H13669

Wind River Delta to Klickitat River Delta

OPR-N338-NRTSE-22
Columbia River, WA and OR
Oregon
Washington

Responsible Party
DOC/NOAA/NOS/OCS -- Office of Coast Survey
Contact Information
HSD.Chief@noaa.gov
Field Unit
NOAA NRT-Seattle
Survey Dates
August 17, 2022 - October 27, 2022
License Information
CC0-1.0
Approver
LTJG Ashley Howell

Platform and Sonar Equipment

NRT Seattle (S3006)

Kongsberg Maritime EM 2040C
Kongsberg Maritime EM 2040C

Bathymetry Grid

H13669_MB_50cm_CRD_1of2 *North American Datum 1983 (2011) Projected UTM 10, Mean Lower Low Water*

					Fixed	Variable
Sounding Technique:	***Multibeam***	Full Seafloor Coverage:	***Yes***	Feature Detection Size:	***1.0m***	***N/A***
Features Detected:	***Yes***	Bathymetric Coverage:	***Yes***	Uncertainty Horizontal:	***2m***	***N/A***
Least Depth Detected:	***Yes***	Interpolated:	***No***	Uncertainty Vertical:	***0.15m***	***0.75%***

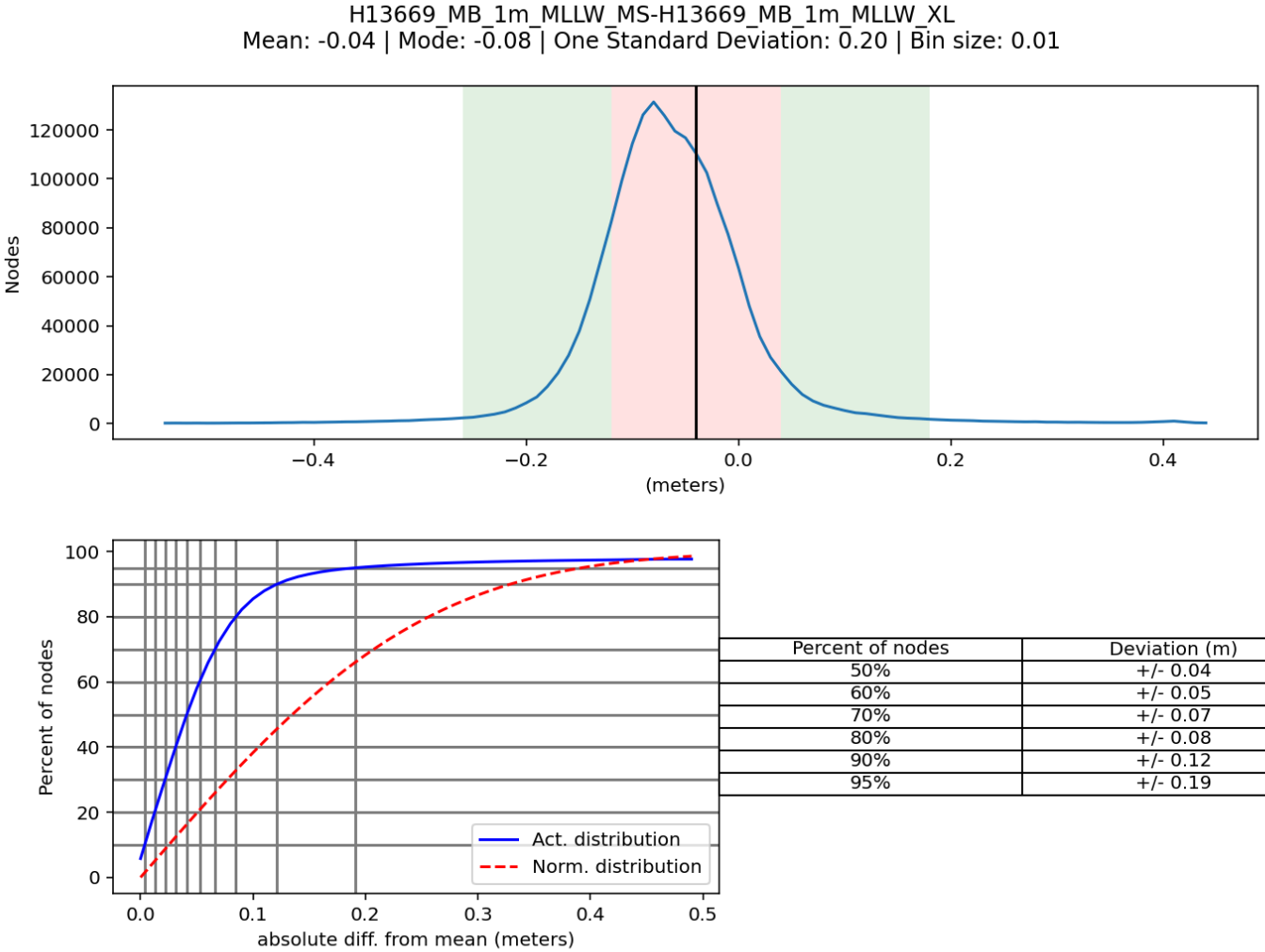
H13669_MB_VR_CRD_2of2 *North American Datum 1983 (2011) Projected UTM 10, Mean Lower Low Water*

					Fixed	Variable
Sounding Technique:	***Multibeam***	Full Seafloor Coverage:	***Yes***	Feature Detection Size:	***2.0m***	***10%***
Features Detected:	***Yes***	Bathymetric Coverage:	***Yes***	Uncertainty Horizontal:	***5m***	***5%***
Least Depth Detected:	***Yes***	Interpolated:	***No***	Uncertainty Vertical:	***0.15m***	***0.75%***

Quality Control Procedure

Crosslines

To evaluate crosslines, a 1 meter CUBE surface using strictly mainscheme lines, and a 1 meter CUBE surface using strictly crosslines were created. From these two surfaces, a difference surface (mainscheme - crosslines = difference surface) was generated using Pydro's Compare Grids tool at a 1 meter resolution. Statistics show the mean difference between the depths derived from mainscheme and crosslines was -0.04 meters (with mainscheme being shoaler) and 95% of nodes falling within 0.19 meters. For the respective depths, the difference surface was compared to the allowable NOAA uncertainty standards using Compare Grids. Crosslines fell short of the requirement of 4% coverage with a total of 3.10%.



Percent of nodes	Deviation (m)
50%	+/- 0.04
60%	+/- 0.05
70%	+/- 0.07
80%	+/- 0.08
90%	+/- 0.12
95%	+/- 0.19

H13669 crossline and mainscheme difference statistics

Junction Overlap

Junction analysis was not performed for this survey

Statistical Analysis

NRT-SE's primary bathymetric data review and quality control tool is the CARIS CUBE surfaces. The CUBE algorithm generates a surface consisting of multiple hypotheses that represent the possible depths at any given position. The CUBE surface is a grid of estimation nodes where depth values are computed based on

the horizontal and vertical uncertainty of each contributing sounding. Any individual sounding's uncertainty, or Total Propagated Uncertainty (TPU), is derived from the assumed uncertainty in the echosounder measurement itself, as well as the contributing correctors from sound speed, water levels, position, and attitude. TPU values for tide and sound velocity must be entered for each vessel during TPU computation, unless using TCARI, where uncertainty is added directly to survey lines by Pydro.

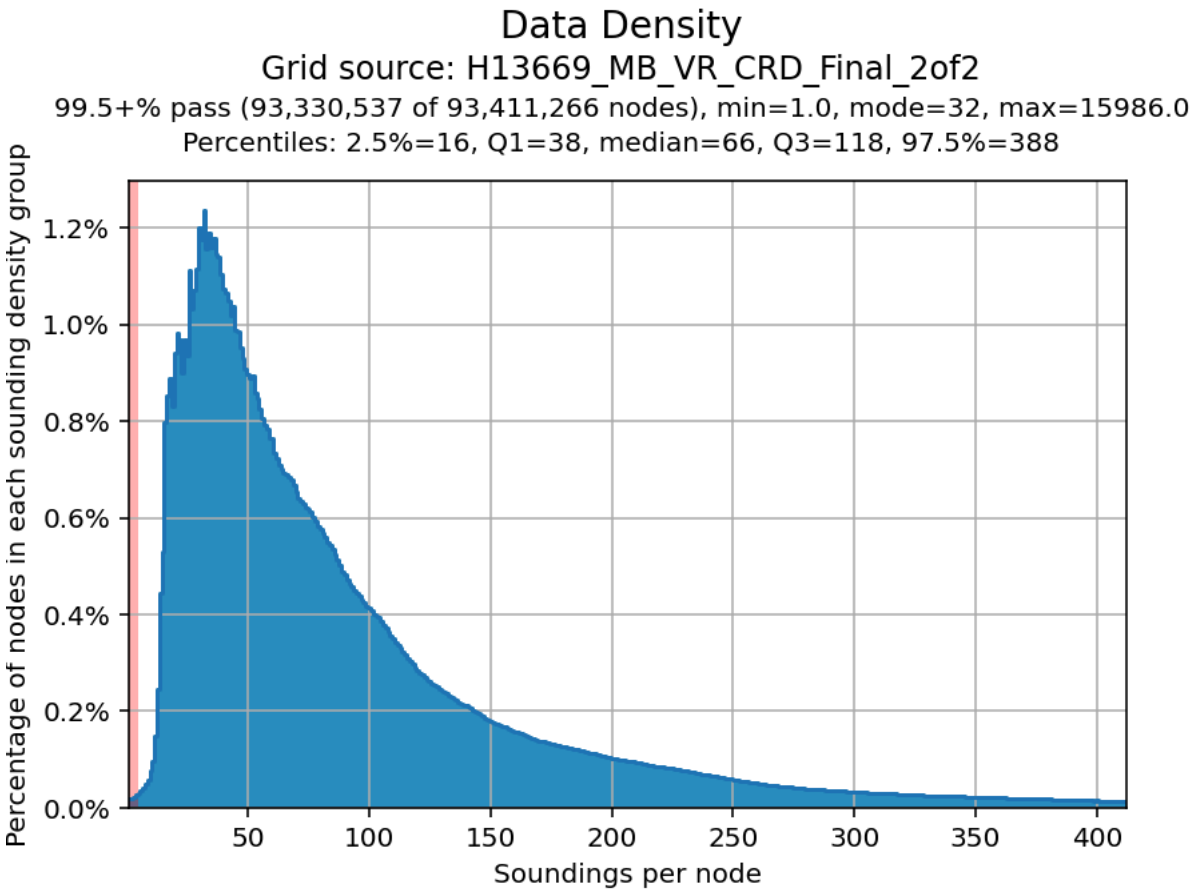
NRT-SE is currently using the following uncertainty values: GPS tide uncertainty is unique to the separation model in use. Measured sound speed uncertainty was set to a recommended value of 2 m/s as recommended by the FPM when 1 cast is taken every 4 hours. Surface sound speed value is dependent on the manufacturer specifications of the unit utilized to measure surface SV values for refraction corrections to flat-faced transducers. The AML Oceanographic Micro-X probe with an SV-Xchange sensor has a published accuracy of 0.025 m/s, however, a value of 0.5 m/s is used for surface sound speed uncertainty.

All other error estimates are read from the Hydrographic Vessel File (HVF). The HVF contains all offsets and system biases for the survey vessel and its systems, as well as error estimates for latency, sensor offset measurements, attitude and navigation measurements, and draft measurements. In addition, the HVF specifies which type of sonar system the vessel is using.

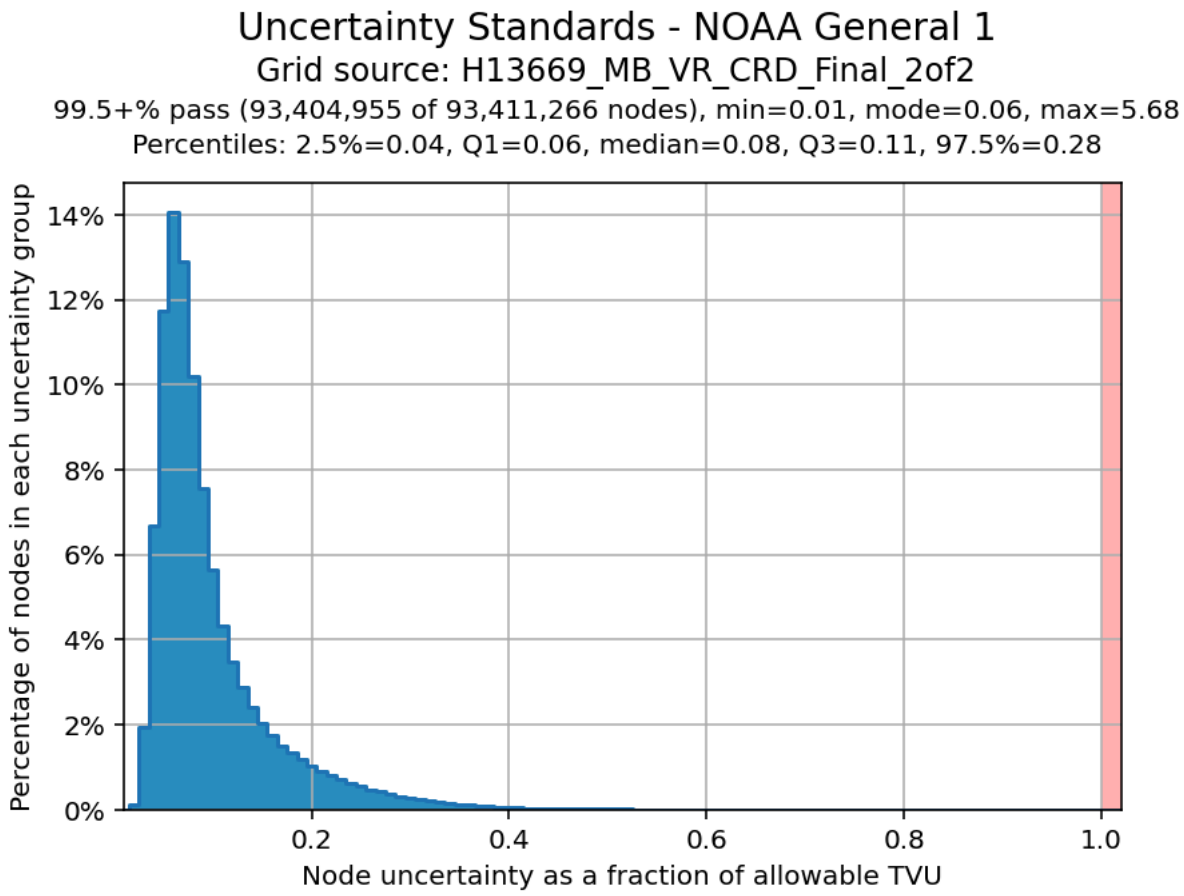
In addition to the usual a priori estimates of uncertainty, some real-time and post-processed uncertainty sources were also incorporated into the depth estimates. Real-time uncertainties from the Kongsberg EM2040C were recorded and applied in post-processing. Applanix TrueHeave files are recorded, which include an estimate of the heave uncertainty, and are applied during post processing. Uncertainties associated with vessel roll, pitch, gyro, and navigation are applied in CARIS HIPS and SIPS via a SBET and RMS files generated in POSPac.

The Grid QA tool within QC Tools was used to analyze data density and uncertainty of gridded data. The finalized VR and 50 cm surfaces were analyzed using the Pydro QC Tools Grid QA feature to determine compliance with specifications. Density requirements for H13669 were achieved with at least 99.5+% of surface nodes containing five or more soundings as required by HSSD Section 6.9.

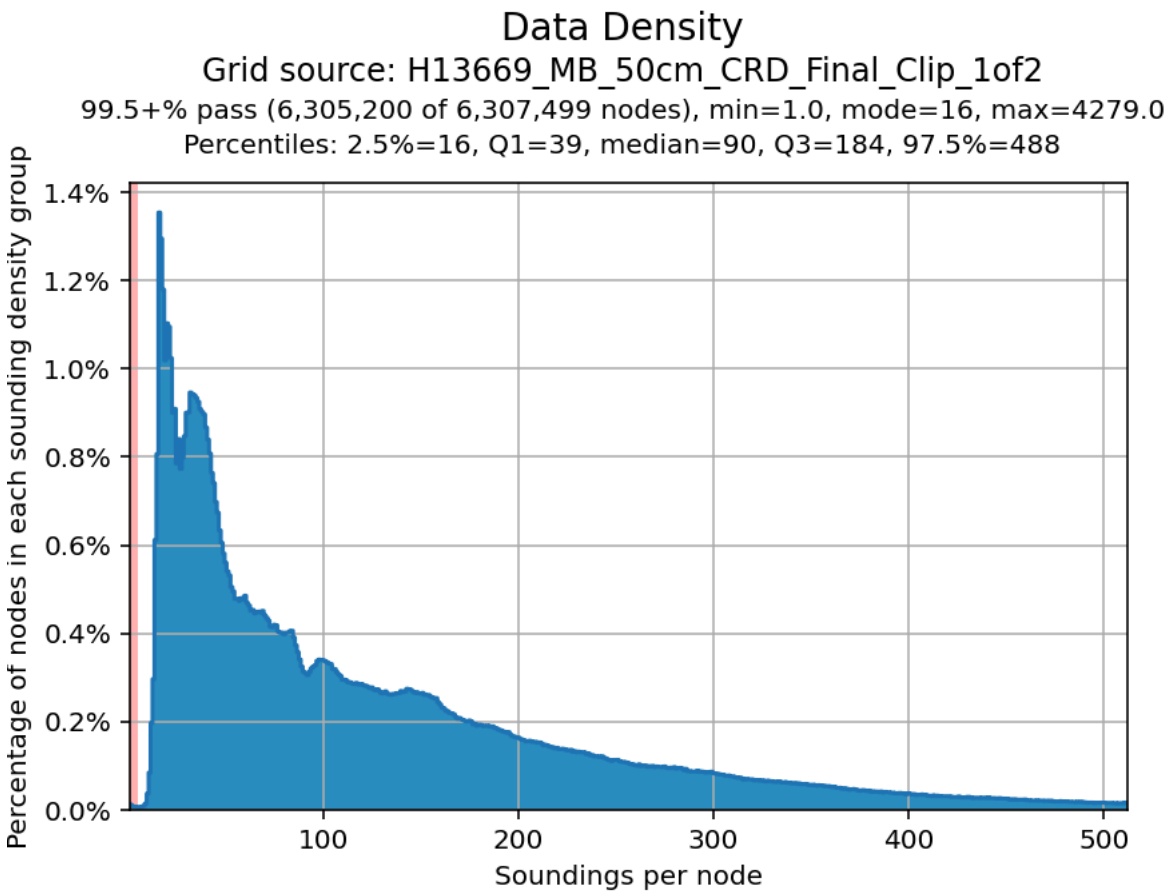
The surface was analyzed using the HydrOffice QC Tools Grid QA feature to determine compliance with specifications. Overall, 99.5+% of nodes within the surface meet NOAA Allowable Uncertainty specifications for H13669.



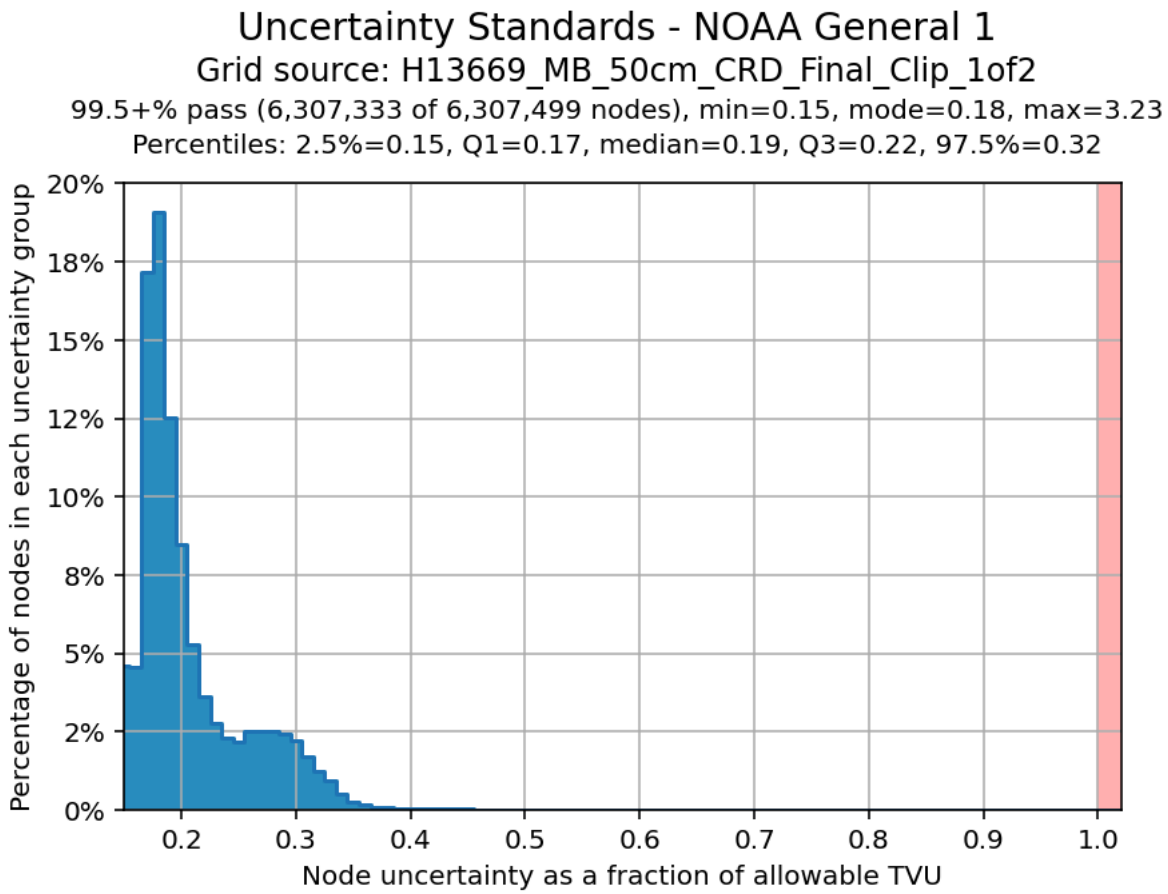
Pydro derived plot showing percent of nodes in compliance with HSSD standards for H13669 VR surface



Pydro derived plot showing TVU compliance of H13669 VR surface



Pydro derived plot showing percent of nodes in compliance with HSSD standards for H13669 50 cm surface



Pydro derived plot showing TVU compliance of H13669 50 cm surface

Directed Editing

The CUBE surface child layers: uncertainty, standard deviation, and node standard deviation were primarily used to help focus directed editing to soundings that were negatively affecting the BASE surface. Another method to check the quality of sounding data prior to submission is the Pydro QC Tools “Flier Finder.” This software scans the CUBE surface for potential anomalous grid data. Lowering the flier height value will increase the sensitivity of the flier finder, resulting in more nodes being flagged. Fliers are then exported as .000 S-57 files that can be imported into CARIS HIPS and SIPS to aid in further cleaning. If desired, the user can set a new tolerance (“Flier height”) and rerun Flier finder.

On occasion, the resolution of the CUBE surface may not be sufficient to capture the high point of a feature. In less than 20 m of water, any feature where the most probable accurate sounding is shoaler than the CUBE surface by greater than one half the allowable error OCS Quality Metrics for Uncertainty is considered inadequately captured by the CUBE surface. In greater than 20m of water, this allowable error is expanded to the full OCS Quality Metric error allowance at that depth. Although missed shoal points may occur on irregular shoals or rock pinnacles, man-made features such as piles and wrecks are of particular concern. These features have very slender high points that extend far above the surrounding seafloor as well as the CUBE surface. To ensure that these features are properly represented, the shoalest point is flagged “designated” in CARIS. During the “finalization” process, the CUBE surface is forced to honor all soundings which have been flagged “designated.” In the case of a survey where the high points of many features (i.e. a boulder field) are not being captured by the CUBE surface, the hydrographer may decide to produce higher resolution CUBE surfaces to ensure that these features are being honored.

Holiday Identification

Most holidays are identified and addressed while in the field. During data acquisition, the display of the real-time swath coverage is based upon the matrix file, a polygon with user-defined geographic bounds and resolution set up prior to data collection. The resolution of the matrix is selected to match depth range of the polygon currently being worked on. The launch coxswain uses this matrix display to adjust the line as it is driven so that the swath currently being collected overlaps the grid of previously collected data. In this way, insufficient overlap can be seen and addressed immediately.

The Pydro QC Tools "Holiday Finder" is used to detect holidays in post-processing. This tool scans the grid, and any empty nodes surrounded by populated nodes are identified and was run in conjunction with a visual inspection of all surfaces by the hydrographer. The user can specify whether to search for holidays according NOAA HSSD. In the event of finding any holidays in post-processing, small polygons are made in HIPS to direct data acquisition to fill them in.

Due to an issue with the POS files from part of DN300 , some lines were removed from the project The lines removed included a number of holiday lines on the west of the sheet. Removing these lines led to an increase in holidays, particularity along the steep margins around Memaloose Island. In geneal these holiday are down-slope holidays and least depths in these areas are maintained.

Holiday Finder identified 64 holidays for H13669_MB_VR_CRD_2of2 and 9 holidays for H13669_MB_50cm_CRD_1of2.

Survey Adequacy

These data are adequate to supersede charted data in their common areas.

Imagery Coverage

N/A

Data Interpolation

N/A

Backscatter

Calibration Method

N/A

Dynamic Range

MBES frequency and settings remained unchanged throughout the survey area. Swath width was manually decreased in shallow water to mitigate edge fliers.

Acquisition Configuration

N/A

Environmental Variable

N/A

Acquisition Output

Kongsberg EM2040C stores the raw backscatter data in the .all file. Raw MBES backscatter was logged as part of the .all file of 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 package.

Report of Survey

Uncertainty Source

Total Propagated Uncertainty (TPU) values for H13669 were derived from a combination of fixed values for equipment and vessel characteristics, as well as field assigned values for sound speed uncertainties. The uncertainty for the VDatum model was provided to the field units. In addition to the usual a prior estimates of uncertainty, some real time and post processed uncertainty sources were also incorporated into the depth estimates of the survey. Real-time uncertainties from the Kongsberg MBES sonars were incorporated and applied during post processing. Uncertainties associated with vessel roll, pitch, gyro, navigation, and heave were applied during post-processing. All of the aforementioned uncertainties were applied in CARIS.

As stated, H13669 is an ellipsoidally referenced survey (ERS) and the tidal component was accomplished with a separation model. There are two places in CARIS where the user directly defines uncertainty values for use in CARIS to calculate TPU values, in the HVF and the direct input of SV and GPS model values during the TPU computation. TPU values for all motion, navigation position and timing values are taken directly from Appendix IV (Uncertainty values for use in CARIS with vessels equipped WITH an attitude sensor) of the FPM. All timing values were set to 0.001 seconds as outlined for setups with Ethernet connections and precise timing. All offset values were chosen to be 0.02 meters based on the accuracy provided by professional surveys. All MRU alignment values are derived from the patch test. The gyro value is taken directly from the standard deviation of the yaw values. The pitch/roll value is combined as one in the HVF and is computed as the square root of pitch standard deviation squared plus roll standard deviation squared.

Error Source

POS files for the morning of DN300, the last day of survey, were unrecoverable during processing. Post processed SBETs could not be created or applied to lines 1447 - 1539. These lines were removed from the survey as post processed positioning is unavailable and no uniform static offset could be applied. The lines removed where mainscheem on the west edge of the survey and a number of holiday lines on the west of the sheet. Removing these lines led to an increase in holidays, particularity along the steep margins around Memaloose Island.

Unusual Condition

Areas of dense vegetation exist along the edges throughout the survey area. Where vegetation was readily identifiable and distinguishable from rocky areas, it was removed from the data and sea-grass symbols were included in the final feature file.

Sand waves also exist throughout the survey area and are highly changeable temporarily.

Additional Information

NOAA Final Feature File Product Specification was used to create the FFF but the specification does not have CRD as a possible 'Sounding Datum' selection and MLLW was selected instead. Sounding Datum is Columbia River.

PI Alteration

The Navigation Response Branch Chief received authorization from the Pacific Hydrographic Branch to submit H13669 in accordance with the HSSD 2024 on April 18, 2024. The Project Instructions stated that object detection acquisition was required for assigned priority areas as safe operations permitted and complete coverage elsewhere in H13669. H13669 was processed to Critical specifications for priority areas and General 1 specifications for elsewhere.

Supplementals

- Final Survey Outline *(Dec 19, 2024)*
- NCEI Sound Speed Data *(Jul 27, 2024)*

Approval Statement

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 and approved all data and metadata. The survey meets or exceeds requirements as set forth in the Project Instructions and NOS Hydrographic Surveys Specifications and Deliverables. The survey is complete and no additional work is required with the exception of any deficiencies noted in the Report of Survey.

Approver Name	Approver Title	Approver Certification
LTJG Ashley Howell	Chief of Party	

Personnel

Name	Title	Certification
LT Carly Robbins	Sheet Manager	

Full Equipment List

Equipment Type	Manufacturer and System	Model Number	Serial Number	Calibration Date	Frequency	Accuracy Check Date
NRT Seattle (S3006)						
Positioning and Attitude System	Applanix POS MV 320 v5	POS MV V5	5926	2022-03-29	NA	NA
Multibeam	Kongsberg Maritime EM 2040C	EM2040C	1158	2018-05-02	300 kHz	2019-03-28
Multibeam	Kongsberg Maritime EM 2040C	Processing Unit 2U	CZC3440R5X	2018-05-02		2019-03-28
CTD	SonTek CastAway-CTD	SonTek	CC1433007	2021-05-04	N/A	2021-05-04
Sound Speed System	AML Oceanographic MicroX SV	Micro-X	203521	2019-04-23	N/A	2019-04-23