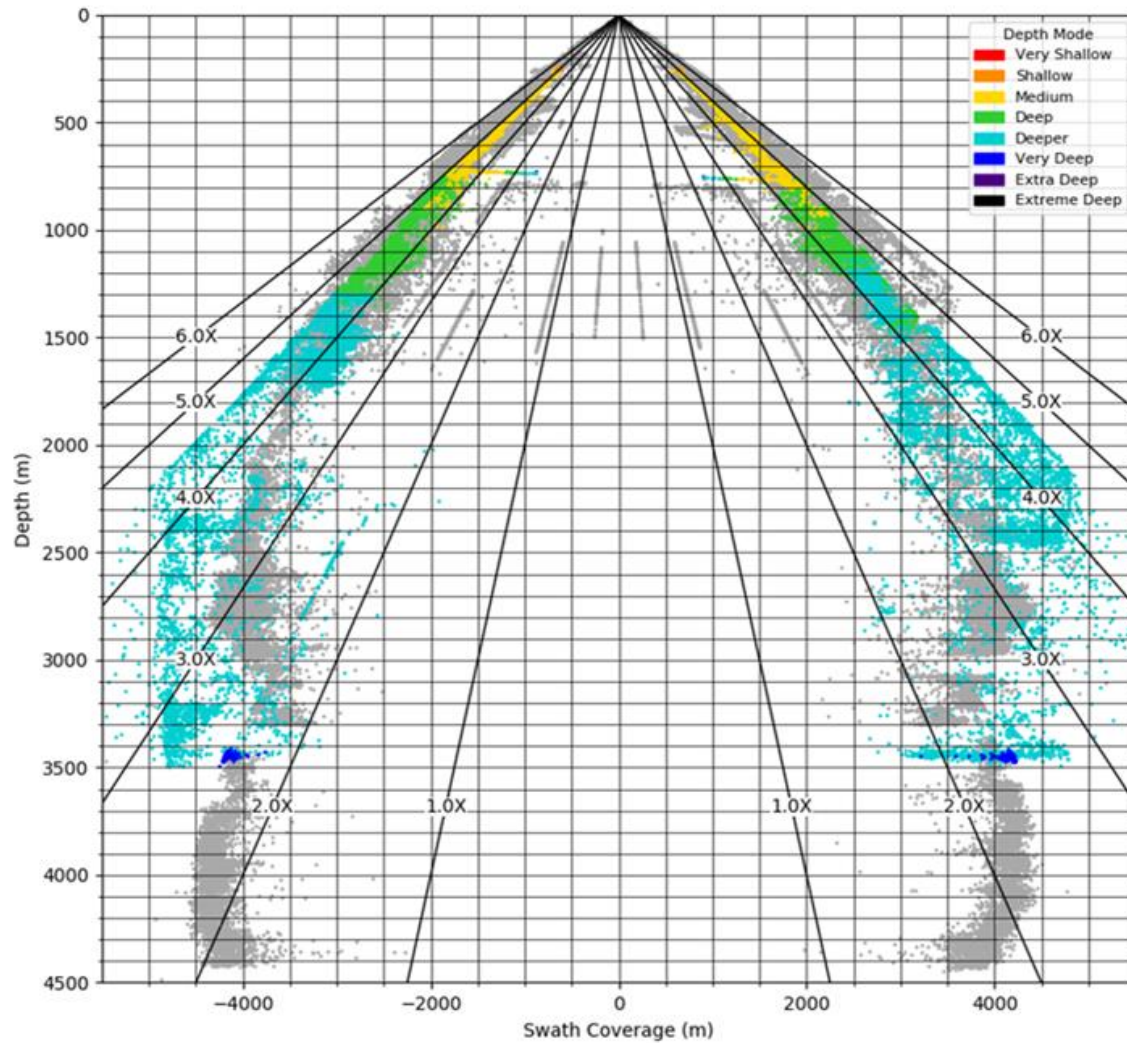
Search Filters:

- ☒ Search Acquisition Parameters
- Show when: ANY parameter matches
- ☐ Depth Mode: All
- ☐ Swath Mode: All
- ☐ Pulse Form: All
- ☐ Swath Angle (deg): All 65
- ☐ Swath Cover. (m): All 20000
- ☐ Frequency: All
- Installation Parameters:
 - ☒ Waterline
 - ☒ Array Offsets
 - ☒ Pos. Offsets

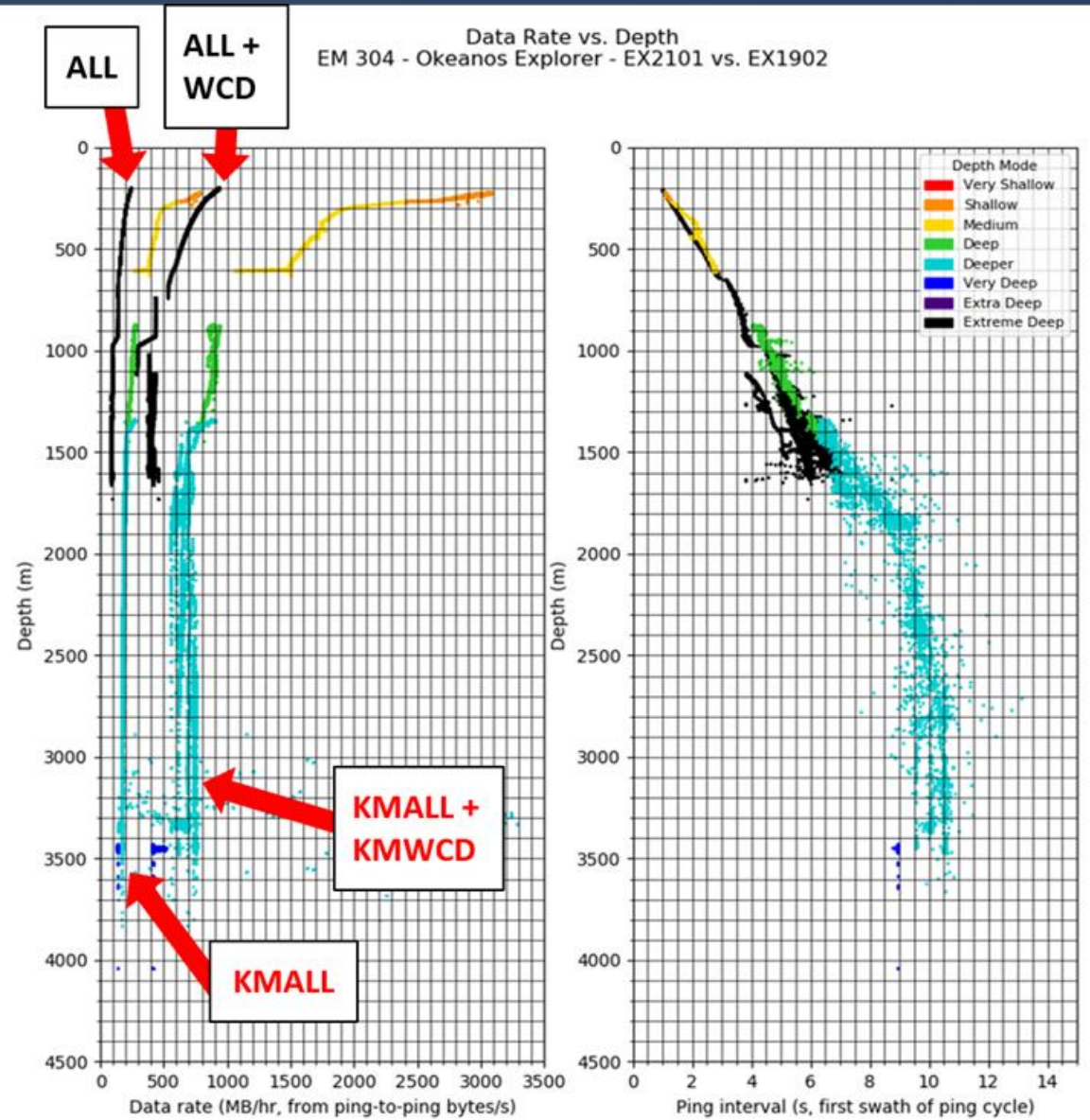
Buttons: Update Search, Save Search Log

Swath Coverage Plotter: Data Rates

Swath Width vs. Depth
EM 304 - Okeanos Explorer - EX2101



Data Rate vs. Depth
EM 304 - Okeanos Explorer - EX2101 vs. EX1902



Anomalous EM304 data rates between 600-850 m have been omitted

Swath Coverage Plotter

The screenshot displays the 'Swath Width vs. Depth' (EM 304) software interface. The main window shows a swath plot with depth on the y-axis (0 to 5000 m) and swath coverage on the x-axis (-4000 to 6000 m). The plot features a central track of data points (blue dots) and a wider area of data points (green dots). A color-coded depth scale is visible on the right side of the plot, ranging from 0 to 5000 m. The software interface includes a top menu bar (File, Edit, View, etc.), a toolbar with various icons, and a right-hand panel with settings for data display and processing. The bottom status bar shows the current file name and the user's name.

These tests are valuable for a wide variety of purposes, such as survey planning, system acceptance testing against expected performance, evaluating noise impacts of the vessel and other sensors, and routine quality assurance testing to detect hardware degradation or damage (e.g., following a dry dock maintenance period). These data can be collected, archived, and compared throughout the service life for a given system, and across similar systems installed aboard multiple vessels. Accordingly, swath coverage testing is a standard MAC SAT and QAT activity, and can be conducted opportunistically during transits for remote processing.

Plot

Use custom system information

Model: 2012-04-04

Ship Name: Ship Name N/A

Cruise Name: Cruise Name

Depth reference

Reference data to: Waterline

Paint style

☒ New data

☐ Archive data

Depth: Solid Color

Segment Color:

Select Color

Plot data on:

Use custom plot lines

Scale color map to: All data

Point size: 5

Min: 0

Max: 1000

Capacity: 288

Min: 0

Max: 1000

Use custom plot lines

Depth: 3 Width: 10

Date range: 3500

Plot Int.: 10

Show swath angle lines

Max: 75

Interval: 15

Show water depth multiple lines

Max: 0

Interval: 1

Other options

☒ Show reference/filter text

☒ Show grid lines

☒ Show colorbar/legend

☒ Show specification lines

☒ Save standard Figure mode

☒ Show Histograms of soundings

☒ Apply color scales to data plots

☒ Show coverage trend points

Plot

Angle (deg)

Min: 0

Max: 75

Depth (new/archive)

New

Archive

Min depth (m): 0

0

Max depth (m): 10000

10000

Bathycaster (dB)

Min: -50

Max: 0

Ping Interval (sec)

Min: 0.25

Max: 30

Hide angles near runtime limits

Angle buffer (+/-10 degree):

Hide coverage near runtime limits

Coverage buffer (+/-10 m):

100

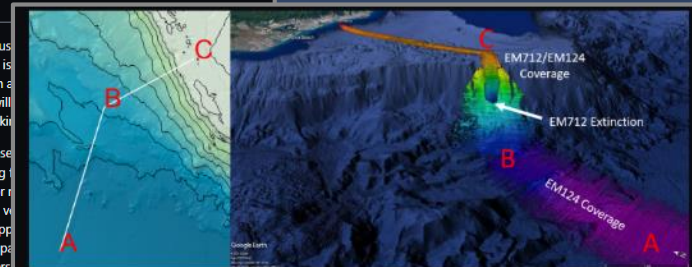
Unit plotted point count (plot filter)

Max. plotted points (0-9999)

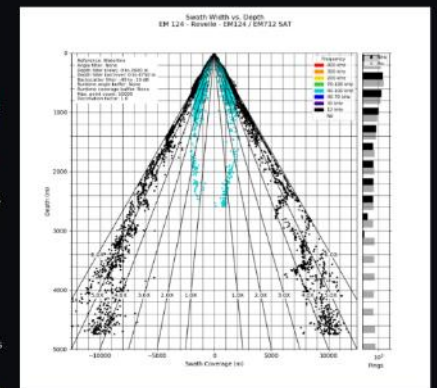
99999

Determination factor (1-999)

For instance, the expected performance for a particular EM304 topside unit / EM302 TX array is shown as red curves on the port and starboard sides in the coverage plotter example above. The underlying points were manually digitized from a sea acceptance report and recorded in the specification format



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	
Depth limits	As needed	
TX power	Maximum	
Frequency	Typical	
Pitch stabilization	Enabled	
Alongship direction	0	
Auto tilt	Off	
Yaw stabilization	RMIH	
Enable scanning	Off	
Spike filter	Medium	
Range gate	Normal	
Phase ramp	Normal	

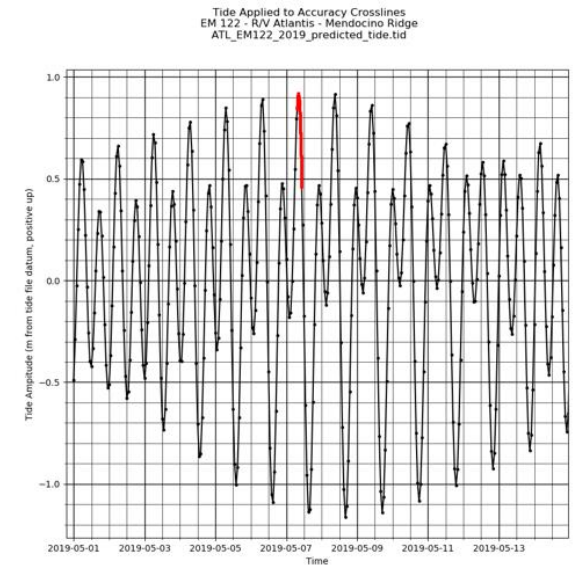
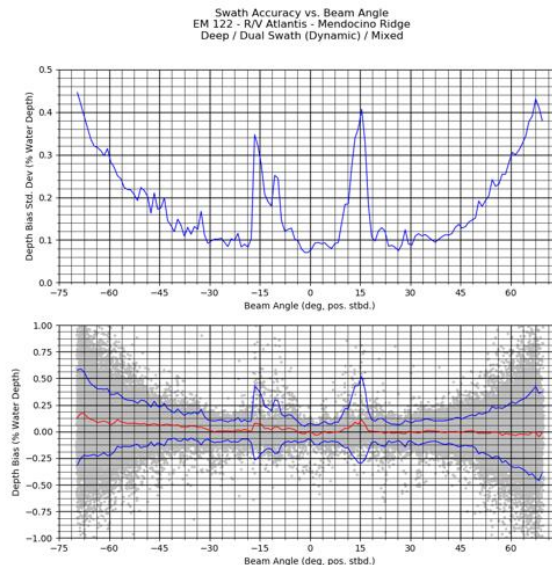
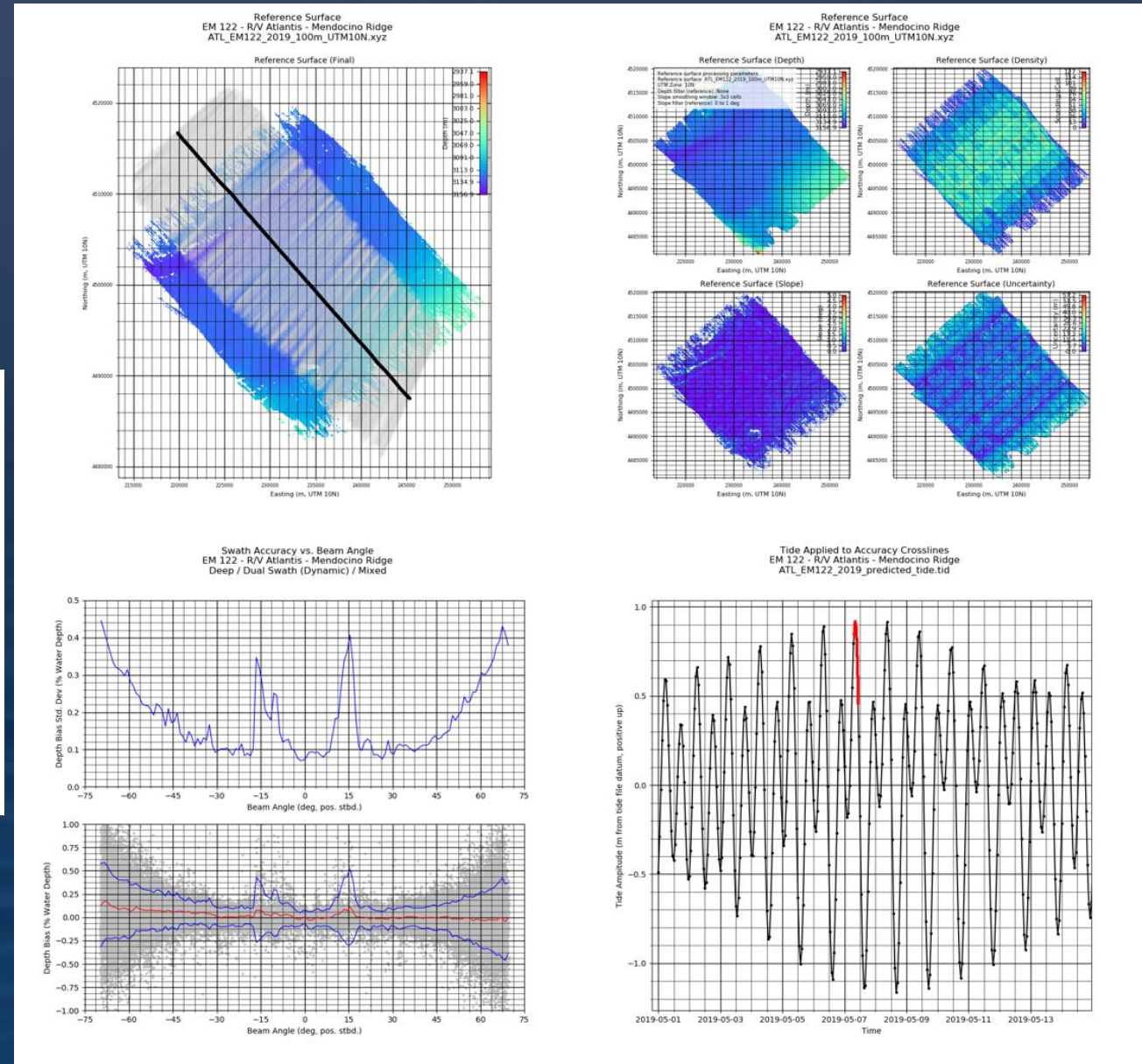
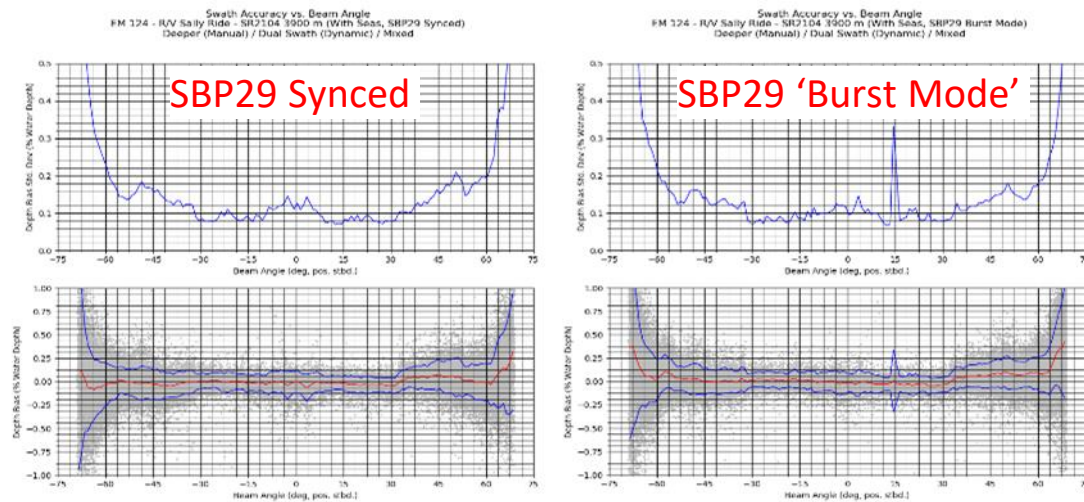


Note that the archive format will continue to change and may be replaced altogether with a new file type. More recent plotting parameters may not have been saved in early archive versions, meaning some plotting options might not be available when these are loaded. The original dataset can be reloaded and plotted to create a new archive if necessary.

The example at right shows EM712 (blue) and EM124 (black) data colored by frequency, clearly indicating differences in coverage as the EM712 approaches attenuation. In this case, the EM124 data is loaded as an archive to show the histogram of sounding distributions for each system separately.

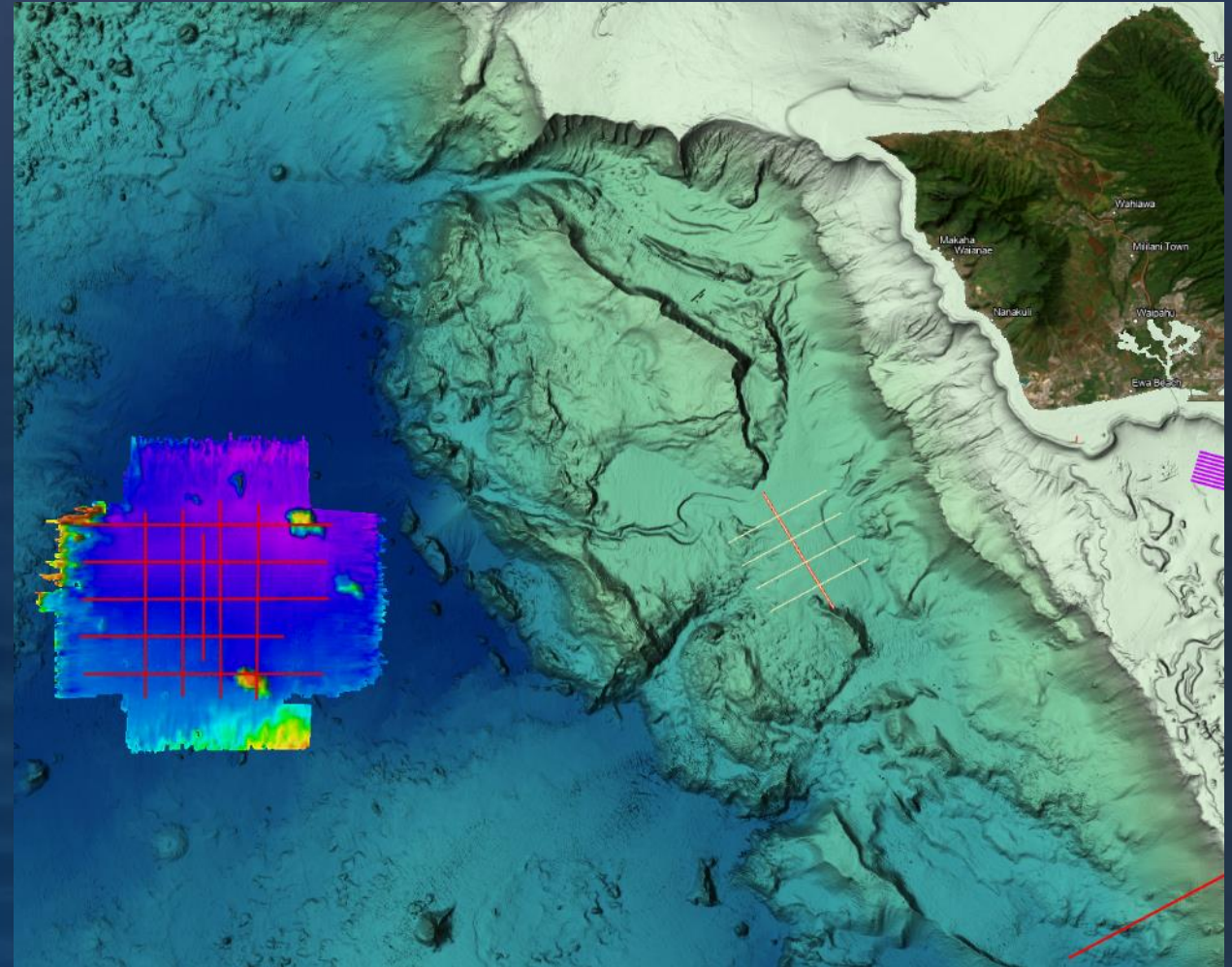
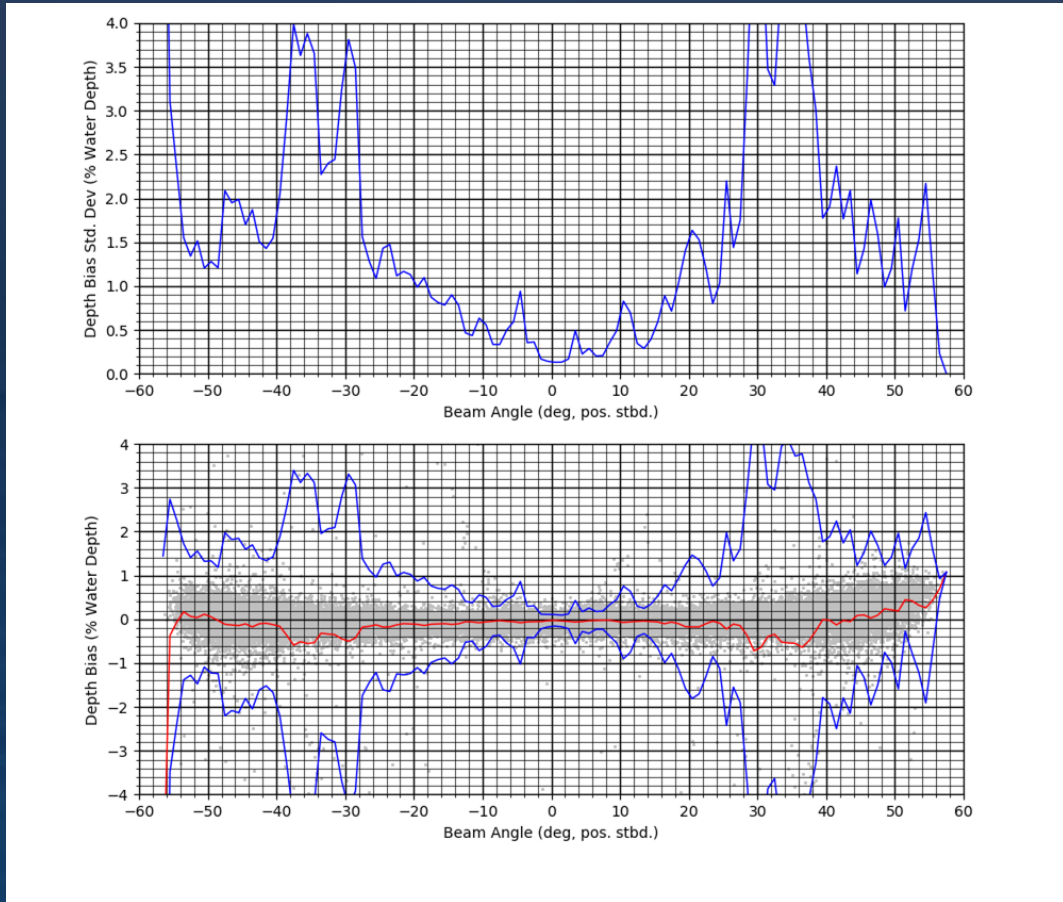
Swath Accuracy Plotter

1. Swath accuracy is impacted by many factors
2. Establish baseline trends (SAT, all modes)
3. Track behavior over time (QAT, opportunistic)



Swath Accuracy Plotter

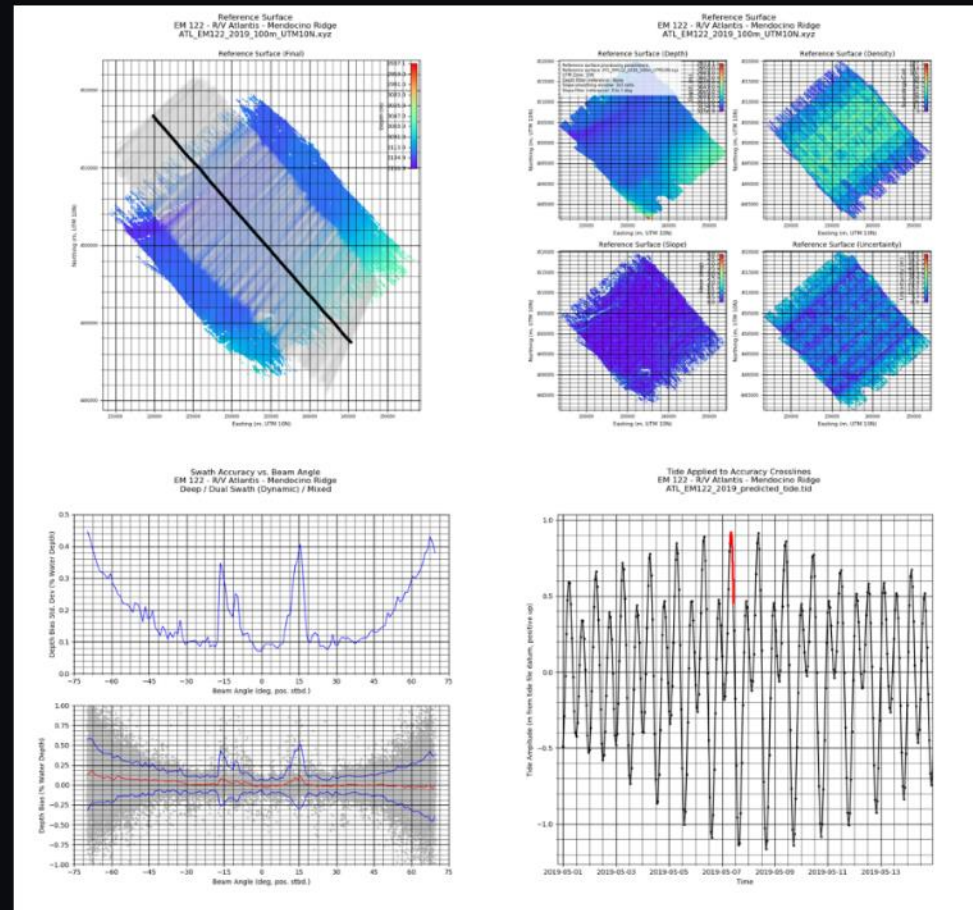
1. Opportunistic crosslines at proven reference sites
2. Catch problems before 'normal' survey operations



Swath Accuracy Plotter: Info on the Wiki

Swath Accuracy Plotter

The swath accuracy plotter compares soundings in a single-pass survey file to a trusted bathymetric reference surface. Differences between 'crossline' soundings and the reference grid are plotted as depth biases in meters (m) or as percentages of water depth (%WD). The mean and standard deviation of these differences are calculated in 1-degree bins across the swath to examine trends.



Data collection

Swath accuracy test data collection is typically broken into two parts:

1. Reference surface
2. Accuracy crosslines

The reference surface is typically surveyed in its entirety before accuracy may be useful when there is uncertainty about approaching weather or the reverse order ensures crosslines are collected first before running as many circumstances.

Scope of data collection

The scope of data collection depends on the modes of interest and their

For example, a new Kongsberg system might be tested across all depth modes (Extra Deep or Extreme Deep, depending on system) using 'typical' runtime set of modes is typically sufficient to characterize baseline performance but might be repeated for quality assurance testing throughout the system's modes to investigate data artifacts in particular conditions or depth range.

More comprehensive testing or troubleshooting might include variations each depth mode to highlight the impacts of each decision, such as:

1. single- and dual-swath;
2. FM enabled and disabled;
3. yaw stabilization enabled and disabled;
4. different survey speeds; and/or
5. other acoustic systems transmitting.

The 'depth modes' for some systems are more commonly described by the operating at 300 kHz with short CW pulse) rather than 'Shallow' or 'Medium' for available modes and review the typical survey runtime parameters to it.

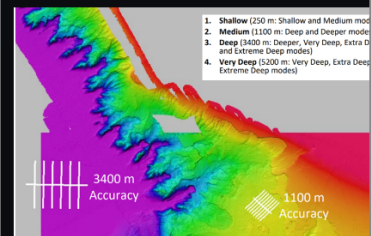
Planning constraints

For systems with discrete depth modes, it would be ideal to conduct an e within the intended depth range for every mode. However, this is usually and some scheduling and planning compromises must be made.

Reference depths

The reference survey is typically the largest time commitment for each test yield real savings. This can be done by grouping the crossline modes of in ideal) and identifying a smaller number of reference depths that will allow for testing, and availability of suitable seafloor, will determine the location.

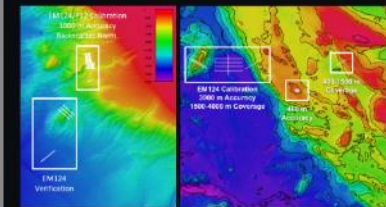
Each working area may be a compromise, selecting from the available sea crossline modes within the constraints of scheduling and sea state. The in sites selected during EM304 MKII sea trials aboard the Okeanos Explorer (seven modes, building into the cruise plan across two distinct working areas transits across these depth ranges were used for swath coverage testing.)



Existing reference surfaces

A suitable reference surface site may already exist, in which case that survey is trusted. For instance, several reference surfaces have been surveyed off San Francisco and San Diego (R/V Roger Revelle, R/V Sikuluaq, and R/V Sally Ride) at depths of

These are readily reused for accuracy crossline testing in future visits by these below). If time allows, a re-survey of an existing reference surface can provide over the same terrain.



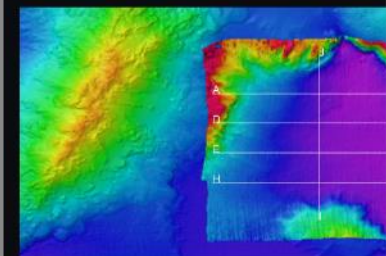
Reference survey acquisition

The reference survey should be planned over relatively flat, benign, homogeneous degrees. Because the selected depths will likely be used for testing several different backscatter normalization across those modes (wiki development; add link to

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
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
4. Number of reference lines to accommodate desired crossline length
 - i. Typically 6-10 reference lines at 1 WD spacing, depending on depth,

Small regions of steeper slopes may be filtered during processing, if present (below). Likewise, the number of lines may be adjusted to fit the terrain and the



Reference survey settings and speed should follow the 'typical' mapping settings narrowed to 65° on each side in order to cover slightly more than 4X WD coverage WD line spacing and increases ping rate (i.e., along-track sounding density) color. Sound speed profiles must be taken and applied routinely throughout the reference survey. Ideally, a CTD or XCTD cast is conducted to get the baseline for salinity and temperature for processing additional XBT casts throughout data collection.

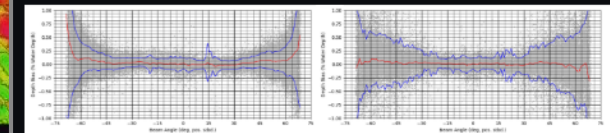
For the example EM124 3900 m reference site above, the reference lines were transmission, and yaw stabilization enabled. The ship operated at its standard specific decision that can be aided by RX noise vs. speed testing) and all other

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.



For the example reference site above, the crosslines were run first in the default mode for this depth (Deeper) plus Deep and Very Deep modes to capture their performance at the limits of the intended depth ranges for those modes. These first three crossline modes were collected dual-swath, FM transmission, and yaw stabilization enabled, with all other echosounders secured.

In this particular SAT example, additional crosslines were run with another echosounder (SBP29) operating in two different modes of synchronization with the EM124 ('sync'd' and 'burst'), as these systems will likely be operated together during future science missions. The last two crossline tests were oriented with the seas in order to reduce the impacts of bubble sweep and utilize the ship time within the constraints of a degrading sea state.

The table below provides an overview of crossline settings at this site, with user-selected mode changes in red. Note that settings determined by the system under these parameters (e.g., swath mode and pulse form when dual-swath and FM transmission are enabled) are left in gray.

Crossline Setting	Depth Mode	SBP29 Mode ¹	Swath Mode ¹	Pulse Form	Yaw Stabilization ²	Swath Direction
1	Deeper	Off	Dual	Mixed	RMH	Into seas
2	Deep	Off	Dual	CW	RMH	With seas
3	Very Deep	Off	Single	FM	RMH	Into seas
4a	Deeper	Sync'd	Dual	Mixed	RMH	With seas
4b	Deeper	Burst	Dual	Mixed	RMH	With seas

Processing

The Swath Accuracy Plotter simply compares the crossline soundings to a reference surface provided by the user. It is not intended to perform data processing steps that are widely available in other software.

The user provides the following inputs:

1. Reference bathymetric grid processed in third-party software
 - i. Format: XYZ ASCII with no header
 - ii. Projection: single UTM zone appropriate for the site
 - iii. Units: meters, z positive up
 - iv. File name includes UTM zone (e.g., "SR2104_EM124_1000m_ref_surf_25m_UTM10N.xyz")
 - v. Tide correction applied prior to export
2. Crossline(s) with sound speed applied during acquisition
 - i. Format: all or .jxmail
3. OPTIONAL: Sounding density grid associated with the bathymetry grid
 - i. Format: XYZ ASCII with no header (may export as XYZ and simply change extension)
4. OPTIONAL: Tide file covering the crossline sounding times

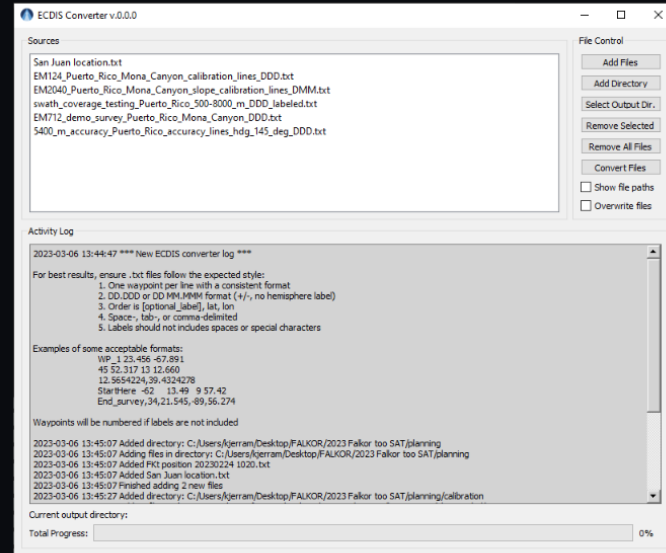
ECDIS Converter

github.com/oceanmapping/community/wik

ECDIS Converter

The ECDIS Converter loads waypoint text files and exports ECDIS .lst files for easier ingestion into ships' navigation systems. This can reduce the time, effort, and opportunity for error in transcribing scientists' waypoints into the bridge officers' preferred formats.

This application is in development and does not provide any verification for correctness of the converted waypoints. Users are responsible for checking .lst output files for agreement with expectations and safety of navigation. If in doubt, convert the waypoints manually or with other software.



Waypoint text file input

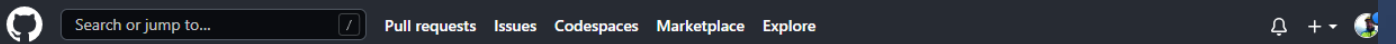
The ECDIS Converter expects the following input .txt format:

1. One waypoint per line with a consistent format
2. DD.DDD or DD MMMMM format (+/-, no hemisphere label)
3. Order is [optional_label], lat, lon
4. Space-, tab-, or comma-delimited
5. Labels should not includes spaces or special characters

Converting to ECDIS format

To export ECDIS .lst files:

1. Add waypoint text files or a source directory
2. Select the output directory, if desired
 - i. If an output directory is not selected, each .lst export will be written to its corresponding input location
3. By default, any existing .lst files with the same name will be skipped to avoid overwriting
 - i. Select 'Overwrite files' to overwrite existing .lst files, if desired
4. Select 'Convert Files' to convert all loaded .txt files to .lst
5. Check the activity log to review any warnings or skipped files
6. Review the waypoints in the ECDIS software to verify correct interpretation
 - i. *Users are responsible for safety of navigation in all circumstances*



Assessment Tools

kjerram edited this page last week · 38 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 v0.0.0

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.

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Using the tools

Swath Coverage Plotter

Purpose

Data collection

Runtime parameters

Synchronization / multiple systems

Plotting and filtering

Theoretical coverage

Archiving

Gap-Filler

Data rates

Attitude latency

Acquisition parameters

Scanning parameters

Searching parameters

Saving results

Swath Accuracy Plotter

Data collection

Scope of data collection

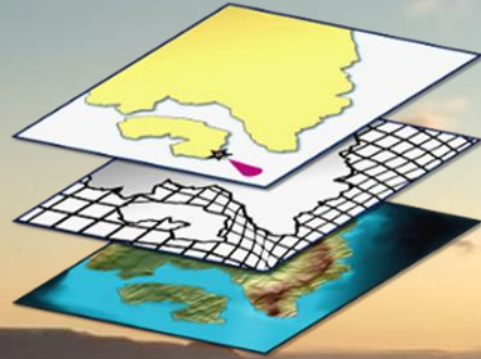
Planning constraints

Reference depths

Existing reference surfaces

Reference survey acquisition

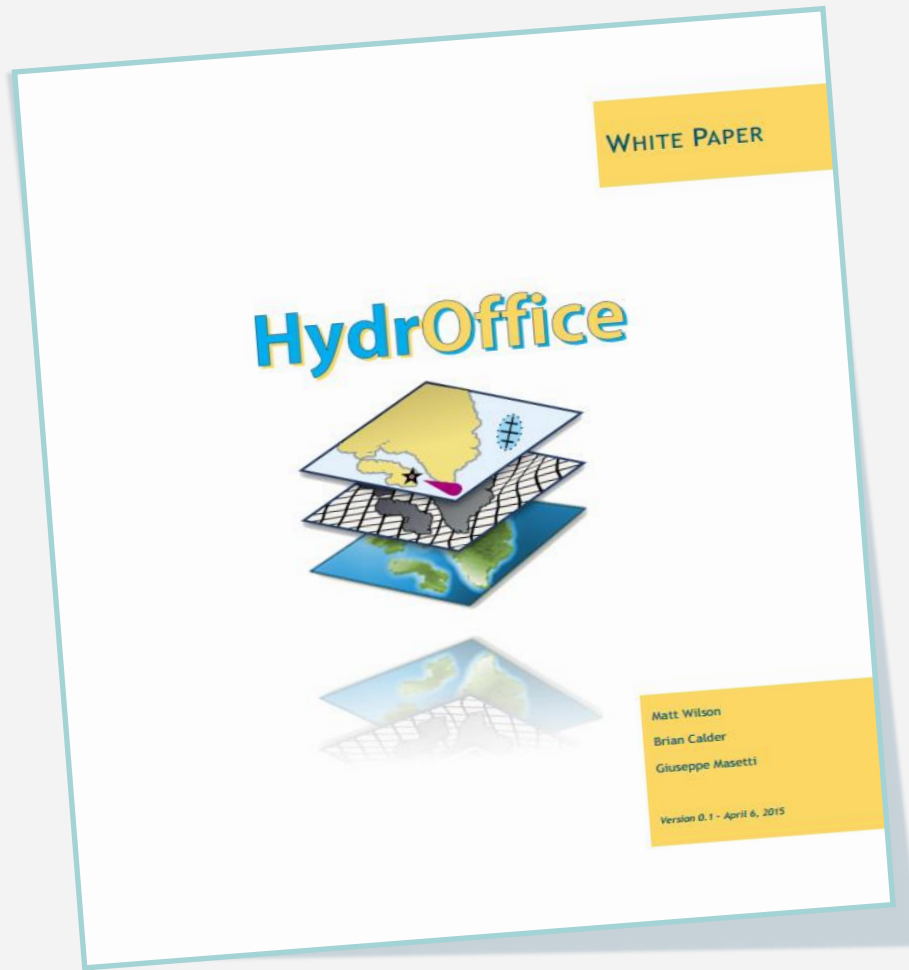




HydrOffice Suite

WHAT IS HYDROFFICE?





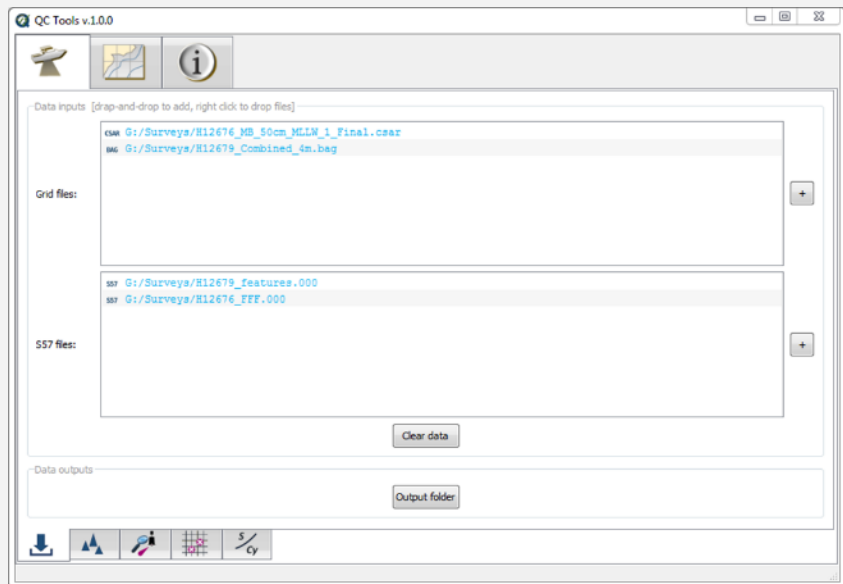
A framework of
libraries and tools
for Ocean Mapping



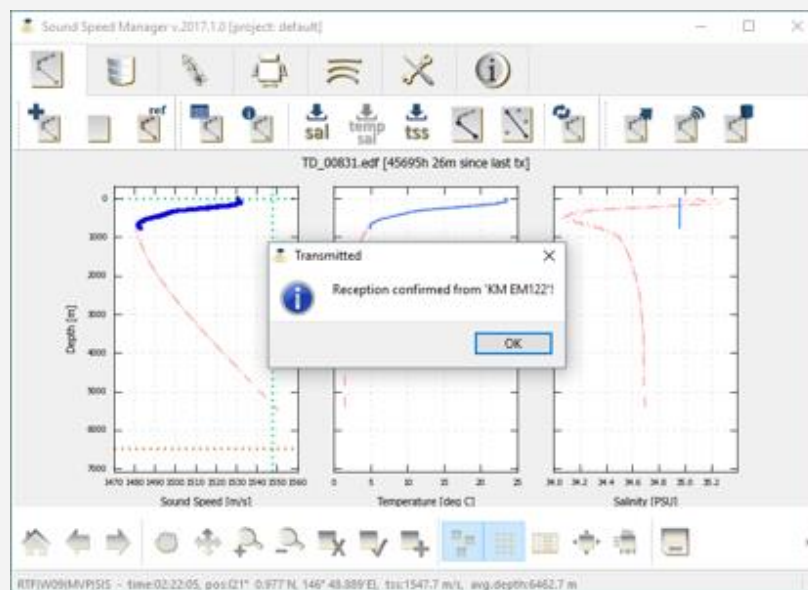
Quickly prototype
and test
innovative ideas



Ease the transition
from research to
operation



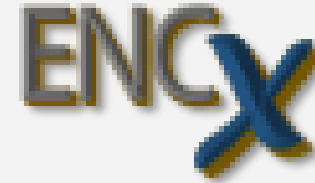
July 2016 Site Review



**March 2017
SSM release**

HYDROFFICE APPS

- BAG Explorer
- ENCx
- ePOM
- SmartMap
- CA Tools
- StormFix
- Bress
- ...





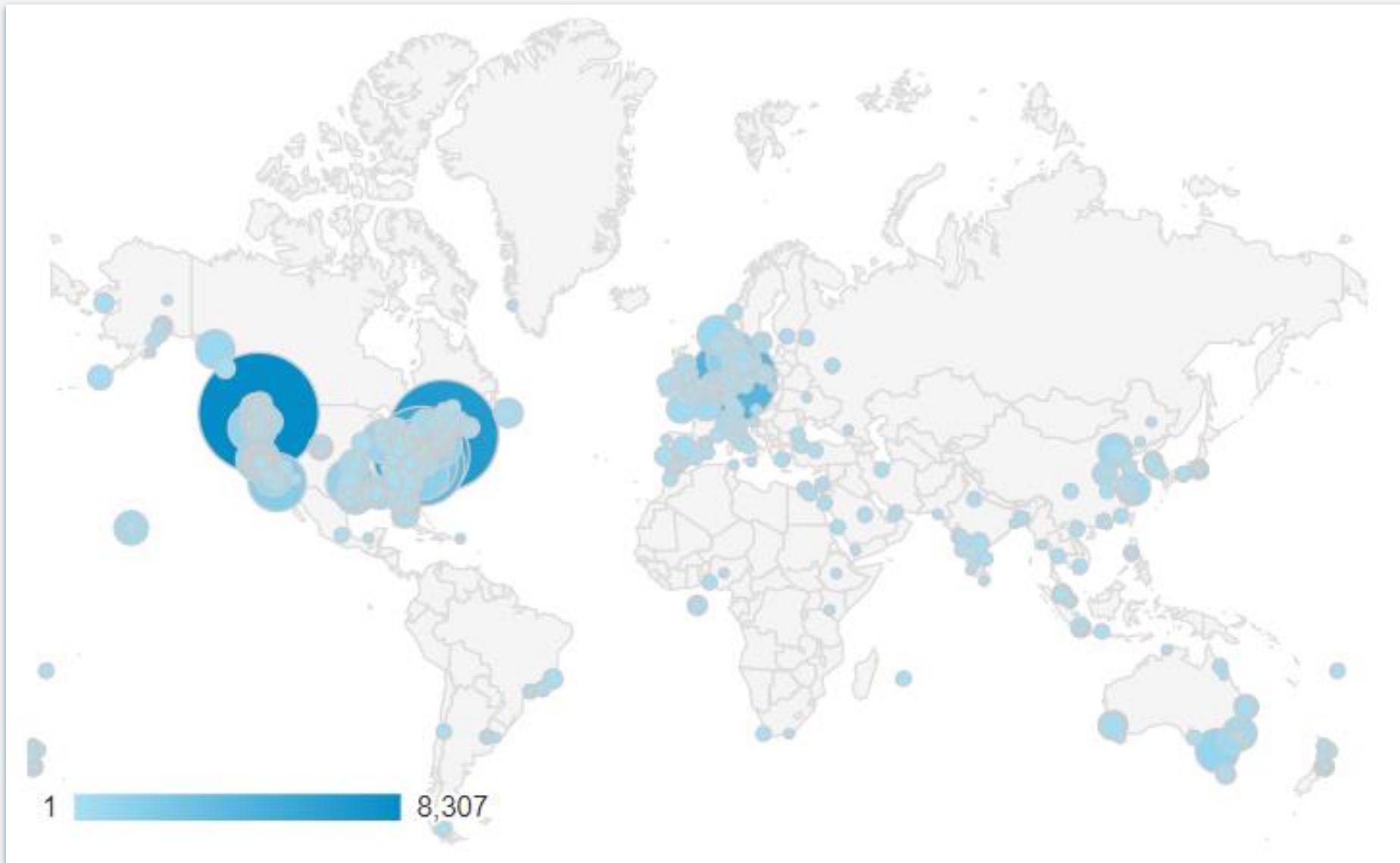
HYDROFFICE APPS & SCRIPTS

OCEAN MAPPING LIBS

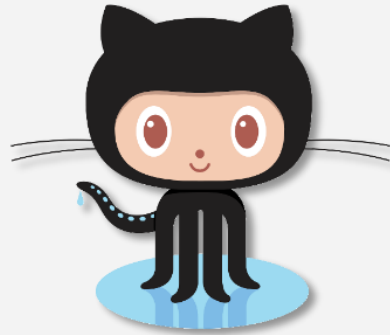
PYTHON SCIENTIFIC STACK



OCS-UNH CO-DEVELOPMENT



Distribution



Python Packages
GitHub @hydrooffice



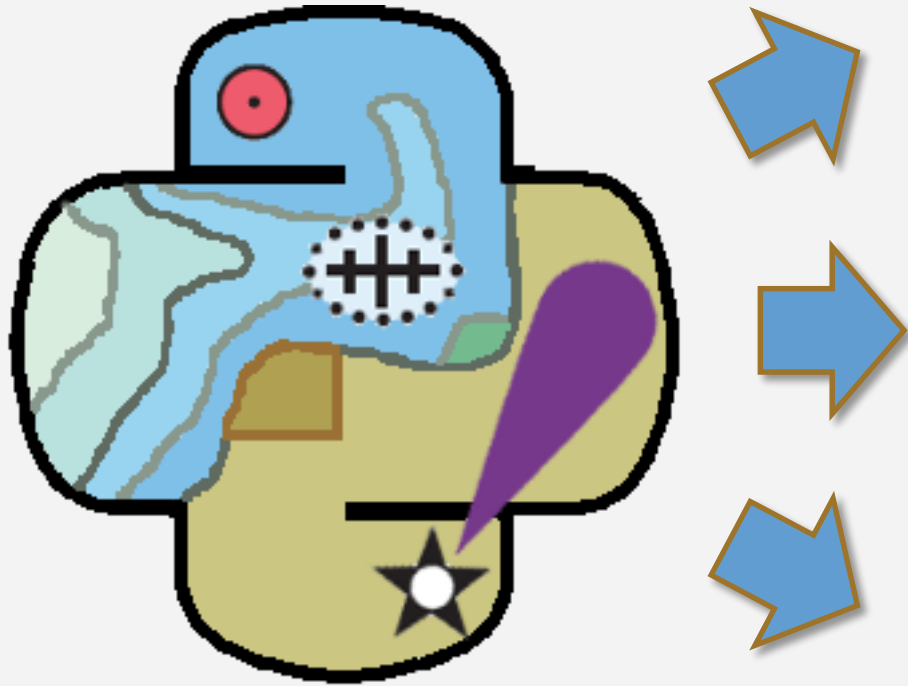
Stand-alone Apps
www.hydrooffice.org



Pydro Universe
www.nauticalcharts.noaa.gov

WHAT IS PYDRO?

PYDRO UNIVERSE



A NOAA **Py**thon Distribution
Managed by OCS HSTB

A Collection of Open-Source
Hydrographic Tools

**A Growing Community of
People with Interests in
Ocean Mapping**

PYDRO INSTALLATION

Url: <https://svn.pydro.noaa.gov/>

The screenshot displays the NOAA Office of Coast Survey Pydro documentation website. The page title is "Introduction to Pydro". The left sidebar contains a "Table Of Contents" with links to "What is Pydro", "Installation", "Redistribution", "Collaboration and Contribution", "Software Updates", "Pydro Explorer", "Licenses and Distribution", "Programs distributed in Pydro", "Downloads and Links", "Letter Transmitting Data", and "Extract Survey Outlines". The main content area shows the "Downloads and Links" section, which includes a list of download links: "Pydro download - full installer (1.2 GB)" and "Pydro Supplementals download - Supporting data (1 GB)". A yellow arrow points to the "Pydro download - full installer (1.2 GB)" link. A download progress window is overlaid on the page, showing the file "PydroSetup_22.1.r10103.exe" with a progress bar and the text "6m left - 23.6 MB of 2.1 GB (5.2 MB/sec)". The window also has a "Show all downloads" button. The bottom of the page includes a "Contact" section with the email address "@NOAA.GOV".

SOUND SPEED MANAGER



SOUND SPEED MANAGER



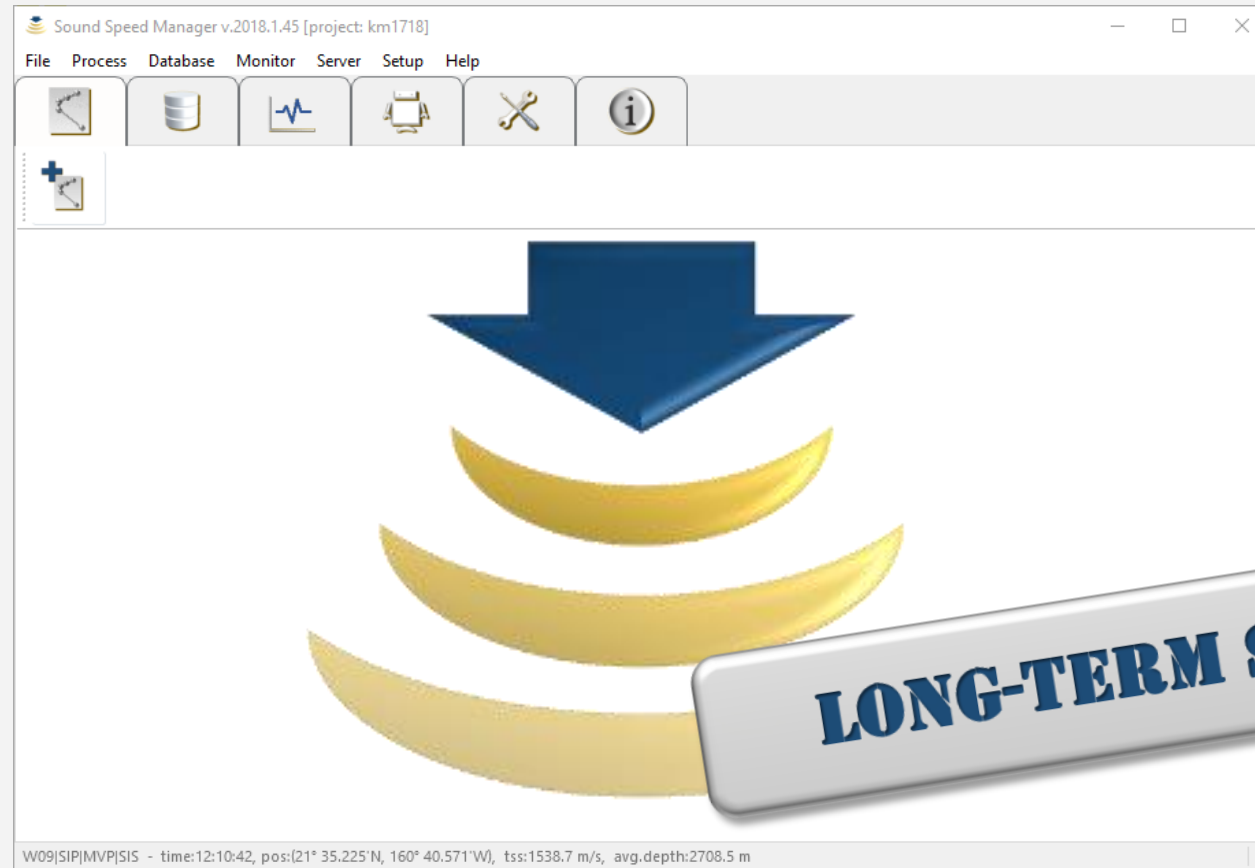
A **ready-to-go** and **free**
solution to ease
the **management of**
sound speed profiles
for ocean mapping

Collaborative Effort

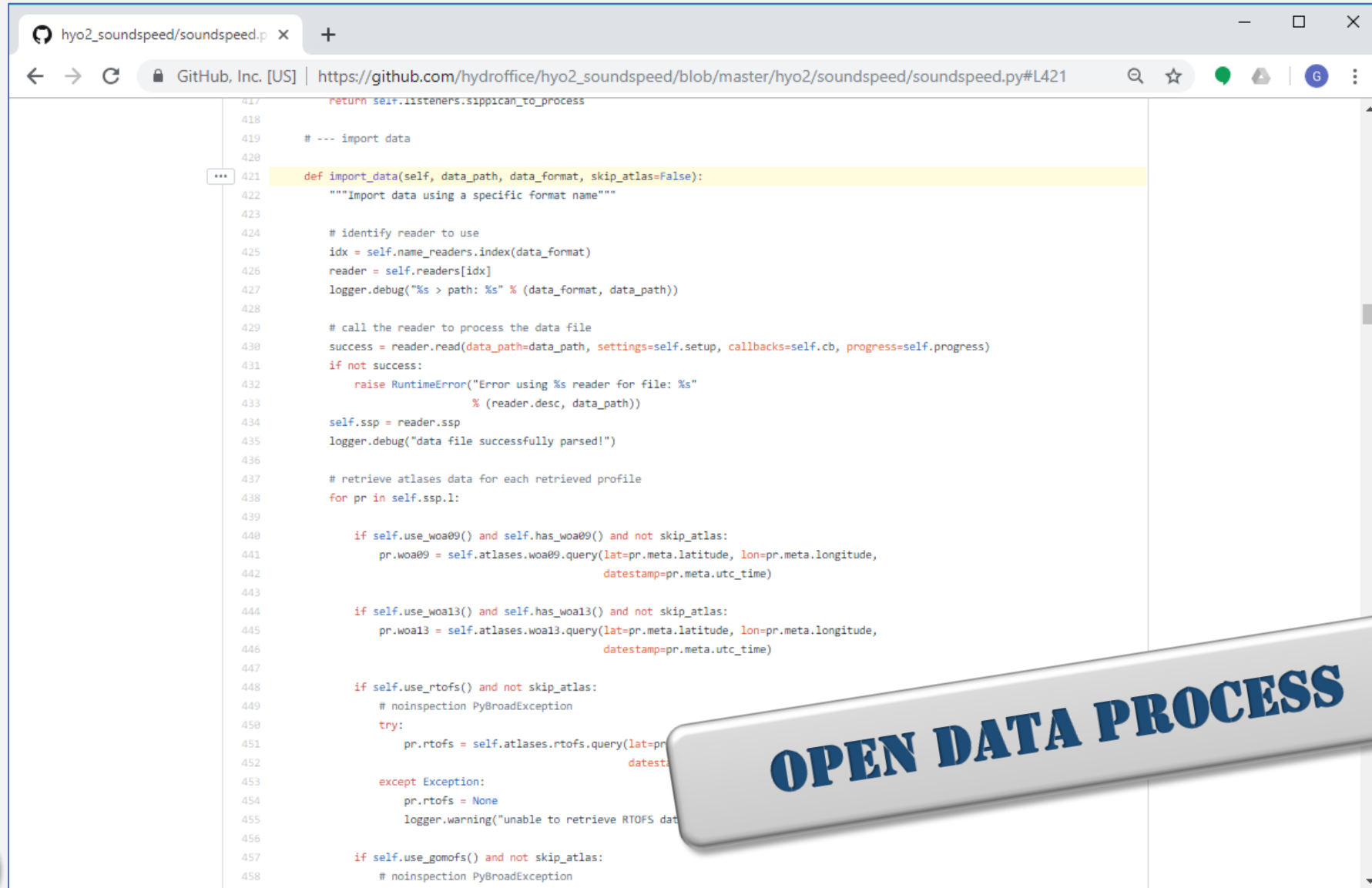


NOAA OCS POCs:

- Barry Gallagher
- Chen Zhang



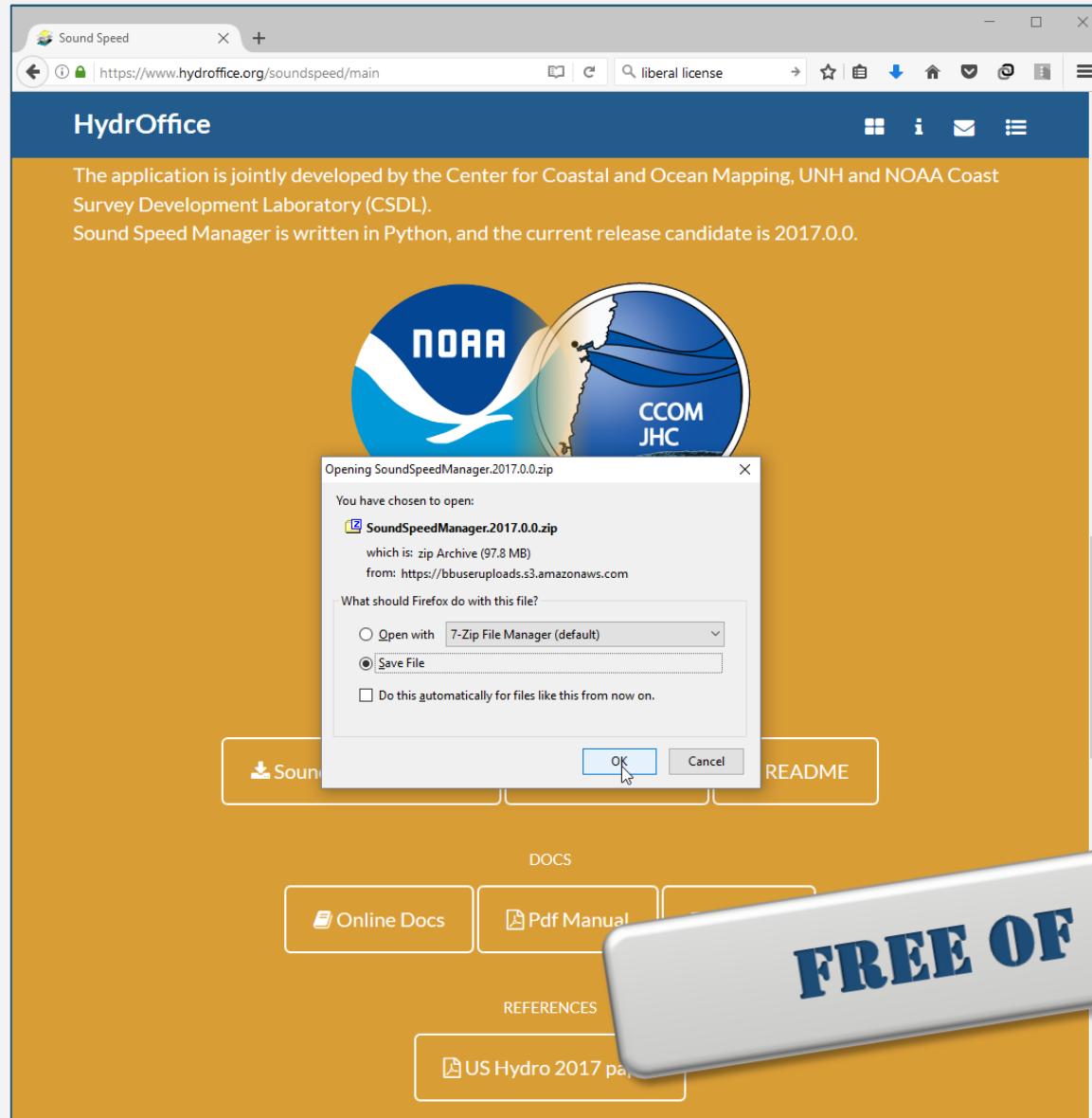
Open Source



```
417         return self.listeners.sippican_to_process
418
419     # --- import data
420
421     def import_data(self, data_path, data_format, skip_atlas=False):
422         """Import data using a specific format name"""
423
424         # identify reader to use
425         idx = self.name_readers.index(data_format)
426         reader = self.readers[idx]
427         logger.debug("%s > path: %s" % (data_format, data_path))
428
429         # call the reader to process the data file
430         success = reader.read(data_path=data_path, settings=self.setup, callbacks=self.cb, progress=self.progress)
431         if not success:
432             raise RuntimeError("Error using %s reader for file: %s"
433                                % (reader.desc, data_path))
434         self.ssp = reader.ssp
435         logger.debug("data file successfully parsed!")
436
437         # retrieve atlases data for each retrieved profile
438         for pr in self.ssp.l:
439
440             if self.use_woa09() and self.has_woa09() and not skip_atlas:
441                 pr.woa09 = self.atlases.woa09.query(lat=pr.meta.latitude, lon=pr.meta.longitude,
442                                                    datestamp=pr.meta.utc_time)
443
444             if self.use_woa13() and self.has_woa13() and not skip_atlas:
445                 pr.woa13 = self.atlases.woa13.query(lat=pr.meta.latitude, lon=pr.meta.longitude,
446                                                    datestamp=pr.meta.utc_time)
447
448             if self.use_rtofs() and not skip_atlas:
449                 # noinspection PyBroadException
450                 try:
451                     pr.rtofs = self.atlases.rtofs.query(lat=pr.meta.latitude, lon=pr.meta.longitude,
452                                                        datestamp=pr.meta.utc_time)
453                 except Exception:
454                     pr.rtofs = None
455                     logger.warning("unable to retrieve RTOFS data")
456
457             if self.use_gomofs() and not skip_atlas:
458                 # noinspection PyBroadException
```

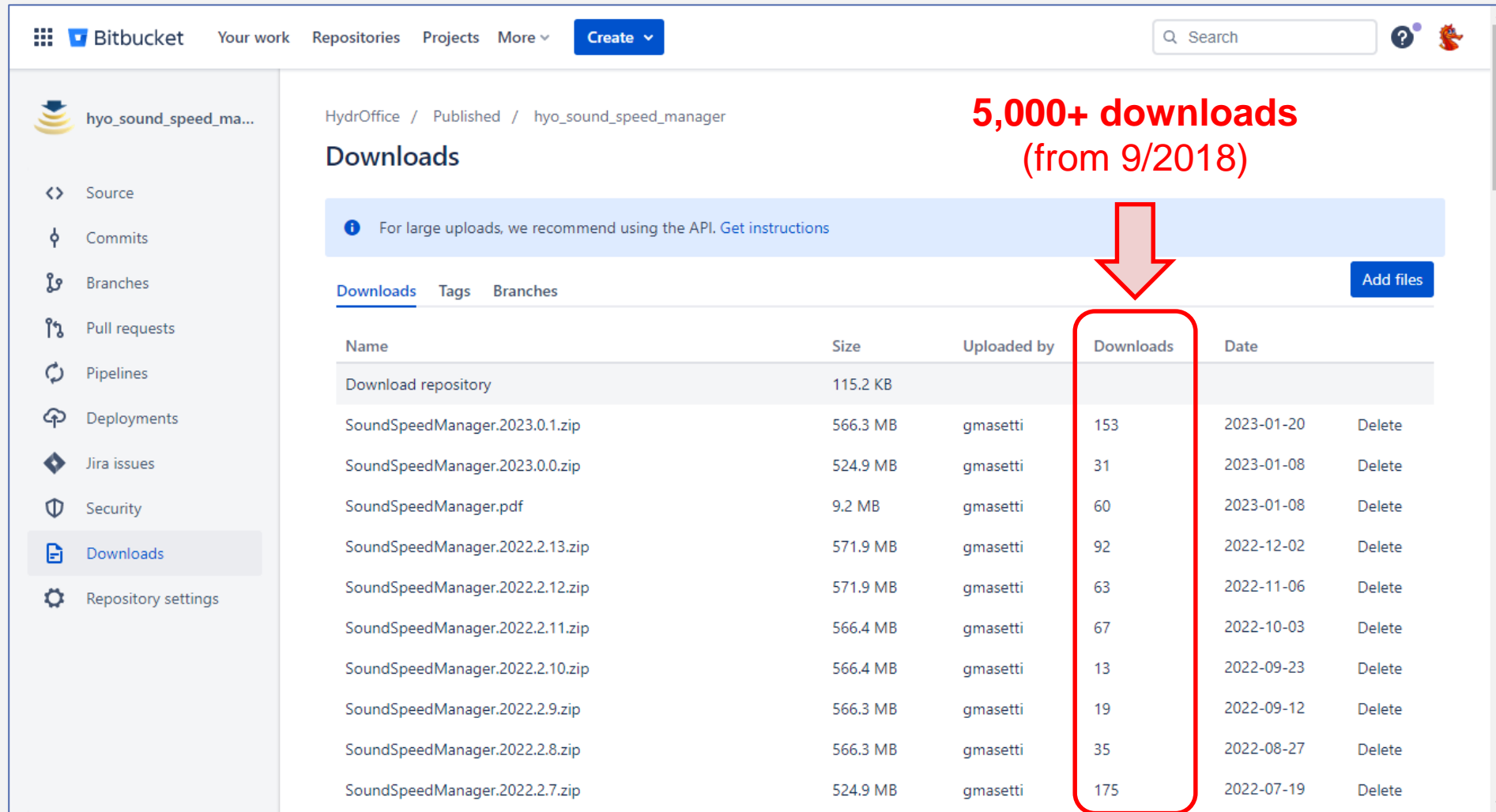
OPEN DATA PROCESS

Liberal License



FREE OF CHARGE

Large User Base



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hyo_sound_speed_ma...

HydrOffice / Published / hyo_sound_speed_manager


Downloads

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Name	Size	Uploaded by	Downloads	Date	
Download repository	115.2 KB				
SoundSpeedManager.2023.0.1.zip	566.3 MB	gmasetti	153	2023-01-20	Delete
SoundSpeedManager.2023.0.0.zip	524.9 MB	gmasetti	31	2023-01-08	Delete
SoundSpeedManager.pdf	9.2 MB	gmasetti	60	2023-01-08	Delete
SoundSpeedManager.2022.2.13.zip	571.9 MB	gmasetti	92	2022-12-02	Delete
SoundSpeedManager.2022.2.12.zip	571.9 MB	gmasetti	63	2022-11-06	Delete
SoundSpeedManager.2022.2.11.zip	566.4 MB	gmasetti	67	2022-10-03	Delete
SoundSpeedManager.2022.2.10.zip	566.4 MB	gmasetti	13	2022-09-23	Delete
SoundSpeedManager.2022.2.9.zip	566.3 MB	gmasetti	19	2022-09-12	Delete
SoundSpeedManager.2022.2.8.zip	566.3 MB	gmasetti	35	2022-08-27	Delete
SoundSpeedManager.2022.2.7.zip	524.9 MB	gmasetti	175	2022-07-19	Delete

Format Converter

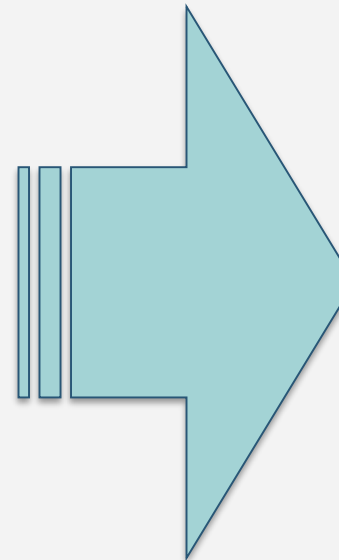
 **Input data** ✕


Import file:

AML	AOML	CARIS
Castaway	CSIRO DTC	Digibar Pro
Digibar S	ELAC	Hypack
Idronaut	ISS	Kongsberg
MVP	OceanScience	RBR
SAIV	SeaAndSun	Seabird
Sippican	Sonardyne	Turo
UNB	Valeport	

Retrieve from:

Project DB	CBOFS	LOOFS
SIS	CREOFS	LSOFS
Seabird CTD	DBOFS	NGOFS
WOA09 DB	GoMOFS	NYOFS
WOA13 DB	LEOFS	SFBOFS
WOA18 DB	LHOFS	SJROFS
OFS .nc	LMOFS	TBOFS
RTOFS		



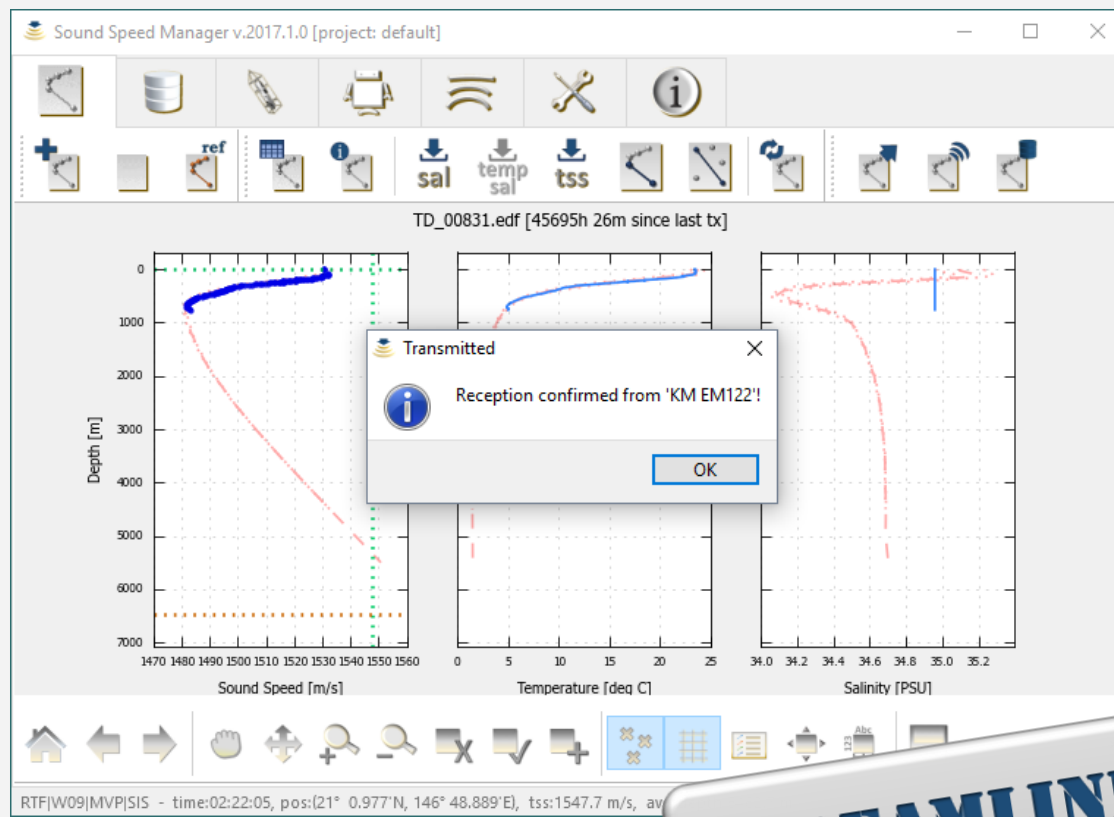
 **Export single profile** ✕

Select output formats:

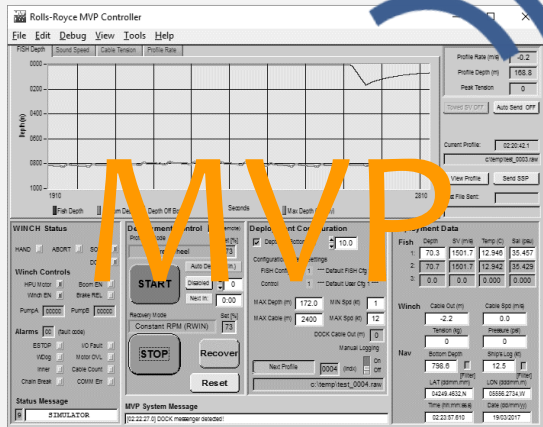
CARIS	CSV
ELAC	HiPAP
Hypack	iXBlue
Kongsberg	NCEI
QPS	Sonardyne
UNB	

☐ Select output folder
☒ Open output folder

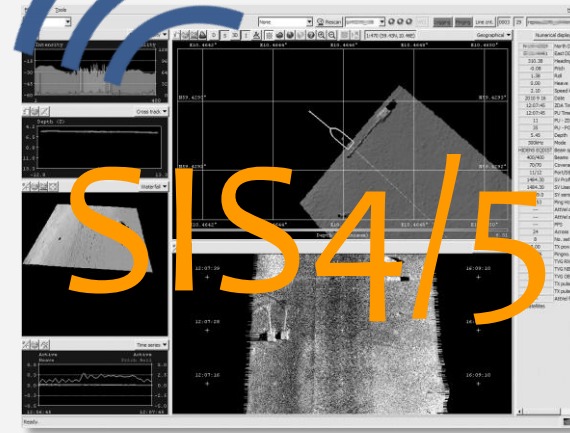
EASY TO EXTEND



STREAMLINE WORKFLOWS



MVP



SIS4/5



Sound Speed Manager v.2017.1.0 [project: FA_ALL]

Profiles:

	id	time	
1	1	2016-05-26 20:17:00	(-132.97
2	2	2016-05-26 22:58:00	(-133.02
3	3	2016-05-24 17:37:00	(-133.04
4	4	2016-05-24 19:23:00	(-133.04
5	5	2016-05-24 22:57:00	(-133.06
6	6	2016-05-25 00:00:00	(-133.06
7	7	2016-05-17 19:20:00	(-133.01
8	8	2016-05-17 22:55:00	(-133.04
9	9	2016-06-11 22:27:00	(-133.03
10	10	2016-06-11 21:17:00	(-133.03
11	11	2016-06-08 20:40:00	(-133.07
12	12	2016-06-08 22:23:00	(-133.06
13	13	2016-06-08 23:12:00	(-133.01
14	14	2016-06-08 23:38:00	(-133.00
15	15	2016-06-08 17:12:00	(-133.07
16	16	2016-06-08 18:22:00	(-132.97
17	17	2016-06-08 19:28:00	(-133.00
18	18	2016-05-26 17:42:00	(-133.05
19	19	2016-05-26 19:36:00	(-133.02
20	20	2016-05-26 21:51:00	(-133.074499:55.158396)

LeadSheet

Raw	Processed	SIS
	Depth	Speed
00000	0.0	1487.87390137
00001	1.06676244736	1487.87390137
00002	1.09075820446	1487.97485352
00003	1.12069058418	1487.99169922
00004	2.97799444199	1486.64208984
00005	4.02984571457	1485.88720703
00006	5.03996658325	1485.16662598
00007	6.01628684998	1484.71850586
00008	7.02121686935	1484.34790039
00009	8.02173137665	1484.07177734
00010	9.00880908966	1483.96801758
00011	10.0112581253	1483.9642334

original path

Project

New project

Rename project

Switch project

Import data

Open folder

Export info

Output folder

RTF|W09|MVP|SIS - time:02:13:07, pos:(20° 59.543'N, 146° 49.319'E), tss:1547.7 m/s, avg.depth:6415.2 m

SSP INFO IN DATABASE

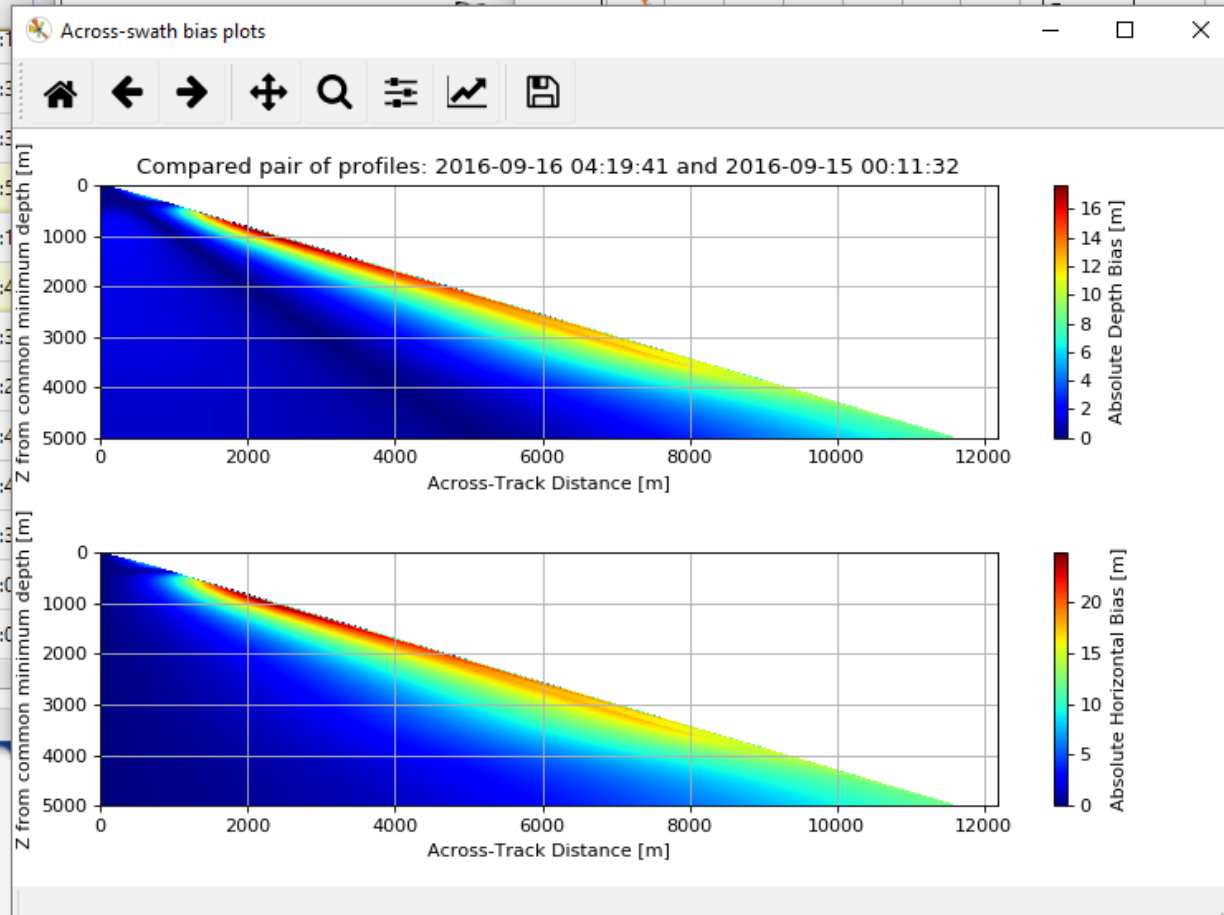
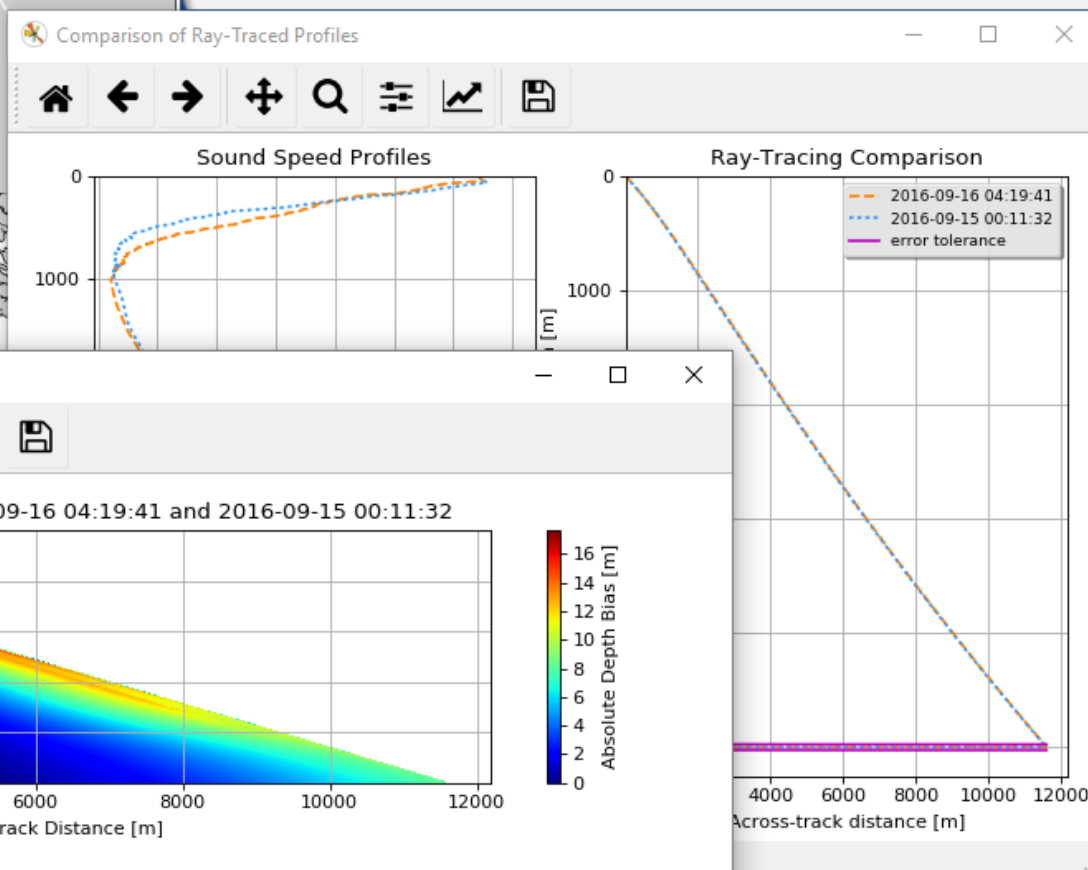
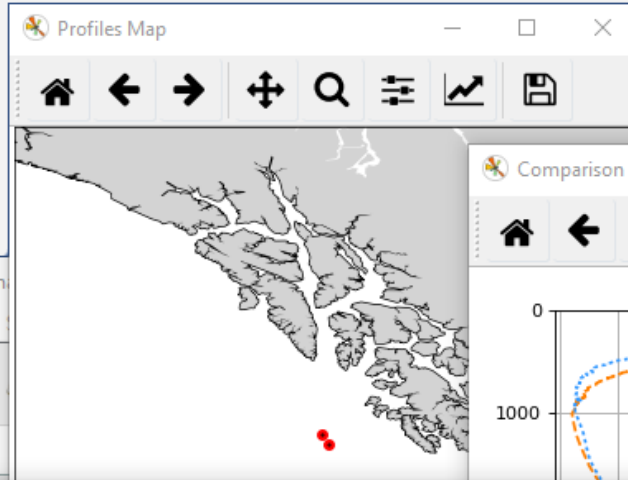
Sound Speed Manager v.2018.1.40 [project: m...]

File Process Database Monitor Server

Profiles:

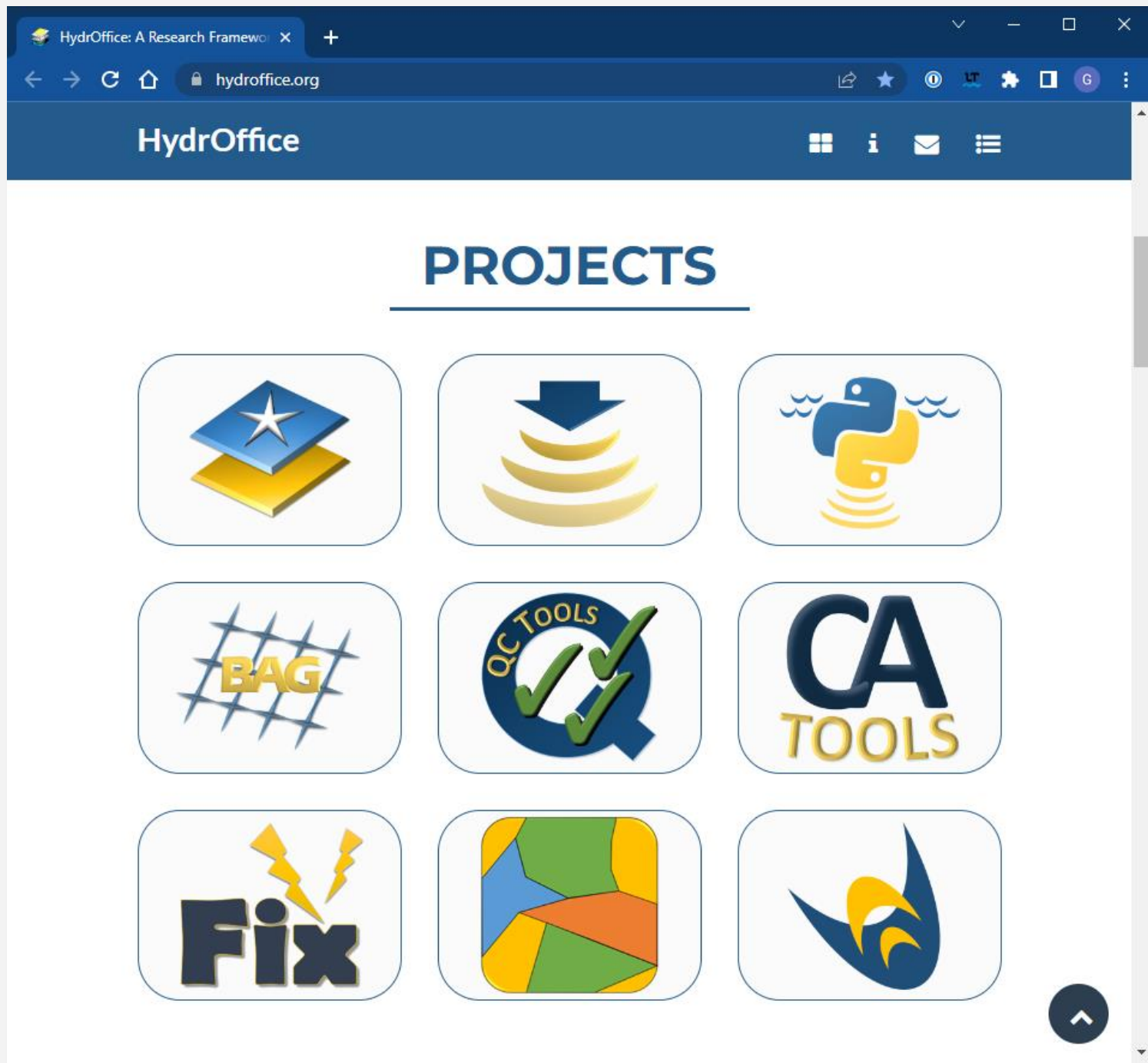
	id	time
11	16	2013-09-03 17:13:1
12	15	2016-09-14 04:13:3
13	12	2016-09-17 00:02:3
14	11	2016-09-17 05:13:5
15	10	2016-09-16 18:06:1
16	9	2016-09-16 04:19:4
17	8	2016-09-16 00:06:3
18	7	2016-09-15 18:01:2
19	6	2016-09-15 12:01:4
20	5	2016-09-15 05:30:4
21	4	2016-09-15 00:11:3
22	3	2016-09-14 18:01:0
23	26	2017-10-23 18:11:0

W09[SIS - XYZ88 NA [pinging?]



OTHER USEFUL TOOLS





A photograph of a sunset over the ocean, taken from the deck of a ship. The sun is low on the horizon, casting a golden glow across the sky and reflecting on the water. The ship's railing is visible on the right side of the frame.

Questions?

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