H12537

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H12537

LOCALITY

State(s):	Alaska
General Locality:	Chatham Strait
Sub-locality:	Offshore N. Chatham Strait

2013

CHIEF OF PARTY
Richard T. Brennan, CDR/NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H12537**

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:	**Chatham Strait**
Sub-Locality:	**Offshore N. Chatham Strait**
Scale:	**40000**
Dates of Survey:	**05/23/2013 to 06/19/2013**
Instructions Dated:	**04/01/2013**
Project Number:	**OPR-O322-RA-13**
Field Unit:	**NOAA Ship *Rainier***
Chief of Party:	**Richard T. Brennan, CDR/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	
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 Geophysical Data Center (NGDC) and can be retrieved via http://www.ngdc.noaa.gov/.

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Descriptive Report to Accompany Survey H12537

Project: OPR-O322-RA-13

Locality: Chatham Strait

Sublocality: Offshore N. Chatham Strait

Scale: 1:40000

May 2013 - June 2013

NOAA Ship *Rainier*

Chief of Party: Richard T. Brennan, CDR/NOAA

A. Area Surveyed

The project area is referred to as Sheet 7: "Offshore N. Chatham Strait" within the Project Instructions (Figure 1). The project area is directly west of Kuiu Island and east of the southern portion of Baranof Island, Alaska.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
56° 57" 0' N 134° 43" 0' W	56° 40" 60' N 134° 24" 0' W

Table 1: Survey Limits

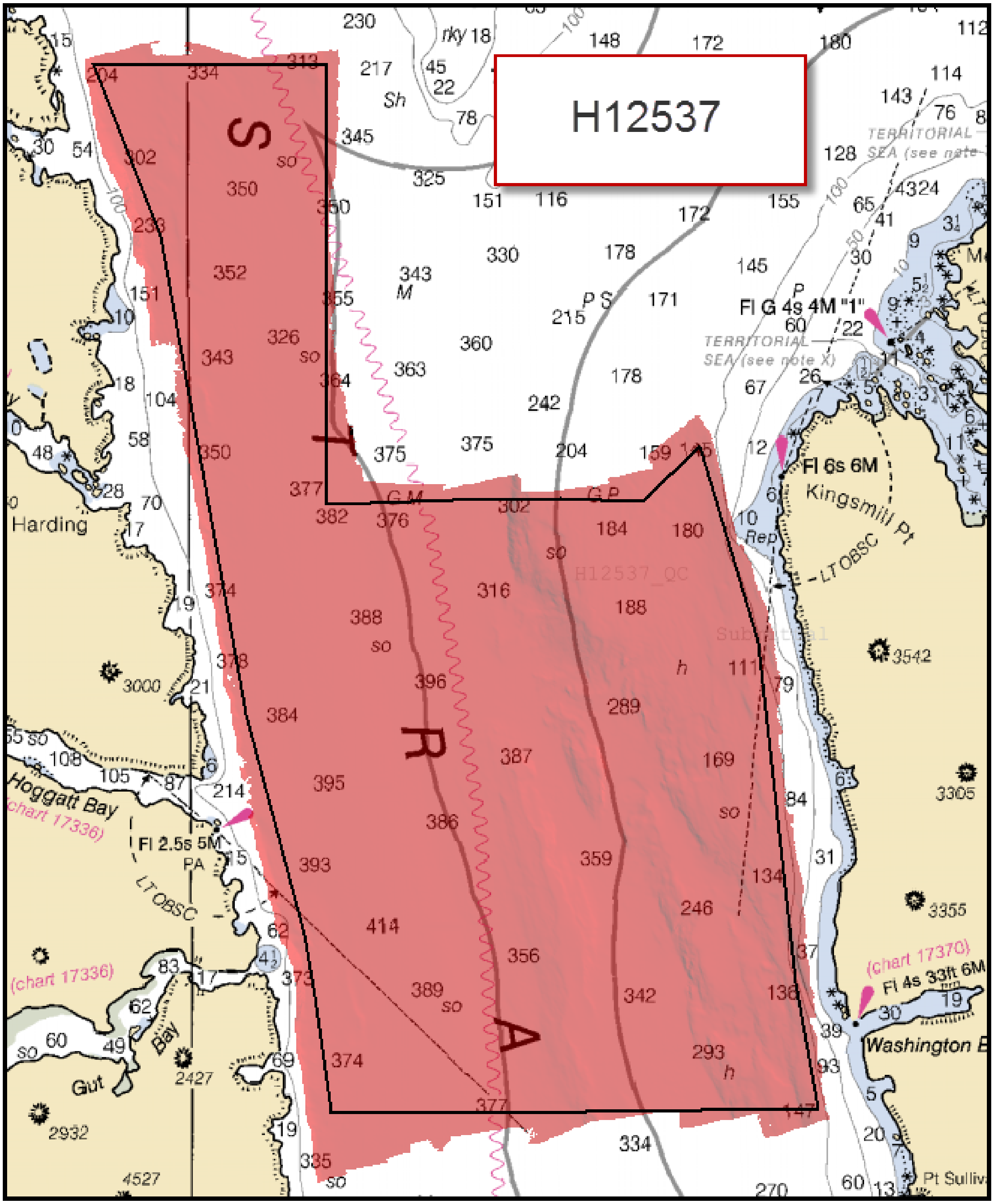


Figure 1: H12537 survey limits.

Survey limits were acquired in accordance with the requirements in the Project Instructions and the Hydrographic Surveys Specifications and Deliverables (HSSD).

A.2 Survey Purpose

The purpose of this project is to provide contemporary surveys to update National Ocean Service (NOS) nautical charting products. Other vessels such as cruise liners, ferries, USCG cutters, US Navy vessels, tugs and barges use the waterway on a regular basis as do larger ships when avoiding storms in the Gulf of Alaska.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

In order to extract some descriptive statistics of the data density achievements, the density layer of each finalized surface was queried within CARIS and then examined in Excel (Figure 3). Data acquired on survey H12537 met complete multibeam echosounder (MBES) coverage requirements including the 5 soundings per node data density requirement outlined in section 5.2.2.2 of the HSSD (Figure 2) with one exception: The 8-meter surface fell slightly short of density requirements, mostly outside of the sheet limits, with 89.5% containing 5 soundings or more per node. Overall, the required data density was achieved in 99.4% of the nodes, and 99.6% of the total area.

Figure 2: H12537 data density.

Resolution	Depth range	Number of nodes	Fewer than five soundings per node	Percent of nodes with greater than five soundings per node
8m	72 - 160m	3,971	415	89.5%
16m	144 - 320m	82,834	529	99.4%
32m	288 - 1000m	258,506	1,044	99.6%
	TOTAL:	345,311	1,988	**99.4%**
	TOTAL (by area):	286,169,792	1,231,040	**99.6%**

Figure 3: Summary table showing the percentage of nodes satisfying the 5 sounding density requirements, sub-divided by the appropriate depth ranges. Note: The final row has a unit of square meters, and sums the number of different resolution nodes into a common unit of area.

The data is adequate for charting despite not meeting the density requirements for the 8-meter surface.

A.4 Survey Coverage

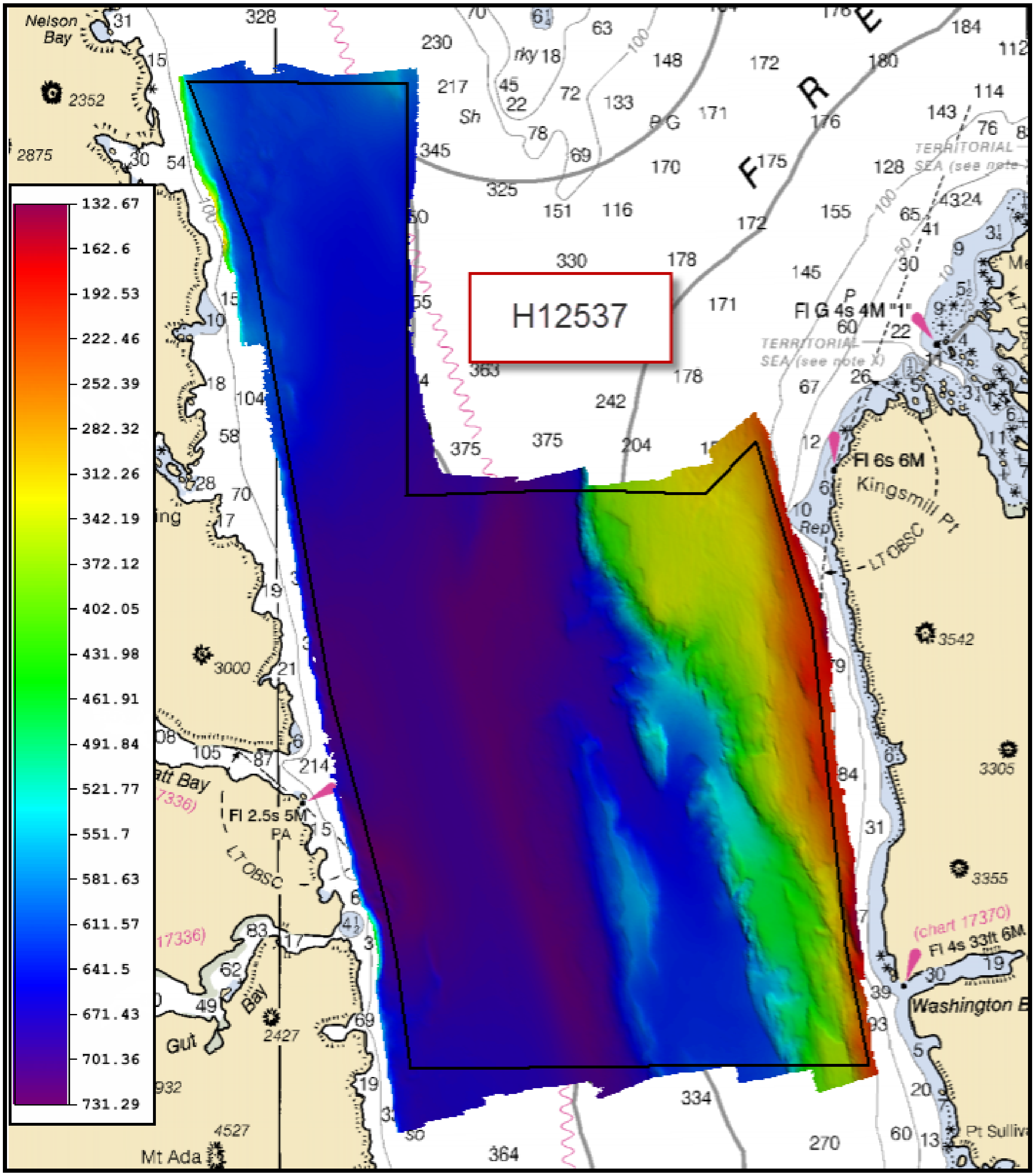


Figure 4: Acquired survey coverage overlaid on Chart 17320. Scale shows depth in meters.

Complete multibeam echosounder (MBES) coverage was achieved within the limits of hydrography as defined in the Project Instructions.

There were several small gaps in coverage in depths of approximately 700 meters. In all cases these gaps in coverage were not navigationally significant.

A.5 Survey Statistics

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

	Vessel	***S221***	***Total***
LNM	**SBES Mainscheme**	0	0
	MBES Mainscheme	101.6	101.6
	Lidar Mainscheme	0	0
	SSS Mainscheme	0	0
	SBES/MBES Combo Mainscheme	0	0
	SBES/SSS Combo Mainscheme	0	0
	MBES/SSS Combo Mainscheme	0	0
	SBES/MBES Combo Crosslines	10.1	10.1
	Lidar Crosslines	0	0
Number of Bottom Samples			0
Number AWOIS Items Investigated			0
Number Maritime Boundary Points Investigated			0
Number of DPs			0
Number of Items Items Investigated by Dive Ops			0
Total Number of SNM			84.0

Table 2: Hydrographic Survey Statistics

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

Survey Dates	Julian Day Number
05/24/2013	144
05/27/2013	147
05/29/2013	149
06/19/2013	170

Table 3: Dates of Hydrography

The total number of SNM were determined to be 81.5 during office review.

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	***S221***
LOA	231 feet
Draft	16.5 feet

Table 4: Vessels Used

All data for survey H12537 was acquired by NOAA Ship RAINIER. The vessel acquired MBES depth soundings and sound velocity profiles.

B.1.2 Equipment

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

Manufacturer	Model	Type
Kongsberg	EM710	MBES
Applanix	POS-MV 4	Vessel Positioning and Attitude System
Odim Brooke Ocean (Rolls Royce Group)	MVP 200	Conductivity, Temperature, and Depth Sensor
Reson	SVP 70	Sound Speed System

Table 5: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

Crosslines, acquired for this survey, totalled 10.2% of mainscheme acquisition.

Multibeam crosslines were acquired using the EM710 on RAINIER. A 32-meter CUBE surface was created using strictly the mainscheme lines, while a second 32-meter CUBE surface was created using only the crosslines, from which a difference surface was generated at a 32-meter resolution (Figure 5). Statistics were then derived from the difference surface and are shown in Figure 6. The average difference between the depths derived from mainscheme and crosslines was 0.31 meters (mainscheme being shoaler) with a standard deviation of 1.70 meters.

For the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 7). In total, 100.0% of the depth differences between H12537 mainscheme and crossline data are within allowable IHO accuracies (Figure 8).

In addition to performing a crossline comparison using surface differencing, the CARIS QC Report was used to compare the crossline soundings to the depth estimates of the 32-meter resolution surface. The depth differences are calculated for each crossline ping and then compared to the allowable IHO uncertainties. The output QC Report classifies the percentage of pings meeting IHO orders by beam angle. The table was copied and examined in Excel (Figure 9). On average, 100.0% of all soundings for any given depth and beam angle meet IHO Order 2 accuracies.

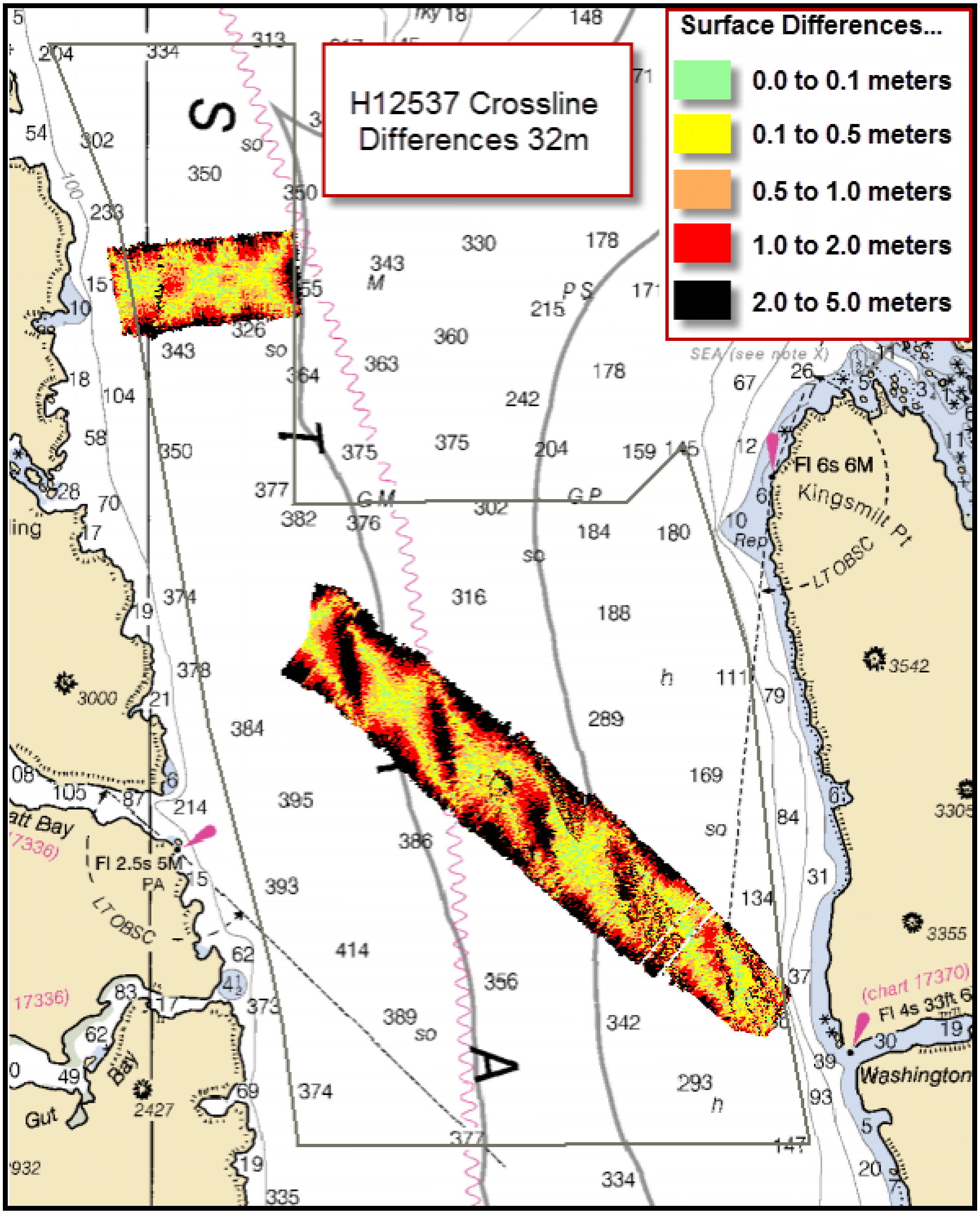


Figure 5: Crossline surface differences.

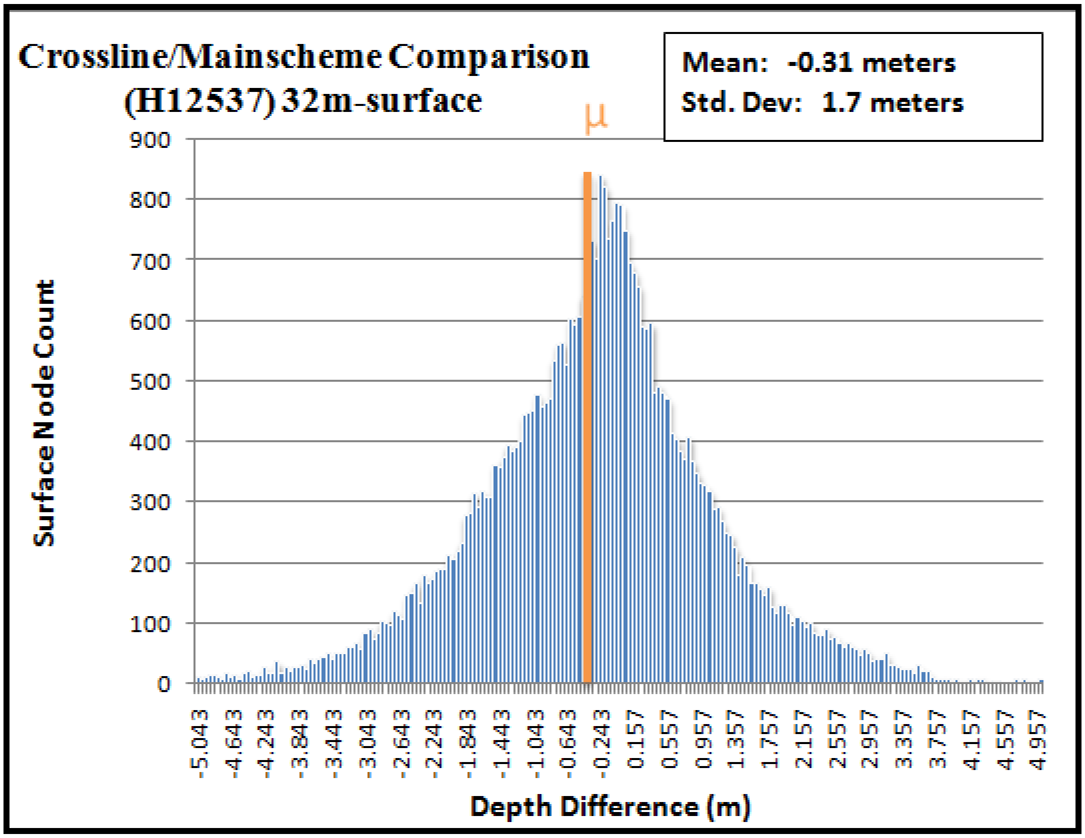


Figure 6: Crossline comparison with mainscheme lines.

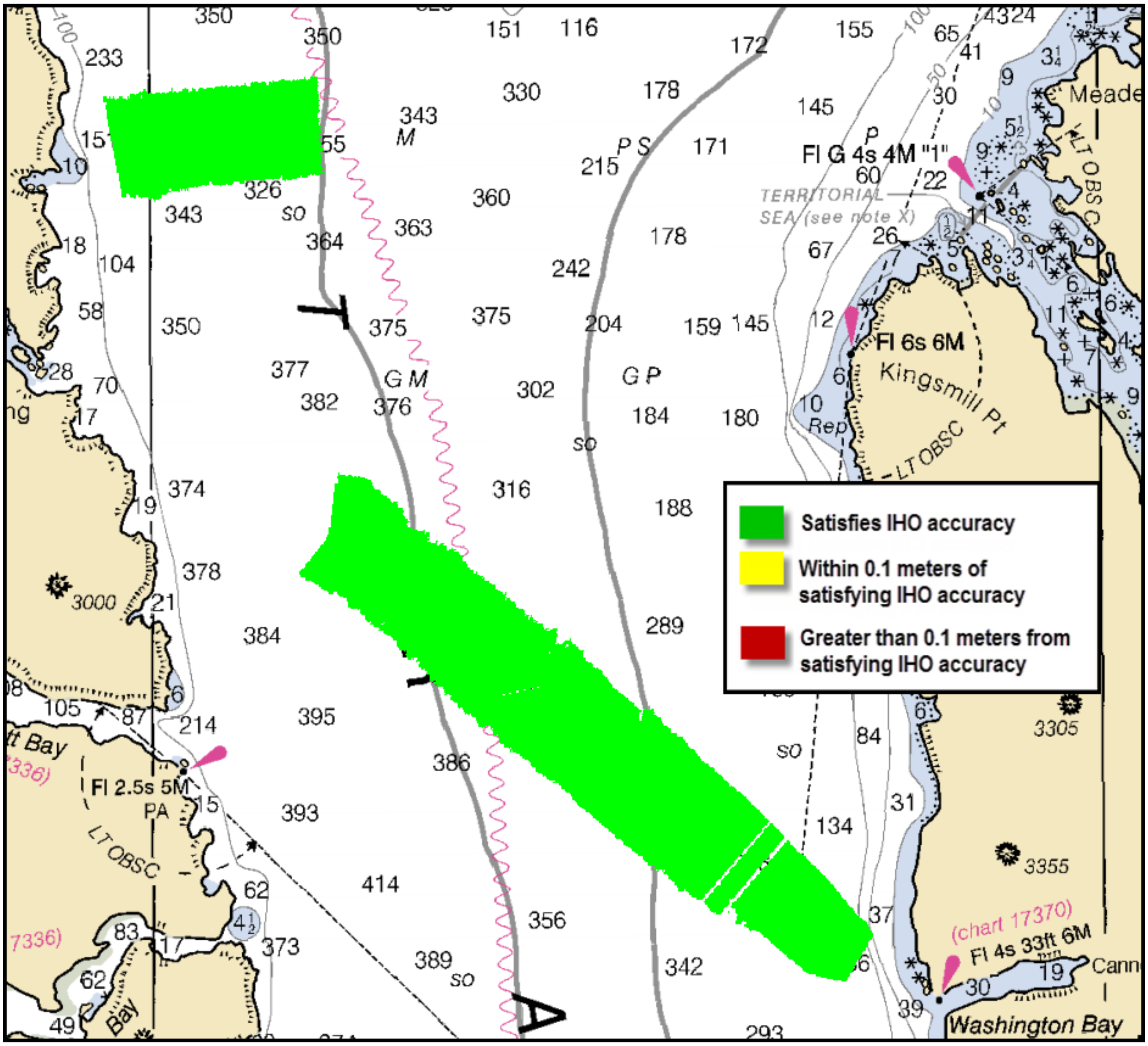


Figure 7: Depth differences between H12537 mainscheme and crossline data as compared to allowable IHO accuracy standards for the respective depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	41,624	41,624	100.0%

Figure 8: Summary table showing percentage of difference surface nodes between H12537 mainscheme and crossline data that meet allowable IHO accuracy standards for the respective depths.

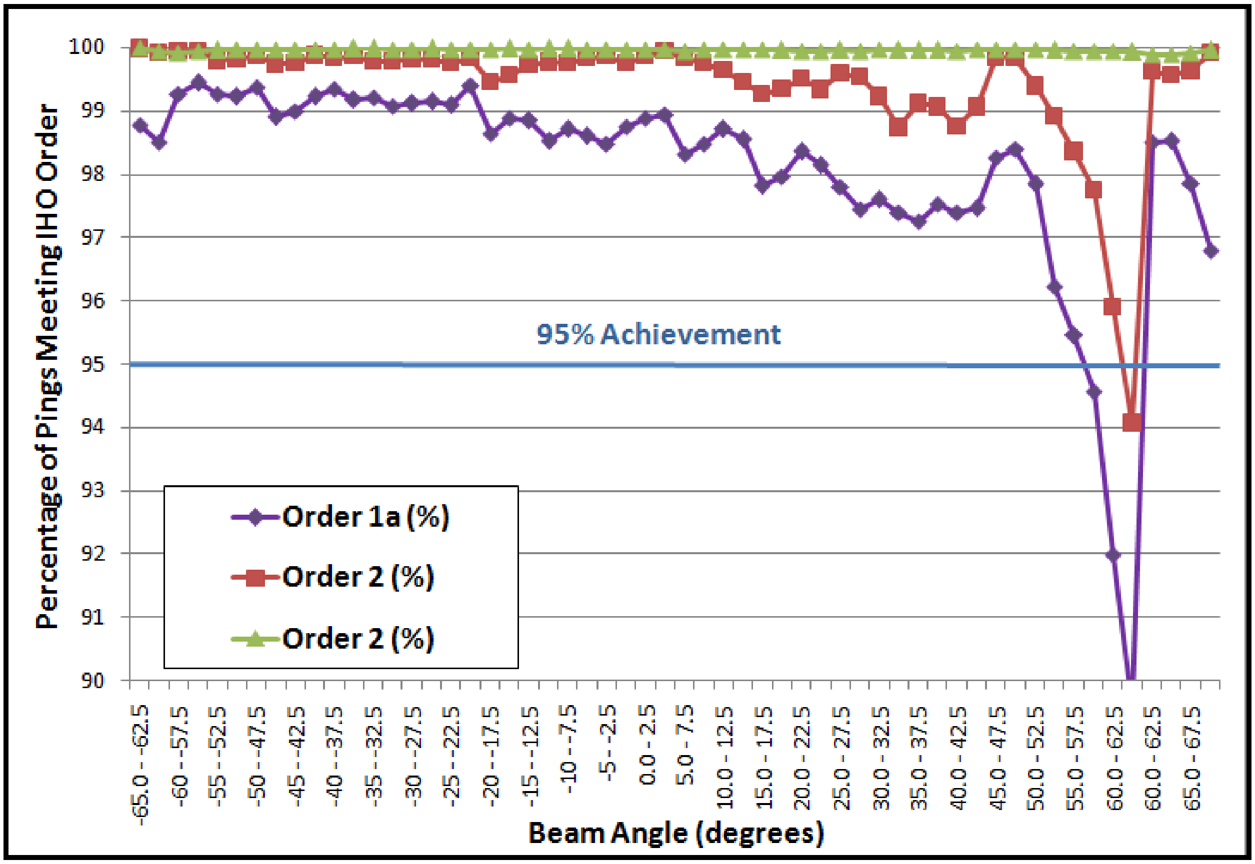


Figure 9: CARIS Crossline QC Report comparing crossline soundings to depth estimates.

B.2.2 Uncertainty

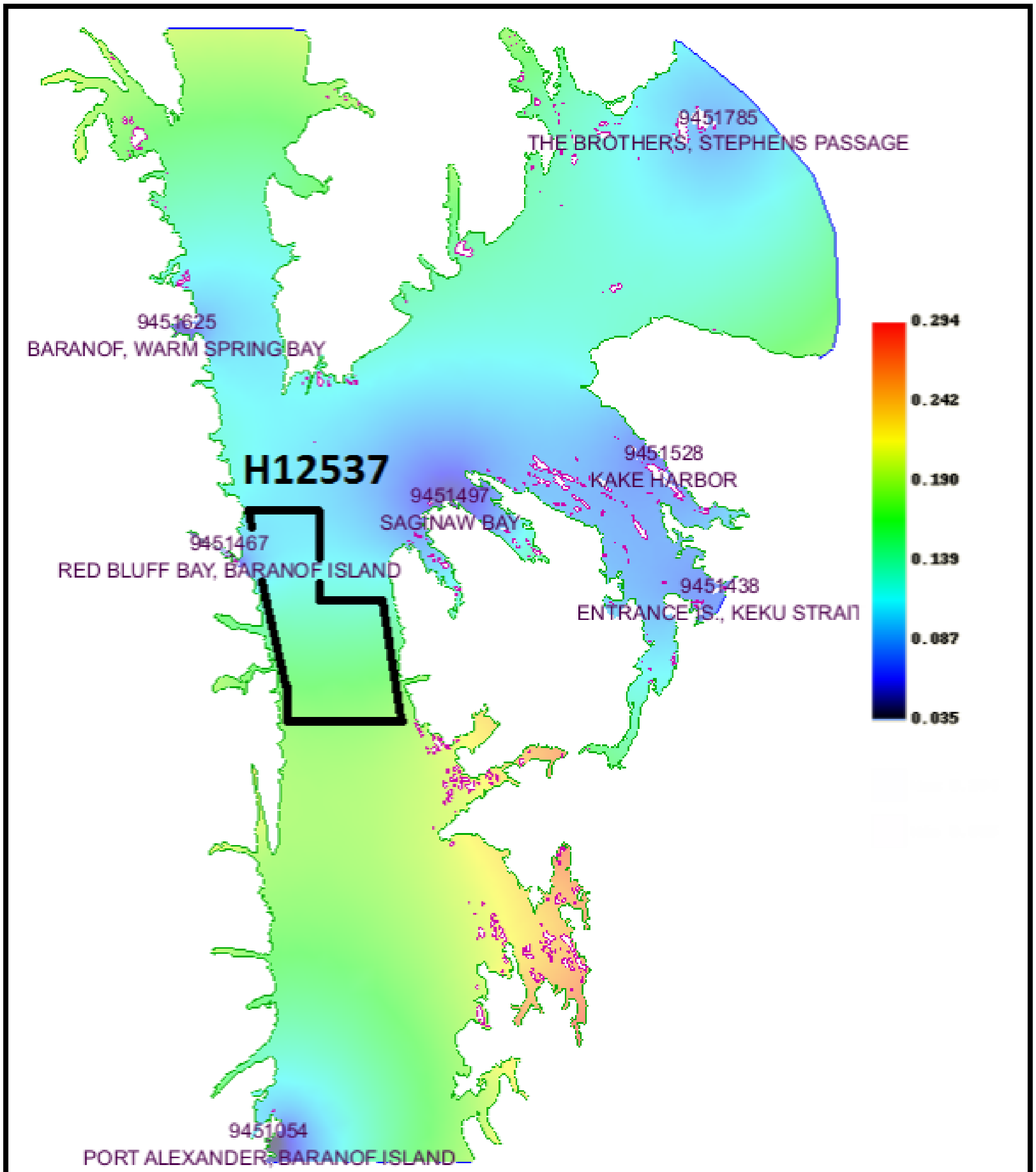
Hull ID	Measured - CTD	Measured - MVP	Surface
S221		1 meters/second	0.05 meters/second

Table 6: Survey Specific Sound Speed TPU Values

Total propagated uncertainty values for survey H12537 were derived from a combination of fixed values for equipment and vessel characteristics, as well as field assigned values for sound speed uncertainties. Tidal uncertainties were provided by NOAA's Center for Operational Oceanographic Products and Services (CO-OPS), and were applied to depth soundings using a Tidal Constituent and Residual Interpolation (TCARI) grid. TCARI automatically calculates the uncertainty associated with water level interpolation, which is then written into the CARIS HDCS (Figure 10). For this reason, no tidal uncertainty values were entered into the Tide Value section of the CARIS Compute TPU function.

Uncertainty values of submitted finalized grids were calculated in CARIS using the "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). To visualize the locations in which accuracy requirements were met for each finalized surface, a custom IHO compliance layer was created, based on the difference between calculated uncertainty of the nodes, and the allowable IHO uncertainty (Figure 11). To quantify the extent to which accuracy requirements were met, the preceding IHO compliance layers were queried within CARIS and then examined in Excel (Figure 12). Overall, 100.0% of survey H12537 met the accuracy requirements stated in the HSSD.

In addition to the usual a priori estimates of uncertainty, some real-time and post-processed uncertainty sources were also incorporated into the depth estimates of survey H12537. Real-time uncertainties from the EM710 were recorded and applied in post-processing. Applanix True Heave files are recorded on all survey vessels, which includes an estimate of the heave uncertainty, and are applied during post-processing. Finally, the post-processed uncertainties associated with vessel roll, pitch, gyro and navigation are applied in CARIS HIPS via an SBET RMS file generated in POSPac.



Gauge Number	Latitude	Longitude	HCs	Residuals	Datum	Gauge Radius	Station Name
9451054	56.24673692	-134.64790043	☑	☑	☑	1500	PORT ALEXANDER, BARANOF ISLAND
9451438	56.81170000	-133.78700000	☑	☐	☑	1500	ENTRANCE IS., KEKU STRAIT
9451528	56.94830600	-133.89472200	☑	☐	☑	1500	KAKE HARBOR
9451625	57.08335600	-134.82500000	☑	☐	☑	1500	BARANOF, WARM SPRING BAY
9451785	57.29657854	-133.79039095	☑	☐	☑	1500	THE BROTHERS, STEPHENS PASSAGE
9451497	56.90367600	-134.30243267	☑	☐	☑	1500	SAGINAW BAY
9451467	56.85490000	-134.72466700	☑	☑	☑	1500	RED BLUFF BAY, BARANOF ISLAND

Figure 10: TCARI uncertainty and location of the tide gauges used for the TCARI grid.

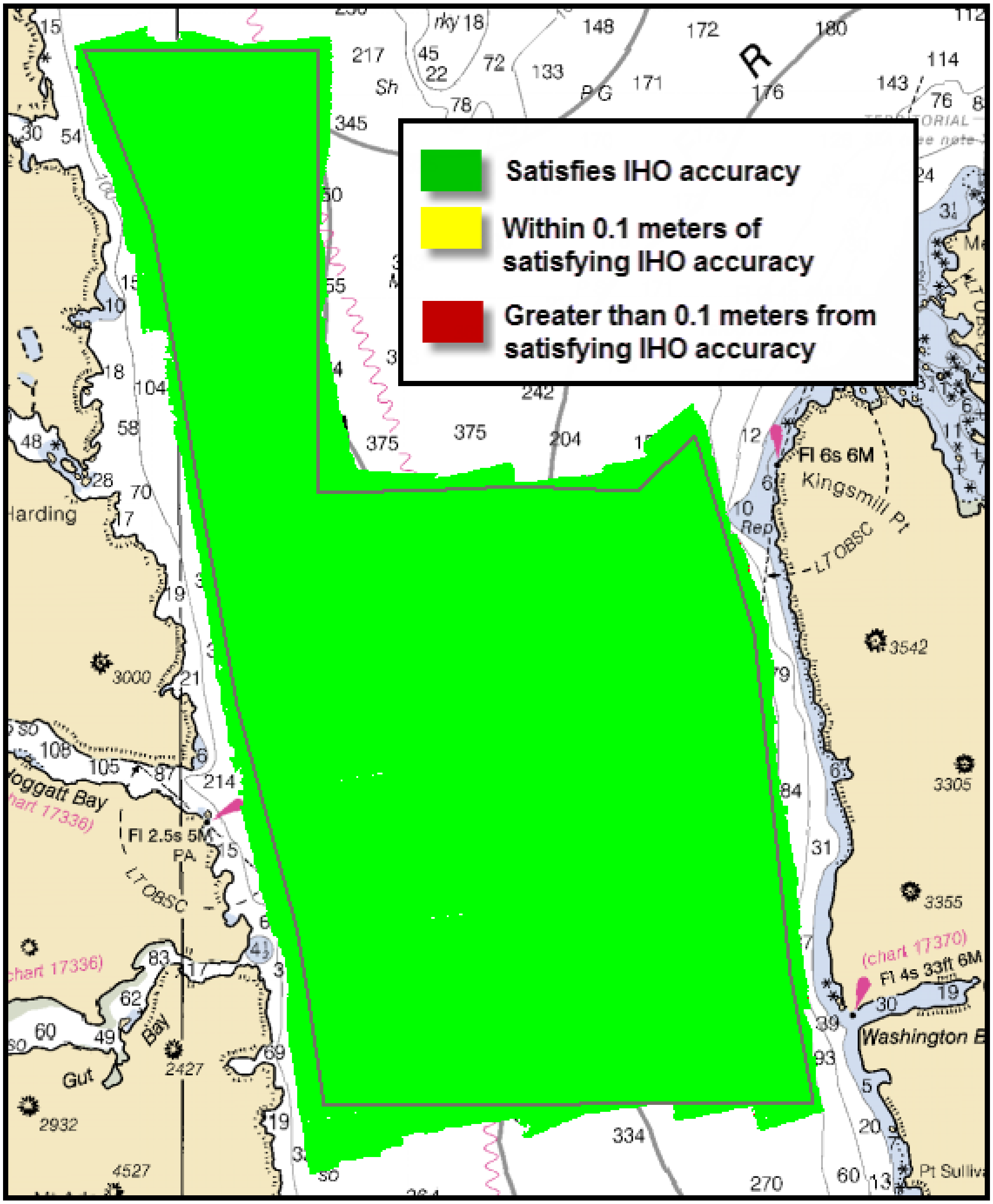


Figure 11: H12537 met IHO accuracy standards for 100.0% of the data.

Resolution	Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
8m	100 - 160m	Order 2	3,993	3,988	99.9%
16m	144 - 320m	Order 2	82,908	82,905	100.0%
32m	288 - 1000m	Order 2	258,132	258,132	100.0%
		TOTAL:	345,033	345,025	**100.0%**
		TOTAL (by area):	285,807,168	285,806,080	**100.0%**

Figure 12: Summary table showing the percentage of nodes satisfying the indicated IHO accuracy level, sub-divided by the appropriate depth ranges.

B.2.3 Junctions

Seven junction comparisons were completed for H12537. Four of these surveys (H12532, H12533, H12534, H12536) were acquired concurrently with this survey, one survey (H10677) was completed in 1996 by NOAA Ship RAINIER, and two surveys (H11707, H11708) were completed in 2007 by FUGRO, Inc. (Figure 13).

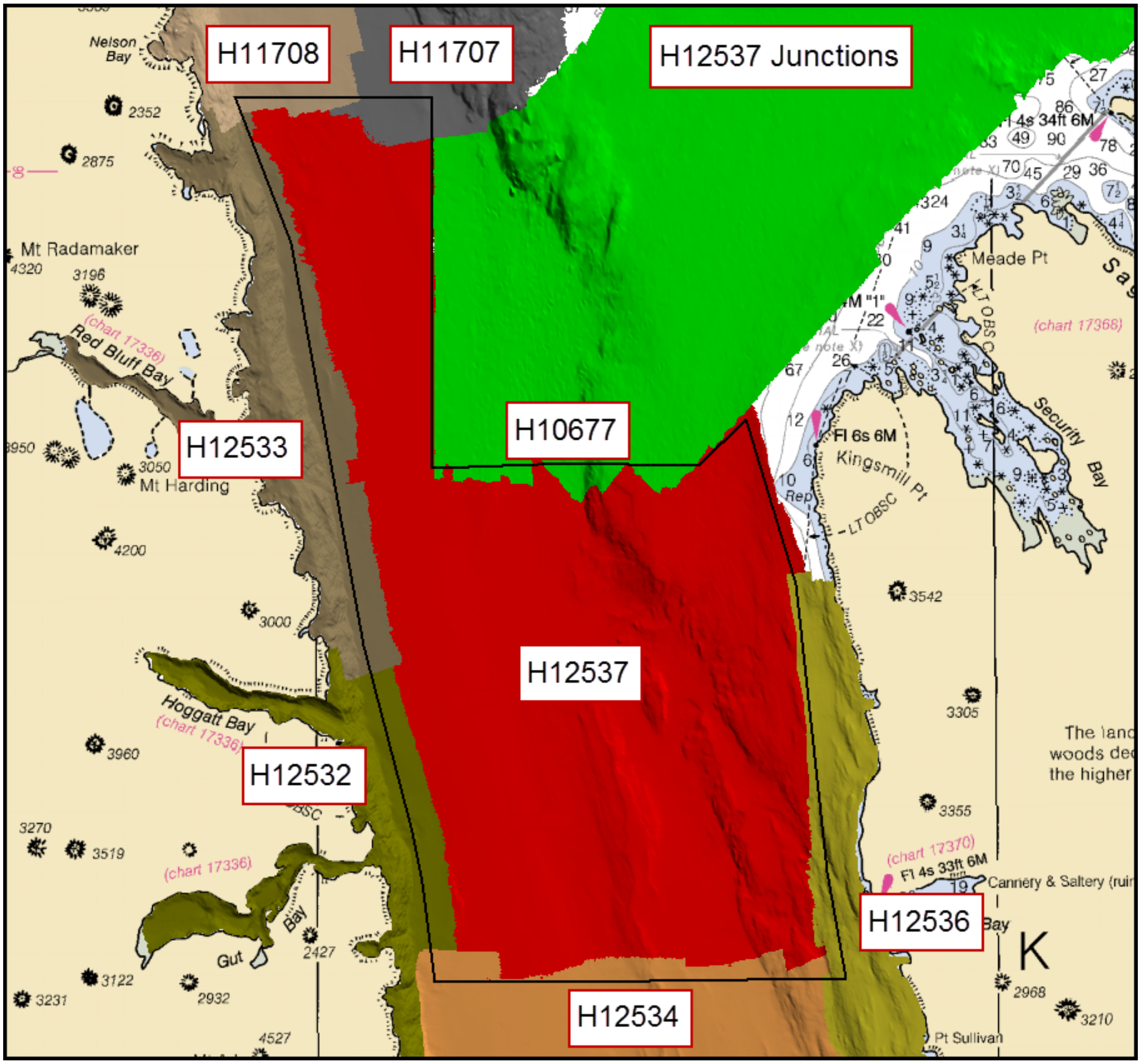


Figure 13: H12537 junctions overview.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H10677	1:40000	1996	NOAA Ship RAINIER	NE
H11707	1:10000	2007	Fugro Pelagos, Inc.	N
H11708	1:20000	2007	Fugro Pelagos, Inc.	N
H12532	1:10000	2013	NOAA Ship RAINIER	W
H12533	1:10000	2013	NOAA Ship RAINIER	SW

<u>H10677</u>

Overlap with survey H10677 was approximately 11,000 meters wide along the northern boundary of H12537 and 8,500 meters wide on the southern boundary (Figure 14). While there are some gaps in the junction area, it is in the opinion of the Hydrographer that there is sufficient overlap for a junction comparison. Depths in the junction area range from approximately 224 to 700 meters. For this comparison, an XYZ file from survey H10677 was converted to a TIN and then gridded at a 32-meter resolution. This surface when then differenced from a 32-meter resolution surface of H12537. A difference surface analysis between depth surfaces for each survey showed H10677 to be an average of 2.41 meters shoaler than H12537, with a standard deviation of 4.40 meters (Figure 15). This is well within allowable IHO Order 2 accuracy at these depths.

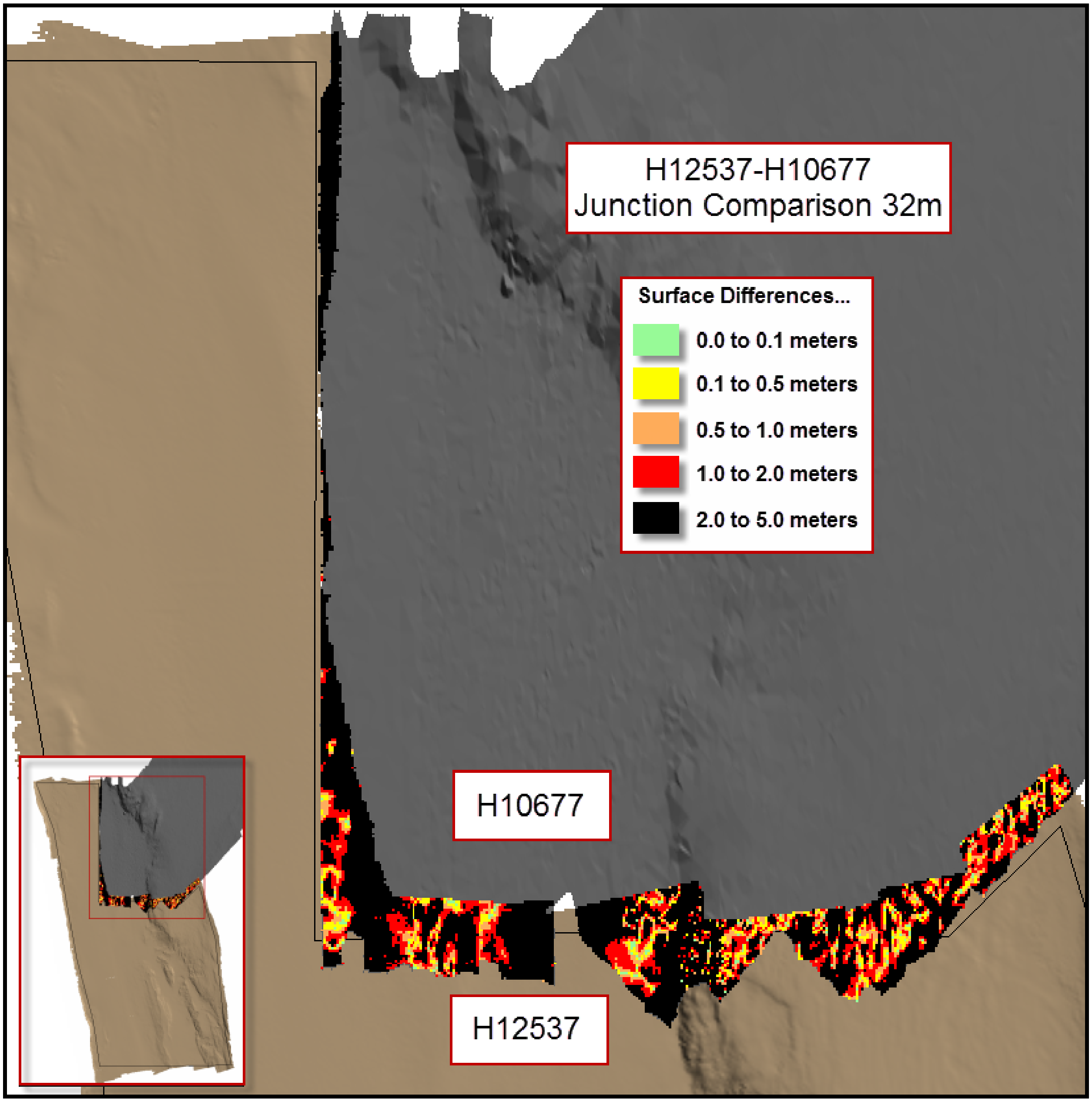


Figure 14: Junction difference with H10677.

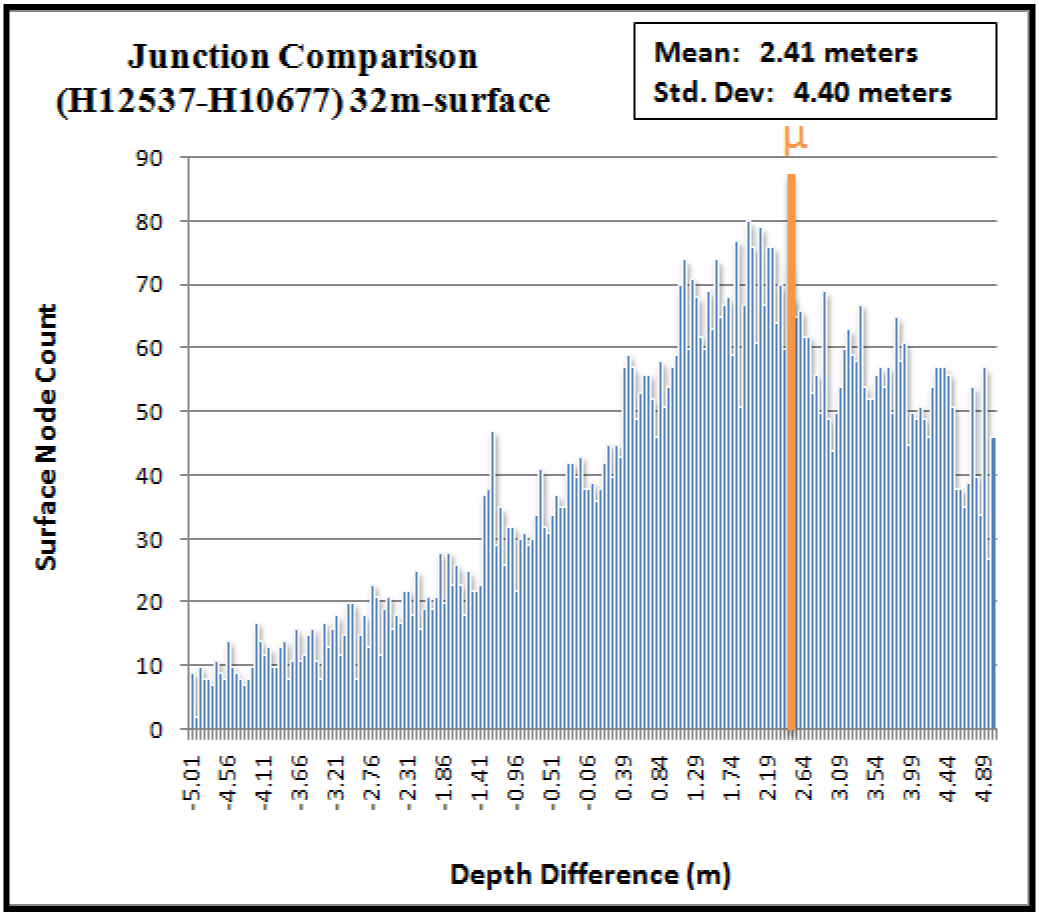


Figure 15: Difference surface statistics between H12537 and H10677 depth layers (32m surfaces). H10677 is on average 2.41 meters shoaler than H12537.

<u>H11707</u>

Overlap with survey H11707 was approximately 1,600 meters along the northern boundary of H12537 (Figure 16). Depths in the junction area range from approximately 550 to 620 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H11707 to be an average of 1.03 meters shoaler than H12537, with a standard deviation of 2.5 meters (Figure 17). This is well within allowable IHO Order 2 accuracy at these depths.

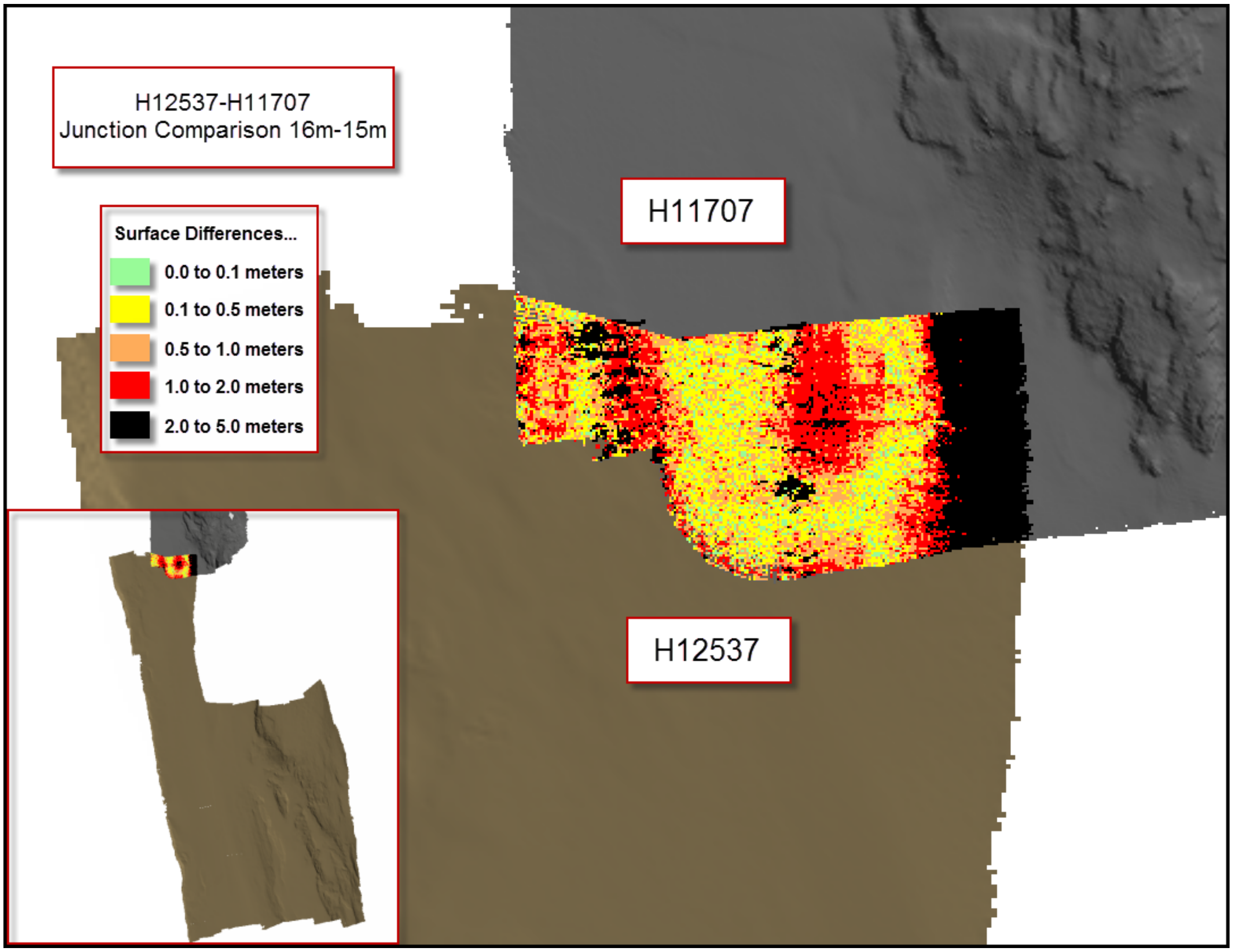


Figure 16: Junction difference with H11707.

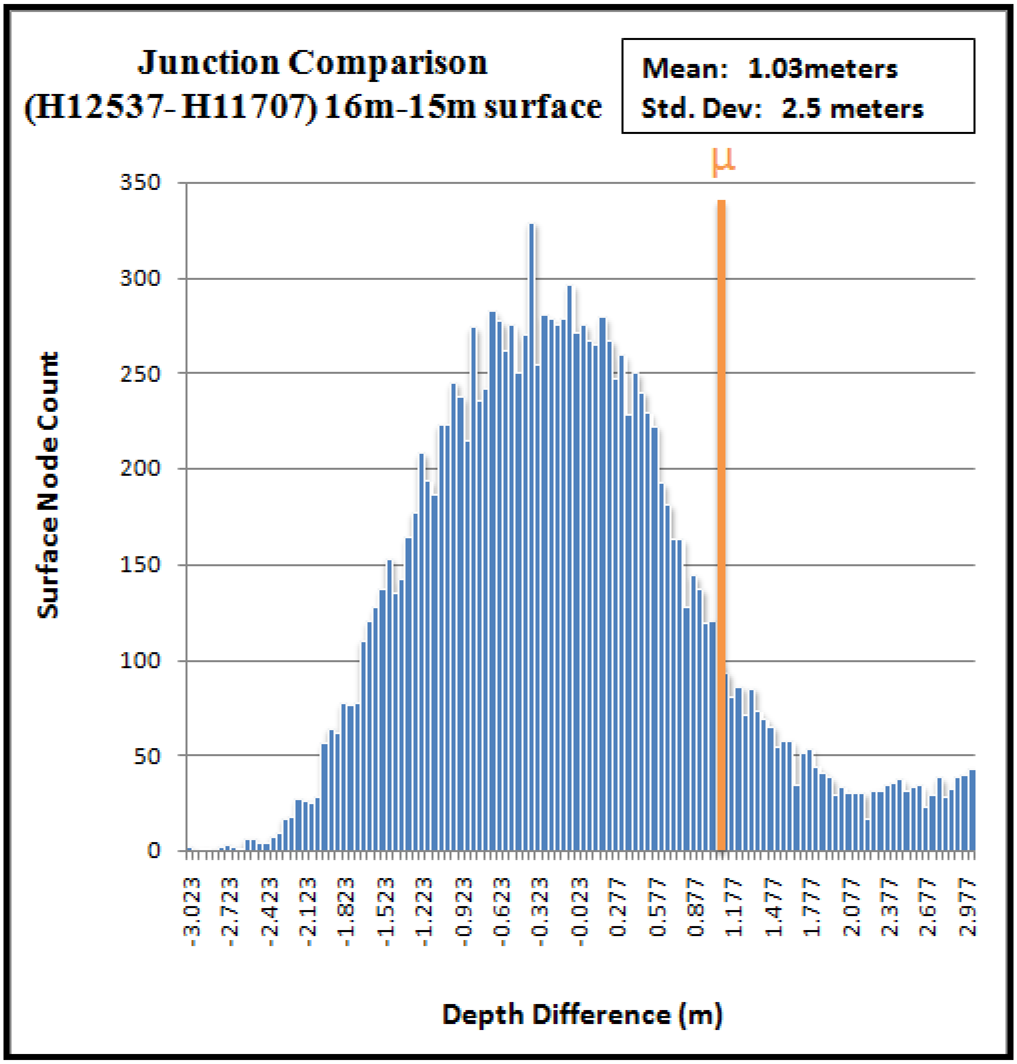


Figure 17: Difference surface statistics between H12537 and H11707 CUBE depth layers (16m-15m surfaces). H11707 is on average 1.03 meters shoaler than H12537.

<u>H11708</u>

Overlap with survey H11708 was approximately 800 meters on the northern boundary of H12537 (Figure 18). Depths in the junction area range from approximately 380 to 650 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H11708 to be an average of 0.73 meters shoaler than H12537, with a standard deviation of 3.70 meters (Figure 19). This is well within allowable IHO Order 2 accuracy at these depths.

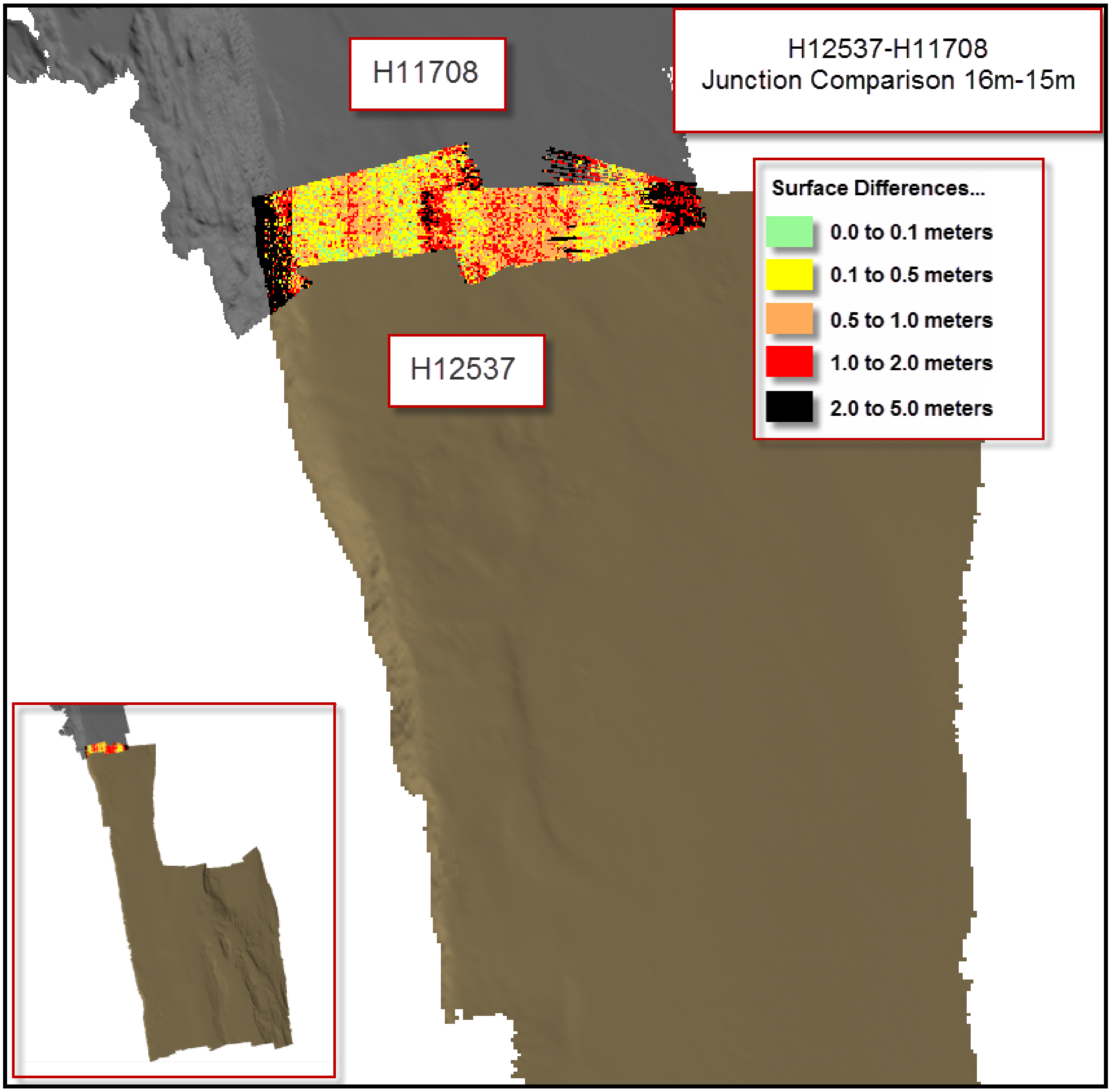


Figure 18: Junction difference with H11708.

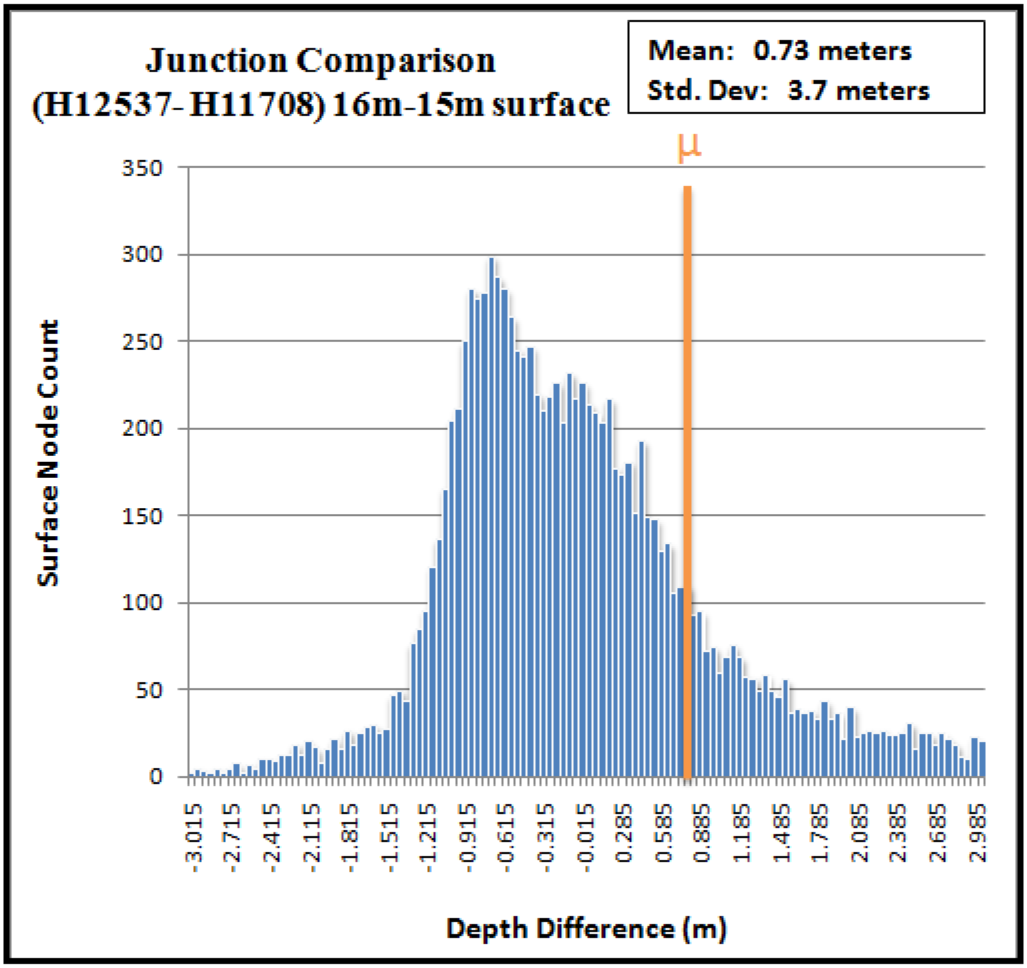


Figure 19: Difference surface statistics between H12537 and H11708 CUBE depth layers (16m-15m surfaces). H11708 is on average 0.73 meters shoaler than H12537.

<u>H12532</u>

Overlap with survey H12532 was approximately 1,000 meters along the western boundary of H12537 (Figure 20). Depths in the junction area range from approximately 495 meters to 725 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12532 to be an average of 0.27 meters shoaler than H12537, with a standard deviation of 2.92 meters (Figure 21).

Due to the wide range of depths in the junction area, using the mean difference did not provide for a full junction analysis. In addition to examining the mean difference, for the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 22). In total, 99.5% of the depth differences between H12537 and junctioning survey H12532 are within allowable IHO accuracies (Figure 23). Inspection of the data in CARIS Subset Editor (Figure 24), shows strong agreement between the two surveys, suggesting that the inconsistencies seen in the difference surface are artifacts of the CUBE gridding algorithm along steeply sloping areas.

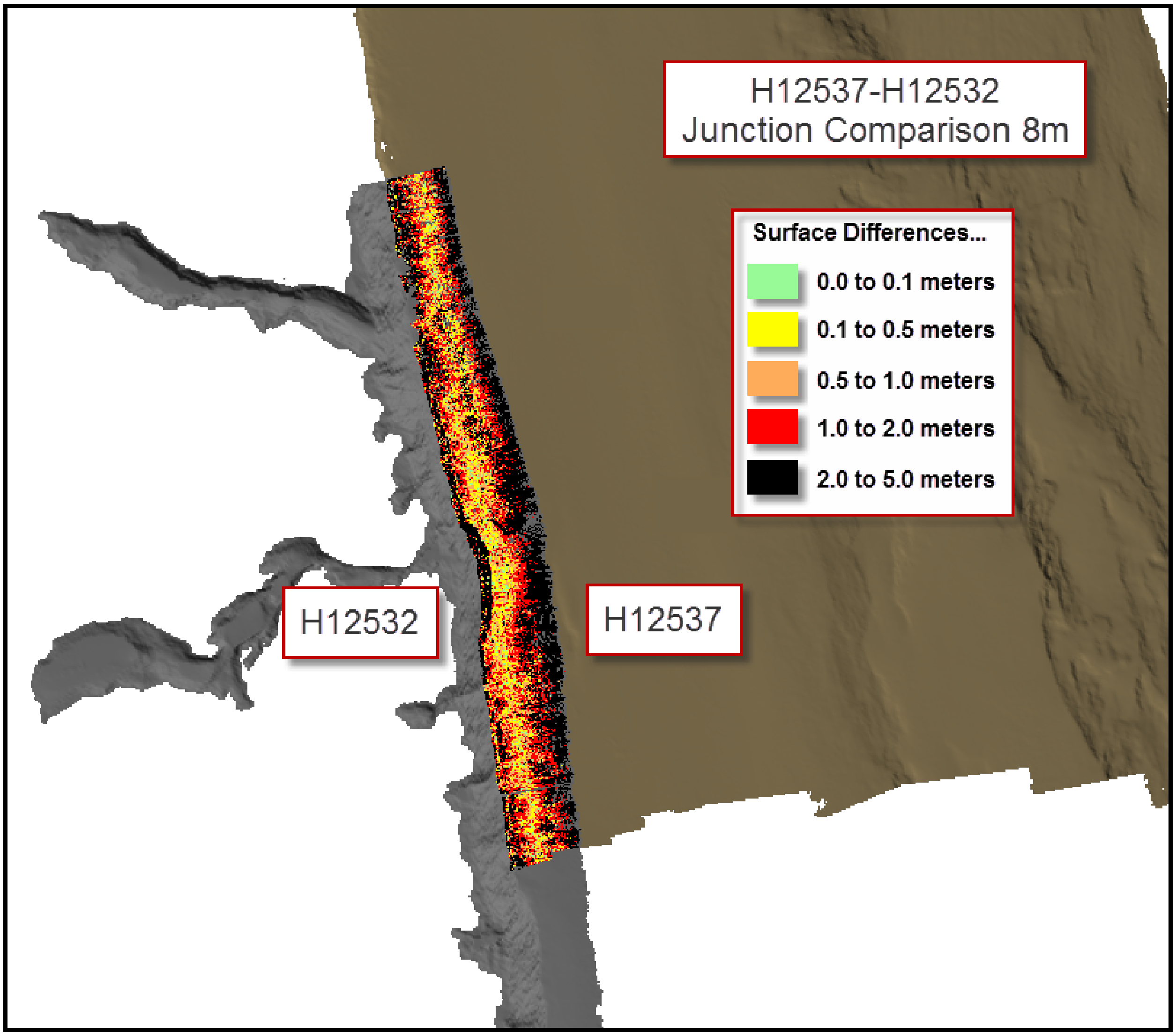


Figure 20: Junction difference with H12532.

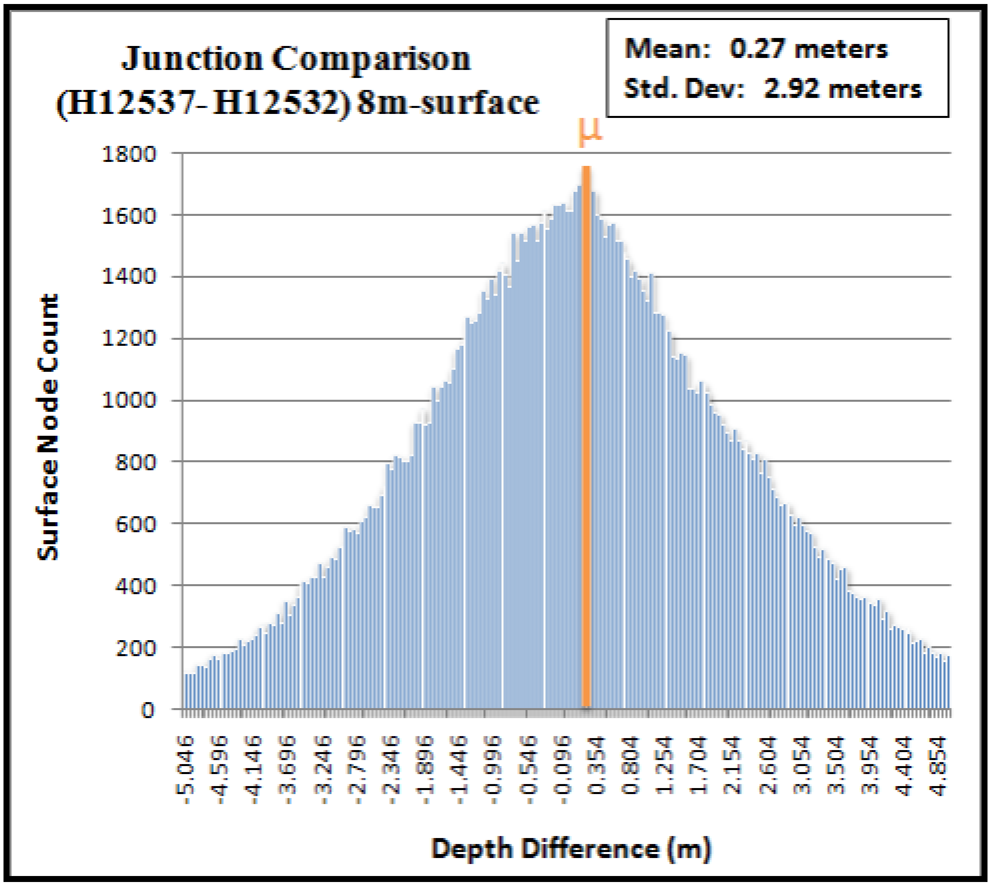


Figure 21: Difference surface statistics between H12537 and H12532 CUBE depth layers (8m surfaces). H12532 is on average 0.27 meters shoaler than H12537.

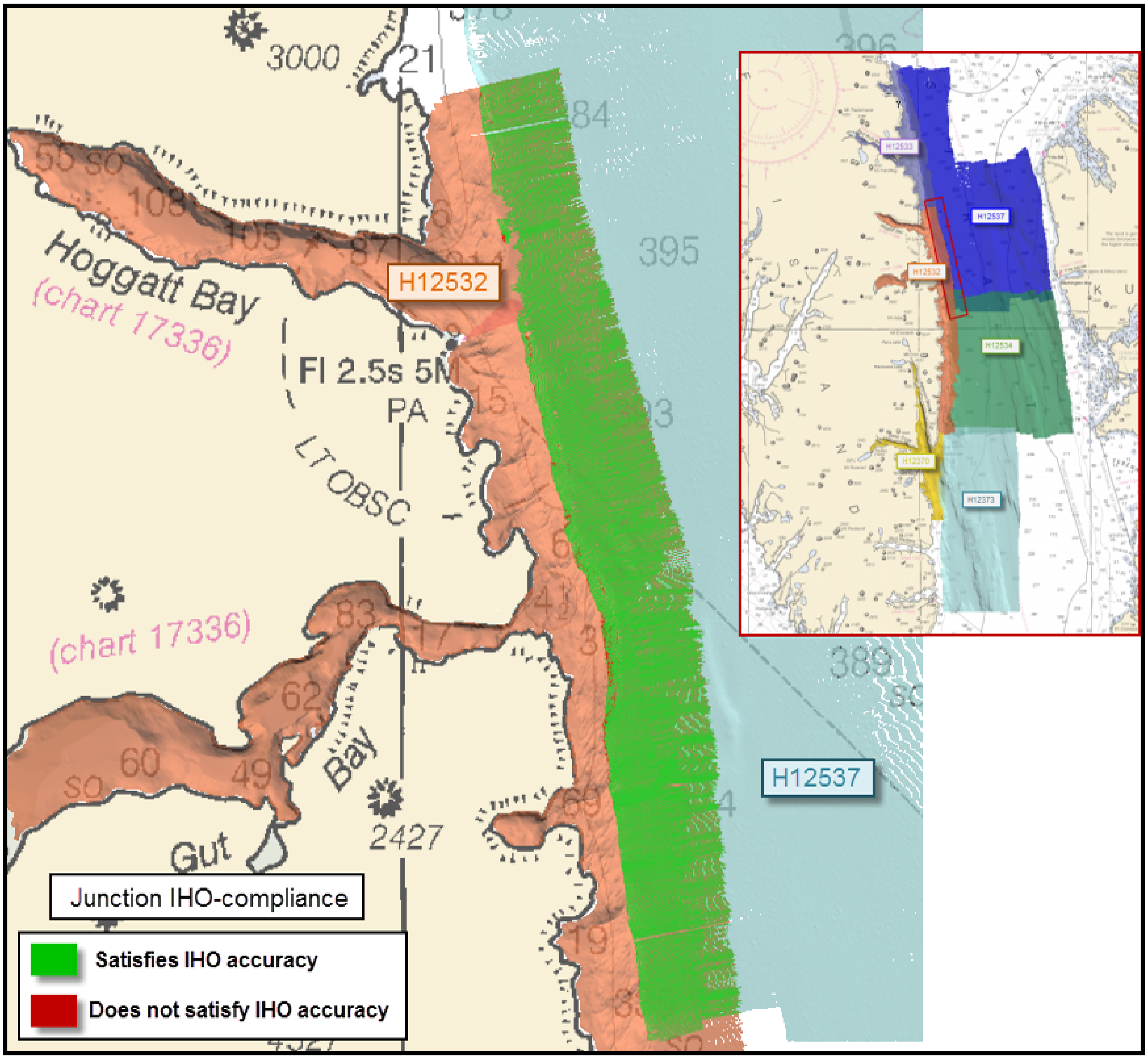


Figure 22: Depth difference between H12537 and junctioning survey H12532 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	172,353	171,555	99.5%

Figure 23: Summary table showing percentage of difference surface nodes between H12537 and junctioning survey H12532 that meet allowable IHO accuracy standards for the associated depths.

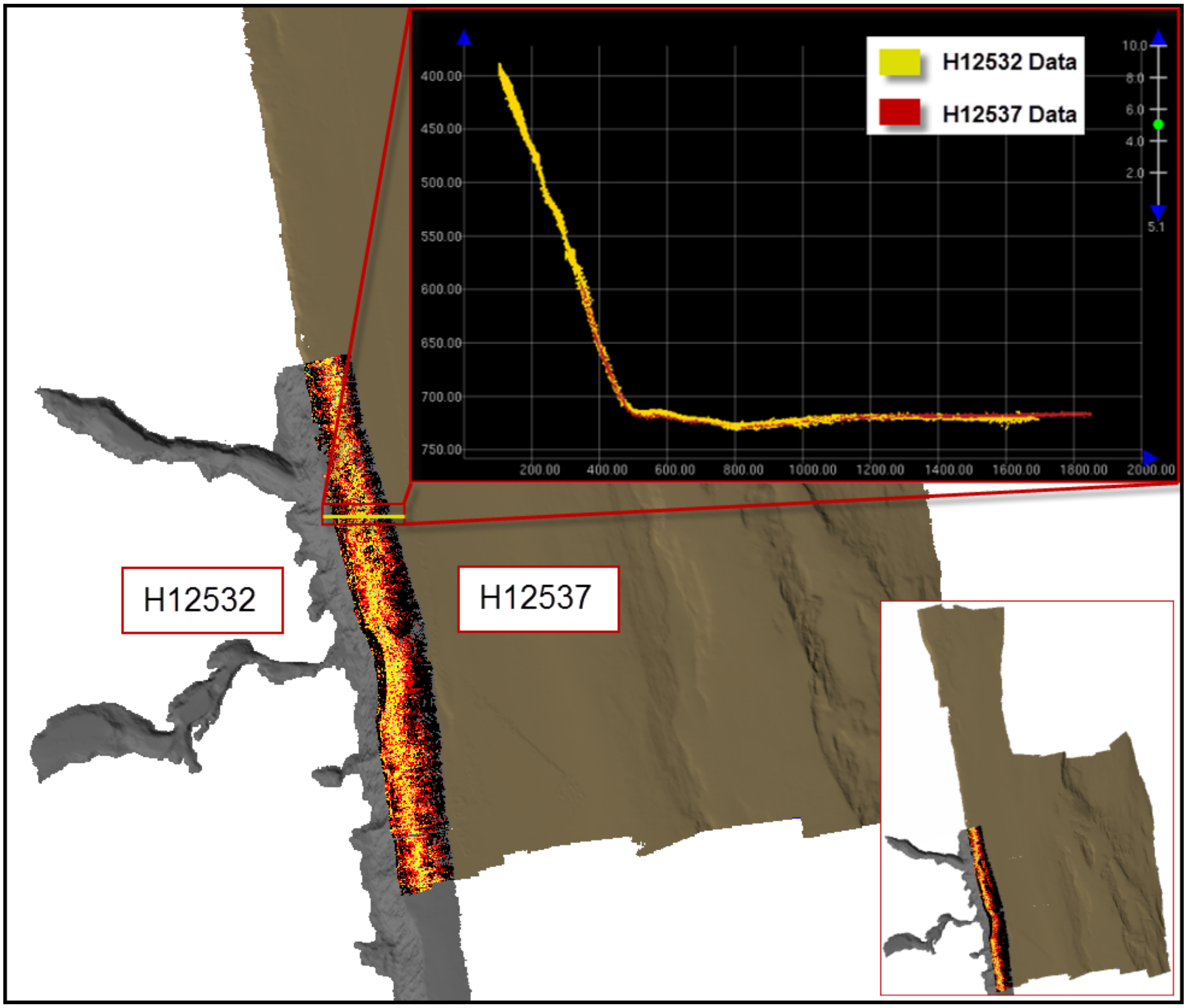


Figure 24: Subset view of sonar data between H12537 (red) and junctioning survey H12532 (yellow).

Larger depth differences between surveys are expected in deep areas and areas with steep topography. The data is adequate for charting.

<u>H12533</u>

Overlap with survey H12533 was approximately 1,400 meters along the western boundary of H12537 (Figure 25). Depths in the junction area range from approximately 295 meters to 715 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12533 to be an average of 0.53 meters shoaler than H12537, with a standard deviation of 3.03 meters (Figure 26). This is well within allowable IHO Order 2 accuracy at these depths.

Due to the wide range of depths in the junction area, using the mean difference did not provide for a full junction analysis. In addition to examining the mean difference, for the respective depths, the difference surface was compared to the allowable IHO accuracy standards (Figure 27). In total, 100.0% of the depth differences between H12537 and junctioning survey H12533 are within allowable IHO accuracies (Figure 28). Inspection of the data in CARIS Subset Editor (Figure 29) shows strong agreement between the two surveys, suggesting that the inconsistencies seen in the difference surface are artifacts of the CUBE gridding algorithm in steeply sloping areas.

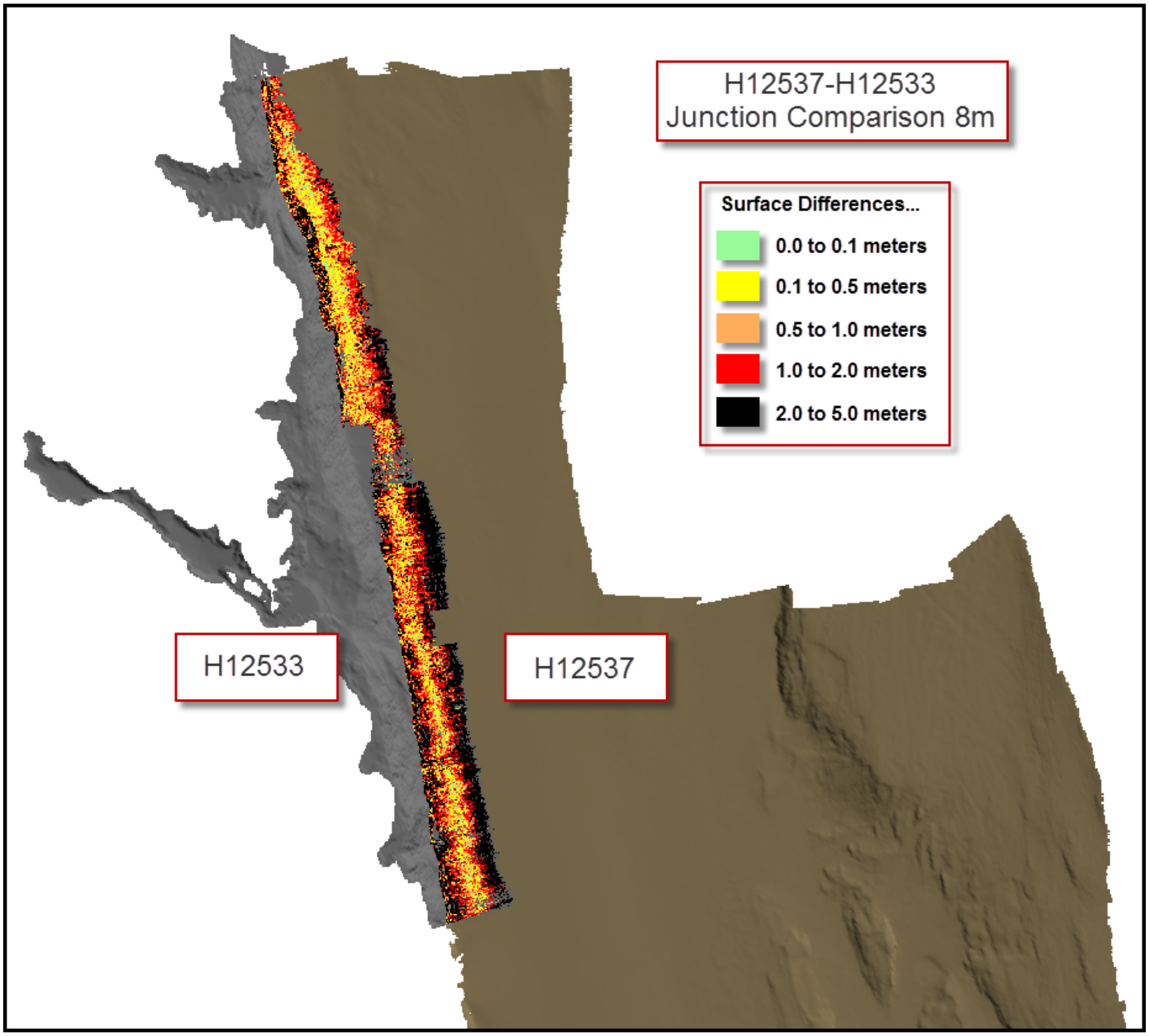


Figure 25: Junction difference with H12533.

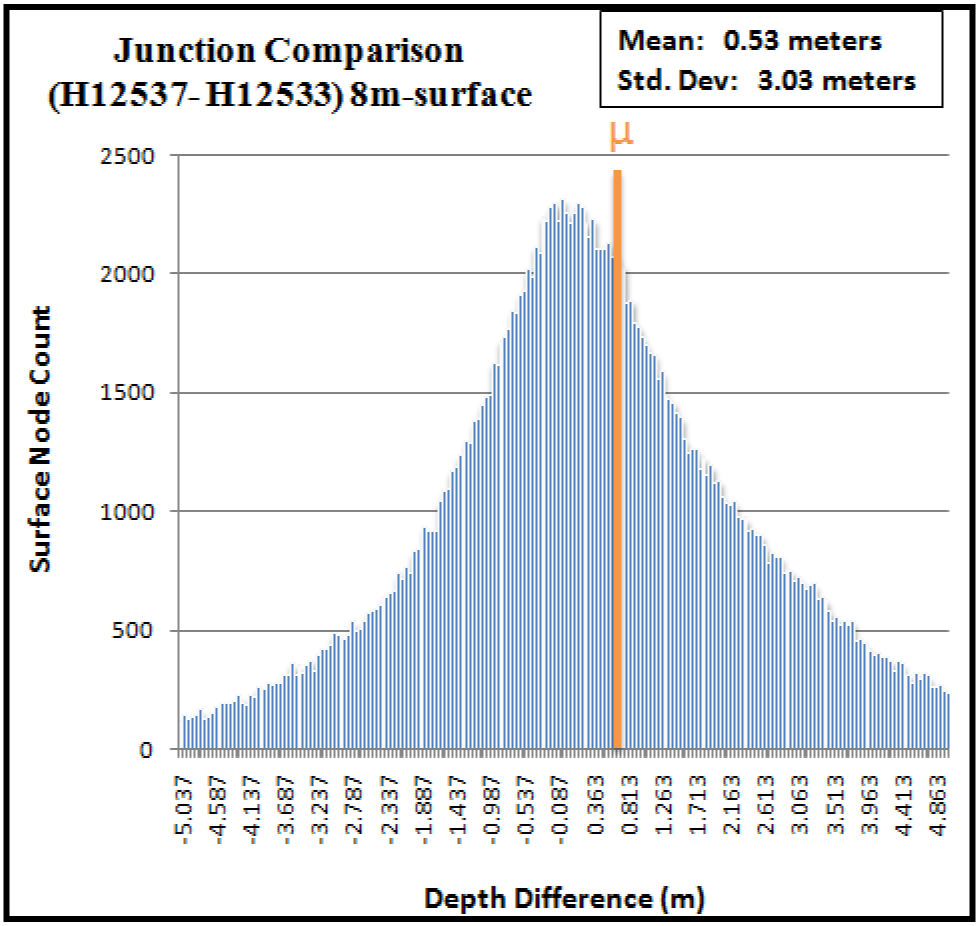


Figure 26: Difference surface statistics between H12537 and H12533 CUBE depth layers (8m surfaces). H12533 is on average 0.53 meters shoaler than H12537.

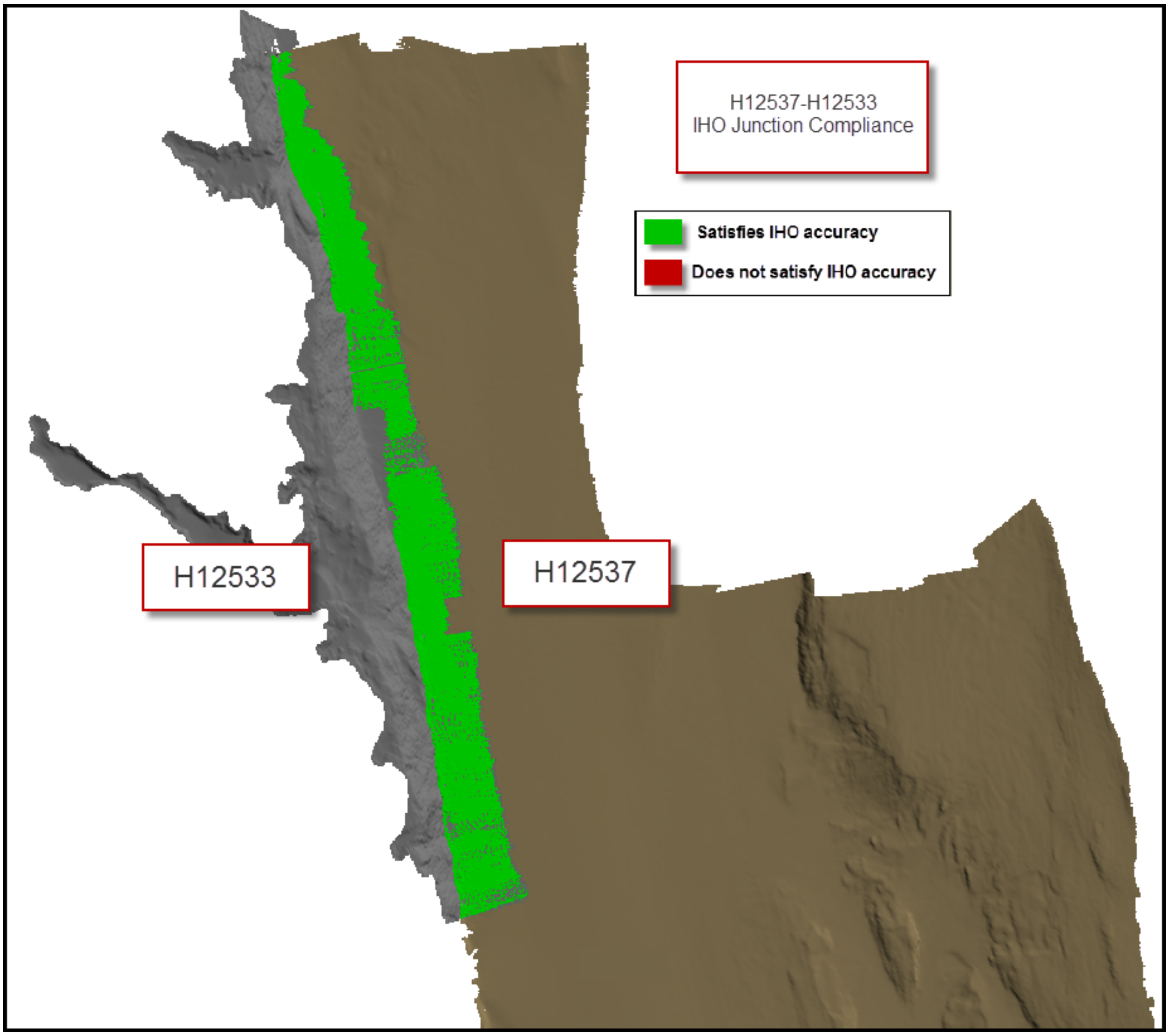


Figure 27: Depth difference between H12537 and junctioning survey H12533 as compared to allowable IHO accuracy standards for the associated depths.

Depth range	IHO Order	Number of nodes	Nodes satisfying IHO accuracy	Percent nodes satisfying IHO accuracy
Greater than 100m	Order 2	200,063	200,063	100.0%

Figure 28: Summary table showing percentage of difference surface nodes between H12537 and junctioning survey H12533 that meet allowable IHO accuracy standards for the associated depths.

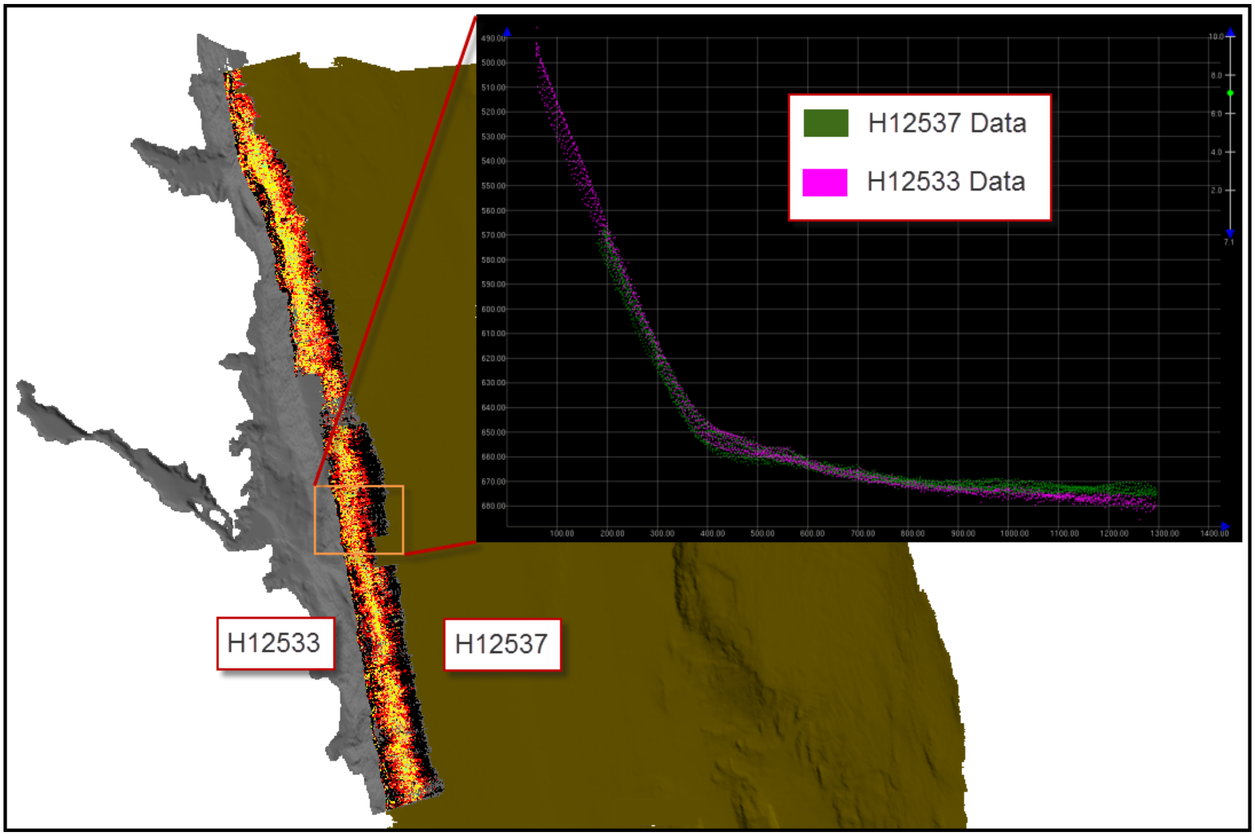


Figure 29: Subset view of sounding data between H12537 (green) and junctioning survey H12533 (pink).
Larger depth differences between surveys are expected in deep areas and areas with steep topography. The data is adequate for charting.

<u>H12534</u>

Overlap with survey H12534 was approximately 700 meters along the southern edge of H12537 (Figure 30). Depths in the junction area range from approximately 197 meters to 710 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12537 to be an average of 0.26 meters shoaler than H12534, with a standard deviation of 1.91 meters (Figure 31). This is well within allowable IHO Order 2 accuracy at these depths.

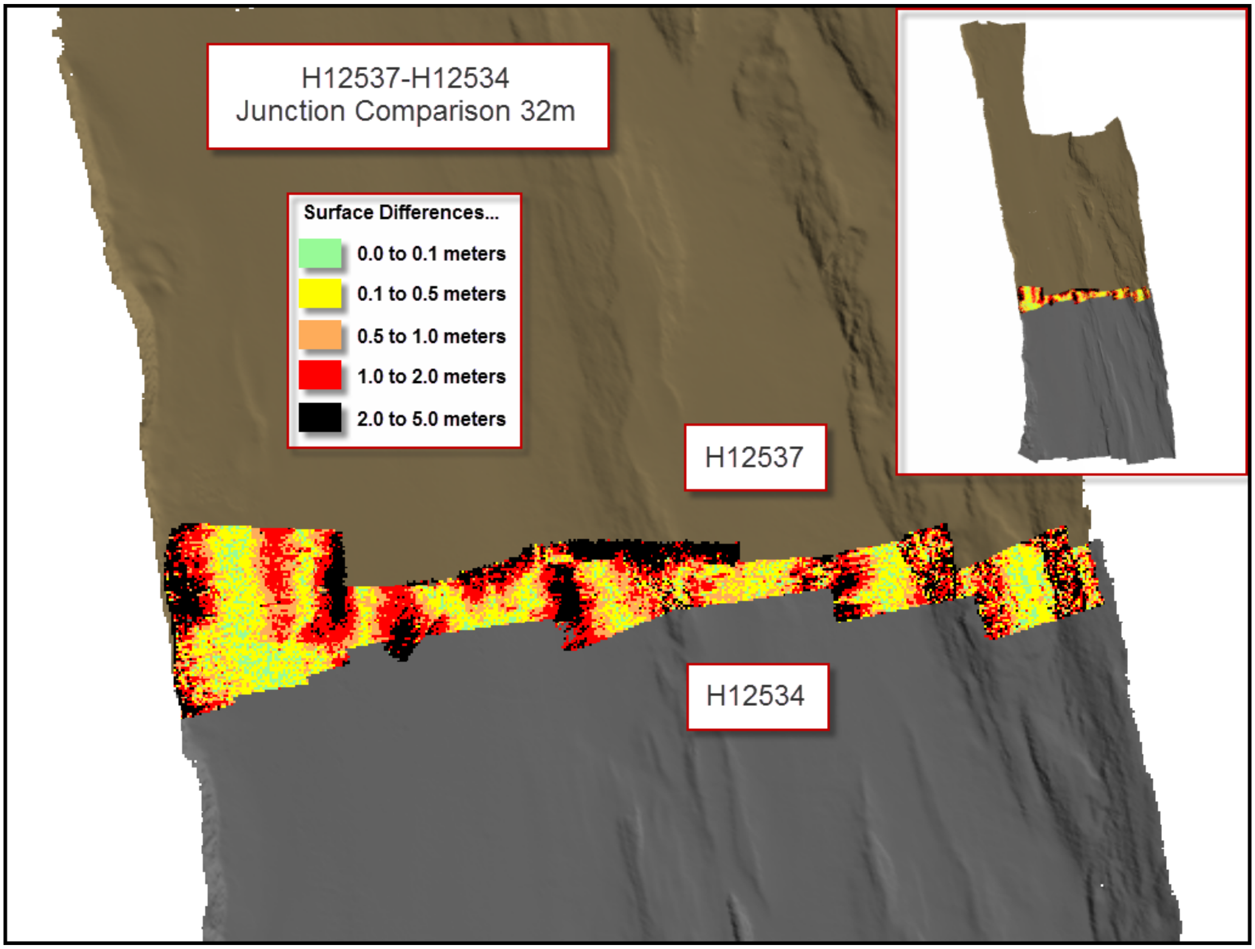


Figure 30: Junction difference with H12534.

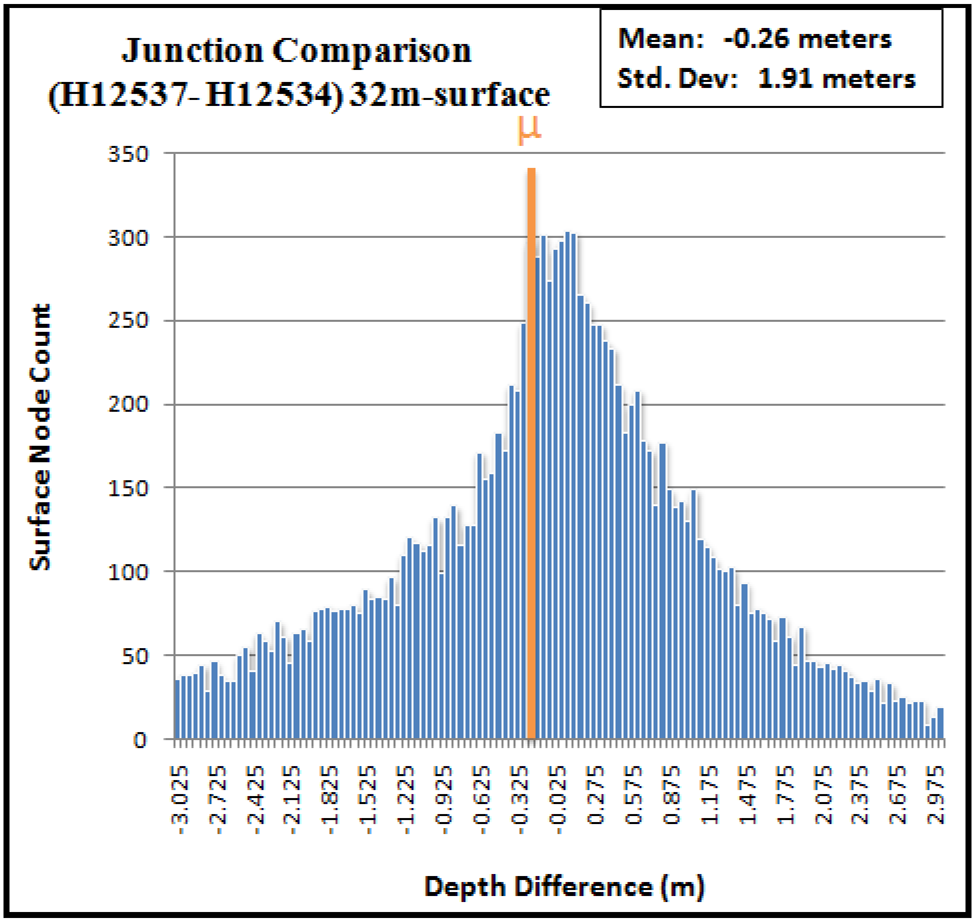


Figure 31: Difference surface statistics between H12537 and H12534 CUBE depth layers (8m surfaces). H12537 is on average 0.26 meters shoaler than H12534.

<u>H12536</u>

Overlap with survey H12536 was approximately 500 meters along the eastern boundary of H12537 (Figure 32). Depths in the junction area range from approximately 145 meters to 400 meters. A difference surface analysis between CUBE depth surfaces for each survey showed H12536 to be an average of 0.03 meters shoaler than H12537, with a standard deviation of 1.23 meters (Figure 33). This is well within allowable IHO Order 2 accuracy at these depths.

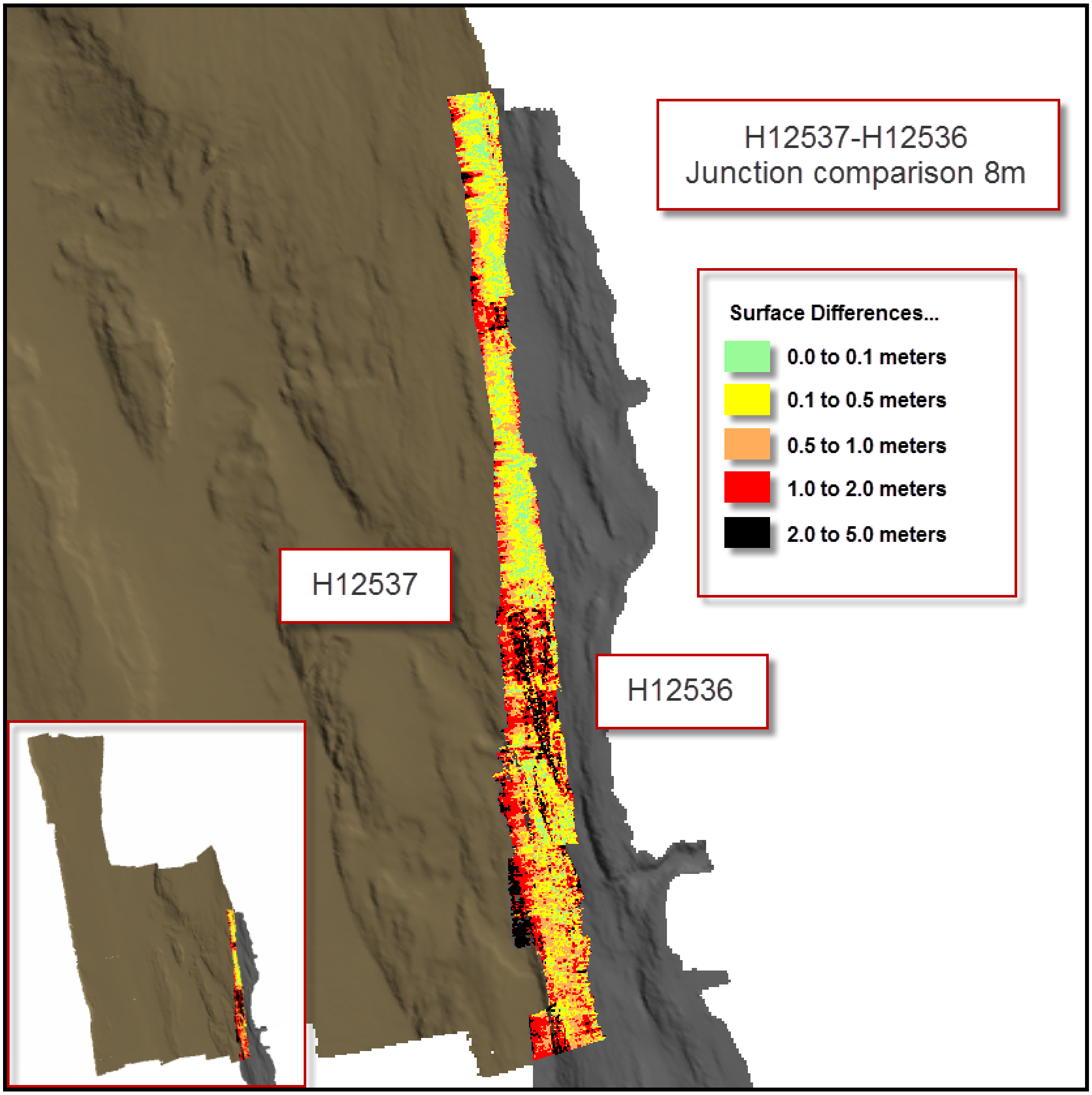


Figure 32: Junction difference with H12536.

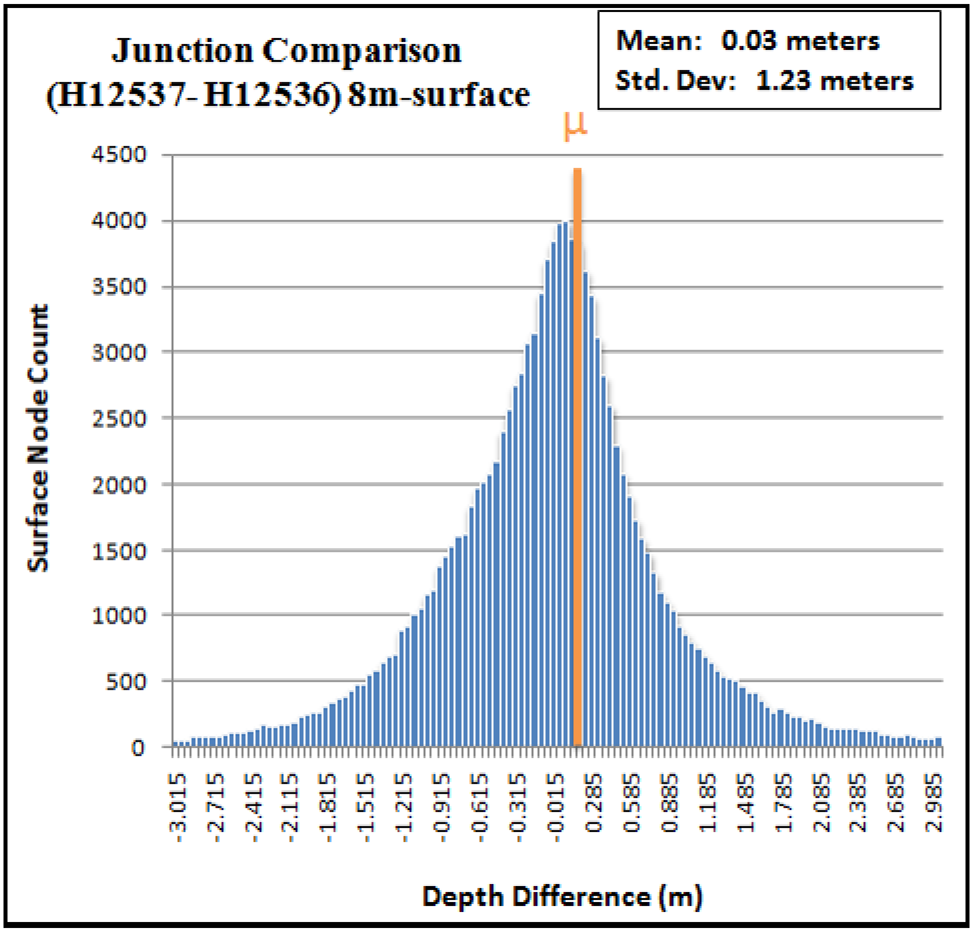


Figure 33: Difference surface statistics between H12537 and H12536 CUBE depth layers (8m surfaces). H12536 is on average 0.03 meters shoaler than H12537.

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>Ellipsoid to Tidal Surface Comparison</u>

Using the GPS height determined from the SBET file, data from H12537 was referenced to the ITRF00 ellipsoid and gridded. By differencing this ellipsoidally-referenced surface (ERS) from the traditional tidally-referenced surface, one should only see the ellipsoidal slope across the length of the survey. Any deviations from this slope would therefore be the result of an error intrinsic to either the ERS or tidal processing work flow. Misprojected SBET's, current-induced dynamic draft, incorrect waterline measurements, corrupt True Heave files, or poorly modeled water levels are all examples of artifacts that can be identified through the difference of the ERS and tidally-referenced surfaces.

Review of the ERS-MLLW difference surface reveals an east to west gradient across the survey, showing the MLLW surface decreasing relative to the ITRF00 ellipsoid (red to blue) (Figure 34). Upon investigation, it was found that the EGM2008-WGS84 geoid-ellipsoid separation model published by the National Geospatial-Intelligence Agency (NGA) showed a similar trend across the survey; these surfaces have a similar slope and magnitude and agree well considering the 2.5' resolution of the NGA surface and the expected differences between the geoid and MLLW (Figure 35).

Additional review shows an apparent artifact in a line running diagonally across the survey (Figures 34 and 35, blue line across red area). This line (S221 DN170 line 0012_20130620_000018) was shown to agree well with surrounding data when referenced to MLLW but was offset from surrounding data when referenced to the ellipse. When the associated SBET was reviewed in POSPac, no immediate deficiencies were noted in the file; however, given the suspect results in the difference surface, the real-time trajectory file was restored for this line. The remaining three lines associated with this SBET were examined in Subset Editor and found to have strong agreement with neighboring lines both at MLLW and the ellipse; and thus, the SBET was retained for those lines.

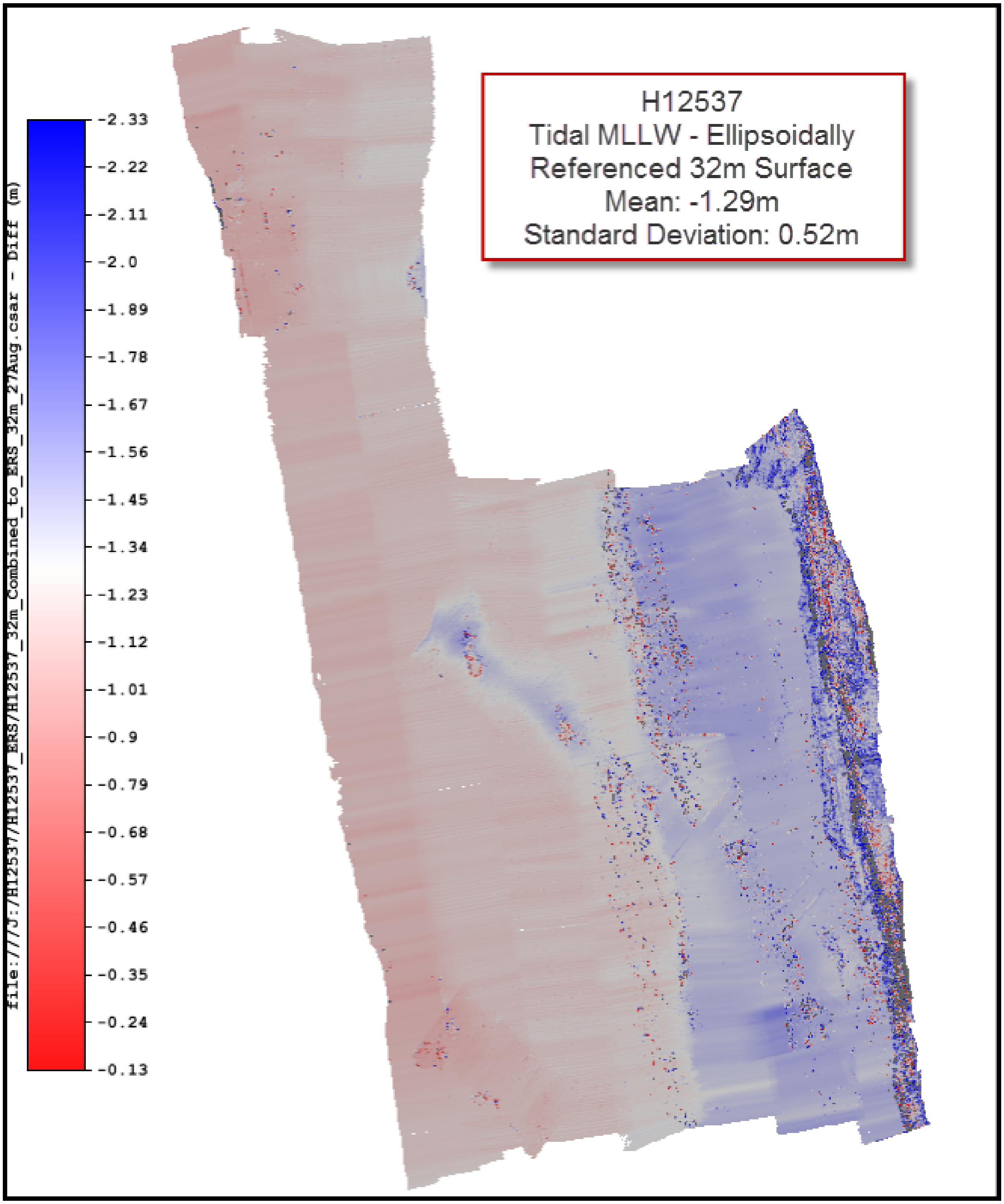


Figure 34: Difference surface between the tidally-referenced and ellipsoidally-referenced surface. MLLW is differenced from the ERS. Red and blue show divergence from the mean.

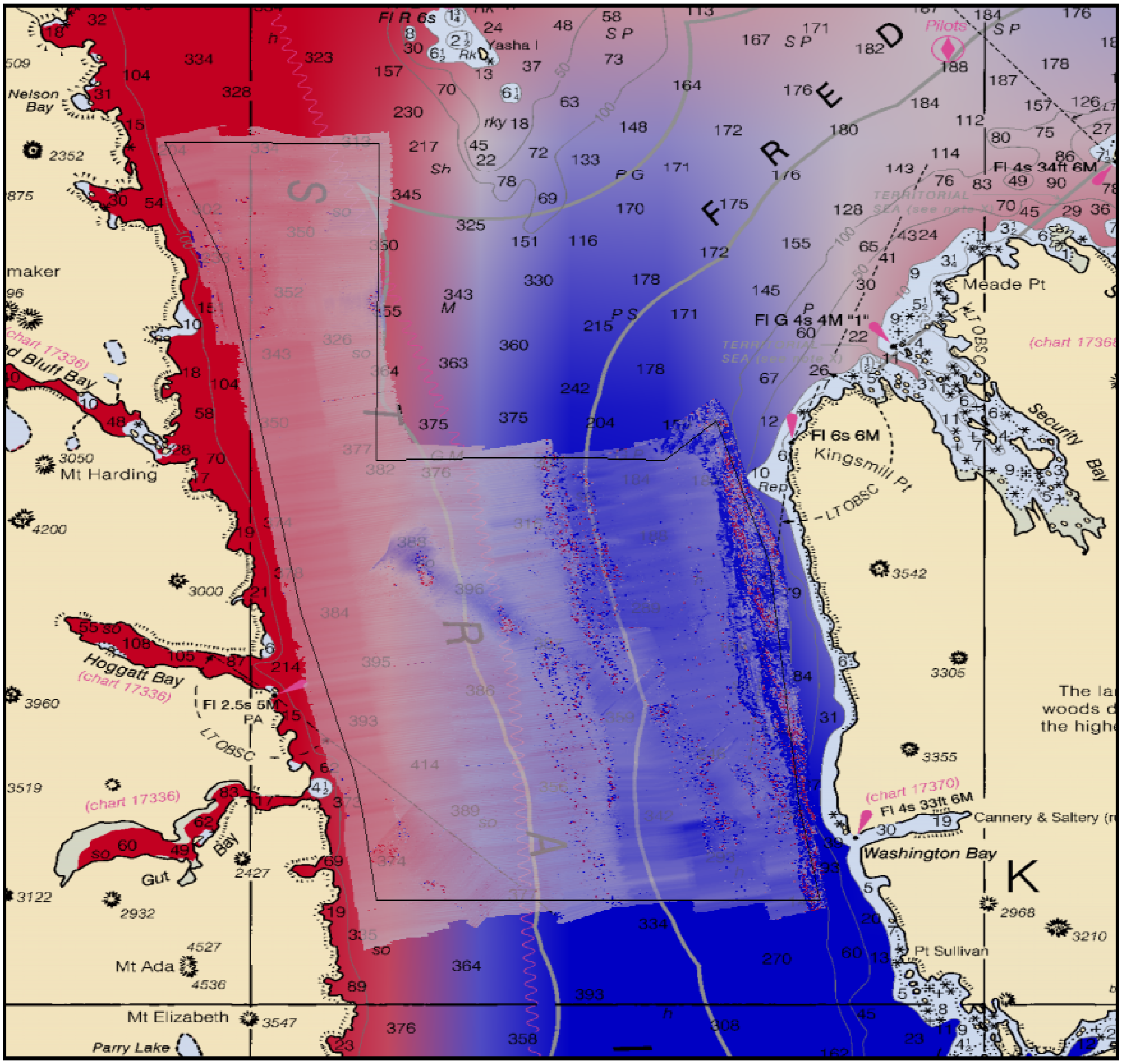


Figure 35: MLLW-ERS difference surface displayed over EGM2008-WGS84 geoid-ellipsoid separation model on Chart 17320. Both separation models show the same general trend.

The data is adequate for charting.

Sound speed artifacts in outer beams

Despite casts being taken as frequently as every 15 minutes, with consideration to spatial distribution, sound speed artifacts were seen within the data. These artifacts occurred as "frowns" due to inadequately modeled refraction. In these areas, the outer beams were flagged as rejected to assist the gridding algorithm in bringing the surface back to better represent the true seafloor. Although some of the artifacts still exist within the data, they are within uncertainty standards specified in Section 5.1.3 of the HSSD. The Hydrographer finds that the data is adequate to supersede charted data (Figure 36).

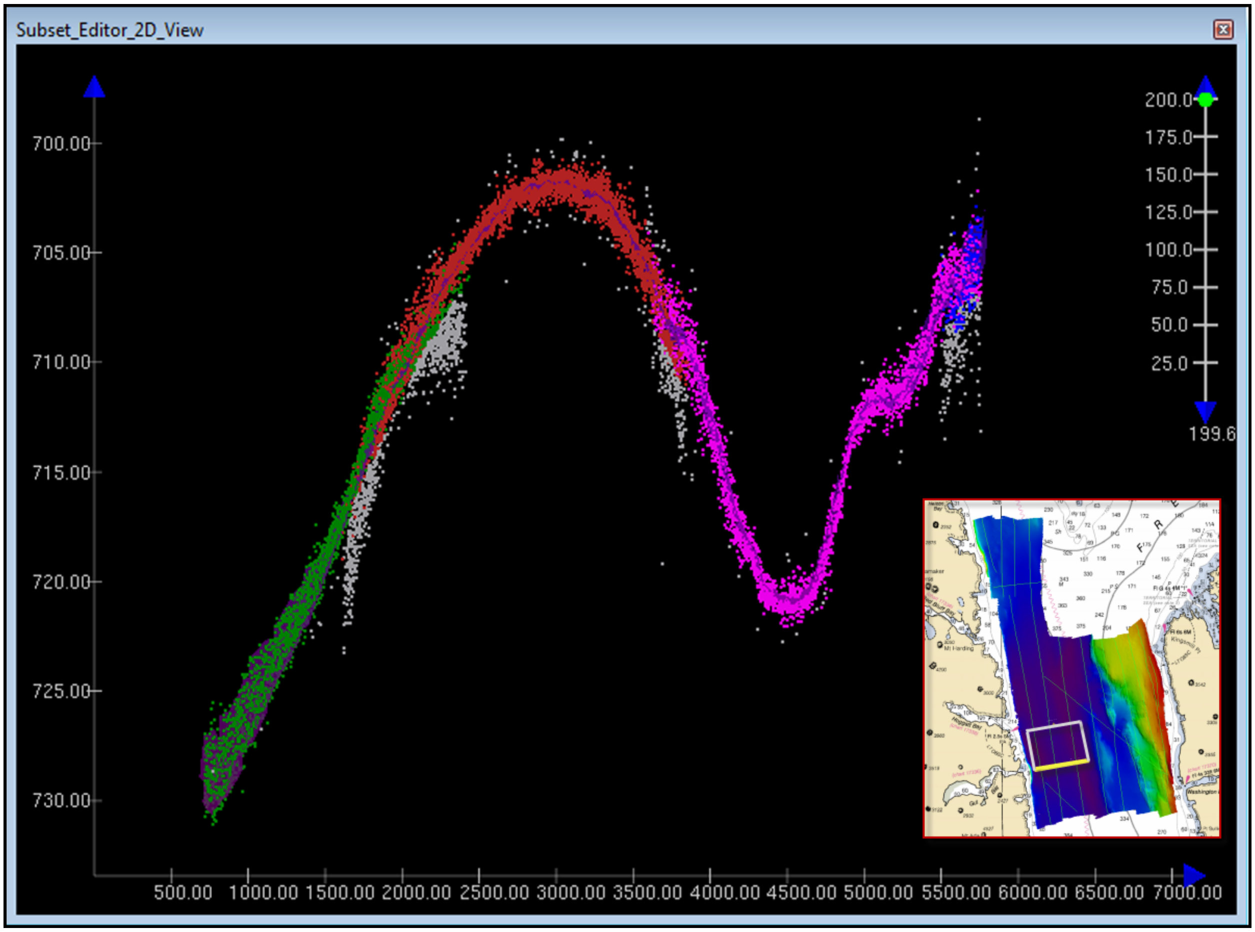


Figure 36: Example of sound speed artifacts seen within H12537 during cleaning.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: For data collected on RAINIER, sound speed profiles were acquired using the Rolls Royce MVP200 approximately every 15 minutes or when recommended by "Cast Time", a cast frequency program developed at the University of New Hampshire. All casts were concatenated into a master file for the entire survey and applied to all lines using the "Nearest in distance within time (4 hours)" profile selection method (Figure 37).

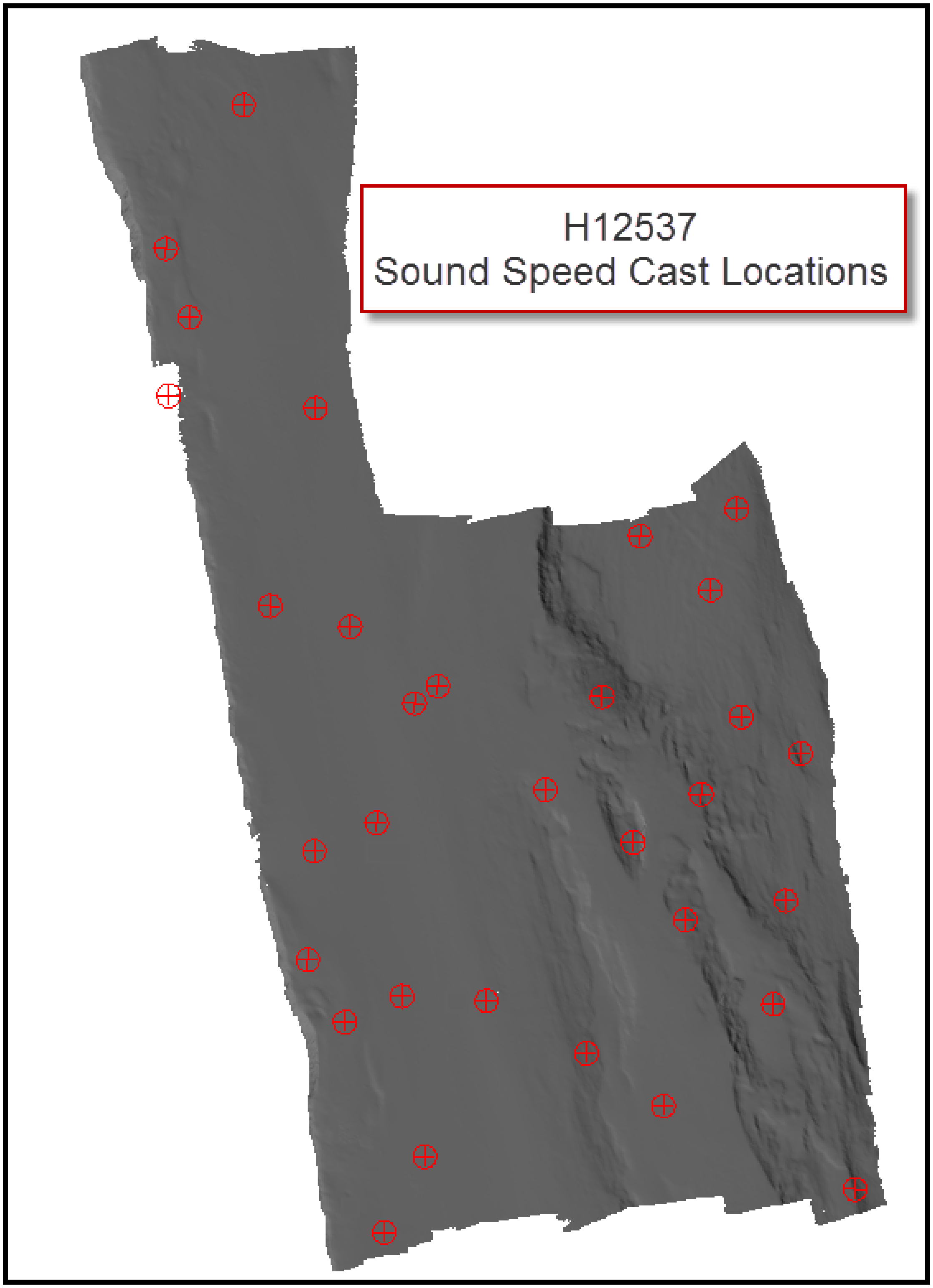


Figure 37: Distribution of sound speed profiles for H12537.

B.2.8 Coverage Equipment and Methods

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

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

The following calibrations were conducted after the initial system calibration discussed in the DAPR:

Calibration Type	Date	Reason
Patch Test	2013-05-25	Update of system configuration.

Table 8: Calibrations not discussed in the DAPR.

In cooperation with the University of New Hampshire and The Center for Coastal and Ocean Mapping, a new vessel file was created for S221 to resolve a recurring artifact seen in the data collected by the Kongsberg EM710 on the RAINIER. On 25 May 2013 (DN146), the ship's system integration was reconfigured, moving the reference point for both the IMU and the sonar to the center of the sonar's transmit array. This implies that both real-time and logged data is in the ship's reference frame, with the EM710 transmitter as the origin.

Necessarily, this new vessel file (S221_Simrad-EM710_TxRef.hvf) contains new patch test values as well as the change to the vessel's reference frame. Three days of data (DN147, DN149, DN170) were acquired using this new configuration. This configuration is further described in the DAPR.

The data logged using the updated configuration is adequate for charting.

B.4 Backscatter

Backscatter data was acquired, but was not formally processed by RAINIER personnel. However, a preliminary mosaic was created (Figure 38). Backscatter was logged as .ALL files and submitted to NGDC, but is not included with the data submitted to the Branch.

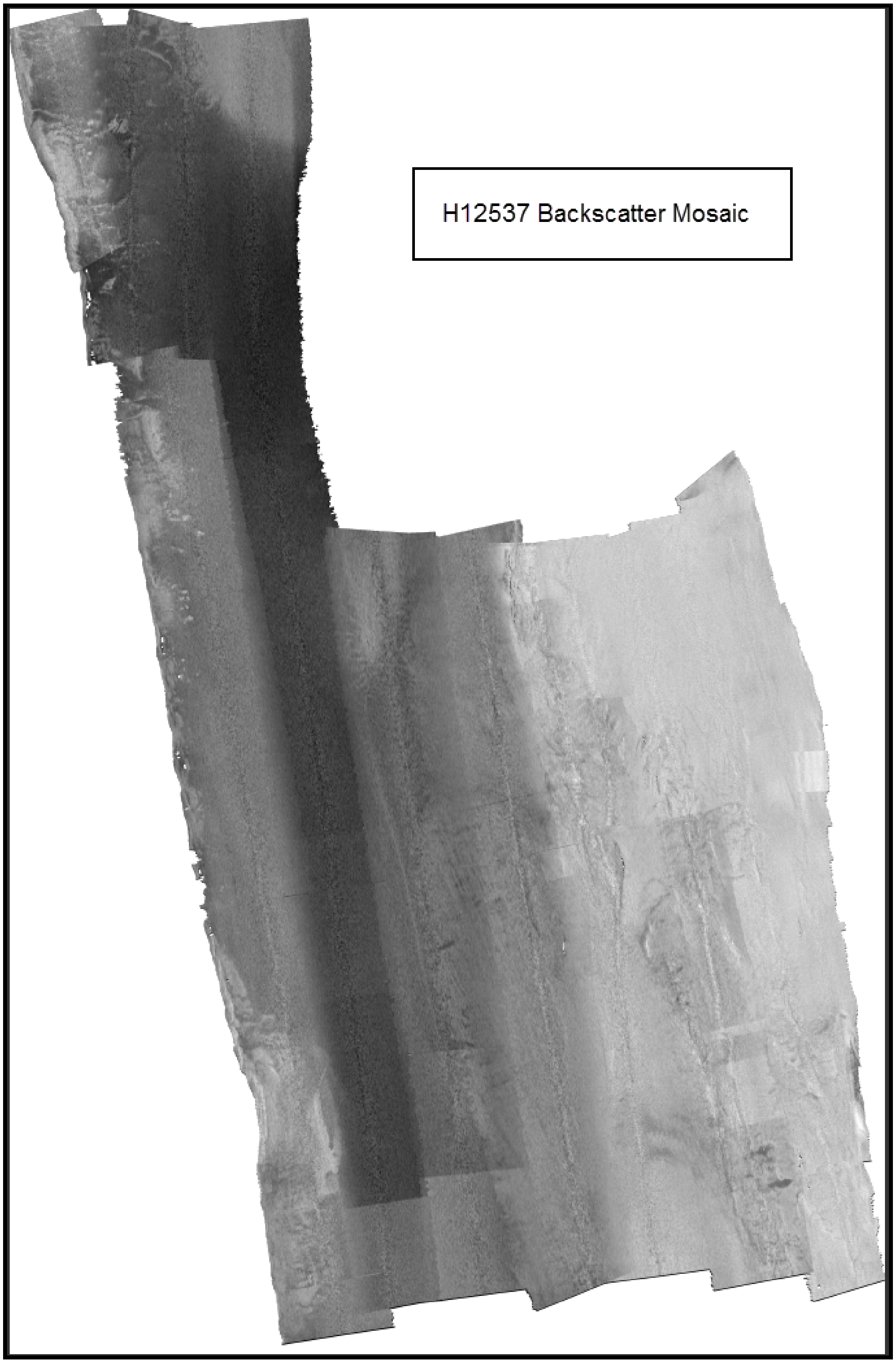


Figure 38: H12537 backscatter mosaic.

B.5 Data Processing

B.5.1 Software Updates

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

The following Feature Object Catalog was used: NOAA Profile V_5_3_2.

All final data processing was performed using CARIS HIPS 8.0.4. It should be noted that all Kongsberg EM710 data was intentionally processed without the Simrad Sound Velocity Correction (SVC) module. This was done in order to avoid a known error in the SVC module associated with reverse-mounted transducers. To accomplish this, a custom CARIS license file was used, which excluded the licensing for the Simrad SVC. For further details, refer to the DAPR.

The processing logs show that the final data processing by the field unit was performed using CARIS HIPS 8.1.1. Data processing in the office was performed using CARIS HIPS 8.1.5.The EM710 data processed using the custom CARIS license file is adequate for charting.

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
H12537_8m	CUBE	8 meters	0 meters - 800 meters	NOAA_8m	Complete MBES
H12537_16m	CUBE	16 meters	0 meters - 800 meters	NOAA_16m	Complete MBES
H12537_32m	CUBE	32 meters	0 meters - 800 meters	NOAA_32m	Complete MBES
H12537_8m_72-160m_Final	CUBE	8 meters	72 meters - 160 meters	NOAA_8m	Complete MBES
H12537_16m_144-320m_Final	CUBE	16 meters	144 meters - 320 meters	NOAA_16m	Complete MBES
H12537_32m_288-1000m_Final	CUBE	32 meters	288 meters - 1000 meters	NOAA_32m	Complete MBES
H12357_32m_Combined	CUBE	32 meters	132 meters - 731 meters	NOAA_32m	Complete MBES

Table 9: Submitted Surfaces

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.

Standard Vertical Control Methods Used:

TCARI

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

Station Name	Station ID
Port Alexander	9451054

Table 10: NWLON Tide Stations

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

Station Name	Station ID
Red Bluff Bay, AK	9451467

Table 11: Subordinate Tide Stations

There was no Water Level file associated with this survey.

File Name	Status
O322RA2013.tc	Preliminary
O322RA2013_Final.tc	Final

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

A request for final approved tides was sent to N/OPS1 on 06/21/2013. The final tide note was received on 08/30/2013.

The Final Approved Water Level files associated with this survey are 9451054.tid and 9451467.tid. See attached tide note dated August 27, 2013.

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- 08 North.

<u>The following PPK methods were used for horizontal control:</u>

Single Base

In conjunction with this project, a GNSS base station was established by RAINIER personnel on a small island at the head of Red Bluff Bay, near the northwest extents of the survey. Vessel kinematic data was post-processed using Applanix POSPac processing software as described in the DAPR. Single Base processing was used for the entire survey. One line (S221 DN170 line 0012_20130620_000018) displayed a vertical offset from surrounding data when referenced to the ellipse. The associated SBET was removed from this line (see B.2.6 Factors Affecting Soundings).

The following user installed stations were used for horizontal control:

HVCR Site ID	Base Station ID
Red Bluff Bay	N/A

Table 13: User Installed Base Stations

The data from the line that did not have SBET applied is adequate for charting.

The following DGPS Stations were used for horizontal control:

DGPS Stations
Annette Island, AK (323 kHz)
Level Island, AK (295 kHz)

Table 14: USCG DGPS Stations

D. Results and Recommendations

D.1 Chart Comparison

D.1.1 Raster Charts

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

Chart	Scale	Edition	Edition Date	LNM Date	NM Date
17320	1:217828	18	03/2008	03/04/2008	03/01/2008

Table 15: Largest Scale Raster Charts

17320

A comparison was performed with Chart 17320 (1:217,828) using a CARIS sounding layer based on the combined finalized surface from H12537 and a contour layer based on the same surface. The charted 100-fathom contour lies seaward of the surveyed 100-fathom contour on the eastern side of the survey. The Hydrographer recommends that soundings and contours, as surveyed, fully supersede prior data in their common areas to better reflect the depths seen throughout this survey.

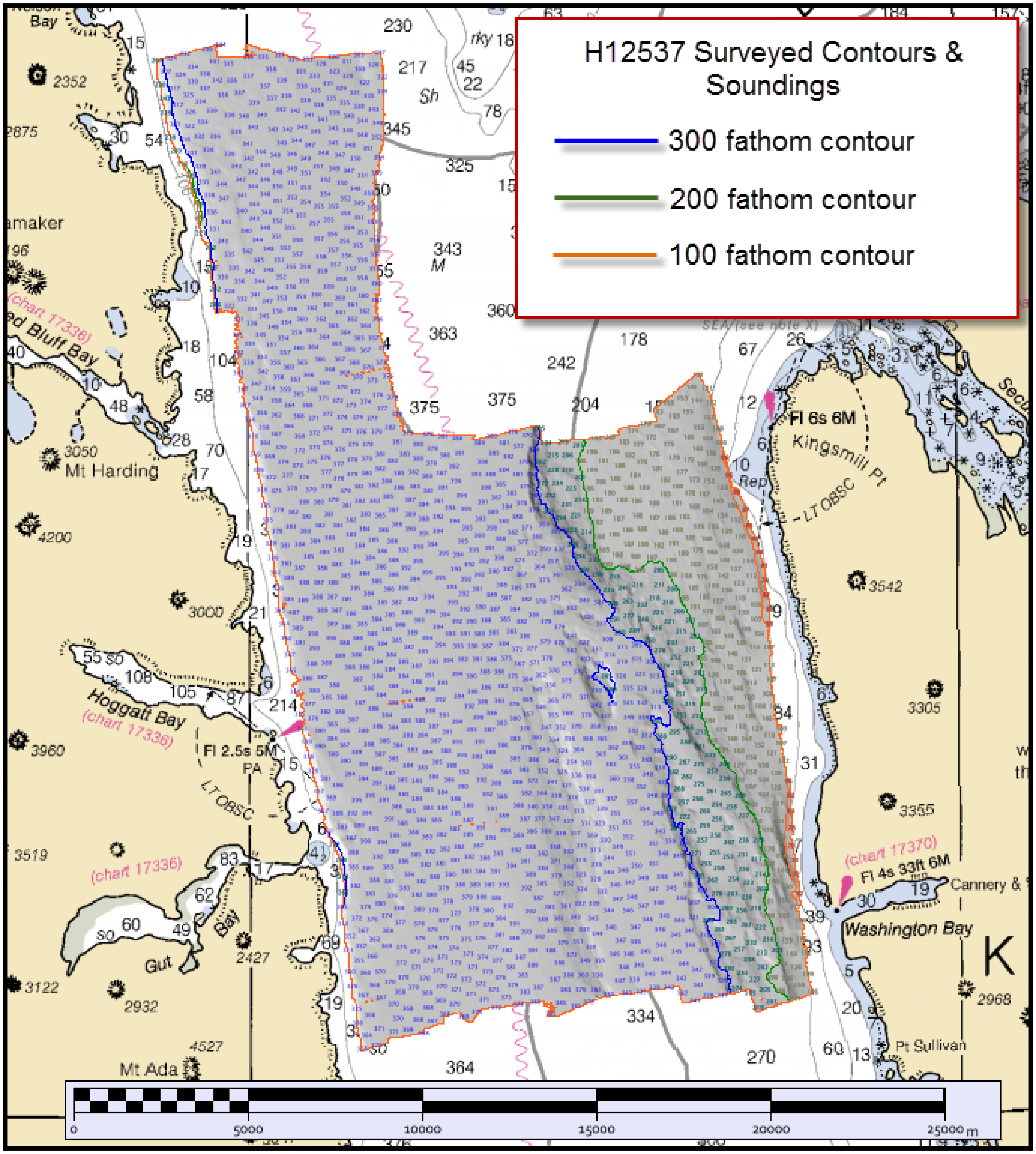


Figure 39: Comparison of charted (17320) 100-fathom contours derived from survey H12537. Contours deviated more than 400 meters in some locations, most likely a result of smoothing. All soundings in fathoms.

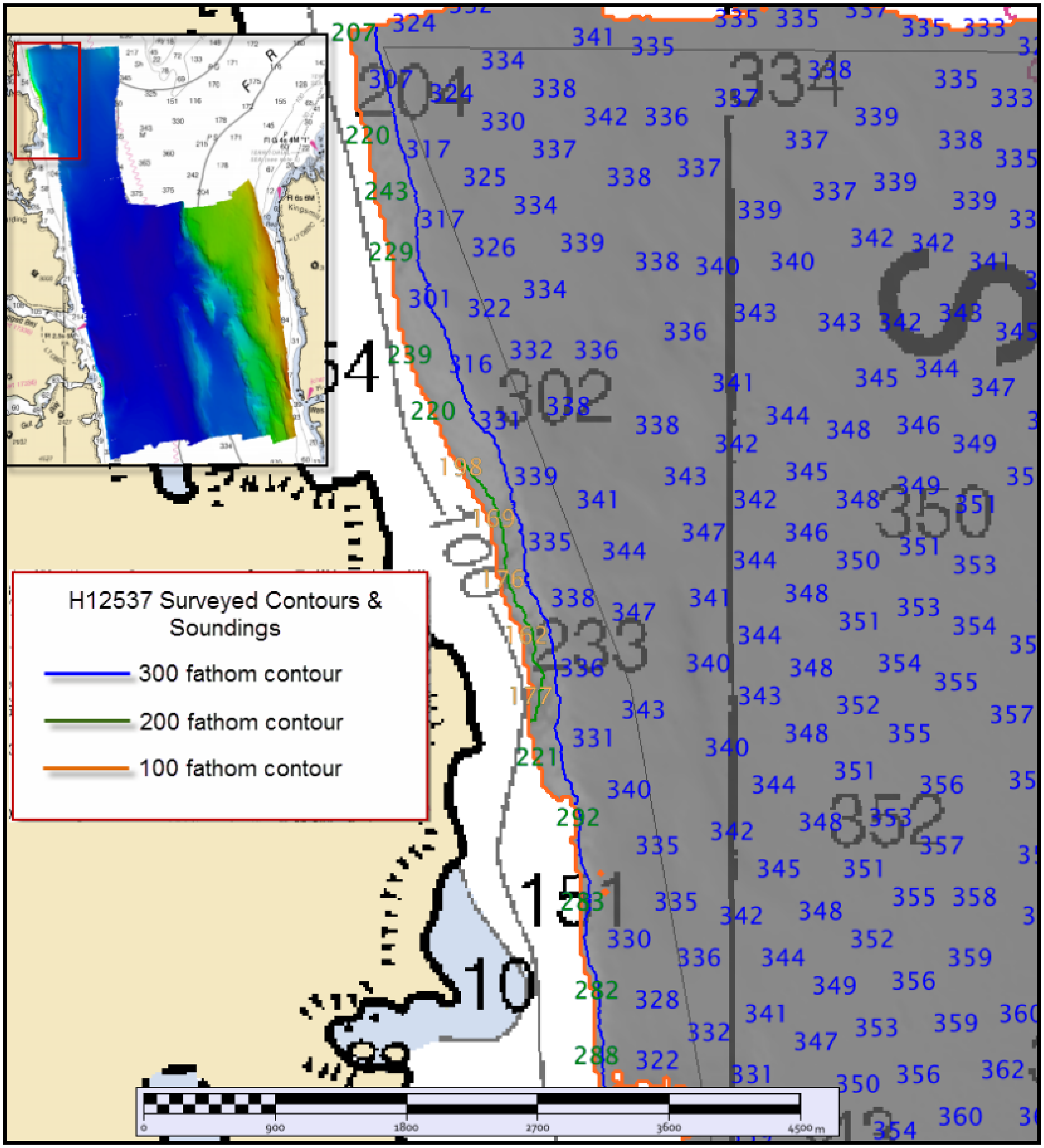


Figure 40: Close-up of northwest corner of H12537 showing comparison of contours derived from survey H12537 and those depicted on Chart 17320.

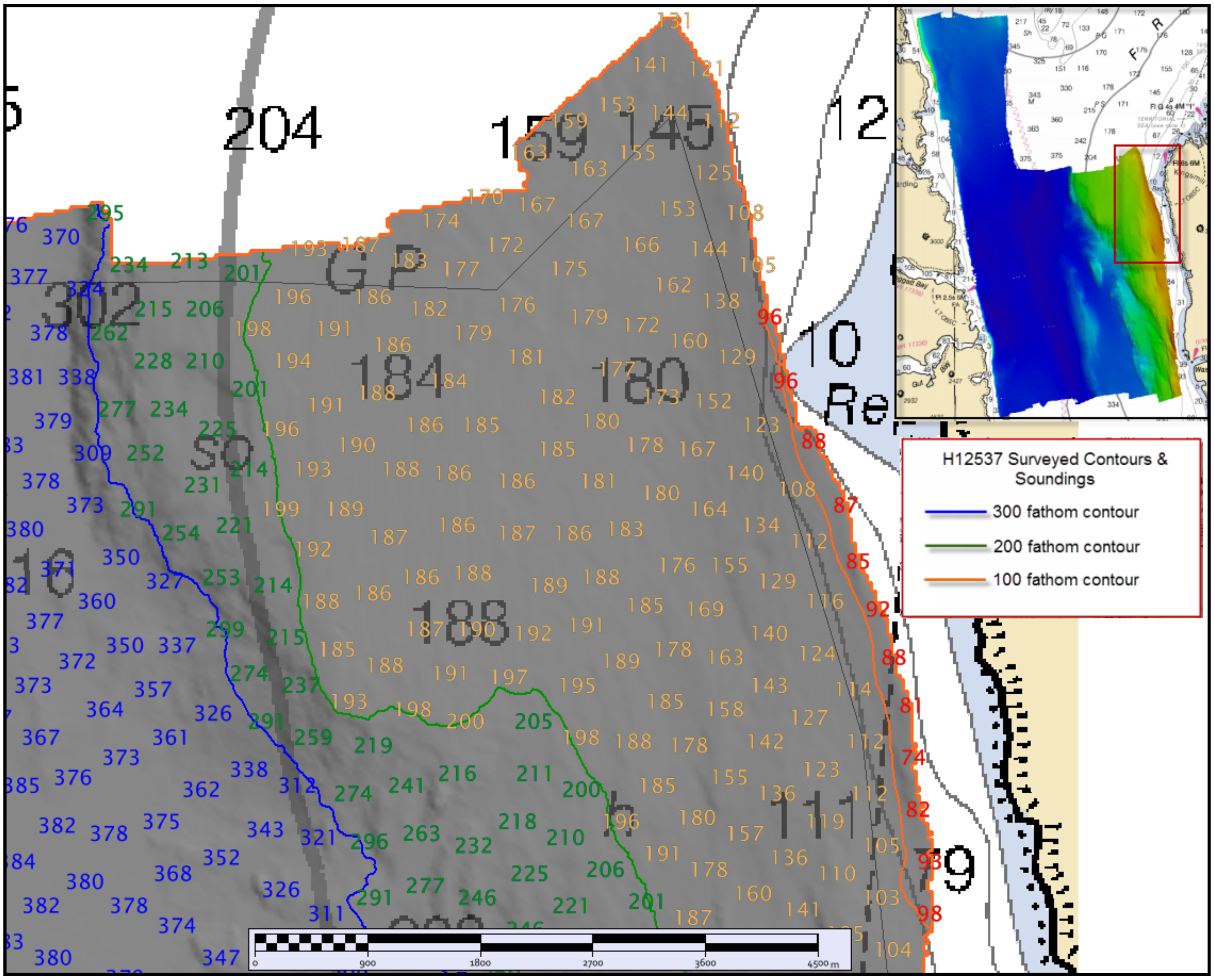


Figure 41: Close-up of northeast corner of H12537 showing comparison of contours derived from survey H12537 and those depicted on Chart 17320.

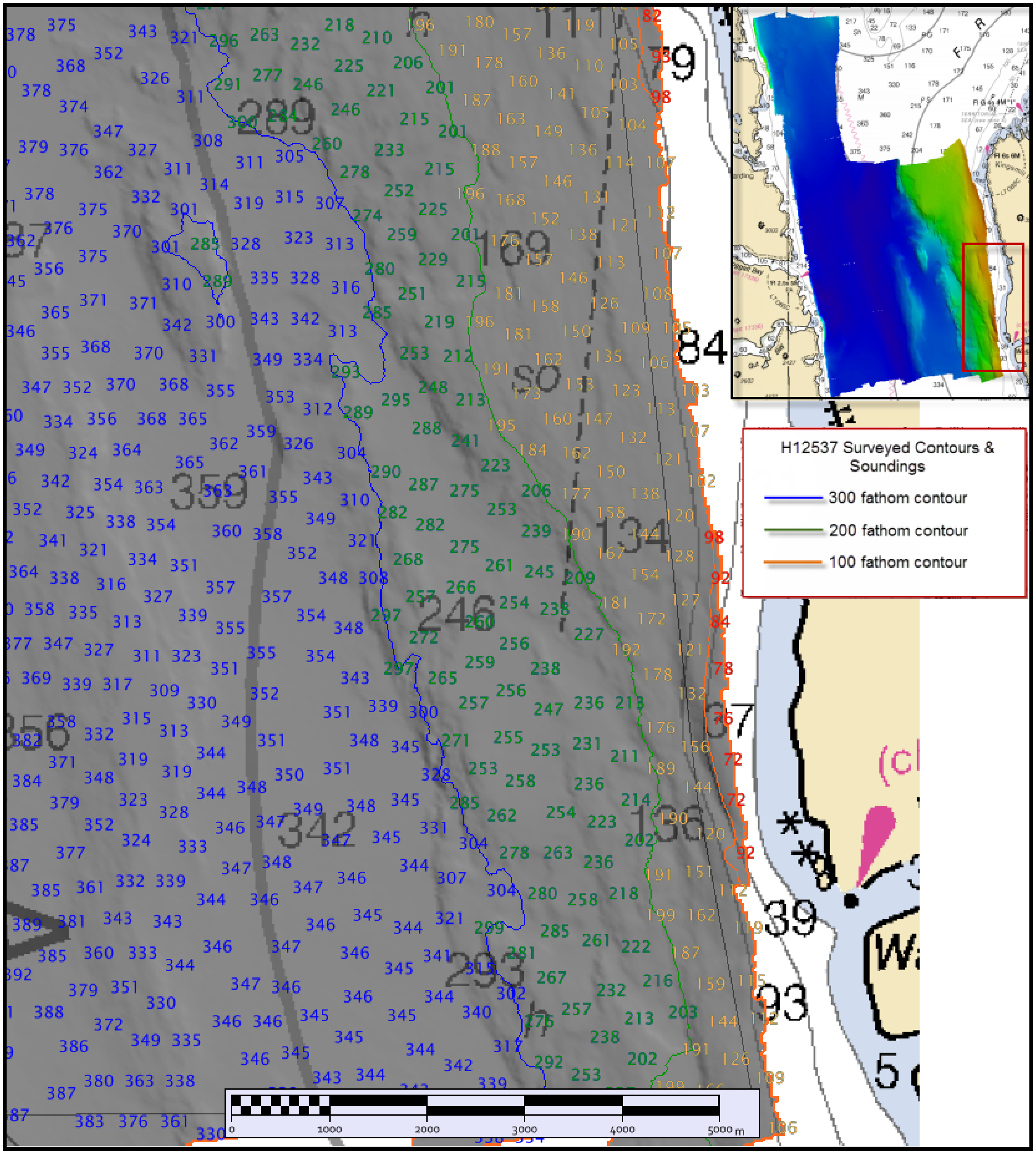


Figure 42: Close-up of southeast corner of H12537 showing comparison of contours derived from survey H12537 and those depicted on Chart 17320.

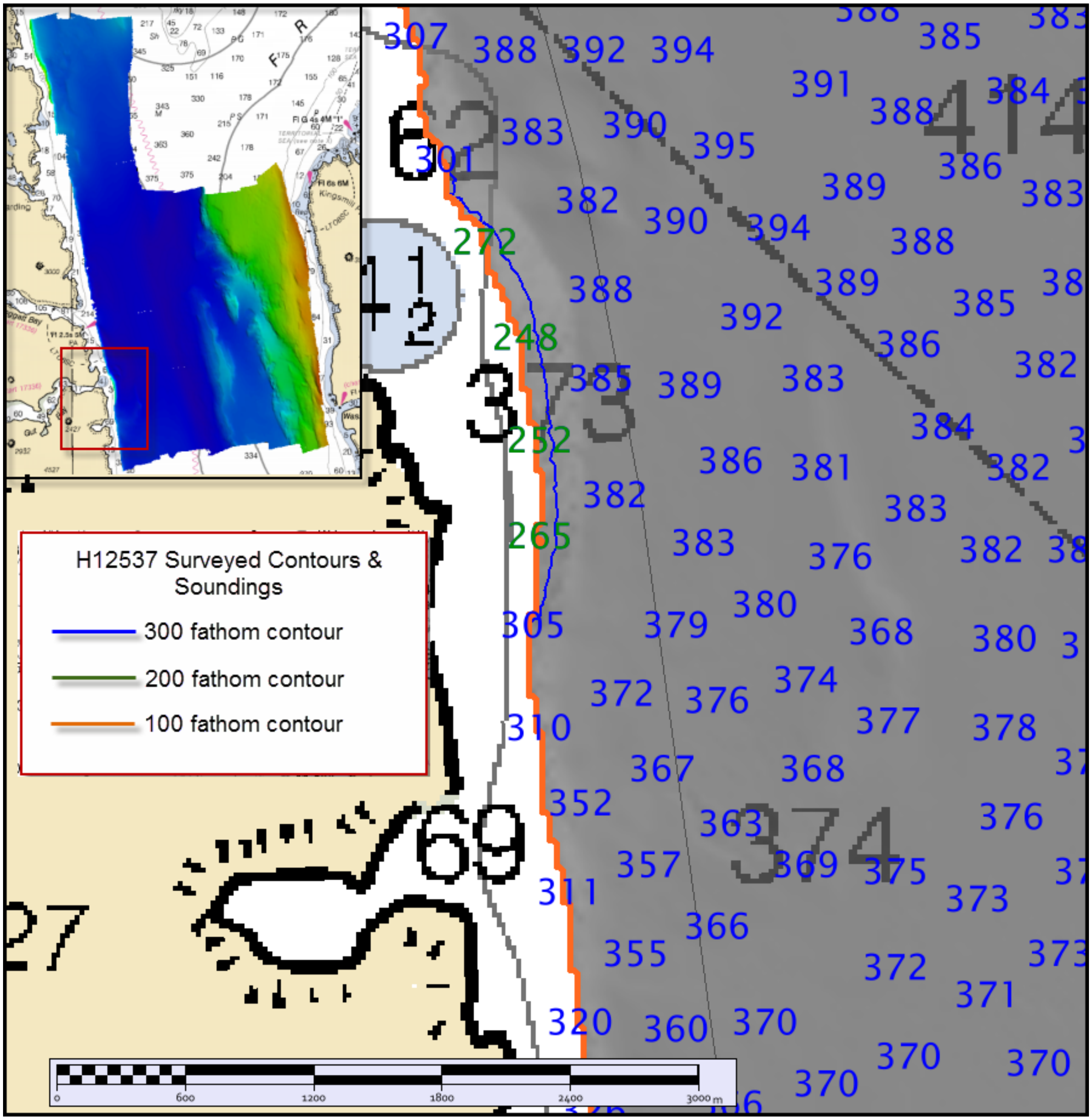


Figure 43: Close-up of southwest corner of H12537 showing comparison of contours derived from survey H12537 and those depicted on Chart 17320.

H12537 overlaps small portions of Charts 17336_3 (1:20,000), 17336_4 (1:20,000) and 17368_5 (1:40,000), however, there were no charted depths or features in the common area available for comparison.

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?
US3AK4PM	1:217828	9	03/21/2011	09/20/2012	NO

Table 16: Largest Scale ENCs

US3AK4PM

ENC US3AK4PM coincides with raster 17320. The depths and contours of the ENC match the raster, and the comparison between survey H12537 and the ENC is equivalent to the preceding comparison with Chart 17320.

H12537 overlaps small portions of ENCs US5AK2YM (1:20,000) and US5AK3TM (1:40,000), however, there were no charted depths or features in the common area available for comparison.

D.1.3 AWOIS Items

No AWOIS items were assigned for this survey.

D.1.4 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.1.5 Charted Features

No charted features exist for this survey.

D.1.6 Uncharted Features

No uncharted features exist for this survey.

D.1.7 Dangers to Navigation

No Danger to Navigation Reports were submitted for this survey.

D.1.8 Shoal and Hazardous Features

No shoals or potentially hazardous features exist for this survey.

D.1.9 Channels

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

D.1.10 Bottom Samples

No bottom samples were required for this survey.

Charted bottom samples exist within the survey area, but were not investigated during the survey. Charted bottom samples will be retained in the common area.

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 exist 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.

A charted submarine cable exists within the survey, but it was not investigated. The charted cable will be retained as charted.

D.2.6 Ferry Routes and Terminals

No ferry routes or terminals exist for this survey.

D.2.7 Platforms

No platforms exist for this survey.

D.2.8 Significant Features

No significant features exist for this survey.

D.2.9 Construction and Dredging

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

D.2.10 New Survey Recommendations

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

D.2.11 New Inset Recommendations

No new insets are recommended for this area.

E. Approval Sheet

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

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

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys and Specifications Deliverables Manual, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. 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
Richard T. Brennan, CDR/NOAA	Commanding Officer, NOAA Ship RAINIER	10/30/2013	
Meghan E. McGovern, LT/NOAA	Field Operations Officer, NOAA Ship RAINIER	10/30/2013	Date: 2013.10.30 10:18:20 -07'00'
James B. Jacobson	Chief Survey Technician, NOAA Ship RAINIER	10/30/2013	James Jacobson I have reviewed this document 2013.10.30 08:58:36 -08'00'
C.D. McBride	Assistant Survey Technician, NOAA Ship RAINIER	10/30/2013	

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
TPU	Total Porpagated 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 : August 27, 2013

HYDROGRAPHIC BRANCH: Pacific
HYDROGRAPHIC PROJECT: OPR-O322-RA-2013
HYDROGRAPHIC SHEET: H12537

LOCALITY: Offshore NW/NE Chatham Strait,AK
TIME PERIOD: May 24 - June 20, 2013

TIDE STATION USED: 9451054 Port Alexander,AK
Lat.56° 14.8’ N Long. 134° 38.8' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.070 meters

TIDE STATION USED: 9451467 Red Bluff Bay, AK
Lat. 56° 51.4' N Long. 134° 43.5' W
PLANE OF REFERENCE (MEAN LOWER LOW WATER): 0.000 meters
HEIGHT OF HIGH WATER ABOVE PLANE OF REFERENCE: 3.631 meters

REMARKS: RECOMMENDED GRID
Please use the TCARI grid "O322RA2013_Final.tc" as the final grid for project OPR-O322-RA-2013, H12537, during the time period between May 24 and June 20, 2013.

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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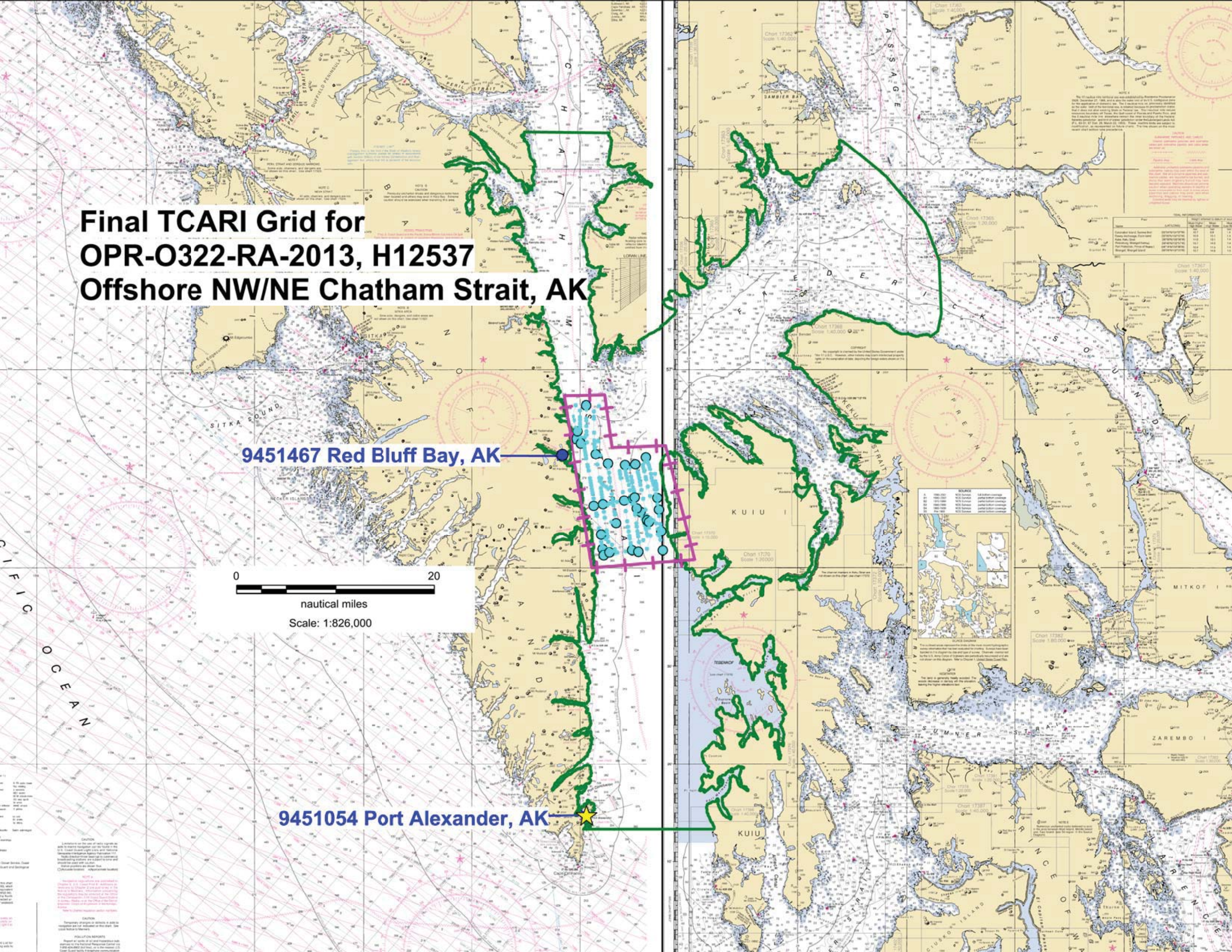
CHIEF, PRODUCTS AND SERVICES BRANCH



Final TCARI Grid for
OPR-O322-RA-2013, H12537
Offshore NW/NE Chatham Strait, AK
9451467 Red Bluff Bay, AK
9451054 Port Alexander, AK
0
20
nautical miles
Scale: 1:826,000

APPROVAL PAGE

H12537

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

- H12537_DR.pdf
- Collection of depth varied resolution BAGS
- Processed survey data and records
- H12537_GeoImage.pdf

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

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Date: 2014.09.19 07:41:29 -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.

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Approved:____

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