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

Data Acquisition & Processing Report

Type of Survey:	Navigable Area
Project Number:	OPR-G343-FH-17
Time Frame:	August - November 2017

LOCALITY

State(s):	Florida
General Locality:	true

2017

CHIEF OF PARTY
LCDR Matthew J. Jaskoski, NOAA

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Data Acquisition and Processing Report

NOAA Ship *Ferdinand R. Hassler*
Chief of Party: LCDR Matthew J. Jaskoski, NOAA
Year: 2017
Version: 1.1
Publish Date: 2017-09-27

A System Equipment and Software

A.1 Survey Vessels

A.1.1 NOAA Ship FERDINAND R. HASSLER

<table>
<tr><td>Vessel Name</td><td colspan="2">NOAA Ship FERDINAND R. HASSLER</td></tr>
<tr><td>Hull Number</td><td colspan="2">S250</td></tr>
<tr><td>Description</td><td colspan="2">FERDINAND R. HASSLER is a Small Waterplane Area, Twin-Hull (SWATH) coastal mapping vessel.</td></tr>
<tr><td rowspan="3">Dimensions</td><td>LOA</td><td>37.7 meters</td></tr>
<tr><td>Beam</td><td>18.5 meters</td></tr>
<tr><td>Max Draft</td><td>3.85 meters</td></tr>
<tr><td rowspan="2">Most Recent Full Static Survey</td><td>Date</td><td>2011-09-04</td></tr>
<tr><td>Performed By</td><td>Raymond C. Impastato, Professional Land Surveyor</td></tr>
<tr><td rowspan="2">Most Recent Partial Static Survey</td><td>Date</td><td>2012-06-12</td></tr>
<tr><td>Performed By</td><td>Kevin Jordan, NGS</td></tr>
<tr><td rowspan="2">Most Recent Partial Offset Verification</td><td>Date</td><td>2013-04-07</td></tr>
<tr><td>Method</td><td>Optical level run while ship was out of drydock. A level loop was run from the POS antenna to each sensor mounted on the ship's hull. In addition, measurements were made to both IMU base plates through the 7125 cable passage. The resulting offsets from this survey were used to verify and update Z offsets between all sensors.</td></tr>
</table>

Figure 1: NOAA Ship FERDINAND R. HASSLER

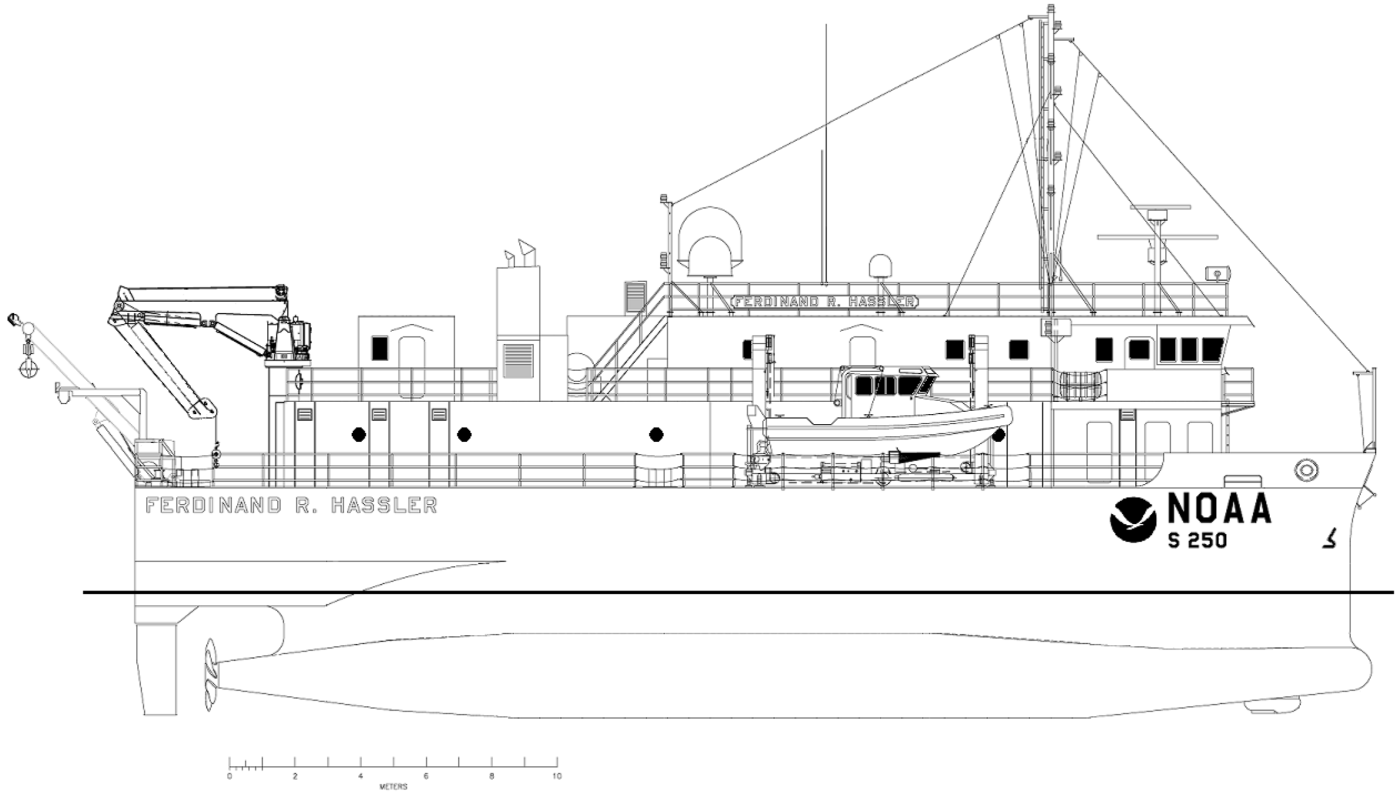


Figure 2: NOAA Ship FERDINAND R. HASSLER, starboard view

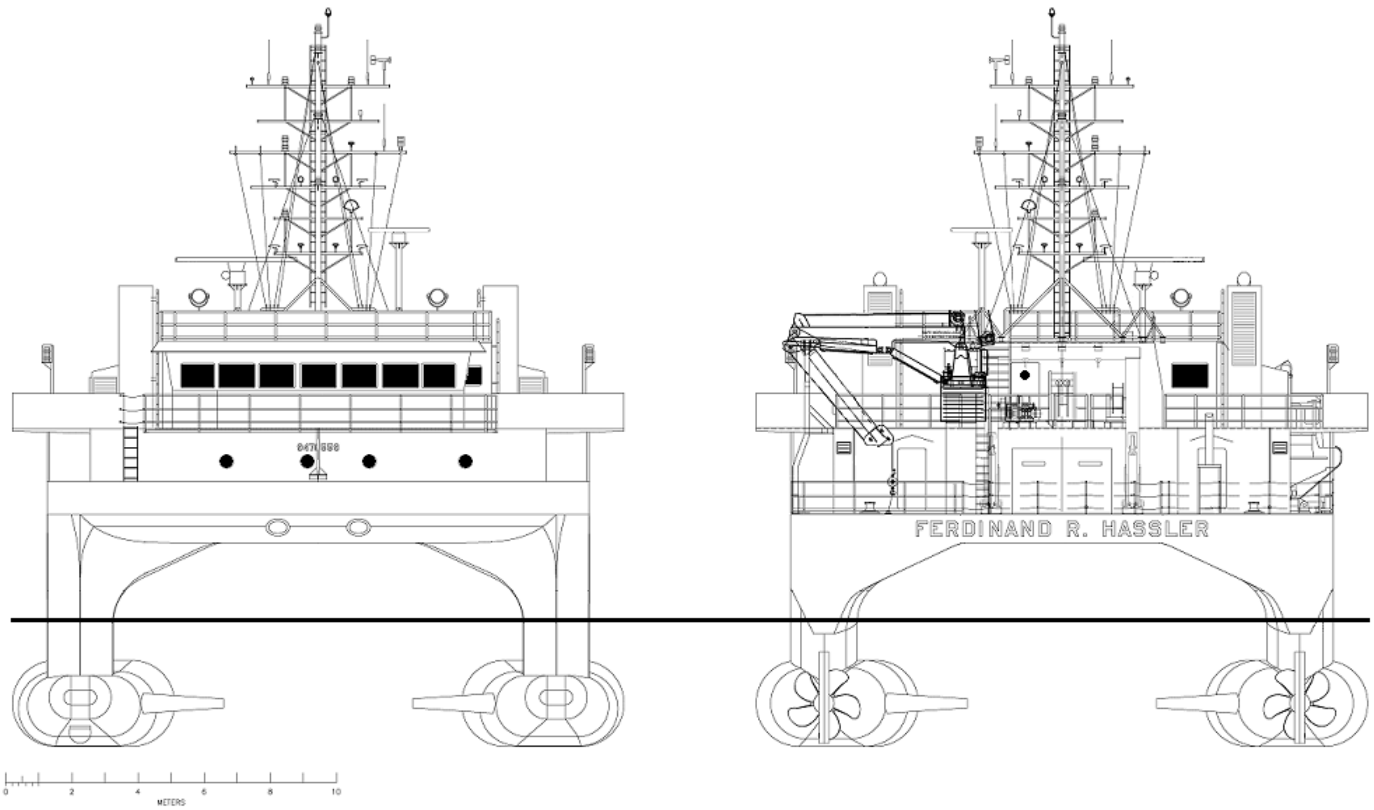


Figure 3: NOAA Ship FERDINAND R. HASSLER, bow and stern view

A.2 Echo Sounding Equipment

A.2.1 Multibeam Echosounders

A.2.1.1 RESON 7125

Manufacturer	RESON
Model	7125
Description	The RESON 7125 is a dual head, dual frequency system configured to work as one unit. While the particulars of the port system are specified in this section and the starboard head in the following section, this description and following quality control addresses the two heads as an integrated system. The port and starboard sonars are mounted in their respective hulls with a 4.5 degree outboard tilt. The sonars can be operated independently, but are typically operated together as a dual-head system using frequency modulated (FM) pulses combined with center frequency separation to enable simultaneous pinging between the heads. When operated as a dual head system, the starboard system acts as the master and the port system

	the slave. The range scale, ping rate, surface sound speed, and time varied gain (TVG) parameters are controlled by the master. Patch Tests - A patch test was conducted for each sonar heads in both 200kHz and 400kHz modes on August 30, 2017 (Dn242) in the vicinity of Jacksonville, FL. Reference Surfaces - In conjunction with the patch test noted above, a reference surface for both sonar heads in both 400kHz and 200kHz modes was conducted on August 30, 2017 (Dn242) in the vicinity of Jacksonville, FL.

Inventory — *S250*

Component	Processor	Transceiver	LCU	Receiver	Projector
Model Number	N/A	N/A	N/A	N/A	N/A
Serial Number	18210412051	212036	0212036	0214074	2611093
Frequency	N/A	N/A	N/A	200/400 kHz	200/400 kHz
Calibration	N/A	N/A	N/A	N/A	N/A
Accuracy Check	N/A	N/A	N/A	N/A	N/A

Figure 4: 7125 Housing flush-mounted on hull

A.2.1.2 Reson 7125

Manufacturer	Reson
Model	7125

Description	Starboard system of a dual head configuration. For a description of this system and associated quality control tests, see entry for port 7125.						
Inventory	*S250*	*Component*	Processor	Transceiver	LCU	Receiver	Projector
		Model Number	N/A	N/A	N/A	N/A	N/A
		Serial Number	18215011048	212035	212035	1215068	1111236
		Frequency	N/A	N/A	N/A	200/400 kHz	200/400 kHz
		Calibration	N/A	N/A	N/A	N/A	N/A
		Accuracy Check	N/A	N/A	N/A	N/A	N/A

A.2.2 Single Beam Echosounders

No single beam echosounders were utilized for data acquisition.

A.2.3 Side Scan Sonars

No side scan sonars were utilized for data acquisition.

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

Manufacturer	Unknown

Model	N/A		
Description	FERDINAND R. HASSLER is equipped with one lead line. Lead lines are used for measurements near shore over submerged shoals and for echosounder depth comparisons.		
Inventory	*S 250*	*Component*	Leadline
		Model Number	Traditional
		Serial Number	RA6S
		Calibration	N/A

Figure 5: Leadline fitted with custom mud-shoe to limit penetration of soft bottoms.

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 320 V5

Manufacturer	Applanix
Model	POS MV 320 V5
Description	Tightly coupled GPS and inertial positioning and attitude sensing system for port hull. Inertial Measurement Unit (IMU) is located below water line close to the port side 7125

	wet end. GPS antennae are located on the O-2 level of S250. The V5 system was installed on July 29, 2013.

Inventory	*S250 Port*	*Component*	IMU	PCS	Antenna	Antenna
		Model Number	Type 36	POS/MV 320 V5	GA830 GNSS/ MSS	GA830 GNSS/ MSS
		Serial Number	2423	5806	6997	5401
		Calibration	N/A	N/A	N/A	N/A
	S250 Starboard	*Component*	PCS	IMU	Antenna	Antenna
		Model Number	POS/MV 320 V5	Type 36	GA830 GNSS/ MSS	GA830 GNSS/ MSS
		Serial Number	5807	2672	7000	5415
		Calibration	N/A	N/A	N/A	N/A

A.5.2 DGPS

DGPS equipment was not utilized for data acquisition.

A.5.3 GPS

GPS equipment was not utilized for data acquisition.

A.5.4 Laser Rangefinders

A.5.4.1 Laser Technology Inc. TruPulse 360R

Manufacturer	Laser Technology Inc.		
Model	TruPulse 360R		
Description	Rugged and waterproof laser rangefinder which provides full measurement capabilities of distances, heights and azimuths.		
Inventory	*S250*	*Component*	Rangefinder
		Model Number	TruPulse 360R
		Serial Number	2557
		Calibration	N/A

Figure 6: TruPulse 360R Laser Rangefinder

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

A.6.1.1 Rolls-Royce Brooke-Ocean MVP200

Manufacturer	Rolls-Royce Brooke-Ocean
Model	MVP200

<table>
<tr><td>Description</td><td colspan="5">Moving Vessel Profiler equipped with an AML micro-CTD in a single sensor free fall fish. The free fall fish was re-terminated on September 28, 2017 due to chaffing issues and verified to be in working order by repeat usage. Chaffing was caused by outer arm guide block which was replaced on September 26, 2017.</td></tr>
<tr><td rowspan="4">Inventory</td><td rowspan="4">S250</td><td>Component</td><td>Winch</td><td>Towfish</td></tr>
<tr><td>Model Number</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Serial Number</td><td>10794</td><td>11406</td></tr>
<tr><td>Calibration</td><td>N/A</td><td>N/A</td></tr>
</table>

A.6.2 CTD Profilers

A.6.2.1 Sea-Bird Electronics SeaCat 19plus 350 meter and 3500 meter

<table>
<tr><td>Manufacturer</td><td colspan="2">Sea-Bird Electronics</td></tr>
<tr><td>Model</td><td colspan="2">SeaCat 19plus 350 meter and 3500 meter</td></tr>
<tr><td>Description</td><td colspan="2">Internal logging conductivity, temperature, and depth measuring devices.</td></tr>
<tr><td rowspan="4">Inventory</td><td>Component</td><td>CTD</td></tr>
<tr><td>Model Number</td><td>SBE 19plus</td></tr>
<tr><td>Serial Number</td><td>19P65591-6918</td></tr>
<tr><td>Calibration</td><td>2017-01-23</td></tr>
</table>

A.6.3 Sound Speed Sensors

A.6.3.1 AML Oceanographic micro-CTD

Manufacturer	AML Oceanographic
Model	micro-CTD
Description	The AML micro-CTD in active use was last calibrated in October 2013 but was initially put into service in August 2017. Out-of-the-box calibration is considered valid for one year after put into service, August 2018. Micro-CTD 8660 and 8661 both have pressure sensors rated for 6,000m which will be exchanged for more appropriate 1,000m pressure sensors later in the field season.

Inventory	*S250*	*Component*	MVP Sound Speed Sensor
		Model Number	Micro CTD
		Serial Number	8615
		Calibration	2013-10-01

A.6.3.2 RESON SVP-70

Manufacturer	RESON
Model	SVP-70
Description	Sound velocity probe developed for fixed-mount installation near RESON 7125 transducer heads which uses a direct path echosounding technique that instantly compensates for temperature and pressure with internal sensors, providing accurate surface sound velocity measurements for beam steering. The starboard cable run from the RESON TPU to the wet end is inoperable. SVP-70 1317122 is installed on the port hull and being fed into the starboard RESON TPU which is then repeated via network broadcast to the port RESON TPU. SVP-70 0217026 is being held has spare in ship's storage.

Inventory	*S250*	*Component*	Surface Sound Speed Sensor	Surface Sound Speed Sensor
		Model Number	SVP 70	SVP 70
		Serial Number	1317122	0217026
		Calibration	2017-07-17	2017-05-25

A.6.4 TSG Sensors

No surface sound speed sensors were utilized for data acquisition.

A.6.5 Other Sound Speed Equipment

No surface sound speed sensors were utilized for data acquisition.

A.7 Computer Software

A.7.1 CARIS HIPS/SIPS

Manufacturer	CARIS
Software Name	HIPS/SIPS

Version	10.3.2
Installation Date	2017-08-01
Use	Processing

A.7.2 CARIS Bathy BASE Editor

Manufacturer	CARIS
Software Name	Bathy BASE Editor
Version	4.2.13
Installation Date	2017-08-01
Use	Processing

A.7.3 CARIS Plot Composer

Manufacturer	CARIS
Software Name	Plot Composer
Version	5.3
Installation Date	2017-08-01
Use	Processing

A.7.4 Applanix POSPac MMS

Manufacturer	Applanix
Software Name	POSPac MMS
Version	8.1
Installation Date	2017-08-01
Use	Processing

A.7.5 NOAA Pydro Explorer

Manufacturer	NOAA
Software Name	Pydro Explorer
Version	17.06
Installation Date	2017-08-01
Use	Processing

A.7.6 NOAA Velocipy

Manufacturer	NOAA
Software Name	Velocipy
Version	16
Installation Date	2015-02-16
Use	Processing

A.7.7 IVS 3D Fledermaus

Manufacturer	IVS 3D
Software Name	Fledermaus
Version	7.7.6
Installation Date	2017-08-30
Use	Processing

A.7.8 Hypack Hypack/Hysweep

Manufacturer	Hypack
Software Name	Hypack/Hysweep
Version	2017
Installation Date	2017-08-01
Use	Acquisition

A.7.9 Applanix POS View

Manufacturer	Applanix
Software Name	POS View
Version	8.46
Installation Date	2015-08-01
Use	Acquisition

A.7.10 Synergy Synergy

Manufacturer	Synergy
Software Name	Synergy
Version	1.4.14
Installation Date	2014-02-17
Use	Acquisition

A.7.11 VideoLAN VLC Media Player

Manufacturer	VideoLAN
Software Name	VLC Media Player
Version	2.2.6
Installation Date	2017-09-19
Use	Processing

A.8 Bottom Sampling Equipment

A.8.1 Bottom Samplers

A.8.1.1 Ponar Wildco 1728

Manufacturer	Ponar Wildco
Model	1728
Description	Grab sampler triggered by contact with sea floor. A custom mount equipped with camera and light was designed for the acquisition of video of the seafloor. A Go Pro Hero 3 camera is rigged as a drop camera to function along with grab sampler. The camera contains a 12 MP sensor capable of 1440p at 48fps. This camera supplements the data gathered with the grab sampler, and allows the field unit to provide data from null samples from the sediment sampler.

Figure 7: Ponar grab sampler

Figure 8: Camera with custom mount allowing for high quality video of the seafloor

Figure 9: GoPro video camera

B System Alignment and Accuracy

B.1 Vessel Offsets and Layback

B.1.1 Vessel Offsets

Sensor offsets are measured with respect to the vessel's reference point. These offsets are derived from the full survey performed in the shipyard, a partial survey performed by NGS personnel, and measurements/ verifications performed by FERDINAND R. HASSLER personnel. All offsets are tracked and updated as needed on a spreadsheet submitted with the appendices of this report.

The port IMU serves as the reference point for the port-only 7125 HSX configuration, the port 7125 s7k configuration, and the side scan sonar. For all other vessel configurations the starboard IMU is the reference point.

POS GPS antennae pairs are mounted to a 2 meter length of channel extrusion in a fore and aft orientation.

B.1.1.1 Vessel Offset Correctors

Vessel	FH_S250S_7125_512bms_400kHz			
Echosounder	Teledyne Reson SeaBat 7125 (400kHz 512 Beams)			
Date	2014-01-01			
Offsets			*Measurement*	*Uncertainty*
	MRU to Transducer	*x*	1.424 meters	0.050 meters
		y	0.380 meters	0.050 meters
		z	1.358 meters	0.050 meters
		x2		
		y2	meters	meters
		z2	meters	meters
	Nav to Transducer	*x*	4.528 meters	0.050 meters
		y	-2.320 meters	0.050 meters
		z	14.278 meters	0.050 meters
		x2		
		y2	meters	meters
		z2	meters	meters
	Transducer Roll	*Roll*	-4.500 degrees	

<table>
<tr><td>Vessel</td><td colspan="4">FH_S250S_7125_512bms_200kHz</td></tr>
<tr><td>Echosounder</td><td colspan="4">Teledyne Reson SeaBat 7125 (200kHz 256 Beams)</td></tr>
<tr><td>Date</td><td colspan="4">2014-01-01</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>1.424 meters</td><td>0.050 meters</td></tr>
<tr><td>y</td><td>0.380 meters</td><td>0.050 meters</td></tr>
<tr><td>z</td><td>1.358 meters</td><td>0.050 meters</td></tr>
<tr><td>x2</td><td></td><td></td></tr>
<tr><td>y2</td><td>meters</td><td>meters</td></tr>
<tr><td>z2</td><td>meters</td><td>meters</td></tr>
<tr><td rowspan="6">Nav to Transducer</td><td>x</td><td>4.528 meters</td><td>0.050 meters</td></tr>
<tr><td>y</td><td>-2.320 meters</td><td>0.050 meters</td></tr>
<tr><td>z</td><td>14.278 meters</td><td>0.050 meters</td></tr>
<tr><td>x2</td><td></td><td></td></tr>
<tr><td>y2</td><td>meters</td><td>meters</td></tr>
<tr><td>z2</td><td>meters</td><td>meters</td></tr>
<tr><td>Transducer Roll</td><td>Roll</td><td>-4.500 degrees</td><td></td></tr>
</table>

<table>
<tr><td>Vessel</td><td colspan="4">FH_S250P_7125_512bms_400kHz</td></tr>
<tr><td>Echosounder</td><td colspan="4">Teledyne Reson SeaBat 7125 (400kHz 512 Beams)</td></tr>
<tr><td>Date</td><td colspan="4">2014-01-01</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>-1.244 meters</td><td>0.050 meters</td></tr>
<tr><td>y</td><td>0.362 meters</td><td>0.050 meters</td></tr>
<tr><td>z</td><td>1.349 meters</td><td>0.050 meters</td></tr>
<tr><td>x2</td><td></td><td></td></tr>
<tr><td>y2</td><td>meters</td><td>meters</td></tr>
<tr><td>z2</td><td>meters</td><td>meters</td></tr>
<tr><td rowspan="6">Nav to Transducer</td><td>x</td><td>-2.246 meters</td><td>0.050 meters</td></tr>
<tr><td>y</td><td>-2.351 meters</td><td>0.050 meters</td></tr>
<tr><td>z</td><td>14.269 meters</td><td>0.050 meters</td></tr>
<tr><td>x2</td><td></td><td></td></tr>
<tr><td>y2</td><td>meters</td><td>meters</td></tr>
<tr><td>z2</td><td>meters</td><td>meters</td></tr>
<tr><td>Transducer Roll</td><td>Roll</td><td>4.500 degrees</td><td></td></tr>
</table>

Vessel	FH_S250P_7125_512bms_200kHz			
Echosounder	Teledyne Reson SeaBat 7125 (200kHz 256 Beams)			
Date	2014-01-01			
Offsets			*Measurement*	*Uncertainty*
	MRU to Transducer	*x*	-1.244 meters	0.050 meters
		y	0.362 meters	0.050 meters
		z	1.349 meters	0.050 meters
		x2		
		y2	meters	meters
		z2	meters	meters
	Nav to Transducer	*x*	-2.246 meters	0.050 meters
		y	-2.351 meters	0.050 meters
		z	14.269 meters	0.050 meters
		x2		
		y2	meters	meters
		z2	meters	meters
	Transducer Roll	*Roll*	4.500 degrees	

B.1.2 Layback

Side Scan Sonar was not used for this project.

Layback correctors were not applied.

B.2 Static and Dynamic Draft

B.2.1 Static Draft

Because of her SWATH design, FERDINAND R. HASSLER is particularly susceptible to loading and trim. While underway, the ballast is actively managed to maintain the draft at the design draft of 3.77 meters. During typical survey operations, HASSLER burns approximately 4,000 liters of diesel per day. At a density of 0.83 kilograms/liter this is approximately 3.3 metric tons of fuel per day. At design draft of 3.77 meters, 1.3 metric tons is required to submerge an additional 0.01 meters of the hull in salt water. The daily fuel burn would thus account for 0.03 meters of variation in the draft. Ballast is adjusted daily to account for fuel burn and the levels in other tanks. Uncertainty is estimated at 0.05 meters. The assumed design waterline of 3.8 meters and measured offsets to IMU were used to determine the static draft of the reference point.

B.2.1.1 Static Draft Correctors

Vessel		*S250* Port 200kHz	*S250* Stbd 200kHz	*S250* Port 400kHz	*S250* Stbd 400kHz
Date		2017-08-28	2017-08-28	2017-08-28	2017-08-28
Loading		0.05 meters	0.05 meters	0.05 meters	0.05 meters
Static Draft	*Measurement*	-2.383 meters	-2.383 meters	-2.383 meters	-2.383 meters
	Uncertainty	0.05 meters	0.05 meters	0.05 meters	0.05 meters

B.2.2 Dynamic Draft

Dynamic draft is calculated as the dynamic height of the vessel reference point as a function of vessel speed compared to the height at rest. This correction is applied during CARIS processing. An ellipsoidally referenced dynamic draft measurement (ERDDM) was performed on following guidelines in the 2014 FPM on August 30, 2017 (Dn242) for vessel S250. An area was selected about 12NM off the FL coast near Jacksonville where the slope of the geoid was minimal. Data were acquired with canards at zero trim angle. During all survey operations, the canards are set to zero trim angle. Speeds from 6 to 10 knots were run in one direction. The ship was then turned to the reciprocal heading, brought to a complete stop, and then the speeds from 6 to 10 knots were run in the opposite direction. The fourth order polynomial results for the dynamic draft curves from the port and starboard side were averaged. Averages are being calculated from all ERDDM tests since the installation of the buoyancy appendages in 2013. The 2017 results and comparisons between 2011 - 2017 can be found included in the attached appendices. Results from the last five years were averaged for use as the dynamic draft corrector values for 2017. Due to mechanical limitations of FH Launch 2702, no ERDDM was conducted.

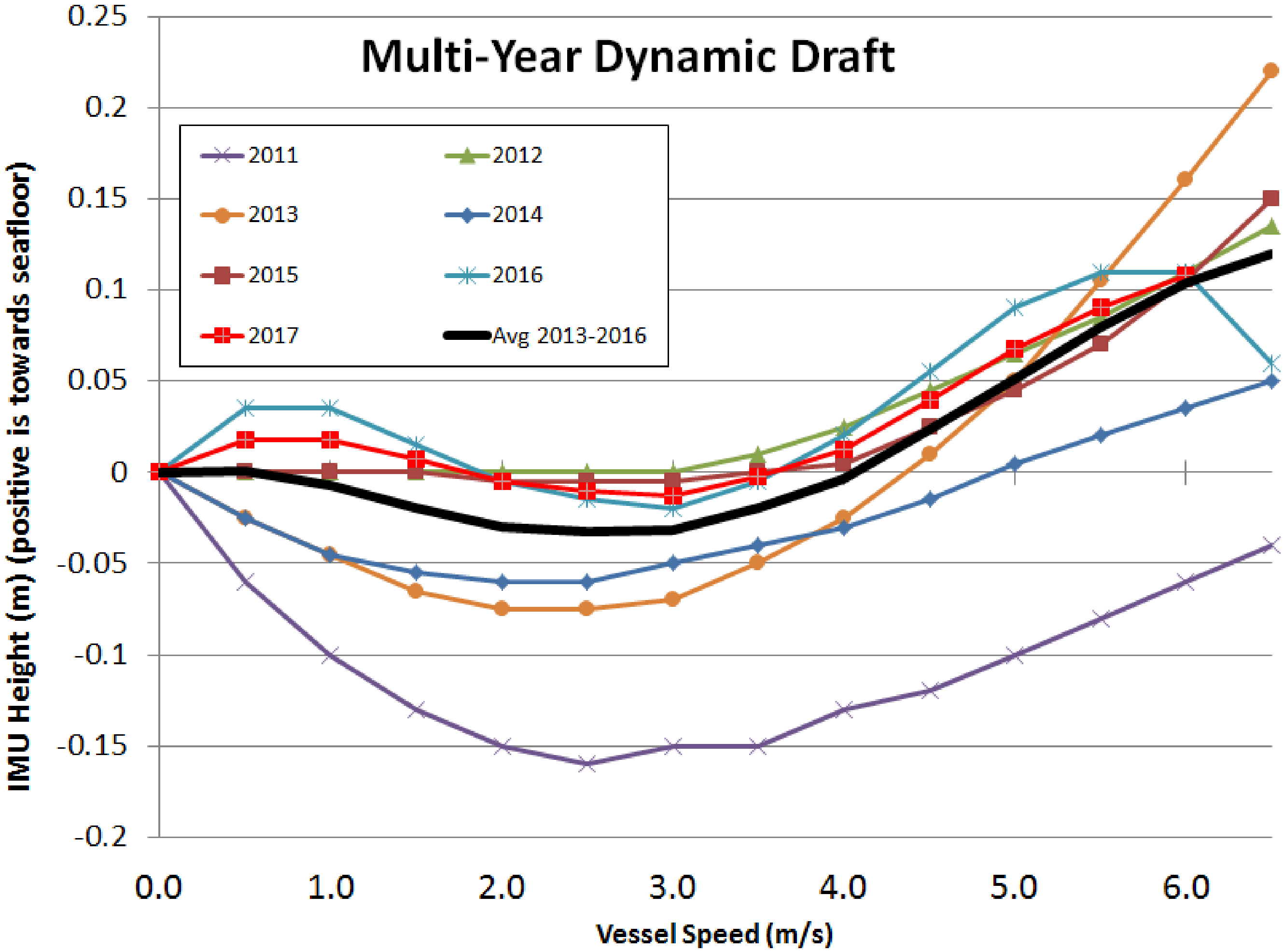


Figure 10: S250 dynamic draft derived from ERDDM methods comparison from 2011-2017

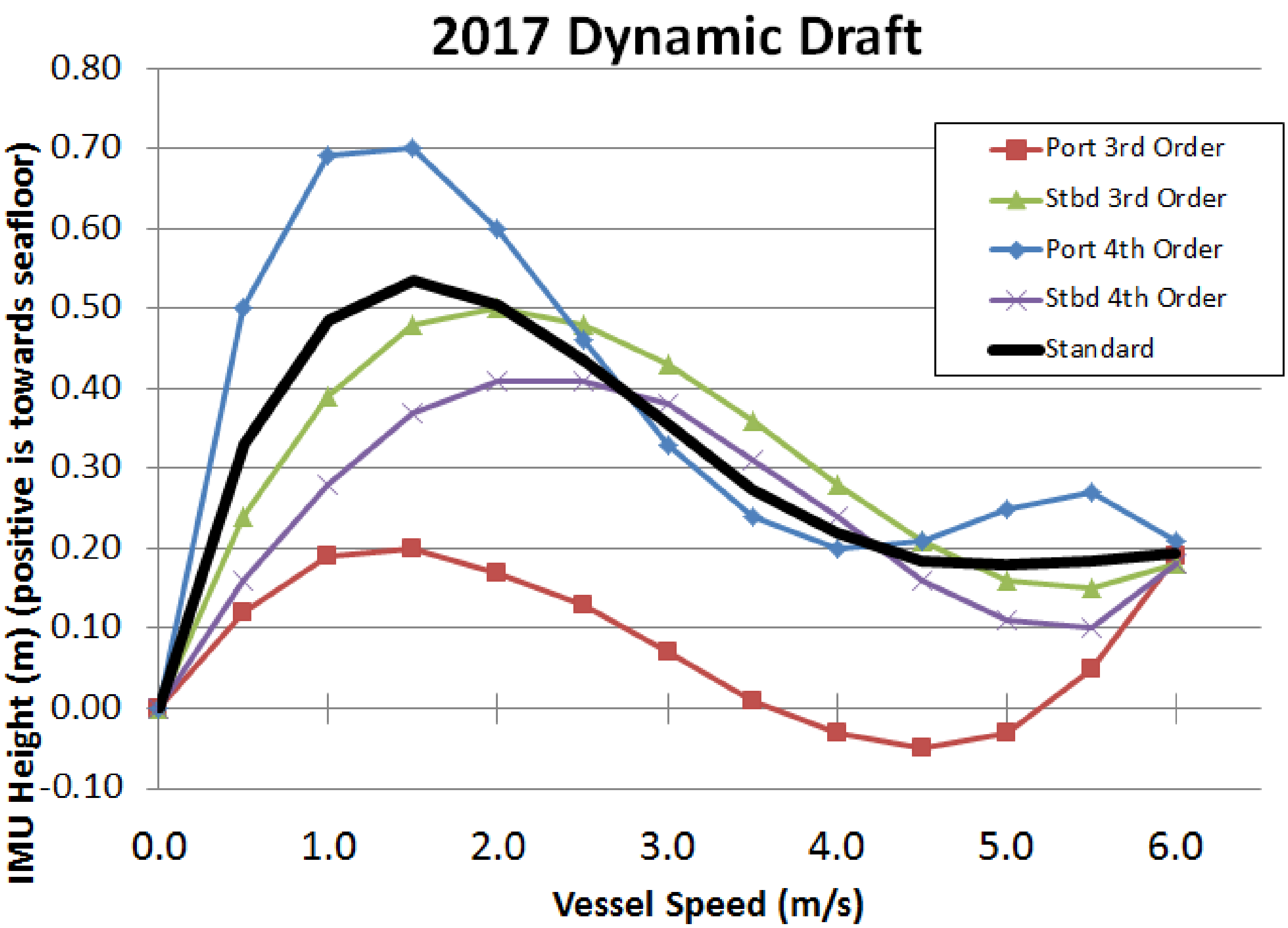


Figure 11: S250 dynamic draft derived from ERDDM methods.

B.2.2.1 Dynamic Draft Correctors

Vessel	*S250* Port 200kHz		*S250* Stbd 200kHz		*S250* Port 400kHz		*S250* Stbd 400kHz	
Date	2017-08-28		2017-08-28		2017-08-28		2017-08-28	
Dynamic Draft	*Speed (m/s)*	*Draft (m)*	*Speed (m/s)*	*Draft (m)*	*Speed (m/s)*	*Draft (m)*	*Speed (m/s)*	*Draft (m)*
	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
	0.5	0.00	0.5	0.00	0.5	0.00	0.5	0.00
	1.0	-0.01	1.0	-0.01	1.0	-0.01	1.0	-0.01
	1.5	-0.02	1.5	-0.02	1.5	-0.02	1.5	-0.02
	2.0	-0.03	2.0	-0.03	2.0	-0.03	2.0	-0.03
	2.5	-0.03	2.5	-0.03	2.5	-0.03	2.5	-0.03
	3.0	-0.03	3.0	-0.03	3.0	-0.03	3.0	-0.03
	3.5	-0.02	3.5	-0.02	3.5	-0.02	3.5	-0.02
	4.0	0.00	4.0	0.00	4.0	0.00	4.0	0.00
	4.5	0.02	4.5	0.02	4.5	0.02	4.5	0.02
	5.0	0.05	5.0	0.05	5.0	0.05	5.0	0.05
	5.5	0.08	5.5	0.08	5.5	0.08	5.5	0.08
	6.0	0.10	6.0	0.10	6.0	0.10	6.0	0.10
	6.5	0.12	6.5	0.12	6.5	0.12	6.5	0.12
Uncertainty	*Vessel Speed (m/s)*	*Delta Draft (m)*	*Vessel Speed (m/s)*	*Delta Draft (m)*	*Vessel Speed (m/s)*	*Delta Draft (m)*	*Vessel Speed (m/s)*	*Delta Draft (m)*
	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

B.3 System Alignment

B.3.1 System Alignment Methods and Procedures

Shallow water (18 meters) reference surfaces were performed in the vicinity of Jacksonville, FL on August 30, 2017 (Dn242). For the 200kHz systems, the starboard head was on average 0.03 meters deeper with a standard deviation of 0.05. For the 400kHz systems, the starboard head was on average 0.07 meters deeper with a standard deviation of 0.02.

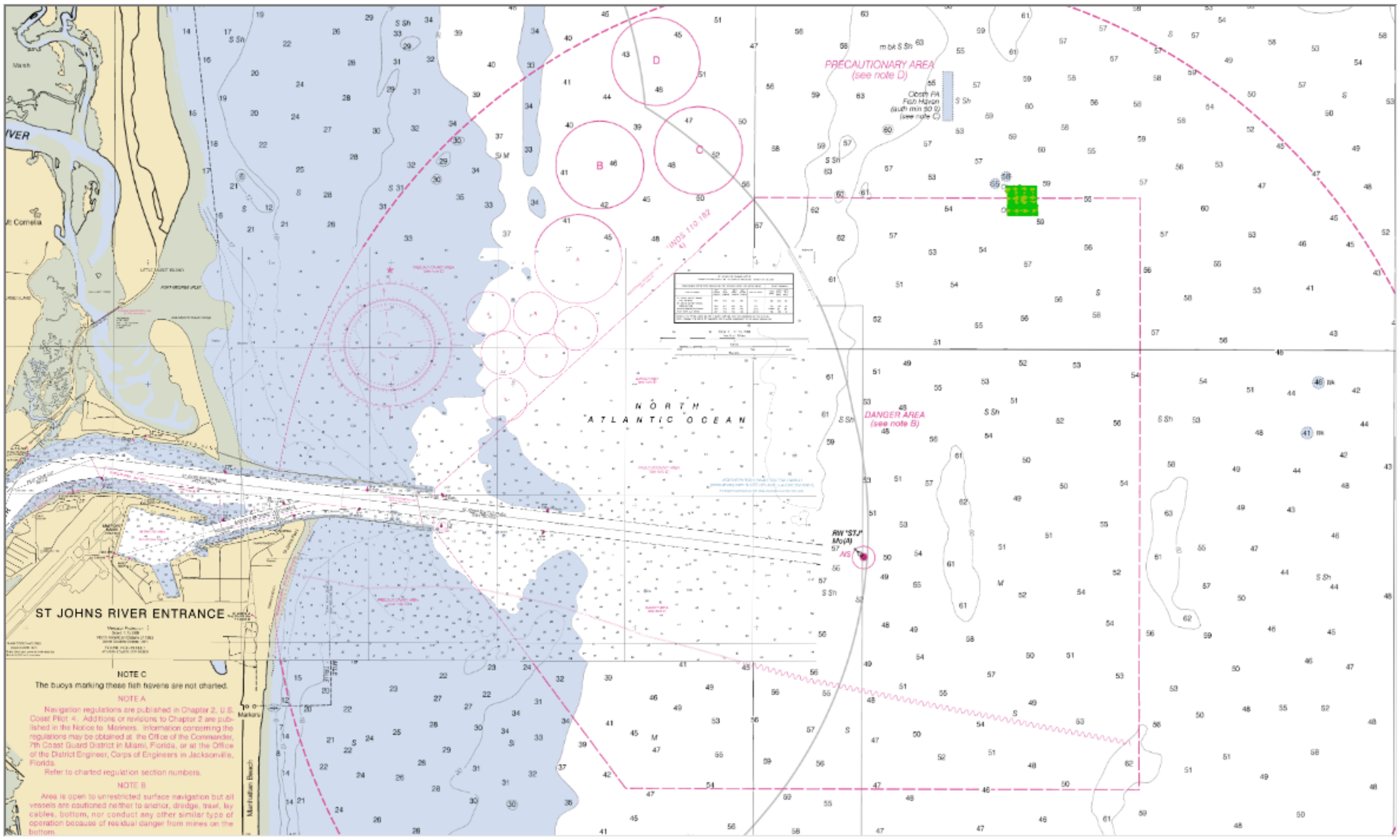


Figure 12: Reference surface general location near Jacksonville, FL

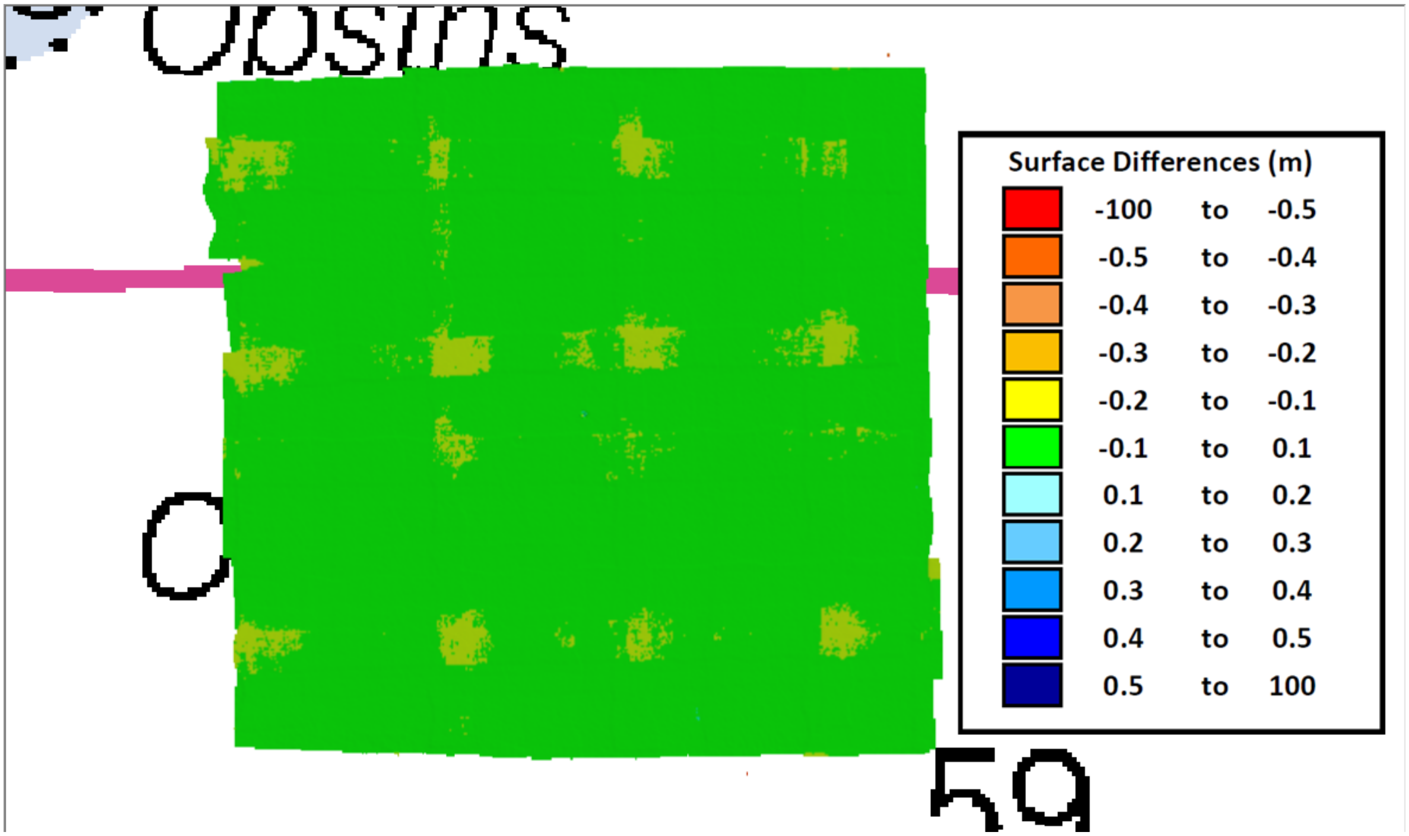
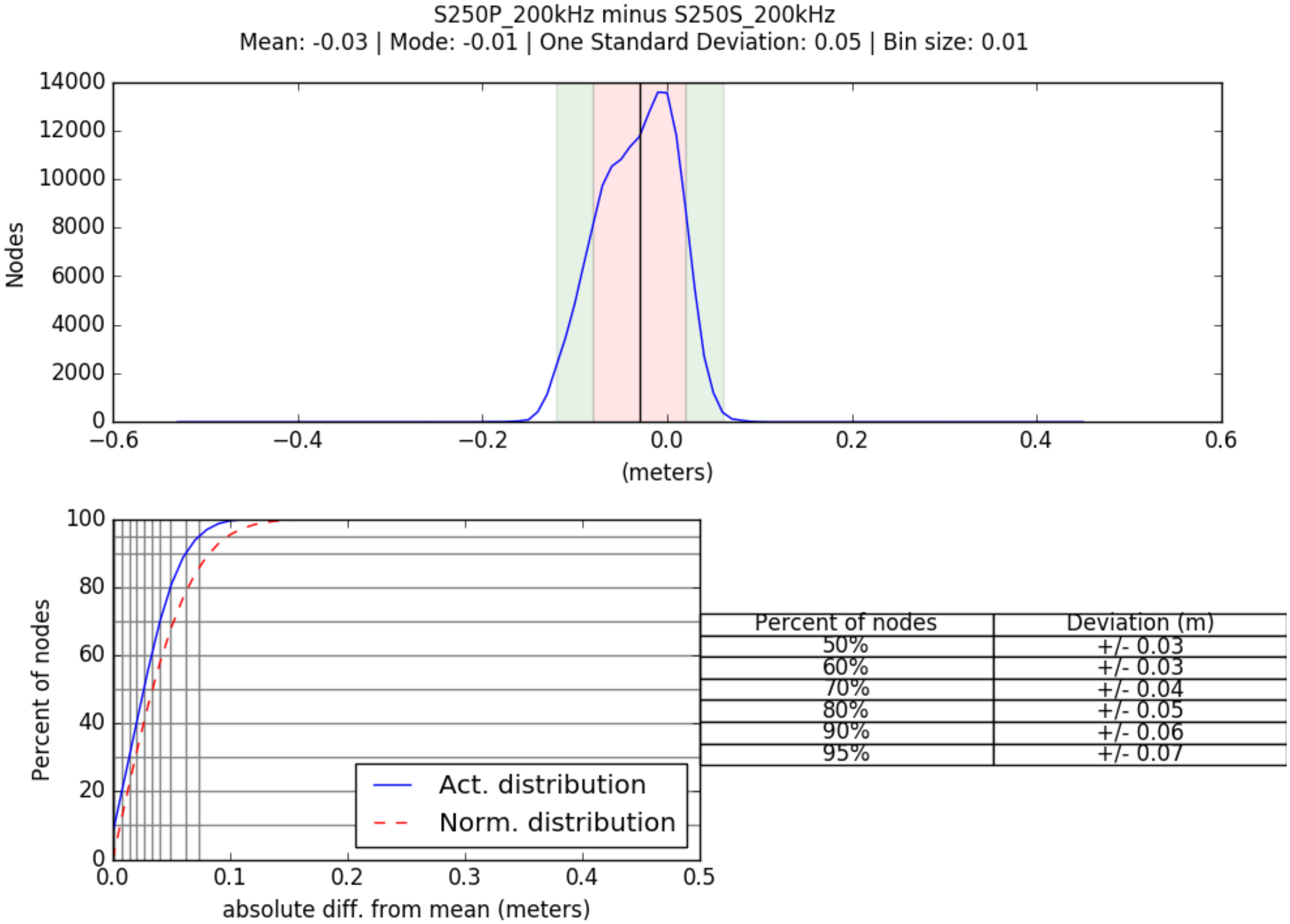


Figure 13: Difference surface; port RESON 7125 200kHz minus starboard RESON 7125 200kHz



Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.03
70%	+/- 0.04
80%	+/- 0.05
90%	+/- 0.06
95%	+/- 0.07

Figure 14: Statistics; port RESON 7125 200kHz minus starboard RESON 7125 200kHz

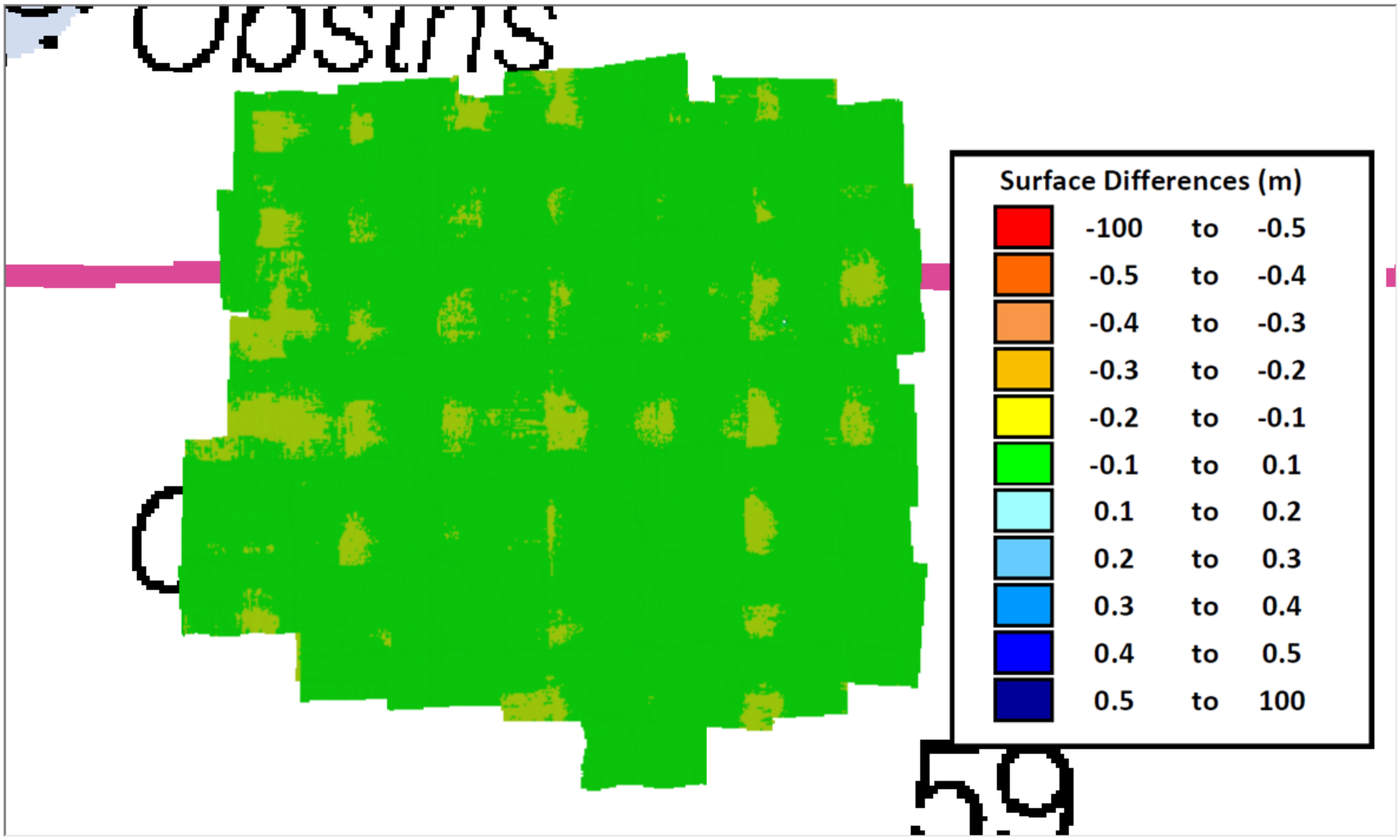
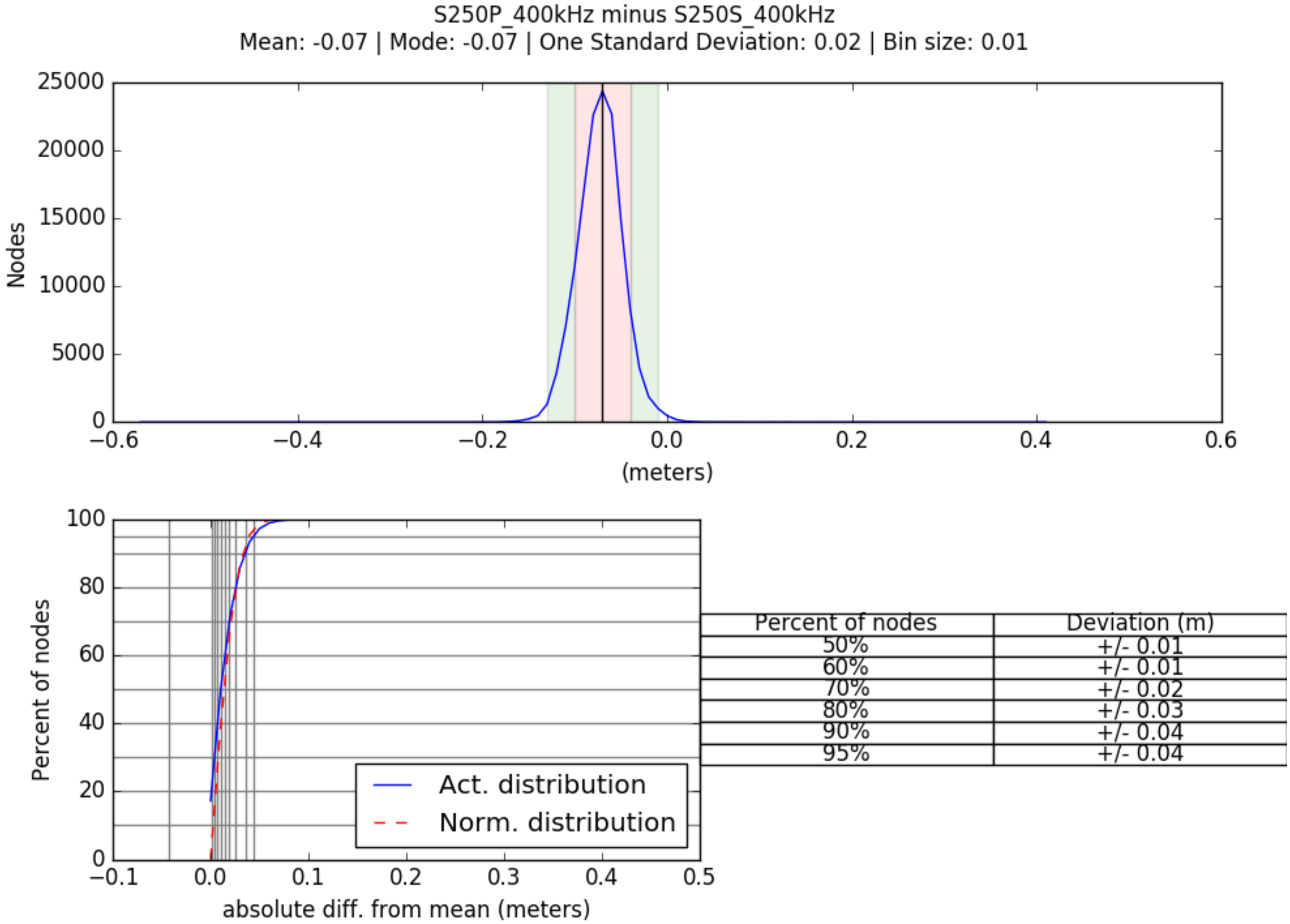


Figure 15: Difference surface; port RESON 7125 400kHz minus starboard RESON 7125 400kHz



Percent of nodes	Deviation (m)
50%	+/- 0.01
60%	+/- 0.01
70%	+/- 0.02
80%	+/- 0.03
90%	+/- 0.04
95%	+/- 0.04

Figure 16: Statistics; port RESON 7125 400kHz minus starboard RESON 7125 400kHz

B.3.1.1 System Alignment Correctors

Vessel	S250		
Echosounder	Teledyne Reson SeaBat 7125 (400kHz 512 Beams) Stbd 400kHz		
Date	2017-08-28		
Patch Test Values		*Corrector*	*Uncertainty*
	Transducer Time Correction	0.00 seconds	0.005 seconds
	Navigation Time Correction	0.00 seconds	0.005 seconds
	Pitch	-0.12 degrees	0.060 degrees
	Roll	0.07 degrees	0.060 degrees
	Yaw	0.31 degrees	0.090 degrees
	Pitch Time Correction	0.00 seconds	0.005 seconds
	Roll Time Correction	0.00 seconds	0.005 seconds
	Yaw Time Correction	0.00 seconds	0.005 seconds
	Heave Time Correction	0.00 seconds	0.005 seconds

Vessel	S250		
Echosounder	Teledyne Reson SeaBat 7125 (200kHz 256 Beams) Stbd 200kHz		
Date	2017-08-28		
Patch Test Values		*Corrector*	*Uncertainty*
	Transducer Time Correction	0.00 seconds	0.005 seconds
	Navigation Time Correction	0.00 seconds	0.005 seconds
	Pitch	-0.05 degrees	0.020 degrees
	Roll	0.17 degrees	0.020 degrees
	Yaw	0.43 degrees	0.120 degrees
	Pitch Time Correction	0.00 seconds	0.005 seconds
	Roll Time Correction	0.00 seconds	0.005 seconds
	Yaw Time Correction	0.00 seconds	0.005 seconds
	Heave Time Correction	0.00 seconds	0.005 seconds

Vessel	S250
Echosounder	Teledyne Reson SeaBat 7125 (400kHz 512 Beams) Port 400kHz
Date	2017-08-28
Patch Test Values	

	Corrector	*Uncertainty*
Transducer Time Correction	0.00 seconds	0.005 seconds
Navigation Time Correction	0.00 seconds	0.005 seconds
Pitch	0.20 degrees	0.080 degrees
Roll	-0.11 degrees	0.080 degrees
Yaw	-0.17 degrees	0.070 degrees
Pitch Time Correction	0.00 seconds	0.005 seconds
Roll Time Correction	0.00 seconds	0.005 seconds
Yaw Time Correction	0.00 seconds	0.005 seconds
Heave Time Correction	0.00 seconds	0.005 seconds

Vessel	S250
Echosounder	Teledyne Reson SeaBat 7125 (200kHz 256 Beams) Port 200kHz
Date	2017-08-28
Patch Test Values	

	Corrector	*Uncertainty*
Transducer Time Correction	0.00 seconds	0.005 seconds
Navigation Time Correction	0.00 seconds	0.005 seconds
Pitch	-0.19 degrees	0.060 degrees
Roll	-0.12 degrees	0.060 degrees
Yaw	-0.01 degrees	0.060 degrees
Pitch Time Correction	0.00 seconds	0.005 seconds
Roll Time Correction	0.00 seconds	0.005 seconds
Yaw Time Correction	0.00 seconds	0.005 seconds
Heave Time Correction	0.00 seconds	0.005 seconds

C Data Acquisition and Processing

C.1 Bathymetry

C.1.1 Multibeam Echosounder

Data Acquisition Methods and Procedures

Multibeam data on S250 are logged locally on the RESON topside machines in s7k format. Multibeam data are also acquired through Hypack/Hysweep in HSX format for bathymetry, though these files are only used in the event of errors in the s7k file and are otherwise discarded. The HSX format includes sounding solutions, navigation, and attitude data. Ship navigation and survey line monitoring are performed with Hypack/Hysweep. The s7k format includes sounding solutions, navigation, attitude, and backscatter snippet data. This record is configured to include the following RESON datagrams: 1003: Position; 1012: Roll, Pitch, Heave; 1013: Heading; 7000: 7k Sonar Settings; 7004: 7k Beam Geometry; 7006: 7k Bathymetric Data; 7008: Bathymetry (For UI Display Only); 7017: Bathymetry (RAW for hydrography); 7027: 7k Generic Watercolumn Data (used for snippets backscatter) and 7503: Remote Control Sonar Settings.

All multibeam sonars are configured in equidistant ("Best Coverage" in newest RESON version) beam steering mode. The opening angle of the 7125 systems is configured based on analysis of coverage, speed, and expected sound speed refraction errors for each survey. This angle typically varies between 120 and 140 degrees. Power, gain, and TVG parameters are typically set for a particular project and changes during acquisition are minimal.

The RESON units are interfaced with the acquisition machines through UDP LAN connections over a dedicated network switch (NetGear ProSafe Gigabit Switch). Position and attitude data are passed from the POS-MV to both the RESON machines and to the acquisition computers through dedicated network switches (NetGear ProSafe Gigabit Switch). There is a dedicated switch for the port and starboard POS systems. Time is passed from the POS to the RESON machines via an RS232 serial connection and a PPS pulse via a coaxial cable with BNC connectors. The starboard POS is interfaced with the starboard 7125, which is located in the starboard hull. The port POS is interfaced to the port 7125. A diagram of this configuration is included with the support files to this report.

Data acquired on Launch 2702 are processed by the Sonar Interface Module and delivered to the acquisition machine through a direct ethernet connection and logged using Hypack 2015 in the .HSX and R2Sonic .R2S formats. A swath angle of 120 degrees with the sector rotated 20 degrees to counteract the mounting angle on the hull is used as standard procedure. Bottom sampling is set to equidistant quad which distributes soundings evenly in the across-track direction. Roll stabilization is used and frequency can be adjusted on the fly from 200-400kHz. The sonar has the ability to log TruePix (similar to side scan with 3D relief), Snippets, and Water Column data.

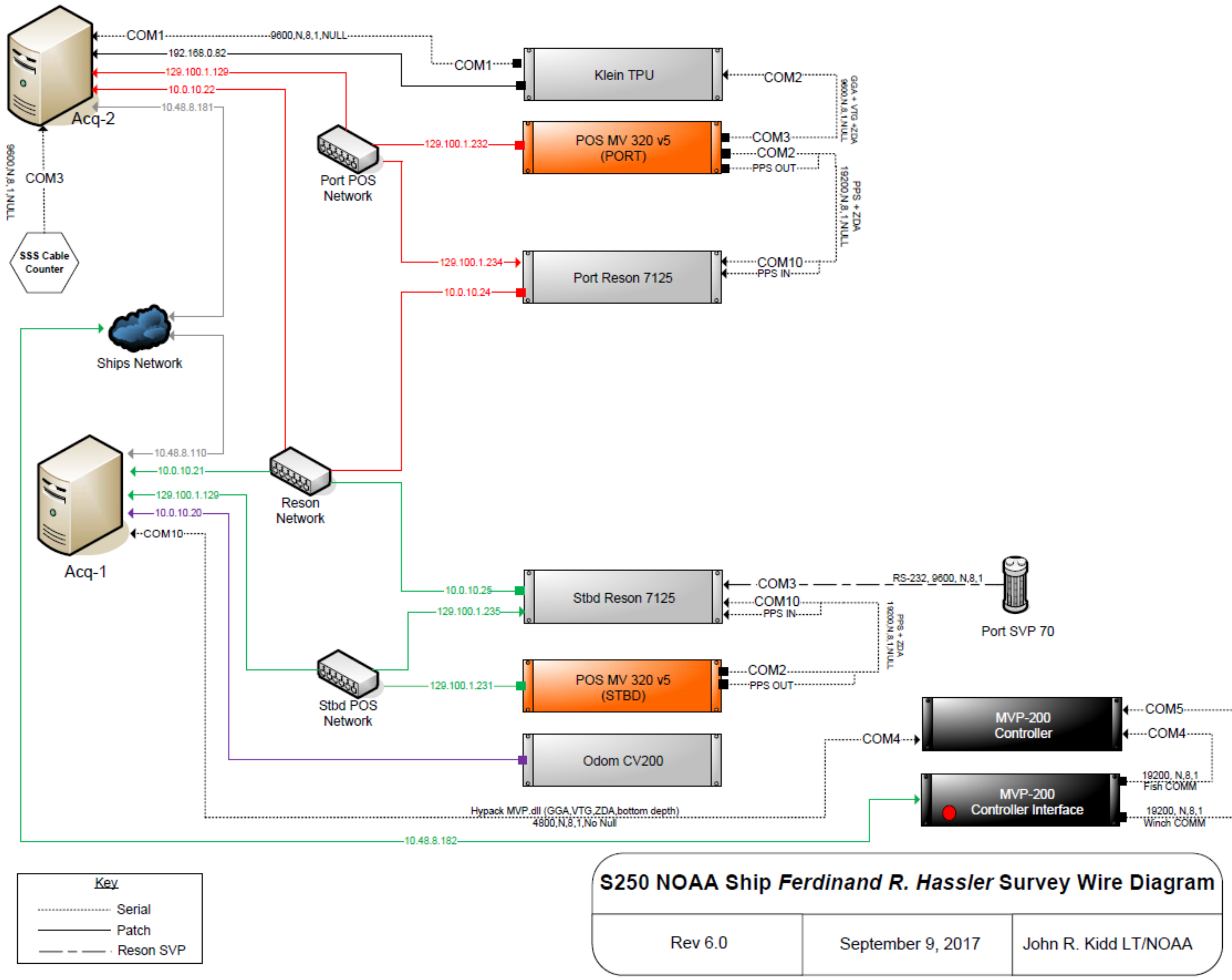


Figure 17: Ship survey systems wiring diagram.

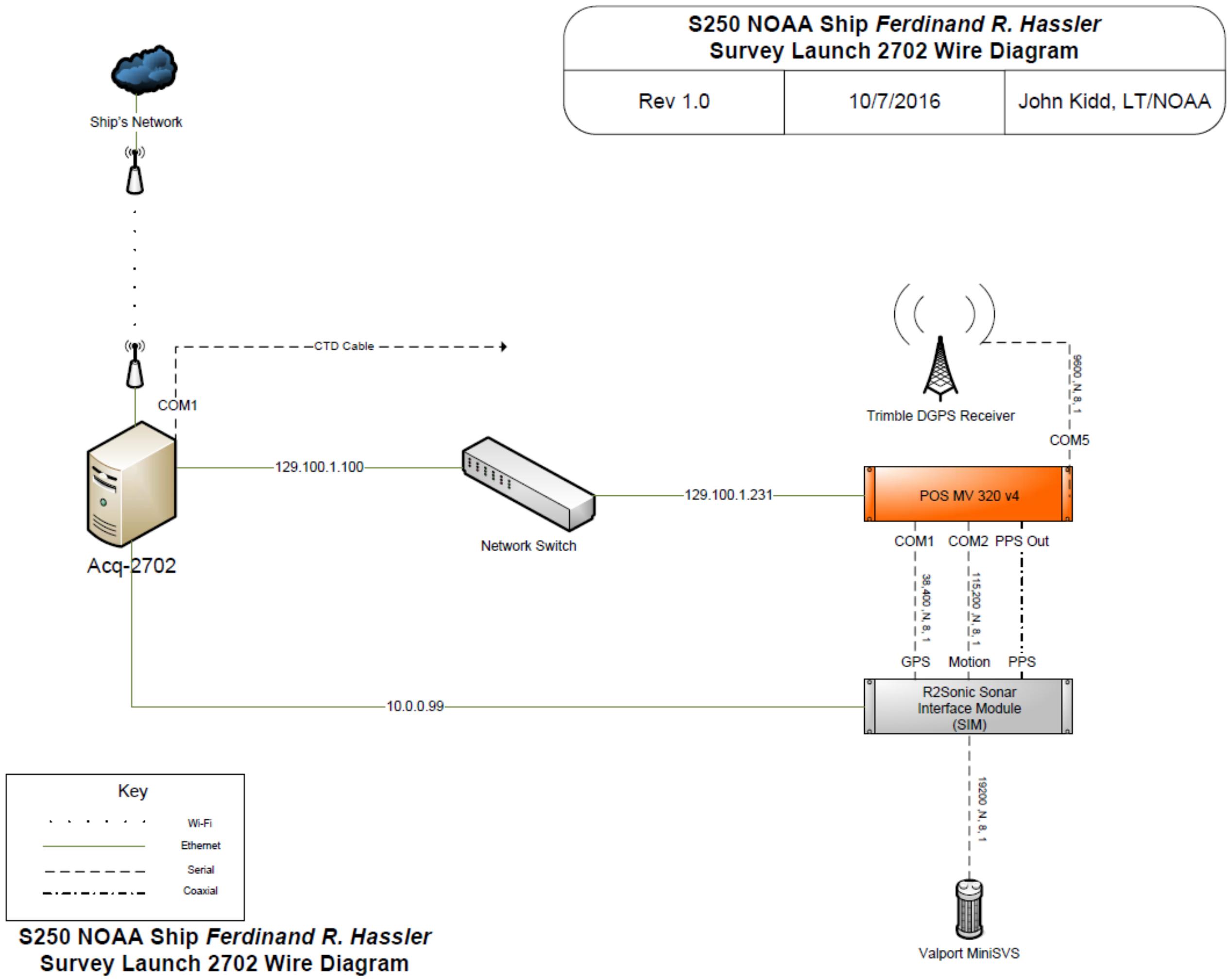


Figure 18: 2702 survey systems wiring diagram.

Data Processing Methods and Procedures

Bathymetry processing followed section 4.2 of the FPM unless otherwise noted. Raw .s7k (Reson 7125s) and .HSX/.R2S (R2Sonic 2022) multibeam data were converted to CARIS HIPS HDCS format using established and internally documented settings. After TrueHeave, water level correctors, Smoothed Best Estimate of Trajectory (SBET), attitude/navigation, and SBET RMS data are applied, GPS Tides are calculated using the HSD Operations Branch provided VDatum separation model. Sound speed correctors are then applied and finally the lines are merged. Once lines are merged, Total Propagated Uncertainty (TPU) is computed using settings documented for each survey in the Descriptive Report. Default CARIS device models (devicemodels.xml) are used during processing.

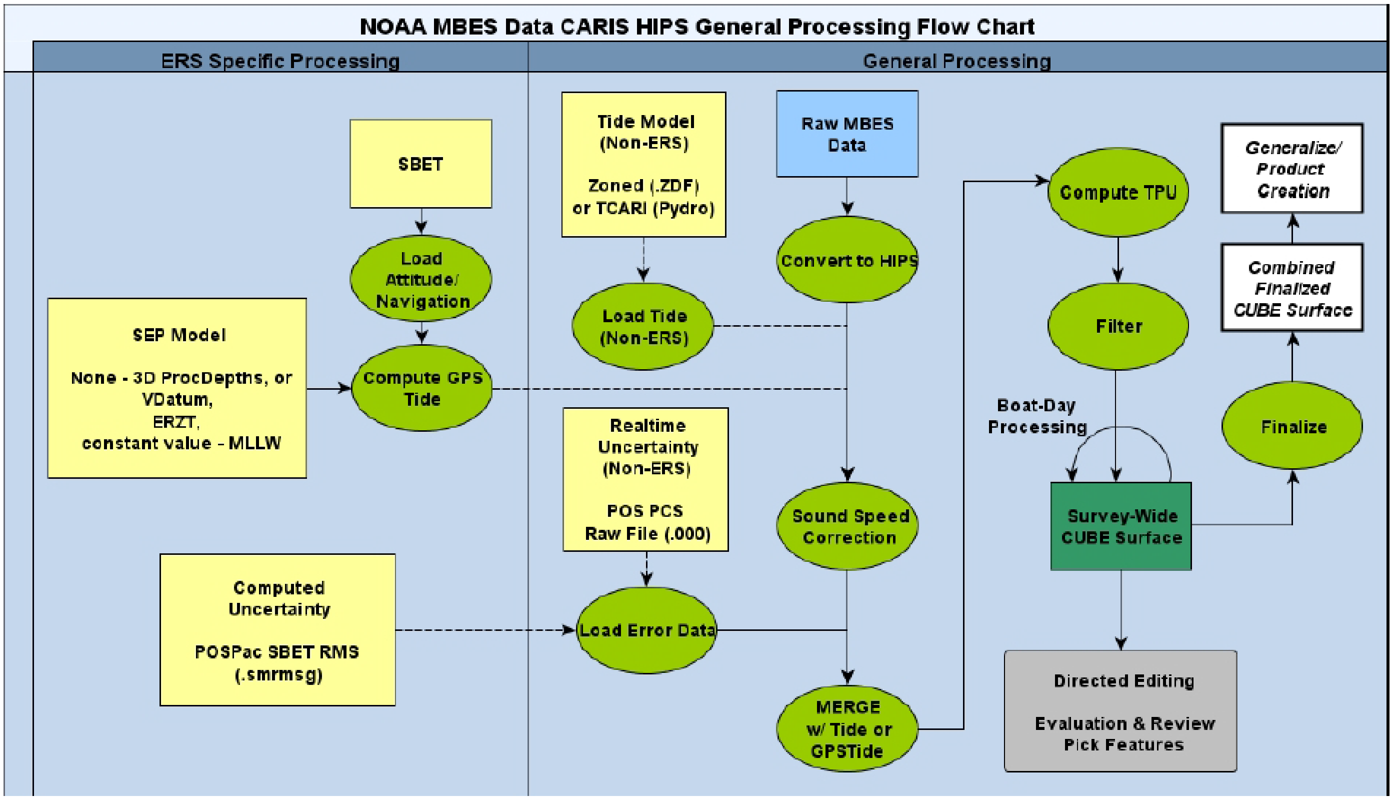


Figure 19: MBES flow diagram

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

The general resolution, depth ranges, and Combined Uncertainty and Bathymetric Estimator (CUBE) parameter settings outlined in section 5.2.2.2 of the HSSD, section 4.2.1.1.1.1 of the FPM, and HTD 2017-2 Variable Resolution Bathymetric Grids are used for surface creation and analysis. If these depth range values for specific resolutions require adjustment for analysis and submission of individual surveys then the required waiver from NOAA HSD Operations is requested. A detailed listing of the resolutions and the actual depth ranges used during the processing of each survey is provided in the Descriptive Report of each survey.

C.1.4.2 Depth Derivation

The surface filtering function in CARIS HIPS is not utilized routinely. If utilized, the individual Descriptive Report lists the confidence level settings for standard deviation used and discuss the particular way the surface filter was applied.

C.1.4.3 Surface Computation Algorithm

BASE surfaces were created using the CUBE algorithm and parameters contained in the NOAA CUBEParams_NOAA_2017.xml file as provided by HSTB. The CUBEParams_NOAA_2017.xml file is included with the HIPS Vessel Files with the individual survey data. The NOAA parameter configurations for variable resolution are used.

The Density & Locale method for hypothesis disambiguation is used. This follows section 4.2.1.1.1 of the FPM as available disambiguation methods. The disambiguation method can be seen in each individual layers properties and can be modified if desired.

C.2 Imagery

C.2.1 Multibeam Backscatter Data

Data Acquisition Methods and Procedures

Backscatter is acquired in the 7008 record logged in the .s7k files directly from the RESON 7125 processors. For the 7125 400kHz systems, snippet size is set to 25 samples in water depths less than 50 meters and to 50 samples in depth greater than 50 meters. The 7125 200kHz system has snippets size set to 100 in depths less than 100 meters and 200 in all depths greater than 100 meters.

Data Processing Methods and Procedures

All processing of backscatter is done using the FM Geocoder Toolbox module of the QPS Fledermaus package. Backscatter processing complies with guidance provided in HTD 2017-4 Processed Backscatter.

C.2.2 Side Scan Sonar

Side scan sonar imagery was not acquired.

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

Data Acquisition Methods and Procedures

Preliminary, observed, and verified water levels are downloaded using FetchTides.

Data Processing Methods and Procedures

Preliminary, observed, and verified water levels are applied to the data using CARIS HIPS Load Tide function. For data submission, depth data are reduced to MLLW either through application of Verified Water levels and Verified Tidal Zoning or using GPS derived vertical positions and the VDatum model. Refer to individual sheet DRs for detailed methods and additional information.

C.3.2.2 Optical Level Data

Optical level data was not acquired.

C.4 Vessel Positioning

Data Acquisition Methods and Procedures

Vessel navigation and attitude is measured by the POS/MV and recorded in the Hysweep .HSX file and the RESON .s7k file.

The Fugro MarineStar satellite based corrector service is used to provide realtime correction to the horizontal position and ellipsoid height for all data acquisition and initial processing. The corrector signal is received on the L1 channel of the POS/MV primary GPS antenna and logged directly into the POS/MV .000 files.

The heave lever arms for S250 are configured to a point on the centerline of the vessel between the two POS IMUs. This is done to prevent long-term static roll angles from causing a steady state heave offset.

Data Processing Methods and Procedures

The POS/MV TrueHeave data are logged within the POS/MV .000 files and are applied in CARIS HIPS during post processing using the "Import/Axillary Data/Applanix POS M/V" function. TrueHeave is a forward-backward filtered heave corrector as opposed to the real time heave corrector, and is fully described in section 6 of the POS/MV V5 User Guide 2011 and V4 User Guide 2009.

The POS files produced during acquisition which contain the Fugro MarineStar satellite based correctors are processed through the POSPac MMS software to produce an SBET in the NAD83 reference frame and an RMS file containing the realtime uncertainty estimates of the position and attitude data. The resulting SBET and RMS files are then applied in CARIS HIPS during post processing using the "Import/Axillary Data/Applanix SBET" and "Import/Axillary Data/Applanix RMS" functions, respectively.

C.5 Sound Speed

C.5.1 Sound Speed Profiles

Data Acquisition Methods and Procedures

Seabird SBE 19plus and MVP sound speed profilers are used regularly to collect sound speed data for ray tracing corrections for the multibeam sonar systems. Due to the time saving potential, the MVP is the primary means of collecting sound speed data. If necessary, the SBE 19plus is hand deployed from the stern.

Casts are taken at least every four hours, but typically far more frequently. The interval between casts is typically between ten and forty minutes based on the observed variability between casts. The Survey Data Monitoring tab within Sound Speed Manager is used to run CastTime which assists the hydrographer determine an appropriate frequency to conduct sound speed profiles.

Data Processing Methods and Procedures

Data are downloaded from the Seabird CTDs with a serial connection to a processing computer in the form of .HEX and .cnv files. Data are instantly transmitted from the MVP towfish to a processing computer once a dynamic cast is completed in the form of .s12, .calc, .eng, .raw, and .log files. Data from both the Seabird and MVP are then processed through Sound Speed Manager to produce CARIS .svp formatted sound velocity profiles. All .svp profiles for a survey sheet are then concatenated to one master file for a survey.

C.5.2 Surface Sound Speed

Data Acquisition Methods and Procedures

Surface sound speed for both Reson 7125's is fed from individual SVP-70 sound velocity sensors mounted near each transducer. While operating in dual-head mode and due to the starboard cable being inoperable, the port SVP-70 feeds both the master and slave.

Data Processing Methods and Procedures

The data collected by the SVP-70 sound velocity sensor are used for realtime beam steering. Sound speed DQAs are conducted by using Pydro's Sound Speed Manager to compare the measured sound speed from the SVP-70 to the measured sound speed from the MVP or CTD at the same depth.

C.6 Uncertainty

C.6.1 Total Propagated Uncertainty Computation Methods

TPU is calculated in CARIS HIPS using the Compute TPU tool. Project specific values for tide and sound speed are entered and used over the duration of each project. Error values for the multibeam and positioning systems were compiled from manufacturer specifications sheets for each sensor and from values set forth in section 4.2.3.8 of the 2014 FPM.

C.6.2 Uncertainty Components

A Priori Uncertainty

Vessel		S250 Port 200kHz	S250 Stbd 200kHz	S250 Port 400kHz	S250 Stbd 400kHz
Motion Sensor	*Gyro*	0.02 degrees	0.02 degrees	0.02 degrees	0.02 degrees
	Heave	5.00% 0.05 meters	5.00% 0.05 meters	5.00% 0.05 meters	5.00% 0.05 meters
	Roll	0.02 degrees	0.02 degrees	0.02 degrees	0.02 degrees
	Pitch	0.02 degrees	0.02 degrees	0.02 degrees	0.02 degrees
Navigation Sensor		1.00 meters	1.00 meters	0.50 meters	0.50 meters

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

Data Acquisition Methods and Procedures

Bottom Sampling followed guidelines set forth in sections 7.1 of the HSSD and 2.5.4.2.1 of the FPM. Unless specified otherwise in the DR, bottom sample locations are guided by analysis of the backscatter and bathymetry of the survey area. Refer to individual sheet DR for additional information.

Data Processing Methods and Procedures

Drop camera video files were processed using VLC Media Player to clip the video starting just before the bottom sampler lands on the sea floor and ending just after recovery was initiated. Bottom sample attribution was conducted as prescribed in section 7.2.3 of the HSSD.

D Data Quality Management

D.1 Bathymetric Data Integrity and Quality Management

D.1.1 Directed Editing

Multibeam data were reviewed and edited in HIPS Subset Editor as necessary. The finalized BASE surfaces, CUBE hypotheses, and python based program, Flyer Finder, guided directed data editing at the appropriate depth range in subset editor. The surfaces and subset editor views were also used to demonstrate coverage and to check for errors due to tides, sound speed, attitude and timing.

Vessel heading, attitude, and navigation data were reviewed with the HIPS navigation editor and attitude editor as deemed necessary upon review of surfaces. Where necessary, fliers or gaps in heading, attitude, or navigation data were manually rejected or interpolated for small periods of time. Any editing of this nature is outlined in the Descriptive Report for the particular survey.

D.1.2 Designated Sounding Selection

Designated soundings were selected as outlined in section 5.2.1.2.3 of the HSSD.

D.1.3 Holiday Identification

The identification of holidays was accomplished by visual inspection of BASE surfaces in addition to using the python based program, Holiday Finder. Holidays were identified as outlined in section 5.2.2.3 of the HSSD.

D.1.4 Uncertainty Assessment

IHO child layers were created using the following two formulas for IHO_1 and IHO_2, respectively; -Uncertainty/((0.5^2 +((Depth*0.013)^2))^0.5) and -Uncertainty/((1.0^2 +((Depth*0.023)^2))^0.5). IHO_1 is created for all soundings less than 100 meters while IHO_2 is for 100 meters and deeper. This layer is then exported and run through an application which computes statistics. The results are reported and analyzed in each sheets' individual DR, but the layers are not submitted with the survey.

D.1.5 Surface Difference Review

D.1.5.1 Crossline to Mainscheme

A crossline to mainscheme comparison was conducted as outlined in section 5.2.4.3 of the HSSD.

D.1.5.2 Junctions

Junction comparisons were conducted as outlined in section 7.2.2 of the HSSD.

D.1.5.3 Platform to Platform

Due to multibeam sonar configuration geometry, the port and starboard sonars have a significant amount of overlap that exists between the inboard areas of each swath. These areas of overlap are differenced to assess platform to platform parity. If substantial discrepancies are observed, the results are notated in the Descriptive Report for the particular survey.

D.2 Imagery data Integrity and Quality Management

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

List of Appendices:

Mandatory Report	***File***
Vessel Wiring Diagram	:\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \FH_2017_Wiring_Diagram.pdf :\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \2702_2017_Wiring_Diagram.pdf
Sound Speed Sensor Calibration	:\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images\8615 Calibration Certificate Pressure_7260.pdf :\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images\8615 Calibration Certificate Temperature_7257.pdf :\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images\008615 Calibration Certificate Conductivity_7262.pdf :\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \CalibrationReport 19P-6918_2017.pdf
Vessel Offset	:\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \S250_Offsets_2013_SFG.xlsx
Position and Attitude Sensor Calibration	:\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \S250_POS_GAMS_Report_2017.xls
Echosounder Confidence Check	
Echosounder Acceptance Trial Results	

Additional Report	***File***
Ellipsoid Referenced Dynamic Draft Model Report	:\07_Systems\DAPR_2017_post_alongside_repai\DAPR_images \ERDDM Summary 2017.xlsx

E. Approval Sheet

As Chief of Party, I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Date	Signature
Matthew Jaskoski, LCDR/NOAA	Chief of Party	10/03/2017	Digitally signed by JASKOSKI.MATTHEW.J.1275636262 Date: 2017.10.04 09:58:32 -04'00'
John Kidd, LT/NOAA	Operations Officer	10/03/2017	LT/NOAA 2017.10.04 09:30:56 -04'00'