F00893
Annapolis

S-E922-NRTNL-24
Annapolis Anchor Investigation
Maryland

Responsible Party
DOC/NOAA/NOS/OCS -- Office of Coast Survey
Contact Information
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Field Unit
NOAA NRT-New London
Survey Dates
April 19, 2024 - April 23, 2024
License Information
CC0-1.0
Approver
LTJG Mark Meadows

Platform and Sonar Equipment

NRT-NL (S3007)

Kongsberg Maritime EM 2040C
Kongsberg Maritime EM 2040C
Kongsberg Maritime EM 2040C

Bathymetry Grid

F00893_MB_VR_MLLW_1of1 (*North American Datum 1983 (2011), Mean Lower Low Water, Projected UTM 18)*

					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:	***0.5m***	***1%***

F00893_MB_VR_MLLW_Final_1of1 (*North American Datum 1983 (2011), Mean Lower Low Water, Projected UTM 18)*

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Quality Control Procedure

Crosslines

Crosslines were not collected on this project given immediate tasking needs of the emergency response and survey prioritzation of USCG identified areas. No crossline comparisons were performed.

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 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-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 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 0.2 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.

The Grid QA tool within QC Tools was used to analyze data density, grid resolution (when using VR surfaces), and uncertainty of gridded data.

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 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. 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.

Survey Adequacy

There are no factors that affect the survey's adequacy and accuracy.

Imagery Coverage

N/A

Data Interpolation

N/A

Junction Overlap

F00893 overlaps with H13508, a 2021 survey. Both survey's were visually compared and were found to generally agree on survey depths. The differences found were all found to be within allowable TVU.

Backscatter

N/A

Report of Survey

Uncertainty Source

Total Propagated Uncertainty (TPU) values for F00893 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 priori 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, F00893 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.

Supplementals

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 Mark Meadows	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	PO Computer	5909	2023-03-27	NA	NA
Positioning System	Trimble Unknown	Trimble GA830	24027	2023-03-27	NA	NA
Positioning System	Trimble Unknown	Trimble GA830	24121	2023-03-27	NA	NA
Positioning and Attitude System	Applanix Unknown	IMU: 10006630	6614	2023-03-27	NA	NA
Multibeam	Kongsberg Maritime EM 2040C	Dual EM 2040C	1435	2024-04-02	200-400kHz	2024-04-02
Multibeam	Kongsberg Maritime EM 2040C	Processing Unit 2U	20097	2024-04-02	N/A	2024-04-02
Multibeam	Kongsberg Maritime EM 2040C	HP RP5 Retail System Model 5810	CZC5503RFP	2024-04-02	N/A	2024-04-02
CTD	SonTek CastAway-CTD	400100	CC1433009	2023-02-16	N/A	2023-02-16
CTD	SonTek CastAway-CTD	400100	CC1433008	2023-01-20	N/A	2023-01-20
Sound Speed System	AML Oceanographic Micro SV-Xchange	Micro X	206566	2021-03-18	N/A	2021-03-18