H12898

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12898

LOCALITY

State(s):	Alaska
General Locality:	South Coast of Kodiak Island
Sub-locality:	South of Cape Kaguyak

2016

CHIEF OF PARTY
CDR Mark Van Waes, NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12898**

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):	**Alaska**
General Locality:	**South Coast of Kodiak Island**
Sub-Locality:	**South of Cape Kaguyak**
Scale:	**40000**
Dates of Survey:	**06/24/2016 to 07/30/2016**
Instructions Dated:	**06/13/2016**
Project Number:	**OPR-P335-FA-16**
Field Unit:	**NOAA Ship *Fairweather***
Chief of Party:	**CDR Mark Van Waes, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Side Scan Sonar**
Verification by:	**Pacific 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 Centers for Environmental Information (NCEI) and can be retrieved via http://www.ncei.noaa.gov/.

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Descriptive Report to Accompany Survey H12898

Project: OPR-P335-FA-16

Locality: South Coast of Kodiak Island

Sublocality: South of Cape Kaguyak

Scale: 1:40000

June 2016 - July 2016

NOAA Ship *Fairweather*

Chief of Party: CDR Mark Van Waes, NOAA

A. Area Surveyed

The survey area is located on the Southern Coast of Kodiak Island within the sublocality of Southern Cape Kaguyak.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
56° 54' 47.31" N 153° 46' 29.21" W	56° 44' 52.09" N 153° 26' 18.37" W

Table 1: Survey Limits

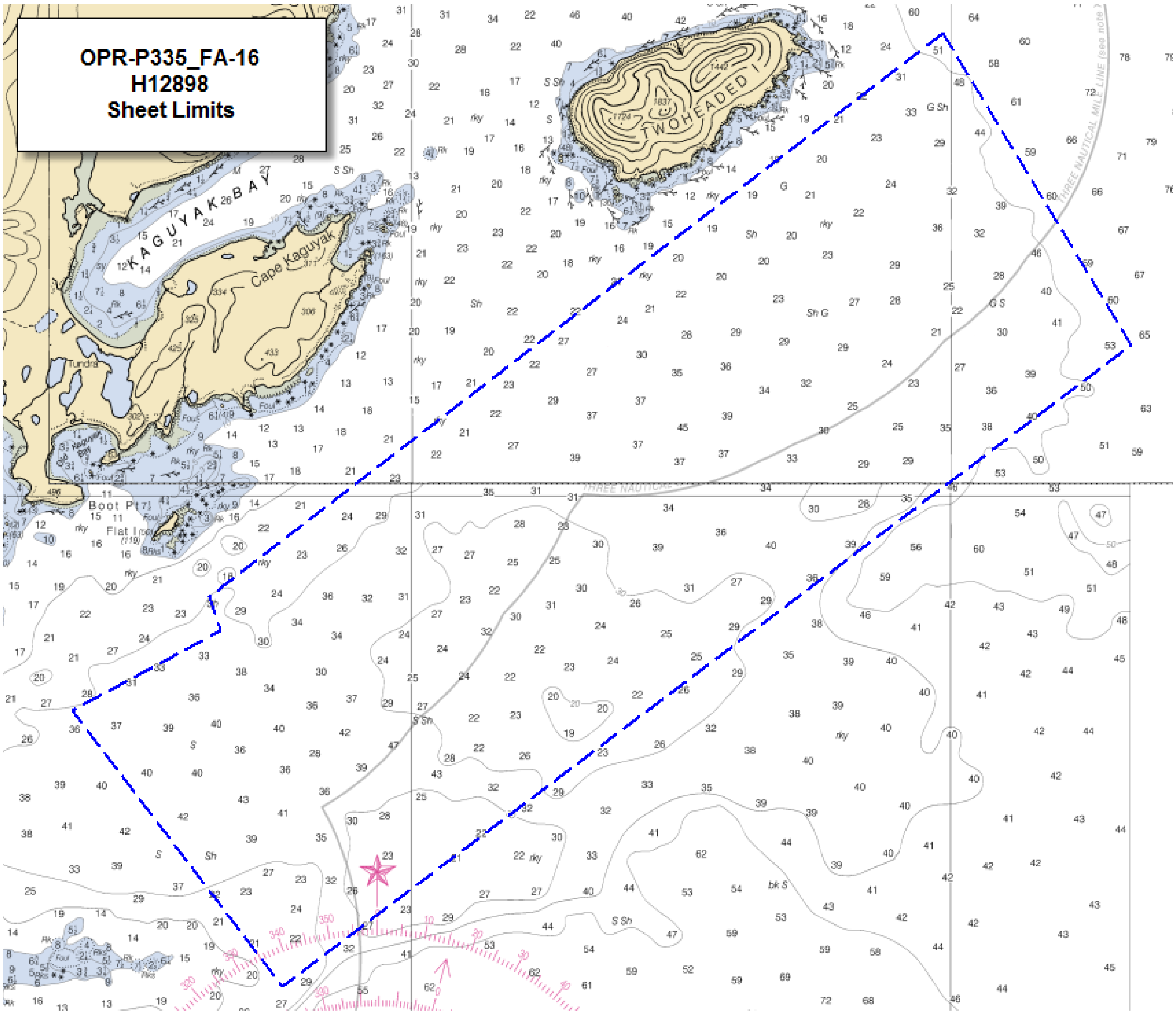


Figure 1: H12898 Sheet Limits (in blue) overlaid onto Charts 16590 and 16592.

Survey limits were acquired in accordance with the requirements in the Project Instructions and the HSSD.

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. Survey area will address 43 square nautical miles of navigationally significant water. This survey will also support seismic research for tsunami risk analysis by United States Geological Survey (USGS) and Alaska Department of Fish and Game (ADF&G).

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H12898 meet multibeam echo sounder (MBES) coverage requirements for complete coverage, as required by the HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty (see Section B.2.10), and density requirements (see Section B.2.11). Additional compliance statistics can be found in the Standards and Compliance Review located in Appendix II of this report.

A.4 Survey Coverage

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

Water Depth	Coverage Required
Greater than 8 meters water depth	Complete Coverage MBES with Backscatter. Refer to HSSD Section 5.2.2.3.

The entirety of H12898 was acquired with complete coverage MBES depth and Backscatter data meeting the requirements listed above and in the HSSD, see Figure 2 for an overview of coverage.

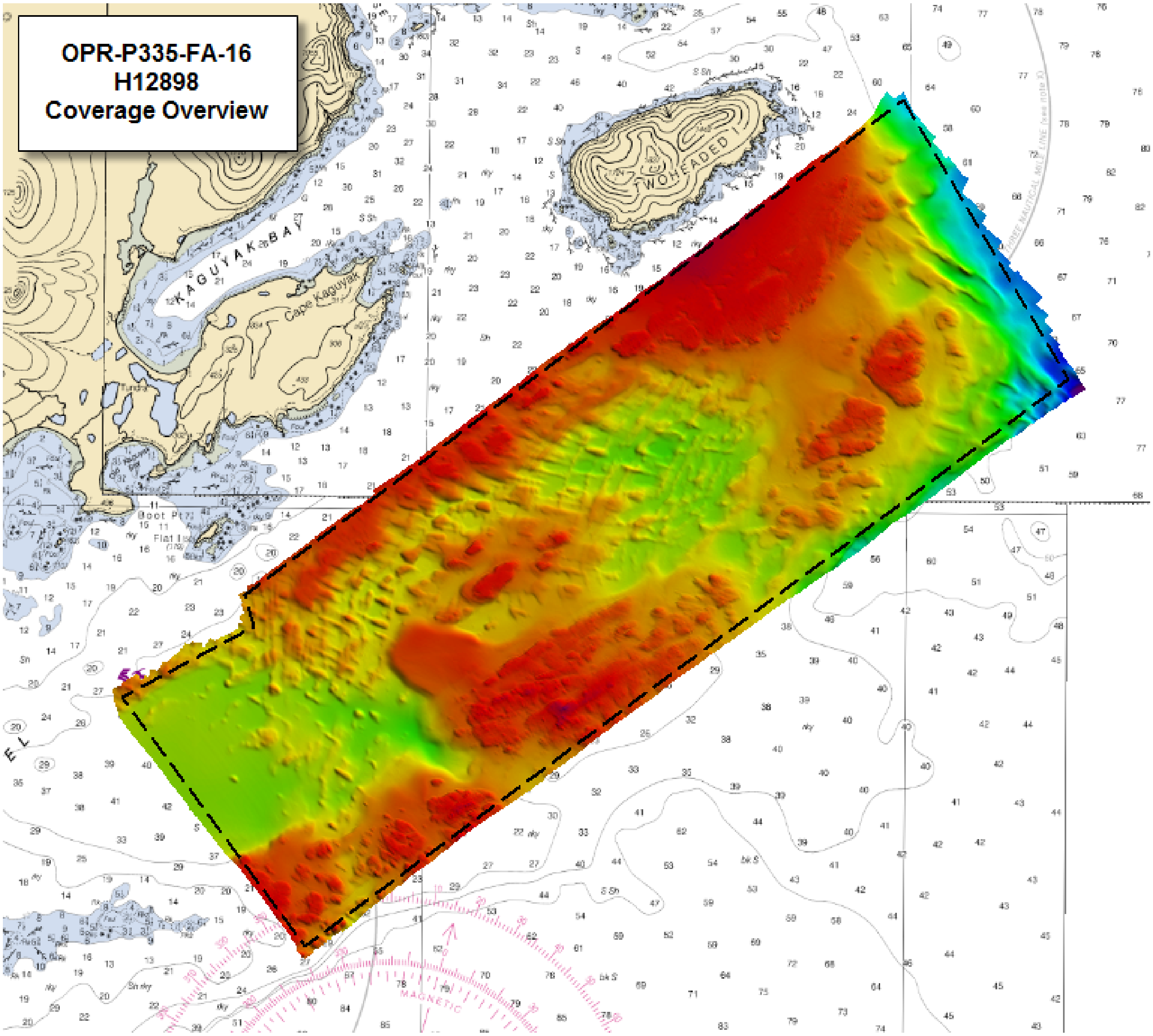


Figure 2: H12898 survey coverage (8m surface) overlaid onto Charts 16590 and 16592 with 5x vertical exaggeration.

A.5 Survey Statistics

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

	HULL ID	*S220*	*2805*	*Total*
LNM	SBES Mainscheme	0	0	0
	MBES Mainscheme	496.07	10.34	506.41
	Lidar Mainscheme	0	0	0
	SSS Mainscheme	0	0	0
	SBES/SSS Mainscheme	0	0	0
	MBES/SSS Mainscheme	0	0	0
	SBES/MBES Crosslines	15.42	14.50	29.92
	Lidar Crosslines	0	0	0
Number of Bottom Samples				4
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				42.81

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/24/2016	176
06/25/2016	177

Survey Dates	Day of the Year
07/06/2016	188
07/07/2016	189
07/10/2016	192
07/11/2016	193
07/14/2016	196
07/15/2016	197
07/16/2016	198
07/17/2016	199
07/18/2016	200
07/19/2016	201
07/20/2016	202
07/21/2016	203
07/28/2016	210
07/29/2016	211
07/30/2016	212
07/31/2016	213

Table 3: Dates of Hydrography

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	***S220***	***2805***
LOA	70.40 meters	8.64 meters
Draft	4.88 meters	1.12 meters

Table 4: Vessels Used

B.1.2 Equipment

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

Manufacturer	**Model**	**Type**
Kongsberg	EM710	MBES
RESON	7125	MBES
Applanix	POS/MV	Positioning and Attitude System
Seabird	SBE 19Plus	Conductivity, Temperature, and Depth Sensor
Rolls Royce	MVP 200	Conductivity, Temperature, and Depth Sensor
RESON	SVP70	Sound Speed System
RESON	SVP71	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines acquired for this survey totaled 5.91% of mainscheme acquisition.

Crosslines were collected, processed and compared in accordance with section 5.2.4.3 of the HSSD. To evaluate crosslines, an 8 meter CUBE surface using strictly mainscheme lines, and an 8 meter CUBE surface using strictly crosslines were created. From these two surfaces, a difference surface (mainscheme - crosslines = difference surface) was generated at an 8 meter resolution (see Figure 3) and is submitted in the Separates II Digital Data folder. Statistics show the mean difference between the depths derived from mainscheme and crosslines was -0.02 meters (mainscheme being shoaler) with a 95% of nodes falling within +/- 0.27 meters (Figure 4). For the respective depths, the difference surface was compared to the allowable NOAA accuracy standards (Figure 5). In total, 99.93% of the depth differences between H12898 mainscheme and crossline data are within allowable NOAA uncertainties (Figure 6).

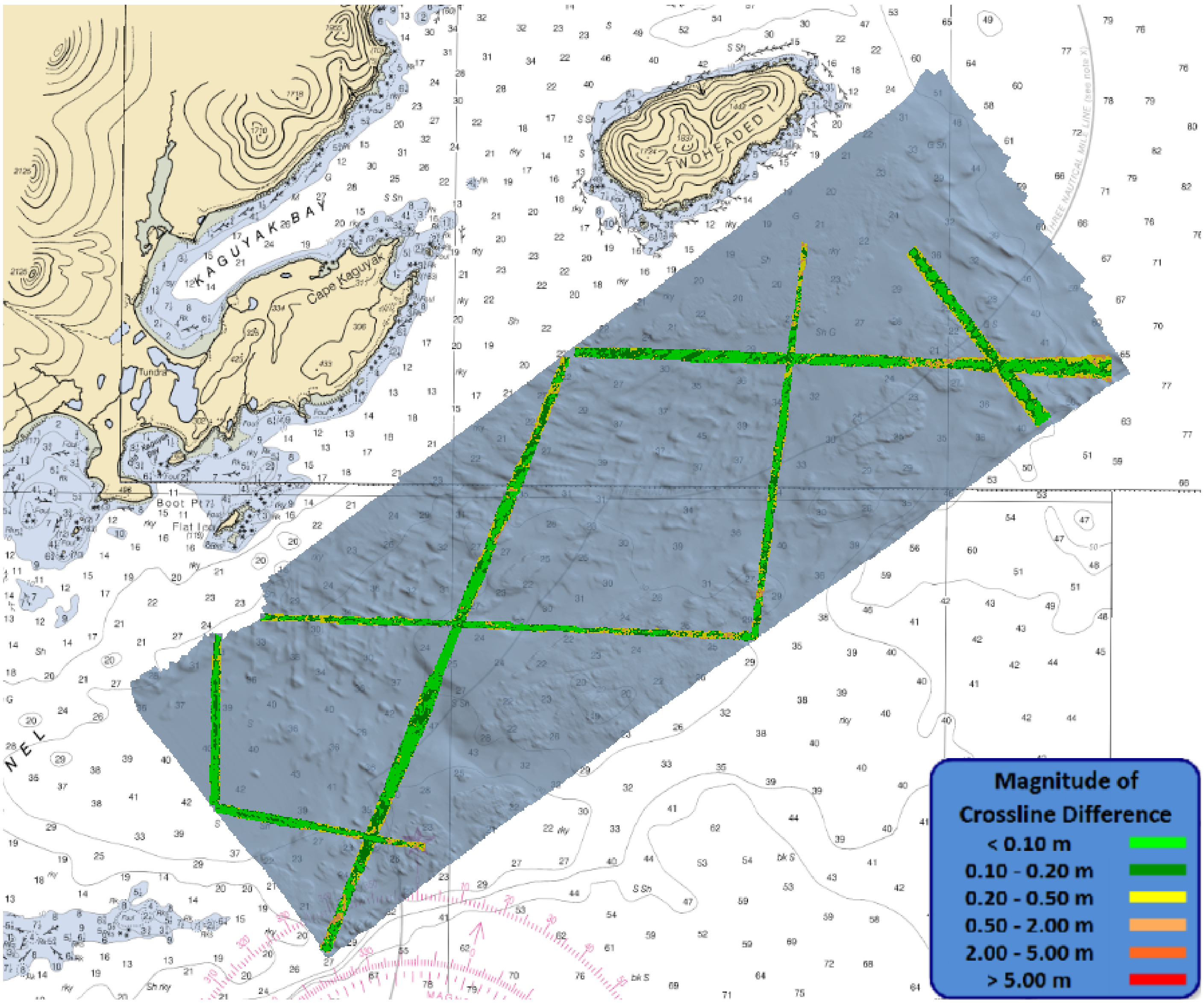
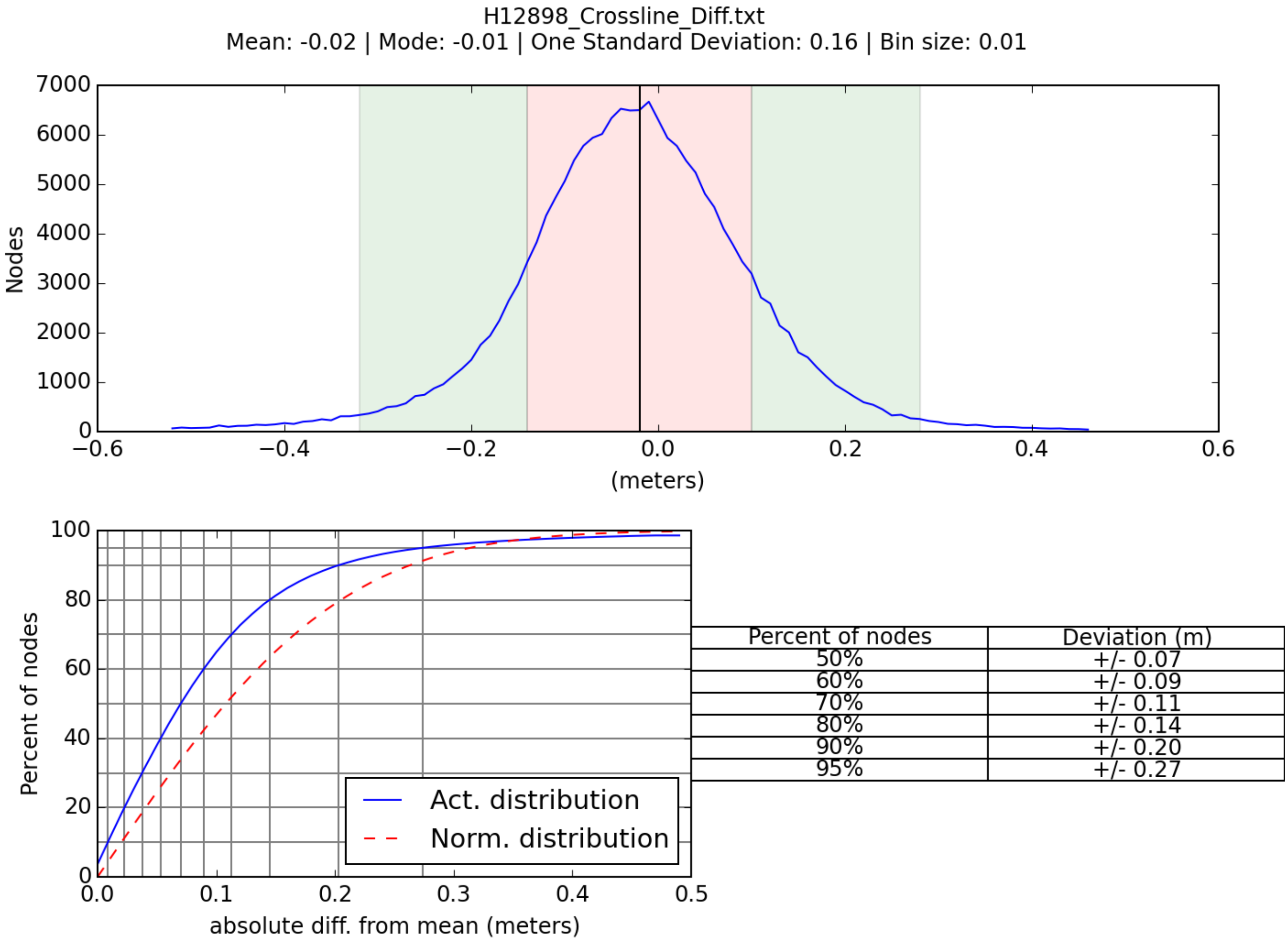


Figure 3: Overview of H12898 crosslines.



Percent of nodes	Deviation (m)
50%	+/- 0.07
60%	+/- 0.09
70%	+/- 0.11
80%	+/- 0.14
90%	+/- 0.20
95%	+/- 0.27

Figure 4: H12898 crossline and mainscheme difference statistics.

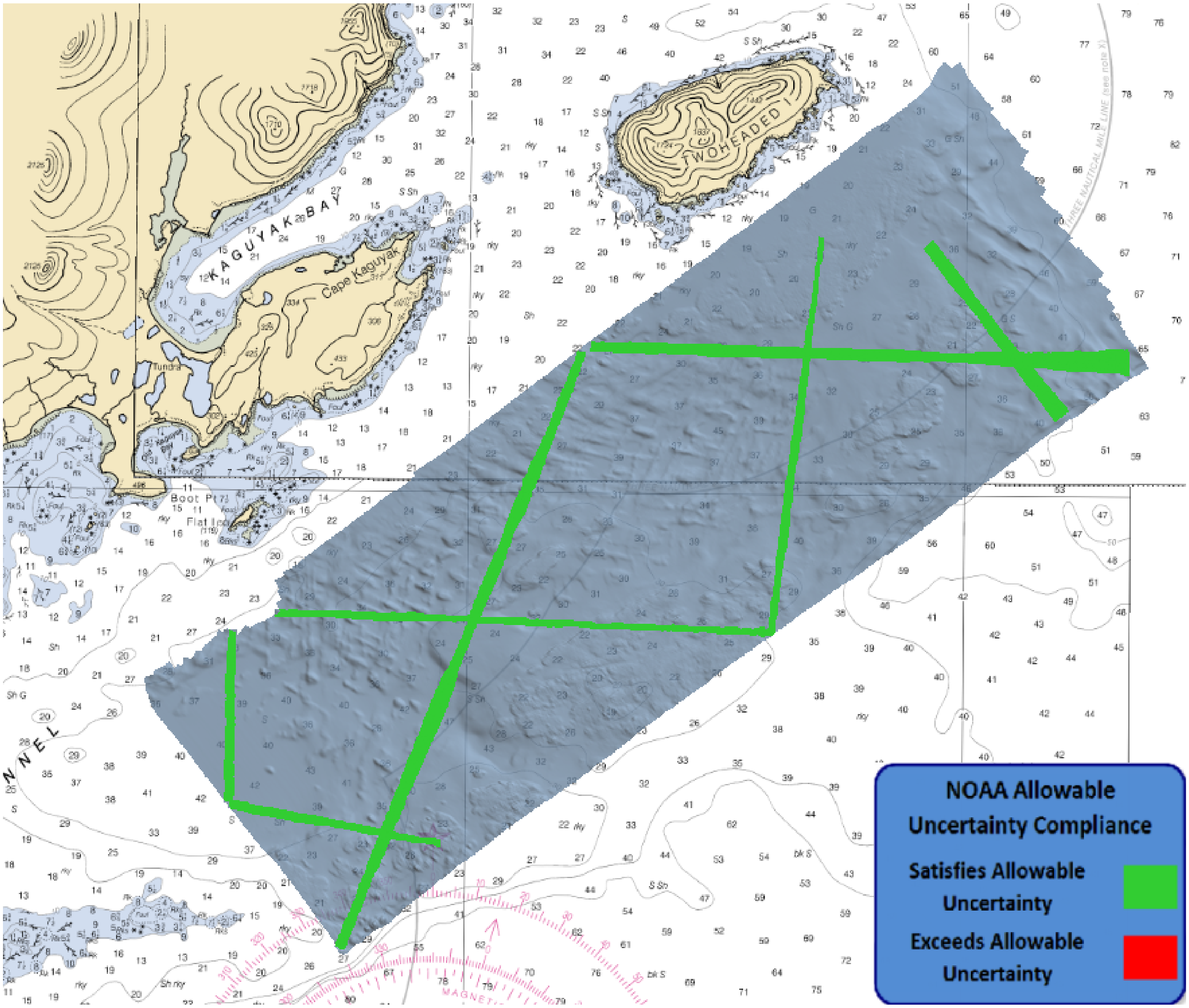


Figure 5: Depth differences between H12898 mainscheme and crossline data as compared to NOAA allowable uncertainty standards for the associated depths.

H12898 Crossline Differencing NOAA Allowable Uncertainty		
Total Nodes	Passed Nodes	Failed Nodes
178548	178427	121
Percentage Nodes Passed: 99.93%		
Percentage Nodes Failed: 0.07%		

Figure 6: H12898 crossline surface statistics showing percentage of nodes meeting NOAA allowable uncertainty.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Measured	Zoning	Method
0 meters	0 meters	TCARI
0 meters	0.02 meters	ERS via PMVD

Table 6: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
2805	2 meters/second	N/A meters/second	0.5 meters/second
S220	N/A meters/second	1 meters/second	0.5 meters/second

Table 7: Survey Specific Sound Speed TPU Values.

Real-time uncertainties were provided via EM710 and Reson 7125 MBES data, Applanix Delayed Heave RMS, and TCARI tides. Following post-processing of vessel motion, real-time uncertainties of vessel roll, pitch, gyro and navigation are applied in CARIS HIPS and SIPS via an Smoothed Best Estimate of Trajectory (SBET) RMS file generated in Applanix POSPac.

B.2.3 Junctions

H12898 junctions with two adjacent surveys from this project, H12897, H12910, and one survey from a prior project, H12686, as shown in Figure 7. Data overlap between H12898 and each adjacent survey was achieved. These areas of overlap between surveys were reviewed in CARIS HIPS and SIPS by surface differencing (at equal resolutions) to assess surface agreement. The multibeam data were also examined in CARIS Subset Editor for consistency and agreement. The junctions with H12898 are within the NOAA allowable uncertainty in their areas of overlap. For all junctions with H12898, a negative difference indicates H12898 was shoaler, and a positive difference indicates H12898 was deeper.

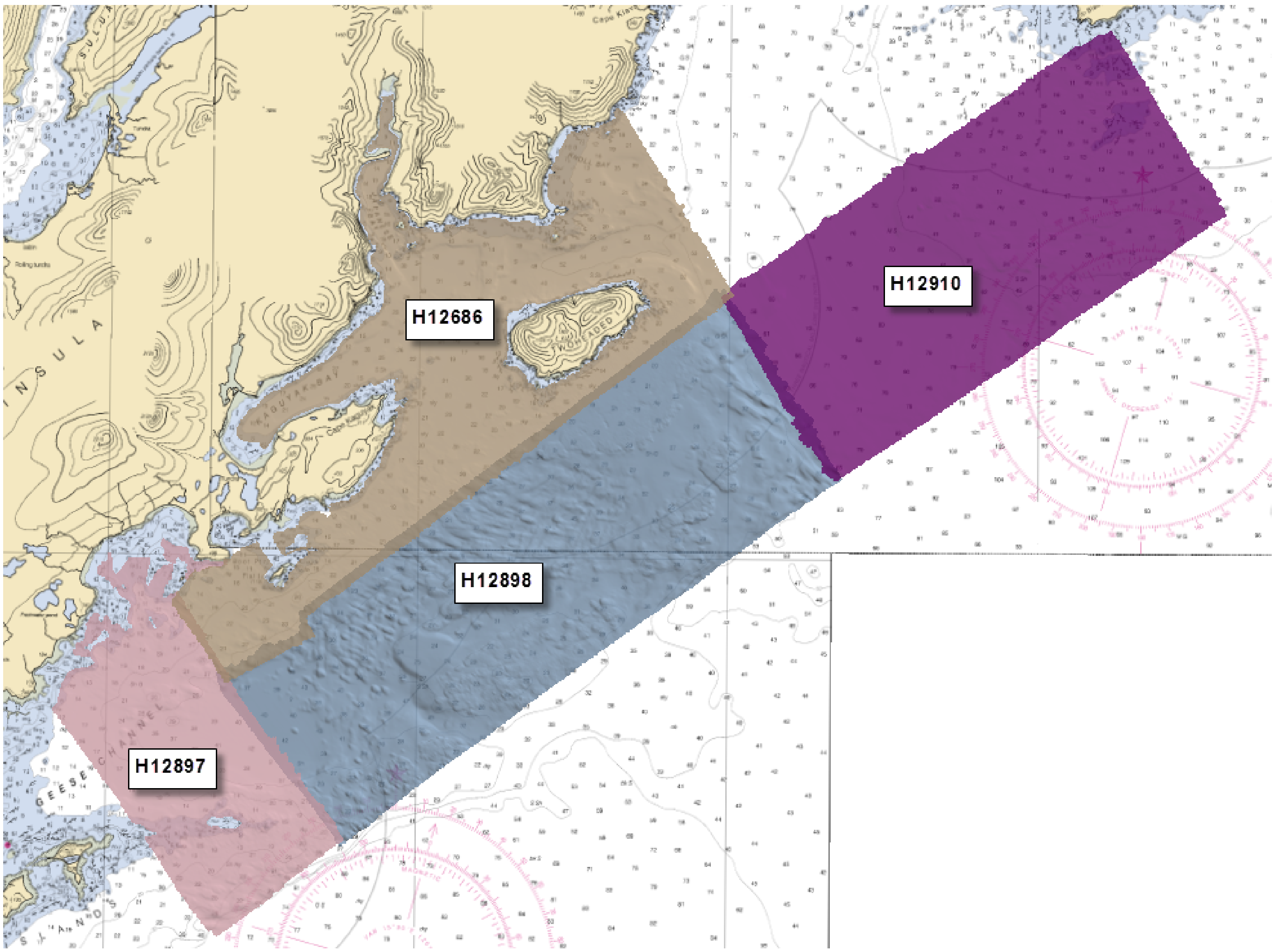


Figure 7: Overview of H12898 junction surveys.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H12897	1:40000	2016	NOAA Ship FAIRWEATHER	SW
H12686	1:40000	2014	NOAA Ship FAIRWEATHER	N
H12910	1:40000	2016	NOAA Ship FAIRWEATHER	NE

Table 8: Junctioning Surveys

H12897

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12898 and the 8 meter combined surface from H12897. The statistical analysis of the difference surface shows a mean of -0.02 meters with 95% of all nodes having a maximum deviation of +/- 0.23 meters, as seen in Figure 9. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 10). It was found that 99.95% of nodes are within NOAA allowable uncertainty (Figure 11).

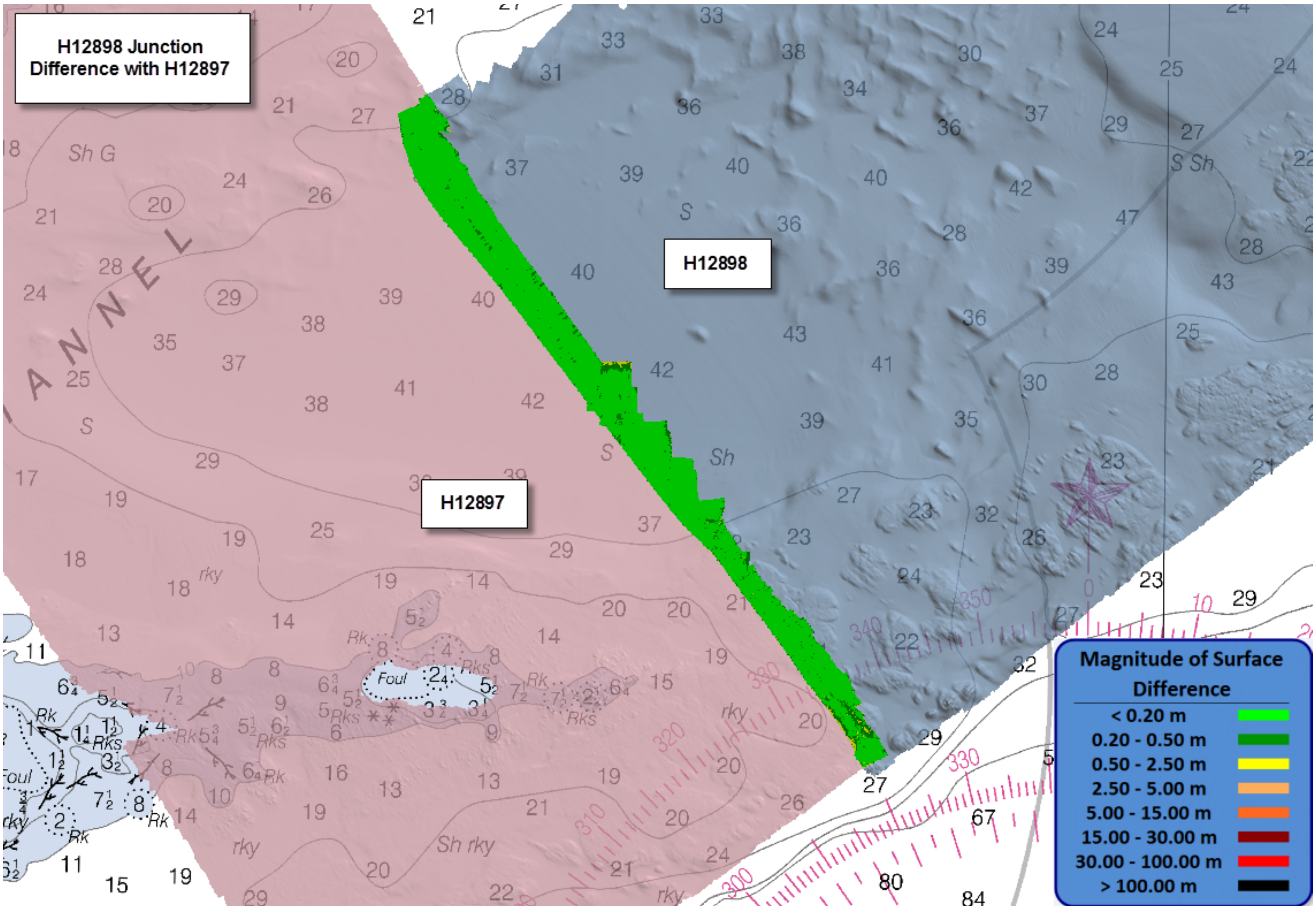
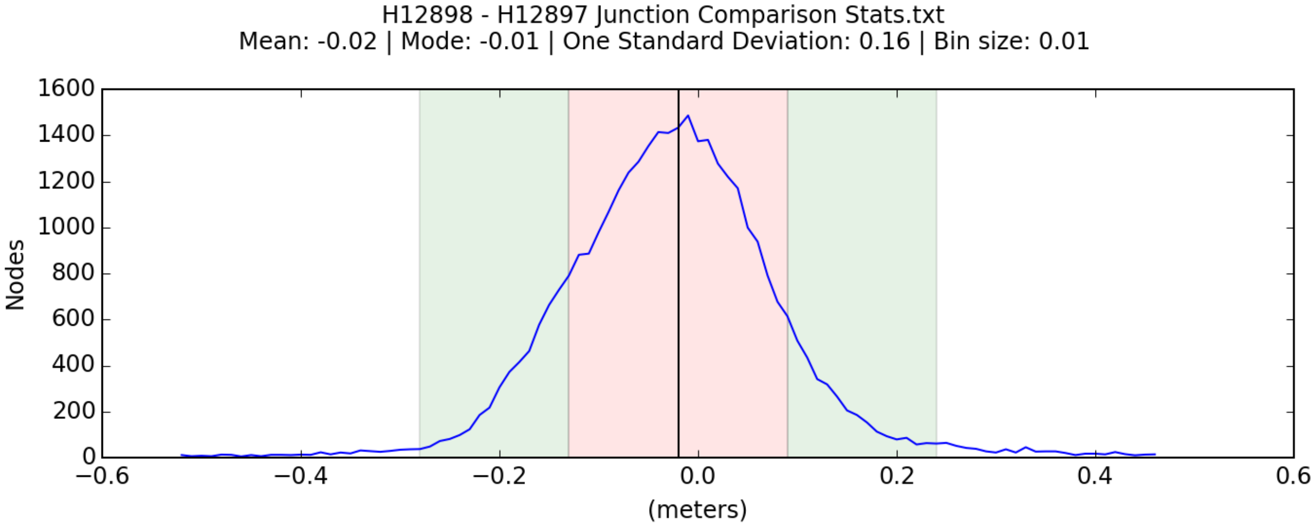
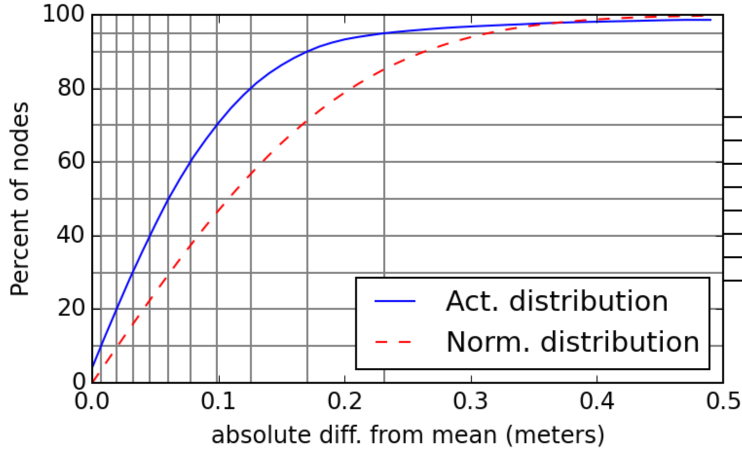


Figure 8: Difference surface between H12898 and junctioning survey H12897.





Percent of nodes	Deviation (m)
50%	+/- 0.06
60%	+/- 0.08
70%	+/- 0.10
80%	+/- 0.13
90%	+/- 0.17
95%	+/- 0.23

Figure 9: Difference surface statistics between H12898 and H12897 (8 meter surface).

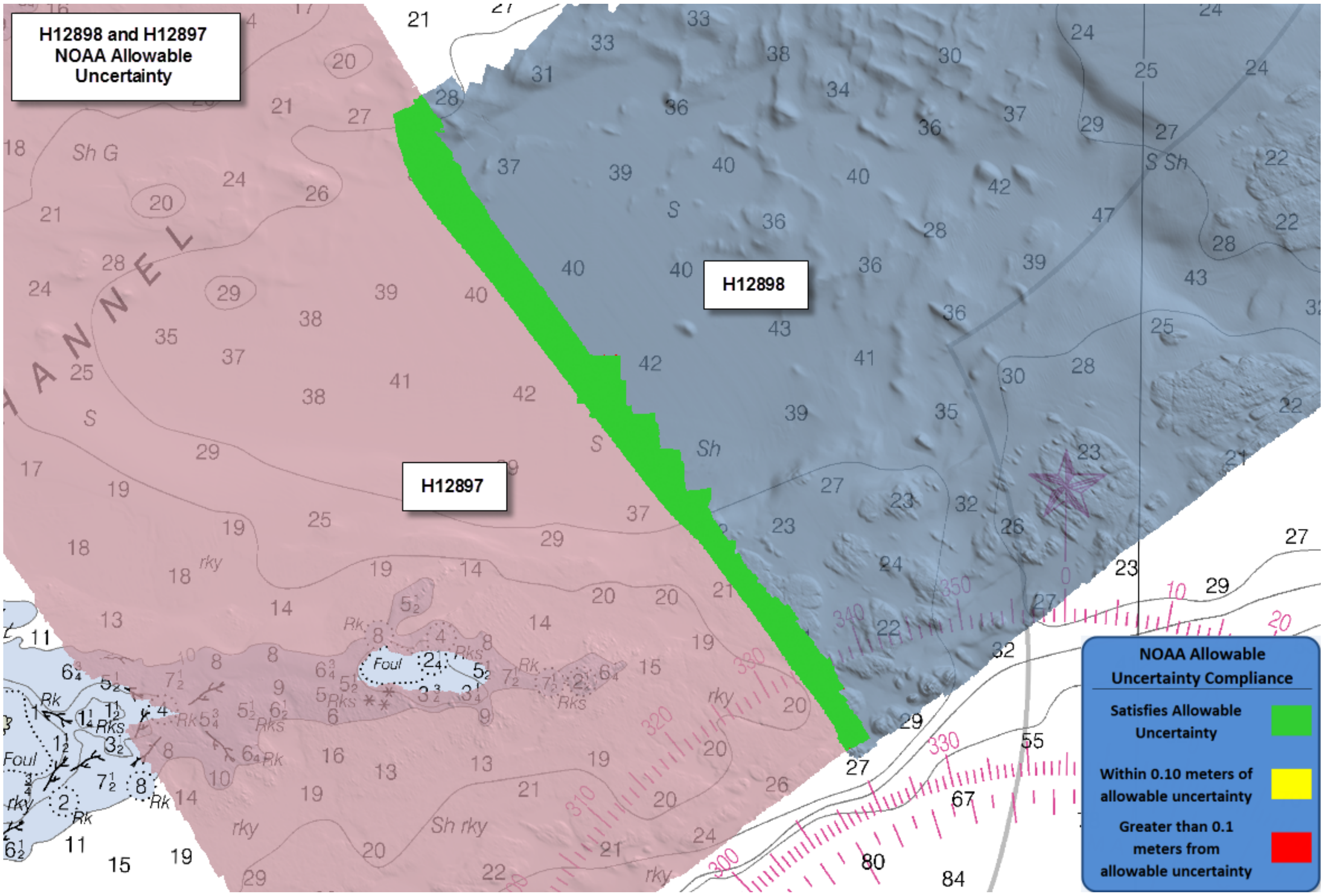


Figure 10: Difference surface compliance with regard to NOAA allowable uncertainty between H12898 and junctioning survey H12897.

H12898 H12897 Differencing NOAA Allowable Uncertainty

Total Nodes	Passed Nodes	Failed Nodes
34583	34566	17
Percentage Nodes Passed: 99.95%		
Percentage Nodes Failed: 0.05%		

Figure 11: H12898 junction with H12897 NOAA allowable uncertainty statistics.

<u>H12686</u>

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12898 and the 8 meter combined surface from H12686. The statistical analysis of the difference surface shows a mean of -0.11 meters with 95% of all nodes having a maximum deviation of +/- 0.30 meters, as seen in Figure 13. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 14). It was found that 99.95% of nodes are within NOAA allowable uncertainty (Figure 15).

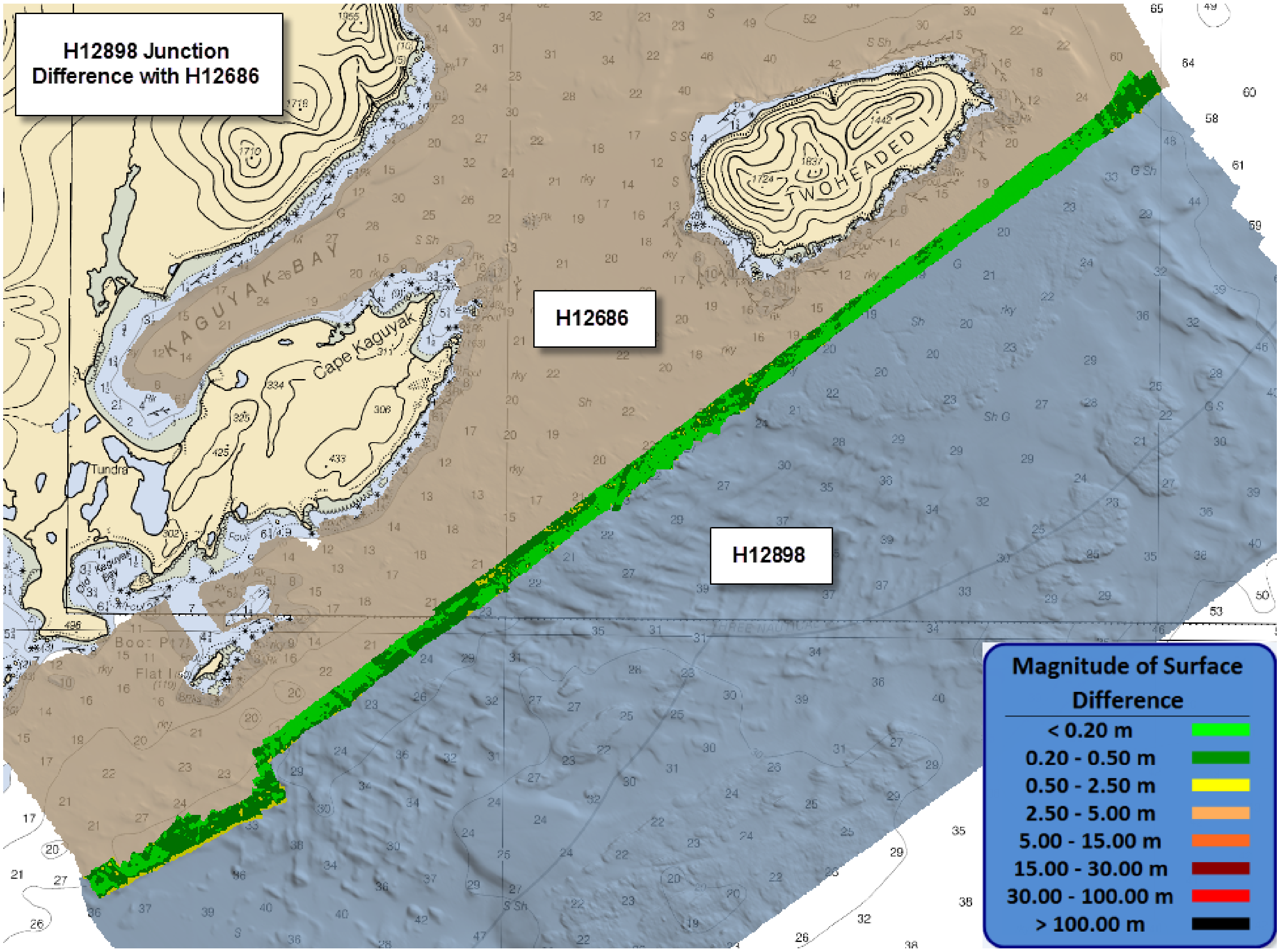
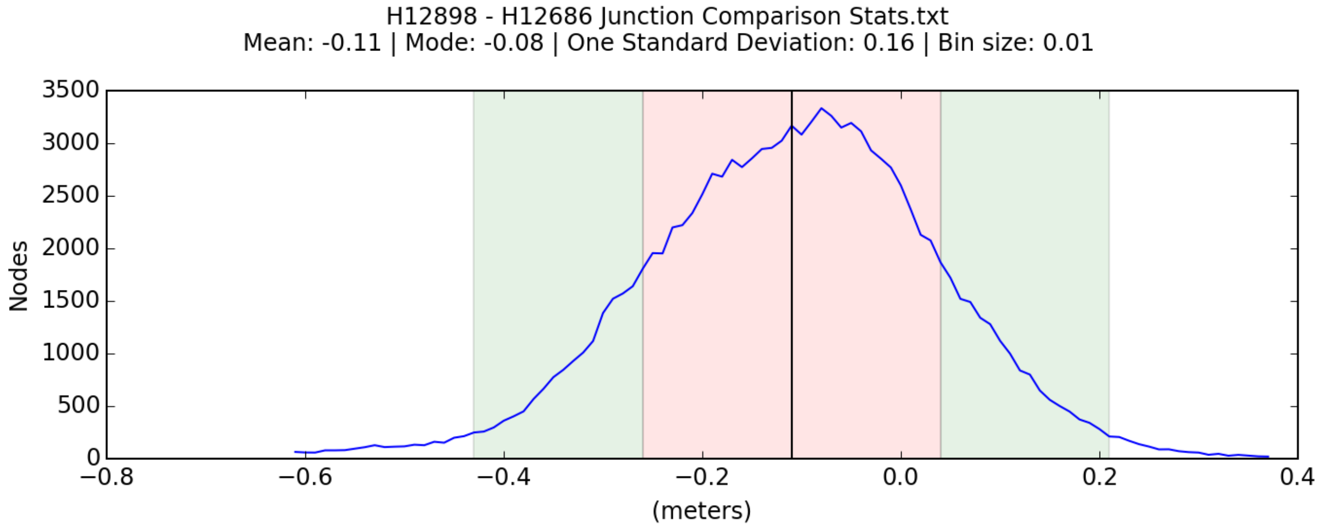
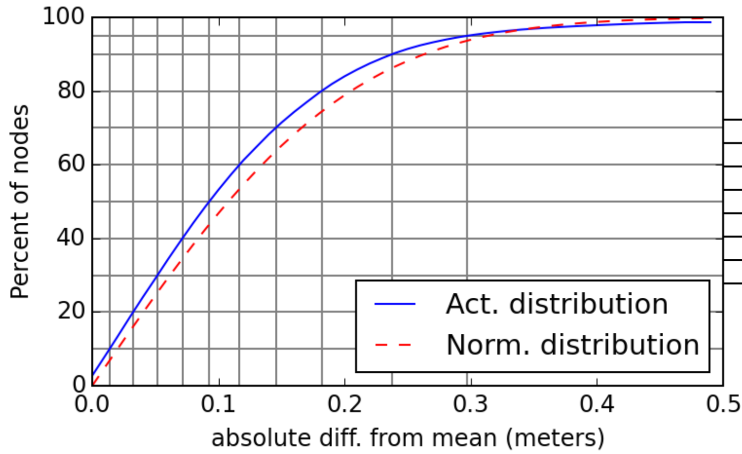


Figure 12: Difference surface between H12898 and junctioning survey H12686.





Percent of nodes	Deviation (m)
50%	+/- 0.09
60%	+/- 0.12
70%	+/- 0.15
80%	+/- 0.18
90%	+/- 0.24
95%	+/- 0.30

Figure 13: Difference surface statistics between H12898 and H12686 (8 meter surface).

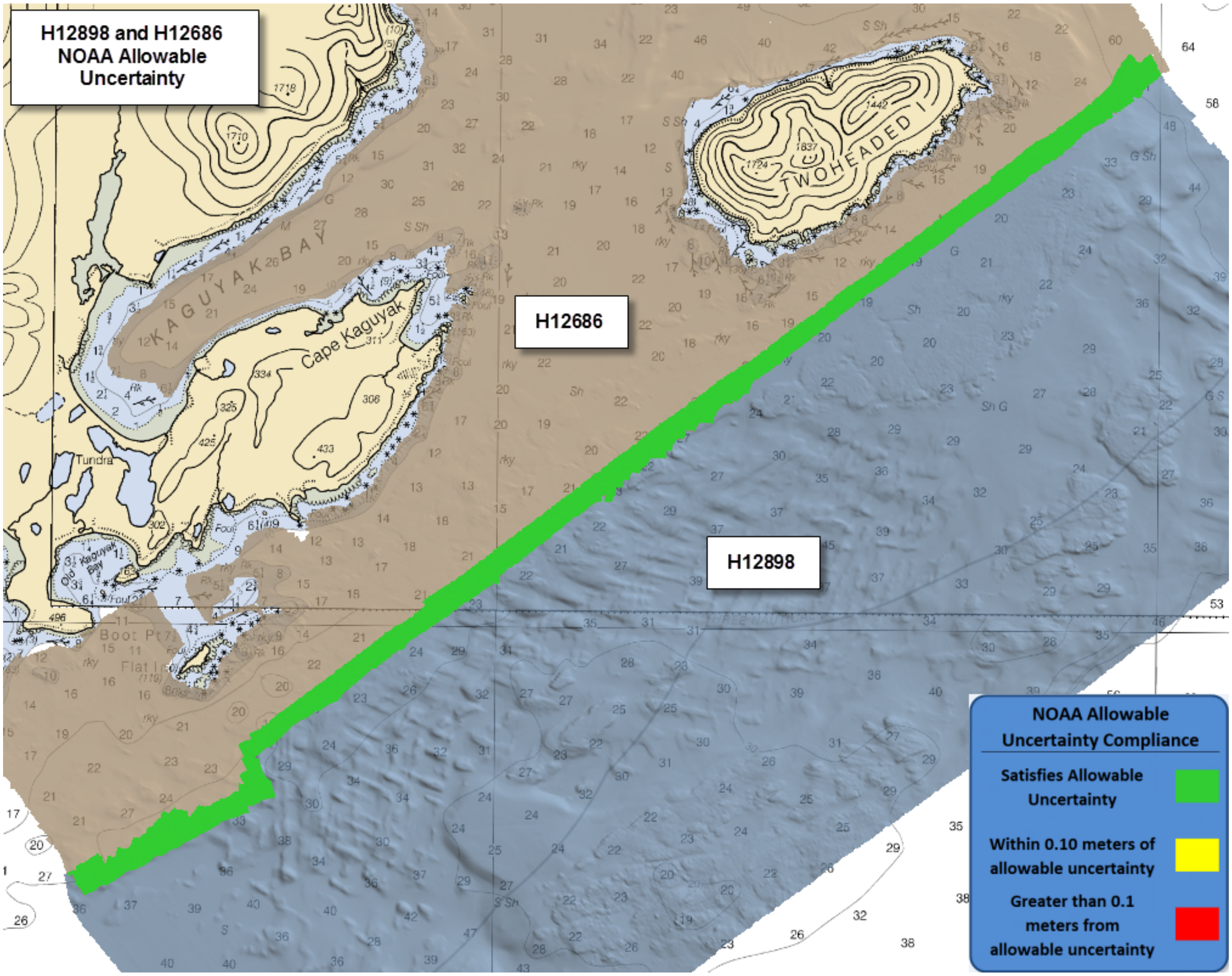


Figure 14: Difference surface compliance with regard to NOAA allowable uncertainty between H12898 and junctioning survey H12686.

H12898 H12686 Differencing NOAA Allowable Uncertainty

Total Nodes	Passed Nodes	Failed Nodes
34583	34566	17
Percentage Nodes Passed: 99.95%		
Percentage Nodes Failed: 0.05%		

Figure 15: H12898 junction with H12686 NOAA allowable uncertainty statistics.

H12910

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the 8 meter combined surface from H12898 and the 8 meter combined surface from H12910. The statistical analysis of the difference surface shows a mean of 0.22 meters with 95% of all nodes having a maximum deviation of +/- 0.38 meters, as seen in Figure 17. In addition, a comparison surface was created between the difference surface and the NOAA allowable uncertainty (See Figure 18). It was found that 100.00% of nodes are within NOAA allowable uncertainty (Figure 19).

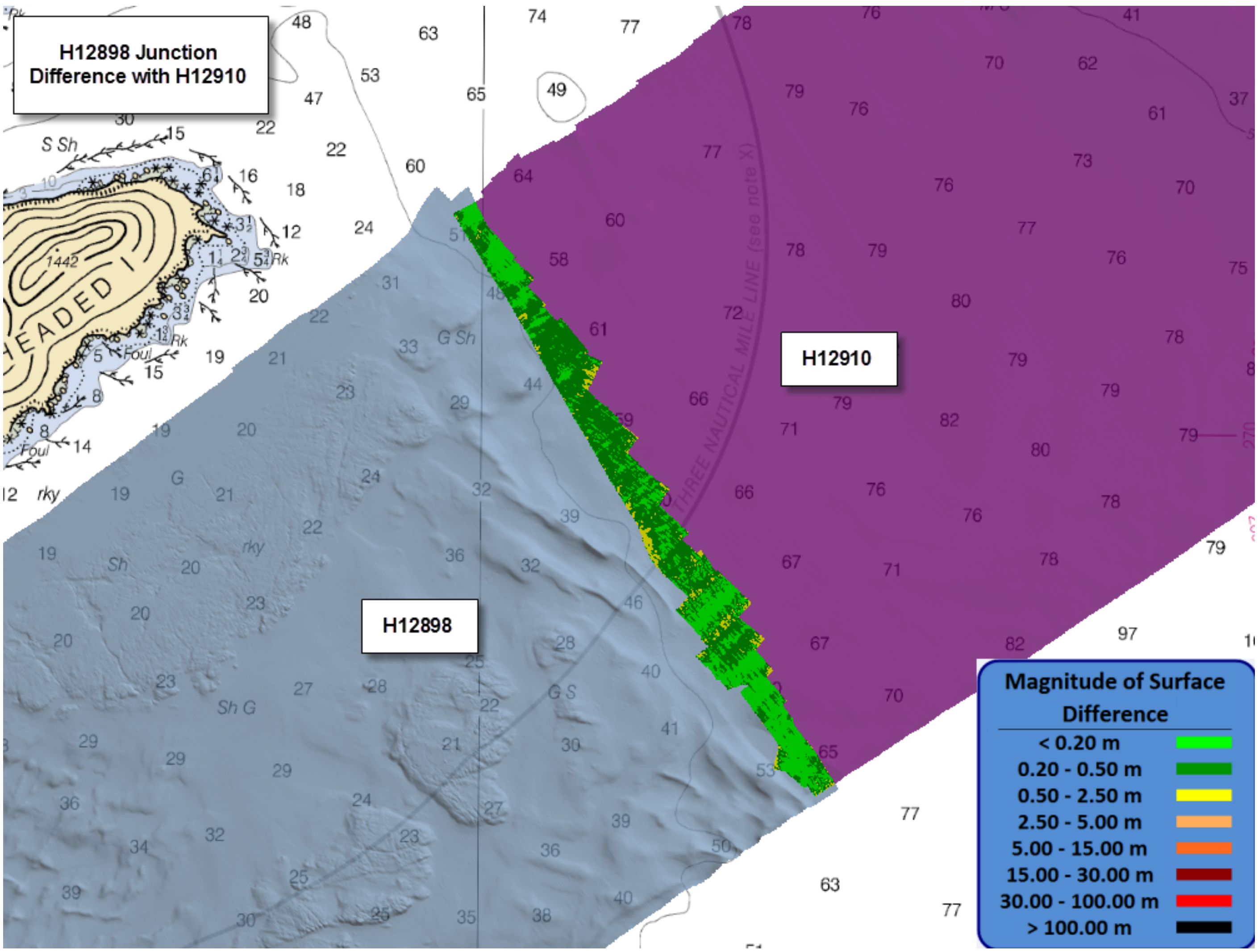
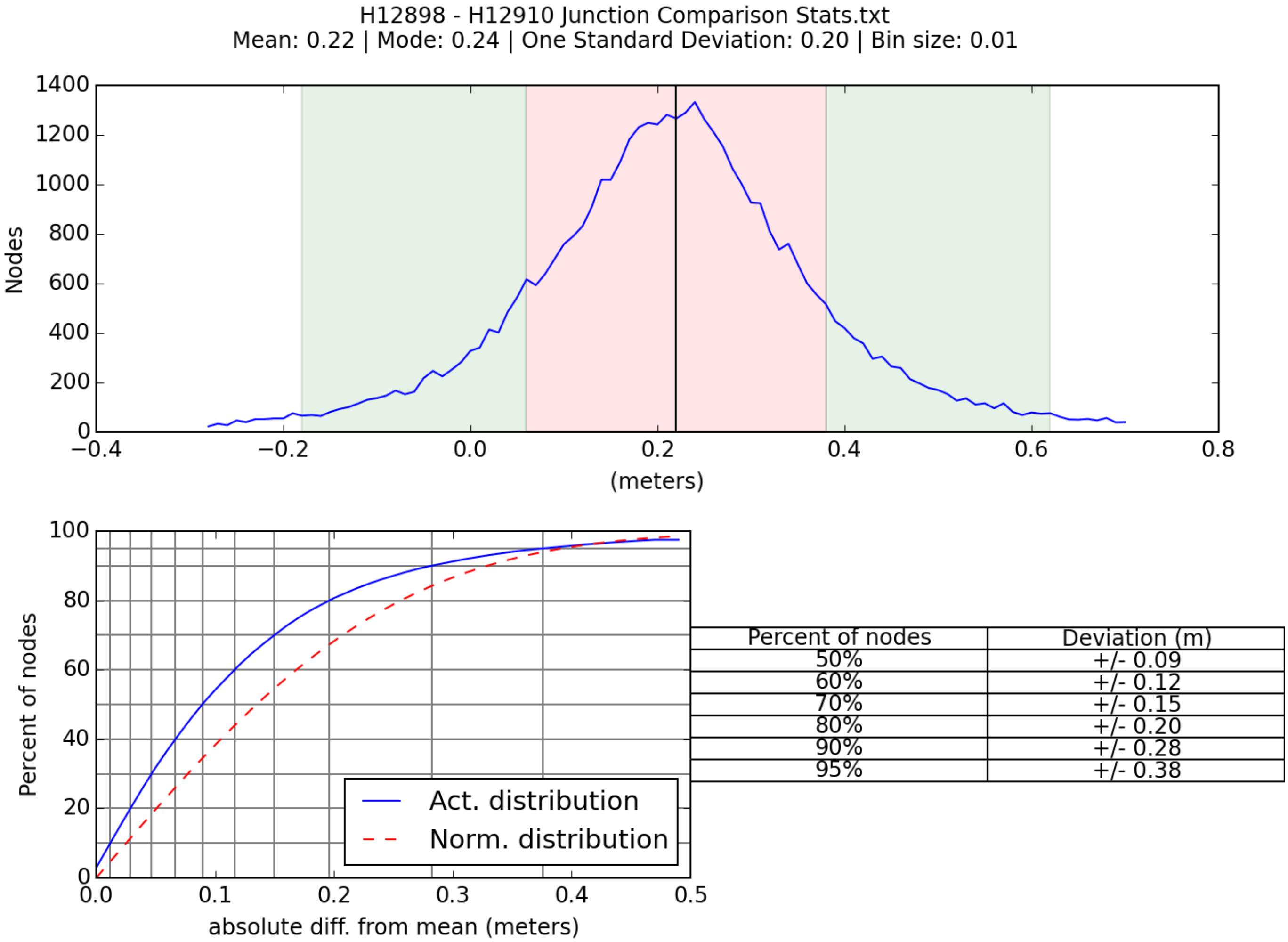


Figure 16: Difference surface between H12898 and junctioning survey H12910.



Percent of nodes	Deviation (m)
50%	+/- 0.09
60%	+/- 0.12
70%	+/- 0.15
80%	+/- 0.20
90%	+/- 0.28
95%	+/- 0.38

Figure 17: Difference surface statistics between H12898 and H12910 (8 meter surface).

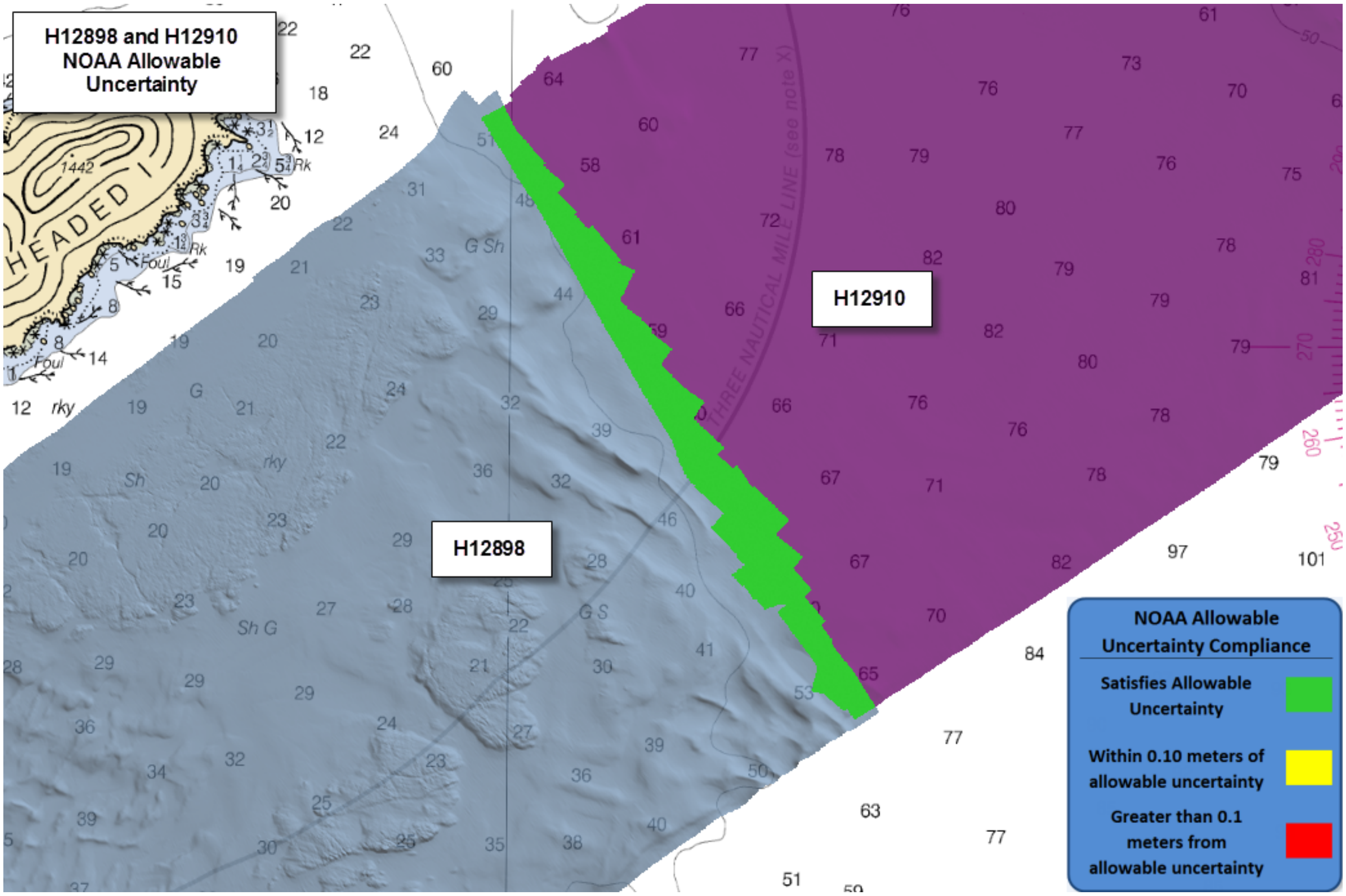


Figure 18: Difference surface compliance with regard to NOAA allowable uncertainty between H12898 and junctioning survey H12910.

H12898 H12910 Differencing NOAA Allowable Uncertainty

Total Nodes	Passed Nodes	Failed Nodes
43010	43010	0
Percentage Nodes Passed: 100.00%		
Percentage Nodes Failed: 0.00%		

Figure 19: H12898 junction with H12910 NOAA allowable uncertainty statistics.

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

There were no conditions or deficiencies that affected equipment operational effectiveness.

B.2.6 Factors Affecting Soundings

<u>Sea State</u>

During acquisition on H12898 multiple weather events occurred off the coast of Kodiak Island causing large swell conditions in the working area. The greatest affected days were day numbers 196 and 197. Due to the sea conditions as well as currents in the project area, S220 experienced hard pitching when surveying into seas and swell. In many cases, the pitching caused the Kongsberg EM-710 to experience "blow outs" where the sonar periodically lost bottom track, producing significant noise across the swath. These data were examined by the Hydrographer in CARIS Subset Editor and the spurious soundings were flagged as "rejected" in order to allow the surface to more accurately represent the seafloor. (Figure 20).

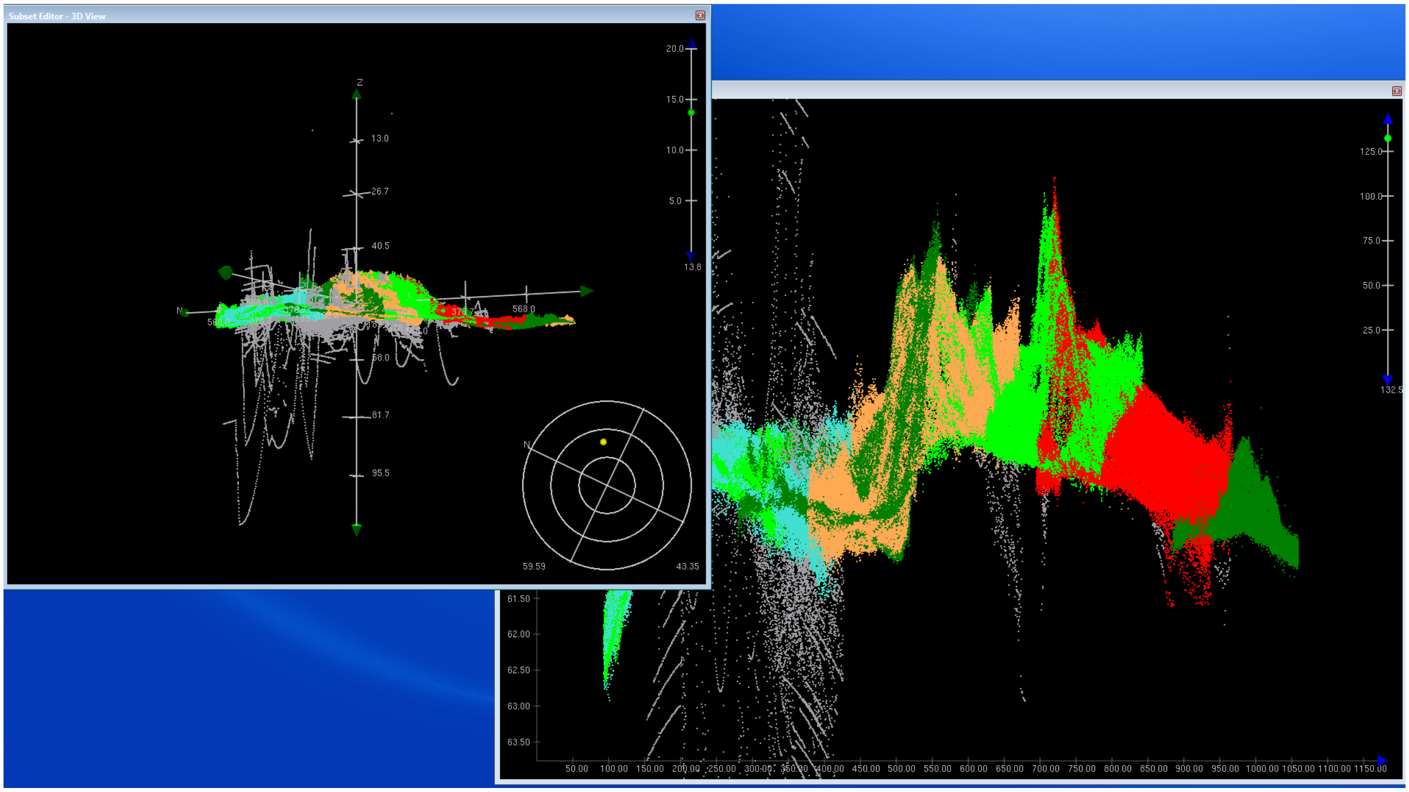


Figure 20: Example of DN196 sea state.

<u>Sound Speed</u>

Multiple instances of sound speed artifacts were observed within the data when viewed at high exaggeration. The majority of these artifacts were seen at the extents of the outer beams where sea state compounded sound speed uncertainties causing small ripples to be visible within the surfaces at high levels of exaggeration. Numerous spot-checks in CARIS Subset Editor showed all areas to be well within NOAA allowable uncertainties.

The most significant sound speed artifact within the survey was found in the northeastern portion of the survey area near Twoheaded Island (see Figure 21). Upon investigation it was determined that the sound speed cast applied to the line was not representative for the full extents of the line, causing some limited "frowning" at the eastern extents of the line. No other temporally adjacent casts were available to apply to the data and the Hydrographer flagged all erroneous data below the true seafloor as "rejected" (Figure 22). The resulting surfaces are within NOAA allowable uncertainties and remain adequate to supersede previous data.

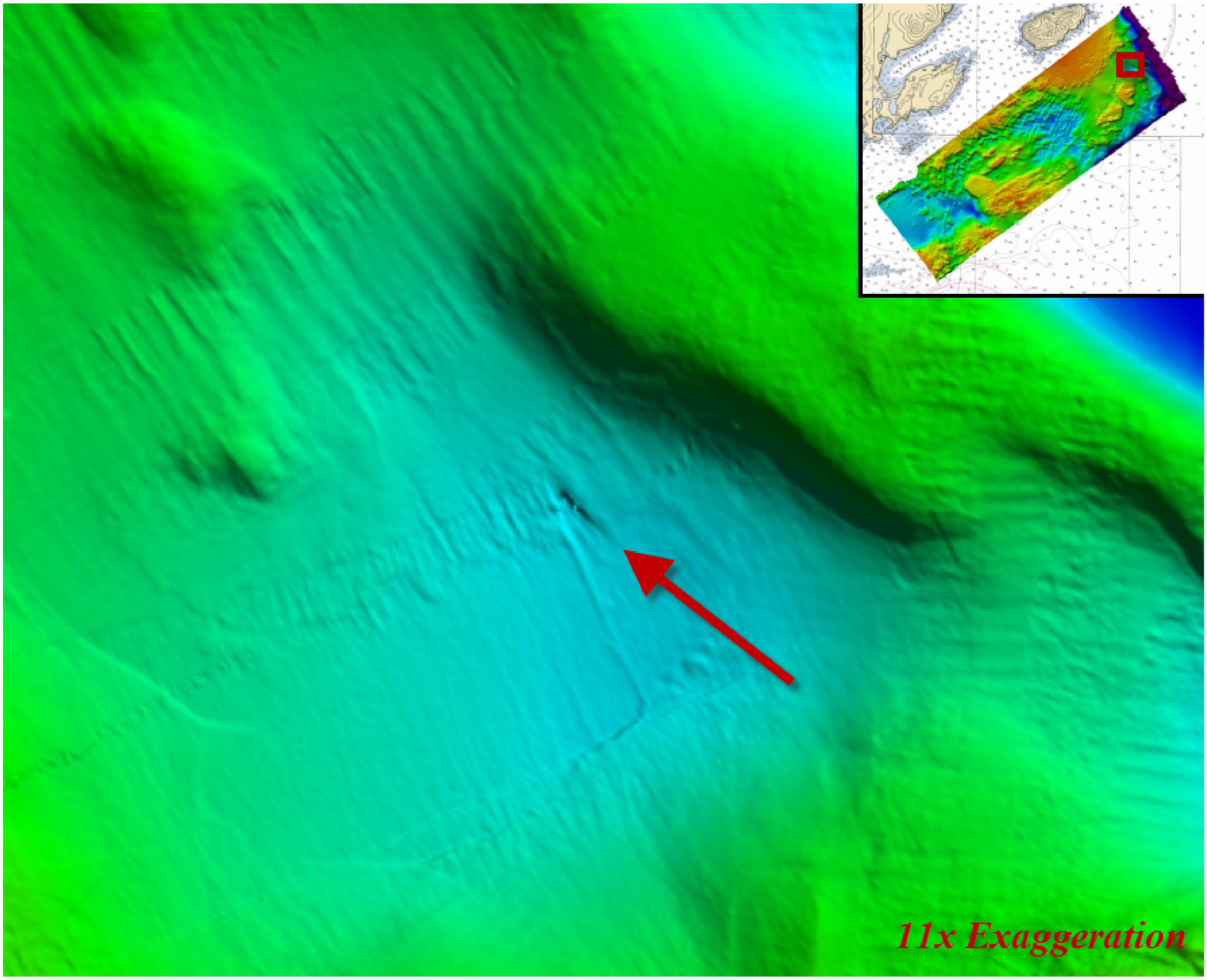


Figure 21: Example of effects of incorrect sound speed impacting surface.

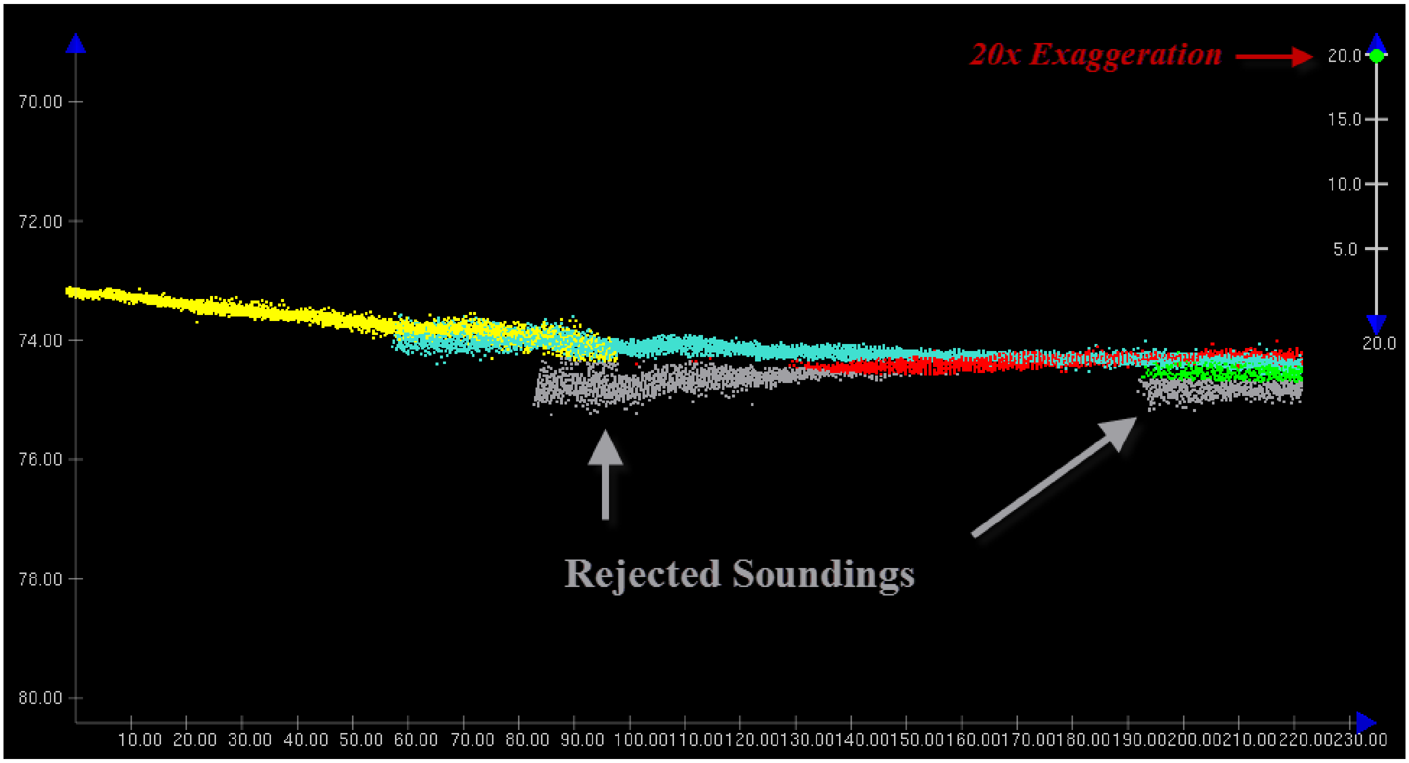


Figure 22: Subset of surface shown in Figure 21 showing "frowns" in data caused by sound speed issues (20x vertical exaggeration).

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were conducted at a minimum of one every 2 hours during launch acquisition. MVP casts on S220 were conducted at an average interval of 15 minutes as recommended by Pydro's CastTime software, which determines optimum cast frequency based on the observed sound speed variations from previous casts. All sound speed methods were used as detailed in the DAPR.

On DN211, the MVP towfish was lost while towing at the docked position due to a sudden material failure of the MVP cable. In order to continue survey operations, static CTD casts were performed with a SeaBird 19plus CTD. The maximum time between casts was 30 minutes for this period, which is in accordance with HSSD Section 5.2.3.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Holidays

H12898 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. No true holidays which meet the 3 by 3 node definition were identified via Pydro QC Tools Holiday Finder tool. This tool automatically scans finalized surfaces for holidays as defined in the HSSD and was run in conjunction with a visual inspection of all surfaces by the Hydrographer. Although numerous apparent holidays were flagged by Holiday Finder, all were examined and all were determined to be areas where an adjoining finalized surface covered the gap (e.g. a holiday in the 4m finalized surface was covered by the 2m finalized surface due to the area being shoaler than the depth range for the 4m surface) as shown in figure 23.

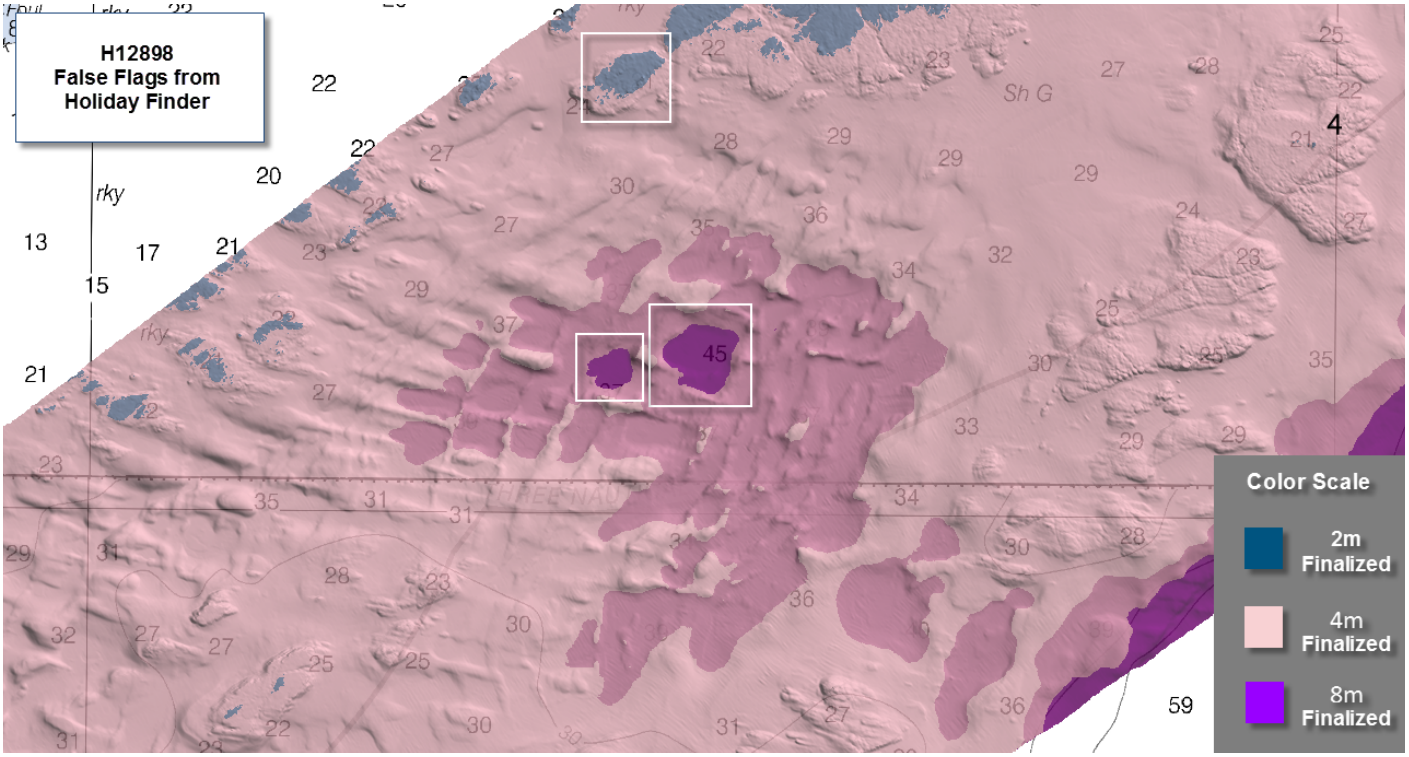


Figure 23: H12898 apparent holidays in coverage.

B.2.10 NOAA Allowable Uncertainty

To verify that all data meets the accuracy specifications as stated in HSSD Section 5.1.3, a child layer titled “NOAA_Allowable_1” was created for each of the 2-meter, 4-meter, and 8-meter (72-100m) and "NOAA_Allowable_2" for the 8-meter (100-160m) finalized surfaces using the equations stated in section C. 2.1 of the DAPR. These surfaces were then analyzed using the Pydro QC Tools Grid QA feature to determine what percentage of each surface meets specifications. Figure 24 shows an overview of the NOAA Allowable Uncertainty layers for all surfaces. Figure 25 shows the corresponding statistics for each individual surface. Overall, 98.91% of nodes with all surfaces meets or exceeds NOAA Allowable Uncertainty specifications for H12898. For individual graphs per surface of density requirements, see the Standards and Compliance Review located in Appendix II.

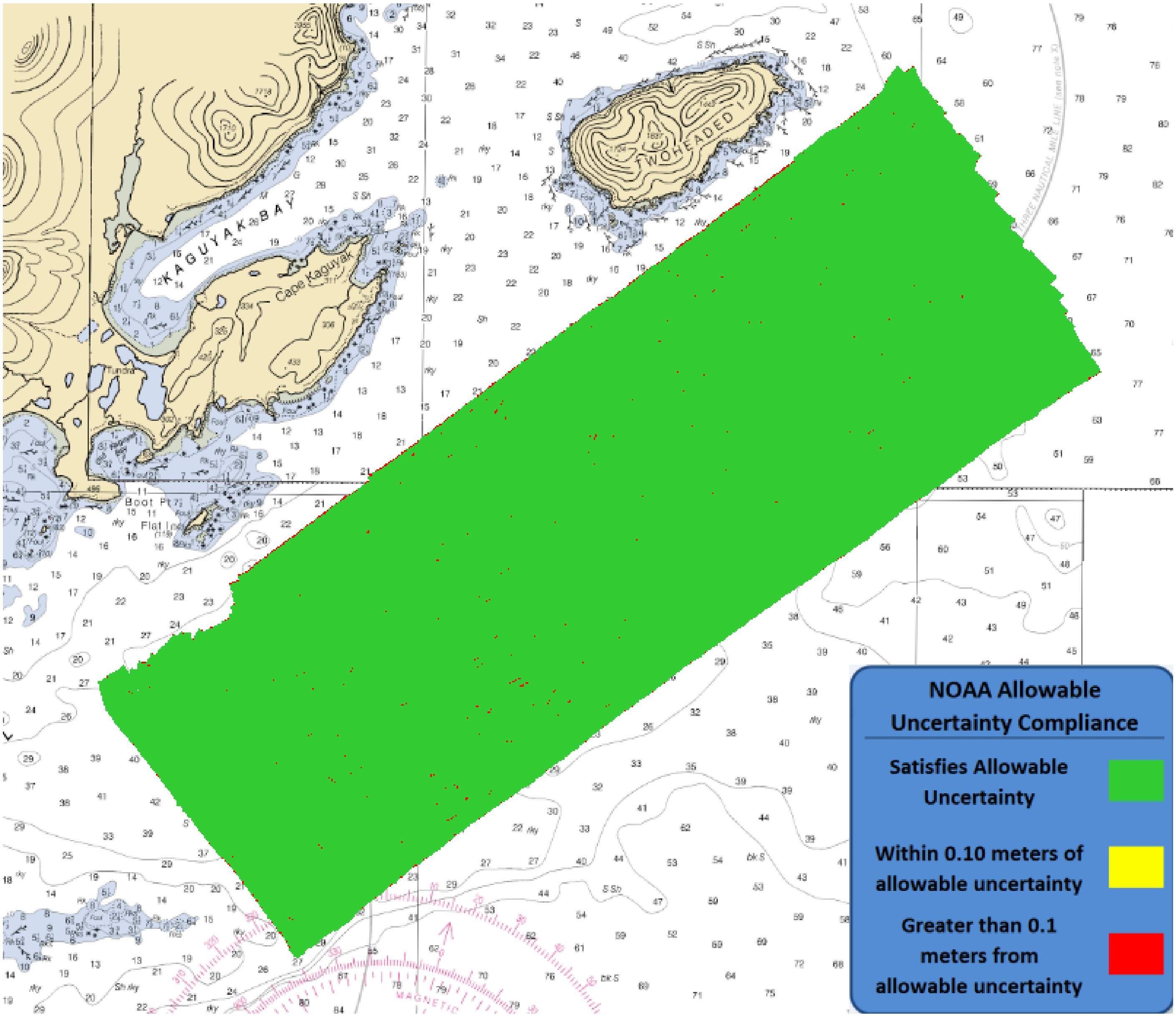


Figure 24: H12898 Allowable Uncertainty Overview.

H12898 NOAA Allowable Uncertainty

	Total Nodes	Passed Nodes	Percent Pass
2m	1,574,920	1,525,889	96.89%
4m	8,297,446	8,233,734	99.23%
8m	594,469	593,142	99.78%
	Total Nodes		10,466,835.00
	Total Nodes Pass		10,352,765.00
	Total Percent Pass		98.91%

Figure 25: H12898 NOAA Allowable Uncertainty Statistics.

B.2.11 Density

Finalized surfaces were analyzed using the Pydro QC Tools Grid QA feature and the results are shown in Figure 26 below. Density requirements for H12898 were achieved with at least 99.98% of finalized surface nodes containing five or more soundings as required by HSSD Section 5.2.2.3. For individual graphs (per surface) of density requirements, see the Standards and Compliance Review located in Appendix II.

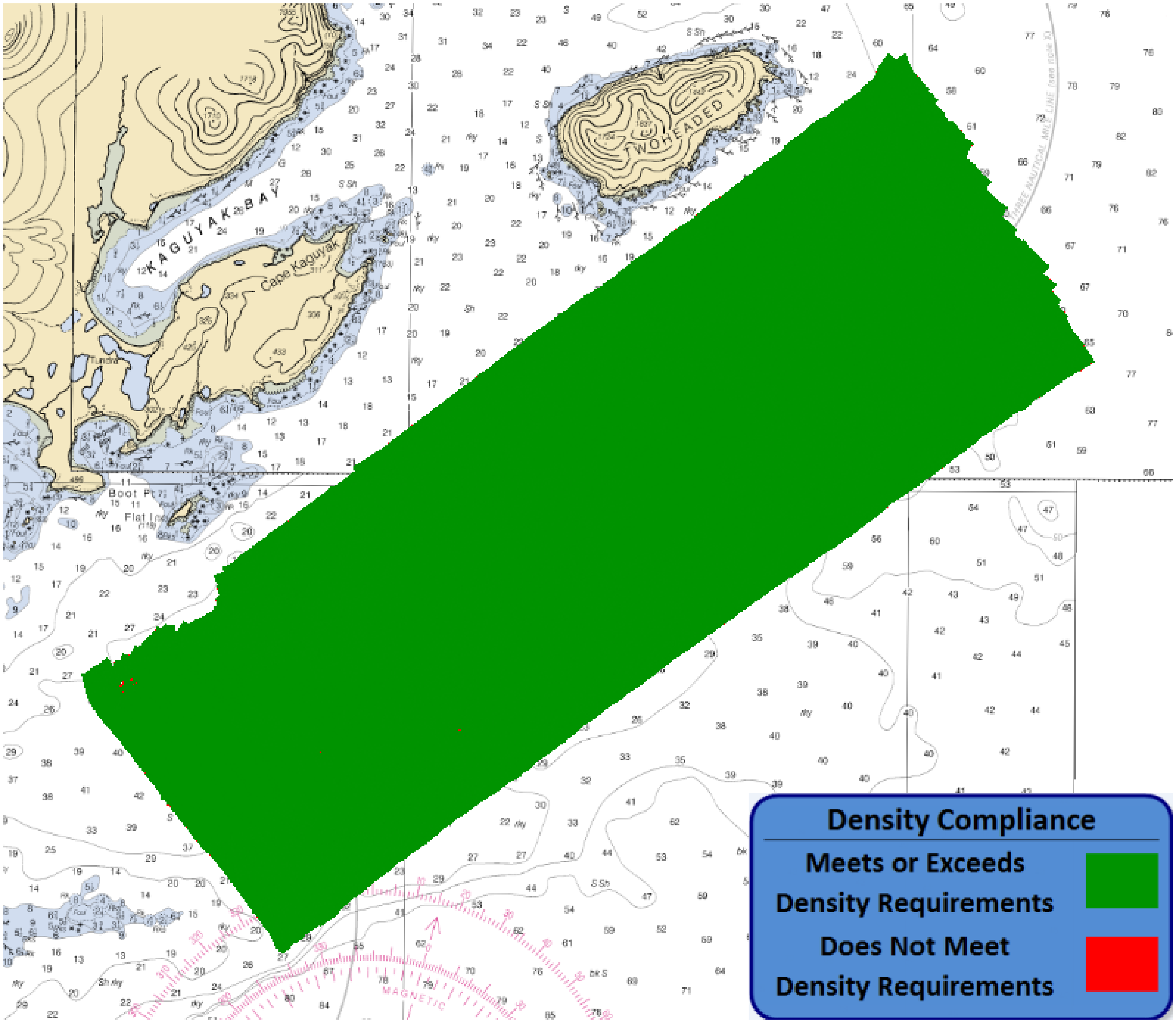


Figure 26: H12898 Density Compliance Overview.

H12880 Density Statistics	Total Nodes	Passed Nodes	Percent Pass
2m	1,574,920	1,574,070	99.95%
4m	8,297,446	8,296,121	99.98%
8m	594,469	594,196	99.95%
	Total Nodes		10,466,835
	Total Nodes Pass		10,464,387
	Total Percent Pass		99.98%

Figure 27: H12898 Density Compliance Statistics.

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

Raw Backscatter was logged as .7k file for Reson 7125 data and within the .all file for Kongsberg EM710 data. The data were submitted to Pacific Hydrographic Branch for processing. One line per vessel per day of backscatter was processed by the field unit for quality control.

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
Teledyne CARIS	HIPS and SIPS	9.1

Table 9: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	Fledermaus FMGT	7.5.3

Table 10: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Profile version 5.4.

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
H12898_MB_2m_MLLW	CUBE	2 meters	-	NOAA_2m	Complete MBES
H12898_MB_4m_MLLW	CUBE	4 meters	-	NOAA_4m	Complete MBES
H12898_MB_8m_MLLW	CUBE	8 meters	-	NOAA_8m	Complete MBES
H12898_MB_2m_MLLW_Final	CUBE	2 meters	18 meters - 40 meters	NOAA_2m	Complete MBES
H12898_MB_4m_MLLW_Final	CUBE	4 meters	36 meters - 80 meters	NOAA_4m	Complete MBES
H12898_MB_8m_MLLW_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Complete MBES

Table 11: Submitted Surfaces

The NOAA CUBE parameters defined in the HSSD were used for the creation of all CUBE surfaces in Survey H12898. The surfaces have been reviewed where noisy data, or "fliers," are incorporated into the gridded solutions causing the surface to be shoaler or deeper than the true sea floor. Where these spurious soundings cause the gridded surface to be shoaler or deeper than the reliably measured seabed by greater than the maximum allowable Total Vertical Uncertainty at that depth, the noisy data have been rejected by the Hydrographer and the surface recomputed.

Flier Finder v3, part of the QC Tools package within Pydro, was used to assist the search for spurious soundings following gross cleaning. Flier Finder was run multiple times for each surface, reducing the flier height value for each consecutive run. This allowed Flier Finder to accurately and quickly identify gross fliers, but as the flier height was reduced the effectiveness of the tool diminished. With smaller heights, Flier Finder began to incorrectly flag dynamic aspects of the seafloor such as steep drop offs and rocky areas as fliers resulting in hundreds of false positives. At this point, the hydrographer ceased using the tool and returned to manual cleaning for these dynamic regions of seafloor.

B.5.3 Data Logs

Data acquisition and processing notes are included in the acquisition and processing logs, and additional processing such as final tide and sound speed application are noted in the H12898 Data Log spreadsheet. All data logs are submitted digitally in the Separates I folder.

C. Vertical and Horizontal Control

Additional information discussing the vertical or horizontal control for this survey can be found in the accompanying HVCR.

C.1 Vertical Control

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

<u>Traditional Methods Used:</u>

TCARI

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

Station Name	Station ID
Kodiak Island	9457292
Alitak	9457804

Table 12: NWLON Tide Stations

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

Station Name	Station ID
Offshore Sitkalidak Island GPS Buoy	945AAAA
Offshore Geese Island GPS Buoy	945BBBB

Table 13: Subordinate Tide Stations

File Name	Status
9457292.tid	Verified Observed
9457804.tid	Verified Observed

Table 14: Water Level Files (.tid)

File Name	Status
P335FA2016_Verified.tc	Preliminary

Table 15: Tide Correctors (.zdf or .tc)

A request for final approved tides was sent to N/OPS1 on 07/31/2016. The final tide note was received on 12/02/2016.

Initial reduction of acquired data to MLLW was accomplished via traditional tidal means using the Tidal Constituent And Residual Interpolation (TCARI) grid provided by HSD-OPS. Following the successful application of SBETs and computation of an Ellipsoidally Referenced Zone Tide (ERZT) separation model, ERS methods were used for reducing data to MLLW.

As ERS methods were successful for the reduction to MLLW, final tides were not necessary for H12898. As processing was completed prior to receiving final tides, a waiver was obtained from HSD-OPS for the submission of H12898 without final tides applied. This correspondence has been included in Appendix II, accompanying this submission.

The GPS Buoy Station IDs are not correct in Table 13. Their working IDs in the project were as follows: Offshore Sitkalidak Island GPS Buoy is TMB230; Offshore Geese Island GPS Buoy is TMB320.

<u>ERS Methods Used:</u>

ERS via Poor Mans VDATUM

Ellipsoid to Chart Datum Separation File:

P335FA2016_PMVD_UTM-NAD83-5N_WGS84-MLLW_Composite.csar

ERS methods were used as the final means of reducing H12898 to MLLW for submission. Data were initially reduced via traditional tidal means until an ERZT separation model could be calculated. This empirically derived model was then checked for consistency and compared to the Poor Man's VDatum (PMVD) separation model provided with the Project Instructions. The PMVD separation model was then vertically shifted such that the average difference between these two separation models is zero. This vertical shift de-biases the PMVD separation model, correcting for local offsets that cannot be effectively modeled by the PMVD. In areas where the PMVD model did not have sufficient coverage such as near shore areas, the ERZT separation model was appended to the PMVD model creating the composite ERZT/PMVD separation model listed above and used to reduce H12898 to MLLW. For further information see the ERS Capability Memo, submitted under separate cover.

C.2 Horizontal Control

The horizontal datum for this project is World Geodetic System of 1984 (WGS84).

The projection used for this project is UTM Zone 5 North.

The following PPK methods were used for horizontal control:

Single Base

Vessel kinematic data were post-processed using Applanix POSPac processing software and Single Base Positioning methods described in the DAPR. Smoothed Best Estimate of Trajectory (SBET) and associated error (RMS) data were applied to all MBES data in CARIS HIPS.

For further details regarding the processing and quality control checks performed see the H12898 POSPAC Processing Logs spreadsheet located in the Separates folder. See also the OPR-P335-FA-16 Horizontal and Vertical Control report, submitted under separate cover.

Hydrographic Technical Directive (HTD) 2016-3, which revises the horizontal datum requirement to NAD83, was released after PIs had been issued and acquisition commenced on OPR-P335-FA-16. The field unit conferred with HSD-OPS and determined no waiver was needed to maintain WGS84 as the datum for submission. This correspondence has been included in Appendix II.

The following CORS Stations were used for horizontal control:

HVCR Site ID	Base Station ID
AC34	Old Harbor
AC45	Sitkinak Island

Table 16: CORS Base Stations

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
9677	PZ 2014

Table 17: User Installed Base Stations

Differential correctors from the US Coast Guard beacon at Kodiak, AK (313kHz) were used in real-time during acquisition when not otherwise noted in the acquisition logs, and were the sole method of positioning of bottom samples.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Kodiak, AK (313kHz)

Table 18: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed between survey H12898, and Charts 16590 and 16592, as well as ENCs US5AK5LM and US5AK5NM, using CARIS HIPS and SIPS sounding and contour layers derived from the 8 meter combined surface. The contours and soundings were overlaid on the chart to assess differences between the surveyed soundings and charted depths. To more accurately visualize trends within these differences, an 8 meter TIN surface was interpolated from the ENC sounding layer. This surface was then differenced with a corresponding 8 meter surface from H12898 and visualized in Figure 28. In this difference surface red colors indicate H12898 was shoaler than the ENC US4AK5LM, green colors indicate agreement, and blue colors indicate H12898 was deeper than ENC US4AK5LM.

All data from H12898 should supersede charted data. In general, surveyed soundings agree with the majority of charted depths.

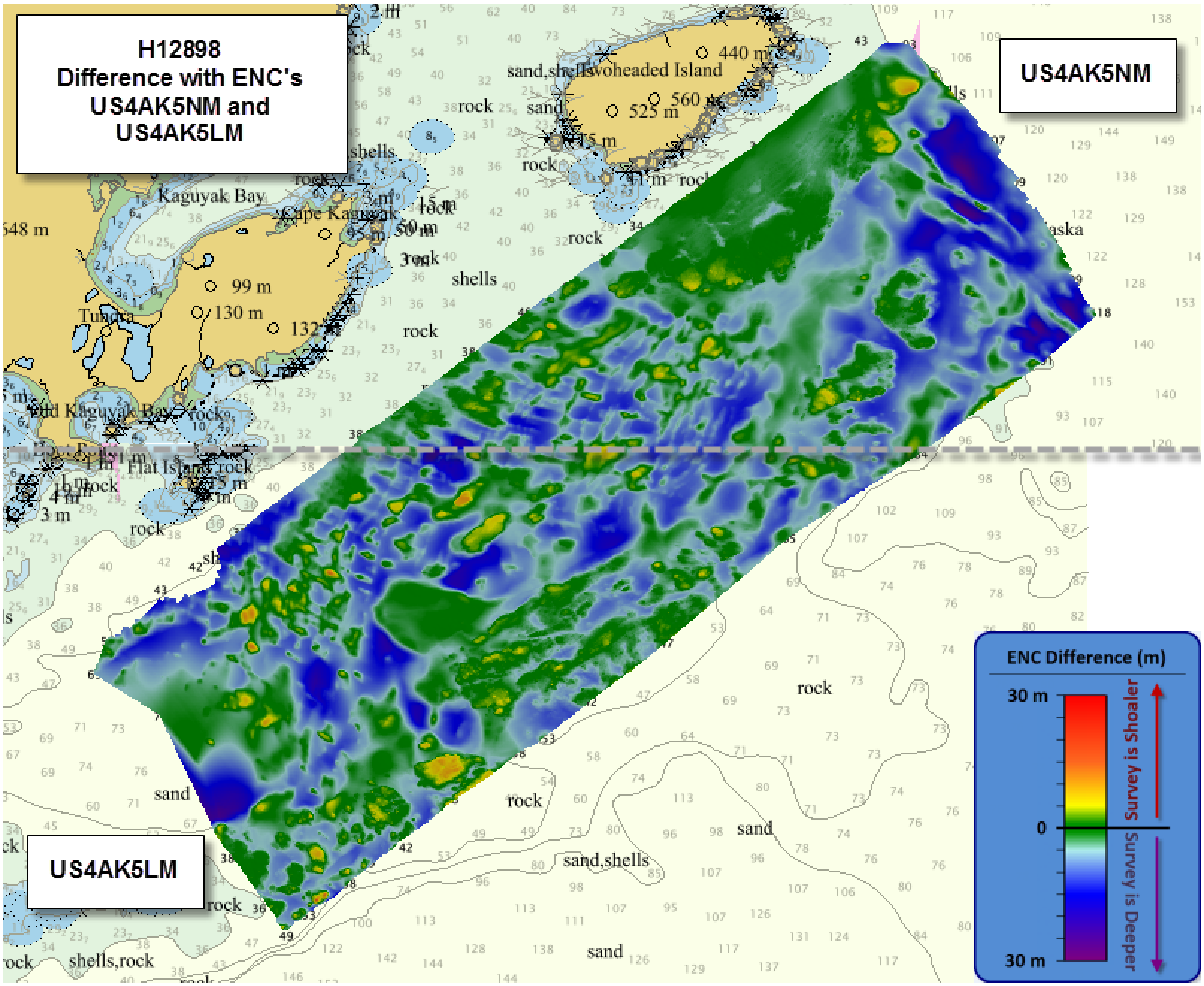


Figure 28: Difference surface between H12898 and interpolated TIN surface from US4AK5LM and US4AK5NM.

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
16590	1:81529	12	09/2014	02/16/2016	02/20/2016
16592	1:80728	11	07/2014	02/16/2016	02/20/2016

Table 19: Largest Scale Raster Charts

<u>16590</u>

The charted soundings and contours of Chart 16590 are identical to those found on ENC US4AK5LM and US4AK5NM. As such, all discussions regarding comparisons between surveyed soundings and charted depths are covered under the ENC's US4AK5LM and US4AK5NM discussions below.

<u>16592</u>

The charted soundings and contours of Chart 16592 are identical to those found on ENC US4AK5LM and US4AK5NM. As such, all discussions regarding comparisons between surveyed soundings and charted depths are covered under the ENC's US4AK5LM and US4AK5NM discussions below.

D.1.2 Electronic Navigational Charts

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

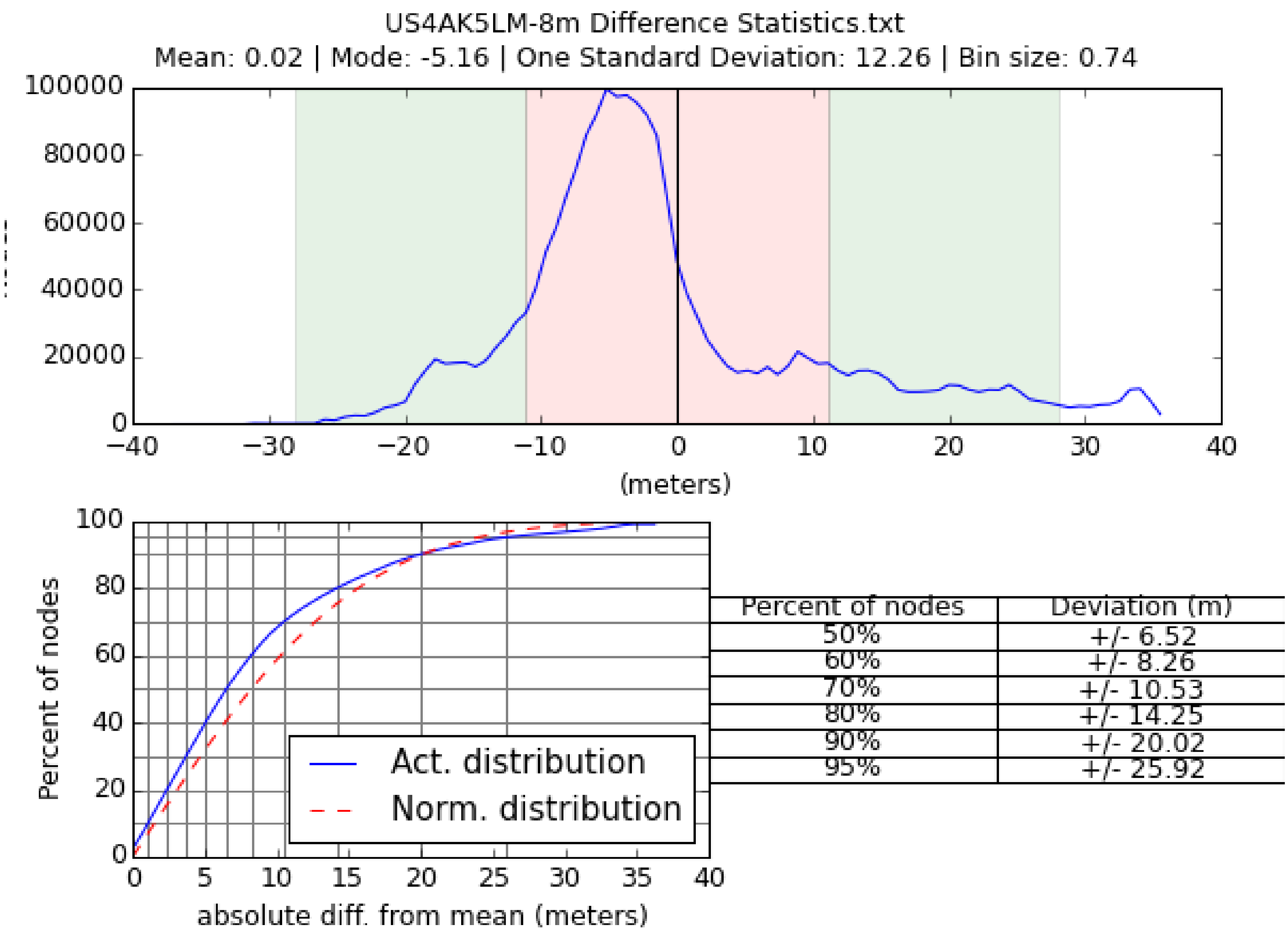
ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US4AK5LM	1:81529	9	10/27/2015	10/27/2015	NO
US4AK5NM	1:80728	10	11/19/2015	11/19/2015	NO

Table 20: Largest Scale ENCs

<u>US4AK5LM</u>

Soundings from H12898 are in general agreement with charted depths on ENC US4AK5LM, with most depths agreeing within 1-2 fathoms. The statistical analysis of the difference surface shows a mean of 0.02 meters with 95% of all nodes having a maximum deviation of +/- 25.92 meters, as seen in Figure 29.

Contours from H12898 are in general agreement with charted contours on ENC US4AK5LM as shown in Figure 30. The largest differences are seen in the offshore 30 fathom contour line, where surveyed and charted contours differ by over 600 meters as seen in Figure 31.



Percent of nodes	Deviation (m)
50%	+/- 6.52
60%	+/- 8.26
70%	+/- 10.53
80%	+/- 14.25
90%	+/- 20.02
95%	+/- 25.92

Figure 29: Difference surface statistics between H12898 and interpolated TIN surface from US4AK5LM.

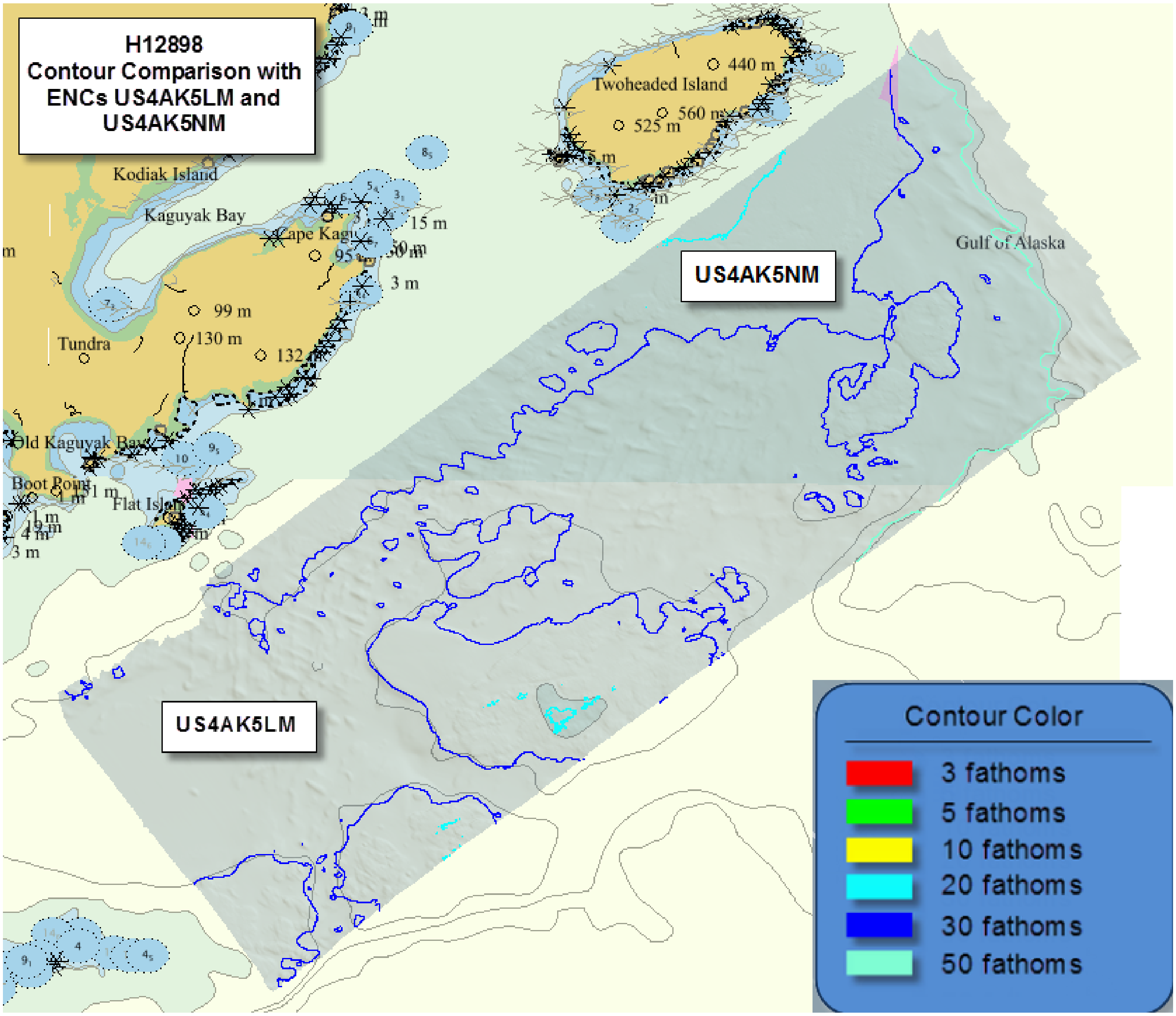


Figure 30: H12898 surveyed contour overview with ENCs US4AK5LM and US4AK5NM.

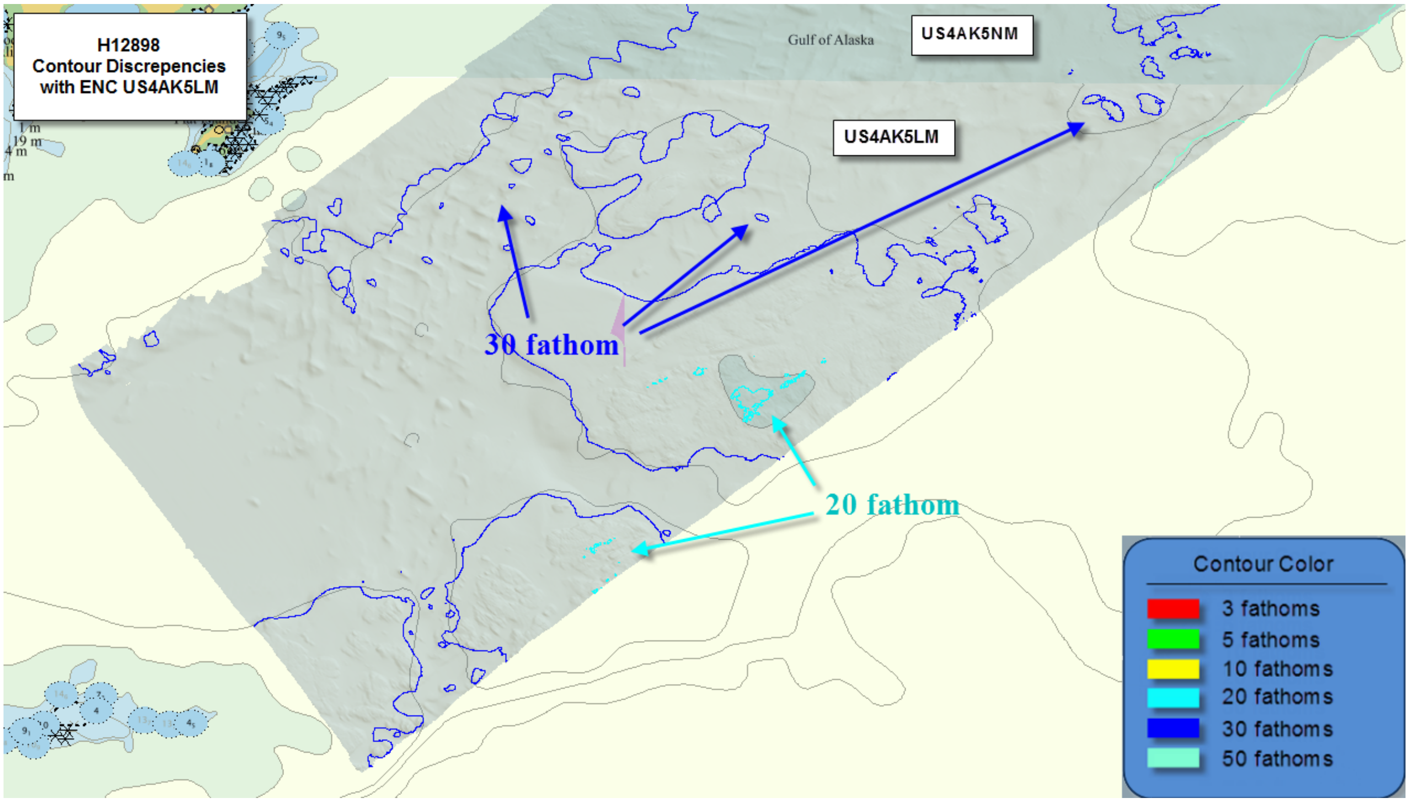
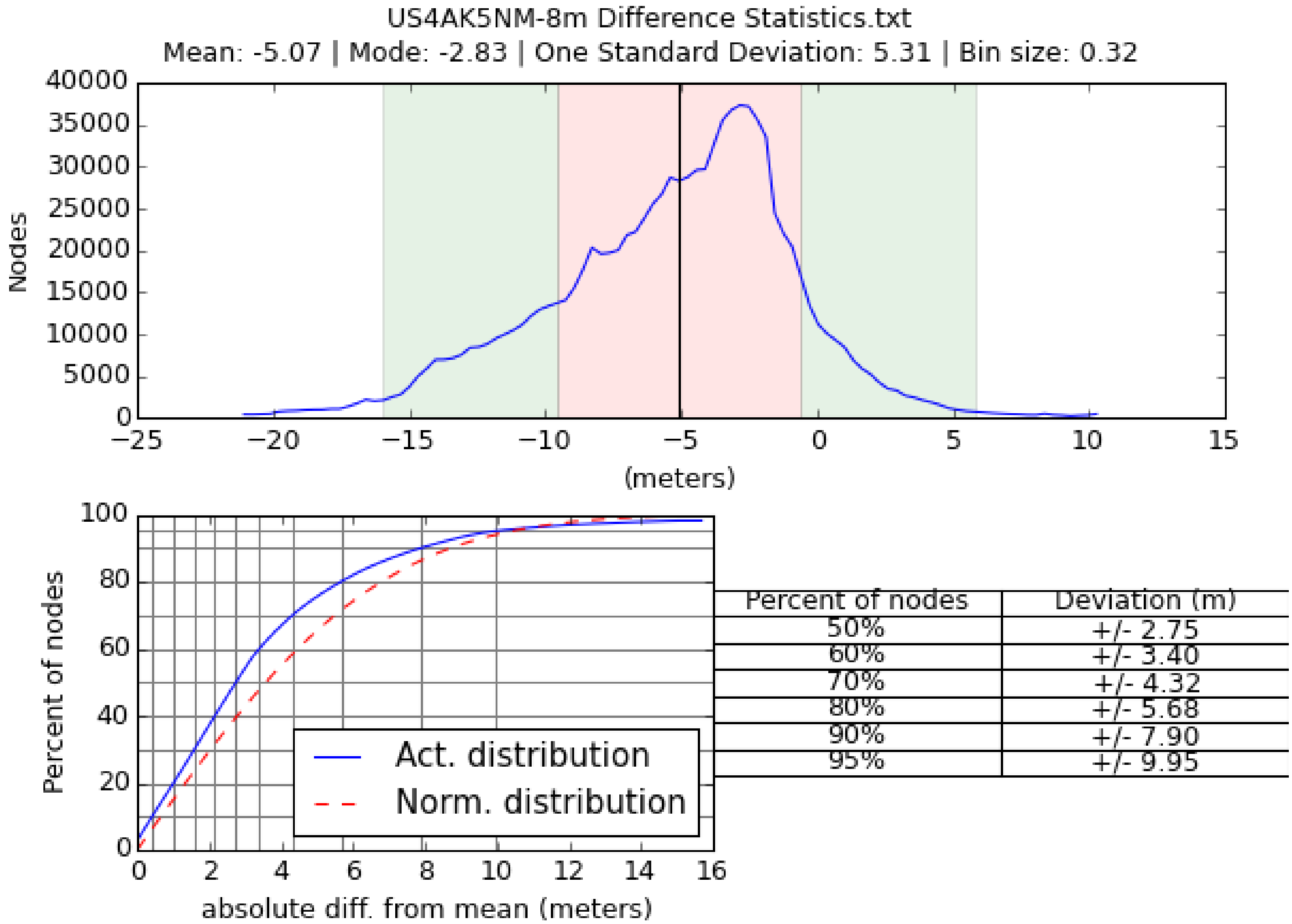


Figure 31: H12898 proposed update of 20fm and 30fm contours

US4AK5NM

Soundings from H12898 are in general agreement with charted depths on ENC US4AK5NM, with most depths agreeing within 1-2 fathoms. The largest differences are seen in the southeast corner of the surveyed area where differences range to 9 fathoms as seen in Figure 33. The statistical analysis of the difference surface shows a mean of -5.07 meters with 95% of all nodes having a maximum deviation of +/- 9.95 meters, as seen in Figure 32.

Contours from H12898 are in general agreement with charted contours on ENC US4AK5NM as shown in Figure 30. Furthermore, the Hydrographer recommends that 20 fathom and 30 fathom contours be added to ENC US4AK5NM to provide additional information to the mariner as shown in Figure 34.



Percent of nodes	Deviation (m)
50%	+/- 2.75
60%	+/- 3.40
70%	+/- 4.32
80%	+/- 5.68
90%	+/- 7.90
95%	+/- 9.95

Figure 32: Difference surface statistics between H12898 and interpolated TIN surface from US4AK5NM.

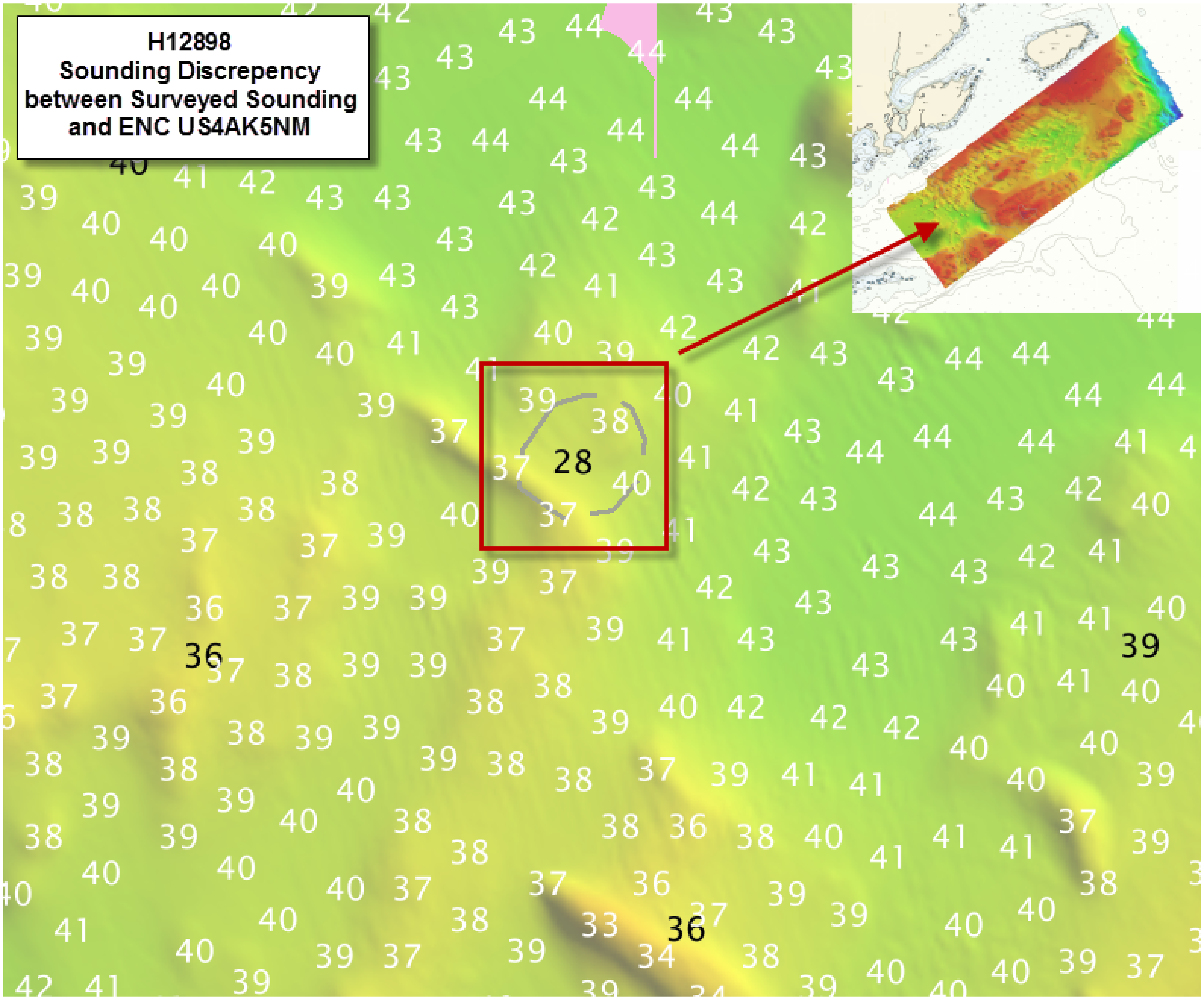


Figure 33: H12898 sounding discrepancy between surveyed soundings and ENC US4AK5NM in fathoms.

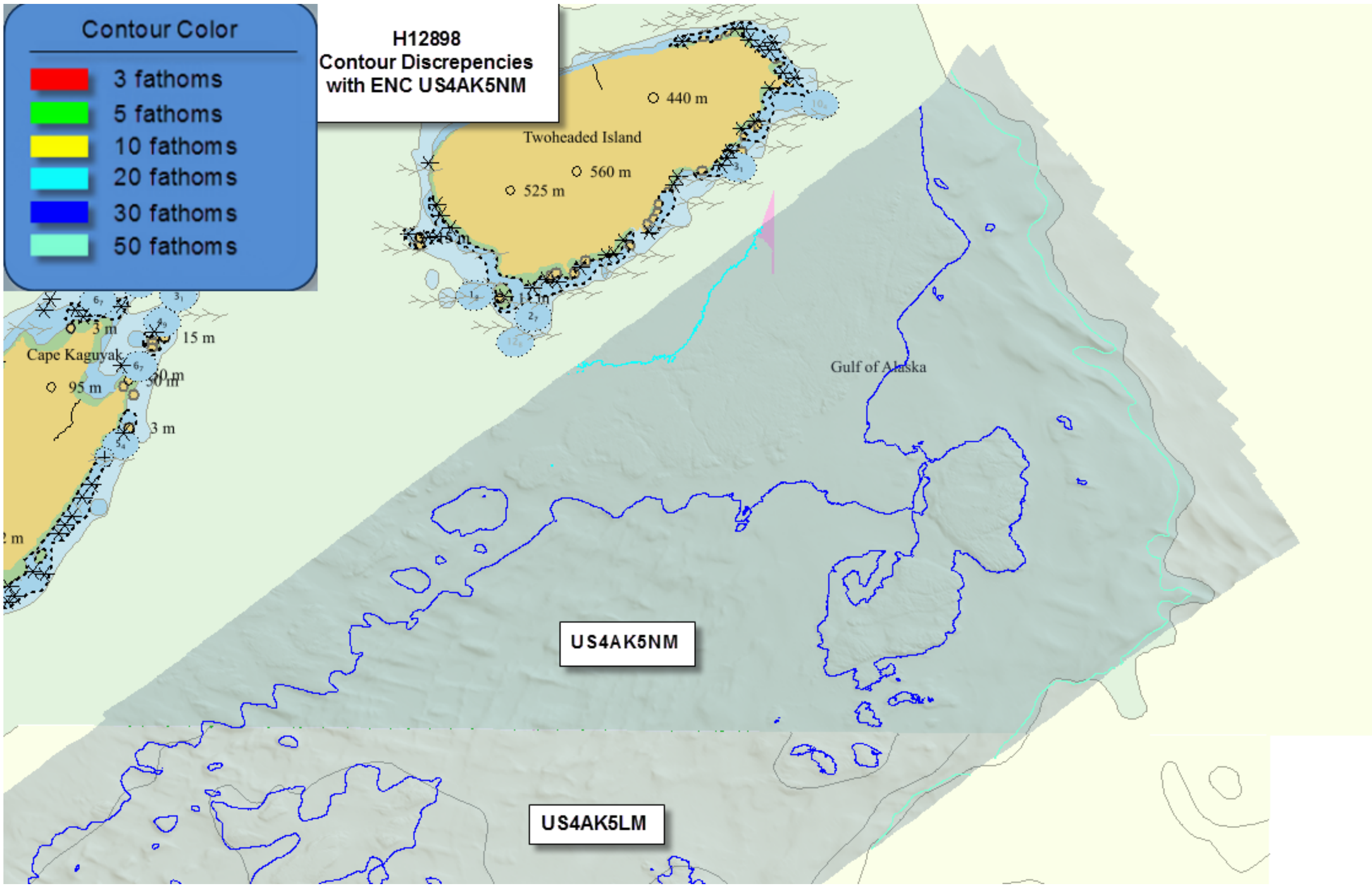


Figure 34: H12898 recommend addition of and 20fm, 30fm, and 50fm contour onto ENC US4AK5NM.

D.1.3 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.4 Charted Features

No charted features exist for this survey.

D.1.5 Uncharted Features

No uncharted features exist for this survey.

D.1.6 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.7 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.8 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.1.9 Bottom Samples

Four bottom samples were acquired in accordance with the Project Instructions for survey H12898. One of the four samples returned no good sample after repeated attempts. The remaining three samples returned good results. All were entered in the H12898 Final Feature File. See Figure 35 for location overview.

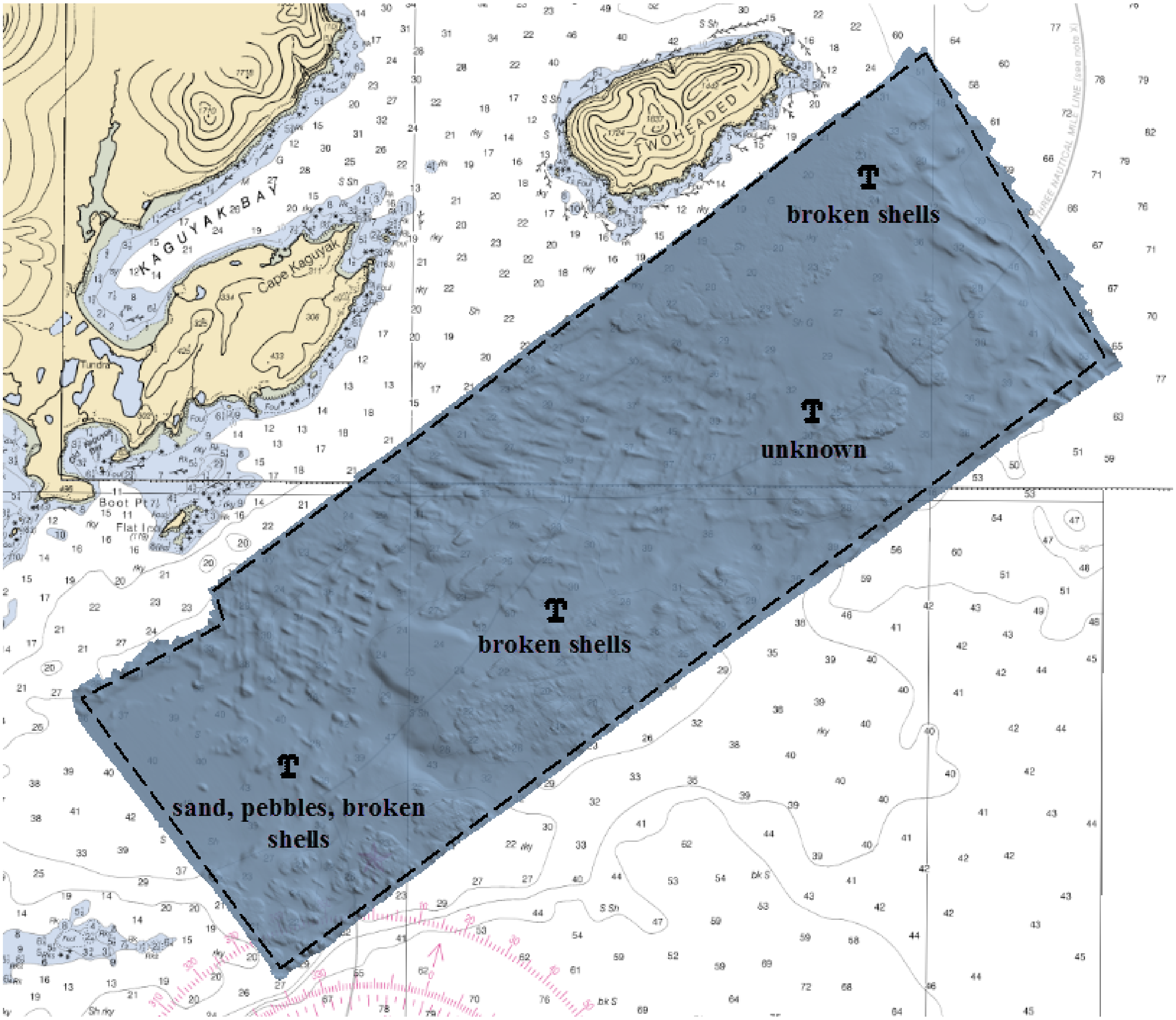


Figure 35: H12898 Bottom Sample Location Overview.

D.2 Additional Results

D.2.1 Shoreline

Shoreline was not assigned in the Hydrographic Survey Project Instructions or Statement of Work.

D.2.2 Prior Surveys

No prior survey comparisons were assigned for this survey.

D.2.3 Aids to Navigation

No Aids to navigation (ATONs) exist for this survey.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

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 Recommendation

No new surveys or further investigations are recommended for this area.

D.2.11 Inset Recommendation

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 Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives, except as noted in this Descriptive Report. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required unless otherwise noted herein.

Report Name	Report Date Sent
Coast Pilot Report	2016-11-10
Data Acquisition and Processing Report	2016-11-08
Horizontal and Vertical Control Report	2016-11-14

Approver Name	Approver Title	Approval Date	Signature
CDR Mark Van Waes, NOAA	Chief of Party	11/21/2016	VAN WAES.MARK.1240076329 2016.11.21 20:02:28 -08'00'
LT Bart Buesseler, NOAA	Field Operations Officer	11/21/2016	Digitally signed by BUESSELER.BART.OWEN.1396600559 Date: 2016.11.21 19:49:34 -08'00'
HCST Douglas Bravo	Chief Survey Technician	11/21/2016	Douglas Bravo 2016.11.21 19:48:29 -08'00'
ENS Tyler Fifield, NOAA	Sheet Manager	11/21/2016	FIFIELD.TYLER.P.1502767573 2016.11.21 19:47:36 -08'00'

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

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

TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : December 2, 2016

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-P335-FA-16
HYDROGRAPHIC SHEET: H12898

LOCALITY: South of Cape Kaguyak, South Coast of Kodiak Island
TIME PERIOD: June 25 to July 31, 2016

TIDE STATION USED: Kodiak Island, AK 9457292
Lat. 57° 43.8' N Long. 152° 30.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.400 meters

TIDE STATION USED: Alitak, AK 9457804
Lat. 56° 53.8' N Long. 154° 14.9' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.311 meters

Tide STATION USED: Sitkalidak Island GPS Tide Buoy, AK 9457512
Lat. 56° 57.9' N Long. 153° 15.1' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.307 meters

Tide STATION USED: Geese Island GPS Tide Buoy, AK 9457726
Lat. 56° 35.7' N Long. 153° 59.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 2.483 meters

REMARKS: RECOMMENDED GRID
Please use the TCARI grid "P335FA2016Final.tc" as the final grid for project OPR-P335-FA-16, during the time period between June 25 to July 31, 2016.

Refer to attachments for grid 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).

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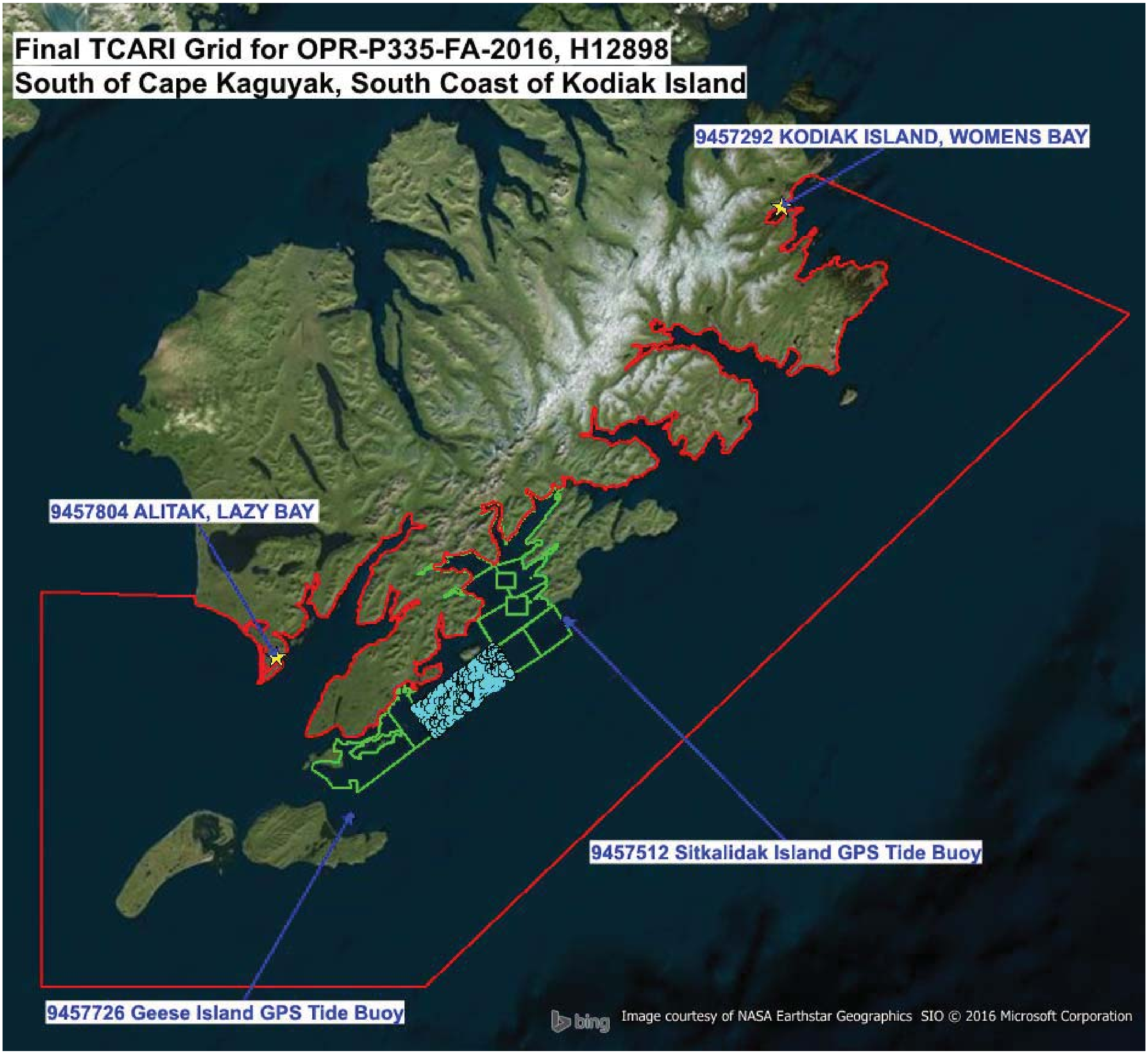
Date: 2016.12.02 14:42:32 -05'00'

CHIEF, OCEANOGRAPHIC DIVISION



Final TCARI Grid for OPR-P335-FA-2016, H12898
South of Cape Kaguyak, South Coast of Kodiak Island
9457292 KODIAK ISLAND, WOMENS BAY
9457804 ALITAK, LAZY BAY
9457512 Sitkalidak Island GPS Tide Buoy
9457726 Geese Island GPS Tide Buoy
bing
Image courtesy of NASA Earthstar Geographics SIO © 2016 Microsoft Corporation

APPROVAL PAGE

H12898

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

- H12898_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12898_GeoImage.pdf

The survey evaluation and verification has been conducted according current OCS Specifications.

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DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=HOLMBERG.PETER.SCOTT.1365886101
Date: 2017.05.31 14:13:14 -07'00'

Approved:____

Peter Holmberg
Cartographic Team Lead, Pacific Hydrographic Branch

The survey has been approved for dissemination and usage of updating NOAA's suite of nautical charts.

Digitally signed by EVANS.BENJAMIN.K.1237217094
Date: 2017.05.26 18:38:54 -07'00'

Approved:____

CDR, Benjamin K. Evans, NOAA
Chief, Pacific Hydrographic Branch