U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Data Acquisition and Processing Report

Type of Survey: Hydrographic

Project No.: S-T342-AHI-09

Time Frame: April 2009

LOCALITY

State: Hawaii

General Locality: North Pacific Ocean

2009

CHIEF OF PARTY
Paul Turner, NOAA

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APPENDICES

INTRODUCTION

This hydrographic project was completed as specified by Hydrographic Survey Letter Instructions S-T342-AHI-09, signed March 27, 2009. This Data Acquisition and Processing Report includes project level information common to Sheet A (H12046 - Honolulu Harbor, HI) and Sheet B (H12047 - Approaches to Honolulu, HI).

All sheets have the general locality of North Pacific Ocean and are located in the state of Hawaii.

Survey specific details will be listed in Descriptive Reports as needed. Unless otherwise noted, the acquisition and processing procedures used and deliverables produced are in accordance with the NOAA *Hydrographic Survey Specifications and Deliverables Manual (HSSDM) April 2008*, the *Field Procedures Manual (FPM), May 2008 and* Hydrographic Surveys Technical Directives (HTD) 2008-5, 2008-9 and 2009-2.

R/V AHI – F2505

A EQUIPMENT

Descriptions of the equipment and systems used during project S-T342-AHI-09, including hardware and software used for data acquisition, data processing and horizontal and vertical control operations are listed below.

1.0 Hardware

1.1 Hardware Systems Inventory

Information on the hardware used during project S-T342-AHI-09 is included in the 2009 RV AHI Systems Inventory spreadsheet located in Appendix 4 of this report.

1.2 RESON 8101ER Multibeam Echosounder (MBES)

The AHI is equipped with a RESON SeaBat 8101 MBES with the Extended Range and snippet option. The 8101ER is a 240 kHz multibeam system with a swath coverage of 150°. The swath is made up of 101 discrete beams with an along-track and across-track beamwidth of 1.5°. It has a specified depth range of up to 500 meters. The typical operational depth range of the 8101 during the project was 3 to 40 meters.

The 8101 transducer is rigidly attached along the keel of the vessel as shown in Figures 1 and 2 below.

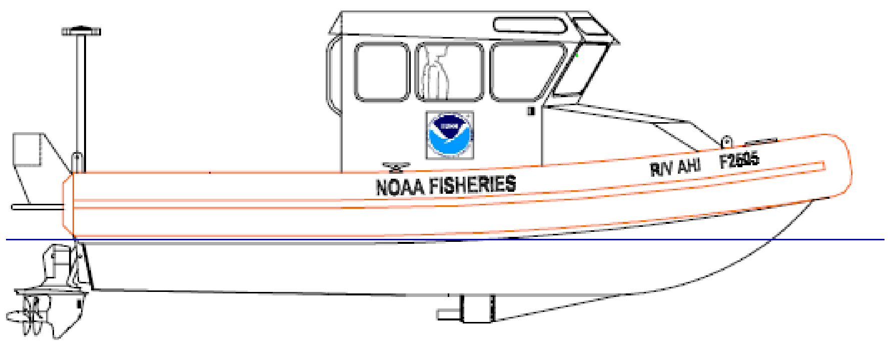

Figure 1 – Side View of Reson 8101 Transducer Mount

Figure 2 – Reson 8101 Transducer

1.3 Manual Sounding Equipment – Lead Lines

A description of the lead line used for echosounder comparison tests is included in the 2009_AHI Lead Line Comparison Report located in Appendix 5.

1.4 Positioning, Heading, and Attitude Equipment

1.4.1 TSS Positioning and Orientation System for Marine Vehicles (POS/MV)

The AHI is equipped with a TSS POS/MV 320 V4, configured with TrueHeave. The POS/MV calculates position, heading, attitude, and vertical displacement (heave) of a vessel. It consists of a rack mounted version 2.12 POS Computer System (PCS), a strap down IMU-200 Inertial Measurement Unit (IMU), and two Trimble GPS antennas corresponding to GPS receivers in the PCS. The AHI's POS MV IMU is located along the centerline of the vessel, 0.80 m. forward of the reference point. The primary GPS antenna is mounted on the forward, port side of the cabin and the secondary antenna is mounted on the aft, starboard side of the cabin.

Timing between the sonar swath, position, heading and attitude information was synchronized by utilizing the POS/MV 320 PPS signal and a time card in the ISS-2000 acquisition computer. The PPS signal synchronized the time the ISS-2000 computer which then sent a serial timing signal to the RESON topside unit. Vessel wiring diagrams are included in Appendix I.

POS/MV controller software was used to monitor position accuracy and quality during data acquisition. This ensured that positioning accuracy requirements were met, as outlined in the *HSSDM*. The POS/MV controller software provides clear visual indications whenever accuracy thresholds are exceeded.

GAMS (GPS Azimuth Measurement Sub-system) calibrations were performed on the AHI's POS/MV unit on March 13, 2007. The GAMS calibration procedure was conducted in accordance with instructions in chapter 4 of the *POSMV V4 Installation and Operation Guide*, 2005. Results and screen grabs of the POS/MV setup are included in the 2007 RV AHI POS-MV spreadsheet located in Appendix 5.

1.4.2 CSI Wireless MBX-35

R/V AHI is equipped with a CSI Wireless MBX-35 DGPS receiver which was used to supply RTCM messages to the POS/MV for differential GPS positions.

1.5 SBE 19 SEACAT Profiler

An SBE 19 SEACAT Conductivity, Temperature, and Depth (CTD) sound velocity profiler (s/n 3029) was used to acquire all sound velocity data during the project. The SBE 19 SEACAT sound velocity profiler was calibrated by the manufacturer in June 2008 and the calibration files are located in Appendix IV.

1.6 Vertical Control Equipment

1.6.1 Water Level Gauges

No water level gauges were installed by NOAA personnel. See the Tide Requirements document (T342AHI2009.doc) included with the project data for further information on stations and tide requirements.

2.0 Software

2.1 Software Systems Inventory

Information on the software used during project S-T342-AHI-09 is included in the 2009 RV AHI Systems Inventory spreadsheet located in Appendix 4 of this report.

2.2 Data Acquisition Software

2.2.1 SAIC ISS-2000 Software

R/V AHI is equipped with Science Applications International Corporation (SAIC) ISS-2000 Integrated Survey System. This is a fully integrated data planning, acquisition, and processing software package. The software is described in the SAIC_ISS2000.pdf document located in Appendix 6.

2.3 Data Processing Software

2.3.1 NOAA Hydrographic Systems and Technology Programs (HSTP) Software

Sound velocity data is processed with Velocwin, in-house software produced and maintained by NOAA's Hydrographic Systems and Technology Programs (HSTP) division, along with Sea-Bird SeaTerm and Sea-Bird SBE Data Processing software.

2.3.2 CARIS

CARIS HIPS (Hydrographic Information Processing System) is used to process all shallow water multibeam data including data conversion, filtering, tide correcting, merging and cleaning. CARIS HIPS also calculates the Total Propagated Error (TPE) used to produce Bathymetry Associated with Statistical Error (BASE) surfaces which assist the Hydrographer in data cleaning and analysis.

2.3.3 MapInfo

MapInfo is used to review tables and workspaces associated with assigned projects received from Hydrographic Survey Division (HSD). MapInfo may also be used to produce scaled plots produced for public relation purposes. HydroMI, an HSTP produced MapBasic program, is used through MapInfo to convert tide and tidal zoning files into a format that is useable in CARIS HIPS, and obtain latitude/longitude coordinates for pre-survey planning.

3.0 Vessels

The NOAA Research Vessel AHI (F-2505), a 25 ft. aluminum-hulled launch, was used to acquire all multibeam and sound velocity data during the project.

A description of the vessel and offset measurements are included in Appendix 1.

4.0 Data Acquisition

4.1 Horizontal Control

Differential GPS (DGPS) was the sole method of positioning used during the project. Differential correctors were supplied to the POS/MV by a CSI Wireless MBX-35 DGPS receiver.

4.2 Multibeam Echosounder Acquisition and Monitoring Procedures

All multibeam data were acquired in Generic Sensor Format (GSF) using Science Applications International Corporation's (SAIC) ISS-2000 software. The data were monitored in real-time using the ISS-2000 data display windows and the on-screen displays for the RESON SeaBat 8101ER. Range scale, power, gain, and pulse width were adjusted directly using the Reson controller to ensure best data quality. Additionally, vessel speed was adjusted as necessary to ensure the required along-track coverage for object detection in accordance with the HSSDM and FPM. Vessel speed generally ranged from four to five and a half knots.

4.3 Shoreline Verification

Shoreline verification was not required for this project.

5.0 Bottom Sample Acquisition

Bottom samples were not required for this project.

B QUALITY CONTROL

1.0 Uncertainty Modeling

Error values for the multibeam and positioning systems on R/V AHI were compiled from manufacturer specification sheets for each sensor (Heave, Pitch, Roll, Position, and Heading) and from values set forth in the FPM.

The following TPE values for tide and sound velocity were used during the project:

TPE Type	Value Used	Comments
Tide Value Measured	0.01	RSS of error estimates associated with each six minute tidal value.
Tide Value Zoning	0.07	1 sigma value derived from T342AHI2009 tide document.
Sound Speed Value Measured	0.50	Estimated error for SeaBird 19 Profiler.
Sound Speed Value Surface	0.00	No sound velocity correction was used at the transducer face.

The final uncertainty values (no change for 2009) for R/V AHI are shown in the 2007 RV Vessel Offsets spreadsheet located in Appendix 1. Uncertainty values relating to vessels and survey systems were entered into the HIPS Vessel File (HVF). Uncertainty values for tide and sound velocity were entered during the CARIS Compute TPE process.

2.0 Data Processing and Review

Raw GSF multibeam data were converted to Caris HDCS format. True Heave and water level data were then applied to all lines and the lines merged. Once lines were merged Total Propagated Error (TPE) was computed.

Vessel heading, attitude, and navigation data were reviewed in HIPS navigation editor and attitude editor. Where necessary, fliers or gaps in heading, attitude, or navigation data were manually rejected or interpolated for small periods of time.

BASE surfaces were created using the Combined Uncertainty and Bathymetric Estimator (CUBE) algorithm and parameters contained in the Cubeparams_NOAA.xml. BASE surfaces were created using the parameters specified in the file associated with the grid resolution.

Multibeam data were reviewed and edited in HIPS swath editor and in subset mode as necessary. The BASE surface was used for directed data editing in subset editor, to demonstrate coverage, and to check for errors resulting from tide, sound velocity, attitude and timing.

A detailed listing of the resolutions and depth ranges used during the processing of each survey, along with the corresponding fieldsheet(s), will be provided in the descriptive report of each survey.

In areas of navigational significance where the BASE surface did not depict the desired depth for the given area, a designated sounding was selected. Designated soundings were selected as outlined in Chapter 5 of the *HSSDM*.

C Corrections to Echo Soundings

1.0 Vessel HVFs

A CARIS HIPS Vessel Files (HVF) was created for multibeam data. The multibeam HVF is used only to define the AHI's equipment uncertainty, as all offsets and sound velocity are applied during acquisition.

After data collection was begun, an offset was noted in the data and tracked down to a constant 0.8 m draft offset being applied in the ISS-2000 software. It was decided to leave the offset in the software and correct the data in CARIS using a -0.8 meter offset applied in the Z value for the Swath 1 sensor in the AHI_F2505_RESON8101_09.hvf.

The HVF is included in Appendix 3.

2.0 Vessel Offsets

Sensor offsets were measured with respect to the AHI's reference point (RP). A vessel survey was completed for the R/V AHI on March 15, 2007 and the vessel offset report is included in Appendix I. As no changes were made to any of the AHI's survey or position sensors and equipment since the 2007 survey only a simple verification survey was completed in 2009 and is described in the 2009_AHI_Verification_Survey document in Appendix 1.

3.0 Dynamic Draft

Dynamic draft observations were conducted for the AHI on May 17, 2009 in Kalihi channel (outside the Port of Honolulu) using a surface analysis method. The final results are included in the DDSSM_AHI spreadsheet located in Appendix 5.

4.0 Patch Test

A patch test was conducted for the multibeam acquisition system on the AHI on April 14, 2009. The results of the patch test are included in the 2009 RV AHI MBES_Cal_Table.xls spreadsheet located in Appendix 5.

5.0 Attitude

All attitude corrections were generated by the POS/MV using data from the IMU-200 Inertial Measurement Unit (IMU). IMU values for uncertainty of heave, pitch and roll are included in the 2007 RV AHI Vessel Offsets.xls spreadsheet located in Appendix I.

5.1 True Heave

R/V AHI is equipped with the POS/MV TrueHeave (TH) option. True Heave is a ‘delayed’ heave corrector as opposed to ‘real time’ heave corrector and is fully described in Section 6 of the *POS/MV Version 4 Installation and Operation Manual*. Daily TH files were logged through the Ethernet Logging function in the POS/MV controller software. To ensure proper calculation of TH, files were logged for at least three minutes past the end of each day’s survey operations.

6.0 Sound Velocity

Sound velocity profiles were acquired with a SeaBird Electronics SeaCat SBE 19 Conductivity, Temperature, and Depth (CTD) profiler. Daily sound velocity profiles from the SBE 19 were downloaded using Velocwin and Sea-Bird SeaTerm software. Sea-Bird SBE Data Processing software was then used to process and create a converted data (.cnv) file which was loaded into the ISS-2000 software and used to correct multibeam data for sound velocity during data acquisition. Sound velocity profiles were not applied in during CARIS data processing.

Sound velocity casts were conducted at a minimum of one cast for every four hours of data acquisition.

7.0 Water Level

The vertical datum for this project is Mean Lower-Low Water (MLLW). Predicted water level correctors from the primary tide station at Honolulu, HI (163-2340) were downloaded from the CO-OPS website and used for water level corrections during the course of the project.

The files for the relevant days were collated into a tide station master file which was converted to CARIS .tid file format in MapInfo using HydroMI. Water level data in the .tid files were applied to data using the zone definition file (T342AHI2009CORP.zdf). This zoning file was created using the CO-OPS zoning files in MapInfo table format and Hydro MI’s “Export Tide Region to CARIS HIPS zdf File” utility. The zoning table was saved in a Latitude, Longitude projection and exported. This was necessary as the original .zdf file supplied by CO-OPS was in X,Y coordinates which did not open in CARIS HIPS. The new .zdf file was checked against the original to ensure that the areas and correctors applied to the tide data was accurate.

The Descriptive Report for each survey will indicate the source of final approved water levels and the date they were applied to the data.

See the Tide Requirements document (T342AHI2009.doc) included with the project data for further information on stations and tide requirements.

D Approval Sheet

As project leader, I have ensured that standard field surveying and processing procedures were used during this project in accordance with the Field Procedures Manual (May, 2008) and the NOS Hydrographic Surveys Specifications and Deliverables Manual (2008) and all relevant Technical Directives issued through April, 2009. All departures from these standard practices are described in this Data Acquisition and Processing Report and/or the relevant Descriptive Reports.

I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

Digitally signed by Kurt Brown
Date: 2009.05.06 08:32:43 -07'00'

Approved and Forwarded: ______________________________
Kurt Brown, Physical Scientist, NOAA