H12614

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12614

LOCALITY

State(s):	New Hampshire
General Locality:	Gulf of Maine
Sub-locality:	Hampton Beach to Little Boars Head

2013

CHIEF OF PARTY
LCDR Benjamin K. Evans, NOAA

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Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H12614

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):	**New Hampshire**
General Locality:	**Gulf of Maine**
Sub-Locality:	**Hampton Beach to Little Boars Head**
Scale:	**20000**
Dates of Survey:	**09/08/2013 to 09/13/2013**
Instructions Dated:	**08/20/2013**
Project Number:	**OPR-A321-FH-13**
Field Unit:	**NOAA Ship *Ferdinand R. Hassler***
Chief of Party:	**LCDR Benjamin K. Evans, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Mean 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 Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany Survey H12614

Project: OPR-A321-FH-13

Locality: Gulf of Maine

Sublocality: Hampton Beach to Little Boars Head

Scale: 1:20000

September 2013 - September 2013

NOAA Ship *Ferdinand R. Hassler*

Chief of Party: LCDR Benjamin K. Evans, NOAA

A. Area Surveyed

The survey area is located in the Gulf of Maine, within the sublocality of Hampton Beach to Little Boars Head.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
42° 57" 47.2' N 70° 41" 59.48' W	42° 53" 42.06' N 70° 31" 55.32' W

Table 1: Survey Limits

The full area assigned for H12614 was not surveyed due to time constraints on this project. The western half of the survey area was not completed. Figure 2 depicts the coverage area and assigned sheet limits for H12614.

A.2 Survey Purpose

The primary purpose of this project is to support safe navigation through the acquisition and processing of hydrographic data for updating the National Ocean Service's (NOS) nautical charting products.

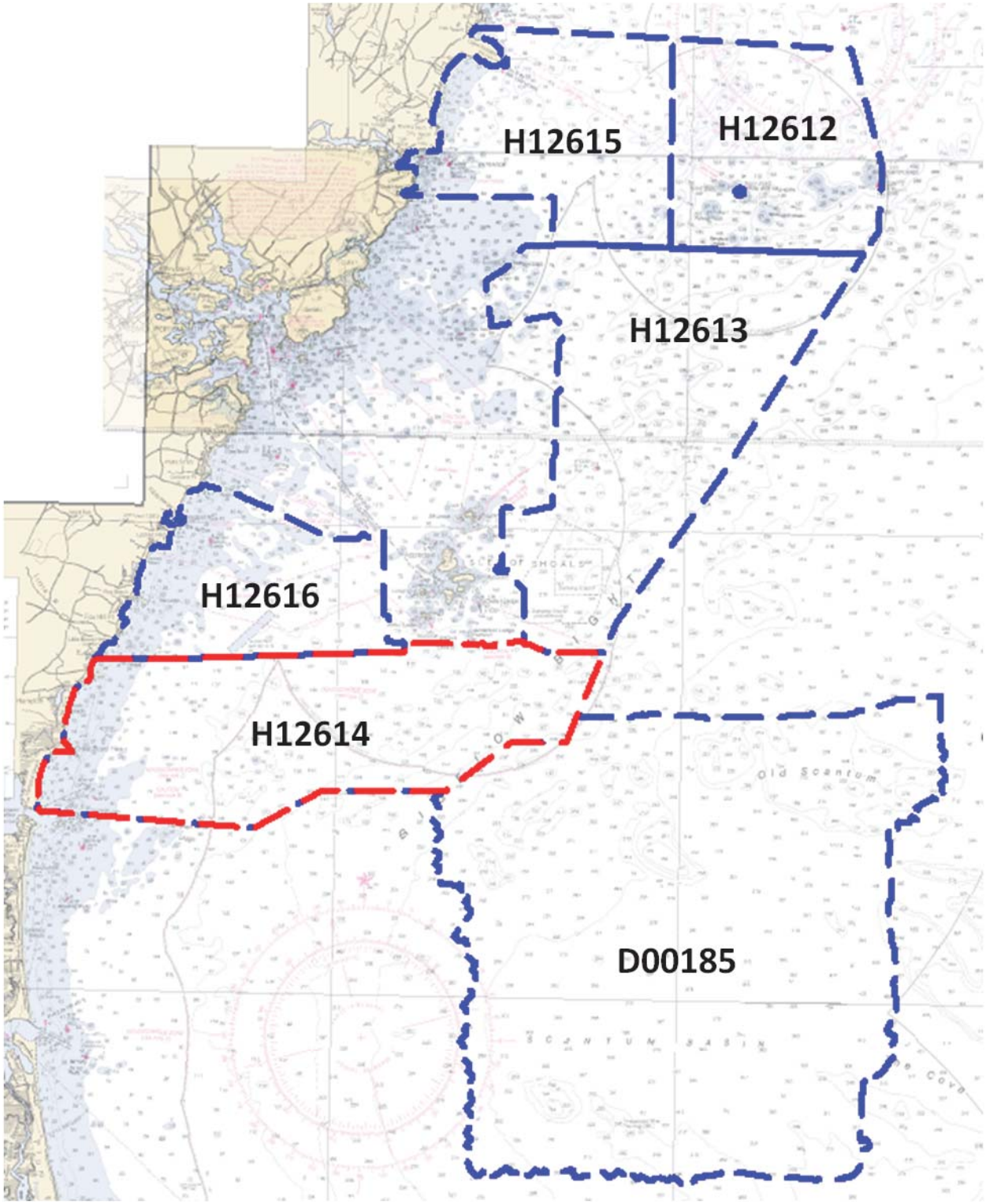


Figure 1: H12614 Sheet Layout

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

A.4 Survey Coverage

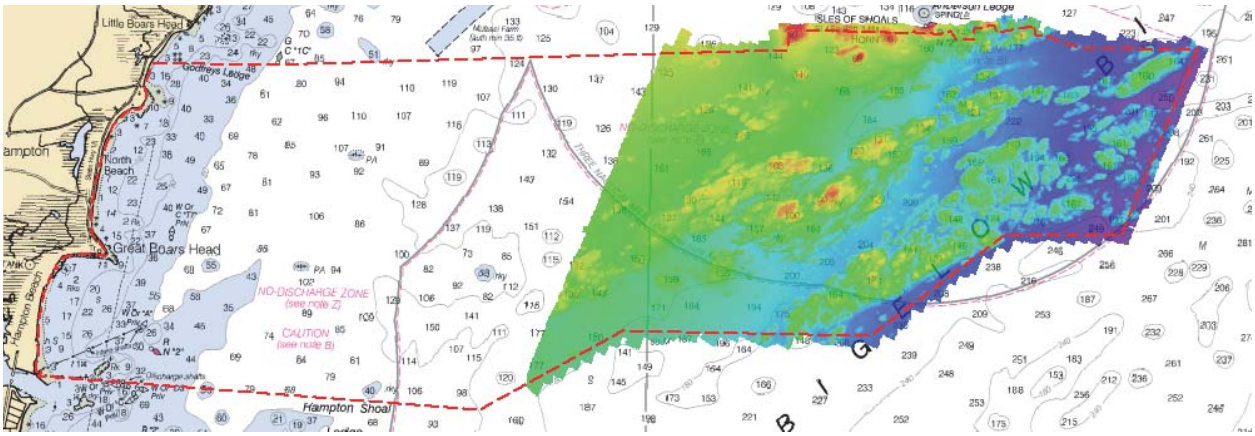


Figure 2: H12614 Coverage Area and Assigned Sheet Limits

Several insignificant holidays are present in the coverage of H12614. Examples are shown in Figures 3 and 4. Analysis of surrounding data shows that the least depths over all significant features have been achieved and the holidays do not compromise survey integrity.

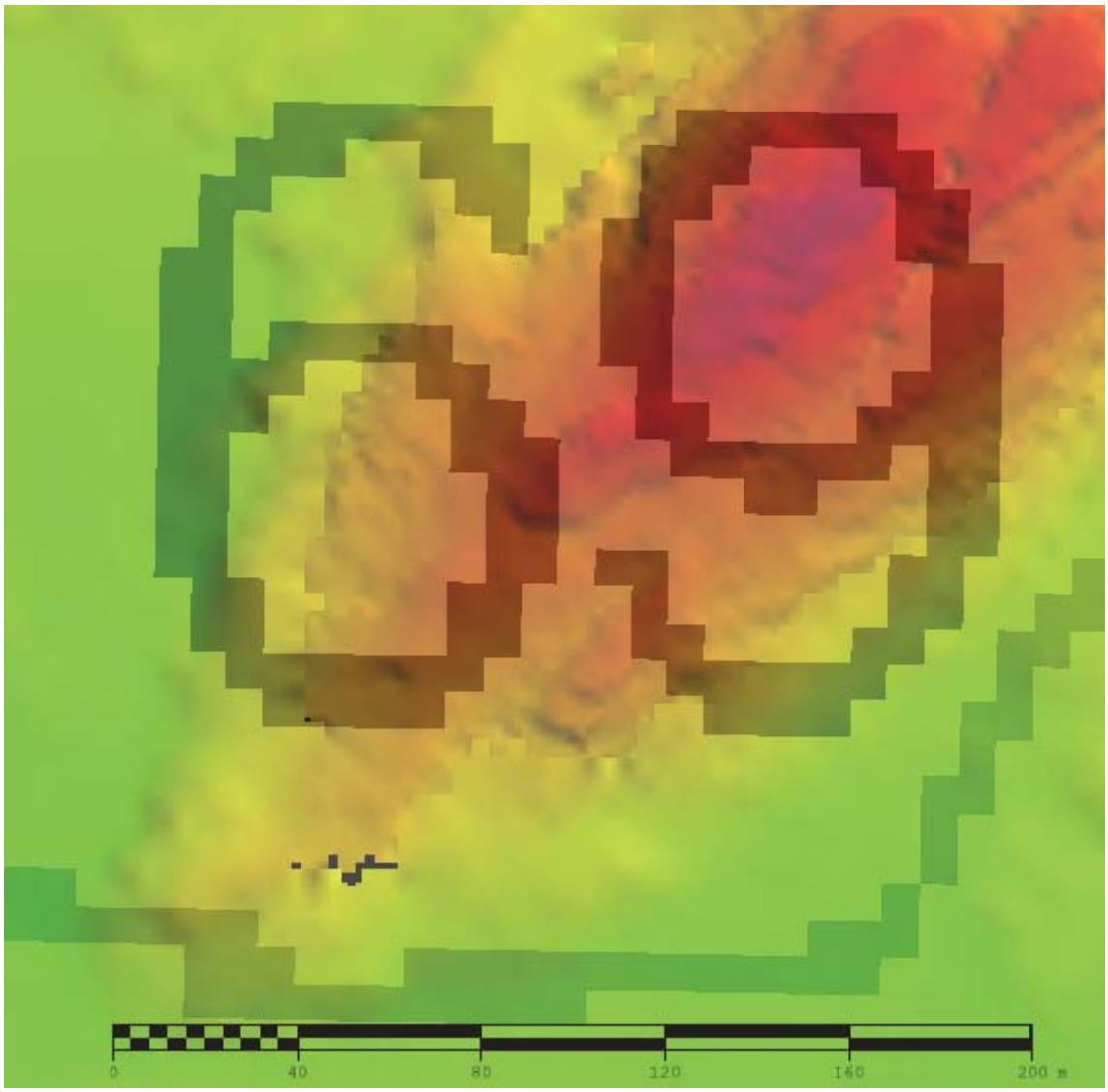


Figure 3: Down slope holiday in 2 and 4-meter surfaces.

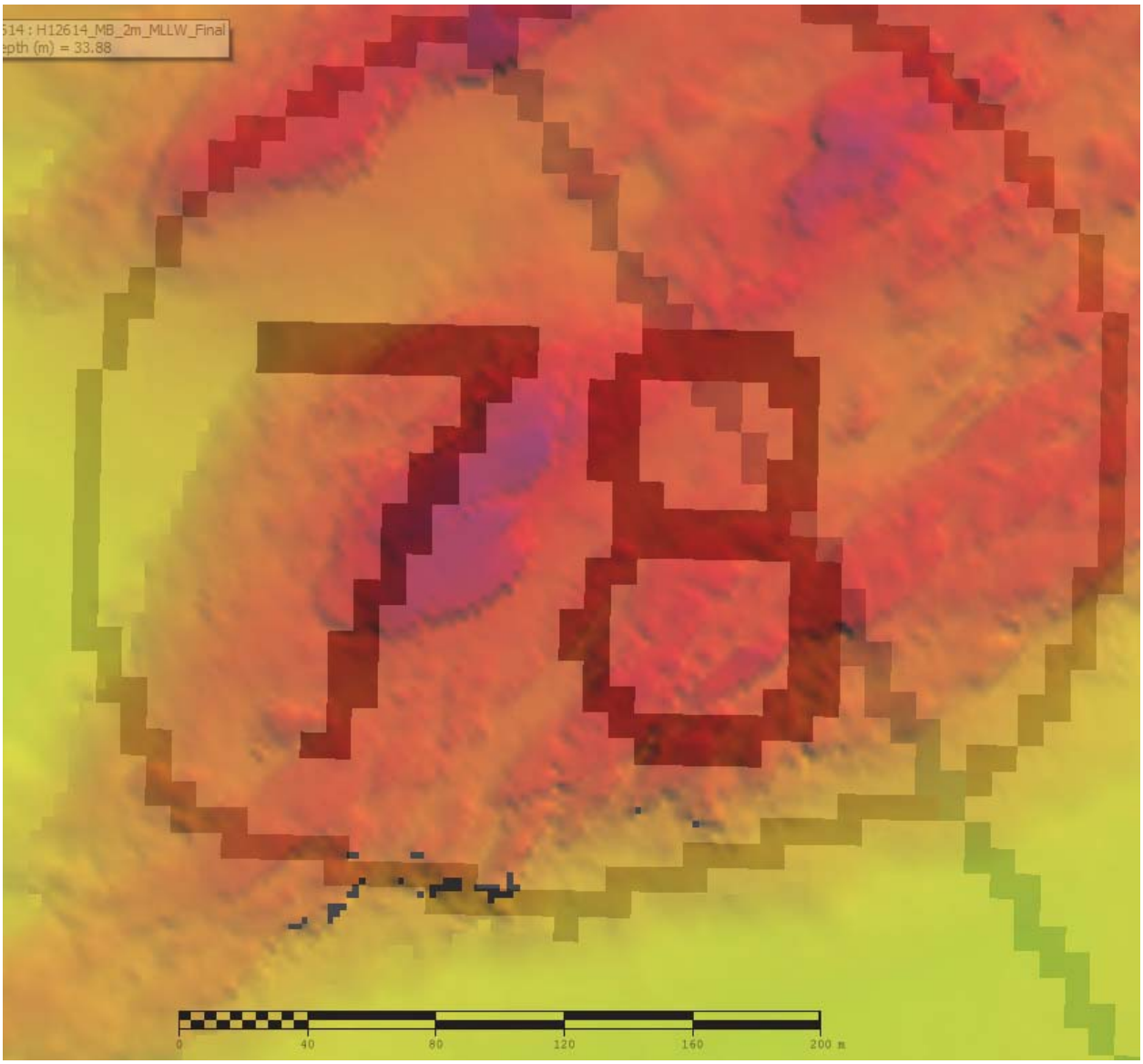


Figure 4: Down slope holiday in 2 and 4-meter surfaces.

A.5 Survey Statistics

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

	Vessel	***Total***
LNM	**SBES Mainscheme**	0
	MBES Mainscheme	190.59
	Lidar Mainscheme	0
	SSS Mainscheme	0
	SBES/MBES Combo Mainscheme	0
	SBES/SSS Combo Mainscheme	0
	MBES/SSS Combo Mainscheme	0
	SBES/MBES Combo Crosslines	12.25
	Lidar Crosslines	0
Number of Bottom Samples		9
Number AWOIS Items Investigated		0
Number Maritime Boundary Points Investigated		0
Number of DPs		0
Number of Items Items Investigated by Dive Ops		0
Total Number of SNM		16.97

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Julian Day Number
09/08/2013	251
09/10/2013	253
09/11/2013	254
09/12/2013	255
09/13/2013	256

Table 3: Dates of Hydrography

Survey lines were run with a dual-head muiltibeam echosounder. Linear nautical miles for the dual-head system were calculated using statistics from the starboard head.

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	*S-250*
LOA	37.7 meters
Draft	3.85 meters

Table 4: Vessels Used

NOAA Ship FERDINAND R. HASSLER (S250) acquired all data within the limits of H12614.

B.1.2 Equipment

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

Manufacturer	Model	Type
Reson	7125	MBES
Reson	7111	MBES
Applanix	POS M/V Version 5	Positioning and Attitude System
Hemisphere	MBX-4	Attitude System
Reson	SVP 70	Sound Speed System
Brooke Ocean	MVP-30	Sound Speed System
AML	Smart SV&P	Sound Speed System
Seabird	SBE45	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 6.4% of mainscheme acquisition.

Crosslines were filtered to remove soundings greater than 45 degrees from nadir. To evaluate crossline agreement, two 4-meter surfaces were created: one from mainscheme soundings, the other from crossline soundings. These two surfaces were differenced using CARIS HIPS and SIPS. The statistical analysis of the differences between the mainscheme and crossline surfaces are shown in Figure 6. The average difference between the surfaces is -0.11 meters, with 95% of the nodes agreeing within +/- 0.59 meters.

Large differences between the mainscheme and crossline depths appear to be caused by two primary factors: a negative bias due to a known bottom detection algorithm artifact for the 7111 (Figure 7), and high standard deviation thought to result from high relief in particular areas of the survey. To investigate the standard deviation, Figure 8 shows the differenced crossline surface (mainscheme minus crosslines) with a colored range scale centered about the mode, essentially removing the depth bias of the 7111. White indicates the mean (-0.1m to -0.08 m), blue displays divergence from the mean (-0.1m to -0.59m & -.08m to 0.41m) and magenta is a further divergence from the mean (-5m to -0.59 & 0.41m to 5m). The greatest differences appear to be in the deeper SE area of the sheet and over an areas of high relief. Despite the 7111 artifacts, the crosslines provide a positive check of general internal consistency.

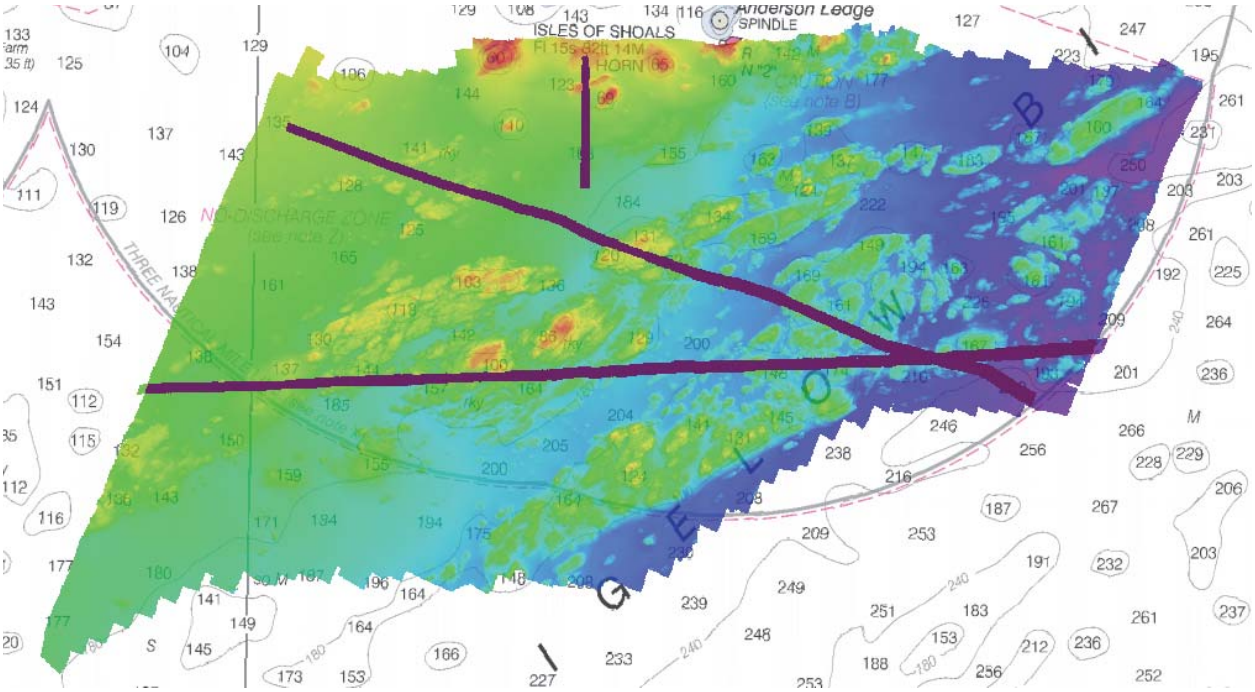
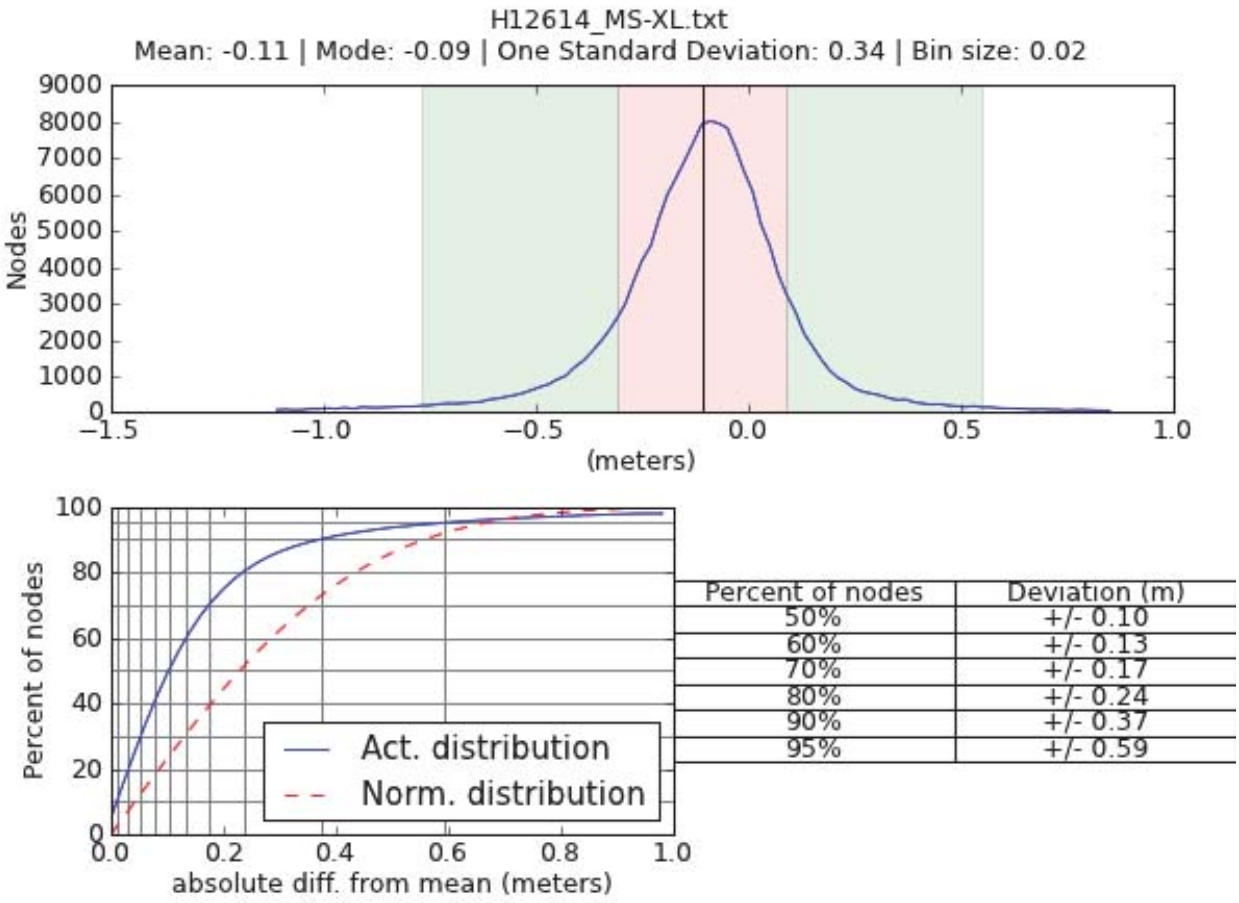


Figure 5: Location of crosslines, shown in purple, overlaid on 4-meter combined MBES surface.



Percent of nodes	Deviation (m)
50%	+/- 0.10
60%	+/- 0.13
70%	+/- 0.17
80%	+/- 0.24
90%	+/- 0.37
95%	+/- 0.59

Figure 6: H12614 Crossline Difference Statistics: Mainscheme minus Crossline

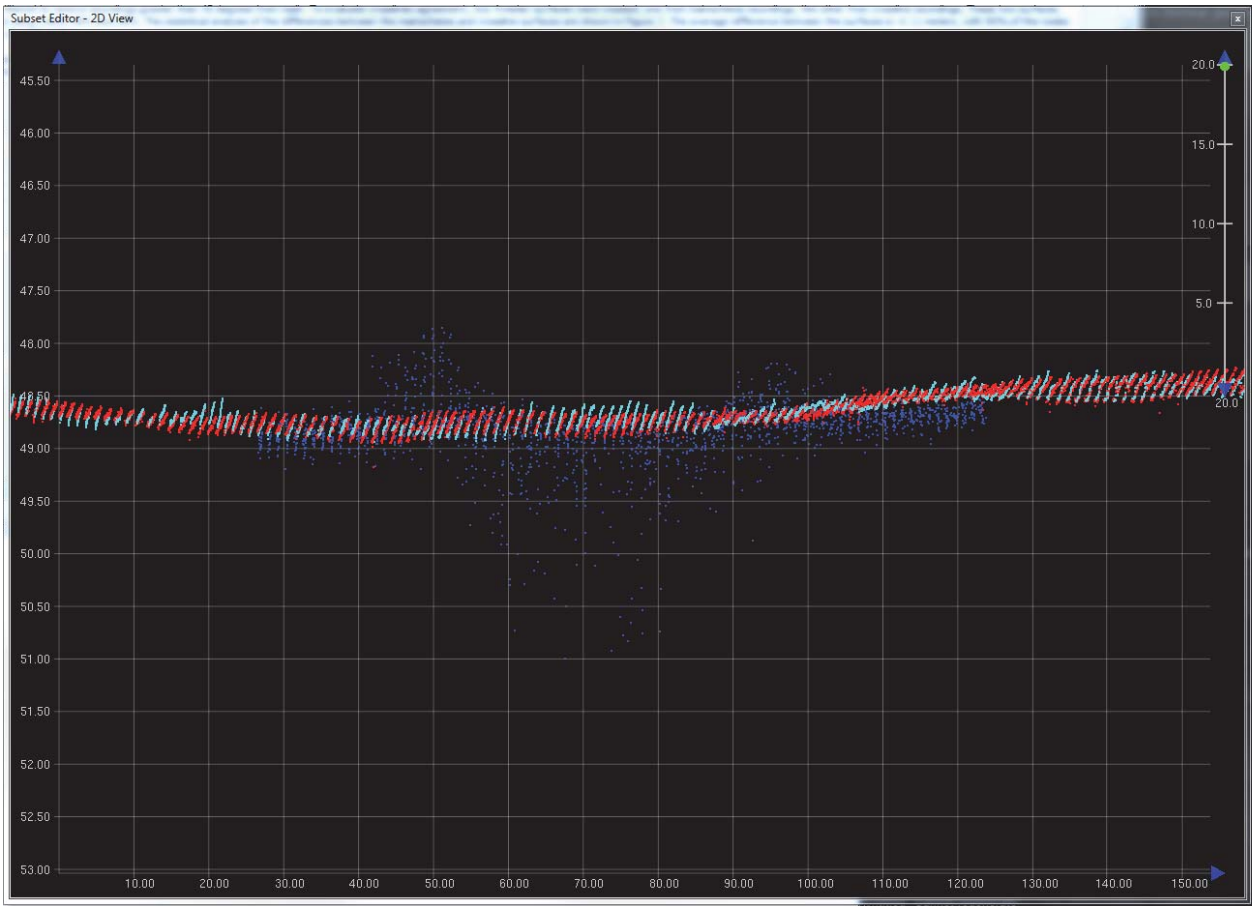


Figure 7: Example of 7111 nadir artifacts in CARIS Subset Editor. Red and light blue lines are mainscheme lines, dark blue are data from 7111.

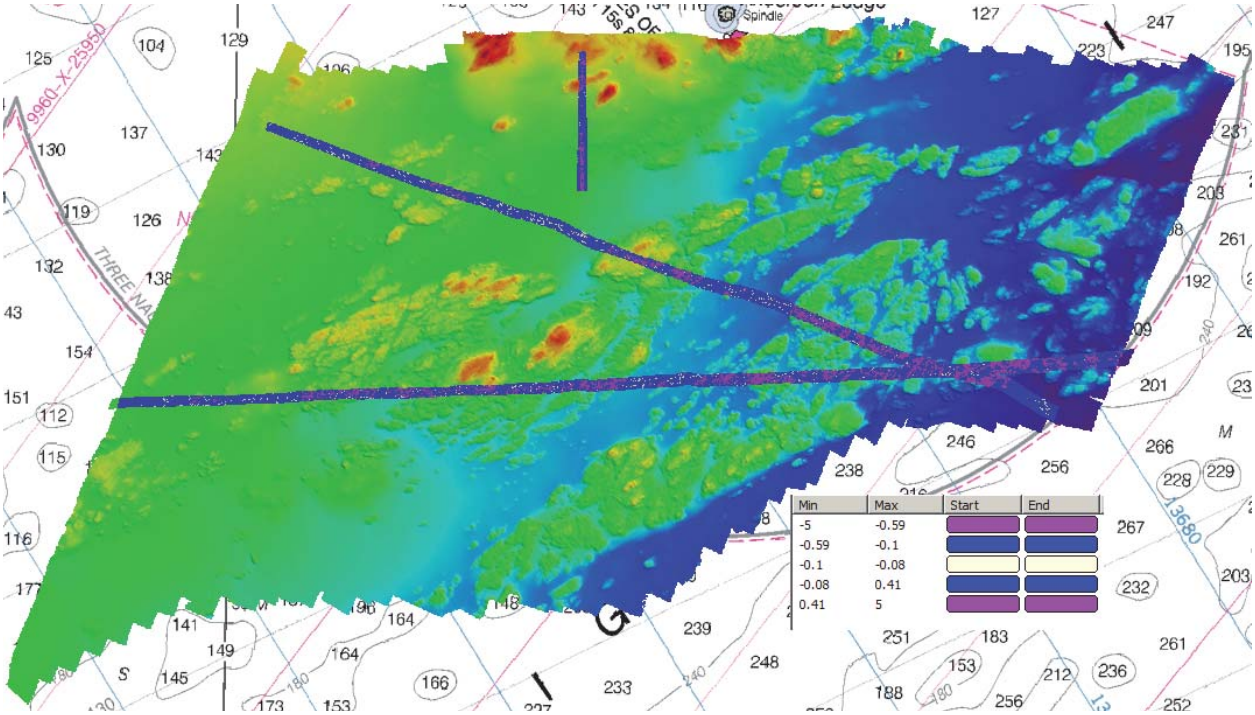


Figure 8: H12614 crossline differenced surface (MS-XL), overlaid on 4-meter combined MBES surface; white indicates difference approximately equal to the mode (-0.1 to -0.08 m), blue displays divergence from the mode (-0.1m to -0.59m & -.08m to 0.41m) and magenta is a further divergence from the mode (-5m to -0.59 & 0.41m to 5m).

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning
0.01 meters	0.21 meters
0.01 meters	0.081 meters

Table 6: Survey Specific Tide TPU Values

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

Table 7: Survey Specific Sound Speed TPU Values

A tide uncertainty value of 0.21, listed in Table 6, was provided by CO-OPs and is applied to lines reduced via zoned tides. A tide uncertainty of 0.081 is applied to lines reduced via VDatum, which was provided by HSD OPS in the Project Instructions.

Data collected with the Starboard Reson on Dn253 do not have true heave or SBETs applied. POS positioning data was not recorded separately for this day. As a result, real-time heave data was used. Real-time heave has a greater uncertainty, and therefore the uncertainty in the grid and its associated soundings are higher. See Section B.2.9 for additional information on Total Vertical Uncertainty for H12614.

In addition, four lines were reduced to MLLW via traditional tides because application of the SBET solution caused a vertical offset when reducing to MLLW with GPS tides. See Section B.3. for further information.

B.2.3 Junctions

Unless otherwise noted, the junctioning surfaces were subtracted from a 4-meter combined surface of H12614 to assess sounding consistency. The areas of overlap between sheet H12614 and its junction sheets, shown in Figure 9, from OPR-A321-FH-13 were reviewed in CARIS Subset Editor.

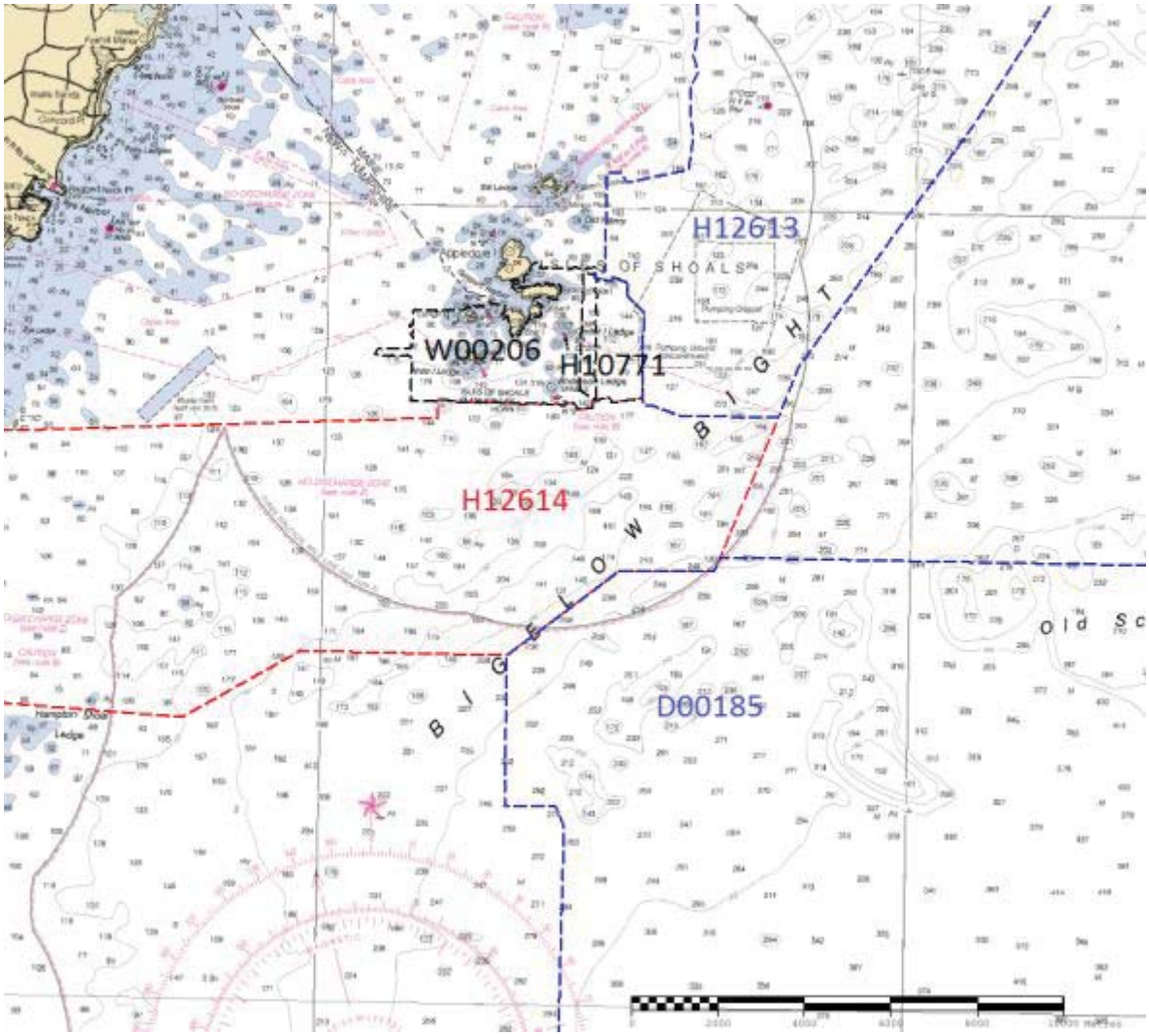


Figure 9: Surveys junctioning H12614. Surveys in blue are part of OPR-A321-FH-13. Surveys in black were provided with project instructions.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H10771	1:10000	1997	NOAA Ship RUDE	N
W00206	1:10000	2009	UNH - R/V Coastal Surveyor	N
H12613	1:40000	2013	NOAA Ship FERDINAND R. HASSLER	NE
D00185	1:40000	2013	NOAA Ship FERDINAND R. HASSLER	SE

Table 8: Junctioning Surveys

H10771

Data for survey H10771 was provided with the project instructions as a 15-meter irregular grid of shoal-biased soundings in an .xyz format (see H10771 DR for submitted sounding selection). The .xyz file was imported into CARIS BASE Editor where a TIN was created. A 4-meter interpolated surface was created from this TIN for the purposes of junction analysis. The 4-meter combined surface created for H12614 was differenced with the interpolated surface of H10771 (Figure 10). A statistical analysis was performed on the resulting difference surface; the mean difference was 0.84 meters with a standard deviation of 1.41 meters (Figure 11). The differences can be attributed to the sparse data which was used to create the TIN and the accompanying interpolated surface. The hydrographer compared the .xyz data to the combined surface and found most soundings had a difference of no greater than 1 meter.

The hydrographer recommends that H12614 supersede H10771 in the common area.

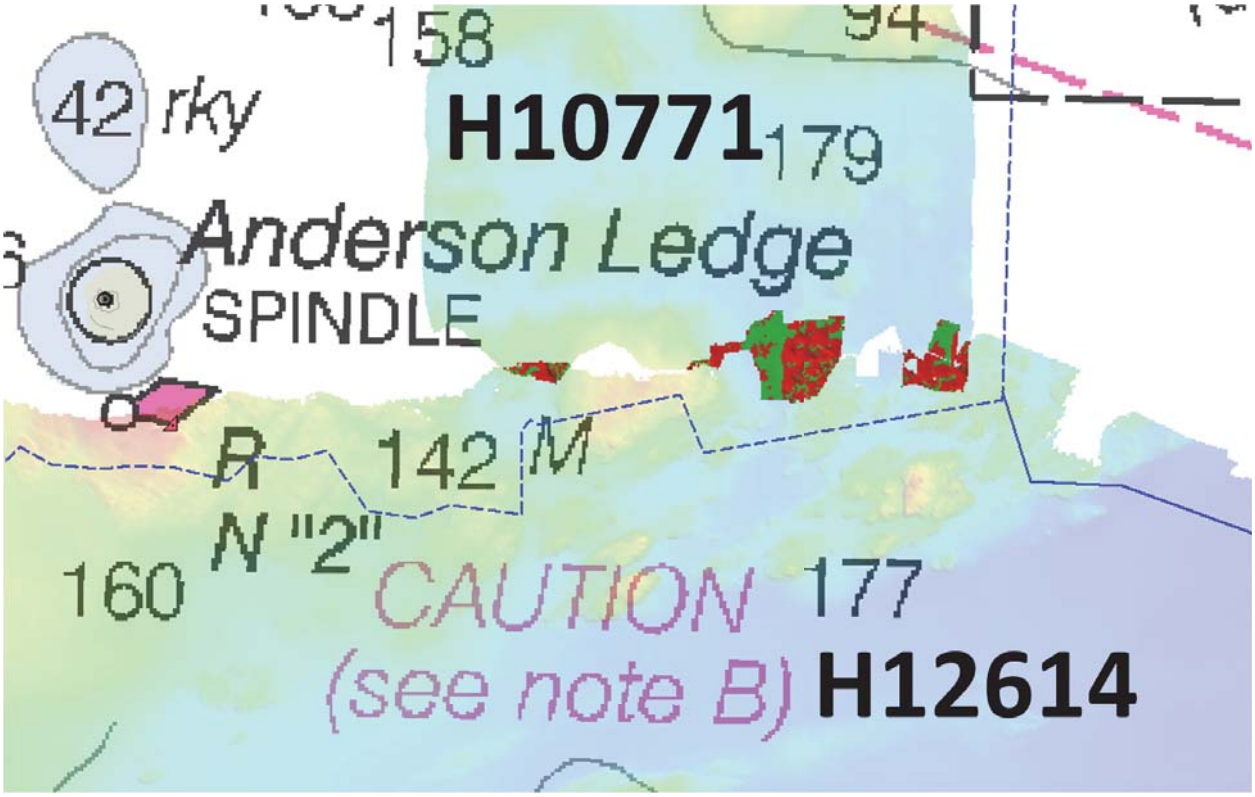
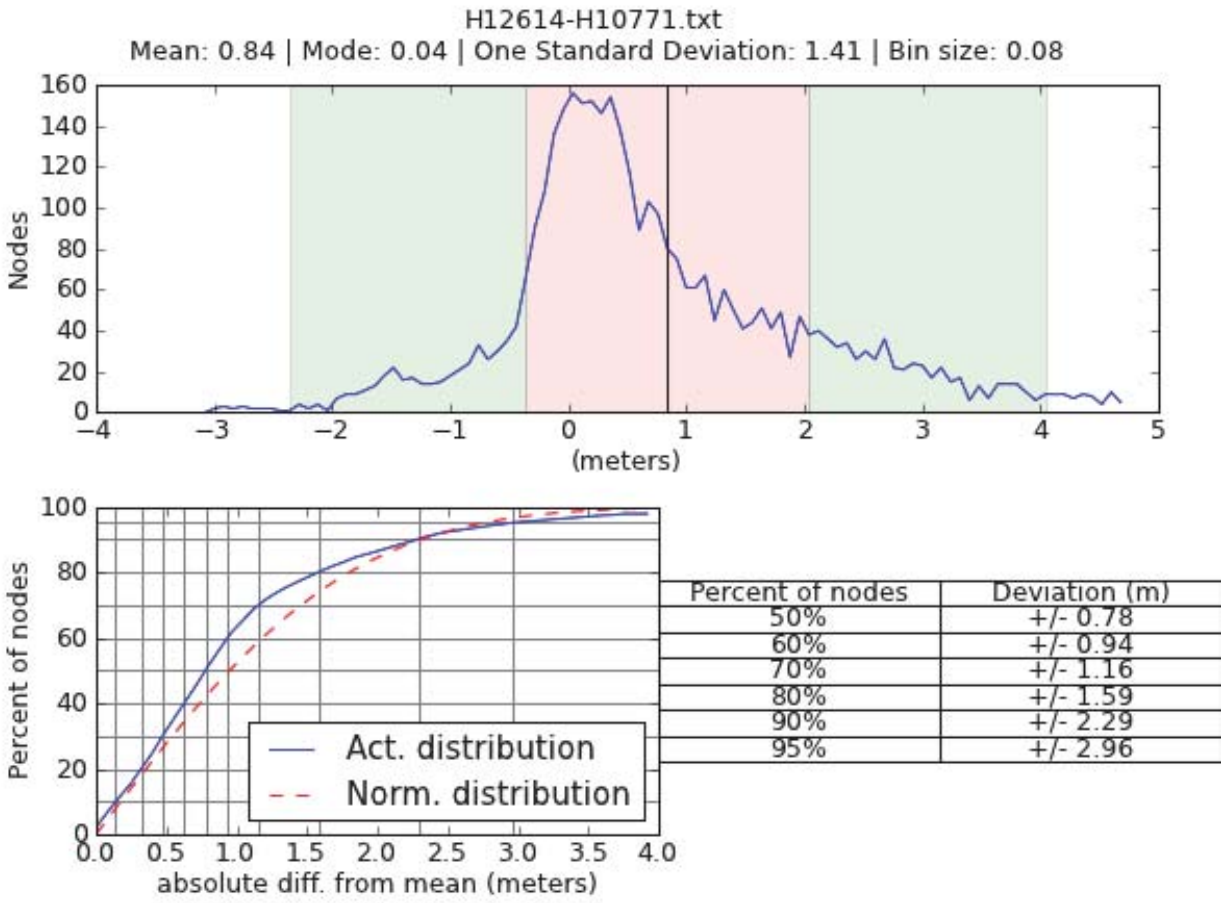


Figure 10: Area of overlap between H12614 and H10771; green indicates agreement (-0.05m to 0.05m), red represents areas where the difference is greater than +/- 0.05m.



Percent of nodes	Deviation (m)
50%	+/- 0.78
60%	+/- 0.94
70%	+/- 1.16
80%	+/- 1.59
90%	+/- 2.29
95%	+/- 2.96

Figure 11: Difference surface statistics computed H12614 minus H10771.

W00206

Survey W00206 was completed in 2009 by R/V COASTAL SURVEYOR as apart of the UNH/CCOM Summer Hydrography Course. The extent of overlap with H12614 is shown in Figure 12. A 4-meter surface from H12614 was differenced with the 1m BAG archival surface provided by OPS. The average difference of surfaces is 0.05 meters with a standard deviation of 0.41 meters. 95% of nodes agreed within +/- 0.74 meters, as shown in Figure 13. Differences are evident on the slopes of rocky seabed areas and possibly because H12614 data is more sparse in this area due to depth constraints of the HASSLER. Additionally, W00206 has possible fliers retained in the surface that would affect this analysis.

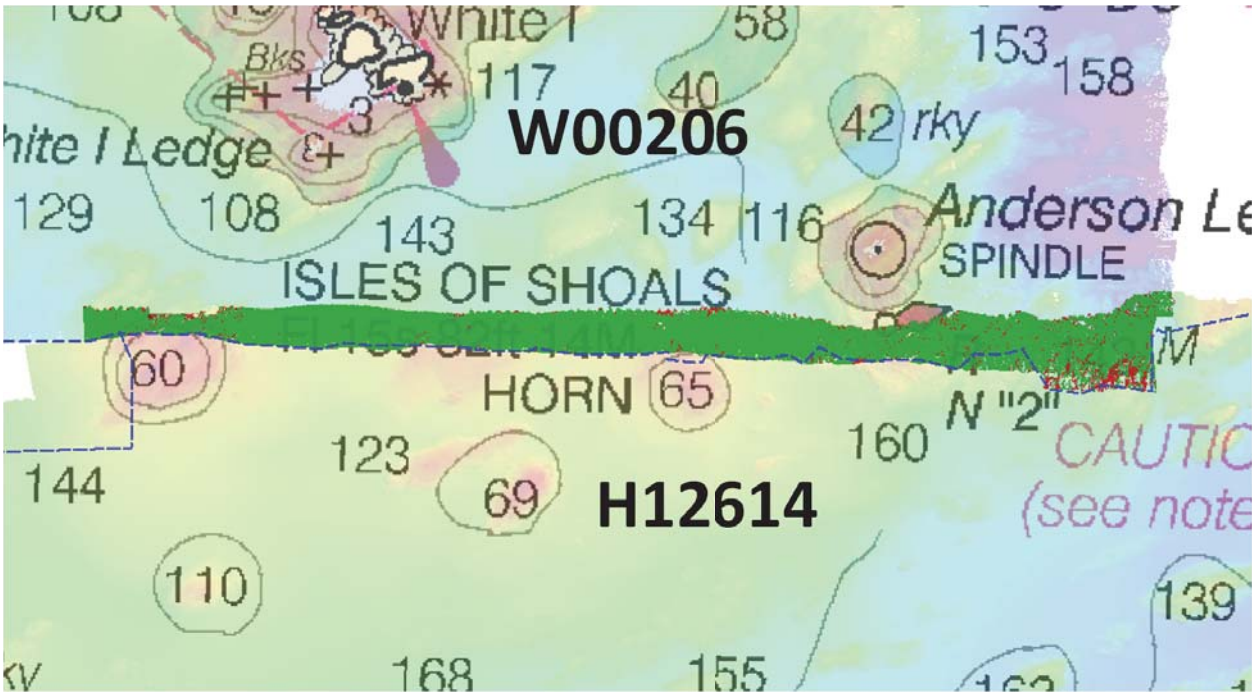
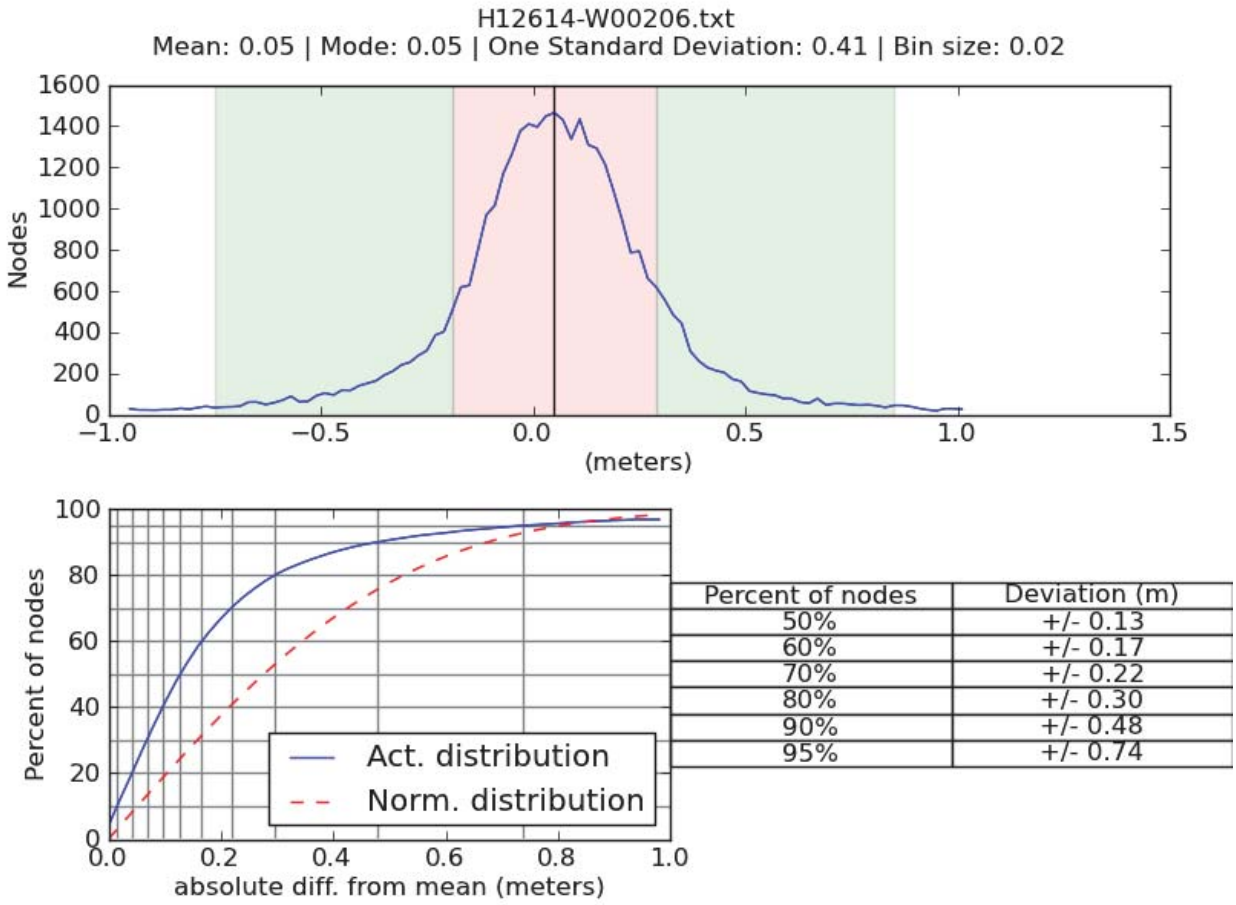


Figure 12: Area of overlap between H12614 and W00206; green indicates agreement (-0.05m to 0.05m), red represents areas where the difference is greater than +/- 0.05m.



Percent of nodes	Deviation (m)
50%	+/- 0.13
60%	+/- 0.17
70%	+/- 0.22
80%	+/- 0.30
90%	+/- 0.48
95%	+/- 0.74

Figure 13: Difference surface statistics computed for H12614 minus W00206.

H12613

Survey H12613 was assigned as a part of OPR-A321-FH-13. The extent of overlap with H12614 is shown in Figure 14. Two 4-meter combined surfaces were differenced. Of the over 75 thousand overlapping nodes, the average difference is -0.03 meters with a standard deviation of 0.38 meters. 95% of all differences are less than +/- 0.62 meters from the mean, as shown in Figure 15. The majority of the differences between the surveys were examined in CARIS Subset Editor to determine the cause of the disagreement. Most differences are evident on the slopes of rocky seabed areas.

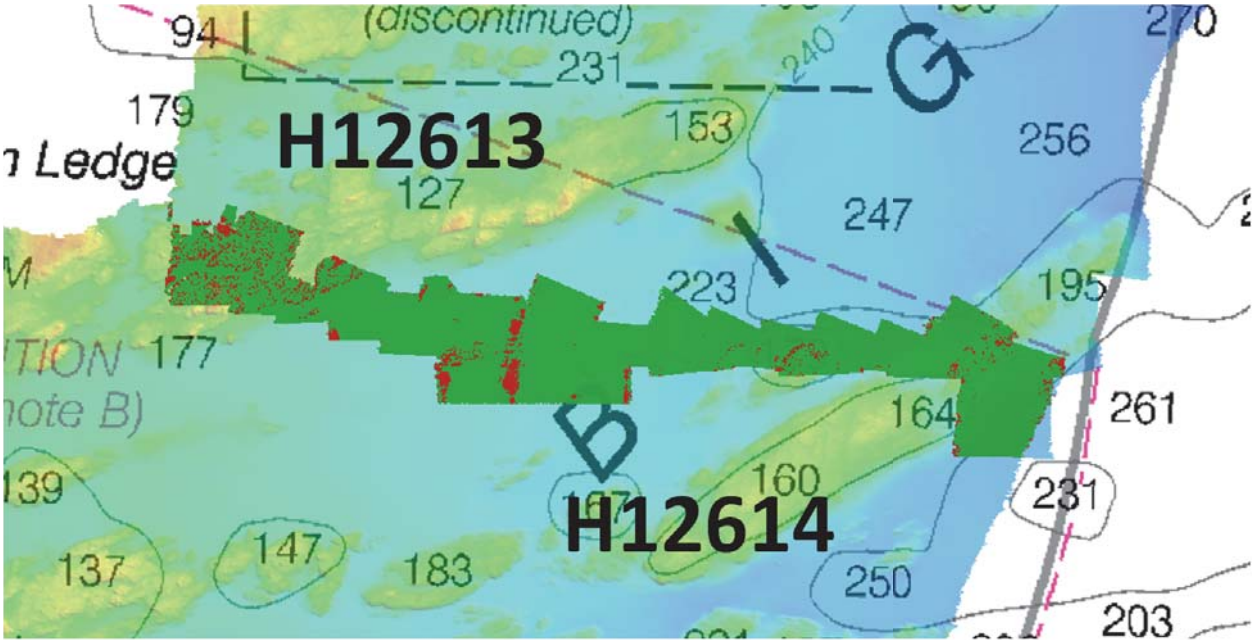


Figure 14: Area of overlap H12614 and H12613; green indicates agreement (-0.05m to 0.05m), red represents areas where the difference is greater than +/- 0.05m.

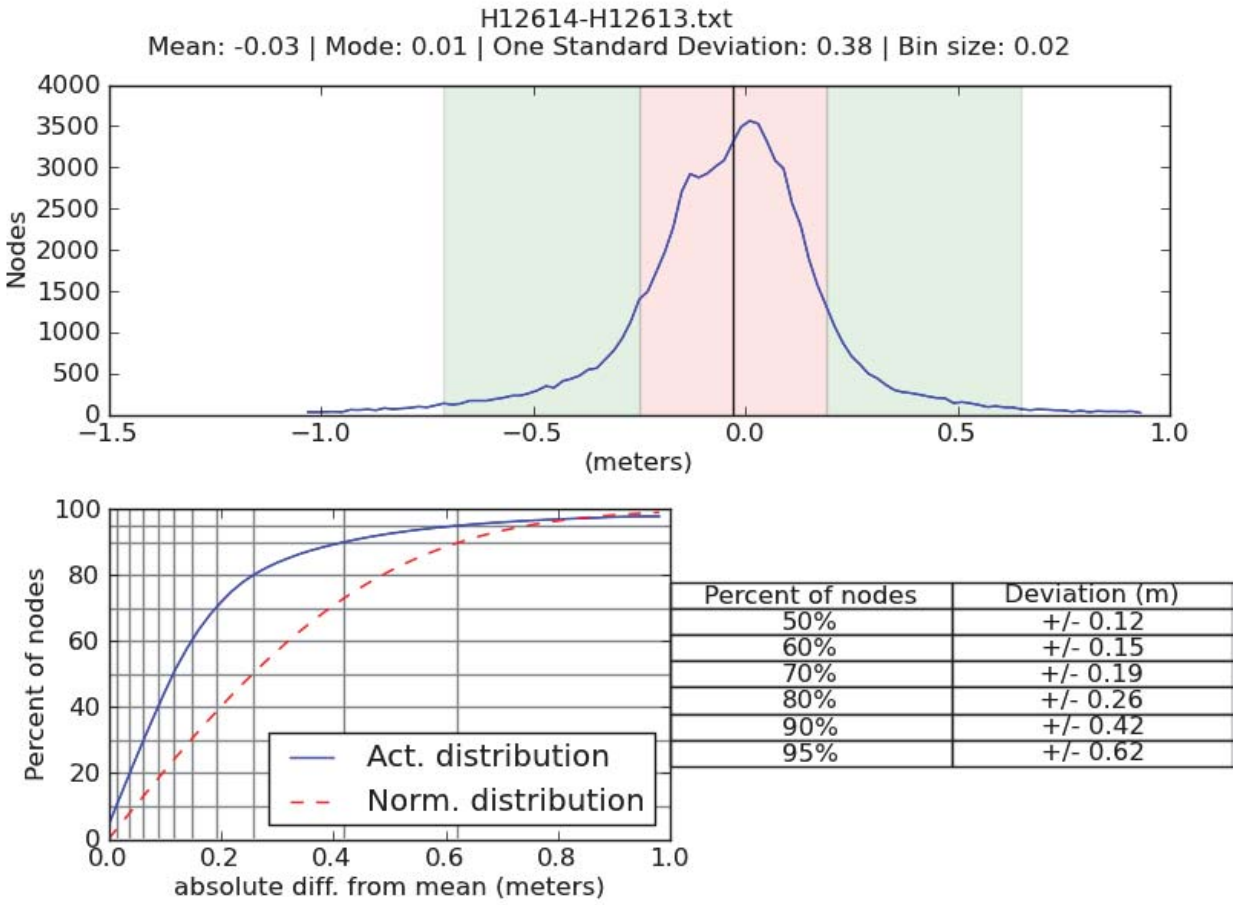


Figure 15: Difference surface statistics computed for H12614 minus H12613.

D00185

Survey D00185 was assigned as a part of OPR-A321-FH-13. The extent of overlap with H12614 is shown in Figure 16. Two 4-meter surfaces were differenced. Of the over 160,000 overlapping nodes, the average difference is -0.03 meters with a standard deviation of 0.37 meters. 95% of all differences are less than +/- 0.66 meters from the mean, as shown in Figure 17. The majority of the differences between the surveys were examined in CARIS Subset Editor to determine the cause of the disagreement. Most differences are evident on the slopes of rocky seabed areas.

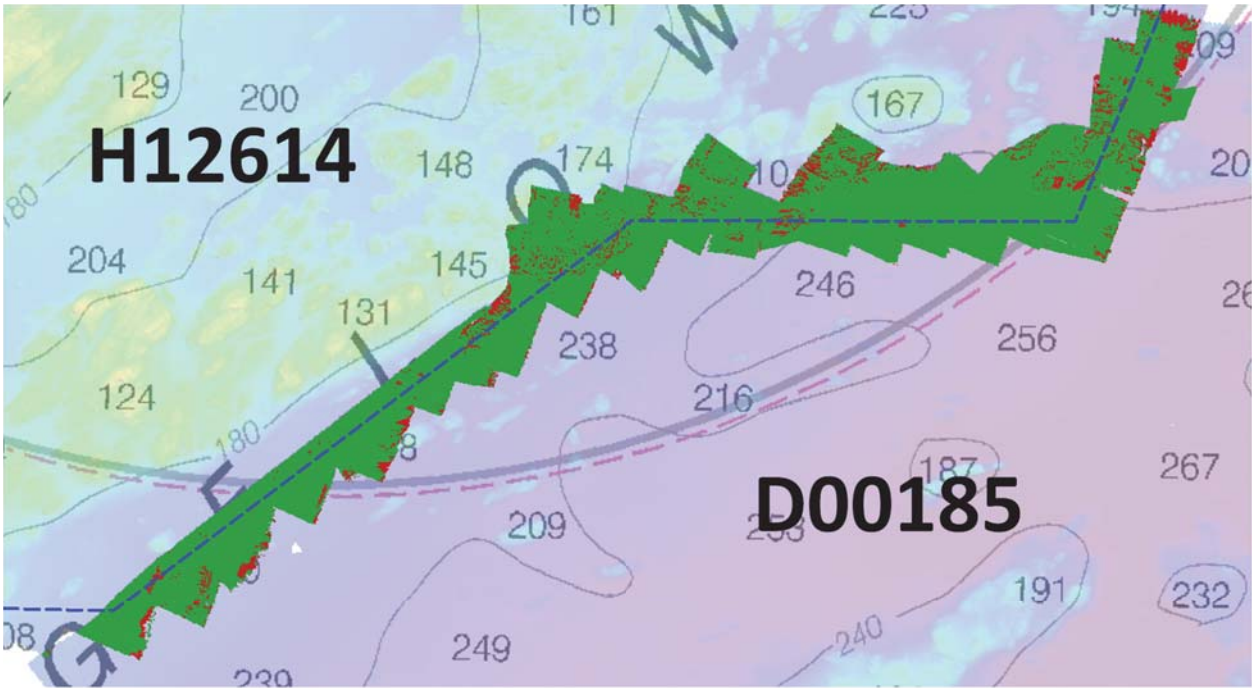


Figure 16: Area of overlap H12614 and D00185; green indicates agreement (-0.05m to 0.05m), red represents areas where the difference is greater than +/- 0.05m.

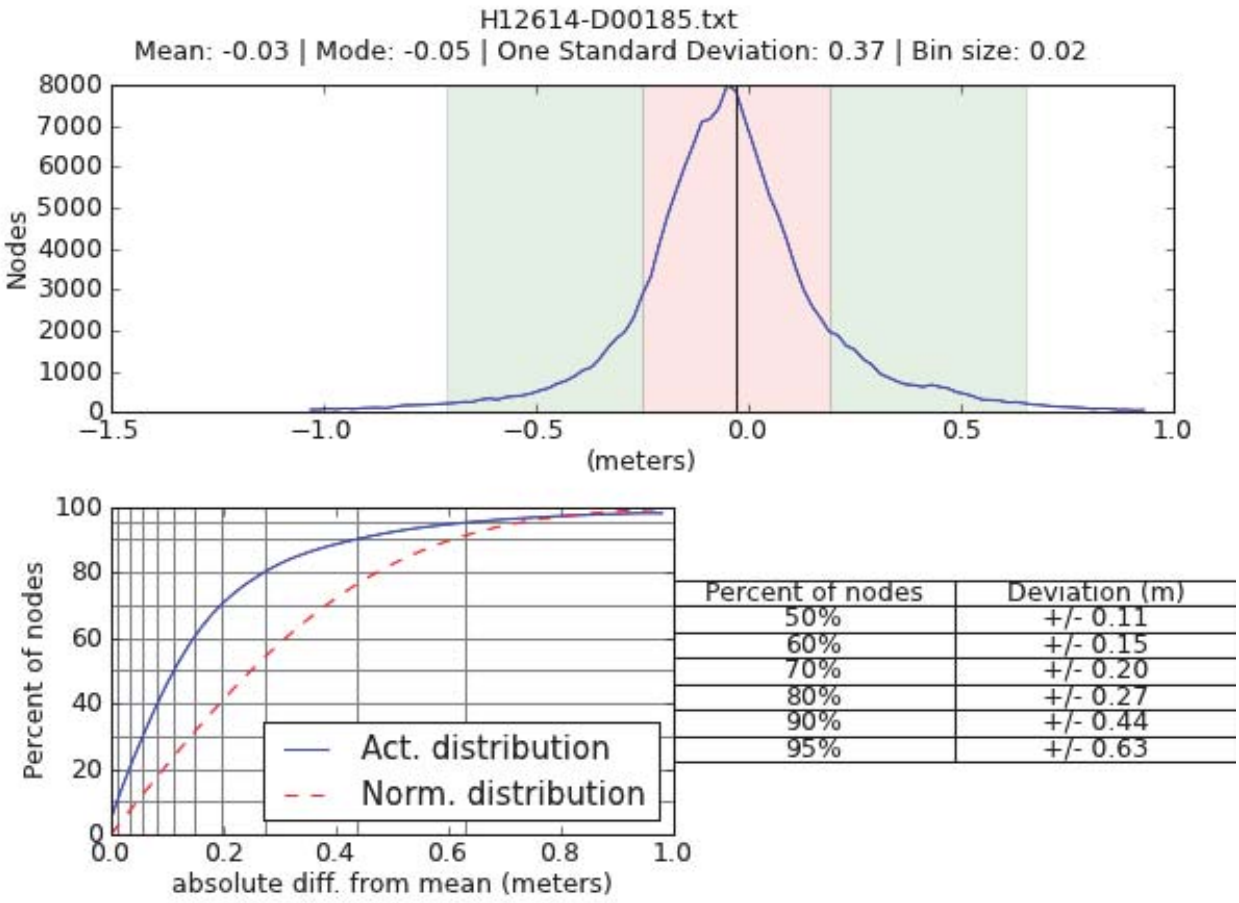


Figure 17: Difference surface statistics computed for H12614 minus D00185.

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

Poor Sonar Tuning

Throughout H12614, sonar range scale was not appropriately adjusted during survey operations, which compromised the quality of the outerbeam data. The hydrographer rejected soundings which impacted the surface. Figure 18 provides an example of outerbeam noise due to poor tuning.

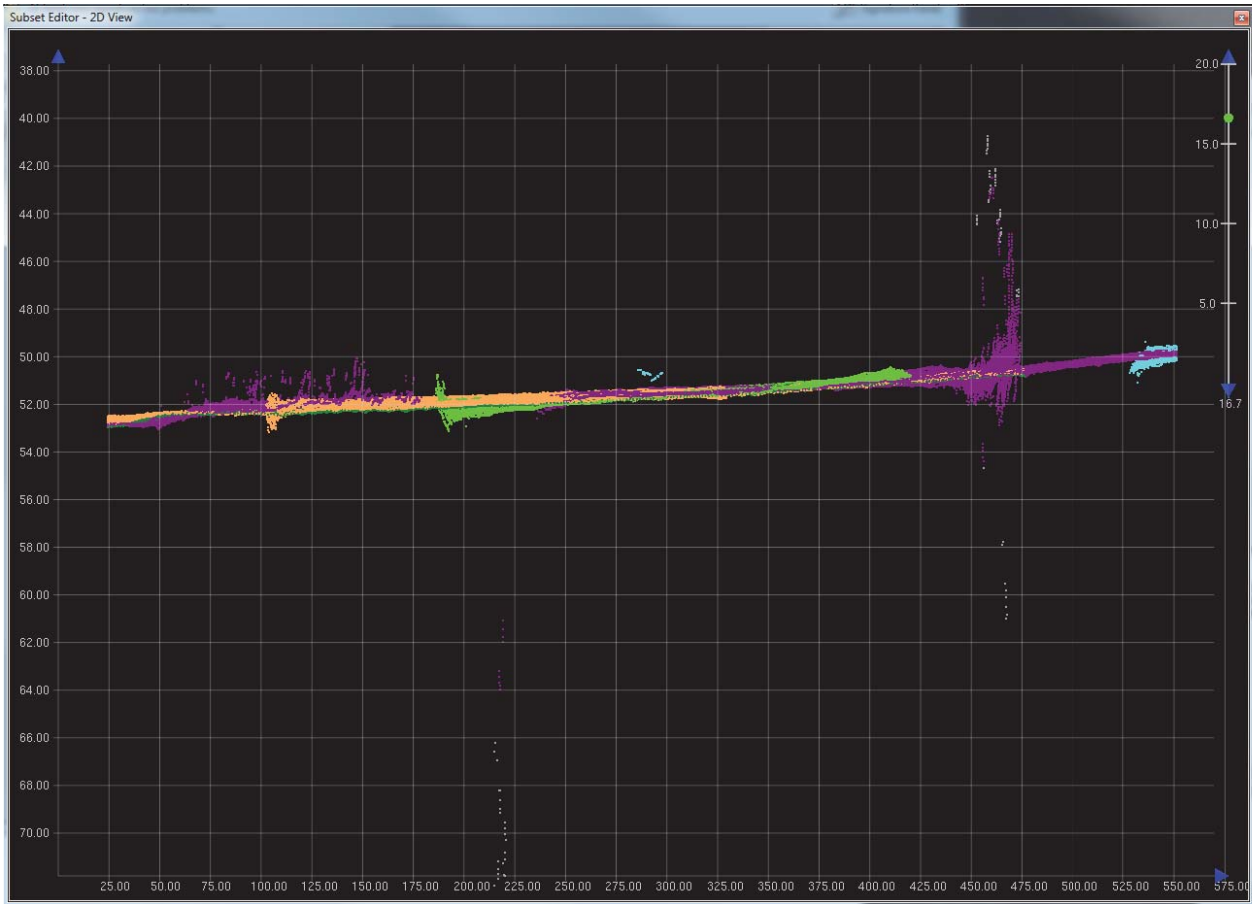


Figure 18: Poor data quality in the outerbeams.

B.2.6 Factors Affecting Soundings

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were taken approximately every 4 hours.

The sound speed corrections were applied with Nearest in Distance within Time of 3 three hours with the exception of the following:

Nearest in distance within 4 hours:
Dn251: All Lines.
Dn253: All lines.
Dn255: 20130912_200217 (Port) and 20130912_200218 (Starboard)

Nearest in distance within 6 hours:
Dn255: 20130912_142134 and 20130912_221907 (7111)

Nearest in time:
Dn256: All lines

B.2.8 Coverage Equipment and Methods

Figure 19 shows the percentage of nodes which are populated with 5 or more soundings. The hydrographer has inspected areas where density requirements were not achieved. Generally low density occurred in areas where features were not present (e.g. flat seafloor) or on the down slopes in rocky seabed areas.

The 50-cm surface exhibits several low along-track density areas due to inadequate range scale adjustments during acquisition. Some areas of the 50-cm surface do not meet object detection data density requirements. However, there is no evidence of shoaling or significant features in these areas of low density. The hydrographer considers these density holidays to be insignificant.

Surface	Percentage of Nodes with 5 or More Soundings
50cm	79.72
2m	99.63
4m	99.91

Figure 19: Nodes meeting density requirements

B.2.9 Total Vertical Uncertanty Analysis

A custom layer was created on finalized surfaces showing the uncertainty of individual nodes in relation to the allowable uncertainty for their depths. A statistical analysis was performed with a custom Python script, and the results are shown in Figure 20. Areas that did not meet IHO Order 1 requirements were examined by the hydrographer. Generally these nodes existed along slopes in rocky seabed areas.

Surface	Percentage of Nodes with Uncertainty less than or equal to allowable IHO Error
50cm	97.13
2m	97.26
4m	99.94

Figure 20: Nodes meeting uncertainty requirements

B.3 Echo Sounding Corrections

B.3.1 Corrections to Echo Soundings

In limited areas throughout the survey, errors in the GPS-derived vertical position solution led to vertical errors in the associated soundings. The altitude errors were located by examining the surface for areas of high standard deviation. CARIS Subset Editor and Attitude Editor were used to isolate the error in these cases to a GPS height error.

The errors are most apparent in the “GPS Tide” record generated in CARIS. The record is calculated during the “Calculate GPS Tide” process by removing the inertial generated heave record (TrueHeave) from the post-processed GPS height solution (from the applied SBET) and applying the datum-ellipsoid transformation model. The resultant record should contain both the tidal signal and any loading or dynamic draft effects. When an apparent vertical error occurred in the corrected soundings, the GPS Tide record was examined in Altitude Editor. For anomalies of short duration which occur within the line, GPS Tide anomalies were rejected and the resultant gap was linearly interpolated. As a result, the vertical error in the corrected soundings was eliminated. Sections of the following lines were handled in this way:

Port:
Dn251; 20130908_215222

Starboard:
Dn251; 20130908_215222
Dn254; 20130911_051240, 20130911_234419

Figures 21-23 show an example of GPS Tide edits made in Altitude Editor.

In cases where the anomalies were longer than 10 minutes in length, or at the beginning or end of a line, lines were reduced to MLLW with verified tides. The following lines were handled in this way:

Starboard:
Dn254; 20130911_173233
Dn255; 20130912_051104, 20130912_025352, 20130912_175752

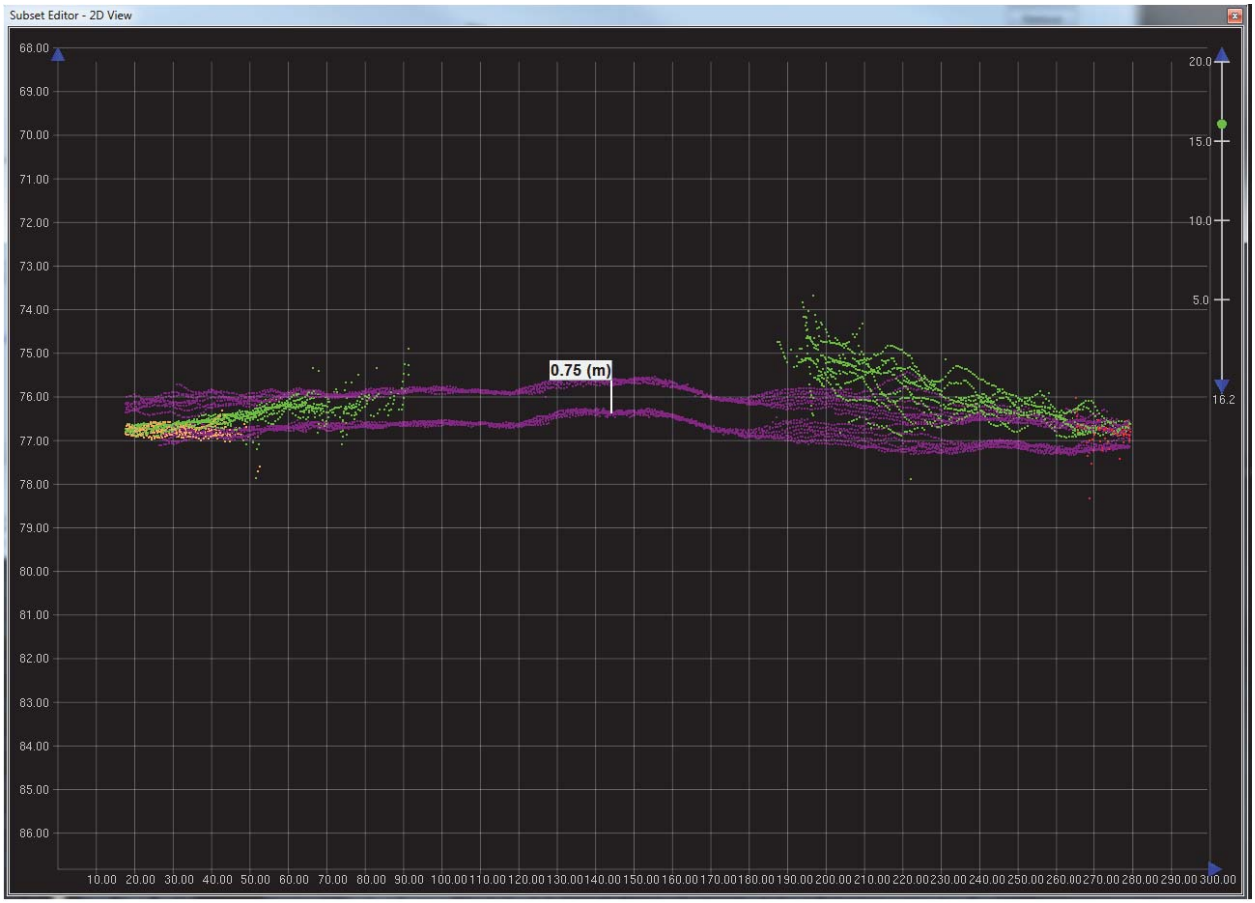


Figure 21: Vertical offset of 0.75 meters as a result of altitude error.

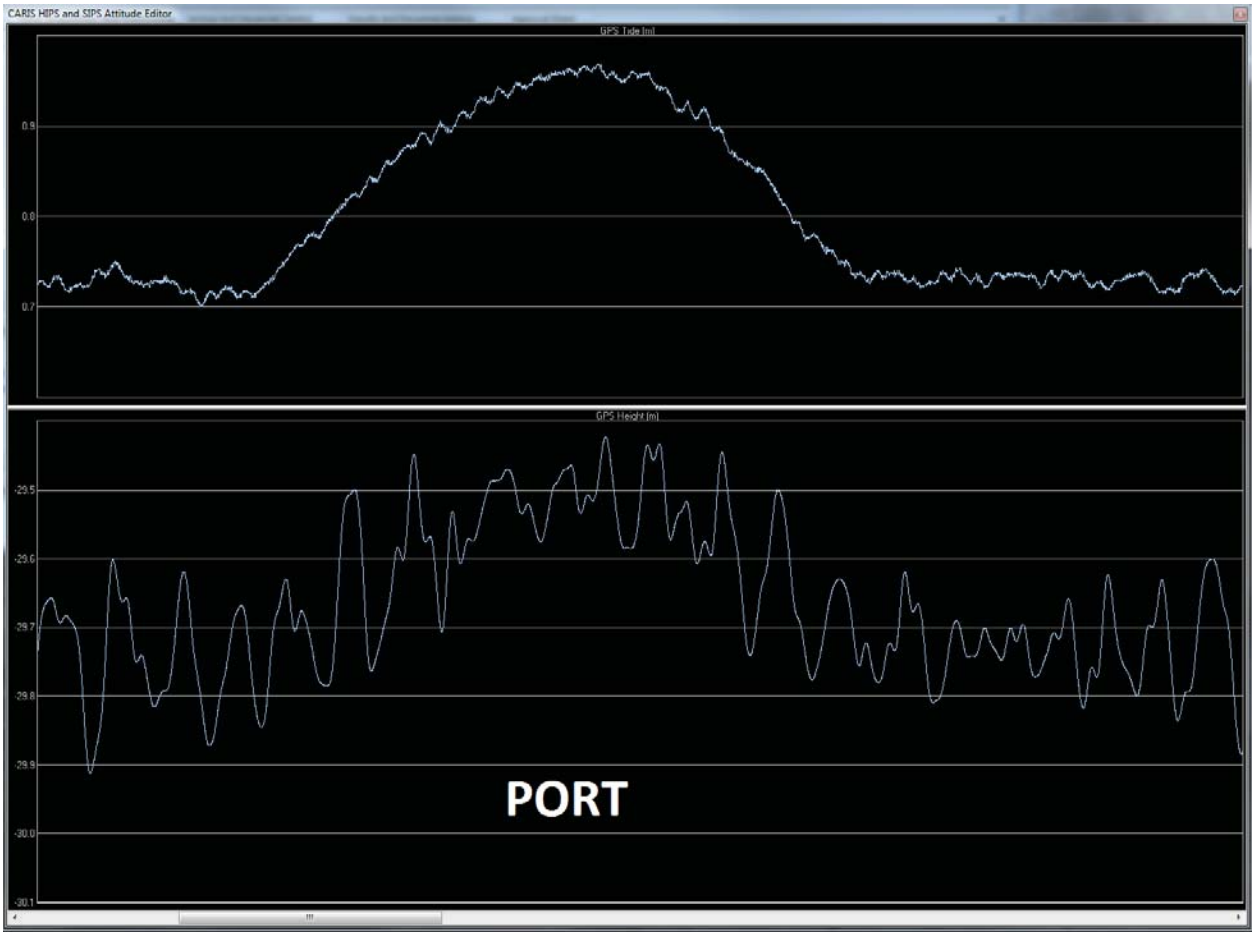


Figure 22: Port line 20130908_215222 in Altitude Editor prior to edits.

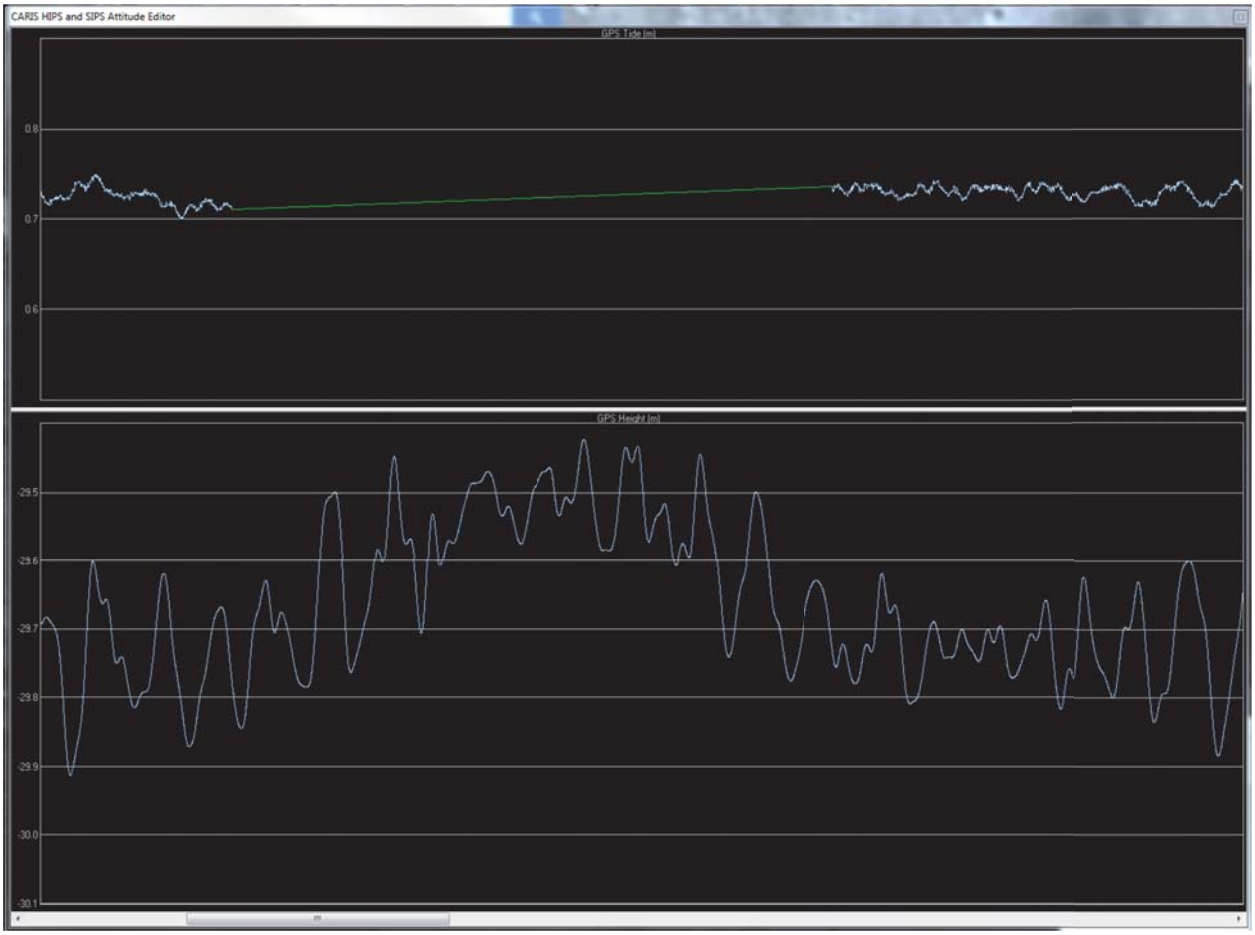


Figure 23: Port line 20130908_215222 in Altitude Editor post interpolation.

B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

B.3.3 Sound Velocity Error

Some areas of the survey exhibit sounding errors in the outer beams, likely resulting from uncorrected refraction due to low frequency sound speed casts as described in Section B.2.7. In some cases, as seen in Figure 24, the errors exceed IHO Order 1 acceptable uncertainty. Sound speed-induced error is most prevalent in the NW portion of the survey on Dn255. The resultant artifacts have been aggressively cleaned, however some errant data remains to prevent unnecessary holidays in the surface (Figure 25). These small areas exceed the allowable total vertical uncertainty of 0.7 meters for the depth. However, the hydrographer recommends that these data be accepted as the seabed is largely featureless in the areas of worst error, and the general trend of the bottom is preserved in the CUBE surface.

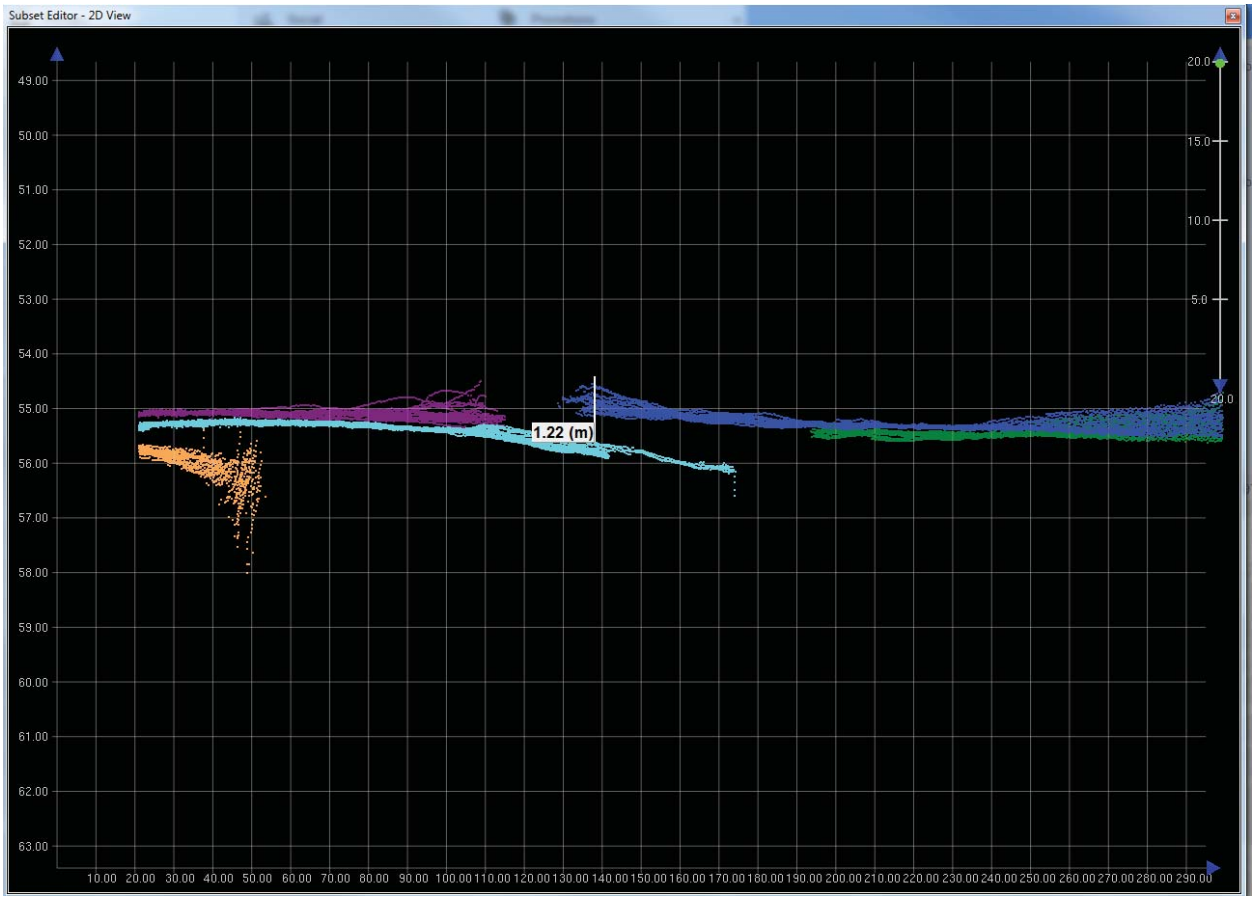


Figure 24: Example of lines where outerbeams exhibit sound velocity errors.

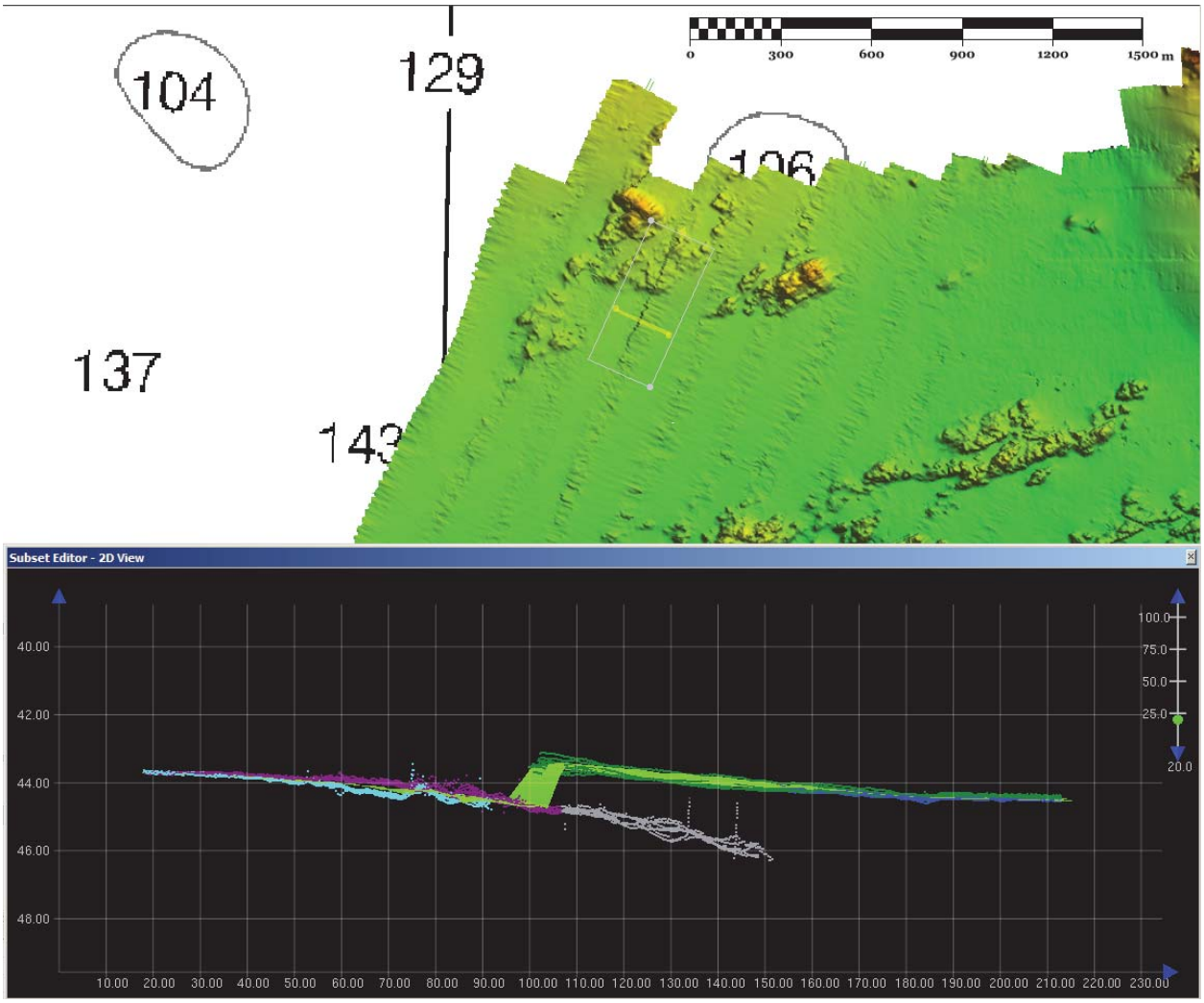


Figure 25: Sound velocity errors in the NW section of H12614 with the 4-meter finalized surface (top) at 10 times vertical exaggeration. Examples of rejected data in CARIS Subset Editor (Bottom).

B.4 Backscatter

Raw Backscatter was logged as .s7k files and is submitted with H12614 raw bathymetry.

Backscatter was logged in the Reson datagram 7008 snippets record in the raw .s7k files. The .s7k file also holds the navigation record and bottom detections for all lines of survey H12503. The files were paired with the CARIS HDCS data, imported and processed using Fledermaus Geocoder Toolbox, version 7.3.2b-beta, build 406, 64-bit version.

The GSF files containing the extracted backscatter are submitted with the data in this survey. The processed mosaic is submitted as both a geoTiff and a scalar attached to the bathymetric Fledermaus .sd file.

B.5 Data Processing

B.5.1 Software Updates

There were no software configuration changes after the DAPR was submitted.

The following Feature Object Catalog was used: NOAA Extended Attribute File 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
H12614_MB_50cm_MLLW	CUBE	0.5 meters	18.08 meters - 217.71 meters	NOAA_0.5m	Object Detection
H12614_MB_50cm_MLLW_Final	CUBE	0.5 meters	18.08 meters - 20 meters	NOAA_0.5m	Object Detection
H12614_MB_2m_MLLW	CUBE	2 meters	18.52 meters - 103.75 meters	NOAA_2m	Complete MBES
H12614_MB_2m_MLLW_Final	CUBE	2 meters	18.31 meters - 40 meters	NOAA_2m	Complete MBES
H12614_MB_4m_MLLW	CUBE	4 meters	18.57 meters - 80.67 meters	NOAA_4m	Complete MBES
H12614_MB_4m_MLLW_Final	CUBE	4 meters	36 meters - 80.67 meters	NOAA_4m	Complete MBES

Table 9: Submitted Surfaces

The depth resolution of the 4-meter finalized surface was increased to incorporate deeper depths. The density of soundings in the deeper depths support a 4-meter surface in this area.

C. Vertical and Horizontal Control

All vertical and horizontal control activities conducted during the course of this survey are fully addressed in the following sections. Therefore, no separate HVCR is submitted.

C.1 Vertical Control

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

Standard Vertical Control Methods Used:

Discrete Zoning

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

Station Name	Station ID
Fort Point, NH	842389

Table 10: NWLON Tide Stations

File Name	Status
A321FH2013CORP.zdf	Final Approved

Table 11: Water Level Files (.tid)

File Name	Status
8423898.tid	Final

Table 12: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 09/18/2013. The final tide note was received on 09/19/2013.

Preliminary zoning is provisionally accepted as the final zoning for survey H12614. See Appendix I for Provisional Tide Note for Hydrographic Survey.

Non-Standard Vertical Control Methods Used:

VDatum

Ellipsoid to Chart Datum Separation File:

H12614 is referenced to MLLW by ellipsoidal methods using the Ellipsoid to Chart Separation File, with exception of the lines discussed in Section B.2.2 and B.2.2.7 which were reduced to chart datum using zoned water levels.

Per the Project Instructions, a VDatum evaluation was performed and submitted to HSD prior to H12614 final processing. Based on this evaluation, the hydrographer recommended VDatum for final datum reduction. The Chief, Hydrographic Surveys Division, approved the use of VDatum for H12614. See Appendix II for correspondence associated with this decision.

C.2 Horizontal Control

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

The projection used for this project is 19N.

The following PPK methods were used for horizontal control:

Smart Base

All data submitted as H12614 have SBETs applied for post processed horizontal position. DGPS positioning, shown in Table 14, was used for real-time horizontal control during data acquisition.

While planning for project OPR-A321-FH-13, a proposed smartbase network was analyzed. According to active CORS stations, a reference station (NHUN) is located on the University of New Hampshire Campus in Durham, New Hampshire. This station is within the 50km radius specified in the HSSD 2013. Data acquisition during the first leg of the project (8/12/13-8/21/13) revealed that this reference station rarely had continuous coverage throughout a 24-hour period. As a result of these gaps, data from station NHUN could not be utilized in post-processing and the Smartbase project does not meet the specifications of the 2013 HSSD.

The hydrographer contacted the NHUN operators and learned that the station was not expected to be repaired in the near future. However, the University operates an alternate reference station on Odiorne Point, which is ideally situated for use on OPR-A321-FH-13. This station was found to be more reliable, and the hydrographer arranged to utilize the data. This station is referred to by either the name “Odiorne” or “8276” in the submitted data. Base station coordinates were computed by averaging three days of 24-hour OPUS solutions. With the use of this reference station, all data collected after September 4th meets specifications of the HSSD 2013.

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
Penobscot 6	PNB6
MTS Yarmouth Coop	YMTS
Gorham	MEGO
Boston WAAS 1	ZBW1
Westford	WES2
MTS Fox Coop	XMTS
Machias	MEMA
Bar Harbor	BARH
U New Hampshire	NHUN
Acushnet 6	ACU6
Acushnet 5	ACU5
Odiorne Point	8276

Table 13: CORS Base Stations

The following DGPS Stations were used for horizontal control:

DGPS Stations
Brunswick, ME (316kHz)

Table 14: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

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
13274	1:40000	28	04/2011	10/22/2013	11/02/2013
13278	1:80000	28	08/2013	10/22/2013	11/02/2013

Table 15: Largest Scale Raster Charts

13274

Generally, soundings from H12614 agree with chart 13274 within 6 feet. Surveyed soundings are generally shoaler than charted depths. It is notable that in rocky seabed areas, surveyed soundings were up to 21 feet shoaler than charted depths. Soundings posing a hazard to surface navigation have been submitted as Dangers to Navigation (see Section D.1.7). The hydrographer recommends that the current survey data supersede charted depths in the common area.

13278

Generally, chart 13278 and survey H12614 agree within 6 feet. On the eastern side of the sheet, where rocky seabeds exist, surveyed soundings are, on average, shoaler by up to 25 feet. Soundings posing a hazard to surface navigation have been submitted as Dangers to Navigation (see Section D.1.7). A particularly notable difference of interest is a pinnacle southeast of Anderson Ledge (Figure 26), which was surveyed to a depth of 89 feet in charted depths of approximately 127-177 feet. The hydrographer recommends that the current survey data supersede charted depths in the common area.

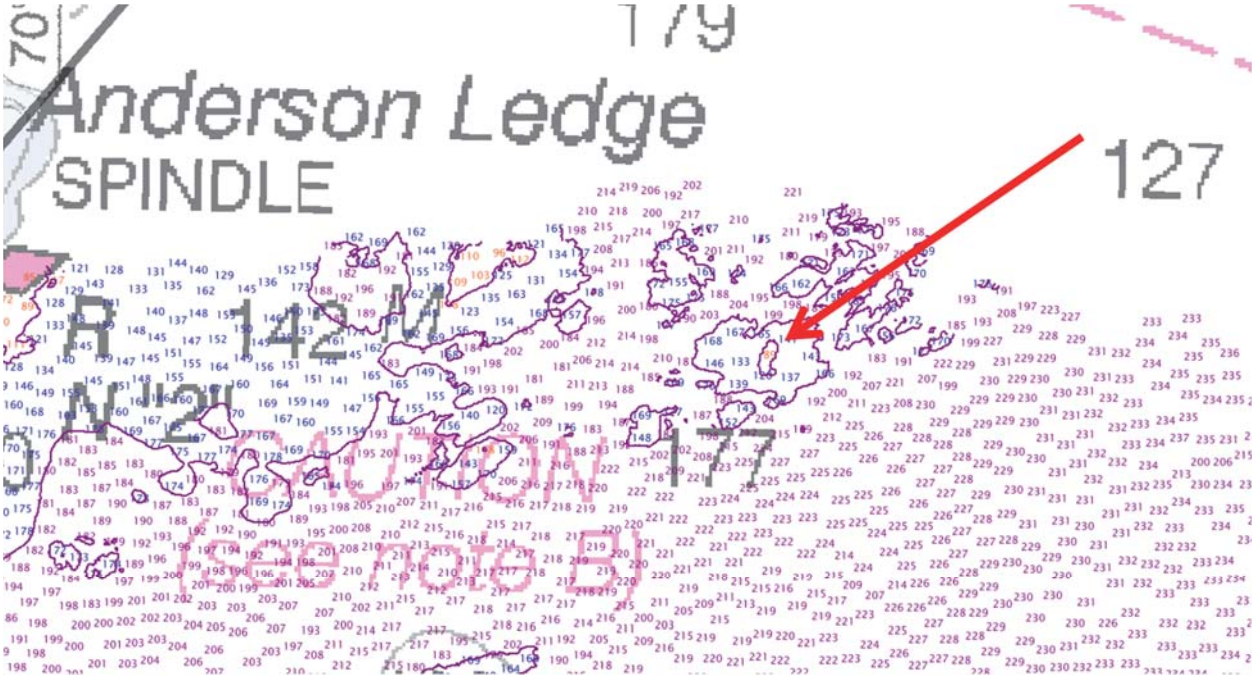


Figure 26: 89 foot surveyed sounding in the vicinity of a 177 foot charted depth.

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?
US4MA04M	1:80000	21	10/24/2013	04/08/2013	NO
US5MA19M	1:40000	4	10/24/2013	08/27/2012	NO

Table 16: Largest Scale ENCs

US4MA04M

Comparison of H12614 with ENC US4MA04M revealed the same discrepancies as comparison with raster chart 13278. See section D.1.1 for details.

US5MA19M

Comparison of H12614 with ENC US5MA19MM revealed the same discrepancies as comparison with raster chart 13274. See section D.1.1 for details.

D.1.3 AWOIS Items

Three AWOIS items exist for this survey. These items (Figure 27) are in the western portion of the sheet, which was not surveyed due to time constraints, and the items were not addressed.

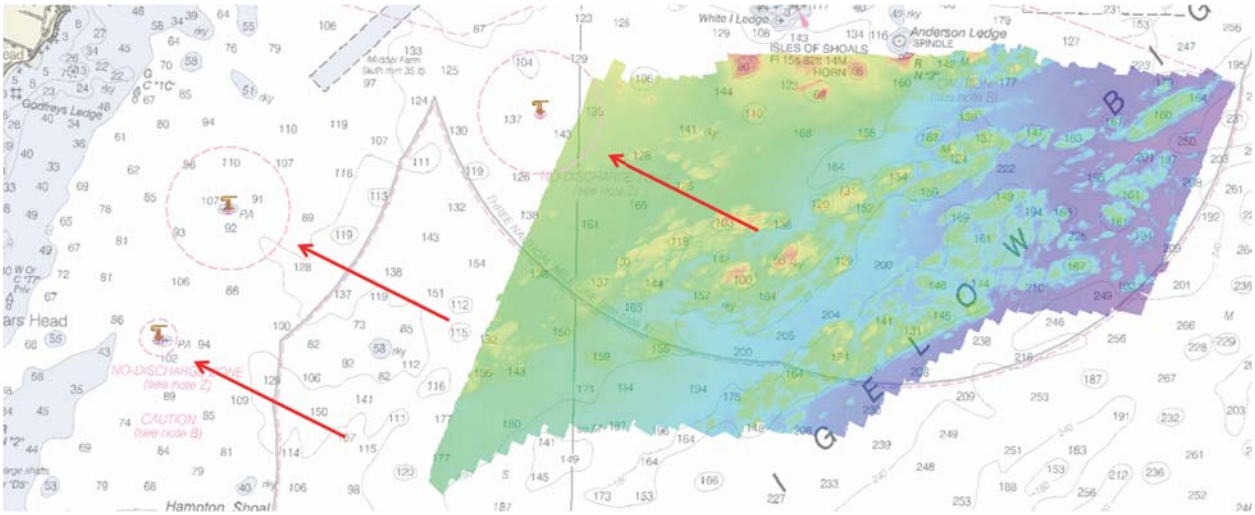


Figure 27: AWOIS items and coverage obtained for H12614.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

Charted features that contain the label PA were assigned in the Composite Source File (CSF), but were not investigated. These features are in the western portion of the sheet that was not surveyed due to time constraints.

D.1.6 Uncharted Features

No uncharted features exist for this survey.

D.1.7 Dangers to Navigation

Danger to Navigation Report, containing two dangers to navigation, was submitted to NDB on 10/18/2013. Danger to Navigation Report and correspondence are included in Appendix II of this report.

D.1.8 Shoal and Hazardous Features

Numerous shoals exist within the extents of H12614. However, there are no new features which pose a hazard to surface navigation which have not been discussed elsewhere in this report.

D.1.9 Channels

No channels exist for 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.

D.1.10 Bottom Samples

Nine bottom samples were attempted by HASSLER Personnel in positions prescribed by HSD Operations Branch. Three bottom samples were not delivered in the Final Feature File because a sample was not returned after three attempts. The remaining 6 bottom samples have been provided in H12614_Final_Feature_File.000. A Bottom Sample Acquisition Log for H12614 is provided in Separates Section I., Acquisition & processing Logs, along with the Acquisition Logs.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was assigned in the Hydrographic Survey Project Instructions, but was not investigated. The western portion of the sheet contains shoreline features but due to time constraints, that portion of the sheet was not completed.

FERDINAND R. HASSLER is not equipped with a survey launch. Even had time constraints not curtailed this survey, shoreline would have been unaddressed due to the platform's inability to survey in areas shallower than 30 feet.

D.2.2 Prior Surveys

Prior surveys were available, but not compared with current data.

D.2.3 Aids to Navigation

One Aid to Navigation (ATON) falls within the limits of this survey. The aid was observed visually from the ship and found to be on station and serving its intended purpose.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

Submarine features were assigned in the Composite Source File (CSF), but were not investigated. The western portion of the sheet contained these features but due to time constraints, that portion of the sheet was not surveyed.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No significant features exist for 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 Recommendations

The hydrographer recommends the western portion of H12614 be surveyed by a platform suited for nearshore work.

D.2.11 New Inset Recommendations

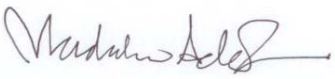
No new insets are recommended for this area.

E. Approval Sheet

As Chief of Party, field operations for this hydrographic survey were conducted under my direct supervision, 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 with the exception of discrepancies noted in this report. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required except as noted in Section D.2.10 of this report.

Approver Name	Approver Title	Approval Date	Signature
LCDR Benjamin K. Evans, NOAA	Chief of Party	12/06/2013	
LT Madeleine M. Adler, NOAA	Field Operations Officer	12/06/2013	
Tyanne Faulkes	Physical Scientist, Atlantic Hydrographic Branch	12/06/2013	

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 19, 2013

HYDROGRAPHIC BRANCH: Atlantic
HYDROGRAPHIC PROJECT: OPR-A321-FH-2013
HYDROGRAPHIC SHEET: H12614

LOCALITY: Hampton Beach to Little Boars Head, Gulf of Maine
TIME PERIOD: September 8 – September 13, 2013

TIDE STATION USED: 842-3898 Fort Point, NH
Lat: 43° 4.3'N Lon: 70° 42.7'W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.735 meters

REMARKS: RECOMMENDED ZONING
Preliminary zoning is provisionally accepted as the final zoning for project OPR-A321-FH-2013, H12614, during the time period between September 8 - September 13, 2013.

Please use the zoning file A321NF2013CORP submitted with the project instructions for OPR-A321-FH-2013. Zone NA169 is the applicable zone for H12614.

Refer to attachments for zoning information.

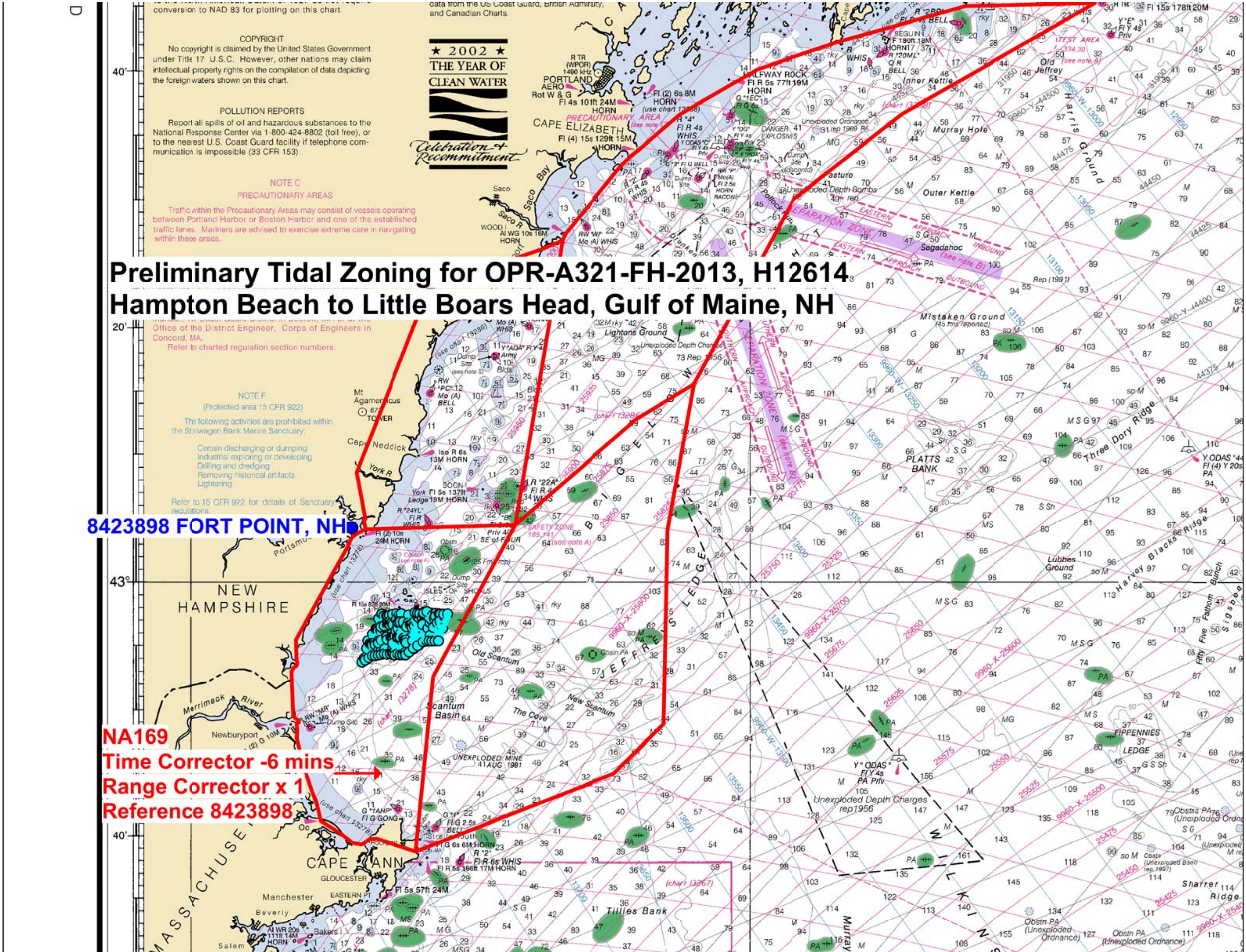
Note 1: Provided time series data are tabulated in metric units (meters), relative to MLLW and on Greenwich Mean Time on the 1983-2001 National Tidal Datum Epoch (NTDE).

Note 2: Annual Leveling for the tide station at Fort Point, NH (8423898) was not completed in FY13. A review of the verified leveling records from October 2002 - 2012 show the tide station benchmark network to be stable within an allowable 0.009 m tolerance. This Tide Note may be used as final stability verification for the purposes of survey OPR-A321-FH-2013, H12614. CO-OPS will immediately provide a revised Tide Note should subsequent leveling records indicate any benchmark network stability movement beyond the allowable 0.009 m tolerance.

HOVIS.GERALD.THOMAS.1365860250

Digitally signed by HOVIS.GERALD.THOMAS.1365860250
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOVIS.GERALD.THOMAS.1365860250
Date: 2013.09.25 07:50:01 -04'00'

Chief, Products and Services Branch



Preliminary Tidal Zoning for OPR-A321-FH-2013, H12614
Hampton Beach to Little Boars Head, Gulf of Maine, NH
8423898 FORT POINT, NH
NA169
Time Corrector -6 mins
Range Corrector x 1
Reference 8423898
COPYRIGHT
No copyright is claimed by the United States Government under Title 17 U.S.C. However, other nations may claim intellectual property rights on the compilation of data depicting the foreign waters shown on this chart.
POLLUTION REPORTS
Report all spills of oil and hazardous substances to the National Response Center via 1-800-424-8802 (toll free), or to the nearest U.S. Coast Guard facility if telephone communication is impossible (33 CFR 153).
NOTE C
PRECAUTIONARY AREAS
Traffic within the Precautionary Areas may consist of vessels operating between Portland Harbor or Boston Harbor and one of the established traffic lanes. Mariners are advised to exercise extreme care in navigating within these areas.
★ 2002 ★
THE YEAR OF
CLEAN WATER
Celebration + Recommitment
NOTE F
(Protected area 15 CFR 922)
The following activities are prohibited within the Stellwagen Bank Marine Sanctuary:
Certain discharging or dumping
Industrial exploring or developing
Drilling and dredging
Removing historical artifacts
Lightering
Refer to 15 CFR 922 for details of Sanctuary regulations.
NEW HAMPSHIRE
MASSACHUSETTS
CAPE ANN
CAPE ELIZABETH
PORTLAND
Jeffreys Ledge
Platts Bank
Three Dory Ridge
Tillies Bank
Scantum Basin
Old Scantum
New Scantum
Mistaken Ground
Outer Kettle
Inner Kettle
Murray Hole

APPENDIX II

SUPPLEMENTAL SURVEY RECORDS AND CORRESPONDENCE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Coast Survey
Silver Spring, Maryland 20910-3282

December 5, 2013

MEMORANDUM FOR: LCDR Marc S. Moser, NOAA
Commanding Officer, NOAA Ship *Ferdinand Hassler*

FROM: Jeffrey Ferguson
Chief, Hydrographic Surveys Division

SUBJECT: Vertical Datum Transformation Technique,
OPR-A321-FH-13, Approaches to Portsmouth, NH

Hydrographic surveys H12614 & H12615 are approved for vertical reduction to chart datum, Mean Lower Low Water (MLLW), using the NOAA Vertical Datum Transformation (VDatum) (http://vdatum.noaa.gov) derived separation (SEP) model..

Approval of VDatum, in lieu of the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) discrete zoning package as per the Project Instructions, is based on your recommendation and the review of comparison results you included in your attached email from November 30, 2013.

The results of the data analysis show that ellipsoidally referenced survey (ERS) techniques with VDatum used as the vertical datum reducer meet or exceed horizontal and vertical specifications for hydrographic surveys.

The comparison techniques are in line with the procedures that were developed and approved as part of the CSDL Ellipsoidally Referenced Survey (ERS) project. These procedures and deliverables were recently added to the April 2013 edition of the NOS Hydrographic Surveys Specifications and Deliverables document.

You shall include a description of your ERS processing procedures and the comparisons you conducted between ERS and traditional tides or prior survey data in the appropriate Descriptive Report (DR), Horizontal and Vertical Control Report and/or Data Acquisition and Processing Report. As appropriate in the DR, document specific vessel day(s) or line(s) that have not been processed using VDatum as the vertical reducer to MLLW where discrete zoning provides better results and/or where vertical uncertainties of your post processed vertical positional data are inaccurate.

Include this memo in the supplemental correspondence Appendix of the DR.

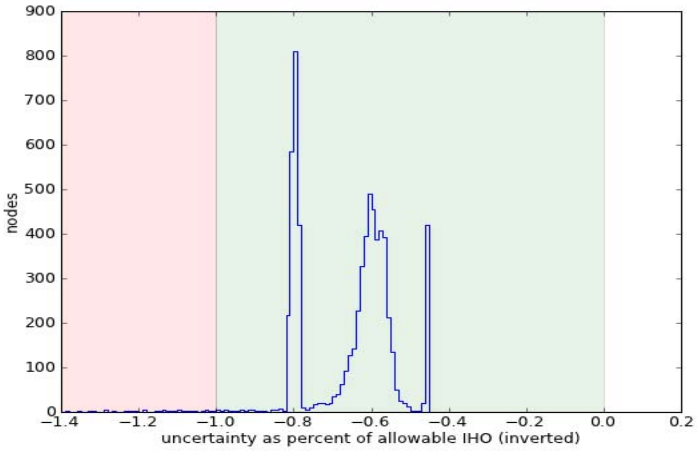
H12614_MB_50cm_MLLW_Final

The finalized surface has 6899 nodes with 72547 soundings.

Uncertainty Standards

97.13% | PASS

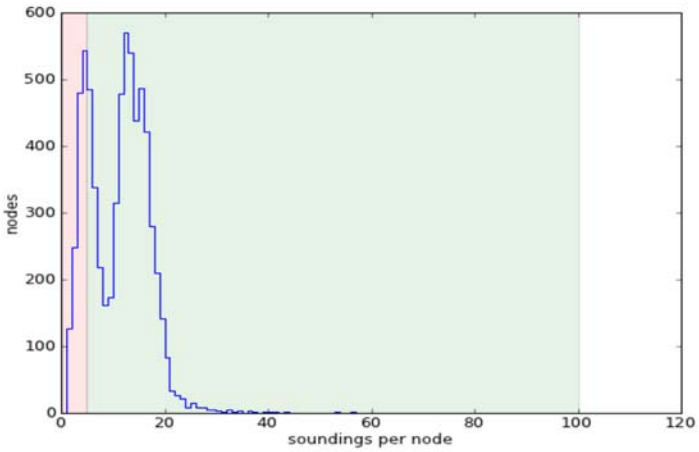
Nodes with Uncertainty less then or equal allowable IHO error **97.13%** (6701/6899).



Object Detection Coverage

79.72% | FAIL

Nodes with 5 or more soundings **79.72%** (5500/6899).
Sounding count average is **10.52** soundings per node.
Sounding count mode is **13** soundings per node.



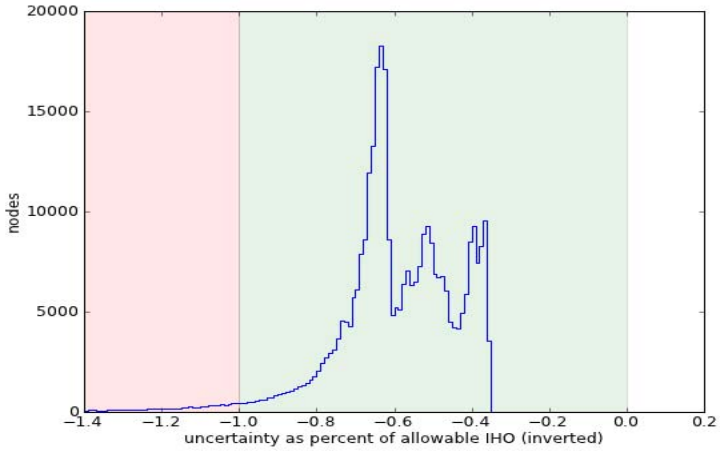
H12614_MB_2m_MLLW_Final

The finalized surface has 345324 nodes with 16408788 soundings.

Uncertainty Standards

97.26% | PASS

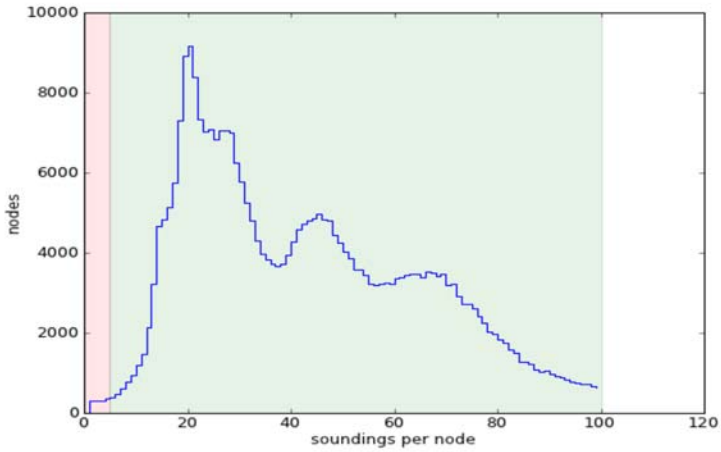
Nodes with Uncertainty less then or equal allowable IHO error **97.26%** (335868/345324).



Object Detection Coverage

99.63% | PASS

Nodes with 5 or more soundings **99.63%** (344054/345324).
Sounding count average is **47.52** soundings per node.
Sounding count mode is **21** soundings per node.



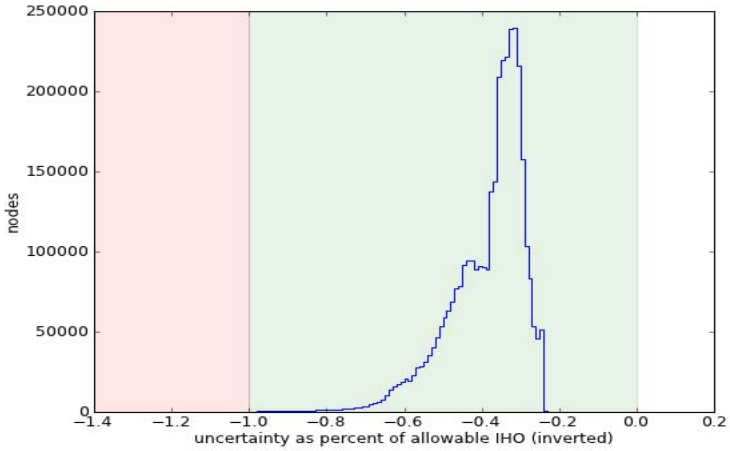
H12614_MB_4m_MLLW_Final

The finalized surface has 3576153 nodes with 354708048 soundings.

Uncertainty Standards

99.94% | PASS

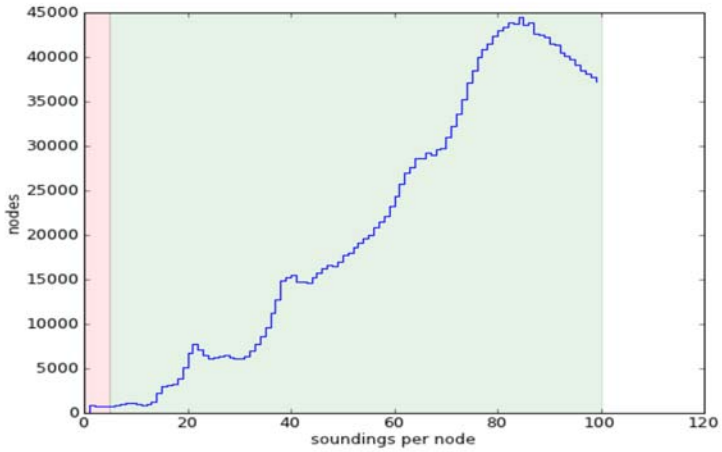
Nodes with Uncertainty less then or equal allowable IHO error **99.94%** (3573849/3576153).



Object Detection Coverage

99.91% | PASS

Nodes with 5 or more soundings **99.91%** (3573062/3576153).
Sounding count average is **99.19** soundings per node.
Sounding count mode is **85** soundings per node.



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
NOAA Ship *Ferdinand R. Hassler* (S-250)
Box 638, New Castle, NH 03854

November 29, 2013

MEMORANDUM FOR: Jeffrey Ferguson
Chief, Hydrographic Survey Branch

FROM: LCDR Benjamin K. Evans, NOAA
Commanding Officer

TITLE: OPR-A321-FH-13 VDatum Evaluation and Deliverable Recommendation

Ferdinand R. Hassler personnel conducted a comparison of VDatum based Ellipsoid Referenced Survey (ERS) versus discrete tidal zoning vertical transformation techniques using crossline data per the Hydrographic Survey Project Instructions (PI). In addition we conducted comparisons using the difference between crosslines and mainscheme to give a better recommendation on internal consistency. While there are differences between the two data reduction methods, there is no justification to disprove or suspect the VDatum separation model. Results and analysis of the comparison are in the attached report.

When successful, ERS methods generally result in a more internally consistent sounding set. However, we experienced some problems in reliably processing the vessel trajectory relative to the ellipsoid. We recommend that the entirety of H12613 be submitted with zoned water level correctors and that surveys H12614 and H12615 be submitted as hybrids, with the majority of data reduced by VDatum.

It is understood that upon review of this report, a determination will be made for the final vertical transformation technique to be used to create the final deliverables.

Attachment

Table of Contents

List of Figures

List of Tables

1.0 Introduction

This document is an interim report describing methods and results of the vertical datum analysis component of the vertical control requirements of the Hydrographic Survey Project Instructions for OPR-A321-FH-13 Approaches to Portsmouth (July 25, 2013). The project is located in the vicinity of the Gulf of Maine and includes hydrographic surveys H12613, H12614, and H12615. The Project Instructions require the field unit to recommend the final vertical transformation technique after analyzing crossline data. The recommendations and supporting data included in this report are intended for use by the Hydrographic Surveys Division (HSD) to support the final decision on the use of ellipsoidally-referenced survey (ERS) methods in lieu of traditional tides for final water level correctors for the OPR-A321-FH-13 survey.

The basis of this analysis is a comparison of discrete tidal zoning and Vertical Datum Transformation (VDatum) as methods for vertical control. Because discrete tidal zoning is the conventional and accepted method, it is regarded as a baseline for this evaluation.

2.0 Procedure

The VDatum evaluation was conducted according to the instructions in Appendix 1 of the project instructions. Additional guidance found in the Pydro distribution (Pydro\Lib\site-packages\HSTP\Pydro\ PostAcqTools_CompareTSeries.docx) was followed for the direct comparison of data.

Project crossline data was reduced to Mean Lower Low Water (MLLW) via conventional discrete tidal zoning. A second set of crossline data was reduced using VDatum. Time series data for the nadir depth was extracted from both data sets and differenced using the Pydro PostAcq toolset.

In addition, CARIS surfaces of crossline and mainscheme data were analyzed in both discrete zoning and VDatum methods. This analysis was used to evaluate the internal consistency of data and detect any spatial patterns in the difference that may have suggested inconsistencies in the VDatum model.

Survey limits for the areas used in this assessment are shown in Figure 1. The ship acquired data in H12613, H12615, and the eastern half of H12614. These surveys account for three of the eight assigned priorities within project OPR-A321-FH-13. Survey D00185 was excluded from this evaluation due to its low priority and distance offshore. Due to time constraints, the ship did not acquire data on any other sheets.

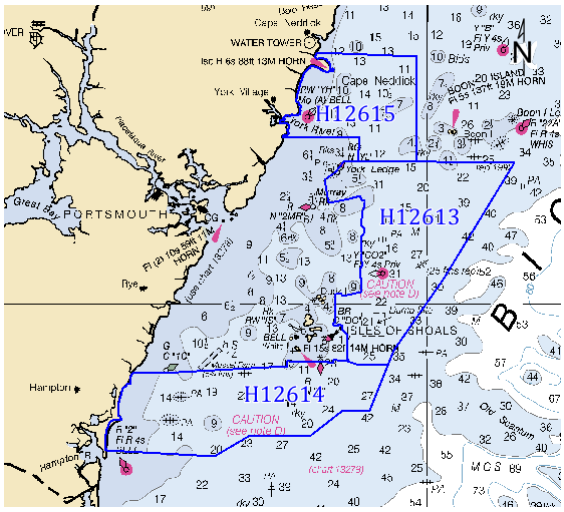


Figure 1: Sheet limits for Project OPR-A321-FH-13. Sheets H12613, H12615, and the eastern half of H12614 were surveyed by *Ferdinand R. Hassler*.

3.0 Results and Discussion

This report will answer three questions:

- Is the VDatum model correct in the geographic location of this project?
- Is the internal consistency of the data improved by ERS methods?
- What method of vertical control is appropriate for specific surveys?

3.1 VDatum Model Accuracies

To analyze the VDatum model, the ellipsoid to MLLW .xyz separation file provided by HSD Operations was rendered as a surface. This was examined to assess the overall slope of the model within the survey area, and thus the magnitude of vertical error resulting from any horizontal offset. The surface was also inspected for errors that could be the result of inconsistencies within the VDatum model. This surface is shown in Figure 2.

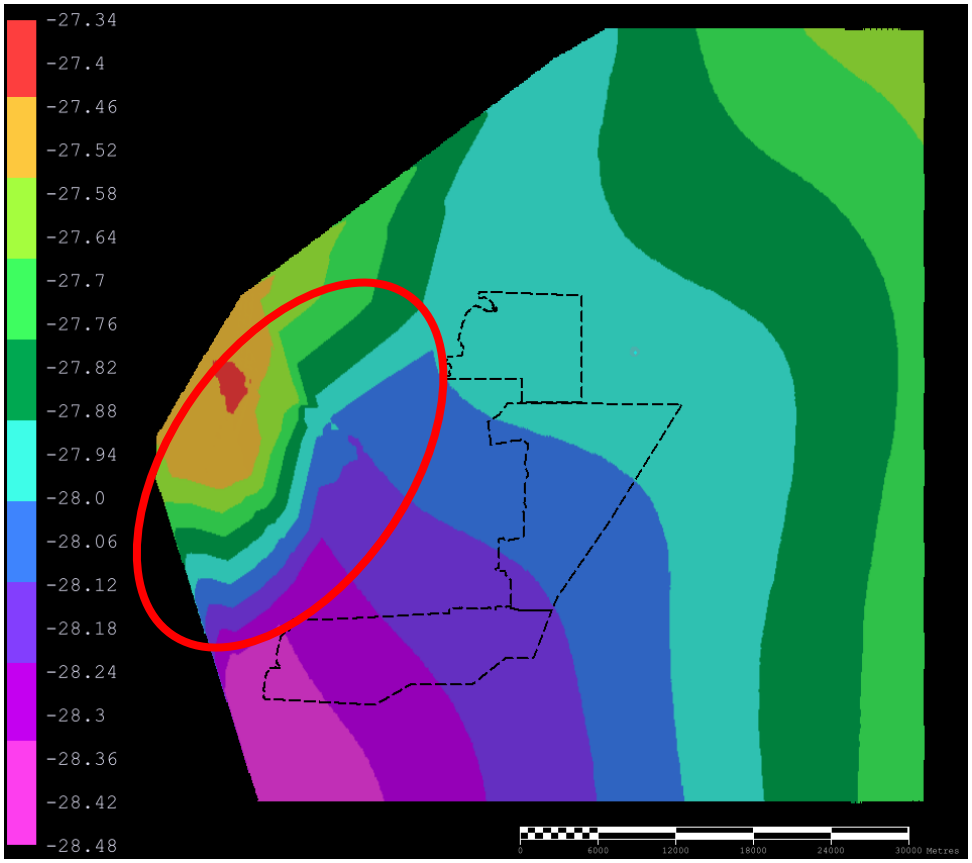


Figure 2. 2013_A321_VDatum_NAD83Ellip_MLLW.xyz separation model overlaid with H12613, H12614, and H12615 survey areas. Colored bands correspond to 11 cm intervals. The red oval encompasses a model artifact outside of the project area.

As illustrated in Figure 2, the separation model is free of gaps and anomalies within the surveys acquired in OPR-A321-FH-13 (black dashed outline). The discontinuity artifact in the VDatum model, (red circle) located west of the project area, is thought to be the junction of two VDatum models that falls outside the project limits and does not affect these results. Overall, the model appears adequate for use within the limits of project OPR-A321-FH-13.

In accordance with Appendix I of the Project Instructions, Pydro's Post Acquisition Tool utility was used to compare the nadir depths from data corrected with VDatum and zoned tides. As shown in Table 1, the average differences range from 0.063 to -0.090 meters. These differences may arise from many different sources including: poor vertical GPS solutions, poor zoning model, errors in dynamic draft values and loading errors.

XL Discrete - VDatum (PostAcq Tools)		
H12613		
Sonar	**Mean (m)**	**95% of nodes (m)**
Port 7125	0.063	+/-0.258
Stbd 7125	-0.065	+/-0.218
H12614		
7111	-0.031	+/-0.160
H12615		
7111	-0.090	+/-0.120

Table 1. Results of Pydro PostAcq Tools script run on OPR-A321-FH-13

Water depths within the boundaries of this comparison range from 10 to 88 meters. The total allowable vertical uncertainty in this depth range is between 0.51 and 1.25 meters at 95% confidence accounting for all errors. Of this total uncertainty, approximately 0.2 meters is budgeted for water level corrections.

- For survey H12613, the mean difference between discrete tides and VDatum is less than the allowed water level uncertainty, but the distribution at 95% confidence exceeds it. These results suggest that the methods have statistically significant differences for this survey.
- For surveys H12614 and H12615, differences between the two methods yield mean results and distributions less than this allowable water level uncertainty. The VDatum method is statistically indistinguishable from the accepted zoned tides approach.

Additional statistical analyses were performed with a difference surface (discrete tides minus VDatum). This surface was created to examine spatial trends in the data. The crossline surface for H12613 contains data from both port and starboard sonars. An image of the resulting surface overlaid on the VDatum model is shown in Figure 3. The crossline surface is displayed with a color range file. White indicates 'zero' (-0.01 to 0.01 m), blue displays divergence from zero (-0.01 to -0.2m and 0.01 to 0.2 m) and magenta is a further divergence from zero outside of the uncertainty budget for water level correction.

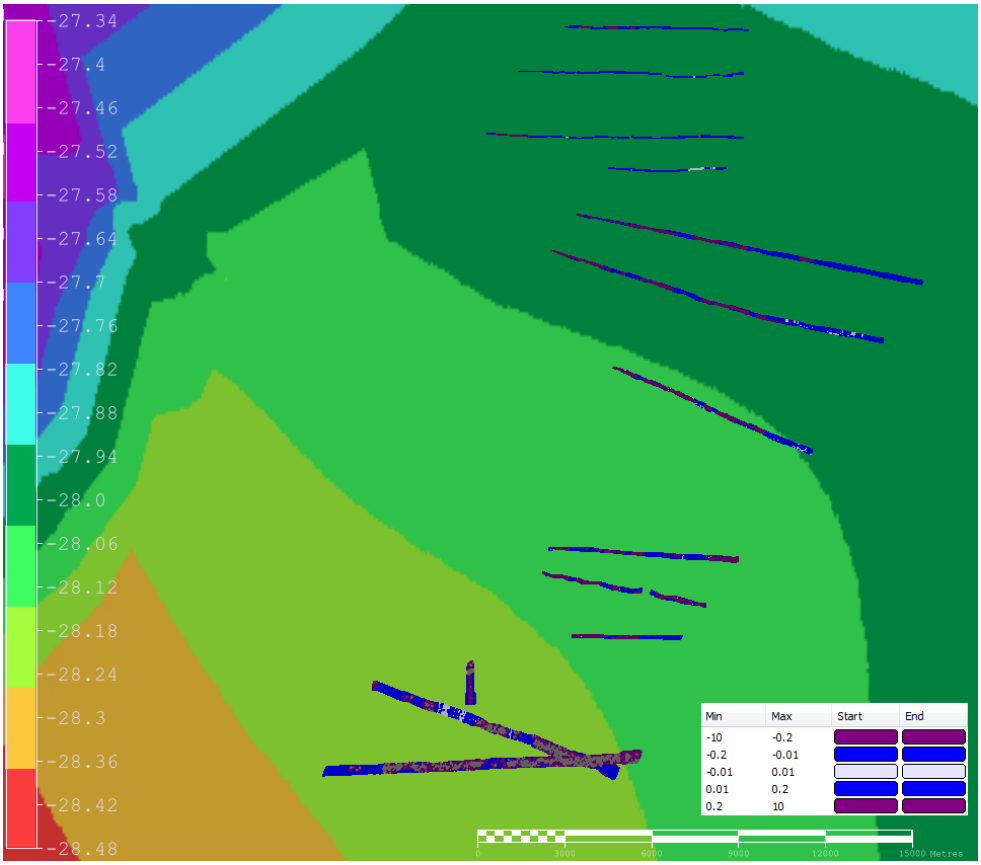


Figure 3. H12613 discrete minus VDatum crossline CUBE surface. VDatum separation model color legend is on the left and the crossline color range is defined in the bottom right corner.

Figures 4-6 display the statistical analyses of the differenced surface. 95% of differences for all sheets were less than +/-0.28 meters. The differenced surface for H12615 exhibits a bi-modal distribution with a mean of -0.09 meters (Figure 6). Tidal zoning, VDatum separation, and ship navigation were analyzed and do not correlate with any change in the differenced surface. The difference between the modes is less than the portion of uncertainty budget reserved for water level correctors. For the purposes of VDatum evaluation with respect to survey submittal, the bi-modal distribution was not investigated further.

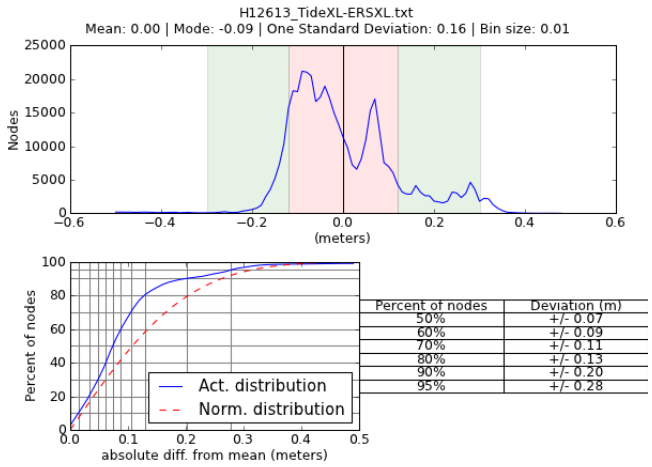


Figure 4. Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12613.

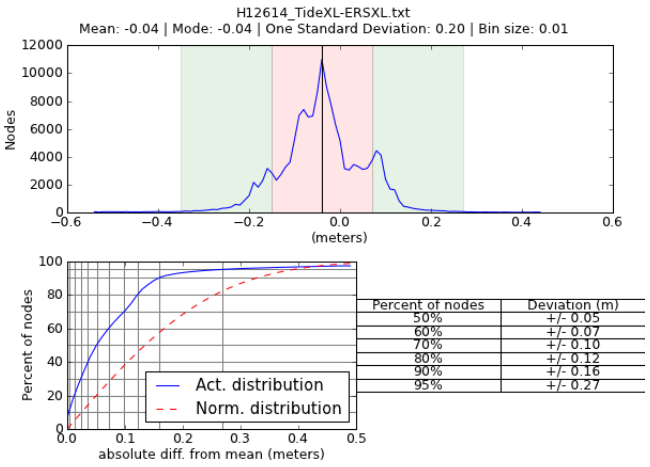


Figure 5. Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12614.

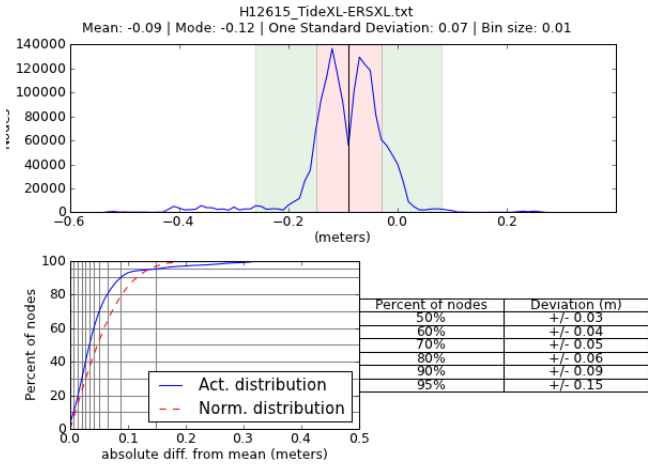
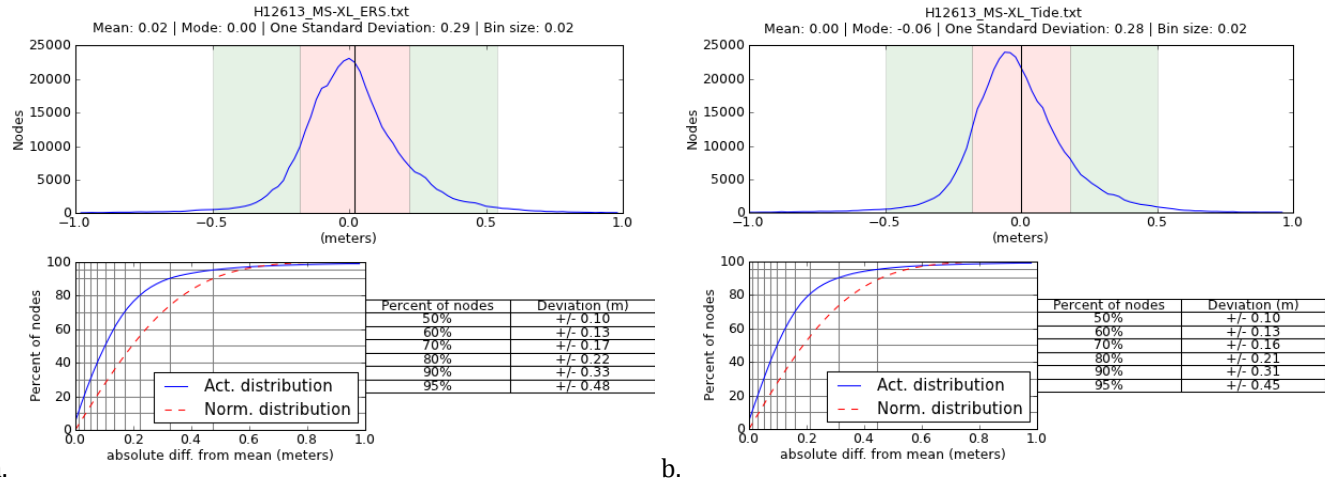


Figure 6. Statistics of the discrete zoned tide crossline surface minus the VDatum crossline surface for H12615.

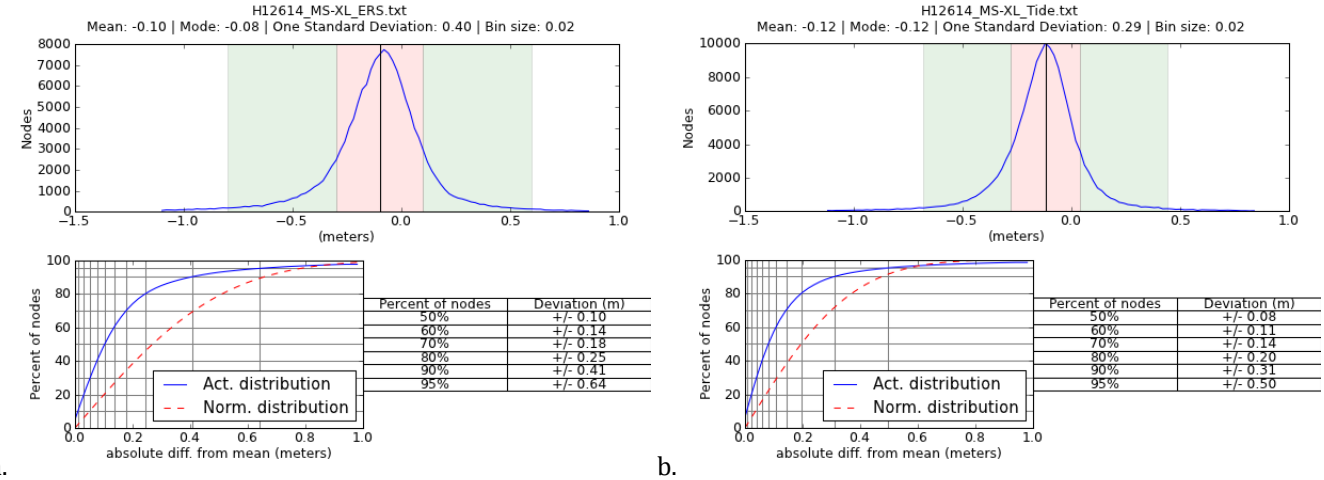
3.2 Data Internal Consistency

To analyze the internal consistency of ERS methods a crossline analysis was completed over the entire sheet for both discrete zoning and VDatum. The results of these differences are shown in Figures 7-9.



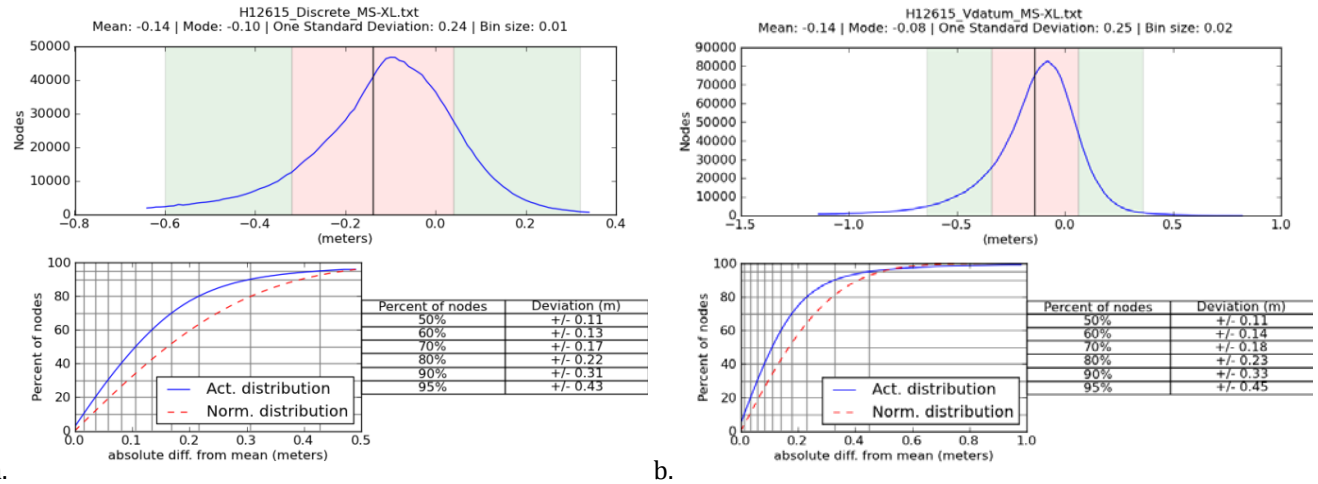
a. b.

Figure 7. Difference statistics for H12613 mainscheme/crossline analysis of data with discrete zoned tides applied (7a) and data with VDatum applied (7b).



a. b.

Figure 8. Difference statistics for H12614 mainscheme/crossline analysis of data with discrete zoned tides applied (8a) and data with VDatum applied (8b).



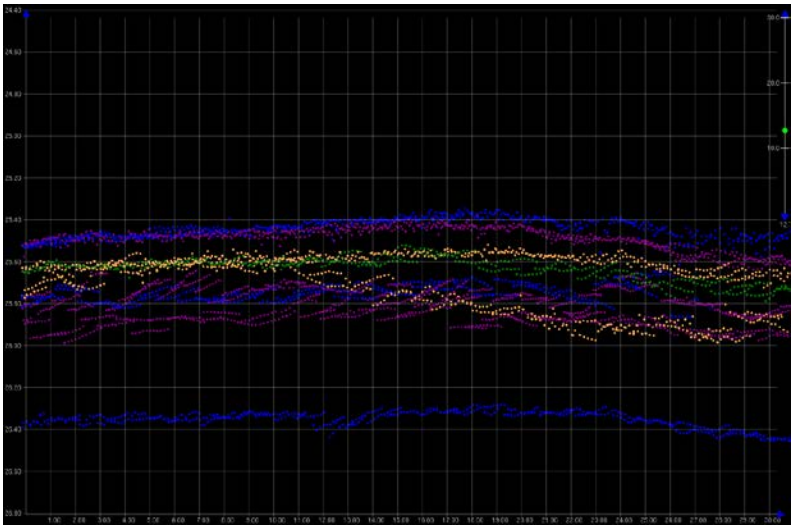
a. b.

Figure 9. Difference statistics for H12615 mainscheme/crossline analysis of data with discrete zoned tides applied (9a) and data with VDatum applied (9b).

The results show that discrete zoned tides have marginally better internal consistency of the data. As seen in Figures 7-9, mean values show a difference of up to 0.02 meters with a difference in standard deviation of up to 0.12 meters between tidal and VDatum reduced data. The largest differences were noticed on H12614, Figure 8.

Data reduced by VDatum within H12613 had vertical offsets ranging from 0.2 meters to 1 meter, shown in Figure 10. When reduced by discrete zoned tides, the same data shows agreement. To isolate whether differences are a result of VDatum or of poor smoothed best estimate and trajectory (SBET) solutions, data from H12613 was referenced to the ellipsoid. The same offsets were noticed with the data referenced to the ellipsoid that were noticed when the data was reduced to MLLW. This indicates that discrepancies between data reduced by discrete zoned tides and VDatum are likely due to SBET solutions and may not be a result of the VDatum separation model of the area.

a.



b.

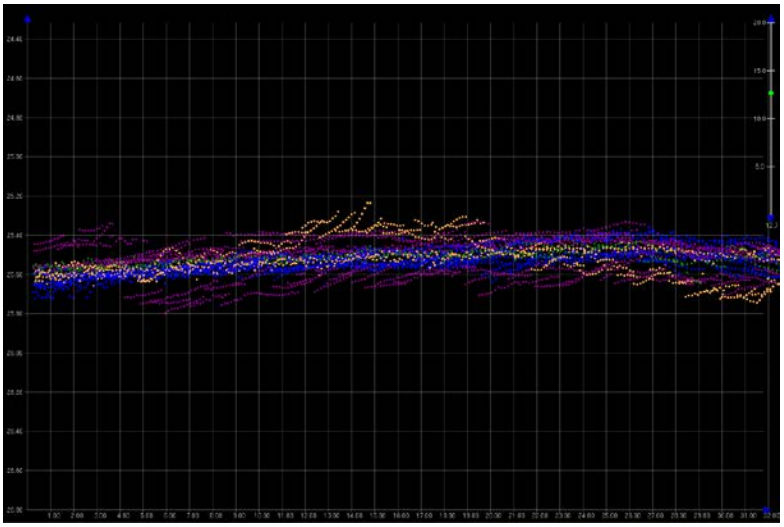


Figure 10. Vertical offsets in H12613 data reduced by VDatum (10a). The same subset of data reduced by discrete tides (10b).

4.0 Discussion

Comparison between discrete tides and VDatum indicate that the VDatum model for this area accurately reduces the data to mean lower low water (MLLW). In addition, the quality of internal consistency for VDatum is equivalent to discrete zoned tides. We believe the VDatum model for this area to be accurate.

Post-processed solutions were not consistently accurate for the entirety of OPR-A321-FH-13. After SBET application, several lines exhibited unrealistic vertical offsets during periods of low positional accuracy.

ERS reduced by VDatum eliminates several sources of vertical errors that can be attributed to traditional tide models and ship water line estimators, such as dynamic draft. An ERS approach is therefore desired when possible. However, ERS and VDatum require good position solutions to be effective. If a sheet contains excessive poor post-processed position solutions, it will be necessary to reduce with discrete zoned tides. As such, the application of VDatum should be performed on a sheet by sheet basis.

5.0 Recommendation

For surveys H12614 and H12615, the comparison between VDatum and discrete zoning is within the acceptable range of uncertainty. Isolated areas of poor post-processed position data, which otherwise meet ERS criteria, will need to be corrected with discrete zoned tides. While internal consistency was better with data reduced by zoned tides, the differences are marginal and it is recommended to apply the VDatum model (Table 2).

In the case of H12613, poor post-processed position data were prevalent, thus ERS is not a valid solution. It is recommended that discrete zoned tides be used to reduce data within the sheet limits of H12613.

Sheet	Recommended Method	Reason
H12613	Discrete Zoned	Poor SBETS creating vertical offsets
H12614	VDatum	Good solutions, statistical agreement
H12615	VDatum	Good solutions, statistical agreement

Table 2. Recommended method to reduce data submitted from OPR-A321-FH-13 to MLLW

We recommend this VDatum model be considered for use with future surveys in the area, provided position solutions are accurate.

APPENDIX III

FEATURES REPORT

(NO AWOIS ITEMS, DTONS, WRECKS, OR MARITIME BOUNDARIES)

APPROVAL PAGE

H12614

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 NGDC for archive

- H12614_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12614_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: 

Lieutenant Matthew Jaskoski, NOAA
Chief, Atlantic Hydrographic Branch