

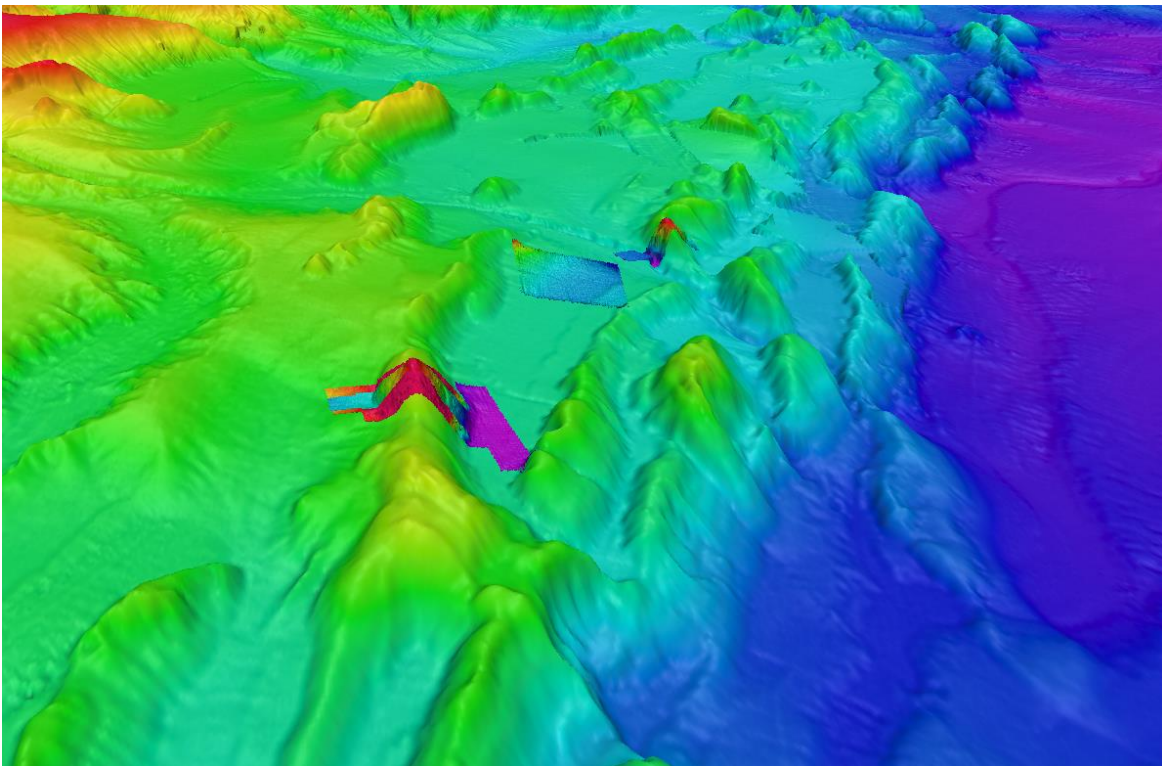
E/V Nautilus

EM302 Multibeam Echosounder

System Review

NA070

April 10-15, 2016



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Table of Contents

Table of Contents.....	2
Introduction	4
Cruise Participants.....	5
Survey System Components.....	5
Activities	5
Overview of System Geometry.....	5
TX and RX Arrays.....	6
MRU	6
Calibration	6
Calibration Results.....	8
System Geometry and SIS Parameters (15 April 2015)	10
Accuracy Assessment.....	11
Shallow Accuracy Assessment.....	11
Deep Accuracy Assessment.....	15
Accuracy Results – FM Dual-Swath.....	17
Achieved Coverage	18
Noise Level Assessment	19
Self Noise Results – Speed – Into Swell	20
Self Noise Results – Speed – With Swell	22
Self Noise Versus Azimuth	24
Transducer and System Health.....	25
Impedance Results – Receiver.....	26
Impedance Results – Receiver Transducer.....	26
Impedance Results – Transmitter.....	27
Summary and Recommendations.....	28
References	29
Appendix.....	30
Self Noise Results – Speed – Into Seas (6 kts)	30
Self Noise Results – Speed – Into Seas (8 kts)	32
Self Noise Results – Speed – With Seas (6 kts)	34
Self Noise Results – Speed – With Seas (8 kts)	36
Self Noise Results – Speed – With Seas (10 kts)	38
Self Noise Results – Speed – With Seas (11 kts)	40
Self Noise Results – Swell – 000° (With Swell).....	42
Self Noise Results – Swell – 045°	44
Self Noise Results – Swell – 090°	46
Self Noise Results – Swell – 135°	48
Self Noise Results – Swell – 180° (Into Swell).....	50
Self Noise Results – Swell – 225°	52

Self Noise Results – Swell – 270°	54
Self Noise Results – Swell – 315°	56
Self Noise Results – Swell – 360° (With Swell).....	58
SIS Screenshots – Installation Parameters (15 April 2016)	60
SIS Screenshots – Runtime Parameters	68
SIS Screenshots – PU Status	72
SIS Screenshots – Datagram Distribution.....	73

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of UNH or NSF.

Cover image: SE-looking perspective view of bathymetry off British Columbia with NA070 pitch, yaw, and roll calibration and verification lines. All surfaces shown with 6x vertical exaggeration and individual color scales for contrast. Background bathymetry from GMRT.

Introduction

The E/V *Nautilus* undertook an engineering shakedown leg (NA070) in order to perform an assessment of the vessel's Kongsberg EM302 multibeam echosounder. Data were collected near the continental shelf break (Figure 1) offshore from Victoria, British Columbia during April 10-15, 2016. Paul Johnson and Kevin Jerram provided logistical and technical support for mission planning, data collection, and analysis. This report presents:

- an overview of the data collected and the processing methods applied to it;
- accuracy assessments at two depth ranges and swath coverage analysis across all depths surveyed;
- a history of all changes made to the system configuration, starting from the initial install and up through the most recent calibration, prior to the start of the 2016 operational season;
- amplitudes and spectra of vessel self-noise measured by the multibeam receiver at various speeds and headings relative to a prevailing swell;
- EM302 impedance data to document receiver and transducer health.

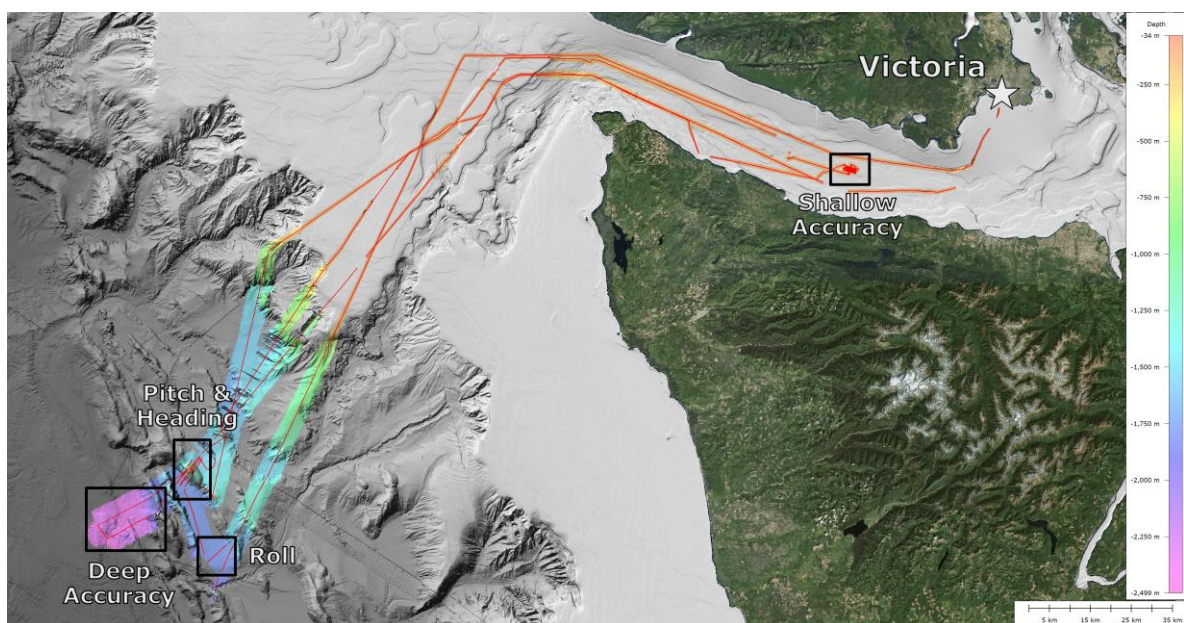


Figure 1. EM302 system testing was performed during NA070 at the continental shelf break off Victoria, British Columbia, using an accuracy assessment reference surface previously collected by the R/V Thompson and nearby seafloor features conducive to calibration.

Cruise Participants

Tim Brogdon	Reuben Mills
Josh Chernov	Nicole Raineault
Dwight Coleman	Brian Raynes
Mark DeRoche	Trevor Shepherd
Ethan Gold	Scott Stamps
Kevin Jerram	Ian Vaughn
Paul Johnson	Regina Yopak
Reny Kane	Jon Zand
Justin Lowe	

Survey System Components

The mapping system consists of the following primary components:

1. Kongsberg Maritime EM302 multibeam echosounder (30 kHz), v1.3.1, s/n 110
2. Kongsberg Maritime Seafloor Information System (SIS), v4.1.3
3. Kongsberg Seatex Seapath 330+ vessel navigation system
 - Seapath 330+ GNSS antennae
 - MRU 5+, s/n C126NS2018
4. AML Oceanographic Micro-X surface sound speed sensor
5. Sippican expendable bathythermograph (XBT) profiling system

Activities

Cruise activities included a review of the survey system geometry, calibration for residual angular offsets of the motion sensor ('patch test'), accuracy evaluation with respect to a bathymetric reference surface created during R/V Thompson cruise TN144 (2002), ship speed self noise and ship azimuth self noise testing in well-developed sea states, receiver and transmitter impedance testing, and swath coverage/extinction evaluation on and off the continental shelf break.

Ancillary activities included support for watchstander training, verification of the Knudsen subbottom profiler operation, and surveys of opportunity during transits.

Overview of System Geometry

In this report, we use the term 'system geometry' to mean the linear and angular offsets of the primary components of the multibeam mapping system, including the transmit array (TX), receive array (RX), and ship navigation sensor (MRU). These parameters are critical for data collection in an unbiased and repeatable manner. Table 1 presents a chronological outline of documented modifications to system geometry.

Table 1. Documented modifications to system geometry.

Date	Cruise ID	Location	Event	References
2013 March		Istanbul, Turkey	Install EM302 MBES, Seatex Seapath 330+ MRU, AML Oceanographic surface sound speed sensor, Sippican XBT profile; establish vessel reference frame and survey sensor offsets	Kongsberg Maritime (KM) Harbor Acceptance Test (HAT) report, Parker Maritime survey report
2013 April	NA025	Toulon, France	EM302 sea acceptance trials; MRU angular offsets determined by patch test and applied in SIS	UNH/IFREMER Sea Acceptance Trials (SAT) report, Gates Acoustic Services report
2013 June	NA030	Gulf of Mexico	Original MRU 5+ unit replaced with spare by KM engineer at start of NA030	2014 EM302 Multibeam Echosounder System Review
2014 May	NA040	Gulf of Mexico	Original MRU 5+ unit reinstalled by KM engineer at start of NA040; EM302 system performance review; residual angular offsets determined by patch test and applied in SIS	2014 EM302 Multibeam Echosounder System Review
2015 April	NA055	Gulf of Mexico	EM302 system performance review; residual angular offsets determined by patch test and applied in SIS	2015 EM302 Multibeam Echosounder System Review
2016 April	NA070	Victoria, British Columbia	EM302 system performance review; residual angular offsets determined by patch test and applied in SIS	2016 EM302 Multibeam Echosounder System Review (this document)

TX and RX Arrays

Linear and angular offsets of the TX and RX arrays were determined from a ship survey performed by Parker Maritime in Istanbul in March of 2013 (see Parker Maritime survey report and UNH/IFREMER Sea Acceptance Trial [SAT] report for details). Offsets of the hull-mounted arrays are not expected to have changed since the Parker survey. Accordingly, no array offset modifications are documented in this report.

MRU

All modifications to the system geometry since installation have involved the MRU. Prior to the 2013 season, linear and angular offsets of the original MRU were determined from the Parker Maritime survey and SAT patch test, respectively. Subsequent modifications to the MRU from July, 2013 (NA030) through April, 2015 (NA055) and resulting angular offsets determined by patch testing are documented in the NA040 and NA055 multibeam evaluation reports. Linear offsets have not been modified at any point. A review of the installation parameters in SIS at the start of NA070 confirmed that the NA055 calibration results were maintained without modification (accidental or otherwise) throughout the 2015 season and leading into 2016. Residual angular offsets determined through patch testing and verification lines during NA070 have been applied in SIS and are documented in this report.

Calibration

A patch test was conducted at the start of NA070 to determine residual angular offsets of the MRU in the order of pitch, roll, and yaw. No latency test was performed, as this has not been evident during previous evaluations or during the start of NA070. Data were collected in depths of 1500-1900 m over seabed features near the continental shelf break southwest of Victoria, British Columbia (Figure 2). Descriptions of the rationale for calibration line planning are available in the *Cookbook for Caris HIPS 8.1 Patch Test with Kongsberg EM302*, which was developed with examples from NA040.

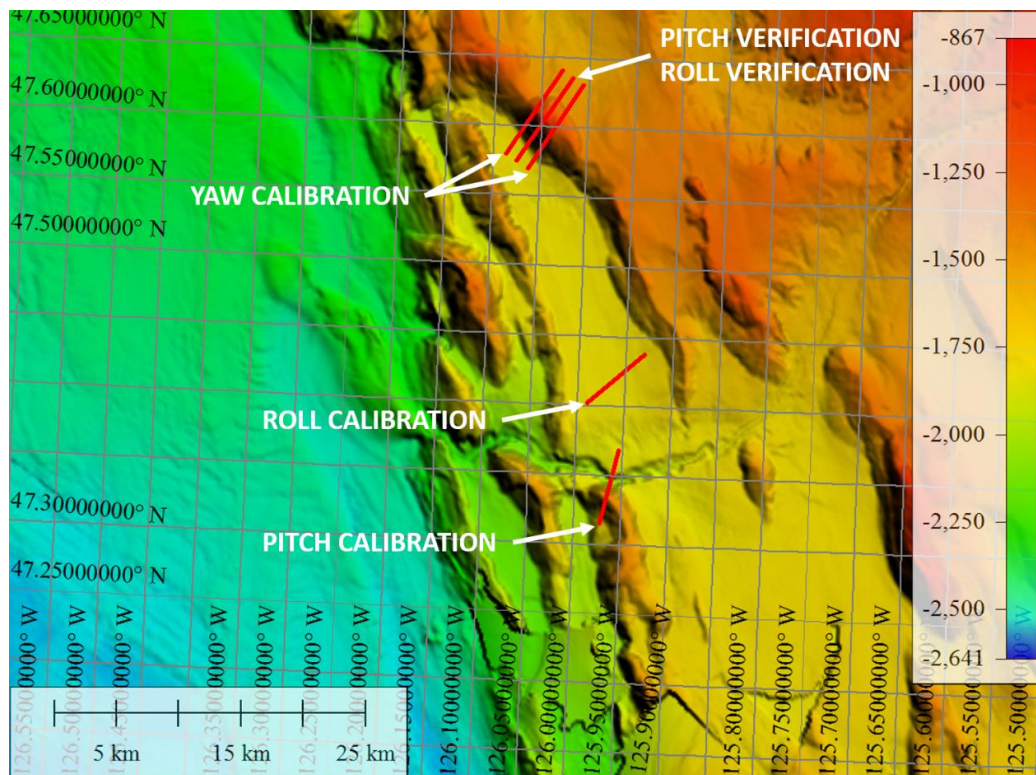


Figure 2. Layout of NA070 calibration sites (presented in Global Mapper using historic multibeam echosounder data downloaded from the GMRT database). The pitch result from the southern calibration site was verified using a higher quality seafloor feature to the north; this northern site was also used for yaw calibration. Due to time constraints with a developing sea state, the initial roll calibration result was verified by fully opening the swath over flat seafloor at the southwestern portions of the pitch verification lines.

Immediately prior to pitch calibration, an XBT profile was acquired to 760 m depth and processed using WinMK and SVP Editor to remove spurious sound velocities, apply salinity data from the World Ocean Atlas (2009), extend the cast to 12,000 m per SIS requirements, and load the resulting sound speed profile into SIS. The sound speed environment was observed to be sufficiently stable (i.e., yielding acceptably small refraction artifacts) to apply the same profile for all other calibration lines.

All calibration lines were collected at a vessel speed of 6-7 kts over ground due to engine-related difficulties operating the vessel at slower speeds for extended periods. While this speed reduces the alongtrack sounding density compared to previous patch tests performed at 4-6 kts, the lengths of the calibration lines generally ensured sufficient data quantity for calibration purposes. To maximize ping rate and sounding density, the EM302 was configured as follows:

Depth mode:	AUTO
Dual-swath mode:	enabled (dynamic)
Transmit mode:	FM enabled (unchecked)
Yaw stabilization:	enabled (rel. mean heading)
Pitch stabilization:	enabled
Beam spacing:	High density equidistant
Swath width:	Pitch: 20°/20° port/stbd
	Roll: 70°/70° port/stbd
	Yaw: 15°/50° port/stbd and 50°/15° stbd/port

Calibration survey data were collected using the post-NA055 angular offsets as the initial starting point for real-time processing in SIS. Accordingly, the angular offsets determined from the NA055 calibration constituted ‘residual’ values to be summed with the NA055 values. Angular offsets were determined in the order of pitch first, roll second, and yaw third. To minimize coupling of angular offsets in the calibration results, each angular offset was updated in SIS after completion of its respective calibration procedure and before the start of survey data collection for the next offset calibration. Calibration tools in SIS and QPS Qimera were used separately to evaluate each set of calibration lines. Results from multiple independent examinations of each dataset by Johnson and Jerram typically agreed within 0.02° and were agreed upon before application in SIS.

Calibration Results

Despite data quality difficulties at the first pitch site, small trends requiring residual angular offsets were observable for the pitch and roll datasets. A pitch adjustment of -0.02° and roll adjustment of +0.03° were applied in SIS. The yaw calibration lines suggested no clear trend requiring an angular adjustment and this value was left as its post-NA055 value. The pitch and roll adjustments were verified by collection and examination of a second set of calibration lines at a higher quality seafloor feature with excellent results (zero residual evident). No evidence indicating latency in the system was observed at any point during NA070.

Figure 3 to 5 depict example transects using the Qimera calibration tool for the pitch, roll, and yaw calibration data sets. The final value for each offset is based on examination of multiple transects in the Qimera and SIS calibration tools and represent the angle adjustments applied in the MRU Installation Parameters in SIS (Table 2). NA070 survey data for accuracy and extinction testing utilized these post-calibration values and appear to be free of offset-related artifacts.

Table 2. Summary of MRU angular offsets in SIS from NA070. The post-NA070 values should be used until another the MRU is modified or a calibration otherwise becomes necessary.

Angular Offset	Pre-NA070 Value	NA070 ‘Residual’	Post-NA070 Value
Pitch	-0.12°	-0.02°	-0.14°
Roll	+0.13°	+0.03°	+0.16°
Yaw	+0.11°	+0.00°	+0.11°

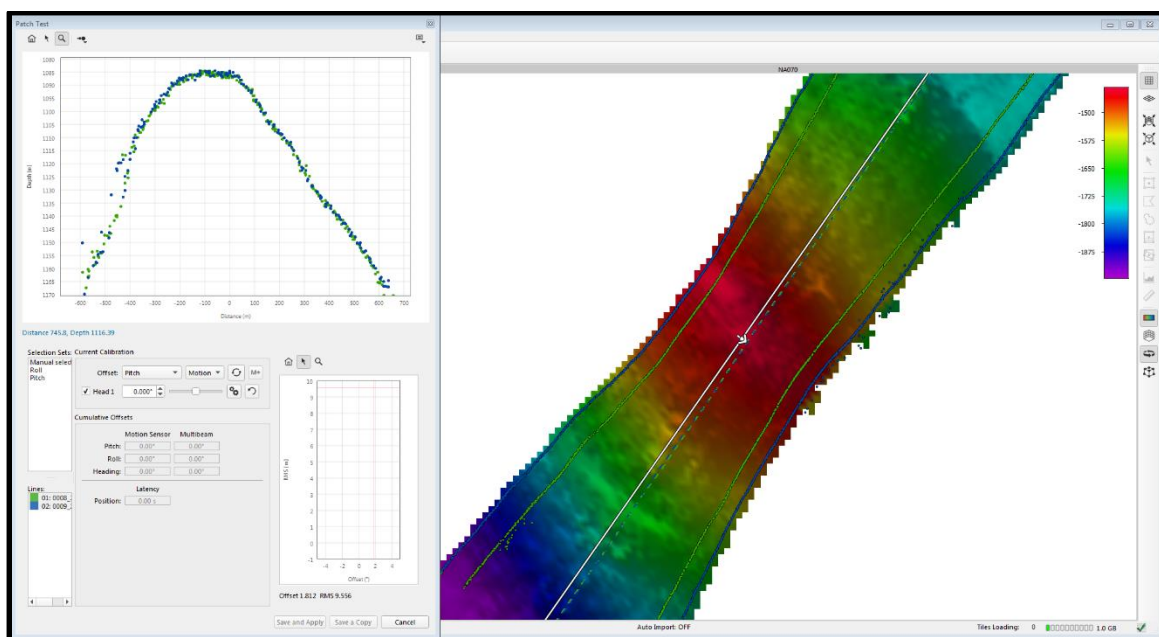


Figure 3. Example subset of pitch verification data in Qimera confirming an adjustment of -0.02° from -0.12° to -0.14°.

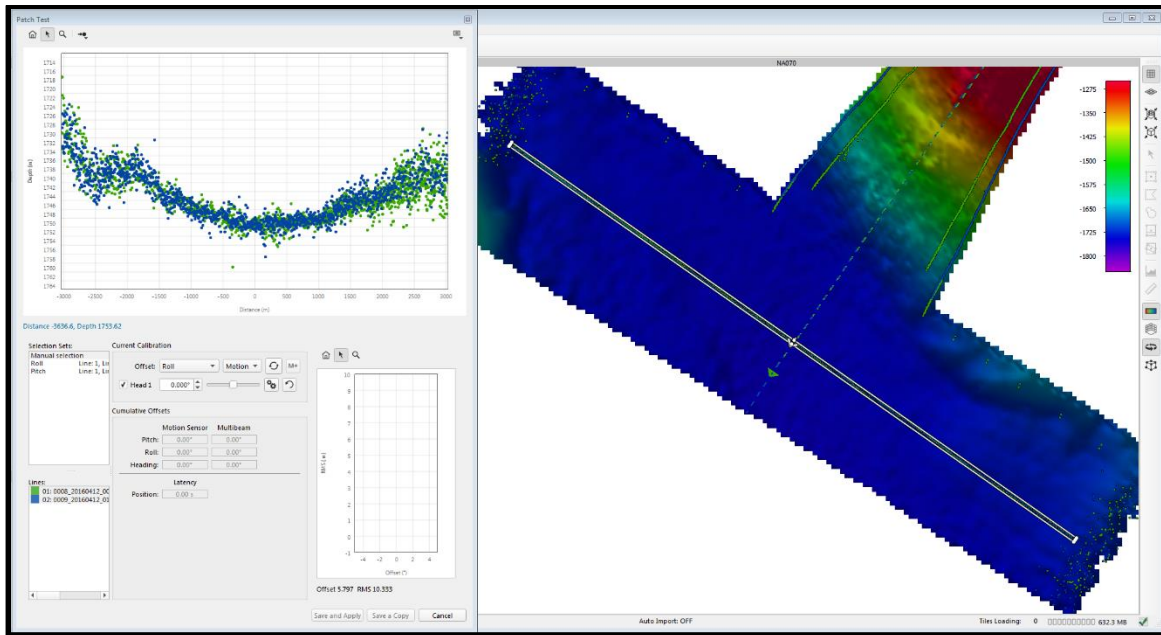


Figure 4. Example subset of roll verification data in Qimera confirming an adjustment of $+0.03^\circ$ from $+0.13^\circ$ to $+0.16^\circ$.

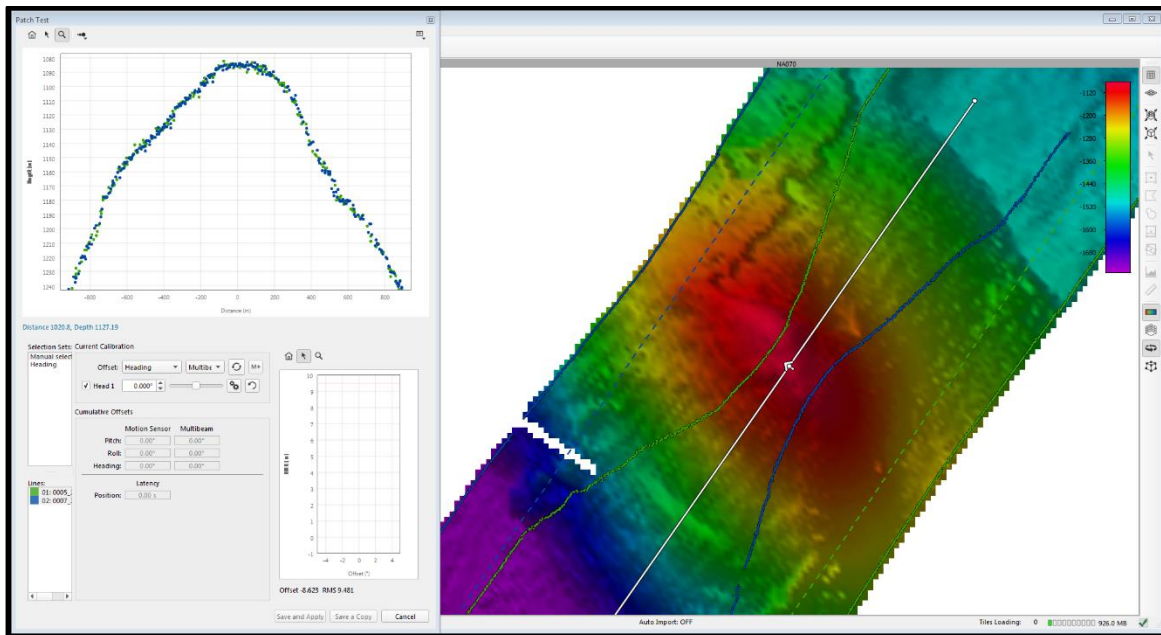


Figure 5. Example subset of yaw calibration data in Qimera showing 0.00° residual angular offset. No change was made to the MRU yaw offset.

System Geometry and SIS Parameters (15 April 2015)

Table 3 includes the SIS configuration for the linear and angular offsets of the TX and RX arrays and the MRU at the end of the NA070 leg on April 15, 2015. Aside from applying the residual MRU pitch and roll angular offsets determined from the NA070 patch test, no further modifications were expected or made to the SIS Installation Parameters (Figure 6). Additional screenshots of SIS parameters are available in the Appendix. These offsets represent the survey configuration which will be used at the start of the 2016 Nautilus operational season based on existing documentation and patch test results. All values are with respect to the Kongsberg (SIS) reference frame. These parameters are to be used until sensor locations or orientations are modified or it is determined that a new patch test should be undertaken.

Table 3. SIS PU parameters for linear and angular offsets at the end of NA070. (Note that MRU linear offsets are zero because navigation data from the Seapath 330+ navigation system are referenced to the Navigation Reference Point. This configuration has not changed, but was incorrectly described as being referenced to the center of the TX array in earlier reports.)

	X (m)	Y (m)	Z (m)	Roll (°)	Pitch (°)	Yaw (°)
Vessel Reference Origin	0.000	0.000	0.000	-	-	-
Navigation Reference Point	0.000	0.000	0.000	-	-	-
EM302 TX	+3.496	-0.137	+2.731	+0.61	+0.01	+0.22
EM302 RX	+1.516	+0.033	+2.732	+0.72	+0.32	+0.08
Seapath MRU	0.000	0.000	0.000	+0.16	-0.14	+0.11

Location offset (m)

	Forward (X)	Starboard (Y)	Downward (Z)
Pos, COM1:	0.00	0.00	0.00
Pos, COM3:	0.00	0.00	0.00
Pos, COM4/UDP2:	0.00	0.00	0.00
TX Transducer:	3.496	-0.137	2.731
RX Transducer:	1.516	0.033	2.732
Attitude 1, COM2/UDP5:	0.00	0.00	0.00
Attitude 2, COM3/UDP6:	0.00	0.00	0.00
Waterline:			-1.77

Offset angles (deg.)

	Roll	Pitch	Heading
TX Transducer:	0.61	0.01	0.22
RX Transducer:	0.72	0.32	0.08
Attitude 1, COM2/UDP5:	0.16	-0.14	0.11
Attitude 2, COM3/UDP6:	0.00	0.00	0.00
Stand-alone Heading:			0.0

Figure 6. SIS screen captures of PU parameters for linear and angular offsets of system components after NA070.

Accuracy Assessment

Accuracy testing was conducted using both a shallow and deep water site due to weather-related changes in the cruise plan. For the shallow site, the reference surface was constructed using bathymetric data collected during NA070, while the deep water surface was constructed from data collected by the R/V *Thompson* in 2002. Vessel speed was limited to 8 kts during acquisition of the shallow water reference surface and during the collection of the shallow and deep water crosslines. Sound speed profiles were collected using XBTs and applied immediately prior to the start of reference surface data collection and as needed during further acquisition of reference surface data and crossline data.

All soundings in the reference surfaces and accuracy cross lines were corrected for tide using data from the Oregon State tidal prediction software (volkov.oce.orst.edu/tides/otps.html) and applied through Qimera. Furthermore, bathymetric slopes were computed for the reference surfaces and used to mask (exclude) areas of significant topography ($>5^\circ$) from the crossline analysis. Finally, reference surfaces were masked to only include areas where a significant number of sounding contributed to the gridded node. All cross lines were run orthogonally to the reference surface main lines to reduce the effects of any biases compounding or cancelling across the swath. Fortunately, noise due to ship heading relative to the prevailing seas was not a major factor on either the reference surface lines or cross lines headings.

Outliers (such as bottom detections at constant range across the swath due to interference) were removed from the accuracy analysis, as these would clearly be edited during normal bathymetric processing. In all cases, the mean depth bias and depth bias standard deviations as a percentage of water depth were computed in 1° angular bins across the swath for each configuration. The EM302 configurations and accuracy results for the shallow and deep water sites are presented in the following sections.

Shallow Accuracy Assessment

Due to weather-related changes to the cruise plan, two accuracy assessments were conducted in different depth ranges covering the SHALLOW and DEEP operational modes of the EM302. The shallow reference surface was collected in water depths of ~ 165 m in the Strait of Juan de Fuca traffic separation zone (Figure 7). The reference surface was collected in SHALLOW depth mode with Dual Swath - Dynamic transmit mode, pitch stabilization enabled, and yaw stabilization off. XBTs were cast to full water depth, processed in SVP Editor, and applied in SIS prior to reference surface collection and at the start of accuracy crosslines. However, these XBTs did not fully capture the variability of the sound speed environment. Raw crossline files were corrected for tide and small adjustments were made to the sound speed profile in order to suppress outer beam refraction issues; data within $\sim \pm 50^\circ$ of nadir were gridded at 5 m using a median method. Grid cells with fewer than 20 soundings were masked from the final reference surface; additionally, areas with slopes greater than 5° were also masked. Four pairs of crosslines were run using SHALLOW depth mode with different swath and stabilization options applied (Table 4); no other depth modes were tested for this site.

It is noted that a heave-like artifact is present in the shallow reference surface. The apparent period of the heave is correlated with ship heading, strongly suggesting the effect of long-period swell on the order of 0.5 m. The apparent period of the swell likely exceeded the heave period filter settings in the Seapath (5 seconds) and thus impacts the survey data. Future surveys in similar shallow water with subtle, long-period swell may require adjustment of the Seapath heave period filter to better remove this effect. Fortunately, the significant swell observed during the rest of NA070 in deeper water was successfully filtered and did not appear to impact vertical referencing of the data.

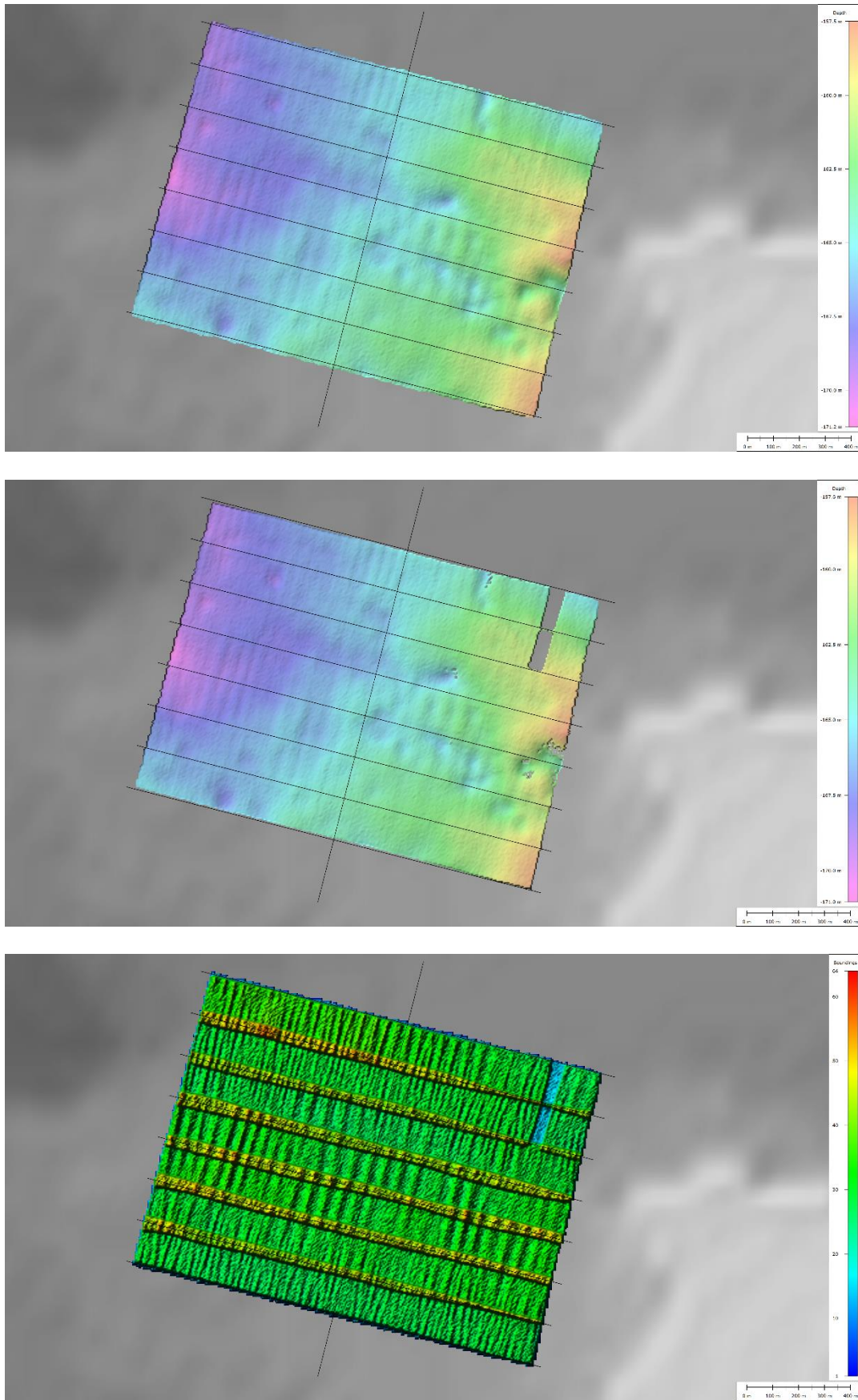


Figure 7. Top: overview of the shallow reference surface gridded at 5 meters (top). Middle: overview of the shallow reference surface after masking for sounding density and slope. Grid cells with fewer than 20 soundings and regions with slopes greater than 5° have been masked to avoid accuracy comparisons over low-quality areas. The color scale ranges from 157.6 to 171.0 m in both figures. Bottom: sounding density in the 5-m grid; the color scale ranges from 0 to 64 soundings per grid cell.

Table 4. SIS Runtime Parameters for each cross line over the shallow reference surface. Note that FM Disable is unchecked, but the EM302 uses only CW transmit mode in SHALLOW depth mode.

EM302 RUNTIME PARAMETERS	Cross Line Settings 1	Cross Line Settings 2	Cross Line Settings 3	Cross Line Settings 4
Sector Coverage				
Max. Angle (port)	75°	75°	75°	75°
Max. Angle (stbd)	75°	75°	75°	75°
Max. Coverage (port)	5000 m	5000 m	5000 m	5000 m
Max. Coverage (stbd)	5000 m	5000 m	5000 m	5000 m
Ang. Coverage Mode	AUTO	AUTO	AUTO	AUTO
Beam Spacing	HD EQDST	HD EQDST	HD EQDST	HD EQDST
Depth Settings				
Force Depth	n/a	n/a	n/a	n/a
Min. Depth (m)	100	100	100	100
Max. Depth (m)	250	250	250	250
Dual Swath Mode	DYNAMIC	SINGLE	DYNAMIC	DYNAMIC
Ping Mode	SHALLOW	SHALLOW	SHALLOW	SHALLOW
FM Disable	Unchecked	Unchecked	Unchecked	Unchecked
Transmit Control				
Pitch Stabilization	ENABLED	ENABLED	ENABLED	DISABLED
Along Direction	0°	0°	0°	0°
Heading	0°	0°	0°	0°
Yaw Stab. Mode	DISABLED	DISABLED	REL. MEAN HDG.	DISABLED
Heading	0°	0°	0°	0°
Heading Filter	MEDIUM	MEDIUM	MEDIUM	MEDIUM

The crossline results presented in Figure 8 generally indicate accuracy to within 0.15% water depth (WD) across the majority of the swath for each setting. As the Strait of Juan de Fuca is a highly variable sound speed environment, these results are likely biased by time-varying refraction artifacts, especially in the outer swath. Each evaluation in Figure 8 shows a ‘frowning’ refraction trend in the outer swath. This trend is symmetrical on the port and starboard sides and does not suggest any of the asymmetric outer beam wobble seen in some EM systems. Examining the generally flat trend of depth bias out to ~60°, the increased depth standard deviation observed beyond ~60° is attributed partially to the typical increase in sounding uncertainty in the outer beams and partially to refraction.

Within +/-10° of nadir, the accuracy crossline soundings (gray points) clearly show the ‘Erik’s Horns’ nadir-ring bottom tracking artifact. This is commonly observed among other EM systems, especially when surveying soft sediments (such as those expected at the shallow accuracy site) using ‘lower’ frequencies (e.g., EM122 and EM302). Many combinations of Runtime Parameter filters have been applied with unremarkable results in trials aboard other vessels. When this nadir bottom tracking artifact is observed out to approximately 10° in combination with acoustic penetration of the sediments directly at nadir, some improvement can usually be made by tilting the transmit swath toward the slope (or forward over flat seafloor) by 1-2°. For the purposes of the accuracy assessment, the transmit fan was not tilted to attempt to reduce this nadir-ring tracking artifact. It should be noted that while the shallow accuracy site is still within the operational range of the EM302, higher frequency systems (e.g., EM710) are better suited for this depth range.

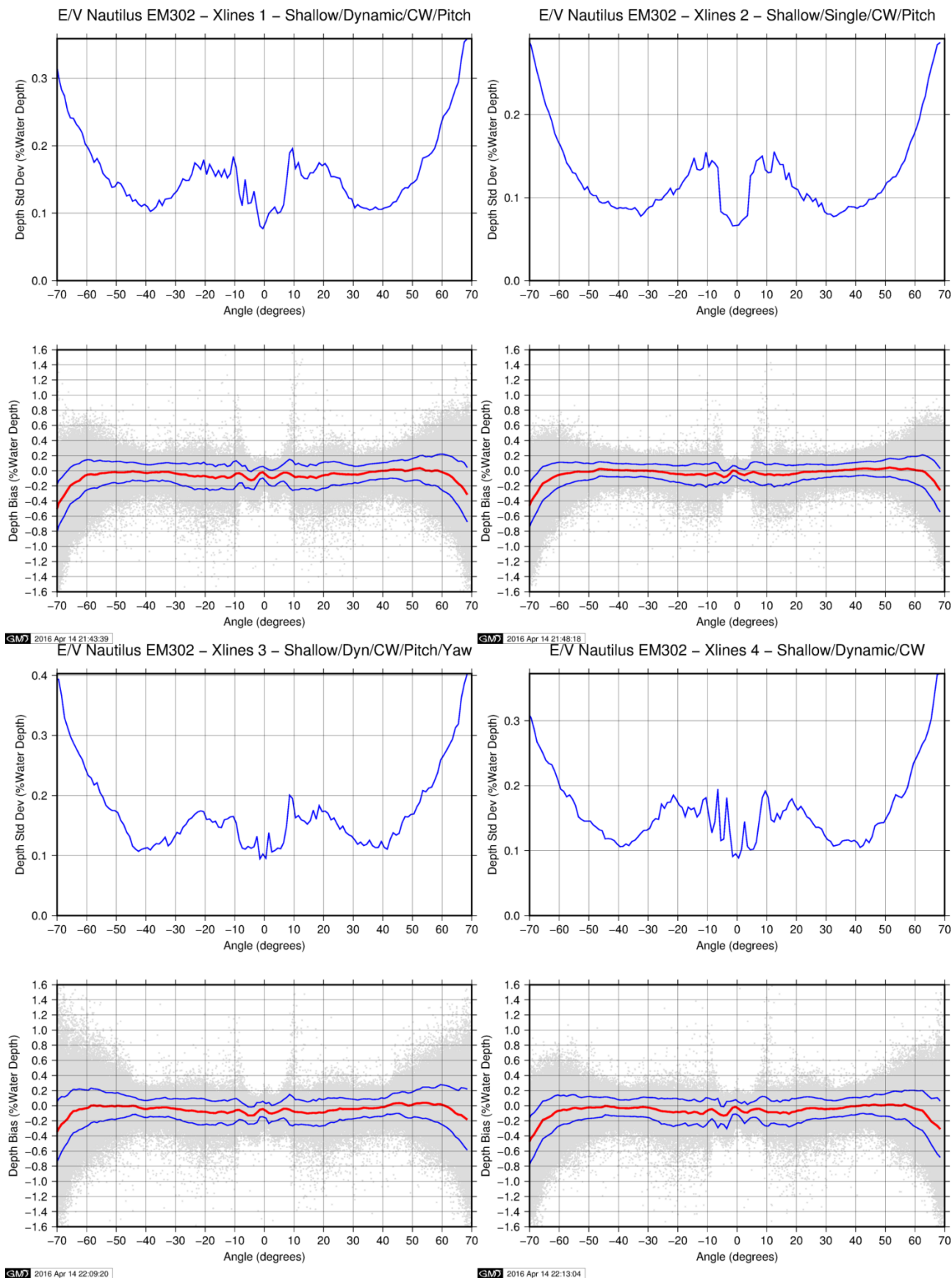


Figure 8. Shallow accuracy results for crossline settings 1-4 (clockwise from upper left). The top plot for each test depicts the depth standard deviations (top) and biases (bottom) as percentages of water depths for all cross line soundings collected at 8 kts. The bottom plot for each test includes all raw soundings (grey points), the mean depth bias (red line), and the standard deviation of depth bias (blue lines) for each beam angle.

Deep Accuracy Assessment

In order to save a substantial amount of survey time during NA070, the planned deep accuracy assessment utilized a reference surface collected by the R/V *Thompson* with an EM300 in 2002 (cruise TN144). This surface includes water depths of 1200-2500 m off the continental shelf break (Figure 7), though only the deeper sections with slopes less than 5° were deemed suitable for the accuracy assessment. Raw files from cruise TN144 were corrected for tide, gridded at 50 m using a median method, then masked for regions with slopes greater than 5° or sounding density lower than 15 soundings per grid cell.

Due to sea state, scheduling constraints, and consideration for the suitable area of the reference surface, only one crossline was run using the most conventional mapping configuration for this depth range (Table 5) at a speed of 8 kts. An XBT was collected to 760 m, processed in SVP Editor, and applied in SIS prior to the crossline.

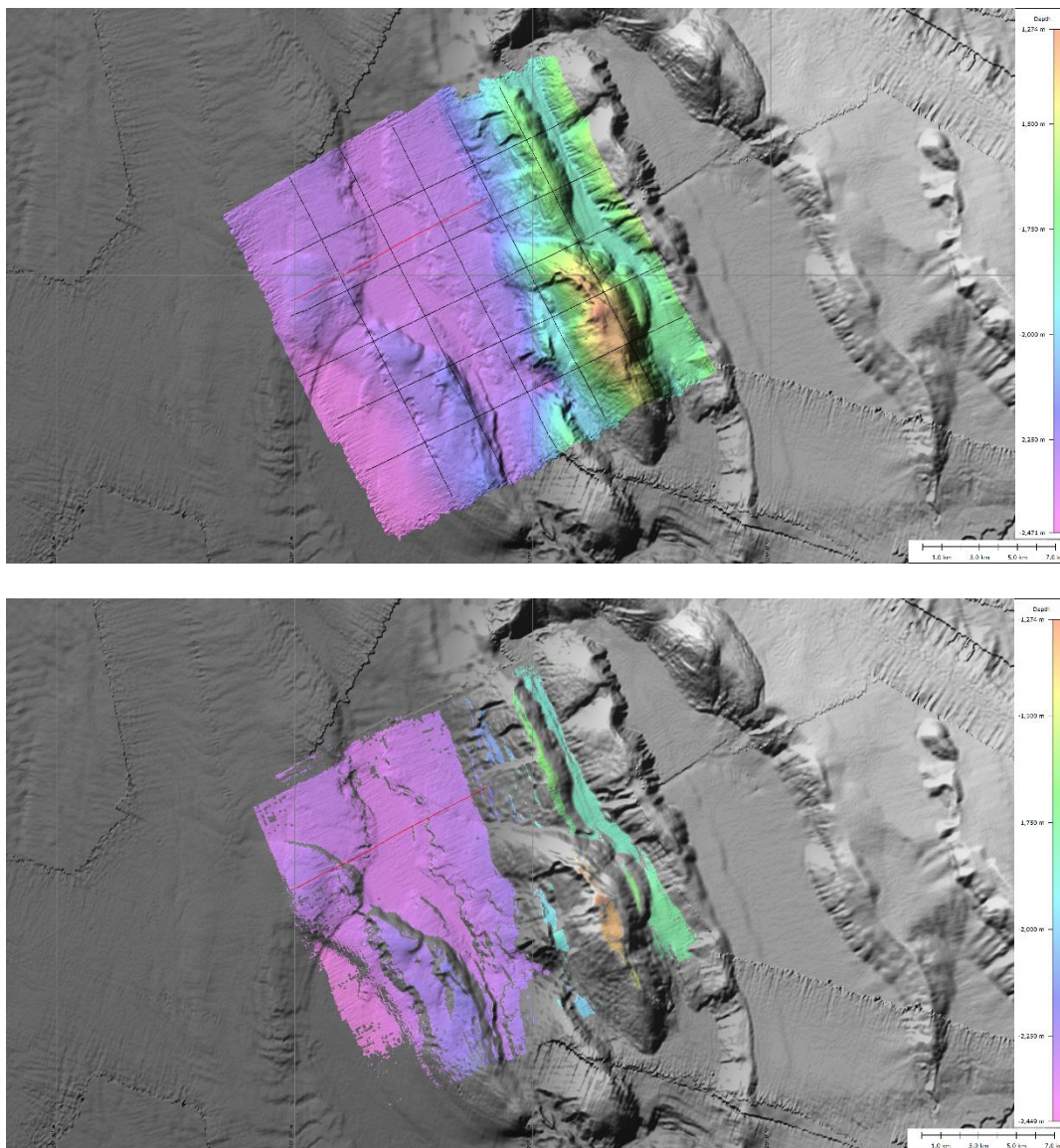


Figure 9. Top: overview of the deep reference surface gridded at 50 meters (top). Bottom: overview of the deep reference surface after masking for sounding density and slope. Grid cells with fewer than 15 soundings and regions with slopes greater than 5° have been masked to avoid accuracy comparisons over low-quality areas. The color scale ranges from 1274 to 2471 m in both figures. The accuracy crossline track is shown in red.

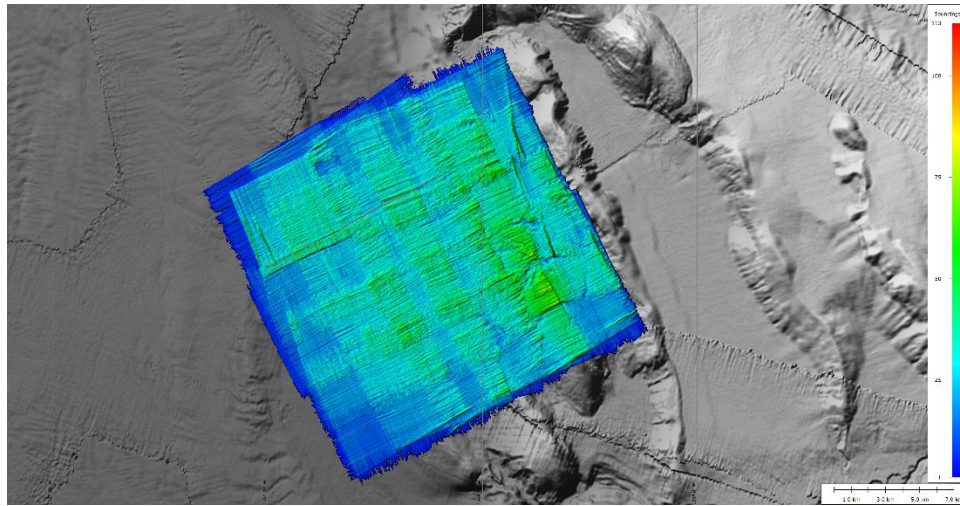
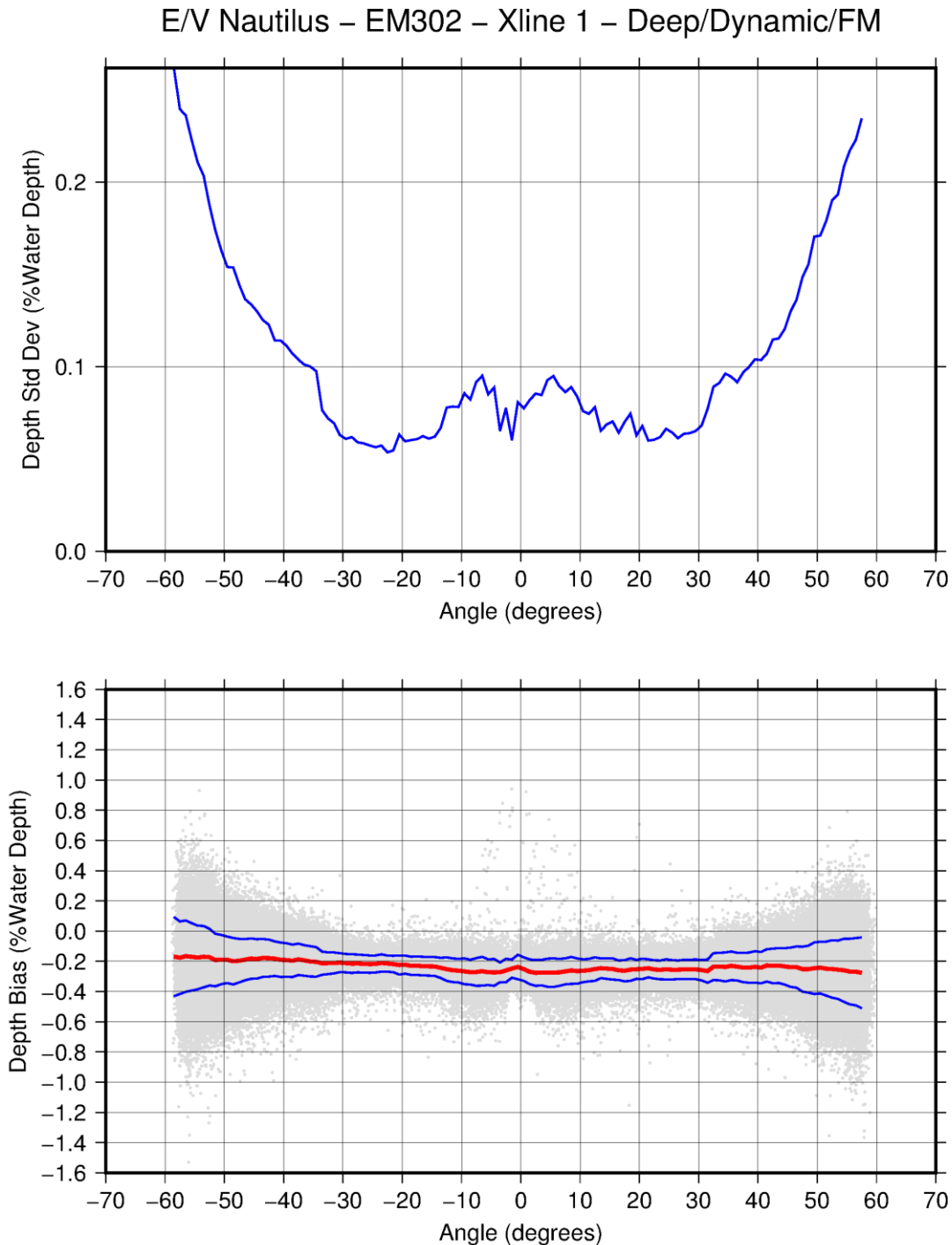


Figure 10. Overview of deep reference surface sounding density. The color scale ranges from 1 to 113 soundings per grid node.

Table 5. SIS Runtime Parameters for each cross line over the deep reference surface. With FM Disable unchecked, the EM302 used an FM transmit mode in DEEP depth mode.

EM302 RUNTIME PARAMETERS	Cross Line Settings 1
Sector Coverage	
Max. Angle (port)	75°
Max. Angle (stbd)	75°
Max. Coverage (port)	5000 m
Max. Coverage (stbd)	5000 m
Ang. Coverage Mode	AUTO
Beam Spacing	HD EQDST
Depth Settings	
Force Depth	n/a
Min. Depth (m)	1600
Max. Depth (m)	2500
Dual Swath Mode	DYNAMIC
Ping Mode	DEEP
FM Disable	Unchecked
Transmit Control	
Pitch Stabilization	ENABLED
Along Direction	0°
Heading	0°
Yaw Stab. Mode	DISABLED
Heading	0°
Heading Filter	MEDIUM

Accuracy Results – FM Dual-Swath



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Figure 11. Depth standard deviations (top) and biases (bottom) as percentages of water depths for all cross line soundings collected at 8 kts using FM, dual-swath configuration (cross line settings 1). The bottom figure includes all raw soundings (grey points), the mean depth bias (red line), and the standard deviation of depth bias (blue lines) for each beam angle.

Examining Figure 11, it can be seen that the EM302 provides fairly unbiased soundings over the majority of the swath in the mode tested. The small, non-linear refraction-like bias noted in the NA040 and NA055 evaluations is not evident in these results. However, there is a 0.2% bulk deep bias across the swath compared to the TN144 reference surface. The origin of this bias is not entirely clear, but is likely due to the historic dataset with uncertain vertical offsets applied

during acquisition (e.g., 0.2% of 2300 m is roughly equal to the transducer draft during TN144). Importantly, comparing the NA070 and other E/V Nautilus datasets to more modern surveys has shown no such bulk bias and this appears to be purely an artifact of this particular comparison to an older reference surface.

Ignoring the 0.2% bulk bias across the swath for the reasons outlined above, the observed trends in standard deviations are still within the expected performance tolerances of the system as a whole, with no significant difference in performance compared to 2014 or 2015. A large portion of the swath shows beam-wise depth standard deviations of less than 0.1% of water depth. The standard deviations about the mean bias are typically within $\pm 0.15\%$ to $\pm 0.25\%$ water depth ($1-\sigma$) across the majority of the swath with higher uncertainties at the limits of the swath, as expected and typical for these systems. As a whole, the 2016 accuracy assessment shows depth standard deviation trends across the swath that are as good or better than previous evaluations. It is worth noting that this deep accuracy assessment took place in the highest sea experienced during any of the quality assurance tests.

Achieved Coverage

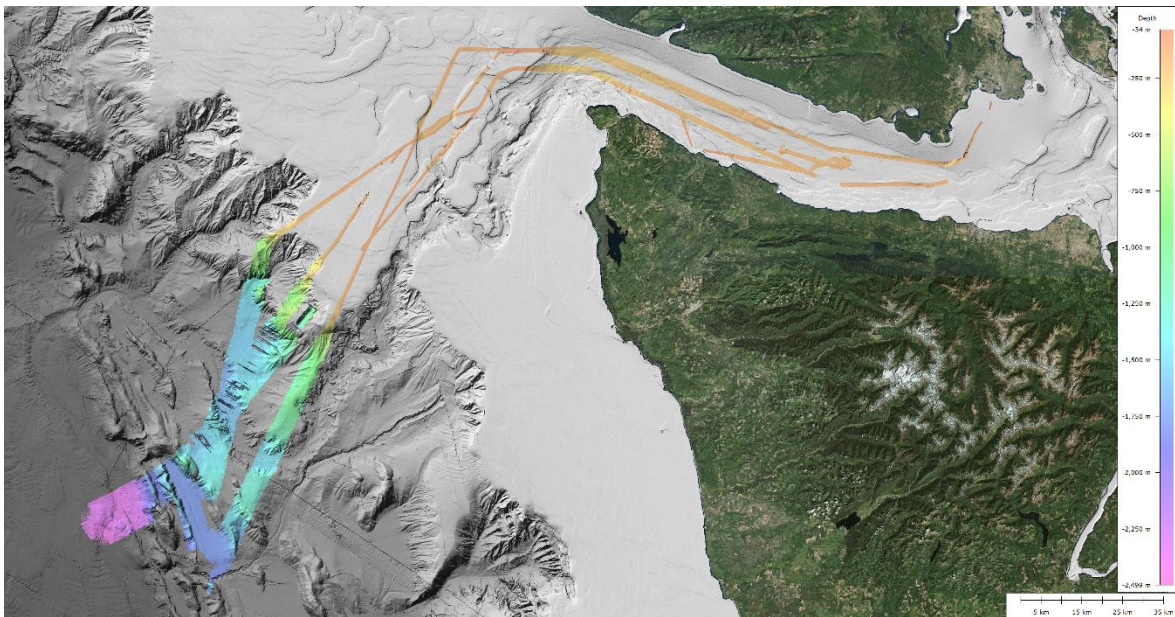


Figure 12. Overview of data used to calculate the swath coverage in Figure 13.

The swath coverage performance was evaluated by tracking the outermost port and starboard soundings from all data acquired during the transits, patch test, shallow reference surface collection and accuracy assessment, and deep accuracy assessment (Figure 12). Figure 13 depicts the across-track swath width on the seafloor versus water depth up to approximately 2500 m. Ideally, all data included in the swath coverage analysis should have been collected in automatic angular coverage mode, automatic depth mode, and automatic transmit mode in order to calculate the swath width as a function of depth using settings optimized by the EM302 for maximum coverage. However, as during NA040 and NA055, other test activities were being undertaken during the cruise and the data utilized to produce the coverage plots were collected with many different Runtime Parameters, including limitations to the angular coverage (during patch testing only), changes to the depth mode, and both CW and FM transmit modes.

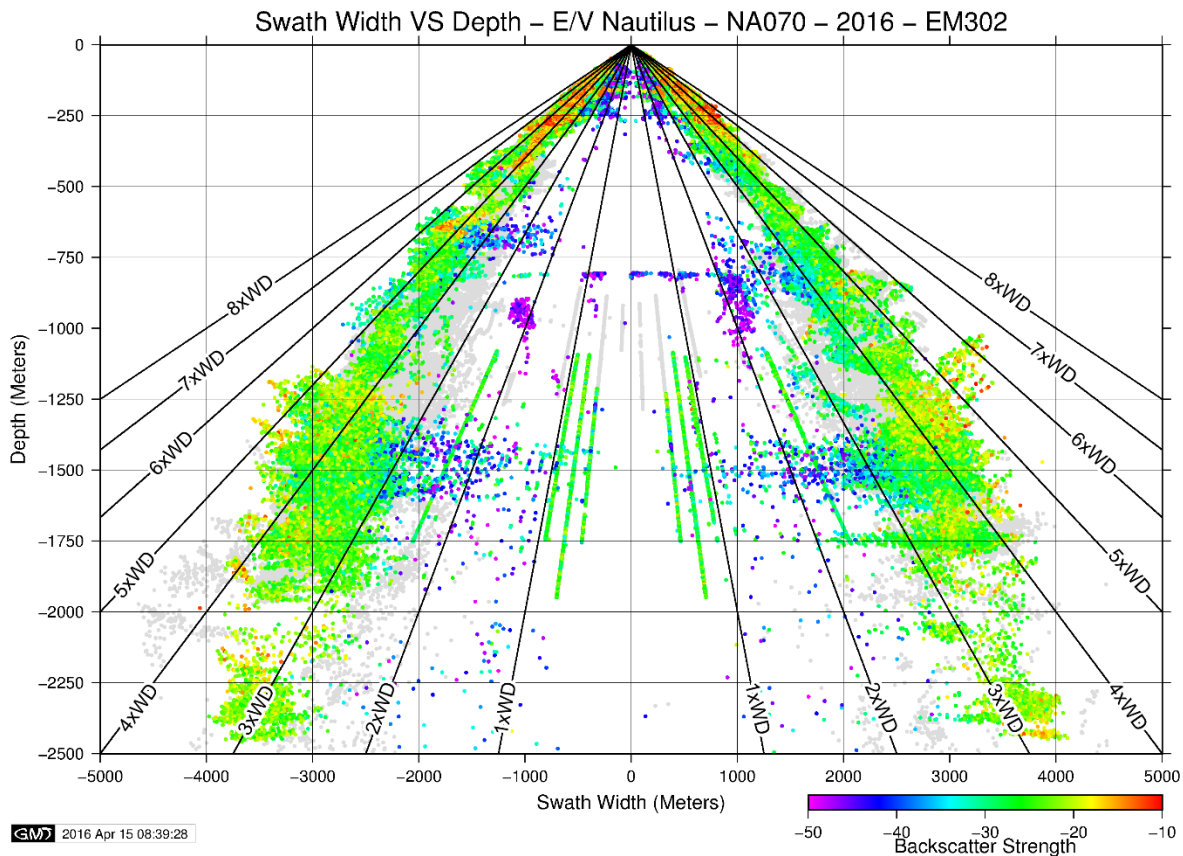


Figure 13. EM302 coverage evaluation plot showing outmost sounding coverage (i.e., swath width) versus depth. Colors of the points are based on the backscatter strengths of the contributing sounding. Extinction data from 2015 (NA055) are shown as gray points for reference.

Despite significantly increased sea state compared to previous evaluations, the swath width observed during NA070 compares favorably with NA040 and NA055 results, providing across-track coverage of 7 to 6 times water depth in shallow waters up to 300 m depth and 5 to 4 times water depth to approximately 1750 m depth. At depths greater than 1500-1800 m, the system tracked consistently 3 times water depth down to 2500 m. The coverage achieved up to 2500 m depth is comparable to other EM302 installations and indicates that the system is performing well. Note that a major difference in Figure 13 compared to previous evaluations is that outer beam soundings with backscattering strengths greater than -15 dB have been eliminated. These soundings likely fell on rugged features of the continental shelf break facilitating stronger backscatter values and atypically wide across-track ranges.

Noise Level Assessment

To assess vessel noise at the transducers, measurements were made at the receiver while the vessel operated at a variety of speeds and headings relative to the swell. Speed-dependent self noise was measured at 6-8 kts while heading into a 3-4 m swell (Figure 14-16) and then measured at 6-11 kts while heading with the swell (Figure 17-19). Winds were 30-40 kts during data collection. These plots clearly show significant and consistent elevated noise heading into the swell, with the worst levels observed at the higher speed. When traveling with the swell, the speeds of 8-10 kts proved favorable for ship self-noise while the 6 kt and 11 kt speeds showed significantly elevated noise environments. These speed-related noise trends have been observed during previous evaluations and confirm the recommended survey speed of 8 kts whenever possible. Because of the high sea state and other engineering constraints, the range of speeds run for these tests was significantly reduced compared to previous years.

The well-developed sea state also enabled a more comprehensive test of the vessel self noise versus heading relative to swell. Receiver noise was measured in eight directions separated by 45°, starting with the swell (called heading 000 in

these tests) while the vessel transited at 8 kts (Figures 19-21). This test has been run in previous years in calmer seas with varied results and inconclusive trends. As expected, the NA070 swell azimuth tests in 3-4 m seas (Figure 20-22) show a clear trend toward reduced self noise levels when traveling with the seas (swell arriving on the port quarter, stern, or starboard quarter) and increased levels heading into the sea (especially with swell arriving between the port side and bow).

The NA070 self noise results are also presented as frequency spectra for each RX board. This is a new analytical product derived from the RX Spectrum BIST data collected during each speed and azimuth test. The board noise spectrum results correlate very well with the other RX channel noise tests in terms of speeds and azimuth-related noise intensity trends. As this is the first year presenting this information, it may prove more useful during future evaluations in monitoring noise levels at each board, especially if there is a particular frequency of concern (e.g., ship noise changes). The primary point of concern for this year's test is that RX board 4 shows elevated noise levels on the lower end of the spectrum (26-30 kHz); this should be monitored over future visits.

Self Noise Results – Speed – Into Swell

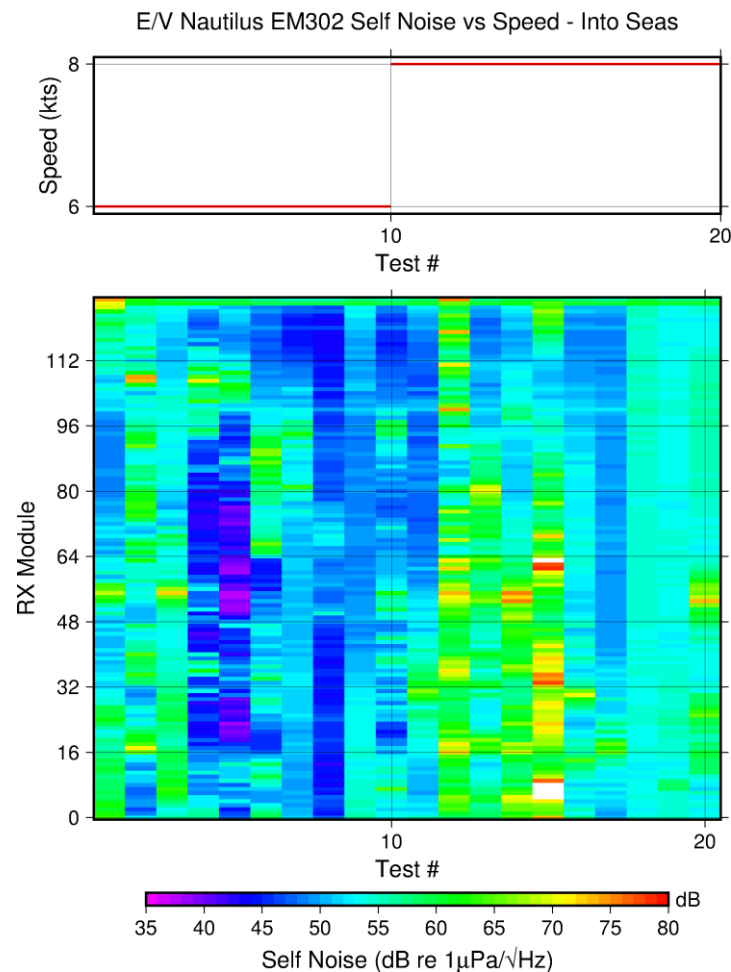


Figure 14. Receiver module self noise versus test number at vessel speeds of 6-8 kts while heading into a 3-4 m swell. Ten test measurements were made at each speed.

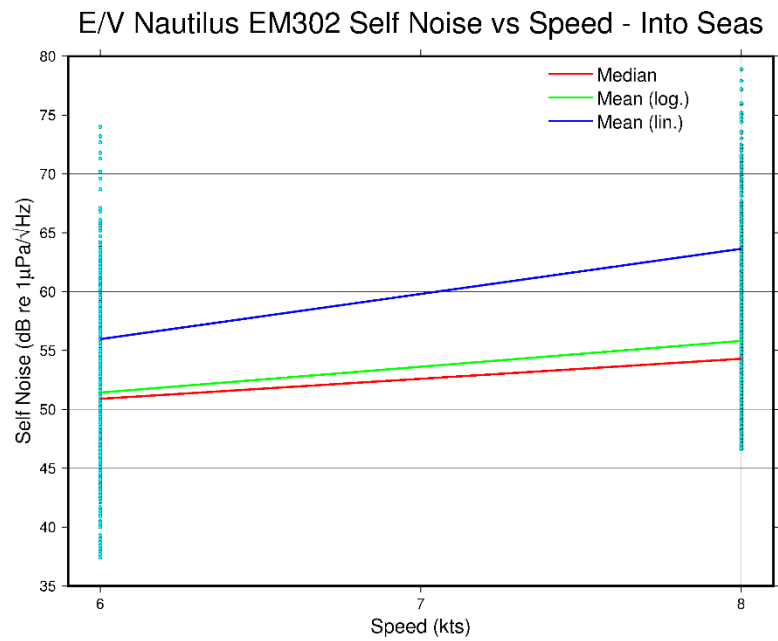


Figure 15. Receiver module self noise versus speed while heading into a 3-4 m swell.

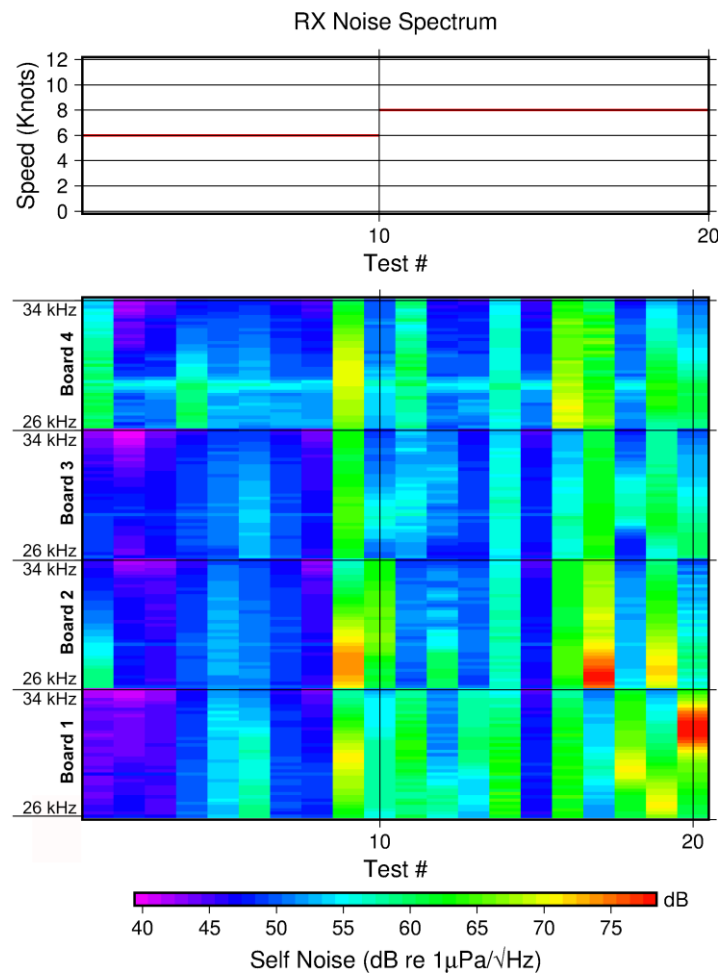


Figure 16. Receiver noise spectrum for each board while heading into a 3-4 m swell.

Self Noise Results – Speed – With Swell

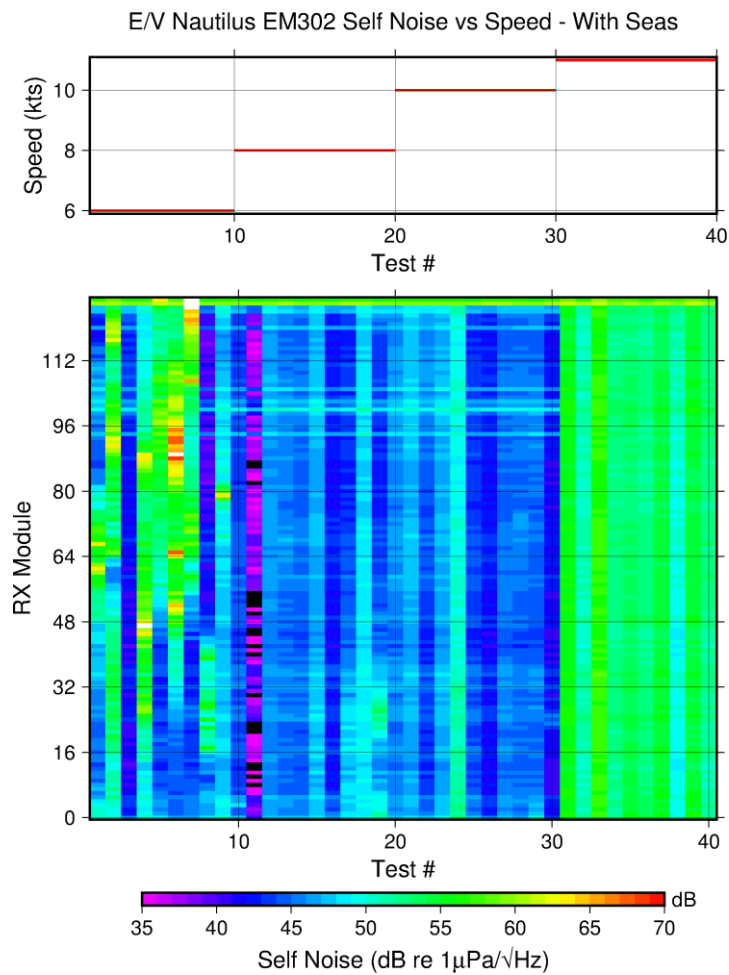


Figure 17. Receiver module self noise versus test number at vessel speeds of 6-11 kts while heading with a 3-4 m swell. Ten test measurements were made at each speed.

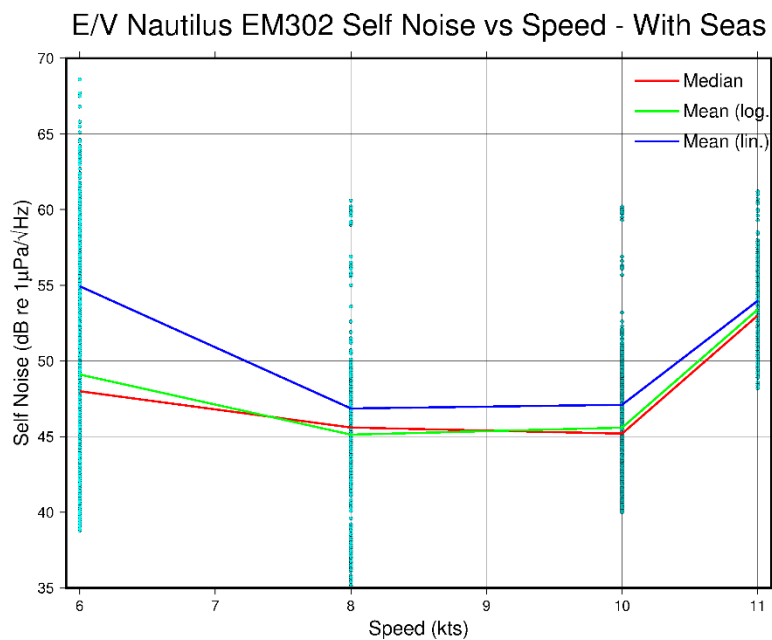


Figure 18. Receiver module self noise versus speed while heading with a 3-4 m swell.

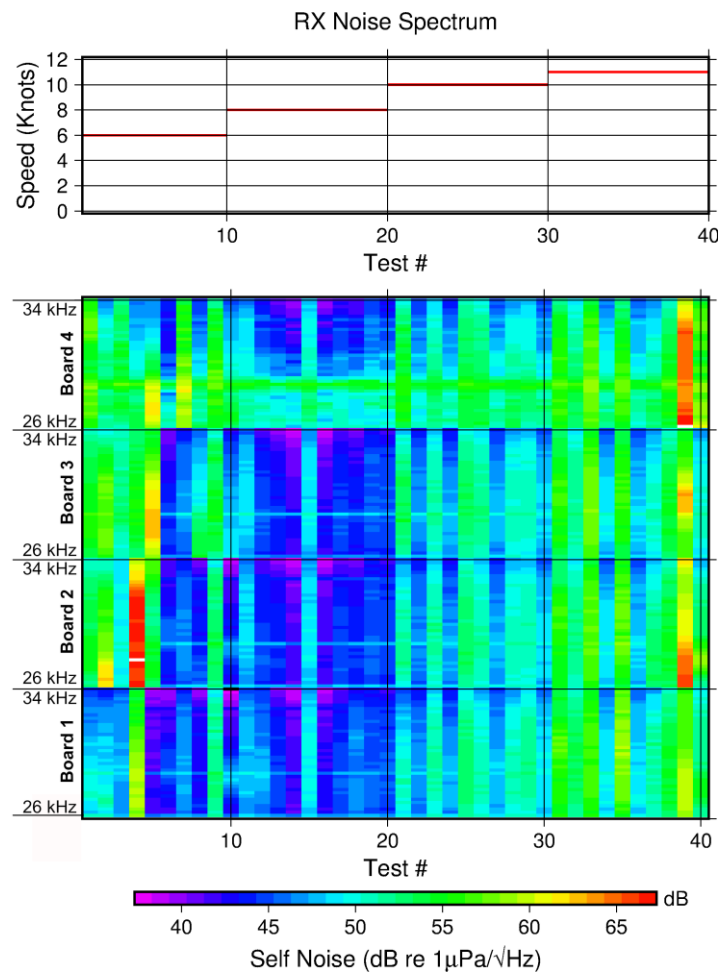


Figure 19. Receiver noise spectrum for each board while heading with a 3-4 m swell.

Self Noise Versus Azimuth

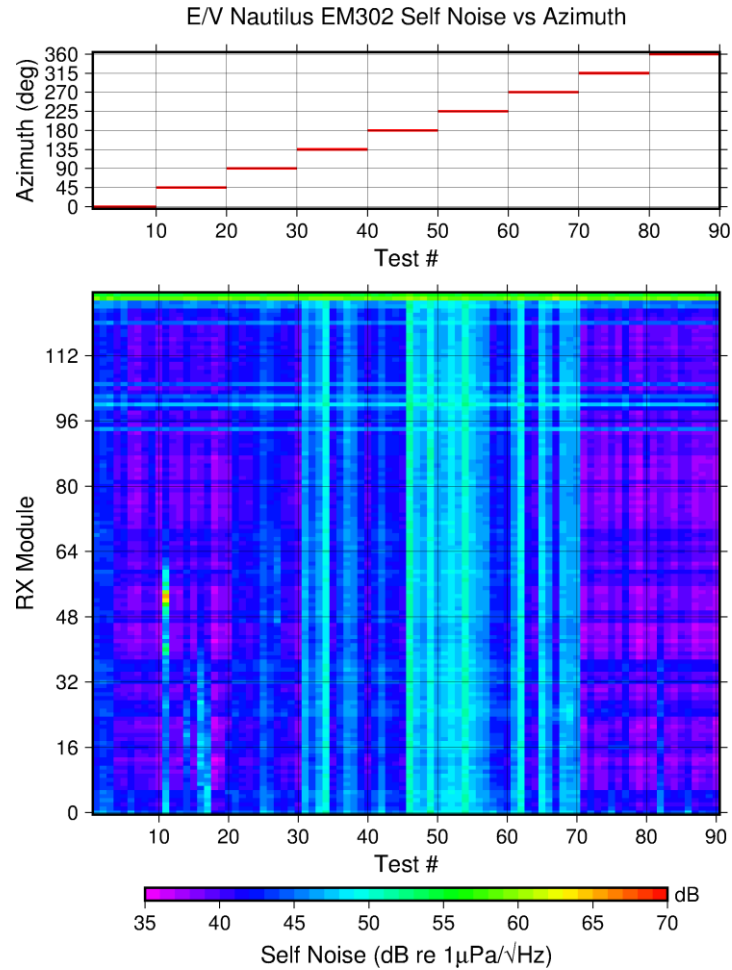


Figure 20. Receiver module self noise versus test number at vessel azimuth relative to the prevailing seas (3-4 m swell). Azimuth of 0° corresponds to vessel heading with the swell. Vessel speed was 8 kts for all tests and ten measurements were made at each heading.

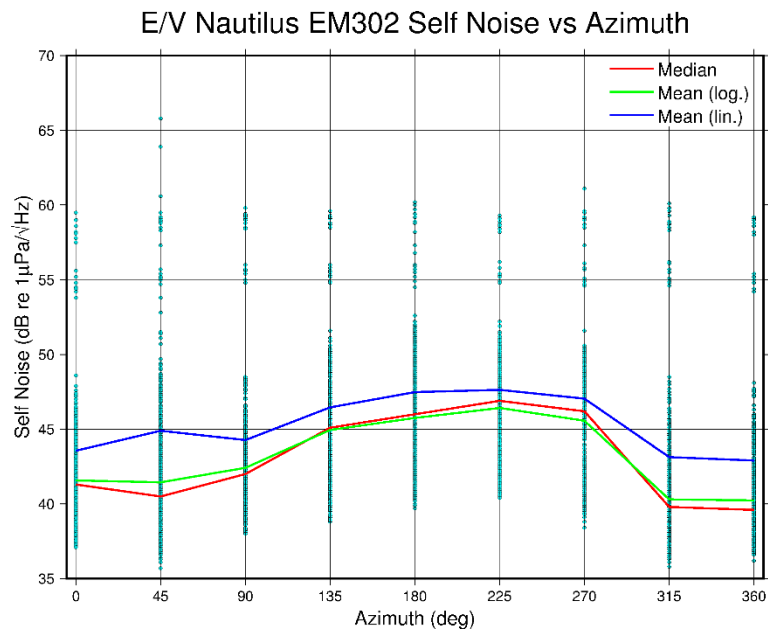


Figure 21. Receiver module self noise versus azimuth relative to a 3-4 m swell under high wind conditions (30-40 kts). Azimuth at 0° is with the swell directions, while azimuth 180° is into the seas.

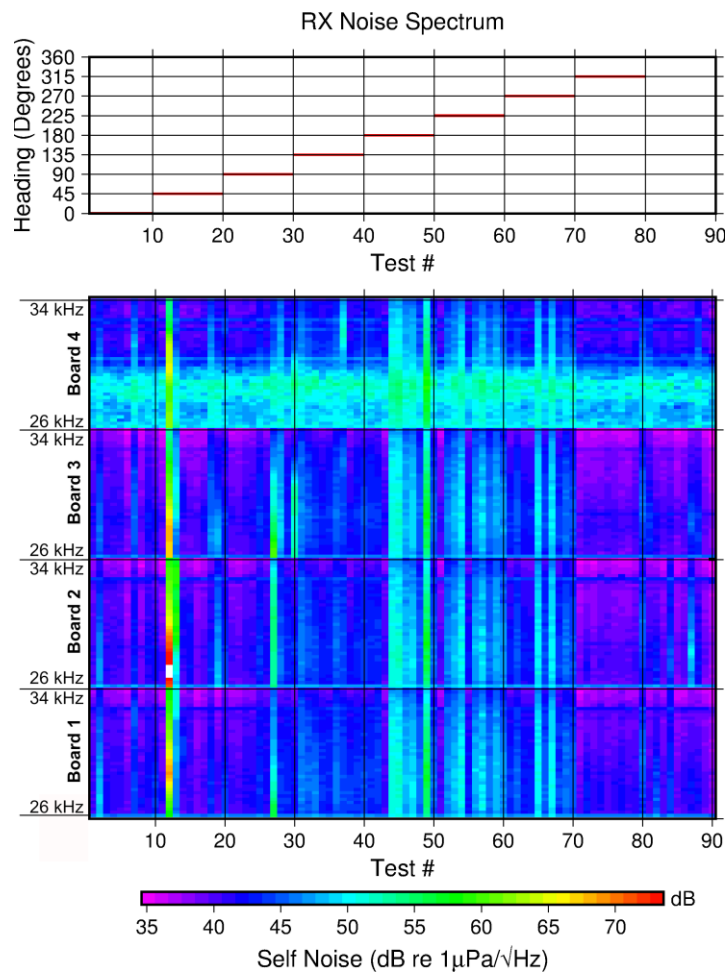


Figure 22. Receiver module noise spectrum versus azimuth relative to a 3-4 m swell. Azimuth at 0° is with the swell directions, while azimuth 180° is into the seas.

Transducer and System Health

A full Built-In Self Test (BIST) diagnostic routine was run prior to departure as well as a few times while underway. Among other tests, the BIST provides the ability to perform impedance measurements of the transmitter and receiver arrays and receiver. These test results may be used as proxies the health of transducer elements and receiver, as these components of the mapping system have been known to degrade with time. It is important to note that the BIST impedance measurements do not provide a full characterization of transducer properties as a function of frequency, which requires direct impedance measurements using a Kongsberg tool. However, BISTs provide useful information for monitoring overall transducer health and should be run on a routine basis. It should be noted that the BISTs conducted through the SIS interface do not record the transmitter impedance; these values must be recorded through a separate telnet session into the TRU (see Appendix for instructions).

The EM302 receiver and receiver transducer impedances, as measured through the BIST routines, were compared to measurements made throughout the 2013-15 seasons, as well as those conducted during previous system acceptance tests. NA070 BIST results were found to be in excellent agreement with the previous three years' worth of BIST data, suggesting minimal degradation or other changes of the arrays (Figure 23-25). The TX impedance is generally higher across the entire array compared to previous years; this may be due to significantly colder waters in 2016. All but one transmitter impedance value fell within normal ranges (Figure 25). This figures shows that channel 15 in TX slot 12 reported a high impedance in 2014-16, however, this is not expected to significantly impact transmitter performance.

Impedance Results – Receiver

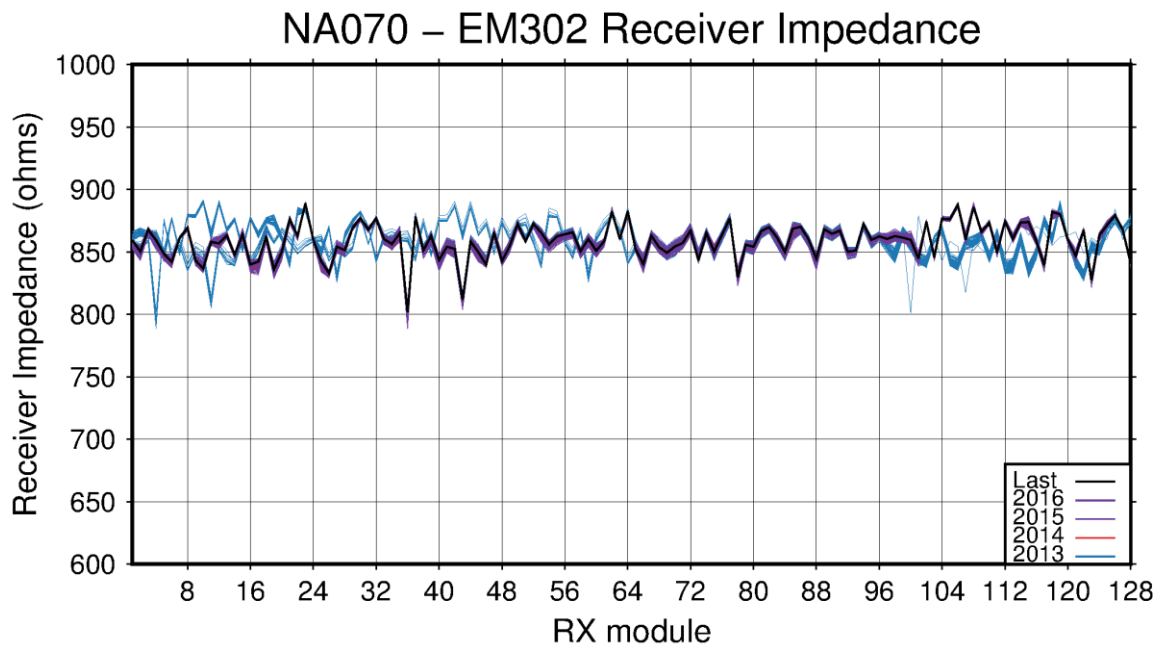


Figure 23. EM302 receiver impedance measurements during NA070 and previous evaluations. The impedance range on the Y-axis represents the range defined by Kongsberg within which the system will pass a BIST test.

Impedance Results – Receiver Transducer

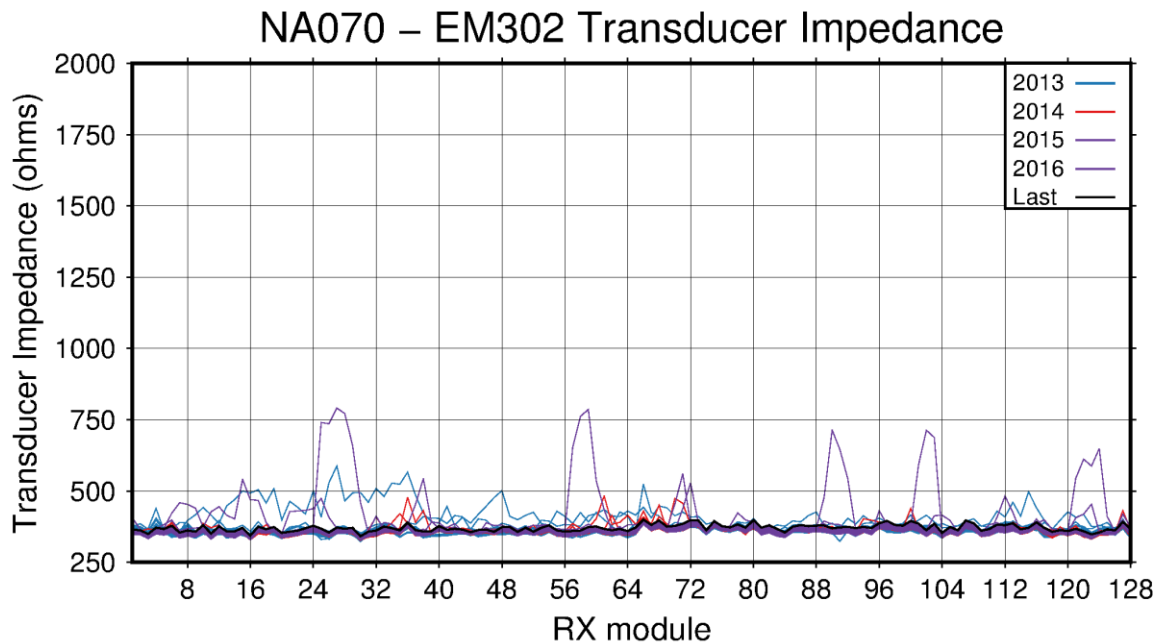


Figure 24. EM302 receiver transducer impedance measurements during NA070 and previous evaluations. The impedance range on the Y-axis represents the range defined by Kongsberg within which the system will pass a BIST test.

Impedance Results - Transmitter

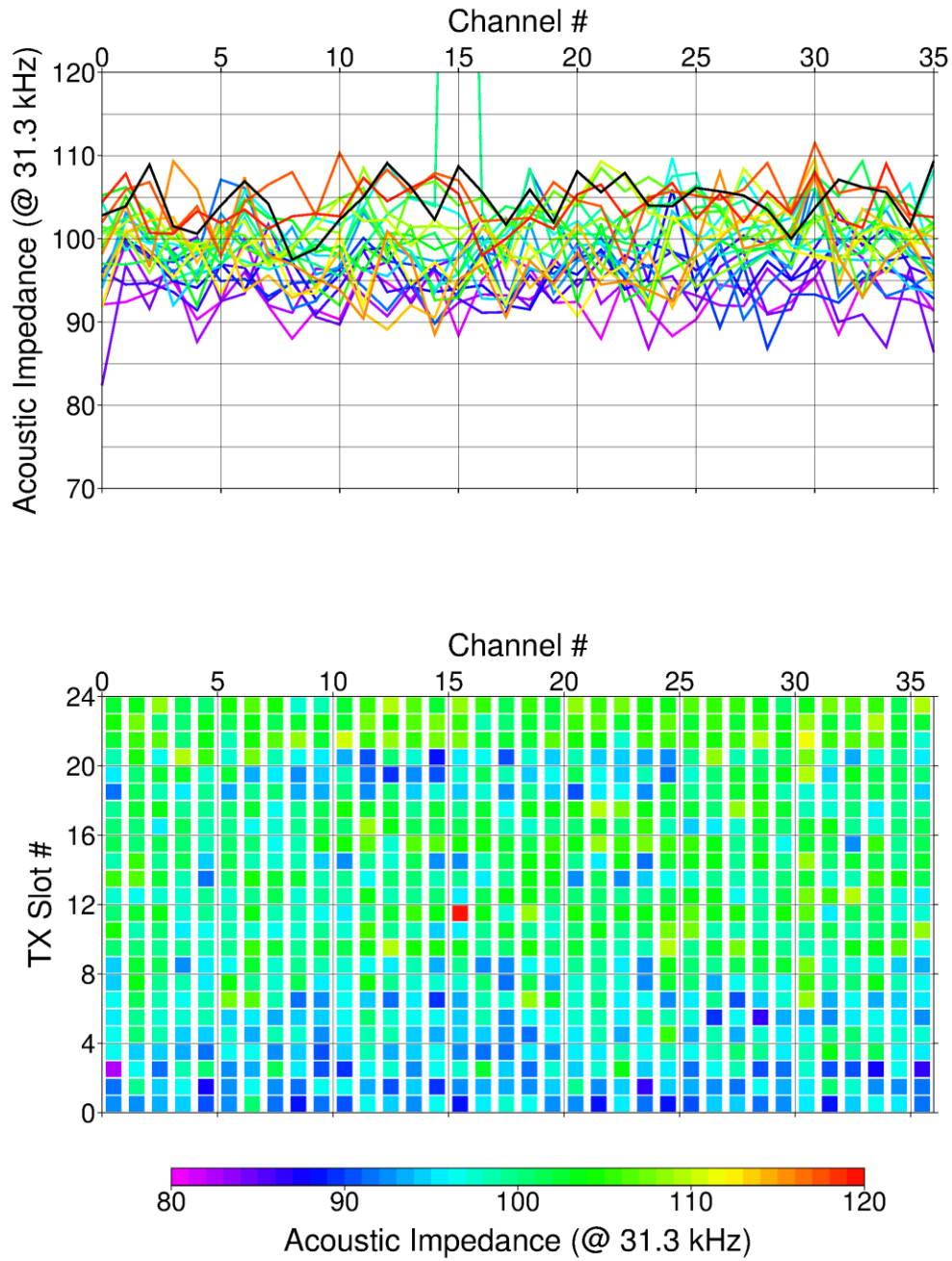


Figure 25. EM302 transmitter acoustic impedances as observed during NA070. Individual colors in the top figure correspond to individual slots across all channels. Slot 12, channel 15 exhibited high impedance in 2014-16, shown by the turquoise line with a spike in the top figure and red square in the bottom figure.

Summary and Recommendations

- Heading into the 2016 operating season, the EM302 and associated sensors aboard E/V *Nautilus* are working well compared to previous evaluations and to other EM302 systems examined recently. The patch test showed very slight pitch and roll adjustments, indicating no major changes to the system geometry.
- Sensor positions and SIS Installation Parameters have not been changed (except for the pitch and roll calibration results discussed above) and should not be changed. A PU Parameters file containing all SIS Installation Parameters and Runtime Parameters were written to disk on the primary acquisition machine (and stored on the nautilusfs share) at the end of NA070. If any problems or questions arise with any parameters, this file should be reloaded to restore a functional configuration for SIS. Johnson and Jerram have a copy of this file and can provide it if required.
- The onboard technical staff have collected routine BIST results throughout the previous year. This practice provides excellent information for tracking system health and should be continued moving forward.
- As discussed in the NA055 report, the ethernet cables between the switch and TX boards in the TRU cabinet are extremely sensitive to vibration and deformation, resulting in lost connectivity to individual boards. Due to the high vibration environment, this could result in component failure during startup or survey. This occurred once during NA070 and resolved with adjustment of the ethernet cables and a restart of the TRU.
- Ethan Gold reported that the PPS dropouts that had been previously plaguing the system have been resolved by removing the PPS board in the back of the TRU and readjusting the adjacent ‘metal fingers’ to avoid contact with the board. Special care should be taken during future board reseating to ensure no short circuits from this design issue.
- SSP Manager software was installed and configured on the Subbottom / SVP Editor machine. The previous install of the SVP Editor is still active and available, but the new SSP Manager software is now better supported if any issues arise. Once the workflow for importing underway CTD data is established, it is recommended that SSP Manager software be used moving forward.
- A very large backlog of SIS surveys was maintained on the MB Acquisition computer. It is highly recommended that these be removed from the SIS database in order to avoid potential SIS instability issues observed on other vessels.
- The Knudsen subbottom profiler was operated during NA070, providing the chance to confirm synchronization with the EM302 and general data quality.
- The 2013 SAT report included several recommendations to address installation and operation concerns specific to E/V *Nautilus* (e.g., power supply issues) and to avoid problems commonly experienced aboard other similarly equipped research vessels (e.g., accidental motion sensor alteration). Many of these recommendations have been implemented over the previous three seasons, while a few remain relevant as of NA070 and are listed below.
 - A removable protective structure, such as a cage-like cover, should be built around the MRU to help

prevent accidental impact damage. This structure should be large enough to prevent workers in the TRU room from stepping on the MRU plate, provide secure routing for the cable, and ensure ample air flow for cooling.

- Ample labeling should be placed around the MRU to warn workers of the sensitivity and importance of the equipment.
- Ensure cables behind the MRU are supported and not in contact with any other apparatus in the TRU room.

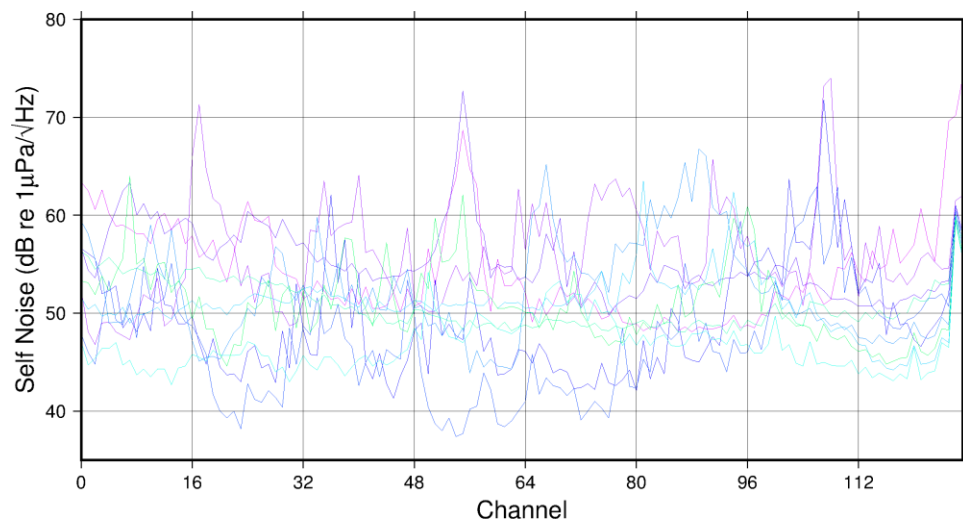
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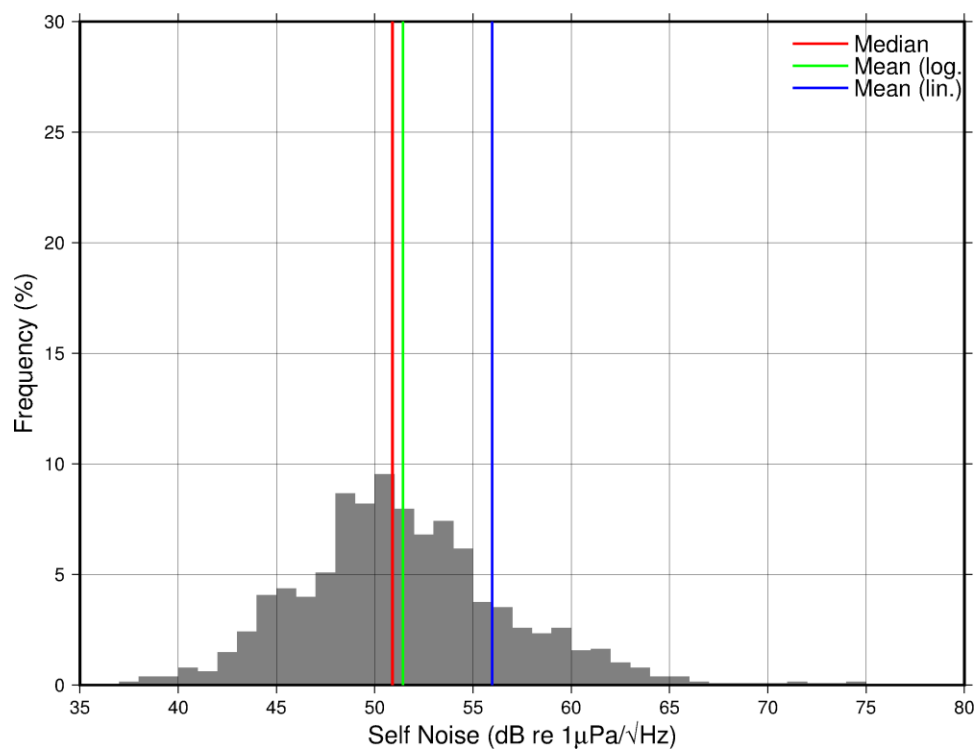
Appendix

Self Noise Results – Speed – Into Seas (6 kts)

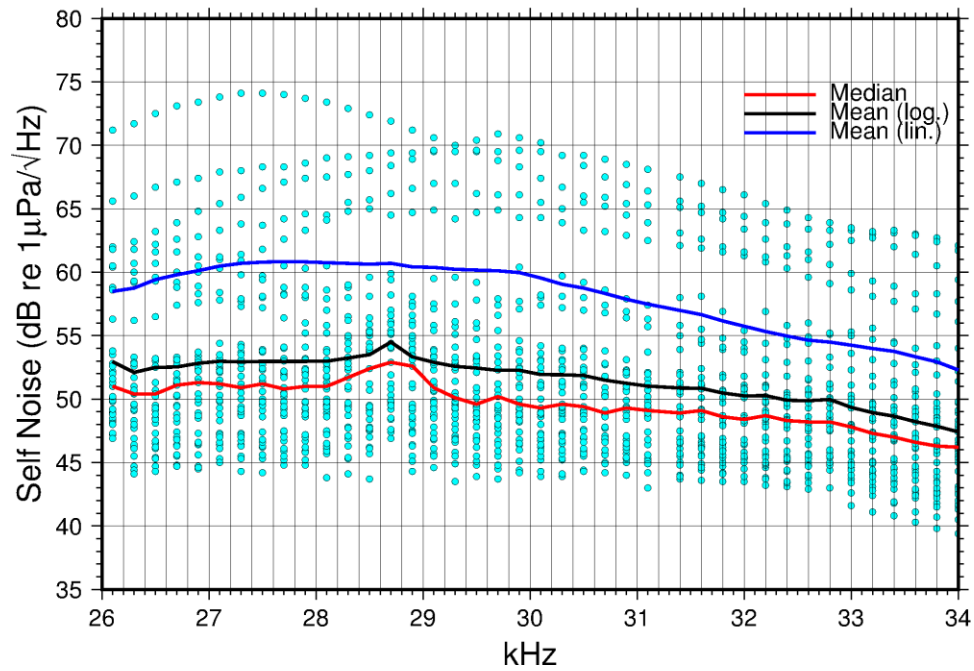
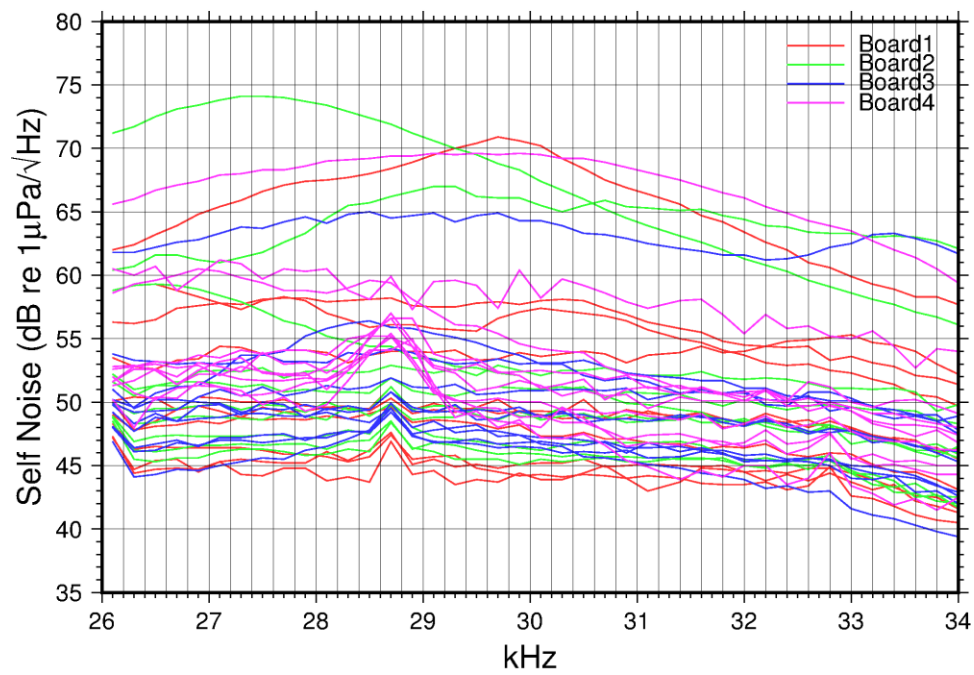
E/V Nautilus EM302 Self Noise - Into Seas 6 kts



E/V Nautilus EM302 Self Noise - Into Seas 6 kts

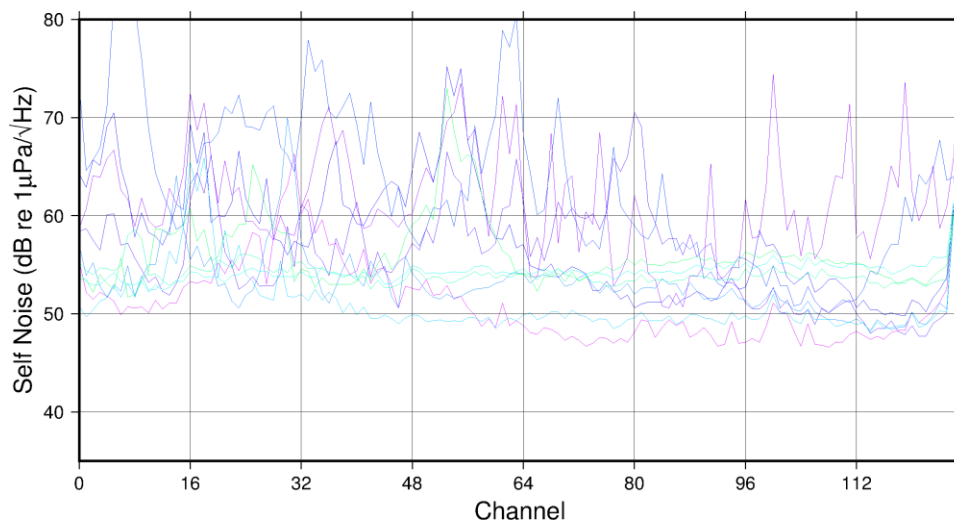


E/V Nautilus EM302 RX Noise Spectrum - Into Seas - 6 knots

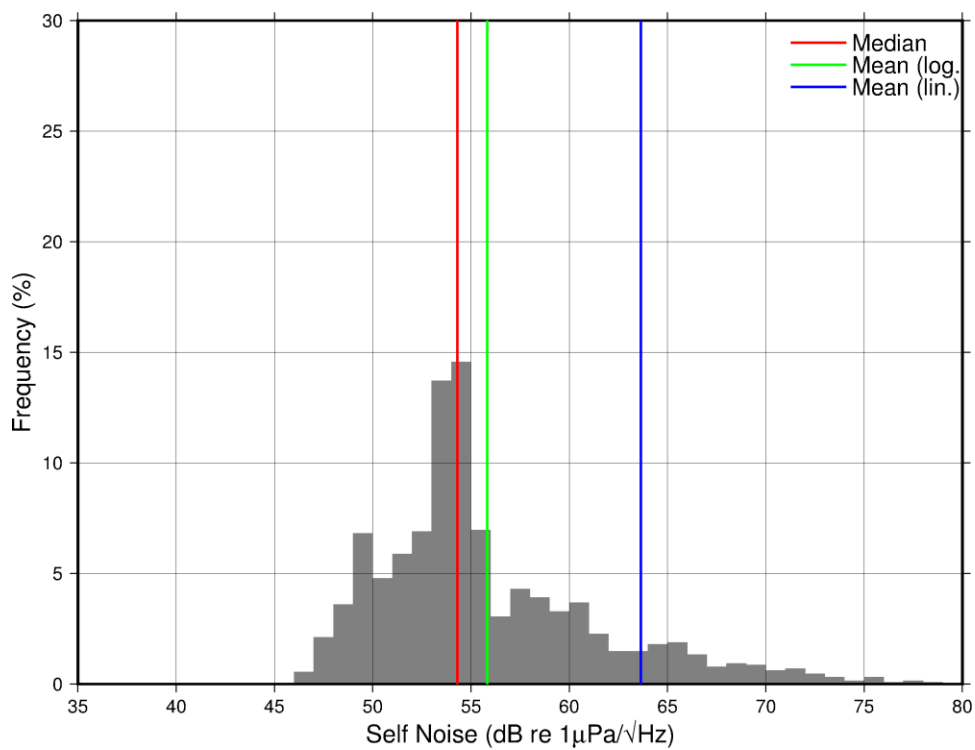


Self Noise Results – Speed – Into Seas (8 kts)

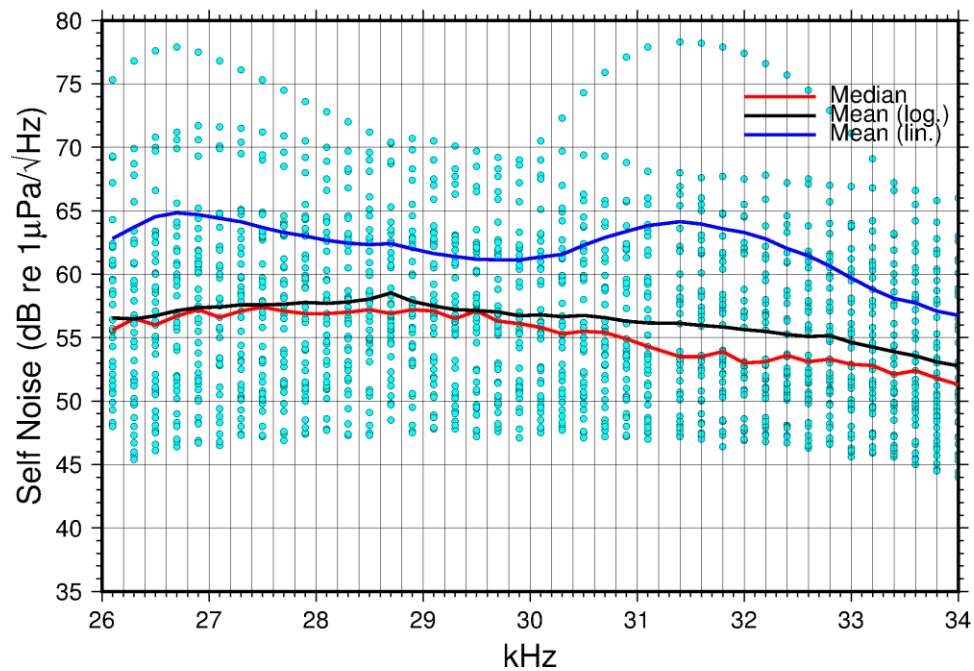
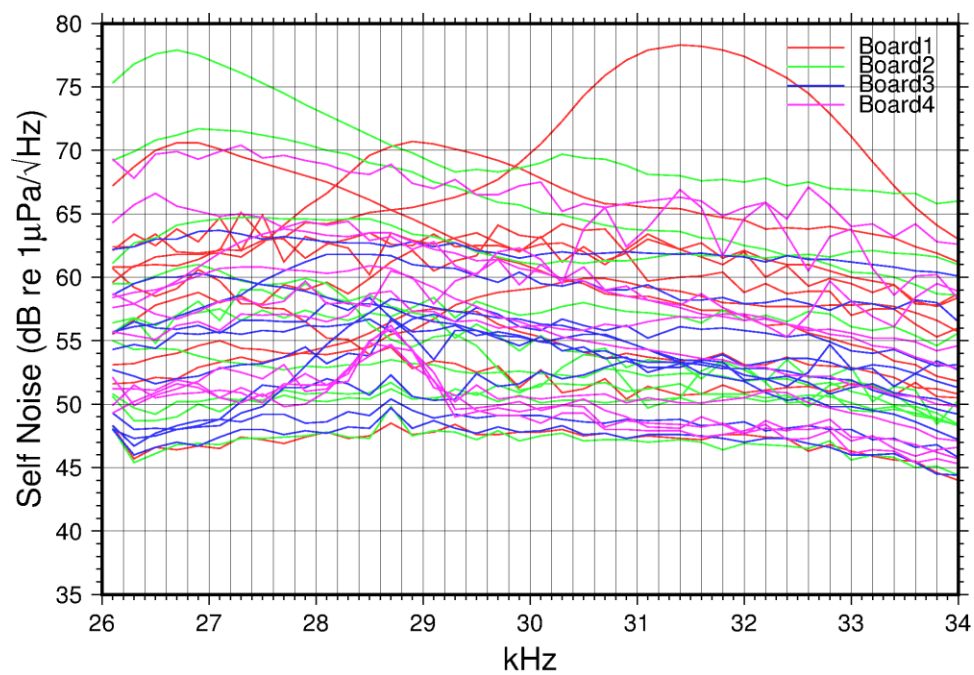
E/V Nautilus EM302 Self Noise - Into Seas 8 kts



E/V Nautilus EM302 Self Noise - Into Seas 8 kts

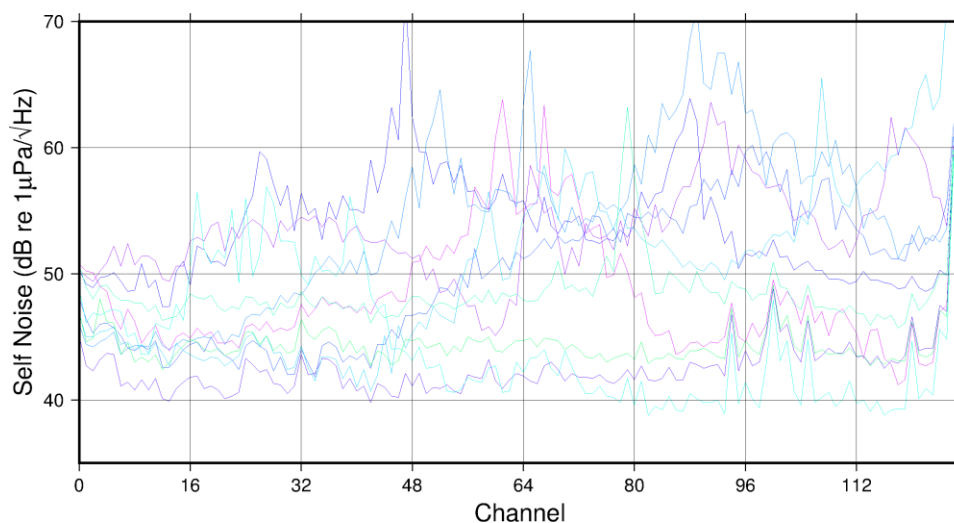


E/V Nautilus EM302 RX Noise Spectrum - Into Seas - 8 knots

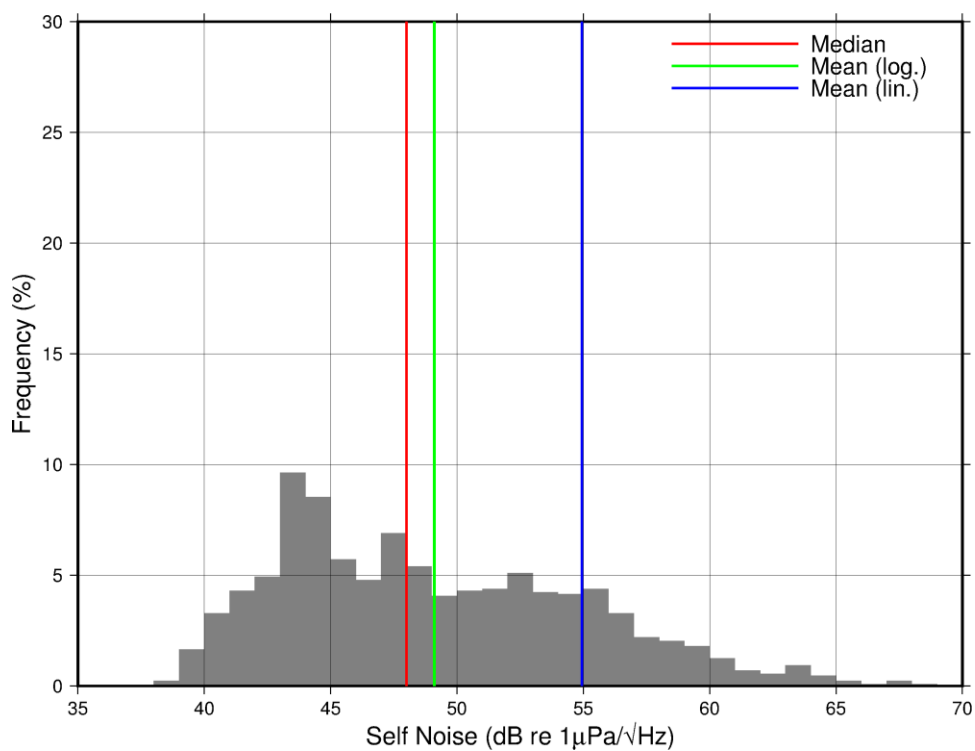


Self Noise Results – Speed – With Seas (6 kts)

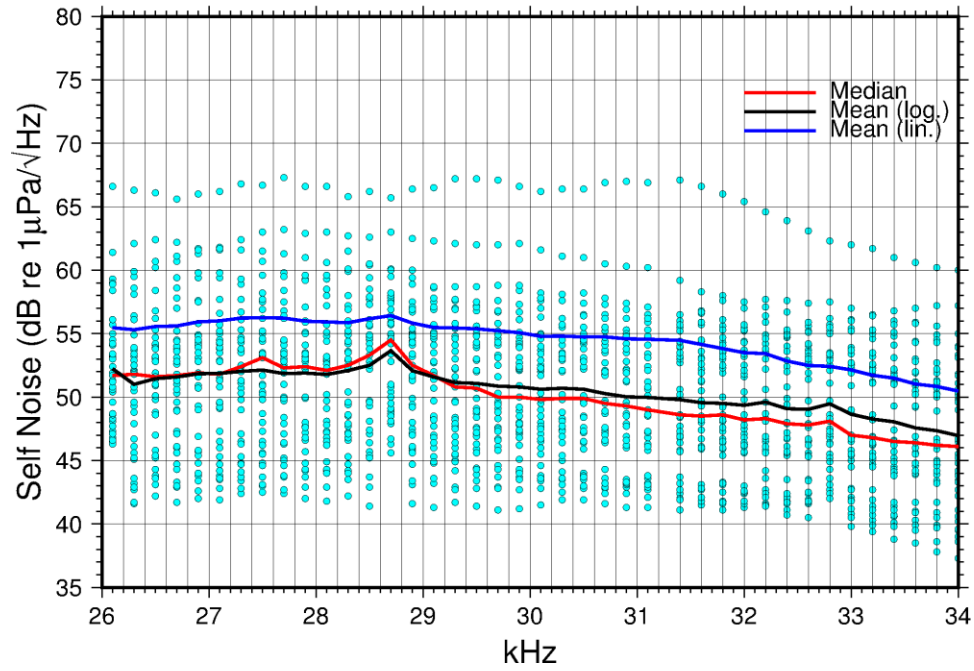
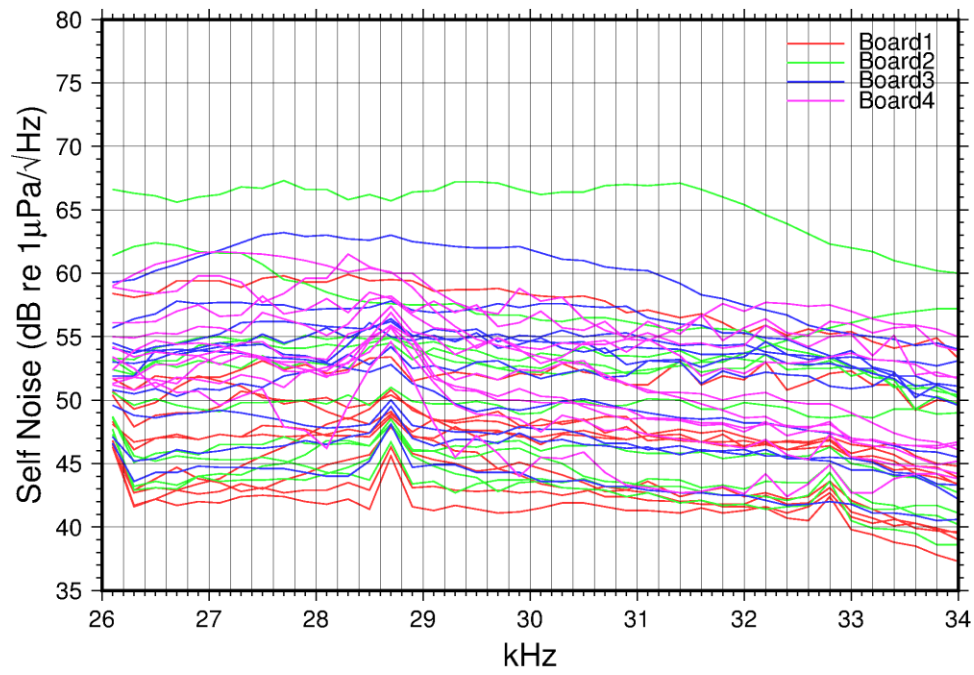
E/V Nautilus EM302 Self Noise - With Seas 6 kts



E/V Nautilus EM302 Self Noise - With Seas 6 kts

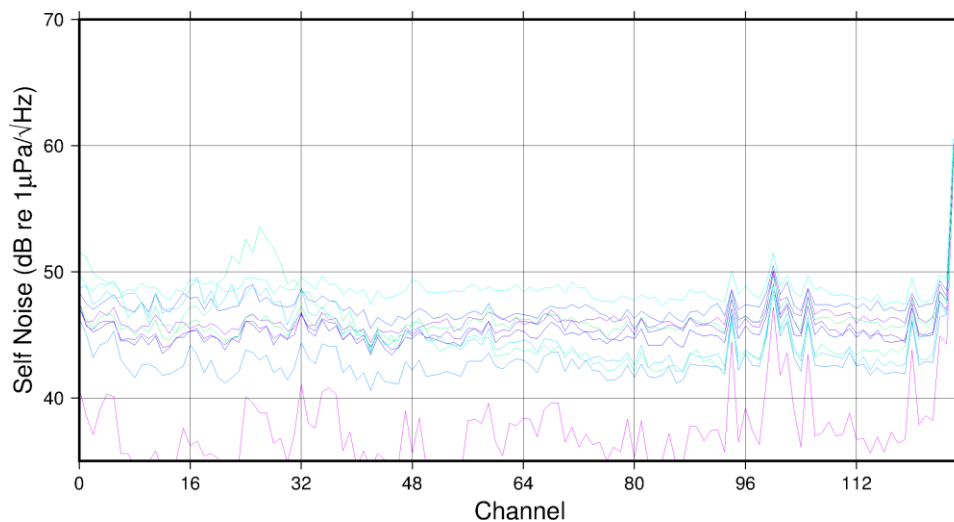


E/V Nautilus EM302 RX Noise Spectrum - With Seas - 6 knots

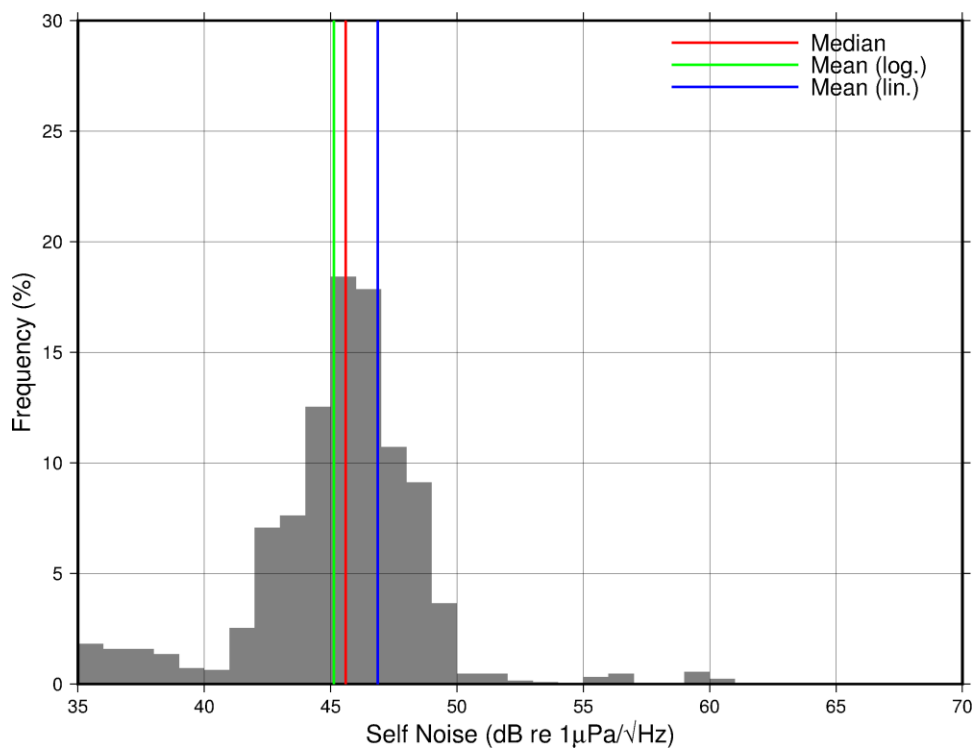


Self Noise Results – Speed – With Seas (8 kts)

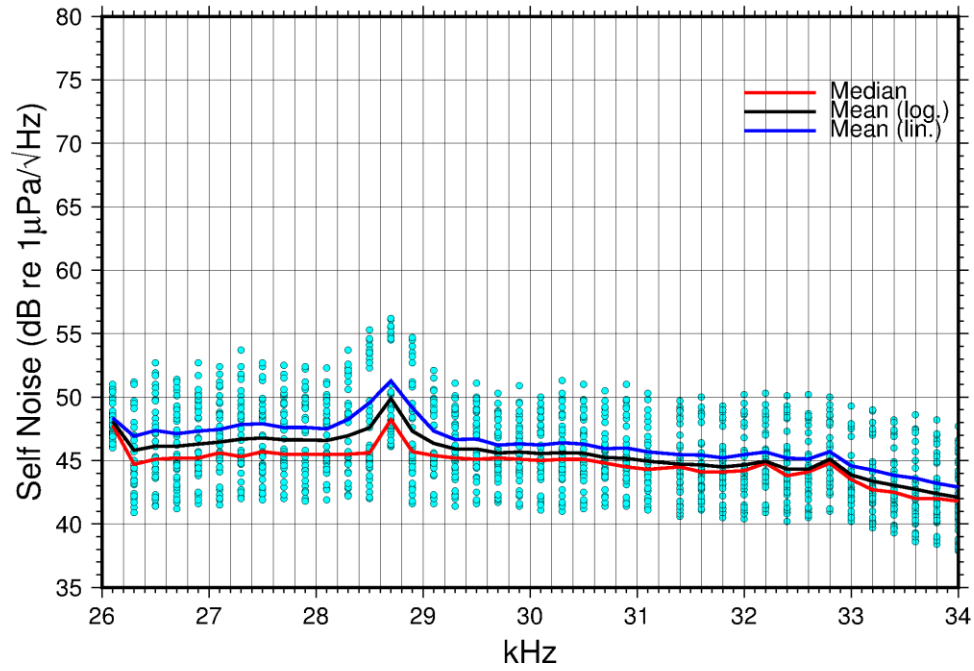
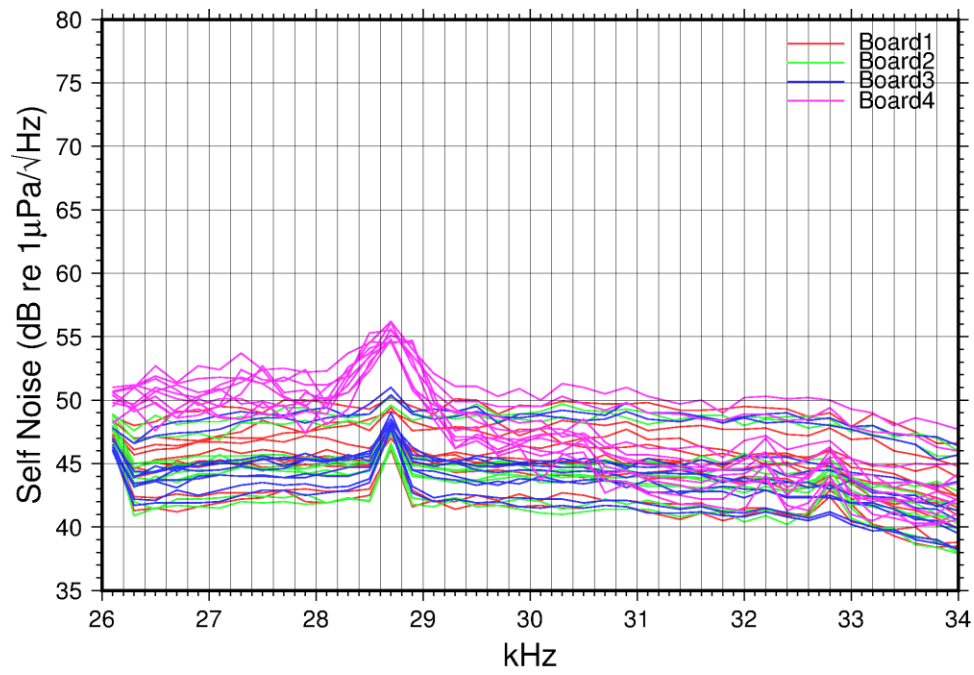
E/V Nautilus EM302 Self Noise - With Seas 8 kts



E/V Nautilus EM302 Self Noise - With Seas 8 kts

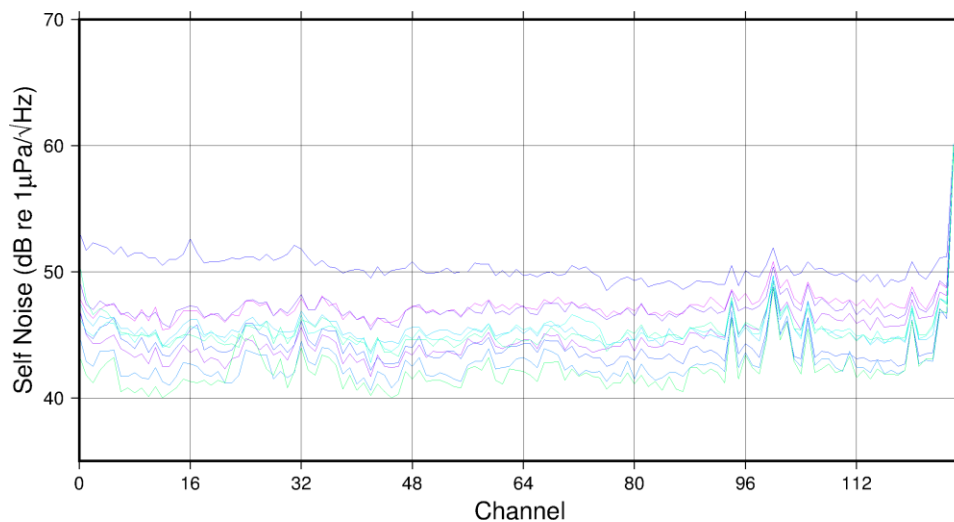


E/V Nautilus EM302 RX Noise Spectrum - With Seas - 8 knots

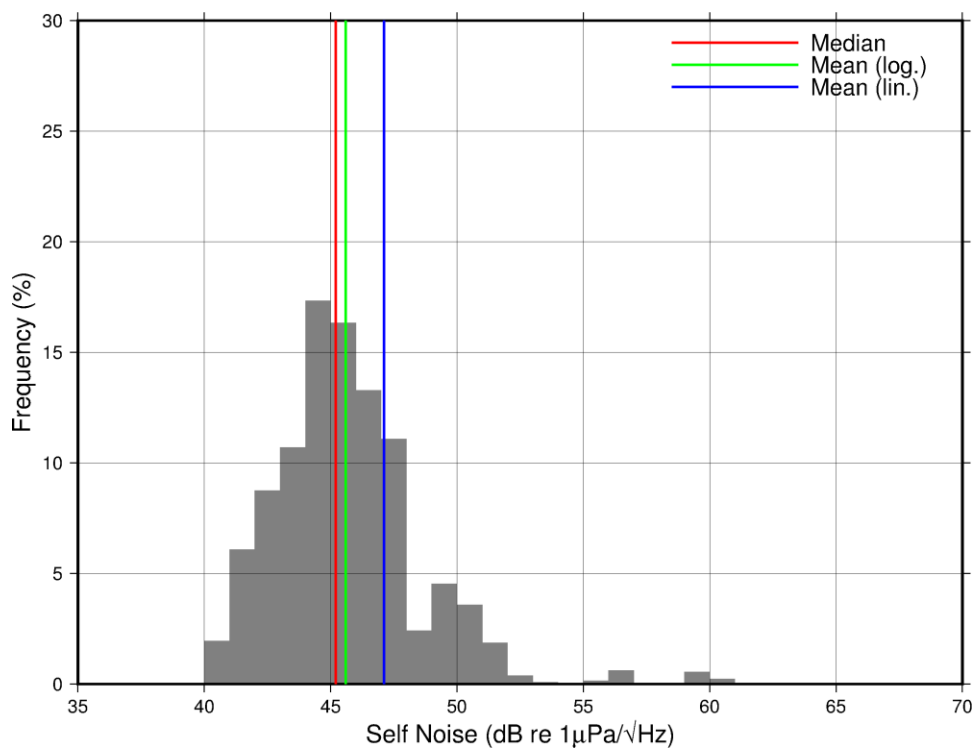


Self Noise Results – Speed – With Seas (10 kts)

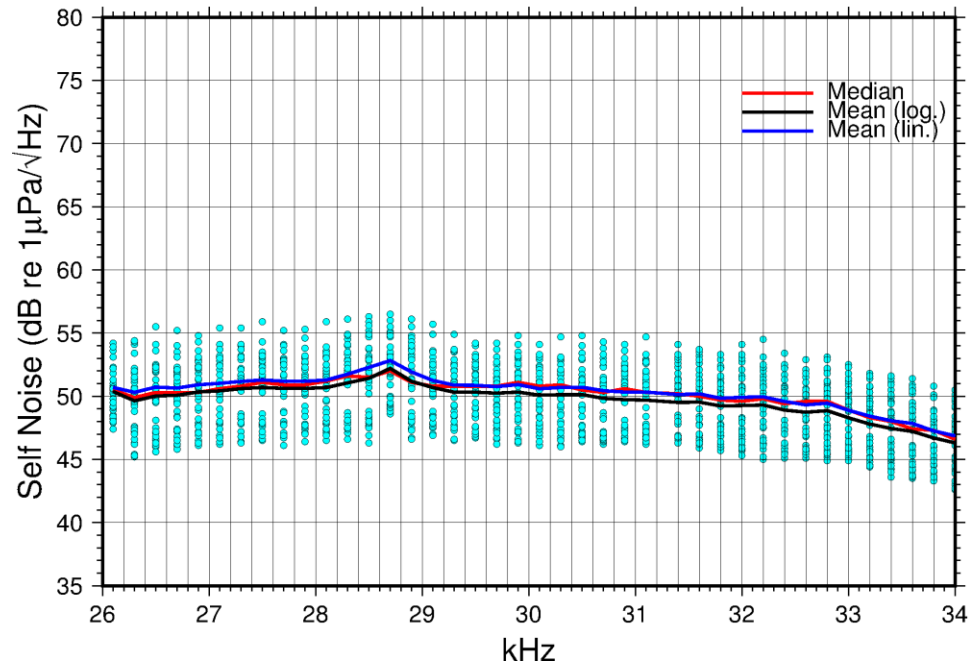
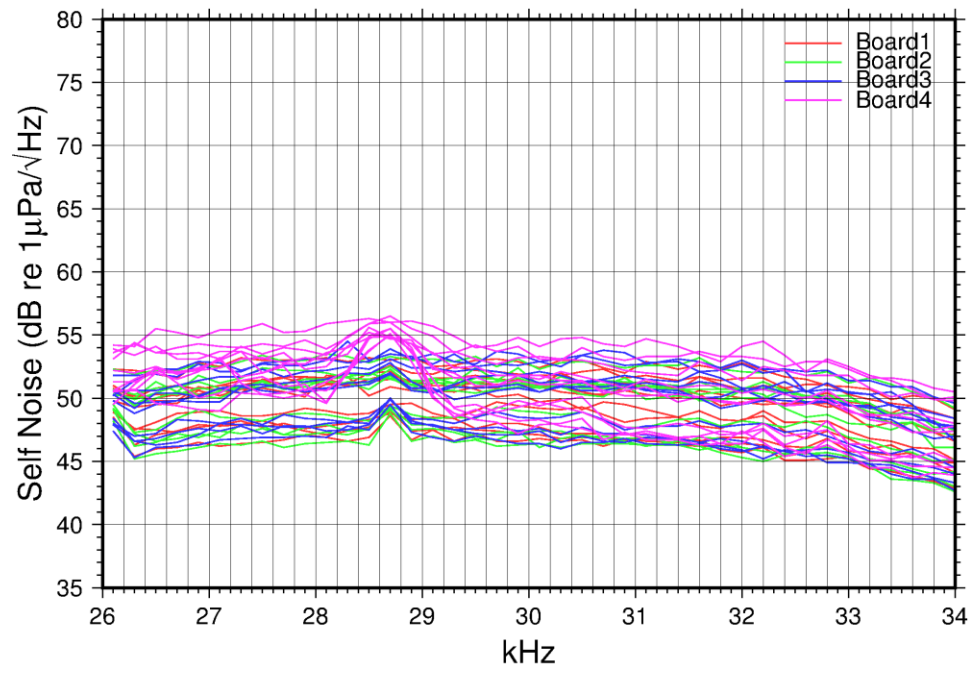
E/V Nautilus EM302 Self Noise - With Seas 10 kts



E/V Nautilus EM302 Self Noise - With Seas 10 kts

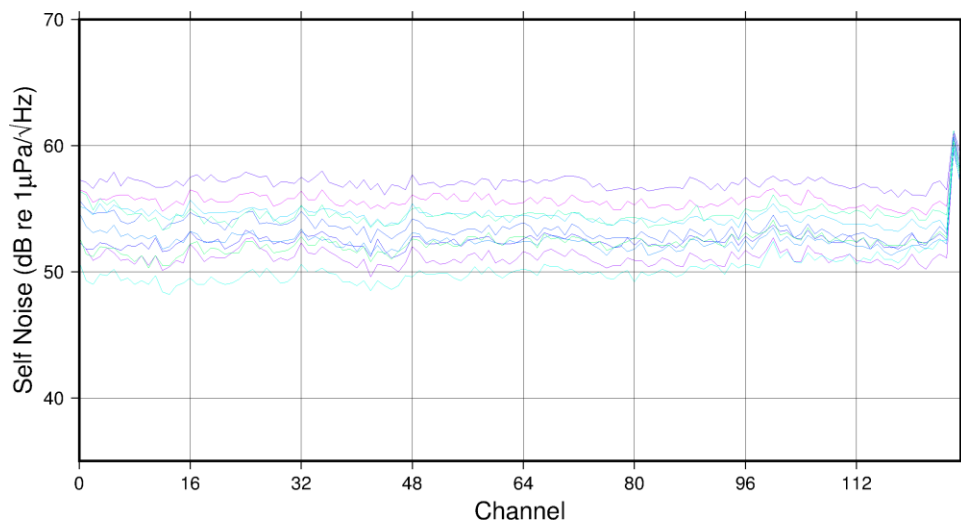


E/V Nautilus EM302 RX Noise Spectrum - With Seas - 10 knots

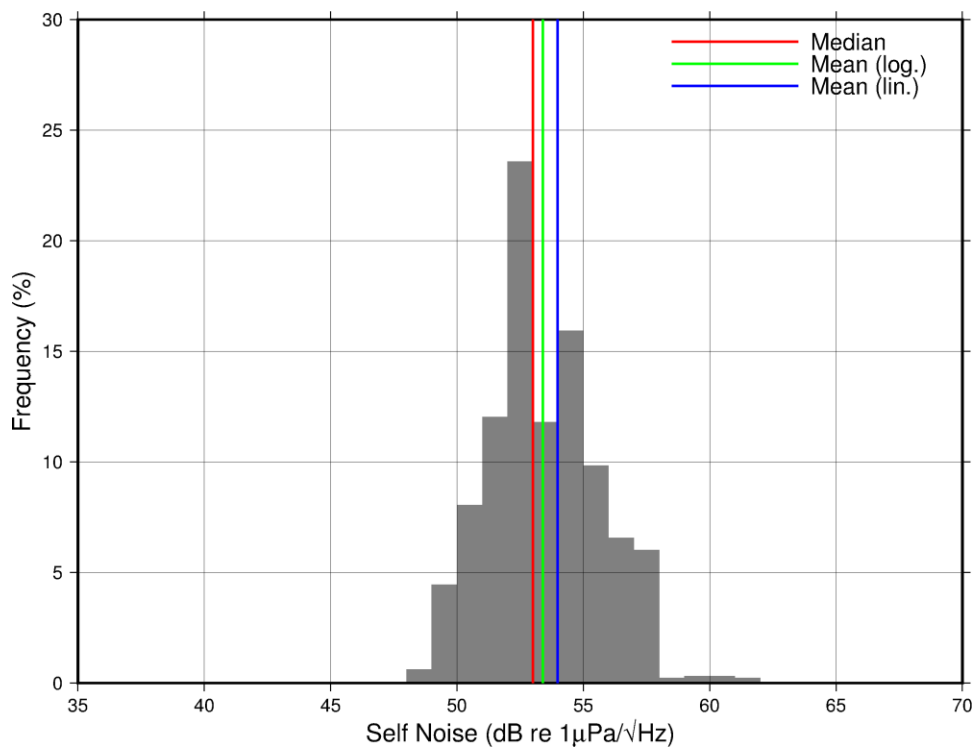


Self Noise Results – Speed – With Seas (11 kts)

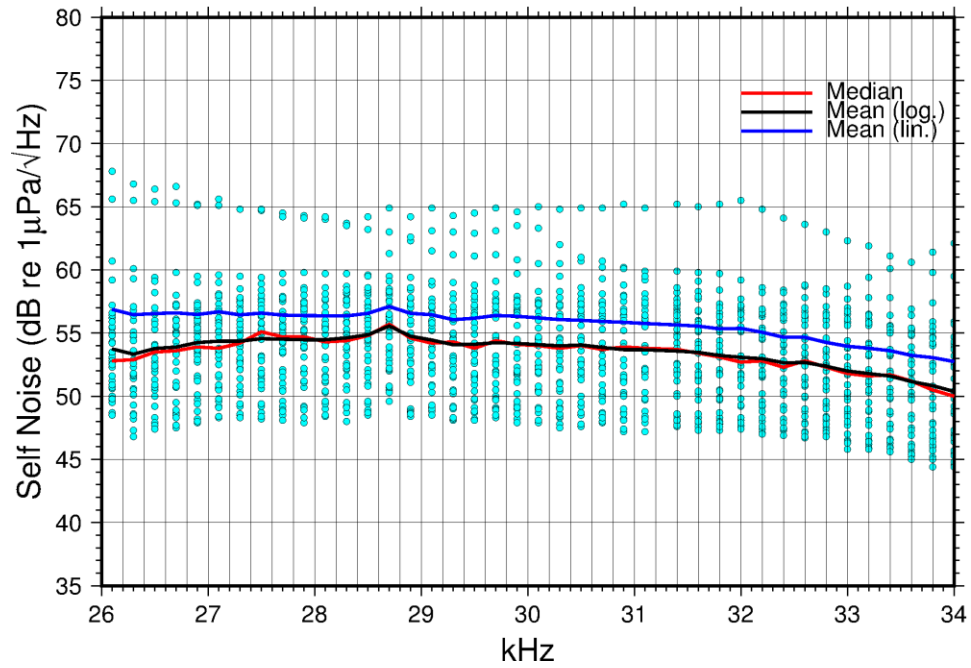
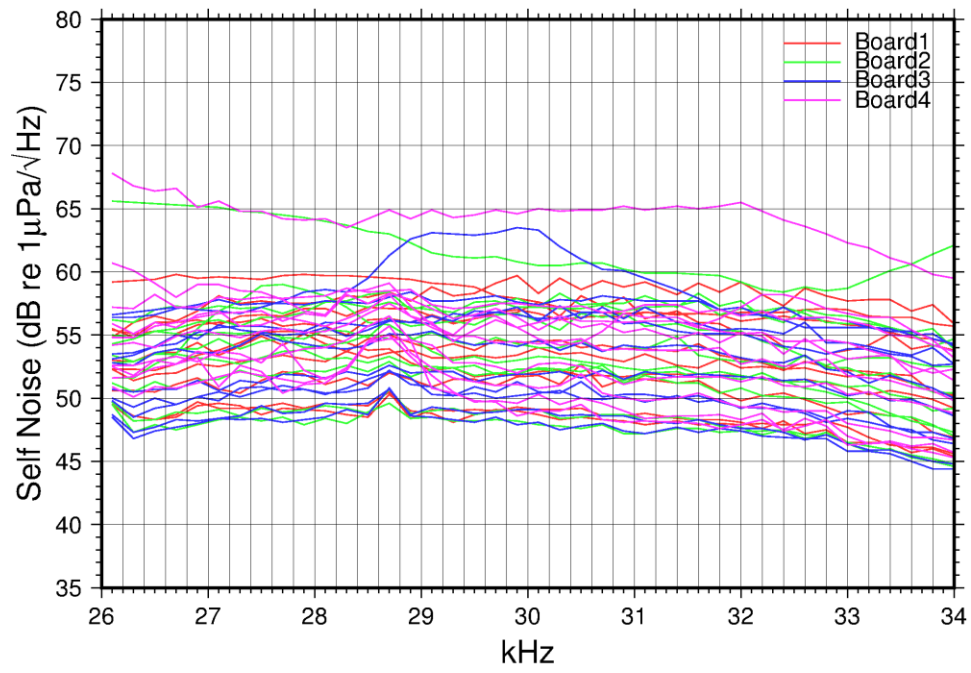
E/V Nautilus EM302 Self Noise - With Seas 11 kts



E/V Nautilus EM302 Self Noise - With Seas 11 kts

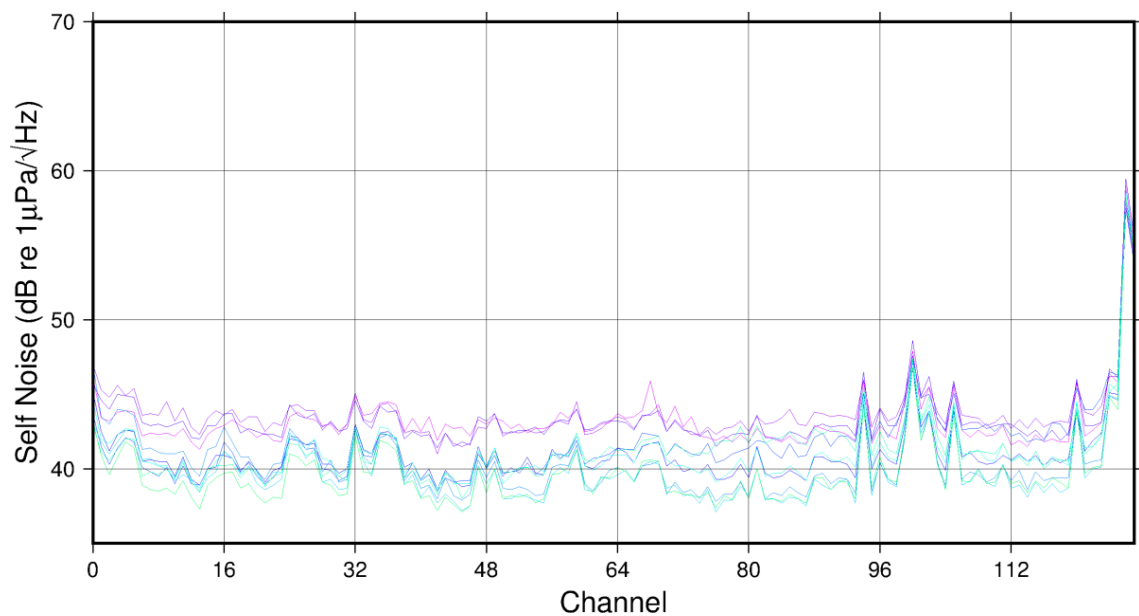


E/V Nautilus EM302 RX Noise Spectrum - With Seas - 11 knots

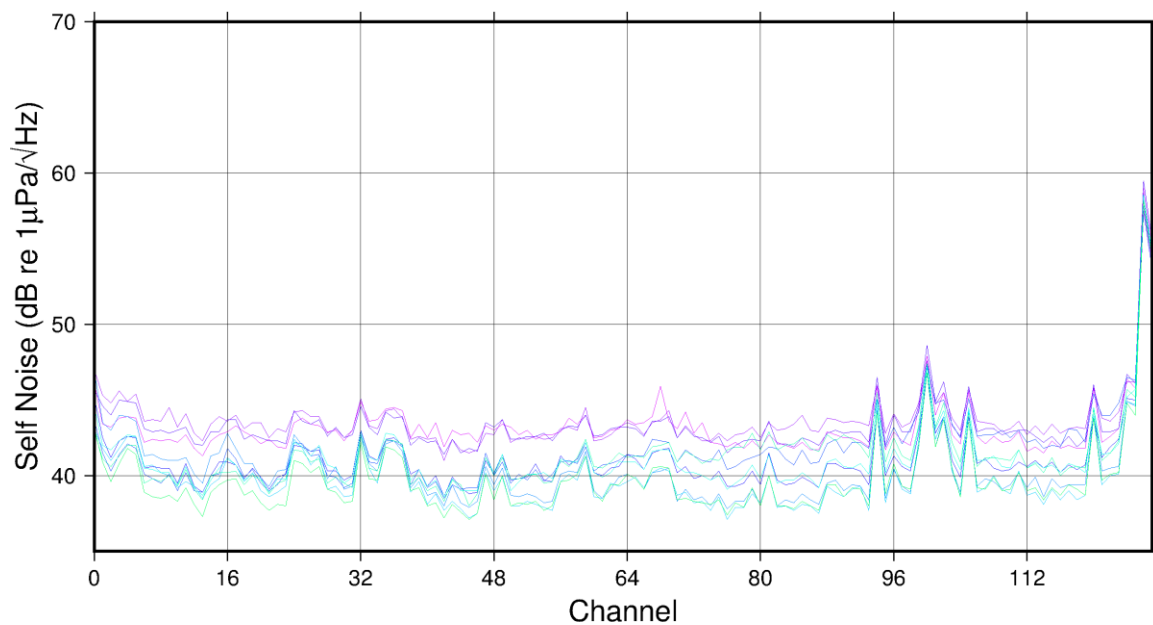


Self Noise Results – Swell – 000° (With Swell)

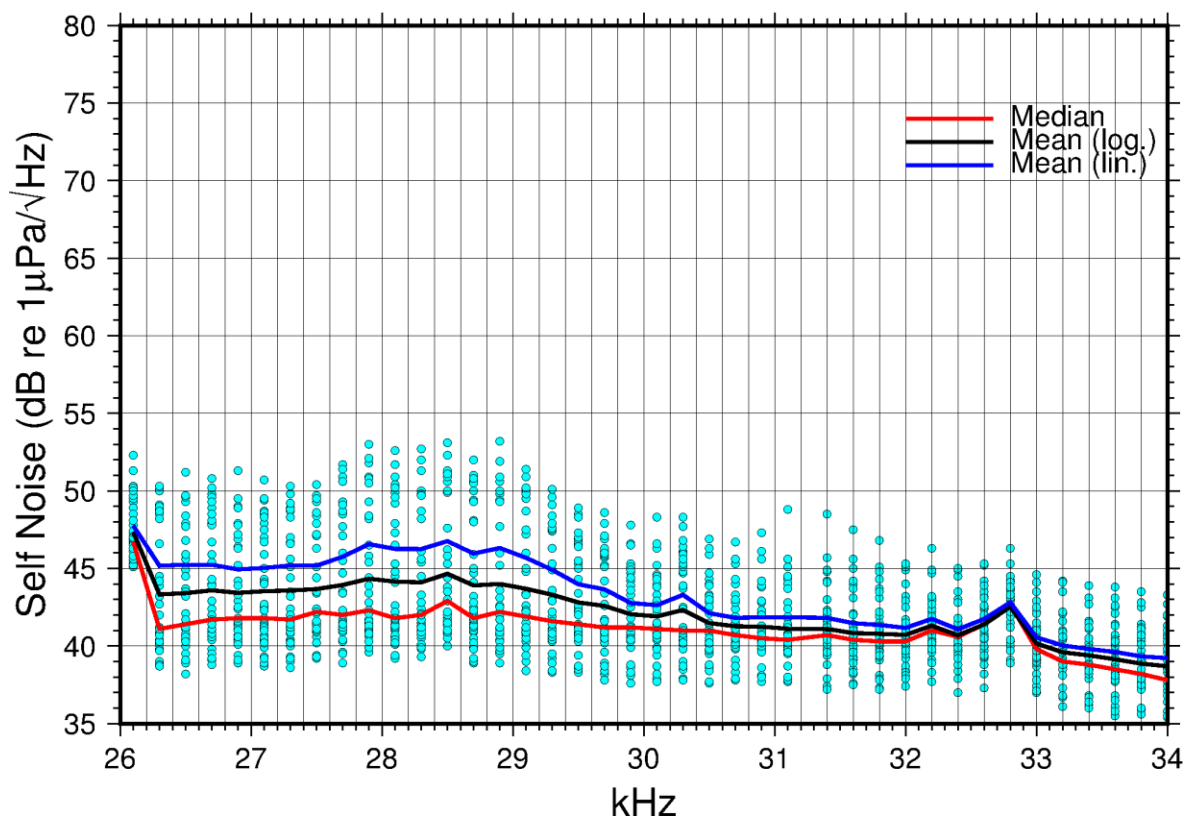
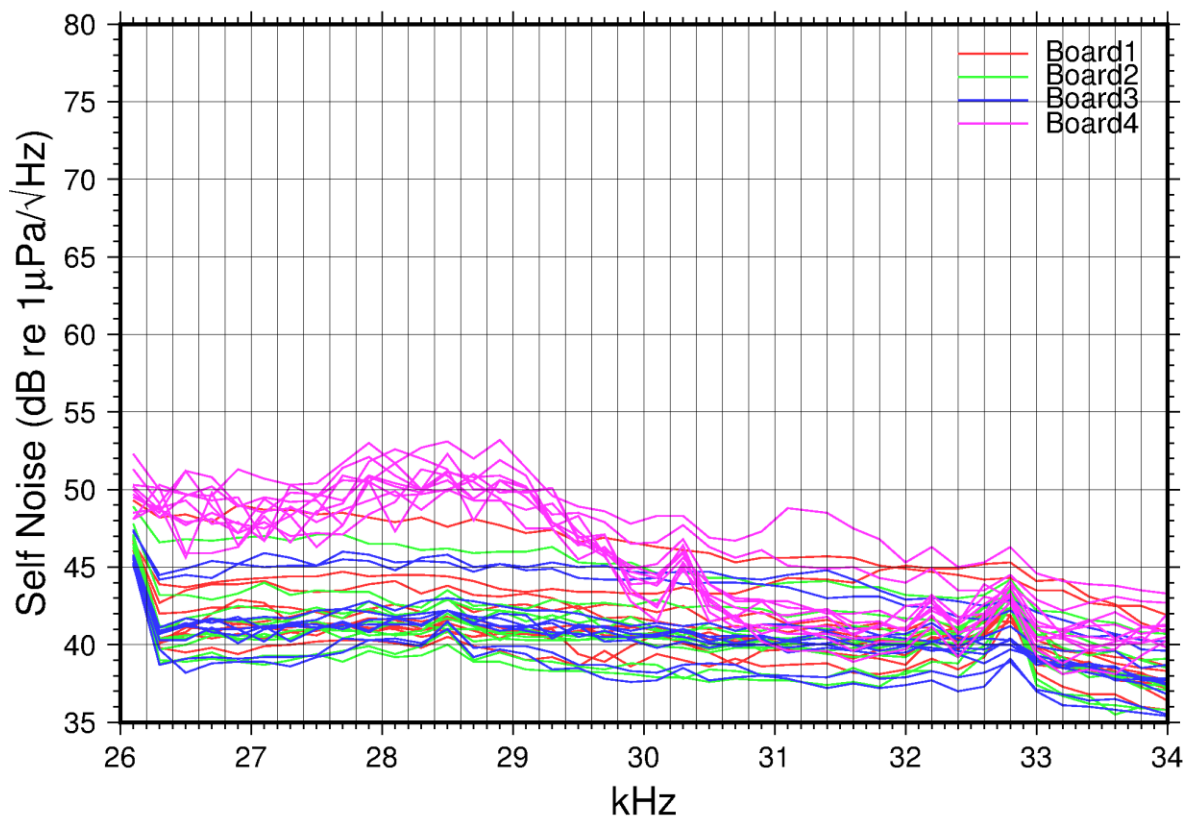
E/V Nautilus EM302 Self Noise - 0 deg



E/V Nautilus EM302 Self Noise - 0 deg

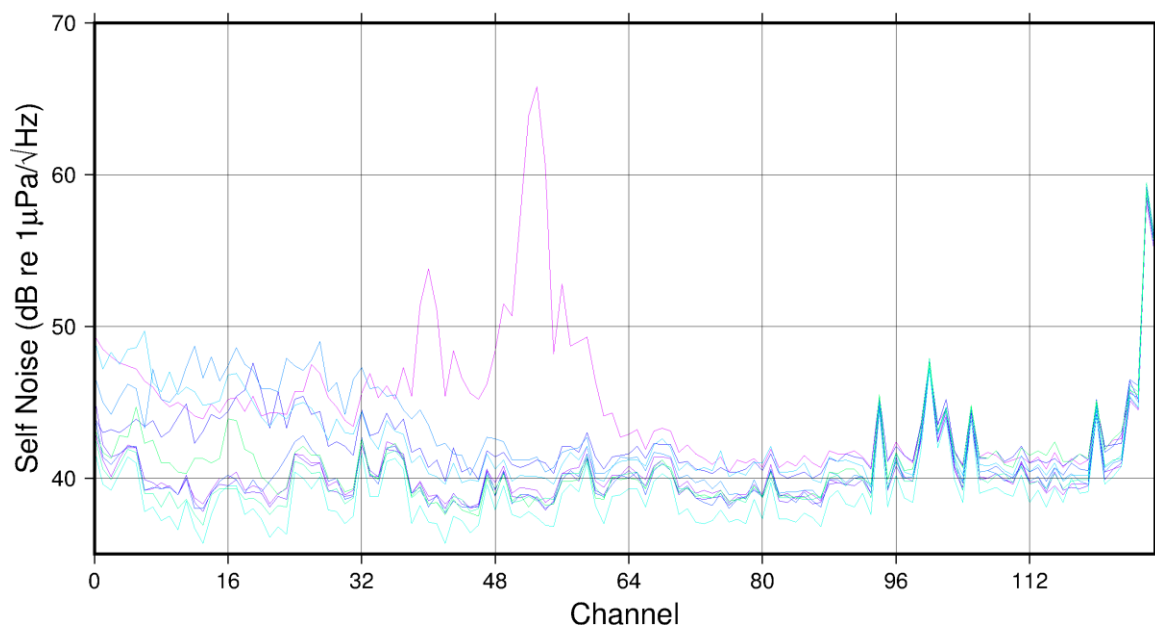


E/V Nautilus EM302 RX Noise Spectrum - 0 Degrees

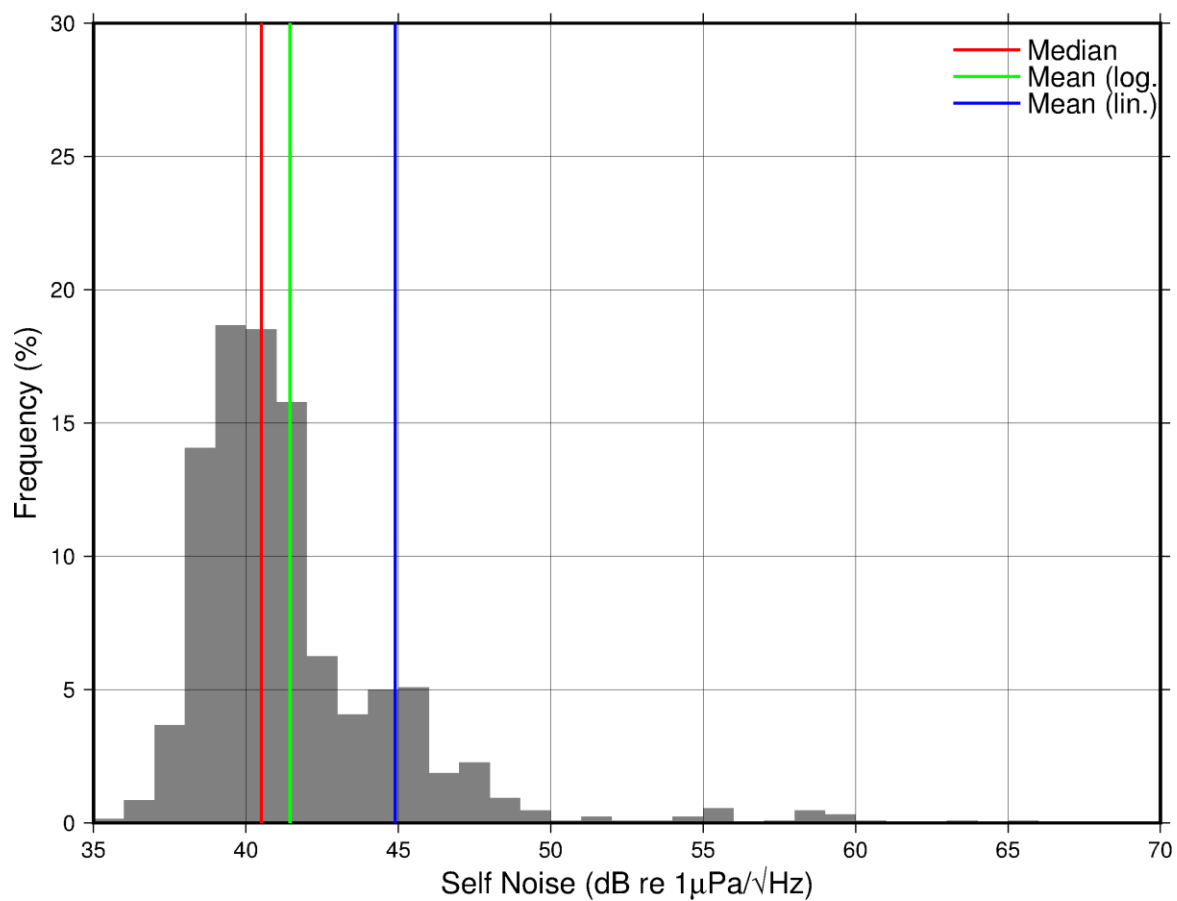


Self Noise Results – Swell – 045°

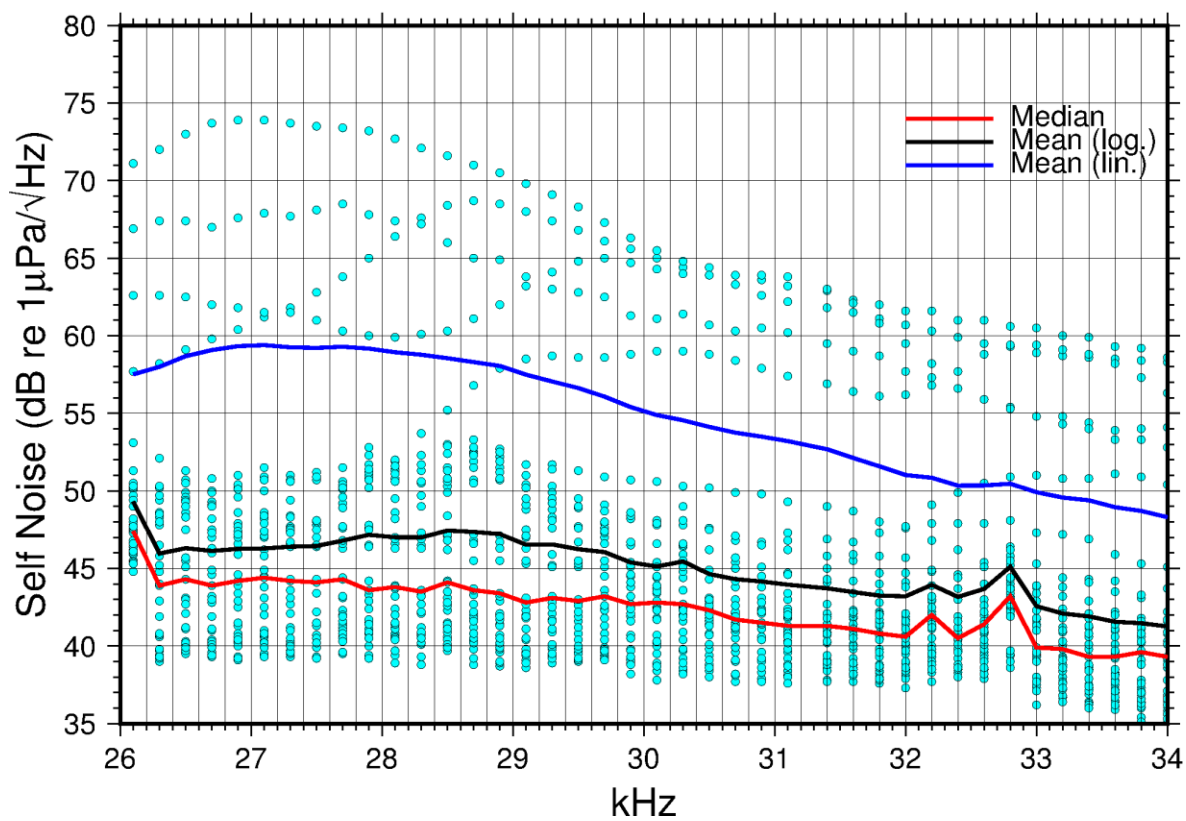
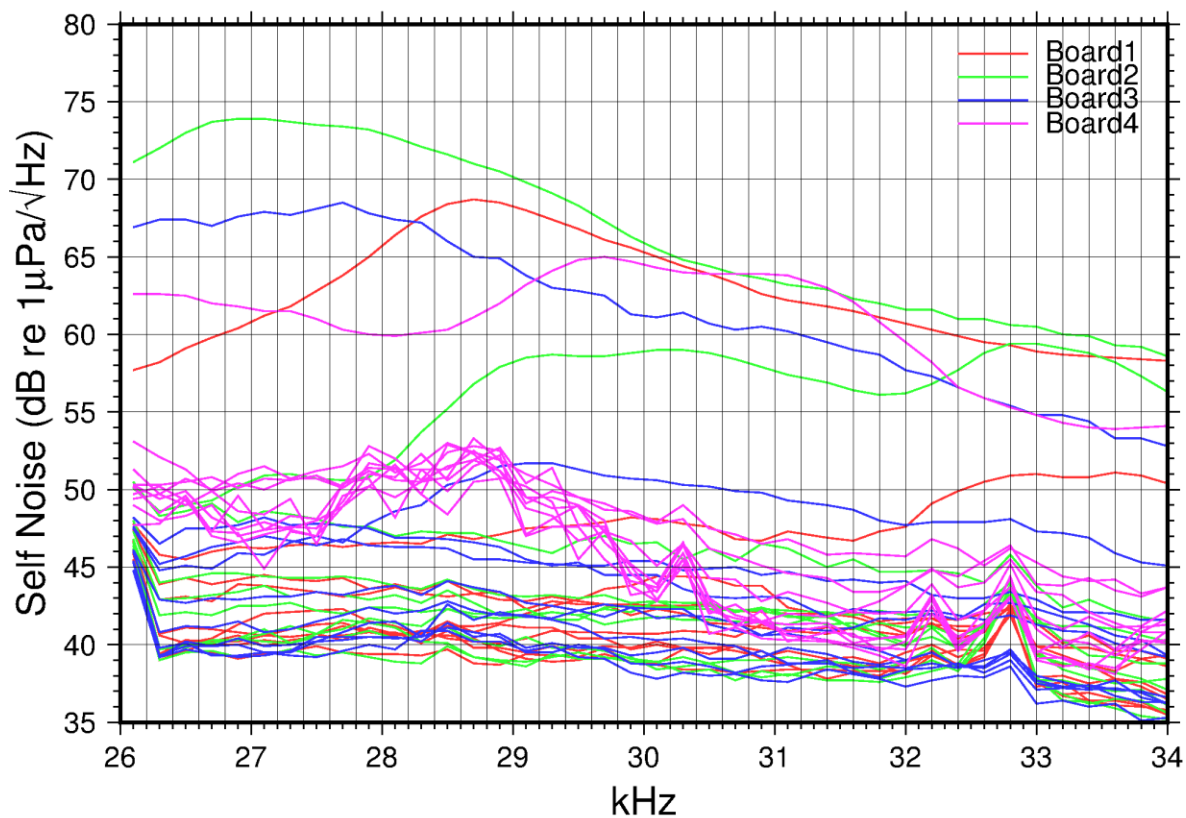
E/V Nautilus EM302 Self Noise - 45 deg



E/V Nautilus EM302 Self Noise - 45 deg

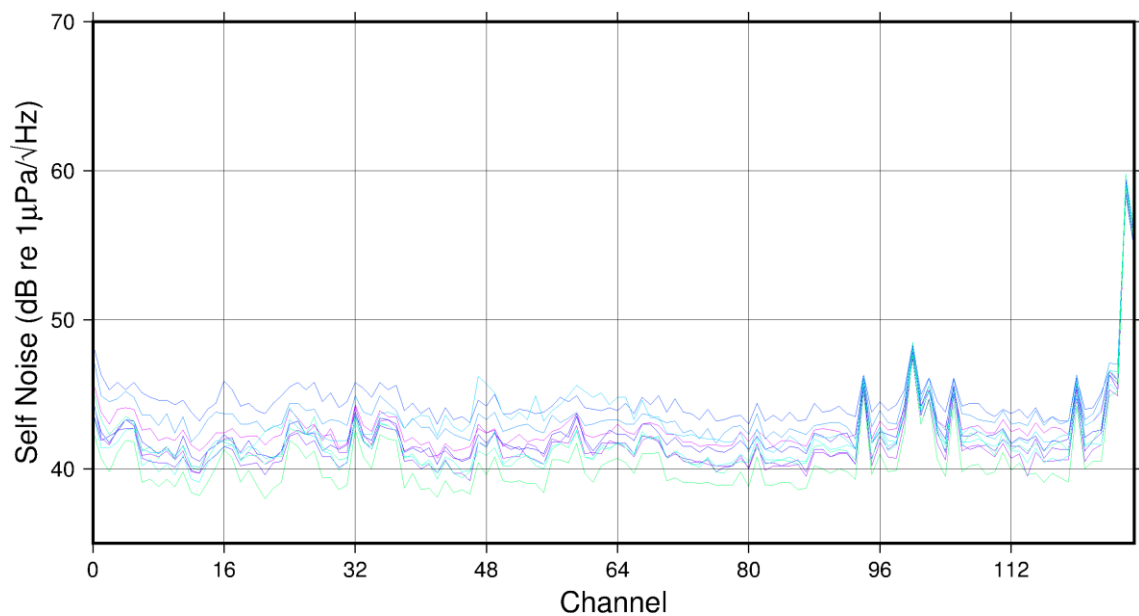


E/V Nautilus EM302 RX Noise Spectrum - 45 Degrees

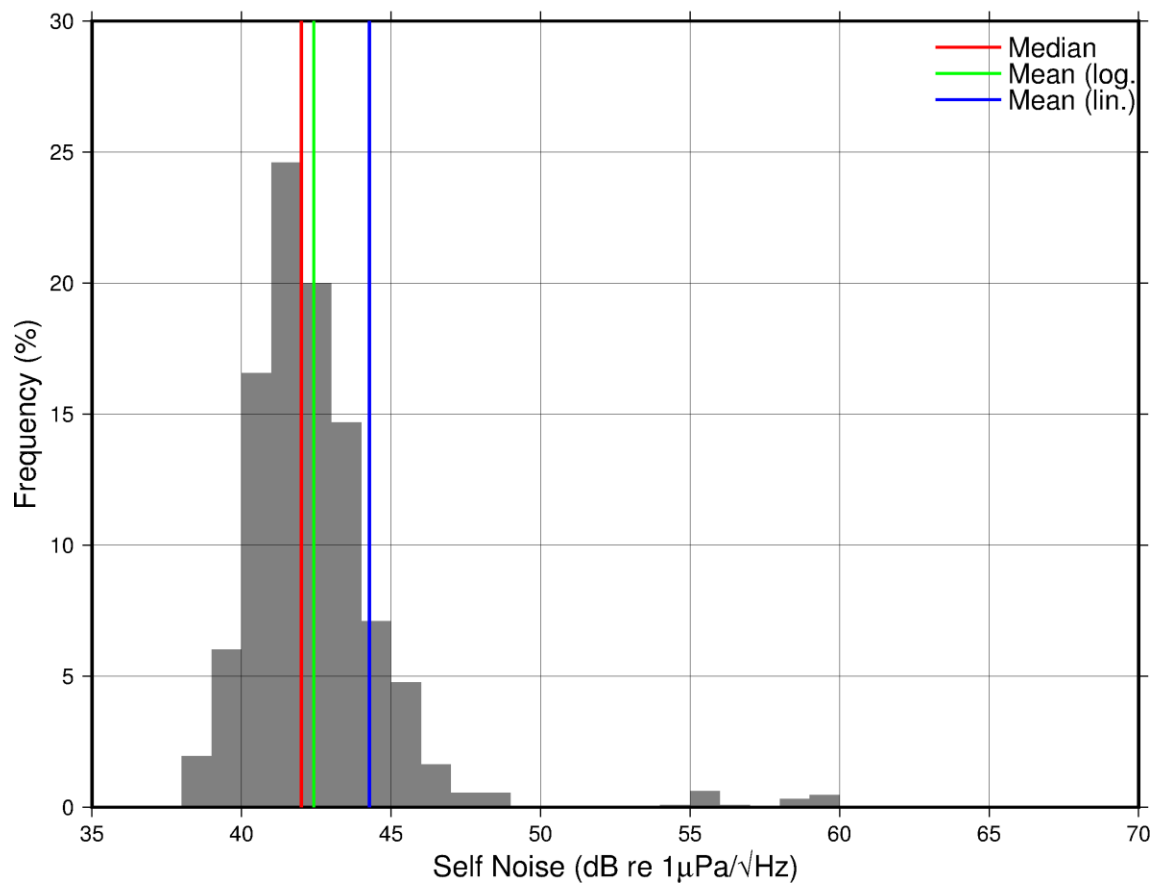


Self Noise Results – Swell – 090°

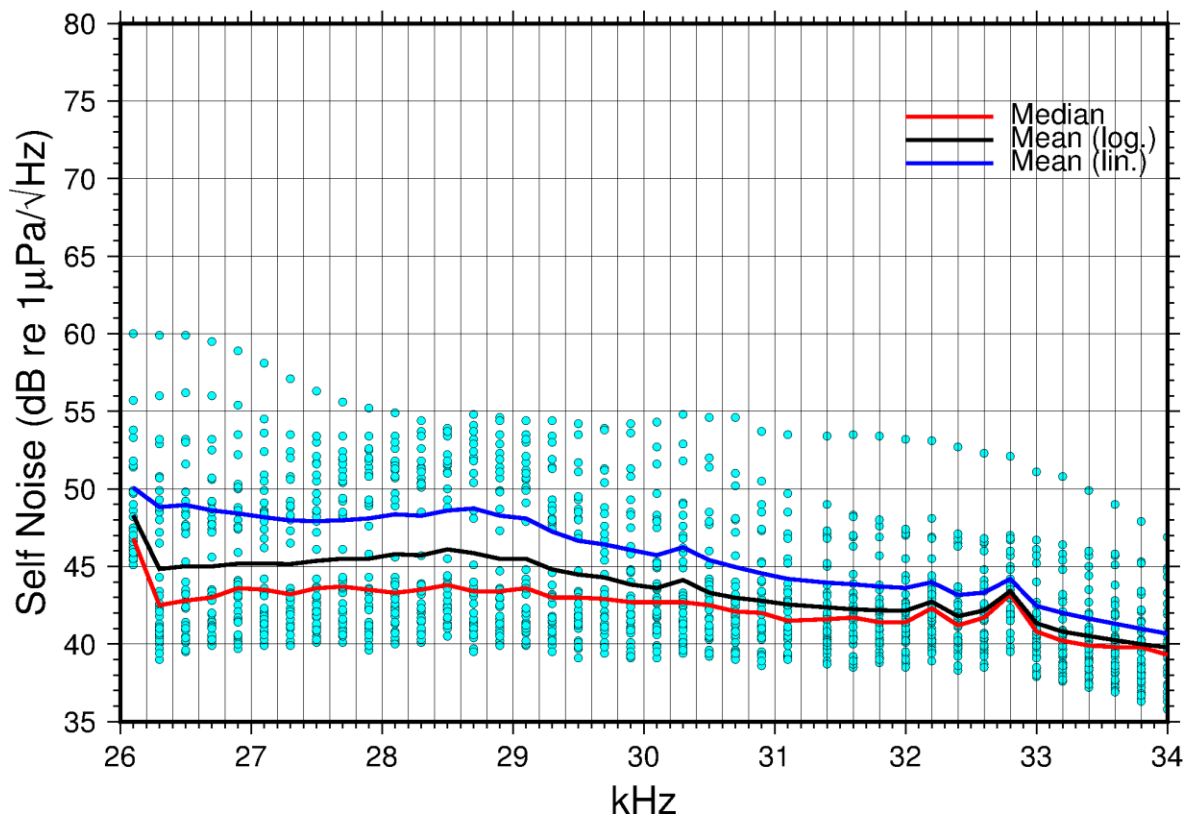
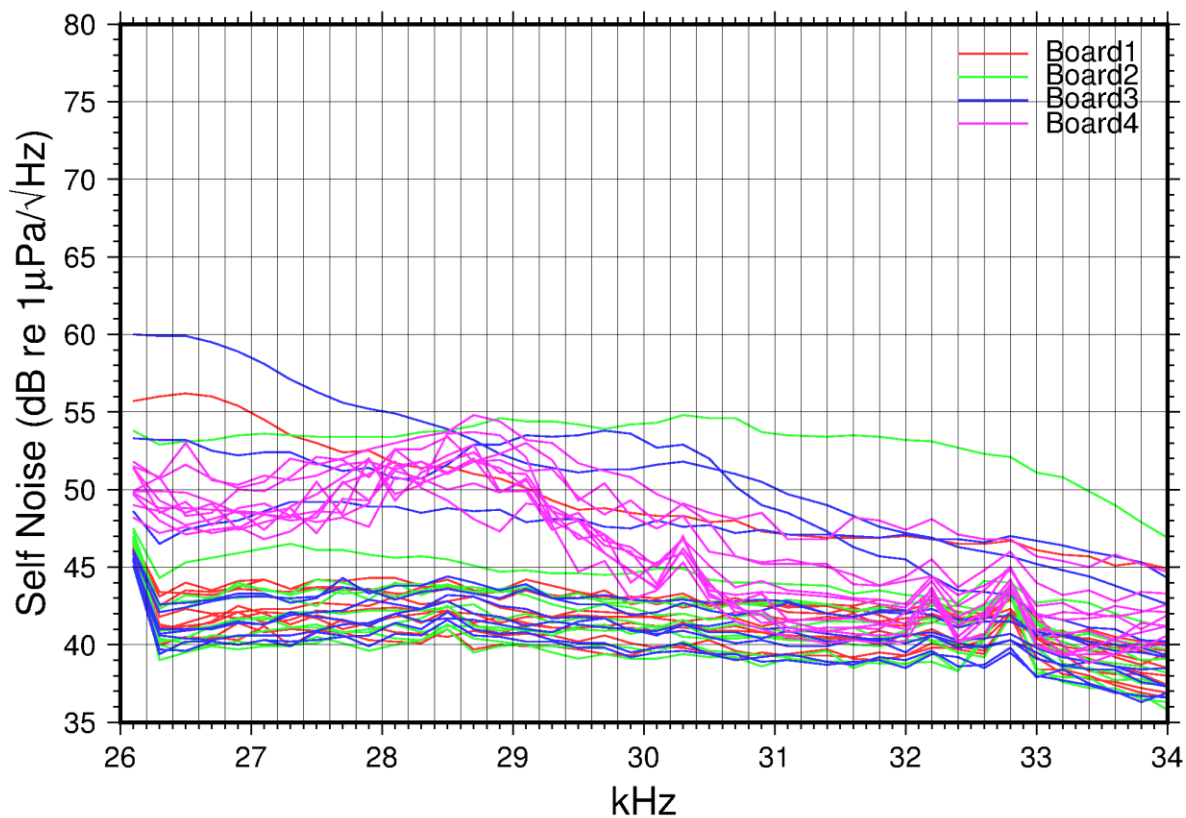
E/V Nautilus EM302 Self Noise - 90 deg



E/V Nautilus EM302 Self Noise - 90 deg

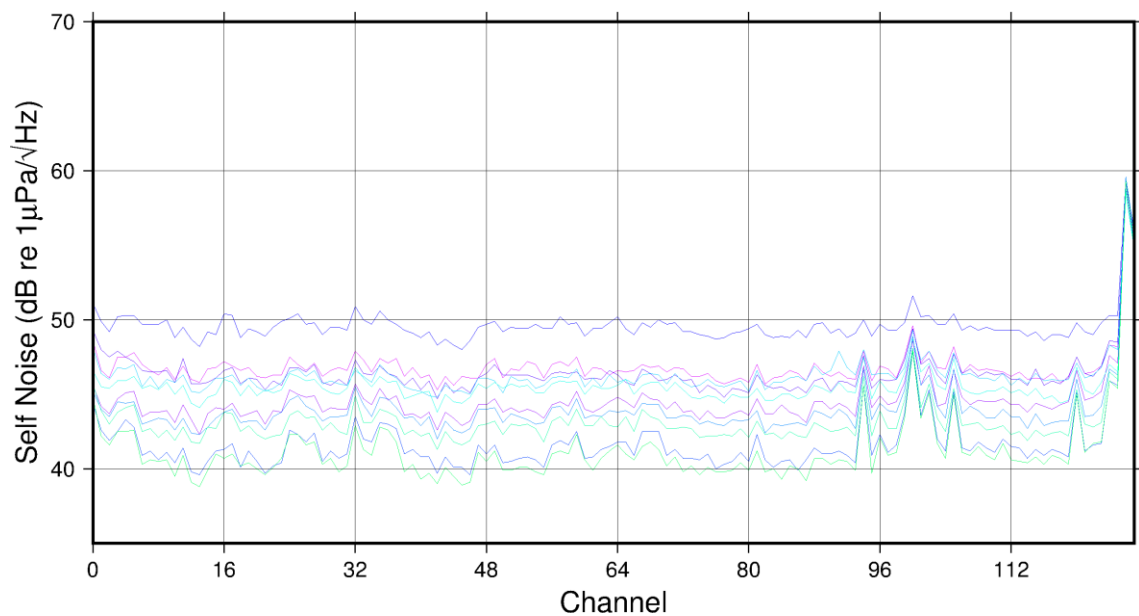


E/V Nautilus EM302 RX Noise Spectrum - 90 Degrees

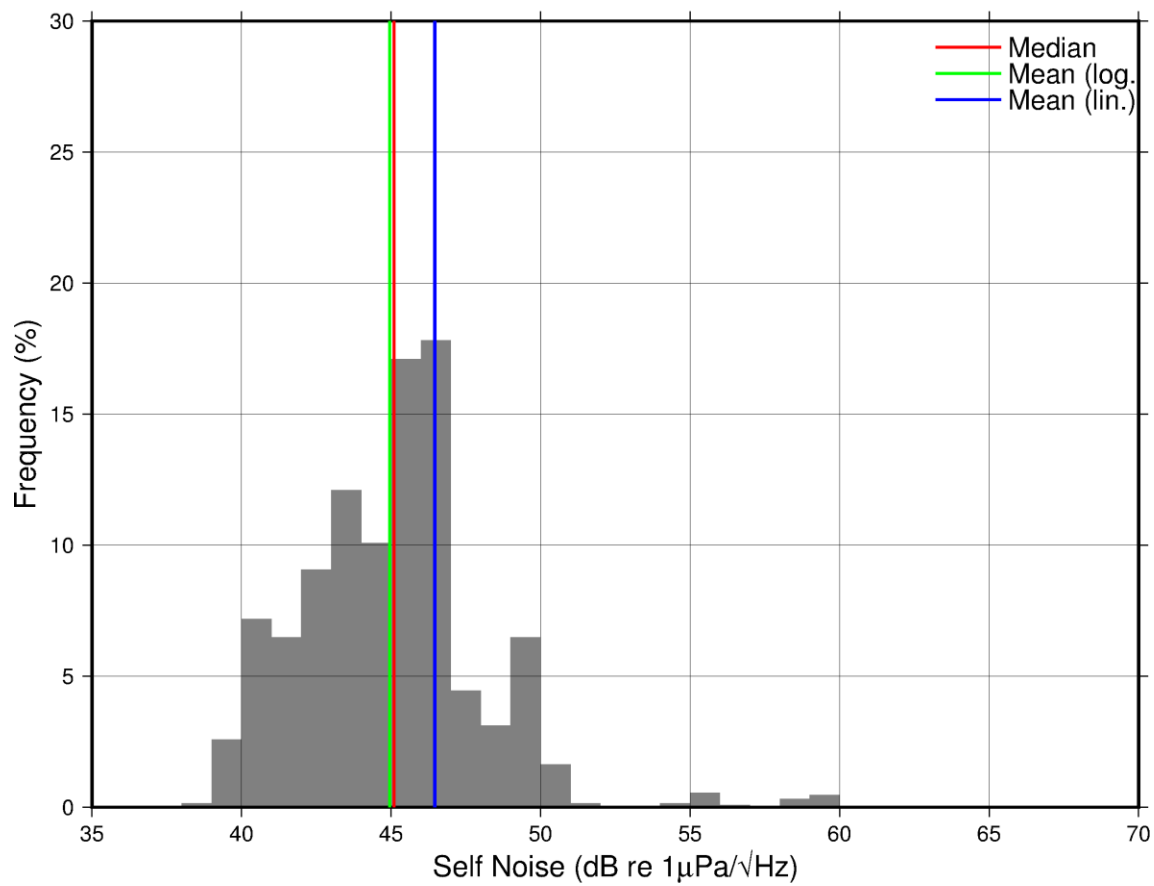


Self Noise Results - Swell - 135°

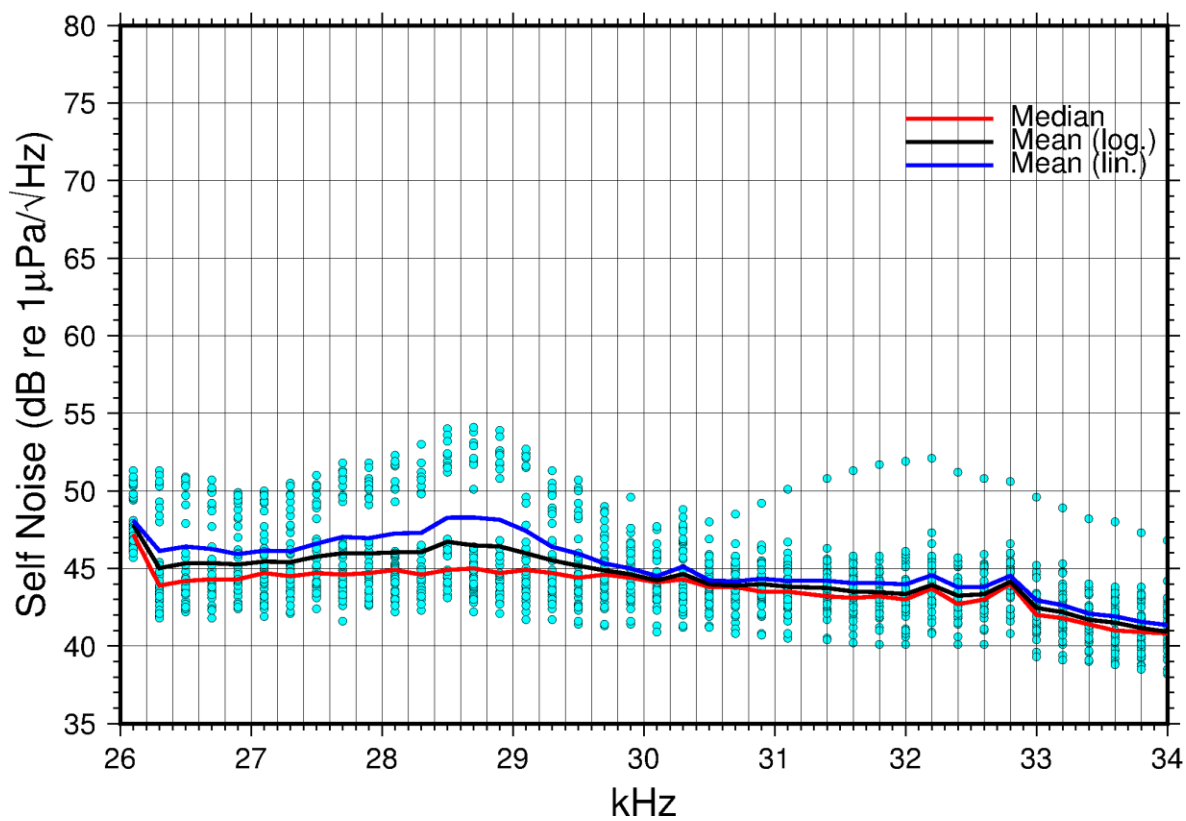
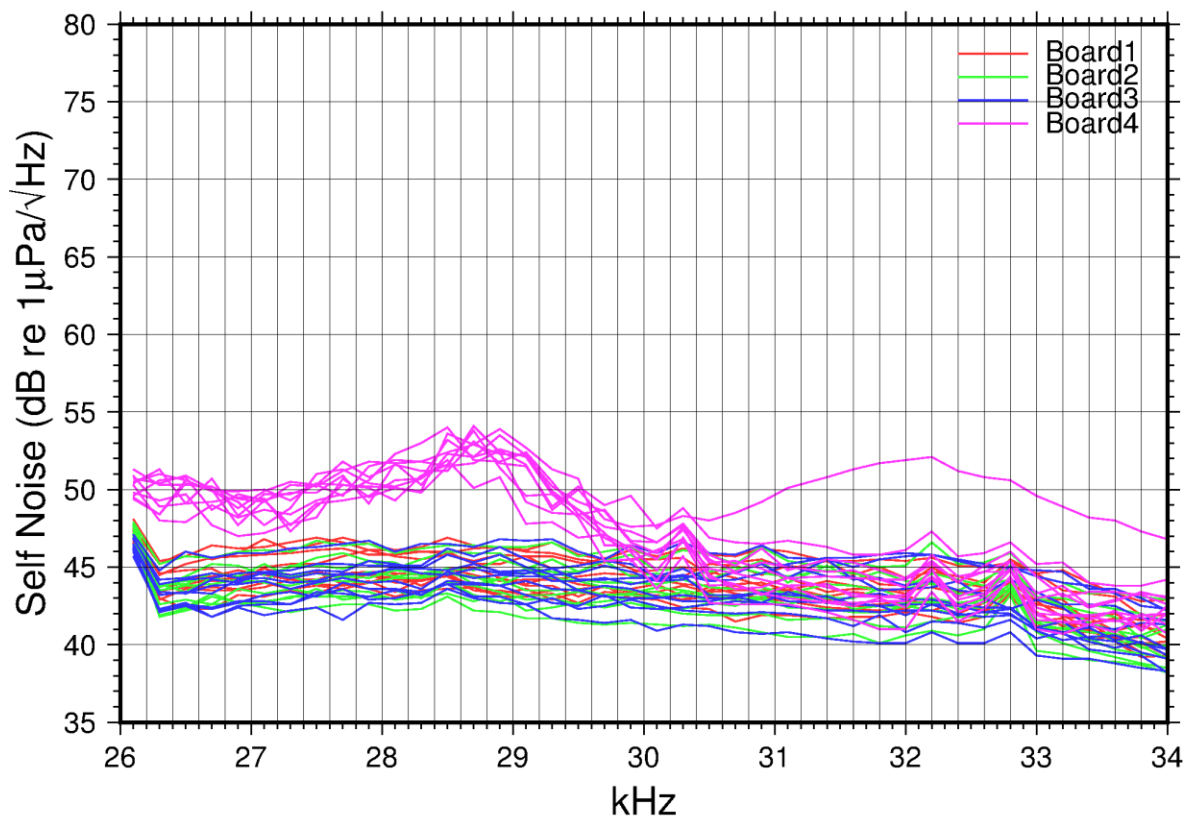
E/V Nautilus EM302 Self Noise - 135 deg



E/V Nautilus EM302 Self Noise - 135 deg

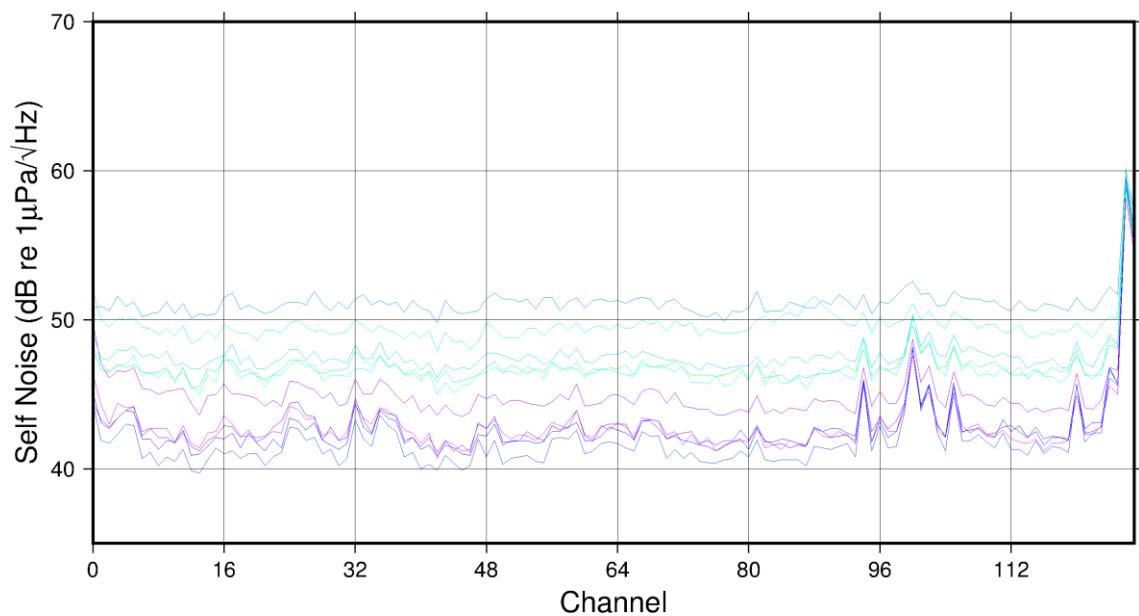


E/V Nautilus EM302 RX Noise Spectrum - 135 Degrees

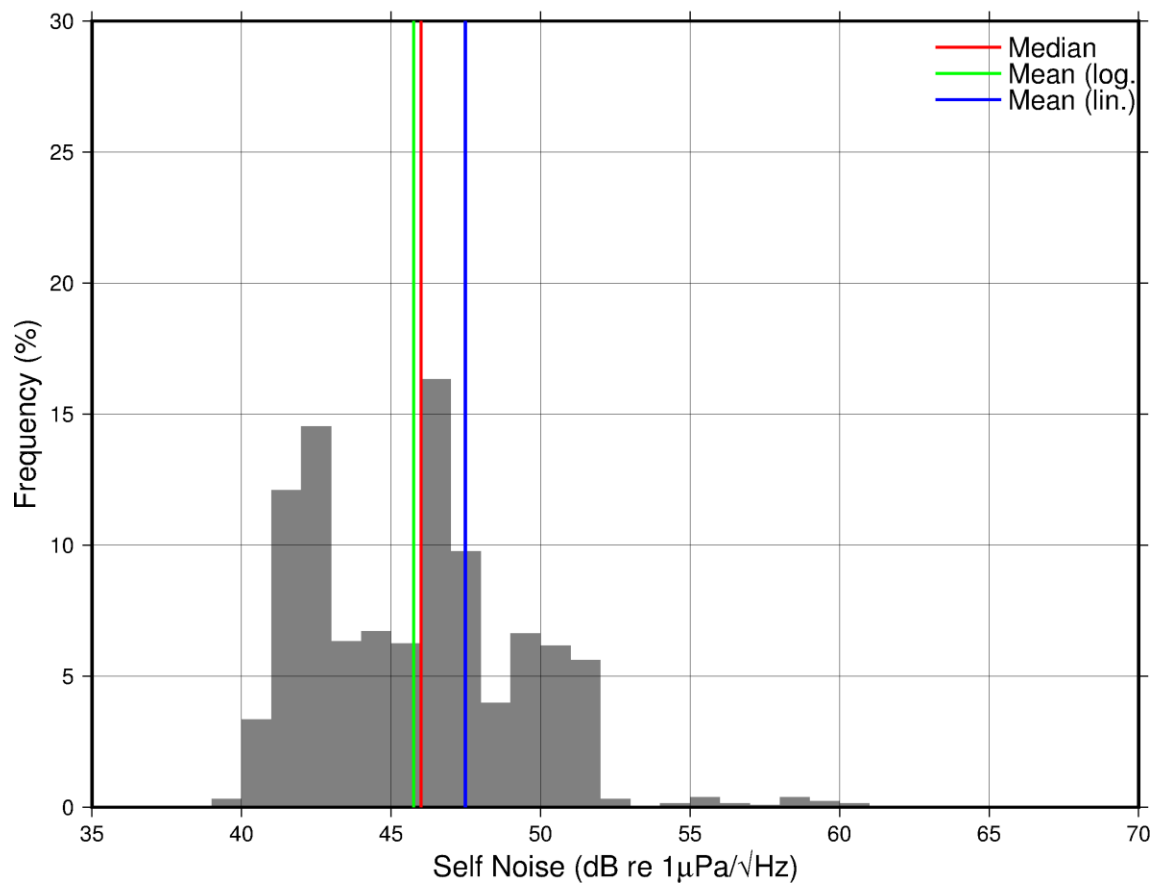


Self Noise Results - Swell - 180° (Into Swell)

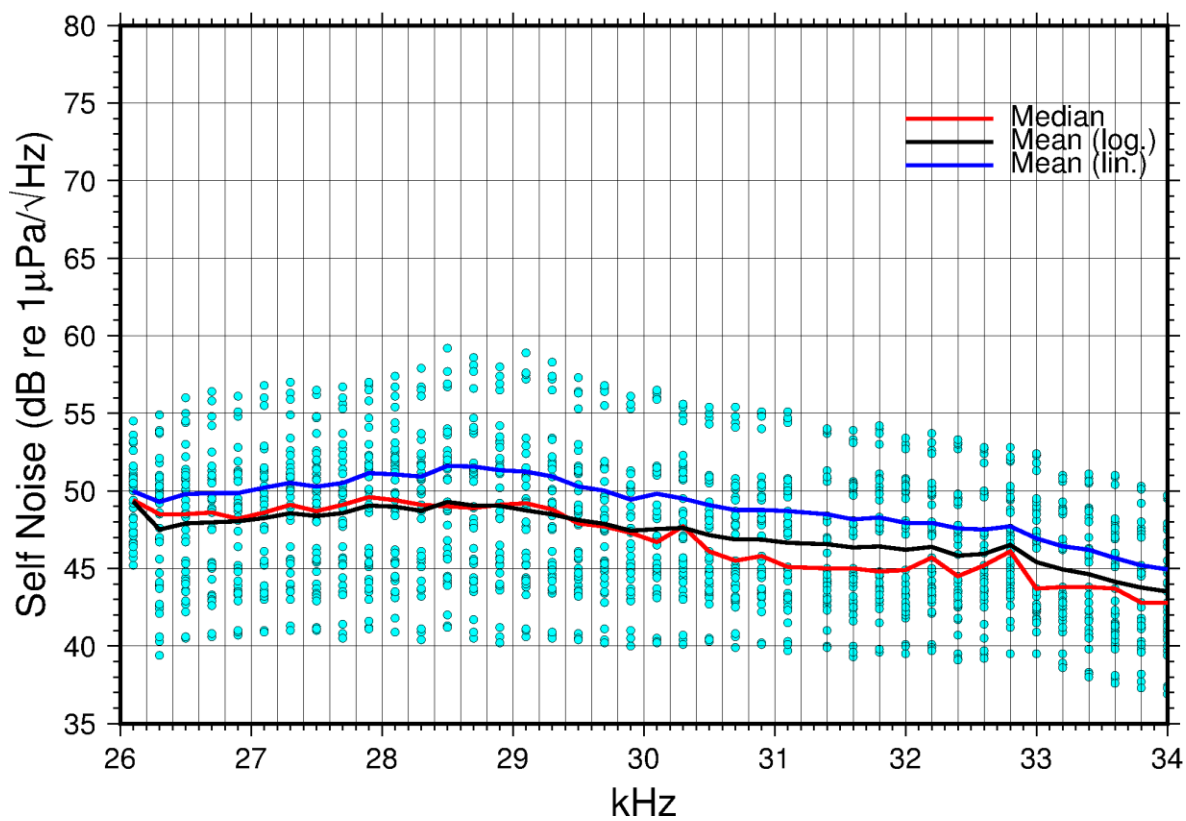
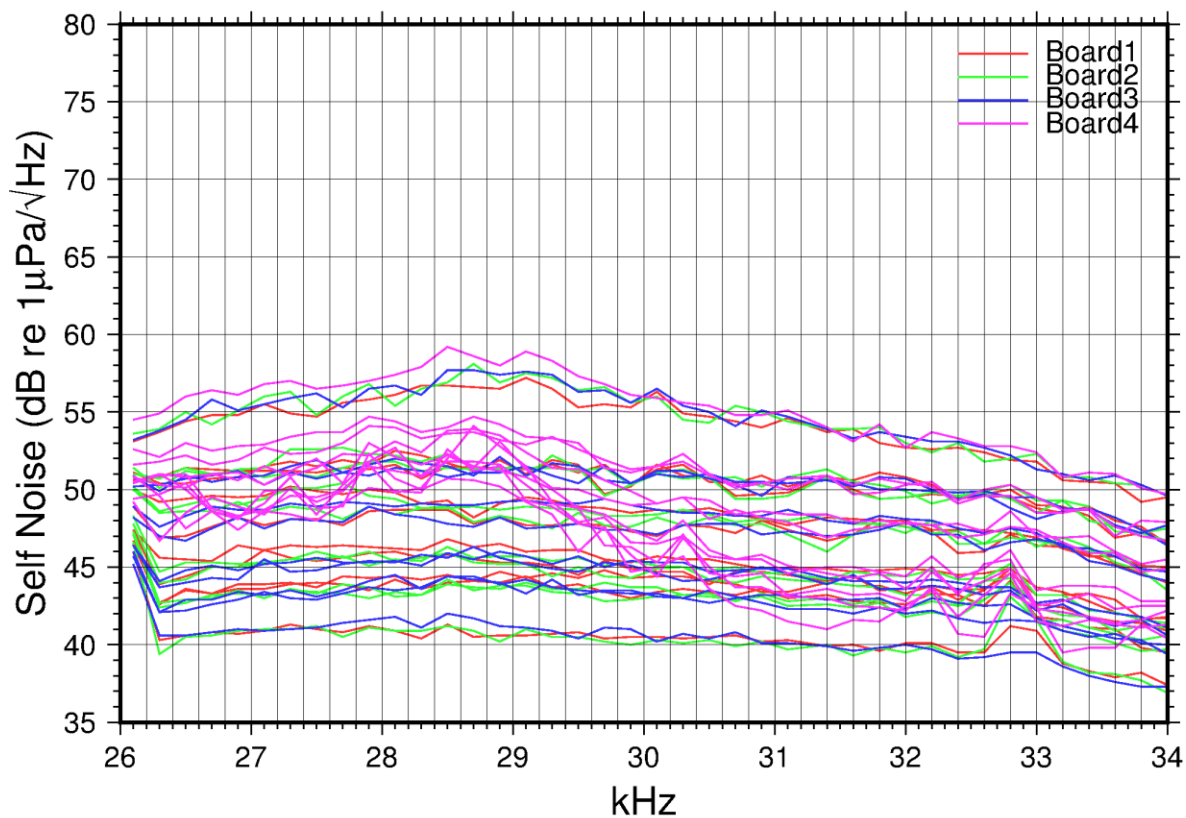
E/V Nautilus EM302 Self Noise - 180 deg



E/V Nautilus EM302 Self Noise - 180 deg

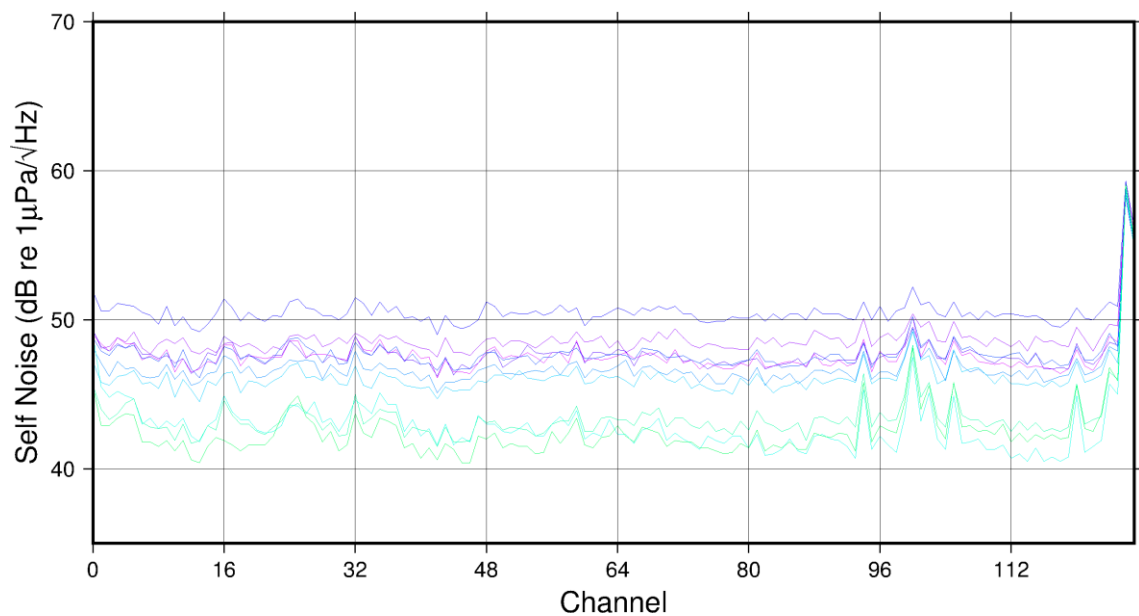


E/V Nautilus EM302 RX Noise Spectrum - 180 Degrees

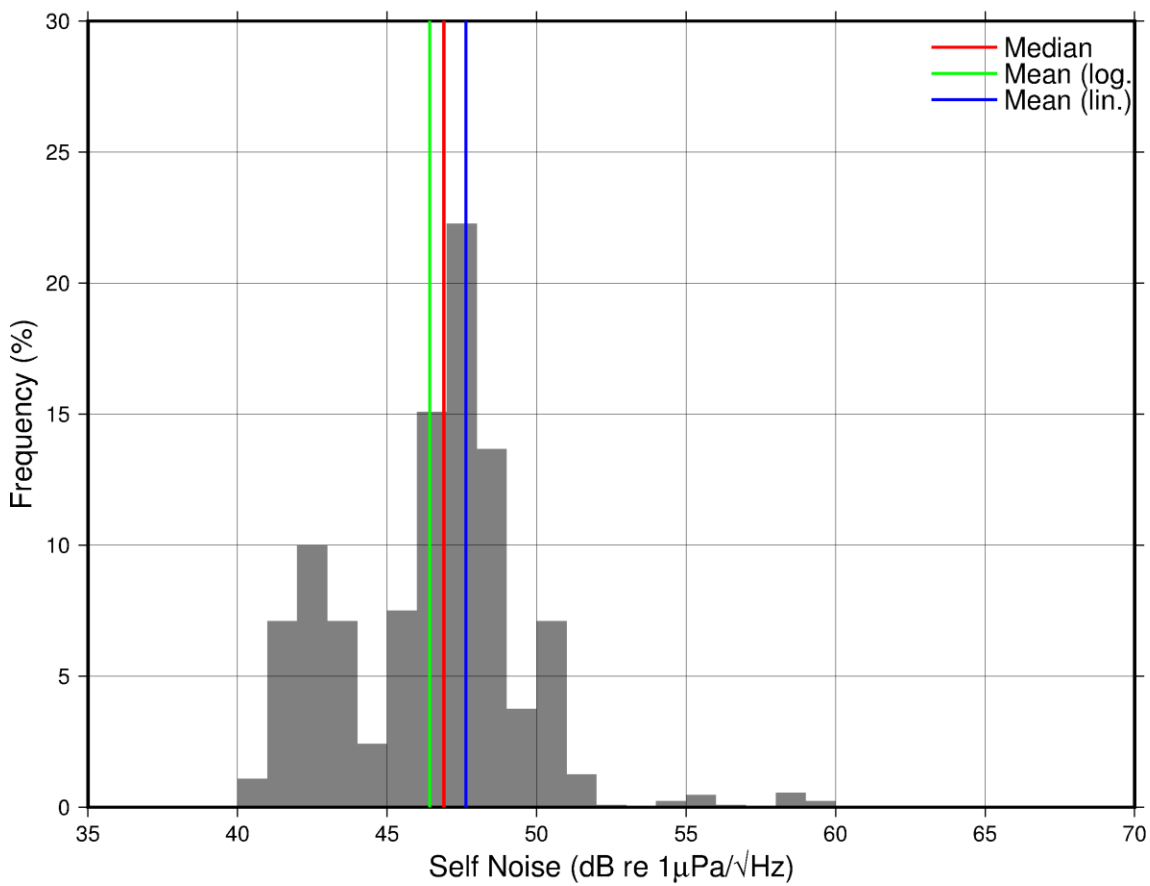


Self Noise Results - Swell - 225°

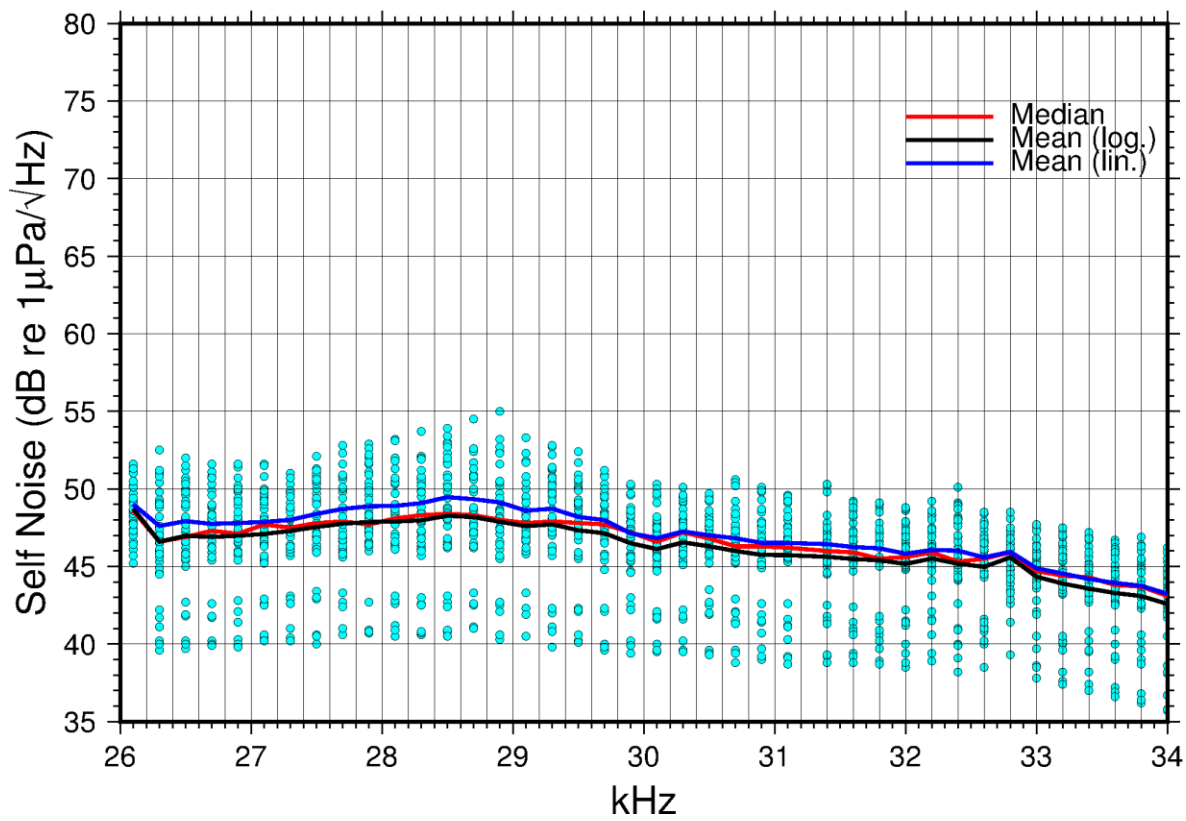
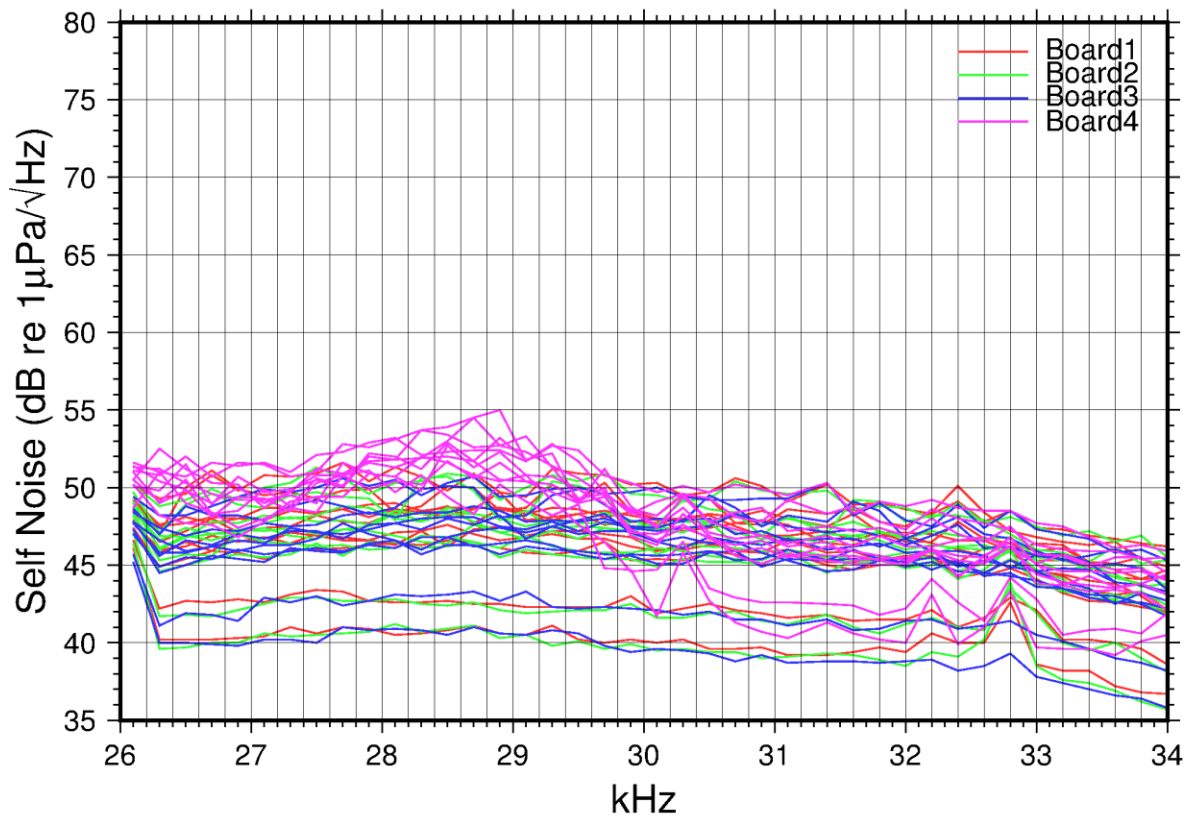
E/V Nautilus EM302 Self Noise - 225 deg



E/V Nautilus EM302 Self Noise - 225 deg

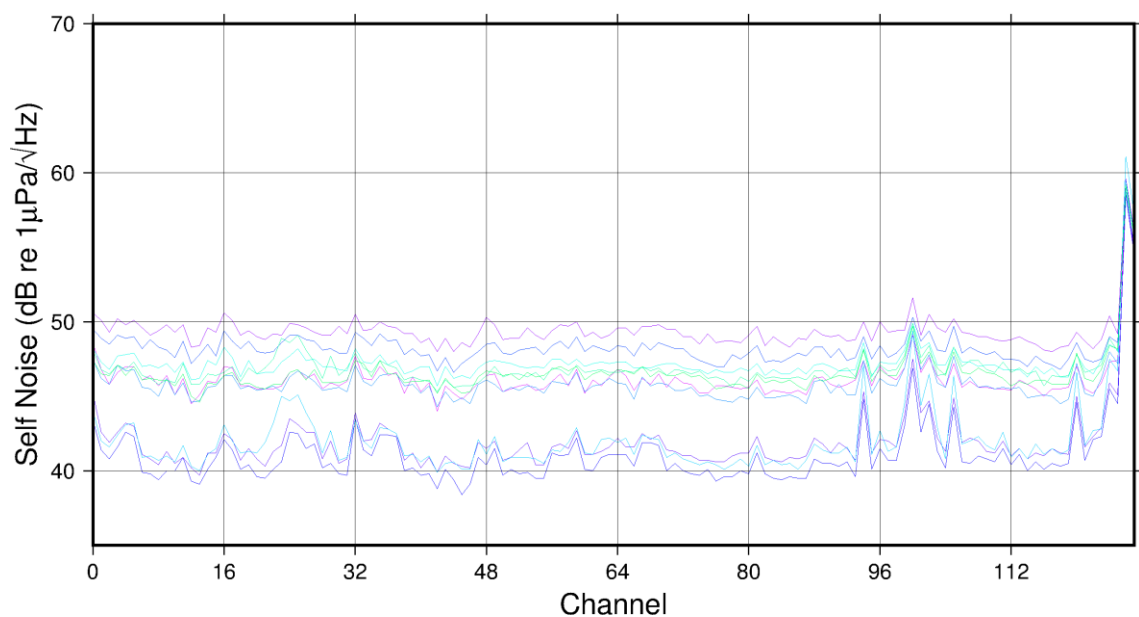


E/V Nautilus EM302 RX Noise Spectrum - 225 Degrees

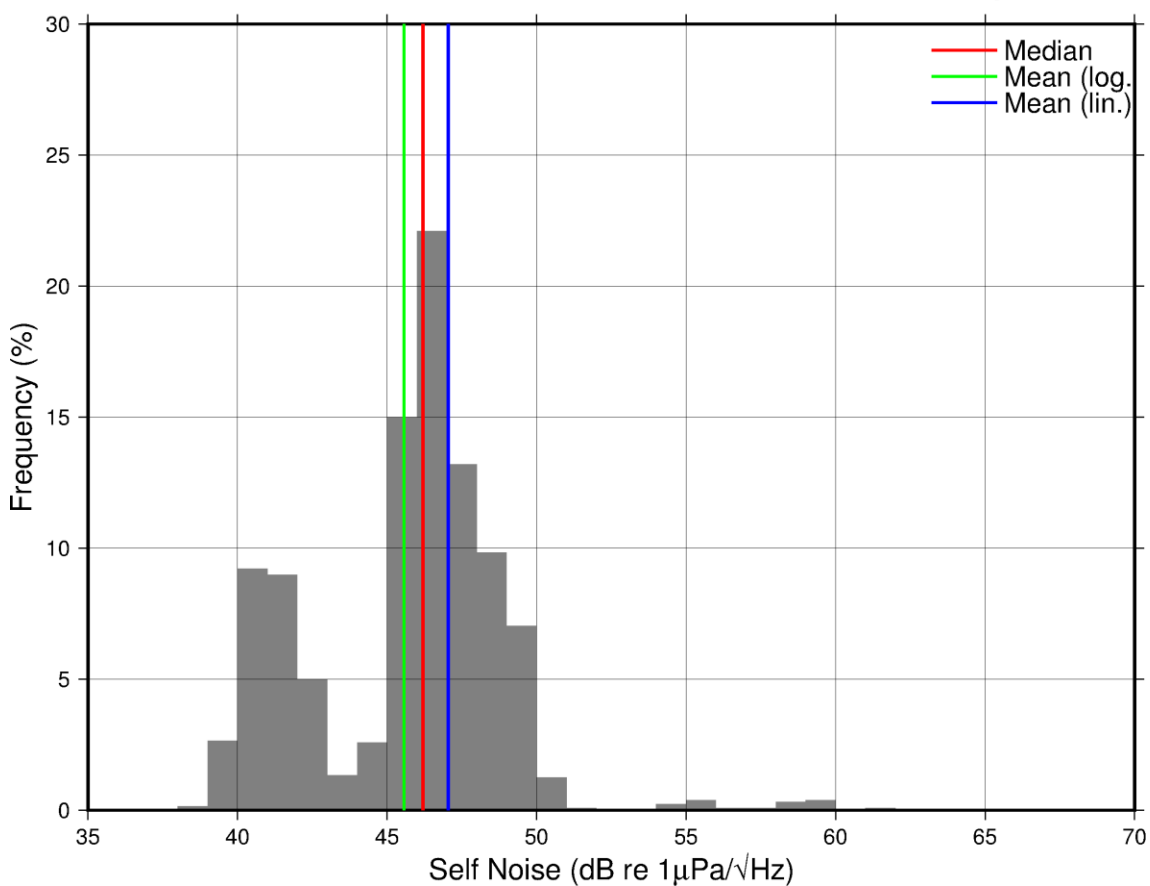


Self Noise Results - Swell - 270°

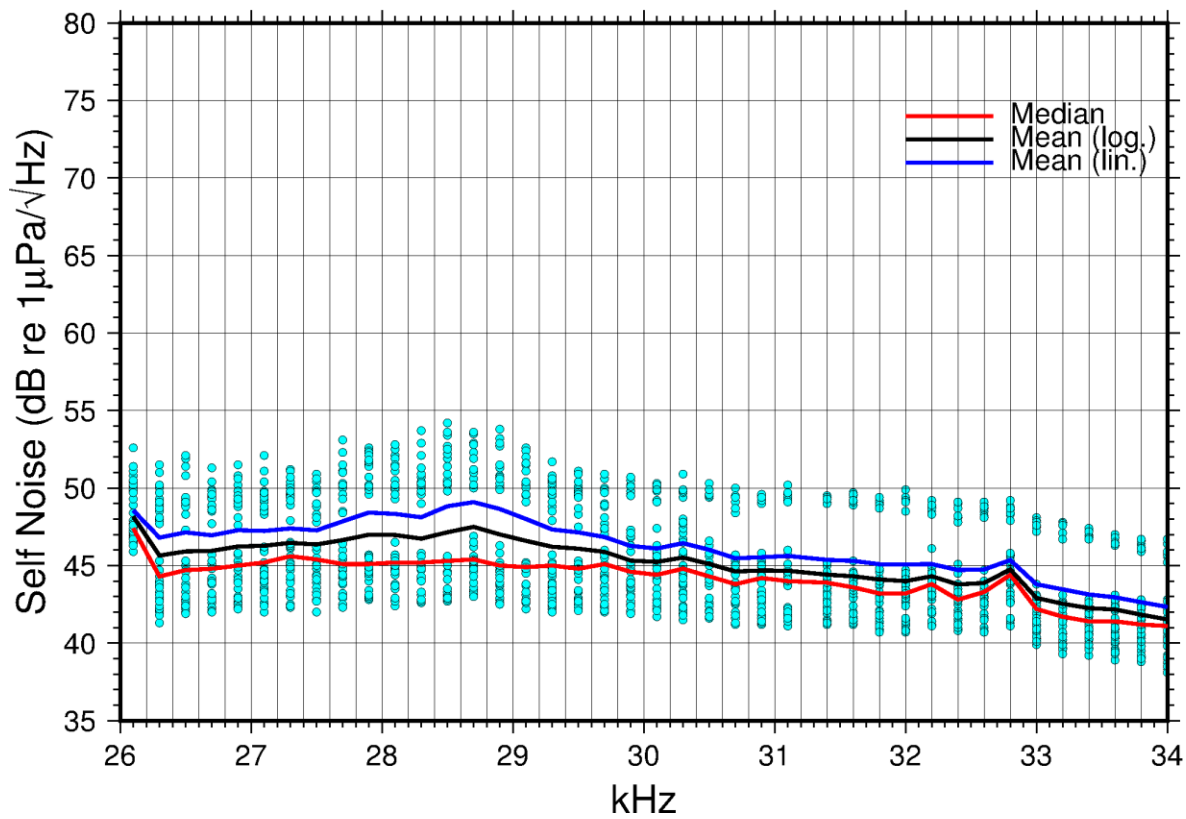
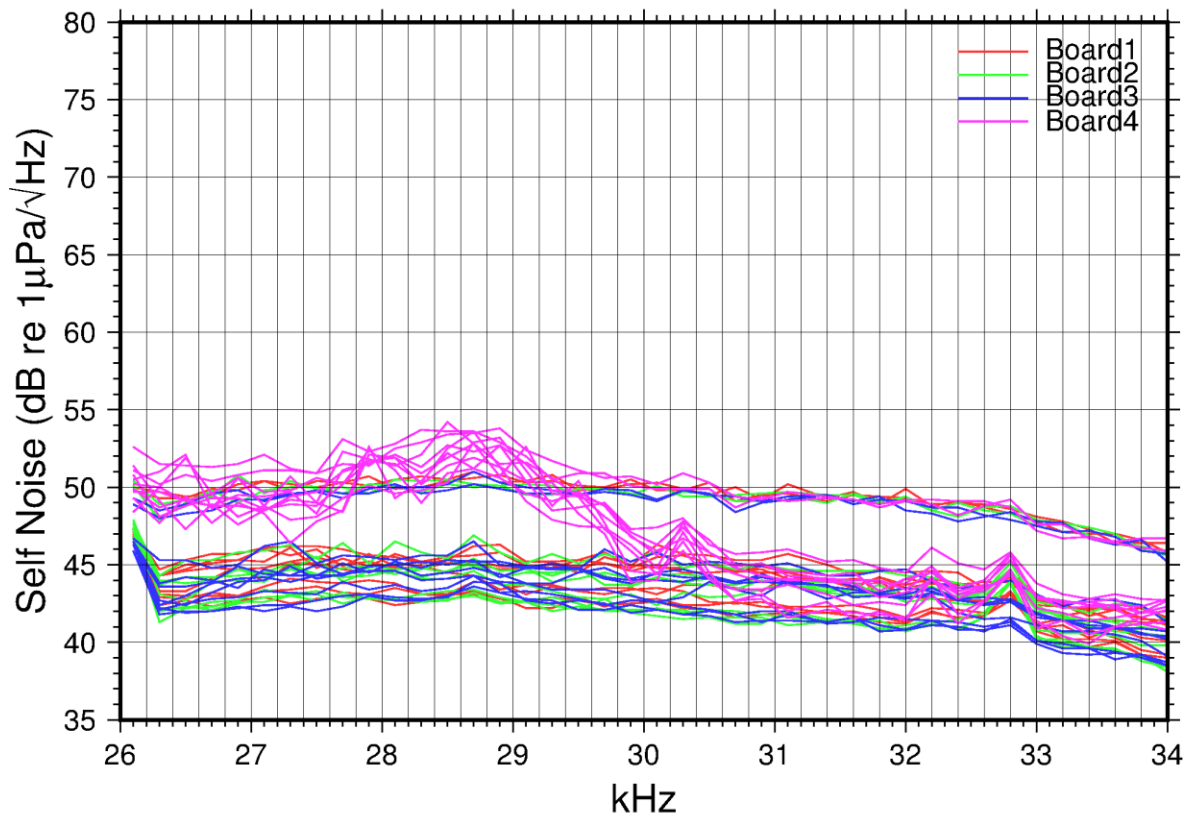
E/V Nautilus EM302 Self Noise - 270 deg



E/V Nautilus EM302 Self Noise - 270 deg

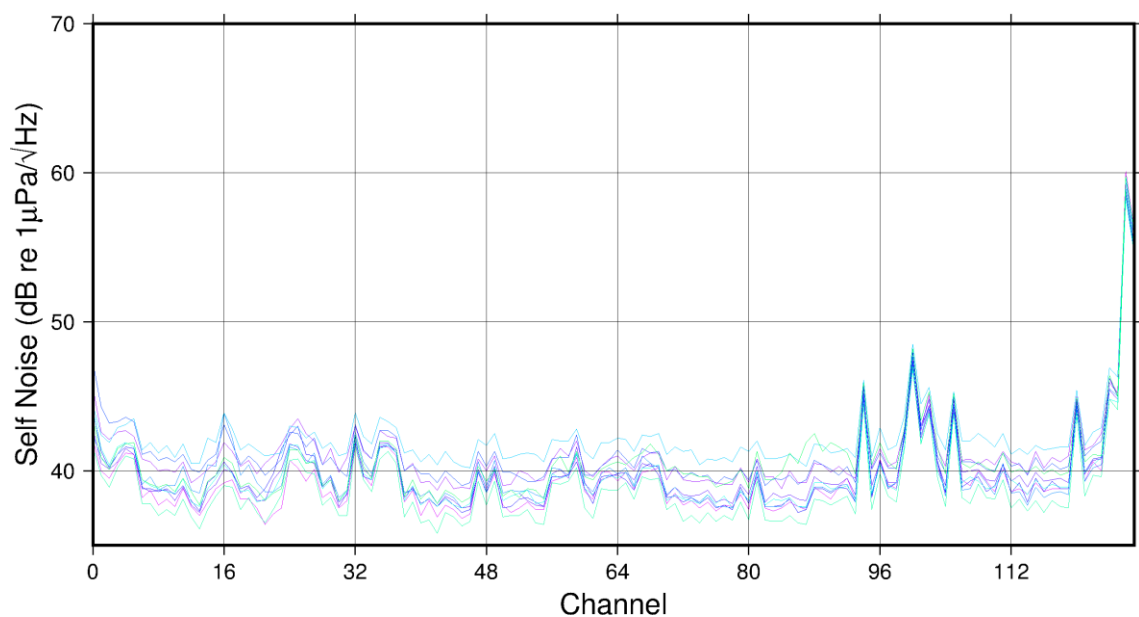


E/V Nautilus EM302 RX Noise Spectrum - 270 Degrees

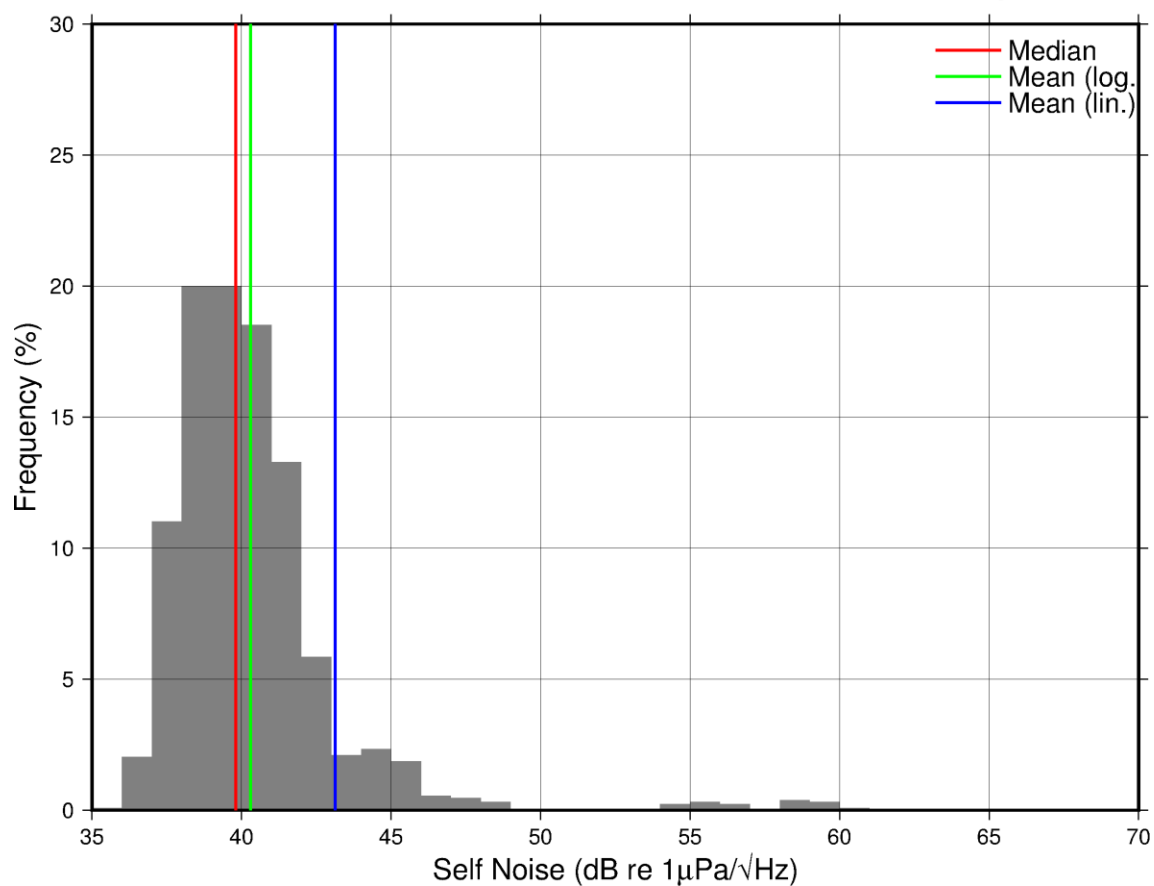


Self Noise Results - Swell - 315°

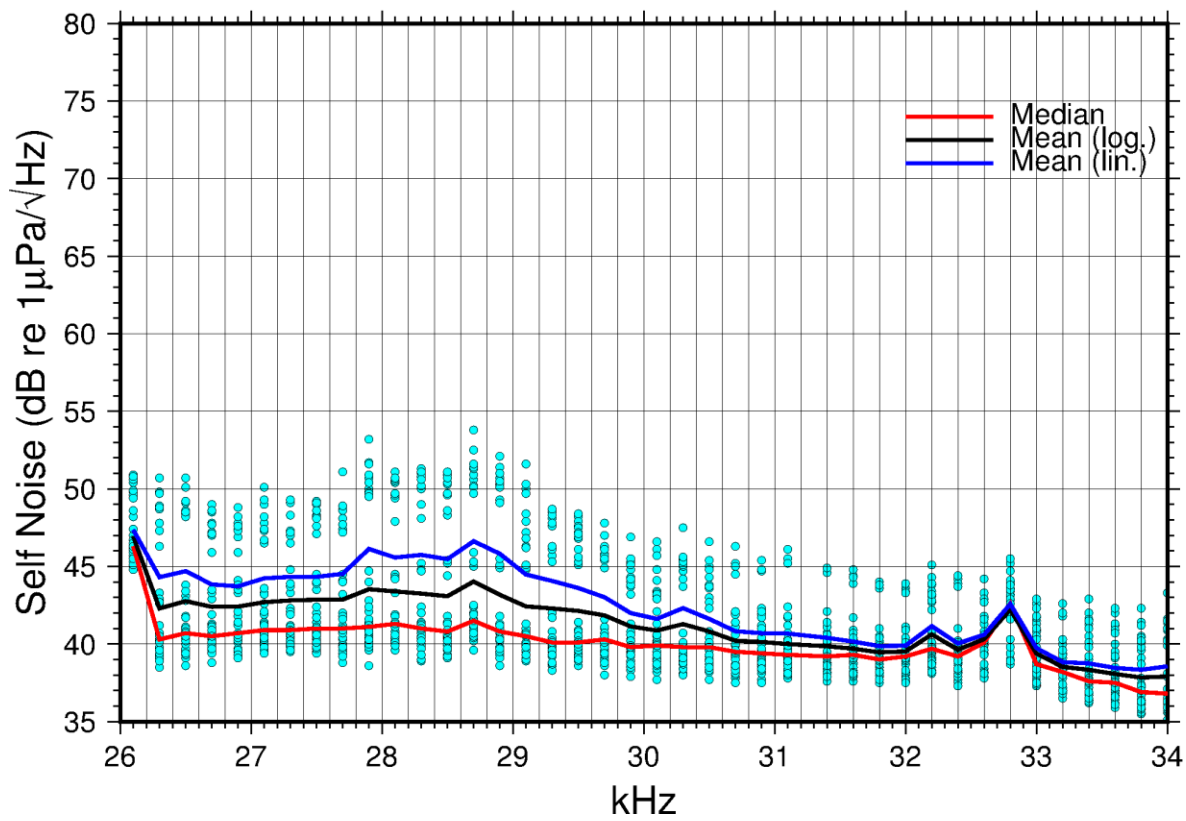
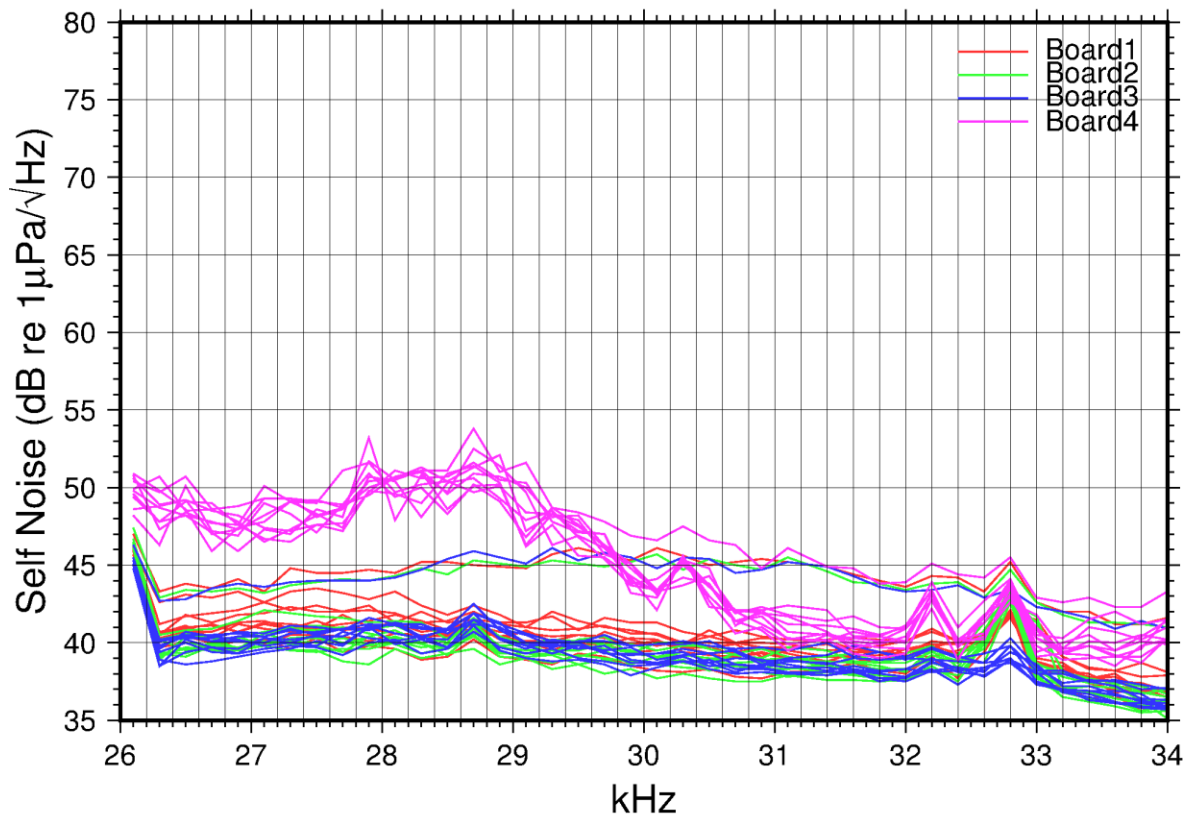
E/V Nautilus EM302 Self Noise - 315 deg



E/V Nautilus EM302 Self Noise - 315 deg

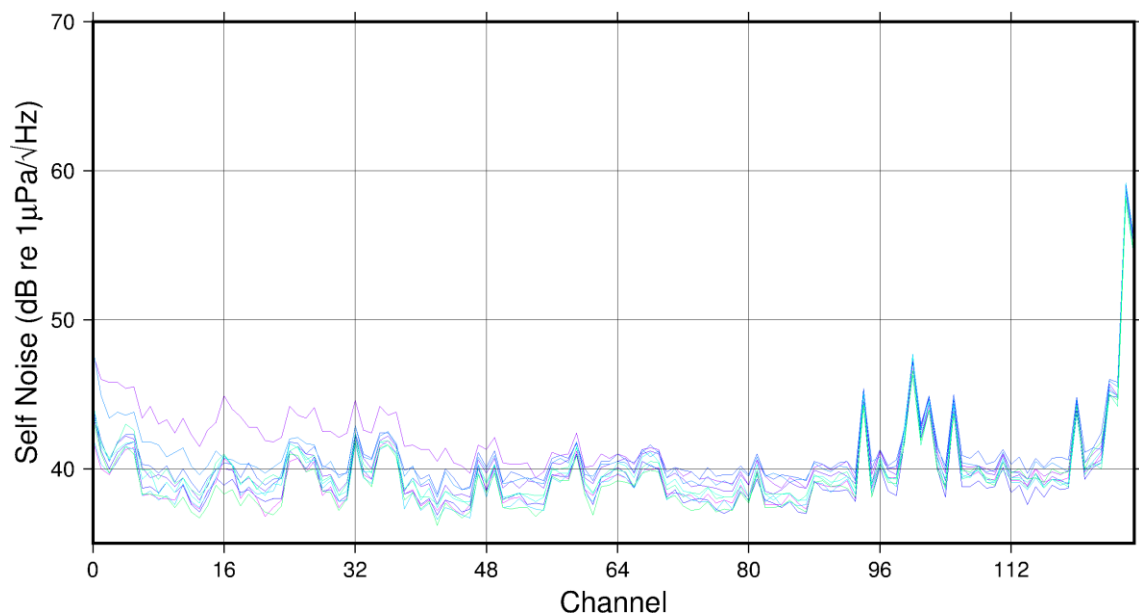


E/V Nautilus EM302 RX Noise Spectrum - 315 Degrees

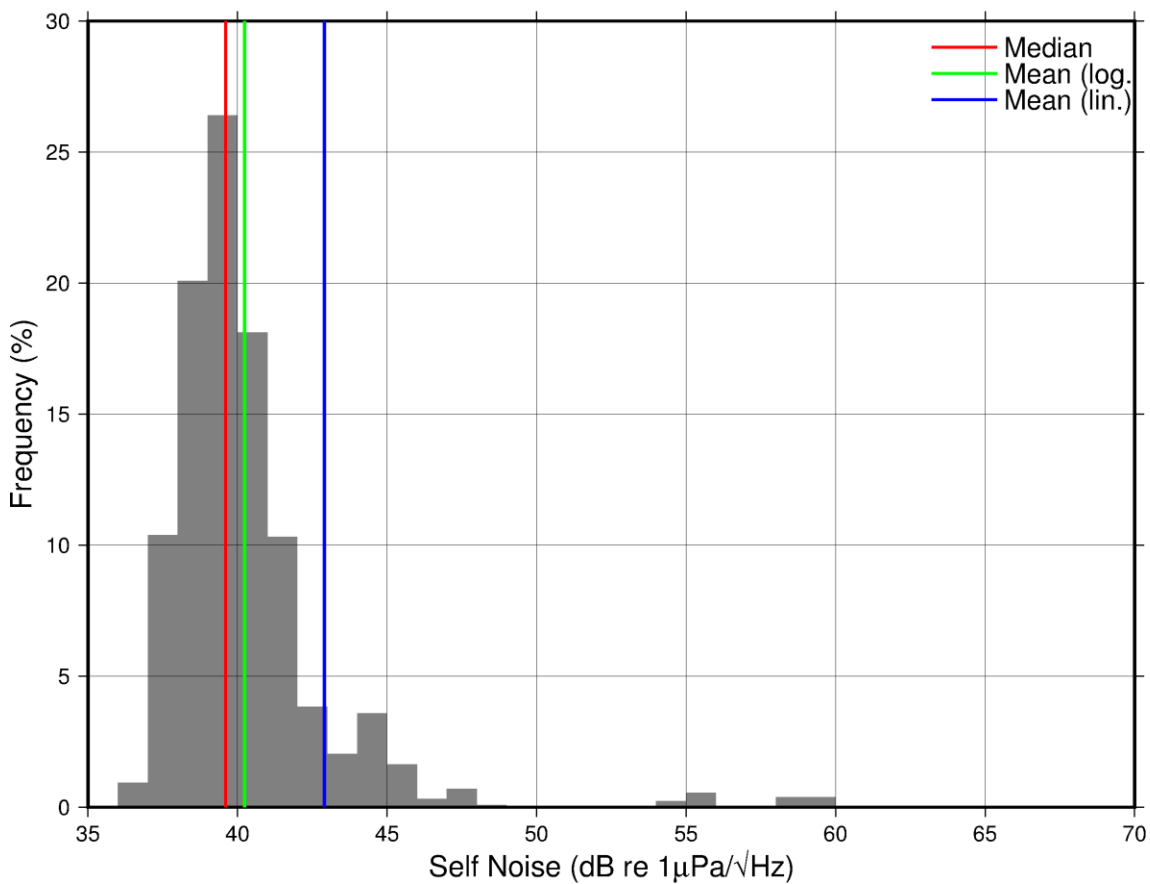


Self Noise Results – Swell – 360° (With Swell)

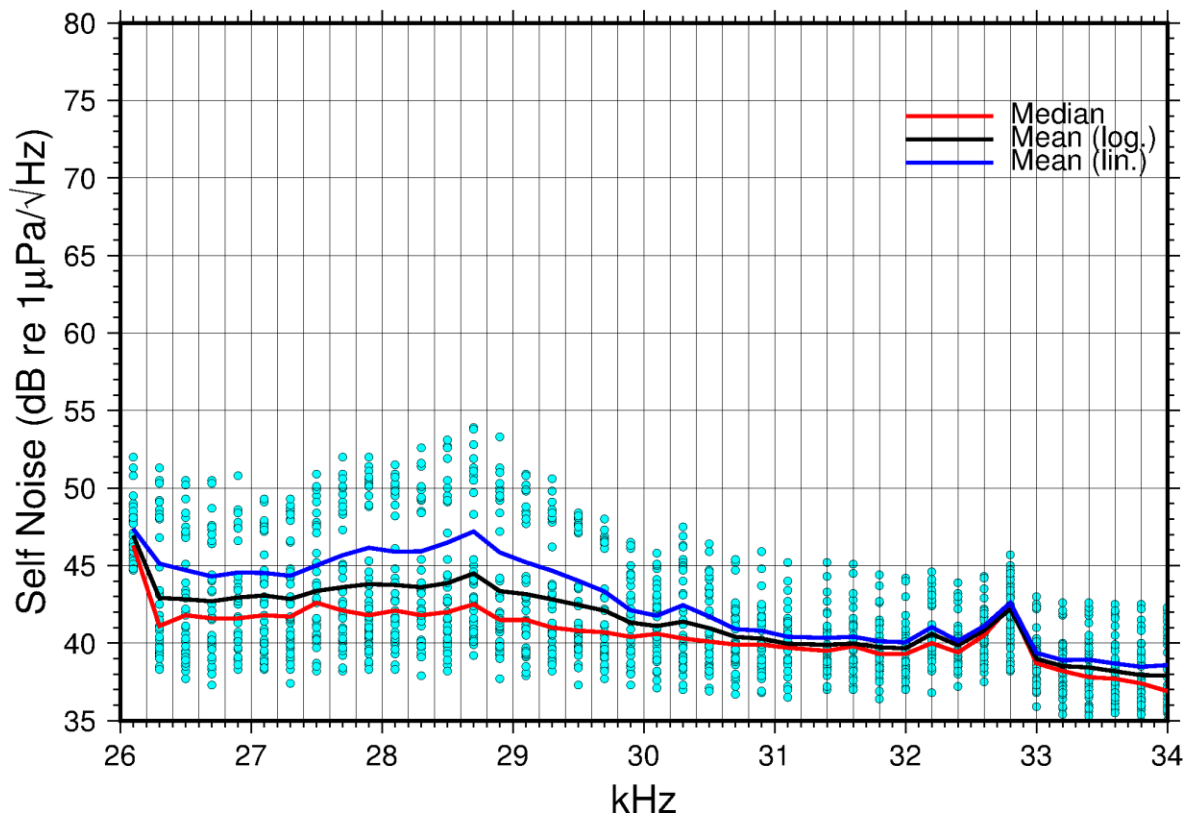
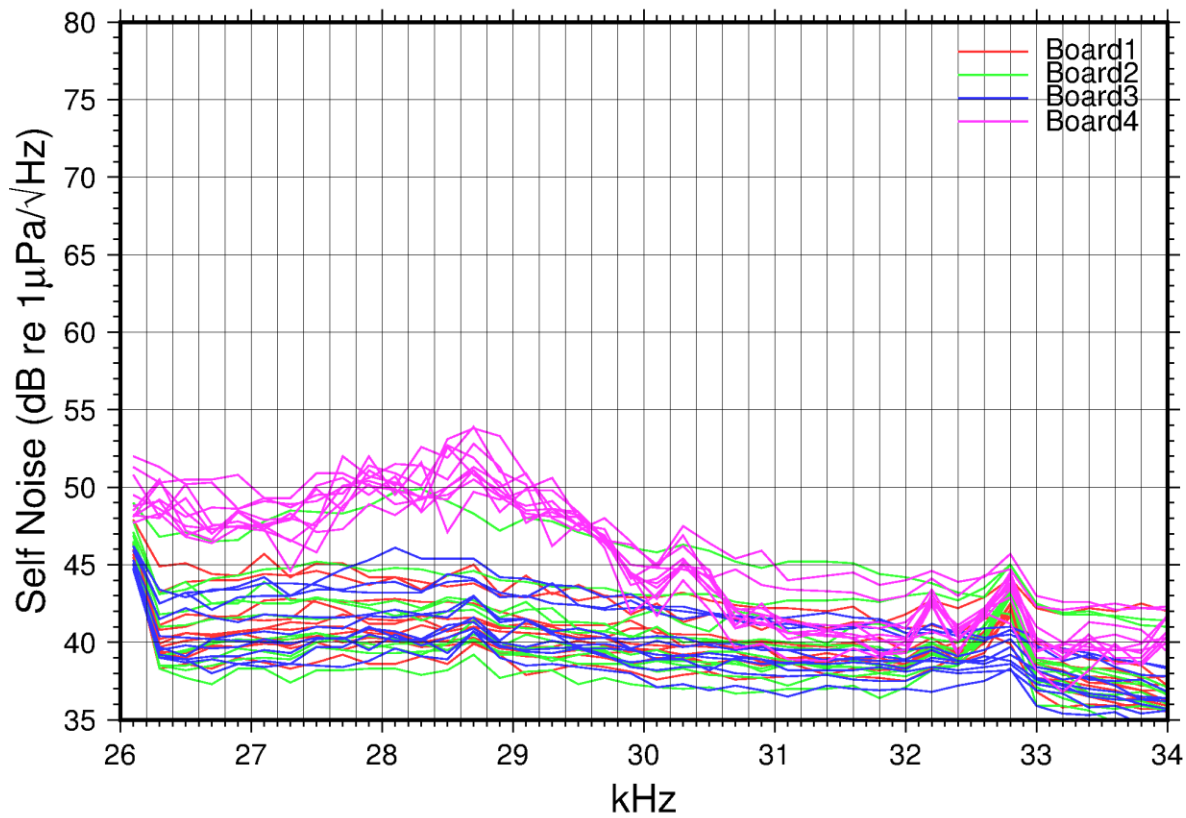
E/V Nautilus EM302 Self Noise - 360 deg



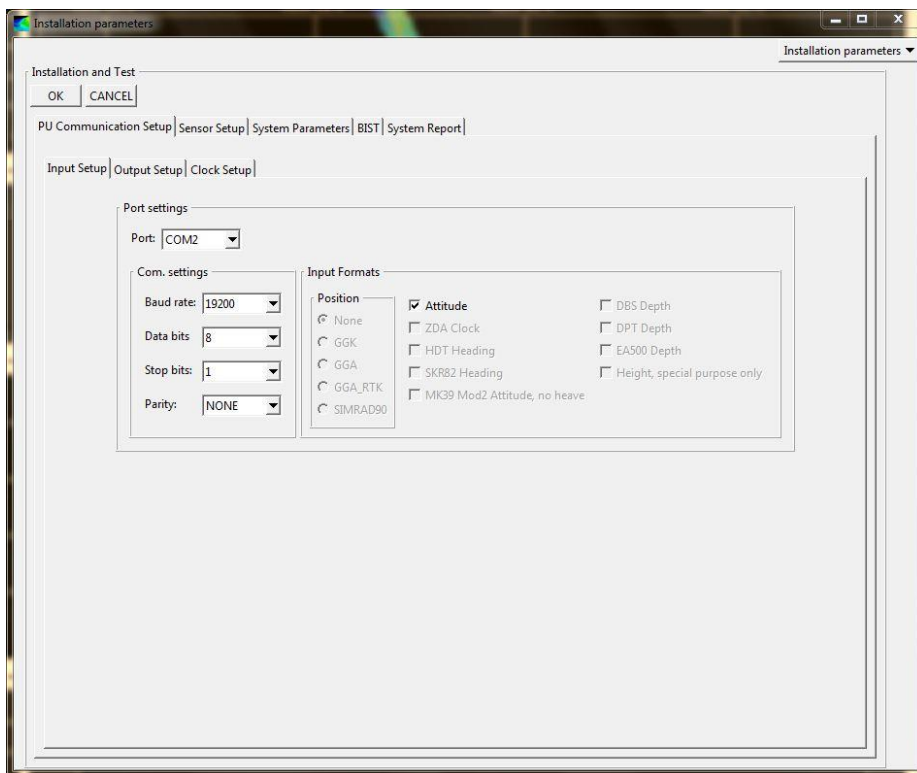
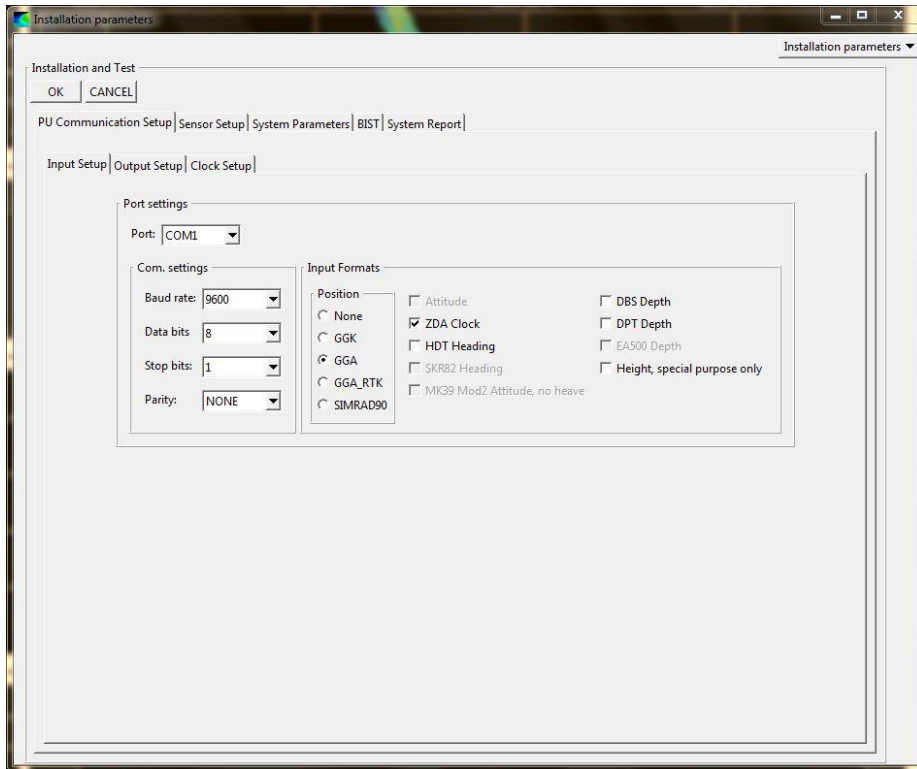
E/V Nautilus EM302 Self Noise - 360 deg

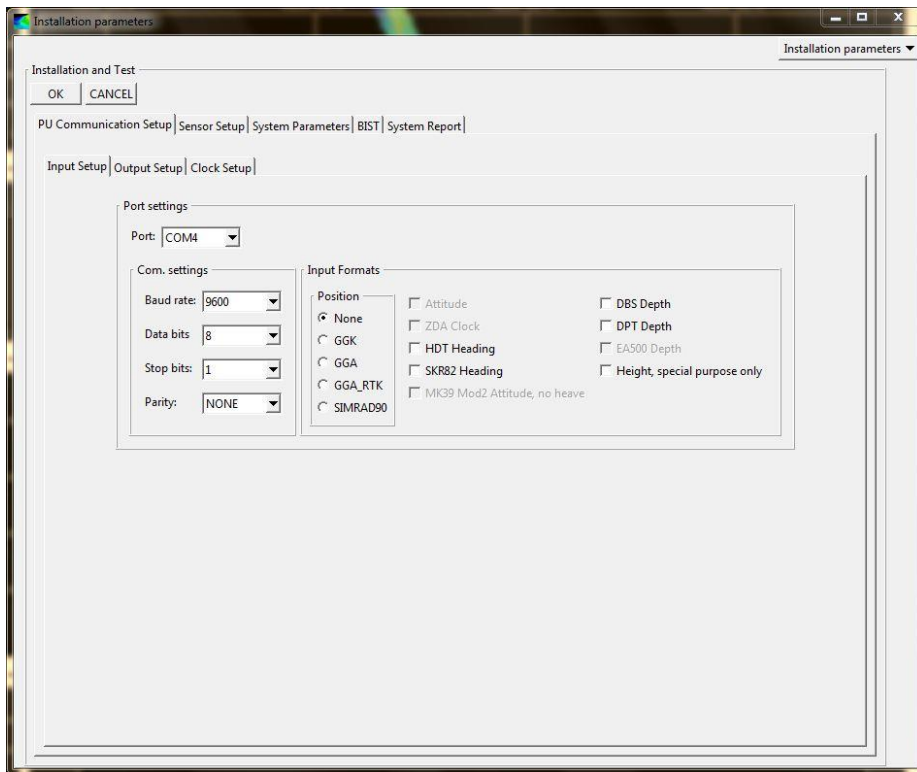
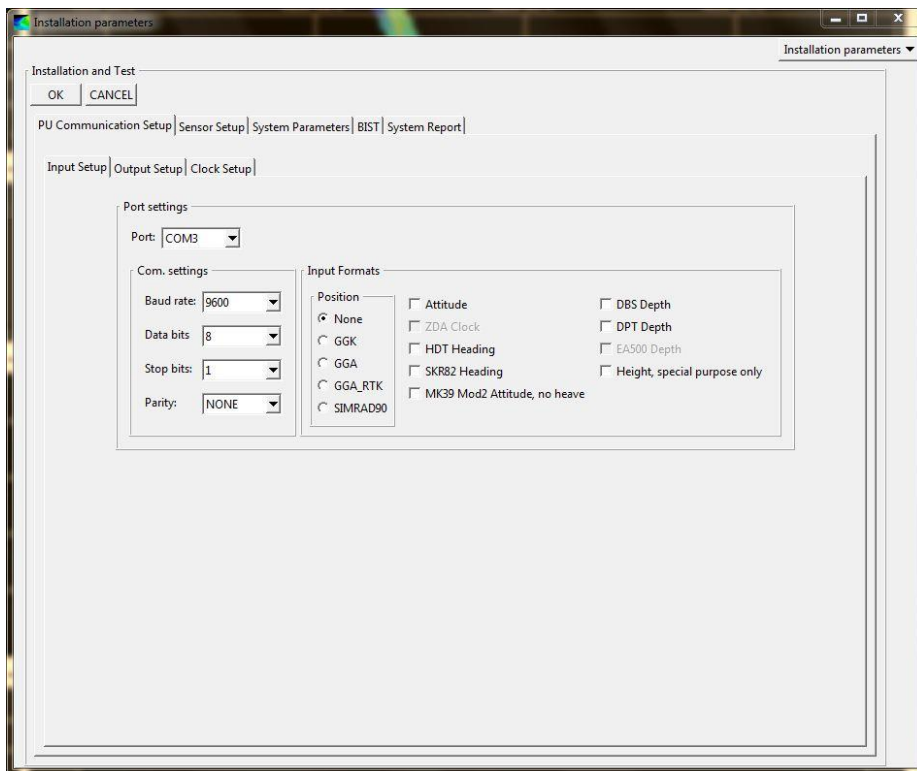


E/V Nautilus EM302 RX Noise Spectrum - 360 Degrees



SIS Screenshots – Installation Parameters (15 April 2016)





Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

Port settings

Port: UDP2

Com. settings

Baud rate: Data bits: Stop bits: Parity:

Input Formats

Position

☒ None ☐ Attitude ☐ DBS Depth

☐ GGK ☐ ZDA Clock ☐ DPT Depth

☐ GGA ☐ HDT Heading ☐ EAS00 Depth

☐ GGA_RTK ☐ SKR82 Heading ☐ Height, special purpose only

☐ SIMRAD90 ☐ MK39 Mod2 Attitude, no heave

Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

Port settings

Port: UDP5

Com. settings

Baud rate: Data bits: Stop bits: Parity:

Input Formats

Position

☒ None ☐ Attitude ☐ DBS Depth

☐ GGK ☐ ZDA Clock ☐ DPT Depth

☐ GGA ☐ HDT Heading ☐ EAS00 Depth

☐ GGA_RTK ☐ SKR82 Heading ☐ Height, special purpose only

☐ SIMRAD90 ☐ MK39 Mod2 Attitude, no heave

☒ Attitude/Velocity

Ethernet Interface Settings

UDP Port settings

UDP5: 3001 Use Ethernet 2 ☒

UDP6: 3000 Use Ethernet 2 ☐

Ethernet 2 settings

IP addr: 192.168.1.1

Net mask: 255.255.0.0

Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

Port settings

Port: UDP6

Com. settings

Baud rate: Data bits: Stop bits: Parity:

Input Formats

Position

None GGK GGA GGA_RTK SIMRAD90

Attitude ZDA Clock HDT Heading SKR82 Heading MK39 Mod2 Attitude, no heave Attitude/Velocity

DBS Depth DPT Depth EA500 Depth Height, special purpose only

Ethernet Interface Settings

UDP Port settings

UDP5: 3001 Use Ethernet 2 UDP6: 3000 Use Ethernet 2

Ethernet 2 settings

IP addr: 192.168.1.1 Net mask: 255.255.0.0

Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

UDP Host Port: SIS Logging

Port addr: 16101

Log watercolumn to separate file

PU broadcast enable (on port 1999)

Datagram subscription

Depth Raw range and beam angle Seabed Image Central Beams Position Attitude Heading Height Clock Single beam echosounder depth

Sound Speed Profile Runtime Parameters Installation Parameters BIST Reply Status parameters PU Broadcast Detection quality Internal, Scope Data

Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

UDP Host Port: User Defined

Port addr: 16103

☒ Log watercolumn to separate file

☒ PU broadcast enable (on port 1999)

Datagram subscription

<input checked="" type="checkbox"/> Depth	<input checked="" type="checkbox"/> Sound Speed Profile
<input type="checkbox"/> Raw range and beam angle	<input type="checkbox"/> Runtime Parameters
<input type="checkbox"/> Seabed Image	<input type="checkbox"/> Installation Parameters
<input type="checkbox"/> Central Beams	<input type="checkbox"/> BIST Reply
<input checked="" type="checkbox"/> Position	<input type="checkbox"/> Status parameters
<input type="checkbox"/> Attitude	<input type="checkbox"/> PU Broadcast
<input type="checkbox"/> Heading	<input type="checkbox"/> Detection quality
<input type="checkbox"/> Height	<input type="checkbox"/> Internal, Scope Data
<input type="checkbox"/> Clock	
<input type="checkbox"/> Single beam echosounder depth	

Installation parameters

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Input Setup | Output Setup | Clock Setup

UDP Host Port: Watercolumn

Port addr: 0

☒ Log watercolumn to separate file

☒ PU broadcast enable (on port 1999)

Datagram subscription

<input type="checkbox"/> Depth	<input type="checkbox"/> Sound Speed Profile
<input type="checkbox"/> Raw range and beam angle	<input type="checkbox"/> Runtime Parameters
<input type="checkbox"/> Seabed Image	<input type="checkbox"/> Installation Parameters
<input type="checkbox"/> Central Beams	<input type="checkbox"/> BIST Reply
<input type="checkbox"/> Position	<input type="checkbox"/> Status parameters
<input type="checkbox"/> Attitude	<input type="checkbox"/> PU Broadcast
<input type="checkbox"/> Heading	<input type="checkbox"/> Detection quality
<input type="checkbox"/> Height	<input type="checkbox"/> Internal, Scope Data
<input type="checkbox"/> Clock	
<input type="checkbox"/> Single beam echosounder depth	

Installation parameters

Installation and Test

OK

CANCEL

PU Communication Setup

Sensor Setup

System Parameters

BIST

System Report

Input Setup

Output Setup

Clock Setup

Clock

Source:

External ZDA Clock

Offset (sec.):

0

1PPS Clock Synch:

Rising Edge

Installation parameters

Installation and Test

OK

CANCEL

PU Communication Setup

Sensor Setup

System Parameters

BIST

System Report

Settings

Locations

Angular Offsets

Positioning System Settings

Positioning System Ports:

COM1

Time to use

☐ Datagram
 ☒ System

☐ Enable position motion correction

Position delay (sec.):

0.000

Datum:

WGS84

Log all heights

Enable

☐

Pos. qual. indicators for height acceptance

Attitude Sensor Settings

Attitude Sensor Ports:

COM2

Roll reference plane

☐ Horizontal (DMS)
 ☒ Rotation (POSMV/MRU)

Attitude Delay (msec):

0

Active Sensors

Position:

COM1

Attitude:

COM2

Heading:

COM2

Velocity:

UDP5

65

Installation parameters

Installation and Test

OK

CANCEL

PU Communication Setup

Sensor Setup

System Parameters

BIST

System Report

Settings

Locations

Angular Offsets

Location offset (m)

	Forward (X)	Starboard (Y)	Downward (Z)
Pos, COM1:	0.00	0.00	0.00
Pos, COM3:	0.00	0.00	0.00
Pos, COM4/UDP2:	0.00	0.00	0.00
TX Transducer:	3.496	-0.137	2.731
RX Transducer:	1.516	0.033	2.732
Attitude 1, COM2/UDP5:	0.00	0.00	0.00
Attitude 2, COM3/UDP6:	0.00	0.00	0.00
Waterline:			-1.77

Installation parameters

Installation and Test

OK

CANCEL

PU Communication Setup

Sensor Setup

System Parameters

BIST

System Report

Settings

Locations

Angular Offsets

Offset angles (deg.)

	Roll	Pitch	Heading
TX Transducer:	0.61	0.01	0.22
RX Transducer:	0.72	0.32	0.08
Attitude 1, COM2/UDP5:	0.16	-0.14	0.11
Attitude 2, COM3/UDP6:	0.00	0.00	0.00
Stand-alone Heading:			0.0

Installation parameters

Installation parameters ▾

Installation and Test

OK CANCEL

PU Communication Setup | Sensor Setup | System Parameters | BIST | System Report

Misc. parameters

Ship's noise level: NORMAL ▾

System Gain Offset

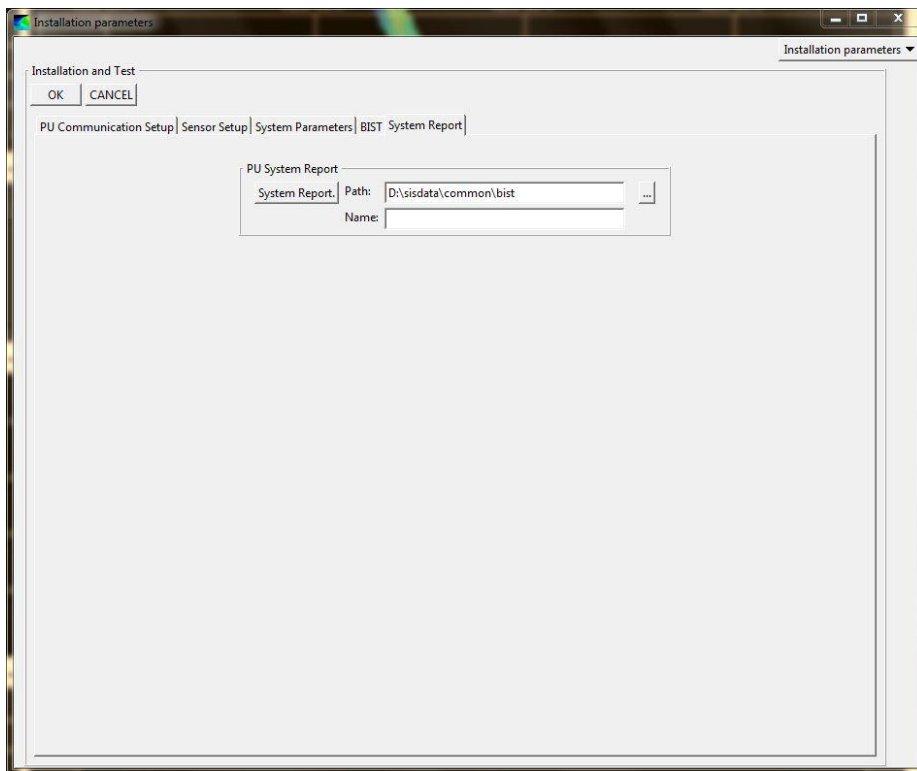
BS Offset (dB) 0.0

Opening angles

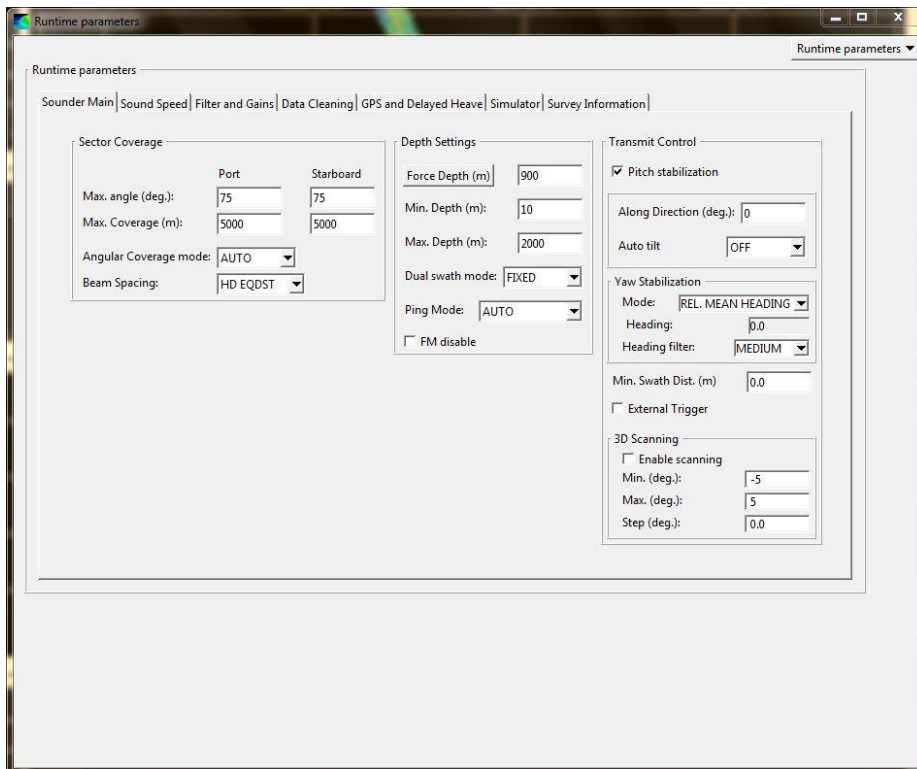
RX Opening angle: 1 ▾

TX Opening angle: 1 ▾

[illegible]



SIS Screenshots – Runtime Parameters



Runtime parameters

Sounder Main | Sound Speed | Filter and Gains | Data Cleaning | GPS and Delayed Heave | Simulator | Survey Information

Sound Speed Profile

Use Sound Speed Profile: 20160412_204515.asvp

Abs. coeff. files, salinity: f:\data\common\svp_abscoeff\20160412_204515_salinity_03500

Abs. coeff. files, CTD: D:\sisdata\common\svp_abscoeff\20160412_204515

Sound Speed at Transducer

Source: SENSOR

Sound Speed (m/sec.): 1537

Sensor Offset (m/sec.): 0.0

Filter (sec.): 20

Runtime parameters

Sounder Main | Sound Speed | Filter and Gains | Data Cleaning | GPS and Delayed Heave | Simulator | Survey Information

Filtering

Spike Filter Strength: MEDIUM

Range Gate: NORMAL

Phase ramp: NORMAL

Penetration Filter Strength: MEDIUM

☒ Slope

☐ Aeration

☐ Sector Tracking

☒ Interference

Backscatter Adjustment

Normal incidence corr. (deg.): 6

Beam Intensity:

☒ Use Lambert's law

Absorption Coefficient

Source: CTD profile

Salinity (parts per thousand): 35

31.5 kHz: 7.210

Mammal protection

TX power level (dB): Max.

Soft startup ramp time (min.): 0

Water Column

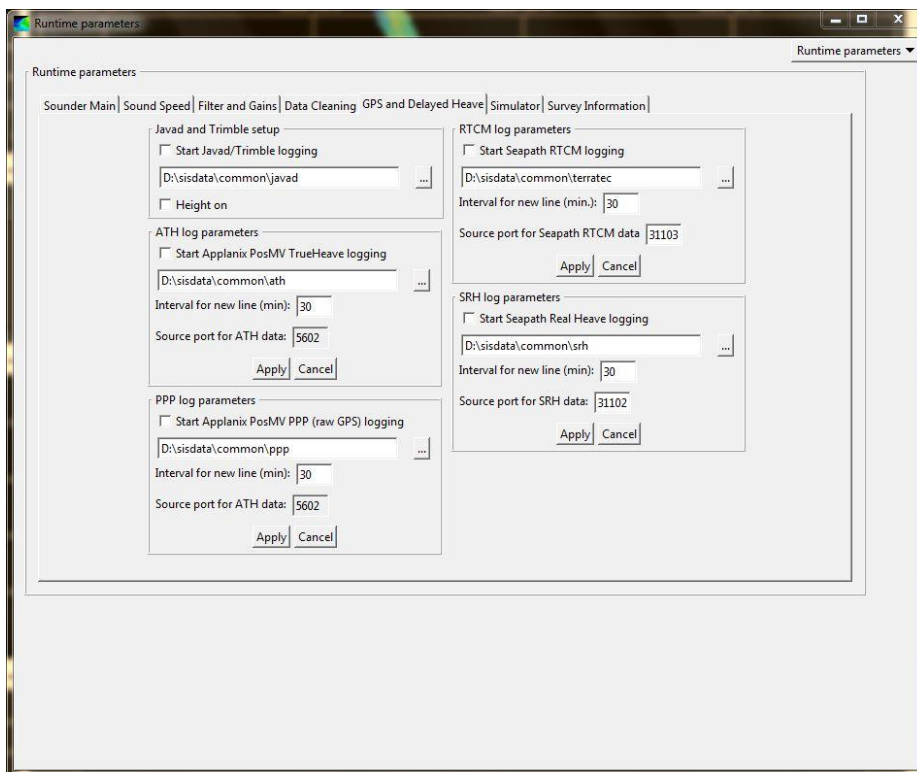
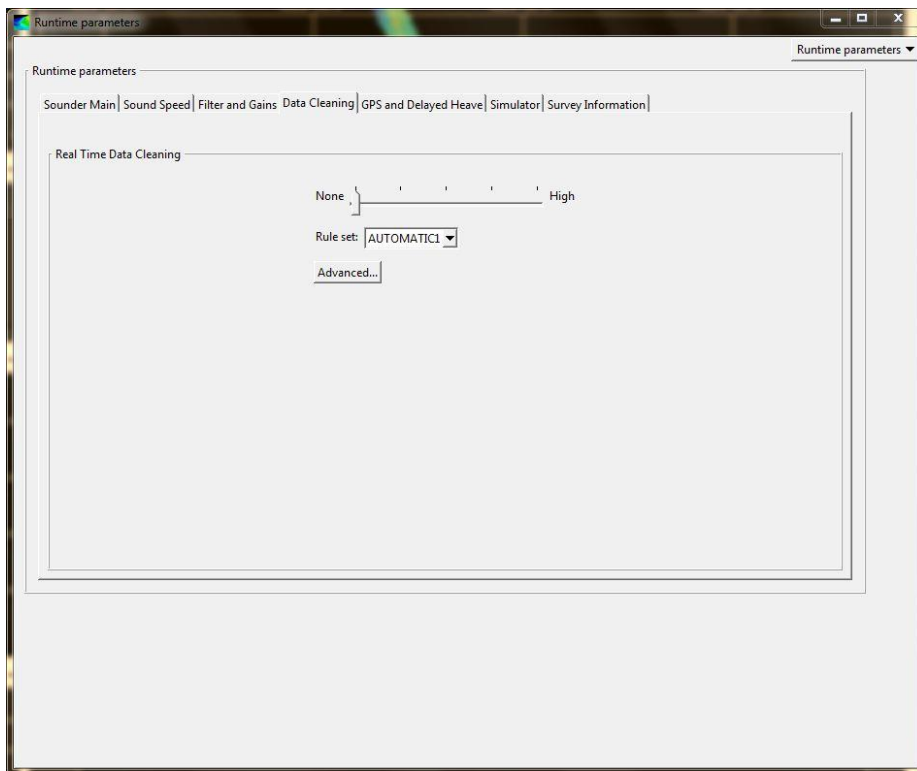
30 log R

30 dB Offset

Special Mode

☐ Sonar

☐ Passive



Runtime parameters

Runtime parameters

Sounder Main | Sound Speed | Filter and Gains | Data Cleaning | GPS and Delayed Heave | Simulator | Survey Information

Simulation setup

Simulator min. depth (m): 390

Simulator max. depth (m): 390

Enable Simulation ☐

Step along (%): 0

Slant across (deg.): 0

Parameters for Scope Display

Beam no.: 200 Swath no.: 0

Runtime parameters

Runtime parameters

Sounder Main | Sound Speed | Filter and Gains | Data Cleaning | GPS and Delayed Heave | Simulator | Survey Information

Survey Information

Time created: 2016-4-12 15:1:0

User: SIS user

Grid cell size [m]: 60.00

Number of cells in processing grid: 64

Projection: MERCATOR_WGS84

From template: Default

Survey Comment:

SIS Screenshots – PU Status

PU sensor status

PU Sensor input status

	COM1	COM2	COM3	COM4	UDP2	UDP5	UDP6
GGA	P						
GGK							
GGA_RTK							
GST							
SIMRAD90							
Attitude		HM					
MK39 Mod2 Attitude, no heave							
HDT Heading							
SKR82 Heading							
ROV. depth							
ZDA Clock							
Height, special purpose only							
DBS Depth							
DPT Depth							
EA500 Depth							
Attitude/Velocity						A	
1PPS Clock Synch.							

P = active Position sensor
M = active Motion/Attitude sensor
H = active Heading sensor
A = active Attitude/Velocity sensor

Reload

SIS Screenshots – Datagram Distribution

Request datagrams from EM

Echosounder

EM302_110

Datagram

Position (P)


Options

All

IP:Port

Subscribe

Unsubscribe



Please restart SIS for changes to take effect

	Datagram	IP:Port	Interval
►	Information	localhost:9004	All
	Information	localhost:4002	All
	Motion sensor	localhost:4002	All
	Clock	localhost:4002	All
	Depth	localhost:4002	All
	Installation	localhost:9004	All
	Position	localhost:16108	All
	Position	localhost:9004	All
	Position	localhost:9009	All
	Position	localhost:4002	All
	Position	HDPC:5052	All
	Runtime	localhost:4002	All
	XYZ88	localhost:4002	All
	Height	localhost:4002	All
	Watercolumn	localhost:16102	All
	Depth	10.1.70.16:51010	Every 10. second
	Sound speed profile	10.1.70.83:16103	All
	Position	10.1.70.83:16103	All
	XYZ88	10.1.70.83:16103	All
	Depth	10.1.70.16:51012	All
	Position	10.1.70.16:51011	All

Exit

Help

Transmitter Impedance BIST Instructions

In order to monitor transmitter array health on a more routine basis with minimal hassle, the following BIST steps can be followed to measure element impedance indirectly, through the transceiver. It is *not* necessary to run this test as frequently as the 'full BIST' routine (which is typically run at the start of every survey aboard E/V *Nautilus*), but running the TX channels impedance test below on an annual or semi-annual basis provides an important window into transmitter health over its service life.

Record TX impedance BIST results via telnet into the EM302 TRU [IP address 157.237.14.60 below] when not pinging:

1. Open a command prompt
2. Type 'telnet -f TX_BIST_[date and file name].txt 157.237.14.60' and hit ENTER
3. Type 'bist' and hit ENTER
4. Type '30' and hit ENTER
 - a. Wait for the TRU to run the BIST
5. Type '31' and hit ENTER
 - a. Wait for the TRU to run the BIST
6. Type '32' and hit ENTER
 - a. Wait for the TRU to run the BIST
7. Type '33' and hit ENTER
 - a. Wait for the TRU to run the BIST
8. Type '34' and hit ENTER
 - a. Wait for the TRU to run the BIST
9. Type '-1' and hit ENTER
10. Close the command prompt or type 'exit' and hit ENTER