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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey: __Navigable Area / Homeland Security__

Time Frame: __2002 Field Season__

2002

CHIEF OF PARTY

LCDR Andrew L. Beaver, NOAA

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DATE:____

Data Acquisition and Processing Report
to Accompany 2002 Hydrographic Surveys

NOAA Ship RUDE (s590)
LCDR Andrew L. Beaver, NOAA, Commanding

A. EQUIPMENT

A.1 Platforms

All data were acquired from NOAA Ship RUDE (s590, EDP #9040) and NOAA Survey Launch 1419. RUDE is equipped with multi-beam, vertical beam echosounders, and side scan sonar. Launch 1419 is equipped with vertical beam echosounders and side scan sonar. RUDE is a Class V Hydrographic Survey Ship, 90 feet in length overall, with a 22-foot beam and 7-foot draft. Launch 1419 is a 23-foot SeaArk aluminum launch, with an 8.5 foot beam, and 1.5 foot draft. Refer to Appendix III for more detailed vessel descriptions and equipment positioning diagrams.

A.2 Sounding Instruments

Vertical Beam Echo Sounder

RUDE and Launch 1419 are equipped with Odom Echotrac DF3200 MKII Dual Frequency Vertical-Beam Echosounders (VBES) configured for 24 and 200 kHz operation. Both frequencies are digitized and recorded at 5 Hz. Actual ping rates are dependent on the depth of water. Aboard RUDE, the VBES provides soundings during side scan sonar acquisition and quality control for the ship's multi-beam echosounder system (see below). On Launch 1419, the VBES is the primary sounding instrument.

On each platform, VBES data is logged by the Hypack software package (see section A.5 below), but paper records are acquired and retained for comparison with digitized depths during processing.

The VBES data was acquired in conjunction with side scan sonar or multi-beam echo sounder acquisition. Side Scan Sonar line spacing was dictated by the acquisition requirements of the survey. Multibeam echosounder data was acquired during shoal developments with a typical line spacing of 10 meters.

Shallow Water Multi-Beam Echosounder

RUDE is equipped with a RESON Seabat 8125 Shallow Water Multi-Beam Sonar System (SWMB). The SWMB is a 455 kHz multi-beam sonar designed for water depths of up to 248 meters. The 8125 utilizes an integrated transmit/receive head, which is pole mounted on the port side of the vessel. The 8125 projects a single transmit pulse, which is formed on receive into 240 beams, each 0.5° (across track) by 1.0° (along track). Due to incomplete water column characterization and shallow grazing angles the outer beams, (beams 1-22 and 225-240) were rejected during post-acquisition processing. The ping rate for the 8125 is 40.05 Hz to 3.02 Hz, depending on range scale. The 8125 transmit power level and Time Varied Gain (TVG) receiver gain controls were adjusted to minimize returns from water column clutter and surface reflection. The 8125 Depth filters were adjusted to remove aberrant shallow and deep returns during acquisition. During SWMB data acquisition, the ship was operated at speeds resulting in a minimum of 3.2 pings / 3 meters along track bottom coverage. The 8125 generates digital sounding data and backscatter that is logged by the ISIS software package (see section A.5 below).

A reference surface test was conducted in spring 2002 to assess the precision of the SWMB system. This test showed that under the prevailing conditions at that time and location, RUDE's sonar systems exceeded the International Hydrographic Organization "Special Order" specification. See the report attached in Appendix V for complete results. During data acquisition SWMB outer beams, and VBES or Nadir beams were continuously compared using the ISIS "Bathymetry Confidence" utility.

To achieve 100% MultiBeam Echosounder (MBES) coverage, lines were run parallel to bottom contours at spacing of approximately 2 ½ times the water depth. After initial acquisition, coverage plots were generated and reviewed, and additional lines were planned to fill any gaps.

Side Scan Sonar

RUDE and Launch 1419 carry Klein 5000 High Speed High Resolution Side Scan Sonar (HSHRSSS) towfish and Klein 3000 dual frequency towfish, respectively. All Klein 5000 side-scan sonar data were recorded digitally from the Transceiver and Processing Unit 5105 (TPU) using the ISIS software and archived in the Extended Triton Format (*.XTF) files (see section A.5). All Klein 3000 side-scan sonar data were recorded digitally from the TPU using the SonarPro software and archived in the SonarPro Data Format (*.SDF). KLEIN 5000 towfish transmits at 500 kHz. KLEIN 3000 towfish transmits at 100 kHz and 500 kHz.

RUDE's ship wake turbulence limits SSS acquisition by RUDE to depths greater than approximately 8 meters. SSS from Launch 1419 is similarly limited to depths greater than roughly 4 meters.

Side scan sonar lines were planned to run parallel to bottom contours, spaced according to the range scale appropriate for the water depth. Range scale of 75 meters was selected based on the Homeland Security project instructions. Lines were planned with 15m of overlap with adjacent swaths on either side.

Vessel speed was adjusted to ensure that an object one meter in characteristic size would be detected and clearly imaged across the sonar swath. Confidence checks were performed and noted frequently to ensure this standard of resolution was met.

Lead Line
A lead line was used to confirm the calibration of RUDE's VBES and SWMB systems in the spring of 2002. This test showed that under the conditions at the time of the calibration, RUDE's sonar systems exceed the IHO "Special Order" specification. See the report attached in Appendix V for complete results.

Diver Least Depth Gauge
RUDE divers were equipped with a diver least depth gauge for item investigations. The calibration report is included in Appendix V. The accuracy of RUDE's diver least depth gauge was also assessed as part of the Lead Line comparison test mentioned above.

A.3 Positioning and Attitude Instruments

RUDE

POS/MV 320
RUDE's primary positioning and attitude sensor is a POS/MV Model 320 Ver. 3. This system combines data from an inertial attitude sensor and carrier-phase GPS receivers to compute position, heading, heave, pitch, and roll to the accuracy required for shallow water multibeam sonar surveys. The three major components of the POS/MV are: an Inertial Measurement Unit (IMU) mounted at the ship's center of motion; two GPS antennas on the ship's mast mounted perpendicular to the line of the ship; and a Pos Computer System (PCS) processing unit on the bridge.

Differential GPS corrector input from an external source is required. The GPS receivers in the POS/MV processor compute RUDE's position and heading by measuring the phase difference of the GPS signals arriving at the two antennas and computing the vector between them. The resulting GPS position is corrected for the lever arm from the antennas to the center of motion. The GPS heading data and linear and angular acceleration values from the IMU are processed through Kalman filtering. This filter is designed to produce output that reflects high frequency changes in vessel position and attitude as measured by the IMU while constraining the drift of this sensor with the long-term stability of GPS.

Heave is computed by double integration of acceleration in the vertical axis as measured by the IMU. Since this measurement is subject to long term drift, the data are high pass filtered with a rolloff frequency and damping coefficient selected to stabilize the measurement while preserving the phase and amplitude of the ship's vertical position in sea states anticipated in RUDE's area of operations.

All data are corrected to the position of the IMU. The final position, heave, and attitude data are output to the Hypack and Isis data acquisition systems via RS-232 serial. This correction data is stored within the Hypack and Isis output data files. The POS/MV system is configured for 20 Hz output of the "TSS" Heave / Roll / Pitch message and 5 Hz output of the NMEA-0183 GGA and HDT messages. (See POS/MV settings Appendix II).

Trimble DSM-212L

RUDE's backup positioning system is a Trimble DSM-212L DGPS receiver. The DSM-212L is an integrated unit combining a 12 channel L1 C/A code receiver with a 2 channel Differential Beacon receiver. This unit is used primarily to receive USCG Differential Beacon messages, which are passed to the POS/MV. Although the DSM-212L has the ability to automatically select stations based on signal strength or geographic proximity, the receiver was manually tuned to avoid unexpected and undocumented changes in the differential beacon in use.

Position, time, and velocity data from the Trimble is available in a 1 Hz NMEA message as a backup to the POS/MV. The DSM-212L was configured using the "TSIP Talker" software to suspend output in the event NOS Hydrographic Position Control specifications were not met.

Magnavox MX-50

The MX-50 is a manually tuned single channel differential beacon receiver that is carried as a backup to the Trimble DSM-212L

Yokogawa CMZ700S Gyrocompass

RUDE is equipped with a Yokogawa CMZ700S gyrocompass. While this instrument serves primarily as a heading reference for navigation, its output is fed to the hydrographic survey systems as well. The CMZ700S is configured to deliver the NMEA-0183 HDT message at 5 Hz.

POS/MV Failures

The POS/MV Controller software version 1.2 enables the user to automatically calibrate the lever arm configuration settings. This is accomplished by activation of the GPS Azimuth Measurement Subsystem (GAMS) Calibration Controller. This was first conducted on April 24, 2002. It was necessary to repeat the procedure at intermittent times throughout the field season. Calibration settings determined by the GAMS Calibration Controller did not vary sufficiently to affect data quality or accuracy.

On May 7, 2002, the POS/MV heave bandwidth and heave damping ratio were adjusted to correct for long-term heave anomalies observed in the multibeam data. Multibeam data was monitored throughout the season to ensure that varying sea states did not produce further heave artifacts.

Between April 24, 2002 and May 30, 2002, the POS/MV was subject to frequent failures of the primary GPS receiver on days of high precipitation. On May 20, 2002, the primary GPS antenna was replaced. The problem was not corrected. On May 31, 2002, the GPS antenna cable for the primary GPS receiver was replaced resolving the problem.

On July 15, 2002, the POS/MV Controller settings for "Reference to Primary GPS Lever Arm" and "IMU frame with respect to Reference Frame" were determined to be incorrect utilizing multibeam imagery. It was ascertained that the port side antenna is the primary antenna (the offsets were configured with the starboard side antenna as primary) and the correct offsets were entered into "Reference to Primary GPS Lever Arm. The IMU position was re-measured and was determined to be incorrectly oriented. The corrected orientation settings were entered into "IMU frame with respect to Reference Frame". The orientation changes corrected the problems observed. Multibeam imagery was monitored throughout the remainder of the season for indications of incorrect offsets.

LAUNCH 1419

Starlink DNAV-212

Launch 1419 is equipped with primary and backup Starlink DNAV-212 DGPS receivers, which provide position, timing, velocity, and course. The Starlink is an integrated 12 Channel L1 C/A code and 2 Channel Differential Beacon receiver. The Starlink receivers were configured with the "Starinit" software to suspend output in the event NOS Hydrographic Position Control specifications are not met, and manually tune the differential beacon receiver to the desired frequency. The Starlink receivers produce the NMEA-0183 GGA and VTG messages at 1 Hz.

S.G. Brown Meridian Surveyor Gyrocompass

Launch 1419 is equipped with an S.G. Brown Meridian Surveyor gyrocompass. This instrument serves as a heading reference for navigation and its output is fed to the hydrographic survey systems as well. The Meridian Surveyor is configured to deliver the NMEA-0183 HDT message at 10 Hz.

Heave and Attitude

Launch 1419's primary positioning and attitude sensor is a TSS Dynamic Motion Sensor DMS05. This system combines data from an inertial attitude sensor and carrier-phase GPS receivers to compute position, heading, heave, pitch, and roll to the accuracy required for shallow water vertical beam sonar surveys. The major component of the DMS05 is a Linear Accelerometer Array mounted amidships on the boat's starboard side.

GPS speed and vessel track information from the DNAV-212 GPS receiver is utilized by the DMS05 for calculations during vessel turns. The GPS speed is used in the calculation to determine the value for centripetal acceleration. The GPS vessel track information provides a reference for the vertical rate sensors to eliminate the affects of drift or accumulative errors in the measurement of the rate of turn (ω) and allows a more accurate assessment of the magnitude of centripetal acceleration. The GPS input becomes ineffective if the vessel speed falls below 1 meter/sec.

Heave is computed by double integration of the output from the linear accelerometer array. A filtering action takes place after each integration to limit the low frequency response of the system and to allow recovery from the erroneous effects of random noise and horizontal acceleration. A bandwidth period of 12 seconds was chosen to optimize the phase and amplitude of the vessel's vertical position to sea states anticipated in Launch 1419's area of operations.

The final heading, position, heave, and attitude data are output to the Hypack data acquisition system via RS-232 serial. The SonarPro system receives GPS information only.

A.4 Ancillary Instruments

Sound Velocity

Conductivity, temperature, and depth profiles were acquired using two Seabird Seacat SBE-19 Conductivity, Temperature, and Depth (CTD) profilers. The SBE-19 is a self-contained, battery-powered unit with a serial interface for configuration and data download. RUDE's SBE-19's are equipped with a 300 psi pressure gauge to provide high resolution data in the relatively shallow water typical of RUDE's areas of operations. Sound velocity files in CARIS format were computed using the "Velociwin" software described in section A.5.

During MBES data acquisition, CTD casts were conducted when starting work in an area and every 4 hours thereafter, or when the surface sound velocity was observed to have drifted outside accepted limits as discussed below. For VBES data, casts were conducted weekly or when survey personnel suspected a significant change in the properties of the water column. The calibration records are included in the Appendix V.

Surface sound velocity was continuously monitored during acquisition with a Odom Hydrographic Digibar Pro sound velocimeter. During MBES data acquisition, a new CTD cast was taken if the surface sound velocity was observed to have changed more than +/-2 m/s from its value at the last CTD cast. The calibration records for this instrument are included in Appendix V.

Monthly comparisons of the two Seacat CTDs and weekly comparisons between the CTD in use and the Digibar Pro were conducted to monitor data quality from these instruments.

Cable Counter

RUDE is equipped with an MD Totco Cable counter that measures the side scan towfish tow cable by counting revolutions of the towing block on the A-frame. The length of cable deployed is computed automatically and output to Hypack.

Launch 1419 cable counter is read by the operator and manually input into the SonarPro software.

Bottom Sampler

Where required by project instructions, RUDE personnel acquired sediment samples from the sea floor in the survey area. The primary tool for this operation is a “clamshell” style gravity-closed sediment sampler, which penetrates approximately 0.05m into the bottom.

A.5 Data Acquisition and Processing Software

Coastal Oceanographics Hypack Max is used for survey navigation, Detached Positioning (DP), and VBES data logging. Hypack is also used for overall data acquisition control, and passes file names, line start and end messages, and fix numbers to ISIS via a serial link. In addition, during side scan sonar operations, Hypack collects cable out data and computes towfish position, which, along with raw water depth from the VBES, was also passed to ISIS.

Shallow Water Multibeam and Side Scan Sonar data is collected in the Triton Elics International ISIS software package (v5.84) and logged in the “eXtended Triton Format (.xtf) file format. Because of improved timing precision, vessel position is logged to the “sensor” field of the XTF data structure, and towfish position, if present, was recorded in the “ship” position. Water depth, required for recomputation of towfish position, is stored in “Aux 1”. Cable count was recorded in “Aux 2” and moved to the “cable out” field during post-acquisition. The program XTFFieldSwap.exe accomplished the “Aux 2 “to” “cable count” conversion. The XTFFieldSwap program was provided by Triton as a fix to ISIS v5.84.

The PCs running Hypack and Isis were automatically synchronized to UTC time from the NMEA-0183 GPS messages.

CTD casts were downloaded and processed in the Velociwin program supplied by the Hydrographic Systems and Technology Program (HSTP). This software was also used to process diver's least depth gauge readings.

Preliminary tide data was either directly collected from the Center for Operational Oceanographic Products and Services' web site, or sent to RUDE via the "Tidebot" automated tides email system. Verified tides were downloaded from the CO-OPS web site as they became available. All tide data was zone corrected using either MapInfo's ZDF file creation utility or HSTP's "HP Tools" software.

All sonar data was processed in the CARIS HIPS system.

Processed soundings, side scan sonar contacts, dives, and DPs were inserted and analyzed in HSTP's "Pydro" software. This system was used for all feature assessment and bathymetry excessing.

Final plots were generated in the Mapinfo Professional GIS. Bathymetry gridding and difference mapping for surface analysis in Mapinfo was accomplished using Northwood Geosciences "Vertical Mapper".

Please refer to Appendix II for tables listing data acquisition and processing hardware serial numbers and software versions.

B. QUALITY CONTROL

Please refer to Appendix III for detailed Data Acquisition and Processing Flow Diagrams

B.1 Bathymetry Data

Vertical Beam Sonar Data

Vertical Beam sonar data were converted from Hypack format to CARIS format using the CARIS "Hypack" data converter (See Conversion Parameters Appendix II).

After conversion, the data were opened in CARIS Navigation Editor, Attitude Editor, and Single Beam Editor. Vessel navigation data was manually checked for speed jumps greater than 2 knots, which were rejected with interpolation.

Attitude data (if present) were checked for errors or gaps. Sounding were checked for aberrant pings.

Survey personnel scanned raw VBES soundings in CARIS Single Beam Editor. The digital data were compared with analog paper records to ensure no valid depths were missed by the bottom detection algorithm or aberrant pings were accepted. Low frequency soundings found to be more shoal than the corresponding high frequency depths were manually “selected”.

Multibeam Sonar Data

Multibeam sonar data were converted from XTF format to CARIS format using the CARIS converter (See Conversion Parameters Appendix II)

After conversion, the data were opened in CARIS Navigation Editor, Attitude Editor, Swath Editor, and Subset Editor. Attitude data was checked for errors or gaps. Vessel navigation data was manually checked for speed jumps greater than 2 kts, which were rejected with interpolation. Raw MBES soundings were first observed in CARIS Swath Editor. Occasionally, bottom type of the survey area or sea state during acquisition caused aberrant pings. These “fliers” were rejected. In main scheme areas survey personnel employed the CARIS depth filter to facilitate cleaning. The filter was configured as a window with appropriate lateral, upper, and lower constraints chosen based on the expected mean depth and the variability of bathymetry. After applying the filter, survey personnel reviewed the data to ensure that only those soundings that were clearly incorrect had been rejected (See Conversion Parameters Appendix II).

Soundings were then examined in CARIS Subset Editor. Survey personnel examined questionable soundings on a case by case basis, with consideration given to any side scan sonar features in the area, the receive strength of the echo, and surrounding soundings. All soundings that remained ambiguous after this process were identified for further investigation and left in the data set.

Final Processing of Sounding Data

After the initial scan of VBES and MBES soundings, the data were sound velocity corrected. The sound velocity profiles that were nearest in time were applied to the sounding data.

Zoned tides were applied in the field to all bathymetry data. Preliminary observed water levels were obtained from either the CO-OPS web site or through Tidebot email. The tide Zone Definition File (ZDF) was either supplied with the project information or created through MapInfo’s export tide region to CARIS HIPS ZDF format utility supplied by HSTP. The resulting zone file and tide files were applied to the corresponding data in CARIS, and merged. When Verified Tides became available, these data were downloaded from the CO-OPS site and applied to the bathymetric data through a re-merge.

Once data acquisition and processing was complete for a particular area, survey personnel check scanned all soundings in CARIS subset mode. Subset mode was used for check scanning because it provides an opportunity to examine data in the context of surrounding lines, therefore highlighting errors which may have affected only a specific line or day. In areas of 100% MBES coverage, overlap also allowed many of the ambiguous soundings identified during the initial scan to be resolved.

After final data cleaning and correction was complete, survey personnel created a CARIS field sheet. The data was gridded with a 0.33 - 5m resolution, from which digital terrain models and sun-illuminated images were drawn. These products were analyzed to assess coverage and highlight remaining data problems.

B.2 Side Scan Sonar Imagery

All side scan sonar imagery was converted from SDF or XTF formats to CARIS format using CARIS converters (See conversion parameters Appendix II).

After conversion, the data were opened in CARIS Navigation Editor, Attitude Editor, and Side Scan Editor. Survey personnel checked vessel attitude (if present), cable out, Gyro, and sonar height. Vessel navigation data was manually checked for speed jumps greater than 2 kts. Data showing these speed jumps were rejected with interpolation.

After confirming the validity of the vessel navigation, cable out, and towfish depth values, survey personnel then use the “recompute towfish navigation” function to calculate towfish position. The CARIS towfish positioning is based on a smoothed course made good value from the towing vessel.

Side scan sonar data were scanned in CARIS Side Scan Editor. Survey personnel corrected errors in bottom tracking, slant range corrected the imagery at default resolution (0.1m), and scanned the data for significant contacts. Contacts deemed “significant” included, but were not limited to, contacts with a shadow indicating a contact height of 1 m or greater in water depths of 20m or less or contact heights 10% of the water depth in water deeper than 20m. Other contacts considered significant by RUDE personnel included smaller contacts in particularly shoal areas or channels, cables and pipelines, large sand wave ridges, and contacts of possible historical significance.

Point feature contacts were picked using CARIS “single point contacts”. Larger and line features were picked using CARIS “multipoint contacts”. All contacts were descriptively labeled and feature codes selected if conclusive identification was possible. Tif images of all contacts were saved. After the initial SSS imagery scan, a check scan of all data was conducted.

Survey personnel assessed SSS coverage by using CARIS to mosaic side scan data. These mosaics were drawn at 1 - 5m resolution, using the "interpolation" and "autoseam" options.

B.3 Data Analysis

HSTP's Pydro software package was the primary tool for sounding and feature integration and assessment. Side scan contacts and detached positions were inserted into the Pydro Preliminary Smooth Sheet (PSS). Bathymetry was imported into Pydro at a 15m by 15m shoal biased grid. Survey sheet officers used Pydro to assess and categorize contacts, and suppress soundings to produce a shoal biased bathymetry data set at the scale of the survey.

Pydro provides four flags for categorizing features: "Significant", "Chart", "Investigate", and "DTON". In addition, pydro provides "Primary" and "Secondary" flags for grouping correlated features.

After insertion, SSS features were first categorized by significance. Contacts that met the standard of significance described in section B.2. were marked as such; those contacts which were deemed insignificant were marked "Resolved" and not investigated further. Also, multiple contacts representing the same physical feature were grouped. The contact that the hydrographer believed best represented the feature (typically, the most clear SSS image) was selected as the "Primary" contact, while the rest were flagged as "Secondary."

Significant contacts were then reassessed to determine if additional investigation (typically SWMB development) was required. Using the "bathymetry grid" feature of pydro, the hydrographer checked the bathymetry coverage of the contact in question. If additional bathymetry was required, the "investigate" flag was checked. This could then be queried in Mapinfo to select only those contacts requiring development for line planning.

After contacts were sufficiently investigated, they were further assessed to determine whether they required charting. Features that the hydrographer believed should be added or retained on the chart were marked as such. Features that posed a special threat to vessel traffic had their shoal soundings marked as "DTONS", and a Danger to Navigation Report was generated.

Using Pydro, a single physical feature selected for charting can have as many as three "Primary" features associated with it. The first is the SSS feature, which has imagery of the contact, but low positional accuracy. Second, the contact can have a significant bathymetry sounding selected, which contains the least depth and position at which the feature should be charted. Finally, if the feature was investigated by divers, the detached position from the dive may be selected as a primary feature as well.

Contacts and bathymetry analyzed in Pydro were opened in Mapinfo for plotting and contact development planning. Contact and sounding plots were printed at survey scale for final survey assessment.

C. CORRECTIONS TO ECHOSOUNDINGS

It is OCS and RUDE policy that all data be acquired and logged in raw format without application of any corrections for vessel offsets, sensor alignment, sound velocity profile, or tides. These factors are logged separately or contained in the CARIS "Vessel Configuration File" (VCF), and applied in post-acquisition data processing.

C.1 Vessel Offsets and Static Draft

RUDE

Vessel offsets for NOAA Ship RUDE were last measured during the 1999-2000 winter inport while the ship was in drydock. The POS/MV IMU position was measured at the beginning of the field season, and again during the course of the field season. These measurements are reflected in the offset drawing included in Appendix III.

On April 26, May 2, and May 7, 2002 RUDE conducted patch tests to determine navigation timing and multi-beam head alignment errors for the CARIS Vessel Configuration File. The results of this operation are included in Appendix III.

Launch 1419

Launch 1419's offsets were measured on September 9, 2002 after the boat was delivered from SeaArk Marine. See Appendix III for 1419's offset diagram

Application

Static transducer offsets are applied to all bathymetry data during the CARIS "SVP Correct" operation. Horizontal offsets are applied during CARIS "Merge".

C.2 Dynamic Draft

RUDE

RUDE's dynamic draft was determined by traditional rod leveling methods. A report describing this operation and its results is included in Appendix III

Launch 1419

Launch 1419's dynamic draft was determined by traditional rod leveling methods. A report describing this operation and its results is included in Appendix III

Application

Dynamic Draft corrections are applied to all bathymetry data in the CARIS "SVP Correct" operation.

C.3 Attitude and Heave

Heave, pitch, and roll corrections are applied to all bathymetry data in the CARIS "SVP Correct" operation. Yaw corrections are applied during CARIS "Merge".

C.4 Sound Velocity Profile

RUDE carries two Seabird SBE-19 Conductivity, Temperature, and Depth profilers. These instruments are returned to the manufacturer yearly for calibration. Records of the latest calibrations are included in Appendix IV

RUDE personnel conducted weekly CTD data quality assessments comparing CTD readings to surface sound velocity and seawater temperature measured by the Digibar Pro and engine room sea chest thermometer. In addition, dual CTD casts were conducted monthly, and processed using the Velociwin "comparison cast" feature.

As described in Section A.4, A.5, and B.1, raw conductivity, temperature and depth data were processed to produce sound velocity files in CARIS format. These profiles are applied in CARIS "SVP Correct".

C.5 Water Levels

Soundings were corrected to Mean Lower Low Water using first Preliminary Unverified tides, and then Verified tides when available, according to the procedure described in Section B.1. All raw tide data were corrected according to the zoning provided with the relevant project instructions prior to application to bathymetry data.

During bathymetric data collection, subordinate gauges included in the project instructions were monitored via the CO-OPS web site, "Tidebot" email, and the CORMS Morning Report. When water level measurement problems were suspected, RUDE personnel brought them to the attention of CO-OPS staff before continuing bathymetric data acquisition.

Water level corrections are applied during CARIS "Merge".

D. APPROVAL SHEET

LETTER OF APPROVAL

Data acquisition and processing were conducted under my direct supervision with frequent personal checks of progress and adequacy. All equipment was continuously monitored for proper operation during data acquisition and all supplemental and supporting records were reviewed in their entirety.

This Data Acquisition and Processing Report is adequate to accompany all Descriptive Reports for surveys including data collected during NOAA Ship RUDE's 2002 Field Season.

Respectfully Submitted:

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Approved:

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