H13687

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13687

LOCALITY

State(s):	Ohio
General Locality:	Lake Erie
Sub-locality:	10 NM Northeast of Lorain Harbor

2022

CHIEF OF PARTY
Matthew J. Jaskoski, CDR/NOAA

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Date:

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

REGISTRY NUMBER:

HYDROGRAPHIC TITLE SHEET

H13687

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):	**Ohio**
General Locality:	**Lake Erie**
Sub-Locality:	**10 NM Northeast of Lorain Harbor**
Scale:	**40000**
Dates of Survey:	**09/17/2022 to 10/03/2022**
Instructions Dated:	**09/14/2022**
Project Number:	**OPR-W386-TJ-22**
Field Unit:	**NOAA Ship *Thomas Jefferson***
Chief of Party:	**Matthew J. Jaskoski, CDR/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Atlantic Hydrographic Branch**
Soundings Acquired in:	**meters at Low Water Datum IGLD-1985**

Remarks:

Any revisions to the Descriptive Report (DR) applied during office processing are shown in red italic text. The DR is maintained as a field unit product, therefore all information and recommendations within this report are considered preliminary unless otherwise noted. The final disposition of survey data is represented in the NOAA nautical chart products. All pertinent records for this survey are archived at the National Centers for Environmental Information (NCEI) and can be retrieved via https://www.ncei.noaa.gov/. Products created during office processing were generated in NAD83 UTM 17N, LWD-IGLD 1985. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

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Descriptive Report to Accompany Survey H13687

Project: OPR-W386-TJ-22

Locality: Lake Erie

Sublocality: 10 NM Northeast of Lorain Harbor

Scale: 1:40000

September 2022 - October 2022

NOAA Ship *Thomas Jefferson*

Chief of Party: Matthew J. Jaskoski, CDR/NOAA

A. Area Surveyed

Survey H13687, located approximately 10 NM Northeast of Lorain Harbor, Cleveland, OH, was conducted in accordance with coverage requirements set forth in the Project Instructions (PIs) OPR-W386-TJ-22.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
41° 38' 17.6" N 82° 16' 59.9" W	41° 34' 34.2" N 81° 50' 24.3" W

Table 1: Survey Limits

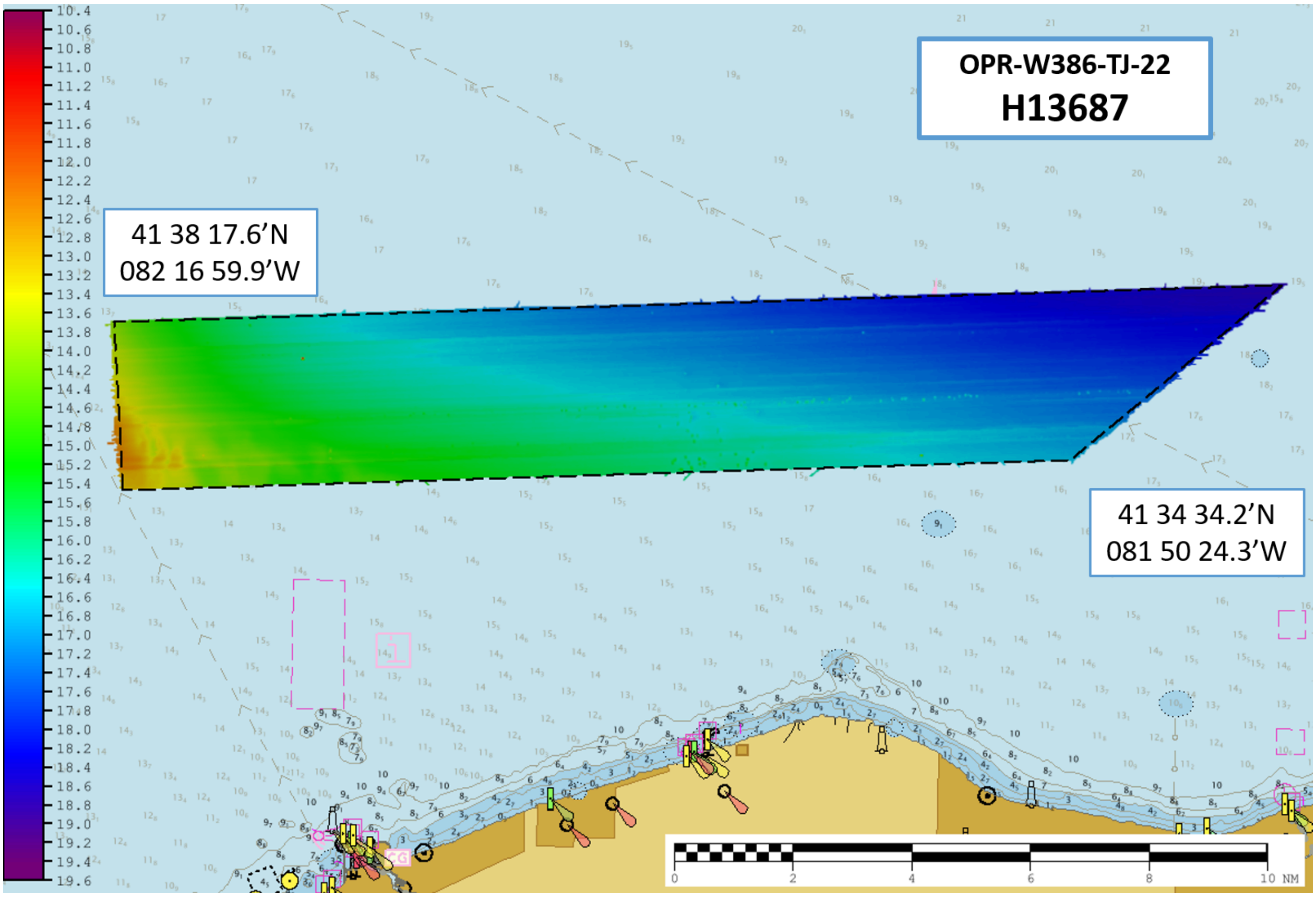


Figure 1: Survey layout for H13687, plotted over ENC US4OH01M. Black outline represents the survey limits set forth by the Project Instructions.

Survey data were acquired in accordance with the PIs and the 2022 Hydrographic Surveys Specifications and Deliverables (HSSD) (Figure 1).

A.2 Survey Purpose

The Port of Cleveland is one of the largest ports in the Great Lakes and ranks within the top 50 ports in the United States. Roughly 13 million tons of cargo are transported through Cleveland Harbor each year supporting over 20,000 jobs and $3.5 billion in annual economic activity (1) . This project will provide modern bathymetric data for the Cleveland area as well as the vicinity of South Bass Island and Presque Isle. The project area was identified as a statistically significant hot spot within the 2018 Hydrographic Health model, a risk model that Coast Survey uses for evaluating priorities based upon navigational risks and the necessary quality of data to support modern traffic. Most of this area has not been surveyed since the 1940s, and experiences significant vessel traffic.

A modern bathymetric survey in this area will identify hazards and changes to the seafloor, provide critical data for updating National Ocean Service (NOS) nautical charting products and improve maritime safety. Survey data from this project is intended to supersede all prior survey data in the common area.

1. https://www.portofcleveland.com/

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Data acquired in H13687 meet 100% multibeam echo sounder (MBES) coverage requirements for complete coverage, as specified in the 2022 HSSD. This includes crosslines (see Section B.2.1), NOAA allowable uncertainty (see Section B.2.2), and density requirements (see Section B.5.2).

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 (Refer to HSSD Section 5.2.2.3)
All waters in survey area	Acquire backscatter data during all multibeam data acquisition (Refer to HSSD Section 6.2)

Table 2: Survey Coverage

Survey coverage is in accordance with requirements listed in Table 2 and the 2022 HSSD. Coverage requirements were met with 100% complete coverage MBES.

There are three holidays present in the acquired MBES coverage. In Figure 2 below, Holiday 1, located at 41° 37' 21.22" N 082° 13' 44.27" W, was created as a result of rejecting data from a DriX-12 MBES data artifact (see Section B.2.5 for more information regarding the artifact). Holiday 2, located at 41° 35' 27.45" N 081° 59' 53.39" W, was created as a result of a sonar drop-out in MBES data from S222. Holiday 3, located at 41° 35' 12.54" N 081° 56' 45.81" W, is outside of the sheet limits and is covered by data acquired for sheet H13616.

Additionally, gaps in coverage exist on the western sheet edge where acquired MBES coverage did not meet the assigned sheet limits (Figure 3). While there is no guarantee of the absence of significant features within the coverage gaps, the hydrographer does not believe any navigational hazards exist from shoals based on examination of surrounding bathymetry.

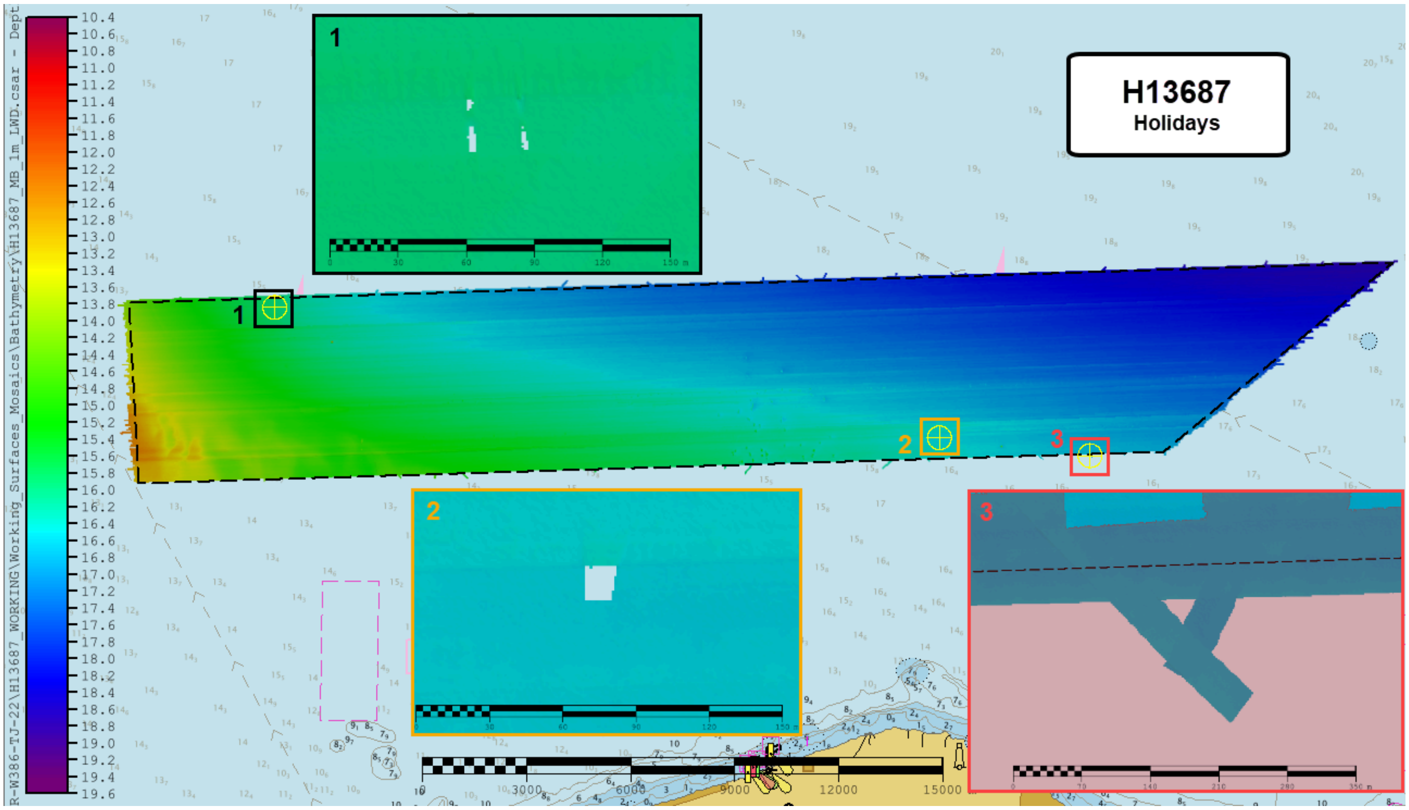


Figure 2: Holidays in coverage acquired for H13687.

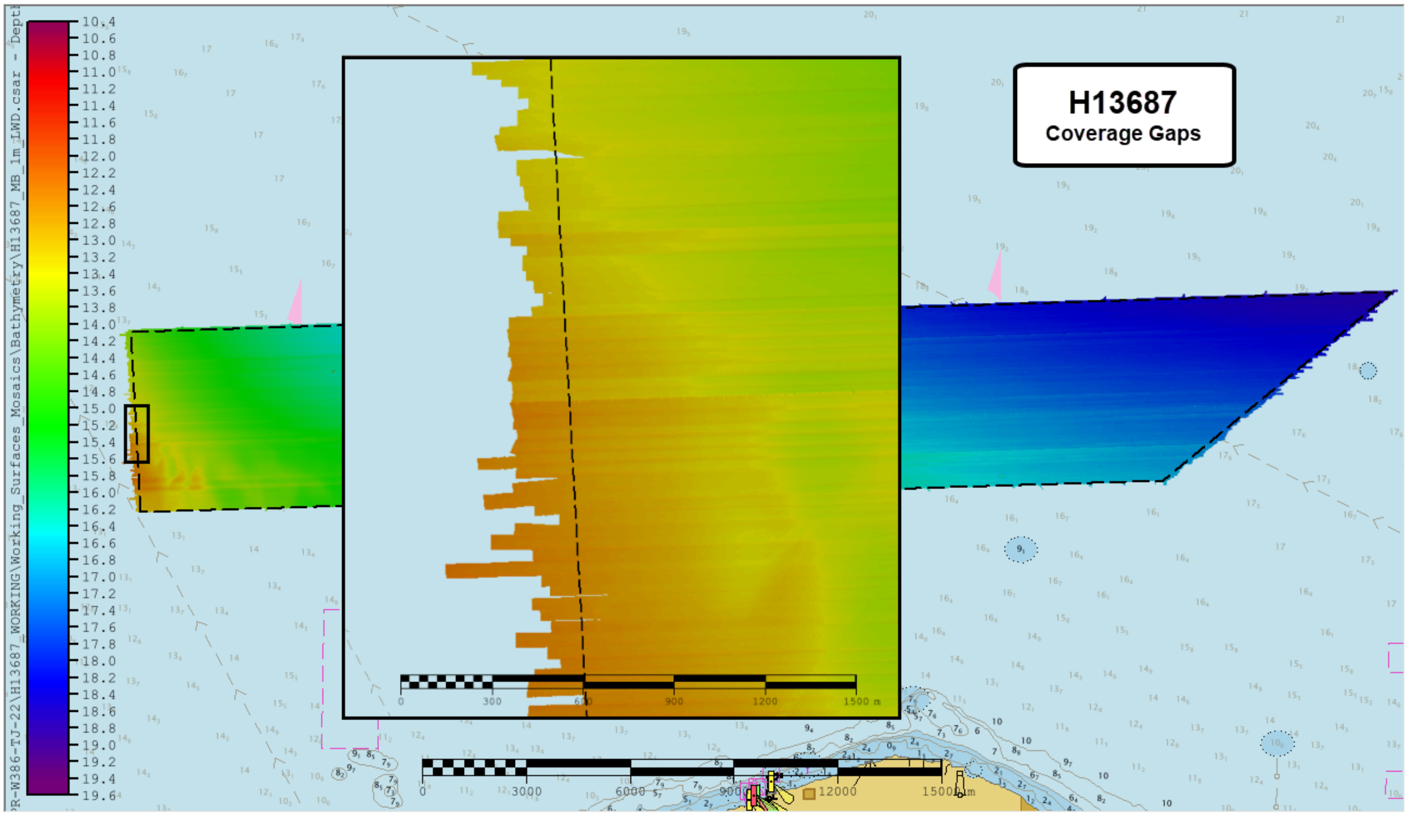


Figure 3: Gaps in coverage on western sheet edge where coverage did not reach the assigned sheet limits.

A.6 Survey Statistics

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

	HULL ID	*S222*	*DriX12*	*Total*
LNM	SBES Mainscheme	0.0	0.0	0.0
	MBES Mainscheme	1699.15	747.28	2540.84
	Lidar Mainscheme	0.0	0.0	0.0
	SSS Mainscheme	0.0	0.0	0.0
	SBES/SSS Mainscheme	0.0	0.0	0.0
	MBES/SSS Mainscheme	0.0	0.0	0.0
	SBES/MBES Crosslines	94.41	0.0	94.41
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				0
Number Maritime Boundary Points Investigated				0
Number of DPs				0
Number of Items Investigated by Dive Ops				0
Total SNM				51.58

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
09/17/2022	260
09/18/2022	261

Survey Dates	Day of the Year
09/19/2022	262
09/20/2022	263
09/21/2022	264
09/22/2022	265
09/23/2022	266
09/24/2022	267
09/25/2022	268
09/26/2022	269
09/27/2022	270
10/03/2022	276

Table 4: Dates of Hydrography

B. Data Acquisition and Processing

B.1 Equipment and Vessels

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

B.1.1 Vessels

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

Hull ID	***S222***	***DriX-12***
LOA	63.4 meters	7.7 meters
Draft	4.6 meters	2.0 meters

Table 5: Vessels Used

Figure 4: NOAA Ship Thomas Jefferson S222

Figure 5: Autonomous Survey Vehicle DriX-12

B.1.2 Equipment

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

Manufacturer	Model	Type
Applanix	POS MV 320 v5	Positioning and Attitude System
Kongsberg Maritime	EM 2040	MBES
Kongsberg Maritime	EM 2040	MBES Backscatter
Valeport	Thru-Hull SVS	Sound Speed System
AML Oceanographic	MVP200	Conductivity, Temperature, and Depth Sensor
AML Oceanographic	MVP-X	Sound Speed System
Valeport	SWiFT SVP	Conductivity, Temperature, and Depth Sensor
Valeport	MiniSVS	Sound Speed System
iXblue	Unknown	Positioning and Attitude System

Table 6: Major Systems Used

Refer to the DAPR for a complete description of systems and equipment used by S222 and DriX-12.

B.2 Quality Control

B.2.1 Crosslines

S222 collected 94.4 linear nautical miles of MBES crosslines, or 3.8% of mainscheme MBES data. The crosslines acquired represent good spatial and depth diversity for the survey area (Figure 6). A 1m single resolution (SR) Combined Uncertainty and Bathymetry Estimator (CUBE) surface of mainscheme data and a 1m SR CUBE surface of crossline data were differenced. The resulting mean was 0.05 m with a standard deviation of 0.06 m (Figure 7). While the fraction of allowable error varies more than expected due to features in crosslines, over 99.5% of nodes are compliant with fraction of allowable error standards (Figure 8). Visual inspection of the difference surface indicated no systematic issues.

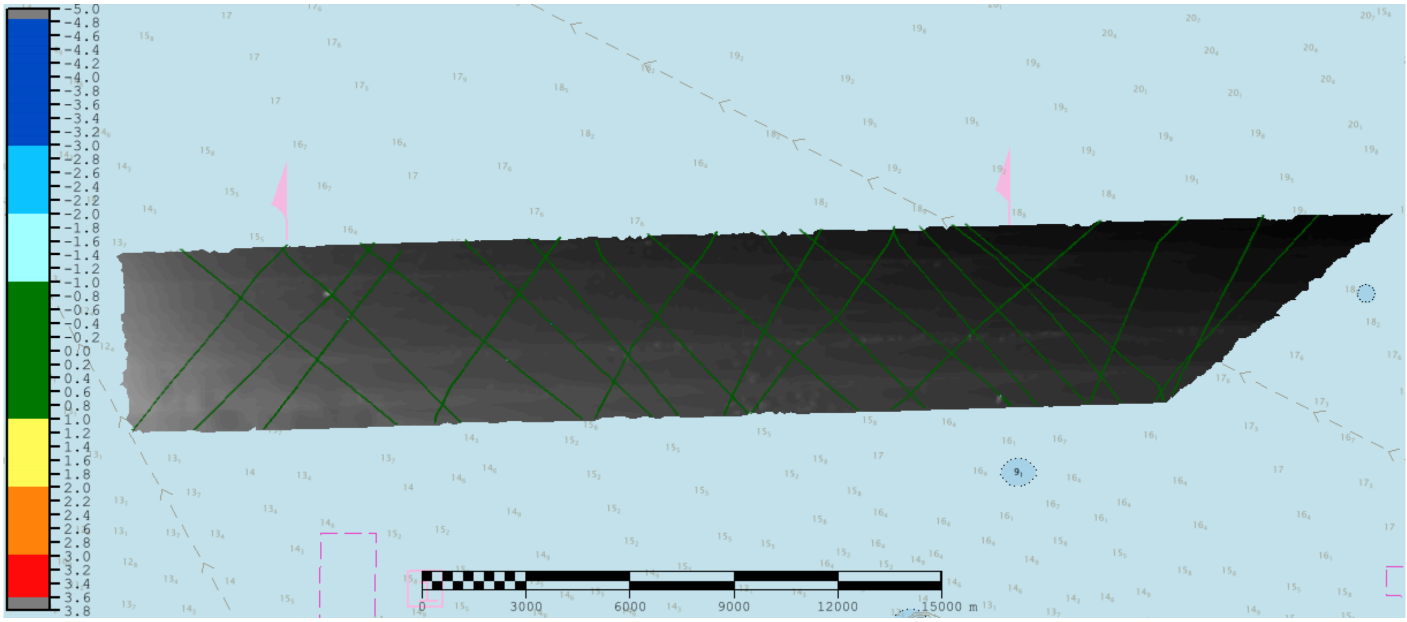
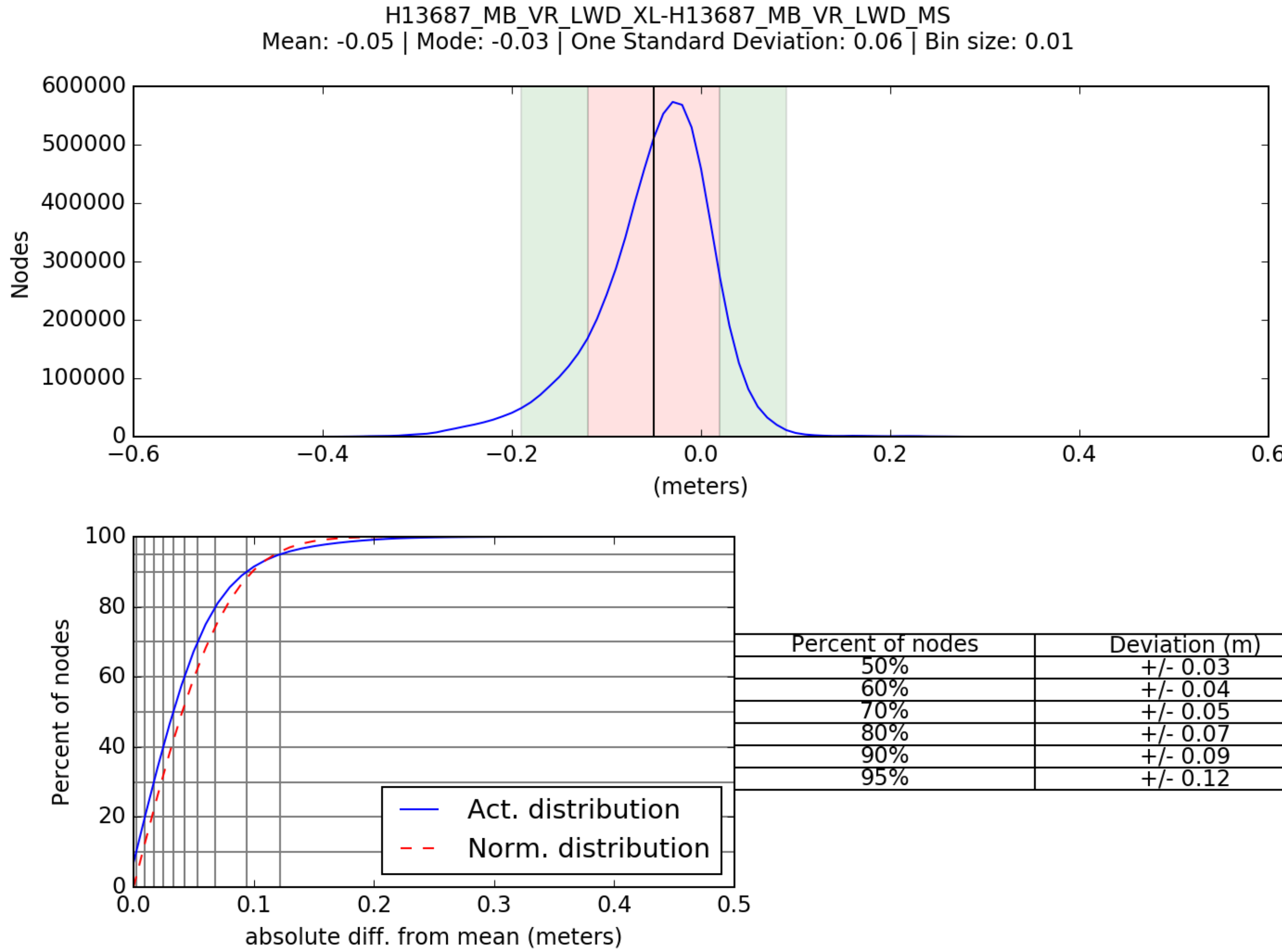


Figure 6: H13687 crossline fractional allowable error shown in color, overlaid onto survey data shown in greyscale.



Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.04
70%	+/- 0.05
80%	+/- 0.07
90%	+/- 0.09
95%	+/- 0.12

Figure 7: H13687 crossline and mainscheme comparison

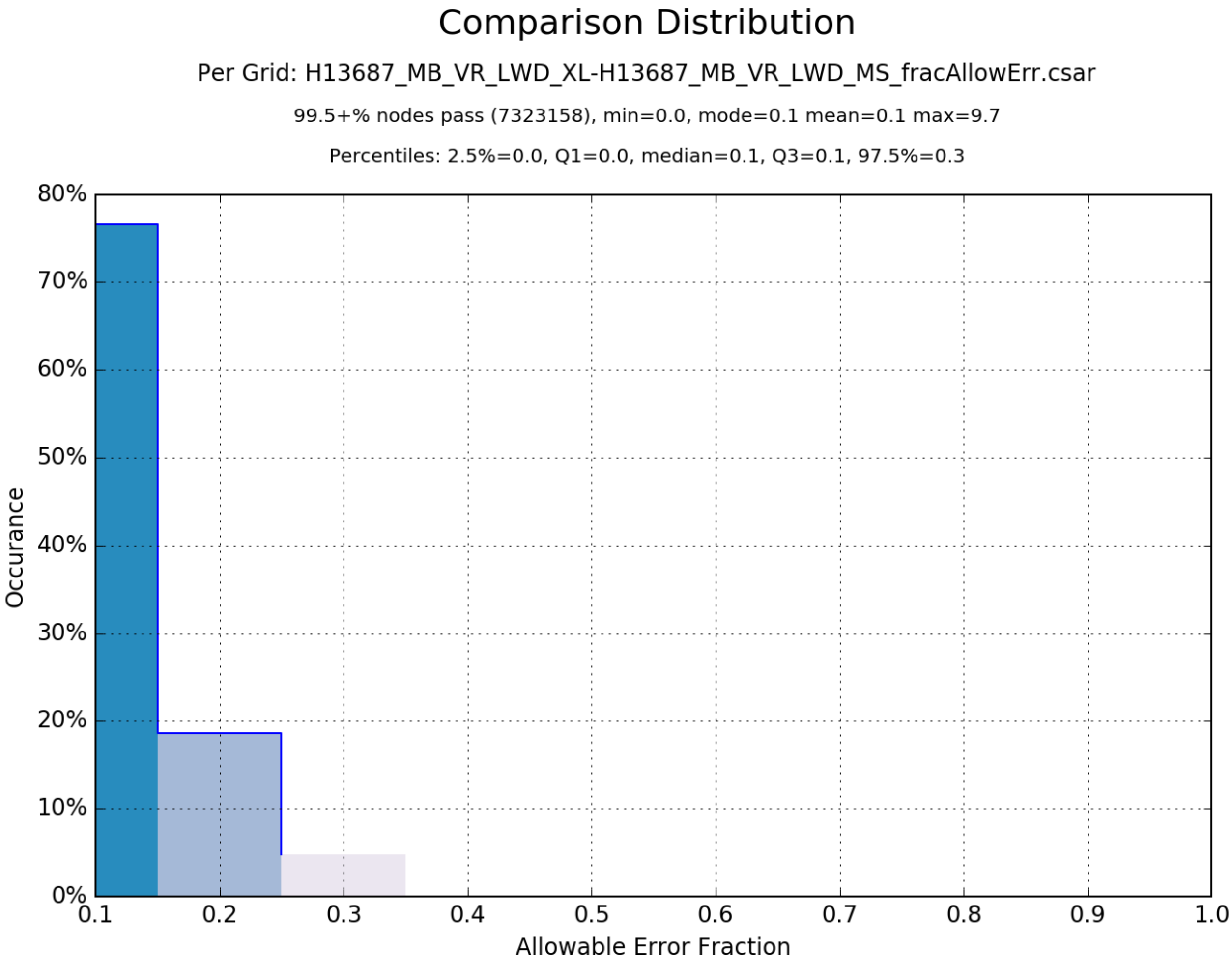


Figure 8: H13687 fractional allowable error node distribution

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.045 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
S222	N/A meters/second	4 meters/second	N/A meters/second	0.2 meters/second
DriX-12	4 meters/second	N/A meters/second	N/A meters/second	0.2 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

The bathymetric surface's uncertainty layer is compliant with 2022 HSSD uncertainty standards. Over 99.5% of all nodes pass uncertainty standards (Figure 9).

While the overall uncertainty layer is compliant with 2022 HSSD specifications, there is a partial line acquired by DriX-12 that exceeds maximum allowable uncertainty (Figure 10). While the exact cause of the increased uncertainty is unknown, the hydrographer suspects the source to be related to the vertical uncertainty of the SBET applied to the line. However, soundings associated with this section of the line are in close agreement with overlapping data from S222 (Figure 11) and no significant features or shoals exist in the area.

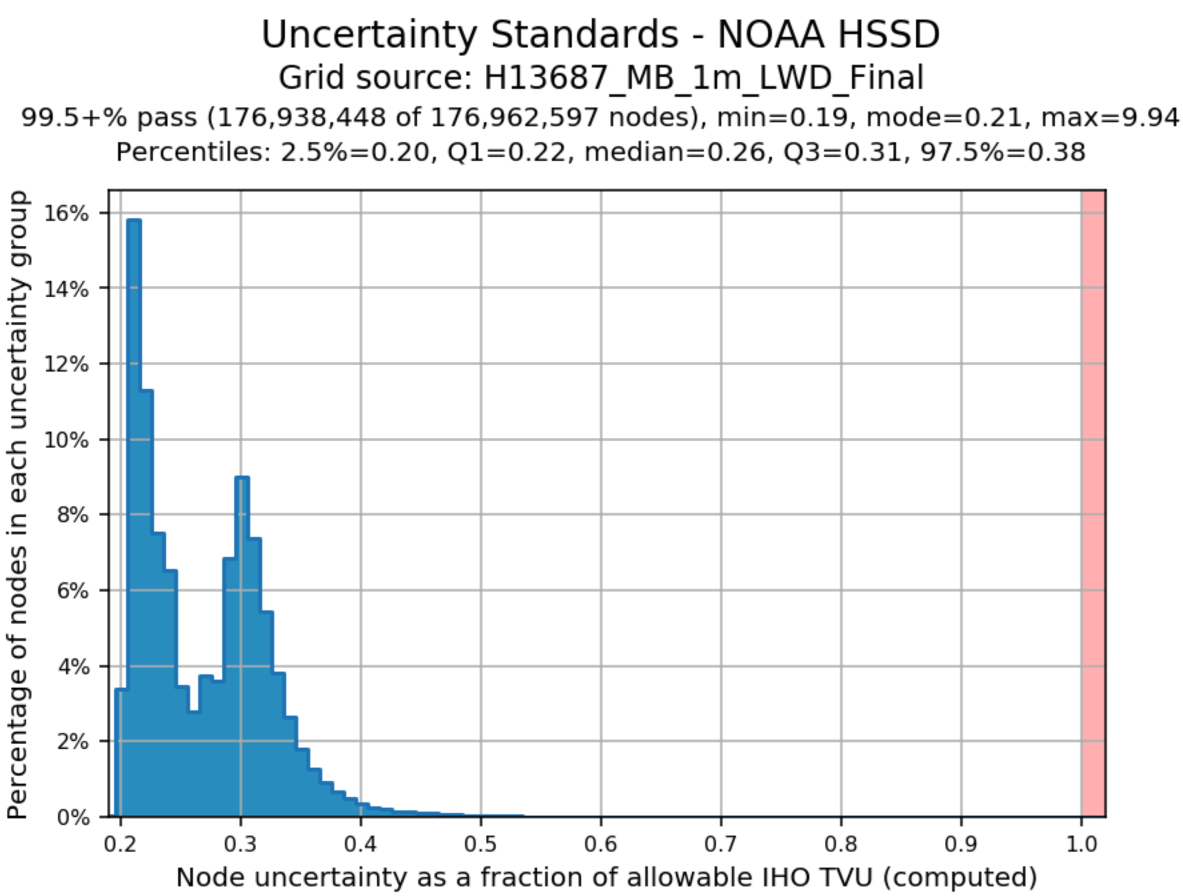


Figure 9: H13687 uncertainty standards.

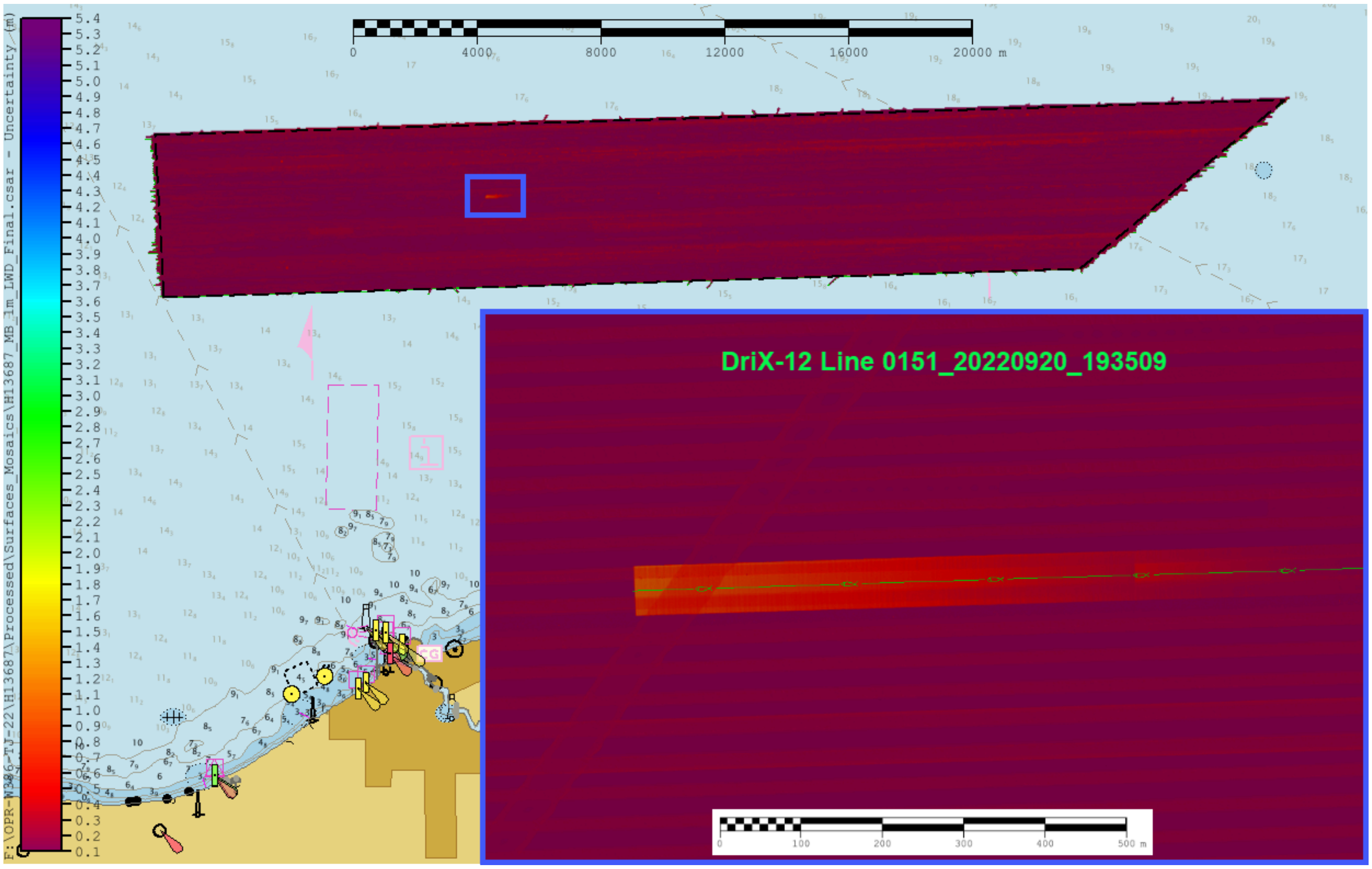


Figure 10: DriX-12 line showing increased uncertainty values of up to 1m.

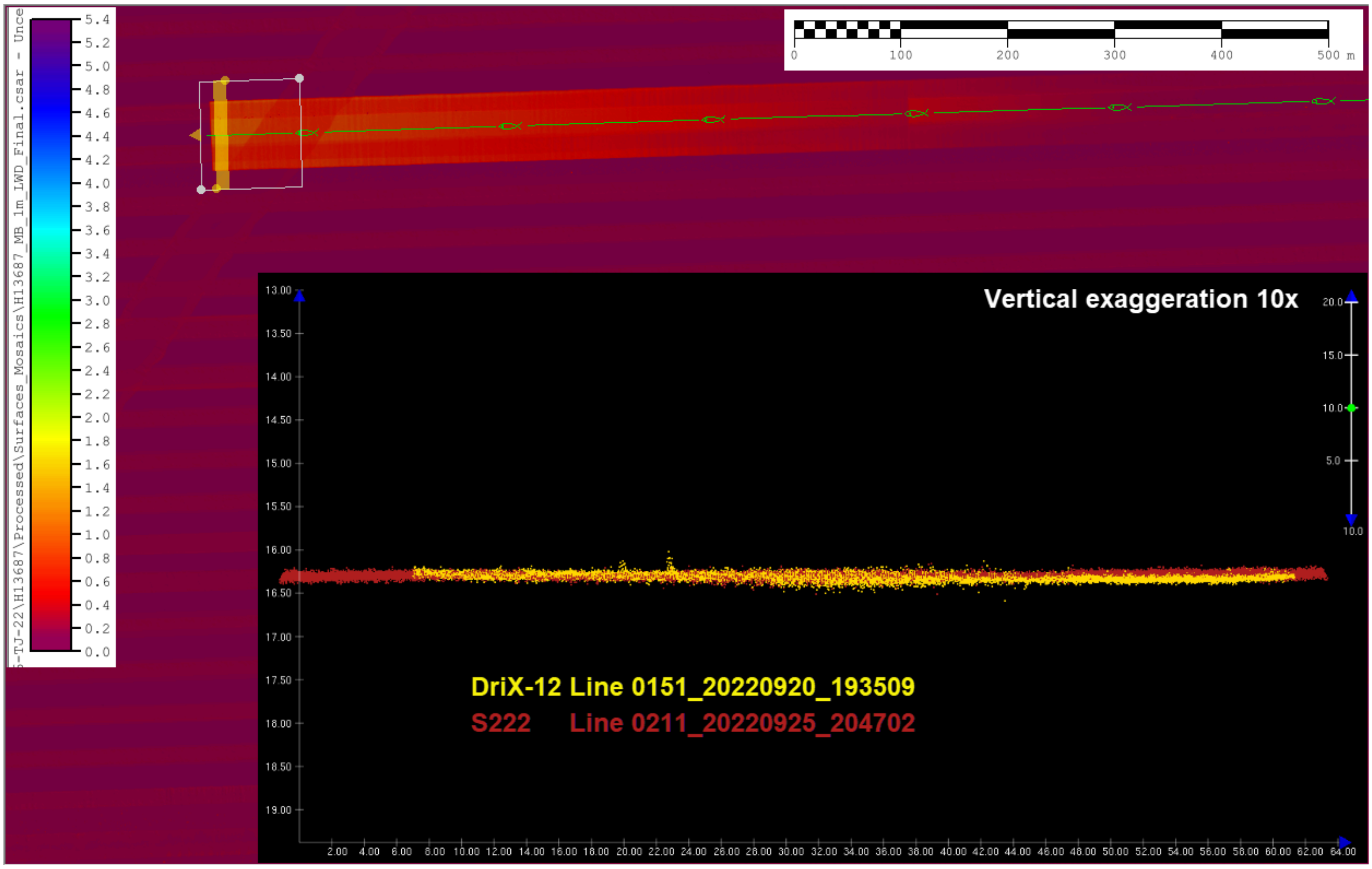


Figure 11: Caris Subset Editor 2D view of DriX-12 soundings (yellow) with overlapping S222 soundings (red) showing good agreement in area of increased uncertainty.

B.2.3 Junctions

Survey H13687 junctions with contemporary surveys H13616, H13617 and H13682 within the OPR-W386-TJ-22 project (Figure 12). Information regarding junction analyses can be found below.

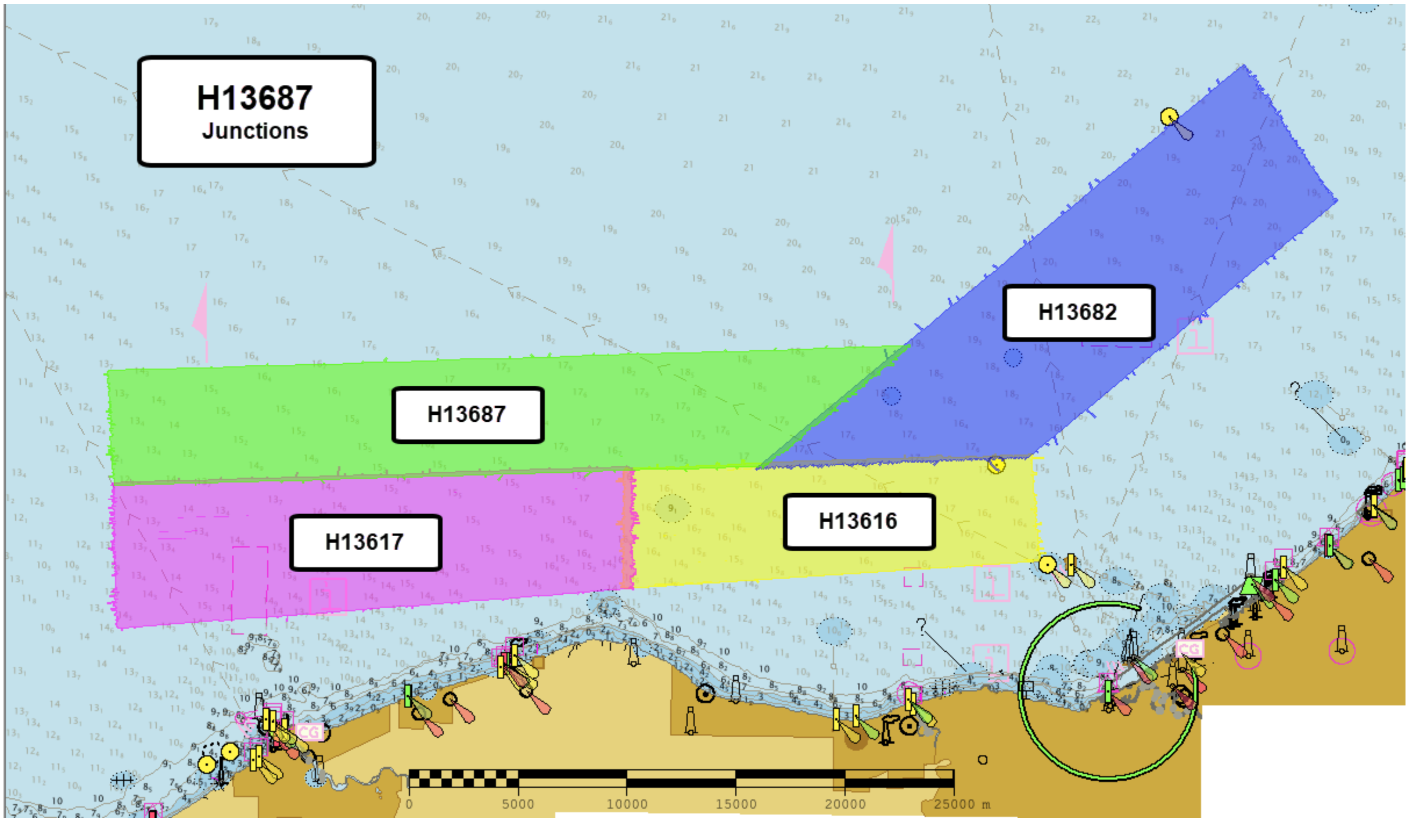


Figure 12: Overview of contemporary surveys which junction with H13687.

The following junctions were made with this survey:

Registry Number	Scale	Year	Field Unit	Relative Location
H13616	1:5000	2022	Thomas Jefferson	SE
H13617	1:5000	2022	Thomas Jefferson	S
H13682	1:10000	2022	Thomas Jefferson	E

Table 9: Junctioning Surveys

<u>H13616</u>

The southern edge of H13687 junctions with sheet H13616 (Figure 13). A 1m SR CUBE surface of H13687 data and a VR CUBE surface of H13616 were differenced. The mean difference between bathymetric surface nodes was 0.05m with a standard deviation of 0.05m (Figure 14) and 100% of compared grid nodes were compliant with fraction of allowable error standards (Figure 15). Statistics and visual inspection indicate that surveys H13687 and H13616 are in general agreement.

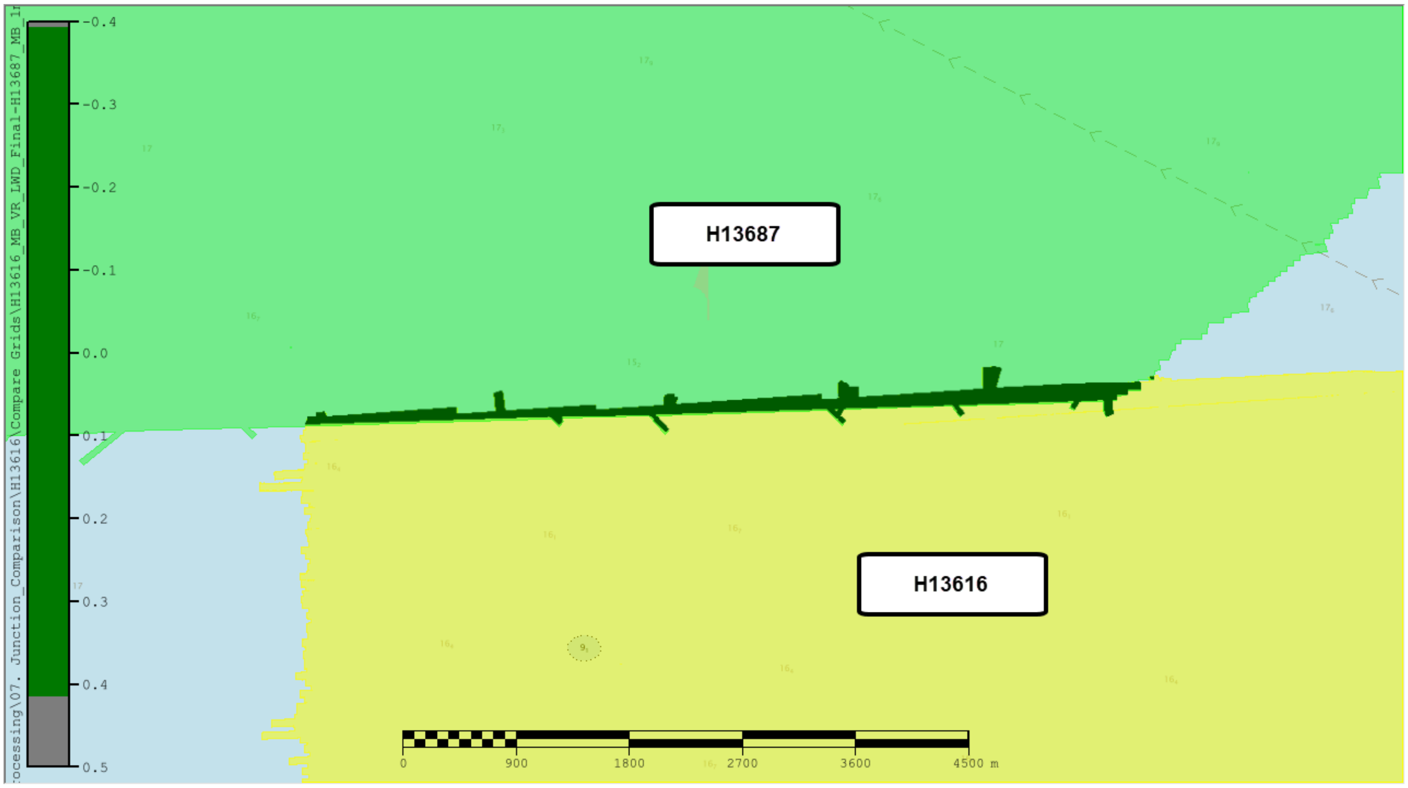
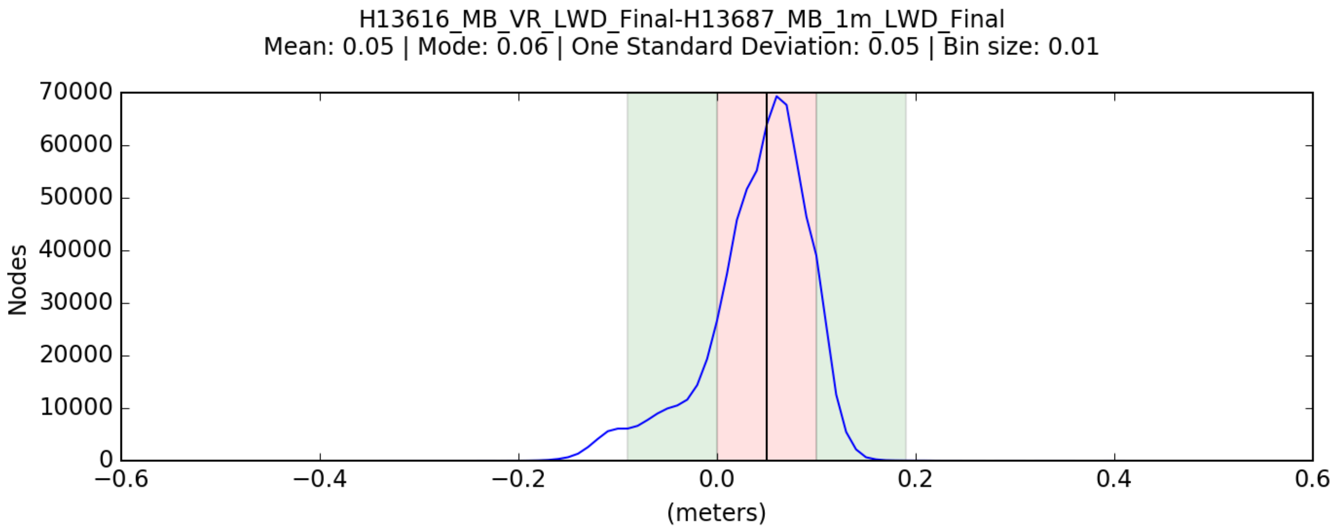
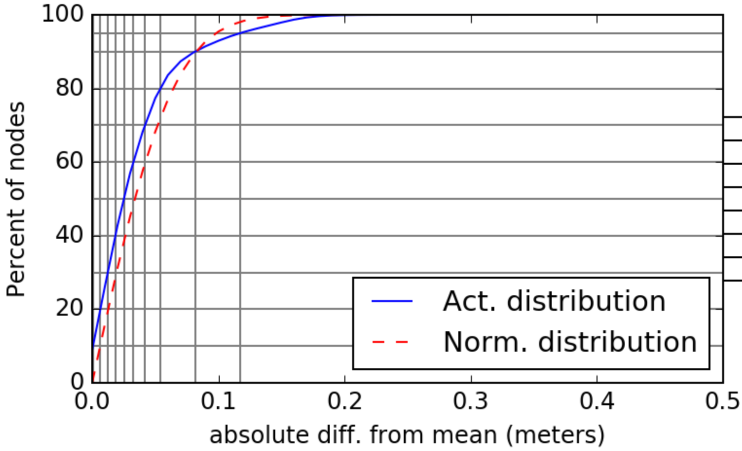


Figure 13: Fraction of allowable error surface difference comparison in color between H13687 and H13616.





Percent of nodes	Deviation (m)
50%	+/- 0.03
60%	+/- 0.03
70%	+/- 0.04
80%	+/- 0.05
90%	+/- 0.08
95%	+/- 0.12

Figure 14: H13687 and H13616 surface difference comparison statistics.

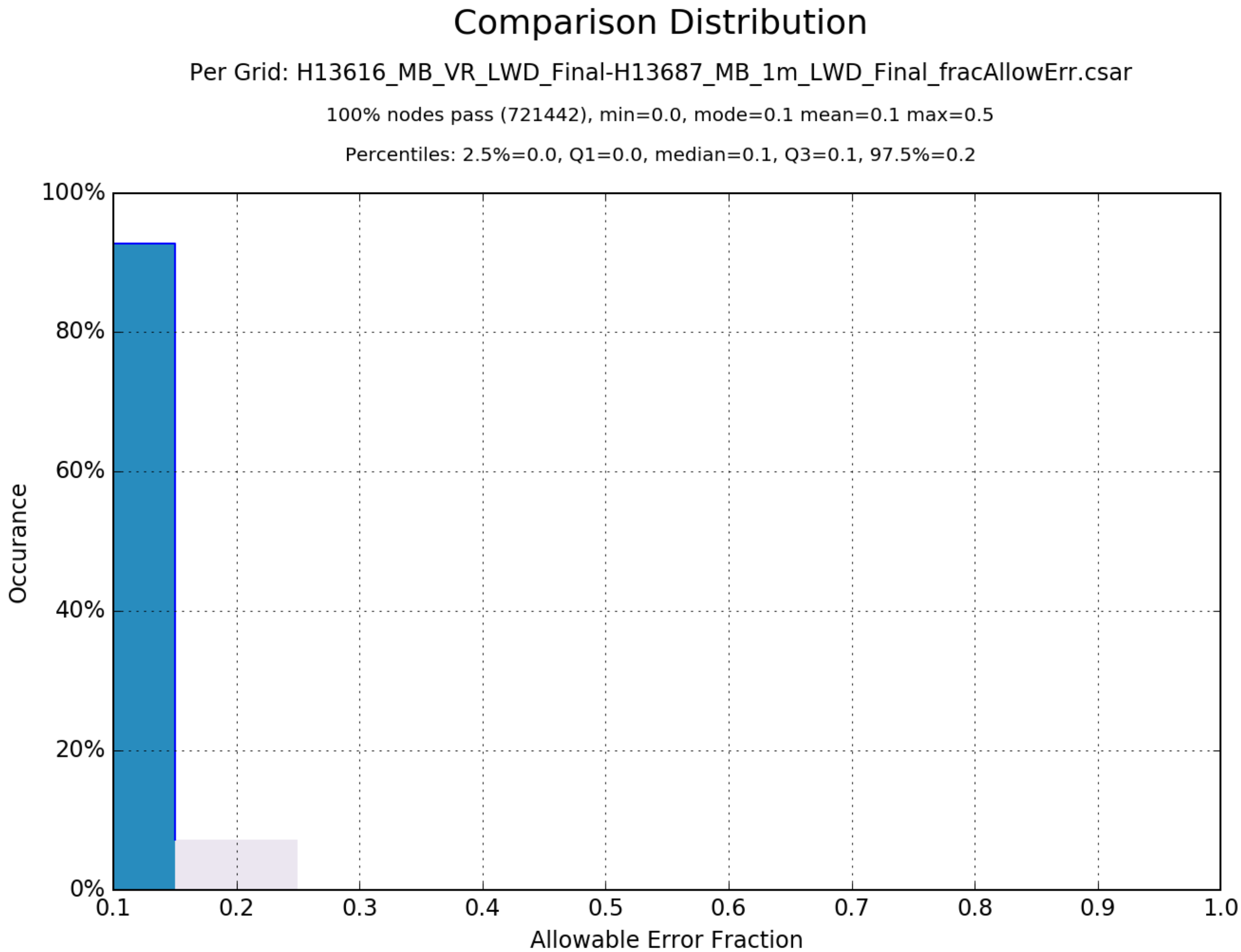


Figure 15: H13687 and H13616 fraction of allowable error statistics.

H13617

The southern edge of H13687 junctions with sheet H13617 (Figure 16). A 1m SR CUBE surface of H13687 data and a 1m SR CUBE surface of H13617 were differenced. The mean difference between bathymetric surface nodes was 0.07m with a standard deviation of 0.04m (Figure 17) and and 100% of compared grid nodes were compliant with fraction of allowable error standards (Figure 18). Statistics and visual inspection indicate that surveys H13687 and H13617 are in general agreement.

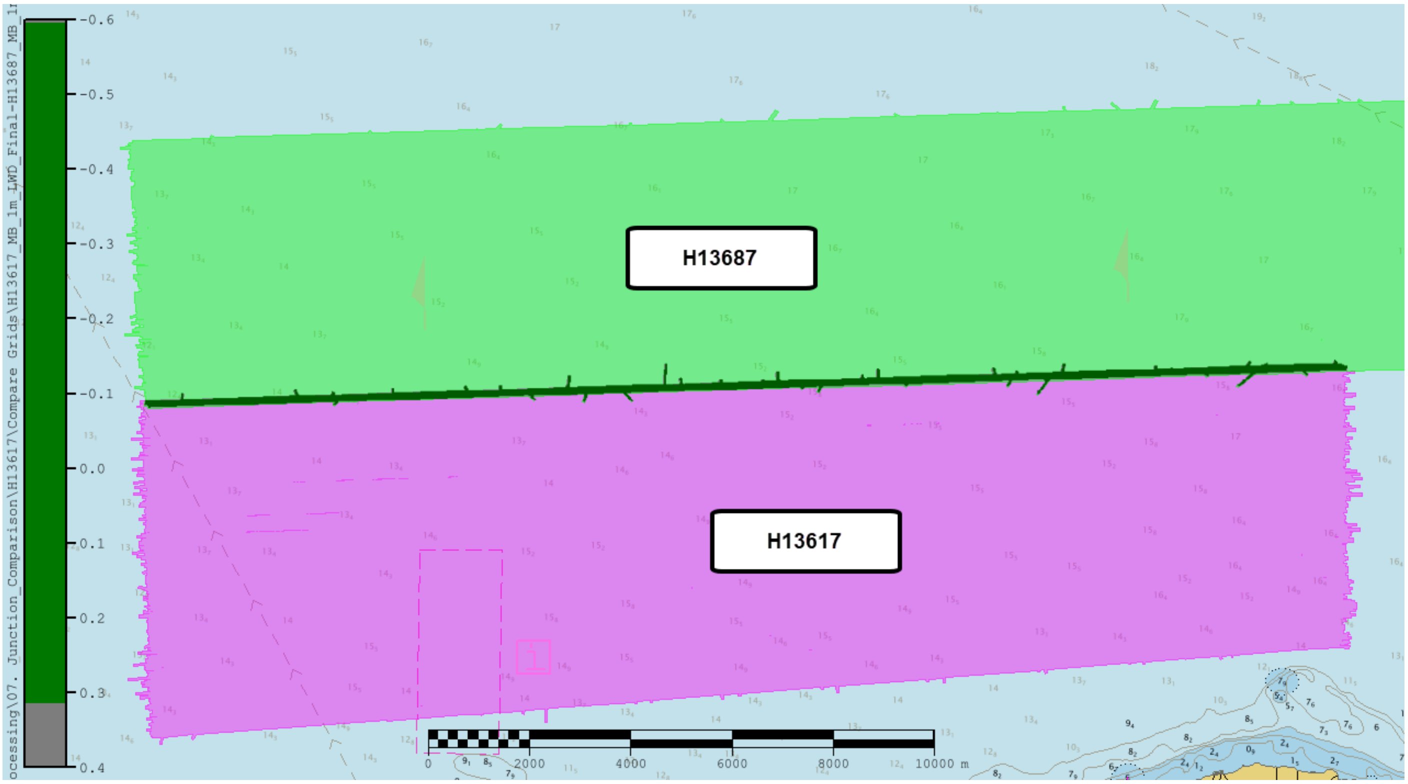
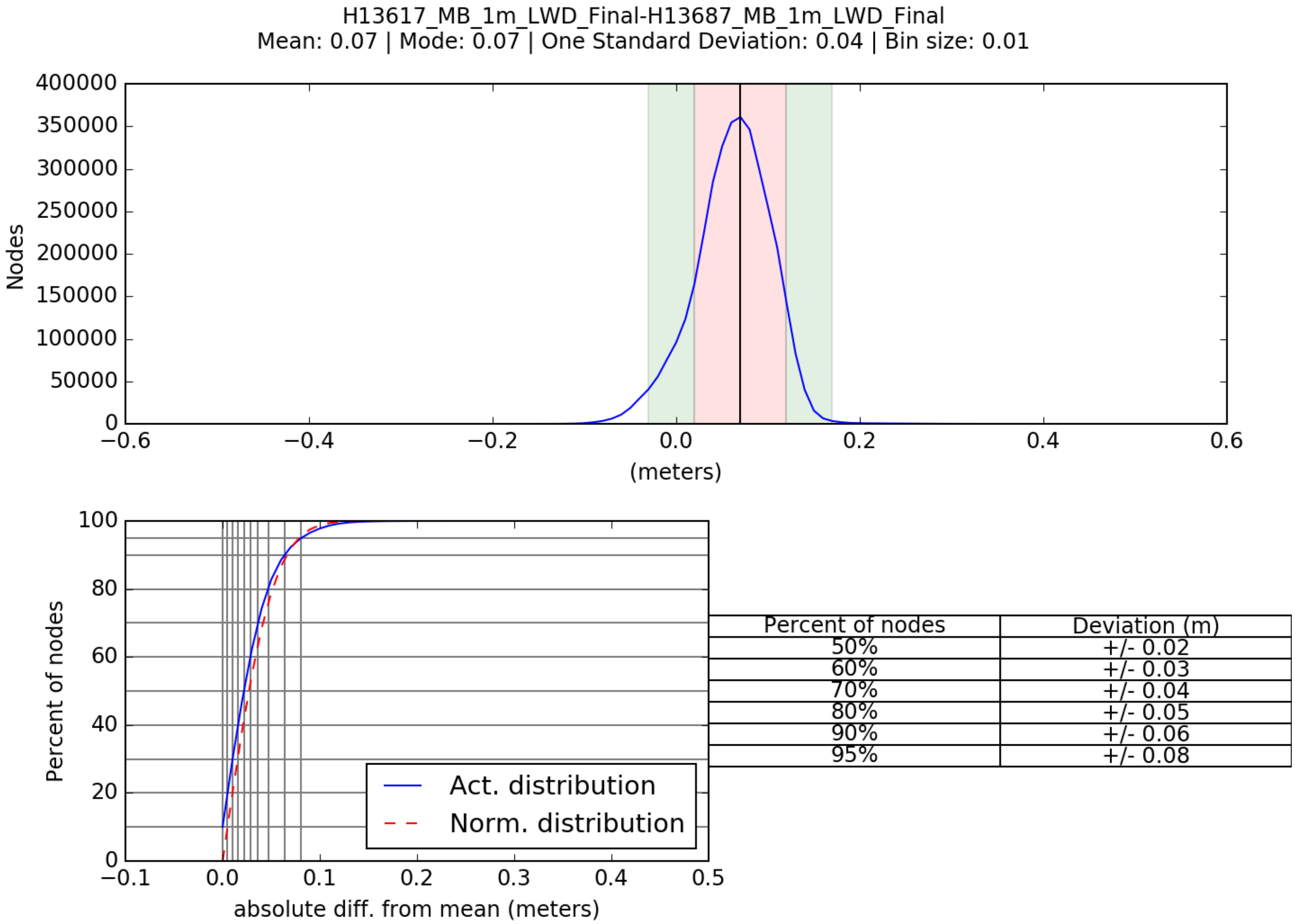


Figure 16: Fraction of allowable error surface difference comparison in color between H13687 and H13617.



Percent of nodes	Deviation (m)
50%	+/- 0.02
60%	+/- 0.03
70%	+/- 0.04
80%	+/- 0.05
90%	+/- 0.06
95%	+/- 0.08

Figure 17: H13687 and H13617 surface difference comparison statistics.

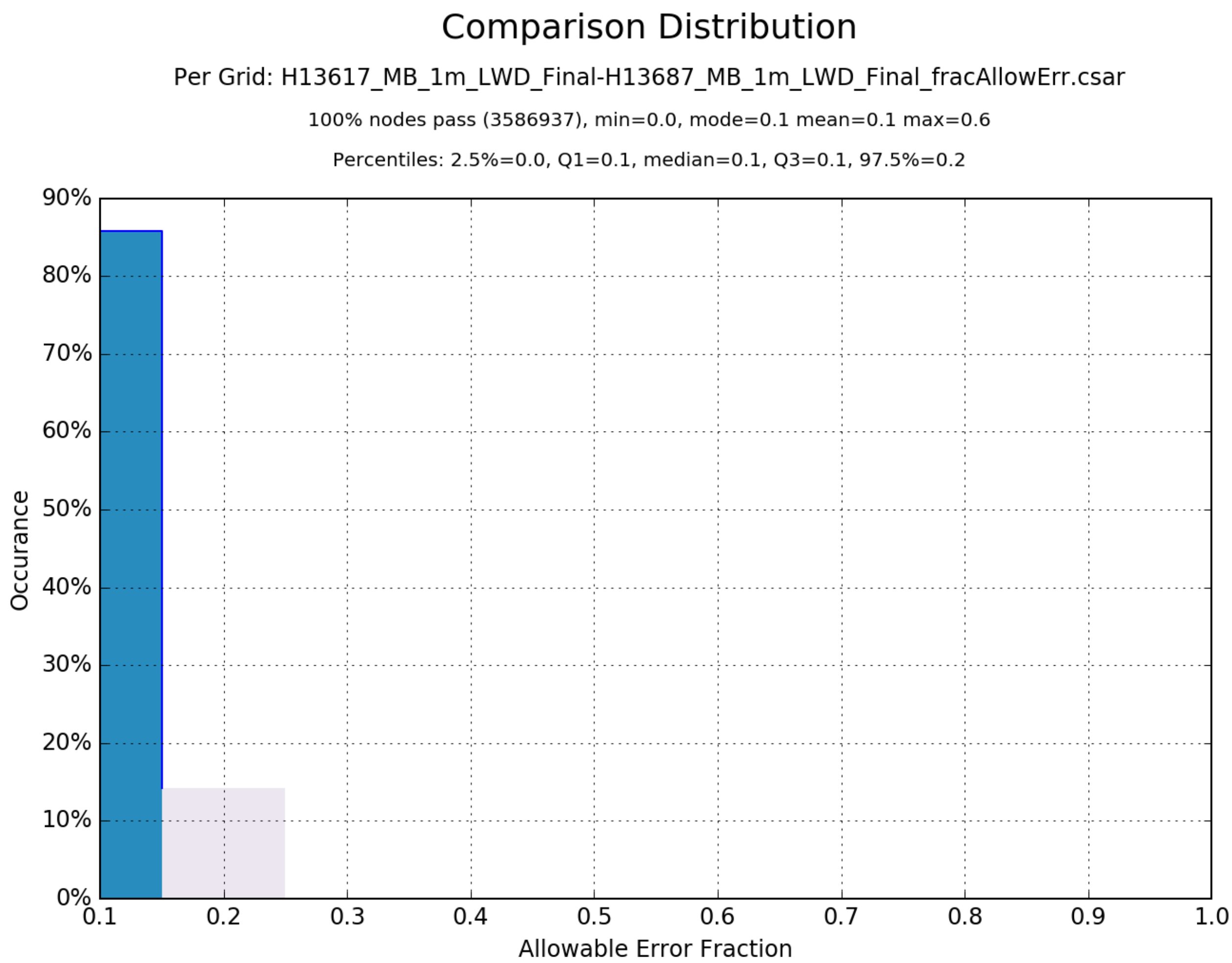


Figure 18: H13687 and H13617 fraction of allowable error statistics.

<u>H13682</u>

The eastern edge of H13687 junctions with sheet H13682 (Figure 19). A 1m SR CUBE surface of H13687 data and a VR CUBE surface of H13682 were differenced. The mean difference between bathymetric surface nodes was 0.11m with a standard deviation of 0.08m (Figure 20) and 100% of compared grid nodes were compliant with fraction of allowable error standards (Figure 21). Statistics and visual inspection indicate that surveys H13687 and H13682 are in general agreement.

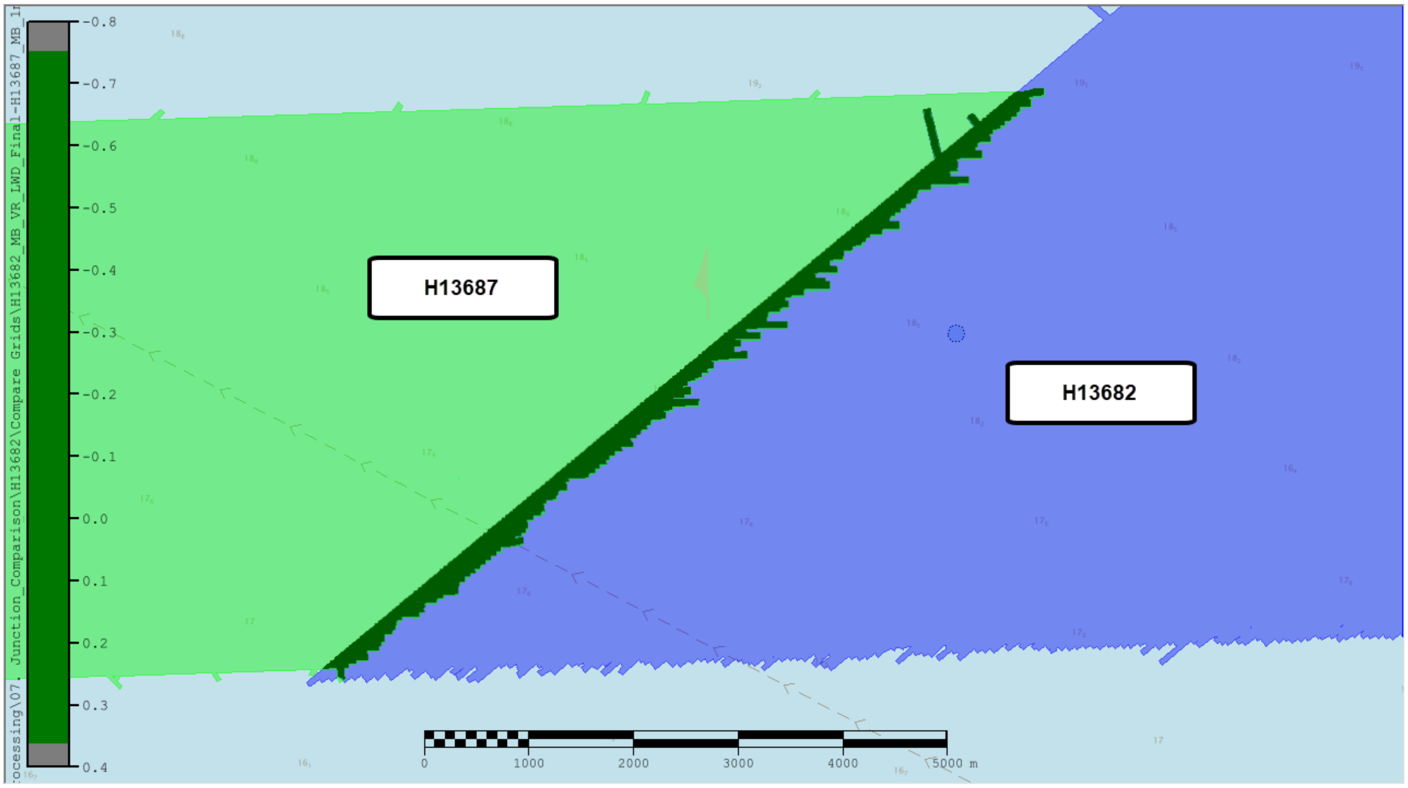
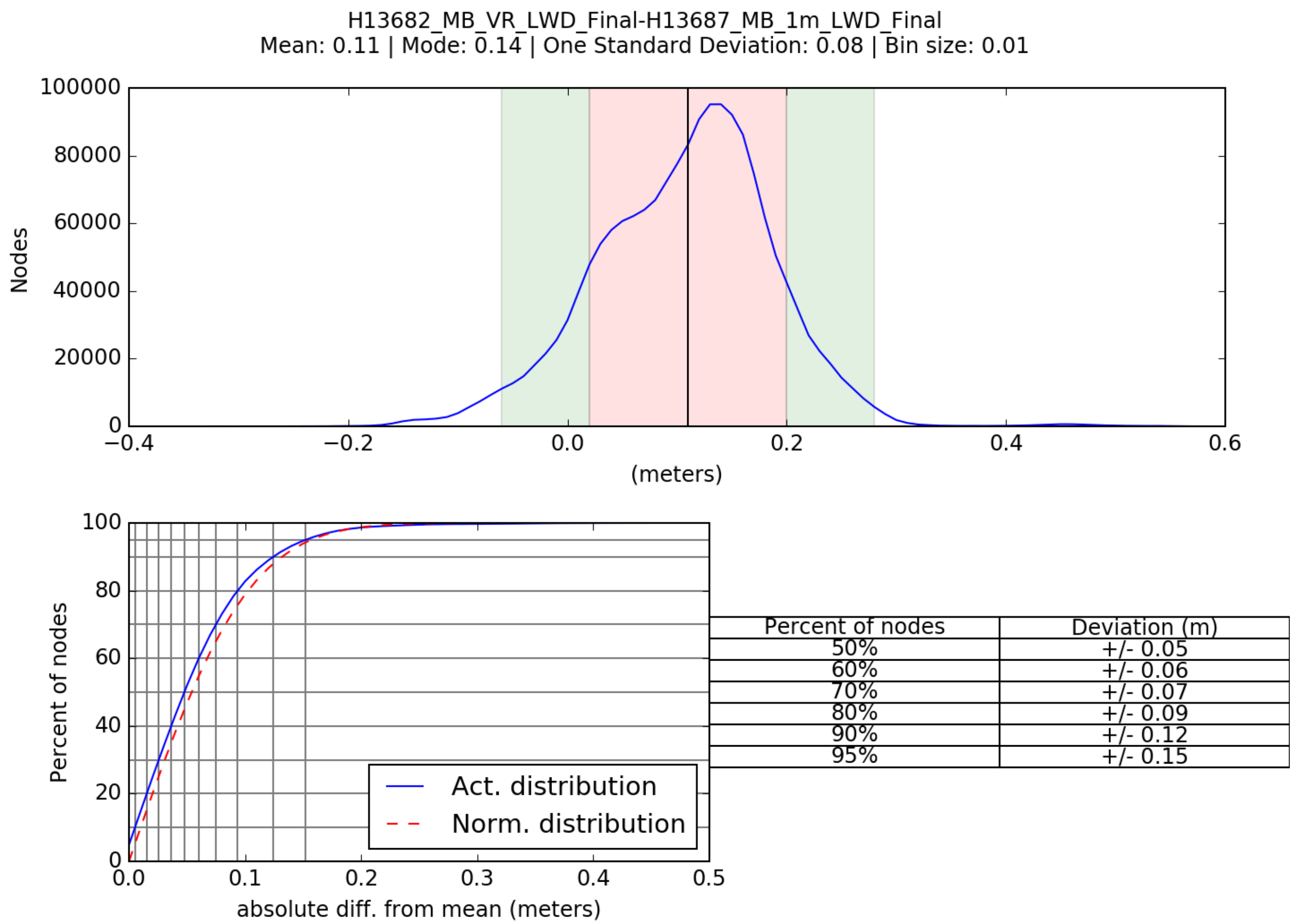


Figure 19: Fraction of allowable error surface difference comparison in color between H13687 and H13682.



Percent of nodes	Deviation (m)
50%	+/- 0.05
60%	+/- 0.06
70%	+/- 0.07
80%	+/- 0.09
90%	+/- 0.12
95%	+/- 0.15

Figure 20: H13687 and H13682 surface difference comparison statistics.

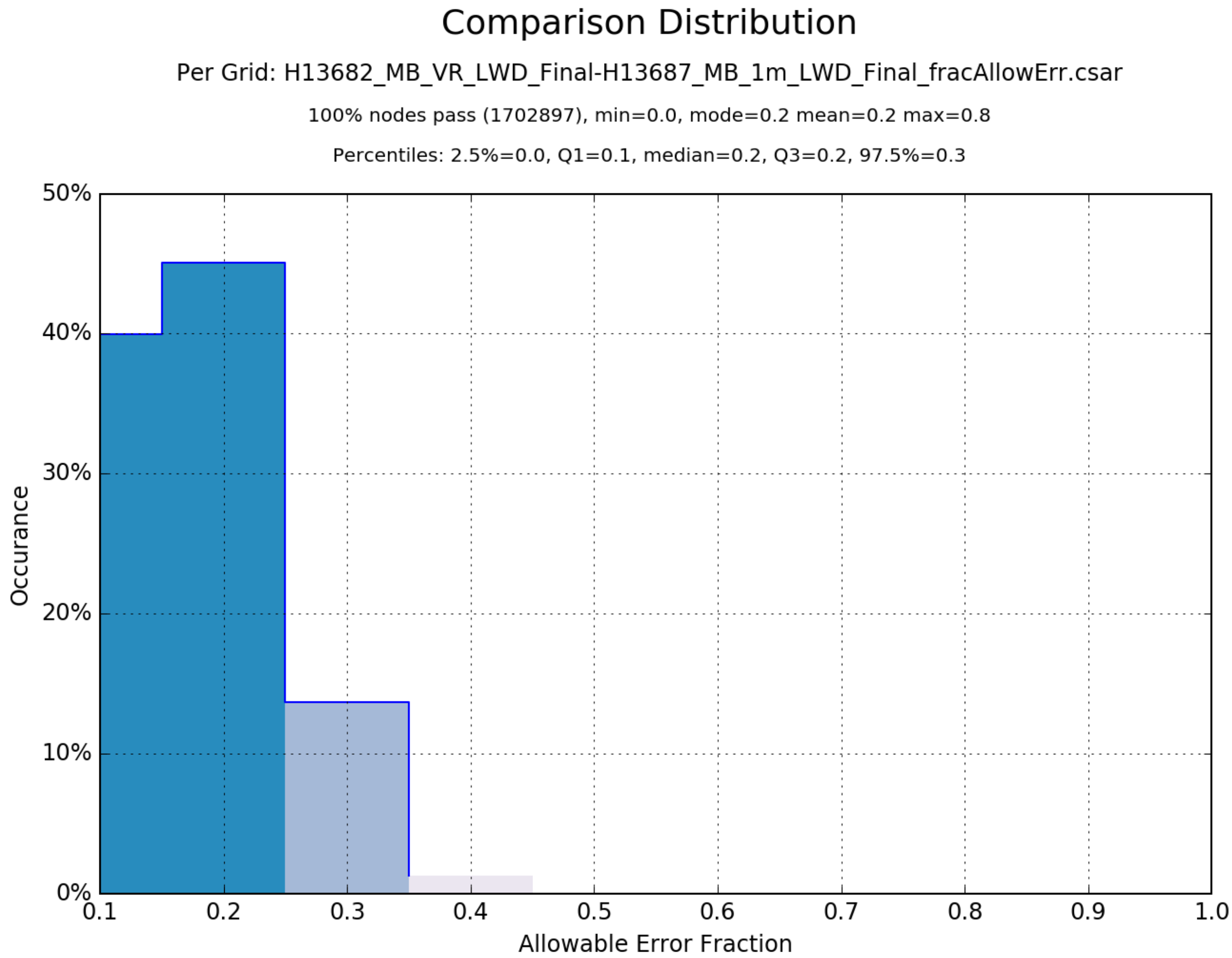


Figure 21: H13687 and H13682 fraction of allowable error statistics.

B.2.4 Sonar QC Checks

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

B.2.5 Equipment Effectiveness

Artifact observed in DriX-12 Data

During post-acquisition data processing and review, an artifact was observed in data acquired by DriX-12 that occurred in numerous locations throughout the survey area (Figure 22). The cause of this artifact is unknown and efforts were made to reject affected sounding from being included in the delivered surfaces which resulted in one of the holidays discussed in section A.4.

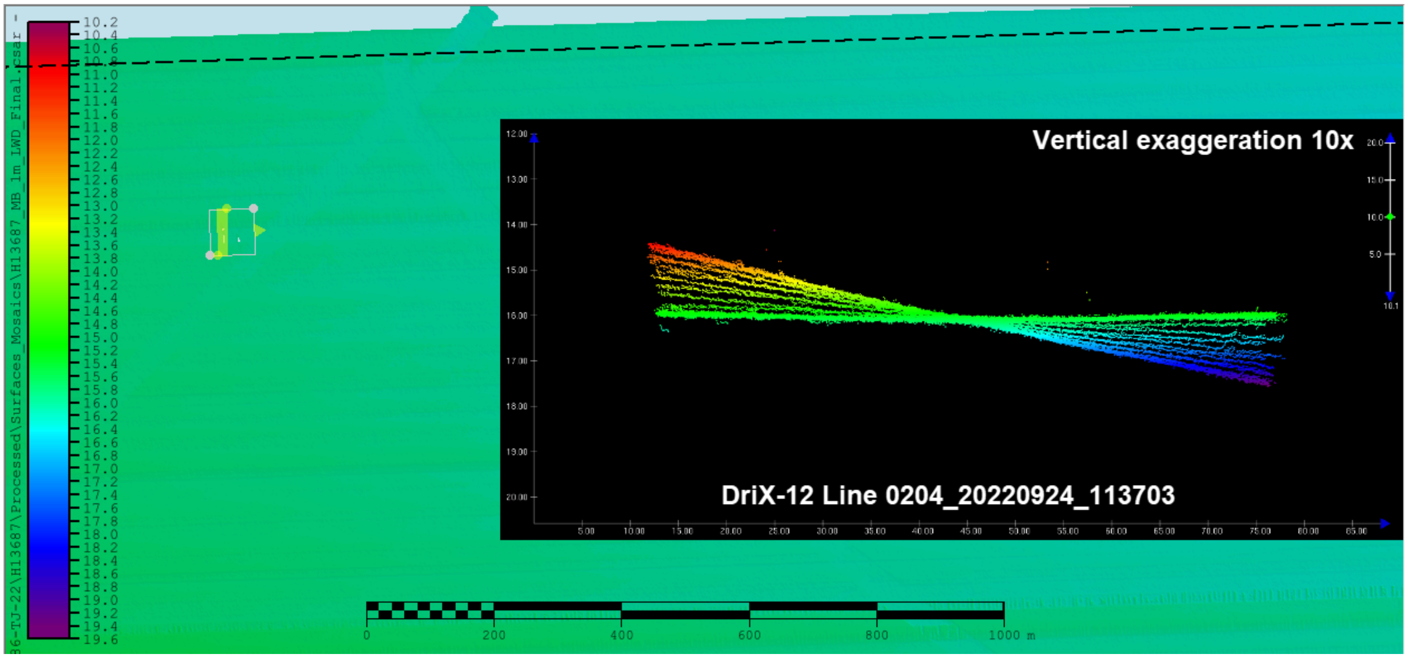


Figure 22: Caris Subset Editor 2D view of one example of DriX-12 data artifact.

B.2.6 Factors Affecting Soundings

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Conductivity, temperature, and depth (CTD) casts were conducted at the start of acquisition each day and at a minimum of once every four hours during acquisition using an MVP 200 system and a Valeport SWiFT CTD. Cast frequency was increased in areas where a change in surface sound speed greater than two meters per second was observed. MVP casts on S222 were conducted at an average interval of 45 minutes, guided by observation of the surface sound speed and targeted to deeper areas. All sound speed methods were used as detailed in the DAPR.

A total of 183 sound speed profiles were collected as part of acquisition of H13682 and display good spacial diversity (Figure 23). Three of these casts were located outside of the sheet limits and display profiles representative of the area. One cast was taken 780m outside of the assigned survey limits, but the profile displays typical conditions for the area and has been retained for processing. All sound speed profile data were concatenated into a master file for the sheet. MBES data were corrected by applying profiles nearest in distance in time (4 hours) using this master file.

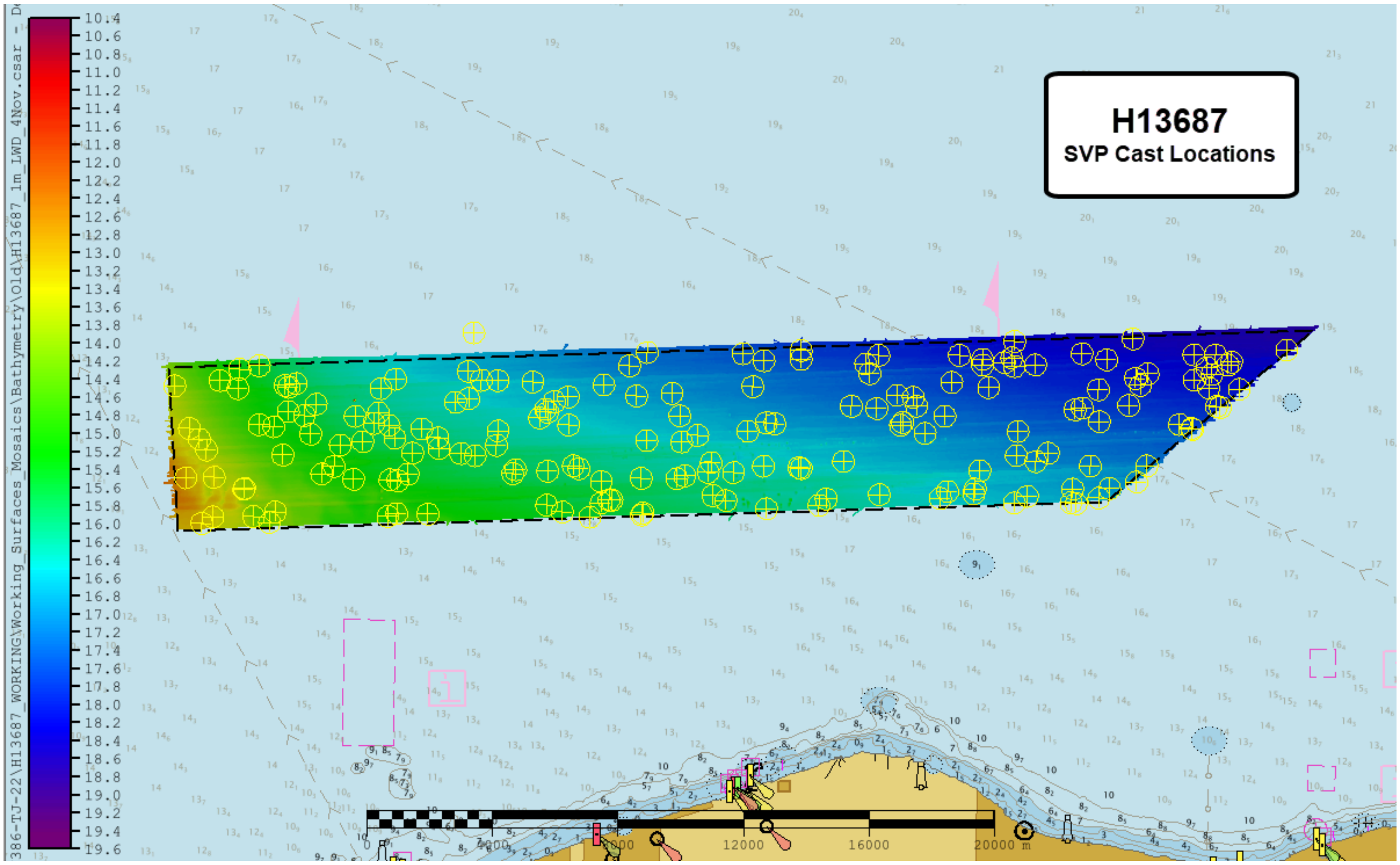


Figure 23: Overview of all sound velocity casts collected on H13687.
Cast locations shown as yellow targets overlaid on MBES data.

B.2.8 Coverage Equipment and Methods

Complete coverage requirements were met by 100% complete coverage MBES as specified under section 5.2.2.3 of the 2022 HSSD. Autonomous survey vehicle DriX-12 was outfitted with a Kongsberg EM2040 MBES system and was primarily used to acquire 100% complete coverage MBES. Vessel S222 was outfitted with a Kongsberg EM2040 MBES system and was primarily used to acquire 100% complete coverage MBES, crosslines, developments, and holidays.

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

All equipment and survey methods were used as detailed in the DAPR. Raw MBES backscatter was logged as part of the .all file from the Kongsberg EM2040 systems. Backscatter was processed in QPS Fledermaus GeoCoder Toolbox (FMGT) software, and the exported geotiffs are included in the final processed data submission package (Figures 24 and 25).

There is one holiday present in the backscatter mosaic from vessel S222. The holiday is located at 41° 35' 27.45'' N 081° 59' 53.39'' W and coincides with an MBES sonar dropout (see Holiday 2 in Figure 2).

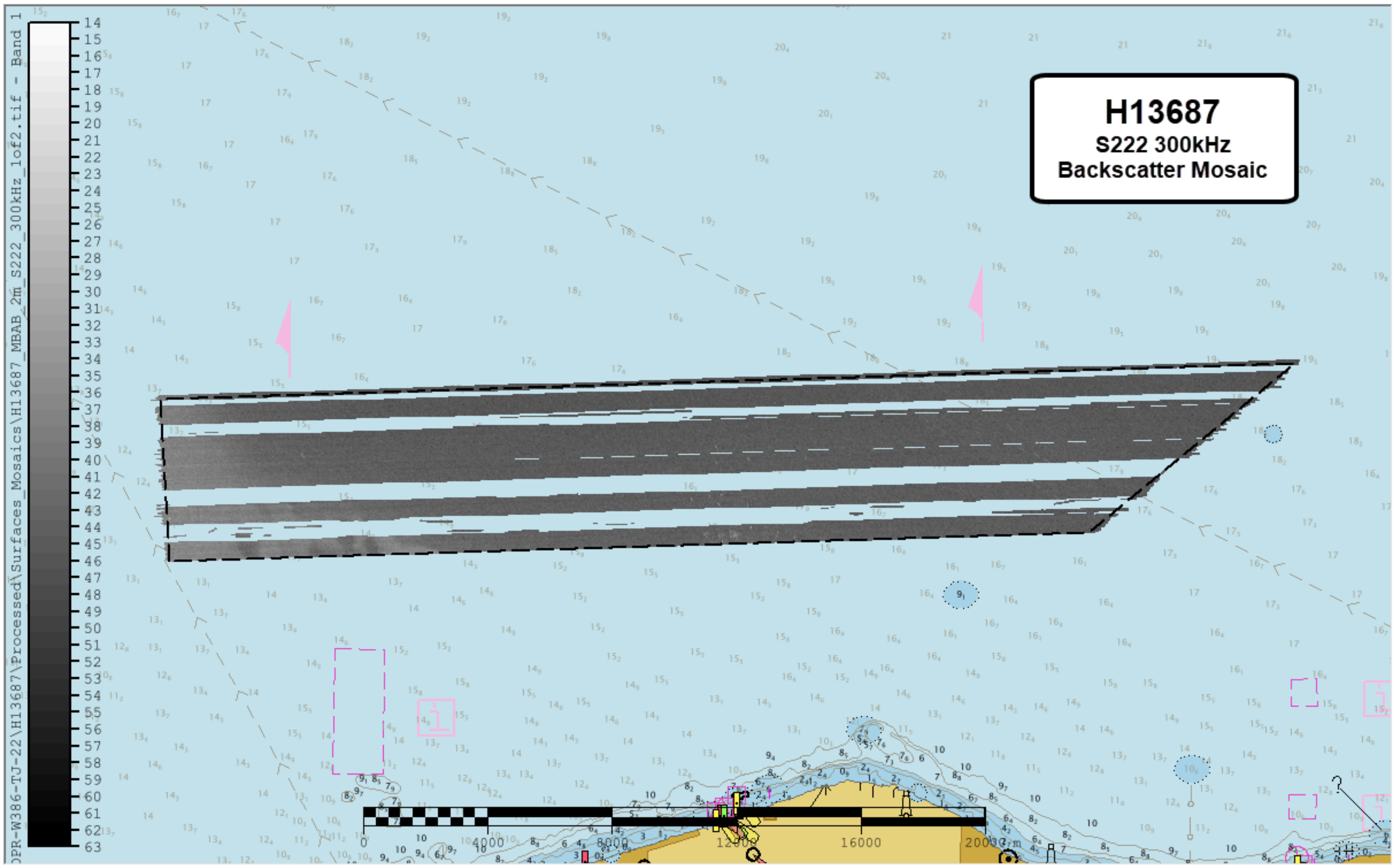


Figure 24: 300kHz backscatter mosaic from data acquired by S-222.

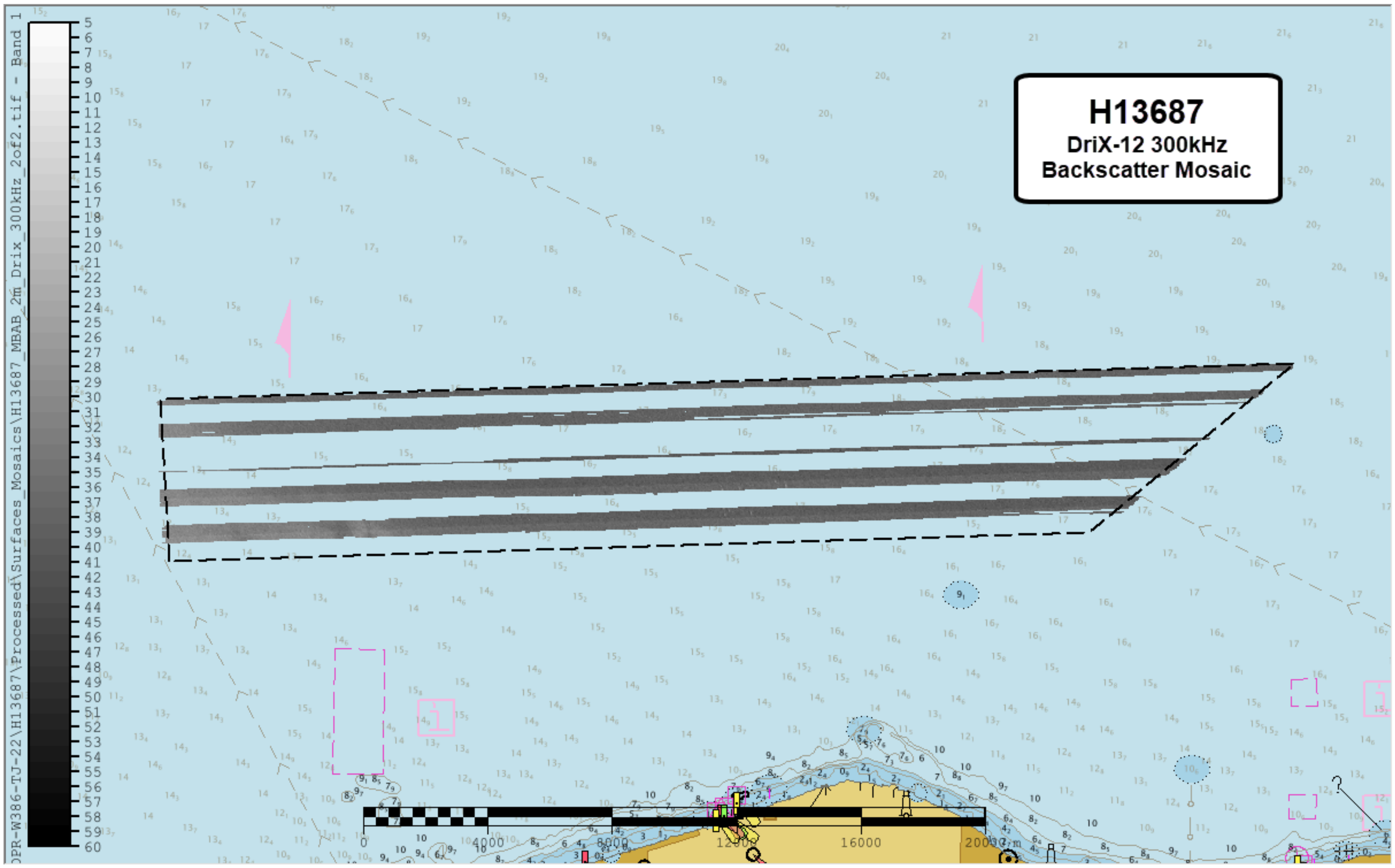


Figure 25: 300kHz backscatter mosaic from data acquired by DriX.

B.5 Data Processing

B.5.1 Primary Data Processing Software

The following Feature Object Catalog was used: NOAA Profile Version 2022.

Feature Object Catalog NOAA Profile Version 2022 was used for all S-57 attribution in the Final Feature File (FFF). All other software were used as detailed in the DAPR.

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
H13687_MB_1m_LWD	CARIS Raster Surface (CUBE)	1 meters	10.45 meters - 19.46 meters	NOAA_1m	Complete MBES
H13687_MB_1m_LWD_Final	CARIS Raster Surface (CUBE)	1 meters	10.28 meters - 19.46 meters	NOAA_1m	Complete MBES
H13687_MBAB_2m_S222_300kHz_1of2	MB Backscatter Mosaic	2 meters	-	N/A	Complete MBES
H13687_MBAB_2m_DriX_300kHz_2of2	MB Backscatter Mosaic	2 meters	-	N/A	Complete MBES

Table 10: Submitted Surfaces

Complete coverage requirements were met by 100% complete coverage MBES as specified under section 5.2.2.2 of the 2022 HSSD. All bathymetric grids for H13687 meet density requirements per the 2022 HSSD (Figure 26).

There are three holidays present in the coverage acquired for H13687. Reference Section A.4 for more information.

After multiple rounds of surface cleaning, eight fliers remain as detected by NOAA's QCTools Flier Finder available in the Pydro 19+ suite. The hydrographer reviewed the flagged grid nodes, considers them to be accurate representations of the lake bed, and has retained them in the final delivered surfaces.

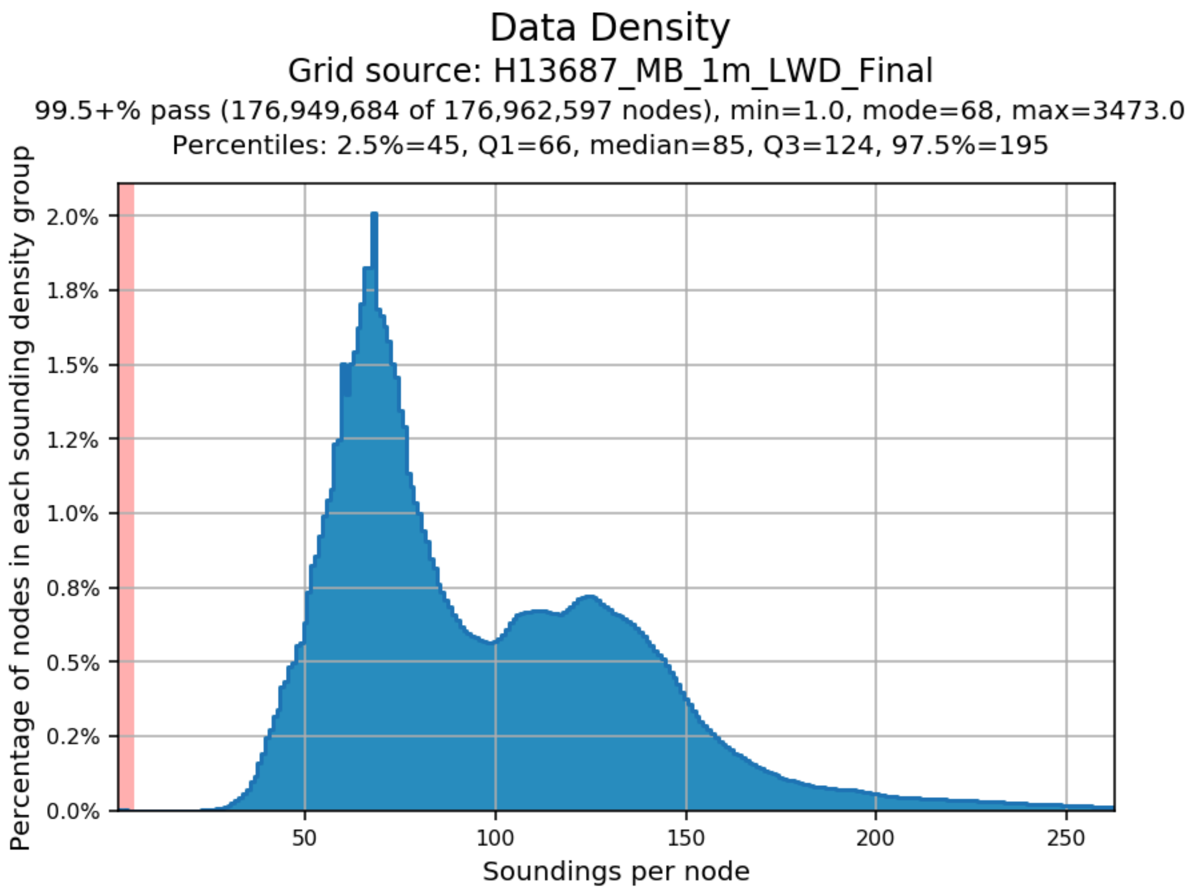


Figure 26: H13687 data density standards.

C. Vertical and Horizontal Control

No Horizontal and Vertical Control Report (HVCR) is required for this survey.

C.1 Vertical Control

The vertical datum for this project is Low Water Datum IGLD-1985.

ERS Datum Transformation

The following ellipsoid-to-chart vertical datum transformation was used:

Method	Ellipsoid to Chart Datum Separation File
ERS via VDATUM	OPR-W386-TJ-22_NAD83_2011_VDatum_LWD_IGLD85

Table 11: ERS method and SEP file

All soundings submitted for H13687 are reduced to LWD IGLD-85 using VDatum techniques as outlined in the DAPR.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum of 1983 (NAD 83).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 17.

PPP

GrafNav PPP service was used with a dual frequency Septentrio GNSS system to obtain highly accurate ellipsoidally referenced position data to meet ERS specifications for H13687 MBES data collected by DriX-12.

RTK

Trimble-RTX service was used with an Applanix POS MVv5 GNSS_INS system to obtain highly accurate ellipsoidally referenced position data to meet ERS specifications for H13687 MBES data from vessel S222.

WAAS

The Wide Area Augmentation System (WAAS) was used for real-time horizontal control during data acquisition on vessels S222 and DriX-12.

D. Results and Recommendations

D.1 Chart Comparison

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
US4OH01M	1:180000	17	03/31/2022	07/27/2022

Table 12: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

Surveyed soundings and contours were compared against previously charted data on ENC US4OH01M. Depth values were found to be in general agreement with previously charted soundings. No danger to navigation reports were submitted for this survey and all data acquired on H13687 are recommended to supersede prior data.

D.1.3 Charted Features

No charted features exist for this survey.

D.1.4 Uncharted Features

Five new features were discovered and investigated during acquisition on H13687. Reference the Final Feature File included in the final delivery package for more information.

D.1.5 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.2 Additional Results

D.2.1 Aids to Navigation

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

D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

D.2.3 Bottom Samples

No bottom samples were required for this survey.

D.2.4 Overhead Features

No overhead features exist for this survey.

D.2.5 Submarine Features

No submarine features exist for this survey.

D.2.6 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 or Environmental Conditions

No abnormal seafloor or environmental conditions 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 ENC Scale Recommendations

No new ENC scales are recommended for this area.

E. Approval Sheet

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

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

The survey data meets or exceeds requirements as set forth in the NOS Hydrographic Surveys Specifications and Deliverables, Field Procedures Manual, Letter Instructions, and all HSD Technical Directives. 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
Matthew J. Jaskoski, CDR/NOAA	Commanding Officer	03/03/2023	JASKOSKI.MATTHEW.JACOB.1275636262 2023.03.02 11:47:12 -05'00'
Sydney M. Catoire, LT/NOAA	Field Operations Officer	03/03/2023	CATOIRE.SYDNEY.MARIE.1120060623 Digitally signed by CATOIRE.SYDNEY.MARIE.1120060623 Date: 2023.03.03 09:20:30 -05'00'
Erin K. Cziraki	Chief Survey Technician	03/03/2023	CZIRAKI.ERIN.KAYE.1550015338 Digitally signed by CZIRAKI.ERIN.KAYE.1550015338 Date: 2023.03.03 10:26:34 -05'00'

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	Continuously Operating Reference Station
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
ERTDM	Ellipsoidally Referenced Tidal Datum Model
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

Acronym	**Definition**
HSSD	Hydrographic Survey Specifications and Deliverables
HSTB	Hydrographic Systems Technology Branch
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
MBAB	Multibeam Echosounder Acoustic Backscatter
MCD	Marine Chart Division
MHW	Mean High Water
MLLW	Mean Lower Low Water
NAD 83	North American Datum of 1983
NALL	Navigable Area Limit Line
NTM	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
RNC	Raster Navigational Chart
RTK	Real Time Kinematic
RTX	Real Time Extended
SBES	Singlebeam Echosounder
SBET	Smooth Best Estimate and Trajectory
SNM	Square Nautical Miles
SSS	Side Scan Sonar
SSSAB	Side Scan Sonar Acoustic Backscatter
ST	Survey Technician
SVP	Sound Velocity Profiler
TCARI	Tidal Constituent And Residual Interpolation
TPU	Total Propagated Uncertainty
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
UTM	Universal Transverse Mercator
XO	Executive Officer
ZDF	Zone Definition File