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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

Data Acquisition & Processing Report

Type of Survey: Hydrographic

Project No.: S-P909-FA-07

Time frame: May - August 2007

LOCALITY

State: Alaska

General Locality: Vicinity of Semidi Islands

2007

CHIEF OF PARTY

CDR Andrew L Beaver, NOAA

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DATE

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HVFs, DeviceModel, and Sound Speed DQA data

INTRODUCTION

This hydrographic project was completed as specified by Hydrographic Survey Project Instructions S-P909-FA-07, signed April 25, 2007. This Data Acquisition and Processing Report includes project level information common to sheet E, H11687.

This sheet has the general locality of Vicinity of Semidi Islands and is located in the state of Alaska.

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 2007*, and the *Field Procedures Manual (FPM), March 2007*. Hydrographic Surveys Technical Directives (HTD) 2004-1, and 2007-1 through 2007-8 were followed during the course of this project.

A EQUIPMENT

Detailed descriptions of the equipment and systems, including hardware and software, used for bathymetric data acquisition, horizontal and vertical control operations, shoreline acquisition, and processing are listed below.

1.0 Hardware

The hardware listed in this section was used during project S-P909-FA-07.

1.1 Hardware Systems Inventory

Detailed hardware information, including installation dates and serial numbers, is included in Appendix I of this report. Manufacturer's product specifications are included in Appendix II.

1.2 Echo Sounding Equipment

1.2.1 Reson 8111ER Multibeam Echosounder (MBES)

FAIRWEATHER is equipped with a RESON SeaBat 8111 MBES with the Extended Range (ER) and snippet options. The 8111ER is a 100 kHz multibeam system with swath coverage of 150°. The swath is made up of 101 discrete beams with an along-track and across-track beamwidth of 1.5°. The typical operational depth range of the 8111ER on the FAIRWEATHER is 20 to 600 meters. No calibration information was provided by the manufacturer for the system.

The 8111ER is hull-mounted within a reinforced projection that extends 27 inches below the keel. It is located 39.5" starboard of the centerline at approximately frame 29. It has a specified depth range of 3 to 1200 meters.

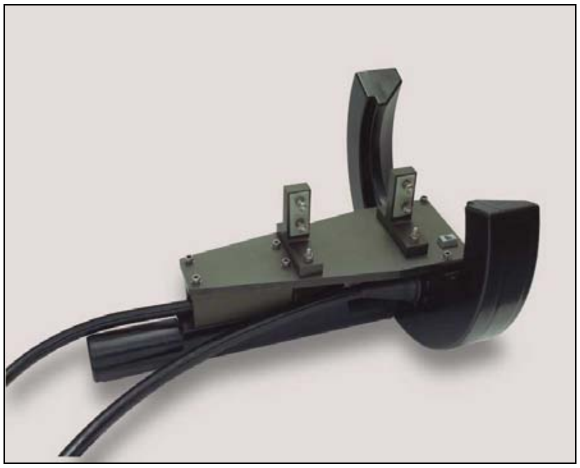

Figure 1: RESON SeaBat 8111ER MBES

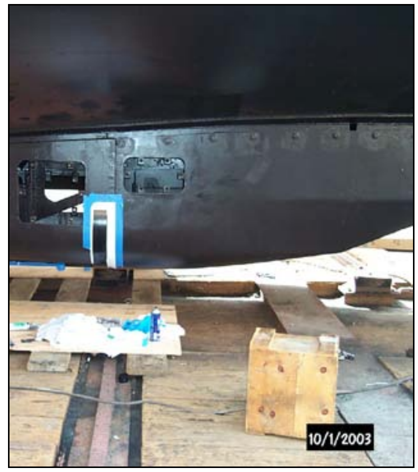

Figure 2: RESON SeaBat 8111ER MBES on FAIRWEATHER

Figure 3: RESON SeaBat 8160

Figure 4: RESON SeaBat 8160 on FAIRWEATHER

1.3 Positioning, Heading, and Attitude Equipment

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

FAIRWEATHER is equipped with a TSS POS/MV 320 V4, configured with TrueHeave™ and Precise Timing. 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 GPS antennas corresponding to GPS receivers in the PCS. The port side antenna is designated as the primary receiver, and the starboard side antenna is the secondary receiver. Differential correctors are supplied to the POS MV by a CSI wireless MBX-3S Automatic Differential GPS receiver. On May 6, 2007 (DN 126) FAIRWEATHER changed the POS MV firmware to version 3.41 and the controller software to version 3.4.0.0.

For all multibeam systems aboard FAIRWEATHER, timing between the sonar swath, position, heading and attitude information was synchronized by utilizing the TSS POS/MV 320 v.4's. A timing string was sent from the POS/MV to the RESON topside unit and to the ISIS computer recording the incoming data. Vessel wiring diagrams are included in Appendix III.

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.

1.3.2 POS/MV GAMS Calibration

GAMS (GPS Azimuth Measurement Sub-system) calibrations were performed on each of the three POS/MV units. The GAMS calibration procedure was conducted in accordance with instructions in chapter 4 of the *POSMV V4 Installation and Operation Guide*, 2005. Results are included in the individual vessel reports and spreadsheets, with calibration details located in Appendix III-5.

1.3.3 CCSI Wireless MBX-3S DGPS Receiver

FAIRWEATHER is equipped with commercial grade CSI Wireless MBX-3S DGPS Receivers that are used in conjunction with TSS POS/MV to provide vessel positioning during data acquisition. The DGPS receivers are configured in manual mode to allow reception of only one U.S. Coast Guard (USCG) differential GPS beacon station. Beacons used for a given survey will be reported in individual descriptive reports. Vessel wiring diagrams are in Appendix III.

Where available, Differential GPS (DGPS) was the sole method of positioning. Differential corrections from the U.S. Coast Guard beacon at Cold Bay (289 kHz) used. In areas where DGPS could not be accessed, data were acquired in Course Acquisition mode. These data are indicated on the acquisition logs in Separate I.

1.4 Sound Velocity Equipment

1.4.1 SBE 19*plus* SEACAT Profiler

FAIRWEATHER is equipped with three SBE 19*plus* SEACAT sound velocity profilers used to acquire conductivity, temperature, and depth (CTD) data in the water column to determine the speed of sound through water. Two of the SBE 19*plus* profilers have pressure sensors rated to 1000 meters. The third has a pressure sensor rated to 3,500 meters.

The SBE 19*plus* SEACAT sound velocity profilers were calibrated by the manufacturer and current calibration files were returned with the units. Calibration files for 2007 are located in Appendix V.

Periodic quality assurance checks include comparison casts between CTD instruments. Data quality assurance (DQA) checks include comparison casts between two instruments as per section 1.5.2.2 of the *FPM* for each survey. Results of the comparison casts are located in the *SV_Maintenance and Testing_2007.xls* file in Appendix VI. Any DQA checks subsequent to this DAPR will be included in Separate II of the survey's descriptive report.

To ensure that the CTDs continue to function properly a stringent maintenance schedule will be followed using guidelines from the manufacturer's recommendations. This will include a thorough rinsing of the instrument with distilled water after each cast. On a regular basis each CTD will be flushed with a Triton X-100 solution. On a regular basis the CTD was flushed with a 500-1000 ppm bleach solution followed by flushing with a Triton X-100 solution.

1.4.2 SBE 45 Micro Thermosalinograph (TSG)

FAIRWEATHER is equipped with one SBE 45 MicroTSG. The SBE 45 uses continuously pumped sea water to measure conductivity and temperature near the ship's hull mounted transducers. The intake is located 9 feet below the DWL (13 ft) between frames 11 and 12.

The conductivity and temperature information is converted to sound velocity and output to the RESON 8160's and 8111's processing units. The 8160 requires sound velocity information for beam forming and pitch stabilization while the 8111 only requires it for pitch stabilization. Standard procedure is to operate the 8111 in non-pitch stabilized mode, and apply pitch in post processing. The Reson 8160 cannot be used to acquire data without real time sound velocity information.

The unit was calibrated during the winter inport in Seattle. The current calibration report is included in Appendix V.

1.4.3 Moving Vessel Profiler 200

A Brooke Ocean Technology, Ltd. (BOT) Moving Vessel Profiler 200 (MVP200) is mounted in the aft starboard corner of the fantail (see Figure 12). The MVP200 system is a self contained sound velocity profiling system capable of sampling water column profiles to 200m depth from a vessel moving up to 12 knots. The system is configured with a Single Sensor Free Fall Fish (SSFFF) outfitted with an Applied Microsystems Ltd. Sound Velocity and Pressure Smart Sensor. Deeper profiles can be obtained by reducing the vessel speed. When the vessel is holding station, the system is capable of recording casts over 600m in depth.

The MVP system consists of a winch, cable, fish (the towed unit with the sound velocity sensor), support assembly, and controlling hardware and software. During ship acquisition, the fish is deployed using the on-deck controller and towed with enough cable out to keep the fish 3-5 m below the water surface. A "messenger" (a short cable-thickening sleeve) is set to allow the system to keep the appropriate amount of cable out and is reset as needed when the ship acquisition speed is altered.

During SVP acquisition, the controlling computer application, BOT MVP version 2.26 is used to control the MVP system and to acquire SVP data. MVP allows for three acquisition modes: 1) automatic continuous multiple cast freefall casting while at speed, 2) single cast freefall casting while at speed, and 3) single cast winch speed casting while stationary. The user limits the depth to which the fish will fall by setting 1) the depth-off-bottom and 2) the maximum depth. Either single, individually initiated casts can be performed at the discretion of the Hydrographer or the auto deploy function can be enabled and set with varying intervals (every 2 minutes, for example) for deployment.

Periodic quality assurance checks include comparison casts between the MVP and the SBE 19*plus* SEACATs. Data quality assurance (DQA) checks include comparison casts between two instruments as per section 1.5.2.2 of the *FPM* for each survey. A record of the DQA tests performed aboard the ship is kept and is included in Appendix VI.

Figure 12: FAIRWEATHER's MVP200 sound velocity system

2.0 Software

2.1 Software Systems Inventory

An extensive software inventory with documentation, of the software systems used by the NOAA ship FAIRWEATHER, is maintained as a *Survey Software* spreadsheet and included in Appendix I. This spreadsheet includes specifics such as software applications, versions, and hot fixes, in addition to dates loaded on specific computers within the survey department.

2.2 Data Acquisition Software

2.2.1 Isis Sonar/ BathyPro/ DelphMap/ DelphNav

The FAIRWEATHER uses the Triton Imaging Inc. software packages Isis Sonar and Sonar Suite to acquire multibeam echo sounder and backscatter data on all of its multibeam platforms. Sonar Suite has two software packages, DelphNav and DelphMap, which work together along with Isis Sonar to produce real time data planning, acquisition, and execution.

Triton Imaging BathyPro is an add-on package for Isis Sonar which processes XTF data real-time to produce DTMs supported by DelphMap. Triton Imaging DelphNav is an add-on package to DelphMap used for line planning and vessel navigation. Triton Imaging DelphMap is a stand-alone GIS program which combines georeferenced bathymetric digital terrain models and reference files such as raster charts and vector shoreline files to display real-time bathymetric bottom coverage.

See Appendix VIII for Standard Operating Procedures associated with *Configuring ISIS RT Bathy_SOP*.

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. Velocwin creates and archives water column profiles, performs quality assurance, and processes pressure based depth data. Velocwin creates a standard file format across NOAA's hydrographic fleet for sound velocity profiles applied to shallow water multibeam and single beam data.

Pydro, another NOAA program produced and maintained by HSTP, is used to process features such as detached positions (DP), generic positions (GP), and Automated Wreck and Obstruction Information System (AWOIS) contacts. PYDRO also converts and attributes features according to S-57 standards for insertion into CARIS Notebook.

2.3.2 CARIS

CARIS HIPS™ (Hydrographic Information Processing System) is used to process all shallow water multibeam data including data conversion, filtering, sound velocity, 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.

CARIS Notebook™ is used to compile and display source shoreline, shoreline updates and S-57 features imported from Pydro. The .hob files created in Notebook are the current shoreline deliverables.

2.3.3 Fledermaus™

Fledermaus ™, an Interactive Visualization Systems 3D™ (IVS 3D) program, is used for data visualizations and creation of data quality control products, public relations material and reference surface comparisons.

As an additional data quality assurance check, Fledermaus ™ may be used to examine the CARIS surfaces prior to submission. The CARIS file is converted to a Fledermaus .sd file via the Avggrid and Dmagic programs.

2.3.4 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

3.1 Vessel Inventory

The NOAA Ship FAIRWEATHER (S220) is equipped to acquire multibeam echosounder (MBES) and sound velocity profile (SVP) data. See Appendix I for the complete vessel inventory.

3.2 Noise Analysis

The FAIRWEATHER sonar system RESON 8111ER underwent noise analysis testing on October 11, 2004. The results are used during acquisition to enhance data quality and are included in Appendix III-S220-7. The Standard Operating Procedure for Survey Speeds to be run while acquiring data with the RESON 8111ER is included in Appendix VIII.

4.0 Data Acquisition

4.1 Horizontal Control

A complete description of horizontal control for the project can be found in the *S-P909-FA-07 Horizontal and Vertical Control Report (HVCR)*, submitted under separate cover.

The horizontal datum for this project is the North American Datum of 1983 (NAD83).

Multibeam and shoreline data were differentially corrected in real time using correctors provided by Coast Guard beacons at Cold Bay (289 kHz). If loss of the differential beacon resulted in any data being recorded with C/A GPS positions it will be noted in the descriptive report for the survey.

System Checks were not performed during this project. Based on correspondence between personnel from the Hydrographic Systems and Technology Program and FAIRWEATHER, system checks were deemed unnecessary. Refer to correspondence included in Appendix VII.

4.2 Multibeam Echosounder Acquisition and Monitoring Procedures

Methods of acquisition took into consideration system performance limitations, the bottom topography, water depth, and the ability of the vessel to safely navigate the area.

All multibeam data were acquired in Triton Elic’s extended transfer format (XTF) and monitored in real-time using the 2-D and 3-D data display windows and the on-screen displays for the RESON SeaBat 8111ER. Adjustable parameters that were used to control the RESON from the ISIS software include range scale, power, gain, and pulse width. These parameters were adjusted as necessary 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 to minimize noise from the data. The *RESON 81XX SOP* (standard operating procedure) and the *TEI_RT_Bathy SOP* detail the settings and procedures used during acquisition of data on the RESON systems and in Isis aboard the FAIRWEATHER. Both are included in Appendix VIII.

Mainscheme multibeam sounding lines using the RESON SeaBat 8111ER were run at a set line spacing of approximately one thousand meters. The Real Time Bathy displayed the acquired multibeam swath during acquisition and was monitored to ensure coverage as specified in the Project Instructions.

4.3 Shoreline Verification

No Shoreline data were acquired by FAIRWEATHER personnel for project S-P909-FA-07.

4.4 Shoreline Data Processing

No Shoreline data were acquired by FAIRWEATHER personnel for project S-P909-FA-07.

5.0 Bottom Sample Acquisition

No bottom samples were acquired for project S-P909-FA-07.

B QUALITY CONTROL

The FAIRWEATHER has numerous standard operating procedures (SOPs) that are followed by personnel throughout the survey to ensure consistent high quality data and products. A detailed *Data Processing Work Flow*, *Shoreline Processing Flowchart* and several key SOPs that differ from the *FPM* or are specific only to FAIRWEATHER are included for reference in Appendix VIII.

1.0 Uncertainty Modeling

Error values for the multibeam and positioning systems on FAIRWEATHER were compiled from manufacturer specification sheets for each sensor (Heave, Pitch, Roll, Position, and Heading) and from values set forth in NOAA HTD 2007-2.

Estimates for the error in measuring vessel offsets, multibeam system biases (timing, pitch, roll and yaw) and dynamic draft are the standard deviations of the set of values reached for each of these corrections resulting from several people processing the data.

In the specific case of MRU Alignment error; values were set after an email exchange between RAINIER, FAIRWEATHER, HSTP and CO-OPS (see TPE_MRU Alignment.txt email messages in Appendix VII). The error value for MRU alignment deviated from that set in HTD 2007-2 due to the directive's value for MRU alignment error being set too high (possibly due to a misinterpretation of what the alignment error represented). This error should represent the standard deviation of measurement of the error derived from multiple people processing the patch test. Based on this, the MRU alignment errors were significantly lower than the 1 degree value set in HTD 2007-2.

An estimate of the total error due to tides was not included in the Letter Instructions for the project, but a value of 0.14 meters (two sigma - 95% confidence level) was given by CO-OPS in the above noted email exchange. Using this value as a reference, tidal errors were set at 0.01 m for the gauge and 0.1 meters for zoning. The 0.01 meter estimate for the gauge is a conservative estimate that can be recalculated based on the sigma values in the final approved water levels. The 0.1 meter estimate for zoning is also a conservative one sigma value based on the total two sigma tide error of 0.14 meters.

The final uncertainty values for FAIRWEATHER tides, and sound velocity, along with information on how the values were derived, are shown in the FA_TPE_Values.xls spreadsheet located in Appendix IV. Uncertainty values relating to vessels and survey systems were entered into the HIPS Vessel File (HVF) for each platform. Uncertainty values for tide and sound velocity were entered during the CARIS Compute TPE process.

2.0 Data Processing

2.1 Multibeam Echosounder Data Processing

Bathymetry processing followed section 4.2 of the *FPM* unless otherwise noted.

Raw XTF multibeam data were converted to Caris HDCS format using settings in the Converting RESON_Data _Precise Timing SOP. True heave, sound velocity 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.xml file. All BASE surfaces were created using the 16m grid parameters designed for depths of 70m and deeper.

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 actual resolutions and depth ranges used during the processing of the survey along with the corresponding fieldsheet(s) is provided in the descriptive report.

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*.

3.0 DATA REVIEW

Specific procedures were used on FAIRWEATHER to ensure quality control of data throughout acquisition, processing, and submission. These procedures are outlined in the *HXXXXX QC Checksheets*, *HXXXXX_Data_Log*, and the *Survey Management SOP* located in Appendix VIII. As detailed in *HXXXXX QC Checksheets*, the QC Check is preformed by the survey manager. The QC Review is conducted by qualified survey personnel (FOO, CST, SST, or PS) other than the survey manager, as an outside review of the survey data and deliverables. The Data Submission and Analog Submission checklists are used to ensure that all data and deliverables are complete and included upon submission. These documents are completed for the survey but only the *HXXXXX_Data_Log* is submitted with the survey data.

C Corrections to Echo Soundings

1.0 Vessel HVFs

CARIS HIPS Vessel Files (HVF) were created by FAIRWEATHER personnel and used to define a vessel's offsets and equipment uncertainty. The HVF is used for converting and processing data collected by each survey platform. For each survey platform, an *HVF Report*, listing specific HVF entries, was produced in the CARIS Vessel Editor and is included in Appendix III. The HVFs used for the current project are included with the digital separates submitted with this report.

2.0 Vessel Offsets

Sensor offsets were measured with respect to each vessel's reference point. The reference point for FAIRWEATHER is the IMU. Specific offset values were input into the POS/MV and the CARIS HIPS Vessel File (HVF).

A ship survey was completed for the FAIRWEATHER by Westlake Consultants, Inc on September 23, 2003 and a POS/MV component spatial relationship survey of the FAIRWEATHER was conducted by NGS in February, 2007. The results of both of these surveys were used to determine the offsets for ship. The reports from each survey are located in documents in Appendix III-S220-2, and the final values for FAIRWEATHER's offsets and explanations of how they were calculated are located in the S220_Offsets & Measurements spreadsheet in the same folder.

3.0 Static and Dynamic Draft

The bow and stern draft marks were used to perform a linear interpolation of the static draft at the FAIRWEATHER's IMU. The static draft was measured multiple times with the vessel under different loading conditions: with and without launches on board and with different amounts of fuel. The final value for the static draft was an average of the most likely loading conditions during survey operations.

The values and calculations for static draft are listed in the Offsets Measurement spreadsheet located in Appendix III.

Dynamic Draft Settlement and Squat (DDSSM) tests were conducted for FAIRWEATHER in April 2007. The final DDSSM values are the average of results obtained from multiple individuals processing the DDSSM data. Detailed processing spreadsheets of DDSSM results are located in Appendix III.

4.0 Patch Tests

Patch tests were conducted for the multibeam acquisition systems on FAIRWEATHER in April 2007. The results of the patch tests, along with the acquisition and processing logs, are included in the MBES Calibration Tables in Appendix III-3.

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 manufacturer specification in Appendix II and are included in the FA_TPE_Values_2007.xls spreadsheet located in Appendix IV.

5.1 True Heave

FAIRWEATHER 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.

In cases where TrueHeave™ could not be applied, real time heave correctors were used. Real time heave data were recorded in Triton Elic's Isis software, stored in the .xtf format and applied as the heave corrector for multibeam data. Data that does not have TrueHeave™ applied will be listed in the individual Descriptive Report for the survey.

6.0 Sound Velocity

The Brooke Ocean Technology Moving Vessel Profiler (MVP) was used to collect sound velocity data to correct data collected with FAIRWEATHER's Reson 8111 multibeam systems.

Sound velocity profiles acquired using the Brooke Ocean Technology Moving Vessel Profiler 200 (MVP) are stored in files labeled .001, .001c, .001d, and .001e (collectively called BOT files) where the number increments by one with each subsequent cast. The .00#c file for each cast was opened with Velocwin and converted into CARIS .svp file format. The individual .svp profiles were concatenated into a single .svp file for the sheet. Individual sound velocity profile files taken by the MVP will not be submitted due to the large number of casts acquired; however, the daily concatenated files are submitted.

The concatenated sound velocity files were applied to multibeam data in CARIS HIPS during data processing. CARIS HIPS uses one of four different algorithms to automatically apply a sound velocity profile stored in the concatenated sound velocity file. They are: "previous in time," "nearest in time," "nearest in distance" and "nearest in distance within time." In general, "previous in time" was the method used for applying sound velocity information in HIPS, but the other methods may have been used in certain situations. The method of applying sound velocity is included in the processing logs that are submitted with each survey.

7.0 Water Level

The vertical datum for this project is Mean Lower-Low Water (MLLW). Predicted water level correctors from the primary tide stations at Sand Point (945-9450) and Alitak (945-7804) 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 (P909FA2007CORP.zdf) supplied by CO-OPS.

A complete description of vertical control for the project can be found in the *S-P909-FA-07 Horizontal and Vertical Control Report (HVCR)*, submitted under separate cover.

D Approval Sheet

An approval sheet with digital signatures is included with this report.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship FAIRWEATHER S-220
1010 Stedman Street
Ketchikan, AK 99901

August 2, 2008

MEMORANDUM FOR: CDR David Neander, NOAA
Chief, Pacific Hydrographic Branch

FROM: CDR Douglas D. Baird, NOAA
Commanding Officer

TITLE: Approval S-P909-FA-7 DAPR

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

This report is respectfully submitted to N/CS34, Pacific Hydrographic Branch.

In addition, the following individuals were responsible for oversight of acquisition and processing of this report:

Matthew Ringel
2008.08.02 20:53:54 Z

LT Matthew Ringel
Field Operations Officer

Attachment

The redundancy in having multiple eyes view a patch test can only be taken so far however. Sea state, speed of the vessel, validity of sound velocity profile, whether that pitch line was run ~exactly~ on top of the sonar-conspicious target will dictate how valid a given set of patch lines are for accurately determining the sonar calibration. It's like we're trying to calculate the average weight of any given Oreo by having a dozen people measure the weight of one specific Oreo. Sure, you'll get a great estimate of the weight of Oreo-X, and sure Nabisco strives to make all Oreos equal -- but can that single (though repeated) measurement ~really~ be extrapolated to all cookies? In magnitude, I would say yes (your single set of patch test values are valid), but I would say the error estimates of the patch values will be smaller than they really are. Anyone feel like doing a week of patch tests to estimate the variability?

SUMMARY #1: 1-degree is an inordinately large estimate of the MRU alignment errors. Instead, compute the Std. Dev. of the values found during the patch test and those should give you a good low-end estimate. Values in the ballpark of 0.25 for gyro and 0.15 for pitch/roll are reasonable estimates of a field units ability to accurately conduct a patch test.

ITEM #2 - Tide values
I'm curious how the field units are coping with the errors associated with tide measured and tide zoning. The tide measured component is straight-forward and can be computed directly from the observed data (looking at past FA projects, 0.01m is a reasonable median). However I feel the tidal zoing error of 0.01 to 0.40 is too large. HSTD 2007-2 claims we will be given values in the Letter Instructions, but the reality of Alaskan survey work is there will seldom be enough historic data for CO-OPS to commit to a zoning error. Speaking with the CST, we elected to high ball the error and use 0.40m when computing TPE (the thought process being, "Well ... it sure is a long way to the primary tide gauge."

I do not know the exact equations involved when it comes to the assimilation of the various components of error in the TPE model, but a qualitative comparison can be made by varying the zoning error (ZE) and examining the changes in the Dp TPE for a subset of pings. Incrementally increasing the ZE causes the vertical TPE (Dp TPE) of a given ping at nadir to converge on twice the value of the ZE, regardless of the initial Dp TPE. See attached picture.

It is worth repeating: regardless of the Dp TPE of a given sounding with a zero ZE, inputting a ZE of 0.40 will lead to a Dp TPE for that same sounding to change to 0.80.

Using the IHO error estimate (Sqrt[a^2 + bd^2]), this would imply all soundings collected in waters shoaler than 48m will automatically be rejected as having not satisfied IHO Order 1. I wish I had a cookie analogy I could insert here.

As of now, FA is proceeding with a zoning error of 0.10, since the pings still appear to retain an essence of the other uncertainties associated with the pings (alignment, POS/MV, precise timing, etc.). Once we begin acquiring data in earnest, we will likely re-evaluate if we're again suffereing from a lack of "IHO-ness".

SUMMARY #2 - A zoning estimate of 0.40m is harsh and will render a surveying platform incapable of acquiring data in waters shoaler than 48m that will satisfy IHO Order 1. FA is proceeding with a value of 0.10m and is standing by for changes. Likely someone from CO-OPS would be in a better position to provide such an estimate vice a group of JO's with their fingers orange from eating Cheetos. Thus far, CO-OPS has punted claiming lack of data - but that doesn't help our error model.

This e'mail is long and I have a sudden urge for junk food. I will close with also stating I believe sound speed error estimates suggested in HSTD 2007-2 are larger than necessary; however, since it does not result in greater than half of my data being deleted ... I will champion that cause another day.

Opinions? I would love to hear them (I've got a hundred screen shots I'm ~dying~ to share).

~~ mike.g.

foo fairweather wrote:

-------- Original Message --------

Subject: MRU allignment error estimates
Resent-Date: Wed, 11 Apr 2007 18:40:18 GMT
Resent-From: FOO.Fairweather@noaa.gov
Date: Wed, 11 Apr 2007 18:32:59 +0000
From: FOO Rainier <foo.rainier@noaa.gov>
To: hydro.geek@noaa.gov
CC: ChiefST Rainier <chiefst.rainier@noaa.gov>, Jake Yoos <Jake.Yoos@noaa.gov>, Olivia Hauser <olivia.hauser@noaa.gov>, Samuel Greenaway <samuel.greenaway@noaa.gov>, CO Rainier <co.rainier@noaa.gov>, _NMAO MOP FOO Fairweather <FOO.Fairweather@noaa.gov>, _NMAO MOA FOO Thomas Jefferson <FOO.Thomas.Jefferson@noaa.gov>, _OMAO MOA FOO Rude <FOO.Rude@noaa.gov>, Mark Van Waes <Mark.Vanwaes@noaa.gov>

Good morning,

I believe that the MRU alignment error estimates recommended by HSTD 2007-2 are too high. The directive suggests that the MRU alignment fields in the TPE section of the HVF be set to a values with "similar magnitude to patch test values," with recommended default values of 1 degree for both gyro and roll/pitch alignment. In accordance with this guidance, RA set the gyro MRU alignment error estimate to 0.5 degrees, and the Roll/Pitch estimate to 1 degree for all Reson-equipped launches prior to the beginning of data acquisition. We immediately found that ~2/3 of our swath width was rejected by the IHO Order 1 TPE filter.

I've attached an Excel worksheet showing examples of this effect for a Reson 8101 operating in 15-20m of water. The left-hand plot shows a representative example of TPE values as a function of beam number with MRU alignment errors set to 0.5 and 1.0 degree as described above. The right-hand plot shows a similar sample (not the exactly the same soundings, but the same line and depth regime) with the MRU alignment error estimates values set to 0 (which is what we previously used).

Obviously, zero error for alignment measurement is unrealistic; however, the recommended values appear to result in absurdly high depth measurement error estimation. It seems that the HSTD was written with the understanding that the MRU alignment error estimate should be an estimate of the alignment error itself, not an estimate of the error in the measurement of that alignment. I believe this interpretation is incorrect. The alignment error estimate is already taken care of by the patch test bias values in the Swath entry. High bias values, if carefully measured, are not necessarily incorrect. Thus, entering the alignment errors as alignment measurement errors can result in incorrect TPE estimation, as in the example attached.

It's certainly difficult to estimate the quality of a patch test, but it seems to me that a more accurate estimate would be to use the standard deviation of the values computed by the various personnel computing the test. This would decouple alignment measurement precision from the alignment accuracy itself, and assign each to its correct place in the data reduction and error estimation process. On RAINIER, we have ~6 people looking at each vessel's patch test, so that gives us a reasonable sample size. Preliminary results of our patch testing indicate that this will produce much smaller (though non-zero) alignment measurement error estimates. At this point, I plan to use these values instead of those recommended in HSTD 2007-2; we will, of course, document this in the reports of those patch tests included with the affected DAPRs. However, I wanted to make others aware this potential problem- it took us a while to figure out why our swath width had mysteriously shrunk. I also recommend that HSD consider re-wording the HSTD to suggest this approach to the estimation of this value.

Thanks,

Ben

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NOAA Marine Operations Center, Pacific
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Seattle, WA 98102

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907 255-1807 or 1809 Ketchikan phone
907 255-1808 Ketchikan fax

808 659 0054 at sea phone

foo.fairweather@noaa.gov
at sea email size limit: 200k
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Diver Least Depth Gauge DQA 2006

OPR-P158-FA-06 Approaches to Cordova, Alaska

Date	UTC Time	DLDG reading	Sea Level Pressure	Gauge ID	Results
08-31-2006	20:44:14	14.39	993	68332	Good
09-01-2006	21:46:49	14.51	1007	68332	Good
09-05-2006	19:14:18	14.67	1020	68332	Good

Gauge 68322 stopped working after the 5 September reading and no new DLDG were obtained prior to the end of the field season

Appendix VII

Correspondence

Shoreline Guidance

Tides – Gravina River

Courtesy Letters

System Check Correspondence

Launch 1018 IMU Tumble Test

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NOAA Marine and Aviation Operations
NOAA Ship FAIRWEATHER S-220
1010 Stedman Street
Ketchikan, AK 99901

August 2, 2008

MEMORANDUM FOR: CDR David Neander, NOAA
Chief, Pacific Hydrographic Branch

FROM: CDR Douglas D. Baird, NOAA
Commanding Officer

TITLE: Approval S-P909-FA-7 DAPR

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

This report is respectfully submitted to N/CS34, Pacific Hydrographic Branch.

In addition, the following individuals were responsible for oversight of acquisition and processing of this report:

Matthew Ringel
2008.08.02 20:53:54 Z

LT Matthew Ringel
Field Operations Officer

Attachment