H13580

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

DESCRIPTIVE REPORT

Type of Survey:	Navigable Area
Registry Number:	H13580

LOCALITY

State(s):	Northern Mariana Islands
General Locality:	Western Pacific Ocean
Sub-locality:	Farallon de Pajaros Island

2022

CHIEF OF PARTY
Héctor L. Casanova, CAPT/NOAA

LIBRARY & ARCHIVES

Date:

U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	REGISTRY NUMBER:
HYDROGRAPHIC TITLE SHEET	**H13580**

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):	**Northern Mariana Islands**
General Locality:	**Western Pacific Ocean**
Sub-Locality:	**Farallon de Pajaros Island**
Scale:	**10000**
Dates of Survey:	**06/23/2022 to 06/24/2022**
Instructions Dated:	**01/07/2022**
Project Number:	**OPR-T381-RA-22**
Field Unit:	**NOAA Ship *Rainier***
Chief of Party:	**Héctor L. Casanova, CAPT/NOAA**
Soundings by:	**Multibeam Echo Sounder**
Imagery by:	**Multibeam Echo Sounder Backscatter**
Verification by:	**Pacific Hydrographic Branch**
Soundings Acquired in:	**meters at Mean Lower Low Water**

Remarks:

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(MA11) UTM 55N. All references to other horizontal or vertical datums in this report are applicable to the processed hydrographic data provided by the field unit.

Table of Contents

List of Tables

List of Figures

Descriptive Report to Accompany Survey H13580

Project: OPR-T381-RA-22

Locality: Western Pacific Ocean

Sublocality: Farallon de Pajaros Island

Scale: 1:10000

June 2022 - June 2022

NOAA Ship *Rainier*

Chief of Party: Héctor L. Casanova, CAPT/NOAA

A. Area Surveyed

The survey area is referred to as H13580, "Farallon de Pajaros Island" (Sheet 10) in the Project Instructions. The assigned survey area encompassed an estimated 270 square nautical miles and is located at the northern most end of the Mariana Island chain.

A.1 Survey Limits

Data were acquired within the following survey limits:

Northwest Limit	Southeast Limit
20° 41' 35.99" N 145° 44' 3.06" E	20° 21' 41.27" N 145° 25' 11.43" E

Table 1: Survey Limits

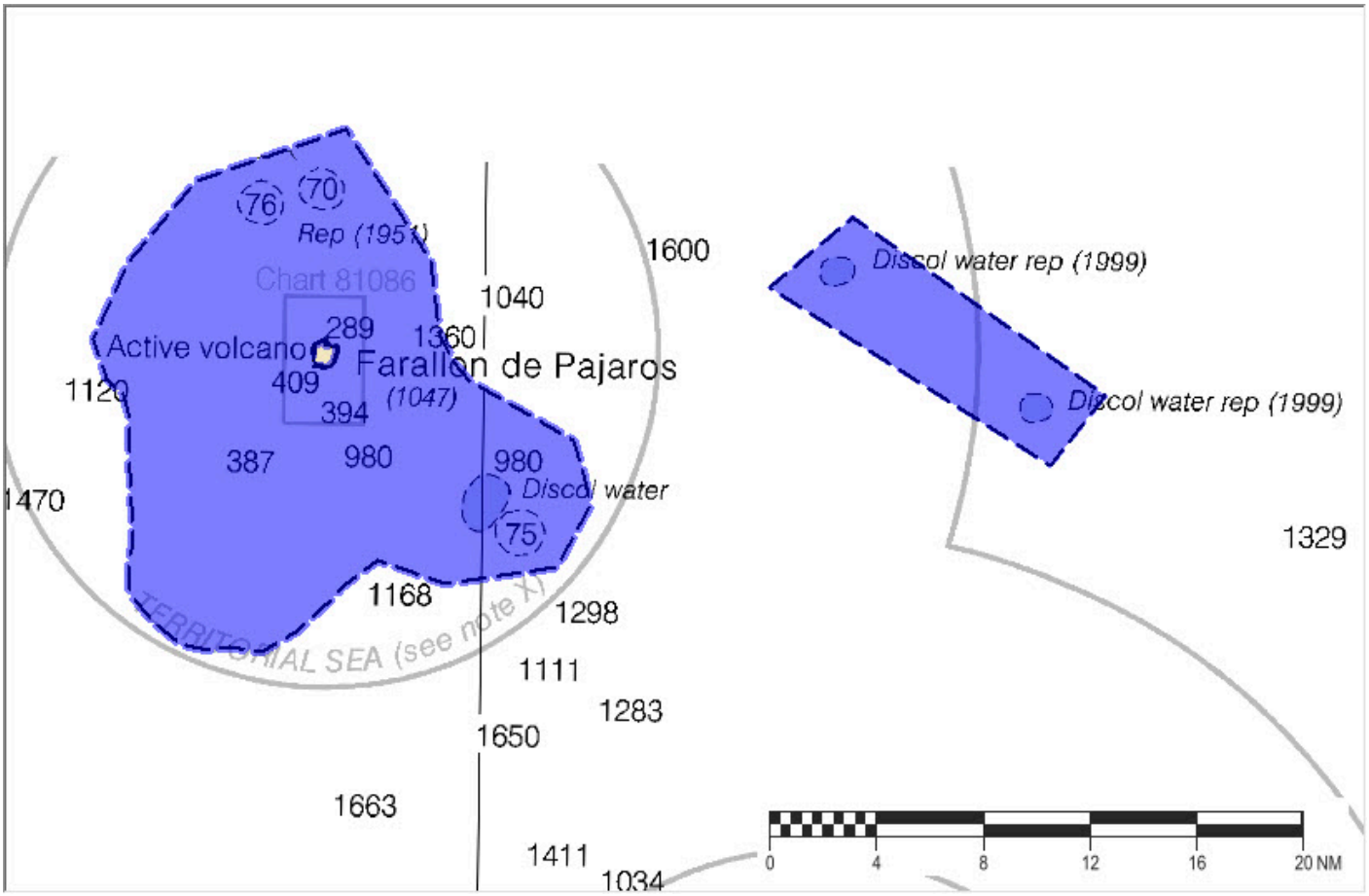


Figure 1: Assigned H13580 survey area.

The originally assigned survey limits extended into areas with depths greater than RAINIER could efficiently acquire quality multibeam data. Therefore we requested, and the Operations Branch approved, that we survey to the 1,500 meter depth contour and not beyond. See supplemental correspondence for more information. The figure below displays the multibeam data acquired on Farallon de Pajaros Island with a color scale that distinguishes the 1500 meter contour in the color pink.

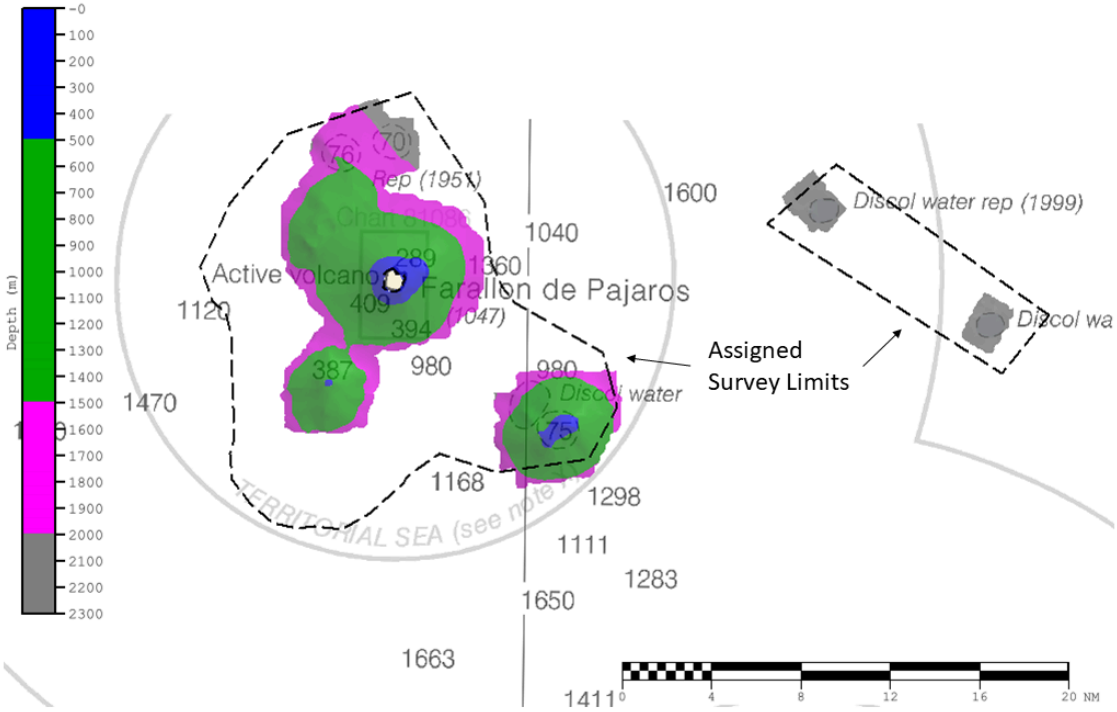


Figure 2: Acquired H13580 survey coverage. The pink colored surface indicates 1500 meter depths or greater. (Chart 81004)

A.2 Survey Purpose

The ecosystem surrounding the Commonwealth of the Northern Mariana Islands (CNMI) is experiencing stress imposed by climate change and other environmental factors. This survey is part of extensive hydrographic project intended to map the bathymetry and habitat around the CNMI in support of nautical charting and habitat mapping.

With the collaboration and partnership of the National Centers for Coastal and Ocean Science (NCCOS), the NOAA Coral Reef Conservation Program (CRCP), and the National Marine Fisheries Service (NMFS), this survey will also study the health of coral reef systems, ocean chemistry, and fisheries habitat. This team has developed a strategy to map the waters from nearshore to depths greater than 1000 meters. Within these waters, the ship's crew and visiting scientists will map bathymetry and backscatter and characterize habitat, while concurrently performing coral reef assessment dives and collecting other oceanographic observations.

Data collected during this mission are pivotal to long-term biological and oceanographic monitoring of coral reef ecosystems around the CNMI. Data from this survey will add to information collected during prior monitoring and mapping projects. Oceanographic and ecological time series data will allow scientists to evaluate potential changes in environmental conditions and coral reef health in the Mariana Archipelago. This will enable federal and state resource managers to more effectively conserve the coral reef ecosystems

of the CNMI, and to manage ecosystems services. Data collected during this survey also support monitoring components of the CRCP Coral Reef Ecosystem Integrated Observing System.

A.3 Survey Quality

The entire survey is adequate to supersede previous data.

Pydro QC Tools 2 Grid QA was used to analyze H13580 multibeam echosounder (MBES) data density. The submitted H13580 Variable Resolution (VR) surface met HSSD density requirements in only 93% of grid nodes as shown in the histogram plot below and not the HSSD required 95% or higher. This outcome was a result of the 32 meter resolution grid being used for depths exceeding 640 meters. The result was also due to the large area of deeper waters exceeding 1500 meters in depth and steep slopes surveyed in this sheet.

Pydro QC Tools 2 Grid QA was also used to analyze H13580 MBES Resolution Requirements. As seen in the figure below, sheet H13580 shows a 97% pass for resolution requirements, meeting the HSSD requirement. Compared to other sheets in project OPR-T381-RA-22, the resolution requirements for sheet H13580 were higher due to the use of the 32 meter resolution grid for depths exceeding 640 meters in the finalized surface, matching HSRR specifications.

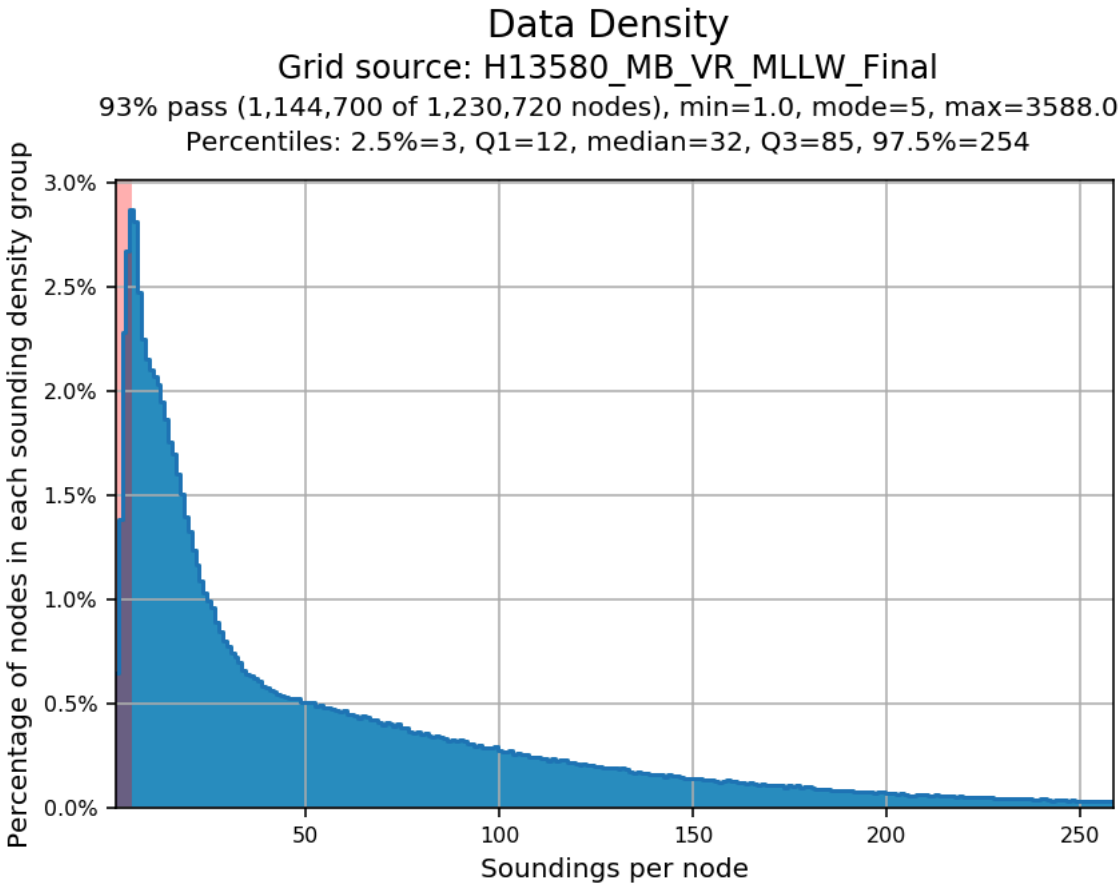


Figure 3: Pydro derived histogram plot showing 93% of nodes meeting HSSD density compliance in H13580 finalized variable-resolution MBES data.

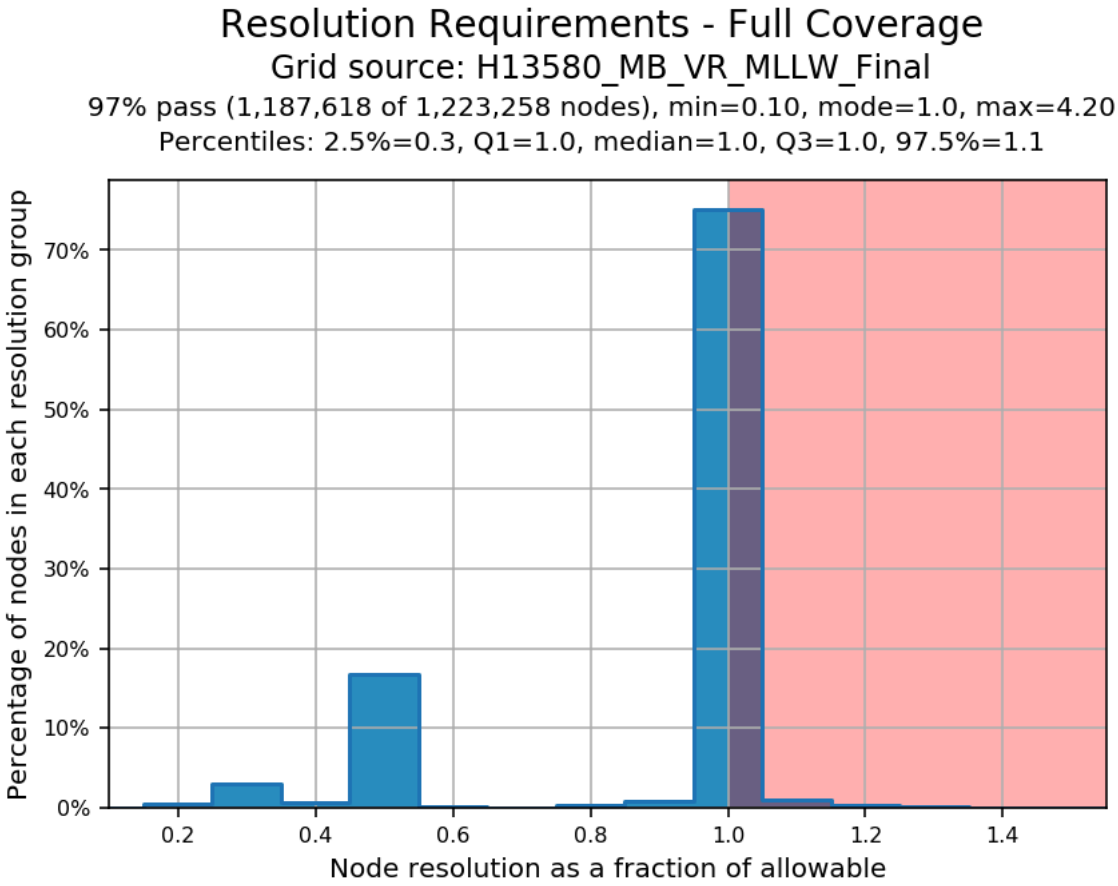


Figure 4: Pydro derived plot showing Grid QA results of H13580 full coverage resolution requirements.

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	Complete Coverage (Refer to HSSD Section 5.2.2.3)

Table 2: Survey Coverage

The entire extent of the assigned sheet limits was not surveyed for H13580. Multibeam Echosounder (MBES) coverage was acquired to the inshore limit of hydrography, the Navigable Area Limit Line (NALL), within a majority of the assigned sheet limits. The NALL is defined as the most seaward of the following: the line defined by the distance seaward from the observed MHW line which is equivalent to the 0.8 millimeters at chart scale (the assigned sheet limits closely reflect this) or the inshore limit of safe navigation. For H13580, per the Project Instructions, the inshore limit of safe navigation was defined as 10 meters water depth or the inshore limit of the PRF polygon. Additionally, per correspondence with the Project Manager, it was determined that NOAA ship RAINIER would only acquire data to 1500 meters. See

supplemental correspondence and the Project Instructions provided with this report for more information. The below figure illustrates the areas in which MBES data were collected.

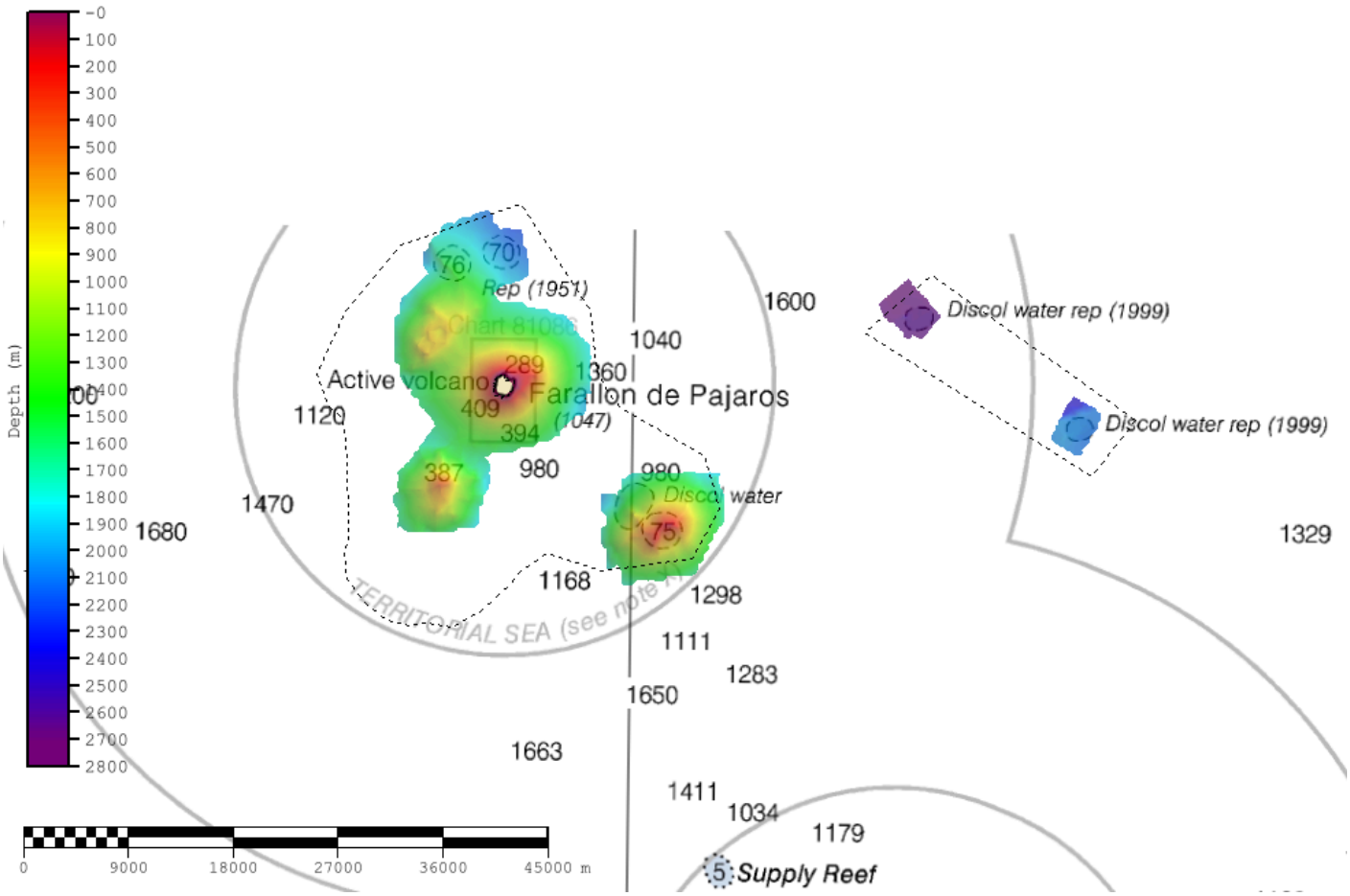


Figure 5: H13580 MBES coverage and assigned survey limits for Farallon de Pajeros Island. (Chart 81004)

A.6 Survey Statistics

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

	HULL ID	*S221*	*2803*	*Total*
LNM	SBES Mainscheme	0.0	0.0	0.0
	MBES Mainscheme	139.75	25.93	165.68
	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	28.93	1.69	30.62
	Lidar Crosslines	0.0	0.0	0.0
Number of Bottom Samples				0
Number Maritime Boundary Points Investigated				0
Number of DPs				1
Number of Items Investigated by Dive Ops				0
Total SNM				123.61

Table 3: Hydrographic Survey Statistics

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

Survey Dates	Day of the Year
06/23/2022	174
06/24/2022	175

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	***S221***	***2803***
LOA	70.4 meters	8.8 meters
Draft	4.7 meters	1.1 meters

Table 5: Vessels Used

Figure 6: NOAA Ship RAINIER with one survey launch, dive boat, and fast rescue boat in view from left to right.

All data for H13580 were acquired by NOAA Ship RAINIER and survey launch 2803. Survey launch 2803 verified shoreline features. The vessels acquired depth soundings, backscatter imagery, and sound speed profiles.

B.1.2 Equipment

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

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

Table 6: Major Systems Used

B.2 Quality Control

B.2.1 Crosslines

NOAA Ship RAINIER and survey launch 2803 acquired 30.6 nautical miles (18.4% of mainscheme) of MBES crosslines across all depth ranges, water masses and boat days that were operationally practical, in order to evaluate the internal consistency of H13580 sonar data. We performed crossline analysis using the Compare Grids function within Pydro Explorer on Caris variable-resolution surfaces of H13580 mainscheme only and crossline only data. Results showed that 97% of grid nodes met allowable uncertainties as shown in the Pydro generated plots below.

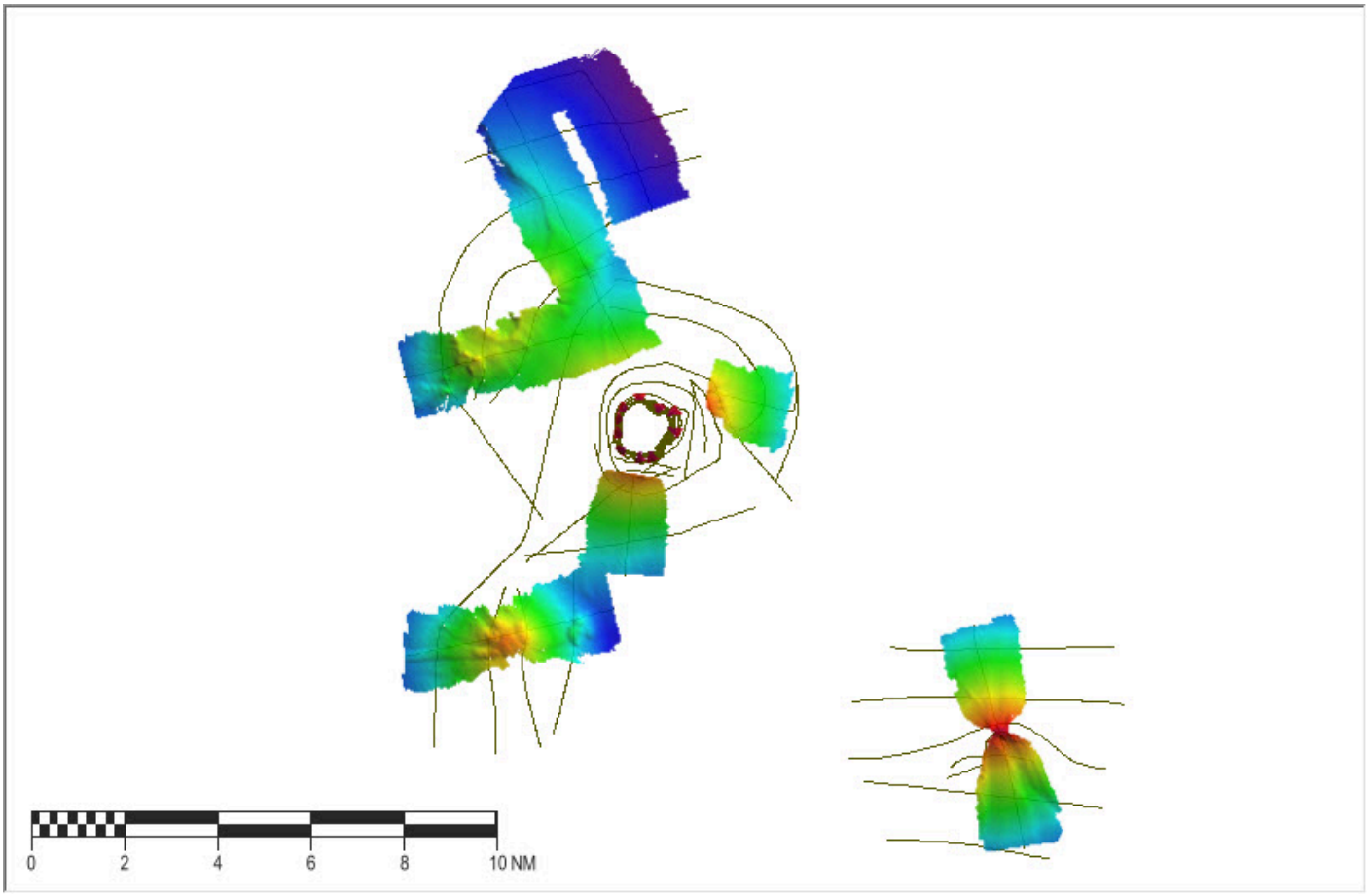


Figure 7: H13580 crossline surface overlaid on mainscheme tracklines.

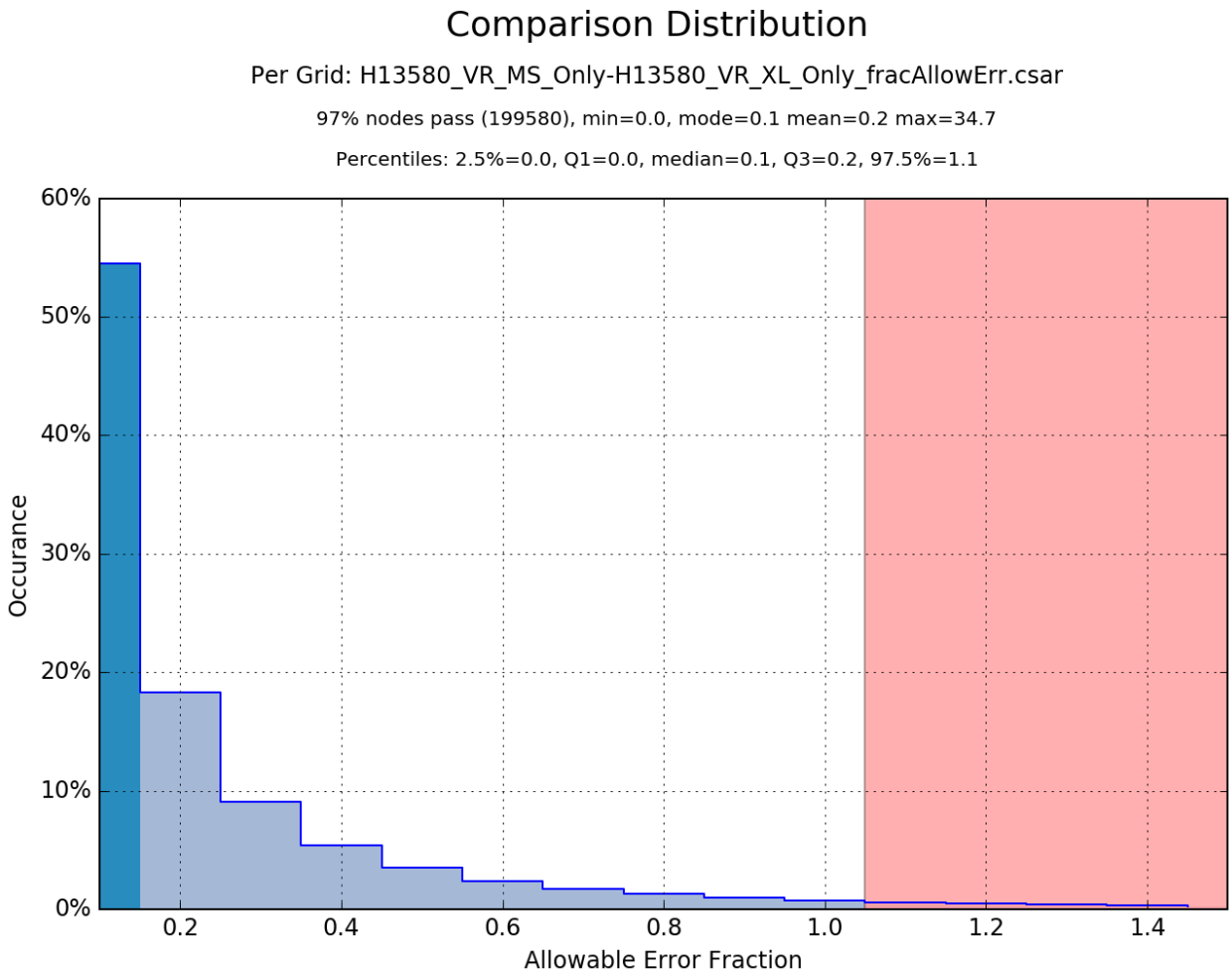
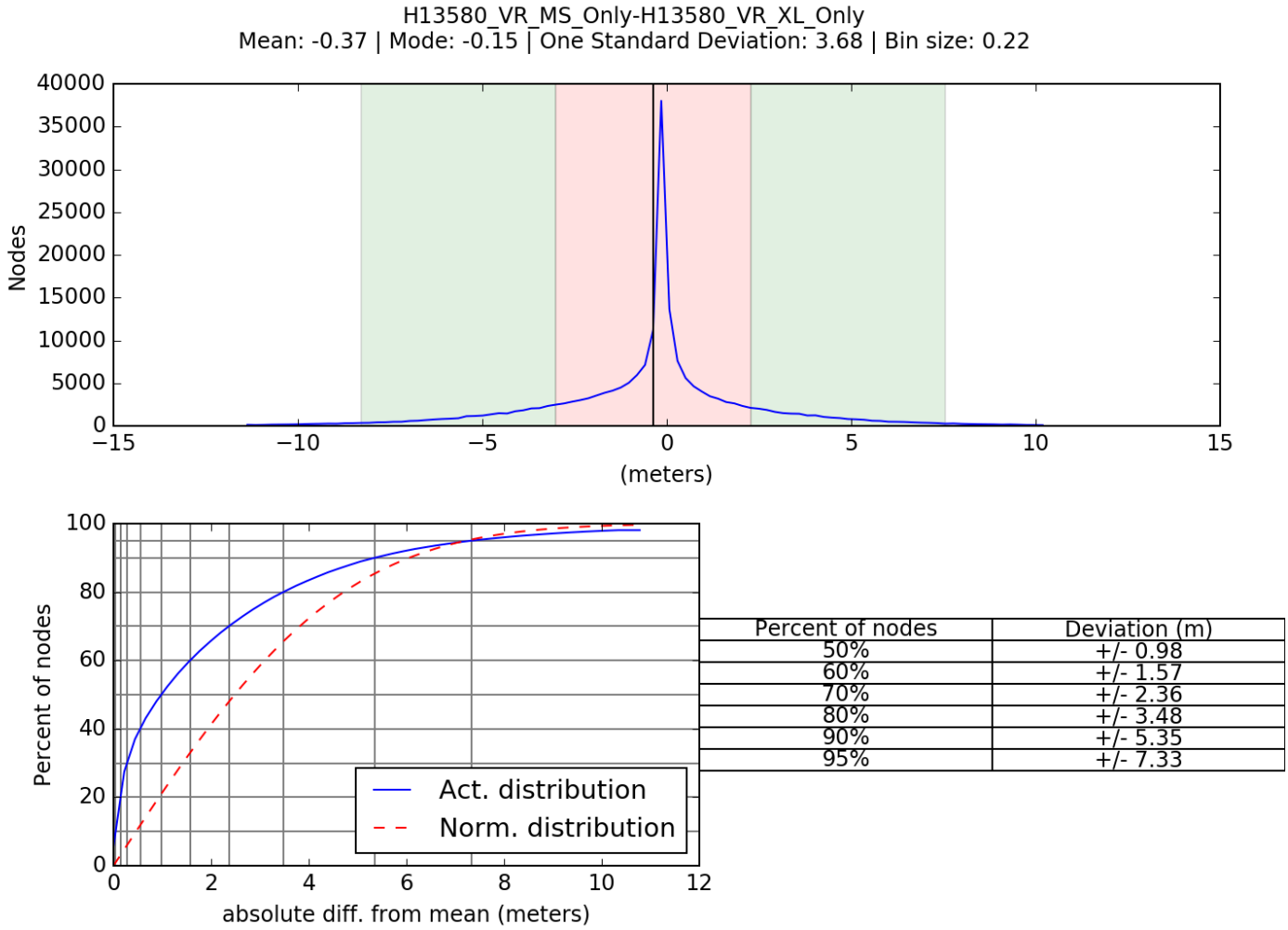


Figure 8: Pydro derived plot showing node percentage pass value of H13580 mainscheme to crossline data.



Percent of nodes	Deviation (m)
50%	+/- 0.98
60%	+/- 1.57
70%	+/- 2.36
80%	+/- 3.48
90%	+/- 5.35
95%	+/- 7.33

Figure 9: Pydro derived plot showing absolute difference statistics of H13580 mainscheme to crossline data.

B.2.2 Uncertainty

The following survey specific parameters were used for this survey:

Method	Measured	Zoning
ERS via VDATUM	0.0 meters	0.11 meters

Table 7: Survey Specific Tide TPU Values.

Hull ID	Measured - CTD	Measured - MVP	Measured - XBT	Surface
S221	N/A	1 meters/second	N/A	0.05 meters/second
2803	3 meters/second	N/A	N/A	0.05 meters/second

Table 8: Survey Specific Sound Speed TPU Values.

Total Propagated Uncertainty (TPU) values for survey H13580 were derived from a combination of fixed values for equipment and vessel characteristics, as well as from field assigned values for sound speed uncertainties. Tidal uncertainty was provided in metadata for the NOAA vertical datum transformation model used for this survey.

In addition to the usual a priori estimates of uncertainty, real-time and post-processed uncertainty sources were also incorporated into the depth estimates of this survey. Real-time uncertainties for position, navigation and vessel motion data from Applanix POS MV were applied during acquisition and initially in post-processing. POSPac SBET and RMS files were subsequently applied in Caris HIPS to supersede POS MV uncertainties associated with GPS height and position.

Uncertainty values of the submitted finalized grids were calculated in Caris using "Greater of the Two" of uncertainty and standard deviation (scaled to 95%). Grid QA v6 within Pydro QC Tools was used to analyze H13580 TVU compliance. H13580 met HSSD requirements in 99% percent of grid nodes as shown in the histogram plot below.

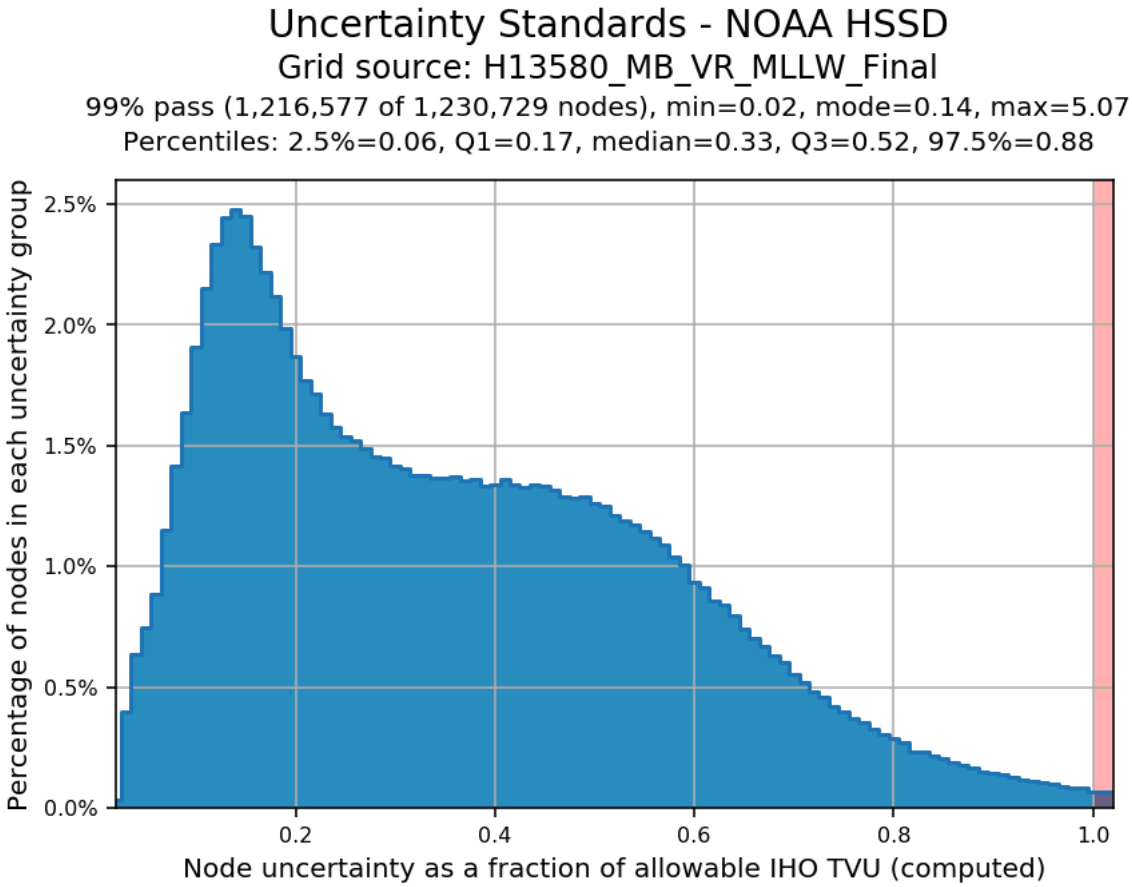


Figure 10: Pydro derived plot showing TVU compliance of H13580 finalized multi-resolution MBES data.

B.2.3 Junctions

There are no contemporary surveys that junction with this survey.

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

There were no other factors that affected corrections to soundings.

B.2.7 Sound Speed Methods

Sound Speed Cast Frequency: Sixteen sound speed profiles ("casts") were acquired for this survey at discrete locations within the assigned area at least once every four hours, when significant changes to surface sound speed were observed, or when shifting operations to a new area. Sound speed profiles were obtained using the Sea-Bird 19plus SEACAT Profilers on survey launch 2803 and the ODIM Brooke MVP200 on the ship. All sound speed profiles were concatenated into a master file and applied to H13580 MBES data using the "Nearest distance within Time" (4 hours) profile selection method.

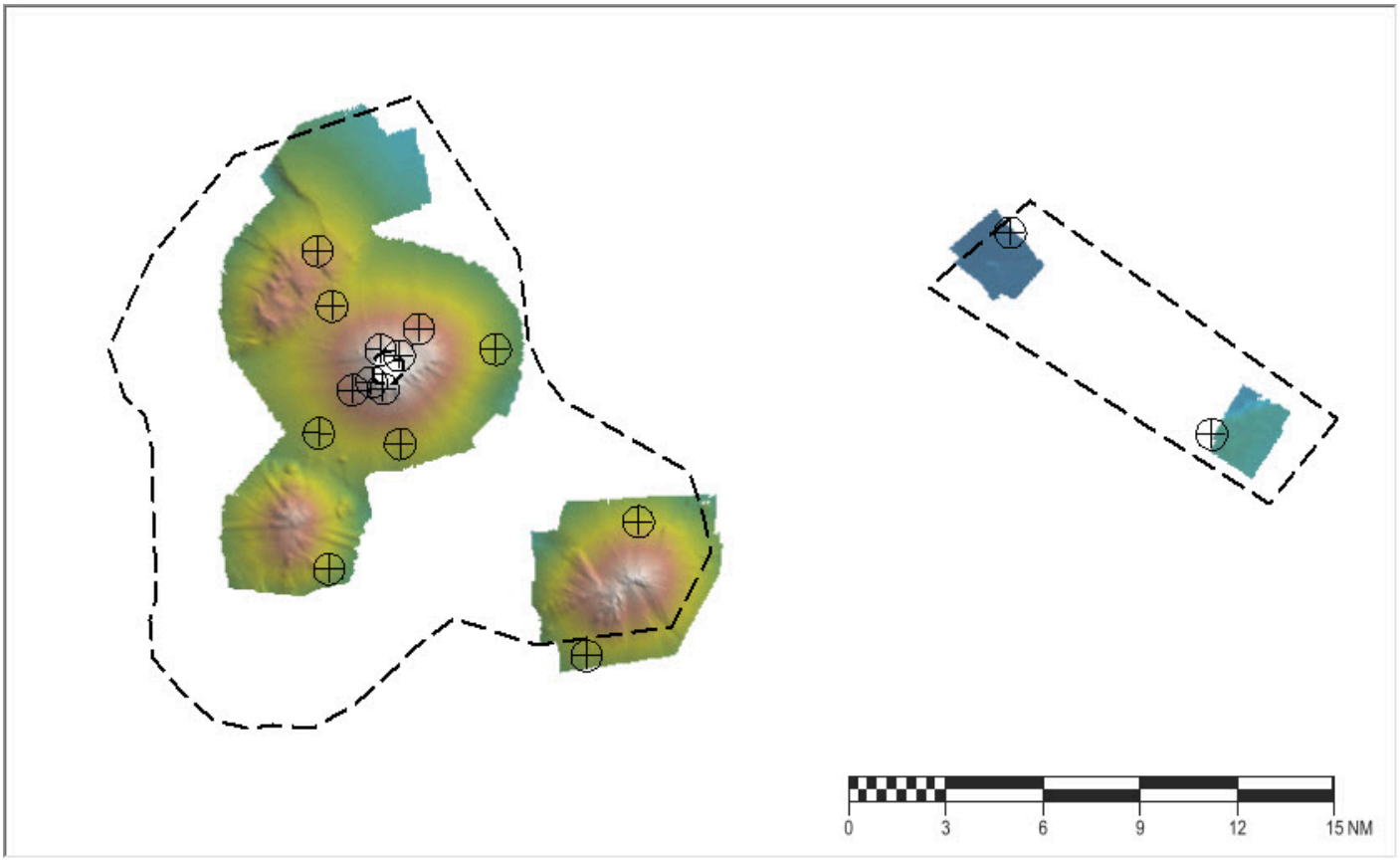


Figure 11: H13580 sound speed cast locations.

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

All sounding systems were calibrated as detailed in the DAPR.

B.4 Backscatter

Raw backscatter data were acquired as .all files logged during MBES operations and subsequently processed by RAINIER personnel. The .GSF files created during processing and backscatter mosaic data has been delivered with this report. Backscatter processing procedures are described in the DAPR.

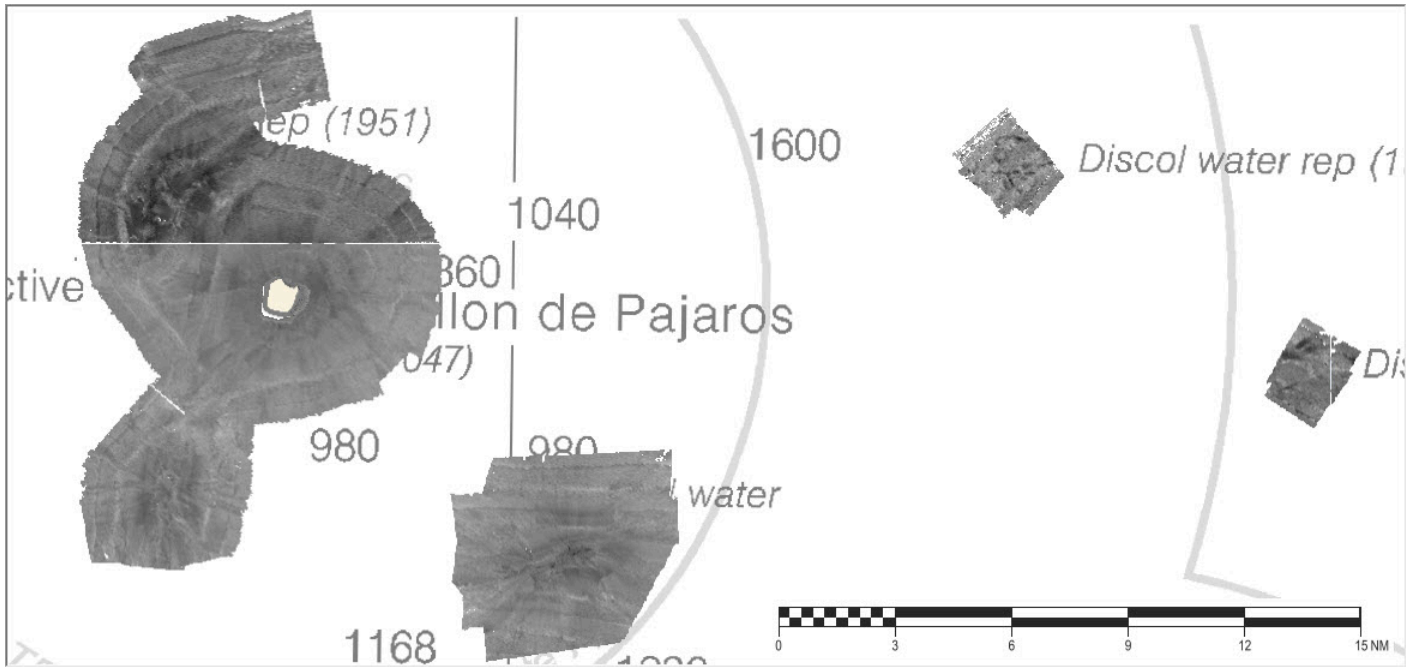


Figure 12: H13580 multibeam acoustic backscatter overview. (Chart 81004)

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 and SIPS	11.4.6

Table 9: Primary bathymetric data processing software

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

Manufacturer	Name	Version
QPS	FMGT	7.10.0

Table 10: Primary imagery data processing software

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

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
H13580_MB_VR_MLLW	CARIS VR Surface (CUBE)	Variable Resolution	4.1 meters - 2715.0 meters	NOAA_VR	Complete MBES
H13580_MB_VR_MLLW_Final	CARIS VR Surface (CUBE)	Variable Resolution	4.1 meters - 2715.0 meters	NOAA_VR	Complete MBES

Table 11: Submitted Surfaces

Submitted H13580 surfaces were generated using NOAA recommended parameters for depth-based (Ranges) Caris variable-resolution bathymetric grids. The submitted surfaces were generated with a Range/ Resolution file, that includes 32 meter grids for depths exceeding 640 meters. The multibeam data were iteratively cleaned of outlying and influential, anomalous soundings using Pydro QC Tools (v3.7.0).

Pydro QC Tool's Flier Finder (v9), with default settings, was used to identify sounding "fliers" in the finalized H13580 VR surface. Obvious noise was rejected by the hydrographer in Caris Subset Editor. After data cleaning, the Flier Finder tool was run again and found 339 potential fliers in the Complete Coverage surface. The potential fliers were investigated and determined to be a result of the significant slope in the terrain and the limited data density on both the steep slope and the offshore edge of coverage. Therefore, these fliers have been found to be false positives. The image below depicts an example of edge fliers determined to be false positives.

Pydro QC Tool's Holiday Finder (v4), with default settings, was used to find holidays in the finalized H13580 VR surface. Zero holidays were detected in the final Complete Coverage surface.

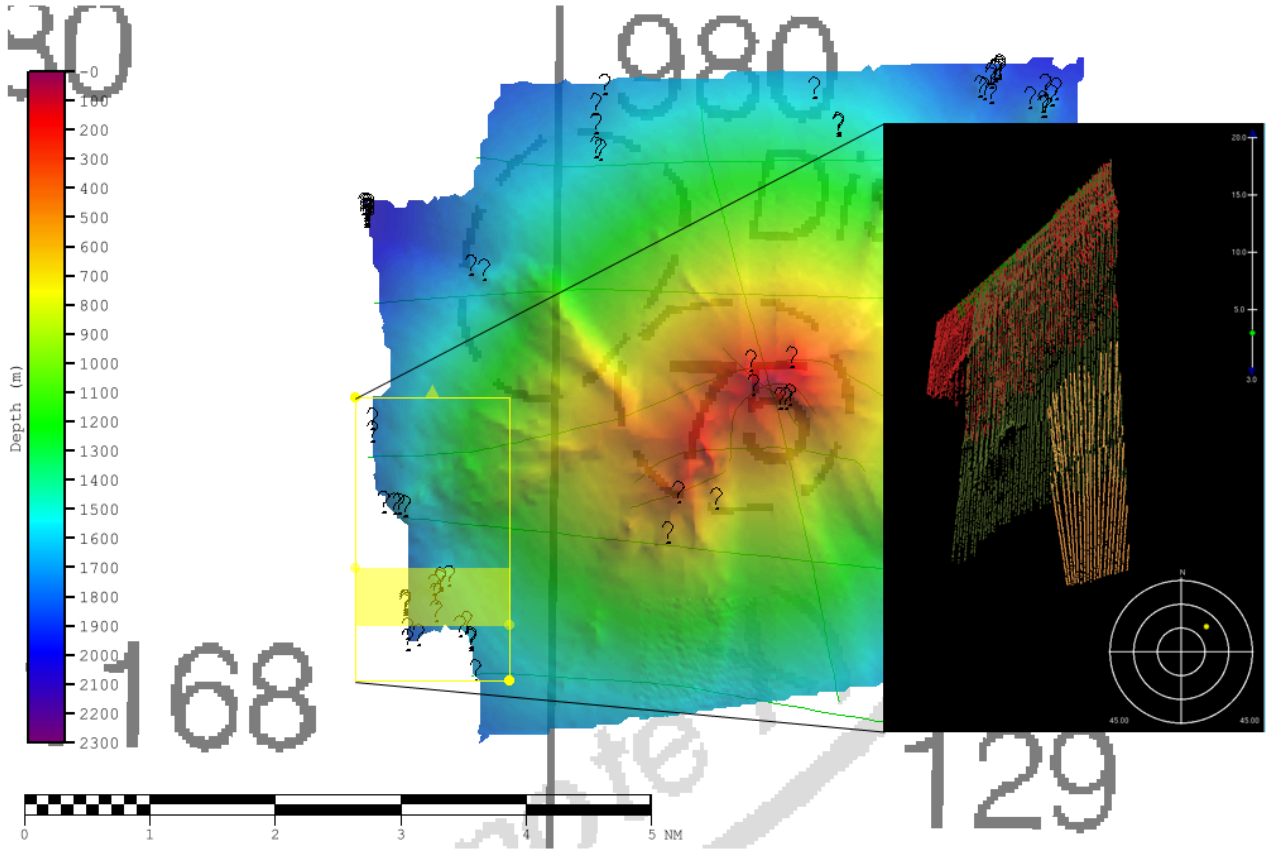


Figure 13: Example of fliers determined to be false positives.

C. Vertical and Horizontal Control

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

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_T381-RA-22_GuamCNMI_EC_ERTDM2021_NAD83(MA11)-MLLW OPR_T381-RA-22_GuamCNMI_EC_ERTDM2021_NAD83(MA11)-MHW

Table 12: ERS method and SEP file

All submitted H13580 MBES data were vertically referenced to the ellipsoid. VDATUM models included with the Project Instructions were used for referencing H13580 data to MLLW and MHW.

C.2 Horizontal Control

The horizontal datum for this project is North American Datum 1983 (MA11).

The projection used for this project is Universal Transverse Mercator (UTM) Zone 55.

RTK

Precise Positioning-Real time Extended (PP-RTX) processing methods were used in Applanix POSPac MMS (v8.5) software for post-processing horizontal correction of submitted H13580 MBES data.

WAAS

The Wide Area Augmentation System (WAAS) was used for real-time horizontal control during data acquisition.

D. Results and Recommendations

D.1 Chart Comparison

Limited shoreline verification was conducted in accordance with applicable sections of NOAA HSSD and FPM using the Composite Source File (CSF) provided by the Operations Branch. In the field, all assigned unverified charted features that were safe to approach, were addressed as required with S57 attribution and recorded in the H13580 Final Feature File (FFF) to best represent the features at chart scale. This file also includes recommendations to update, retain or delete assigned features. Features that were unsafe to approach were attributed in the FFF as Not Addressed, and the reason stated.

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
US5SP08M	1:45602	9	09/30/2020	09/30/2020
US2SP01M	1:931650	19	09/07/2021	09/07/2021

Table 13: Largest Scale ENCs

D.1.2 Shoal and Hazardous Features

No Danger to Navigation Reports were submitted for this survey.

D.1.3 Charted Features

ENC US2SP01M has several areas designated as obstructions that have been covered with MBES data. Three obstructions have been assigned due to discolored water being reported. Two obstructions to the north of Farallon de Pajaros and one obstruction to the southeast of Farallon de Pajaros have been assigned due to the area being "shoaler than range of depth of surrounding depth area." It is recommended that all of these obstructions are removed from the chart due to superseding MBES data as mentioned in the FFF. The figure below shows two obstructions to the north of the Farallon de Pajaros Island with overlaying MBES coverage.

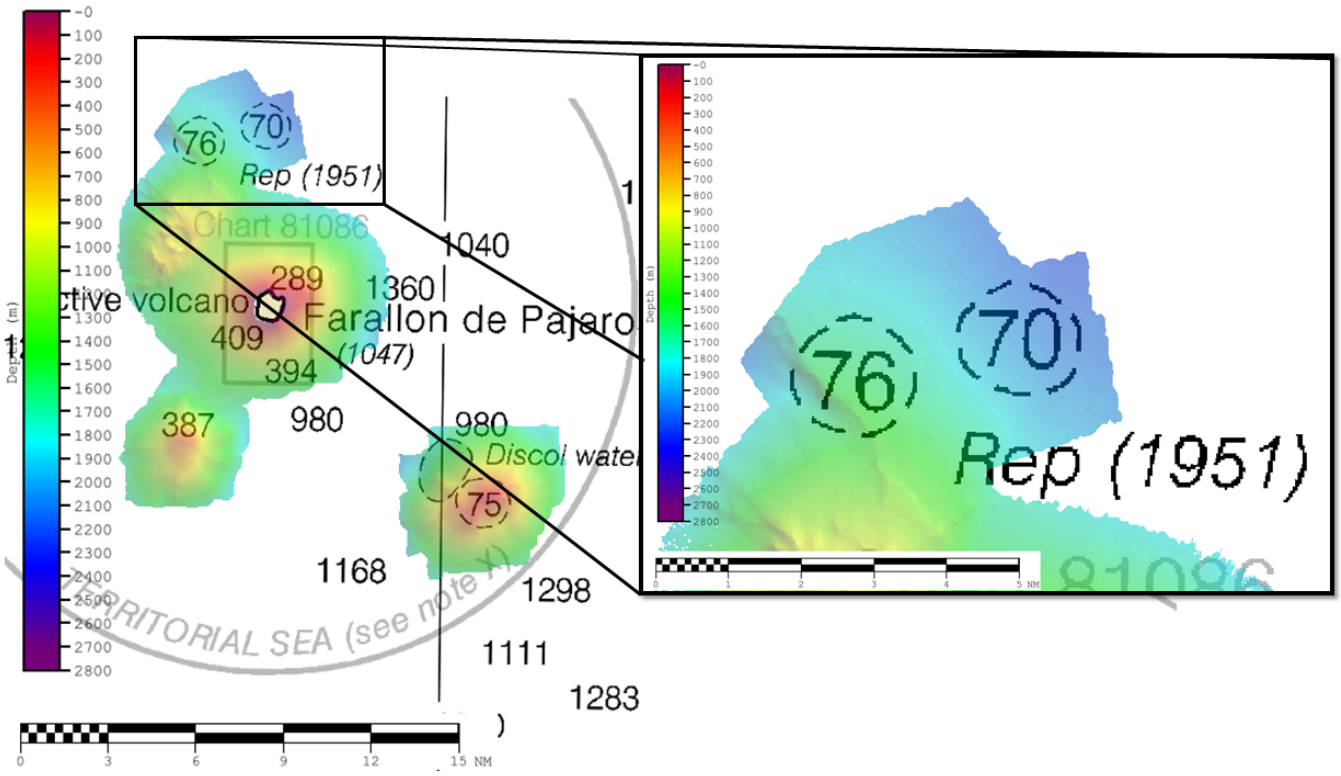


Figure 14: H13580 MBES coverage overtop charted obstructions. (Chart 81004)

D.1.4 Uncharted Features

No uncharted features exist for this survey.

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
Héctor L. Casanova, CAPT/NOAA	Chief of Party	10/06/2022	Digitally signed by CASANOVA.HECTOR.LUIS.1253816461 Date: 2022.10.27 09:29:44 -07'00'
Collin H. Walker, LT/NOAA	Field Operations Officer	10/06/2022	WALKER.COLLIN.HARRISON.1523758540 2022.10.05 15:42:28 -07'00'
James B. Jacobson	Chief Survey Technician	10/06/2022	JACOBSON.JAMES.BRYAN.1269664017 I have reviewed this document 2022.10.06 12:30:04 -07'00'
Franco R. Pilone	Sheet Manager	10/06/2022	Digitally signed by PILONE.FRANCO.REED.1608363684 Date: 2022.10.05 13:23:07 -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