F00878
Thimble Shoal Channel

S-D935-NRTNL-24
Thimble Shoal Auxiliary Channel
Virginia

Responsible Party
DOC/NOAA/NOS/OCS -- Office of Coast Survey
Contact Information
HSD.Chief@noaa.gov
Field Unit
NOAA NRT-New London
Survey Dates
April 16, 2024 - April 29, 2024
License Information
CC0-1.0
Approver
LTJG Carly Robbins

Platform and Sonar Equipment

NRT-NL (S3007)

Kongsberg Maritime EM 2040C

Bathymetry Grid

F00878_MB_1m_MLLW_1of1.bag (*North American Datum 1983, Mean Lower Low Water, Projected UTM 18)*

					Fixed	Variable
Sounding Technique:	***Multibeam***	Full Seafloor Coverage:	***Yes***	Feature Detection Size:	***2.0m***	***N/A***
Features Detected:	***Yes***	Bathymetric Coverage:	***Yes***	Uncertainty Horizontal:	***5m***	***5%***
Least Depth Detected:	***Yes***	Interpolated:	***No***	Uncertainty Vertical:	***0.5m***	***1%***

Quality Control Procedure

Crosslines

Due to time restraints and emergency response needs, cross lines were not collected on survey F00878.

Statistical Analysis

NRT-NL'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 CUBES surface is a grid of estimation nodes where depth values are computed based on the horizontal and vertical uncertainty of each contributing sounding.

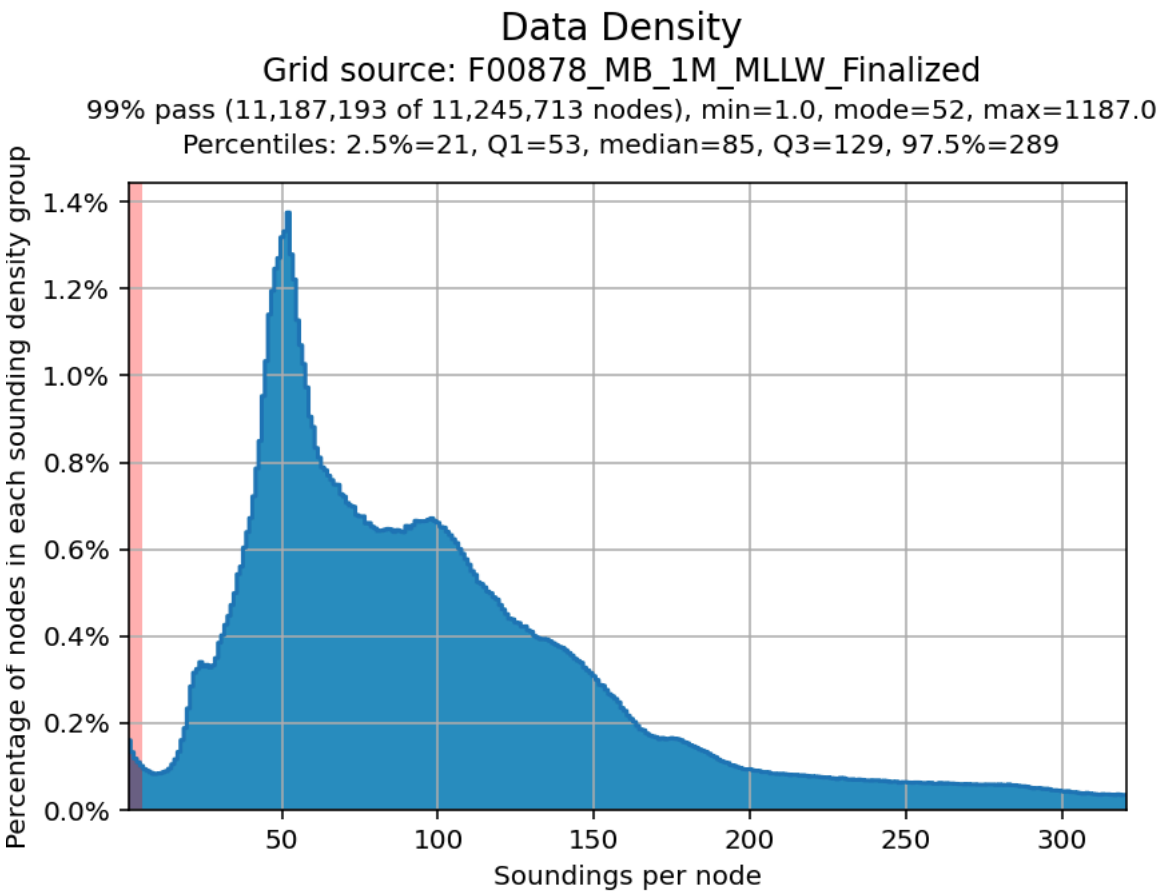
Any individual sounding's uncertainty, or Total Propagated Uncertainty (TPU), is derived from the assumed uncertainty in the echosounder measurement itself, as well as the contributing correctors from sound speed, water levels, position, and attitude. TPU values for tide and sound velocity must be entered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

NRT-NL 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 Field Procedures Manual (FPM) when one cast is taken every four hours. Surface sound speed value is dependent on the manufacturer specifications of the unit utilized to measure surface sound velocity 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 0.2 m/s is used for surface sound speed uncertainty.

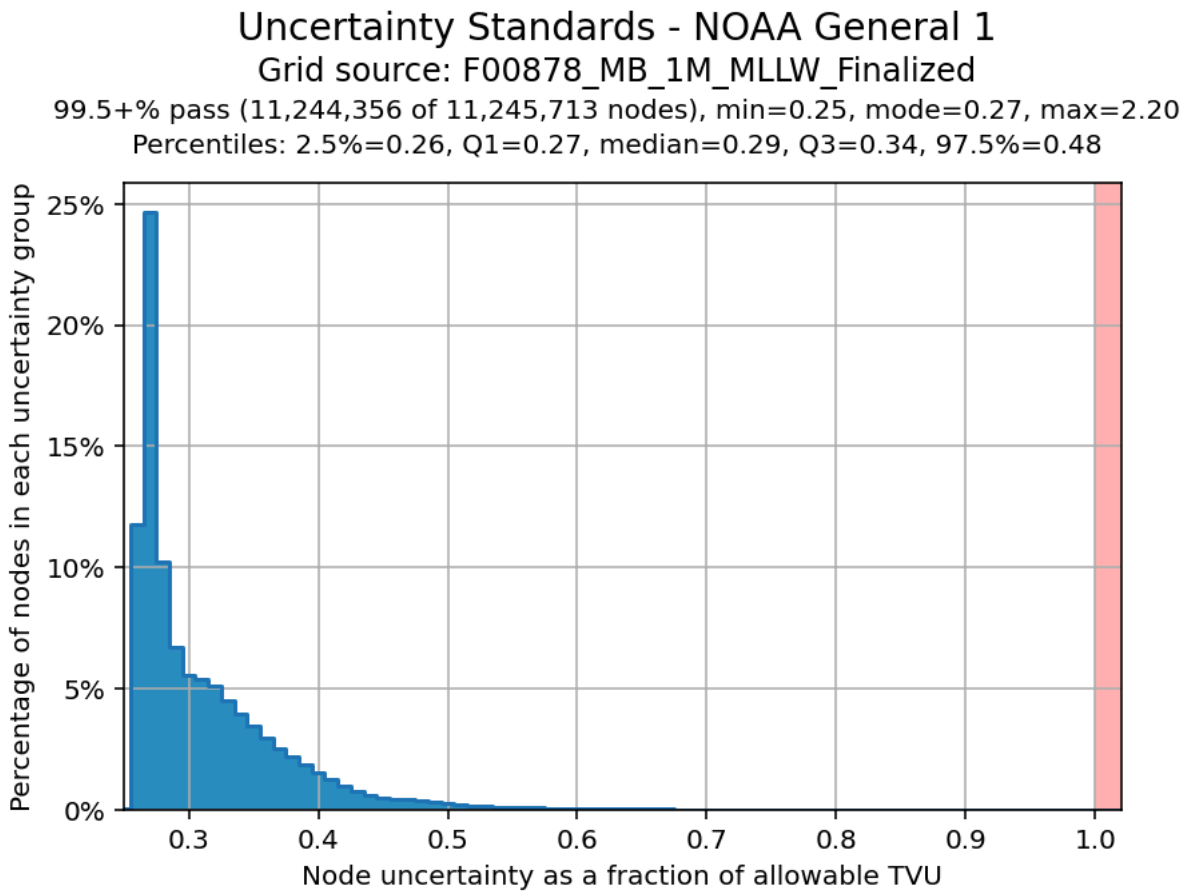
All other error estimates are read from the Hydrographic Vessel File (HVF). The HVF contains all offsets and system biases for the survey vessel and its systems, as well as error estimates for latency, sensor offset measurements, attitude and navigation measurements, and draft measurements. In addition,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

Pdro's Grid QA tool with QC Tools 4 was used to analyze data density and uncertainty of gridded data.



Pydro derived plot indicating percent of F00878 nodes in compliance with HSSD standards.



Pydro derived plot showing TVU compliance of F00878 multibeam 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 20m 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)

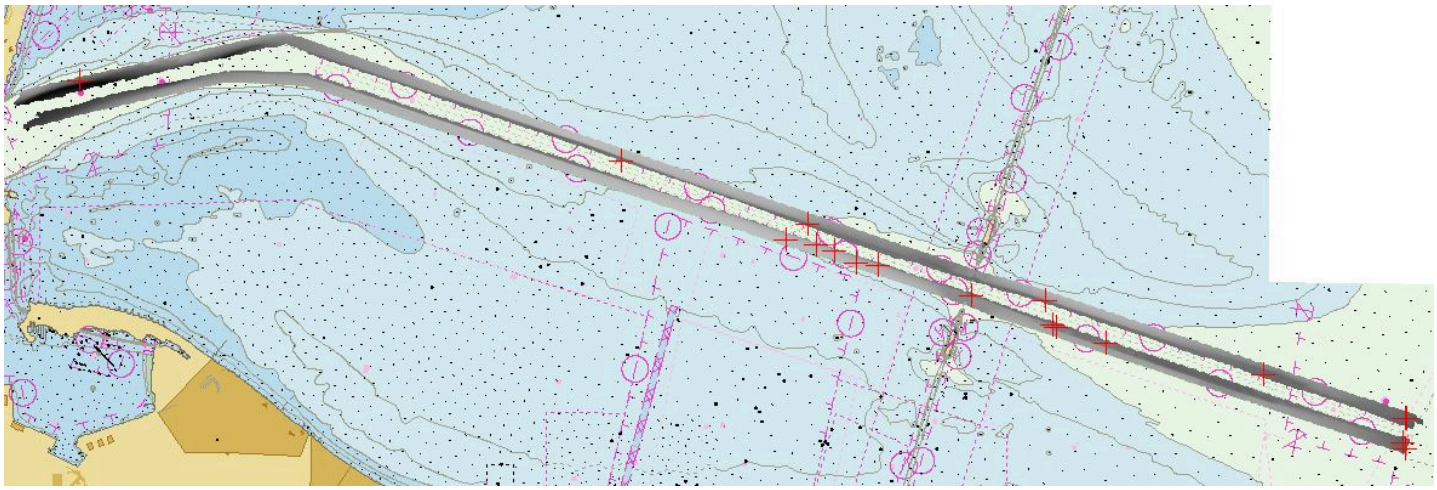
are not being captured by the CUBE surface, the hydrographer may decide to produce higher resolution CUBE surfaces to ensure that these features are being honored.

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 the depth range of the polygon currently being worked on. The launch coxswain uses this matrix display to adjust the lines 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. The user can specify whether to search for holidays according to 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.

Post processing of F00878 did not start until well after the team had left the Chesapeake Bay area and started a new survey in another state. Therefore, twenty holidays meeting the specifications in section 6.5 of the HSSD were not reacquired, these holidays can be found in the F00878_Hoidays.hob file in the QC folder of this survey submission. These holidays were investigated in CARIS subset editor to verify that least depths were found.



F00878 Holidays as indicated by red cross.

Survey Adequacy

The entirety of F00878 is adequate to supersede previous data.

Imagery Coverage

Imagery coverage assessment was not performed for this survey

Data Interpolation

N/A

Junction Overlap

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

No.

Environmental Variable

N/A

Acquisition Output

Backscatter was processed in FMGT successfully.

Report of Survey

Uncertainty Source

Total Propagated Uncertainty (TPU) values for F00878 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, F00878 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.

PI Alteration

F00878 was originally assigned to R/V Bay Hydro II in early 2023. Due to the dredge operations not being completed on time, then a mechanical failure of the R/V Bay Hydro II, this project was postponed until 2024. At which time, it was reassigned to NRT-NL, but under the 2023 requirements. Since, R/V Bay Hydro II crew was processing the survey data that NRT-NL collected in April 2024, a request was made to the Project Manager to change the project requirements to reflect the 20214 HSSD and all of the new specifications. This request was submitted to the Project Manager, with the Chief of NRB being Cced on 08 June 2024 and approved with new PI's on the same day.

Supplementals

- **Final Survey Outline** (*Aug 19, 2024*)
- **NCEI Sound Speed Data** (*Sep 12, 2024*)

Approval Statement

This report has been generated by the NOAA Office of Coast Survey Hydrographic Surveys Division (HSD) based on the assessment of a data package provided to HSD by the Responsible Party. HSD accepts a variety of data from data sources through the External Source Data (ESD) Team. Please contact the HSD Chief (HSD.Chief@noaa.gov) or hydro.info@noaa.gov with any questions.

Approver Name	Approver Title	Approver Certification
LTJG Carly Robbins	Chief of Party	

Personnel

Name	Title	Certification

Full Equipment List

Equipment Type	Manufacturer and System	Model Number	Serial Number	Calibration Date	Frequency	Accuracy Check Date
NRT-NL *(S3007)*						
Positioning and Attitude System	Applanix POS MV 320 v5	POS MV V5	5909	2023-03-27	NA	NA
Multibeam	Kongsberg Maritime EM 2040C	Dual EM 2040C	1435	2023-03-27	kHz	2024-09-09
CTD	YSI CastAway-CTD	400100	CC1433009	2023-01-20	N/A	2023-02-16