U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Ocean Service

Data Acquisition & Processing Report

Type of Survey:	Navigable Area
Project Number:	S-J906-NRTST-23
Time Frame:	May - May 2023

LOCALITY

State(s):	Alabama
General Locality:	Mobile River, Alabama - Africatown Bridge to I65 Bridge

2023

CHIEF OF PARTY
Dan Jacobs

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NOAA Navigation Response Team - Stennis
Chief of Party: Dan Jacobs
Year: 2023
Version: 1.0
Publish Date: 2023-05-17

A. System Equipment and Software

A.1 Survey Vessels

A.1.1 S3008

<table>
<tr><td>Vessel Name</td><td colspan="2">S3008</td></tr>
<tr><td>Hull Number</td><td colspan="2">LALMF056B516</td></tr>
<tr><td>Description</td><td colspan="2">Lake Assault, all aluminum boat built in 2016.</td></tr>
<tr><td rowspan="3">Dimensions</td><td>LOA</td><td>10 meters</td></tr>
<tr><td>Beam</td><td>2.4 meters</td></tr>
<tr><td>Max Draft</td><td>0.5 meters</td></tr>
<tr><td rowspan="2">Most Recent Full Static Survey</td><td>Date</td><td>2021-04-30</td></tr>
<tr><td>Performed By</td><td>University of Southern Mississippi and Josh Bergeron. See full survey report in support files.</td></tr>
<tr><td rowspan="2">Most Recent Partial Offset Verification</td><td>Date</td><td>2023-04-27</td></tr>
<tr><td>Method</td><td>Steel tape verification measurements, annual patch test and annual side scan cofidence radius checks.</td></tr>
</table>

Figure 1: S3008

A.1.2 "Dorothy"

<table>
<tr><td>Vessel Name</td><td>"Dorothy"</td></tr>
<tr><td>Hull Number</td><td>S3005</td></tr>
<tr><td>Description</td><td>Lake Assault, all aluminum boat built in 2016.</td></tr>
<tr><td>Dimensions</td><td><table><tr><td>LOA</td><td>10</td></tr><tr><td>Beam</td><td>2.4</td></tr><tr><td>Max Draft</td><td>0.5</td></tr></table></td></tr>
</table>

Figure 2: S3005

A.2 Echo Sounding Equipment

A.2.1 Multibeam Echosounders

A.2.1.1 Kongsberg EM2040C

While operating in partial coverage, the EM2040C collects data concurrently with the Edge Tech 4125 without acoustic interference, commonly referred to as "skunk striping". NRT Stennis operates the EM2040C at a frequency of 300kHz for normal operations, as specified in the Bergson operator's manual. This configuration provides an ideal mix of resolution and range for surveying within NRT ST's operational area. The specifications below reflect this mode of operation.

<table>
<tr><td>Manufacturer</td><td colspan="3">Kongsberg</td></tr>
<tr><td>Model</td><td colspan="3">EM2040C</td></tr>
<tr><td rowspan="12">Inventory</td><td rowspan="6">S3008</td><td>Component</td><td>Sonar Head</td></tr>
<tr><td>Model Number</td><td>EM2040C</td></tr>
<tr><td>Serial Number</td><td>796</td></tr>
<tr><td>Frequency</td><td>200-400 kHz</td></tr>
<tr><td>Calibration</td><td>2023-04-27</td></tr>
<tr><td>Accuracy Check</td><td>2023-05-10</td></tr>
<tr><td rowspan="6">S3005</td><td>Component</td><td>Sonar Head</td></tr>
<tr><td>Model Number</td><td>EM2040C</td></tr>
<tr><td>Serial Number</td><td>1127</td></tr>
<tr><td>Frequency</td><td>330</td></tr>
<tr><td>Calibration</td><td>2021-05-24</td></tr>
<tr><td>Accuracy Check</td><td>2021-05-24</td></tr>
</table>

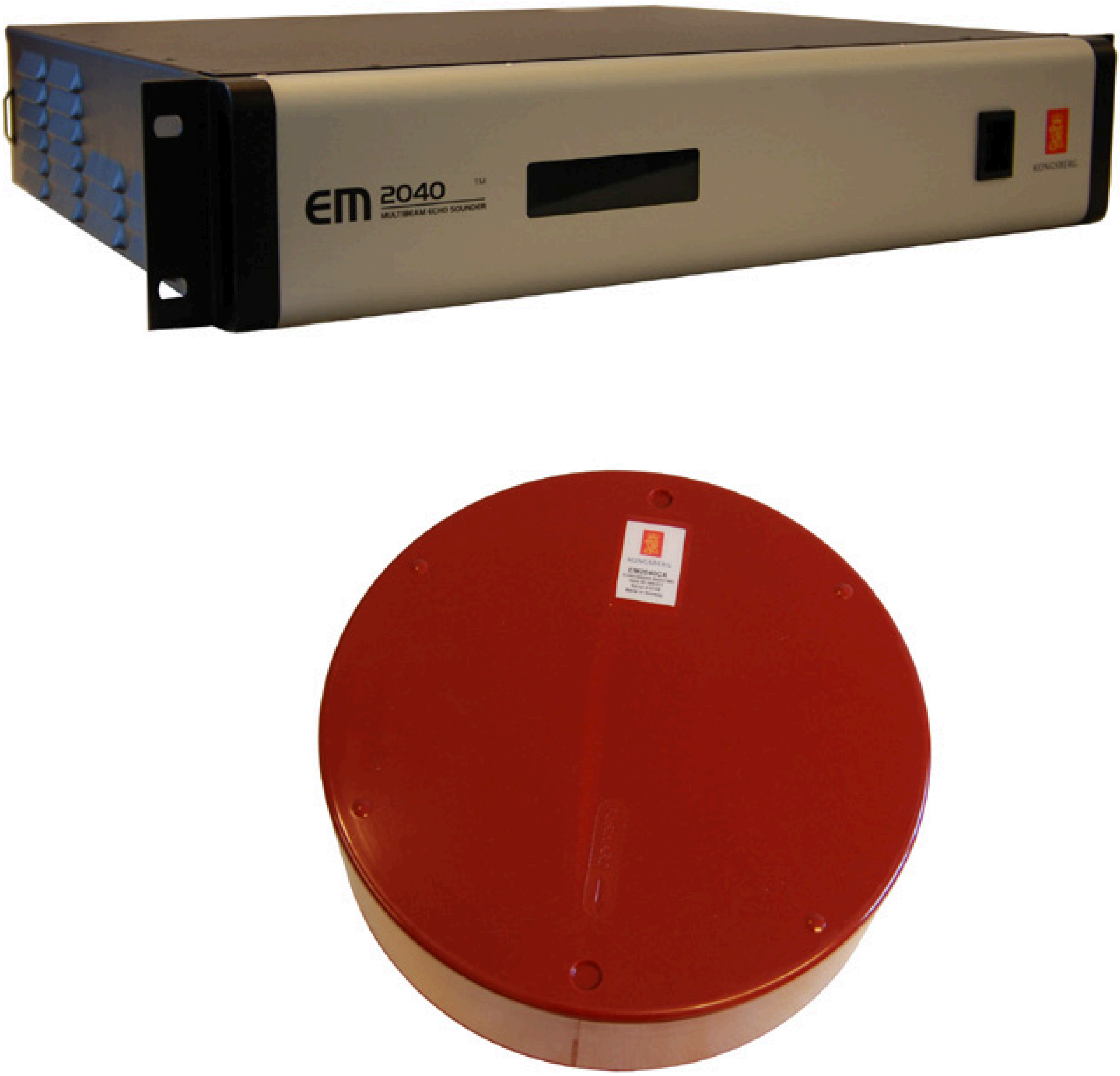

Figure 3: Kongsberg EM2040C

A.2.2 Single Beam Echosounders

No single beam echosounders were utilized for data acquisition.

A.2.3 Side Scan Sonars

A.2.3.1 Edgetech 4125

The Edgetech 4125 system includes a stainless steel towfish, topside processor unit (TPU) and 30 meters of Kevlar tow cable. The towfish's dimensions are 9.5cm in diameter, 97cm in length with an overall weight of 15kg (34 pounds). It has two frequency ranges, 400 and 900 kHz, and is capable of logging data in both frequencies simultaneously. Frequencies are transmitted as linearly-swept, wide-band, high energy acoustic pulses, and the received echoes are processed into high signal-to-noise (SNR) images that can be directly displayed as shades of gray color on a computer monitor. Operating ranges are 150 m at 400 kHz and 75 m at 900 kHz. Horizontal beam widths are 0.46° at 400 kHz and 0.28° at 900 kHz. The vertical beam width is 50°. Across-track resolution is 2.3 cm at 400 kHz and 1.0 cm at 900 kHz. The towfish is pole mounted on a USM pole mount system that connects to a welded plate on the port side of the vessel. The pole mount system allows of easier, and safer, sidescan data collection in shallow areas or channels with high traffic. Data are collected while the vessel travels at, or near, 4kHz. Sidescan data are logged using the Hypack HSX file format.

<table>
<tr><td>Manufacturer</td><td colspan="3">Edgetech</td></tr>
<tr><td>Model</td><td colspan="3">4125</td></tr>
<tr><td rowspan="6">Inventory</td><td rowspan="6">S3008</td><td>Component</td><td>Towfish</td></tr>
<tr><td>Model Number</td><td>4125</td></tr>
<tr><td>Serial Number</td><td>40425</td></tr>
<tr><td>Frequency</td><td>400/900kHz</td></tr>
<tr><td>Calibration</td><td>2023-04-18</td></tr>
<tr><td>Accuracy Check</td><td>2023-05-10</td></tr>
</table>

Figure 4: Edgetech 4125

A.2.4 Phase Measuring Bathymetric Sonars

No phase measuring bathymetric sonars were utilized for data acquisition.

A.2.5 Other Echosounders

No additional echosounders were utilized for data acquisition.

A.3 Manual Sounding Equipment

A.3.1 Diver Depth Gauges

No diver depth gauges were utilized for data acquisition.

A.3.2 Lead Lines

No lead lines were utilized for data acquisition.

A.3.3 Sounding Poles

No sounding poles were utilized for data acquisition.

A.3.4 Other Manual Sounding Equipment

No additional manual sounding equipment was utilized for data acquisition.

A.4 Horizontal and Vertical Control Equipment

A.4.1 Base Station Equipment

No base station equipment was utilized for data acquisition.

A.4.2 Rover Equipment

No rover equipment was utilized for data acquisition.

A.4.3 Water Level Gauges

No water level gauges were utilized for data acquisition.

A.4.4 Levels

No levels were utilized for data acquisition.

A.4.5 Other Horizontal and Vertical Control Equipment

No other equipment were utilized for data acquisition.

A.5 Positioning and Attitude Equipment

A.5.1 Positioning and Attitude Systems

A.5.1.1 Applanix POS MV V

The POS MV V5 is a GNSS-aided inertial navigation system, which provides a blended position solution derived from both an Inertial Motion Unit (IMU) and an integrated GNSS receiver. The IMU and GPS receiver are complementary sensors, and data from one are used to filter and constrain errors from the other. This inter-dependence results in higher position accuracy and fewer errors. Position accuracy is displayed in real time by the POS MV software and is monitored to ensure that positioning accuracy requirements as outlined in the NOS Hydrographic Surveys Specifications and Deliverables (HSSD) were not exceeded. In addition to position, the POS MV also provides accurate navigation and attitude data to correct for the effects of heave, pitch, roll and heading. When using differential correctors, the POS MV generates attitude data in three axes (roll, pitch and heading) to an accuracy of 0.02° or better. Heave measurements supplied by the POS MV maintain an accuracy of 5 cm or 5% of the measured vertical displacement (whichever is greater) for movements that have a period of up to 20 seconds.

<table>
<tr><td>Manufacturer</td><td colspan="3">Applanix</td></tr>
<tr><td>Model</td><td colspan="3">POS MV V</td></tr>
<tr><td rowspan="8">Inventory</td><td rowspan="4">S3008</td><td>Component</td><td>topside box</td></tr>
<tr><td>Model Number</td><td>POS MV V5</td></tr>
<tr><td>Serial Number</td><td>13617</td></tr>
<tr><td>Calibration</td><td>2023-04-12</td></tr>
<tr><td rowspan="4">S3005</td><td>Component</td><td>topside box</td></tr>
<tr><td>Model Number</td><td>320</td></tr>
<tr><td>Serial Number</td><td>13580</td></tr>
<tr><td>Calibration</td><td>2021-05-24</td></tr>
</table>

Figure 5: Applanix POS MV V

A.5.2 DGPS

DGPS equipment was not utilized for data acquisition.

A.5.3 GPS

Additional GPS equipment was not utilized for data acquisition.

A.5.4 Laser Rangefinders

Laser rangefinders were not utilized for data acquisition.

A.5.5 Other Positioning and Attitude Equipment

No additional positioning and attitude equipment was utilized for data acquisition.

A.6 Sound Speed Equipment

A.6.1 Moving Vessel Profilers

No moving vessel profilers were utilized for data acquisition.

A.6.2 CTD Profilers

A.6.2.1 SonTek Castaway

The CastAway-CTD is a small, rugged CTD designed for profiling to depths of up to 100m. The system achieves a 5 Hz response time, fine spatial resolution, and high accuracy, with sound speed measurements accurate within ±0.15 m/s. It uses a six electrode flow-through conductivity cell with zero external field coupled with a rapid response thermistor to attain high measurement accuracies. The instrument is simple to deploy, does not require a pump and is hydrodynamically designed to free fall rate of 1 m/s. Each CastAway-CTD cast is referenced with both time and location using its built-in GPS receiver. Latitude and longitude are acquired both before and after each profile. Plots of conductivity, temperature, salinity and sound speed versus depth can be viewed immediately on the CastAway's integrated color LCD screen. Raw data is downloaded via Bluetooth to the launch acquisition computer for analysis and to export into SIS.

Manufacturer	SonTek	
Model	Castaway	
Inventory	*Component*	Castaway CTD
	Model Number	400100
	Serial Number	1432007
	Calibration	2023-03-08
	Component	Castaway CTD
	Model Number	400100
	Serial Number	1433005
	Calibration	2022-04-21

Figure 6: Castaway CTD

A.6.3 Sound Speed Sensors

A.6.3.1 AML Micro X

The AML MicroX instrument with an SVXchange sensor-head provided surface sound speed data to the Kongsberg EM 2040C for beam forming and steering. The unit is mounted in a removable pole that is inserted into a bracket mounted on the transom between the two motors. The unit is configured to output an AML datagram to SIS.

Manufacturer	AML		
Model	Micro X		
Inventory	*S3008*	*Component*	Sound Speed Sensor
		Model Number	Micro X
		Serial Number	205757
		Calibration	2021-04-08
	S3005	*Component*	Sound Speed
		Model Number	Micro X
		Serial Number	203527
		Calibration	2021-03-18

Figure 7: AML Micro X

A.6.4 TSG Sensors

No TSG sensors were utilized for data acquisition.

A.6.5 Other Sound Speed Equipment

No other surface sound speed sensors were utilized for data acquisition.

A.7 Computer Software

Manufacturer	*Software Name*	*Version*	*Use*
Teledyne CARIS	HIPS and SIPS	11.4	Processing
Teledyne CARIS	HIPS and SIPS	5.5	Processing
Applanix	POS View	10	Acquisition
Applanix	POSPac MMS	8.8	Processing
HSTB	Pydro 22	22.1 (r10470)	Processing
Hypack	Hypack 2022	2022	Acquisition
Kongsberg	Seafloor Information System	4.3.2	Acquisition
Edgetech	Discover	10	Acquisition

A.8 Bottom Sampling Equipment

A.8.1 Bottom Samplers

No bottom sampling equipment was utilized for data acquisition.

B. System Alignment and Accuracy

B.1 Vessel Offsets and Layback

B.1.1 Vessel Offsets

For NRTST, all vessel offset values are stored in POS MV, Lever Arms and Mounting tab. The transducer face is the Reference Point (RP) for hull S3008 and S3005. In August of 2022 an improved "top hat" style IMU on board S3008 replaced one of identical dimensions. Steel tape offset verification was performed to confirm that the legacy offset (MRU to Transducer) values were still valid. Hence no NGS Vessel Offset Survey was performed. Offsets are in the Applanix right-hand Cartesian coordinate system.

B.1.1.1 Vessel Offset Correctors

Vessel	S3008			
Echosounder	Kongsberg 2040C			
Date	2023-04-19			
Offsets			*Measurement*	*Uncertainty*
	MRU to Transducer	*x*	-0.105 meters	0.020 meters
		y	0.074 meters	0.020 meters
		z	-0.366 meters	0.020 meters
		x2	0.000 meters	0.000 N/A
		y2	0.000 N/A	0.000 N/A
		z2	0.000 N/A	0.000 N/A
	Nav to Transducer	*x*	4.149 meters	0.010 meters
		y	-0.898 meters	0.010 meters
		z	-3.220 meters	0.010 meters
		x2	0.000 N/A	0.000 N/A
		y2	0.000 N/A	0.000 N/A
		z2	0.000 N/A	0.000 N/A
	Transducer Roll	*Roll*	0.000 degrees	

<table>
<tr><td>Vessel</td><td colspan="4">S3005</td></tr>
<tr><td>Echosounder</td><td colspan="4">Kongsberg 2040C</td></tr>
<tr><td>Date</td><td colspan="4">2022-03-02</td></tr>
<tr><td rowspan="15">Offsets</td><td rowspan="7">MRU to Transducer</td><td></td><td>Measurement</td><td>Uncertainty</td></tr>
<tr><td>x</td><td>-0.057 meters</td><td>0.020 meters</td></tr>
<tr><td>y</td><td>0.016 meters</td><td>0.020 meters</td></tr>
<tr><td>z</td><td>-0.350 meters</td><td>0.020 meters</td></tr>
<tr><td>x2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td>y2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td>z2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td rowspan="6">Nav to Transducer</td><td>x</td><td>4.161 meters</td><td>0.020 meters</td></tr>
<tr><td>y</td><td>-0.891 meters</td><td>0.020 meters</td></tr>
<tr><td>z</td><td>-3.231 meters</td><td>0.020 meters</td></tr>
<tr><td>x2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td>y2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td>z2</td><td>0.000 N/A</td><td>0.000 N/A</td></tr>
<tr><td>Transducer Roll</td><td>Roll</td><td>0.000 degrees</td><td></td></tr>
</table>

B.1.2 Layback

NONE - Towfish is pole mounted via Universal Sonar Mount (USM). Offsets from origin are recorded in CARIS hvf.

Layback correctors were not applied.

B.2 Static and Dynamic Draft

B.2.1 Static Draft

Static draft corrector values are entered in the Kongsberg SIS Installation Parameters window. In addition to being entered into the SIS Installation Parameters window, waterline values are also entered in the CARIS HVF. This waterline value in CARIS will only be used during Sound Velocity Correction. The Apply switch is also set to “No”. If it is set to “Yes”, the waterline value will be applied twice, once in SIS and again in Merge.

B.2.1.1 Static Draft Correctors

Vessel	*Date*	*Loading*	*Static Draft*	
			Measurement	*Uncertainty*
S3008	2023-04-18	0.015 meters	-0.559 meters	0.024 meters
S3005	2022-03-02	0.030 meters	-0.559 meters	0.030 meters

B.2.2 Dynamic Draft

The calculated dynamic draft values for S3008 were compared to other response teams with the same platform. It was found that there may have been an issue with the tide data as the numbers were quite different than the other teams. It was suggested that all teams should use the same dynamic draft values from a team with the highest confidence in their results. It was suggested that NRT 1 had the best results and that it would be best to use their values. So the Dynamic Draft Correctors displayed in the table and entered into the HVF are from NRT1's 2021 Dynamic Draft measurements. S3008 will continue to use these values for the 2023 field season.

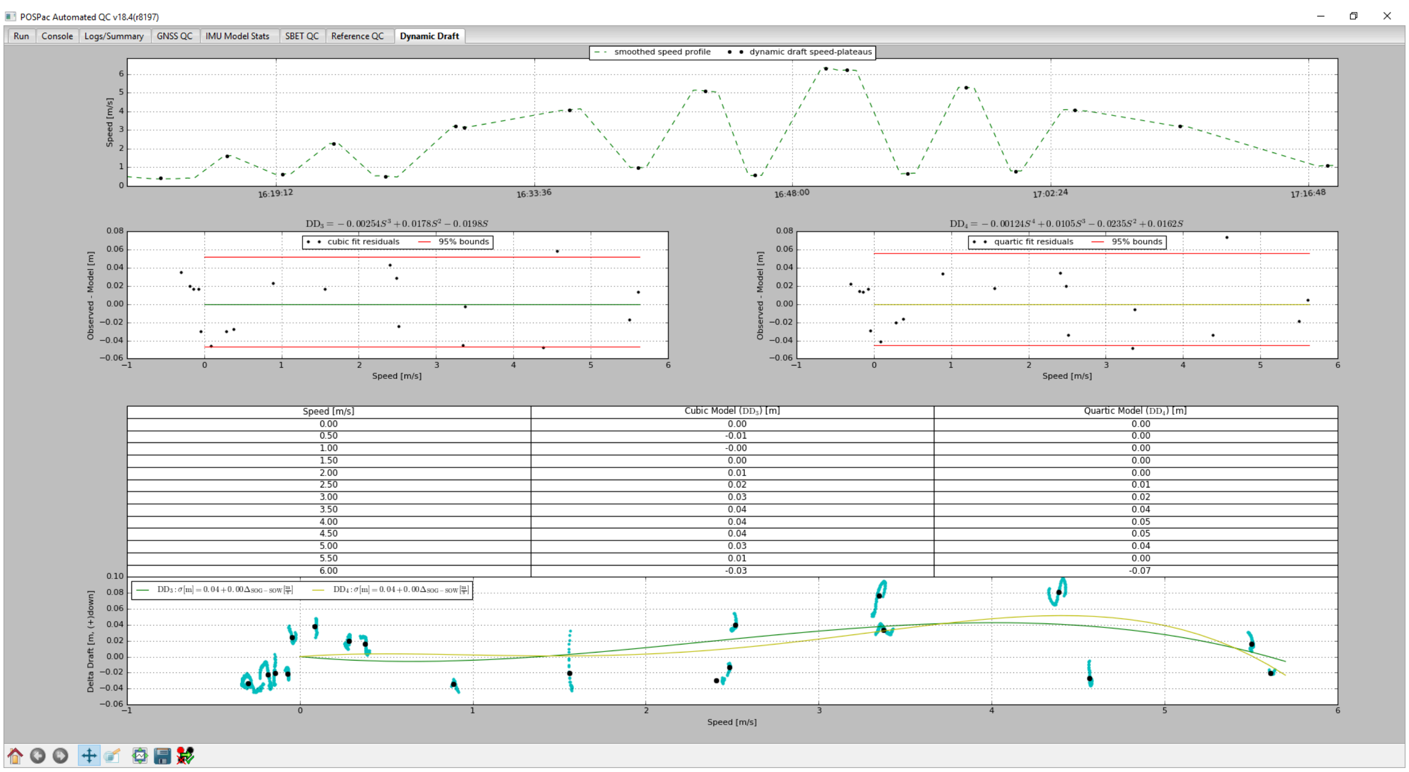

Figure 8: Dynamic Draft Values

B.2.2.1 Dynamic Draft Correctors

<table>
<tr><td>Vessel</td><td colspan="2">S3008</td></tr>
<tr><td>Date</td><td colspan="2">2023-04-10</td></tr>
<tr><td rowspan="10">Dynamic Draft</td><td>Speed (m/s)</td><td>Draft (m)</td></tr>
<tr><td>0.00</td><td>0.00</td></tr>
<tr><td>0.50</td><td>0.03</td></tr>
<tr><td>1.00</td><td>0.04</td></tr>
<tr><td>1.50</td><td>0.04</td></tr>
<tr><td>2.00</td><td>0.04</td></tr>
<tr><td>2.50</td><td>0.05</td></tr>
<tr><td>3.00</td><td>0.08</td></tr>
<tr><td>3.50</td><td>0.12</td></tr>
<tr><td>4.00</td><td>0.16</td></tr>
<tr><td rowspan="2">Uncertainty</td><td>Vessel Speed (m/s)</td><td>Delta Draft (m)</td></tr>
<tr><td>0.05</td><td>0.03</td></tr>
</table>

B.3 System Alignment

B.3.1 System Alignment Methods and Procedures

The 2023 field season patch test was conducted as part of the HSRR (see the Appendix for full report). The patch test determined any roll, pitch, and yaw biases (X, Y, and Z axis) and the time offset between the MBES reference frame and the navigational reference frame. All patch tests are conducted in accordance with the HSSD Section 5.2.4.1. The lines were post-processed and the CARIS Calibration Utility was performed by all NRT-Stennis crew members. The results of the three trials are averaged and the result is recorded in the "IMU Frame w.r.t. Ref. Frame" inputs located in the POS Installation: Lever Arms & Mounting Angles window, after converting the values from the CARIS to the POS M/V coordinate system. Values were found to be within 0.5 degrees or less from the previous year's patch test however, poor sea conditions at the traditional patch grounds on this day (DN110) imposed a less-suitable patch test area in the Gulfport Channel where yaw targets and slope parameters were less suitable. The channel edges were use instead. For this reason, the Field will use last year's (2022) more robust patch values for POSMV5.

B.3.1.1 System Alignment Correctors

Vessel	S3008		
Echosounder	Applanix POS MV 5 (Y=pitch, X=roll, Z=yaw)		
Date	2023-04-20		
Patch Test Values		*Corrector*	*Uncertainty*
	Transducer Time Correction	0.000 seconds	0.000 seconds
	Navigation Time Correction	0.000 seconds	0.000 seconds
	Pitch	-1.000 degrees	0.020 degrees
	Roll	0.135 degrees	0.020 degrees
	Yaw	0.350 degrees	0.020 degrees
	Pitch Time Correction	0.000 seconds	0.000 seconds
	Roll Time Correction	0.000 seconds	0.000 seconds
	Yaw Time Correction	0.000 seconds	0.000 seconds
	Heave Time Correction	0.000 seconds	0.000 seconds

Vessel	S3005		
Echosounder	Applanix POS MV5		
Date	2022-05-25		
Patch Test Values		*Corrector*	*Uncertainty*
	Transducer Time Correction	0.000 seconds	0.000 seconds
	Navigation Time Correction	0.000 seconds	0.000 seconds
	Pitch	0.300 degrees	0.100 degrees
	Roll	0.125 degrees	0.100 degrees
	Yaw	-2.000 degrees	0.150 degrees
	Pitch Time Correction	0.000 seconds	0.000 seconds
	Roll Time Correction	0.000 seconds	0.000 seconds
	Yaw Time Correction	0.000 seconds	0.000 seconds
	Heave Time Correction	0.000 seconds	0.000 seconds

C. Data Acquisition and Processing

C.1 Bathymetry

C.1.1 Multibeam Echosounder

Data Acquisition Methods and Procedures

Kongsberg multibeam data is logged using SIS in the ".all" format. The hydrographer scans the real time SIS data for system wide errors, anomalies, and dropouts. Display windows such as Sea Bed Image, Time Series, Water Fall, and Beam Intensity aid in this task. SIS data is also fed through HYPACKS's HYSWEEP for the coxswain's display. This secondary interface acts as another real time monitoring tool. During acquisition, the hydrographer reviews the real time data and provides feedback to the coxswain in order to ensure acquired data will meet coverage requirements set forth in the Project Instructions and HSSD Section 5.2.2.

Data Processing Methods and Procedures

Following acquisition, multibeam sonar data were processed either using CARIS HIPS and SIPS manually or by using the automated Pydro Explorer application, Charlene, to perform the same steps. The standard data processing steps are as follows:

1. Convert raw Kongsberg (.all) data to the HDCS data format
2. Load delayed heave
3. Load and apply sound velocity correctors
4. Compute GPS tide to transform data from the ellipsoid to the tidal datum using a separation model
5. Merge data to apply position attitude, and dynamic draft correctors to bathymetry and compute the corrected depth of each sounding
6. Compute Total Propagated Uncertainty (TPU)
8. Add data to a CUBE surface encompassing the entire survey
9. Data quality control and analysis

C.1.2 Single Beam Echosounder

Single beam echosounder bathymetry was not acquired.

C.1.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar bathymetry was not acquired.

C.1.4 Gridding and Surface Generation

C.1.4.1 Surface Generation Overview

MBES data are gridded using CARIS HIPS Combined Uncertainty and Bathymetric Estimator (CUBE) algorithm and is processed as described in FPM Section 4.2.1.1, using methods described above in Section C.1.1. The CUBE surface is also created using a grid resolution determined by coverage type and depth, as required by the Project Instructions and specified in the HSSD, Section 5.2.2. The "Depth" layer is reviewed for holidays (gaps in coverage) or erroneous soundings. Any erroneous soundings, known as fliers, are flagged as rejected and removed from the surface so the surface more accurately represents the seafloor. Any least depth on a feature that is not accurately reflected in the surface is flagged as “designated” in order to force the surface to reflect that shoaler depth in accordance with HSSD Section 5.2.1.2.3.

C.1.4.2 Depth Derivation

See Above

C.1.4.3 Surface Computation Algorithm

See Above

C.2 Imagery

C.2.1 Multibeam Backscatter Data

Multibeam backscatter imagery was not acquired.

C.2.2 Side Scan Sonar

<u>Data Acquisition Methods and Procedures</u>

The SSS towfish is deployed on a Universal Sonar Mount (USM) arm fixed to a plate welded onto the port side gunwale near the stern. The arm can be rotated 90 degrees and brought back on board S3008 when acquisition is complete. The range scales of the Edgetech 4125's high and low frequencies can be set independently. Confidence checks are performed daily by observing changes in linear bottom features extending to the outer edges of the digital side scan image, features on the bottom in survey area, and by passing aids to navigation. Daily rub tests are also conducted.

Data Processing Methods and Procedures

Following acquisition, side scan sonar data were processed either using CARIS HIPS and SIPS manually or by using the automated Pydro Explorer application, Charlene, to perform the same steps. The standard data processing steps are as follows:

1. Convert raw Edgetech JSF data to the HDCS data format
2. Digitize towfish height as needed
3. Recompute towfish navigation to compute the position of the towfish in relation to the vessel
4. Review lines for contacts and designate soundings in corresponding multibeam data as needed
5. Create mosaics and evaluate for coverage gaps

C.2.3 Phase Measuring Bathymetric Sonar

Phase measuring bathymetric sonar imagery was not acquired.

C.3 Horizontal and Vertical Control

C.3.1 Horizontal Control

C.3.1.1 GNSS Base Station Data

GNSS base station data was not acquired.

C.3.1.2 DGPS Data

DGPS data was not acquired.

C.3.2 Vertical Control

C.3.2.1 Water Level Data

Water level data was not acquired.

C.3.2.2 Optical Level Data

Optical level data was not acquired.

C.4 Vessel Positioning

Data Acquisition Methods and Procedures

Attitude and Heave data were measured with the sensors described in Section A.5, and applied in post processing during SVP Correct and Merge in CARIS HIPS. S3008 utilizes a heave filter integration method known as “TrueHeave” as described in Section 3.4.1.2 of the 2014 Field Procedures Manual. This filter almost completely eliminates the need for steadying up on lines before logging can begin. TrueHeave data were logged throughout the day via the POS MV's Ethernet logging feature. Data are logged to the acquisition computers hard drive and are approximately 12-Megabyte (MB) files. Each file has a unique identifier for the year, Julian day number, and the vessel number (ex. 2017_214_S3007.000). The multiple POS files that are created from logging in this way are each distinguished by the numbering found in the file type (e.g, 000, 001, 002, etc.). After regular CARIS data conversion, the TrueHeave file was separately loaded into HIPS, replacing the unfiltered heave values recorded in the raw data. TrueHeave is actually applied to the data, if the check box is marked, during the sound velocity correction process. It is standard procedure to begin logging the POS MV Applanix .000 file at least 5 minutes before starting bathymetric data acquisition and letting it run for at least 5 minutes afterward. Although the filter that produces the true heave values by looking at a long series of data to create a baseline needs only 3 minutes before and after the acquisition of bathymetric data, SBET processing which uses the same .000 file, requires logging for 5 minutes before and after bathymetric acquisition. Timing and attitude biases were determined in accordance with Section 1.5 of the Field Procedures Manual, and are described in Section B of this report.

Data Processing Methods and Procedures

The POS/MV file is recorded during acquisition and saved to the network RAW drive. The POS/MV file is loaded, applied to, and merged with the raw sonar data in CARIS via Charlene, using the "Import Auxiliary Data" utility as part of the standard processing flow.

C.5 Sound Speed

C.5.1 Sound Speed Profiles

Data Acquisition Methods and Procedures

The CastAway CTD is the primary instrument to acquire sound velocity profiles, unless otherwise stated in the Descriptive Report. CARIS HIPS then utilizes the concatenated sound velocity data as a corrector . Casts are acquired every 2-4 hours during MBES acquisition. Profiles are collected more frequently when current and weather conditions warrant or when SIS indicates a new cast is needed.

Data Processing Methods and Procedures

All SVP casts are processed using HydrOffice's Sound Speed Manager and exported into SIS to be used in real time beam pattern formation. In CARIS, the "Nearest in Distance Within Time of Four Hours" option is used when correcting the data for sound speed unless otherwise noted in the DR.

C.5.2 Surface Sound Speed

Data Acquisition Methods and Procedures

Surface sound speed data is directly measured by AML's MicroX SV probe.

Data Processing Methods and Procedures

The Kongsberg EM2040C uses the sound velocity profile from the CTD profile for its beam forming equation and only depends on the surface sound speed as a comparison tool to ensure accuracy. This accuracy check is performed by comparing the continuous reading from the surface sound speed profiler to the CTD reading. The reading from the surface sound speed sensor can be applied to the data during processing.

C.6 Uncertainty

C.6.1 Total Propagated Uncertainty Computation Methods

There are two places in CARIS where the user directly defines uncertainty values for use in CARIS to calculate TPU values; in the HVF and the direct input of SV and tide values during the TPU computation. TPU values for all motion, navigation position and timing values are taken directly from Appendix IV (Uncertainty values for use in CARIS with vessels equipped WITH an attitude sensor) of the FPM. All timing values were set to 0.01 seconds as outlined for setups with Ethernet connections and precise timing. All offset values were chosen to be 0.01 meters based on the accuracy provided by professional surveys. All MRU alignment values are derived from the patch test. The gyro value is taken directly from the standard deviation of the yaw values. The pitch/roll value is combined as one in the HVF and is computed as the square root of pitch standard deviation squared plus roll standard deviation squared.

C.6.2 Uncertainty Components

C.6.2.1 A Priori Uncertainty

Vessel		S3008
Motion Sensor	*Gyro*	0.02 degrees
	Heave	5.00% 0.05 meters
	Roll	0.02 degrees
	Pitch	0.02 degrees
Navigation Sensor		1.00 meters

C.6.2.2 Real-Time Uncertainty

Real-time uncertainty was not applied.

C.7 Shoreline and Feature Data

Shoreline and feature data was not acquired.

C.8 Bottom Sample Data

Bottom sample data was not acquired.

D. Data Quality Management

D.1 Bathymetric Data Integrity and Quality Management

D.1.1 Directed Editing

The CUBE surface child layers: uncertainty, standard deviation, and node standard deviation were primarily used to help focus directed editing to soundings that were negatively affecting the BASE surface. Another method to check the quality of sounding data prior to submission is the Pydro QCTools “Flier Finder”. This software scans the CUBE surface for potential anomalous grid data. Lowering the flier height value will increase the sensitivity of the flier finder, resulting in more nodes being flagged. Fliers are then exported as .000 S-57 files that can be imported into CARIS HIPS and SIPS to aid in further cleaning. If desired, the user can set a new tolerance (“Flier height”) and rerun Flier finder.

D.1.2 Designated Sounding Selection

Since the calculated depth for each grid node of a BASE surface is influenced by multiple soundings, the least depth of a feature may not always be accurately represented in the gridded data. Poor sounding density, noisy data, strong filters, and improper data cleaning, can all exacerbate this issue. Therefore, prior to creating a finalized BASE surface, the hydrographer must systematically review significant feature least depths to ensure they are accurately portrayed by the BASE surface. Additional data (including local knowledge, diver investigations, or sidescan sonar) should be reviewed in concert with the depth soundings. If the hydrographer finds that a specific least depth sounding should be represented in the weighted meandepth calculation for the associated BASE surface grid node, that sounding should be flagged “Designated”. A designated sounding is required to be the shoalest sounding of a feature that sits at least 1m above the seafloor and the gridded surface is shown to exceed the allowable TVU at that depth (see Figure 5.1 in section 5.2.1.2.3 of the HSSD). The designated sounding must also be at least 2mm away, at survey scale, from any other shoaler sounding.

D.1.3 Holiday Identification

This survey was a "skunk-stripe" style survey with sidescan sonar data collected concurrently. The survey line spacing was based on a 50m range scale setting of the sidescan sonar. Due to the shallow nature of the survey area the multibeam data did not capture 100 percent of the assigned sheet limits. SSS holidays are easily identified by giving the CARIS SIPS map window a red background and then loading the SSS mosaic.

D.1.4 Uncertainty Assessment

The CUBE algorithm generates a surface consisting of multiple hypotheses that represent the possible depths at any given position. The CUBE surface is a grid of estimation nodes where depth values are computed based on the horizontal and vertical uncertainty of each contributing sounding. Any individual sounding’s uncertainty, or Total Propagated Uncertainty (TPU), is derived from the assumed uncertainty in the echosounder
measurement itself, as well as the contributing correctors from sound speed, water levels, position, and attitude. TPU values for tide and sound velocity must be entered for each vessel during TPU computation, unless using TCARI, where uncertainty is added directly to survey lines by Pydro.

D.1.5 Surface Difference Review

D.1.5.1 Crossline to Mainscheme

Cross-lines with a linear nautical total of at least 4% of mainscheme multibeam lines were run on each survey. Next a CUBE surface was created using strictly the main scheme lines, while a second surface was created using only the crosslines. From these two surfaces, a surface difference was generated (at a 1 meter resolution). Statistics were then derived from the difference surface and documented within the Descriptive Report for each survey.

D.1.5.2 Junctions

Junction overlap areas are acquired so to be at least approximately one bathymetric swath width at the nominal depth of the junction, as per the HSSD. Junction areas are then evaluated to ensure they have met this overlap requirement and also to inspect the relative agreement of depths. When junctions share a common grid resolution, it is chosen to perform the junction analysis.

D.1.5.3 Platform to Platform

None

D.2 Imagery data Integrity and Quality Management

Imagery data integrity and quality management were not conducted for this survey.

E. Approval Sheet

Dan Jacobs, NRT-Stennis Team Lead

The survey is complete and adaqueate for its intended purpose.

Note that S3005 had not received its annual HSRR by the start of the 2023 field season. Per NRB Chief, the vessel will accomplish calibrations after S3005 is stripped down to metal, repainted and Sonar/IMU are re-mounted. Hence S3005's 2022 DAPR is accompanying 3008's 2023 DAPR.

Approver Name	Approver Title	Date	Signature
Dan Jacobs	Chief of Party	05/02/2023	JACOBS.DAN.L.1151633478 Digitally signed by JACOBS.DAN.L.1151633478 Date: 2023.06.28 09:40:48 -05'00'

List of Appendices:

Mandatory Report	***File***
Vessel Wiring Diagram	S3008_WiringDiagram.jpg S3005_Wiring_Diagram_2020.pdf
Sound Speed Sensor Calibration	Castaway_Cal_CC1228004_2022_B.jpg CC1232007.pdf
Vessel Offset	Copy of NRT1_VCS_2021.pdf NRTST_S3005_VCS_2021.pdf
Position and Attitude Sensor Calibration	Lever Arm.PNG S3005_GAMS_2022.pdf
Echosounder Confidence Check	S3008_2040C_MBES_Patch_2023.xlsx
Echosounder Acceptance Trial Results	N/A