H12801

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

DESCRIPTIVE REPORT

Type of Survey: Navigable Area

Registry Number: H12801

LOCALITY

State(s): Rhode Island

General Locality: Rhode Island Sound and Approaches

Sub-locality: Nomans Land

2015

CHIEF OF PARTY
LCDR Briana J. Welton, NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12801

INSTRUCTIONS: The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

State(s):	**Rhode Island**
General Locality:	**Rhode Island Sound and Approaches**
Sub-Locality:	**Nomans Land**
Scale:	**20000**
Dates of Survey:	**06/10/2015 to *07/24/2015***
Instructions Dated:	**05/22/2015**
Project Number:	**OPR-B307-FH-15**
Field Unit:	**NOAA Ship Ferdinand R. Hassler**
Chief of Party:	**LCDR Briana J. Welton, NOAA**
Soundings by:	**Multibeam Echo Sounder Multibeam**
Imagery by:	**Echo Sounder Backscatter Atlantic**
Verification by:	**Hydrographic Branch meters at Mean**
Soundings Acquired in:	**Lower Low Water**

Remarks:

The purpose of this survey is to provide contemporary surveys to update National Ocean Service (NOS) nautical charts. All separates are filed with the hydrographic data. Any revisions to the Descriptive Report (DR) generated during office processing are shown in bold red italic text. The processing branch maintains the DR as a field unit product, therefore, all information and recommendations within the body of the DR are considered preliminary unless otherwise noted. The final disposition of surveyed features is represented in the OCS nautical chart update products. All pertinent records for this survey, including the DR, are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/.

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Descriptive Report to Accompany Survey H12801

Project: OPR-B307-FH-15

Locality: Rhode Island Sound and Approaches

Sublocality: Nomans Land

Scale: 1:20000

June 2015 - July 2015

NOAA Ship Ferdinand R. Hassler

Chief of Party: LCDR Briana J. Welton, NOAA

A. Area Surveyed

Survey H12801 was conducted in Rhode Island Sound around Nomans Land Island as shown in Figure 1.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
41° 20' 19.7" N 70° 53' 0.47" W	41° 13' 2.53" N 70° 42' 20.07" W

Table 1: Survey Limits

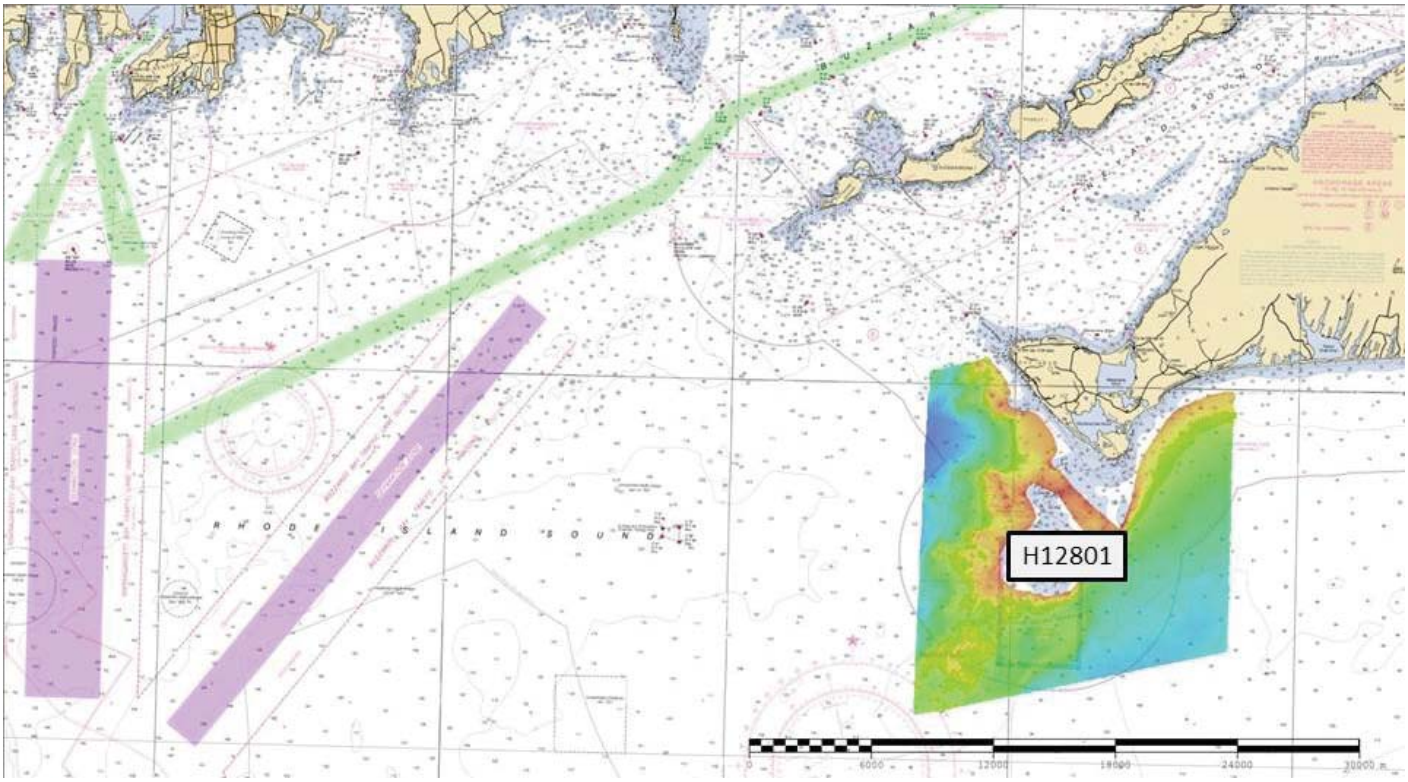


Figure 1: The general locality of the H12801 survey area.

Complete coverage is not achieved due to the lack of an appropriate near shore vessel. FERDINAND R. HASSLER personnel decided unsafe survey conditions exist inshore of the 30-foot contour. Continuous coverage was extended inshore of the North East sheet limit due to reasonable water depth. In addition to using the 30-foot contour as a boundary for the inshore limit, the ship did not enter the near shore areas along Martha's Vineyard that were marked as fish trap areas due to the potential for submerged gear or structures that could be a danger to the ship.

A.2 Survey Purpose

The purpose of this project is to support safe navigation through the acquisition and processing of hydrographic data by updating NOS nautical charting products charts and by the identification and dissemination of dangers to navigation as identified during the course of survey operations.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Only one holiday was found to exist. This holiday was coincidentally covered by a crossline and no significant features were seen in the crossline data.

A.4 Survey Coverage

The following table lists the coverage requirements for this survey as assigned in the project instructions:

Water Depth	Coverage Required
All waters in survey area	A) Complete MBES with backscatter, or B) 100% SSS with concurrent set line spacing MBES with backscatter. Note: Complete MBES is sufficient for both determination of least depth identified with SSS and for disproving a feature - 100% SSS is insufficient to disprove a feature. Refer to Seciton 6.1.2 of the HSSD to confirm proper SSS acquisition parameters. Gaps in SSS coverage should be treated as gaps in MBES coverage and addressed accordingly. H12801 was acquired using option A, complete MBES with backscatter.

Survey coverage was in accordance with the requirements listed above and in the HSSD.

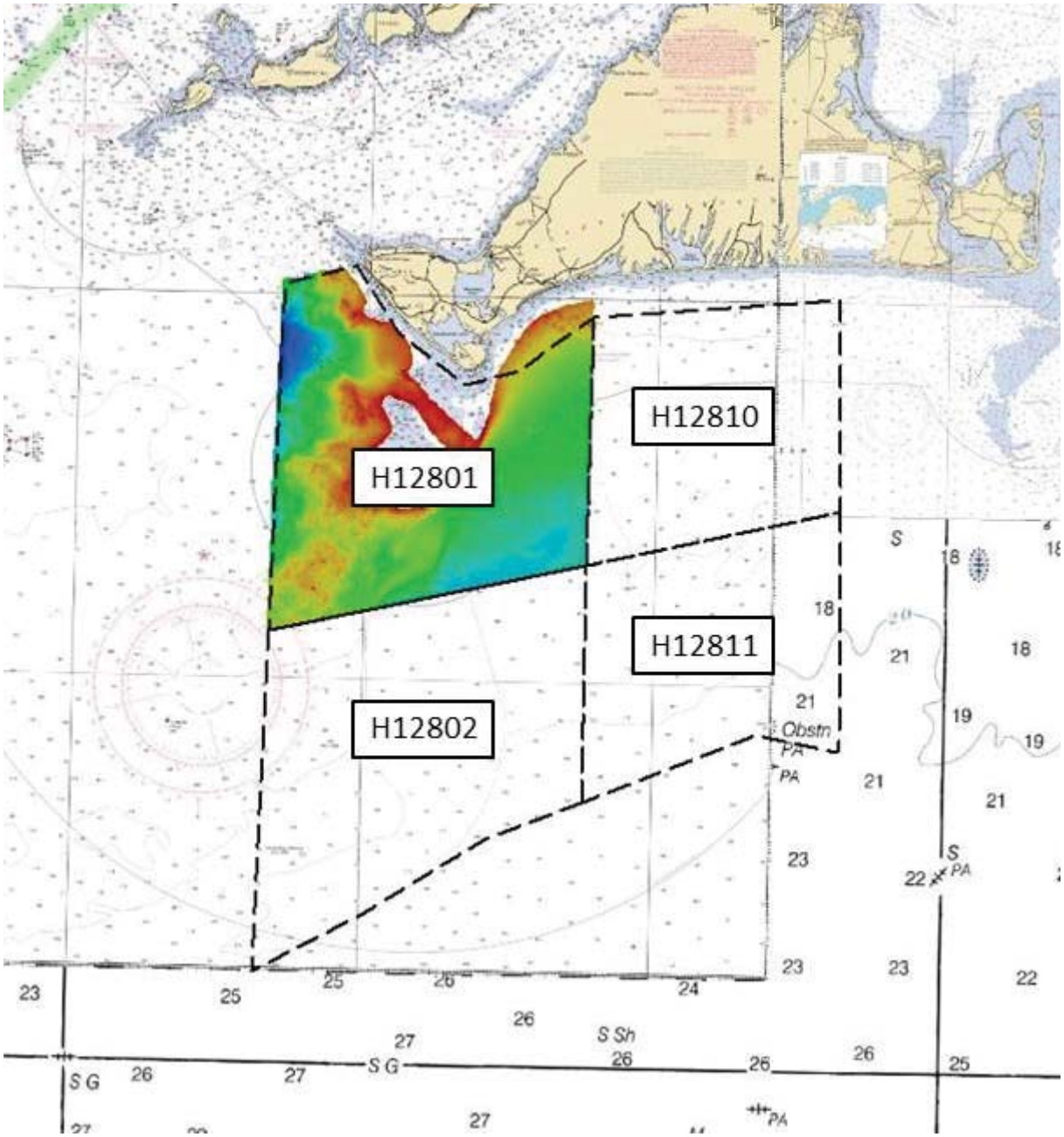


Figure 2: Survey layout for OPR-B307-FH-15 plotted over Chart 13218, 13233, 13237, and 13200.

A.5 Survey Statistics

The following table lists the mainscheme and crossline acquisition mileage for this survey:

	HULL ID	*S250*	*Total*
LNM	SBES Mainscheme	0	0
	MBES Mainscheme	1199.56	1199.56
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/SSS Mainscheme	0	0
	MBES/SSS Mainscheme	0	0
	SBES/MBES Crosslines	57.55	57.55
	Lidar Crosslines	0	0
Number of Bottom Samples			15
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Investigated by Dive Ops			0
Total SNM			51.9

Table 2: Hydrographic Survey Statistics

The following table lists the specific dates of data acquisition for this survey:

Survey Dates	Day of the Year
06/10/2015	161
06/11/2015	162

Survey Dates	Day of the Year
06/12/2015	163
06/13/2015	164
06/14/2015	165
06/16/2015	167
06/17/2015	168
06/18/2015	169
06/25/2015	176
06/26/2015	177
06/27/2015	178
06/28/2015	179
07/01/2015	182
07/17/2015	198
07/18/2015	199
07/22/2015	203
07/24/2015	205

Table 3: Dates of Hydrography

Mainscheme survey lines were run with a dual-head multibeam echosounder configuration with the exception of DN165, 167, 168, and 169 due to a malfunctioning starboard transducer. To calculate the total linear nautical miles for the survey, statistics were generated using the port transducer data to fully encompass the linear nautical miles surveyed.

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the Data Acquisition and Processing Report (DAPR) for a complete description of data acquisition and processing systems, survey vessels, quality control procedures and data processing methods. Additional information to supplement sounding and survey data, and any deviations from the DAPR are discussed in the following sections.

B.1.1 Vessels

The following vessels were used for data acquisition during this survey:

Hull ID	***S250***
LOA	37.7 meters
Draft	3.77 meters

Table 4: Vessels Used

Figure 3: NOAA Ship FERDINAND R. HASSLER alongside pier at Marine Operations Center - Atlantic.

NOAA Ship FERDINAND R. HASSLER (S250), Shown in Figure 3, acquired all data within the limits of H12801.

B.1.2 Equipment

The following major systems were used for data acquisition during this survey:

Manufacturer	Model	Type
Reson	7125	MBES
Applanix	POS M/V 320 V5	Positioning and Attitude System
Hemisphere	MBX-4	Positioning System
Brooke Ocean	MVP-200	Sound Speed System
AML	MicroCTD	Conductivity, Temperature, and Depth Sensor
Reson	SVP-70	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 4.80% of mainscheme acquisition.

Multibeam crosslines were acquired using the RESON 7125 on DN161, DN198, and DN199. A geographic plot of crosslines is shown in Figure 4. Crosslines were filtered to remove soundings greater than 45 degrees from nadir. To evaluate crossline agreement, two 2-meter surfaces were created: one from crossline bathymetry, the other from mainscheme bathymetry. These two surfaces were differenced using CARIS HIPS and SIPS. The statistical analysis of the differences between the mainscheme and crossline surfaces is shown in Figure 5. The average difference between the surfaces is 0.05 meters with a standard deviation of 0.12 meters. 95% of nodes agree within +/- 0.20 meters.

Note: There are some lines that appear to be crosslines but are not included in the crossline analysis because their intended use was ERS checklines.

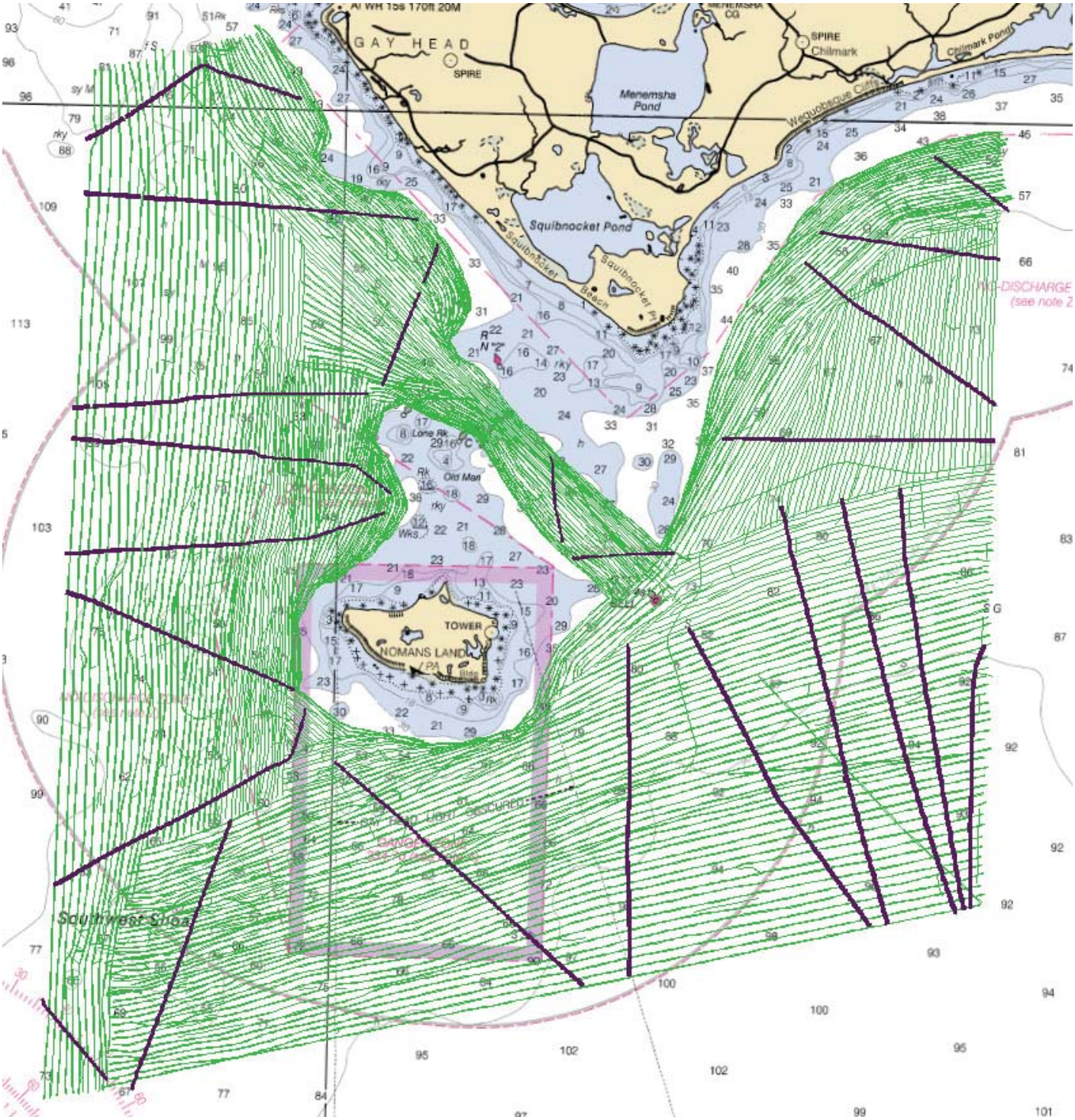
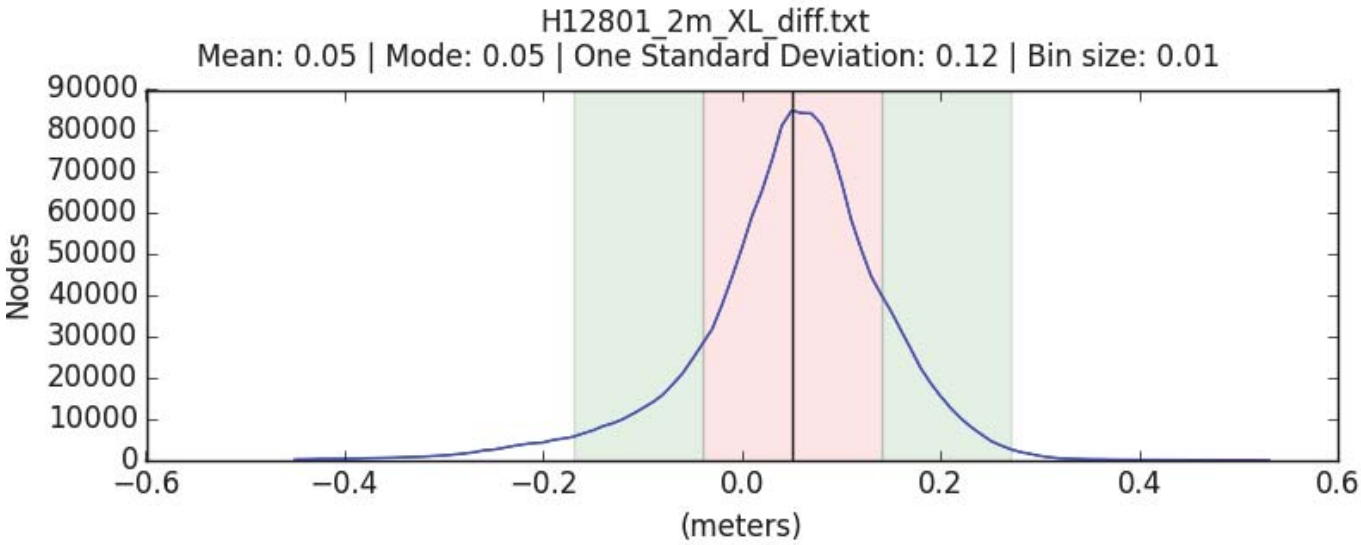
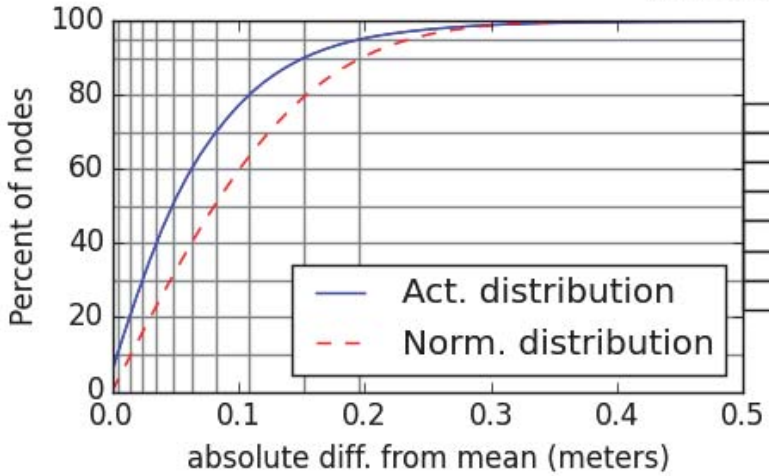


Figure 4: H12801 MBES crossline data shown in purple with mainscheme lines shown in green.





Percent of nodes	Deviation (m)
50%	+/- 0.05
60%	+/- 0.06
70%	+/- 0.08
80%	+/- 0.11
90%	+/- 0.15
95%	+/- 0.20

Figure 5: H12801 crossline difference statistics.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning	Method
0.01 meters	0.132 meters	VDATUM

Table 6: Survey Specific Tide TPU Values

Hull ID	Measured - CTD	Measured - MVP	Surface
S250	1.0 meters/second	1.0 meters/second	0.5 meters/second

Table 7: Survey Specific Sound Speed TPU Values

All data were corrected using GPS tides. The VDatum separation model and associated TPU values of 0.01 meters measured uncertainty and 0.132 meters zoning uncertainty were provided by NOAA HSD Operations Branch and used in the calculation of TPU.

B.2.3 Junctions

The areas of overlap between sheet H12801 and its junction sheets, shown in Figures 6, 8, 10, 12, and 14, were reviewed for agreement. Difference surfaces were created from the surface of H12801 and junction survey's bathymetry to assess sounding consistency.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12707	1:40000	2014	NOAA Ship FERDINAND R. HASSLER	E
H11920	1:10000	2008	NOAA Ship THOMAS JEFFERSON	E
H11922	1:10000	2008	NOAA Ship THOMAS JEFFERSON	NW
H12802	1:40000	2015	NOAA Ship FERDINAND R. HASSLER	S
H12811	1:40000	2015	NOAA Ship FERDINAND R. HASSLER	E

Table 8: Junctioning Surveys

<u>H12707</u>

The area of overlap between survey H12801 and its junction H12707, shown in Figure 6 was reviewed in CARIS Subset Editor. The junctioning surface was subtracted from H12801 to assess sounding consistency.

Survey H12707 was conducted by NOAA Ship FERDINAND R. HASSLER in 2014 during the course of Project OPR-B307-FH-14. A difference surface analysis between H12801 and H12707 2-meter resolution combined surfaces, which included over 3.6 million nodes, showed H12801 to be on average 0.01 meters deeper than H12707, with a standard deviation of 0.12 meters. 95% of all differences are less than 0.21 meters from the mean.

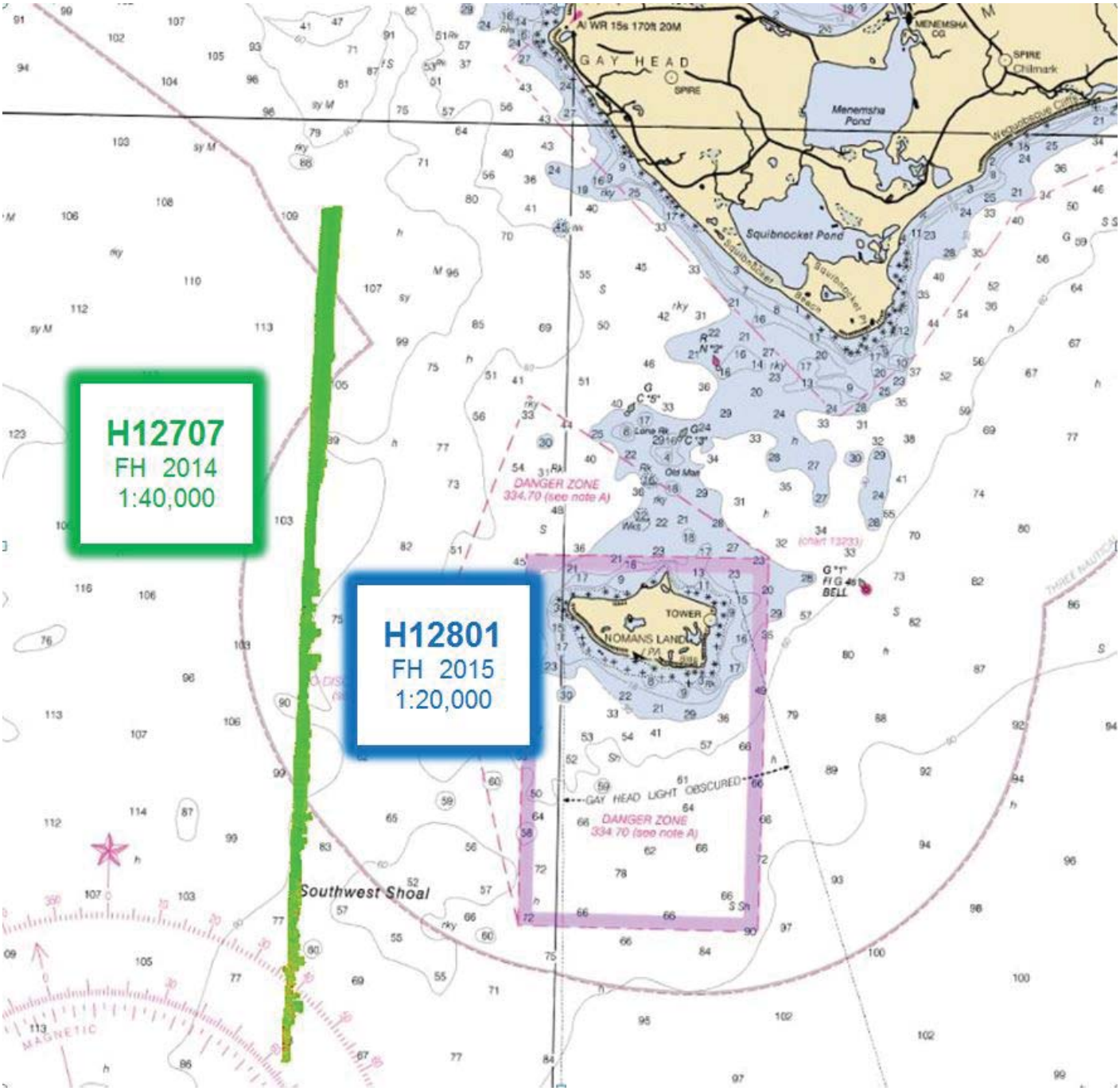
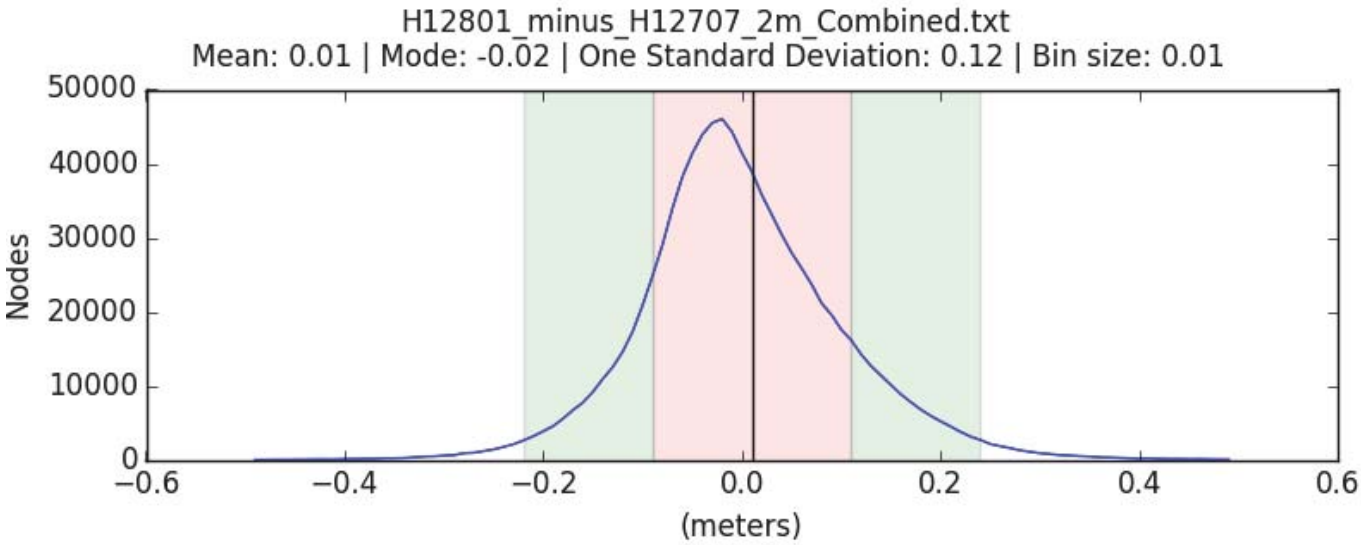
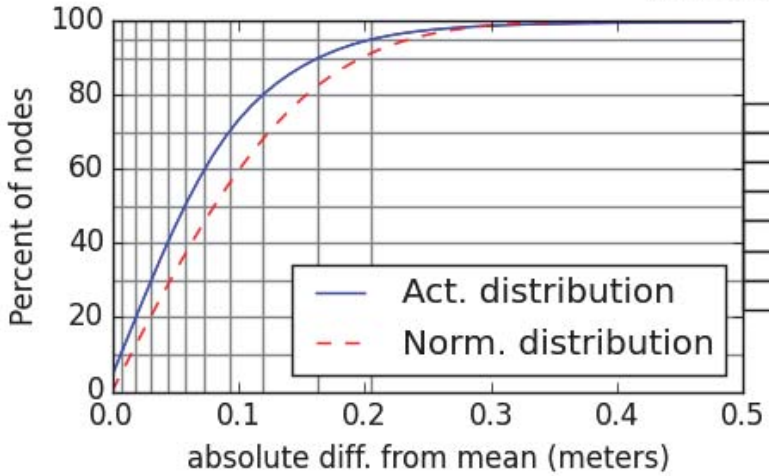


Figure 6: Junctioning area between survey H12801 and H12707.





Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.07
70%	+/- 0.09
80%	+/- 0.12
90%	+/- 0.16
95%	+/- 0.21

Figure 7: Differenced surface statistics - H12801 minus H12707.

H11920

The area of overlap between survey H12801 and its junction H11920, shown in Figure 8, was reviewed in CARIS Subset Editor. The junctioning surface was subtracted from H12801 to assess sounding consistency.

Survey H11920 was conducted by NOAA Ship THOMAS JEFFERSON in 2008 during the course of Project OPR-B307-TJ-08. A difference surface analysis between H12801 and H11920 2-meter resolution surfaces, which included over 158 thousand nodes, showed H12801 to be on average 0.07 meters shallower than H11920, with a standard deviation of 0.25 meters. 95% of all differences are less than 0.42 meters from the mean.

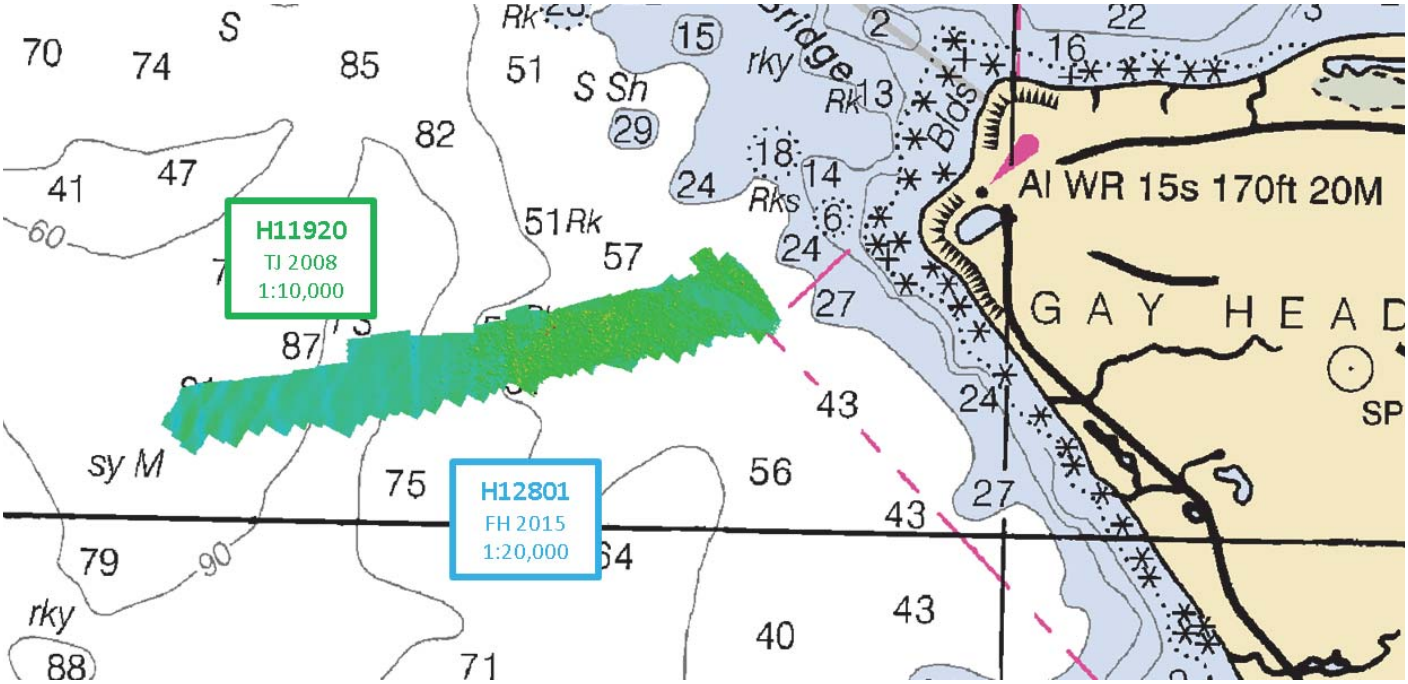
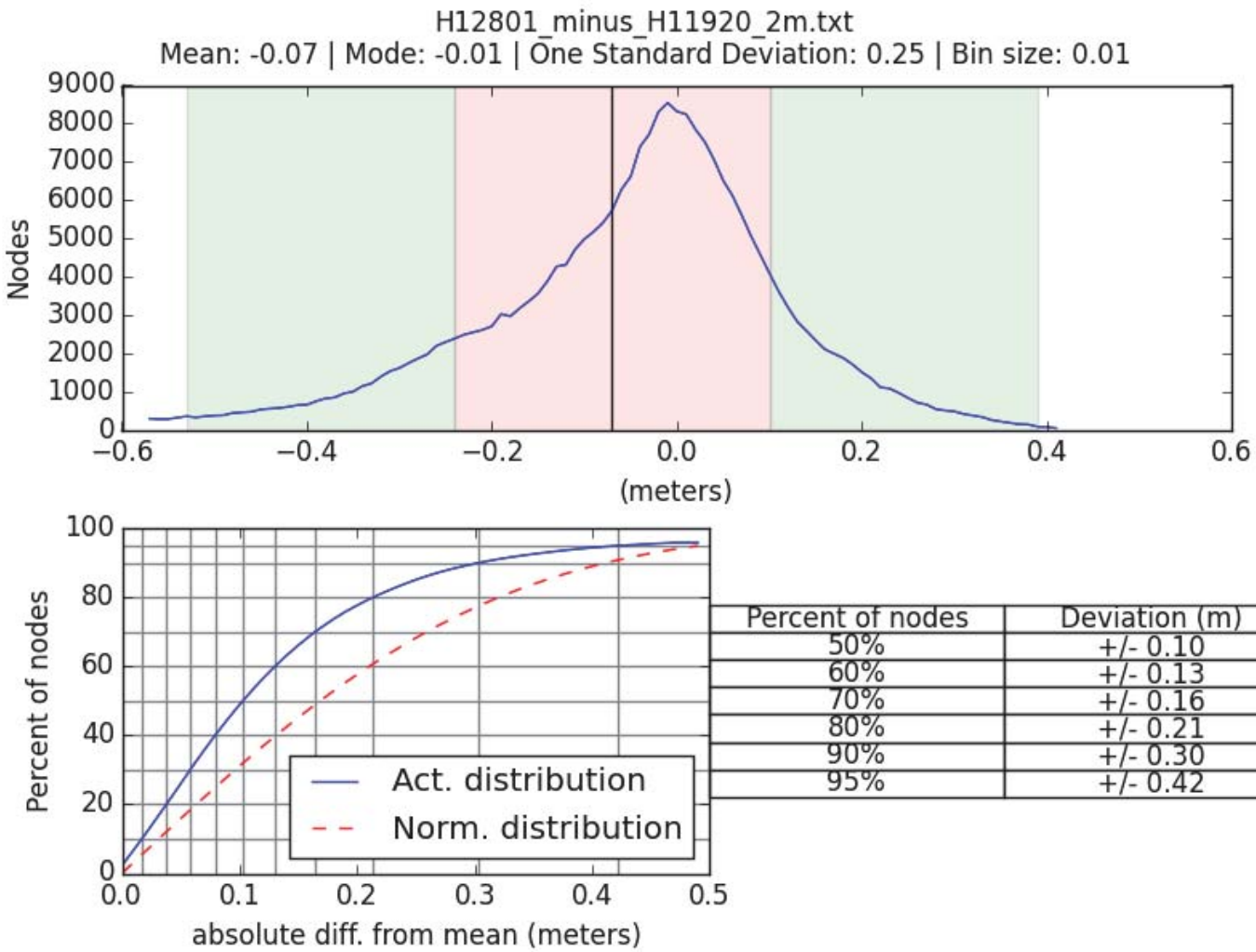


Figure 8: Junctioning area between survey H12801 and H11920.



Percent of nodes	Deviation (m)
50%	+/- 0.10
60%	+/- 0.13
70%	+/- 0.16
80%	+/- 0.21
90%	+/- 0.30
95%	+/- 0.42

Figure 9: Differenced surface statistics - H12801 minus H11920.

H11922

The area of overlap between survey H12801 and its junction H11922, shown in Figure 10, was reviewed in CARIS Subset Editor. The junctioning surface was subtracted from H12801 to assess sounding consistency.

Survey H11922 was conducted by NOAA Ship THOMAS JEFFERSON in 2008 during the course of Project OPR-B307-TJ-08. A difference surface analysis between H12801 and H11922 2-meter resolution surfaces, which included over 500 thousand nodes, showed H12801 to be on average 0.07 meters deeper than H11922, with a standard deviation of 0.15 meters. 95% of all differences are less than 0.29 meters from the mean.

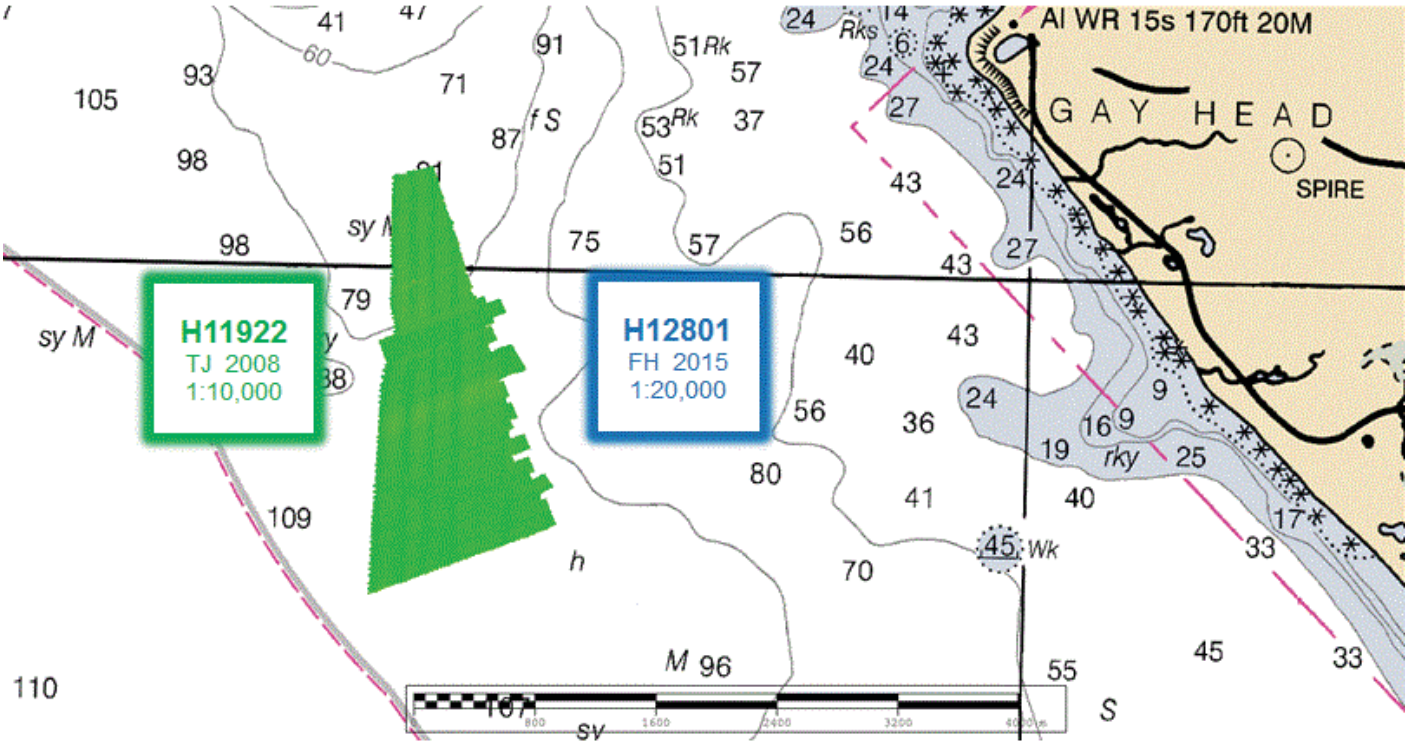
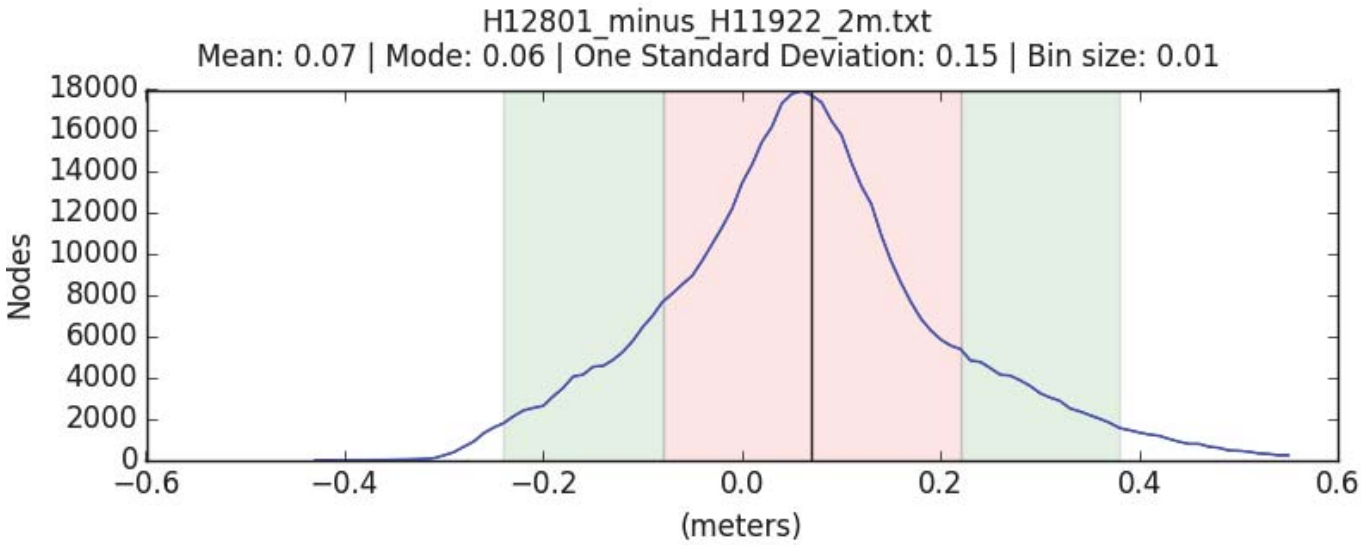
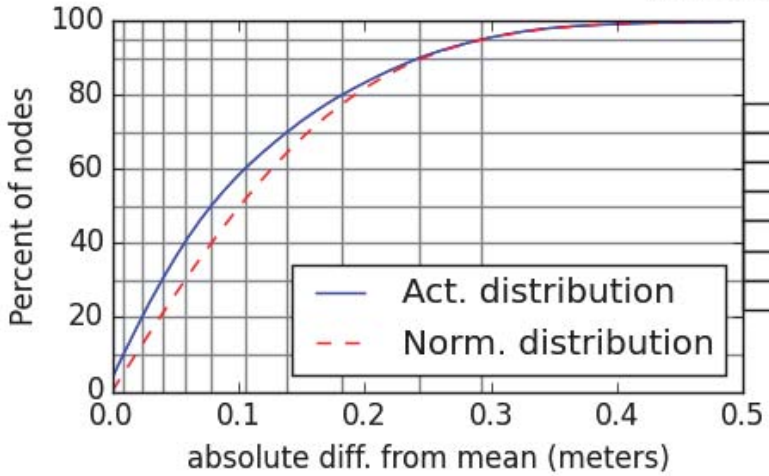


Figure 10: Junctioning area between survey H12801 and H11922.





Percent of nodes	Deviation (m)
50%	+/- 0.08
60%	+/- 0.11
70%	+/- 0.14
80%	+/- 0.18
90%	+/- 0.24
95%	+/- 0.29

Figure 11: Differenced surface statistics - H12801 minus H11922.

H12802

The area of overlap between survey H12801 and its junction H12802, shown in Figure 12, was reviewed in CARIS Subset Editor. The junctioning surface was subtracted from H12801 to assess sounding consistency.

Survey H12802 was conducted by NOAA Ship FERDINAND R. HASSLER in 2015 during the course of Project OPR-B307-FH-15. A difference surface analysis between H12801 and H12802 1-meter resolution surfaces, which included over 2.5 million nodes, showed H12801 to be on average 0.01 meters deeper than H12802, with a standard deviation of 0.13 meters. 95% of all differences are less than 0.27 meters from the mean.

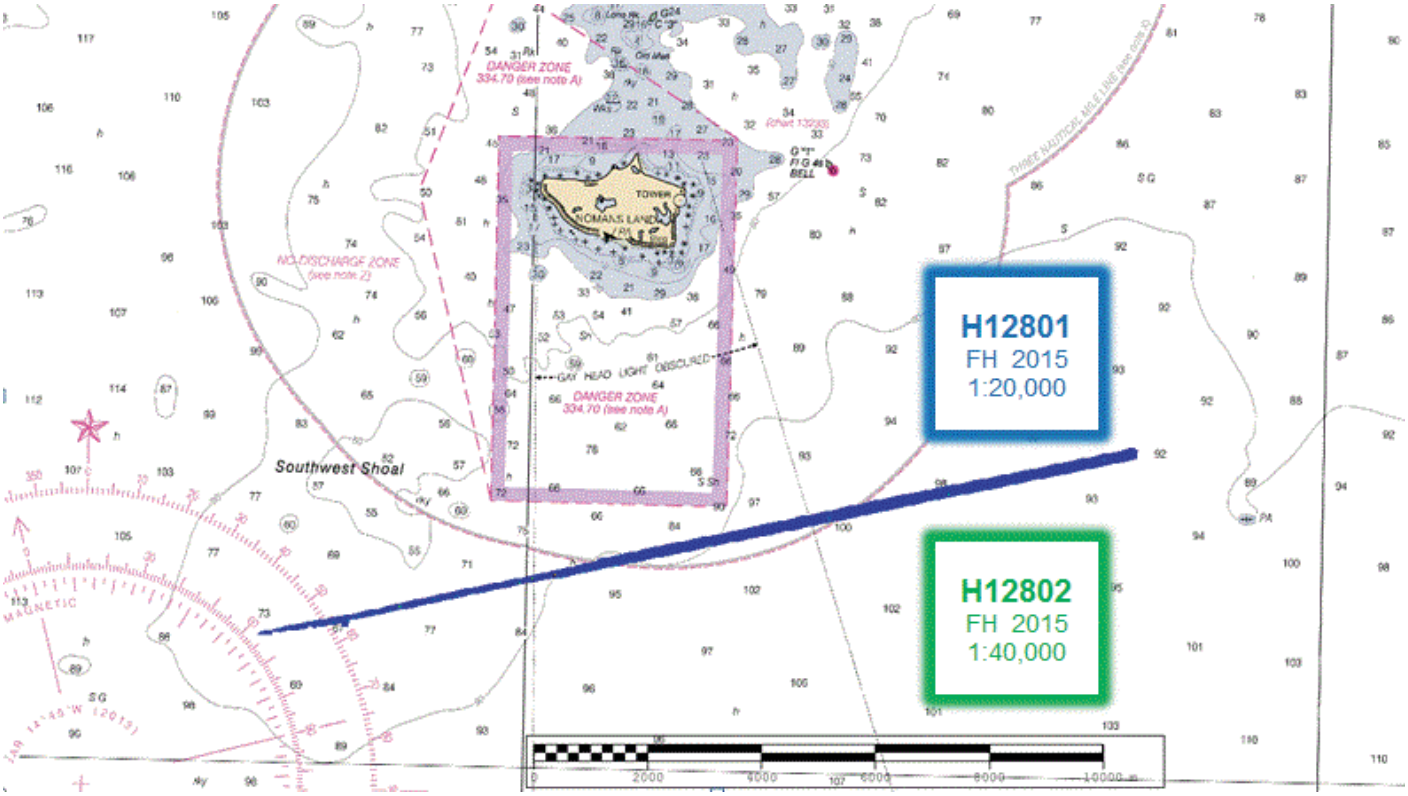
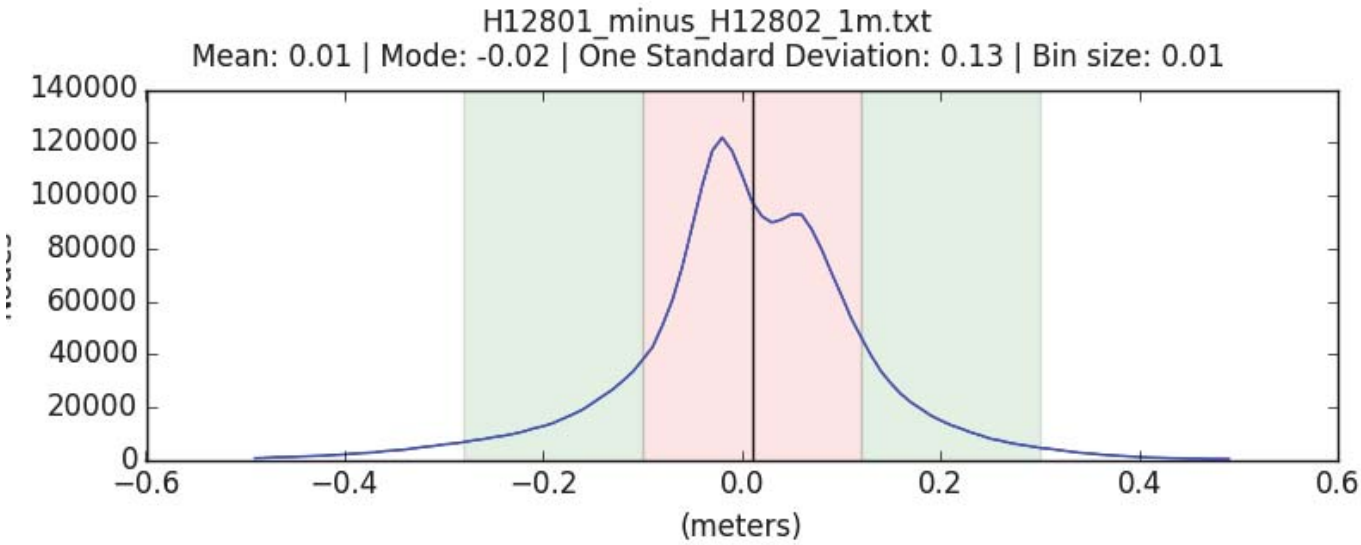
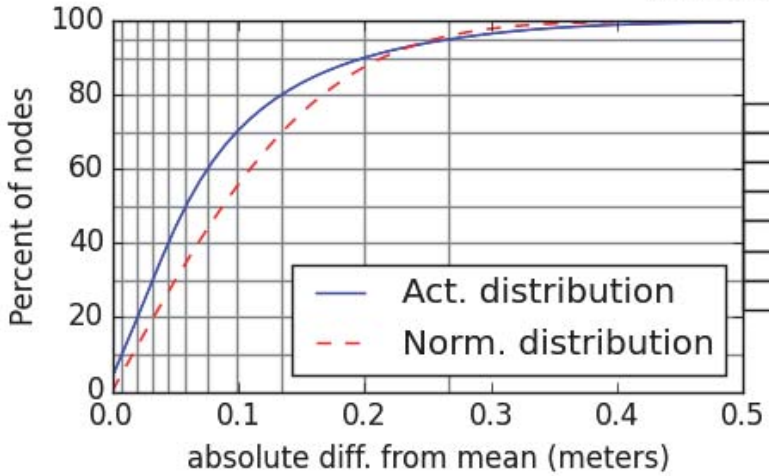


Figure 12: Junctioning area between survey H12801 and H12802.





Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.08
70%	+/- 0.10
80%	+/- 0.13
90%	+/- 0.20
95%	+/- 0.27

Figure 13: Differenced surface statistics - H12801 minus H12802.

H12811

The area of overlap between survey H12801 and its junction H12811, shown in Figure 14, was reviewed in CARIS Subset Editor. The junctioning surface was subtracted from H12801 to assess sounding consistency.

A difference surface analysis between H12811 and H12801 2-meter resolution surfaces, which included over 1 million nodes, showed H12811 on average 0.04 meters deeper then H12801, with a standard deviation of 0.11 meters. 95% of all differences are less than 0.22 meters from the mean. These results may differ from the H12811 DR due to the length of time between survey completion.

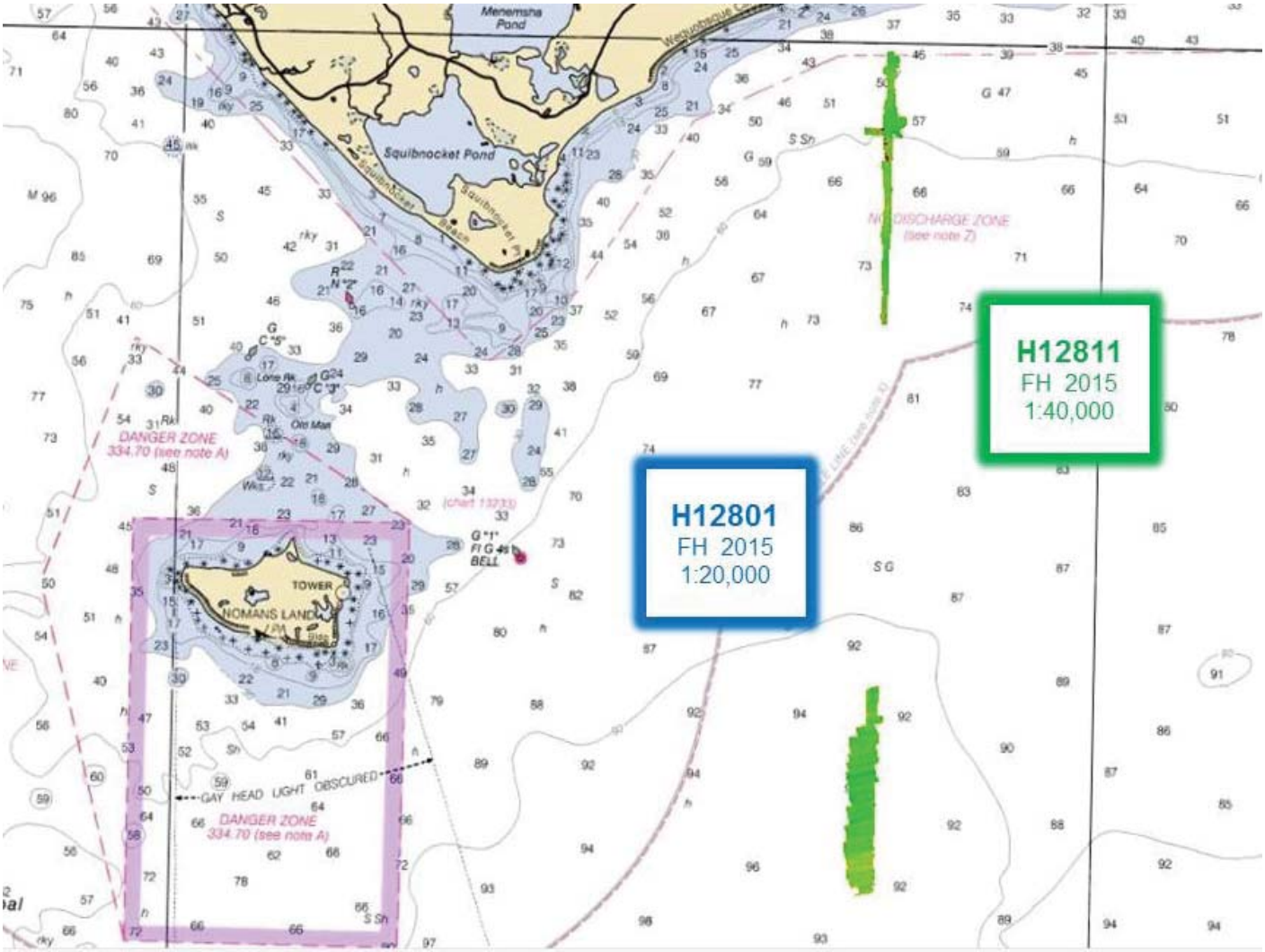
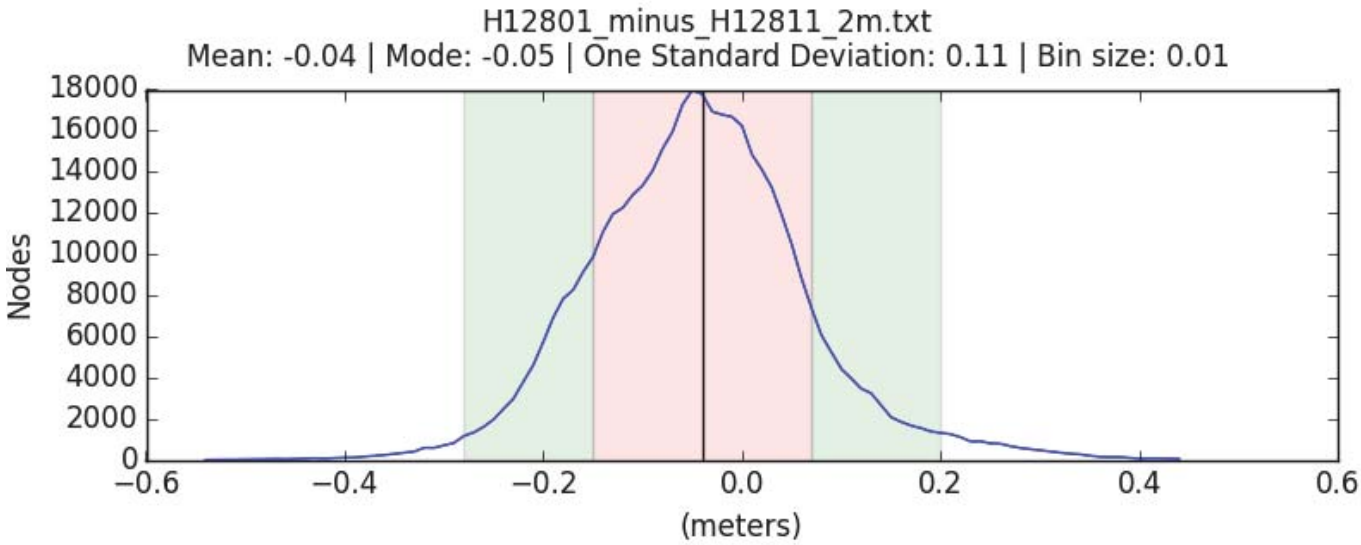
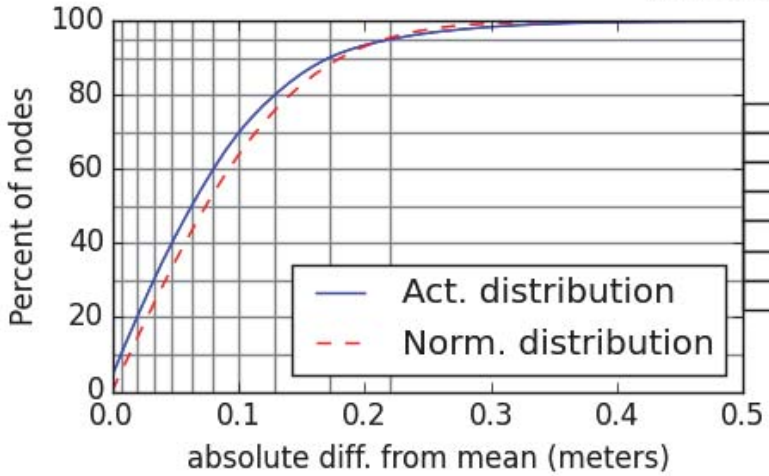


Figure 14: Junctioning area between survey H12801 and H12811.





Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.08
70%	+/- 0.10
80%	+/- 0.13
90%	+/- 0.17
95%	+/- 0.22

Figure 15: Differenced surface statistics - H12801 minus H12811.

B.2.4 Sonar QC Checks

Sonar system quality control checks were conducted as detailed in the quality control section of the DAPR.

B.2.5 Equipment Effectiveness

Starboard Reson 7125 Hard Drive Failure and Reset Errors

Upon the start of sheet H12801, the starboard Reson 7125 was experiencing an increasing number of "reset" errors. These errors would produce a gap in the data lasting for approximately 2-3 seconds along track and at times with a frequency of every 30 seconds. The gaps were producing many holidays that were later reacquired, decreasing the efficiency of operations. After communicating the problem to Reson, it was suggested that the Alpha Data Vertex 6 ("AD") card be replaced. After replacing cards, the gaps seemed to

appear much more infrequent but still occasionally occurred. The source of the Reson reset problem is still unknown but is manageable in its current state by including the gaps in the holiday acquisition plan.

In addition to the data gaps caused by the reset errors, the starboard Reson 7125 internal hard drive in the Reson processing computer failed which caused the inability to both write to and copy from the drive. The large number of data gaps in combination with the above mentioned hard drive failure forced the ship to operate from DN164 (after line 000_1231) through DN169 using only the port Reson 7125. When the hard drive and AD cards were replaced, the ship resumed acquiring data in dual head mode on DN176.

HYPACK Forcing File Extensions

Every line acquired in the extents of survey H12801 had two file extensions applied to each filename during acquisition. This resulted in the raw survey lines being named XXX_XXXX.hsx.s7k, which caused issues processing backscatter data with the Fledermaus FMGT software application. The extension .hsx extension was removed for processing.

B.2.6 Factors Affecting Soundings

Sound Velocity Effects

Some areas within sheet H12801 exhibit sound speed artifacts in the outer beams of the swath. The shallow area north of Nomans Land shown in Figure 16 was particularly susceptible to this problem. During routine ship MBES acquisition, the MVP winch was set to limit the tow fish max depth to 5 meters off of the sea floor. In shallow areas, this would result in a cast of about half the water depth and turned out to be insufficient to completely sample the water column. This caused some large refraction artifacts in the outer beams of the swath that were in some cases on the order of 0.50-0.75 meters different than the nadir beam. Areas with gross sound speed issues were cleaned to the extent practicable (without producing holidays in the surfaces).

Figure 17 shows a brief instance of a jump in surface sound speed that correlates to increased outer beam refraction. Data not within specifications were rejected.

Multiple regions in the survey show evidence of outer beam refraction as seen in Figure 18, however, these errors are still within acceptable uncertainty limits as per the 2015 NOAA HSSD.

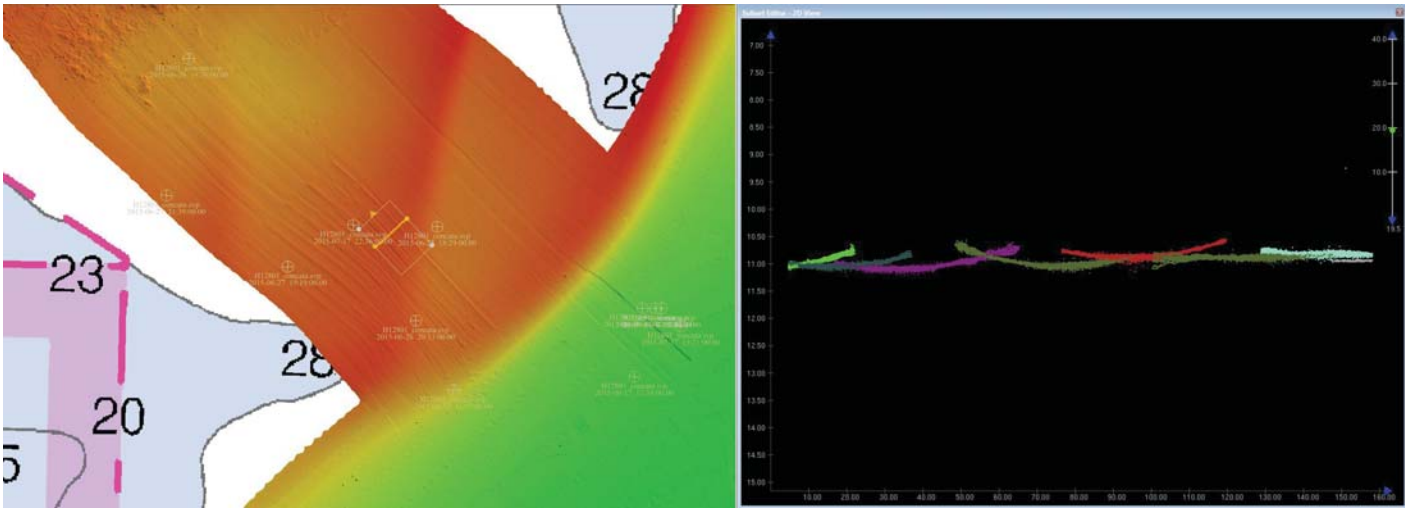


Figure 16: Some areas of the pass north of Nomans Land exhibit SV artifacts due to the MVP not reaching deep enough in the water column.

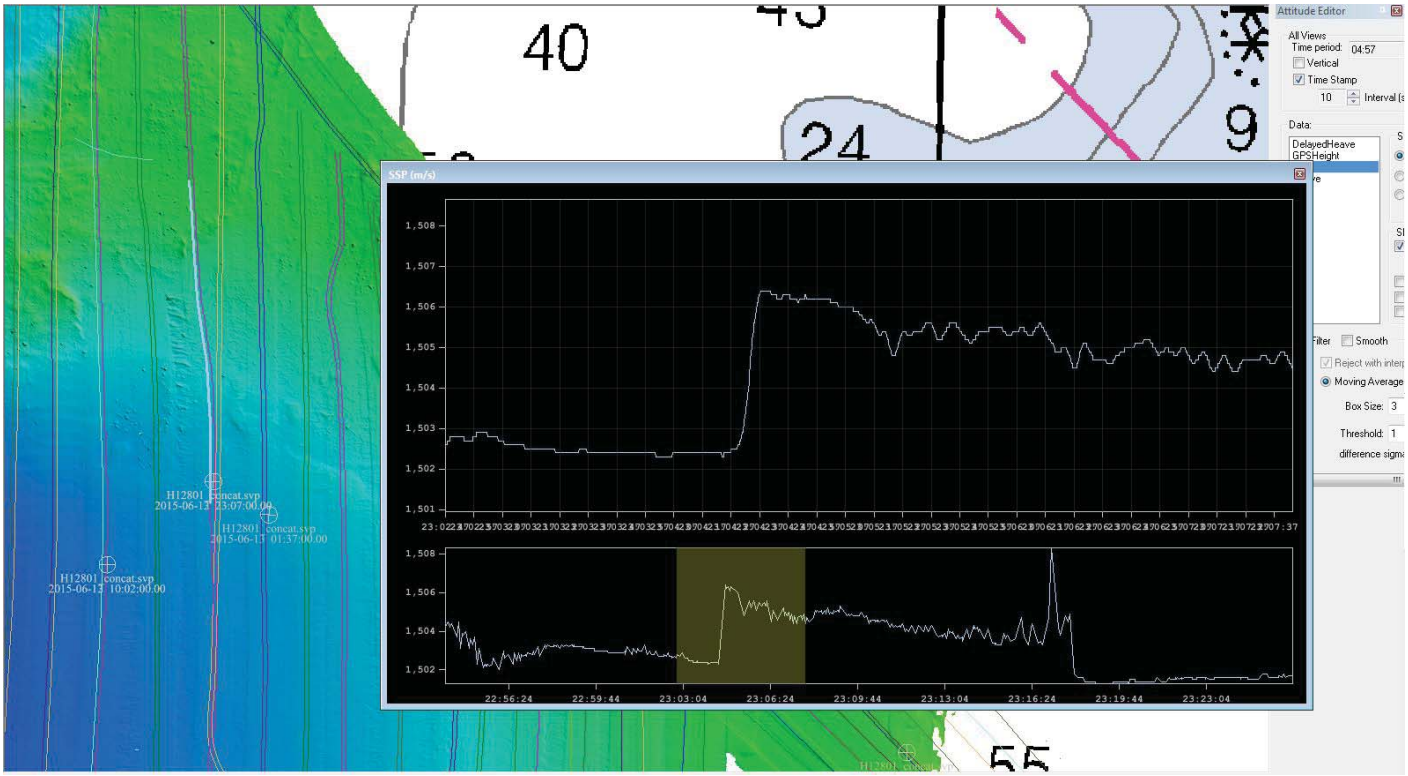


Figure 17: Surface sound speed affecting outer beams.

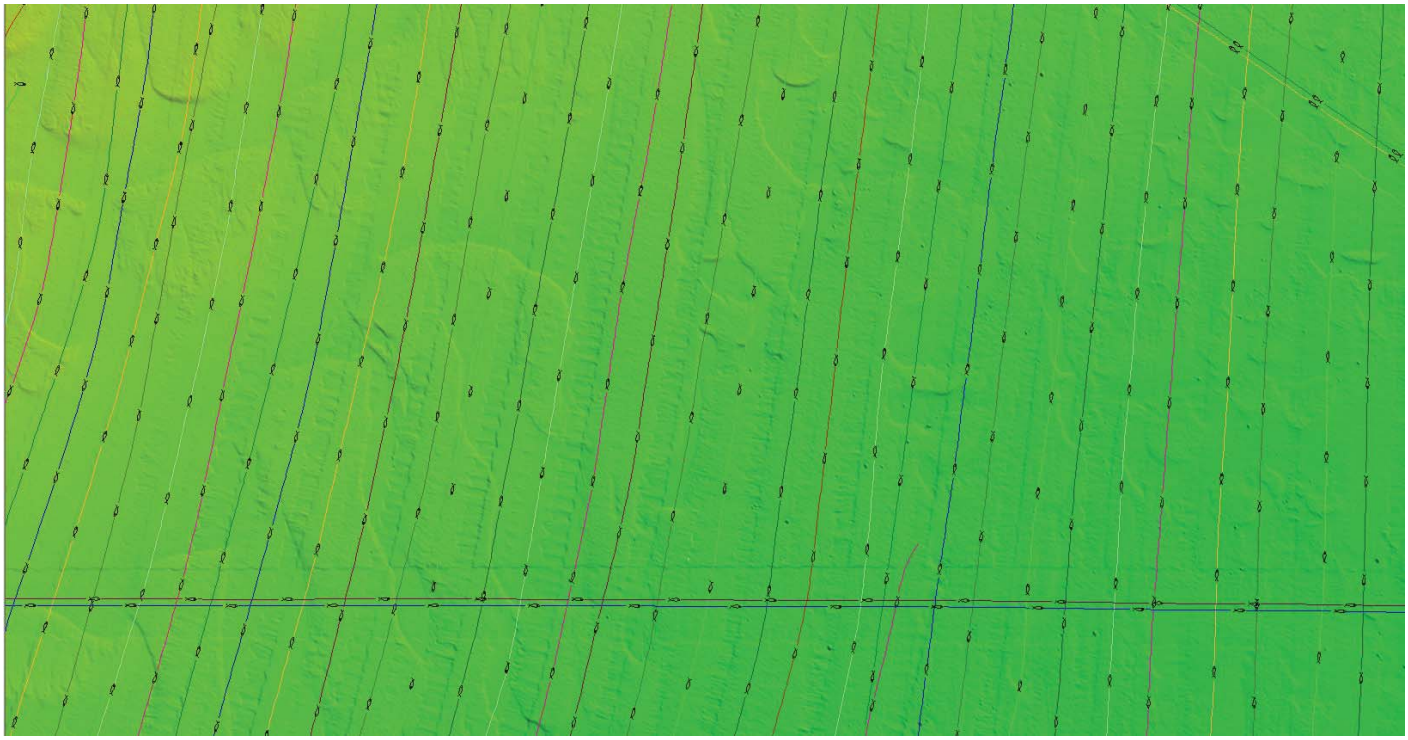


Figure 18: General refraction of the outer beams causing striping appearance in surface.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: CTD casts using the MVP200 were taken approximately every 15-30 min. Comparisons of the cast-to-cast variation were used to direct cast frequency. The casts were then applied in Caris HIPS and SIPS using the Nearest in Distance Within Time of 4 hours option.

B.2.8 Coverage Equipment and Methods

All equipment and survey methods were used as detailed in the DAPR.

B.2.9 Data Density Analysis

A density analysis was run to calculate the number of soundings per surface node. The results determined that over 99% of all nodes in each finalized surface contain five or more soundings for the 1m and 2m surfaces. The density analysis was executed on nodes which are populated by at least one sounding and did not account for holidays located within the surface. The 0.5m density analysis is also included and shows that both the North and South surfaces fall short of the density requirement. To achieve a useful coverage of the 0.5m surface to assist in capturing least depths of rocky areas, it was necessary to extend it beyond what the density supported. A waiver was granted in this instance by the NOAA HSD Operations Branch and correspondance can be found in Appendix II.

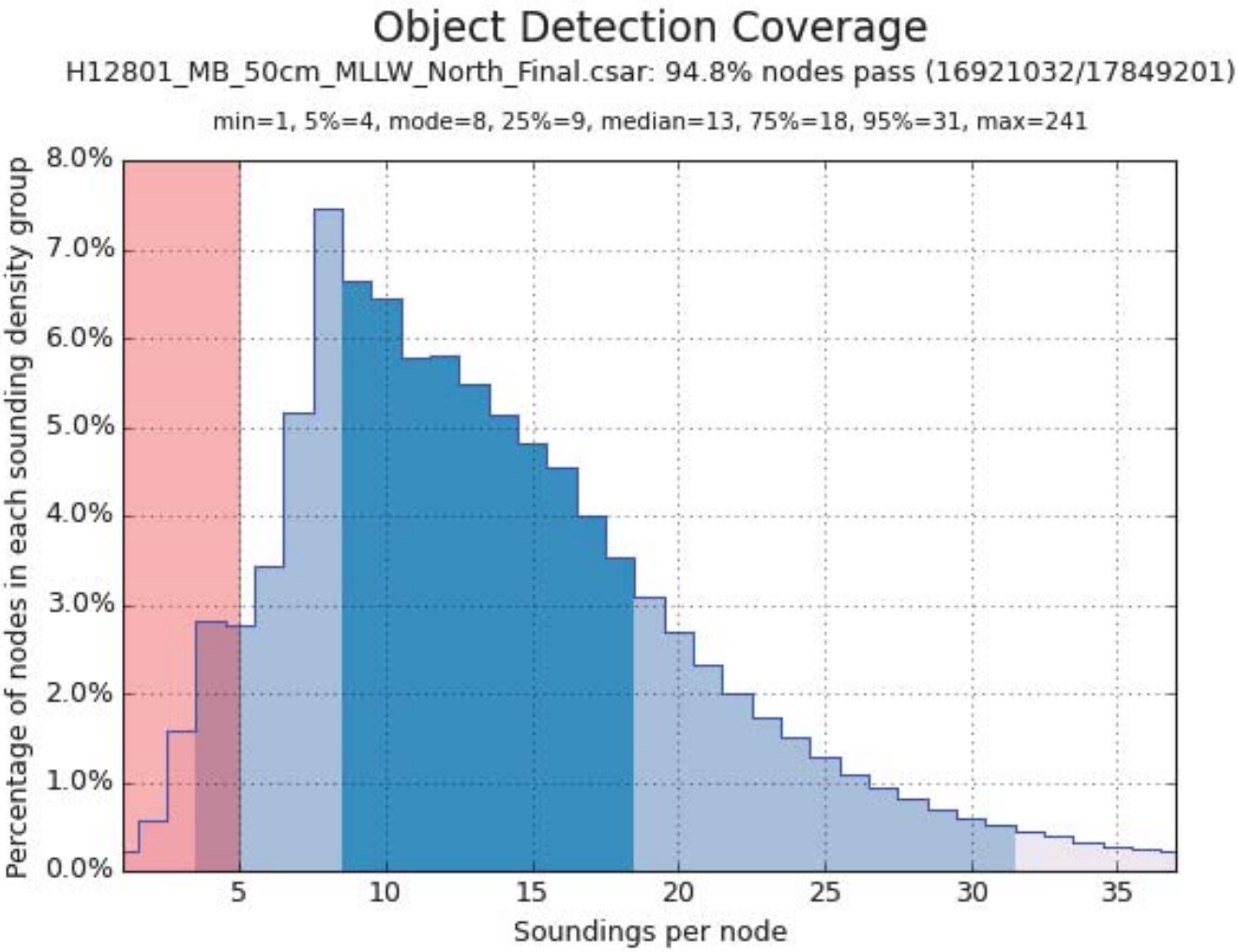


Figure 19: Data density analysis for the northern 0.5m finalized surface.

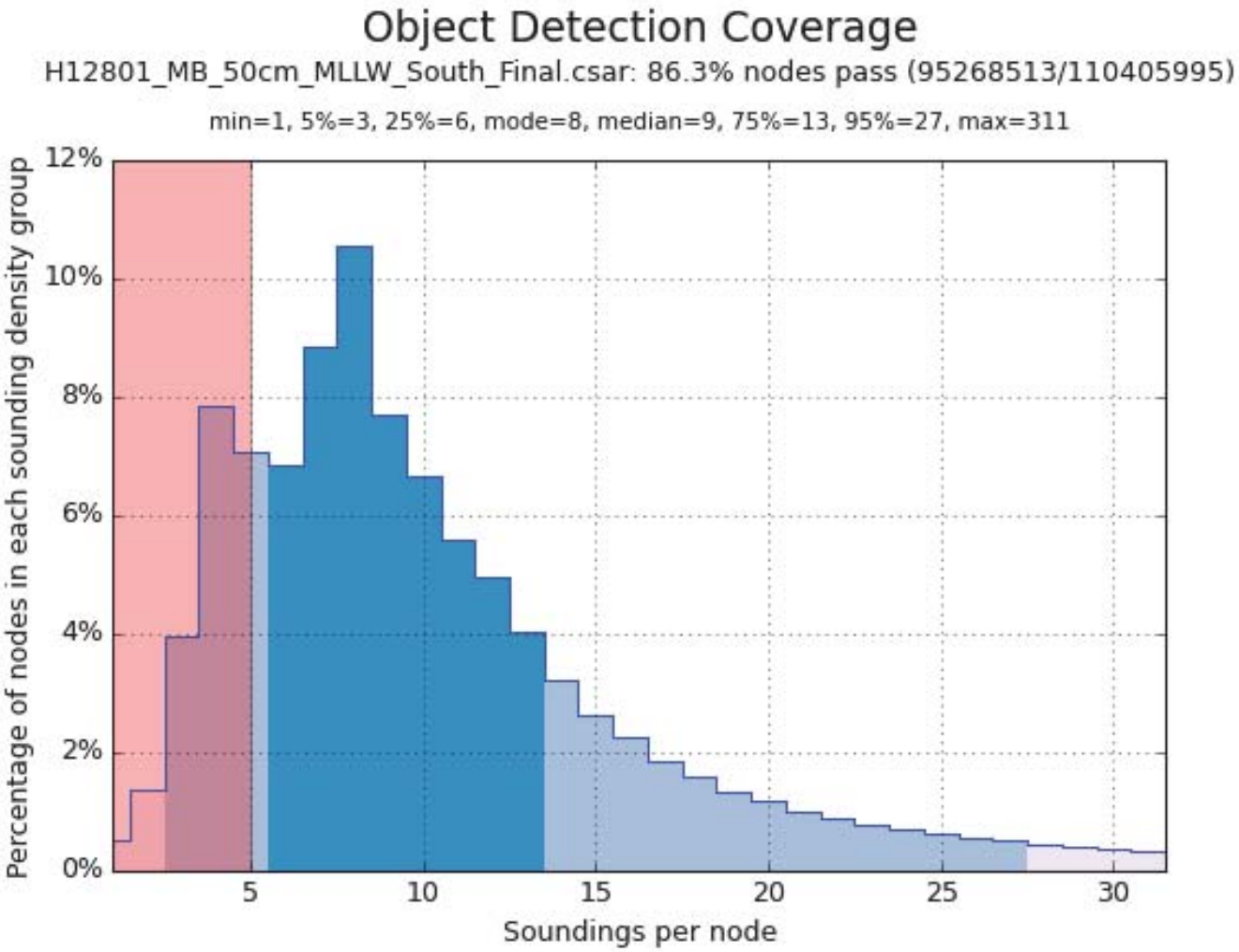


Figure 20: Data density analysis for the southern 0.5m finalized surface.

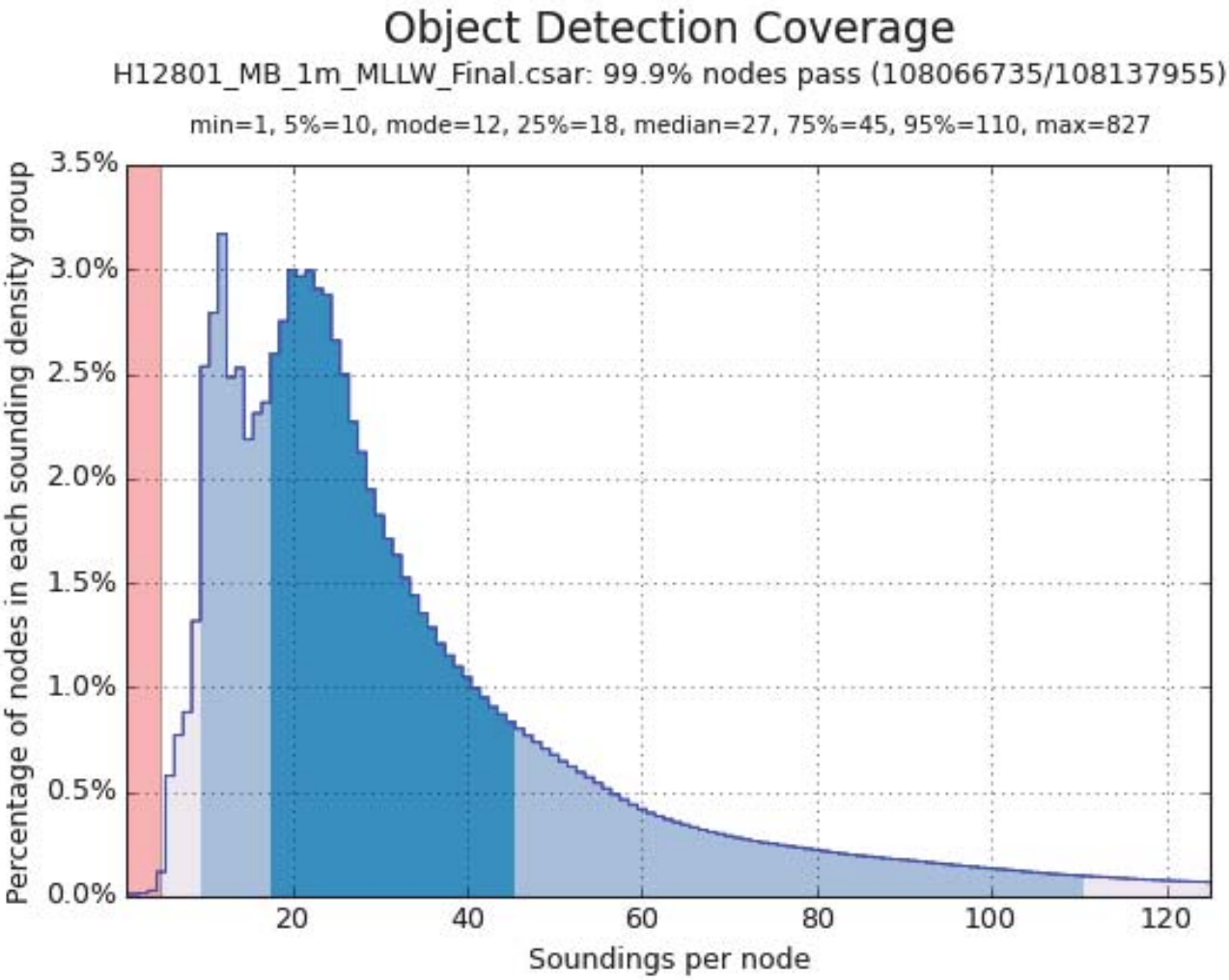


Figure 21: Data density analysis for the 1.0m finalized surface.

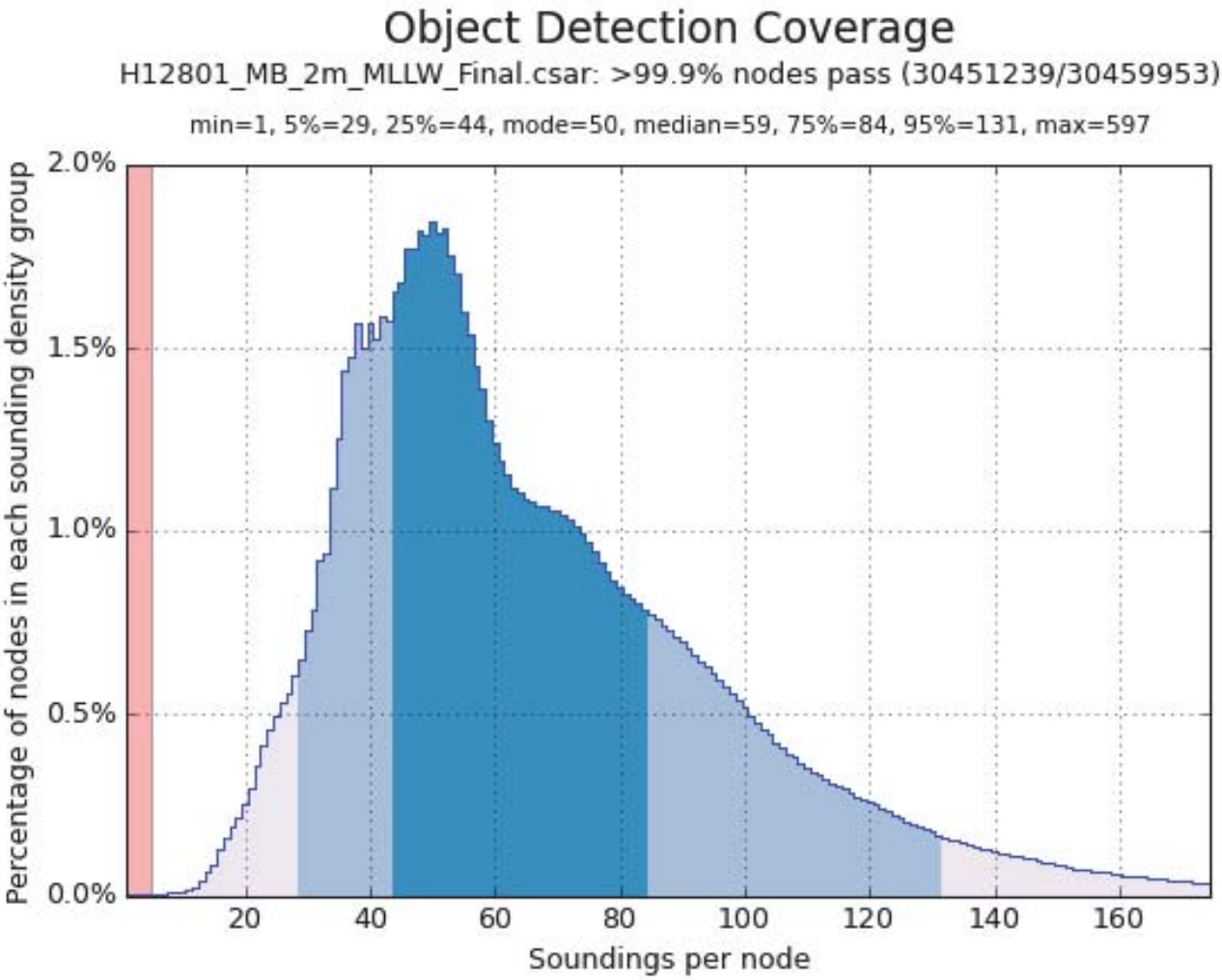


Figure 22: Data density analysis for the 2m finalized surface.

B.2.10 Total Vertical Uncertainty Analysis

Total vertical uncertainty analysis was performed using the Finalized CSAR QA tool within Pydro. The resulting statistical analysis found that 100% of nodes in all finalized surfaces within survey H12801 meet the vertical uncertainty standards.

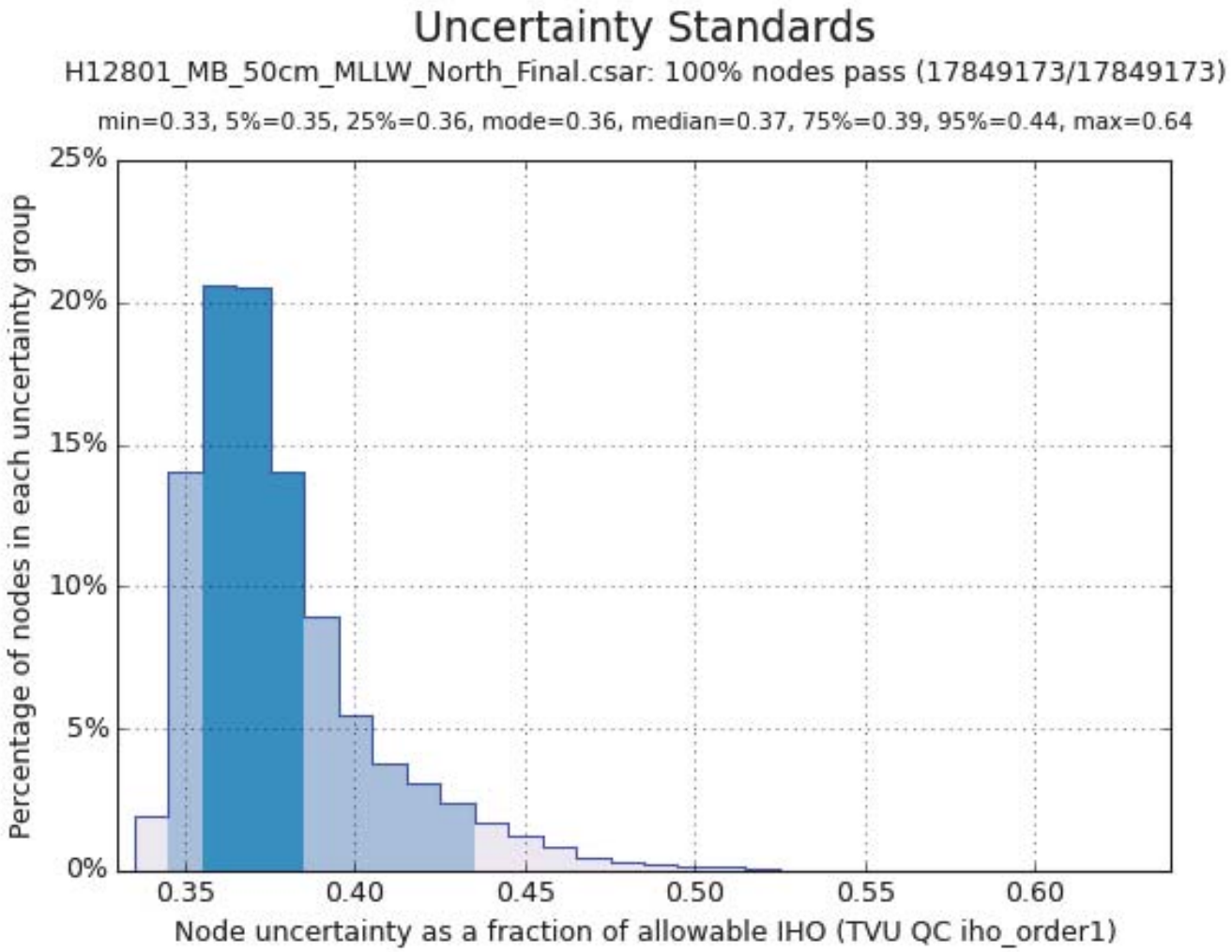


Figure 23: Total vertical uncertainty analysis for the northern 0.5m finalized surface.

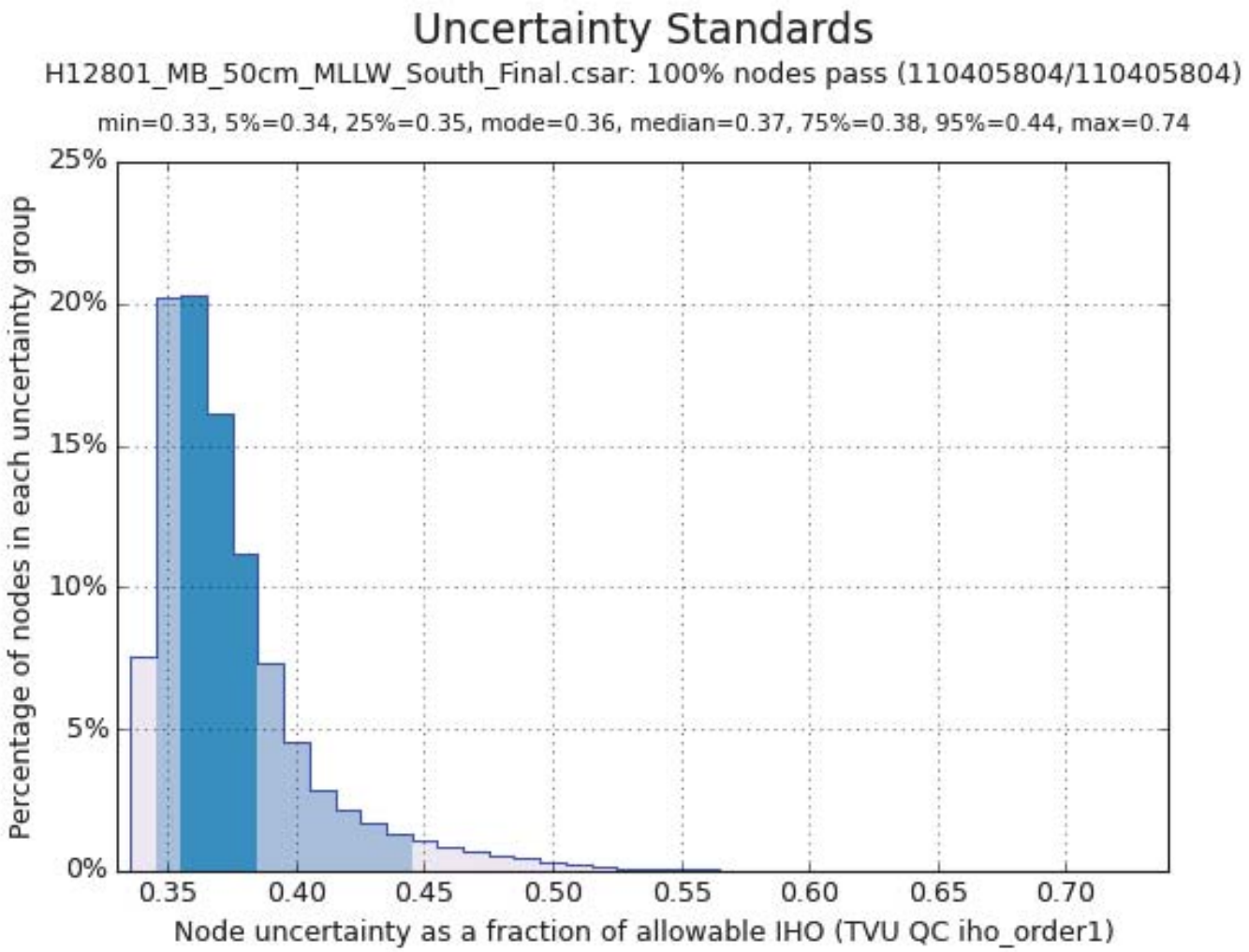


Figure 24: Total vertical uncertainty analysis for the southern 0.5m finalized surface.

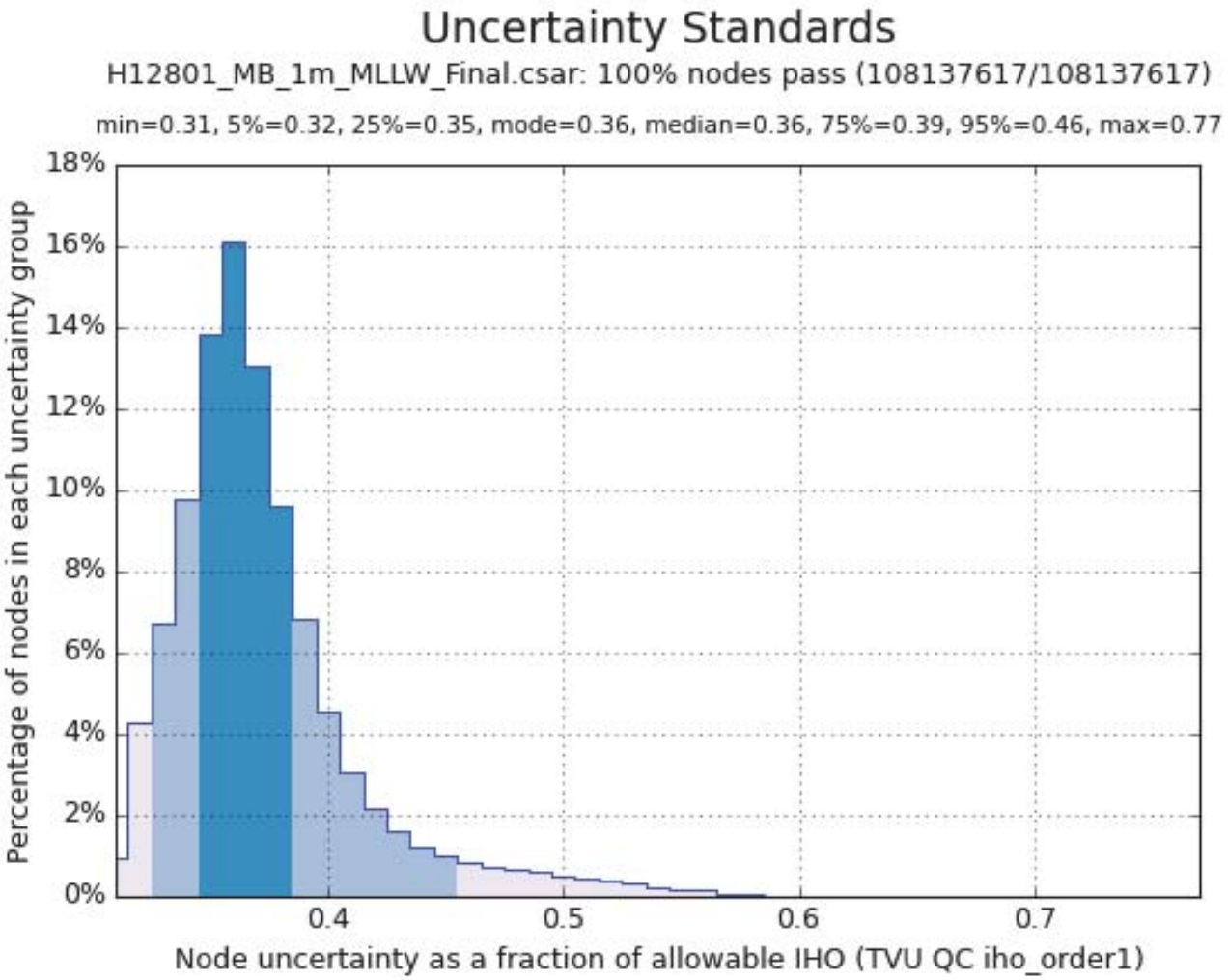


Figure 25: Total vertical uncertainty analysis for the 1m finalized surface.

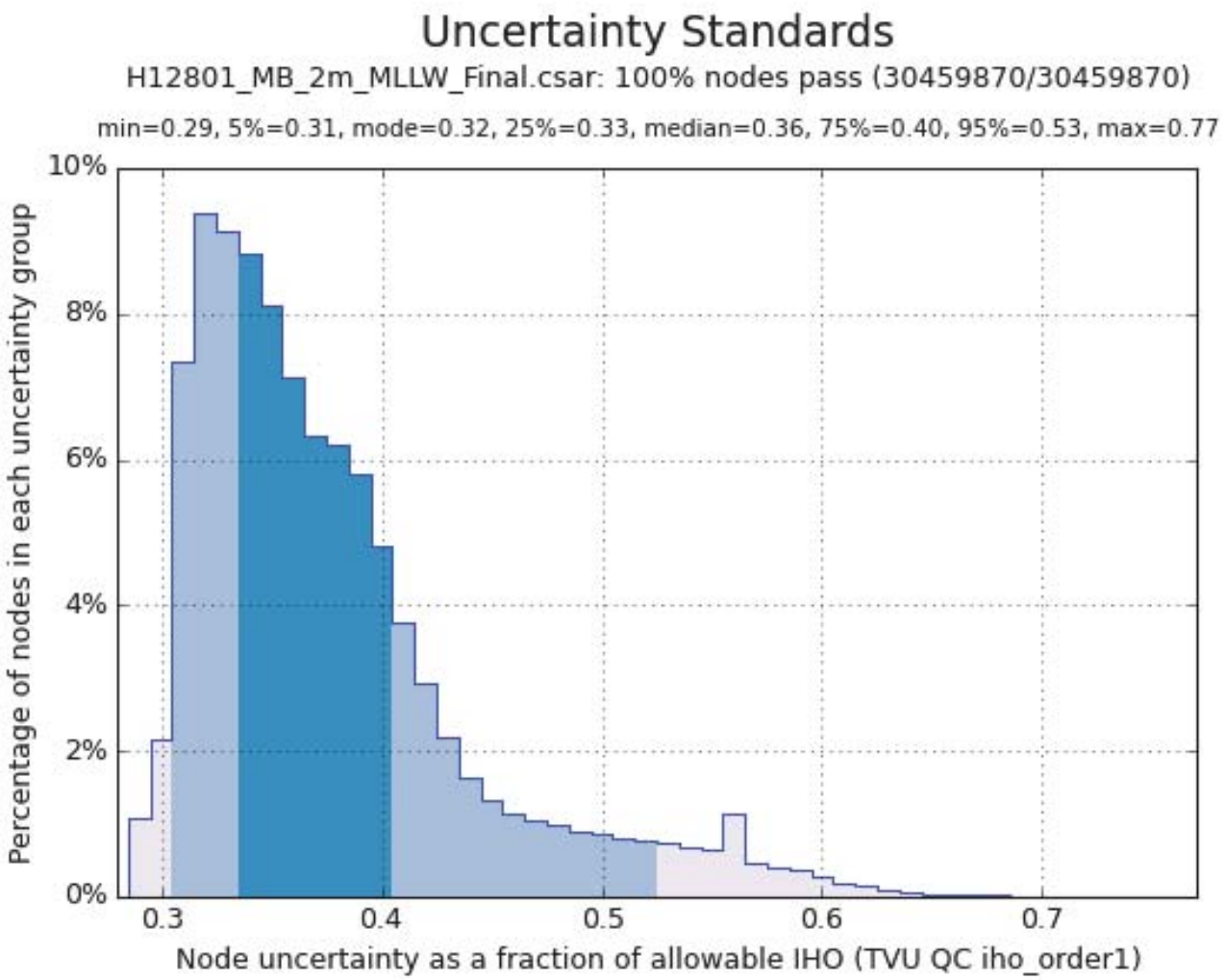


Figure 26: Total vertical uncertainty analysis for the 2m finalized surface.

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

All data reduction procedures conform to those detailed in the DAPR.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Backscatter was logged in Reson datagram 7008 snippets record in the raw .s7k files. The .s7k files also holds the navigation record and bottom detections for all lines of survey H12801. The files were paired with the CARIS HDCS data, imported and processed using Fledermaus Geocoder Toolbox.

The GSF files containing the extracted backscatter are submitted with the data in this survey. The processed mosaic is saved as a Geo-Tiff and also submitted.

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following software program was the primary program used for bathymetric data processing:

Manufacturer	Name	Version
Caris	HIPS and SIPS	9.0.19

Table 9: Primary bathymetric data processing software

The following Feature Object Catalog was used: NOAA Profile Version 5.3.2

B.5.2 Surfaces

The following surfaces and/or BAGs were submitted to the Processing Branch:

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12801_MB_50cm_MLLW_North	CUBE	0.5 meters	7.46 meters - 38.44 meters	NOAA_0.5m	Complete MBES
H12801_MB_50cm_MLLW_South	CUBE	0.5 meters	7.94 meters - 39.19 meters	NOAA_0.5m	Complete MBES
H12801_MB_1m_MLLW	CUBE	1.0 meters	6.29 meters - 37.01 meters	NOAA_1m	Complete MBES
H12801_MB_2m_MLLW	CUBE	2.0 meters	7.20 meters - 35.09 meters	NOAA_2m	Complete MBES
H12801_MB_50cm_MLLW_North_Final	CUBE	0.5 meters	7.40 meters - 20.00 meters	NOAA_0.5m	Complete MBES

Surface Name	Surface Type	Resolution	Depth Range	Surface Parameter	Purpose
H12801_MB_50cm_MLLW_South_Final	CUBE	0.5 meters	7.87 meters - 20.00 meters	NOAA_0.5m	Complete MBES
H12801_MB_1m_MLLW_Final	CUBE	1.0 meters	5.98 meters - 25.00 meters	NOAA_1m	Complete MBES
H12801_MB_2m_MLLW_Final	CUBE	2.0 meters	20.00 meters - 35.09 meters	NOAA_2m	Complete MBES
H12801_MB_2m_MLLW_Combined	CUBE	2.0 meters	5.98 meters - 35.09 meters	NOAA_2m	Complete MBES

Table 10: Submitted Surfaces

Due to the nature of the rocky seafloor and scattered boulders in areas on sheet H12801, the 1m surface was not effective in representing the least depth of the bathymetry. Initially, designated soundings were used to force the finalized surface to the least depth of those areas. This resulted in an unmanageable number of designated soundings and was also deemed unreliable at ensuring least depths are represented by the surface. After consulting the HSD Operations project manager for OPR-D307-FH-15 and members of the Atlantic Hydrographic Branch, permission was obtained to create a 0.5m surface for regions where many designated soundings were needed (emails about this topic are included in Appendix II Supplemental Survey Records and Correspondence).

Since the survey was not conducted with the intent to achieve object detection coverage, the data may not fully support a 0.5m surface. Because holidays are present in the 0.5m surface, the 0.5m surface is completely overlapped with the 1m surface. The 0.5m surface's sole purpose is to reach the least depths on pinnacles. The 1m finalized surface depth ranges were also altered from the HSSD 1m depth range specifications of 0-20m to 0-25m to aid in accurately depicting least depths. Density statistics determined from these surfaces can be found in section B.2.9 Data Density Analysis.

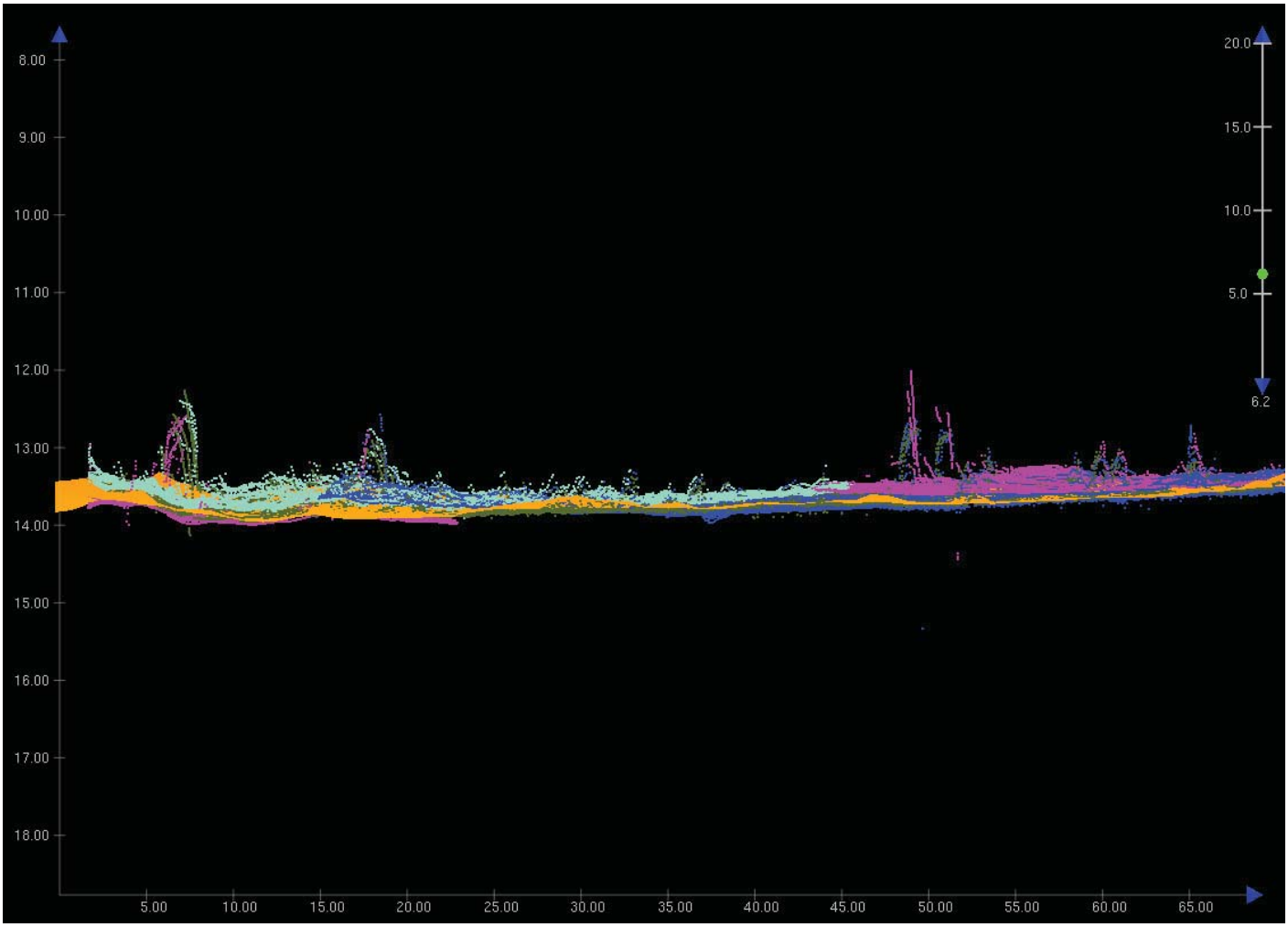


Figure 27: An example of the 1m surface not reaching rock least depths in ~13m of water.

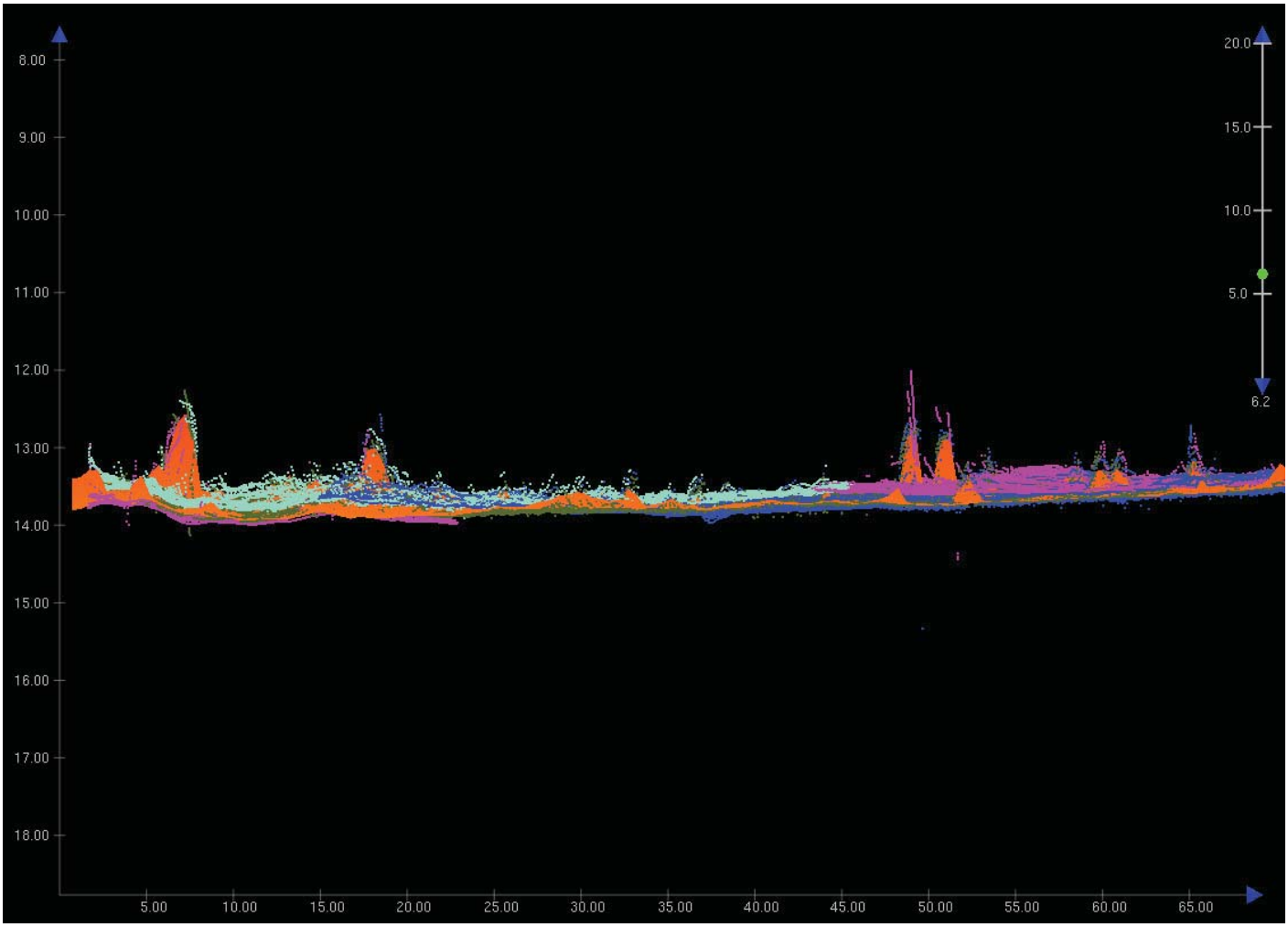


Figure 28: An example of the same location as the previous figure with a 50cm surface better representing least depths on rocks.

B.5.3 Failure to load Delayed Heave

Errors occurred in applying Delayed Heave to data from the port transducer on DN165 resulting in no Delayed Heave applied to the lines for this day. However, this will not affect the data because Smoothed Best Estimate of Trajectories (SBETs) have been applied. In addition to DN165, Delayed Heave was not reapplied to line x000_1547 after reapplying the interpolated SBET. Again, this will not affect the data because of the applied SBET.

B.5.4 Total Number of Designated Soundings

The number of designated soundings in H12801 totaled 361.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying HSTB Base Station Deployment Report.

C.1 Vertical Control

The vertical datum for this project is Mean Lower Low Water.

Standard Vertical Control Methods Used:

TCARI

The following National Water Level Observation Network (NWLON) stations served as datum control for this survey:

Station Name	Station ID
Newport, RI	8452660

Table 11: NWLON Tide Stations

The following subordinate water level stations were established for this survey:

Station Name	Station ID
Martha's Vineyard GPS Buoy, MA	8448875

Table 12: Subordinate Tide Stations

File Name	Status
8452660.tid	Verified Observed

Table 13: Water Level Files (.tid)

File Name	Status
B307FH2015CORP_rev.zdf	Preliminary
B307FH2015_Final.tc	Final

Table 14: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 07/30/2015. The final tide note was received on 09/23/2015.

A final TCARI grid was received for project OPR-B307-FH-15, H12801, during the time period between July 16th and July 26th, 2015. A TCARI grid was possible due to HSTB's water level buoy that was used during the project.

Non-Standard Vertical Control Methods Used:

VDatum

Ellipsoid to Chart Datum Separation File:

2015_OPR-B307-FH-15_VDatum_NAD83_MLLW_revised.csar
2015_OPR-B307-FH-15_VDatum_MLLW_to__NAD83_ReversSEP.csar

All soundings submitted are reduced to Mean Lower Low Water (MLLW) using a VDatum separation model. ERS checklines were run as requested by HSD Operations Branch but were not processed before acquisition was completed. In lieu of processing the ERS checklines, an ERZT separation model was created and compared to the VDatum separation model using a difference surface. A final TCARI grid was used in the creating of the ERZT separation model. The results can be seen in the ERS Memo located in Appendix IV.

A reverse separation model was provided to assist troubleshooting some SBET issues. The SBET issues were corrected either by reprocessing the SBET or by deleting and interpolating through SBET altitude spikes. Further explanation is provided in section C.3.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD83).

The projection used for this project is UTM Zone 19N.

The following PPK methods were used for horizontal control:

Single Base

Single Base was the primary Post Processed Kinematic (PPK) method used for processing of Applanix TrueHeave data and Smooth Best Estimate of Trajectory (SBET) files. The SBET files have been loaded for all lines in survey H12801 and are used to reduce soundings to MLLW.

HSTB installed two base stations on Martha's Vineyard, MA, that that sent real time position correctors to FERDINAND R. HASSLER during the entire acquisition period via 4G internet service. Details are available in the supplemental HSTB field report in Appendix II.

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
Martha's Vineyard 1, Martha's Vineyard, MA	WMVY1
Martha's Vineyard 2, Martha's Vineyard, MA	WMVY2

Table 15: User Installed Base Stations

The following DGPS Stations were used for horizontal control:

DGPS Stations
Acushnet, MA (306 kHz)

Table 16: USCG DGPS Stations

C.3 Additional Horizontal or Vertical Control Issues

3.3.1 Interpolation of SBETs

On occasion, the SBET altitude exhibited spikes resulting in unacceptably high TVU. In these instances, tools in Pydro's POSPAC Automated QC were used to interpolate the SBET (See Figure 29 for an example). The interpolated SBET was exported out of the POSPAC Automated QC tool, opened in POSPAC MMS, and exported again to ensure the SBET was in the correct datum (NAD83). The new SBET contains the prefix "interpolated" or "export" for easy identification. The following SBETs were interpolated for H12801:

DN 178 All Lines (Port) using interpolated_2015_178_S250P_b
DN 203 Line x000_1547 (Port) using interpolated_export_2015_203_S250P_b.out

DN203 Line x000_1547 (Stbd) using export_2015_203_S250_b.out

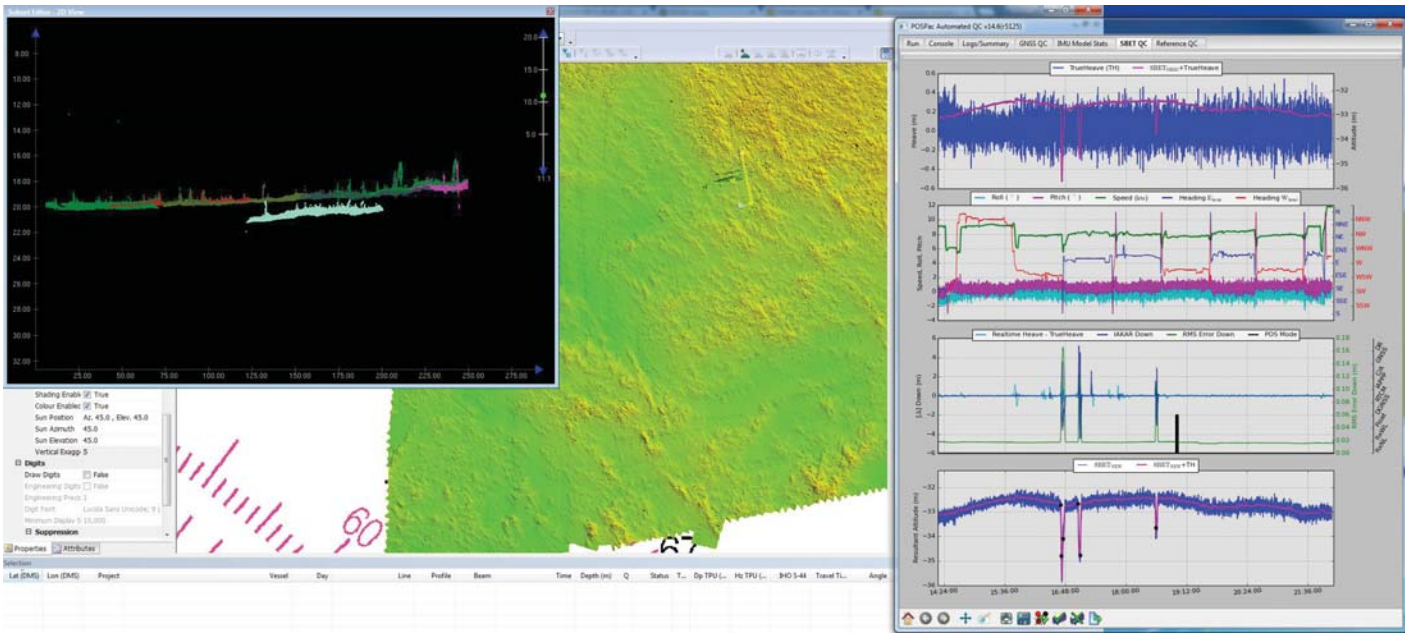


Figure 29: An SBET from DN203 shows the spike causing a large vertical offset in the bathymetry.

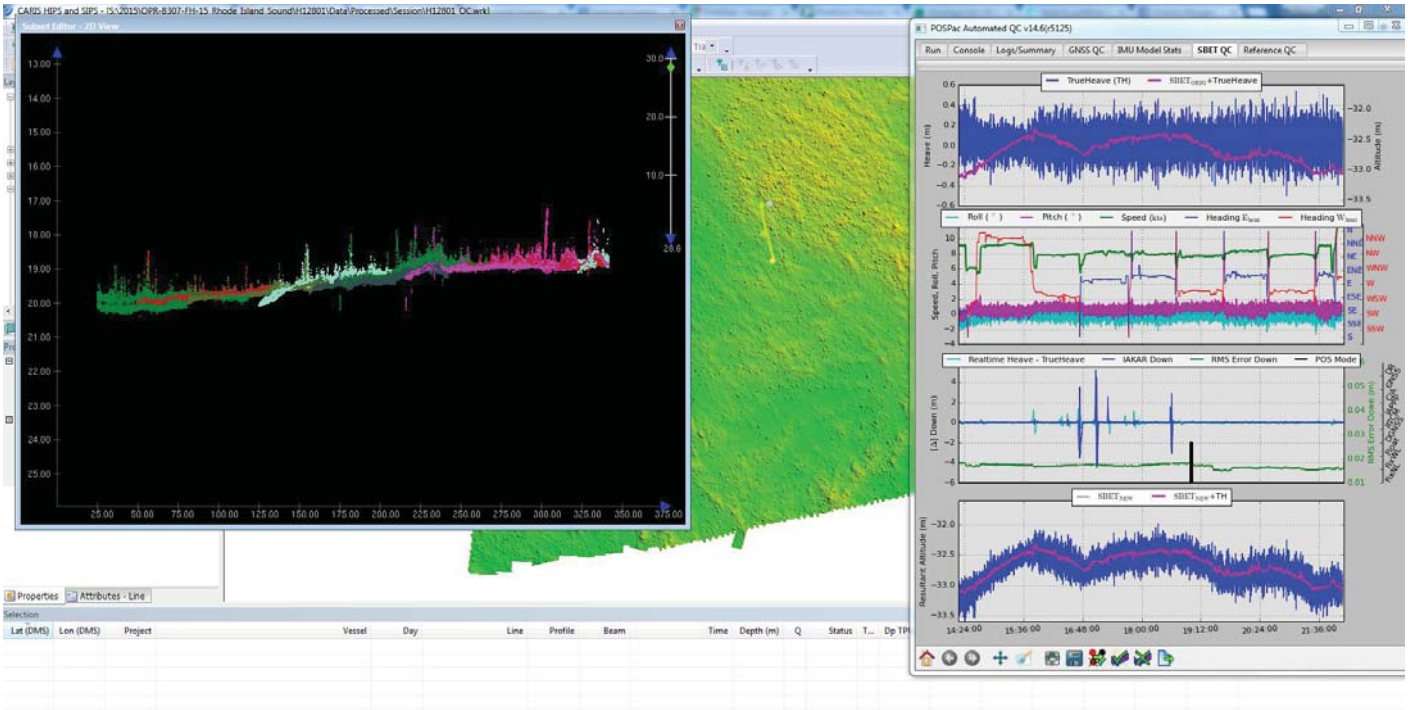


Figure 30: After interpolation of the SBET shown in Figure 28, the offset in bathymetry disappears.

3.3.2 Vertical Offset

During acquisition on H12841 some vertical offsets were observed after GPS tides were applied. The areas affected by the vertical offset were within TVU for the survey and were not investigated further. The POSPAC Automated QC tool was unable to interpolate in these instances. The amount of the offset is approximately 0.15 meters which is within the allowable TVU for the surveyed depths. Examples can be seen from lines acquired on DN163.

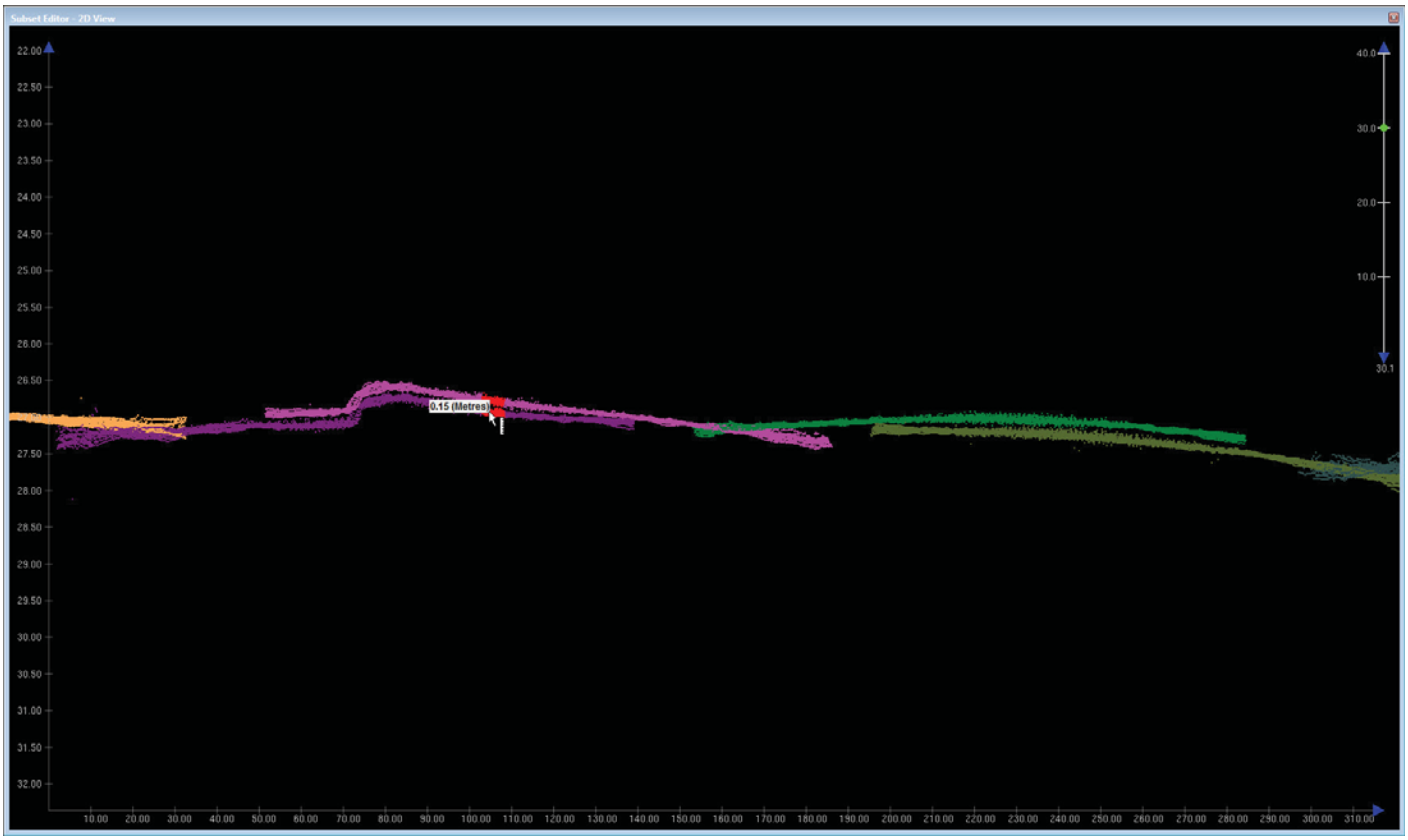


Figure 31: Subset Editor image of 0.15 meter offset in DN163 data.

D. Results and Recommendations

D.1 Chart Comparison

A sounding plot and derived depth contours from the surveyed area to the charted soundings and contours. In general, the depth derived contours align with the charted contours with a few exceptions.

D.1.1 Raster Charts

The following are the largest scale raster charts, which cover the survey area:

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
13233	1:40000	19	01/2011	05/19/2015	05/23/2015
13218	1:80000	42	07/2013	03/31/2015	05/02/2015

Table 17: Largest Scale Raster Charts

<u>13233</u>

Surveyed soundings and contours agree reasonably well with charted depths and contours within 2-4 ft. The MBES coverage indicates boulders scattered throughout a large portion of the survey in which are not represented by the chart. Figure 32 shows some general disagreements between surveyed depths and depth curves and charted soundings and contours.

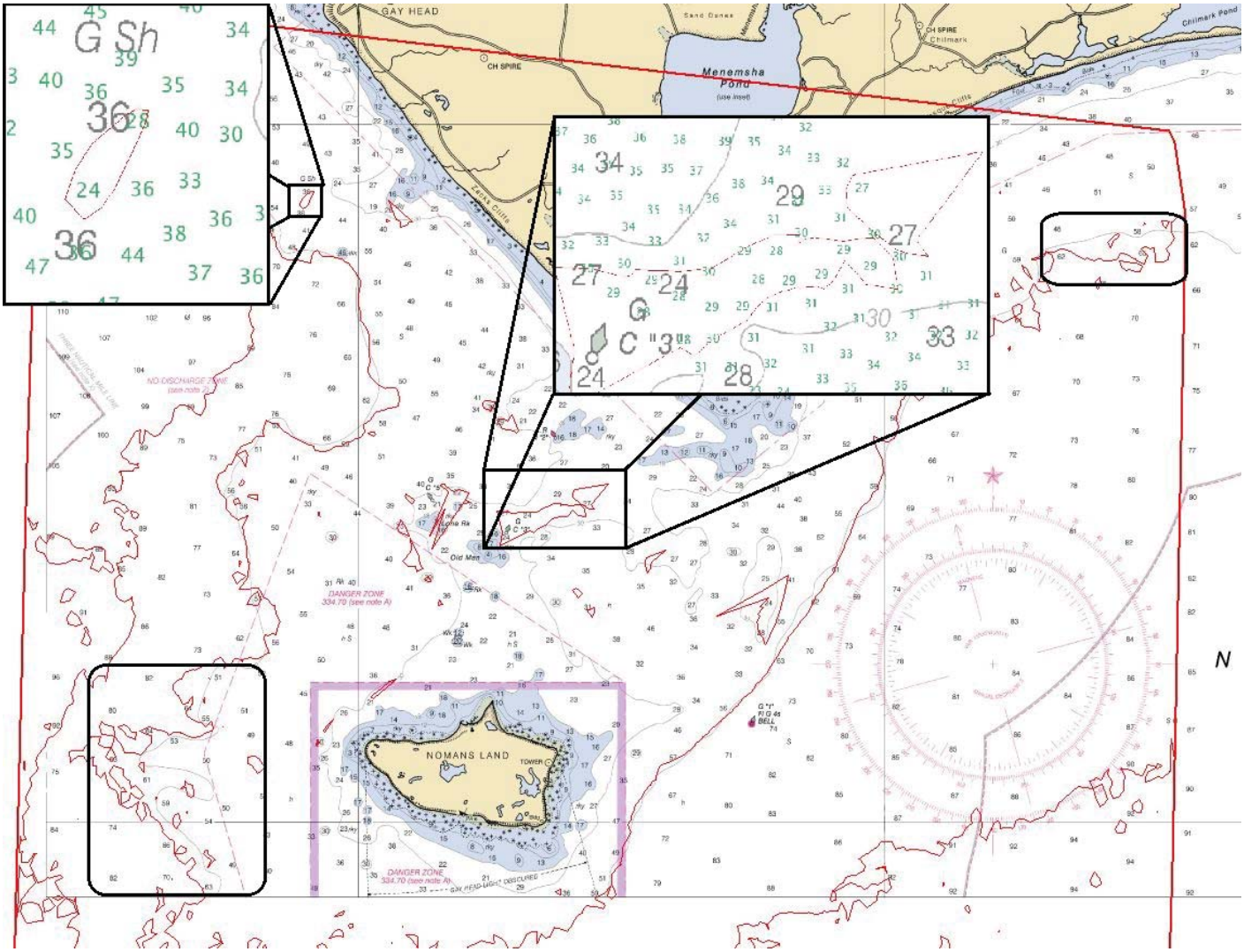


Figure 32: Areas where surveyed depths and depth curves differ from charted soundings and contours from chart 13233.

<u>13218</u>

The differences in 13233 charted 30 and 60 foot contours and surveyed depth curves are shown in Figure 31. Chart 13218 has an additional 90 ft contour and tends to agree with the surveyed contours except some minor differences. Differences are noted in Figure 33.

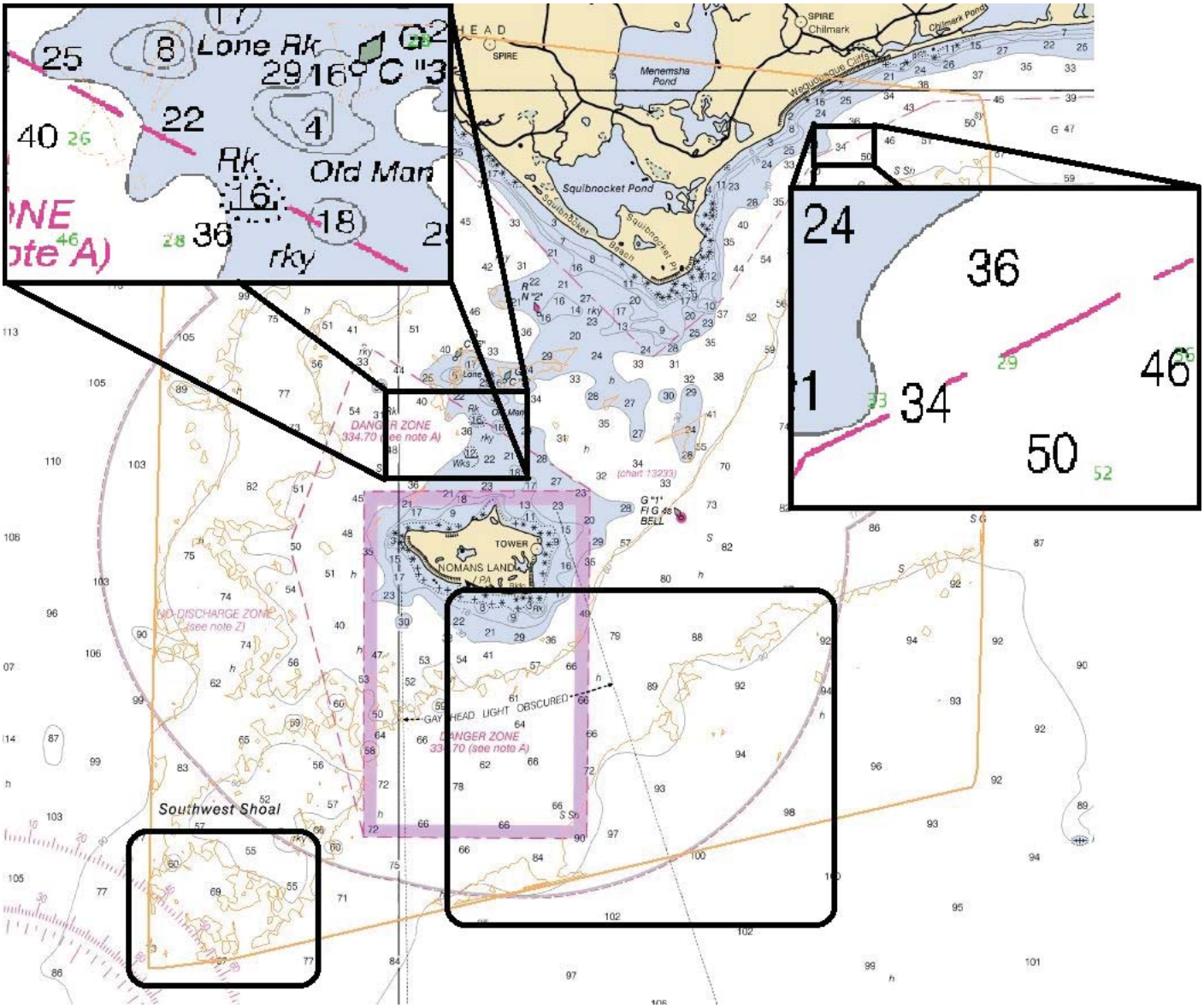


Figure 33: Areas where surveyed depths and depth curves differ from charted soundings and contours from chart 13218.

D.1.2 Electronic Navigational Charts

The following are the largest scale ENCs, which cover the survey area:

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US4MA23M	1:80000	27	04/07/2015	04/07/2015	NO
US5MA29M	1:40000	7	01/26/2015	01/26/2015	NO

Table 18: Largest Scale ENCs

US4MA23M

Soundings were extracted from the S-57 file and imported as a point cloud into Caris HIPS and SIPS. The point cloud was differenced with the 2m surface and a TIN was created. From the TIN, an interpolated surface was created (Figure 34). The depth differences range between -6.47 and 3.34 meters (negative meaning survey data is deeper than charted and positive meaning survey data is shoaler than charted). On average, H12801 is -0.97 meters deeper than ENC US5MA23M soundings.

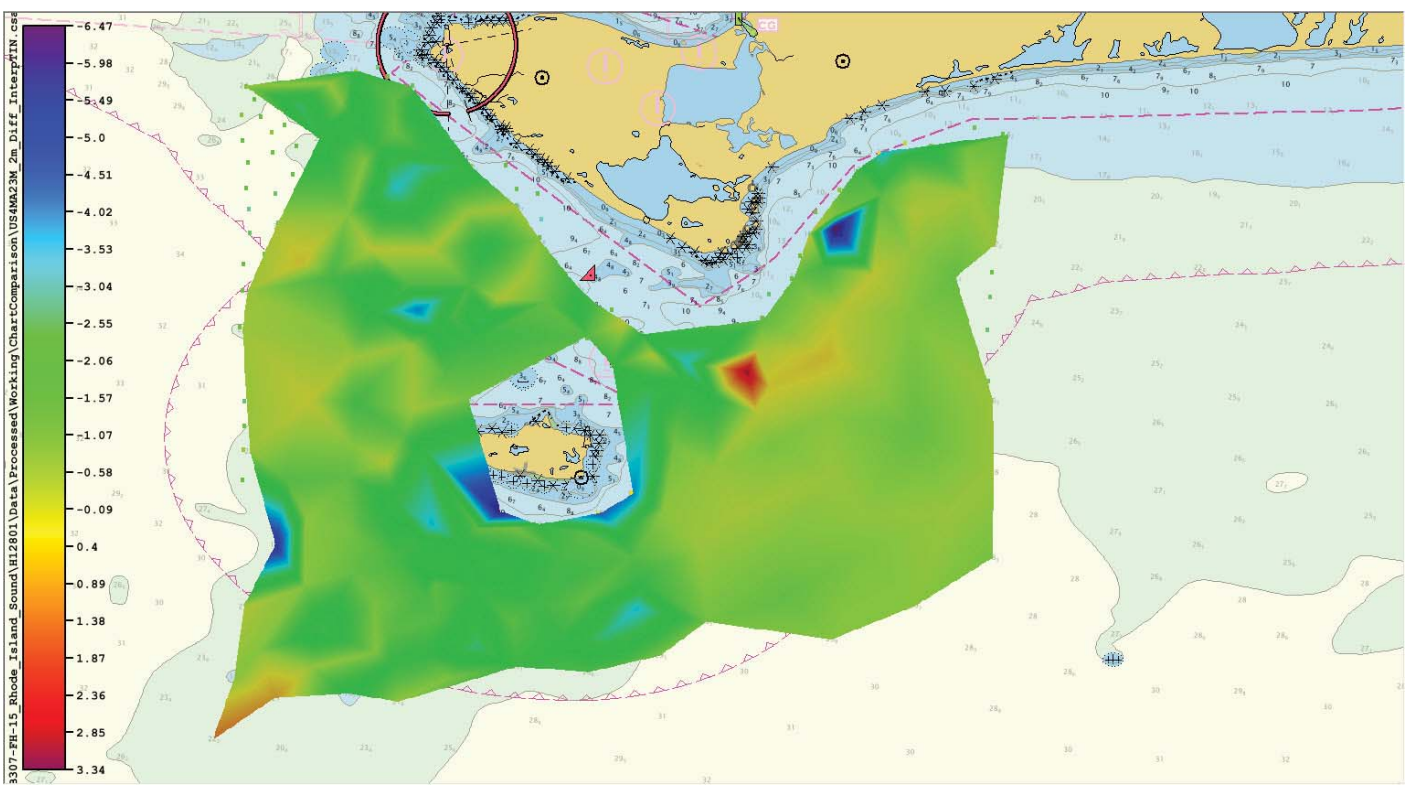
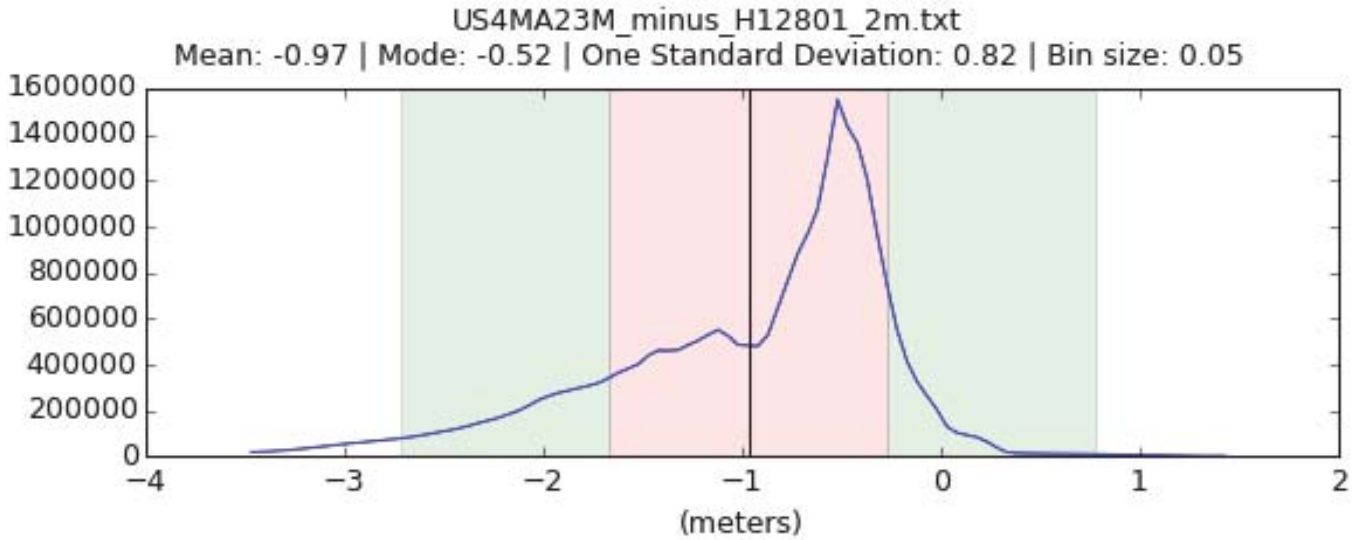
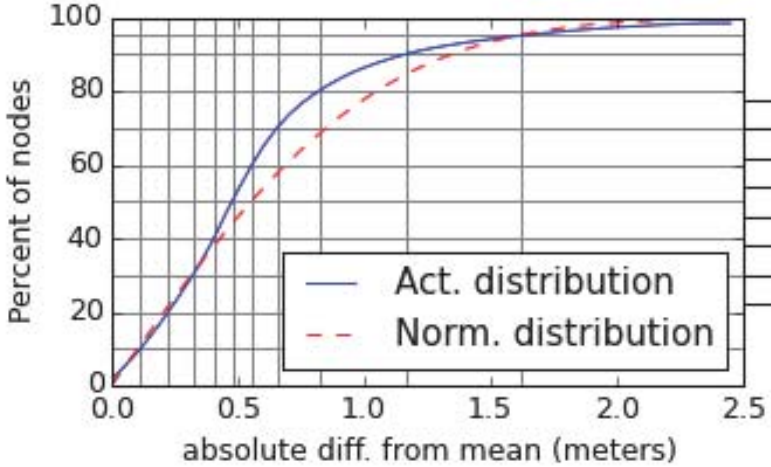


Figure 34: Difference Surface of ENC US4MA23M soundings to an interpolated surface minus H12801.





Percent of nodes	Deviation (m)
50%	+/- 0.48
60%	+/- 0.56
70%	+/- 0.66
80%	+/- 0.82
90%	+/- 1.17
95%	+/- 1.62

Figure 35: ENC US5MA23M Sounding Comparison Statistics

US5MA29M

Soundings were extracted from the S-57 file and imported as a point cloud into Caris HIPS and SIPS. The point cloud was differenced with the 2m surface and a TIN was created. From the TIN, an interpolated surface was created (Figure 36). The depth differences range between -6.2 and 3.82 meters (negative meaning survey data is deeper than charted and positive meaning survey data is shoaler than charted). On average, H12801 is -0.77 meters deeper than ENC US5MA29M soundings.

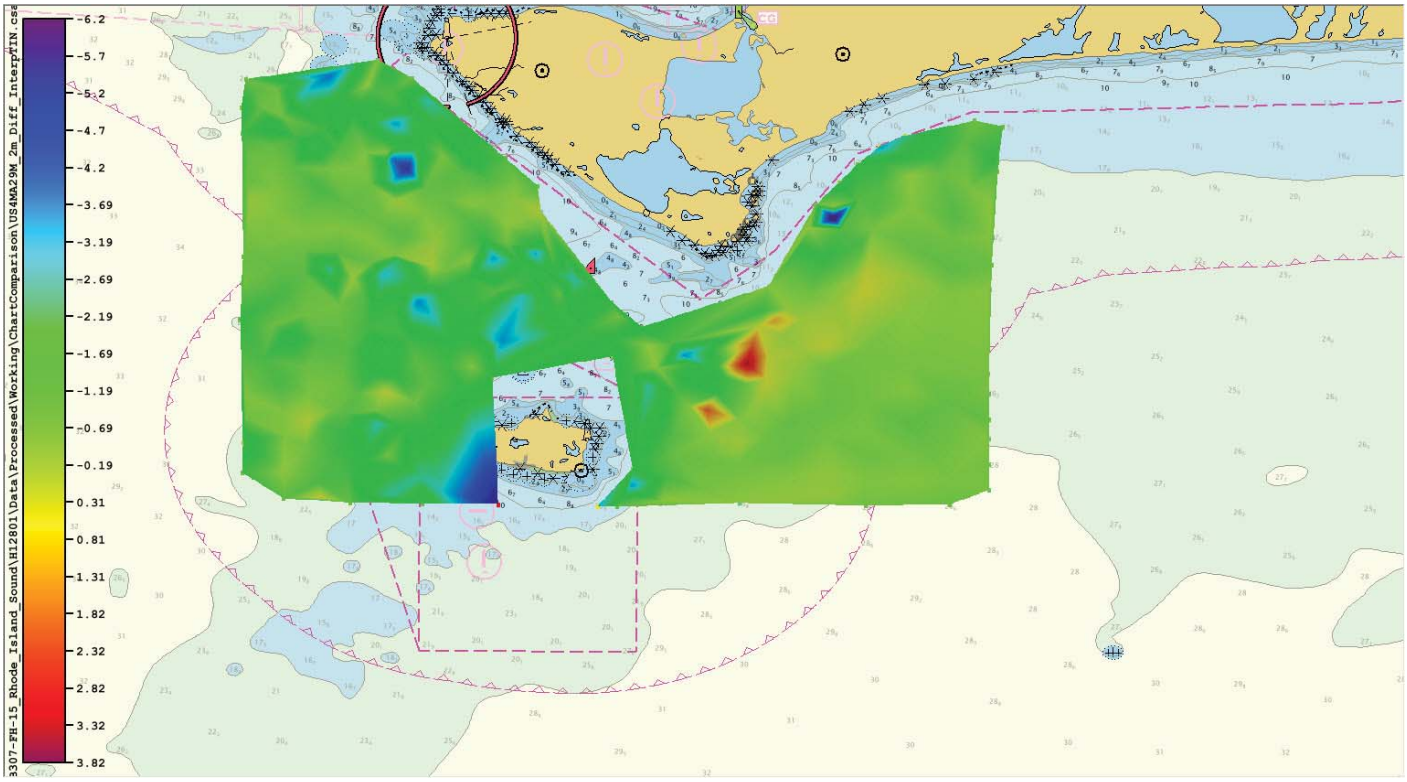
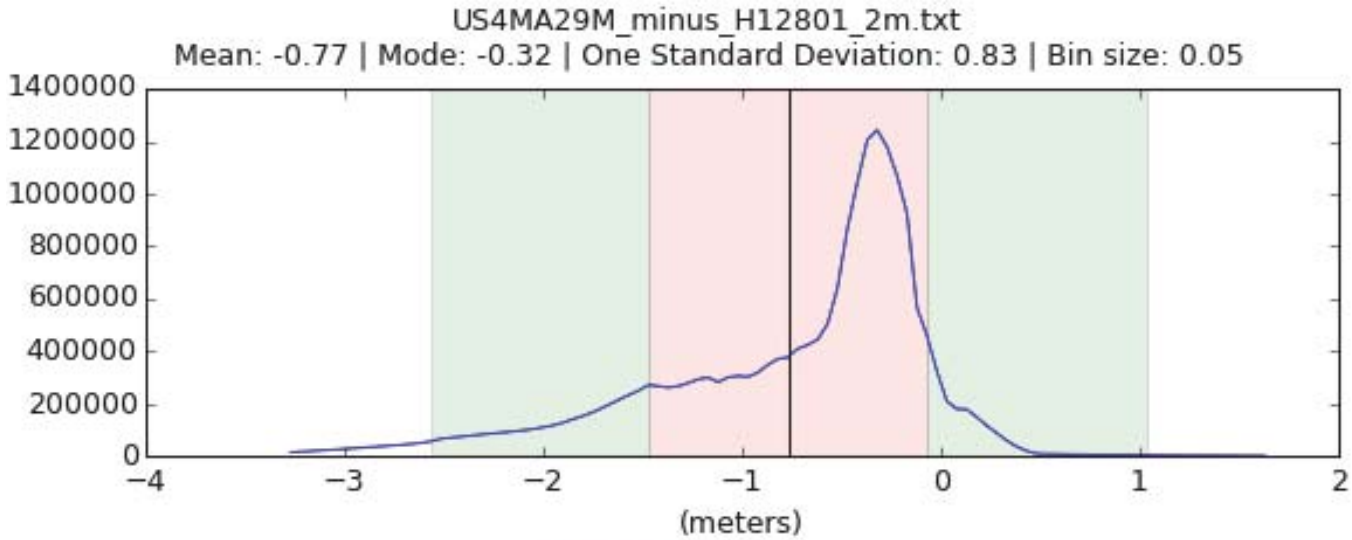
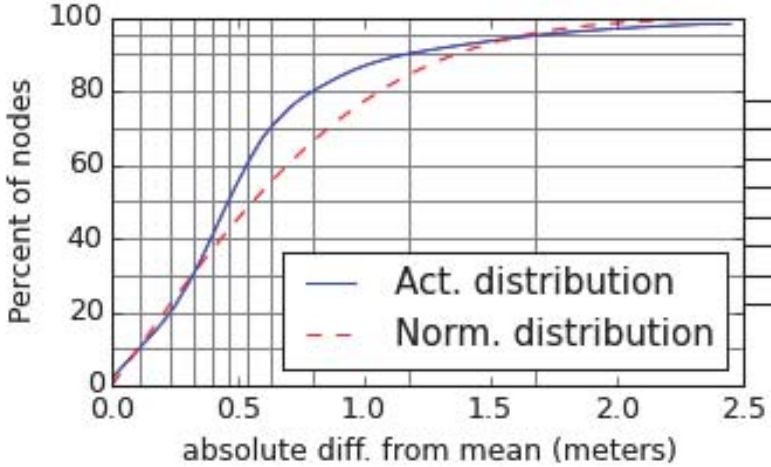


Figure 36: Difference Surface of ENC US5MA29M soundings to an interpolated surface minus H12801.





Percent of nodes	Deviation (m)
50%	+/- 0.46
60%	+/- 0.54
70%	+/- 0.63
80%	+/- 0.80
90%	+/- 1.17
95%	+/- 1.68

Figure 37: ENC US5MA29M Sounding Comparison Statistics

D.1.3 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.4 Charted Features

No charted features exist within the extents of this survey.

D.1.5 Uncharted Features

One uncharted wreck was found within the survey area. Further details can be found in the Final Feature File.

D.1.6 Dangers to Navigation

The following DTON reports were submitted:

DTON Report Name	Date Submitted
H12801 DtoN Report 1	2015-09-25

Table 19: DTON Reports

One Danger to Navigation Report is included in Appendix II of this report.

D.1.7 Shoal and Hazardous Features

No shoals or potentially hazardous features exist within the extents of this survey.

D.1.8 Channels

No channels exist within the extents of this survey. There are no designated anchorages, precautionary areas, safety fairways, traffic separation schemes, pilot boarding areas, or channel and range lines within the survey limits.

It should be noted that the pass between Nomans Land and Squibnocket Point is a common route for fishing boats and other small recreational vessels.

D.1.9 Bottom Samples

A total of twelve bottom samples, chosen from NOAA HSD Operations Branch suggestions and the hydrographer's analysis of acquired backscatter, were taken within the limits of H12801 and are submitted with the FFF, as shown below in Figure 38. Bottom samples ranged from mud to pebbles. Three attempted bottom grabs yielded no return. These samples are not included in the FFF. The positions of these negative samples are shown below in Figure 39.

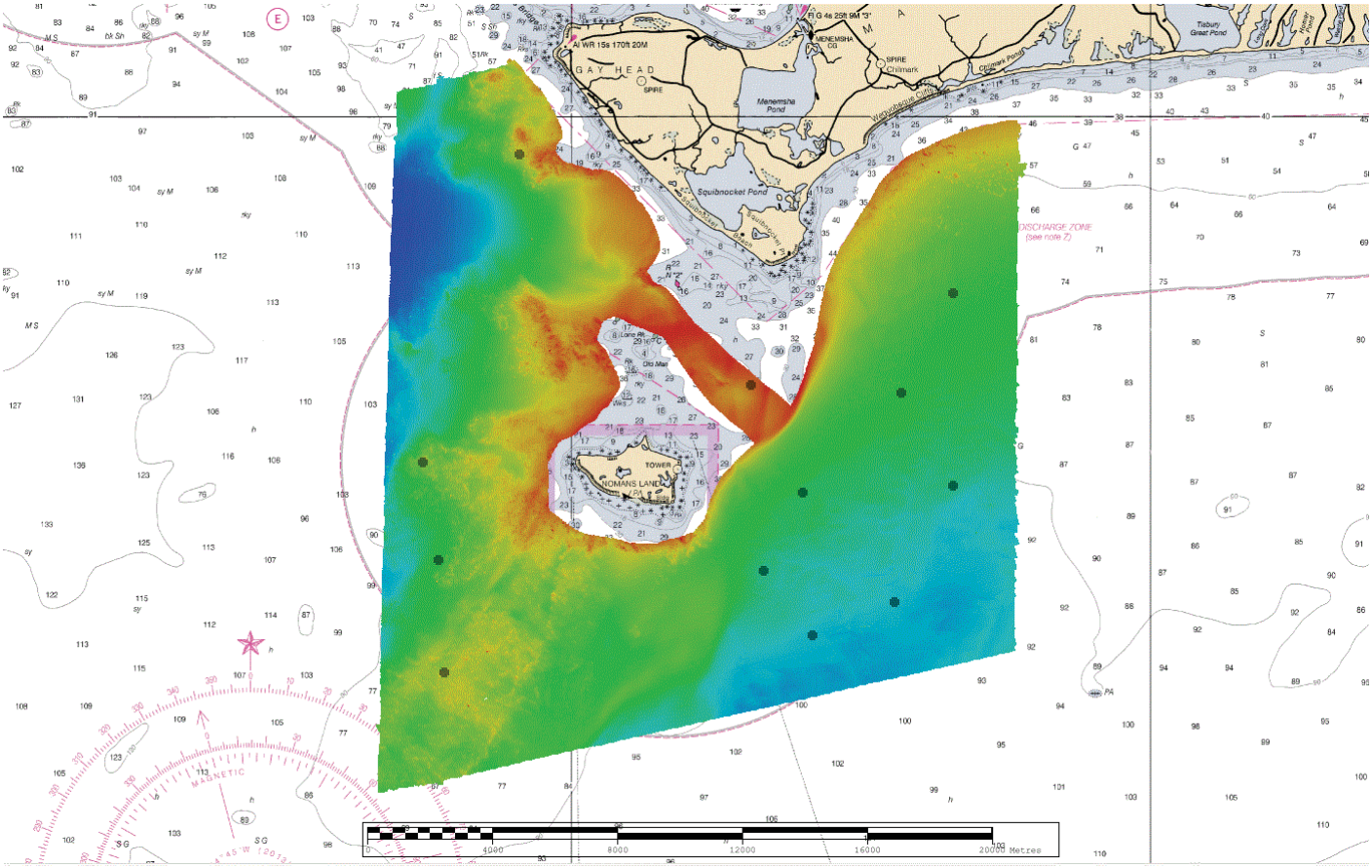


Figure 38: Positions of 12 bottom samples (shown in black)

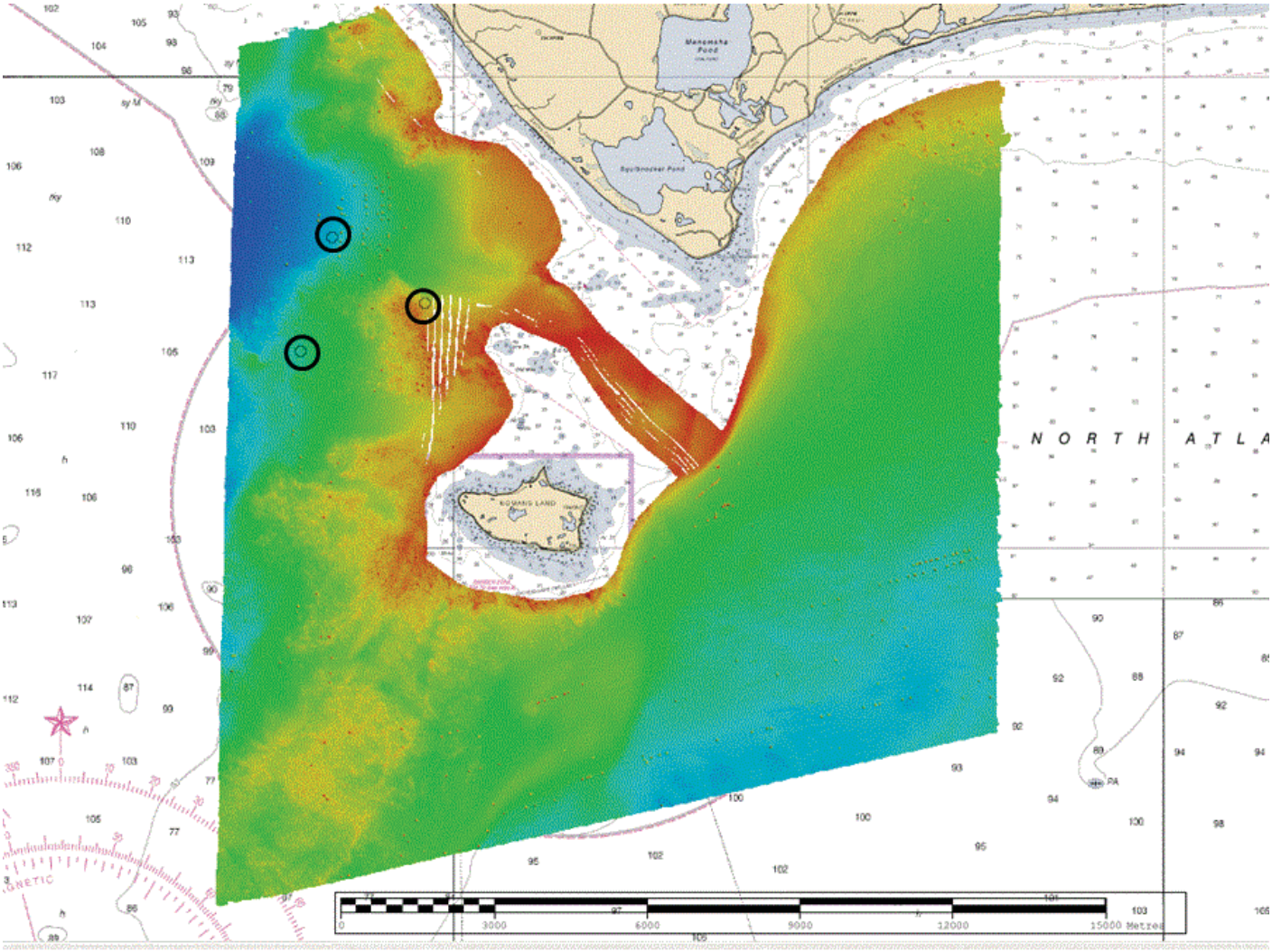


Figure 39: Positions of 3 negative samples (circled in black)

D.2 Additional Results

D.2.1 Shoreline

Shoreline verification was not conducted during this project because of the inability to deploy the ship's survey launch due to a damaged davit. Three features from the Composite Source File were disproved using complete multibeam coverage spanning a radius of 60m around the previously charted feature. These features can be found in the FFF with a recommendation to remove from the chart.

D.2.2 Prior Surveys

No prior surveys were available for comparison with this survey.

D.2.3 Aids to Navigation

Three navigational buoys existed within the survey limits of H12801 that were visually observed and appeared to be correctly positioned.

D.2.4 Overhead Features

No overhead features exist within the extents of this survey.

D.2.5 Submarine Features

No submarine features exist within the extents of this survey.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist within the extents of this survey.

D.2.7 Platforms

No platforms exist within the extents of this survey.

D.2.8 Significant Features

No Significant Features exist within the extents of this survey.

D.2.9 Construction and Dredging

No present or planned construction or dredging exist within the survey limits.

D.2.10 New Survey Recommendation

Due to the large amount of fishing vessel and small boat traffic operating around the shores of Martha's Vineyard and Nomans Land, it's recommended that future surveys are planned to acquire data further inshore of H12801 coverage.

D.2.11 Inset Recommendation

No new insets are recommended for this area.

E. Approval Sheet

Field operations for this hydrographic survey were conducted under the direct supervision of the then Chief of Party, Commander Marc S. Moser, with frequent personal checks of progress and adequacy. I have reviewed the attached survey data and reports.

All field sheets, this Descriptive Report, and all accompanying records and data are approved. All records are forwarded for final review and processing to the Processing Branch.

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.

Report Name	Report Date Sent
OPR-B307-FH-15 Data Acquisition and Processing Report	2016-07-22
2015 Hydrographic Systems Readiness Review Memo	2015-07-06

Approver Name	Approver Title	Approval Date	Signature
LCDR Briana J. Welton, NOAA	Chief of Party	07/20/2016	WELTON.BRIANA.JANE.1267667531 2016.07.20 12:00:08 -04'00'
LT Jon Andvick, NOAA	Field Operations Officer	07/20/2016	Digitally signed by ANDVICK.JON.DOUGLAS.1369596434 Date: 2016.08.06 17:19:25 -04'00'
LT Nick Morgan, NOAA	Sheet Manager	07/20/2016	MORGAN.NICHOLAS.C.1292288138 2016.08.10 16:15:23 -04'00'

F. Table of Acronyms

Acronym	Definition
AHB	Atlantic Hydrographic Branch
AST	Assistant Survey Technician
ATON	Aid to Navigation
AWOIS	Automated Wreck and Obstruction Information System
BAG	Bathymetric Attributed Grid
BASE	Bathymetry Associated with Statistical Error
CO	Commanding Officer
CO-OPS	Center for Operational Products and Services
CORS	Continually Operating Reference Staiton
CTD	Conductivity Temperature Depth
CEF	Chart Evaluation File
CSF	Composite Source File
CST	Chief Survey Technician
CUBE	Combined Uncertainty and Bathymetry Estimator
DAPR	Data Acquisition and Processing Report
DGPS	Differential Global Positioning System
DP	Detached Position
DR	Descriptive Report
DTON	Danger to Navigation
ENC	Electronic Navigational Chart
ERS	Ellipsoidal Referenced Survey
ERZT	Ellipsoidally Referenced Zoned Tides
FFF	Final Feature File
FOO	Field Operations Officer
FPM	Field Procedures Manual
GAMS	GPS Azimuth Measurement Subsystem
GC	Geographic Cell
GPS	Global Positioning System
HIPS	Hydrographic Information Processing System
HSD	Hydrographic Surveys Division
HSSD	Hydrographic Survey Specifications and Deliverables

Acronym	Definition
HSTP	Hydrographic Systems Technology Programs
HSX	Hypack Hysweep File Format
HTD	Hydrographic Surveys Technical Directive
HVCR	Horizontal and Vertical Control Report
HVF	HIPS Vessel File
IHO	International Hydrographic Organization
IMU	Inertial Motion Unit
ITRF	International Terrestrial Reference Frame
LNM	Local Notice to Mariners
LNM	Linear Nautical Miles
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NAIP	National Agriculture and Imagery Program
NALL	Navigable Area Limit Line
NM	Notice to Mariners
NMEA	National Marine Electronics Association
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRT	Navigation Response Team
NSD	Navigation Services Division
OCS	Office of Coast Survey
OMAO	Office of Marine and Aviation Operations (NOAA)
OPS	Operations Branch
MBES	Multibeam Echosounder
NWLON	National Water Level Observation Network
PDBS	Phase Differencing Bathymetric Sonar
PHB	Pacific Hydrographic Branch
POS/MV	Position and Orientation System for Marine Vessels
PPK	Post Processed Kinematic
PPP	Precise Point Positioning
PPS	Pulse per second

Acronym	Definition
PRF	Project Reference File
PS	Physical Scientist
PST	Physical Science Technician
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPE	Total Propagated Error
TPU	Topside Processing Unit
USACE	United States Army Corps of Engineers
USCG	United Stated Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDA	Global Positiong System timing message
ZDF	Zone Definition File

APPENDIX I

TIDE NOTE AND GRAPHICS

UNITED STATES DEPARMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service
Silver Spring, Maryland 20910

PROVISIONAL TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : September 18, 2015

HYDROGRAPHIC BRANCH: Atlantic
HYDROGRAPHIC PROJECT: OPR-B307-FH-2015
HYDROGRAPHIC SHEET: H12801
LOCALITY: Nomans Land, Rhode Island Sound, RI
TIME PERIOD: June 10 - July 24, 2015

TIDE STATION USED: 8452660 Newport
Lat. 41° 30.3'N Long. 71° 19.6' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 1.099 meters

TIDE STATION USED: 8448875 Martha's Vineyard GPS Buoy
Lat. 41° 19.6'N Long. 70° 35.4' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 0.883 meters

REMARKS: RECOMMENDED GRID

Please use the TCARI grid "B307FH2015_Final.tc" as the final grid for project OPR-B307-FH-2015, H12801, during the period between June 10 and July 24, 2015.

Refer to attachments for zoning information.

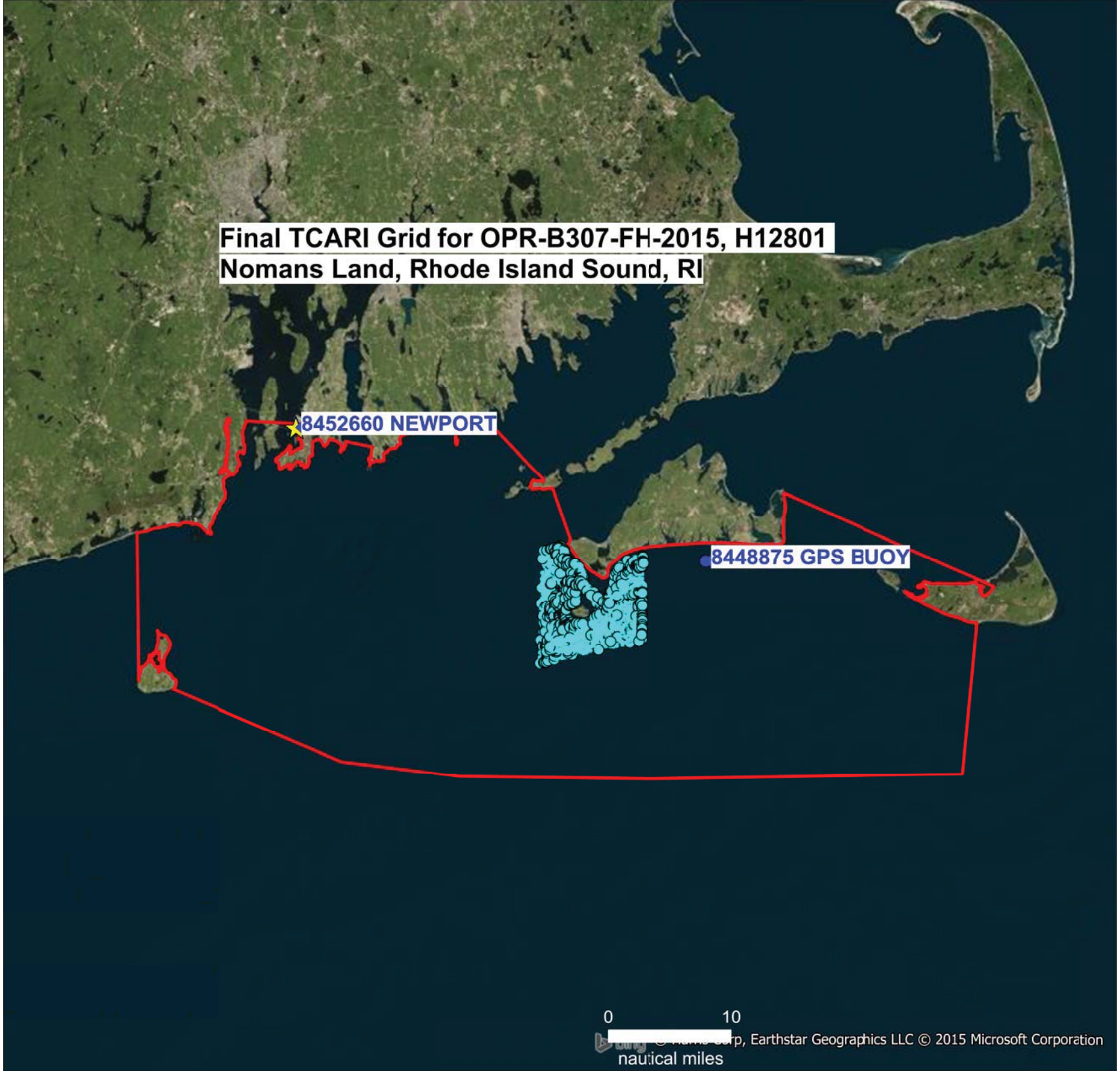
Note 1: Provided time series data are tabulated in metric units(meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

Note 2: Annual leveling for Newport, RI (8452660) was not completed in FY15. A review of the water level data collected during the survey period for this sheet indicates good data quality, however the sensor stability cannot be verified until the most recent set of levels are reviewed. This provisional tide note should be used as the final tide for this sheet and after the leveling information has been received and reviewed, a follow-up memo to OCS will validate the stability of the data. Should the most recent set of levels indicate that the sensor was not stable during the period of survey operations, CO-OPS will immediately provide a revised Tide Note with updated water level reference information.

HOVIS.GERALD.THOMAS.JR.1365860250

Digitally signed by HOVIS.GERALD.THOMAS.JR.1365860250
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.JR.1365860250
Date: 2015.09.23 12:11:07 -04'00'

CHIEF, PRODUCTS AND SERVICES BRANCH


Final TCARI Grid for OPR-B307-FH-2015, H12801
Nomans Land, Rhode Island Sound, RI
8452660 NEWPORT
8448875 GPS BUOY
0
10
nautical miles
© 2015 Microsoft Corporation

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

Patrick Berube - NOAA Federal <patrick.j.berube@noaa.gov>

OPR-B307-FH-15 VDatum evaluation

2 messages

Patrick Berube - NOAA Federal <patrick.j.berube@noaa.gov> Tue, Aug 18, 2015 at 7:50 AM
To: Katrina Wyllie - NOAA Federal <katrina.wyllie@noaa.gov>
Cc: Jon Andvick - NOAA Federal <jon.andvick@noaa.gov>, Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>

Hi Katrina,

I am starting to move on to the VDatum validation for the RI sound project portion of the DR. The checklines were never processed and an evaluation was never completed. Would it be acceptable if I did the ERZT model for each sheet and did a difference surface with the separation model and just include some images and the statistics for the difference in the vertical control portion rather then processing the checklines at this point? If this is not acceptable and I need to submit a report can I just do the report on each sheets ERZT to VDatum difference surface and submit the images and statistics?

Thanks,

Pat

--
NOAA Ship Ferdinand Hassler

Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov> Thu, Aug 20, 2015 at 2:33 PM
To: Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov>, Patrick Berube - NOAA Federal <patrick.j.berube@noaa.gov>, Jon Andvick - NOAA Federal <jon.andvick@noaa.gov>, Marc Moser - NOAA Federal <marc.s.moser@noaa.gov>, Corey Allen - NOAA Federal <corey.allen@noaa.gov>

Pat,
At this point there isn't much point in processing the check lines separately and doing an evaluation comparison to the surface. We can just move on to the ERS memo including the all data (including checklines) referenced to the ellipse using Vdatum SEP model and then the comparison of the Vdatum SEP and the ERZT SEP via difference layers. Just make sure to include the checklines in the ERS comparisons. Hopefully you wont run into any issues with the checklines. Keep me in the loop and I will try to continue to help with this!

Thanks,
Katy Pridgen

Kathryn Pridgen
Physical Scientist
NOAA-HSD OPS
301-713-2722 ext 145
kathryn.pridgen@noaa.gov

On Thu, Aug 20, 2015 at 2:13 PM, Katrina Wyllie - NOAA Federal <katrina.wyllie@noaa.gov> wrote:

> Pat's original email is at the bottom.
>
> If you get stuck on anything, I'm happy to help.
>
> ---------- Forwarded message ----------
> From: **Corey Allen - NOAA Federal** <corey.allen@noaa.gov>
> Date: Wed, Aug 19, 2015 at 9:22 AM

Subject: Re: OPR-B307-FH-15 VDatum evaluation
To: Katrina Wyllie - NOAA Federal <katrina.wyllie@noaa.gov>

at this point performing check with crosslines is moot.

On Tue, Aug 18, 2015 at 9:40 AM, Katrina Wyllie - NOAA Federal <katrina.wyllie@noaa.gov> wrote:

> I think it's fine if he ignores the checklines...those are just a sanity check for us. But, I didn't want to answer this because it's not my call. Thoughts?
> [Quoted text hidden]

--
J. Corey Allen
Team Lead, Operations Branch
Hydrographic Surveys Division
Office of Coast Survey, NOAA
Corey.Allen@noaa.gov
301.713.2777 x119 (Office)
301.717.7271 (Cell)

Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>

RIS H12801 Designated Sounding Issues

8 messages

Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov> Mon, Oct 26, 2015 at 5:04 PM
To: Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>
Cc: Corey Allen - NOAA Federal <corey.allen@noaa.gov>, Castle Parker - NOAA Federal <castle.e.parker@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>

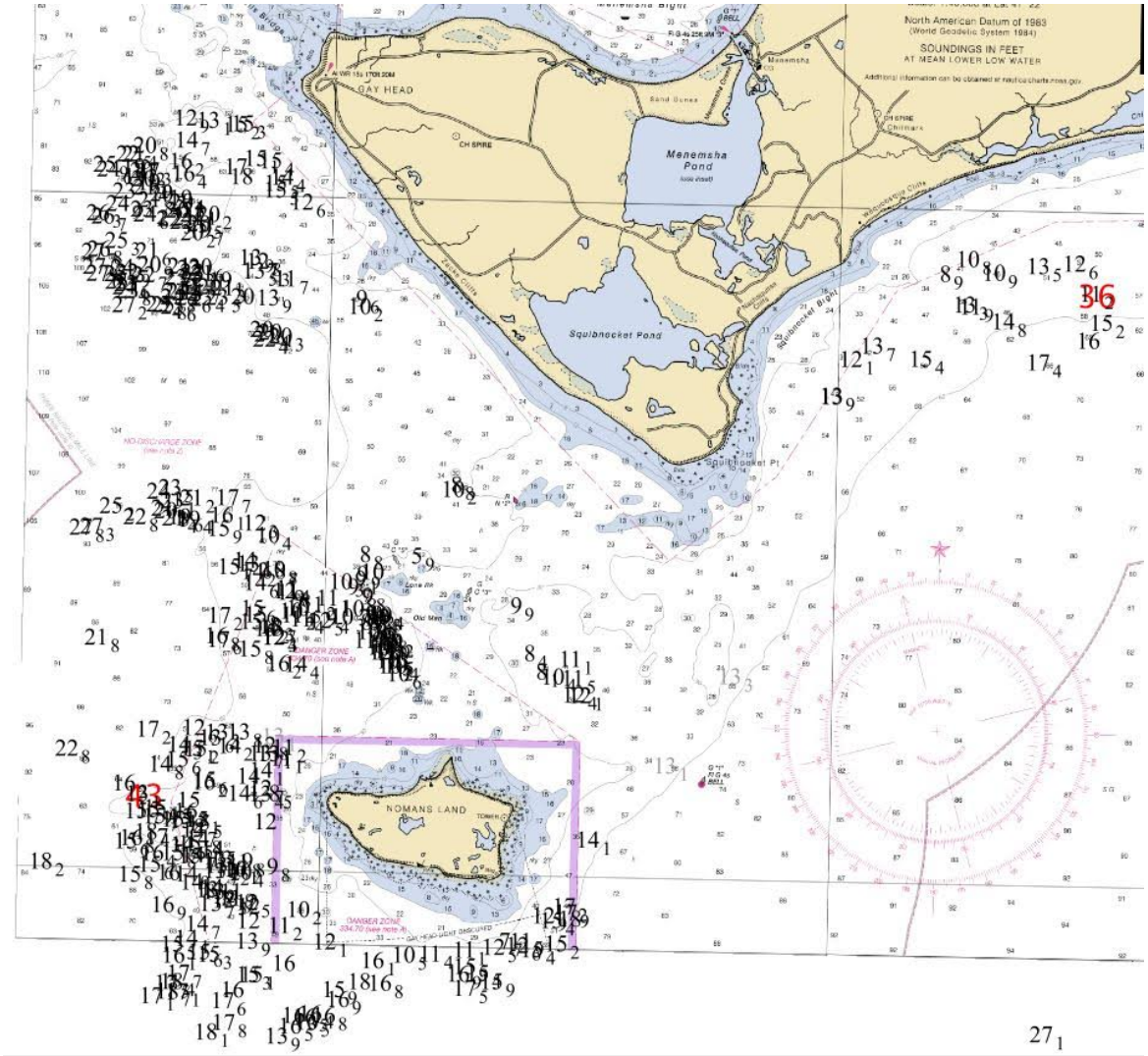
Greetings Kathryn,

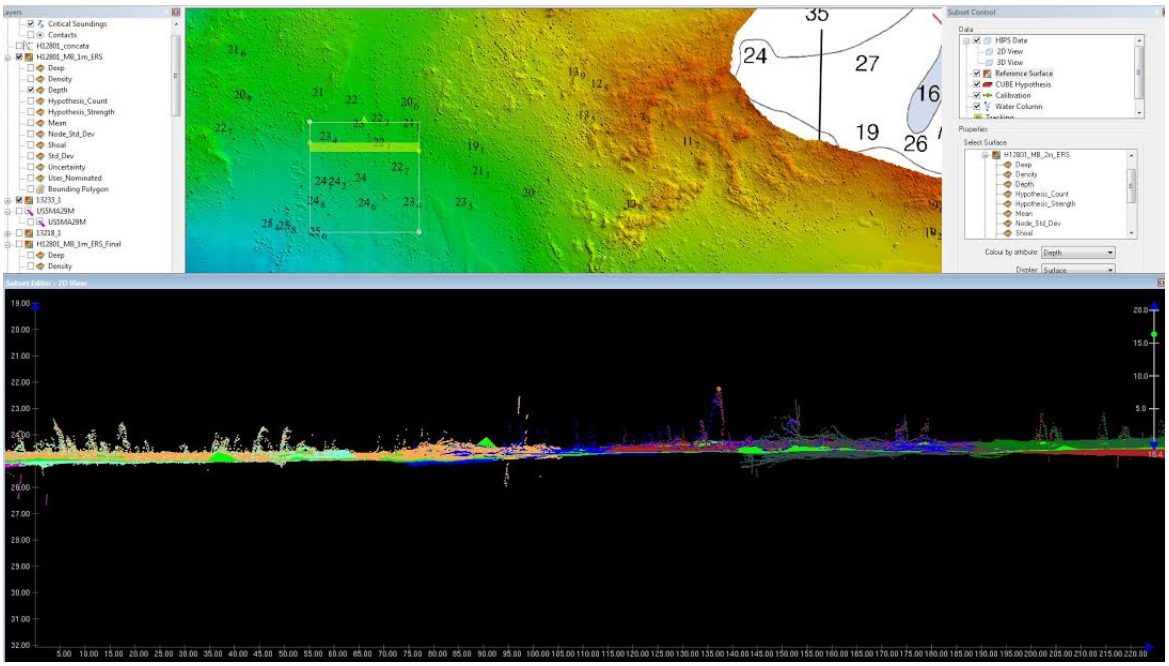
I'm currently working through survey H12801 in Rhode Island Sound. H12801 as compared to the other two surveys that the Hassler did in the area this summer has small rocks and boulders littered all over the survey area. Both the 1m and 2m surfaces are struggling to represent the least depth of the rocks and it's causing me to designate a huge number of soundings (there are already over 350 and still working through the surfaces). Compounding the issue is the fact that this is a larger scale survey (1:20,000 as compared to 1:40,000 with the other two RIS surveys) so the 2mm at chart scale rule means that there will be a higher density of designated soundings.

The amount of designated soundings is pretty excessive for AHB to deal with and to be honest, probably isn't the most reliable way to ensure the surface is grabbing least depths in a thorough manner. Would it be possible to get a waiver from Ops to extend the 1m surface out to deeper depths? O maybe create a 50cm surface? The data density seems to support it however there will be holidays. Perhaps it could be remedied by keeping a large amount of overlap with the different resolution surfaces.

What do you think would be the best way to proceed with this? Attached are a couple screenshots showing what I'm dealing with.

V/r
Nick





--

LT Nick Morgan, NOAA
Navigation Officer
NOAA Ship Ferndiand R. Hassler

Physical Address *(UPS/FedEx):*
UNH Judd Gregg Marine Research Complex
29 Wentworth Rd.
New Castle, NH 03854

Mailing Address*:*
PO Box 638
New Castle, NH 03854

Ship's landline: 603-431-4500
Ship's cell: 603-812-8748
Cell Phone: 907-617-0963

Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov> Tue, Oct 27, 2015 at 3:58 PM
To: Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>

Nick,
Let me look at this and get some feedback on how to handle it and Ill get back to you ASAP!
Thanks for keeping me in the loop!

Katy

Kathryn Pridgen
Physical Scientist
NOAA-HSD OPS
301-713-2702 ext 178
kathryn.pridgen@noaa.gov
[Quoted text hidden]

Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov> Wed, Oct 28, 2015 at 12:12 PM
To: Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>

Sounds good, thanks. Let me know if you need any other screenshots of the data depicting the problem.

-Nick
[Quoted text hidden]

Corey Allen - NOAA Federal <corey.allen@noaa.gov> Thu, Oct 29, 2015 at 12:49 PM
To: Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>
Cc: Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>, Castle Parker - NOAA Federal <castle.e.parker@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>, Michael Gonsalves - NOAA Federal <Michael.Gonsalves@noaa.gov>

AHB,
You guys have any thoughts on this request?

Corey

On Mon, Oct 26, 2015 at 5:04 PM, Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov> wrote:
[Quoted text hidden]

--
J. Corey Allen
Team Lead, Operations Branch
Hydrographic Surveys Division
Office of Coast Survey, NOAA

Corey.Allen@noaa.gov
301.713.2777 x119 (Office)
301.717.7271 (Cell)

Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov> Thu, Oct 29, 2015 at 1:33 PM
To: Corey Allen - NOAA Federal <corey.allen@noaa.gov>
Cc: Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>, Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>, Castle Parker - NOAA Federal <castle.e.parker@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>, Michael Gonsalves - NOAA Federal <Michael.Gonsalves@noaa.gov>

Hey Corey,
this situation mirrors what Hassler was doing last year - prior to the spec change. I see no major problems with us ingesting the finer resolution grid(s) that they create to better capture the natural bathy features.

This, of course, assumes OPS provides a waiver for the finer resolution surfaces not meeting spec, the related email correspondence is captured in the DR appendices and the grids deviation from spec are addressed in the DR body.

Jasko

Lieutenant Commander Matthew Jaskoski, NOAA
Chief, Atlantic Hydrographic Branch
439 W. York St.
Norfolk, VA 23510
Office: 757-441-6746 x200
Cell: 757-647-3356
[Quoted text hidden]

Castle Parker - NOAA Federal <castle.e.parker@noaa.gov> Thu, Oct 29, 2015 at 1:35 PM
To: Corey Allen - NOAA Federal <corey.allen@noaa.gov>, Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>
Cc: Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>, Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov>

Good day Everyone,

OPS, please post the OPR-B307-FH-15 project files on Navigator for AHB to download.

What is the coverage technique? Without reviewing the instructions and knowing the field unit's survey technique, to offer a suggestion is somewhat limited at this point. Setting that aside, if the grid does not honor the least depths of rocks, higher grid resolution is recommended. If acquisition is completed, OPS may need to waive or allow deviation for the density if generating a 50cm grid. From my view point, a large number of designated depths is not an issue. AHB does not have the requirement to validate and verify every single designated depth.

If for instance, the FH maintained the 1m and 2m, but generated a 50cm to honor the shoal depths over the entire area, or in specified areas, when combined the density would not be an issue. It seems appropriate to generate a 50cm grid over the common area of clustered designated depths.

The bottom image does not seems to portray the grid as if it were finalized; the one designated depth I view did not honor a designated depth, and thus assume it was not finalized with designated depths applied. Extending the depth range of the 1m grid will not solve this problem as many of the designate depths within the first image are less than 20m depth.

If this were my survey, I would generate 50cm grids common to the cluster of critical soundings, in addition to the 1m and 2m as described. The only other option is to continue to designate where applicable and finalize the source grids. The higher resolution grid (50cm) is probably the least amount of time and human effort.

$0.02,

Gene

Castle Eugene Parker

NOAA Office of Coast Survey

Atlantic Hydrographic Branch

Hydrographic Team Lead / Physical Scientist

castle.e.parker@noaa.gov

office (757) 441-6746 x115

From: Corey Allen - NOAA Federal [mailto:corey.allen@noaa.gov]
Sent: Thursday, October 29, 2015 12:50 PM
To: Nicholas Morgan - NOAA Federal
Cc: Kathryn Pridgen - NOAA Federal; Castle Parker - NOAA Federal; Tyanne Faulkes - NOAA Federal; Matthew Jaskoski - NOAA Federal; OPS.Ferdinand Hassler - NOAA Service Account; Michael Gonsalves - NOAA Federal
Subject: Re: RIS H12801 Designated Sounding Issues

[Quoted text hidden]

Corey Allen - NOAA Federal <corey.allen@noaa.gov> Thu, Oct 29, 2015 at 1:57 PM
To: Castle Parker - NOAA Federal <castle.e.parker@noaa.gov>
Cc: Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov>, Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>, Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov>

Nick,

Gene's final paragraph sums it up pretty well. If creating the grid proves the least amount of effort for the shoal items, then you have our waiver if those grids fail to meet density requirements. Please heed Jasko's guidance re: documenting this email chain and discussing grid density issues in the DR.

Corey
[Quoted text hidden]

Nicholas Morgan - NOAA Federal <nicholas.morgan@noaa.gov> Thu, Oct 29, 2015 at 2:45 PM
To: Castle Parker - NOAA Federal <castle.e.parker@noaa.gov>
Cc: Corey Allen - NOAA Federal <corey.allen@noaa.gov>, Kathryn Pridgen - NOAA Federal <kathryn.pridgen@noaa.gov>, Tyanne Faulkes - NOAA Federal <tyanne.faulkes@noaa.gov>, Matthew Jaskoski - NOAA Federal <matthew.jaskoski@noaa.gov>, "OPS.Ferdinand Hassler - NOAA Service Account" <ops.ferdinand.hassler@noaa.gov>, Michael Gonsalves - NOAA Federal <michael.gonsalves@noaa.gov>

Gene,

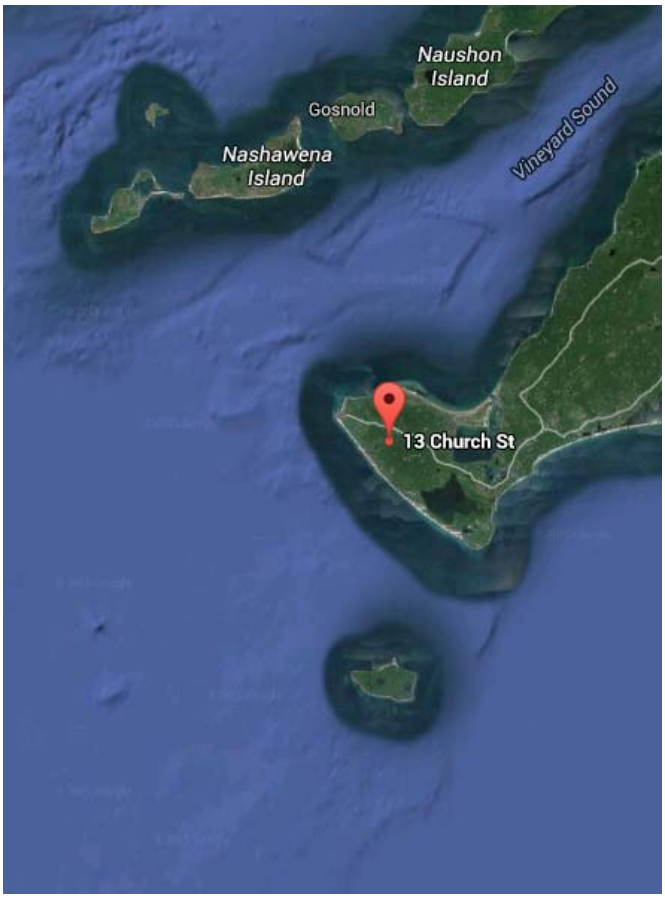
Sorry, I forgot to include some of the information you had questions about. The coverage method is complete MBES with backscatter. And you are correct, that is not a finalized surface. I used the regular surface to so it would be more obvious that the surface is not grabbing to the rocks. There are substantial areas that are greater than 20m where the 2m surface is not honoring least depths as well. I anticipated initially that this wouldn't be much of a problem for the 2m surface due to the the greater uncertainty allowance for depths greater than 20m. However, that wasn't the case and there are lots of rocks and boulders where the difference between the 2m surface and the least depth is greater than the designated sounding threshold. So that kind of added to the DS nightmare.

Unfortunately I have already invested a fair amount of time into designating a lot of soundings (as you can see in the overview picture). But I don't think going through and manually designating that many soundings for that large of an area is the most reliable systematic way to feel confident about getting least depths. So I'll go ahead and try making some 50cm surfaces for the problematic regions of the survey and see how it works out.

Thanks for the feedback everyone.

-Nick

[Quoted text hidden]



MARTHA'S VINYARD BASE STATION DEPLOYMENT

In support of hydrographic surveys by NOAA Ships Ferdinand Hassler

DEPLOYED
22 May, 2015

Glen Rice and LCDR Samuel F. Greenaway
NOAA Office of Coast Survey

Executive Summary

A reference station consisting of three receivers and two antennas were successfully deployed on the western side of Martha's Vineyard, MA. All redundant stations were deployed on 22 May, 2015 at a private residence south of the Aquinnah, MA town center. These stations are intended to provide horizontal and vertical control for Coast Survey projects during the 2015 field season. The data are available to field units through a public NGS FTP server and updated on an hourly basis.

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1 General Overview

Office of Coast Survey (OCS) Hydrographic Services Division (HSD) mandated that all 2015 NOAA surveys be conducted as Ellipsoid Referenced Surveys (ERS). A reference station was deployed on Martha's Vineyard to support surveys assigned to NOAA Hydrographic Ship *Ferdinand R. Hassler* (FH) (Figure 1).

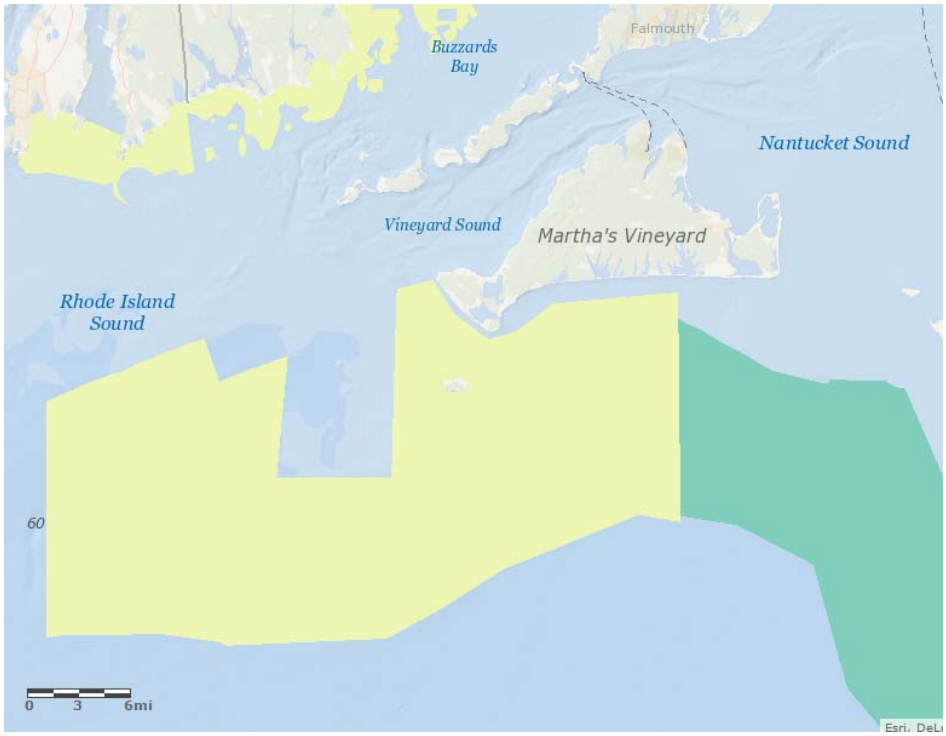

Figure 1 - 2015 HSD Projects (Yellow) and 2016 HSD Projects (Green). From http://www.arcgis.com/home/webmap/viewer.html?webmap=dccb3599aa8d414e83c1989d62ec93a0

Three redundant base stations were successfully deployed during 22 May, 2015. Two of the stations, connected to a single antenna, are uploading data to an NGS FTP site hourly. FH will download the data for post processed kinematic positioning. Additionally, the third receiver is providing real time kinematic positioning (RTK) over networked transport of RTCM via IP (NTRIP). The reference station is planned to be retrieved in September, 2015.

The field party included Hydrographic Systems and Technology Programs (HSTP) personnel Glen Rice and LCDR Samuel Greenaway.

2 Site selection

The equipment available for installation to support the 2015 Martha's Vineyard projects had several site requirements. These requirements included

1. A power source for the equipment
2. A secure, sheltered area for the base station receivers and communications equipment
3. An unobstructed view of the sky for acquiring unmolested GNSS transmissions
4. Reliable cell phone signal for data transfer

Preliminary site selection for deployment of the base station was undertaken by HSD and the Navigation Services Division (NSD). Communication was primarily through the United States Coast Guard to find a deployment site at the Menemsha Coast Guard station. Upon arriving at the Menemsha station, the location appeared to only partially meet the requirements for a long term reference station deployment so the field party elected to explore other locations.

2.1 Menemsha Coast Guard Station

The intended installation at the Menemsha Coast Guard station was on the northwest side of the facility in an open field (Figure 2). The area on the south side of the station is used as a helicopter landing zone, and there was no access to install the base station antennas on any of the buildings. Also, the Coast Guard preferred to keep the antennas on fixed height tripods close to the buildings so the grass could be maintained, which would have resulted in a poor view of the sky. Placing the antennas on fixed height tripods on a grassy surface did not appear to be ideally suited for providing a stable position over the planned four month deployment. Since time permitted the field party looked for an alternate location.

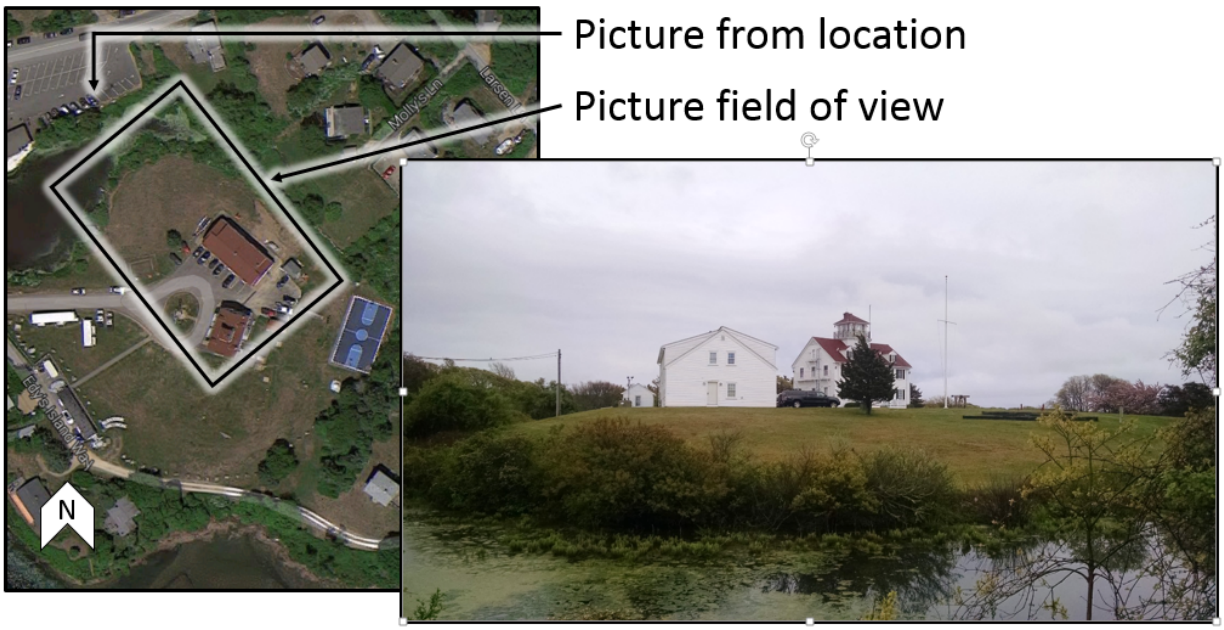

Figure 2 – Menemsha Coast Guard Station as seen from a parking lot on the northwest side.

2.2 13 Church Street, Aquinnah

While exploring town government buildings for an alternate location further west and closer to the project area, the field party came in contact with a local yacht delivery captain. This individual was supportive of NOAA and its mission and offered his house, 13 Church Street in Aquinnah, as an installation location (Figure 3). The field party determined this to be a location more ideally suited for deployment of the reference station as it met the previously listed criteria and was almost three miles closer to the project site.

Figure 3 - The deployment location at 13 Church Street, Aquinnah.

Power is supplied from the house and all equipment is stored indoors, including the cellular modem. Two antenna cables are run through a window to the roof where they have a clear view of the sky (Figure 4).

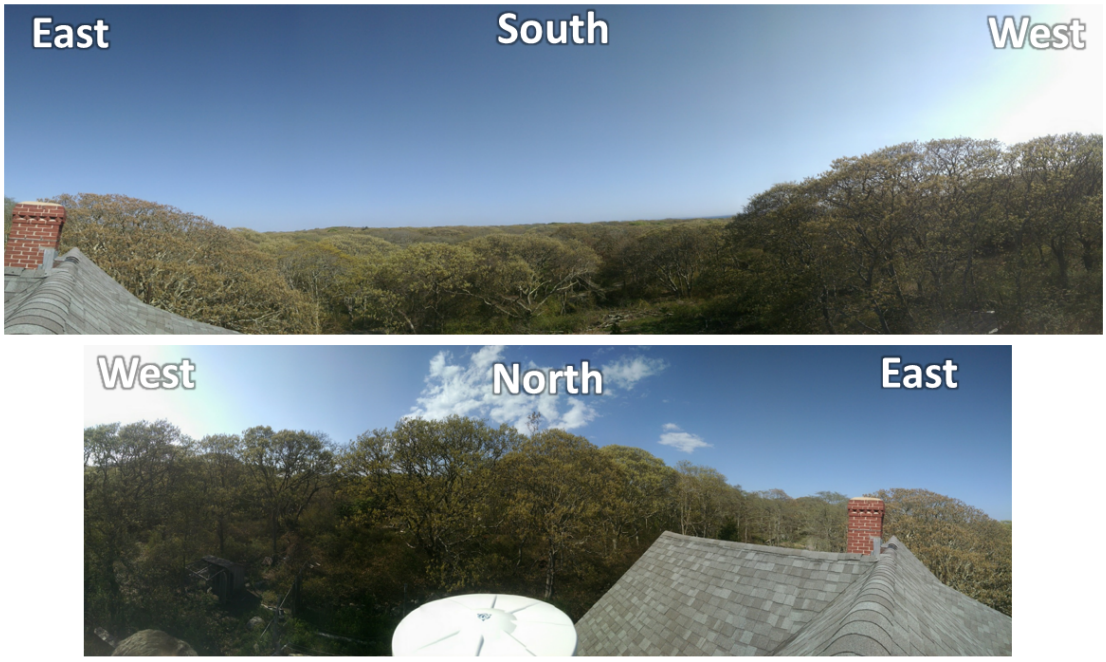

Figure 4 - Base station view of the horizon

3 Installation configuration

National Geodetic Survey (NGS) provided hardware support through two Ashtech Base Stations with associated equipment. FH provided an additional station to maintain some familiarity with the equipment deployed to support their projects. Coast Survey Development Laboratory (CSDL) HSTP provided a Cradlepoint router and cellular modem to deliver communication to and from the base stations, as well as the antenna mounting brackets. The University of New Hampshire (UNH) Center for Coastal and Ocean Mapping provided a "plug computer" to run in the Cradlepoint network for general use.

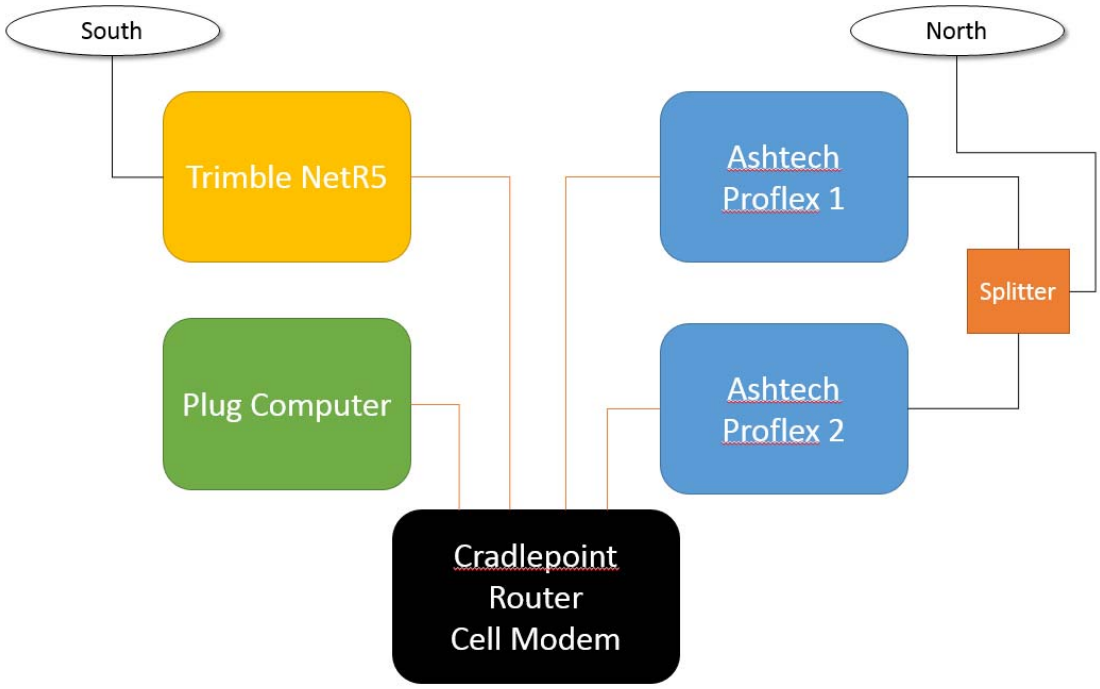

Figure 5 - The deployed equipment.

3.1 Cradlepoint Router

The Cradlepoint router provides both a local area private network and a wireless network, and also access to the internet through a Verizon modem. The router firewall provides security for the local instrumentation which all has a wired connection. The router wireless network is password secured and its existence is not broadcast to avoid encouraging unwanted access.

The Cradlepoint modem was configured by Verizon to have a static IP address. This enabled remote communication to the equipment. Ports 18071, 18072, and 18073 are forwarded from the Cradlepoint firewall to port 80 on the Trimble NetR5 and each of the Ashtech Proflex receivers respectively for remote configuration. Cellular coverage on Martha's Vineyard is provided through many local stations along the road rather than the typical cellular towers. Connectivity is slow, particularly during the day. Connection robustness and bandwidth is a concern on the island.

Remote administration of the Cradlepoint Router can be enabled. Upon deployment this feature was not enabled properly because the static IP, and thereby remote access, was not yet established by

Verizon. Port 18070 was forwarded to port 22 on the Plug Computer for SSH access, and subsequently used to tunnel to the Cradlepoint Router for administration from inside the network. The remote administration option of the Cradlepoint Router has been left disabled since this approach has been proven to work and provides more security. Should the plug computer fail administrative access to the Cradlepoint would be lost until it can be visited on site.

3.2 Plug Computer

A TonidoPlug2 (www.tonidoplug.com) running Debian Linux 6 was installed inside the Cradlepoint network to perform small tasks. This plug computer was provided by UNH/CCOM. As discussed previously, the plug computer ended up serving a central role in accessing the router post installation. In addition, it was configured to perform more roles after deployment, providing adaptability to the configuration. For example, the NetR5 email would not function properly upon deployment. A Postfix email server was configured on the plug computer such that the NetR5 could email the plug computer, and the plug computer then sends the emails through a noaa.base.station@gmail.com address. This address is then forwarded to glen.rice@noaa.gov and ops.ferdinand.hassler@noaa.gov, but more could be configured. The plug computer also checks its IP address each hour and will send an email should the address change. This is to avoid losing communication with the installation since there is no domain name service provided for finding the station. In addition, the plug computer has an FTP server running. The external USB storage in the NetR5 appears to have failed about a week after deployment, and the FTP functionality was failing frequently due to poor connectivity. The NetR5 now FTPs data to the plug computer where it can stored and also pushed by an automated process or accessed through SFTP.

3.3 Ashtech Proflex

Two Ashtech Proflex receivers were both connected to the northern of the two antennas and were deployed as configured by NGS. These receivers record at a 5 second interval and push hourly files to NGS through FTP. NGS concatenates these files each hour and places a single file for all data recorded so far that day on the publicly available FTP site at ftp://geodesy.noaa.gov/cors/spec_prod/SpecRsd/2015 . The filename does not change throughout the day, so the only indicator that the file has been updated is the change in file size. The data from both receivers are posted to the same location on the FTP site with the filename prefix “mvy1” or “mvy2” to differentiate between the two Martha’s Vineyard Proflex receivers.

3.4 Trimble NetR5

The Trimble NetR5 was a last minute addition to the deployment configuration. This receiver is familiar to many Coast Survey field units and thus the field party could remain flexible with its configuration. Since the NGS Ashtech receivers are successfully uploading data to provide support through a public FTP site, the NetR5 can be used for exercising some functionality not normally utilized by NOAA field units.

The Trimble NetR5, originally owned by NOAA Ship Thomas Jefferson but given to FH, is attached to a Trimble Zephyr GNSS Geodetic II antenna. The station is designated as “SPA1” and is configured to record at a 5 second interval to internal storage. While a USB drive was attached to the system upon deployment, the USB drive appeared to fail and thus recording was switched from external to internal storage. Recording at ~120 kB / hour, the internal storage should last for approximately 20 days. When the memory is full old data is automatically deleted. As backup storage, the NetR5 is pushing files to the plug computer on an hourly basis. The capacity of the plug computer is 500 GB, which would last for almost 500 years. Additional work may be done to move these data off the plug computer

automatically so they may be backed up elsewhere, but at this time the data stays on the plug computer to minimize impact on the internet bandwidth bottleneck.

The NetR5 email service did not appear capable of connecting to the gmail smtp server. As a workaround, the NetR5 uses a Postfix email server on the plug computer to forward status and warning emails. The email types configured on the NetR5 are shown in Figure 6.

☑	Alert after a reboot
☑	Alert when Receiver controls are changed
☑	Alert if the data logging terminates or the memory is full
☑	Alert if the FTP push fails
☑	Alert when the receiver starts or stops using its internal battery
☑	Alert when the receiver operating temperature is getting too high or too low
☐	Alert when new firmware is available for update
☑	When a crash occurs, send diagnostic info (including configuration) to Trimble.

☑	Alert when no satellites are tracked
☑	Provide a daily tracking/status summary
☑	Alert if a TCP/IP link or other communication link fails
☐	Alert if a user attempts to log on and is denied access
☑	Alert when the receiver is about to shutdown due to low power
☐	Alert if logging to external USB drive is resumed
☐	Alert when DDNS update failed

Figure 6 - Trimble NetR5 Status and Warning configuration.

The NetR5 is also configured to support real time kinematic (RTK) survey. The NetR5 software can be configured to act as a NTRIP server, a NTRIP caster, or both. In this case, the NetR5 is set as an NTRIP server and is broadcasting CMR+ messages to an NTRIP Caster at UNH/CCOM. The real time data can be accessed through any internet connection (cell or vsat) at ntrip.ccom.unh.edu with an NTRIP client to provide improved real time positioning. Contact glen.rice@noaa.gov for access to the caster.

4 Summary and suggestions

A GNSS base station with two redundant antennas and three redundant receivers was successfully installed to support hydrographic survey south of Martha's Vineyard. The final installation was a collaboration between OCS and NGS with some support from UNH/CCOM. Data is made available through a public NGS ftp on an hourly basis, eliminating the frequent delay in data availability for post processing. An experimental NTRIP caster has also been enabled on a UNH/CCOM server allowing field units with internet access to use RTK for survey, potentially eliminating the need for post processing. Warning emails are sent to the operations officer aboard FH should problems arise with the real time base station.

There are several improvements that could be realized to make the base station installation quicker and more robust. Most Coast Survey reference stations have been set up in regions where there has been limited internet or cell signal access. For stations that are deployed in areas where the internet can be accessed readily, future stations should automate tasks such as uploading data to OPUS and confirming the consistency and quality of the solution. There are some technical solutions that should be taken

from the more remote reference station deployments, primarily using solar panels and backup batteries to maintain the station. This would make the location for the deployment more flexible, while also making its operation more robust during power outages. One flaw with the currently deployed configuration is performance with the loss of power. No additional battery backup was deployed, so should a power loss occur, the base stations will continue to work on internal batteries but the Cradlepoint router and plug computer will be off line until power is restored.

5 Appendix

5.1 Opus Solution for the Ashtech antenna

```
FILE: mvy11530.15o OP1433356134276

 1008   NOTE:  Antenna offsets supplied by the user were zero.  Coordinates
 1008   returned will be for the antenna reference point (ARP).
 1008
                        NGS OPUS SOLUTION REPORT
                        ========================

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

     USER: glen.rice@noaa.gov                    DATE: June 03, 2015
RINEX FILE: mvy11530.15o                         TIME: 18:30:03 UTC


  SOFTWARE: page5  1209.04 master51.pl 022814      START: 2015/06/02  00:00:00
 EPHEMERIS: igr18472.eph [rapid]                    STOP: 2015/06/02  23:59:00
  NAV FILE: brdc1530.15n                       OBS USED: 45267 / 46142   :  98%
  ANT NAME: TRM57971.00     NONE            # FIXED AMB:   134 /   162   :  83%
ARP HEIGHT: 0.000                         OVERALL RMS: 0.014(m)


 REF FRAME: NAD_83(2011)(EPOCH:2010.0000)            IGS08 (EPOCH:2015.4188)

        X:     1576028.088(m)   0.018(m)          1576027.233(m)   0.018(m)
        Y:    -4529494.435(m)   0.012(m)         -4529492.990(m)   0.012(m)
        Z:     4190723.823(m)   0.014(m)          4190723.803(m)   0.014(m)

      LAT:   41 20 18.50777      0.006(m)        41 20 18.54252      0.006(m)
    E LON:  289 11  6.84253      0.013(m)       289 11  6.82822      0.013(m)
    W LON:   70 48 53.15747      0.013(m)        70 48 53.17178      0.013(m)
   EL HGT:           6.192(m)   0.021(m)                4.943(m)   0.021(m)
 ORTHO HGT:          35.602(m)   0.037(m) [NAVD88 (Computed using GEOID12B)]

                     UTM COORDINATES    STATE PLANE COORDINATES
                      UTM (Zone 19)         SPC (2002 MA I)
Northing (Y) [meters]     4577920.662           37638.113
Easting (X)  [meters]      348155.565          473653.138
Convergence  [degrees]    -1.19889238          -0.20808988
Point Scale               0.99988376           0.99999879
Combined Factor           0.99988279           0.99999782

US NATIONAL GRID DESIGNATOR: 19TCF4815577920(NAD 83)
```

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
AI3285	NPRI NAVAL STATION NEW CORS ARP	N413035.415	W0711939.124	46899.1
DE6262	URIL U OF RI COOP CORS ARP	N412920.157	W0713139.777	61905.3
DI0884	ACU6 ACUSHNET 6 CORS ARP	N414435.676	W0705311.720	45353.1

NEAREST NGS PUBLISHED CONTROL POINT

LW4399	GAY HEAD BAPTIST CHURCH CUPOLA	N412027.955	W0704848.386	312.4

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

5.2 OPUS Solution for the Trimble antenna

FILE: 4934K63376201505 OP1433163862151

1008 NOTE: Antenna offsets supplied by the user were zero. Coordinates
1008 returned will be for the antenna reference point (ARP).
1008

NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: noaa.base.station@gmail.com DATE: June 01, 2015
RINEX FILE: 4934149m.15o TIME: 13:05:20 UTC

SOFTWARE: page5 1209.04 master91.pl 022814 START: 2015/05/29 12:00:00
EPHEMERIS: igr18465.eph [rapid] STOP: 2015/05/30 11:50:00
NAV FILE: brdc1490.15n OBS USED: 8553 / 8706 : 98%
ANT NAME: TRM57971.00 NONE # FIXED AMB: 26 / 26 : 100%
ARP HEIGHT: 0.000 OVERALL RMS: 0.010(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2015.4091)

X:	1576028.257(m)	0.005(m)	1576027.402(m)	0.005(m)
Y:	-4529494.871(m)	0.008(m)	-4529493.426(m)	0.008(m)
Z:	4190723.303(m)	0.004(m)	4190723.283(m)	0.004(m)

LAT:	41 20 18.48511	0.003(m)	41 20 18.51986	0.003(m)
E LON:	289 11 6.84323	0.005(m)	289 11 6.82893	0.005(m)
W LON:	70 48 53.15677	0.005(m)	70 48 53.17107	0.005(m)
EL HGT:	6.199(m)	0.008(m)	4.951(m)	0.008(m)
ORTHO HGT:	35.609(m)	0.018(m)	[NAVD88 (Computed using GEOID12B)]	

UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 19)	SPC (2002 MA I)
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Point Scale	0.99988376	0.99999879
Combined Factor	0.99988279	0.99999782

US NATIONAL GRID DESIGNATOR: 19TCF4815577919(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DE6262	URIL U OF RI COOP CORS ARP	N412920.157	W0713139.777	61905.5
DI0884	ACU6 ACUSHNET 6 CORS ARP	N414435.676	W0705311.720	45353.8
AI3285	NPRI NAVAL STATION NEW CORS ARP	N413035.415	W0711939.124	46899.4

NEAREST NGS PUBLISHED CONTROL POINT

LW4399	GAY HEAD BAPTIST CHURCH CUPOLA	N412027.955	W0704848.386	313.1

APPROVAL PAGE

H12801

Data meet or exceed current specifications as certified by the OCS survey acceptance review process. Descriptive Report and survey data except where noted are adequate to supersede prior surveys and nautical charts in the common area.

The following products will be sent to NCEI for archive

- H12801_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12801_H12802_H12811_GeoImage.pdf

The survey evaluation and verification has been conducted according to current OCS Specifications, and the survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Approved: _____

Digitally signed by HILLSTROM.BRIANA.WELTON.1267667531
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=NOAA, cn=HILLSTROM.BRIANA.WELTON.1267667531
Date: 2017.07.21 10:42:34 -04'00'

Lieutenant Commander Briana Hillstrom, NOAA
Chief, Atlantic Hydrographic Branch