H13016

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13016

LOCALITY

State(s):	Alaska
General Locality:	Southeast Alaska
Sub-locality:	Shoe Island

2017

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	**H13016**

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:	**Southeast Alaska**
Sub-Locality:	**Shoe Island**
Scale:	**20000**
Dates of Survey:	**06/06/2017 to 06/21/2017**
Instructions Dated:	**04/12/2017**
Project Number:	**OPR-O190-FA-17**
Field Unit:	**NOAA Ship *Fairweather***
Chief of Party:	**CDR Mark Van Waes, NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

Table of Contents

List of Tables

List of Figures

Descriptive Report to Accompany Survey H13016

Project: OPR-O190-FA-17

Locality: Southeast Alaska

Sublocality: Shoe Island

Scale: 1:20000

June 2017 - June 2017

NOAA Ship *Fairweather*

Chief of Party: CDR Mark Van Waes, NOAA

A. Area Surveyed

The survey area is located in Southeast Alaska within the sub-locality of West of Prince of Wales Island.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
54° 59' 58.33" N 132° 52' 41.16" W	54° 56' 23.01" N 132° 43' 22.22" W

Table 1: Survey Limits

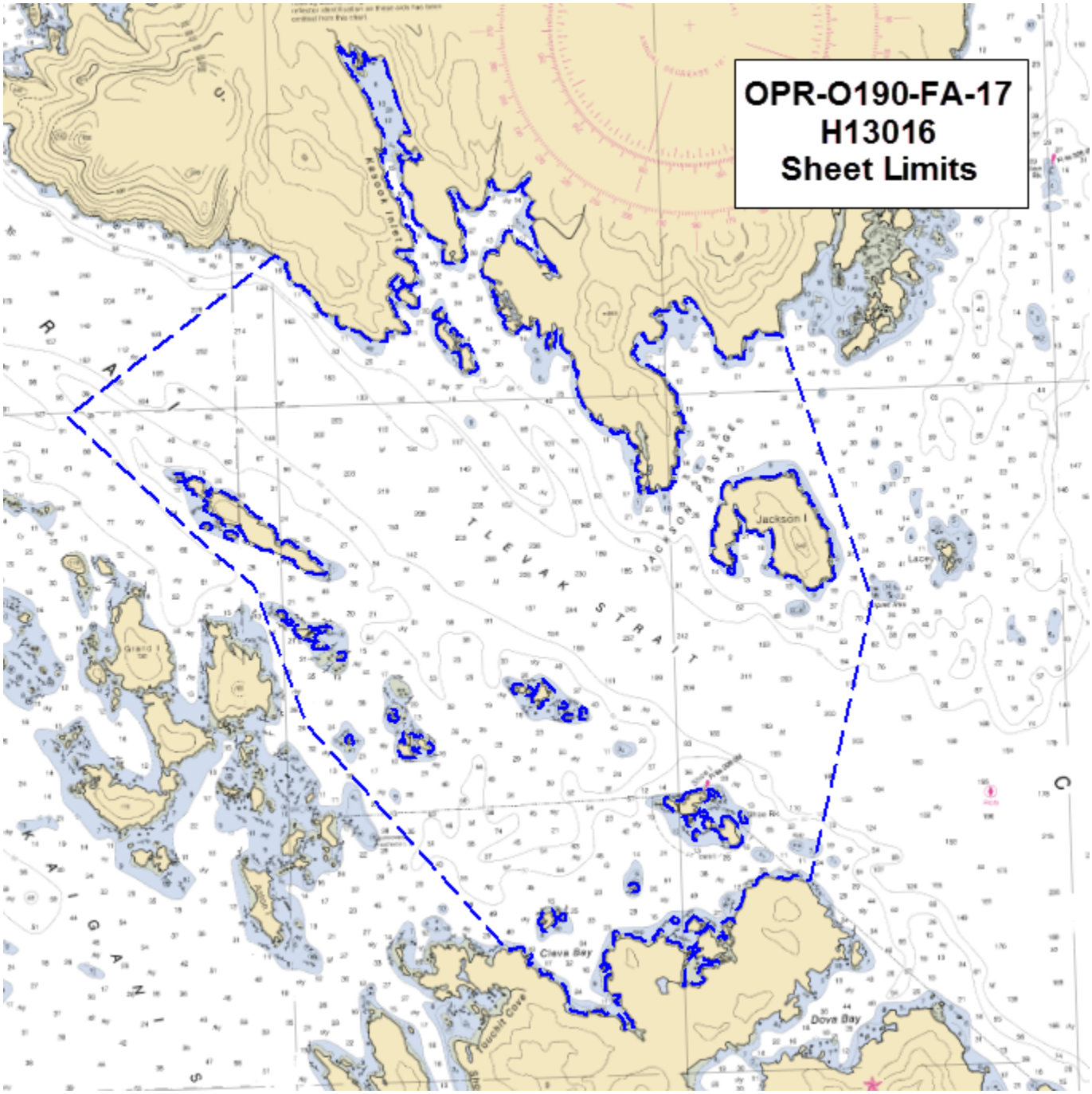


Figure 1: H13016 sheet limits (in blue) overlaid onto Chart 17408 and 17431

Data were acquired to the survey limits in accordance with the requirements listed within the Project Instructions and the April 2017 NOS Hydrographic Surveys Specifications and Deliverables (HSSD), as shown in Figure 1. In all areas where the 4 meter depth contour or the sheet limits were not met, the Navigable Area Limit (NALL) was defined as the inshore limit of bathymetry due to the risks of maneuvering the survey vessel in close proximity to kelp beds and the steep and rocky shoreline. An example of such an area is shown in Figure 2.

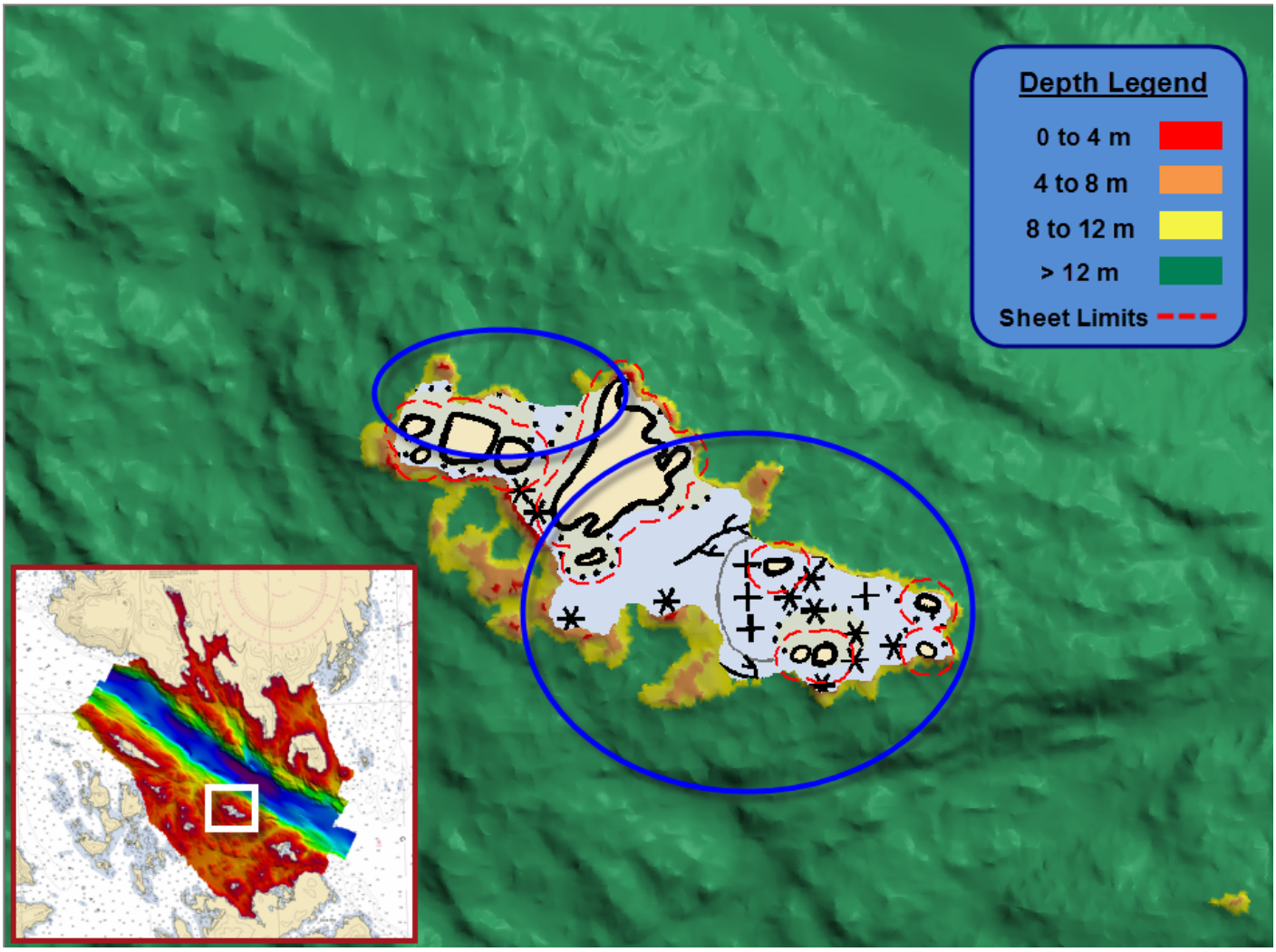


Figure 2: Area where the NALL was defined by the presence of rocks

A.2 Survey Purpose

This project provides a contemporary survey to update National Ocean Service (NOS) nautical charting products in an area where the communities are not accessible by land and the primary means of travel is by sea. Survey vintage in this area dates back to 1912 and 1913 with uncharted dangers littered throughout Tlevak Strait and Cordova Bay. Waterways along the western side of Prince of Wales Island are underlain by pinnacles, rocks, islets, and complex tidal currents. Multiple reported dangerous pinnacles and the local geology give reason to suspect many more such hazards. These waterways are economically significant to the coastal delivery of goods to the towns and villages that are along the region and provide an alternate route to the standard Inside Passage. Numerous fishing villages are on the west side of Prince of Wales Island. Natives and recreational boaters often utilize this area for fishing and transportation. Additionally, the Inter-Island Ferry Authority serves as an important marine link for many of the communities in the Prince

of Wales Island region of Southeast Alaska. Survey data from this project is intended to supersede all prior survey data in the common area.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H13016 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 of 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
All waters in survey area	Complete Coverage multibeam with backscatter.

Table 2: Survey Coverage

The entirety of H13016 was acquired with full coverage MBES, meeting the requirements listed above and in the HSSD. See Figure 3 below for an overview of coverage.

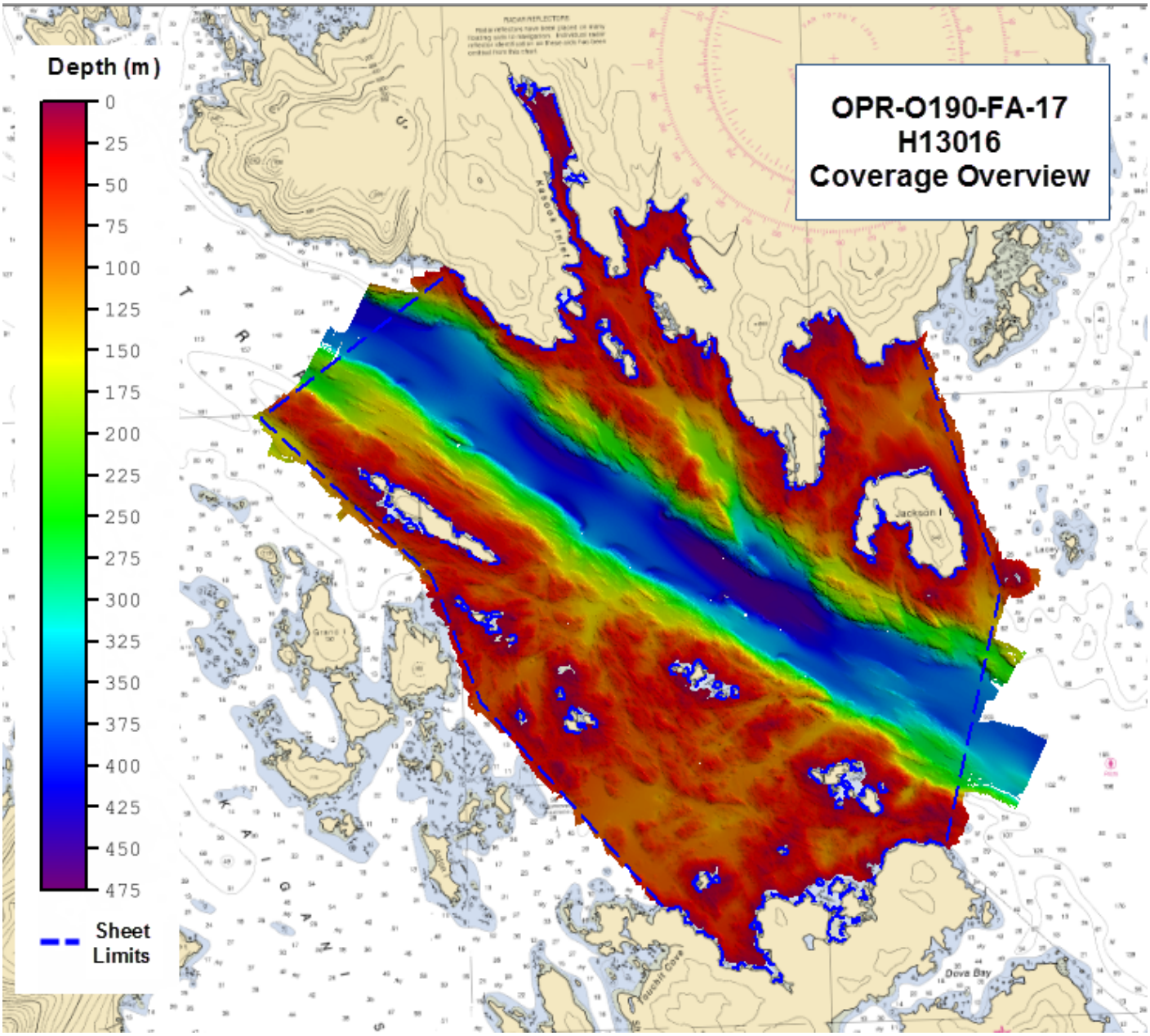


Figure 3: H13016 survey coverage (variable resolution surface) overlaid onto Charts 17408 and 17431

A.6 Survey Statistics

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

	HULL ID	*2806*	*2807*	*2808*	*S220*	*Total*
LNM	SBES Mainscheme	0	0	0	0	0
	MBES Mainscheme	123.13	66.46	45.38	45.38	280.35
	Lidar Mainscheme	0	0	0	0	0
	SSS Mainscheme	0	0	0	0	0
	SBES/SSS Mainscheme	0	0	0	0	0
	MBES/SSS Mainscheme	0	0	0	0	0
	SBES/MBES Crosslines	0	16.94	0	0	16.94
	Lidar Crosslines	0	0	0	0	0
Number of Bottom Samples						7
Number Maritime Boundary Points Investigated						0
Number of DPs						76
Number of Items Investigated by Dive Ops						0
Total SNM						19.48

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/06/2017	157
06/09/2017	160

Survey Dates	Day of the Year
06/11/2017	162
06/12/2017	163
06/13/2017	164
06/18/2017	169
06/19/2017	170
06/20/2017	171
06/21/2017	172

Table 4: Dates of Hydrography

MBES Mainscheme LNM for S220 is incorrect. The actual LNM for this vessel is 19.26.

B. Data Acquisition and Processing

B.1 Equipment and Vessels

Refer to the OPR-O190-FA-17 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*	*2806*	*2807*	*2808*
LOA	70.4 meters	8.6 meters	8.6 meters	8.6 meters
Draft	4.8 meters	1.1 meters	1.1 meters	1.1 meters

Table 5: Vessels Used

B.1.2 Equipment

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

Manufacturer	Model	Type
Kongsberg Maritime	EM 710	MBES
Kongsberg Maritime	EM 2040	MBES
Sea-Bird Scientific	SBE 19plus V2	Conductivity, Temperature, and Depth Sensor
ODIM Brooke Ocean	MVP200	Conductivity, Temperature, and Depth Sensor
Teledyne RESON	SVP 70	Sound Speed System
Teledyne RESON	SVP 71	Sound Speed System
Applanix	POS MV 320 v5	Positioning and Attitude System
Velodyne LiDAR	VLP-16	Lidar System

Table 6: Major Systems Used

The equipment was installed on the survey platforms as follows: S220 utilizes the Kongsberg EM 710 MBES, SVP 70 surface sound speed sensors, and ODIM Brooke Ocean MVP200 for conductivity, temperature, and depth (CTD) casts. All launches utilize Kongsberg EM 2040 MBES, Teledyne RESON SVP71 surface sound speed sensors, and Sea-Bird Scientific 19plus CTD casts. Additionally, Launches 2806 and 2808 are equipped with the Velodyne VLP-16 Lidar for shoreline feature acquisition.

B.2 Quality Control

B.2.1 Crosslines

Multibeam/single beam echo sounder/side scan sonar crosslines acquired for this survey totaled 6.04% of mainscheme acquisition.

Crosslines were collected, processed and compared in accordance with Section 5.2.4.3 of the HSSD. To evaluate crosslines, a surface using strictly mainscheme lines, and a surface using strictly crosslines were created. From these two surfaces, a difference surface (mainscheme - crosslines = difference surface) was generated (Figure 4), and is submitted in the Separates II Digital Data folder. Statistics show the mean difference between the depths derived from mainscheme and crosslines was 0.04 (with mainscheme being shoaler) and 95% of nodes falling within 1.06 meters (Figure 5). For the respective depths, the difference surface was compared to the allowable NOAA uncertainty standards. In total, 99.14% of the depth differences between H13016 mainscheme and crossline data were within allowable NOAA uncertainties.

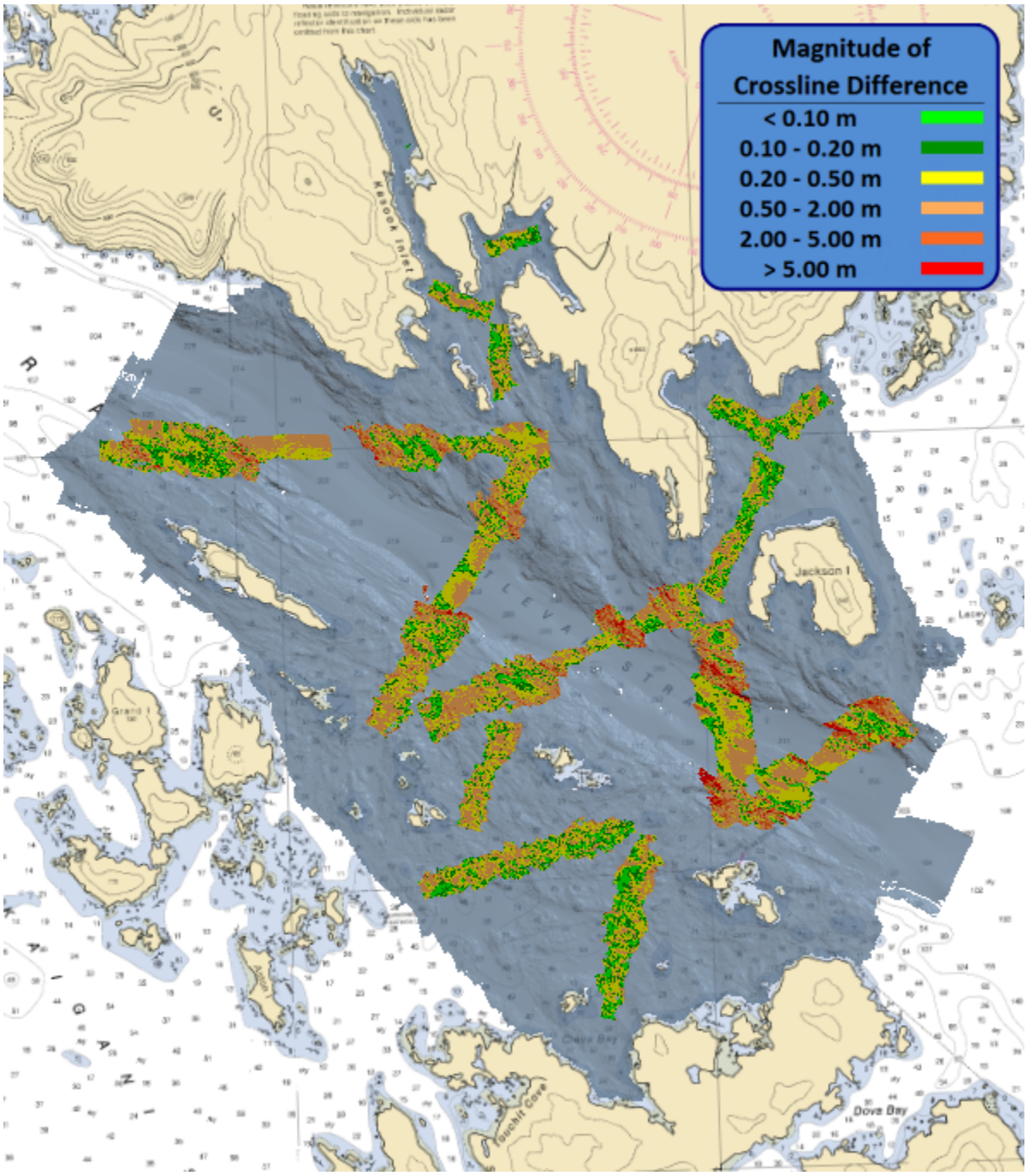
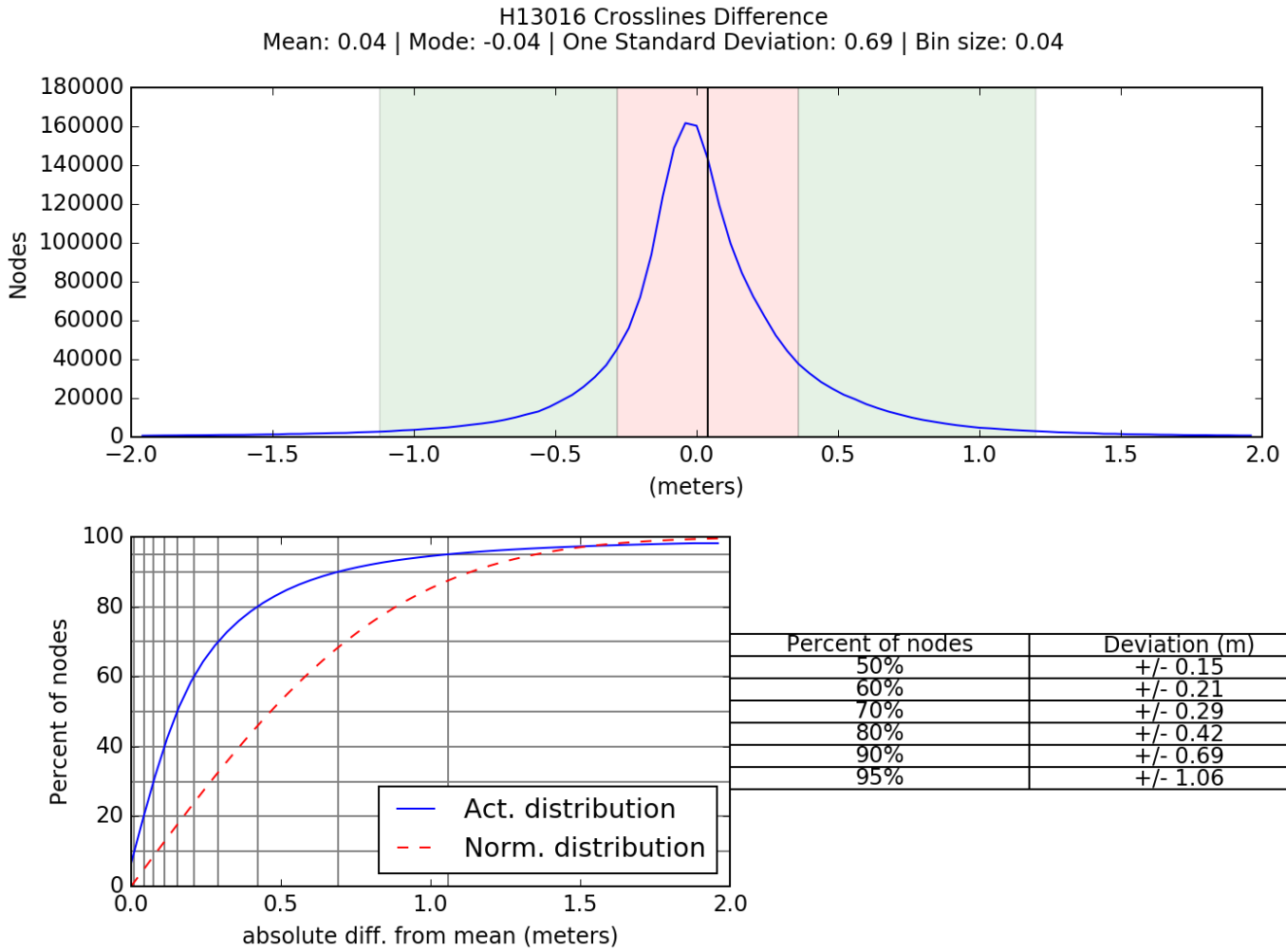


Figure 4: Overview of H13016 crosslines



Percent of nodes	Deviation (m)
50%	+/- 0.15
60%	+/- 0.21
70%	+/- 0.29
80%	+/- 0.42
90%	+/- 0.69
95%	+/- 1.06

Figure 5: H13016 crossline and mainscheme difference statistics

Crosslines totaled 6.6% of mainscheme acquisition.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Real time uncertainty values were calculated by TCARI grid

Method	Measured	Zoning
ERS via PMVD	0.0 meters	0.03 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Surface
S220	N/A meters/second	1 meters/second	0.5 meters/second
280x (all launches)	2 meters/second	N/A meters/second	0.5 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

In addition to the usual a priori estimates of uncertainty provided via device models for vessel motion, ERZT, and Poor Man's VDatum (PMVD), real-time and post-processed uncertainty sources were also incorporated into the depth estimates of survey H13016. Real-time uncertainties were provided via EM 710 and EM 2040 MBES data, Applanix Delayed Heave RMS, and TCARI tides. Following post-processing of the real-time vessel motion, recomputed uncertainties of vessel roll, pitch, gyro and navigation were applied in CARIS HIPS and SIPS via a Smoothed Best Estimate of Trajectory (SBET) RMS file generated in Applanix POSPac.

B.2.3 Junctions

H13016 junctions with two adjacent surveys from this project, H13015 and H12882, as shown in Figure 6. Data overlap between H13016 and each adjacent survey was achieved. These areas of overlap between surveys were reviewed with CARIS HIPS and SIPS by surface differencing to assess surface agreement. The multibeam data were also examined in CARIS Subset Editor for consistency and agreement. The junctions with H13016 are generally within the NOAA allowable uncertainty in their areas of overlap. For all junctions with H13016, a negative difference indicates H13016 was shoaler, and a positive difference indicates H13016 was deeper.

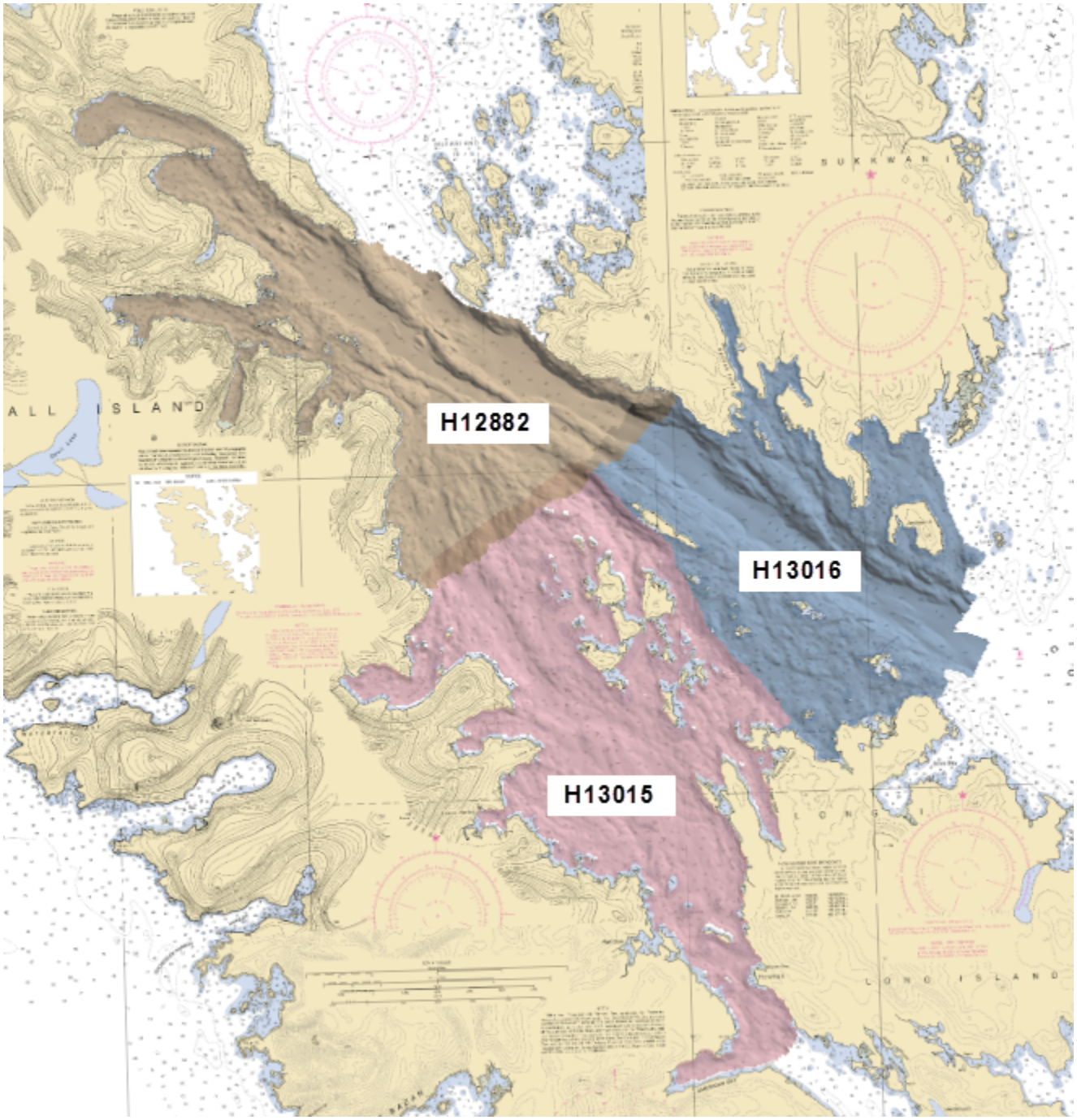


Figure 6: Overview of H13016 junction surveys

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13015	1:20000	2017	NOAA Ship FAIRWEATHER	W
H12882	1:20000	2017	NOAA Ship FAIRWEATHER	N

Table 9: Junctioning Surveys

H13015

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the surface from H13016 and the surface from H13015. The statistical analysis of the difference surface shows a mean of -0.05 meters with 95% of all nodes having a maximum deviation of +/- 0.59 meters, as seen in Figure 8. It was found that 99.08% of nodes are within the NOAA allowable uncertainty. The largest differences are located on the northern side of the junction in a relatively rocky area as seen in Figure 7.

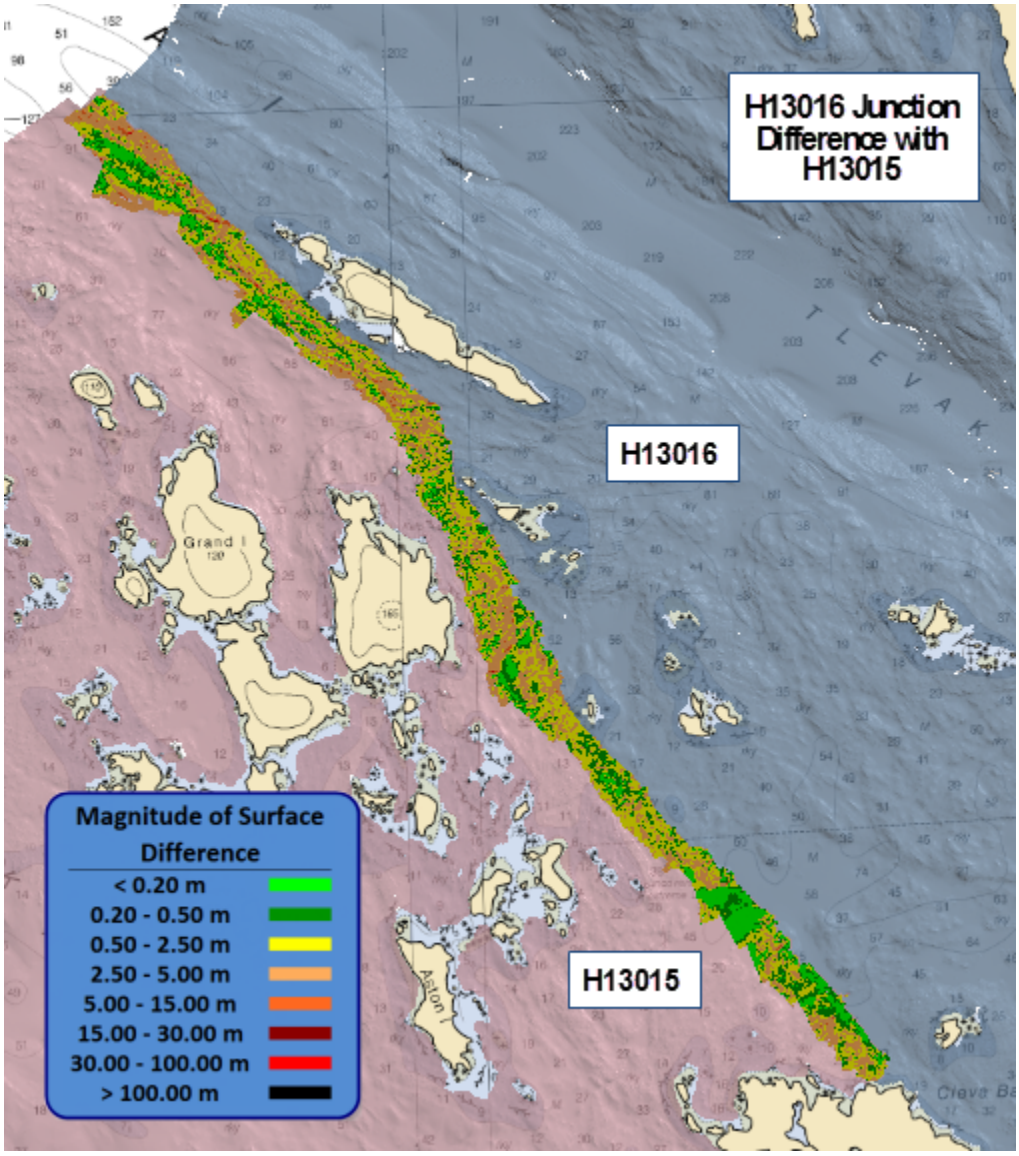
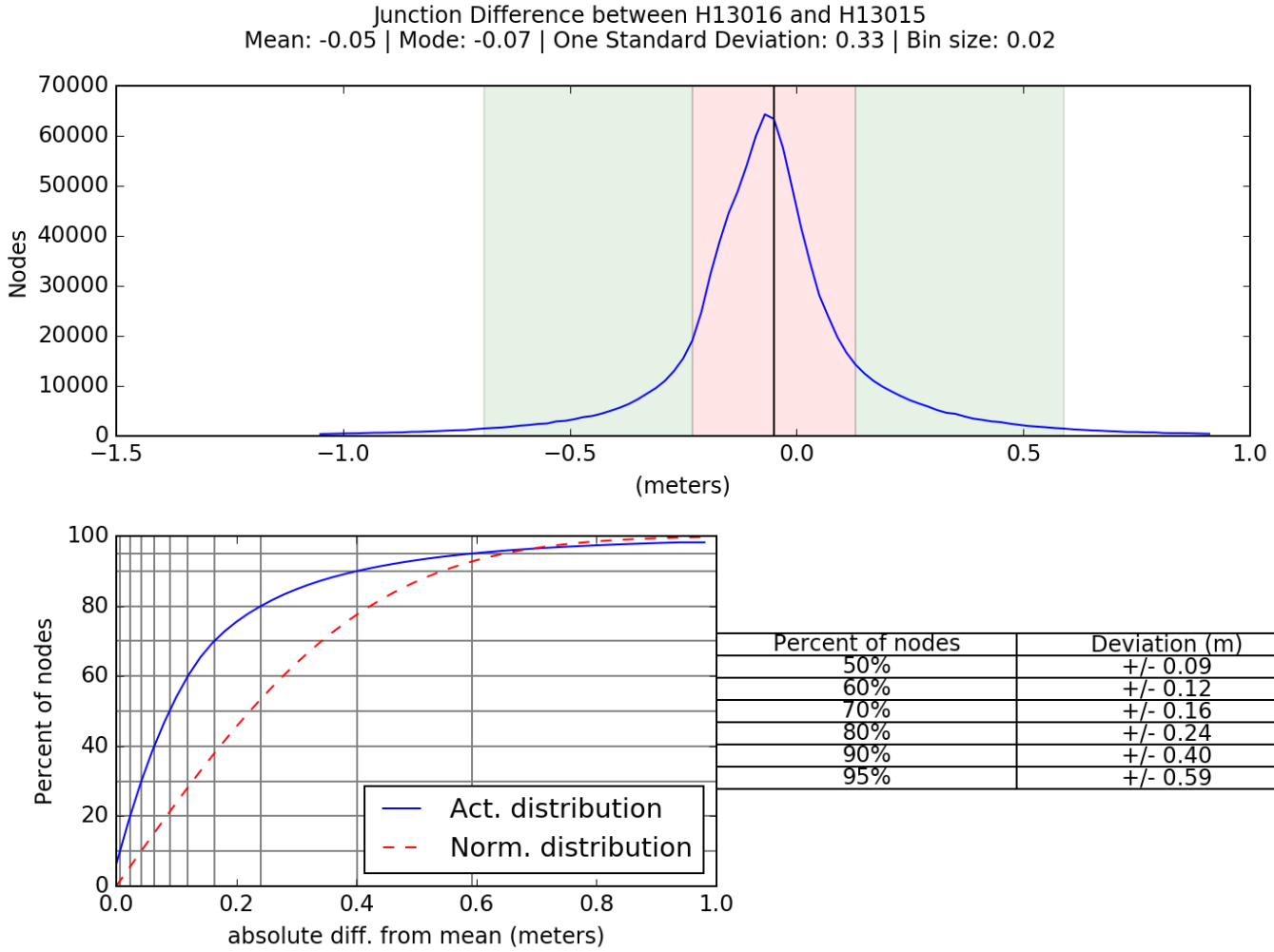


Figure 7: Difference surface between H13016 (blue) and junctioning survey H13015 (pink)



Percent of nodes	Deviation (m)
50%	+/- 0.09
60%	+/- 0.12
70%	+/- 0.16
80%	+/- 0.24
90%	+/- 0.40
95%	+/- 0.59

Figure 8: Difference surface statistics between H13016 and H13015 (variable resolution surface)

H12882

Surface differencing in CARIS HIPS and SIPS was used to assess junction agreement between the surface from H13016 and the surface from H12882. The statistical analysis of the difference surface shows a mean of -0.08 with 95% of all nodes having a maximum deviation of +/- 1.46 meters, as seen in Figure 10. It was found that 98.79% of nodes are within NOAA allowable uncertainty. The largest differences exhibited are in areas where the geologic structure of the sea floor is dynamic, such as steep slopes and rocks, as seen in Figure 9.

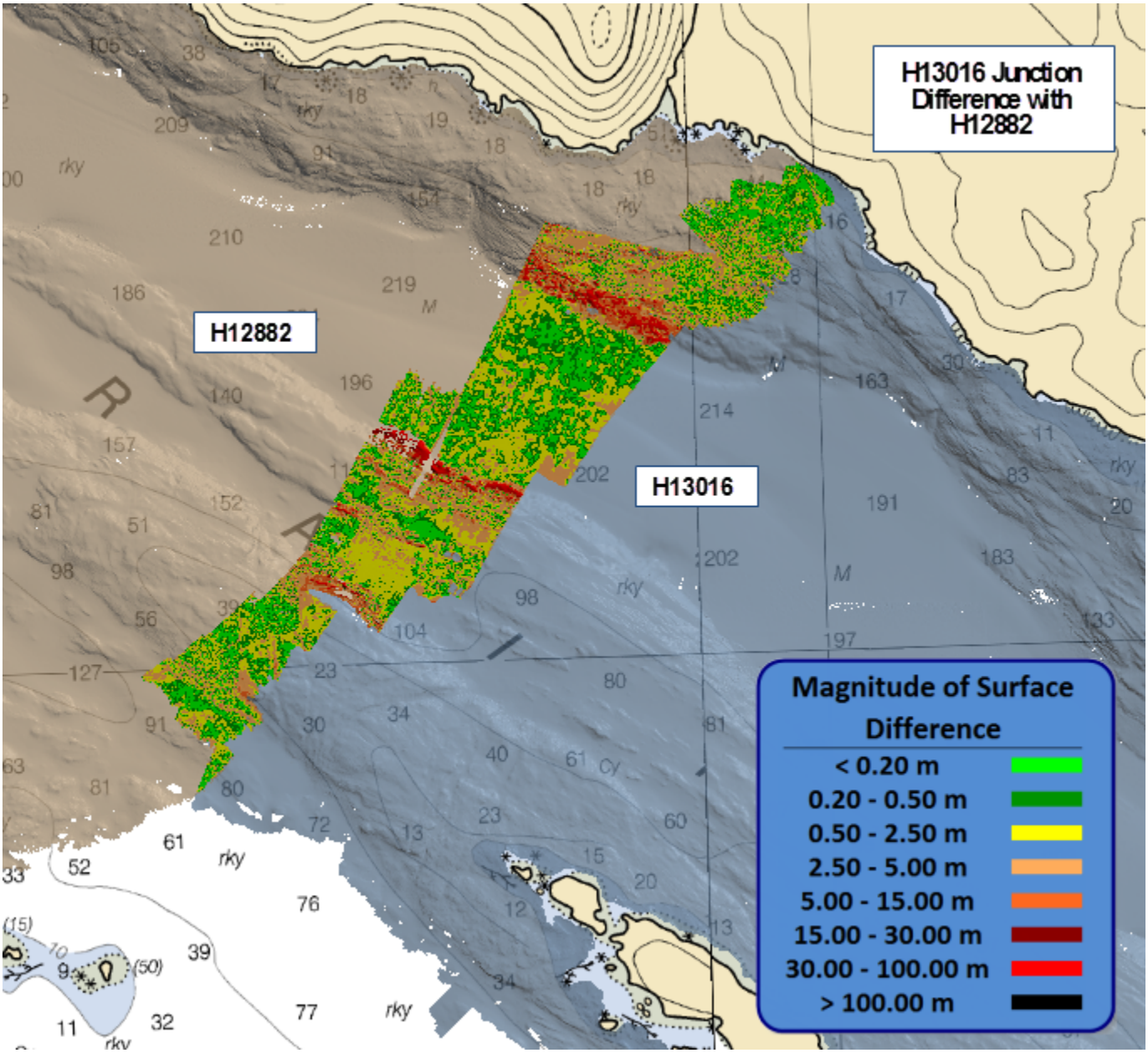
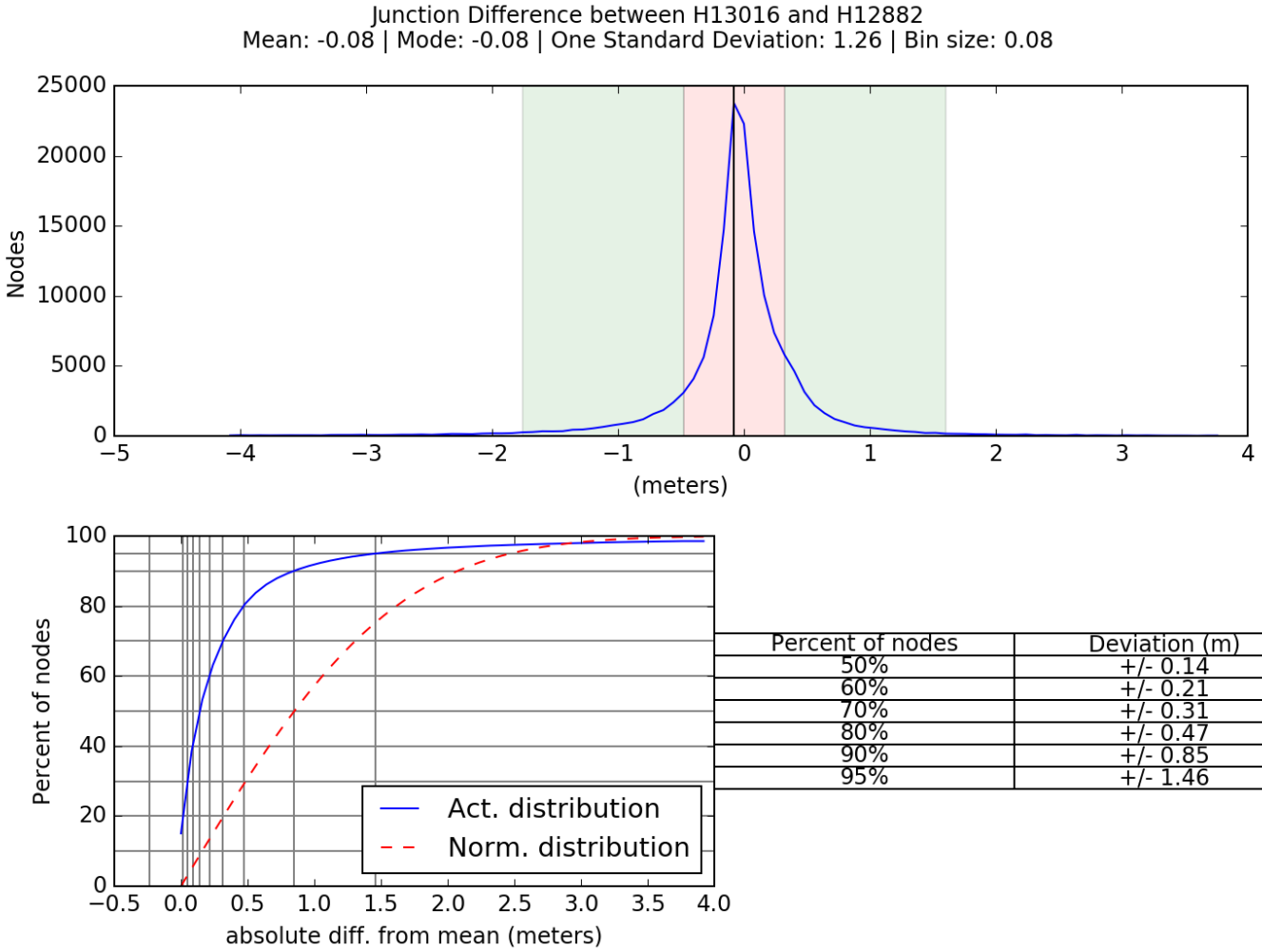


Figure 9: Difference surface between H13016 (blue) and junctioning survey H12882 (brown)



Percent of nodes	Deviation (m)
50%	+/- 0.14
60%	+/- 0.21
70%	+/- 0.31
80%	+/- 0.47
90%	+/- 0.85
95%	+/- 1.46

Figure 10: Difference surface statistics between H13016 and H12882 (variable resolution surface)

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

Sea Grass and Kelp

Kelp and sea grass were present throughout the survey area and at times, indistinguishable from the sea floor. In areas where they were distinguishable, the soundings on the vegetation were rejected to enable more accurate representation of the true sea floor. Where vegetation was indistinguishable, all soundings were retained. Furthermore, in some areas patches of dense kelp prohibited safe navigation of the survey vessels. The limits of these areas were then used to define the NALL (Figure 11). Documentation can be found in the vessel boat sheets, which are located in the Separates I Digital Data Folder.

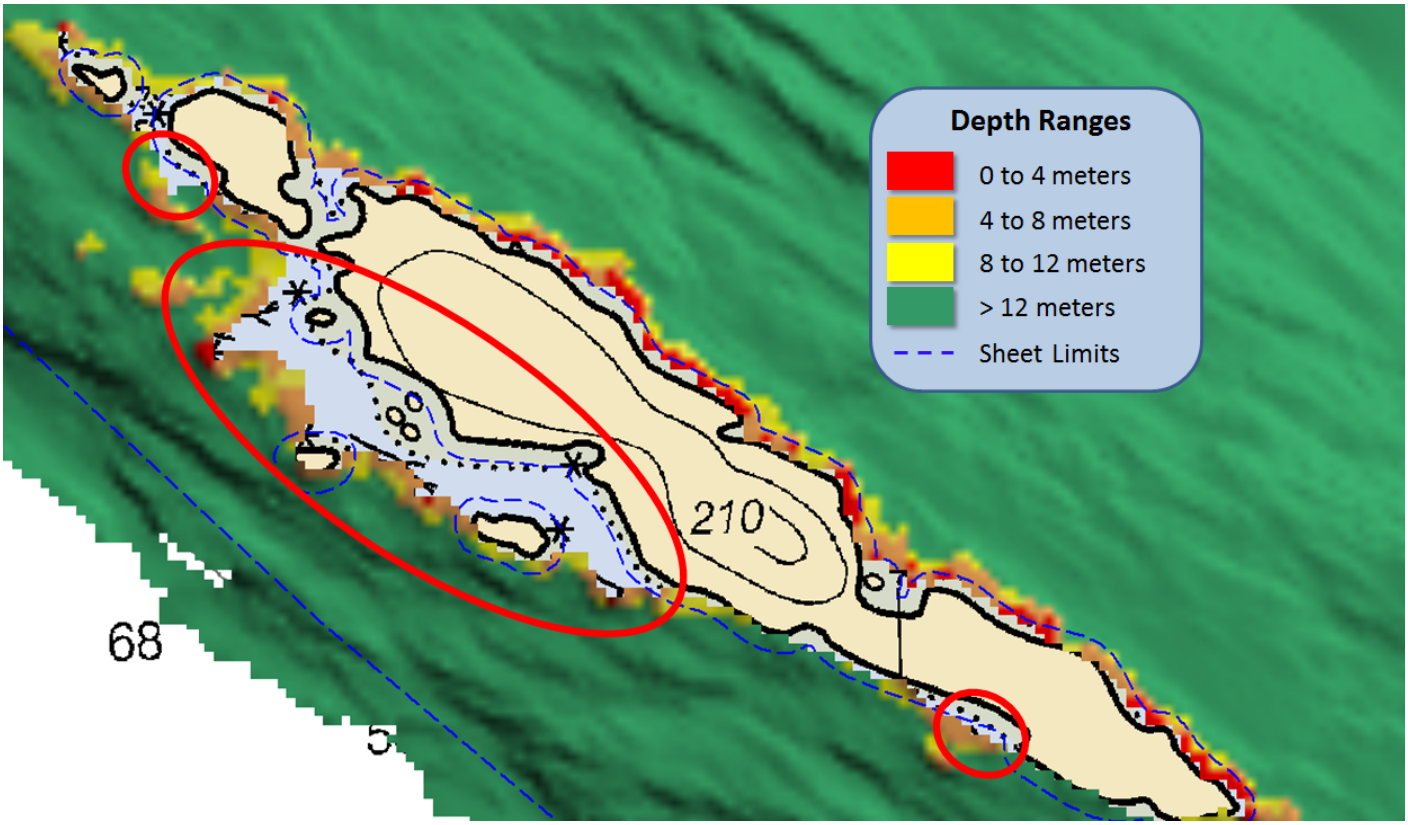


Figure 11: Area where NALL is defined by kelp limits

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Casts were conducted at a minimum of one every four hours during launch acquisition. Casts were conducted more frequently in areas where the influx of freshwater had an effect on the speed of sound in the water column and when there was a change in surface sound speed greater than two meters per second. MVP casts on S220 were conducted at a frequency determined by observation of the surface sound speed and at regular intervals. All sound speed methods were used as detailed in the DAPR.

B.2.8 Coverage Equipment and Methods

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

B.2.9 Holidays

H13016 data were reviewed in CARIS HIPS and SIPS for holidays in accordance with Section 5.2.2.3 of the HSSD. Sixty-six holidays which meet the 3 by 3 node definition were identified via Pydro QC Tools Holiday Finder tool (Figure 12). This tool automatically scans finalized surfaces for holidays as defined in the HSSD and was run in conjunction with a visual inspection of the surface by the hydrographer.

Although numerous apparent holidays were flagged by Holiday Finder, all were examined and 47 holidays are due to acoustic shadowing in steep, rocky areas as seen in Figures 13 and 14. These shadows are formed due to lack of coverage on the "back" side of a feature, usually due to rapid drops in the sea floor in conjunction with poor geometry from the sonar head. The majority of holidays were located in areas deemed unsafe to enter due to proximity to rocks or kelp, with five holidays that are not at the NALL, as shown in Figures 17 and 18. All areas with acoustic shadows were investigated in CARIS subset editor to verify that least depths were found.

Holidays and gaps in coverage are present at the inshore limits of H13016 and are a result of sparse outer beam data while launches developed the inshore limit of safe navigation (NALL). These gaps and holidays are most prevalent in the exposed, rocky areas of H13016 as kelp and nearshore topography made it too dangerous to acquire additional bathymetry, as shown in Figures 15 and Figure 16. Reasonable attempts were made to cover all gaps in coverage that resulted from lack of coverage over the tops of features and underwater rocks when it was safe and prudent to do so. For areas where it was unsafe to do so the features were added or updated accordingly in the Final Feature File accompanying this submission.

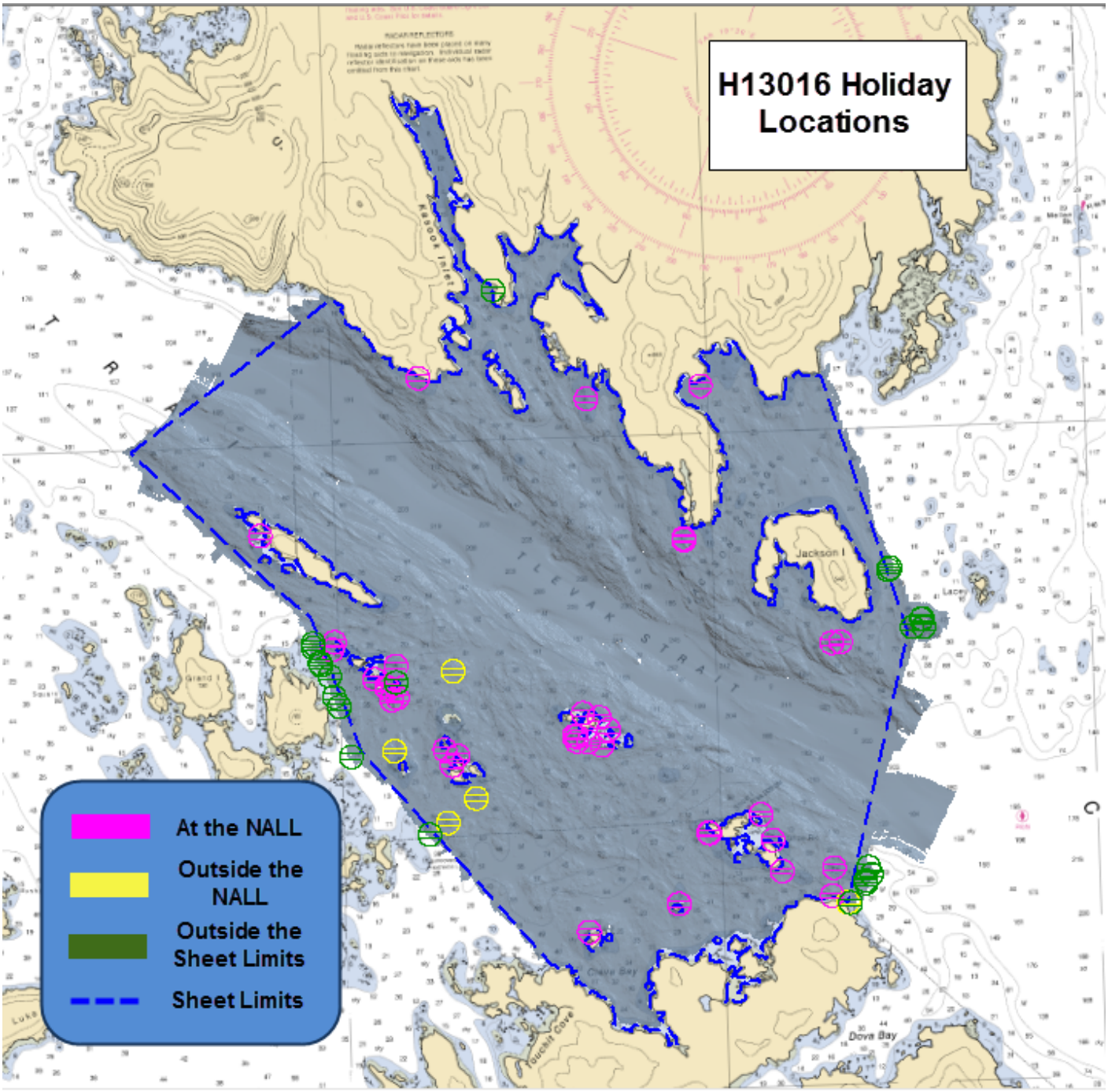


Figure 12: Overview of H13016 holidays found with Holiday Finder

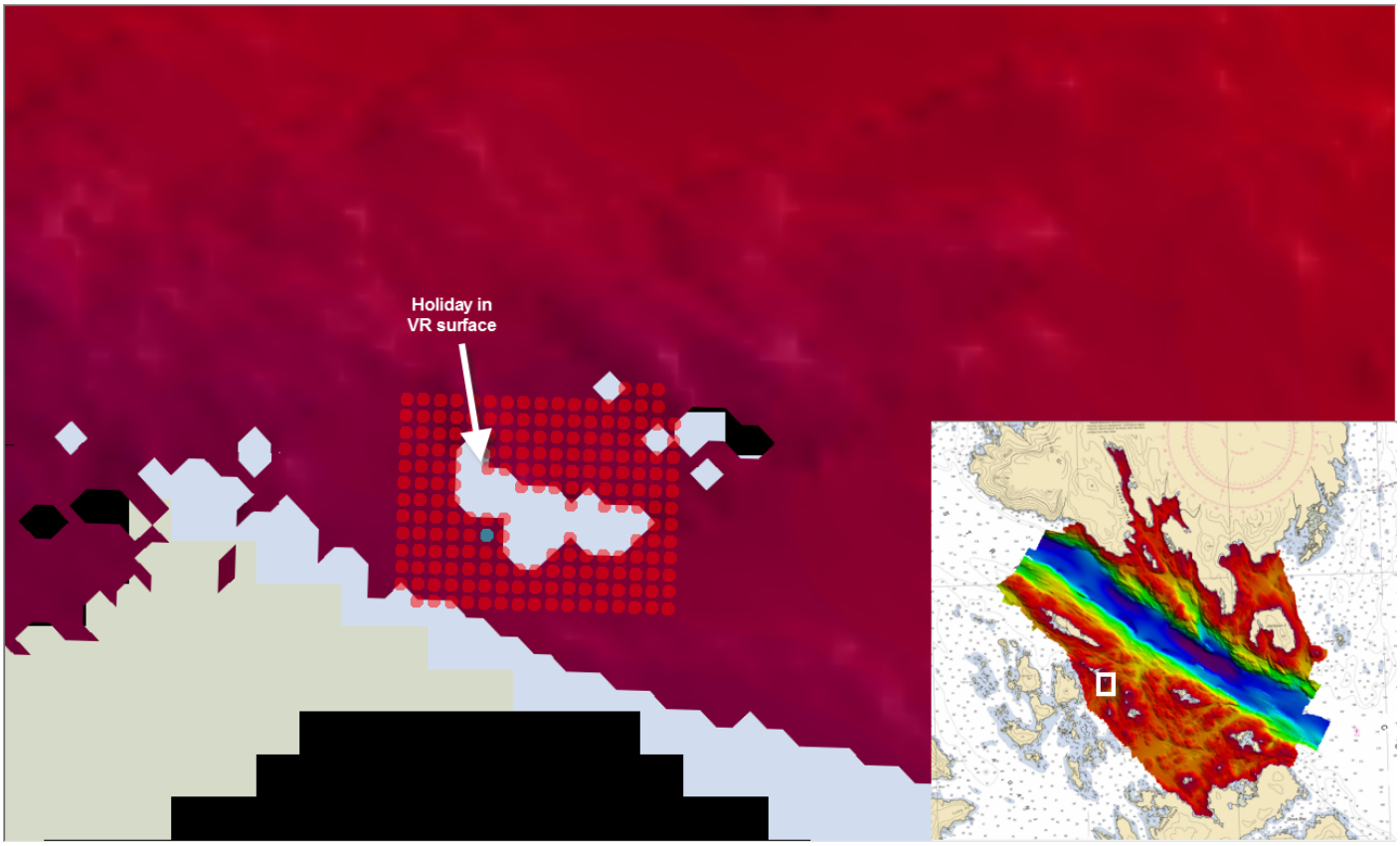


Figure 13: H13016 holiday due to acoustic shadowing

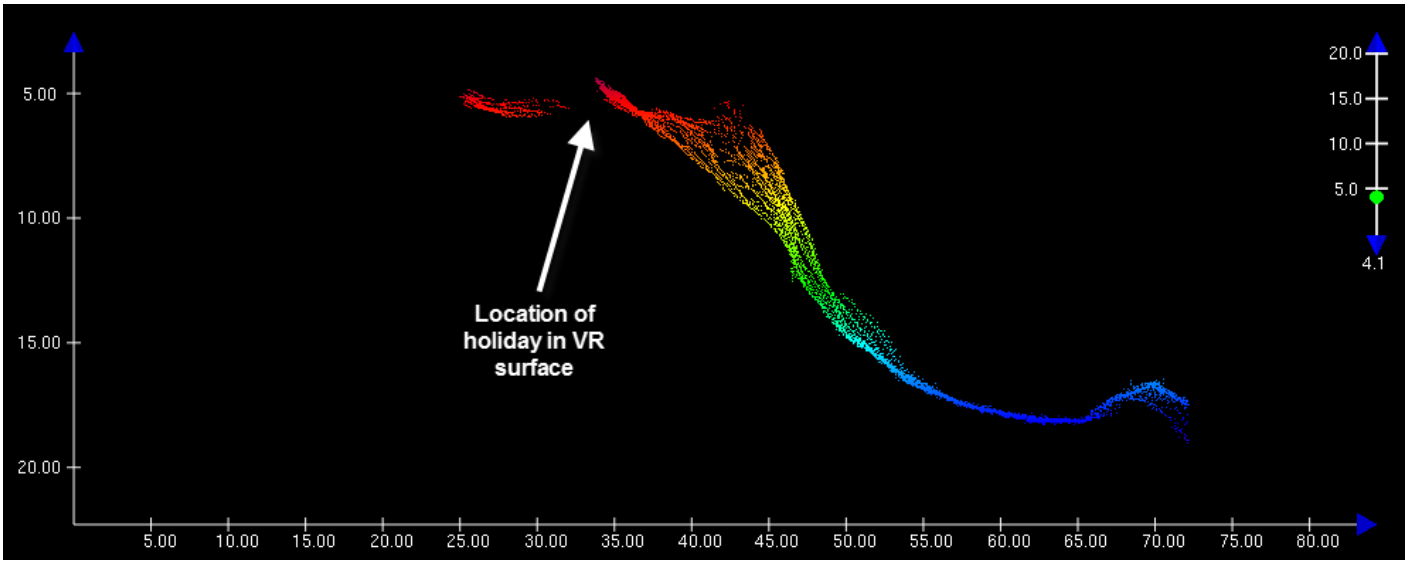


Figure 14: Acoustic shadow holiday viewed in CARIS HIPS and SIPS subset editor

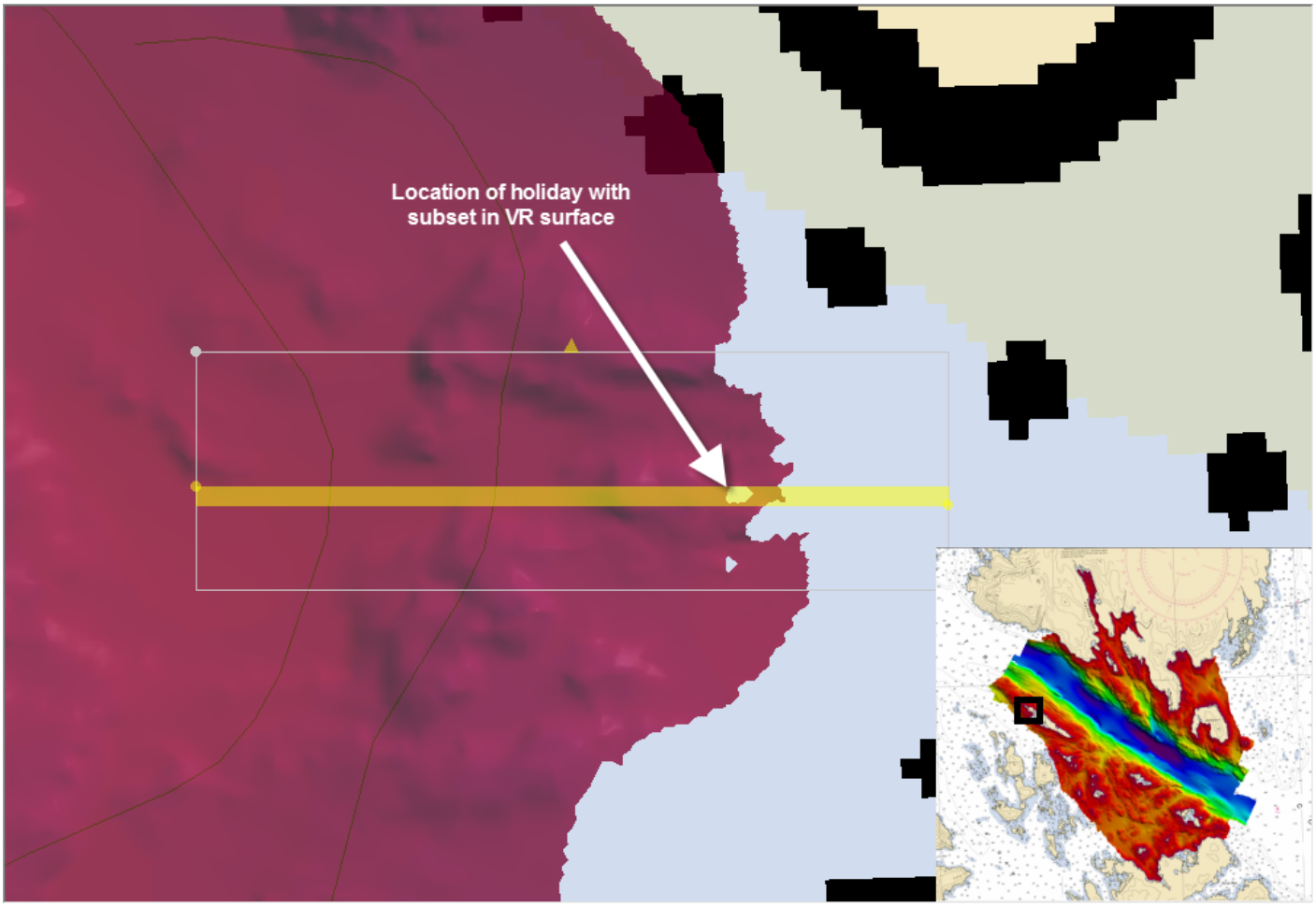


Figure 15: H13016 holiday due to gaps at the NALL

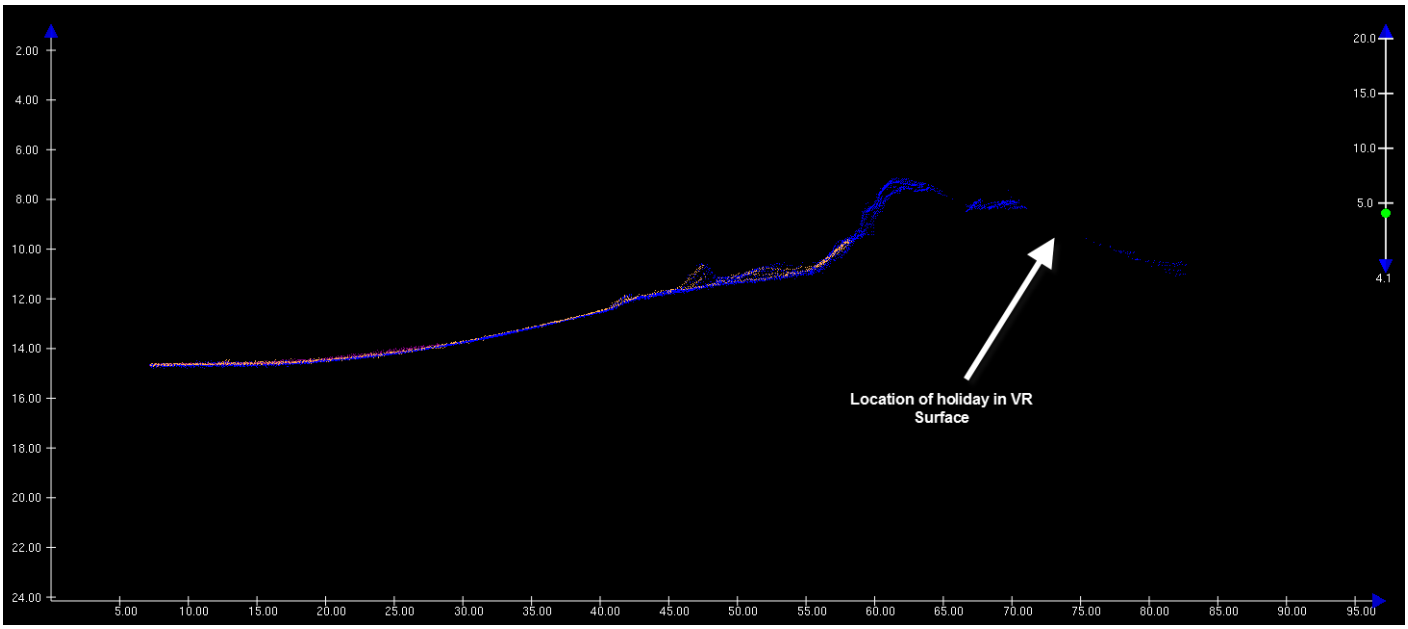


Figure 16: H13016 holiday from gaps at the NALL viewed in CARIS HIPS and SIPS subset editor

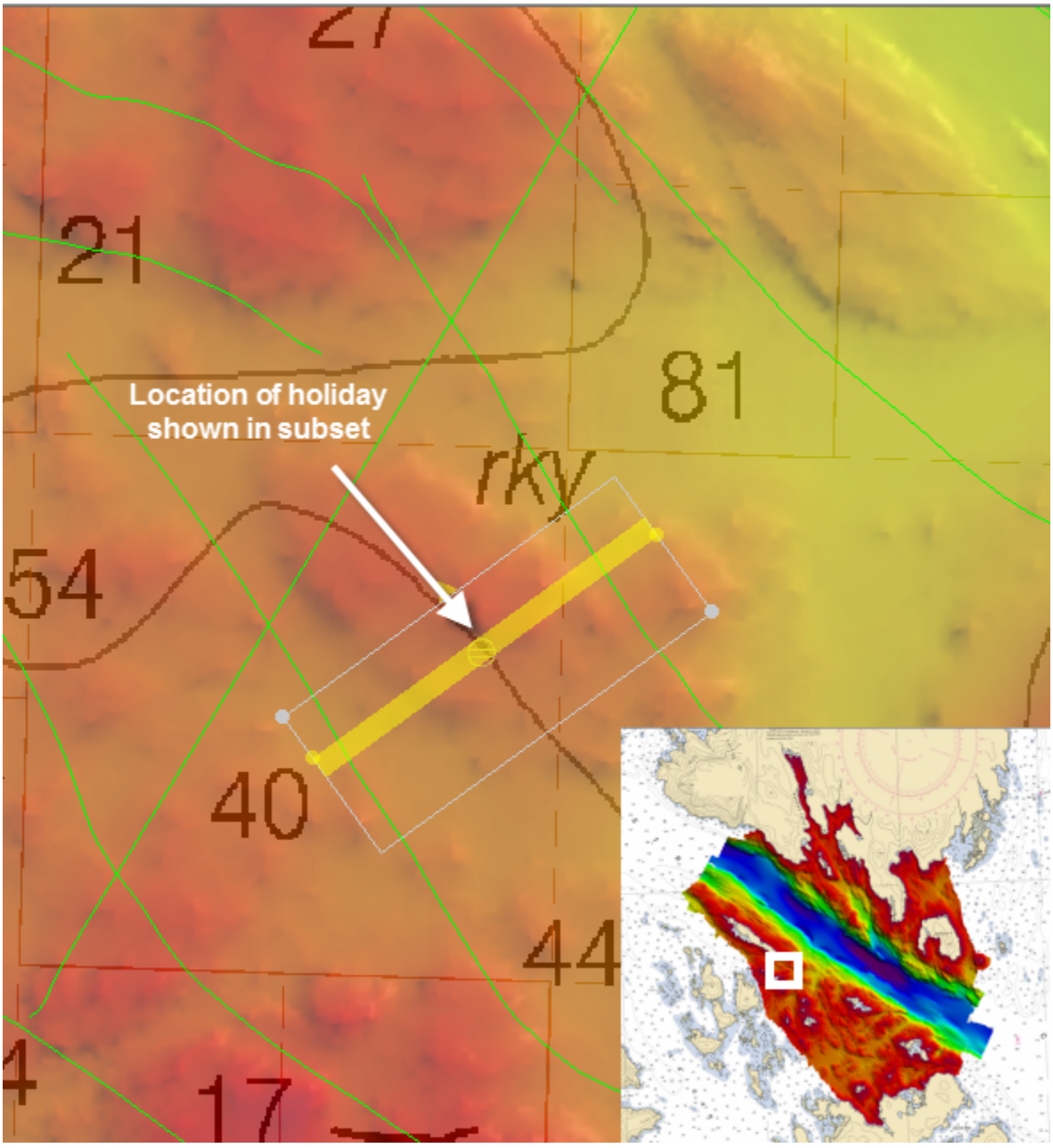


Figure 17: H13016 holiday outside of the NALL

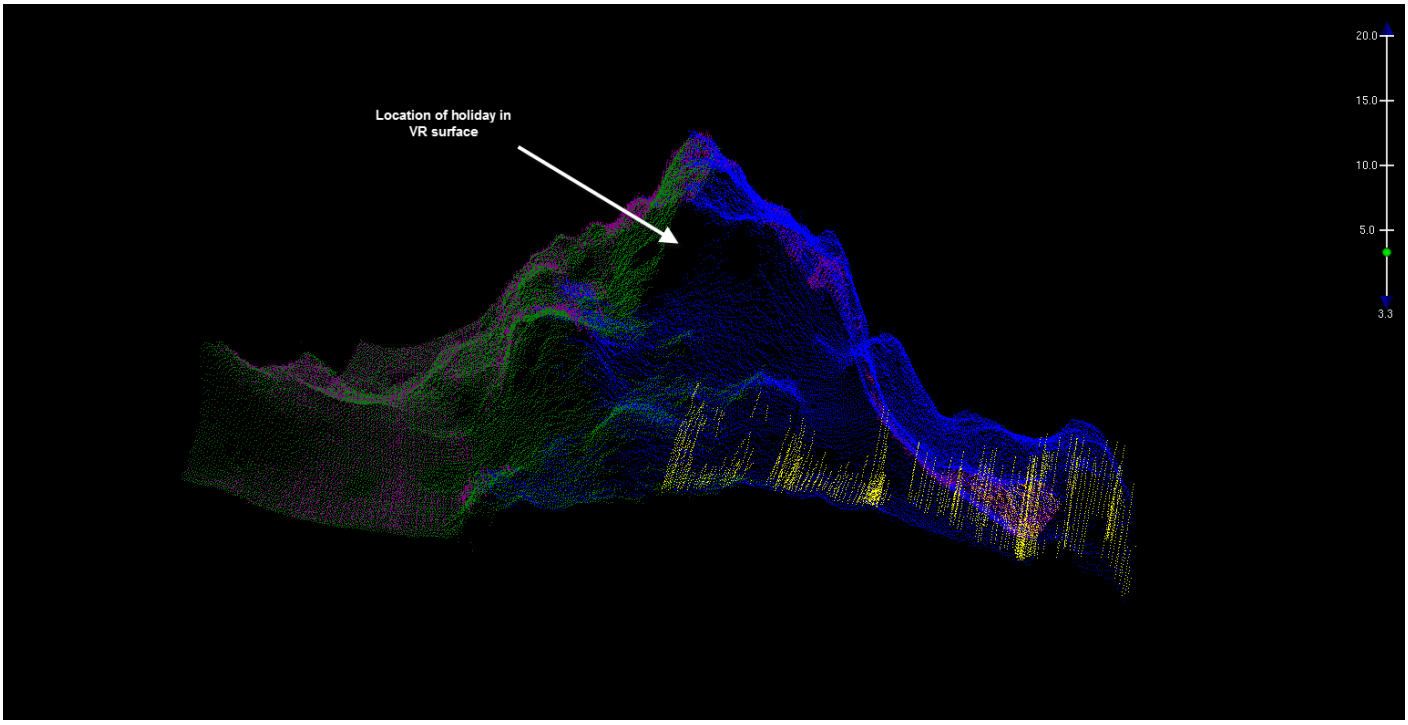


Figure 18: H13016 holiday outside of the NALL viewed in CARIS HIPS and SIPS subset editor

B.2.10 NOAA Allowable Uncertainty

The surface was analyzed using the Pydro QC Tools Grid QA feature to determine what percentage of the surface meets specifications. Overall, 97.69% of nodes with the surface meet NOAA Allowable Uncertainty specifications for H13016. For the individual graph per surface of density requirements, see the Standards and Compliance Review located in Appendix ll.

B.2.11 Density

The surface was analyzed using the Pydro QC Tools Grid QA feature. Density requirements for H13016 were achieved with at least 95.68% of surface nodes containing five or more soundings as required by HSSD Section 5.2.2.3. The few nodes that did not meet density requirements are due to sparse data in the outer beams, especially near steep slopes and rocky areas where acoustic shadowing occurred. For the individual graph of density requirements, see the Standards and Compliance Review located in Appendix ll.

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

Kongsberg EM710 and EM2040 store backscatter data in the .all file. The data have been sent to the Pacific Hydrographic Branch for processing. One line per vessel per day acquisition 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	10.3.3

Table 10: 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 11: Primary imagery data processing software

The following Feature Object Catalog was used: NOAA Extended Attribute Files version 5.6.

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
H13016_MB_VR_MLLW	CARIS VR Surface (CUBE)	1-14 meters	-0.3 meters - 463.8 meters	NOAA_VR	Complete MBES
H13016_MB_VR_MLLW_Final	CARIS VR Surface (CUBE)	1-14 meters	-0.3 meters - 463.8 meters	NOAA_VR	Complete MBES

Table 12: Submitted Surfaces

The NOAA CUBE parameters defined in the HSSD were used for the creation of the variable resolution surface in Survey H13016. The surface has 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 the depth, the noisy data have been rejected by the hydrographer and the surface recomputed.

Flier Finder v5, 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 the surface, reducing 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 sea floor 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 sea floor.

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 H13016 Data Log spreadsheet. All data logs are submitted digitally in the Separates I folder.

B.5.4 Designated Soundings

H13016 contains 1 designated sounding in accordance with HSSD Section 5.2.1.2.3. This designated sounding represents a DTON (see Section D.1.5).

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.

Traditional Methods Used:

TCARI

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

Station Name	Station ID
Ketchikan, AK	9450460

Table 13: NWLON Tide Stations

File Name	Status
9450460.tid	Final Approved

Table 14: Water Level Files (.tid)

File Name	Status
O190FA2017_Verified.tc	Final

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

A request for final approved tides was sent to N/OPS1 on 06/23/2017. The final tide note was received on 07/05/2017.

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.

After final tides were received, the final TCARI grids were applied to the data and used for reducing features to MLLW.

ERS Methods Used:

ERS via Poor Mans VDATUM

Ellipsoid to Chart Datum Separation File:

O190FA2017_PMVD_EPSG3395_NAD83-MLLW_Debiased.csar

ERS methods were used as the final means of reducing H13016 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. The de-biased PMVD was used to reduce H13016 to MLLW.

C.2 Horizontal Control

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

The projection used for this project is UTM Zone 08 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 and SIPS.

For further details regarding the processing and quality control checks performed, see the H13016 POSPac Processing Logs spreadsheet located in the Separates folder. See also the OPR-O190-FA-17 Horizontal and Vertical Control Report (HVCR), submitted under separate cover.

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
9677	Willa Jane

Table 16: User Installed Base Stations

During real-time acquisition, S220 as well as launches 2806, 2807, and 2808 received correctors from the Wide Area Augmentation System (WAAS) for increased accuracies similar to USCG DGPS stations. WAAS and SBETs were the sole methods of positioning for H13016 as no DGPS stations were used for realtime horizontal control.

The following WAAS Stations were used for horizontal control:

DGPS Stations

Table 17: FAA WAAS Stations

D. Results and Recommendations

D.1 Chart Comparison

A comparison was performed between survey H13016 and ENCs US5AK4EM and US5AK4IM using CARIS HIPS and SIPS sounding and contour layers derived from the surface. The contours and soundings were overlaid on the charts to assess differences between the surveyed soundings and charted depths. ENCs were compared to the surface by extracting all soundings from the chart and creating an interpolated TIN surface which could be differenced with the variable resolution surface from H13016.

All data from H13016 should supersede charted data. In general, surveyed soundings agree with the majority of charted depths. A full discussion of the disagreements follows in section D.1.1.

D.1.1 Electronic Navigational Charts

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

ENC	Scale	Edition	Update Application Date	Issue Date	Preliminary?
US5AK4IM	1:40000	6	06/27/2017	06/27/2017	NO
US5AK4EM	1:40000	4	08/15/2016	08/15/2016	NO

Table 18: Largest Scale ENCs

US5AK4IM

Soundings from H13016 are in a general agreement with charted depths on ENC US5AK4IM, with most depths agreeing 1-10 fathoms. The largest differences are seen in rocky areas as well as areas with steep slopes, where differences are observed up to 11 fathoms, as seen in Figure 19.

To more accurately visualize trends within these differences, a 16 meter TIN surface was interpolated from the ENC sounding layer. This surface was then differenced with the surface from H13016. Figure 20 shows an overview of the differences surfaces generated between the surface from H13016 and the 16 meter TIN surfaces generated from ENC Charts US5AK4EM and US5AK4IM. In this difference surface red colors indicate H13016 was shoaler than ENC US5AK4IM, green colors indicate agreement, and blue colors indicate H13016 was deeper than ENC US5AK4IM. The mean difference between surveyed soundings from H13016 and the charted depths on ENC US5AK4IM is 5.85 meters, with 95% of nodes having a deviation of +/- 32.50 meters as shown in Figure 21.

Contours from H13016 are in general agreement with the charted contours on ENC US5AK4IM as shown in Figure 22. An area where the survey derived contours deviate significantly from the charted contours is illustrated in Figure 23.

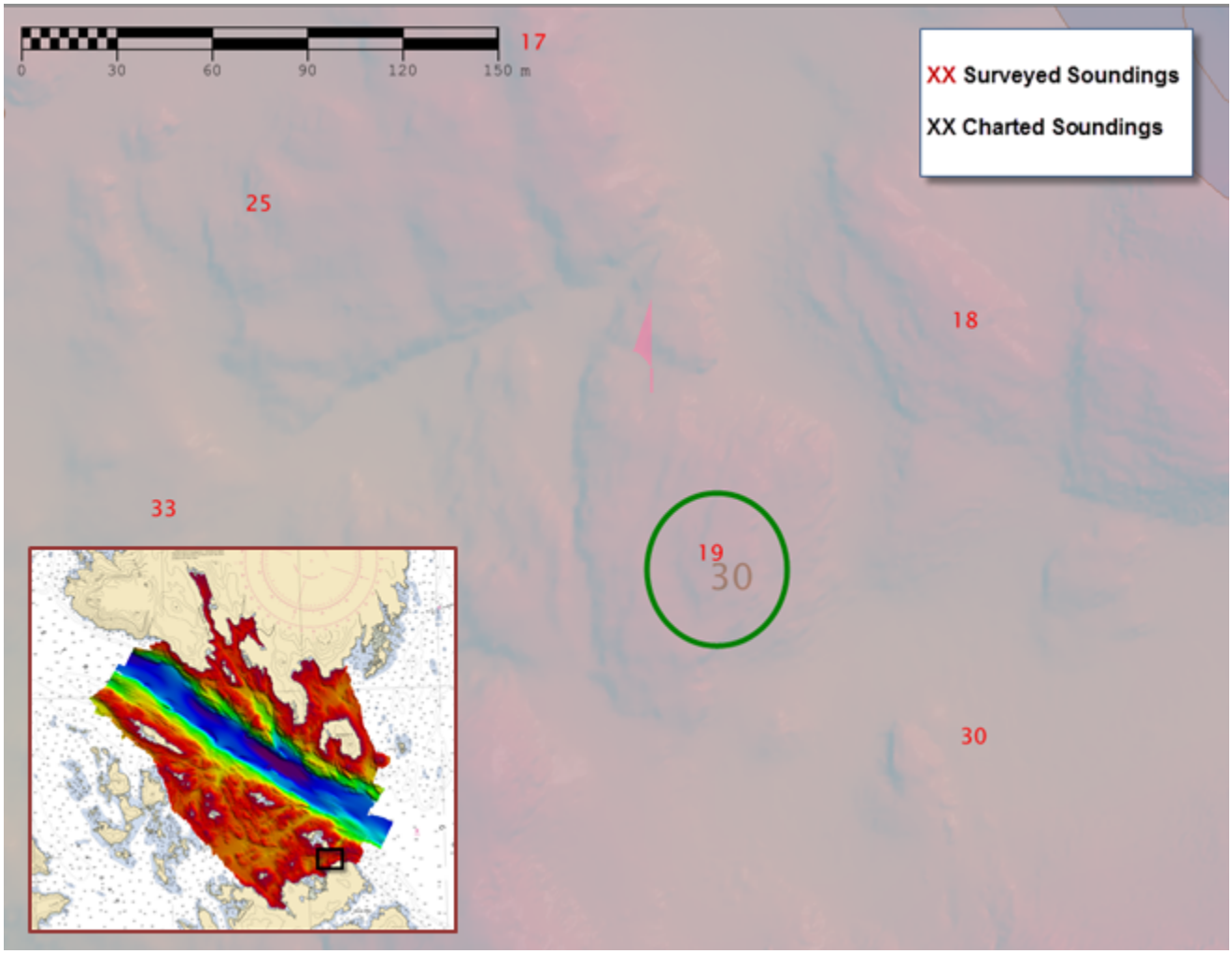


Figure 19: Close up of area where a significant difference exist between H13016 soundings (in red) and ENC US5AK4IM depths (in black)

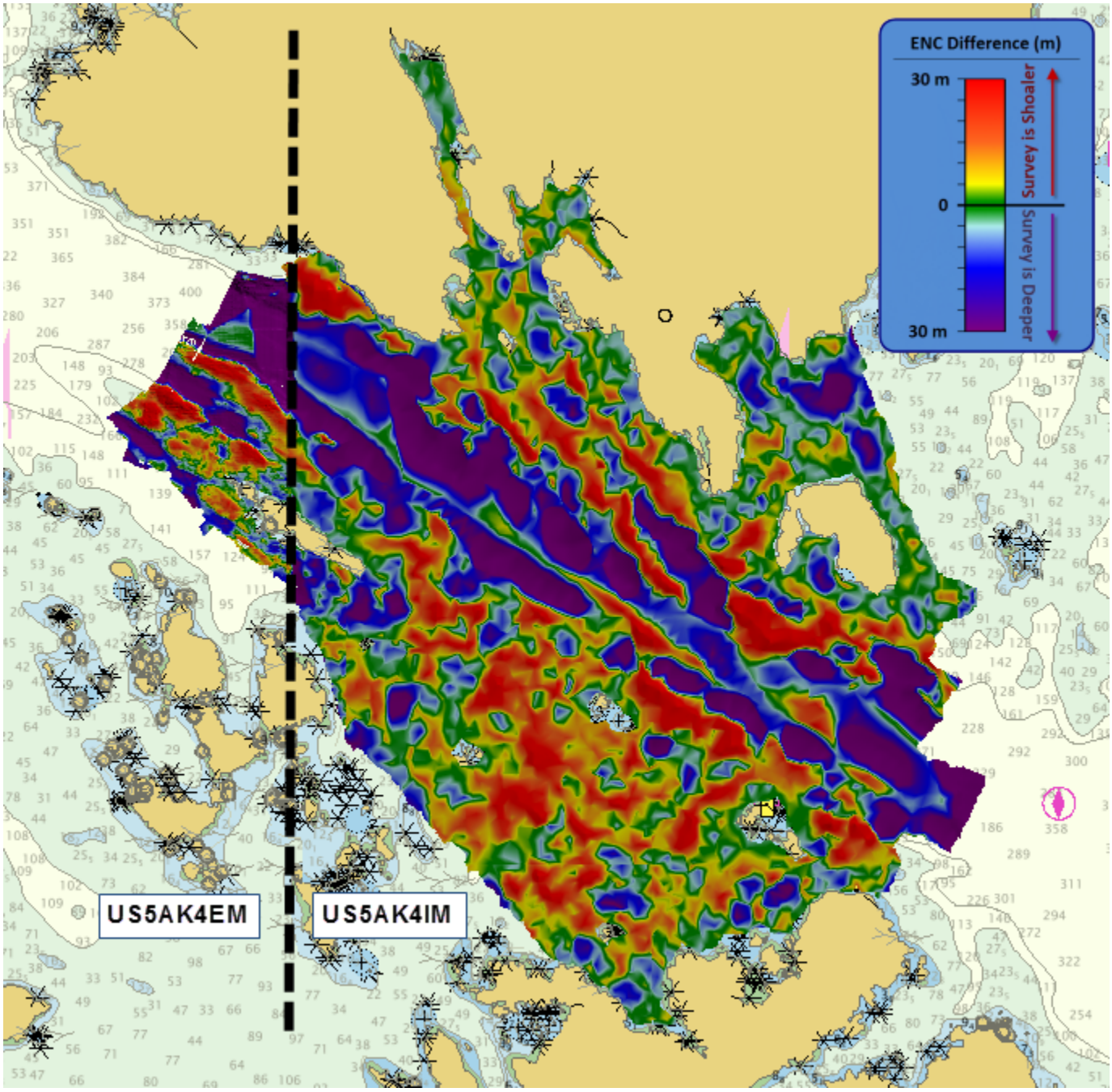
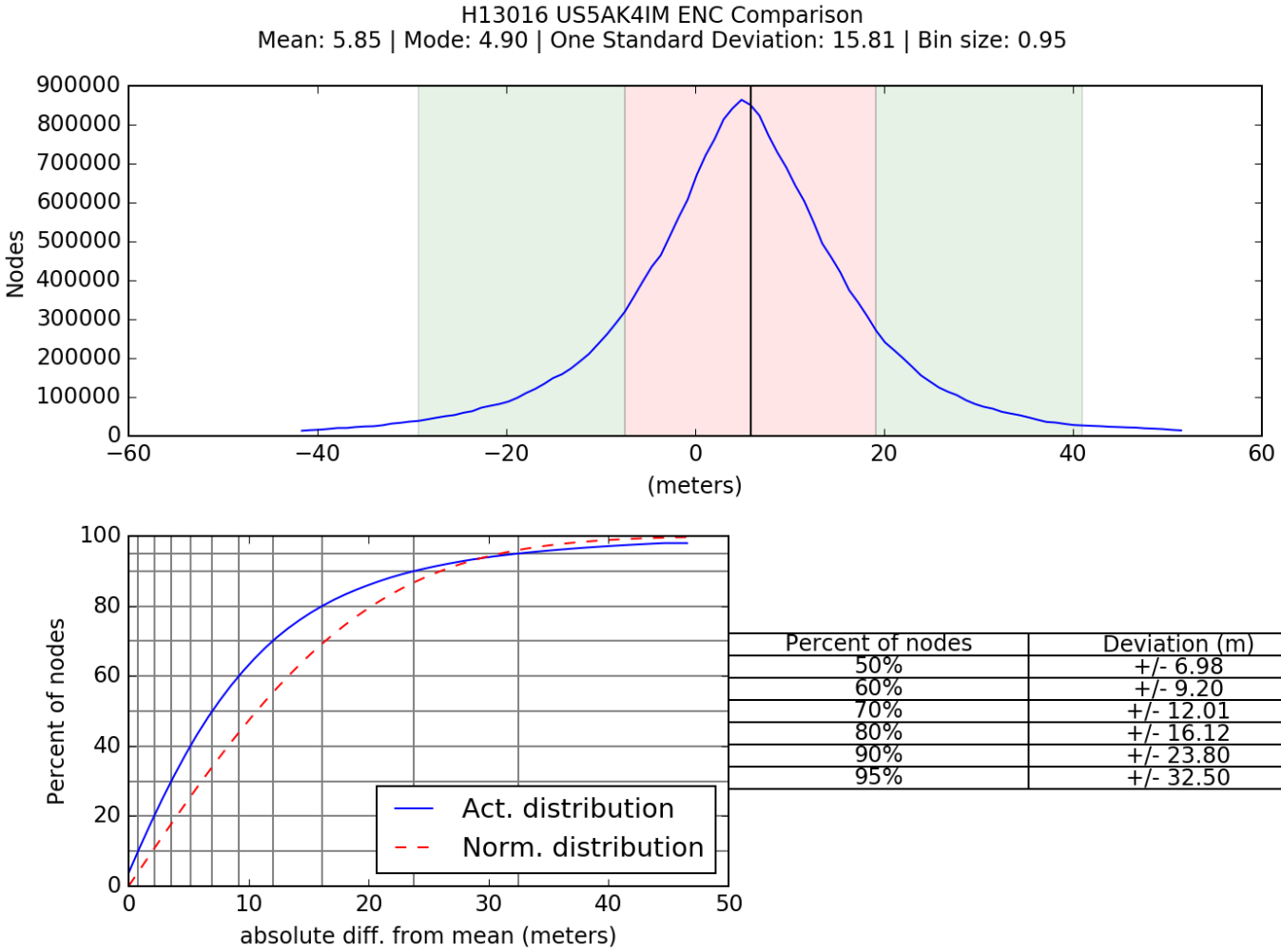


Figure 20: Difference surface between H13016 and interpolated TIN surfaces from Charts US5AK4EM (west) and US5AK4IM (east)



Percent of nodes	Deviation (m)
50%	+/- 6.98
60%	+/- 9.20
70%	+/- 12.01
80%	+/- 16.12
90%	+/- 23.80
95%	+/- 32.50

Figure 21: Difference surface statistics between H13016 and interpolated TIN surface from US5AK4IM

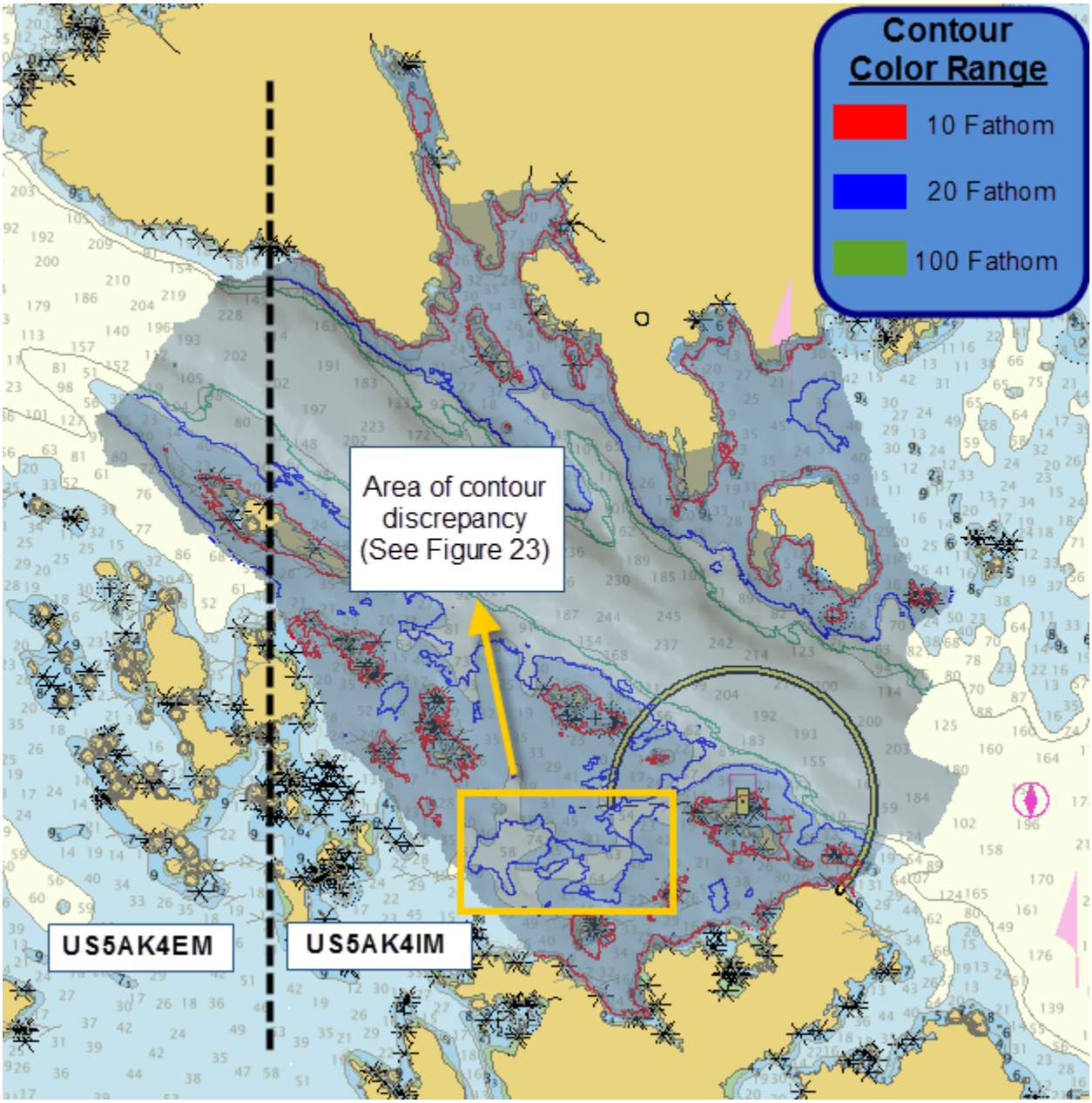


Figure 22: Overview of H13016 contours overlaid onto US5AK4EM and US5AK4IM

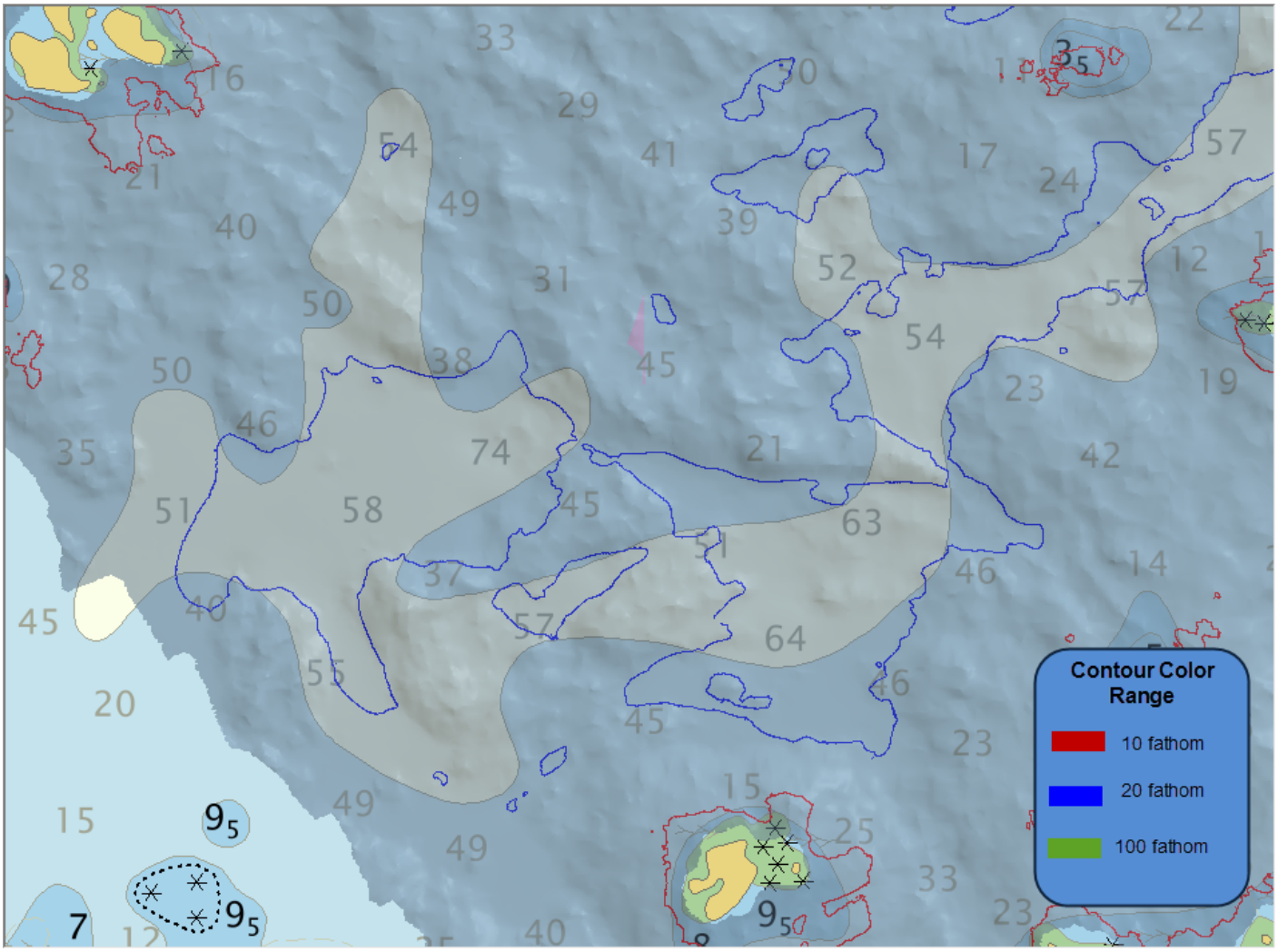


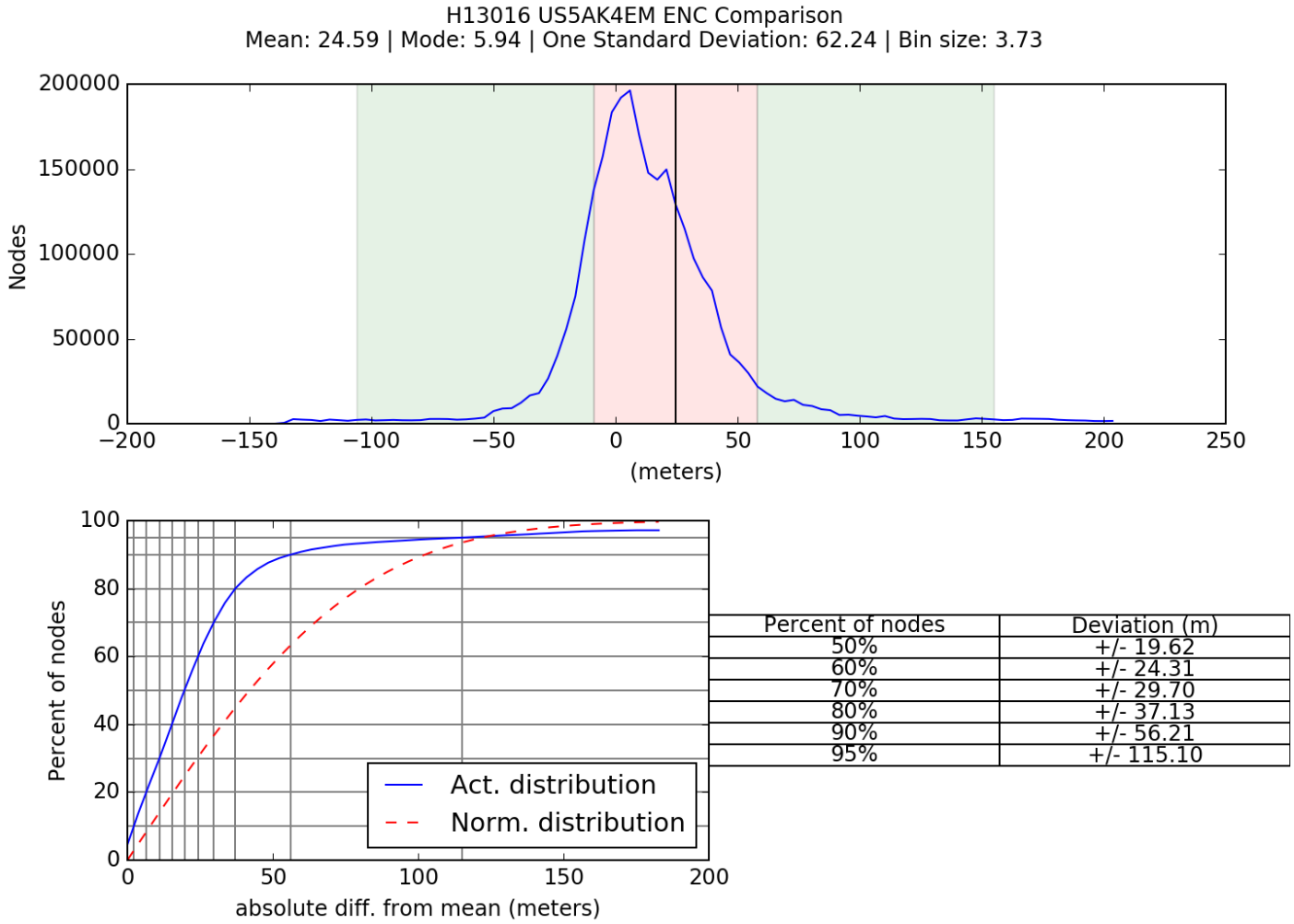
Figure 23: Area in H13016 where significant differences exist between H13016 and US5AK4IM contours

US5AK4EM

Soundings from H13016 are in a general agreement with charted depths on ENC US5AK4EM, with most depths disagreeing to 1-5 fathoms.

To more accurately visualize trends within these differences, a 16 meter TIN surface was interpolated from the ENC sounding layer. This surface was then differenced with the surface from H13016 and visualized in Figure 20 above. In this difference surface red colors indicate H13016 was shoaler than the ENCs, green colors indicate agreement, and blue colors indicate H13016 was deeper than the ENCs. The mean difference between surveyed soundings from H13016 and the charted depths on ENC US5AK4EM is 24.59 meters, with 95% of nodes having a deviation of +/- 115.10 meters as shown below in Figure 24. Due to discrepancies in the TIN surface generated from ENC US5AK4EM, there is a very high difference in the west where the ENC Charts US5AK4EM and US5AK4IM join.

Contours from H13016 are in general agreement with the charted contours on ENC US5AK4EM as shown in Figure 22 above.



Percent of nodes	Deviation (m)
50%	+/- 19.62
60%	+/- 24.31
70%	+/- 29.70
80%	+/- 37.13
90%	+/- 56.21
95%	+/- 115.10

Figure 24: Difference surface statistics between H13016 and interpolated TIN surface from US5AK4EM

D.1.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.3 Charted Features

No charted features exist for this survey.

D.1.4 Uncharted Features

Survey H13016 has 76 new features that are addressed in the H13016 Final Feature File. Of these features there are 9 new Seabed Areas, 1 new Land Area and Land Elevation, 44 new Underwater Rocks, 1 new Obstruction Area, 1 new Designated Sounding, and 19 new Kelp features.

D.1.5 Shoal and Hazardous Features

An uncharted shoal was observed during acquisition, prompting one Danger to Navigation Report to be submitted on 6/13/2017 (Figure 25). The DTON is a 5 foot sounding located immediately adjacent to a 9 fathom charted sounding. The Danger to Navigation Report is included in Appendix II of this report.

The area charted as Triplet Rocks on Chart 17431 lies outside of the sheet limits but was investigated during acquisition (Figure 26). Shoreline and multibeam data were acquired and included in the Final Feature File.

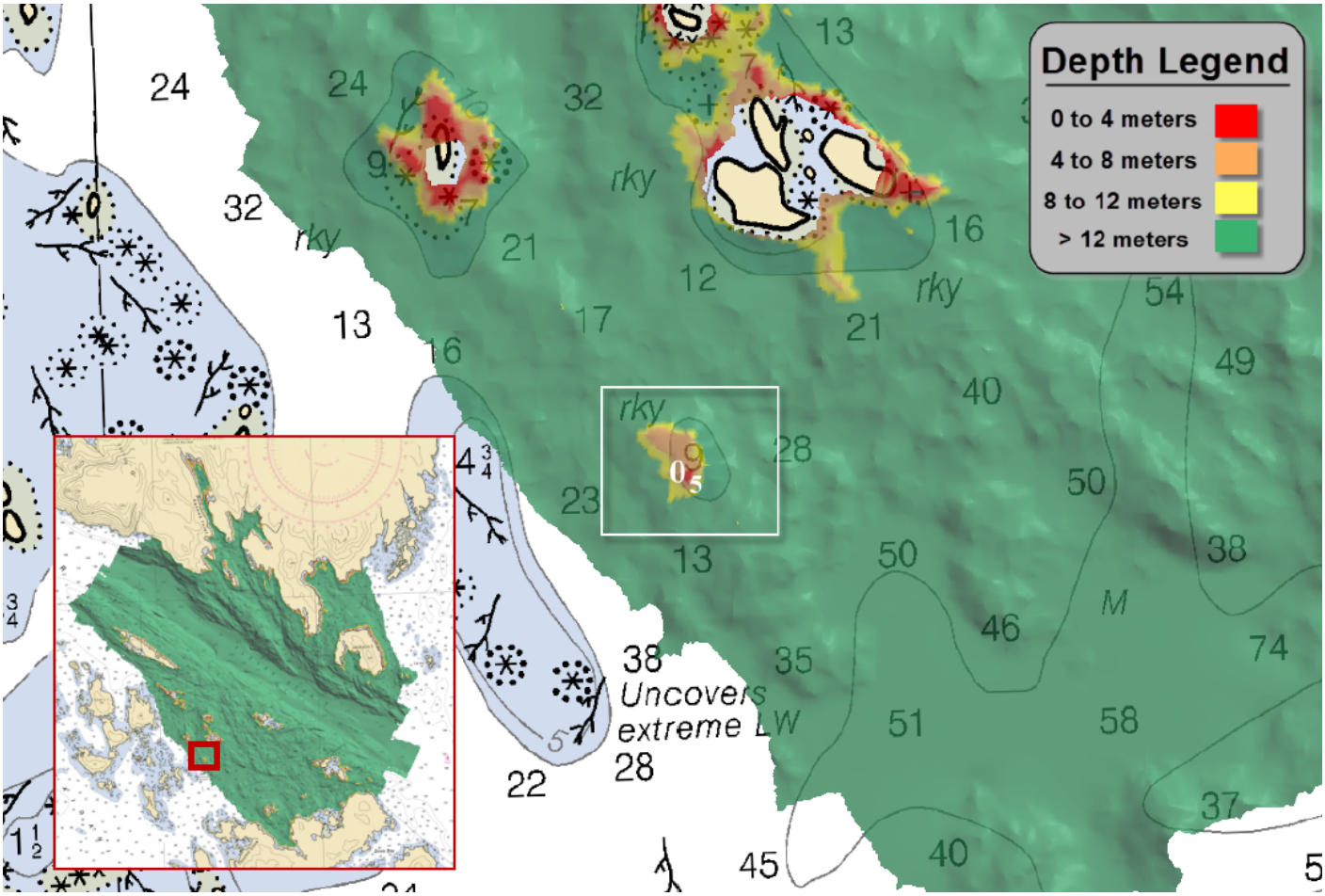


Figure 25: Overview of DTON found northwest of Shoe Island

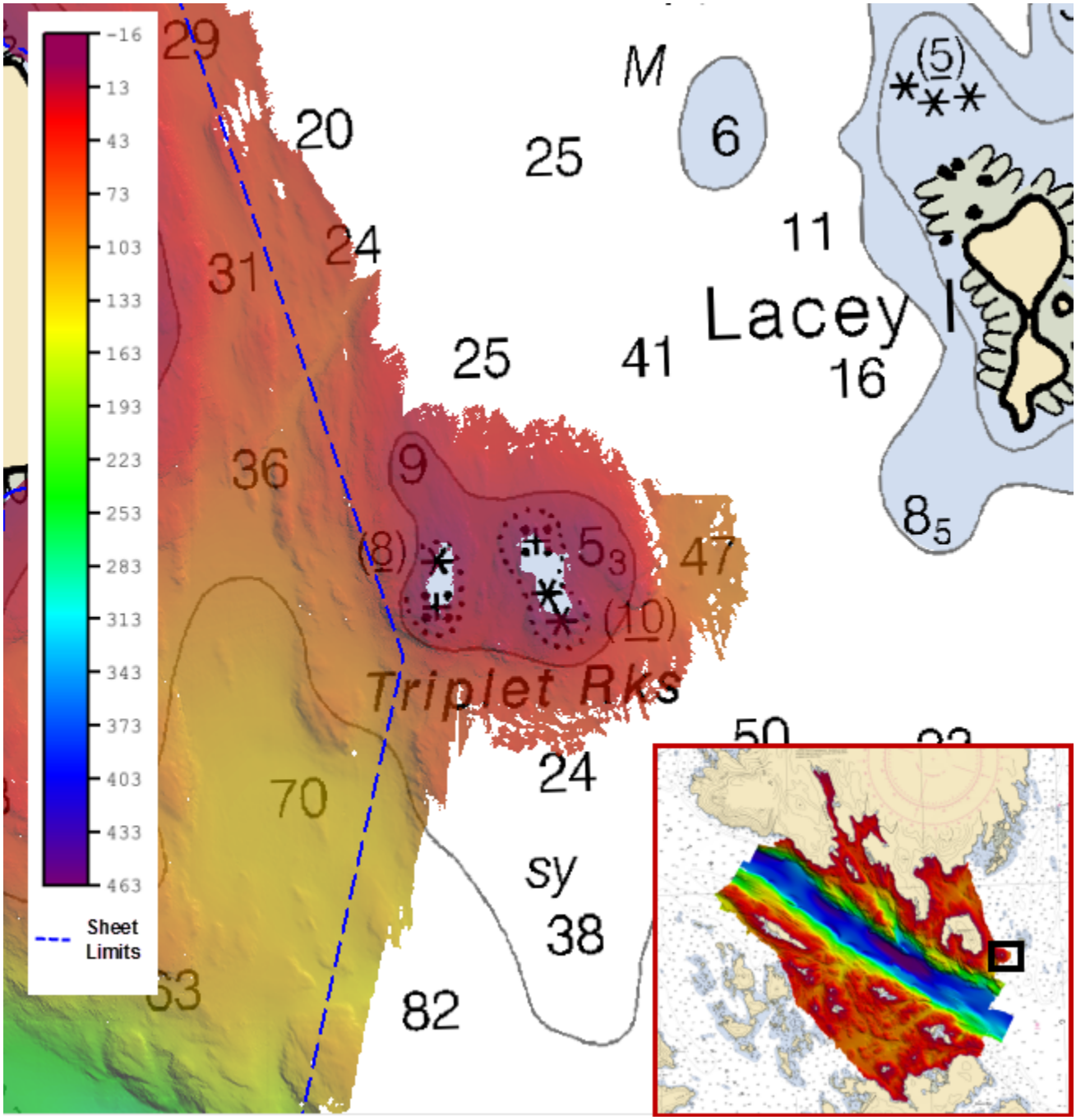


Figure 26: Overview of Triplet Rocks coverage on Chart 17431

D.1.6 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.1.7 Bottom Samples

Seven bottom samples were acquired in accordance with the Project Instructions for survey H13016. All bottom samples were entered in the H13016 Final Feature File. See Figure 27 for a graphical overview of sample locations.

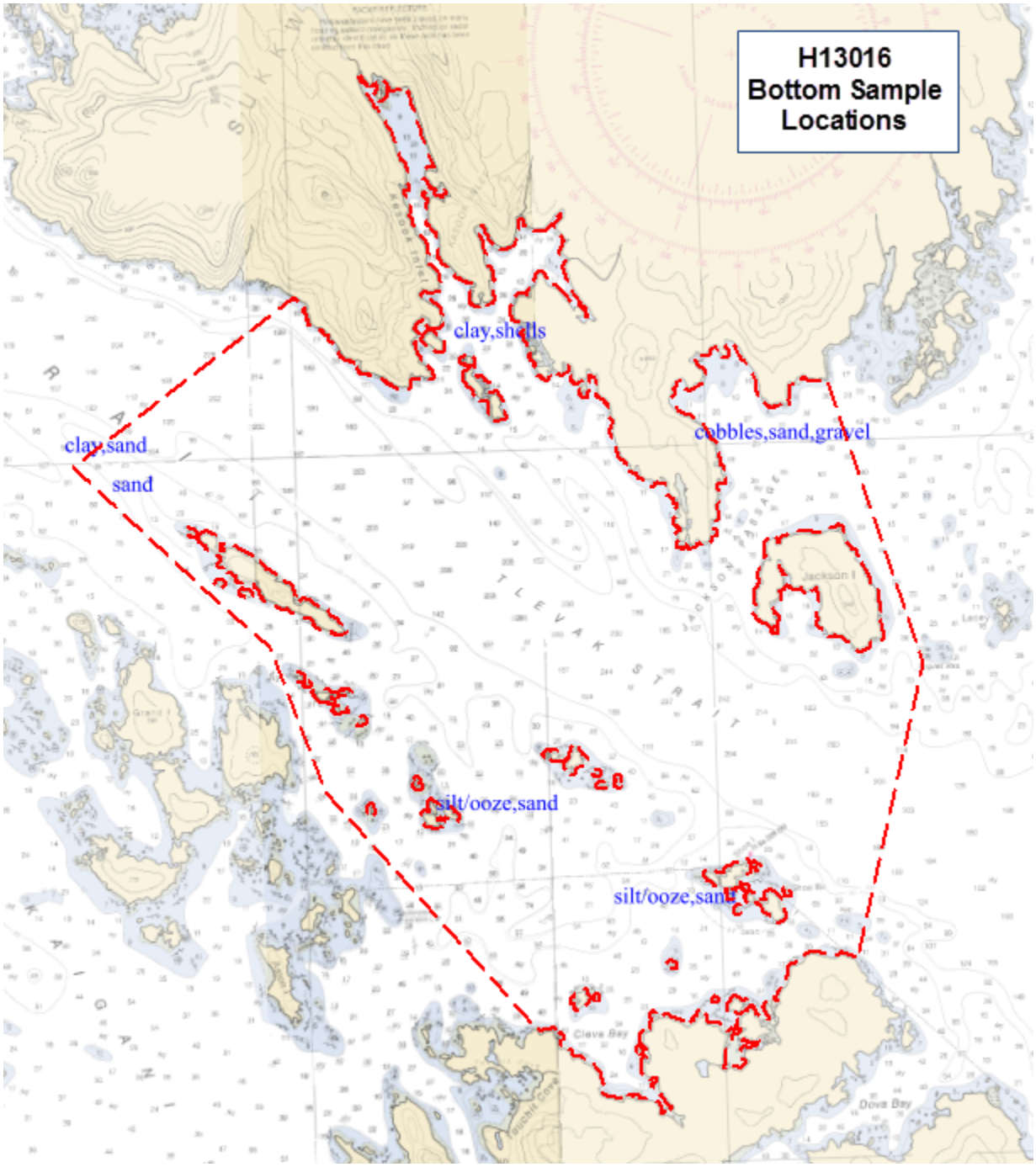


Figure 27: H13016 bottom sample locations

D.2 Additional Results

D.2.1 Shoreline

Fairweather personnel conducted limited shoreline verification and reconnaissance, utilizing vessel mounted lidar, at times near predicted negative or low tides within the survey limits. Annotations, information, and diagrams collected in DP forms and boat sheets during field operations were scanned and included in the Separates I Detached Positions folder. Shoreline verification procedures for H13016 conform to those detailed in the DAPR.

D.2.2 Prior Surveys

No prior survey comparisons exist for this survey.

D.2.3 Aids to Navigation

The flashing six second white light located within H13016 was on station and observed to be serving its intended purpose.

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 Platforms

No platforms exist for this survey.

D.2.7 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.8 Abnormal Seafloor and/or Environmental Conditions

Abnormal seafloor and/or environmental conditions were not observed 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 and Specifications Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. These data are adequate to supersede charted data in their common areas. This survey is complete and no additional work is required with the exception of deficiencies noted in the Descriptive Report.

Approver Name	Approver Title	Approval Date	Signature
CDR Mark Van Waes	Commanding Officer	12/05/2017	VAN WAES.MARK.1240076329 2017.12.06 17:06:23 -06'00'
LT Damian Manda	Field Operations Officer	12/05/2017	MANDA.DAMIAN.CURTIS.1396610660 2017.12.06 07:20:14 -08'00'
HCST Samuel Candio	Chief Survey Technician	12/05/2017	CANDIO.SAMUEL.LOUIS.1515897743 Digitally signed by CANDIO.SAMUEL.LOUIS.1515897743 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=CANDIO.SAMUEL.LOUIS.1515897743 Date: 2017.12.06 17:02:29 -06'00'
HST Rebekah Gossett	Sheet Manager	12/05/2017	GOSSETT.REBEKAH.ROSE.1379960096 2017.12.05 11:53:10 -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	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
PRF	Project Reference File

Acronym	Definition
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 DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Marine and Aviation Operations
NOAA Ship *Fairweather* (S220)
1010 Stedman Street, Ketchikan, Alaska 99901

May 31, 2017

MEMORANDUM FOR: Jacklyn James
Project Manager, OPR-O190-FA-17
Hydrographic Surveys Division Operations Branch

FROM: Commander Mark Van Waes, NOAA
Commanding Officer, NOAA Ship *Fairweather*

SUBJECT: Waiver request – Use of 2017 Hydrographic Surveys Specifications and Deliverables

Fairweather requests a waiver of the OPR-O190-FA-17 Project Instruction (PI) requirement to use the 2016 Hydrographic Surveys Specifications and Deliverables (HSSD), and instead use the 2017 version of the HSSD.

Justification

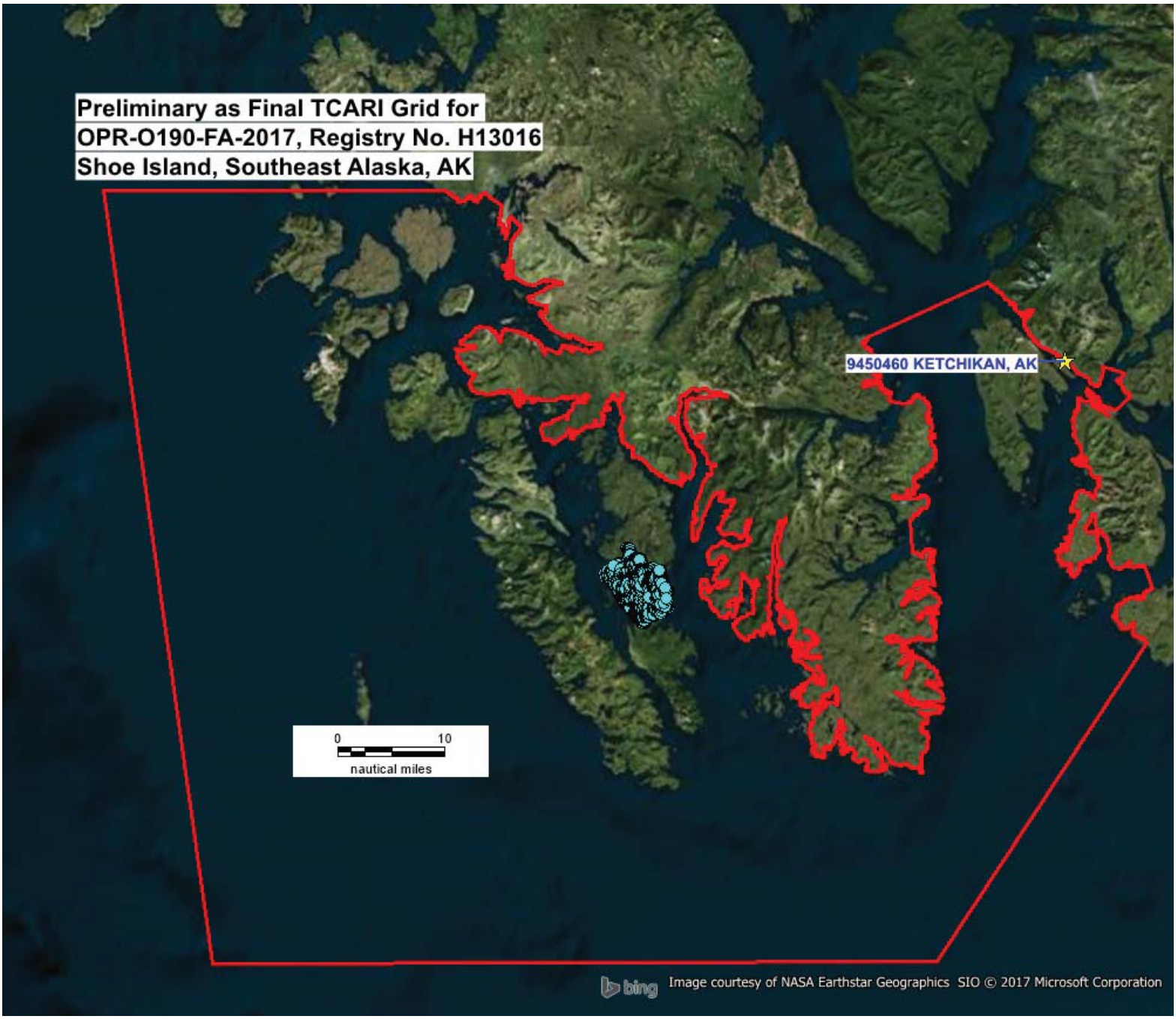
The Project Instructions for OPR-O190-FA-17 were developed under the auspices of the 2016 HSSD, as the 2017 version had not yet been released when the PIs were written. As the 2017 HSSD document has since been released, and *Fairweather* has only just begun acquisition on the project, it would be straightforward to apply the 2017 version to this project. Doing so will allow *Fairweather* to use a consistent set of specifications for the entire field season, and take advantage of the many improvements contained in the 2017 version.

Should use of the 2017 HSSD for this project be approved, one exception will be required. Section 7.3.1 of the 2017 HSSD references a newly-added "investigation requirement" attribute of features in the Composite Source File (CSF). As the CSF for this project was developed under the 2016 HSSD, this field was not populated in the CSF received from the Hydrographic Surveys Division (HSD). That being the case, *Fairweather* would then conform to the applicable requirements of the 2016 HSSD.

Decision

Waiver is: _____ Granted _____ Denied

cc: Chief, HSD OPS
OPS, FA
HCST, FA


Preliminary as Final TCARI Grid for
OPR-O190-FA-2017, Registry No. H13016
Shoe Island, Southeast Alaska, AK
9450460 KETCHIKAN, AK
0
10
nautical miles
bing
Image courtesy of NASA Earthstar Geographics SIO © 2017 Microsoft Corporation

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

PROVISIONAL TIDE NOTE FOR HYDROGRAPHIC SURVEY

DATE : July 05, 2017

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-O190-FA-2017
HYDROGRAPHIC SHEET: H13016
LOCALITY: Shoe Island, Southeast AK
TIME PERIOD: June 06 - June 21, 2017

TIDE STATION USED: 945-0460 Ketchikan
Lat. 55° 19.9'N Long. 131° 37.6' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 4.433 meters

REMARKS: RECOMMENDED GRID Please use the TCARI grid "O190FA2017.tc" as the final grid for project OPR-O190-FA-2017, H13016, during the period between June 06 and June 21, 2017.

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: As of the issuance of this final tide, 2017 annual leveling for Ketchikan, AK (9450460) has not been verified. A review of the verified leveling records from June 2006 - 2016 shows the tide station benchmark network to be stable within an allowable 0.009 m tolerance, annually. This Tide Note may be used as final stability verification for survey OPR-O190-FA-2017, Registry No. H13016. 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.

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CHIEF, PRODUCTS AND SERVICES BRANCH

APPROVAL PAGE

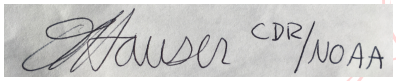
H13016

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

The following products will be sent to NCEI for archive

- Descriptive Report
- Collection of Bathymetric Attributed Grids (BAGs)
- Collection of backscatter mosaics
- Processed survey data and records
- Bottom Samples
- GeoPDF of survey product

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

Approved: 

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Commander Olivia Hauser, NOAA
Chief, Pacific Hydrographic Branch