NOAA FORM 76-35A

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

Data Acquisition & Processing Report

NOAA NAVIGATION RESPONSE TEAM 5
September 2004-December 2005

LOCALITY

New York, Delaware River, Portland, Maine, & Long Island Sound

2005

CHIEF OF PARTY
LTJG Jasper D. Schaer, NOAA

LIBRARY & ARCHIVES
DATE DECEMBER 30, 2005

TABLE OF CONTENTS

HYDROGRAPHIC SYSTEMS CERTIFICATION REPORT

NOAA Navigation Response Team 5
LTJG Jasper D. Schaer, Team Leader

A. EQUIPMENT

All calibration data were acquired by Navigation Response Team 5 (NRT5) on January and June, 2005. NRT5 acquired side scan sonar (SSS) data, multibeam echosounder data (MBES), single beam echosounder (SBES) data, and sound velocity profile (SVP) data. Vessel description and offset measurements are included in Appendix III of this report. Any unusual vessel configurations or problems will be addressed in survey-specific Descriptive Reports.

The methods and systems used to test and calibrate all equipment were determined by the Hydrographer and the Hydrographic Systems Technology Processing Branch-liason, and are in accordance with the Navigation Response Services Branch Standing Letter Instructions (forth coming), the Specifications and Deliverables (March, 2003), and the Field Procedures Manual (May, 2005). Other considerations included system performance limitations, limited time available, and ability of vessel to safely navigate a particular area.

A.1. SOUNDING EQUIPMENT

Inner Space Echosounder – Single Beam Echosounder (SBES)

NRT5's Survey boat S-3002 is equipped with an Inner Space 455i single beam echosounder (SBES) (fig 1). This Inner space echosounder has a single-frequency digital-recording unit with a digital recorder. This unit transducer operates at 208 KHz with a circular beam footprint of 8° at the –12 dB point. If MBES data is collected, SBES data is then archived in raw form, but not generally processed.

Figure 1: Inner Space Single Beam Echosounder

Kongsberg EM3000 – Multibeam Echosounder (MBES)

NOAA NRT5 Survey Boat S-3002 is equipped with a pole-mounted MBES (Fig 2). The Kongsberg EM3000 is a 300 KHz system which measures two-way sound travel times across a 130 swath; each swath consisting of 127 beams individually formed 1.5° x 1.5° beams. This system is used to obtain full-bottom bathymetry coverage in depths generally up to 150 meters, depending on water depth and across-track slope.

Figure 2: Pole-mounted Simrad EM3000

The EM3000 sonar processor incorporates real time sound velocity measurements from a Digibar Pro Profiling Sound Velocimeter (section C.1). These measurements are used for initial beam forming and steering. Four adjustable parameters used to control the EM3000 from the EM3000 controller software include range scale, power, gain, and pulse width, however these are set to range scale = auto, power= 300 Khz, gain=80, pulse width=25 Hz. These parameters are adjusted as necessary to ensure best bottom tracking for bathymetry. Additionally, vessel speed is adjusted as necessary, and in accordance with the NOS Specifications and Deliverables and Standing Project Instructions, to ensure the required along-track coverage for object detection.

Main scheme MBES line plans generally run parallel to the contours at a line spacing approximately three to four times the water depth. For discrete item developments, line spacing is often reduced to two-times water depth to ensure least-depth determination by MBES near-nadir beams.

Diver Least Depth Gauge

Dive investigations are primarily for contact/AWOIS verification and/or least depth confirmation of selected contacts. The unit has not been issued Diver Least-Depth Gauges (DLDG) at this time.

Leadline

Leadlines are used for single beam and multibeam echosounder comparisons. Calibration reports for the leadlines are included in Appendix IV of this report.

A.2. SIDE SCAN SONAR EQUIPMENT

General Operations

Line spacing for side scan sonar (SSS) operations is determined by the required range scale. Typically, to acquire two hundred percent coverage, 40 meter line spacing is used at the 50 m range scale, 60 meter line spacing is used at the 75 m range scale, and 80 m line spacing is used at the 100 meter range scale.

The towfish altitude of eight to twenty percent of the range scale is maintained during data acquisition. SSS altitude for towed operations is adjusted by the amount of deployed tow cable, and to a lesser degree by vessel speed.

Confidence checks are performed daily by observing changes in linear bottom features extending to the outer edges of the digital side scan image, features on the bottom in survey area, and by passing aids to navigation.

Klein 3000 Side Scan Sonar

The Klein System 3000 includes the Model 3210 tow fish, Transceiver Processing Unit (TPU), and Klein workstation. The Model 3210 tow fish (fig 3) operates at a frequency of 500/100 KHz and has a vertical beam angle of 40 degrees. The TPU contains a network card for transmission of the sonar data to the Klein acquisition computer. The acquisition software (Sonarpro) used on the Klein computer saves the raw data in SDF format.

Figure 3: Klein 3000

The standard configuration for using the Klein System 3000 aboard NOAA S3002 has been determined by NRT5 during regular hydrographic survey operations. The 3210 tow fish is deployed from a davit arm using a Dayton electric-hydraulic winch spooled with approximately 50 meters of armored coaxial cable off of the starboard stern of the vessel. The tow cable is lead from the winch upward along the davit arm through a series of snatch blocks and d-rings. The tow cable at the winch is connected to a deck cable through a slip ring assembly mounted coaxially on the winch. Cable-out is controlled by the wheel mounted at the end of the davit arm. The cable is run along the top edge of the wheel and outward toward the towfish. This sensor computes cable out by the number of revolutions of the wheel's sheave. The Dyna Pro cable counter provides a serial message to the **Hypack** acquisition computer. This message is parsed over delph-serial from Hypack to the Klein computer to be saved and included in the raw SDF format. Cable-out is adjusted to 2.0 meters before deployment of the towfish to account for the distance from the water surface to the wheel.

Klein System 3000 towed operations are typically limited to seven or eight knots, speed-over-ground aboard S3002. This is to allow an increased margin for safe navigation, to optimize vessel fuel consumption, minimize towing gear stress, and reduce "strumming" in the tow cable which can interfere with the side scan imagery. Turns to port require the towfish to be drawn in to prevent the tow cable from swinging into the dual outboard propellers.

A.3. POSITIONING EQUIPMENT

Trimble DSM212L DGPS Receivers

NRT5 ‘s Survey Boat S-3002 is equipped with a Trimble DSM212L DGPS receiver for reception of U.S. Coast Guard (USCG) differential GPS (DGPS) beacons, which are used for horizontal position control. The DSM212L is an integrated 12-channel GPS receiver and dual-channel differential beacon receiver. The beacon receiver can simultaneously monitor two USCG DGPS beacon stations. The Trimble DSM212L was configured in manual mode to allow reception of only one beacon station during data acquisition.

DSM212L parameters were configured using Trimble **TSIPTalker**. Configuration is checked frequently throughout the project period. Parameters set included number of visible satellites ($4 SV's), positional dilution of precision (PDOP < 8), maximum pseudo range corrector age (#30 sec), and satellite elevation mask ($8/).

Position quality is monitored real time in the POS/MV controller software. The primary positional quality monitored is HDOP. Where HDOP exceeds 2.5, the data are examined during post-processing, and if necessary, positions interpolated or rejected**.** The Hypack pos.dll (nmea message but for the POS/MV UDP port version) configuration includes a 500-ms update rate and a non-differential alarm in the acquisition window to alert the operator when the signal is lost.

TSS POS/MV Position and Orientation Sensor

NRT5's Survey Boat S-3002 is equipped with a TSS POS/MV Model320 Version 4 (Position and Orientation System for Marine Vessels) to determine position. This system replaced the Version 3 earlier in the year, Feburary 2005 (See POS/MV Configuration Note, Appendix I. The POS/MV is an aided strap down inertial navigation system, which provides a composite position solution derived from both an Inertial Measurement Unit (IMU) and dual-frequency GPS receivers. The IMU and GPS receivers are complementary sensors; data from one are used to filter and constrain errors from the other resulting in high position accuracy. On NRT5's Survey Boat S-3002, the TSS POS/MV is used for MBES, SSS, and SBES position.

Position accuracy and quality are monitored in real time during data acquisition using the POS/MV Controller software to ensure positioning accuracy requirements in the NOS Hydrographic Surveys Specifications and Deliverables are met. The POS/MV Controller software provides clear visual indications whenever accuracy thresholds are exceeded.

A.4. HEADING AND ATTITUDE EQUIPMENT

TSS POS/MV Position and Orientation System

NRT5's Survey Boat S-3002 is equipped with a TSS POS/MV Model 320Version 4 for vessel heading and attitude determination. This system replaced the older Version 3 in February, 2005 (See POS/MV Configuration Note, Appendix I). The POS/MV is an aided strap down inertial navigation system (INS), consisting of an Inertial Measurement Unit (IMU) sensor and two GPS receivers. The IMU senses linear acceleration and angular motion along the three major axes of the vessel. The POS/MV's two GPS receivers determine vessel heading using carrier-phase differential position measurements.

In additional, a Pulse Per Second box (PPS) is used to help correct for time drifts within MBES and Hypack/Hysweep computer. Two PPS messages are sent out from the POS/MV. One into the MBES and the other into a PPS box that then connects to the Hypack/Hysweep computer.

POS/MV Heading Computation

The POS Computer System (PCS) blends data from both the IMU and the two GPS receivers to compute highly accurate vessel heading. The IMU determines accurate heading during aggressive maneuvers and is not subject to short-period noise. However, IMU accuracy characteristically diminishes over time. The GPS receivers compute a vector between two fixed antennas and provide azimuth data using the GPS Azimuth Measurement Subsystem (GAMS). The GAMS calculation for the system was completed earlier this year and re-run when hardware was changed to the Version 4.

GPS heading data is accurate over time, but is affected by short-period noise. The POS/MV combines both heading measurement systems into a blended solution with accuracies greater than either system could achieve alone. On this platform, the TSS POS/MV was used for MBES, SBES, and SSS heading.

POS/MV Heave, Pitch, and Roll Computation

Heave is computed in the POS/MV by performing a double integration of the IMU-sensed vertical accelerations. The POS/MV v4 controller heave filter is used for all data aboard S-3002; a heave bandwidth between 10 and 20 seconds and heave damping ratio of 0.707 are used depending on the conditions at the time of data acquisition. Heave is collected by logging message 7 to a file for the operation for the day.

Both roll and pitch measurements are computed by the IMU after sensor alignment and leveling. The IMU mathematically simulates a gimbaled gyro platform and applies the sensed angular accelerations to this model to determine roll and pitch. Heave, pitch, and roll POS/MV was used for MBES & SBES.

A.5. SOFTWARE

Coastal Oceanographic's **Hypack MAX** is used for vessel navigation and line tracking during acquisition of MBES, Side Scan Sonar, and SBES data. All SBES and MBES data are acquired in **Hypack** in the "RAW" format.

MBES data from NRT5's Survey Boat S-3002 Simrad EM3000 unit are acquired on the hypack computer via the hypack program **Hysweep**. The ship's offset configurations for the transducer and motion sensor were entered into the Caris Vessel Configuration File. Sound velocity and attitude data are not inputted directly at the transceiver unit, but are applied during processing.

Side scan, multibeam echosounder, and singlebeam data are processed using both Caris **HIPS and SIPS 5.4.sp1.** The Caris software applies tide, sound velocity corrections, merges the data, and then determines bias error values in calibration mode. The calculation of Total Propagated Error (TPE) was used during the field season for the creation of BASE (Bathymetry Associated with Statistical Error) surfaces.

All MB soundings, and side scan and MB features are analyzed during post-processing using **Pydro**. This program was created by the NOS Hydrographic Systems and Technology Programs N/CS11 (HSTP) using the **Python 23** programming language to interface with the **HIPS** data directly.

Features are exported from **Pydro** in MIF/MID (**MapInfo** Interchange) format, and imported into **MapInfo**. The soundings are imported into **MapInfo** with a tool that takes soundings from the Preliminary Smooth Sheet from **Pydro**. **MapInfo** is used for final data analysis and for creating final plots. **GeoZui** (UNH, Durham, NH) and **HIPS** are used for visualization and data comparisons.

Raw sound velocity data are processed using **Velocwin,** supplied by NOAA Hydrographic Systems and Technology Program (HSTP). **Velocwin** uses raw salinity, temperature, and pressure measurements to create a sound velocity profile.

A complete list of software and versions is included in Appendix I.

B. DATA PROCESSING AND QUALITY CONTROL

B.1. MULTIBEAM ECHOSOUNDER DATA

Raw HSX multibeam data were converted to HDCS format in **HIPS 5.4 sp1**. Transformation parameters pertaining to the source of the attitude packet is stored in the Log File located in line directory of the **HIPS** data. After conversion, the Total Propagated Error (TPE) was calculated in **Caris HIPS and SIPS 5.4 sp1** to determine the quality of the multibeam data. TPE was calculated using the Caris implementation of the multibeam error model (Hare et al., 1995). Input parameters to the error model were entered into the HVF file (5.4 version of the VCF). A table of these values is provided in Appendix IV.

Vessel heading, attitude, and navigation data were reviewed and edited in line mode (viewed as time series data). Fliers or gaps in heading, attitude, or navigation data were manually rejected or interpolated for small periods of time. Sound velocity correction was applied in **HIPS**. Tide correction was applied to the data during “merge”, and dynamic draft corrections and sensor lever arms are applied in S3002’s MB VCF.

Heave is collected by the Pos/MV into a log file (message 7) and post-processed in Caris HIPS. This is applied prior to the merging data via Process Load True Heave. The MBES’s VCF heave sensor has to be applied -Yes, in order to use this heave data.

The TPE takes into account uncertainties in the measurements coming from each sensor (Heave, Pitch, Roll, Position, Heading, Sound Velocity, and Tide) and uncertainties in static measurements (Draft and Latency) to calculate the total uncertainty.

Caris HIPS and SIPS 5.4 sp1 uses the vertical uncertainty from TPE to produce a BASE

(Bathymetry Associated with Statistical Error) surface. These BASE surface products (Depth, Uncertainty, Density, Standard Deviation, Mean, Shoal, and Deep) could then be used to demonstrate MBES coverage, and to further check for systematic errors such as tide, sound velocity, or attitude and timing errors. Sun-illumination is used to highlight the seabed features. **HIPS** gridded images were created as specified in the NOS Hydrographic Surveys Specifications and Deliverables.

The actual resolution chosen for finalized base surface for NRT5 is 0.75m. This was the recommendation by HSTP. Once the BASE surface has been finalized, they are inserted into Pydro. Bathymetry can be inserted into Pydro using the Insert Caris Lines or Insert HIPS Weighted grid functions. As the final product is a collection of BASE surface, chart comparison and least depths on the features are from the finalized BASE surfaces, not the Caris lines bathymetry.

B.2. SINGLE-BEAM ECHOSOUNDER DATA

SBES data are acquired concurrently with both MBES data and SSS data. When SBES data is not the primary source of bathymetry, i.e. MBES data is also acquired, SBES data is not routinely processed, but may be used for troubleshooting or confidence check purposes. In this case, the raw **Hypack** SBES data are submitted for archival purposes only. This data should not be used for the creation of any product.

When SBES data are the primary source of bathymetry, i.e. collected concurrently with SSS data, SBES data are processed, passed through quality control, and submitted for the purposes of product creation. Following acquisition, single-beam echosounder data are converted from **Hypack** “Raw” format to **HDCS** using **HIPS**. Each line is viewed in **HIPS** Single Beam Editor against the digital trace of the SBES data. Selected soundings are scanned for missed depths. Additional selected soundings are inserted where necessary to define peaks and abrupt changes in slope.

After review and cleaning, **HIPS** is used to merge depth, position and attitude data with sound velocity, tide, vessel offset, and dynamic draft correctors to compute the corrected depth and position of each sounding. All soundings are reviewed again in **HIPS** Subset Mode. Data are compared with adjacent lines and crosslines for systematic errors such as tide or sound velocity errors.

B.3. SIDE SCAN SONAR DATA

Side scan sonar data were converted from *.SDF (SonarPro raw format) to **HIPS.**
Side scan data were processed using **HIPS.**

Post-processing side scan data includes examining and editing fish height, vessel heading (gyro), and vessel navigation records. Fish navigation is recalculated using **HIPS**. Tow point measurements (C-frame and cable out), fish height, and depth are used to calculate horizontal layback.

After fish navigation is recalculated, side scan imagery data are slant-range corrected to 0.1m with beam pattern correction. Depending on the requirements for the survey as stated in the Hydrographic Survey Letter Instructions, one of two methods can be utilized for SSS operations. The first is to acquire 100% or 200% side scan sonar coverage. All significant contacts are then selected and investigated further at the discretion of the hydrographer. Investigation methods used to resolve SSS contacts includes diver investigations and MBES developments. The second method, where full MBES coverage has been obtained, is pick side scan sonar contacts only in areas of incomplete multibeam coverage, on man made features, and ambiguous features.

The slant-range corrected side scan imagery data are closely examined for any targets. Targets-of-interest are evaluated as potential contacts based on apparent shadow length and appearance; particularly targets which do not appear to be natural in origin. Contacts are selected and saved to a contact file for each line of SSS data. Contact selection includes measuring apparent height, selecting contact position, and creating a contact snapshot (*.tif) image.

*Note: Due to distortions to images in Caris post-processing (a bit shift issue with Klein 3000). Features sometimes are selected and created into images using Sonarpro. These new images are then imported into Pydro Smooth Sheet for analyzing in place of same Caris feature tiffs.

C. CORRECTIONS TO ECHO SOUNDINGS

C.1. SOUND VELOCITY

SBE19Plus Conductivity, Temperature, and Depth (CTD) profilers

Sound velocity profiles are acquired with Sea-Bird Electronics SeaCat SBE19Plus CTD profilers. Raw conductivity, temperature, and pressure data are processed using the program **Velocwin** which generates sound velocity profiles for **HIPS**. Sound velocity correctors are applied to MBES and SBES data in **HIPS** during post processing only. Calibration reports for the SBE19Plus CTD and Odom Digibar profilers are included in Appendix III of this report. A CTD and DQA comparison was performed on April 29, 2005, the results of which are listed below. This DQA is produced by comparing our pole mounted Odom Digibar to a single cast made with the SBE19Plus.

CTD DQA test:
4/29/2005 COMPARISON TEST FOR SEACAT PASSED DQA

Digibar Depth (m) = 1.1   Digibar SV (m/sec)= 1469.4
File= 05119092.NYB   Seacat SV (m/sec) = 1470.

The speed of sound through water is determined by a minimum of one cast every four to six hours of MBES data acquired, in accordance with the Standing Letter Instructions and NOS Specifications and Deliverables for Hydrographic Surveys. Casts were conducted more frequently when changing survey areas, or when it was felt that conditions, such as a change in weather, tide, or current, would warrant additional sound velocity profiles. Casts were conducted at least every four hours while collecting data with the EM3000 during the period, while the pole-mounted Odom Digibar was constantly on.

The sound velocity casts are extended in **Velocwin** and applied to the Simrad MBES data in **HIPS** during post processing.

EM3000 Surface Sound Velocity System

NRT 5’s Survey Boat S3002 is equipped with an Odom Digibar Pro surface sound velocity sensor. The sensor is used to measure sound velocity at the depth of the Simrad EM3000 transducer. The sensor is mounted next to the transducer on the pole mount. Weekly and monthly DQA’s are performed to assure both the SBE19Plus and Digibar are working accurately. The DQA is done at the depth of the pole mounted digibar. Sound velocity is taken at this depth by both instruments and Velocwin runs a comparison between the two sets of data. This produces a passing or failing DQA.

C.2. VESSEL OFFSETS AND DYNAMIC DRAFT CORRECTORS

The following table lists each Vessel Configuration File.

VCF NAME	SURVEY SYSTEM
3002_mbes	Simrad Em3000 Multibeam Sonar System
3002_vbes	Innerspace 455i Vertical Beam Echo Sounder
3002sss100k	Klein 3000 Side Scan Sonar Low Frequency
3002sss500k	Klein 3000 Side Scan Sonar High Frequency

Static draft corrections for S3002 were measured October 2004 and re-measured November 2004 (see results Appendix II).

Dynamic draft measurements for S3002 were made on October 2004 and re-measured

March 2005 (see results Appendix II).

Vessel offset measurements were made by National Geodetic Survey on S3002 while in Norfolk, VA on February 17, 2004. The procedure and results are in the Offset Confirmation Report found in Appendix III.

The S3002 sensor offsets are stored in the **HIPS** Vessel Configuration File (3002_mbes& 3002_vbes) and are applied to MBES & SBES data acquired with S3002. All offsets and biases are duplicated in the **Caris HIPS and SIPS 5.4 sp1** Vessel Configuration File (HVF).

S3002 performed a SSS verification during survey operations March 16 – 18, 2005 (see Appendix IV). The Klein SSS offsets are stored in the Caris Vessel Configuration Files and are applied to side scan data during processing in **HIPS**.

C.3. HEAVE, PITCH, ROLL AND HEADING, INCLUDING BIASES AND NAVIGATION TIMING ERRORS

Heave, pitch, roll, and navigation latency biases for S3002's Simrad 3000 were determined during Patch Tests conducted on February 3, 2005 approximately 3 NM north of Atlantic Marine Center in Norfolk, VA. In addition, HSTP recommended that we do a roll and yaw bias test in deeper water, this test was conducted April 13, 2005 in New York Harbor. MBES vessel offsets, dynamic draft correctors, and system bias values are contained in **HIPS** Vessel Configuration Files (VCFs and HVFs) and were created using **HIPS** and **Caris HIPS and SIPS 5.4 sp1**. These offsets and biases are applied to the sounding data during processing in **HIPS**. The VCFs, HVFs and Patch Test data are included with the digital data. The Patch Test Report for S3002 can be found in Appendix IV. A Patch Test or verification of certain biases is also performed at the start of each project before acquiring MBES data in the new area.

C.4. WATER LEVEL CORRECTORS

Soundings are reduced to Mean Lower-Low Water (MLLW) using verified tide data from the local, primary tide gauge obtained from the Center for Operational Oceanographic Products and Services (CO-OPS) web site. For all projects, a simple predicted tide table is applied to MBES data in **HIPS** during the Merge process. A zone-corrected verified tide file is supplied by CO-OPS which is then reapplied to all MB using **HIPS**.

D. APPROVAL

As Chief of Party, I have ensured that standard field surveying and processing procedures were adhered to during this project in accordance with the Hydrographic Manual, Fourth Edition; Hydrographic Survey Guidelines; Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables, as updated for December 30, 2005.

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

Submitted:

Bert S. Ho, NOAA
Physical Scientist Tech, Navigation Response Team 5

Approved and Forwarded:

LTjg Jasper D. Schaer, NOAA,
Navigation Response Team 5, Team Leader (Chief of Party)

APPENDIX I

- Software
- POS/MV Report

Software

NOAA - NRT-5 SYSTEM CERTIFICATION SOFTWARE REPORT - 2005

PROCESSING SOFTWARE

CARIS HIPS and SIPS 5.4 Service Pack 1, HotFix 28 (Dec 2005)
PYDRO Version 5.9.3 (Dec 1, 2005)

DATA ACQUISITION SOFTWARE

HYPACK MAX Version 4.3 (2004)
SONARPRO Version 9.6 (March 2005)

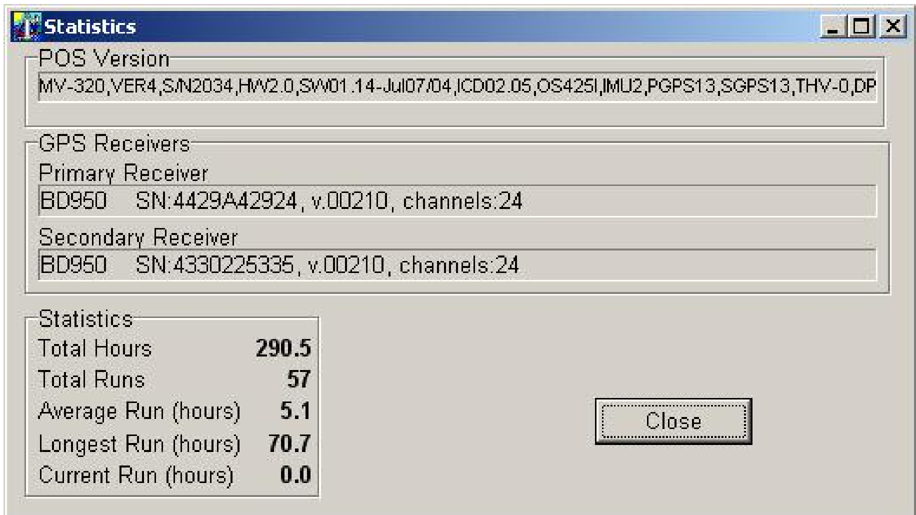
POSITIONING SOFTWARE

POS/MV Controller Version 3.2.0
Trimble TERRASYNC Version 2.41

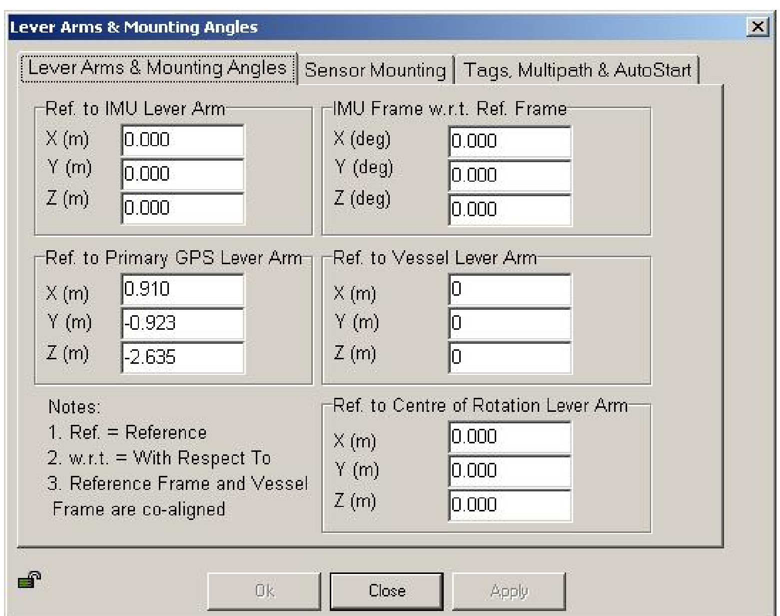
OTHER SOFTWARE

MAPINFO Version 8.0
SEATERM Version 1.3
VELCWIN Version 8.6
MICROSOFT OFFICE XP
GPS PATHFINDER OFFICE 3.00
FUGAWI 3.1.4.746

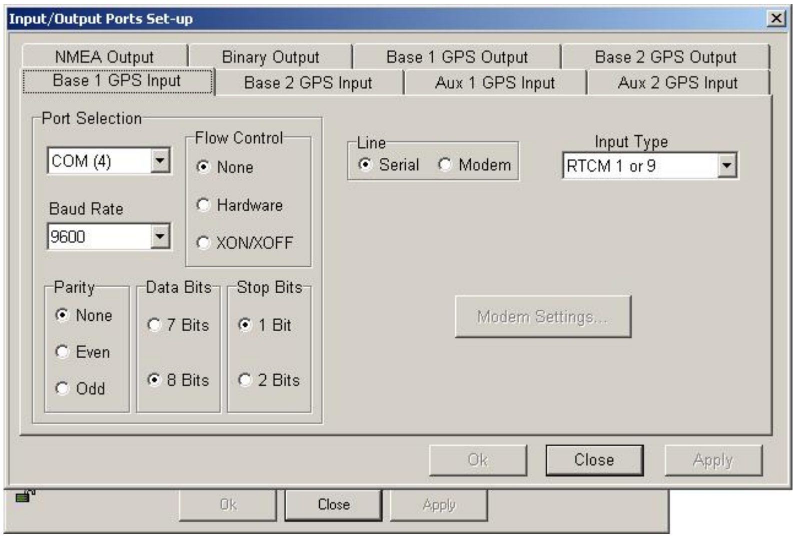
Stats of POS/MV 4.0 changed antenna and hardware (re-ran GAMS)



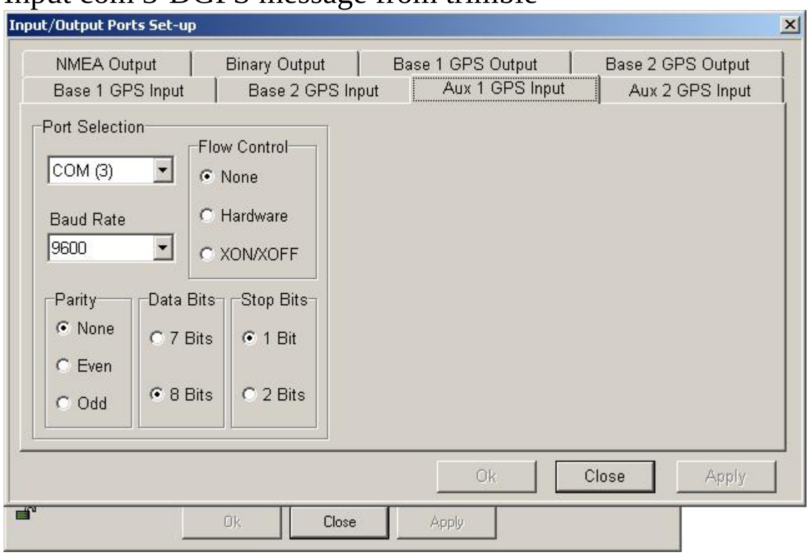
Lever arm offsets from NGS survey



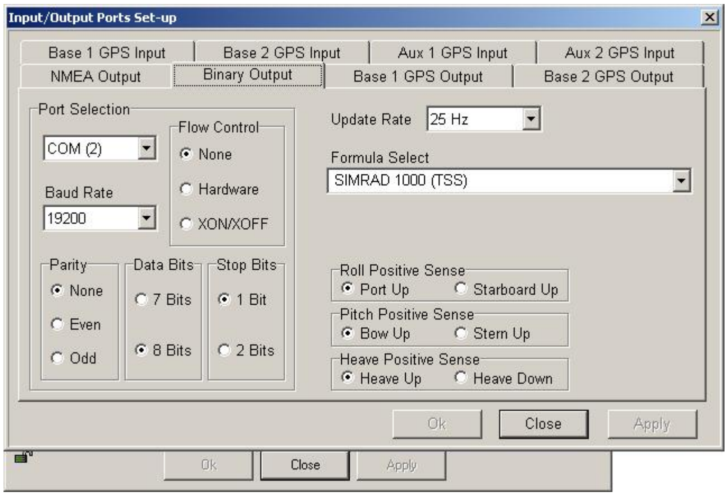
Output com 4 NMEA to SSS & MBES



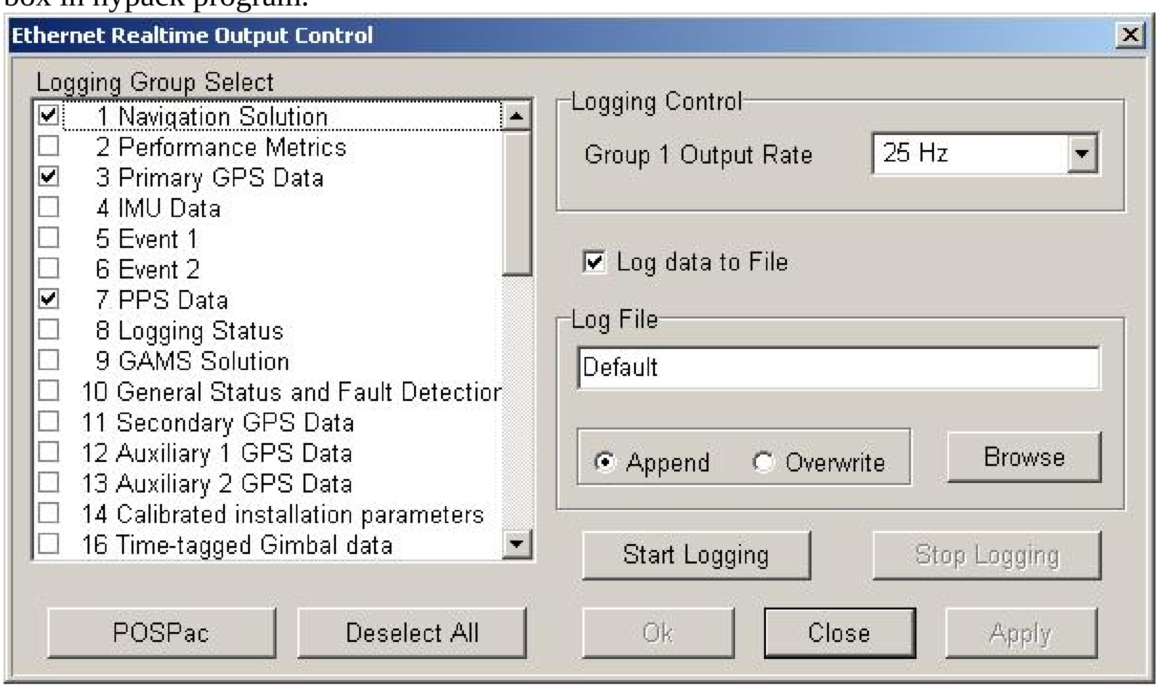
Input com 3-DGPS message from trimble



Output com 2 to MBES (attitude data)



Output to hypack/hysweep over UDP port (message 1, 3, 7, 102, & 111) used with pss box in hypack program.



APPENDIX II

- Static Draft Report
- Dynamic Draft Report

Static Draft Report

Intro:

The Static Draft test was done in September 2004 when LCDR Rick Fletcher came to visit NRT 5 in New York.

Procedure:

With a tape measure, we read off the draft and referenced it back to the imu.

Result:

We calculated a -0.20m below the IMU and add to the CARIS vcf.

Dynamic Report

Intro:

Dynamic draft was conducted by NRT5 on three separate occasions due to issues that we were seeing in our data.

Process

In Norfolk, VA, with help from the THOMAS JEFFERSON Survey team, in February 2005, we ran lines to and from the leveling station on the pier. We would mark down time and speed for each event when we came towards or away from the pier. Most importantly, we would get an at rest value before and after each run, to account for the tide change. We had the MBES arm down when running the type of calibration.

vbes 3002 (rod)	
draft	speed
0	0
0.067	2.5
0.087	4
0.109	5
0.114	6.5
-0.095	8
-0.014	10

mbes 3002(rod)	
draft	speed
0	0
0.03	2
0.03	3.5
-0.01	5
-0.03	6.4
-0.04	7.2

mbes 3002(dave simpson)	
draft	speed
0	0
-0.0625	1.5
-0.0525	3.5
-0.039	5.6
-0.024	6.6
-0.0237	7.2

After HSTP reviewed our patch test with the dynamic draft, we need to re-run a dynamic draft test. We decided to run dynamic draft using a method called “Dave Simpson Model” in New York Harbor. We found a flat spot and called the reference. We ran the same line MBES over the same spot at different speeds. However, most import, we would collect data over the reference spot at rest before and after each run. In Caris post-processing we made individual base surfaces for the different speeds and compared to the at rest reference base surface. We used values from each base surface that had the same position to compare to get the dynamic draft.

Results:

HSTP took our new dynamic draft values and applied to our patch test data. After the HSTP review, they were satisfied with the results. We updated the vcf with these values.

Dynamic Report

Settlement and Squat

VESNO	Date	DN
Location	Type of Water Fresh Salty Brackish	
Wind	Seas	Swell
Avg Depth	Echosounder S/N	Rod S/N
Surveyor	Recorder	Level S/n

RPM: 2500 At Rest Pitch Reading : At rest Roll Reading:

Rod .Readings at Rest (a)		Pass Dir.	Time	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1	
154			1540	0					ft	m
15.2	15.1	To			15.4	15.6	15.6			
15.2	15.1		1545	7.3	15.5	15.5	15.2			
15.1	14.9				15.5	15.3	15.5			
14.8		Away			15.4	15.5	15.4			
			1543	7.1	15.5	15.4	15.7			
					15.4	15.7	15.5			
AVG:	1.5057				To: 1.5455 .0398			.04		
					Away: 1.55 .0443					

≤ 1.54775

RPM: At Rest Pitch Reading : At rest Roll Reading:

Rod .Readings at Rest (a)		Pass Dir.	Time	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1	
									ft	m
		To								
		Away								
AVG:					To:					
					Away:					

Notes: Graph the results. Round corrections to the nearest 0.2ft and 0.1m. If the geography permits, the launch can be driven directly toward the location of the level and several readings may be taken per pass. To avoid the introduction of error due to tidal change, "at-rest" readings should be acquired at the beginning or end of each pass to make tidal corrections insignificant.

Dynamic Report

Settlement and Squat

VESNO S3002	Date Feb 1 2005	DN
Location COE Norfolk VA	Type of Water Fresh Salty Brackish	
Wind	Seas	Swell
Avg Depth	Echosounder S/N	Rod S/N
Surveyor Lewis	Recorder	Level S/n

RPM: 1500		At Rest Pitch Reading :					At rest Roll Reading:			
Rod .Readings at Rest (a)		Pass Dir.	Time 1121	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1 ft	m
15.3	15.4	To			15.3	15.6	15.4			
15.4	15.3		1129	5.0	15.6	15.3	15.3	1.54125		
15.3	15.4				15.4	15.4				
		Away	1121		15.5	15.7	15.5			
				4.5	15.7	15.5	15.7	~~1.43625~~		
					15.4	15.9		1.56125		
AVG:	1.535				To: 1.54125			0.016		
					Away: 1.56125					

RPM: 2000		At Rest Pitch Reading :					At rest Roll Reading:			
Rod .Readings at Rest (a)		Pass Dir.	Time	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1 ft	m
		To			15.5	15.6	15.6			
			1139	6.7	15.7	15.6	15.6	1.55625		
					15.5	15.4				
		Away			15.6	15.7	15.7			
			1137	6.2	15.8	15.7		1.56857		
					15.6	15.7				
AVG:	1.535				To: 1.55625			0.0274		
					Away: 1.56857					

Notes: Graph the results. Round corrections to the nearest 0.2ft and 0.1m. If the geography permits, the launch can be driven directly toward the location of the level and several readings may be taken per pass. To avoid the introduction of error due to tidal change, "at-rest" readings should be acquired at the beginning or end of each pass to make tidal corrections insignificant.

Dynamic Report

Settlement and Squat

VESNO 53002	Date Feb 1	DN
Location COE Pier 2 Norfolk	Type of Water Fresh Salty Brackish	
Wind	Seas Calm	Swell 2
Avg Depth	Echosounder S/N	Rod S/N
Surveyor Lewis	Recorder	Level S/n 7423 BI

Pier to Maersk Cranes

Decanted

RPM: 750		At Rest Pitch Reading :						At rest Roll Reading:		
Rod .Readings at Rest (a)		Pass Dir.	Time	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1	
			1058	0					ft	m
15.8	16.4	To Cove	1102	2.3	15.6	15.6	15.6			
15.8	16.2				15.5	15.6				
15.8	15.7				15.7	15.6				
		Away Cove	1110	1.5	15.8	15.7	15.7			
					15.6	15.7				
					15.7	15.7				
AVG:	1.595				To: 1.56			1.565	0.03 m	
					Away: 1.57					

= 15.45

RPM: 1000		At Rest Pitch Reading :						At rest Roll Reading:		
Rod .Readings at Rest (a)		Pass Dir.	Time	Speed (kts)	Readings from Pass (b)			Difference a-b=c	Correction = c*-1	
									ft	m
		To	~~1115~~		15.5	15.8	15.5			
			1117	3.6	15.8	15.5	15.7	1.56125		
					15.5	15.6				
		Away			15.5	15.6				
			1125	2.6	15.7	15.7		1.5633		
					15.6	15.7				
AVG:	1.595				To: 1.56125			0.03m		
					Away: 1.5633					

1.562275

2500

Notes: Graph the results. Round corrections to the nearest 0.2ft and 0.1m. If the geography permits, the launch can be driven directly toward the location of the level and several readings may be taken per pass. To avoid the introduction of error due to tidal change, "at-rest" readings should be acquired at the beginning or end of each pass to make tidal corrections insignificant.

APPENDIX III

- CTD Report
- Offset Report
- VCF report

CTD Report -pole mount odom

Date:
Apr 20, 2005

Serial #:
SN:98212-042005

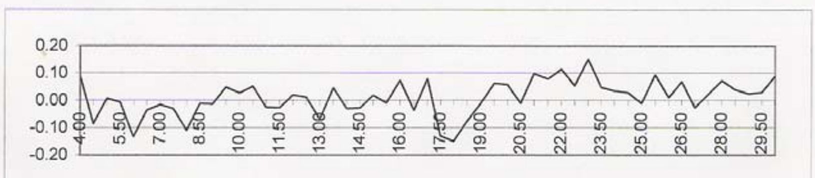
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5549.83	1421.71	0.09	17.50	1474.38	5750.10	1474.25	-0.13
4.50	1423.90	5557.85	1423.81	-0.09	18.00	1476.01	5756.24	1475.86	-0.15
5.00	1426.15	5566.79	1426.16	0.01	18.50	1477.62	5762.65	1477.54	-0.08
5.50	1428.38	5575.22	1428.37	-0.01	19.00	1479.21	5768.95	1479.19	-0.01
6.00	1430.58	5583.12	1430.44	-0.13	19.50	1480.77	5775.20	1480.83	0.06
6.50	1432.75	5591.78	1432.72	-0.04	20.00	1482.32	5781.07	1482.37	0.06
7.00	1434.90	5600.04	1434.88	-0.02	20.50	1483.84	5786.62	1483.83	-0.01
7.50	1437.02	5608.07	1436.99	-0.03	21.00	1485.35	5792.77	1485.44	0.10
8.00	1439.12	5615.76	1439.01	-0.11	21.50	1486.83	5798.35	1486.91	0.08
8.50	1441.19	5624.03	1441.18	-0.01	22.00	1488.29	5804.07	1488.41	0.11
9.00	1443.23	5631.82	1443.22	-0.01	22.50	1489.74	5809.34	1489.79	0.05
9.50	1445.25	5639.76	1445.30	0.05	23.00	1491.16	5815.14	1491.31	0.15
10.00	1447.25	5647.29	1447.28	0.03	23.50	1492.56	5820.10	1492.61	0.05
10.50	1449.22	5654.90	1449.27	0.05	24.00	1493.95	5825.33	1493.98	0.03
11.00	1451.17	5662.03	1451.14	-0.03	24.50	1495.32	5830.51	1495.34	0.03
11.50	1453.09	5669.36	1453.07	-0.03	25.00	1496.66	5835.49	1496.65	-0.01
12.00	1454.99	5676.78	1455.01	0.02	25.50	1497.99	5840.95	1498.08	0.09
12.50	1456.87	5683.90	1456.88	0.01	26.00	1499.30	5845.62	1499.31	0.01
13.00	1458.72	5690.66	1458.66	-0.07	26.50	1500.59	5850.76	1500.66	0.07
13.50	1460.55	5698.07	1460.60	0.05	27.00	1501.86	5855.24	1501.83	-0.03
14.00	1462.36	5704.67	1462.33	-0.03	27.50	1503.11	5860.20	1503.13	0.02
14.50	1464.14	5711.48	1464.12	-0.03	28.00	1504.35	5865.10	1504.42	0.07
15.00	1465.91	5718.37	1465.92	0.02	28.50	1505.56	5869.61	1505.60	0.04
15.50	1467.65	5724.89	1467.63	-0.01	29.00	1506.76	5874.12	1506.78	0.02
16.00	1469.36	5731.75	1469.43	0.07	29.50	1507.94	5878.64	1507.97	0.03
16.50	1471.06	5737.79	1471.02	-0.04	30.00	1509.10	5883.30	1509.19	0.09
17.00	1472.73	5744.61	1472.81	0.08					



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

CTD Report- pole mount odom

Date:
Apr 20, 2005

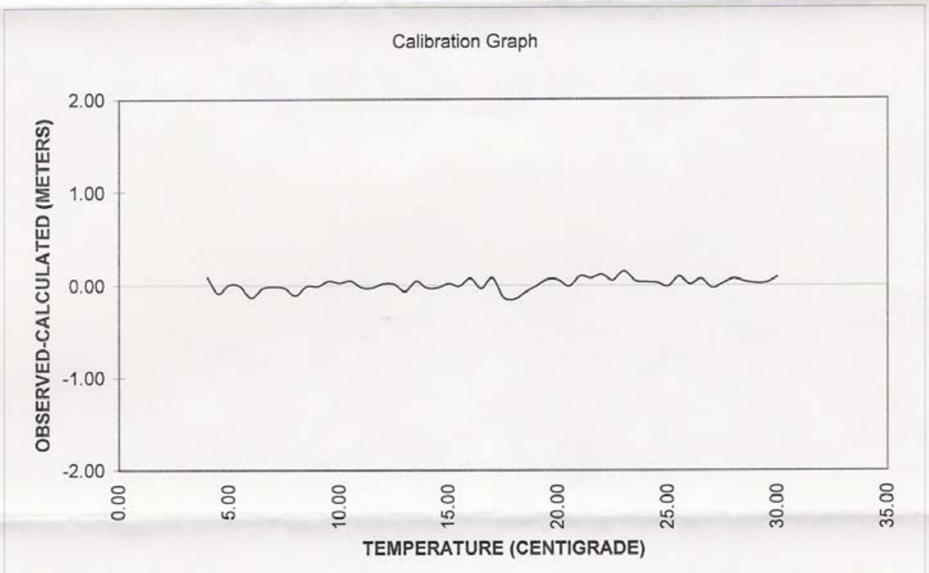
Serial #:
SN:98212-042005

DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:		
	Gradient	**3358**
	Intercept	**343**



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

CTD Report –spare odom

Date:
Aug 06, 2004

Serial #:
SN:98214-080604

DIGIBAR CALIBRATION REPORT

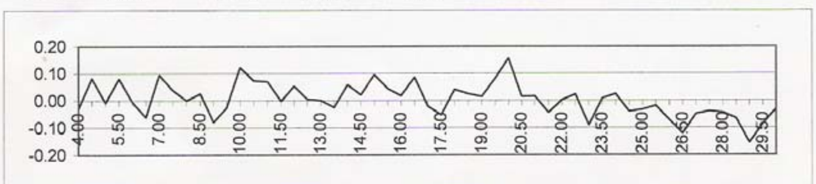
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H²O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5547.31	1421.59	-0.03
4.50	1423.90	5556.46	1423.98	0.08
5.00	1426.15	5564.73	1426.15	-0.01
5.50	1428.38	5573.58	1428.46	0.08
6.00	1430.58	5581.66	1430.57	-0.01
6.50	1432.75	5589.76	1432.69	-0.06
7.00	1434.90	5598.57	1434.99	0.10
7.50	1437.02	5606.47	1437.06	0.04
8.00	1439.12	5614.34	1439.12	0.00
8.50	1441.19	5622.36	1441.21	0.03
9.00	1443.23	5629.78	1443.15	-0.08
9.50	1445.25	5637.71	1445.23	-0.03
10.00	1447.25	5645.92	1447.37	0.12
10.50	1449.22	5653.27	1449.30	0.07
11.00	1451.17	5660.71	1451.24	0.07
11.50	1453.09	5667.79	1453.09	0.00
12.00	1454.99	5675.27	1455.05	0.05
12.50	1456.87	5682.26	1456.88	0.01
13.00	1458.72	5689.33	1458.73	0.00
13.50	1460.55	5696.23	1460.53	-0.02
14.00	1462.36	5703.46	1462.42	0.06
14.50	1464.14	5710.14	1464.17	0.02
15.00	1465.91	5717.16	1466.00	0.10
15.50	1467.65	5723.61	1467.69	0.04
16.00	1469.36	5730.08	1469.38	0.02
16.50	1471.06	5736.82	1471.14	0.09
17.00	1472.73	5742.81	1472.71	-0.02

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
17.50	1474.38	5749.00	1474.33	-0.05
18.00	1476.01	5755.59	1476.05	0.04
18.50	1477.62	5761.68	1477.64	0.02
19.00	1479.21	5767.71	1479.22	0.01
19.50	1480.77	5773.96	1480.85	0.08
20.00	1482.32	5780.15	1482.47	0.16
20.50	1483.84	5785.44	1483.86	0.01
21.00	1485.35	5791.20	1485.36	0.02
21.50	1486.83	5796.64	1486.78	-0.04
22.00	1488.29	5802.42	1488.30	0.00
22.50	1489.74	5808.02	1489.76	0.02
23.00	1491.16	5813.03	1491.07	-0.09
23.50	1492.56	5818.78	1492.57	0.01
24.00	1493.95	5824.14	1493.97	0.03
24.50	1495.32	5829.11	1495.27	-0.04
25.00	1496.66	5834.29	1496.63	-0.03
25.50	1497.99	5839.42	1497.97	-0.02
26.00	1499.30	5844.22	1499.23	-0.07
26.50	1500.59	5848.96	1500.46	-0.12
27.00	1501.86	5854.10	1501.81	-0.05
27.50	1503.11	5858.93	1503.07	-0.04
28.00	1504.35	5863.63	1504.30	-0.04
28.50	1505.56	5868.20	1505.50	-0.07
29.00	1506.76	5872.44	1506.60	-0.16
29.50	1507.94	5877.22	1507.85	-0.09
30.00	1509.10	5881.88	1509.07	-0.03



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

CTD Report-spare odom

Date:
Aug 06, 2004

Serial #:
SN:98214-080604

DIGIBAR CALIBRATION REPORT

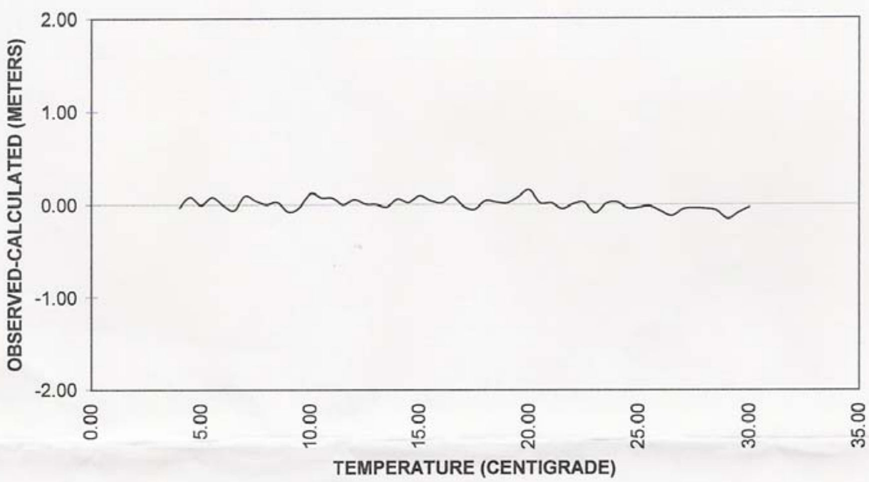
version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

Burn these numbers to EPROM:

	Gradient	**3347**
	Intercept	**289**

Calibration Graph



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

CTD Report-Sea Bird CTD

No papers were found in the CTD box that it was delivered in. The weekly DQA results show that the comparison of the Odom digibar to the Sea Bird CTD is within 1.1m/s. So it is not out of calibration, per say. However, we plan to send the Sea bird CTD to get calibrated as soon as possible because it has surpassed the annual QA test.

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
February 17, 2005

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to accurately determine the spatial relationship of various components of a POS MV navigation system aboard the NOAA boat SS 3002. Additionally, various reference points (bench marks) and a GPS antenna used for navigation were established onboard the vessel to aid in future spatial surveys aboard the boat.

PROJECT DETAILS

This survey was conducted at the I & M Branch facility in Corbin, VA on the 16th of February. The weather was unusually mild with a steady breeze.

INSTRUMENTATION

The Leica (Wild) TC2002 precision total station was used to make all measurements.

Technical Data:

Angle Measurement

Resolution	0.03 seconds
Smallest unit in display	0.1 seconds

Standard Deviation

Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

A standard “peanut” prism was used as a sighting target. This prism was configured to have a zero mm offset.

PERSONNEL

Kendall Fancher	NOAA/NOS/NGS/GSD/I&M BRANCH (540) 373-1243
Steve Breidenbach	NOAA/NOS/NGS/GSD/I&M BRANCH (540) 373-1243

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

ESTABLISHING THE REFERENCE FRAME

A primary reference point, CL1, was set on the centerline of the boat and near the physical center of the boat. To conduct this survey a local coordinate reference frame was established where the X axis runs along the centerline of the boat and is positive from the primary reference point towards the bow of the boat. The Y axis is perpendicular to the centerline of the boat (X axis) and is positive from the primary reference point towards the right, when looking at the boat from the stern. The Z axis is positive in an upward direction from the primary reference point. In this reference frame CL1, the primary reference point, has the following coordinates;
X = 0.000(m)
Y = 0.000(m)
Z = 0.000(m)

A secondary reference point (CL2) was set on the centerline of the boat, near the stern. The Y value of the secondary reference point was assumed to be zero. Determination of

the X value for CL2 was accomplished by measuring the horizontal distance from CL1. Determination of the Z value for CL2 was accomplished by trigonometric leveling from CL1. The determined coordinates for CL2 are;
X = -3.115(m)
Y = 0.000(m)
Z = -0.008 (m)

ESTABLISHING ALL OTHER POINTS

While occupying CL1, a bearing of 180.0000 was input into the instrument and CL2 was input for initialization. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM2 and TP1. TP1 is a temporary point set off of the boat. The established coordinates for TP1 were then stored internally in the instrument.

While occupying TP1, the previously determined bearing to CL1 was recalled and initialization was conducted to CL1. After initialization was conducted, angular and distance measurements were taken to establish the following points; IMU, BM4, BM3, GPS, L1, L2, and TP2. TP2 is a temporary point set off of the boat. The established coordinates for TP2 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously established points;
BM2
X = 0.001(m)
Y = 0.003(m)
Z = 0.007(m)

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

CL2
X = 0.005(m)
Y = 0.000(m)
Z = 0.005(m)

While occupying TP02, the previously determined bearing to TP01 was recalled and initialization was conducted to TP01. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM1, MB1, SB, and TP3. TP3 is a temporary point set off of the boat. The established coordinates for TP3 were then stored internally in the instrument. During these observations, coordinate checks were made to the following previously determined points;
CL1
X = -0.002(m)
Y = -0.003(m)
Z = 0.013(m)

IMU
X = 0.006(m)
Y = -0.010(m)
Z =   0.003 (m)

CL2
X = 0.001(m)
Y = 0.003(m)
Z = 0.007(m)

BM3
X = -0.002(m)
Y = -0.004(m)
Z =   0.000(m)

BM2
X = 0.003(m)
Y = -0.005(m)
Z =   0.003 (m)

GPS
X = 0.003(m)
Y = -0.005(m)
Z =   0.003(m)

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

L1
X = 0.003(m)
Y = -0.004(m)
Z =   0.003(m)

While occupying TP3, the previously determined bearing to TP2 was recalled and initialization was conducted to TP2. After initialization was conducted, angular and distance measurements were taken to establish the following points; BM1, MB1, SB, MB2, and MB3. During these observations, coordinate checks were made to the following previously determined points;

CL1
X = -0.002(m)
Y = 0.002(m)
Z =   0.013(m)

IMU
X = -0.004(m)
Y = 0.000(m)
Z =   0.005(m)

CL2
X = 0.008(m)
Y = -0.008(m)
Z =   0.002(m)

BM3
X = -0.002(m)
Y = 0.000(m)
Z =   0.005(m)

GPS
X = 0.005(m)
Y = 0.006(m)
Z = 0.003(m)

L1
X = 0.001(m)
Y = -0.003(m)
Z = 0.004(m)

NOAA BOAT S 3002
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

L2
X = -0.004(m)
Y = -0.002(m)
Z =   0.001 (m)

BM1
X = -0.001(m)
Y = 0.000(m)
Z =   0.003(m)

MB1
X = 0.003(m)
Y = -0.001(m)
Z =   0.002(m)

TP1

X = 0.000(m)
Y = 0.000(m)
Z = 0.007(m)
Points MB2 and MB3 were established for the purpose of determining a length for the Mulitbeam Sensor arm. A plumb bob was used to project the top center of the arm onto the deck. A plumb bob was also used to project the center of the bottom of the Multibeam Sensor can onto the deck. An inverse was computed between these two surveyed positions for a length value of 1.544(m).

DISCUSSION

All sensor/benchmark coordinates are contained in spreadsheet “S3002.xls. Included in this spreadsheet is the Multibeam Sensor arm length measurement and also an IMU GPS antenna separation value.

The positions given for all GPS antenna are to the top center of the antenna. To correct the Z value contained in the spreadsheet for each antenna to the electronic phase center, I recommend the following steps be taken;

1) Measure the total height of each antenna type. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the spreadsheet Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value.

VCF Report

VCF Files

3002_mbes.hvf


```
<?xml version="1.0"?>
<HIPSVesselConfig Version="2.0">
 <VesselShape>
  <PlanCoordinates>
   <Entry X="-1.350000" Y="-4.150000"/>
   <Entry X="1.340000" Y="-4.150000"/>
   <Entry X="1.340000" Y="1.850000"/>
   <Entry X="-0.005000" Y="4.970000"/>
   <Entry X="-1.350000" Y="1.850000"/>
   <Entry X="-1.350000" Y="-4.150000"/>
  </PlanCoordinates>
  <ProfileCoordinates>
   <Entry Y="-4.150000" Z="0.890000"/>
   <Entry Y="-4.150000" Z="-0.500000"/>
   <Entry Y="1.850000" Z="-0.500000"/>
   <Entry Y="4.970000" Z="0.890000"/>
   <Entry Y="-4.150000" Z="0.890000"/>
  </ProfileCoordinates>
  <RP Length="4.150000" Width="1.340000" Height="0.500000"/>
 </VesselShape>
 <DepthSensor>
  <TimeStamp value="2004-240 00:00:00">
   <Comment value="imu to mbes"/>
   <Latency value="0.000000"/>
   <SensorClass value="Swath"/>
   <TransducerEntries>
    <Transducer Number="1" Model="em3000">
     <Manufacturer value="Kongsberg"/>
     <SerialNumber value=""/>
     <Offsets X="1.174000" Y="2.600000" Z="1.342000" Latency="0.000000"/>
     <MountAngle Pitch="-4.800000" Roll="1.985000" Azimuth="3.000000"/>
    </Transducer>
   </TransducerEntries>
  </TimeStamp>
 </DepthSensor>
 <DraftSensor>
  <TimeStamp value="2004-240 00:00:00">
   <Latency value="0.000000"/>
   <ApplyFlag value="No"/>
   <DraftEntries>
    <Entry Speed="0.000000" Draft="0.000000"/>
    <Entry Speed="2.000000" Draft="0.030000"/>
    <Entry Speed="3.500000" Draft="0.030000"/>
    <Entry Speed="5.000000" Draft="-0.016000"/>
    <Entry Speed="6.400000" Draft="-0.027000"/>
    <Entry Speed="7.200000" Draft="-0.040000"/>
   </DraftEntries>
   <Comment value="recal"/>
  </TimeStamp>
  <TimeStamp value="2004-306 00:00:00">
   <Comment value=""/>
   <Latency value="0.000000"/>
   <ApplyFlag value="Yes"/>
   <DraftEntries>
    <Entry Speed="0.000000" Draft="0.000000"/>
```

<Entry Speed="2.000000" Draft="-0.063000"/>
<Entry Speed="3.500000" Draft="-0.053000"/>
<Entry Speed="4.500000" Draft="-0.040000"/>
<Entry Speed="6.000000" Draft="-0.024000"/>
<Entry Speed="7.500000" Draft="-0.024000"/>
</DraftEntries>
</TimeStamp>
</DraftSensor>
<GyroSensor>
<TimeStamp value="2004-240 00:00:00">
<Latency value="0.000000"/>
<ApplyFlag value="No"/>
<Comment value="(null)"/>
<Manufacturer value="(null)"/>
<Model value="(null)"/>
<SerialNumber value="(null)"/>
</TimeStamp>
</GyroSensor>
<HeaveSensor>
<TimeStamp value="2004-240 00:00:00">
<Latency value="0.000000"/>
<ApplyFlag value="Yes"/>
<Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
<Comment value="(null)"/>
<Manufacturer value="(null)"/>
<Model value="(null)"/>
<SerialNumber value="(null)"/>
</TimeStamp>
</HeaveSensor>
<NavSensor>
<TimeStamp value="2004-240 00:00:00">
<Comment value=""/>
<Latency value="-0.100000"/>
<Manufacturer value=""/>
<Model value=""/>
<SerialNumber value=""/>
<Ellipse value="NA83"/>
<Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
</TimeStamp>
</NavSensor>
<PitchSensor>
<TimeStamp value="2004-240 00:00:00">
<Latency value="0.000000"/>
<ApplyFlag value="No"/>
<Offsets Pitch="0.000000"/>
<Comment value="(null)"/>
<Manufacturer value="(null)"/>
<Model value="(null)"/>
<SerialNumber value="(null)"/>
</TimeStamp>
</PitchSensor>
<RollSensor>
<TimeStamp value="2004-240 00:00:00">
<Latency value="0.000000"/>
<ApplyFlag value="No"/>
<Offsets Roll="0.000000"/>
<Comment value="(null)"/>
<Manufacturer value="(null)"/>
<Model value="(null)"/>
<SerialNumber value="(null)"/>
</TimeStamp>
</RollSensor>
<SVPSensor>
<TimeStamp value="2004-240 00:00:00">
<Latency value="0.000000"/>
<DualHead value="Yes"/>
<Offsets X="1.174000" Y="2.600000" Z="1.342000" X2="0.000000" Y2="0.000000" Z2="0.000000"/>
<MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000" Pitch2="0.000000" Roll2="0.000000" Azimuth2="0.000000"/>
<Comment value="(null)"/>

```
    </TimeStamp>
  </SVPSensor>
  <WaterlineHeight>
    <TimeStamp value="2004-240 00:00:00">
      <Latency value="0.000000"/>
      <WaterLine value="-0.205000"/>
      <ApplyFlag value="Yes"/>
      <StdDev Waterline="0.000000"/>
      <Comment value="recal"/>
    </TimeStamp>
  </WaterlineHeight>
</HIPSVesselConfig>
```


3002_vbes.hvf


```
<?xml version="1.0"?>
<HIPSVesselConfig Version="2.0">
  <VesselShape>
    <PlanCoordinates>
      <Entry X="-1.350000" Y="-4.150000"/>
      <Entry X="1.340000" Y="-4.150000"/>
      <Entry X="1.340000" Y="2.050000"/>
      <Entry X="-0.005000" Y="4.970000"/>
      <Entry X="-1.350000" Y="2.050000"/>
      <Entry X="-1.350000" Y="-4.150000"/>
    </PlanCoordinates>
    <ProfileCoordinates>
      <Entry Y="-4.150000" Z="0.870000"/>
      <Entry Y="-4.150000" Z="-0.500000"/>
      <Entry Y="2.050000" Z="-0.500000"/>
      <Entry Y="4.970000" Z="0.870000"/>
      <Entry Y="-4.150000" Z="0.870000"/>
    </ProfileCoordinates>
    <RP Length="4.150000" Width="1.340000" Height="0.500000"/>
  </VesselShape>
  <DepthSensor>
    <TimeStamp value="2004-240 00:00:00">
      <Comment value="rp to sb-trans"/>
      <Latency value="0.000000"/>
      <SensorClass value="Swath"/>
      <TransducerEntries>
        <Transducer Number="1" StartBeam="1" Model="Unknown">
          <Manufacturer value=""/>
          <SerialNumber value=""/>
          <Offsets X="-0.130000" Y="0.305000" Z="0.389000" Latency="0.000000"/>
          <MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000"/>
        </Transducer>
      </TransducerEntries>
    </TimeStamp>
    <TimeStamp value="2004-306 00:00:00">
      <Comment value="imu to sbes"/>
      <Latency value="0.000000"/>
      <SensorClass value="Swath"/>
      <TransducerEntries>
        <Transducer Number="1" StartBeam="1" Model="Unknown">
          <Manufacturer value="innerspace"/>
          <SerialNumber value=""/>
          <Offsets X="-0.276000" Y="0.040000" Z="0.255000" Latency="0.000000"/>
          <MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000"/>
        </Transducer>
      </TransducerEntries>
    </TimeStamp>
  </DepthSensor>
  <DraftSensor>
    <TimeStamp value="2004-306 00:00:00">
      <Latency value="0.000000"/>
      <ApplyFlag value="Yes"/>
```

```
    <DraftEntries>
      <Entry Speed="0.000000" Draft="0.000000"/>
      <Entry Speed="2.500000" Draft="0.067000"/>
      <Entry Speed="4.000000" Draft="0.087000"/>
      <Entry Speed="5.000000" Draft="0.109000"/>
      <Entry Speed="6.500000" Draft="0.114000"/>
      <Entry Speed="8.000000" Draft="0.095000"/>
      <Entry Speed="10.000000" Draft="0.014000"/>
    </DraftEntries>
    <Comment value=""/>
  </TimeStamp>
</DraftSensor>
<GyroSensor>
  <TimeStamp value="2004-240 00:00:00">
    <Latency value="0.000000"/>
    <ApplyFlag value="No"/>
  </TimeStamp>
  <TimeStamp value="2004-306 00:00:00">
    <Comment value=""/>
    <Latency value="0.000000"/>
    <Manufacturer value=""/>
    <Model value=""/>
    <SerialNumber value=""/>
    <ApplyFlag value="No"/>
  </TimeStamp>
</GyroSensor>
<HeaveSensor>
  <TimeStamp value="2004-240 00:00:00">
    <Latency value="0.000000"/>
    <ApplyFlag value="Yes"/>
    <Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
    <Comment value="(null)"/>
    <Manufacturer value="(null)"/>
    <Model value="(null)"/>
    <SerialNumber value="(null)"/>
  </TimeStamp>
  <TimeStamp value="2004-306 00:00:00">
    <Comment value=""/>
    <Latency value="0.000000"/>
    <Manufacturer value=""/>
    <Model value=""/>
    <SerialNumber value=""/>
    <ApplyFlag value="Yes"/>
    <Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
  </TimeStamp>
</HeaveSensor>
<PitchSensor>
  <TimeStamp value="2004-240 00:00:00">
    <Latency value="0.000000"/>
    <ApplyFlag value="Yes"/>
    <Offsets Pitch="0.000000"/>
    <Comment value="(null)"/>
    <Manufacturer value="(null)"/>
    <Model value="(null)"/>
    <SerialNumber value="(null)"/>
  </TimeStamp>
  <TimeStamp value="2004-306 00:00:00">
    <Comment value=""/>
    <Latency value="0.000000"/>
    <Manufacturer value=""/>
    <Model value=""/>
    <SerialNumber value=""/>
    <ApplyFlag value="Yes"/>
    <Offsets Pitch="0.000000"/>
  </TimeStamp>
</PitchSensor>
<RollSensor>
  <TimeStamp value="2004-240 00:00:00">
    <Latency value="0.000000"/>
    <ApplyFlag value="Yes"/>
```

<Offsets Roll="0.000000"/>
<Comment value="(null)"/>
<Manufacturer value="(null)"/>
<Model value="(null)"/>
<SerialNumber value="(null)"/>
</TimeStamp>
<TimeStamp value="2004-306 00:00:00">
<Comment value=""/>
<Latency value="0.000000"/>
<Manufacturer value=""/>
<Model value=""/>
<SerialNumber value=""/>
<ApplyFlag value="Yes"/>
<Offsets Roll="0.000000"/>
</TimeStamp>
</RollSensor>
<SVPSensor>
<TimeStamp value="2004-306 00:00:00">
<Latency value="0.000000"/>
<DualHead value="Yes"/>
<Offsets X="-0.276000" Y="0.040000" Z="0.255000" X2="0.000000" Y2="0.000000" Z2="0.000000"/>
<MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000" Pitch2="0.000000" Roll2="0.000000"
Azimuth2="0.000000"/>
<Comment value="(null)"/>
</TimeStamp>
</SVPSensor>
<WaterlineHeight>
<TimeStamp value="2004-306 00:00:00">
<Latency value="0.000000"/>
<WaterLine value="-0.200000"/>
<ApplyFlag value="Yes"/>
<StdDev Waterline="0.000000"/>
<Comment value="recal"/>
</TimeStamp>
</WaterlineHeight>
<NavSensor>
<TimeStamp value="2004-240 00:00:00">
<Comment value=""/>
<Latency value="0.000000"/>
<Manufacturer value=""/>
<Model value=""/>
<SerialNumber value=""/>
<Ellipse value="WG84"/>
<Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
</TimeStamp>
<TimeStamp value="2004-306 00:00:00">
<Comment value=""/>
<Latency value="0.000000"/>
<Manufacturer value=""/>
<Model value=""/>
<SerialNumber value=""/>
<Ellipse value="NA83"/>
<Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
</TimeStamp>
</NavSensor>
</HIPSVesselConfig>

3002sss.hvf

<?xml version="1.0"?>
<HIPSVesselConfig Version="2.0">
<VesselShape>
<PlanCoordinates>
<Entry X="-1.350000" Y="-4.150000"/>
<Entry X="1.340000" Y="-4.150000"/>
<Entry X="1.340000" Y="1.850000"/>
<Entry X="-0.005000" Y="4.970000"/>

```
    <Entry X="-1.350000" Y="1.850000"/>
    <Entry X="-1.350000" Y="-4.150000"/>
  </PlanCoordinates>
  <ProfileCoordinates>
    <Entry Y="-4.150000" Z="0.890000"/>
    <Entry Y="-4.150000" Z="-0.500000"/>
    <Entry Y="1.850000" Z="-0.500000"/>
    <Entry Y="4.970000" Z="0.890000"/>
    <Entry Y="-4.150000" Z="0.890000"/>
  </ProfileCoordinates>
  <RP Length="4.150000" Width="1.340000" Height="0.500000"/>
</VesselShape>
<DepthSensor>
  <TimeStamp value="2002-079 00:00:00">
    <Latency value="0.000000"/>
    <SensorClass value="Swath"/>
    <TransducerEntries>
      <Transducer Number="1" StartBeam="1" Model="448">
        <Manufacturer value="Innerspace"/>
        <SerialNumber value="187"/>
        <Offsets X="0.000000" Y="0.000000" Z="0.000000" Latency="0.000000"/>
        <MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000"/>
      </Transducer>
    </TransducerEntries>
  </TimeStamp>
</DepthSensor>
<DraftSensor>
  <TimeStamp value="2002-079 00:00:00">
    <Comment value="(null)"/>
    <Latency value="0.000000"/>
    <ApplyFlag value="Yes"/>
    <DraftEntries>
      <Entry Speed="0.000000" Draft="0.000000"/>
      <Entry Speed="4.100000" Draft="0.010000"/>
      <Entry Speed="6.000000" Draft="0.030000"/>
      <Entry Speed="8.400000" Draft="0.050000"/>
      <Entry Speed="11.400000" Draft="0.000000"/>
      <Entry Speed="15.400000" Draft="-0.080000"/>
      <Entry Speed="24.500000" Draft="-0.010000"/>
    </DraftEntries>
  </TimeStamp>
</DraftSensor>
<GyroSensor>
  <TimeStamp value="2002-079 00:00:00">
    <Latency value="0.000000"/>
    <ApplyFlag value="Yes"/>
    <Offsets>
      <Gyro>
        <Entry Azimuth="0.000000" Offset="0.000000"/>
      </Gyro>
    </Offsets>
  </TimeStamp>
</GyroSensor>
<NavSensor>
  <TimeStamp value="2002-079 00:00:00">
    <Latency value="0.000000"/>
    <Manufacturer value=""/>
    <Model value=""/>
    <SerialNumber value=""/>
    <Ellipse value="WG84"/>
    <Offsets X="0.133000" Y="0.283000" Z="0.097000"/>
    <Comment value="imu to rp"/>
  </TimeStamp>
  <TimeStamp value="2004-306 00:00:00">
    <Comment value="do not imu to rp"/>
    <Latency value="0.000000"/>
    <Manufacturer value=""/>
    <Model value=""/>
    <SerialNumber value=""/>
    <Ellipse value="NA83"/>
```

```
      <Offsets X="0.000000" Y="0.000000" Z="0.000000"/>
    </TimeStamp>
  </NavSensor>
  <SVPSensor>
    <TimeStamp value="2002-079 00:00:00">
      <Latency value="0.000000"/>
      <DualHead value="Yes"/>
      <Offsets X="0.000000" Y="0.000000" Z="0.000000" X2="0.000000" Y2="0.000000" Z2="0.000000"/>
      <MountAngle Pitch="0.000000" Roll="0.000000" Azimuth="0.000000" Pitch2="0.000000" Roll2="0.000000"
Azimuth2="0.000000"/>
    </TimeStamp>
  </SVPSensor>
  <TowedSensor>
    <TimeStamp value="2002-079 00:00:00">
      <Latency value="0.000000"/>
      <Manufacturer value="Dynapar"/>
      <Offsets X="2.180000" Y="-2.820000" Z="-2.640000" Layback="0.000000"/>
      <Comment value="(null)"/>
      <Model value="(null)"/>
      <SerialNumber value="(null)"/>
    </TimeStamp>
    <TimeStamp value="2004-306 00:00:00">
      <Comment value="redone config"/>
      <Latency value="0.000000"/>
      <Manufacturer value="dynapar"/>
      <Model value=""/>
      <SerialNumber value=""/>
      <Offsets X="1.535000" Y="-3.031000" Z="-2.310000" Layback="0.000000"/>
    </TimeStamp>
  </TowedSensor>
  <WaterlineHeight>
    <TimeStamp value="2002-079 00:00:00">
      <Latency value="0.000000"/>
      <WaterLine value="-0.200000"/>
      <ApplyFlag value="Yes"/>
      <StdDev Waterline="0.000000"/>
      <Comment value="(null)"/>
    </TimeStamp>
  </WaterlineHeight>
</HIPSVesselConfig>
```

APPENDIX IV

- Patch Test Report
- SSS Report
- Leadline Report

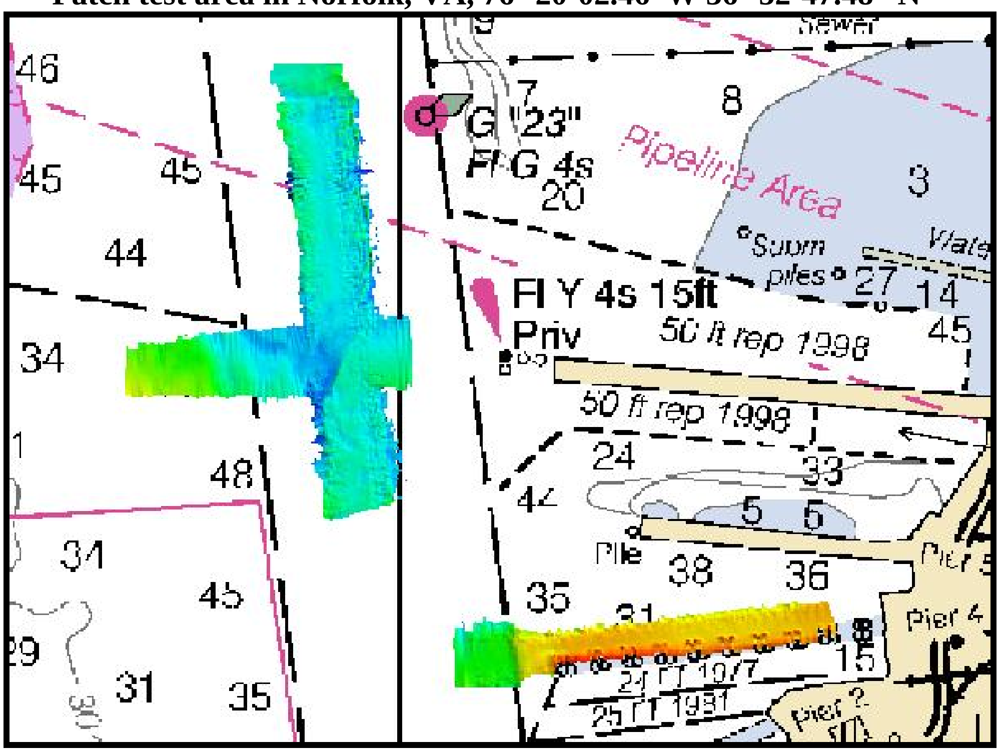
Patch Test Report

SURVEY VESSEL 3002
CERTIFICATION REPORT EM3000

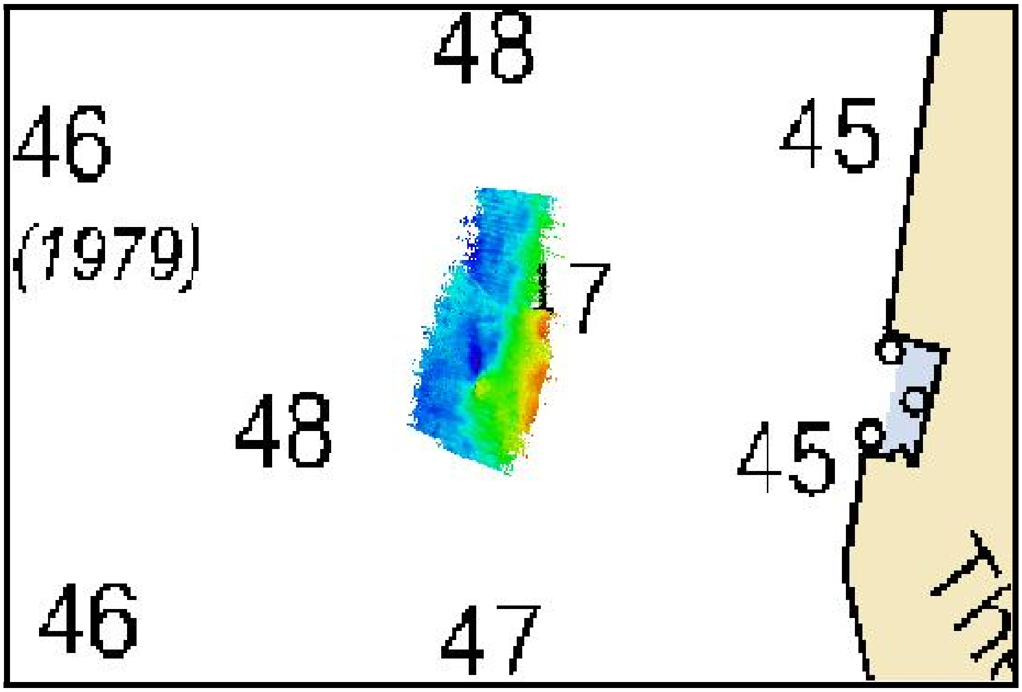
Background:

Prior to the beginning of Survey Operations, certification of the boat equipment and procedures must be performed and submitted to the branch. This document addresses only the Simrad Em3000 certification. At this point it is a fluid document. The Hardware Acceptance Test (HAT) and the System Acceptance Test (SAT) are lengthy check off sheets and at this time it is unknown whether this is to be incorporated into the Certification process. Preliminary tests for Hat, SAT and Pos/MV antenna calibration were performed March 9, 2005 in Norfolk, VA. A second patch test was done in New York to further calibrate the yaw and roll offsets. Patch tests must be completed consistently and offsets must be accurate; this report addresses our methods of acquiring those offsets. All other calibrations from the patch test are addressed in the Caris offsets.

Patch test area in Norfolk, VA, 76° 20’02.46”W 36° 52’47.48” N



Patch test area for roll offsets in New York Harbor / Hudson River
74° 01’24.88” W   40° 42’27.03 N”



Equipment:

Simrad EM3000 multibeam echo-sounder
TSS POS/MV 4 Inertial Motion sensor
Trimble DSM 212L DGPS receiver
2 Trimble GPS Antennas
Seacat SBE19Plus sound velocity profiler

Procedure:

The following is a list of key items that must be covered for SimradEm3000 Certification

Offset Confirmation with date accomplished

- ☐ **3/9 /2005 Horizontal Vertical (Changes)**
- ☐ **3/9 /2005** Sounders
- ☐ **3/9 /2005** SSS
- ☐ **3/9 /2005** Antenna
- ☐ P-Check

- ☐ **3/9 /2005** Static Draft Bubble
- ☐ **11/17/2004** Lead Line Comparison
- ☐ Processing Run Through

Pos/MV Gams Calibration

- ☐ **3/9/2005** The site will be in vicinity of the 2005 patch test for the boat.

Patch test

- ☐ **3/9 /2005, 4/12/2005** Line Plan
- ☐ **3/9 /2005** Forms
- ☐ **2/2004** Hypack setup

EM3000

- ☐ **2/2004** Em3000 Install Parameters
- ☐ Certification/ Calib Note
- ☐ **2/2004** Confirm Transfer Data Transfer Data
- ☐ **3/2005** Time Set UTC

PATCH TEST CALIBRATION

Location:

The location of the patch test will vary with project location. For 2005, project instructions for New York Harbor and the lower Hudson River dictated that a patch test be done in the area of the survey. Patch tests done in Norfolk, VA were part of HSTP's support for calibrating and testing S3002 with NRT5. The locations and coordinates can be found in the chartlet images found at the beginning of this document.

Procedure

Navigation Time delay: two pair of coincident lines run at different speeds and same direction. One pair up the slope and one down the slope, each line within a pair run at 3 and 7 knots over a 6% slope. Each pair of lines was reviewed in CARIS calibration mode for an average along track displacement of soundings.

Pitch: two pair of coincident lines run at same speed and different direction. One pair up slope and one down slope, each line run at 5 knots over a 6% slope. Each pair of lines was reviewed in CARIS calibration mode for an average along track displacement of soundings.

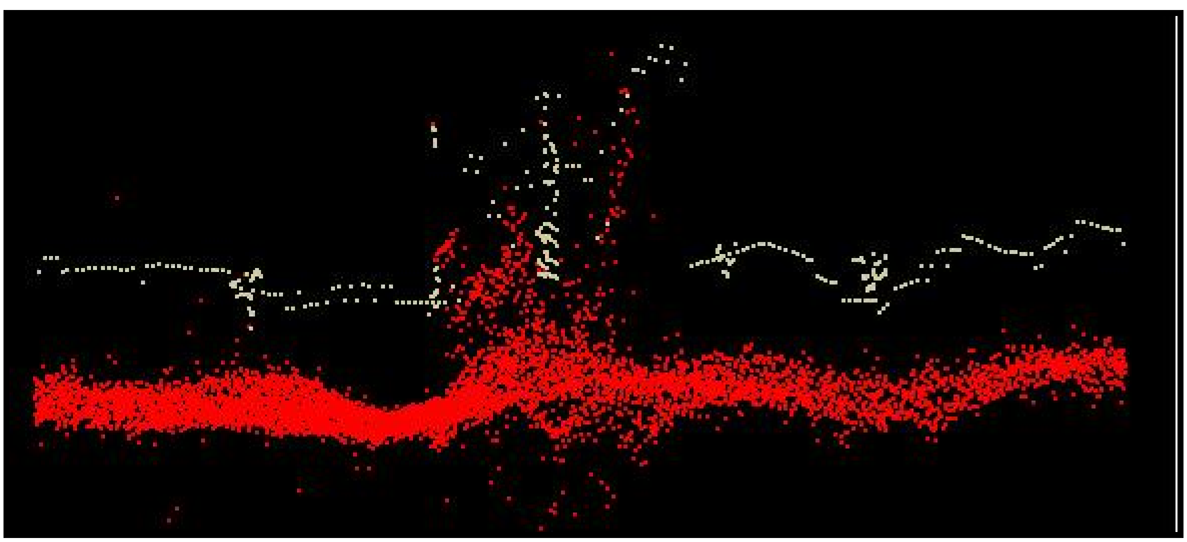
Roll: one pair of coincident lines, run at same speed and different direction in depths of 45 to 50 feet. One checkline run perpendicular to the pair of lines at the same speed for outer beam comparison. The pair of lines was reviewed in CARIS calibration mode for an average across track displacement of soundings. The checkline was reviewed with the pair of coincident lines and averaged with the overall roll bias.

Yaw- one pair of lines offset approximately 15 meters to either side of a charted wreck, run at same speed in opposite direction. The pair of lines was reviewed in CARIS calibration mode for an average along track displacement of soundings.

Deep water lines use the same procedures for pitch and roll. An outer beam roll offset was also acquired. This calibration accounts for the deterioration of the outer coating of the Simrad transducer. These are run perpendicular to each other and the Roll offset tool is used. A notice from Simrad indicated their documentation had the incorrect sign for outer beam offset.

Further assurance checks were made between our Innerspace 455i single beam echo sounder and the soundings obtained with the EM3000. The difference between soundings obtained from both sensors was less than 5cm over the actual shipwreck. See screen shots below.

Soundings over a shipwreck in New York Harbor. Comparison between SBES and MBES sounding data.



	Depth	Latitude	Longitude	Project	Vessel	Day
✓	10.988	40-37-56.36N	74-03-31.20W	nyc_pilots	3002_mbes	2005-104
✓	11.018	40-37-56.30N	74-03-31.11W	nyc_pilots	3002_vbes	2005-108
✓	11.090	40-37-56.30N	74-03-31.15W	nyc_pilots	3002_vbes	2005-108
✓	11.099	40-37-56.30N	74-03-31.14W	nyc_pilots	3002_vbes	2005-108
✓	11.107	40-37-56.30N	74-03-31.12W	nyc_pilots	3002_vbes	2005-108
✓	11.226	40-37-56.40N	74-03-31.17W	nyc_pilots	3002_mbes	2005-104
✓	11.246	40-37-56.40N	74-03-31.18W	nyc_pilots	3002_mbes	2005-104
✓	11.254	40-37-56.41N	74-03-31.38W	nyc_pilots	3002_vbes	2005-108
✓	11.259	40-37-56.36N	74-03-31.16W	nyc_pilots	3002_mbes	2005-104
✓	11.268	40-37-56.29N	74-03-31.34W	nyc_pilots	3002_vbes	2005-108
✓	11.274	40-37-56.29N	74-03-31.37W	nyc_pilots	3002_vbes	2005-108
✓	11.279	40-37-56.30N	74-03-31.17W	nyc_pilots	3002_vbes	2005-108
✓	11.292	40-37-56.29N	74-03-31.40W	nyc_pilots	3002_vbes	2005-108

Patch Test Report

PATCH TESTS **Project** NYC **Vessel** S3002 **DN** ______ **Date** 3-3-05

Consult Caris Field Procedures for Calibration of MBES by Andre Godin 02/96 in the Patch Test Log

Test 1) * Position Time	Running Attributes 500-1000m, Slope10-20° Perpendicular to contour, 1 pair inshore at different speed, 1 pair offshore at different speed, run same Line,	Use Pitch Tool 3-5 Slices along X-Line over all 4 Use Equi angular beam spacing			1st Scan: Initials BSH Observed Error	2nd scan: Initials ____ Observed Error	Avg	Remarks *(Go to Pre Test outer beam First if this is Simrad)
Comparison 1	Inbound Slow Line Name	002-1550	Dir: 83°	Speed: 4.0	.40 .30 .26 (.32)	.38 .30 .34 (3.47)	.33	← ←
	Inbound Fast Line Name	002-1557	Dir: 83°	Speed: 6.5				
Comparison 2	Outbound Slow Line Name		Dir:	Speed:				
	Outbound Fast Line Name		Dir:	Speed:				

Test 2) Pitch	Running Attributes 500-1000m, Slope10-20° Perpendicular to contour, or Feature 1 pair inshore at different speed, run same line 1 pair offshore at different speed, run same Line. Add time delay from Position time test if pitch >1deg redo	Use Pitch Tool 3-5 Slices along X-Line over all 4 Use Equi angular beam spacing			1st Scan: Initials BSH Observed Error	2nd scan: Initials ____ Observed Error	Avg	Remarks
Comparison 1	Inshore Slow Line Name	002-1608	Dir: 83°	Speed: 5.0	-12.0 -5.80 -13.6 (-10.5)	-19.0 -18.0 -18.0 (-18.3)	14.4	←→
	OffShore Slow Line Name	002-1612	Dir: 263°	Speed: 5.0				
Comparison 2	Inshore Fast Line Name		Dir:	Speed:				
	Offshore Fast Line Name		Dir:	Speed:				

Test 3) Roll	Running Attributes 500-1000m Bottom Type Flat 50-250m deep roll bias shows up better	1 pair opposite dir Same Speed(use calculation) 3-5 Slices Across Use Roll Tool Roll			1st Scan: Initials BSH Observed Error	2nd scan: Initials ____ Observed Error	Avg	Remarks
Comparison 1	Line Name	001-1524	Dir: 353	Speed: 5.0	2.20 2.60 3.60 (2.85)	2.4 2.7 2.7 2.6	2.72	←→
	Line Name	004-1532	Dir: 173	Speed: 5.0				
Comparison 2	Line Name		Dir:	Speed:				
	Line Name		Dir:	Speed:				

Test 4 Yaw, AZ or Heading	Running Attributes Two pair: 1st pair adjacent parallel lines same Dir. To be run normal to a prominent bathymetric feature such as a shoal or channel side slope. Do not use a feature with sharp edges such as wrecks since there is more ambiguity in the interpretation 15% overlap. Same Speed 3- Slices along track (center of overlap) Yaw/gyro Tool blue line is center beam take 4 reading adjustments and avg				1st Scan: Initials ____ Observed Error	2nd scan: Initials ____ Observed Error	Avg	Remarks
Comparison 1 both at 090 e.g.	Line Name		Dir:	Speed:	.50 .40			← ←
	Line Name		Dir:	Speed:				
Comparison 2 both at 180 e.g.	Line Name		Dir:	Speed:				
	Line Name		Dir:	Speed:				

Select Lines then corridor watch mouse button sequence (middle button)

	Line Name	Dir:	Speed:				
Comparison 2	Line Name	Dir:	Speed:				

Test 4 Yaw, AZ or Heading	**Running Attributes** Two pair: 1st pair adjacent parallel lines same Dir. To be run normal to a prominent bathymetric feature such as a shoal or channel side slope, Do not use a feature with sharp edges such as wrecks since there is more ambiguity in the interpretation. 15% overlap. Same Speed 3-5 Slices along (center of overlap) Roll Tool blue line is center beam take 4 reading adjustments and avg			1st Scan: Initials____ Observed Error	2nd scan: Initials____ Observed Error	Avg	Remarks
Comparison 1 both at 090 e.g.	009-1840 Line Name	Dir: 003°	Speed: 4 kts	0.50 1.60 .80	1.4 7.5 1.2	.97	
	011-1845 Line Name	Dir: 001°	Speed: 4 kts			2.0	
Comparison 2 both at 180 e.g.	009-1850 Line Name	Dir: 003°	Speed: 4 kts				
	Line Name	Dir:	Speed:			= 1.48	

|Select Lines then corridor watch mouse button sequence (middle button)

Outer Beam offset (for Simrad transducer surface) Optional	**Running** Perpendicular NOTE: This Test is Typically for Simrad type systems only. The key to the calibration is not necessarily pulling the lines together (though they coulbe) But to get the depths of the outside wings of the beams parallel to the comparison line. Two perpendicular lines same speeed			1st Scan: Initials____ Observed Error	2nd scan: Initials____ Observed Error	Avg	Remarks which line is nadir
Comparison 1	Line Name	Dir:	Speed:				
	Line Name	Dir:	Speed:				

	Line Name	Dir:	Speed:				
Comparison 2	Line Name	Dir:	Speed:				
	Line Name	Dir:	Speed:				
Comparison 3	Line Name	Dir:	Speed:				
	Line Name	Dir:	Speed:				
Comparison 4	Line Name	Dir:	Speed:				
	Line Name	Dir:	Speed:				
Comparison 5	Line Name	Dir:	Speed:				
	Line Name	Dir:	Speed:				
Comparison 6	Line Name	Dir:	Speed:				

Remarks: Take a slice of the along the nadir line. Use the roll tool to make one wing of the swath parrallel to the nadir line but not intersecting.. The arm should be about 1/3

SURVEY VESSEL 3002
CERTIFICATION REPORT KLEIN SSS 3000 and TRIMBLE TSC BACKPACK GPS

Background:

SV3002 and NRT-5 are equipped with a Klein 3000 side scan sonar and a Trimble TSC Pathfinder handheld GPS device. We decided to test the quality of both devices with each other by utilizing a pier corner to check positioning accuracy. The test was done mainly to check our offsets and layback of the SSS cable, and to verify that the positioning of targets placed in both Sonar Pro and Caris were accurate enough for item detection and positioning. For SV3002, the position of the towfish is calculated by the POSMV based on the measurements of our layback, which is entered into the HYPACK navigation software.

Equipment:

Klein 3000 Side Scan Sonar
Trimble TSC Pathfinder GPS receiver

Location:

U.S. Army Corp of Engineers Pier at Caven Point Military Terminal, Jersey City, NJ. 74-04-19.69W, 40-41-03.88N

Procedure:

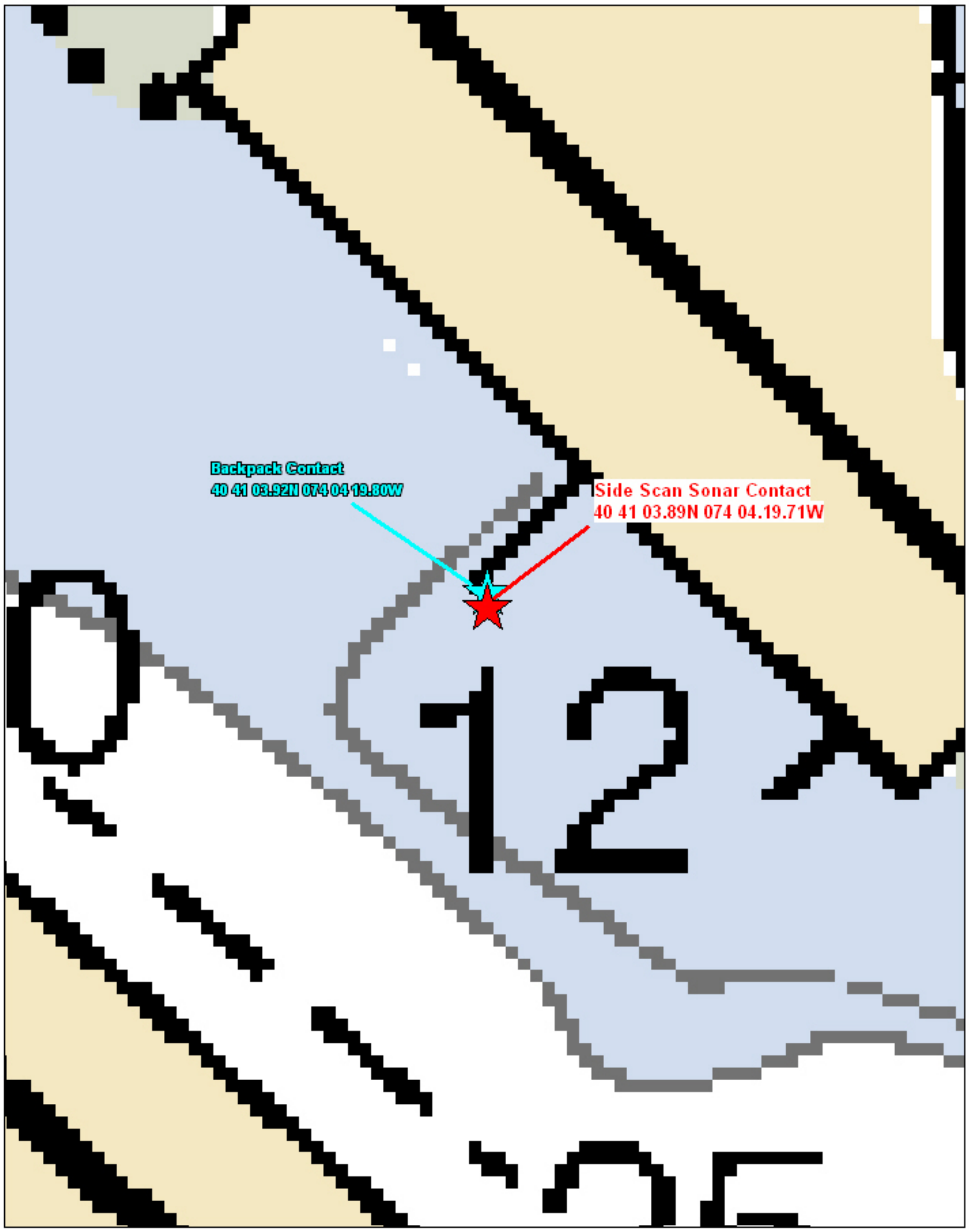
A point was taken at the tip of the corner of the pier using the Trimble TSC backpack unit. The tip of the pier was then side scanned from multiple angles. A third set of coordinates was obtained by driving the boat to the tip of the pier and dropping a target within Hypack. The side scan data was then processed via Caris and contacts were established at the tip of the pier. All three sets of coordinates for the tip of the pier were then compared and found to be within fractions of a second in accuracy. This translates into <2 meters of error, which could have simply been a result of how the pilings extend underwater or the slight distance between the backpack and the outer edge of the piling.

Results:

We have found that all three devices have produced accurate and precise locational information.

Pier Corner: 40/41/03.9255 N
74/04/19.80895 W

SSS Corner: 40/41/03.89 N
74/04/19.71 W



Lead Line Report

LEADLINE COMPARISON SIMRAD and Launch with processing added

Depth units: Meters
Date: 11-17-04

LAT: 40° 40' 03.87" N
LON: 074° 02' 54.49" W

Vessel: S3002 /NRT-5

Time	MB Raw Depth	1014 1005 only +draft	1014 1005 only + vel	=A Depth	Port Lead RP to Bottom	Star Lead RP to Bottom	B Avg Lead RP to Bottom	Port Lead RP to WL	Star Lead RP to WL	C Avg Lead RP to WL	D Lead Depth= B-C	Raw Error= A-D	E Processed depth	Processed error E-D
1827	17.2				17.29									
1835	17.1				~~[illegible]~~	17.21								
1839	17.2				17.33									
1844	17.3					17.29								

If lead line was taken from WL then RP to WL= 0 If taken from RP measure distance or consult offsets.

> Flood ~~current~~ tide

> MBES & VBES collected

Lead Line Report
NRT5

Intro:

Lead Line calibration was conduct in New York Harbor, NY in November 2004 aboard the S3002, NRT5.

Procedure:

One person in the cabin reading the SBES trace would yell mark while on the outside a person with a lead line would take a reading off the lead line at the same time. To get an average of the outside reading, one reading came from port then from starboard.

These values were tabulated and analyzed.

	leadline	vbes
Port	17.29	17.2
Stb	17.21	17.1
Port	17.33	17.2
Srb	17.29	17.3
ave	**17.28**	**17.2**

Results:

The results compare with in a .02 meters or 2 cm of each other. The results are considered to be good for this lead line test.