H13976

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

# DESCRIPTIVE REPORT

| | |
|---|---|
| Type of Survey: | Navigable Area |
| Registry Number: | H13976 |

## LOCALITY

| | |
|---|---|
| State(s): | Louisiana |
| General Locality: | Approaches to Calcasieu |
| Sub-locality: | 20 NM West of Trinity Shoal |

**2024**

CHIEF OF PARTY
Jonathan L. Dasler, PE, PLS, CH

LIBRARY & ARCHIVES

Date:

| U.S. DEPARTMENT OF COMMERCE<br>NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION | REGISTRY NUMBER: |
|---|---|
| **HYDROGRAPHIC TITLE SHEET** | **H13976** |

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): | **Louisiana** |
| General Locality: | **Approaches to Calcasieu** |
| Sub-Locality: | **20 NM West of Trinity Shoal** |
| Scale: | **40000** |
| Dates of Survey: | **11/15/2024 to 01/25/2025** |
| Instructions Dated: | **07/11/2024** |
| Project Number: | **OPR-K356-KR-24** |
| Field Unit: | **David Evans and Associates, Inc.** |
| Chief of Party: | **Jonathan L. Dasler, PE, PLS, CH** |
| Soundings by: | **Multibeam Echo Sounder** |
| Imagery by: | **Multibeam Echo Sounder Backscatter  Synthetic Aperture Sonar** |
| Verification by: | **Atlantic Hydrographic Branch** |
| Soundings Acquired in: | **meters at Mean Lower Low Water** |

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 15N, MLLW. 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 H13976

Project: OPR-K356-KR-24

Locality: Approaches to Calcasieu

Sublocality: 20 NM West of Trinity Shoal

Scale: 1:40000

November 2024 - January 2025

**David Evans and Associates, Inc.**

Chief of Party: Jonathan L. Dasler, PE, PLS, CH

# A. Area Surveyed

David Evans and Associates, Inc. (DEA) conducted a hydrographic survey of the assigned area in the waters offshore of Calcasieu Channel, LA. Survey H13976 was conducted in accordance with the Statement of Work and Hydrographic Survey Project Instructions dated July 11, 2024.

The Hydrographic Survey Project Instructions reference the National Ocean Service (NOS) Hydrographic Survey Specifications and Deliverables Manual (HSSD) (March 2022) as the technical requirements for this project.

## A.1 Survey Limits

Data were acquired within the following survey limits:

| Northwest Limit | Southeast Limit |
|---|---|
| 29° 20' 14.48" N<br>92° 50' 12.48" W | 29° 7' 16.12" N<br>92° 37' 47.46" W |

*Table 1: Survey Limits*

Survey limits were surveyed in accordance with the requirements in the Project Instructions and the HSSD. The assigned survey areas are outlined in Figure 1.

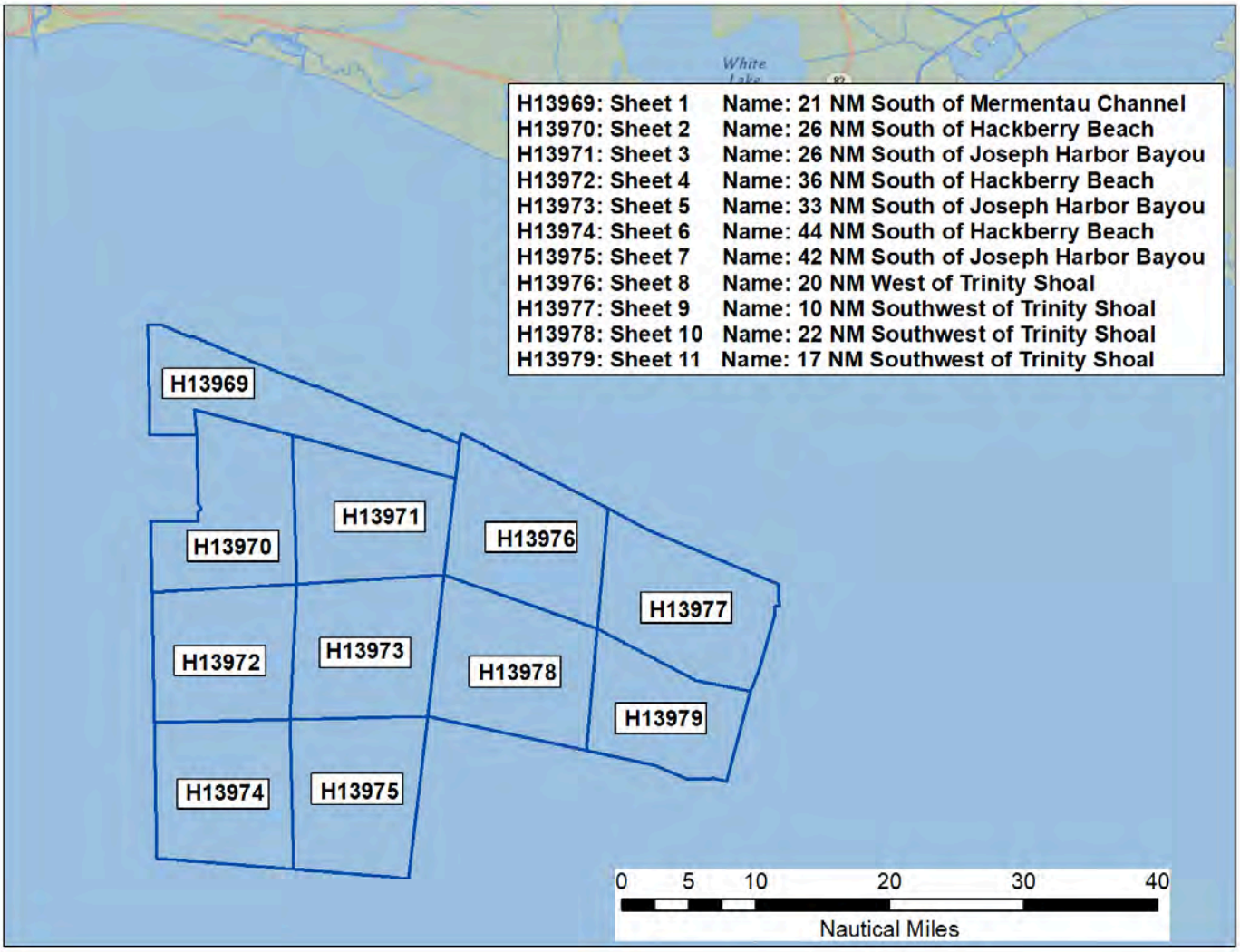



*Figure 1: OPR-K356-KR-24 Assigned Survey Areas*

## A.2 Survey Purpose

The purpose of this survey, defined in the Project Instructions, is as follows: "The waters offshore of Calcasieu Channel, Louisiana have been identified as an area in critical need of updated hydrographic data by NOAA's Hydrographic Health models and the Lake Charles Pilot's Association. The Port of Lake Charles is ranked fourteenth by tonnage for U.S. Ports(1), and the region is expected to see an expansion in marine commerce due in part to an increase in LNG distribution, as well as offshore wind-energy development. Since 2020, the Louisiana Coast has been hit by six hurricanes and two named tropical storms, several of which caused serious damage to the Ports of Lake Charles and Calcasieu. Many parts of the coverage area have not been charted since the 1930s.

This survey will provide contemporary data to update National Ocean Service (NOS) nautical charting products and services, improving the safety of maritime traffic and services available to the Port of Lake

Charles by reducing the current risk that is present due to outdated bathymetry. Survey data from this project is intended to supersede all prior survey data in the common area."

(1) Bureau of Transportation Statistics, 2023 https://www.bts.gov/content/tonnage-top-50-us-water-ports-ranked-total-tons

## A.3 Survey Quality

The entire survey is adequate to supersede previous data.

## 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) |

*Table 2: Survey Coverage*

Complete coverage using 100% side scan sonar (SSS) coverage, collected using seafloor imagery from a synthetic aperture sonar (SAS), with concurrent multibeam echosounder (MBES) was obtained over the entire survey area. Backscatter was logged during all multibeam acquisition. This coverage type follows Option B of the Complete Coverage requirement specified in Section 5.2.2.3 of the 2022 HSSD. In all cases, the inshore limit of hydrography was the Navigable Area Limit Line (NALL) as defined in Section 1.3.2 of the HSSD; however, for this survey, the inshore limit was not encountered and the full extent of the assigned boundary was met.

Figure 2 shows the H13976 survey outline in relation to the assigned survey area.

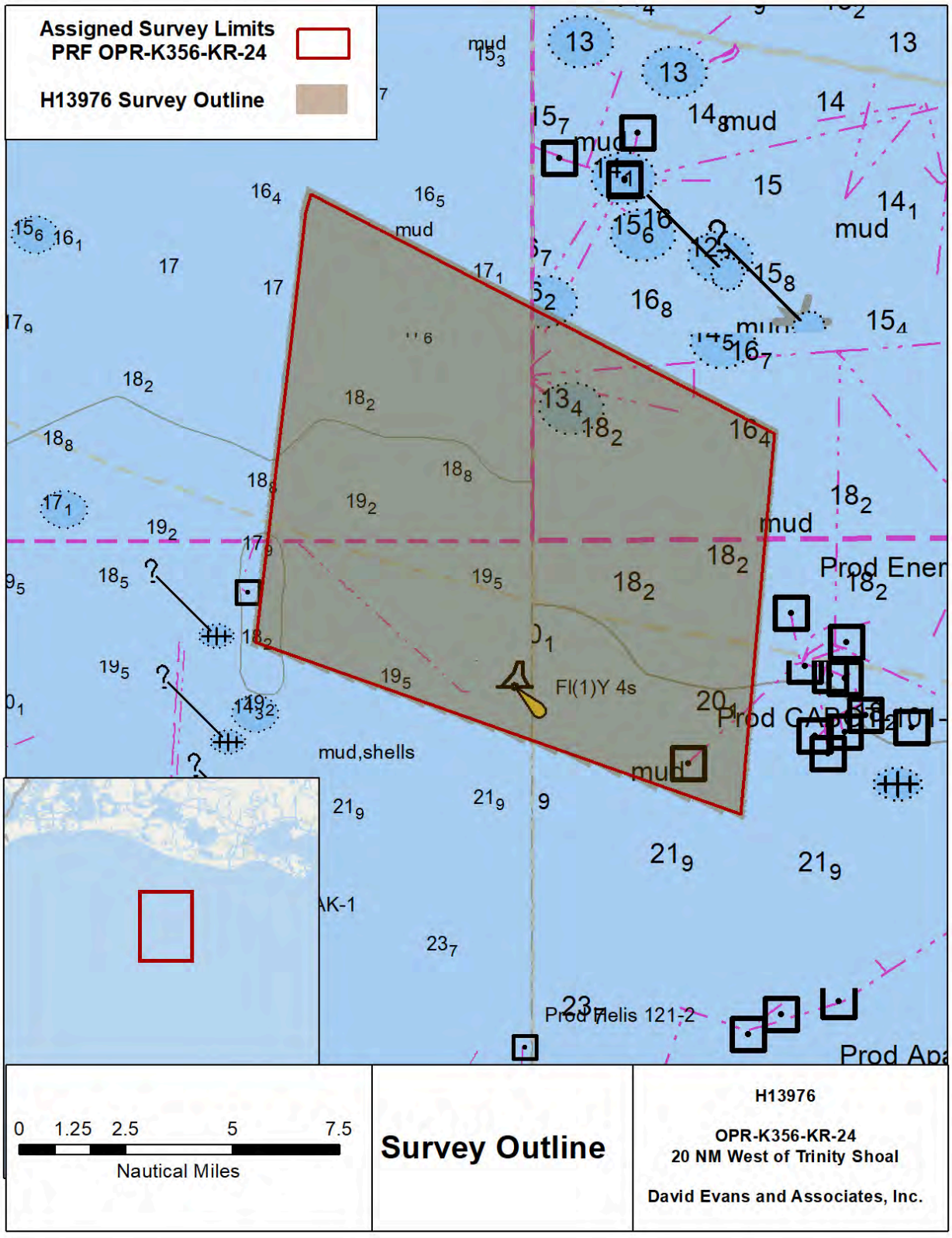



*Figure 2: H13976 Survey Outline*

## A.6 Survey Statistics

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

| | HULL ID | *DriX 5* | *Total* |
|---|---|---|---|
| **LNM** | **SBES Mainscheme** | 0.0 | 0.0 |
| | **MBES Mainscheme** | 5.8 | 5.8 |
| | **Lidar Mainscheme** | 0.0 | 0.0 |
| | **SSS Mainscheme** | 0.0 | 0.0 |
| | **SBES/SSS Mainscheme** | 0.0 | 0.0 |
| | **MBES/SSS Mainscheme** | 1174.92 | 1174.92 |
| | **SBES/MBES Crosslines** | 51.96 | 51.96 |
| | **Lidar Crosslines** | 0.0 | 0.0 |
| **Number of Bottom Samples** | | | 3 |
| **Number Maritime Boundary Points Investigated** | | | 0 |
| **Number of DPs** | | | 0 |
| **Number of Items Investigated by Dive Ops** | | | 0 |
| **Total SNM** | | | 90.1 |

*Table 3: Hydrographic Survey Statistics*

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

| Survey Dates | Day of the Year |
|---|---|
| 11/15/2024 | 320 |
| 11/16/2024 | 321 |
| 11/23/2024 | 328 |
| 11/24/2024 | 329 |
| 11/25/2024 | 330 |
| 11/26/2024 | 331 |
| 11/27/2024 | 332 |
| 11/28/2024 | 333 |
| 12/02/2024 | 337 |
| 12/03/2024 | 338 |
| 12/04/2024 | 339 |
| 12/07/2024 | 342 |
| 12/12/2024 | 347 |
| 12/13/2024 | 348 |
| 12/15/2024 | 350 |
| 12/16/2024 | 351 |
| 12/17/2024 | 352 |
| 01/25/2025 | 25 |

*Table 4: Dates of Hydrography*

# B. Data Acquisition and Processing

## B.1 Equipment and Vessels

A revised Data Acquisition and Processing Report (DAPR), which was submitted with this survey, details equipment and vessel information as well as data acquisition and processing procedures. There were no vessel or equipment configurations used during data acquisition that deviated from those described in the DAPR.

The DriX 5 is a 25-foot uncrewed surface vessel (USV) with a 2.62-foot beam and a draft of 6 feet (Figure 3).

### B.1.1 Vessels

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

| Hull ID | *DriX 5* |
|---|---|
| **LOA** | 25.0 feet |
| **Draft** | 6.0 feet |

*Table 5: Vessels Used*

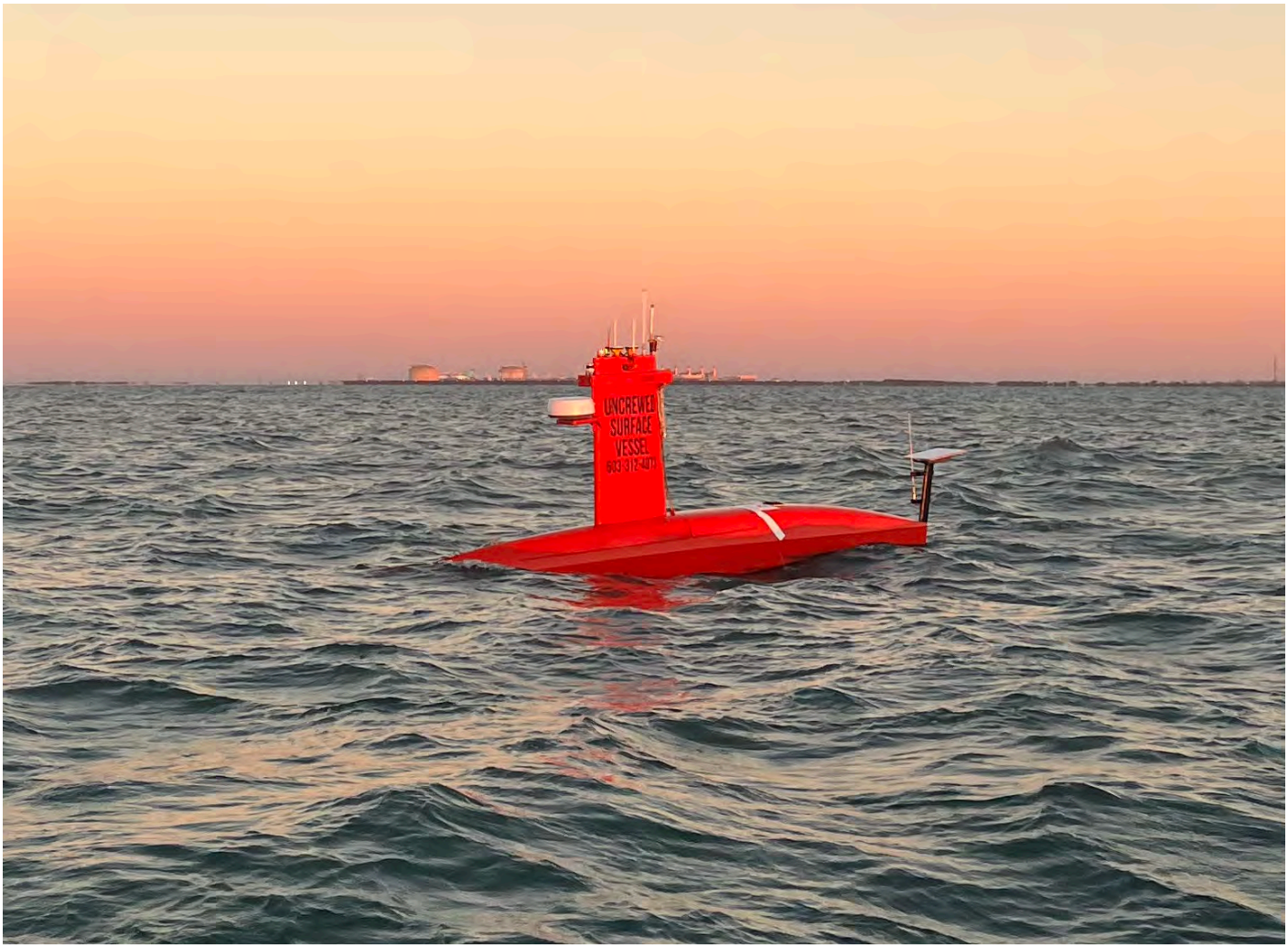



*Figure 3: DriX 5*

### B.1.2 Equipment

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

| Manufacturer | Model | Type |
|---|---|---|
| Kongsberg Maritime | EM 2040-MK2 | MBES |
| Valeport | MiniSVS | Sound Speed System |
| Valeport | SWiFT SVP | Sound Speed System |

*Table 6: Major Systems Used*

Side scan sonar (SSS) seafloor imagery data were collected with an Exail Sams 150 synthetic aperture mapping sonar, and processed in inertial side scan mode. An Exail Phins INS with integrated Septentrio AsteRx-U-Fg GNSS receiver was used as the positioning and attitude system. These systems are not part of the NOAA XML DR schema, and therefore not included in Table 6.

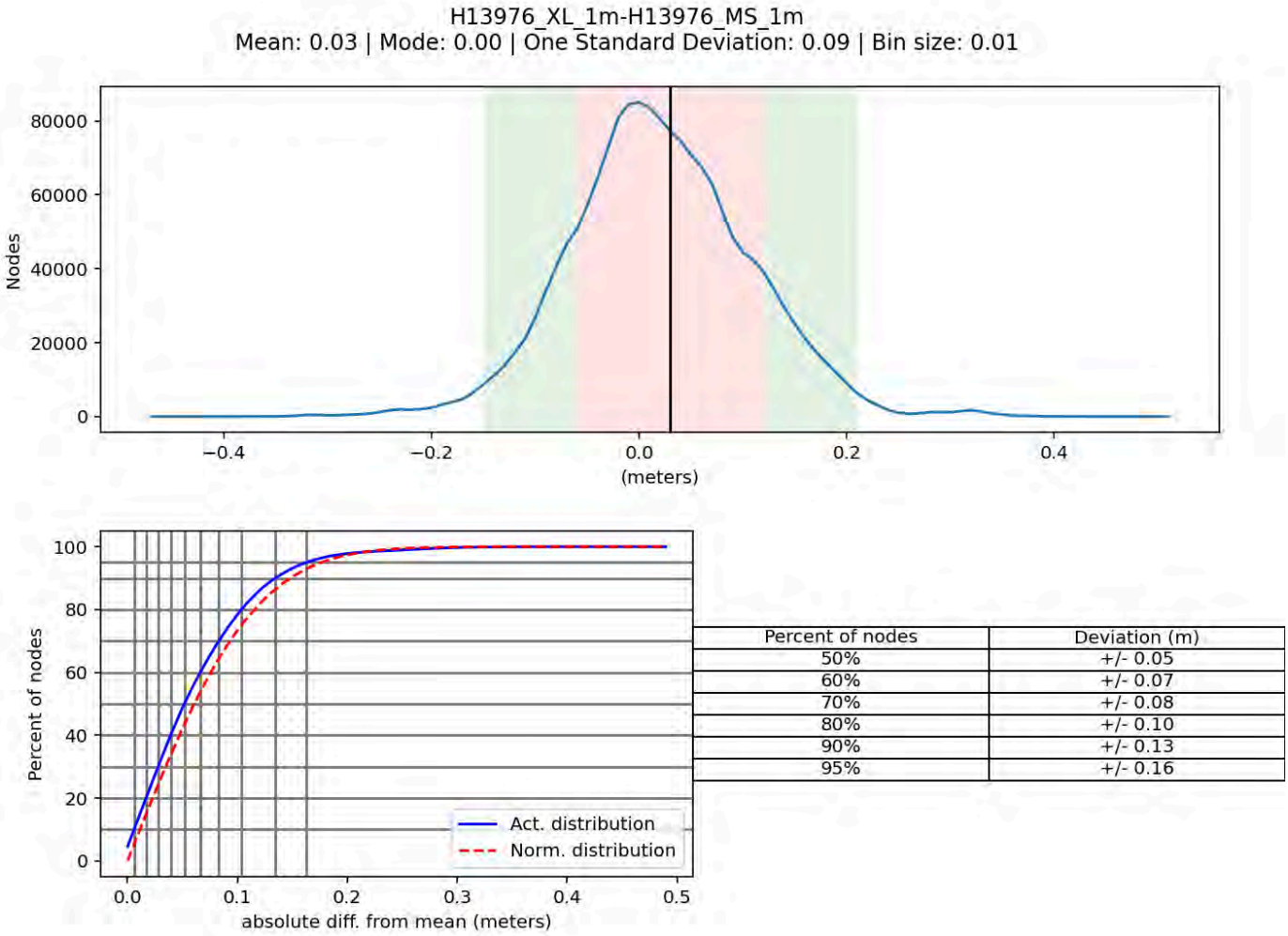
## B.2 Quality Control

### B.2.1 Crosslines

Multibeam crosslines were run across 4.40% of the entire survey area to provide a varied spatial and temporal distribution for analysis of internal consistency within the survey data.

Crossline analysis was performed using the CARIS Hydrographic Information Processing System (HIPS) Quality Control (QC) Report tool, which compares crossline data to a gridded surface and reports results by beam number. Crosslines were compared to a 1-meter Combined Uncertainty and Bathymetry Estimator (CUBE) surface encompassing mainscheme, fill, and investigation data for the entire survey area.

DEA performed an additional crossline analysis using the NOAA Pydro Compare Grids tool to analyze the differences between gridded mainscheme depths and gridded crossline depths. Input grids were 1-meter resolution CUBE surfaces of mainscheme and crossline depths. Results from the crossline-to-mainscheme difference analysis are depicted in Figure 4, with units represented in meters.




| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.05 |
| 60% | +/- 0.07 |
| 70% | +/- 0.08 |
| 80% | +/- 0.10 |
| 90% | +/- 0.13 |
| 95% | +/- 0.16 |

*Figure 4: H13976 Crossline Difference*

### B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

| Method | Measured | Zoning |
|---|---|---|
| ERS via VDATUM | 0.05 meters | 0.097 meters |

*Table 7: Survey Specific Tide TPU Values.*

| Hull ID | Measured - CTD | Measured - MVP | Measured - XBT | Surface |
|---|---|---|---|---|
| DriX 5 | 0.5 meters/second | n/a meters/second | n/a meters/second | 0.5 meters/second |

*Table 8: Survey Specific Sound Speed TPU Values*.

The datum separation (Zoning) uncertainty value of 0.097 meters, used to compute Total Propagated Uncertainty (TPU) listed in Table 7, corresponds to the uncertainty of a revised NAD83 to MLLW SEP file issued by NOAA on July 30, 2024 and does not match the model uncertainty listed in the Project Instructions. Related correspondence is included in Appendix II.

The revised model resolved errors in the original model that were discovered by DEA and reported to NOAA. The OPR-K356-KR-24 DAPR includes more information on the model update.

The DriX 5 used a SWiFT SVP Conductivity, Temperature, and Depth probe (CTD) to acquire sound speed measurements. The measurement uncertainty for these sensors is listed in the CTD column in Table 8.

During surface finalization in HIPS, the "Uncertainty" option was selected, which uses the calculated uncertainty value at the node. Additional discussion of the parameters used to compute TPU is included in the DAPR.

To determine if the surface grid nodes met the International Hydrographic Organization (IHO) Order 1a specification, a ratio of the final node uncertainty to the allowable uncertainty at that depth was determined. As a percentage, this value represents the amount of error budget utilized by the Total Vertical Uncertainty (TVU) at each node. Values greater than 100% indicate nodes exceeding the allowable IHO uncertainty. The resulting calculated node uncertainty as a fraction of allowable IHO Order 1a TVU is shown in Figures 5 and 6.

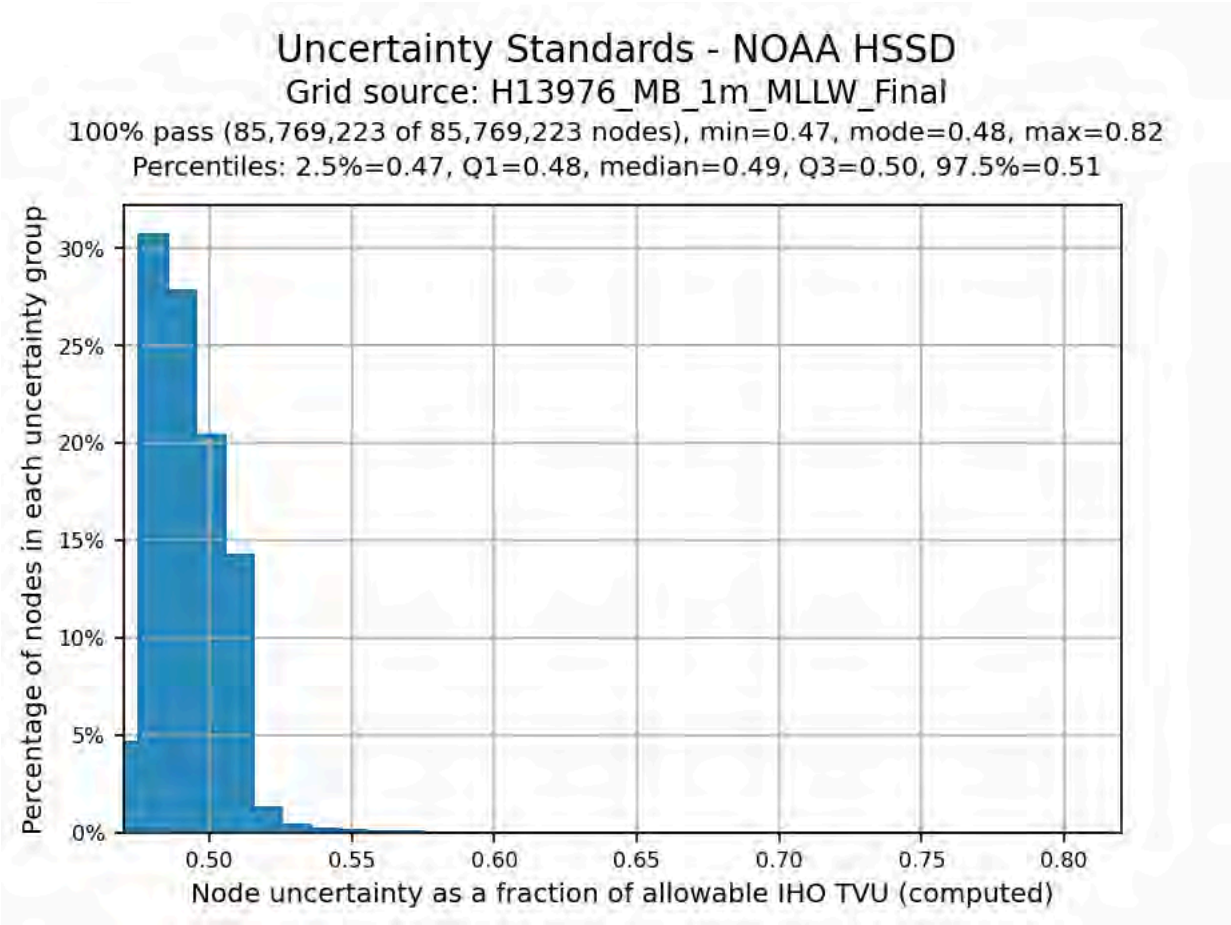



*Figure 5: Node TVU Statistics - 1 meter, Finalized*

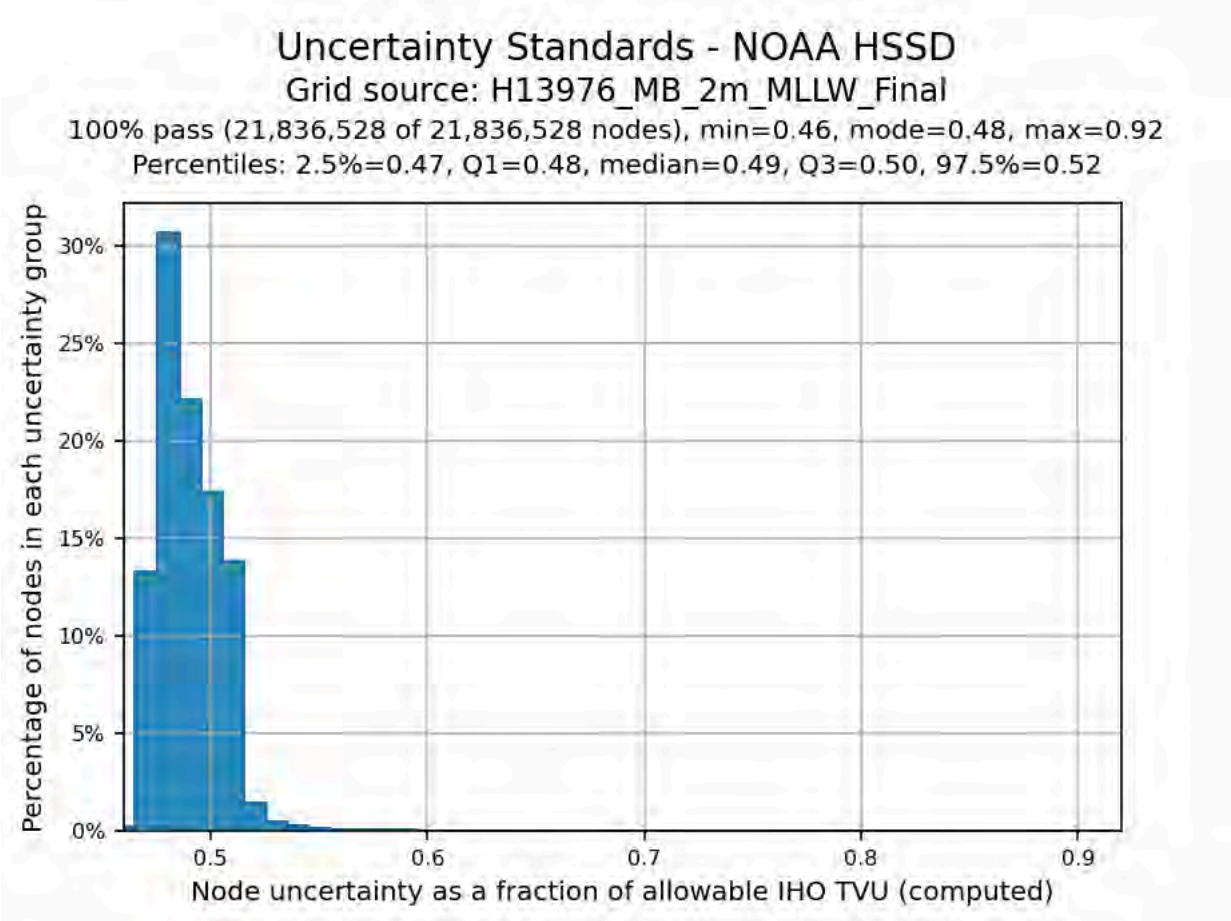



*Figure 6: Node TVU Statistics - 2 meter, Finalized*

### B.2.3 Junctions

Survey H13976 junctions with current surveys H13969, H13971, H13973, H13977, H13978, and H13979, and prior surveys H13820, H13318, and H13316. Figure 7 depicts H13976 and the junctioning surveys.

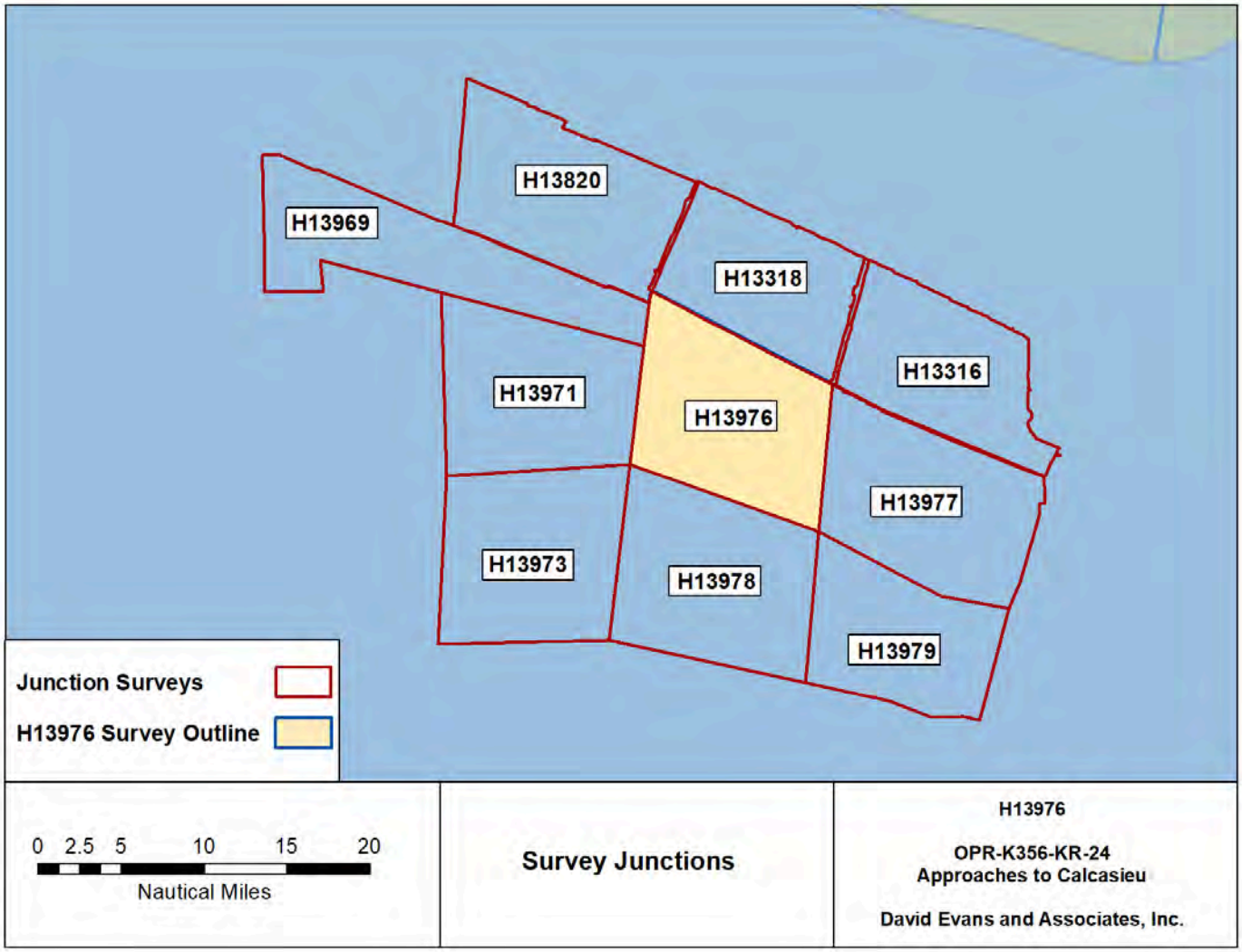



*Figure 7: Survey Junctions with Registry Number H13976*

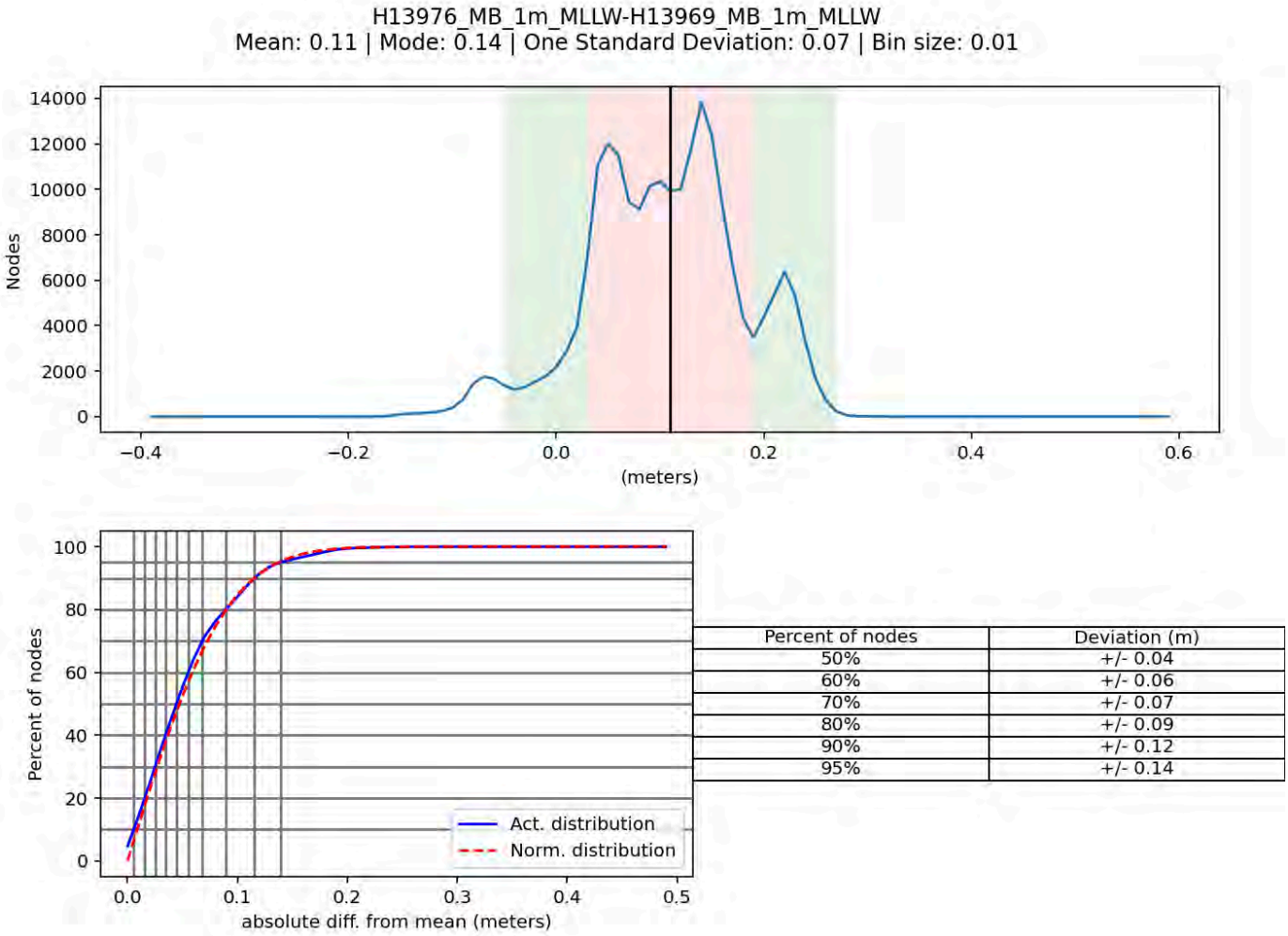
The following junctions were made with this survey:

| Registry Number | Scale | Year | Field Unit | Relative Location |
|---|---|---|---|---|
| H13969 | 1:10000 | 2024 | David Evans and Associates, Inc. | W |
| H13971 | 1:20000 | 2024 | David Evans and Associates, Inc. | W |
| H13973 | 1:20000 | 2024 | David Evans and Associates, Inc. | SW |
| H13977 | 1:40000 | 2024 | David Evans and Associates, Inc. | E |
| H13978 | 1:40000 | 2024 | David Evans and Associates, Inc. | S |
| H13979 | 1:40000 | 2024 | David Evans and Associates, Inc. | SE |
| H13820 | 1:20000 | 2023 | Leidos | NW |
| H13318 | 1:40000 | 2019 | OSI | N |
| H13316 | 1:40000 | 2019 | OSI | NE |

*Table 9: Junctioning Surveys*

H13969

The mean difference between H13976 and H13969 is 11 centimeters (H13976 shoaler than H13969), shown in Figure 8.

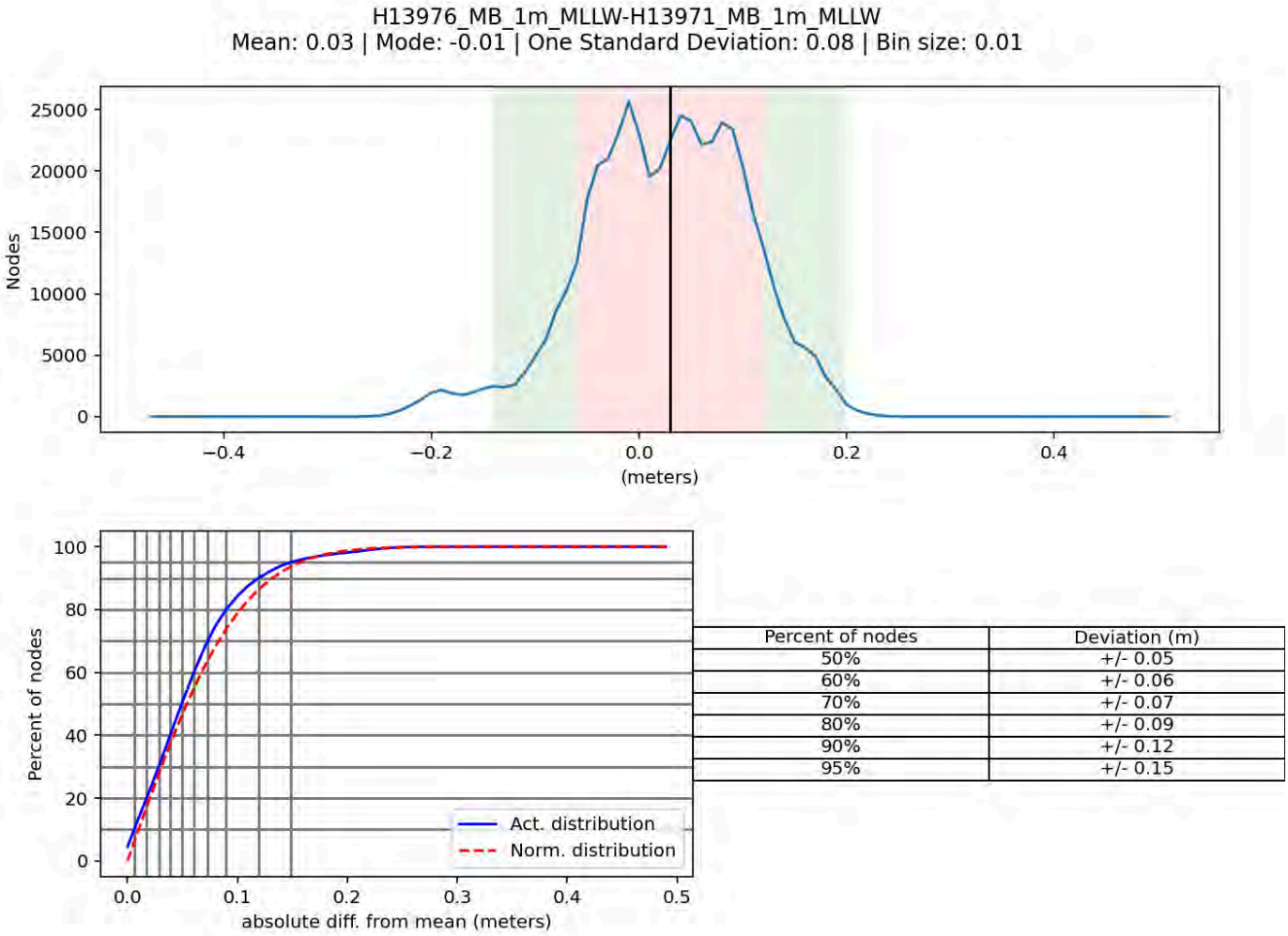



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.04 |
| 60% | +/- 0.06 |
| 70% | +/- 0.07 |
| 80% | +/- 0.09 |
| 90% | +/- 0.12 |
| 95% | +/- 0.14 |

*Figure 8: Distribution Summary Plot of Survey H13976 1-meter vs. H13969 1-meter*

H13971

The mean difference between H13976 and H13971 is 3 centimeters (H13976 shoaler than H13971), shown in Figure 9.

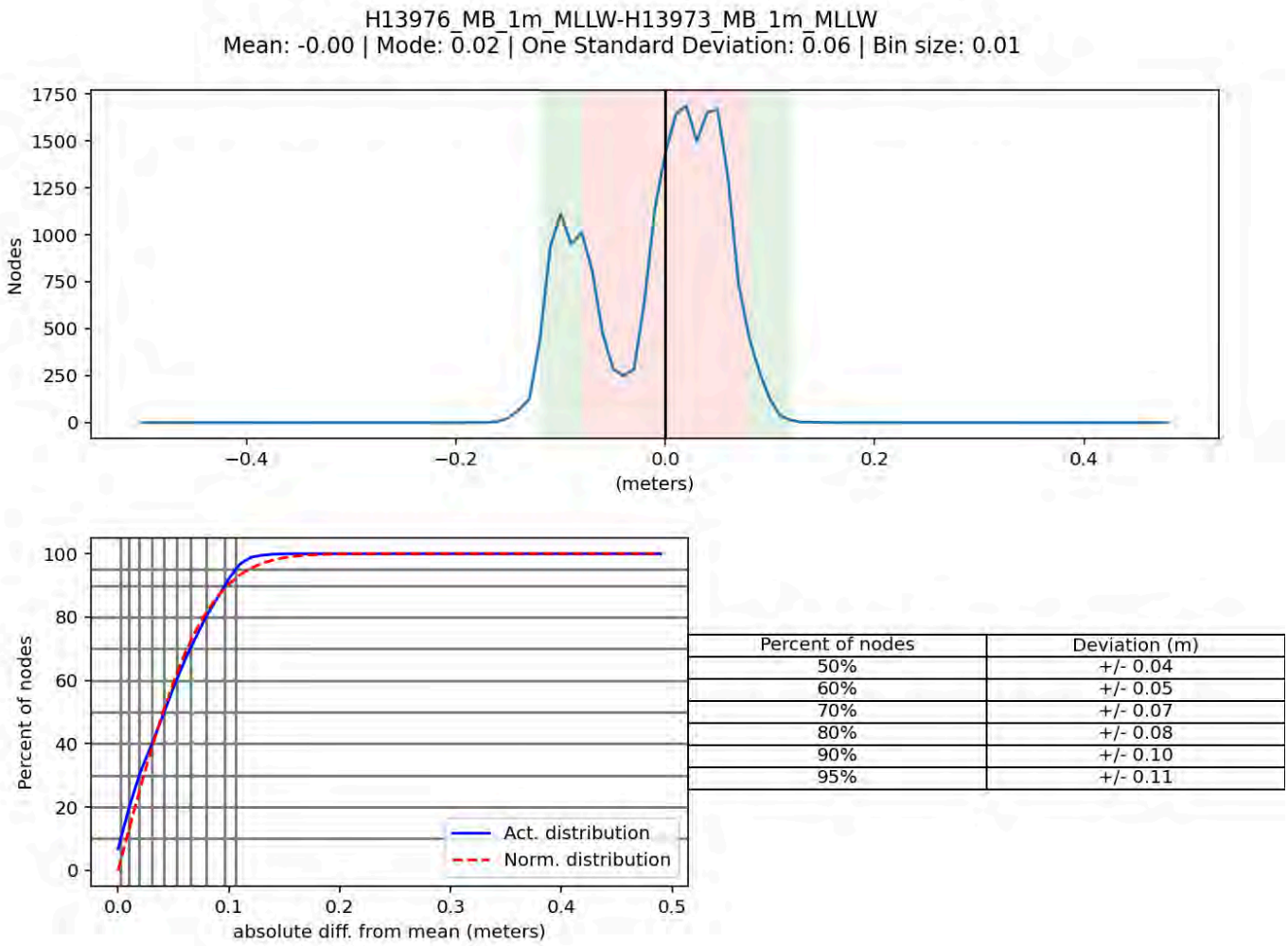



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.05 |
| 60% | +/- 0.06 |
| 70% | +/- 0.07 |
| 80% | +/- 0.09 |
| 90% | +/- 0.12 |
| 95% | +/- 0.15 |

*Figure 9: Distribution Summary Plot of Survey H13976 1-meter vs. H13971 1-meter*

H13973

The mean difference between H13976 and H13973 is 0 centimeters, shown in Figure 10.

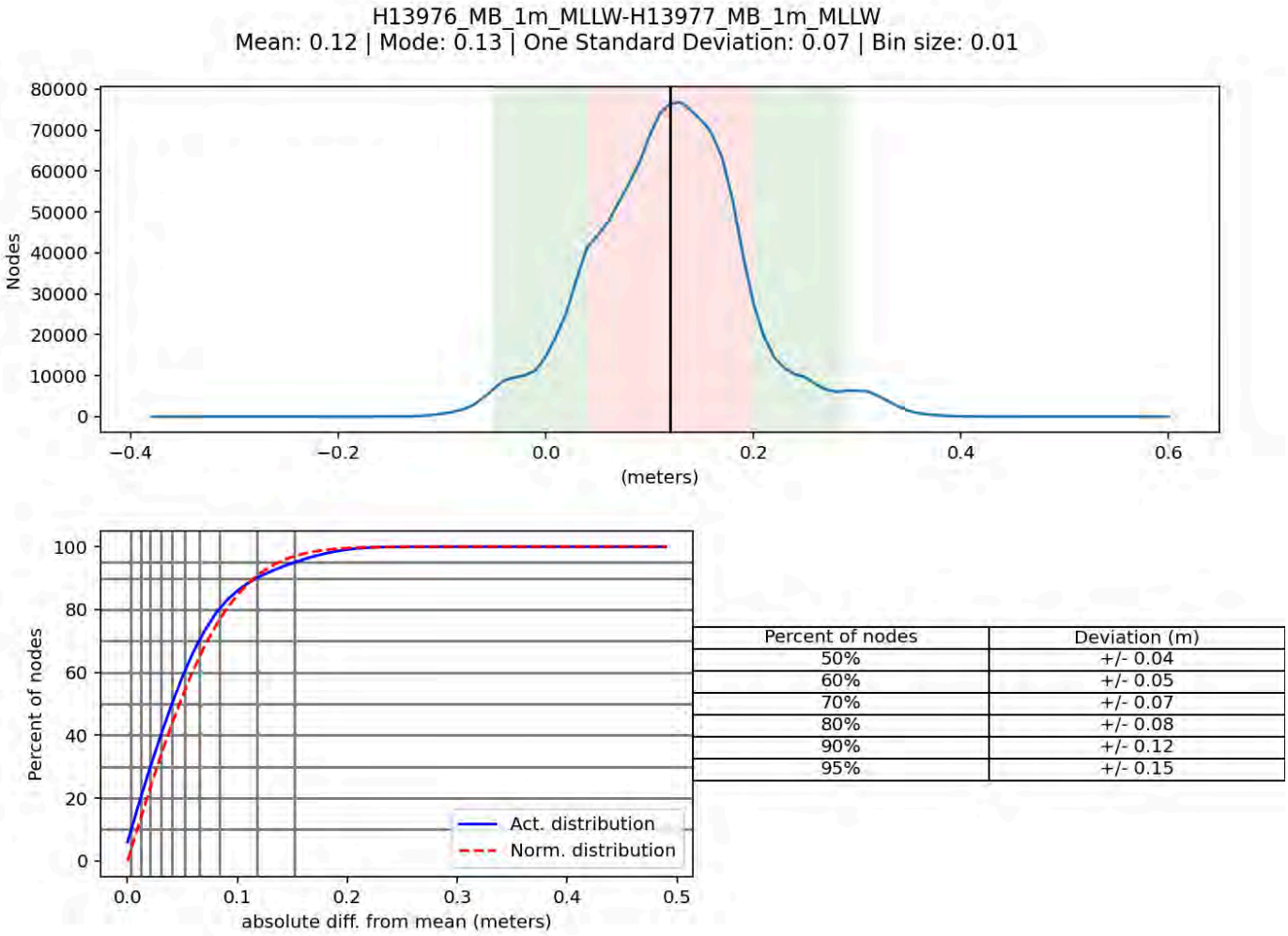



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.04 |
| 60% | +/- 0.05 |
| 70% | +/- 0.07 |
| 80% | +/- 0.08 |
| 90% | +/- 0.10 |
| 95% | +/- 0.11 |

*Figure 10: Distribution Summary Plot of Survey H13976 1-meter vs. H13973 1-meter*

H13977

The mean difference between H13976 and H13977 is 12 centimeters (H13976 shoaler than H13977), shown in Figure 11.

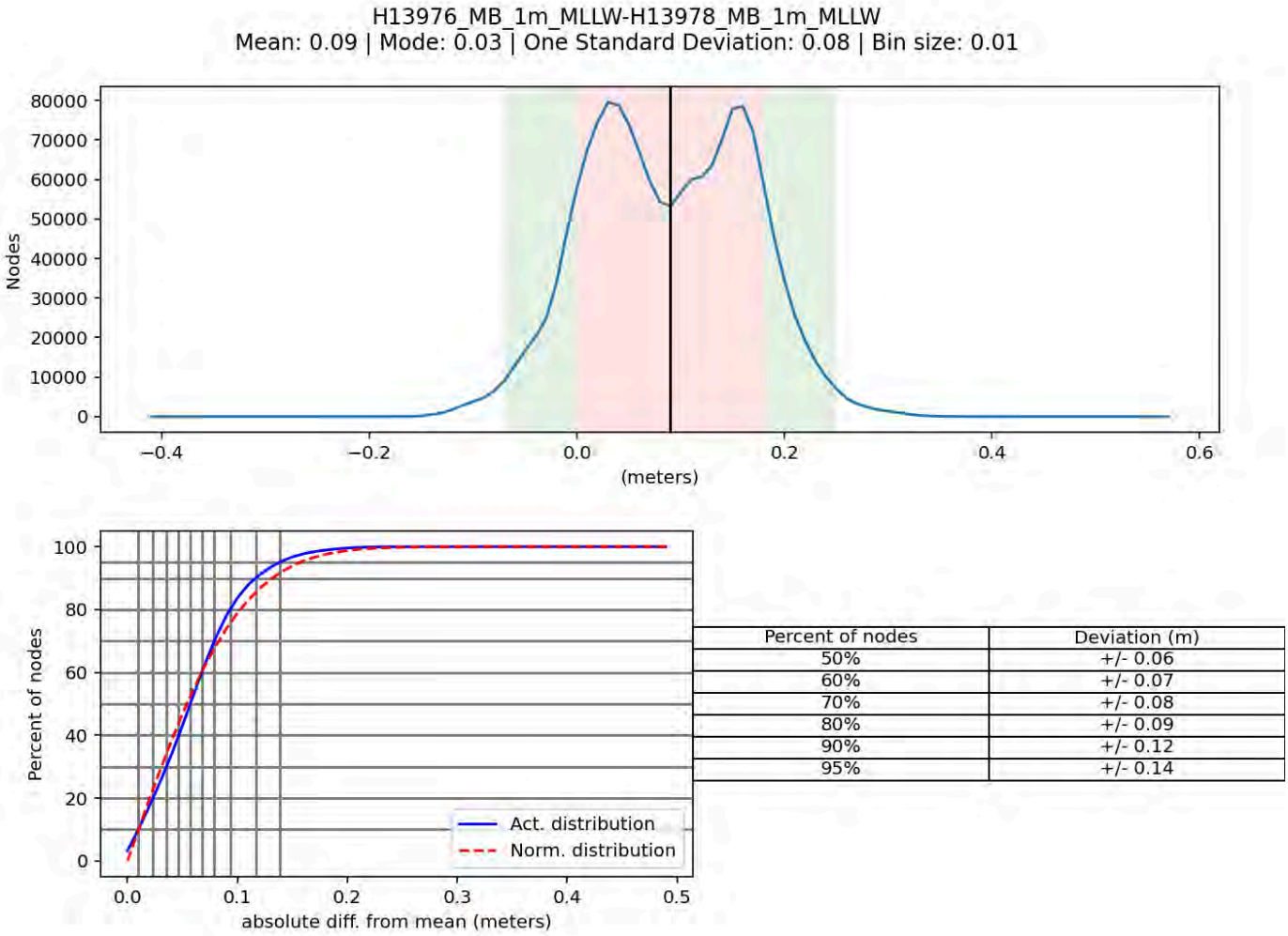



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.04 |
| 60% | +/- 0.05 |
| 70% | +/- 0.07 |
| 80% | +/- 0.08 |
| 90% | +/- 0.12 |
| 95% | +/- 0.15 |

*Figure 11: Distribution Summary Plot of Survey H13976 1-meter vs. H13977 1-meter*

H13978

The mean difference between H13976 and H13978 is 9 centimeters (H13976 shoaler than H13978), shown in Figure 12.

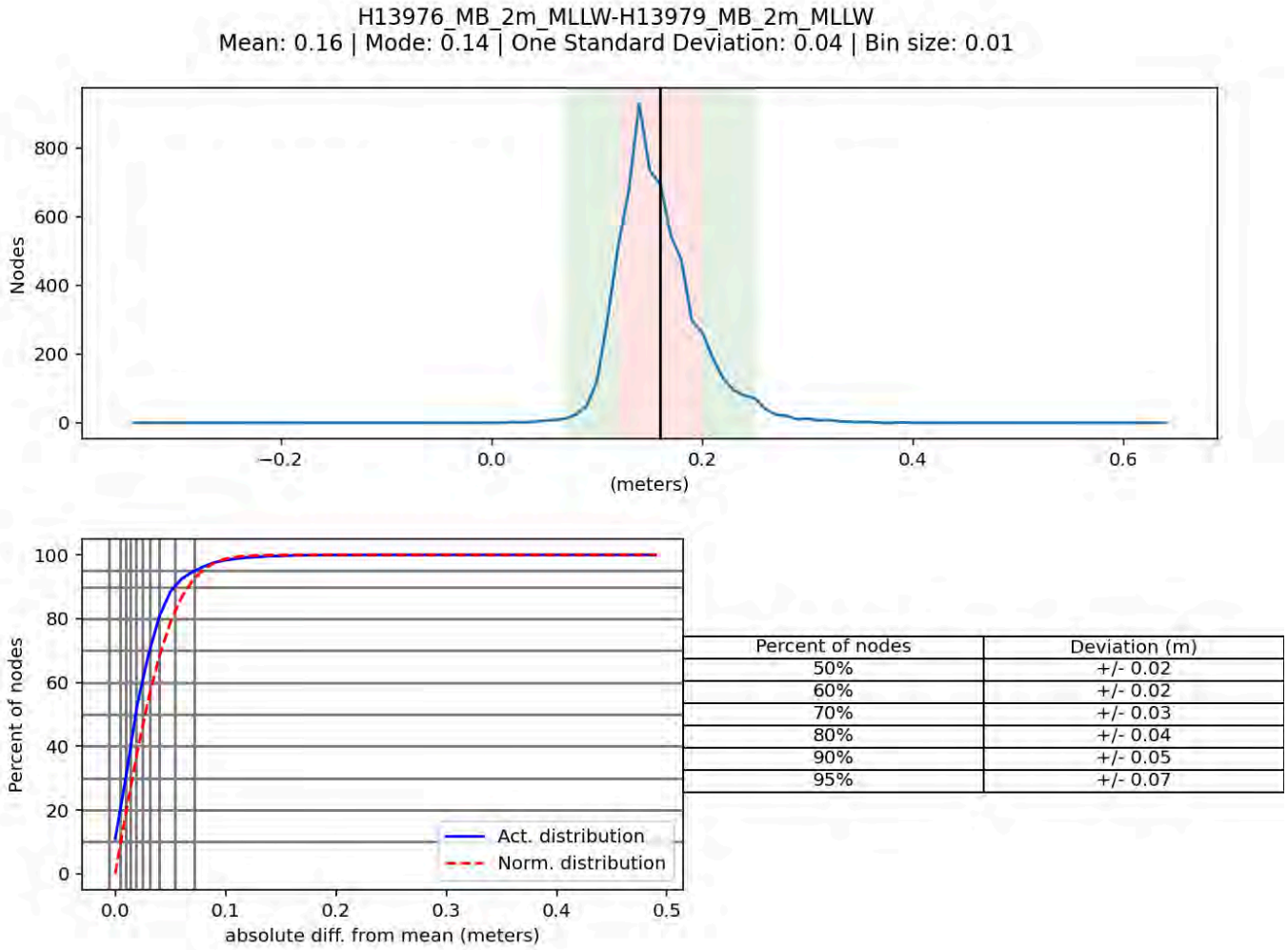



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.06 |
| 60% | +/- 0.07 |
| 70% | +/- 0.08 |
| 80% | +/- 0.09 |
| 90% | +/- 0.12 |
| 95% | +/- 0.14 |

*Figure 12: Distribution Summary Plot of Survey H13976 1-meter vs. H13978 1-meter*

H13979

The mean difference between H13976 and H13979 is 16 centimeters (H13976 shoaler than H13979), shown in Figure 13.

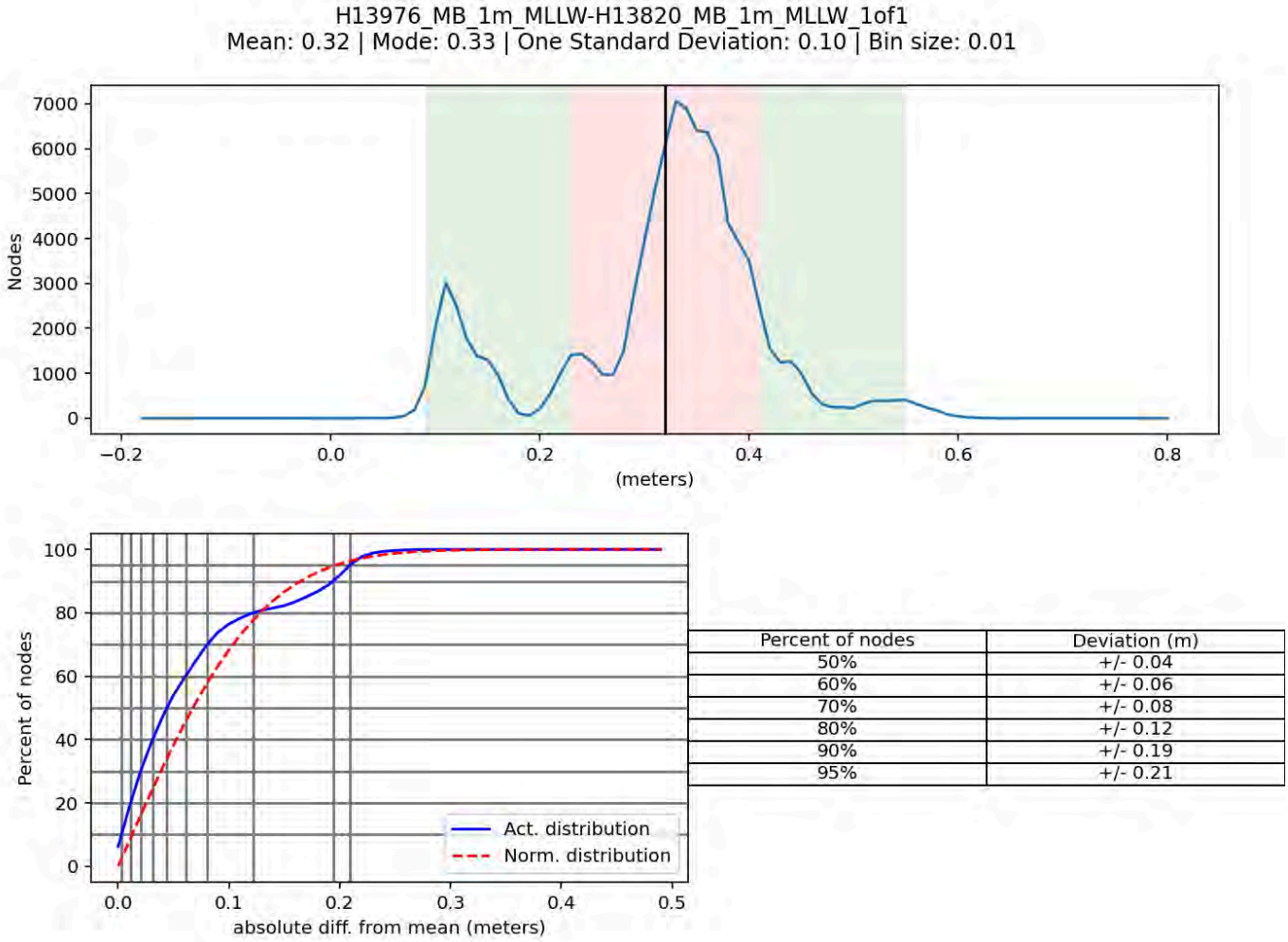



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.02 |
| 60% | +/- 0.02 |
| 70% | +/- 0.03 |
| 80% | +/- 0.04 |
| 90% | +/- 0.05 |
| 95% | +/- 0.07 |

*Figure 13: Distribution Summary Plot of Survey H13976 2-meter vs. H13979 2-meter*

H13820

The mean difference between H13976 and H13820 is 32 centimeters (H13976 shoaler than H13820), shown in Figure 14. The hydrographer investigated potential causes for the higher than expected discrepancy and found an 11-centimeter difference between the separation models used in the two surveys. Applying the ellipsoid to chart-datum separation file from H13820 to the H13976 data would reduce the mean difference to 21 centimeters.

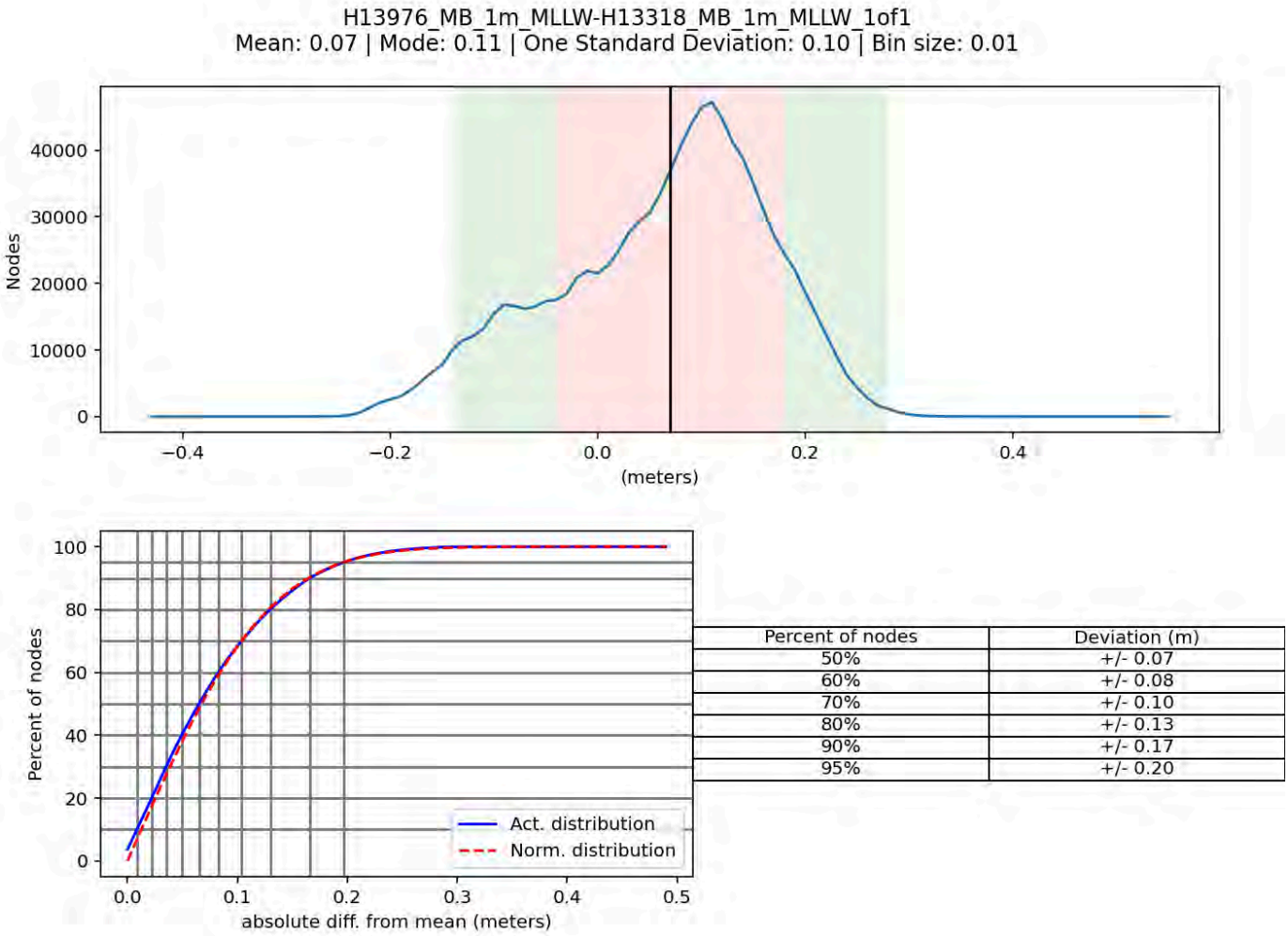



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.04 |
| 60% | +/- 0.06 |
| 70% | +/- 0.08 |
| 80% | +/- 0.12 |
| 90% | +/- 0.19 |
| 95% | +/- 0.21 |

*Figure 14: Distribution Summary Plot of Survey H13976 1-meter vs. H13820 1-meter*

H13318

The mean difference between H13976 and H13318 is 7 centimeters (H13976 shoaler than H13318), shown in Figure 15.

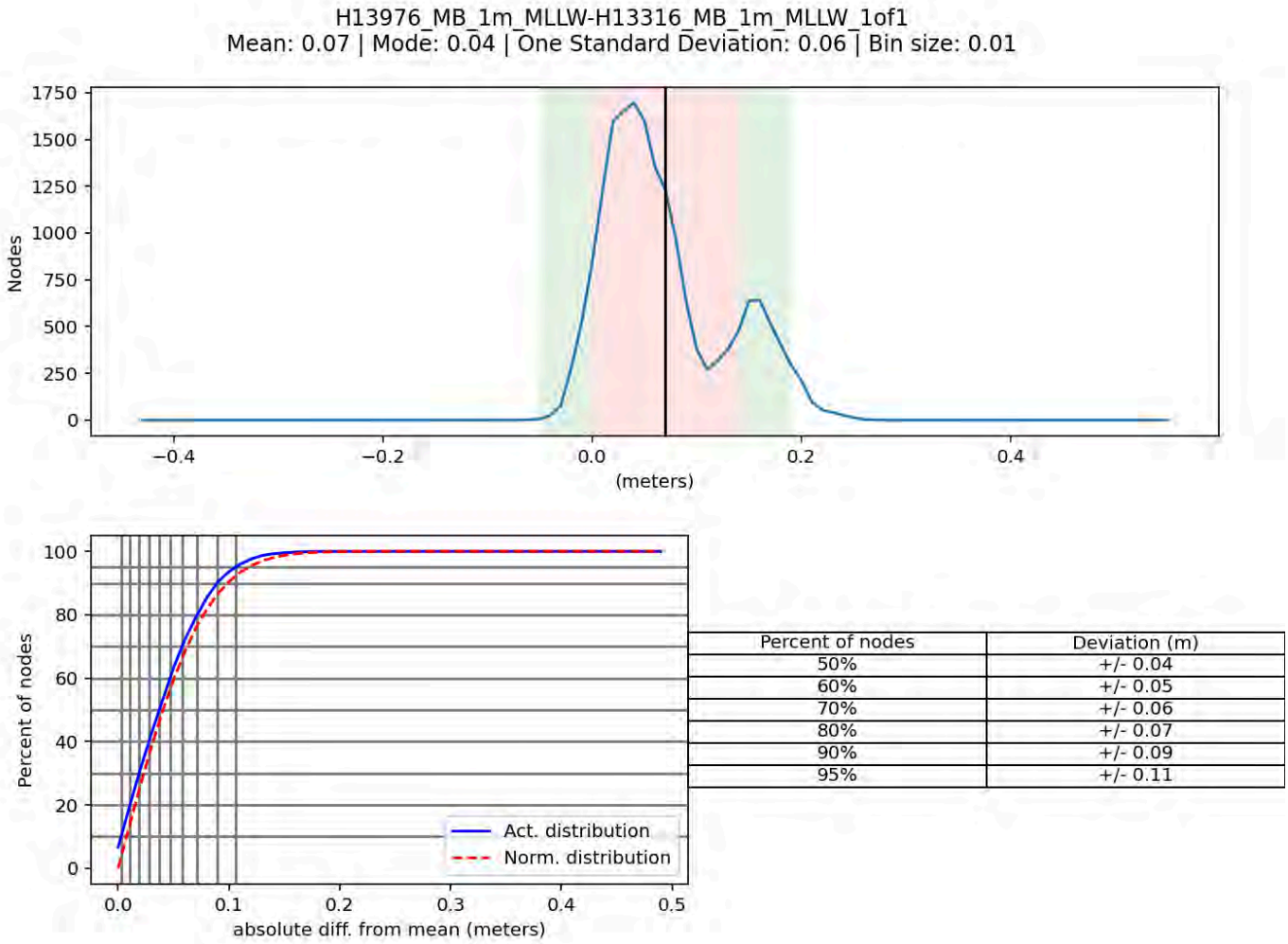



| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.07 |
| 60% | +/- 0.08 |
| 70% | +/- 0.10 |
| 80% | +/- 0.13 |
| 90% | +/- 0.17 |
| 95% | +/- 0.20 |

*Figure 15: Distribution Summary Plot of Survey H13976 1-meter vs. H13318 1-meter*

H13316

The mean difference between H13976 and H13316 is 7 centimeters (H13976 shoaler than H13316), shown in Figure 16.




| Percent of nodes | Deviation (m) |
|---|---|
| 50% | +/- 0.04 |
| 60% | +/- 0.05 |
| 70% | +/- 0.06 |
| 80% | +/- 0.07 |
| 90% | +/- 0.09 |
| 95% | +/- 0.11 |

*Figure 16: Distribution Summary Plot of Survey H13976 1-meter vs. H13316 1-meter*

### B.2.4 Sonar QC Checks

Quality control is discussed in detail in Section B of the DAPR.

Multibeam data were reviewed at multiple levels of data processing, including CARIS HIPS conversion, subset editing, and analysis of anomalies revealed in CUBE surfaces.

Sams 150 data were reviewed at multiple levels of data processing, including during the initial SonarWiz and Delph Geo imports, and preliminary stages of bottom-tracking, navigation review, and contact identification. Data were also reviewed during the final stages of mosaic generation, data coverage and quality assessment, and contact correlation and attribution.

### B.2.5 Equipment Effectiveness

Ping Anomalies

On occasion, anomalous high intensity returns were observed in the Sams 150 seafloor imagery dataset. While recognizable in the raw data and processed imagery, these anomalies were generally isolated to a single ping, and therefore did not significantly affect the ability to discern contacts and meet feature detection requirements.

Starboard Channel Artifacts

Significant artifacts were detected in the starboard channel of the Sams 150 seafloor imagery collected on December 12, 16, and 17, 2024 (DN347, DN351, and DN352). The artifacts appeared to result from a sonar system malfunction. Affected seafloor areas were re-surveyed to acquire data that met feature detection requirements. In the final mosaics, the artifacts are not visible, as either the port channel data was used exclusively for those tracklines, or the trackline draw order was adjusted to prioritize the rerun data over the artifact-affected imagery.

Port and Starboard Signal Imbalance

The seafloor imagery data acquired with the Sams 150 displayed a signal amplitude imbalance between the port and starboard channels. The signal response from the port channel was of greater amplitude than that of the starboard channel. This was corrected in processing during the creation of the calibrated gain curve in Delph Geo software by mirroring the port-side gain calibration to the starboard channel, resulting in a more even-toned mosaic across both channels of the inertial side scan imagery. No correction was necessary for the single-ping XTF dataset processed in SonarWiz software when applying Emprical Gain Normalization (EGN).

Delph Geo Mosaic Processing Errors

During the generation of inertial side scan sonar mosaics in Delph Geo, processing errors were encountered when building mosaics for the following tracklines:

100m_FM_3500uS_80pc_20241116_080139_*
75m_FM_2500uS_80pc_20241128_141841_*
100m_FM_3500uS_80pc_20241215_230803_*

At times these errors prevented the completion of a full mosaic for the trackline. In most cases, any resulting coverage gaps were small and generally limited to the ends of the lines beyond the sheet limits, however, the missing portion of the mosaic for line 100m_FM_3500uS_80pc_20241215_230803_* resulted in a significant gap in coverage. These issues were only observed in the 10-centimeter inertial side scan mosaic

products from Delph Geo. No errors were encountered during the creation of the 1-meter single-ping side scan mosaics in SonarWiz, and these mosaics are complete without coverage gaps.

### B.2.6 Factors Affecting Soundings

Vertical MBES Offset

During processing, an occasional vertical offset was observed in the MBES data on the order of 10 to 20-centimeters. The duration of these offsets lasted sometimes for most of a survey line and occasionally over multiple survey lines. This offset was attributed to a degraded GNSS-INS solution during acquisition. Although the vertical uncertainty increased during this period, it remained within acceptable specifications, as indicated by the bimodal distribution observed in some of the Junction graphics (Figures 8, 10, and 12).

### B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Approximately four-hour intervals

For H13976 survey operations, casts were distributed both temporally and spatially based on observed changes in sound speed profiles. Sound speed readings were applied in CARIS HIPS using the "nearest in distance within time" with a four-hour interval.

### B.2.8 Coverage Equipment and Methods

Survey speeds were maintained to meet or exceed along-track sounding density requirements and side scan sonar ensonification requirements.

Multibeam data and side scan mosaics were thoroughly reviewed for holidays and areas of poor-quality coverage due to biomass, vessel wakes, or other factors. Feature investigations were performed with multibeam sonar to obtain a least depth, meeting the survey’s coverage requirements. Survey coverage for feature disprovals was acquired inside disproval radii to meet the coverage requirement for the area. Additional discussion of coverage methods can be found in the DAPR.

### B.2.9 Density

The sounding density requirement of 95% of all nodes, populated with at least five soundings per node, was verified by analyzing the density layer of the finalized surfaces. Surface results are stated in Figures 17 and 18.

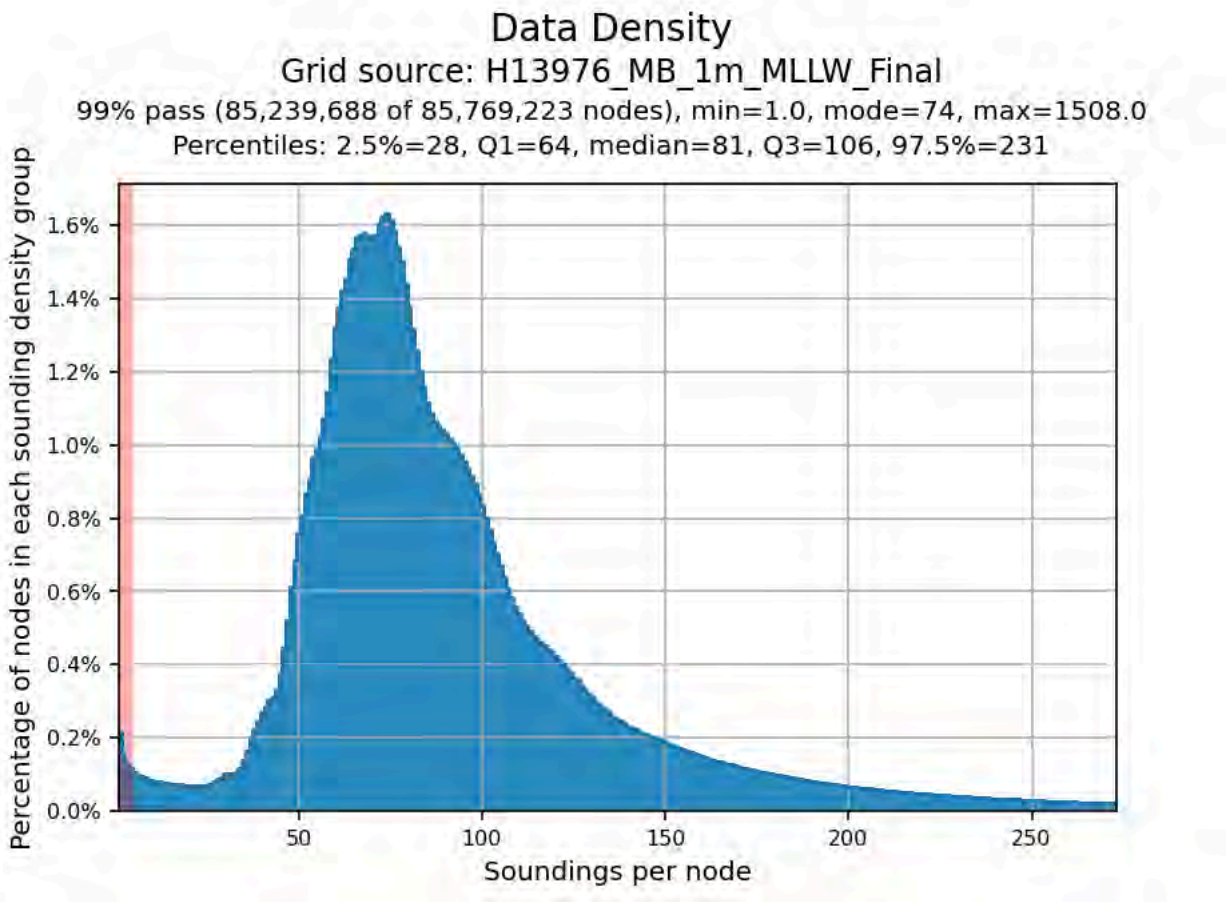



*Figure 17: Node Density Statistics - 1 meter, Finalized*

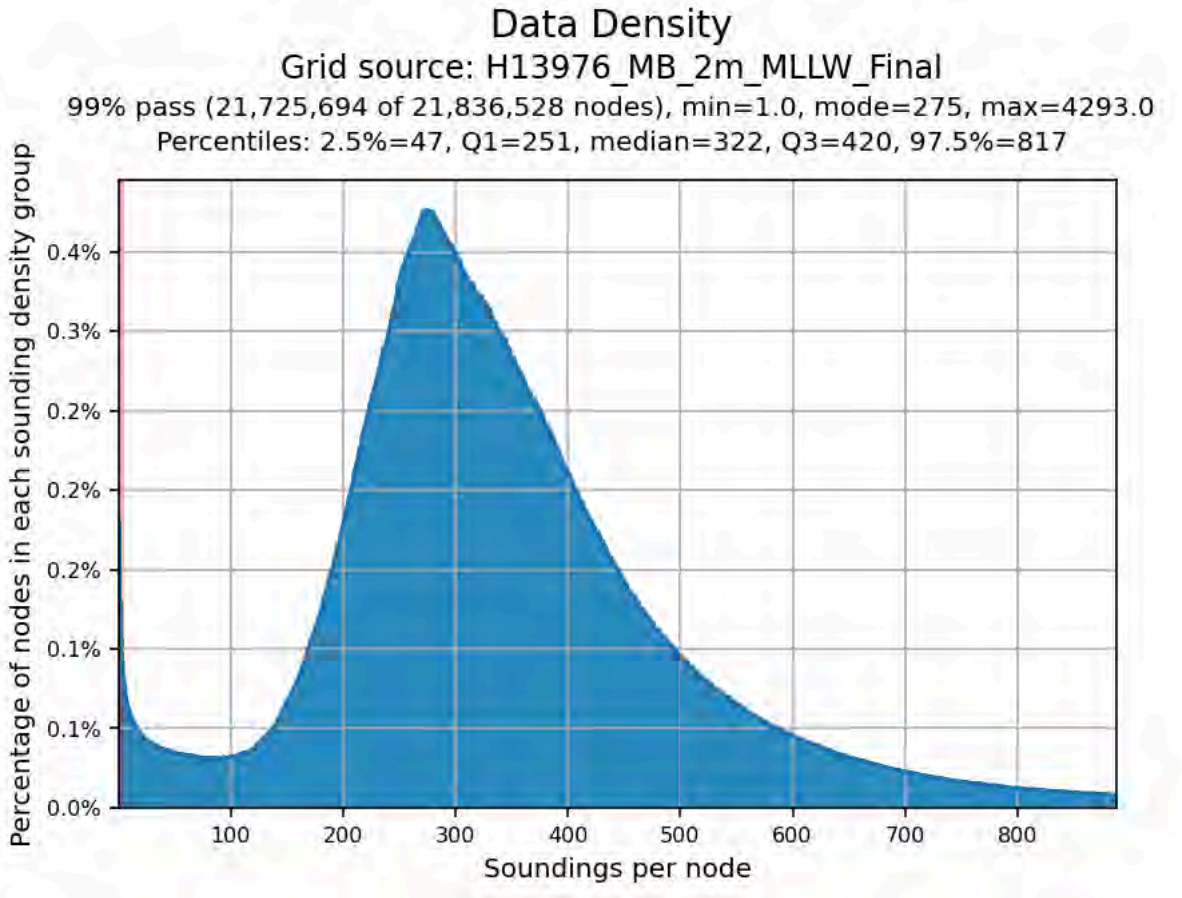



*Figure 18: Node Density Statistics - 2 meter, Finalized*

## B.3 Echo Sounding Corrections

### B.3.1 Corrections to Echo Soundings

Data reduction procedures for survey H13976 are detailed in the DAPR.

### B.3.2 Calibrations

All sounding systems were calibrated as detailed in the DAPR.

## B.4 Backscatter

Multibeam time series backscatter data were logged in Kongsberg KMALL format and are included with the H13976 raw digital deliverables. Backscatter data were referenced to processed multibeam bathymetric data and processed in QPS FMGT. A 2-meter backscatter mosaic is included with the H13976 processed deliverables. A GSF export containing the final bathymetry and backscatter with edits retains the original file names of the raw data files but with the postfix "_merged."

## 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 |
|---|---|---|
| CARIS | HIPS/SIPS | 11.4.29 |

*Table 10: Primary bathymetric data processing software*

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

| Manufacturer | Name | Version |
|---|---|---|
| Chesapeake Technology | SonarWiz | 8.00.01 (64-bit) |
| Exail | Delph Geo | 5.0.506 |
| QPS | FMGT | 7.11.1 |

*Table 11: Primary imagery data processing software*

The following Feature Object Catalog was used: NOAA Profile Version 2024.

A detailed listing of all data processing software is included in the OPR-K356-KR-24 DAPR.

The 90-degree, single-ping XTF data collected with the Sams 150 were processed in Chesapeake SonarWiz software to obtain the primary side scan coverage mosaics for this project. The full SAS XTF data collected with the Sams 150 were processed in Delph Geo software using “inertial side scan sonar” mode to produce high-resolution inertially-corrected seafloor imagery mosaics to aid contact identification in SonarWiz. Further information is available 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 |
|---|---|---|---|---|---|
| H13976_MB_1m_MLLW.csar | CARIS Raster Surface (CUBE) | 1 meters | 16.357 meters - 21.909 meters | NOAA_1m | Complete MBES |
| H13976_MB_1m_MLLW_Final.csar | Finalized CARIS Raster Surface (CUBE) | 1 meters | 13.427 meters - 20.0 meters | NOAA_1m | Complete MBES |
| H13976_MB_2m_MLLW.csar | CARIS Raster Surface (CUBE) | 2 meters | 16.365 meters - 21.868 meters | NOAA_2m | Complete MBES |
| H13976_MB_2m_MLLW_Final.csar | Finalized CARIS Raster Surface (CUBE) | 2 meters | 18.0 meters - 21.868 meters | NOAA_2m | Complete MBES |
| H13976_MBAB_2m_DX_400kHz_1of1.tiff | MB Backscatter Mosaic | 2 meters | - | N/A | Complete MBES |
| H13976_SSSAB_1m_540kHz_1of1.tif | SSS Mosaic | 1 meters | - | N/A | 100% SSS |
| H13976_100P_Inertial_SSS_10cm_Merged.tif | Inertial SSS Mosaic | 10 centimeters | - | N/A | 100% SSS |

*Table 12: Submitted Surfaces*

Bathymetric grids were created relative to Mean Lower Low Water (MLLW) in CUBE format using Complete Coverage resolution requirements as specified in the HSSD. Grid resolution for the backscatter mosaic was determined by the HSSD frequency-dependent resolution requirement.

In the 2-meter MBES surface, the hydrographer notes that QC Tools 3 Holiday Finder flags several false single-pixel holidays. These holidays do not follow the definition outlined in section 5.2.2.3 of the HSSD and, after consultation with the QC Tools support team, it was determined that these holidays are flagged as part of a conservative measure built into the Holiday Finder formula. Since these same data gaps are not flagged on the 1-meter MBES surface, the hydrographer concluded that these are not holidays.

Seafloor imagery was produced using two processing pipelines. Due to the different processing routines of each software, different data inputs, resolutions, and attention to elective processing options such as draw order, gain settings, and vessel-turn clipping, seafloor imagery mosaics produced in Delph Geo may

appear slightly different. These differences may be seen in terms of coverage or quality when compared to their counterparts using conventional single-ping imagery in SonarWiz, and do not meet the standard requirements specified in the HSSD for naming convention, floating point format, or noData value. The 10-centimeter seafloor imagery mosaics provided in this table were created by merging the Delph Geo mosaic tiles into a single TIF image using QGIS software, and may be viewed in their native format only within Delph Geo software.

# C. Vertical and Horizontal Control

A summary of the horizontal and vertical control for survey H13976 follows.

## C.1 Vertical Control

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

ERS Datum Transformation

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

| Method | Ellipsoid to Chart Datum Separation File |
|---|---|
| ERS via VDATUM | OPR-K356-KR-24_NAD83(2011)-MLLW.csar |

*Table 13: ERS method and SEP file*

## C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983 (2011).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 15.

PPP

Different PPP corrections were used during this survey. Fugro Marinestar corrections were used for real-time navigation during acquisition and then later replaced during processing in HIPS with an inertially coupled PPP post processed solution using Novatel Terrastar (NRT) corrections. Real-time navigation for all MBES and single-ping SSS survey lines were overwritten with post-processed navigation solutions in SBET format. Further discussion on post-processing methods and survey control is included in the DAPR.

# D. Results and Recommendations

## D.1 Chart Comparison

The chart comparison was performed by comparing H13976 survey depths to a digital surface generated from the Band 4 electronic navigational charts (ENCs) covering the survey area. A 120-meter product surface was generated from a triangular irregular network (TIN) created from the ENC's soundings, depth contours, and depth features. An additional 120-meter HIPS product surface was generated from the survey's 1-meter CUBE surface. The chart comparison was conducted by creating and reviewing a difference surface using the ENC surfaces and survey surface as inputs. The chart comparison also included a review of all assigned charted features within the survey area. The results of the comparison are detailed below.

The charts used during the comparison were reviewed to check that all United States Coast Guard (USCG) Local Notice to Mariners issued during survey acquisition, and impacting the survey area, were applied and addressed by this survey.

The ENCs used in the chart comparison are listed in Table 14. Figure 19 shows the magnitude of differences along the comparison area.

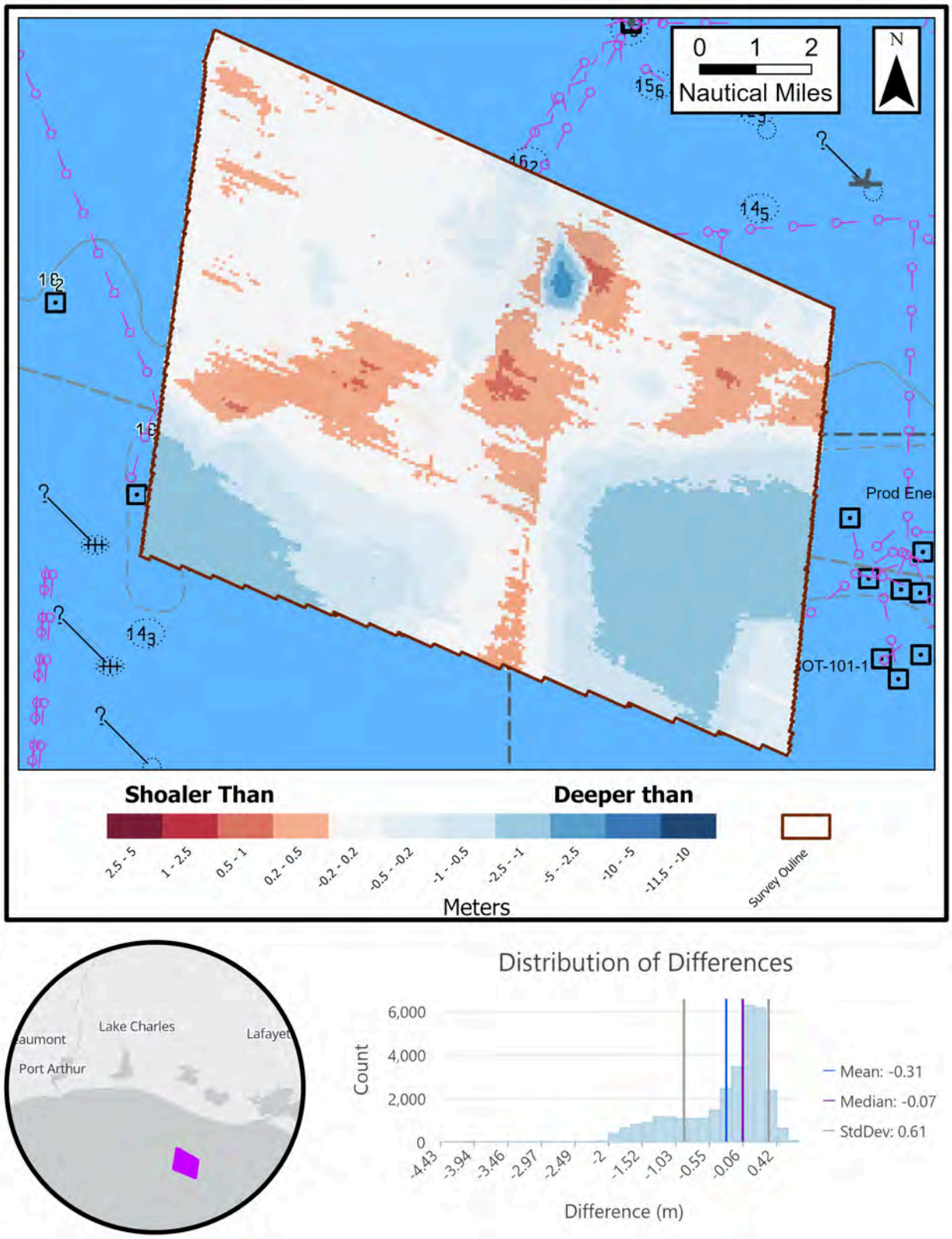



*Figure 19: Depth Difference between H13976 and Band 4 ENCs*

### 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 |
|---|---|---|---|---|
| US4LA1ED | 1:90000 | 1 | 09/03/2024 | 03/26/2025 |
| US4LA1EE | 1:90000 | 1 | 09/03/2024 | 12/17/2024 |

*Table 14: Largest Scale ENCs*

### D.1.2 Shoal and Hazardous Features

One Danger to Navigation (DtoN) report was submitted for this survey.

-H13976 DtoN 01, submitted January 15, 2025, reported one uncharted obstruction within the survey area.

The hydrographer recommends updating the charts to depict the DtoN as portrayed in the Final Feature File (FFF).

### D.1.3 Charted Features

All assigned features included in the project Composite Source File (CSF) have been addressed by the survey and are included in the FFF.

All disproved features have been included in the FFF with a description of "Delete." All new features have been included in the FFF with the surveyed feature depicted and a description of "New."

Contact heights included in the side scan contact .000 file have been sourced from the shadow height measurement obtained from SonarWiz. Due to the limitations in computing accurate heights from side scan shadow lengths, contact heights may not match heights from correlating contacts or feature heights measured from multibeam data included in the FFF. In cases where the shadow height measurement could not be adequately determined, either due to the broad nature of the feature, its proximity to nadir, or simply, the lack of a measurable shadow in the Sams 150 imagery, the contact height is listed as "unknown" and the height of the feature as measured in multibeam from the surrounding natural bottom is provided in the remarks.

### D.1.4 Uncharted Features

All uncharted features are portrayed in the FFF as surveyed and attributed with the description of "New." Refer to the FFF for additional information.

### D.1.5 Channels

No channels exist within the survey limits.

## D.2 Additional Results

### D.2.1 Aids to Navigation

One charted lighted buoy was not observed during survey operations. The AtoN was reported to USCG on January 13, 2025 as missing and is included in the FFF with a recommendation to remove from the charts.

### D.2.2 Maritime Boundary Points

No Maritime Boundary Points were assigned for this survey.

### D.2.3 Bottom Samples

Three bottom samples were acquired on January 25, 2025. The bottom sampling plan was developed to include different bottom types based on imagery observed in the side scan sonar and backscatter mosaics.

### D.2.4 Overhead Features

No overhead features exist for this survey.

### D.2.5 Submarine Features

Assigned submerged pipelines that are within the survey area are included in the FFF. Four sections of exposed pipeline were reported to the Bureau of Safety and Environmental Enforcement (BSEE) on March 17, 2025. Correspondence related to this reporting is included in Appendix II.

### D.2.6 Platforms

Surveyed and disproved platforms are addressed in the FFF.

### 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 construction or dredging activities were observed during survey operations.

### 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 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.

| Report Name | Report Date Sent |
|---|---|
| Data Acquisition and Processing Report Revision | 2025-04-21 |
| Coast Pilot Report | 2025-02-25 |
| Survey Outline | 2024-11-08 |
| Marine Mammal Observers | 2025-02-13 |
| NCEI Sound Speed Data | 2025-02-13 |

| Approver Name | Approver Title | Approval Date | Signature |
|---|---|---|---|
| Jonathan L. Dasler, PE, PLS, CH | NSPS-THSOA Certified Hydrographer, Chief of Party | 04/21/2025 | Digitally signed by Jonathan L. Dasler, PE, PLS, CH Date: 2025.04.21 10:22:16 -07'00' |
| Jason Creech, CH | NSPS-THSOA Certified Hydrographer, Charting Manager / Project Manager | 04/21/2025 | Digitally signed by Jason Creech, CH Date: 2025.04.21 10:22:37 -07'00' |
| James Guilford, CH(A) | NSPS-THSOA Certified Hydrographer, Lead Hydrographer | 04/21/2025 | Digitally signed by James Guilford Date: 2025.04.21 10:23:04 -07'00' |
| Jason Dorfman, CH | NSPS-THSOA Certified Hydrographer, Lead Hydrographer | 04/21/2025 | Digitally signed by Jason Dorfman Date: 2025.04.21 10:23:27 -07'00' |
| Sam Werner | Data Processing Manager | 04/21/2025 | Digitally signed by Sam Werner Date: 2025.04.21 10:23:53 -07'00' |

# 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 |