

MBES – Data Collection



HYSWEEP[®] Overview



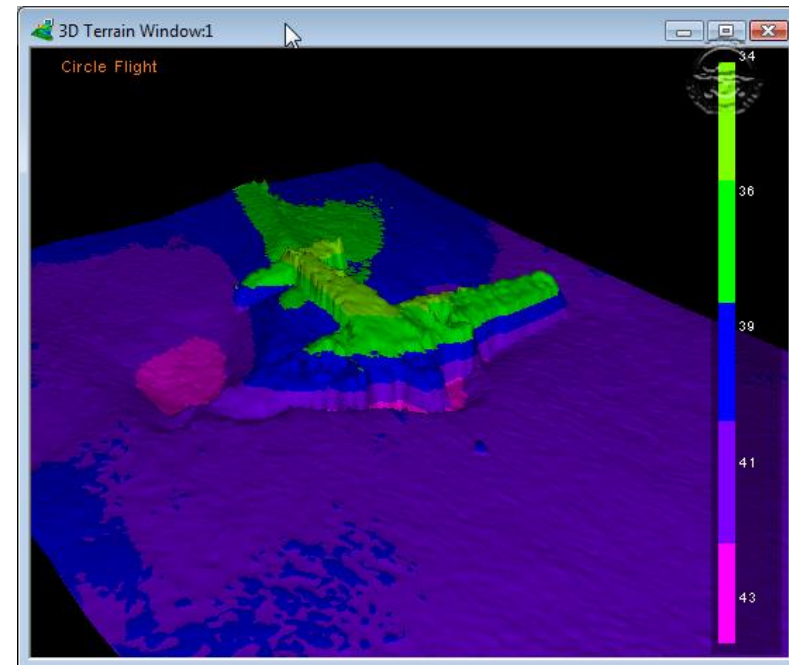
HYPACK 2022 – Training Event

HYSWEEP® Overview



S/V Bufe - USACE Sault Ste. Marie Area Office

Full Coverage Survey of a DC3.



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Multibeam vs. Single Beam

The Good:

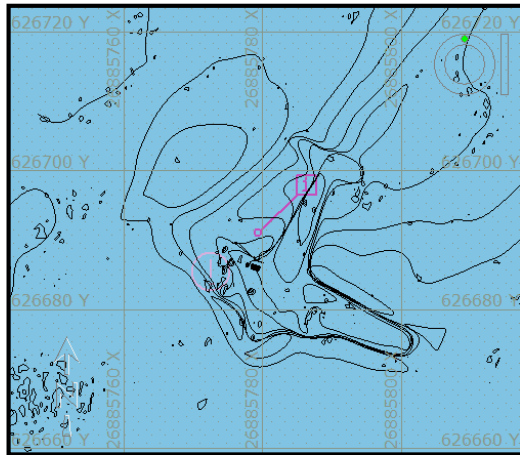
Saves time: Multibeam provides high resolution and full coverage of the seafloor. The data is more accurate for volume computations.

The Bad:

More data to work with but takes more time to process. With additional sensors needed, there are more error sources.

The Ugly:

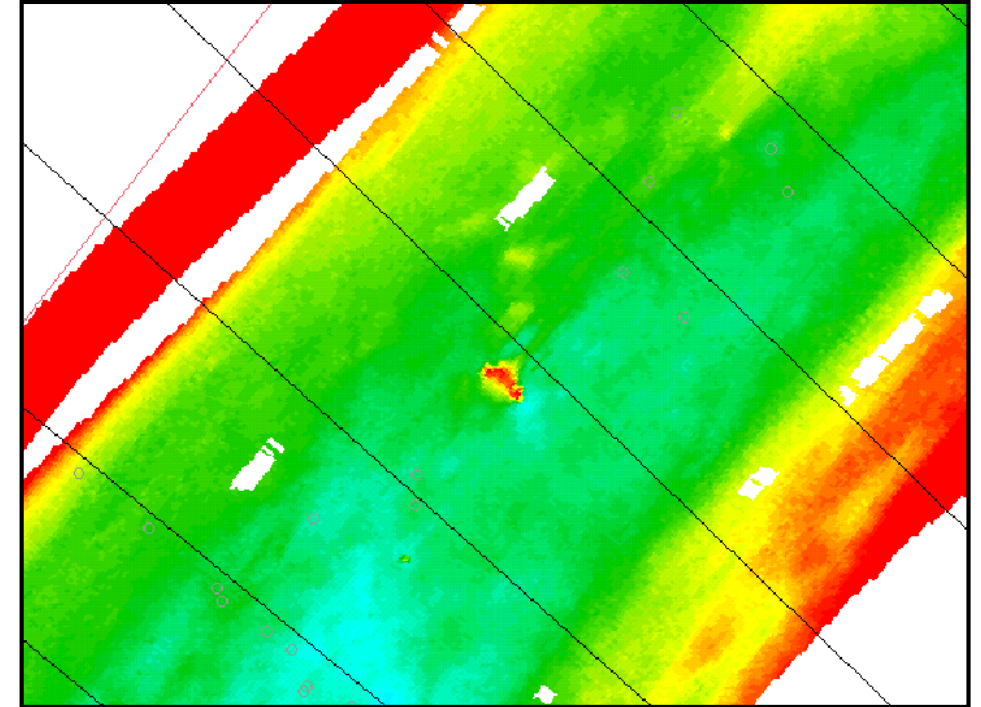
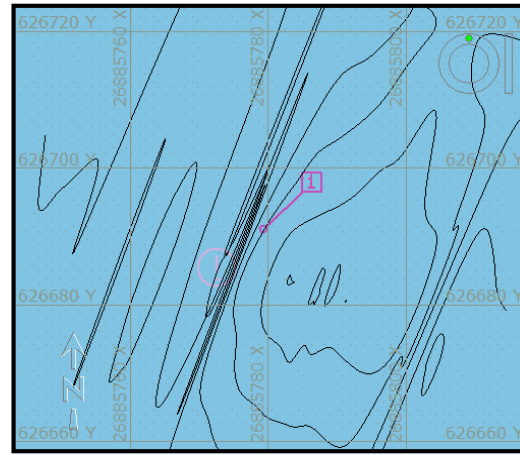
Plane is lost entirely in singlebeam contours.



Multibeam



Singlebeam



Example of using a Multibeam where previous work was with single beam sonar. An Obstruction was easily missed



Multibeam Sonar Types

Beamforming Systems:

Forms beams using an array of transducer elements.

Each beam has a Maximum Response Angle, giving the direction of the beam.

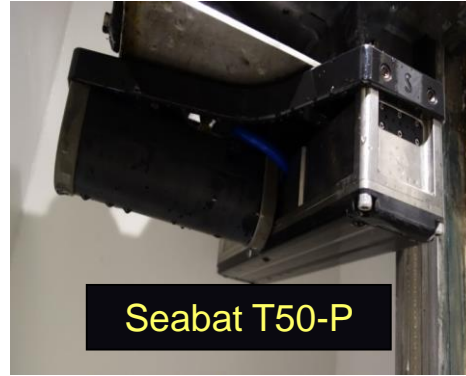
Interferometric Systems:

AKA 'bathymetric sidescan'.

Forms beams from phase angle of backscatter.

Multiple Transducer Systems:

Widely spaced Singlebeam transducers pointing down.



ADCP Systems:

Angular-set transducers

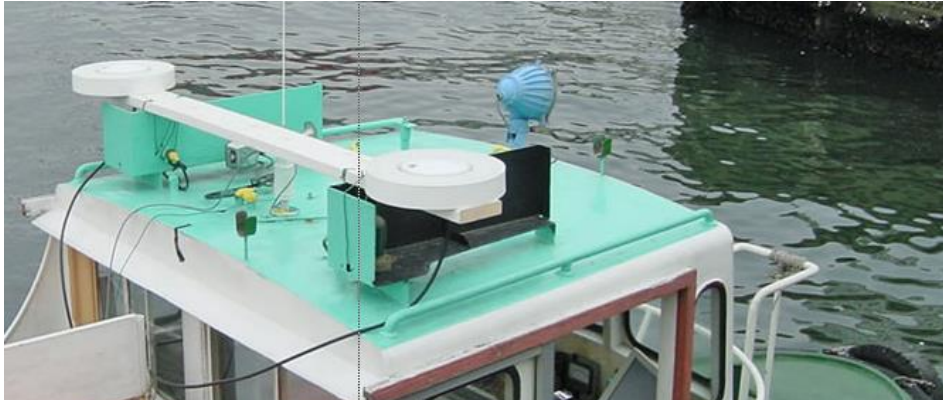


CAATI Systems:

Computed Angle-of-Arrival Transient Imaging.



Support Sensors

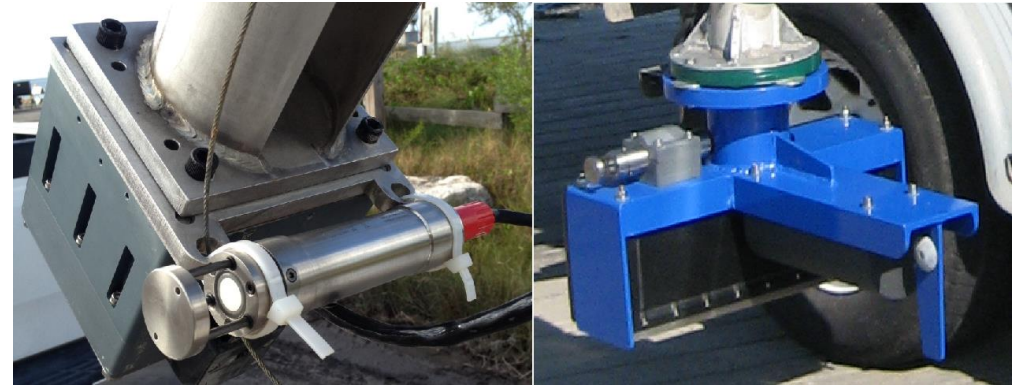


Heading: Using a gyro or dual GPS antenna array.



Motion reference (MRU / IMU):

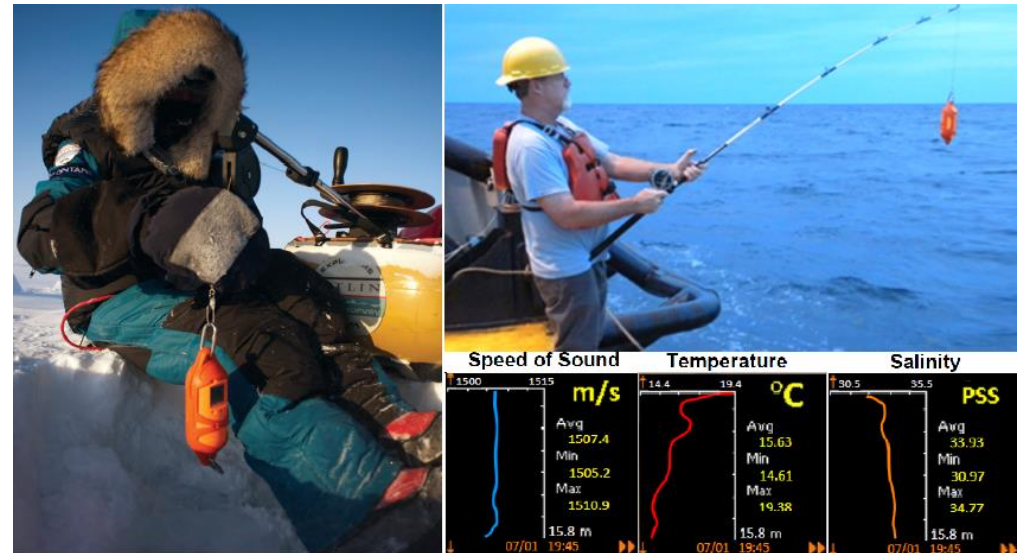
Measures boat heave, pitch and roll.



Sound Speed Sensor & Profiler:

Sensor: Sound speed at sonar head.

Profiler: Sound speed through water column.



HYSWEEP® MB Interfaces

Multibeam Sonars Available in HYSWEEP®:

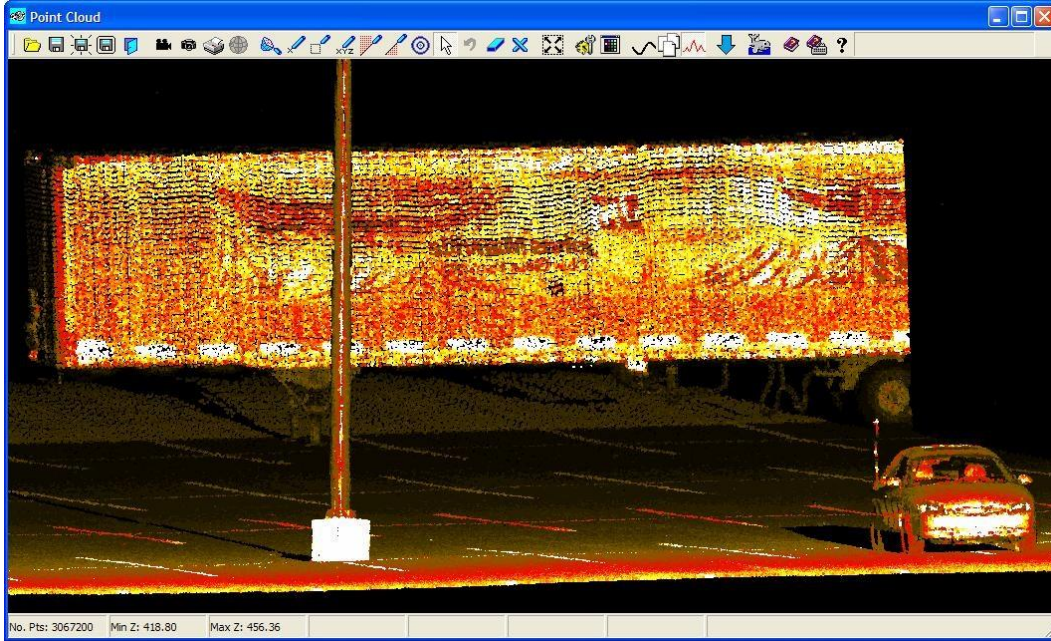
- **Atlas:** Bomasweep, Fansweep, Hydrosweep MD2, MD/30, MD/50, DS.
- **Benthos:** C3D.
- **BlueView:** MB2250/1350, BV5000.
- **EdgeTech:** 2205, 4600/6205.
- **Furuno:** HS Series.
- **GeoAcoustics:** GeoSwath.
- **Ibeam** Multibeam
- **Imagenex:** Delta T, DT100/101 SIR, Dual Delta T
- **IS Tech** Multibeam
- **Kongsberg:** MS1000, M3
- **Klein:** 5000, Hydrochart 3500
- **Norbit:** WBMS single and dual head, WINGHEAD
- **Odom:** ES3, Dual ES3, Echoscan II, Miniscan, MB1 (dual), MB2 (Dual)
- **Picotech:** PicoMBES
- **Ping DSP:** 3DSS-DX, 3DSS-iDX
- **R2Sonic:** SONIC 2020, 2022, 2024, 2026 (Dual – All).
- **Reson:** Seabat 71xx, 81xx, 900x, T20P, T50P/R (Dual – All)
- **Ross:** Smart Sweep.
- **SEA:** Bathyswath, SWATHplus.
- **Seabeam:** 2100, SB1000 Series, 3000 Series.
- **Simrad (Kongsberg):** EM 302, 710, 1002, 2000, 2040(c), 2040 Dual Head, 3000, 3002, 3002 Dual Head, SM2000, ME70 (ALL & KMALL formats)
- **SonTek:** M9 HydroSurveyor
- **Tritech:** SeaKing.
- **WASSP:** Multibeam, DRX

At last count, 50 different multibeam and multiple transducer systems are supported.

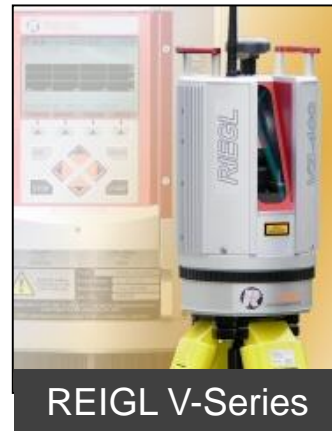


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HYSWEEP® Topographic Lasers

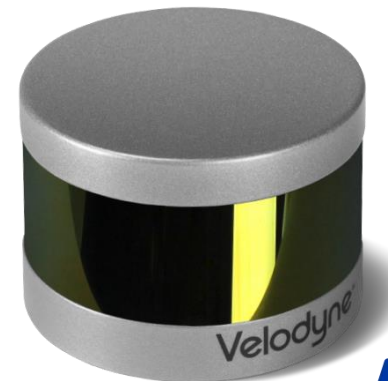


Renishaw Merlin



REIGL V-Series

- **2G Robotics** ULS-500
- **Leica:** P20/P15/P30/P16, P40, P50
- **Newton** Laser (Beta)
- **Optech:** ILRIS, Polaris
- **Ouster** OS-1
- **Quanergy** M8 Beta (Horizontal & Vertical)
- **Renishaw/Carlson:** Dynascan & Merlin
- **RIEGL:** LMS and V Series, miniVUX
- **Trimble:** MX2
- **Velodyne:** VLP-16 (Hi Res)/32, HDL-32E



Velodyne VLP-16

NEW



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xylem
Let's Solve Water

HYSWEEP® Driver Reference

Motion / Heading / Other Sensors:

- **Advanced Navigation:** Spatial, Spatial Dual, Spatial FOG Dual, etc.
- **AML:** AML-3, AML-6
- **Applanix:** POS/MV, (Ocean, Wave, and Surf Master Models).
- **Coda Octopus:** F180.
- **IXSEA:** OCTANS, PHINS, Hydrins.
- **JAE:** JM7531.
- **KVH:** Gyrotrac.
- **Novatel:** SPAN
- **Odim:** MVP (Moving Velocity Profiler - HYPACK Survey driver).
- **SBG:** Ellipse, Ekinox and Apogee Models
- **Seatex:** MRUx.
- **SG Brown:** 1000S.
- **Sontek** YSI Castaway
- **TSS:** 335B, DMS.
- **Valeport:** Swift CTD.
- ******* - Other sensors available via the generic and NMEA drivers.



Sontek Castaway
CTD/SV Probe



AML AML-3
CTD/SV Probe



Valeport Swift
CTD/SV Probe



Installation



Hull Mount



Pole Mount: Over the Side



Pole Mount: Bow



Moon Pool

Sonar mounting (in order of preference *for data quality*):

- Hull mount at boat CG
- Moon pool at boat CG
- Pole mount; bow or over the side

Motion Sensor: Mount at boat CG. Alternate location: As close as possible to boat CG.

Integrated MRU at the Sonar is becoming commonplace.



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HYSWEEP® HARDWARE



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Sensor Interfacing

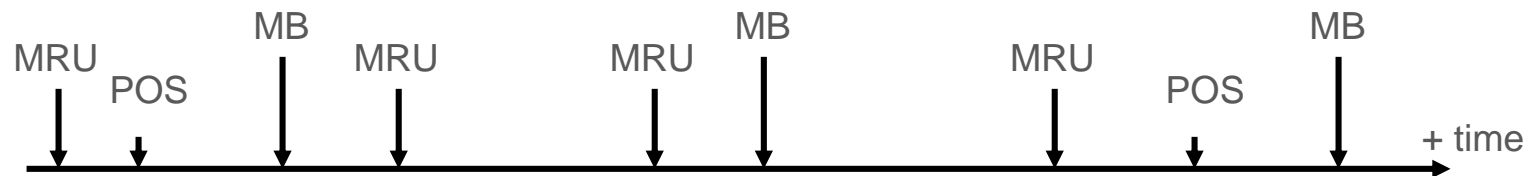
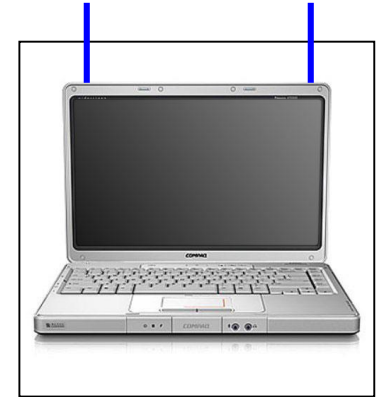
Bringing in the data

- **Network:** For high volume data like multibeam. Data is received with UTC time tag.
- **Serial RS-232:** For lower data volume like GPS.

Time Tagging

- **Very Important** - Device data are correlated by time tags.
- All devices **must** use the same time base – UTC time or PC time.
Without it, data will not be good
- Typically, Motion and Heading messages do not contain time tags. Data gets timed at arrival to COM port.
- Exception is GPS (\$GPGGA has a UTC time tag) and Inertial Systems (embedded time tag in data packet).

Network and COM inputs



Asynchronous data are correlated with time tags.



Do I Need to Synch My Clock to UTC?

If you have a Positioning device that sends datagrams with UTC time stamps, AND devices that do NOT have embedded UTC time stamps, then the answer is:

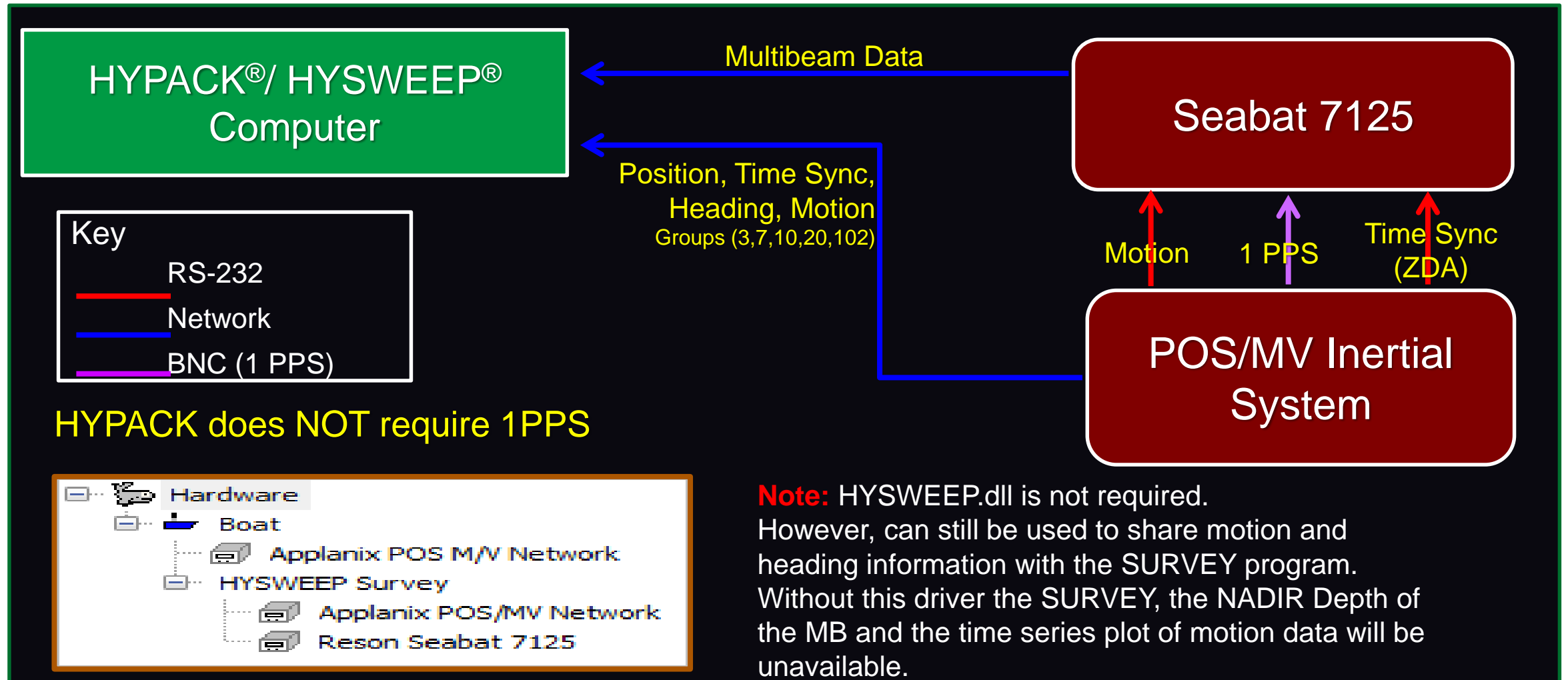
Yes

Examples of when time synch to UTC is required:

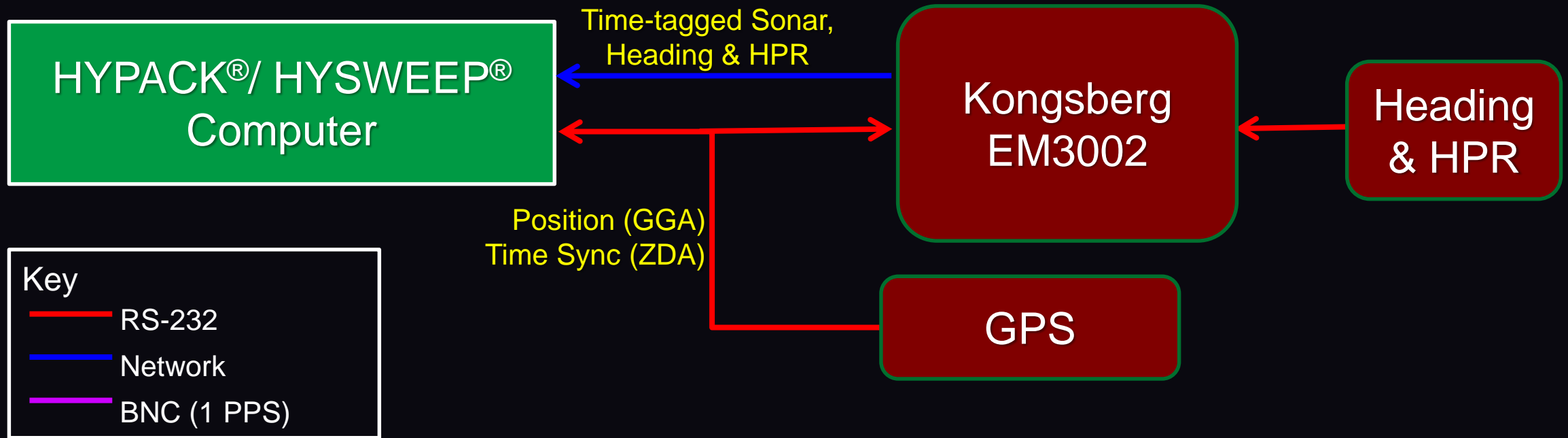
- GPS (UTC), Seabat (UTC), TSS DMS/05 (No time sent), Gyro (No time sent).
- POS/MV (UTC), Seabat (UTC), Single beam on a COM port (No time sent).
- Time Synchronization by GPS ZDA ONLY = +/- 10 – 30 mSec in Latency, however, it can be improved to +/- 1 – 5 mSec in Latency by using a HYPACK 1PPS Box.



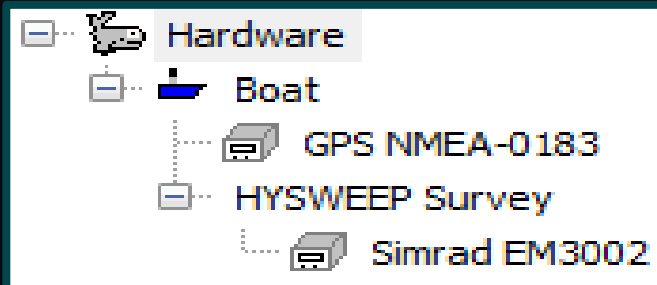
Reson Seabat 7125



Kongsberg EM3002



HYPACK does NOT require 1PPS, but using 1PPS is recommended

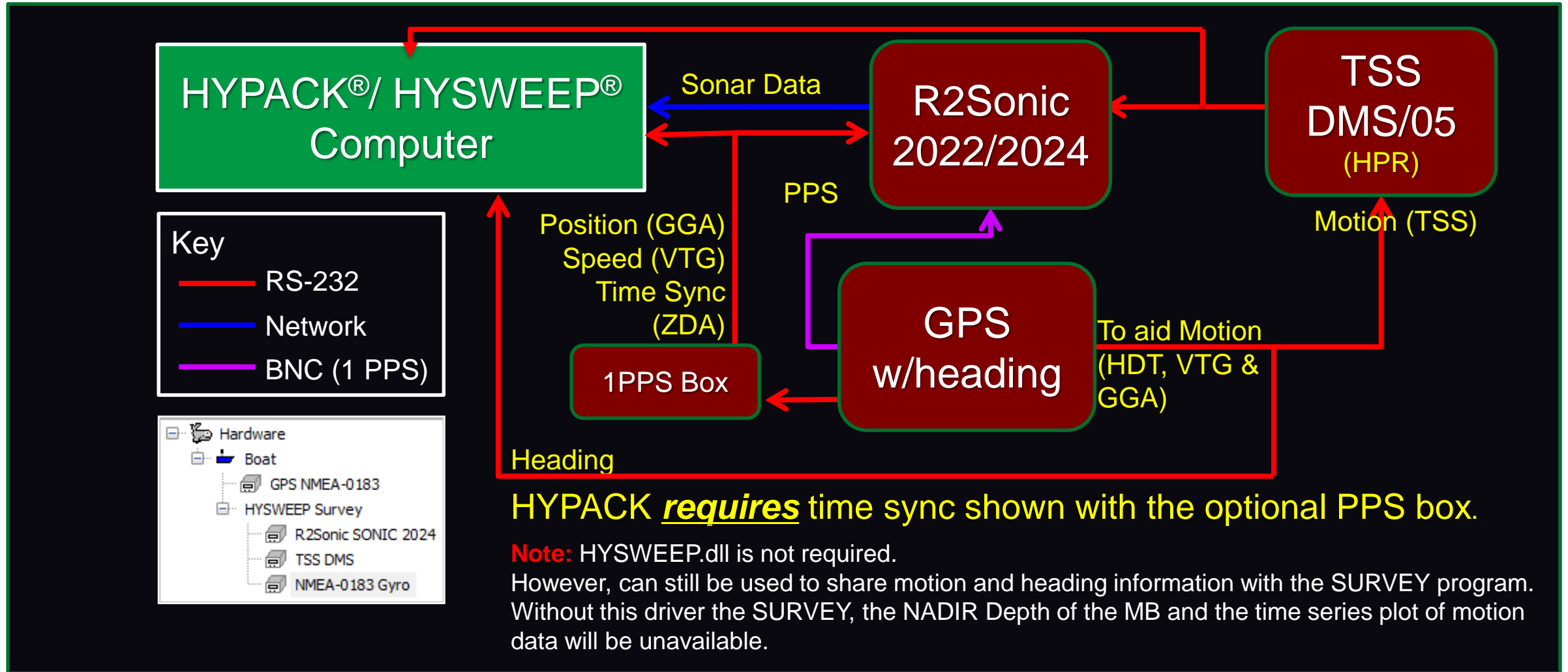


Note: HYSWEEP.dll is not required.

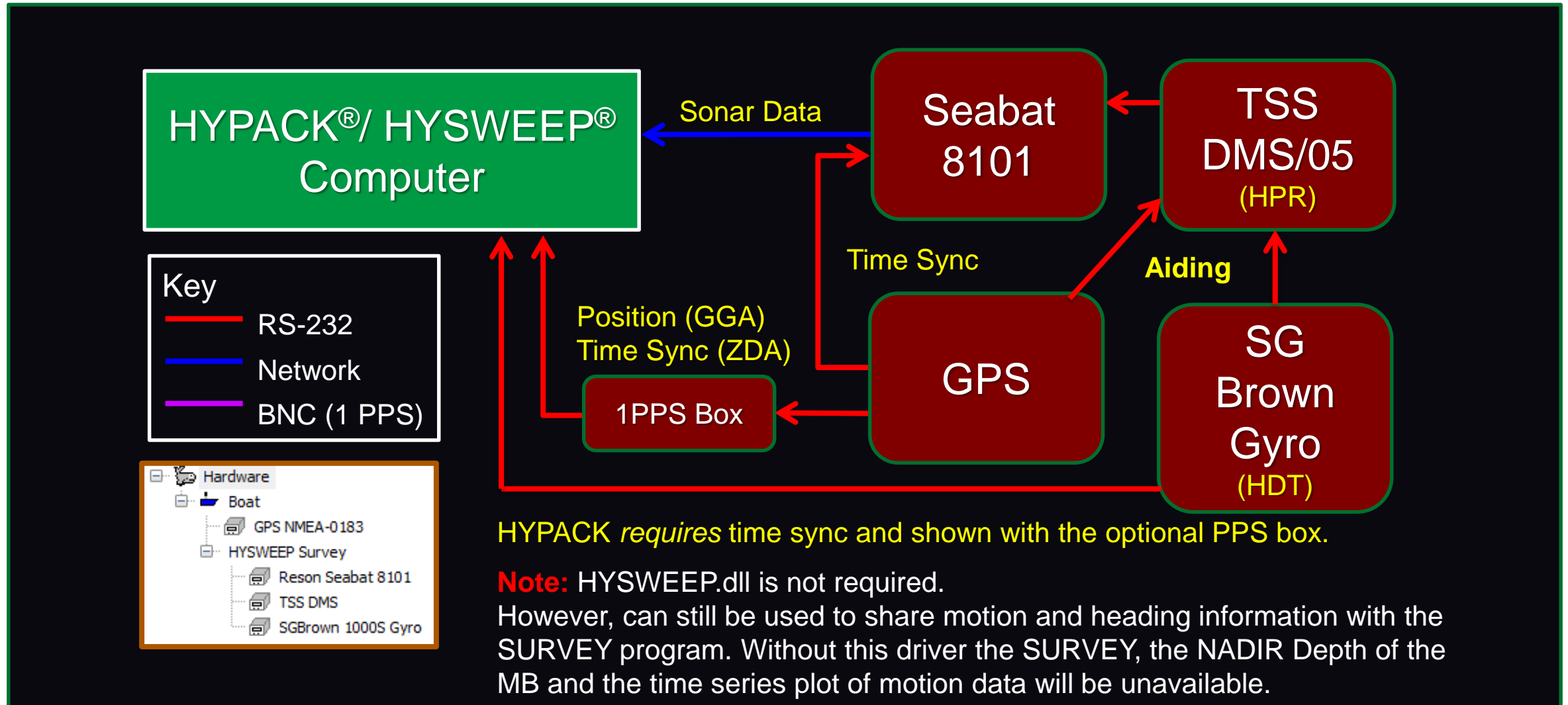
However, can still be used to share motion and heading information with the SURVEY program. Without this driver the SURVEY, the NADIR Depth of the MB and the time series plot of motion data will be unavailable.



R2Sonic with 1PPS Box (example)



Reson 8101 with 1PPS Box:



HYPACK requires time sync and shown with the optional PPS box.

Note: HYSWEEP.dll is not required.

However, can still be used to share motion and heading information with the SURVEY program. Without this driver the SURVEY, the NADIR Depth of the MB and the time series plot of motion data will be unavailable.



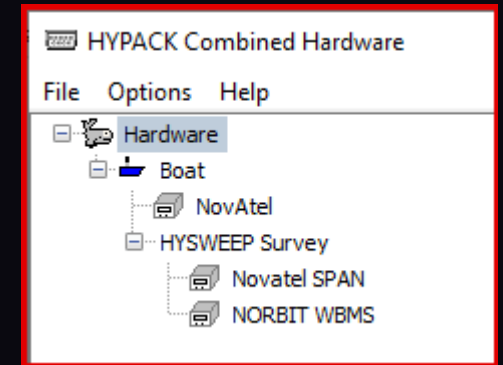
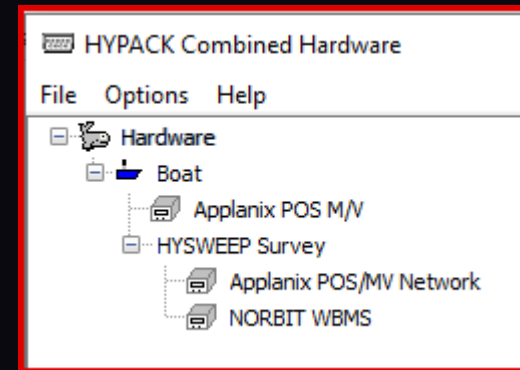
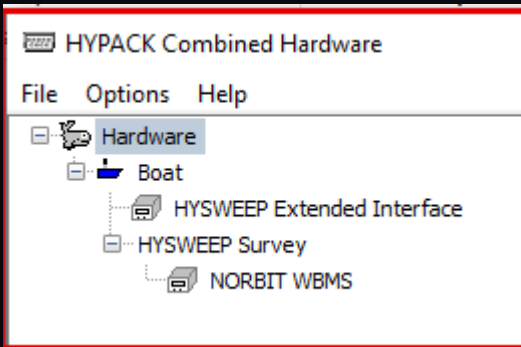
NORBIT iWBMS

HYPACK®/ HYSWEEP®
Computer

Multibeam Data
Position, Time Sync,
Heading, Motion, Tide

NORBIT iWBMS
(w/ integrated IMU)

HYPACK does NOT require 1PPS



Note: HYSWEEP_Extended.dll can also be used to 'share' Position, Tide, Motion, Heading and Nadir Depth information with the SURVEY program. Primarily for Dredge Monitoring. Not recommended for detailed surveying or precise timing.



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Offsets

Adjustment for:

Boat Origin (AKA Reference Point): Vessel Center of Gravity XY.
Static waterline Z.

Device Location: Offsets in X (Starboard), Y (Forward) and Z (Vertical), as measured from boat origin.

(Be aware that X and Y are reversed in most Inertial systems)

Device Rotation: Pitch, Roll and Yaw orientation of directional devices such as multibeam sonar.

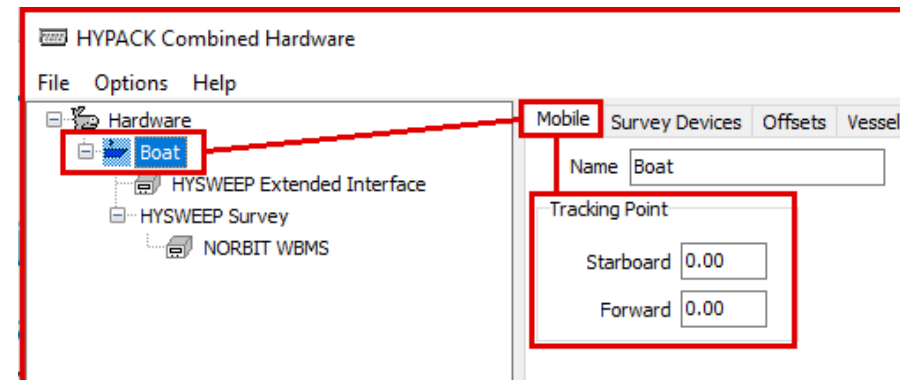
Device Latency: Time delay = data arrival time – data valid time.

Tracking Point: XY location of the sonar head.
Used to adjust the Left/Right indicator.

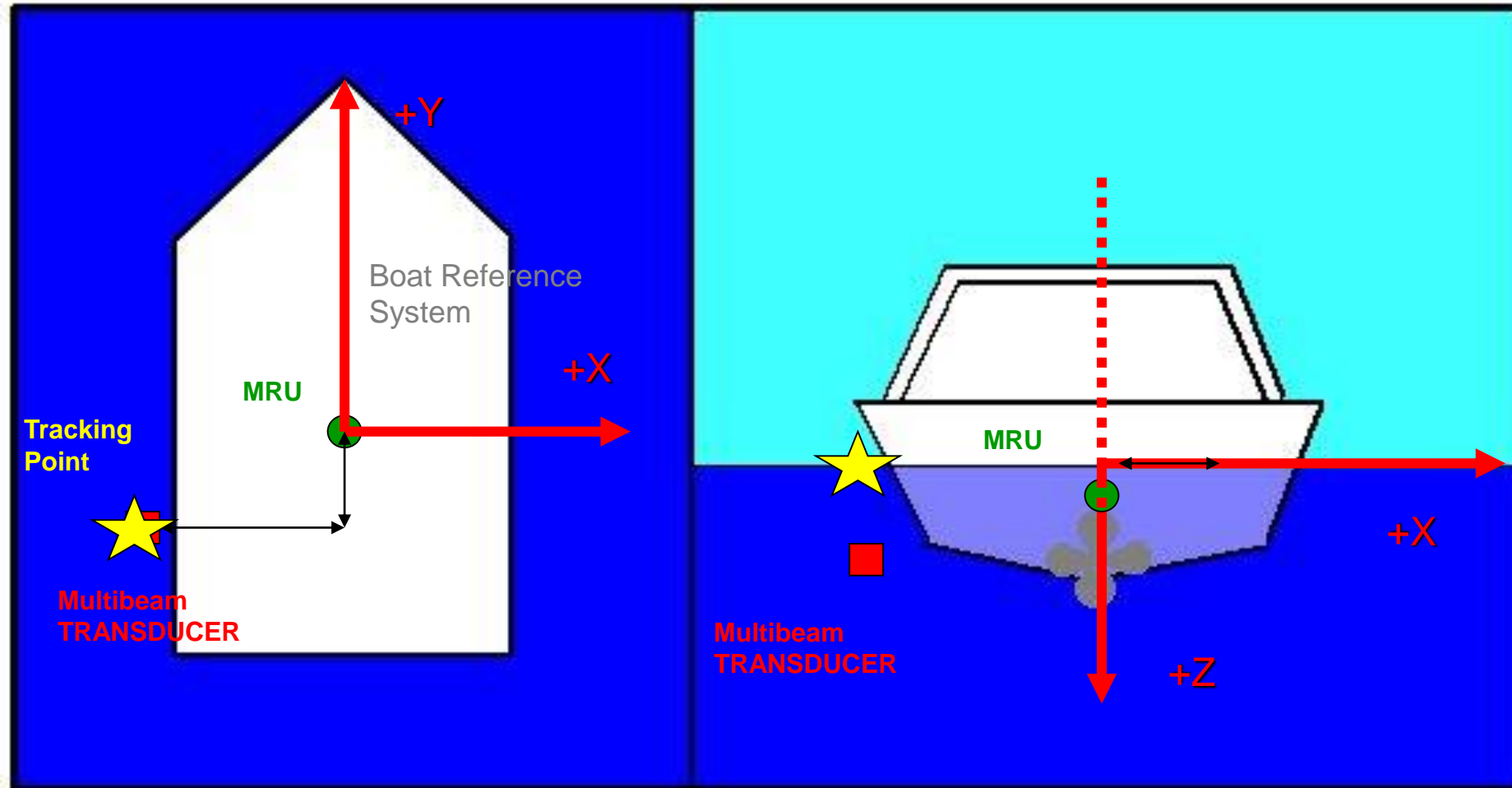
HYPACK HARDWARE – Boat - Mobile



“Red Rogers” and drawing (device locations).



Boat Origin & Tracking Point



In this example, the MRU is at boat origin, tracking point is over the transducer.



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HYPACK® Hardware

Combined Hardware program will set the hardware for both HYPACK® and HYSWEEP®.

The top screenshot shows the 'System' tab of the HYPACK Combined Hardware software. The 'Include' checkbox for 'HYSWEEP Survey' is checked. The 'HYPACK Survey' section has several unchecked options: 'Installed on Towfish', 'Show XYZ Files', 'Start Logging at Startup', and 'Individual Tide Per Mobile'. The 'Sidescan Survey' section has the 'Include' checkbox unchecked. The 'Synchronize Computer Clock' section has 'None (no synchron)' selected.

The bottom screenshot shows the 'All Offsets' tab. It features a table of 'Available' devices and an 'Installed' list. The 'Available' table lists various survey devices with their versions. The 'Installed' list contains 'GPS NMEA-0183'. Below the tables are buttons for 'Add -->', '<-- Remove', 'Nav. Stations', and 'Setup'. The 'View' section has 'Description' selected. The 'Functions' section has several checkboxes checked, including 'Record raw message', 'Position', 'Depth', 'Heading', 'Speed', 'Tide', and 'Record device specific messages'. The 'Options' section has 'Record raw data' and 'Record quality data' checked, and 'Use for matrix update' unchecked.

Available	Version
3D LR Indicator	16.1.2.0
ADCP Driver	19.1.0.0
Advanced Navigation INS	21.2.1.0
AIS Interface	14.0.2.6
AIS Tide Receiver	14.0.1.0
Allied Signal LAZ-4100 Echoso...	14.0.1.3
Anemometer Driver	18.2.0.0

Installed
GPS NMEA-0183

- System Tab:
 - Include HYSWEEP Survey
- Main page:
 - Configure HYPACK SURVEY (Boat) devices and then HYSWEEP SURVEY devices

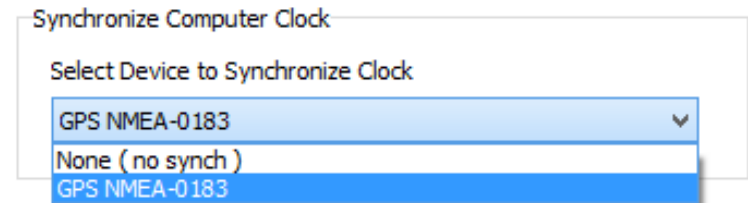


HARDWARE (HYPACK® SURVEY)

Positioning Devices (Heading and RTK Tide, as needed):

GPS.DLL (just about any make and model)	COM Port or Network
ADVANCEDNAVIGATION.DLL (ANSS INS Systems)	Network
POSMV.DLL (Applanix INS Systems)	Network
F180.DLL (CODA F-series INS Systems)	Network
HYSWEEP_EXTENDED.DLL (NORBIT INTEGRATED INS Systems)	Network
IXSEA.DLL, PHINS.DLL, OCTANS.DLL (iXBlue/iXSEA INS Systems)	Network
SEAPATH.DLL (Kongsberg INS Systems)	Network
NOVATEL.DLL (Novatel INS Systems)	Network
SBG.DLL (SBG INS Systems)	COM Port or Network
SONARDYNE.DLL (Sonardyne INS Systems)	Network
VECTORNAV.DLL (VectorNav INS Systems)	Network

- Select 'Time Synch' option on the HYPACK configuration page (as needed).



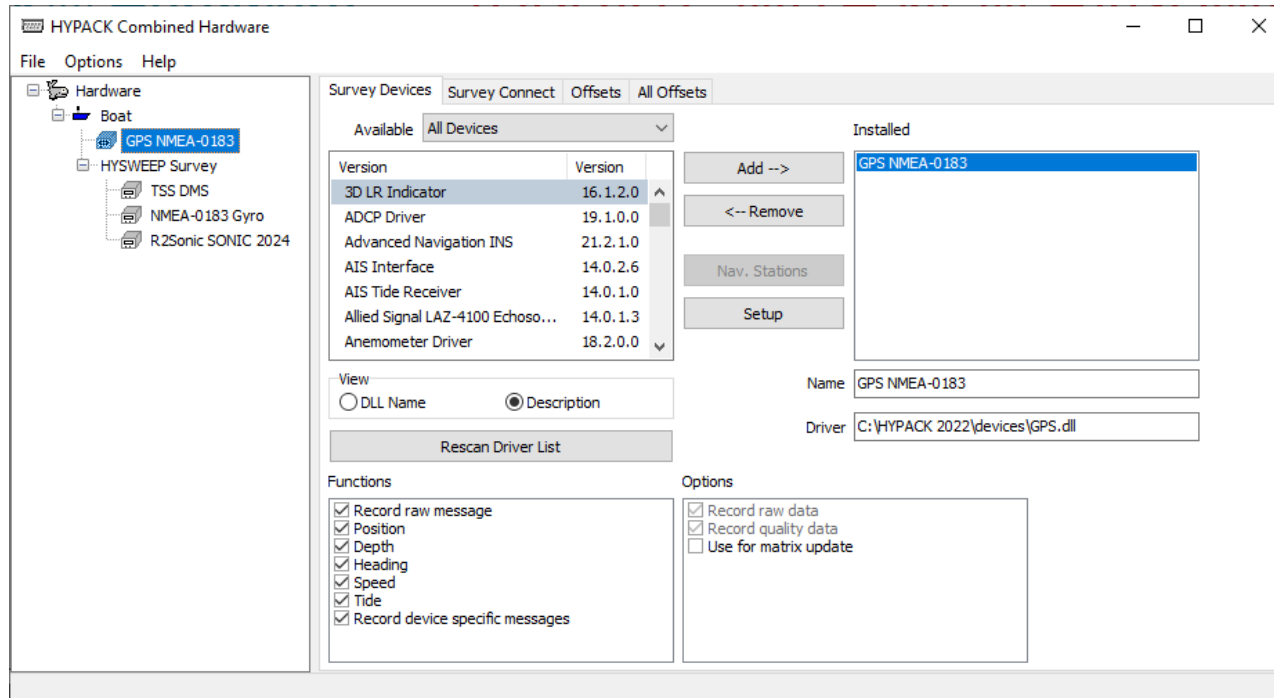
HARDWARE (Configure HYSWEEP®)

Configure the **HYSWEEP® Survey** section for:

- Multibeam, Motion sensor and Heading.

Select from Manufacturer/Model list and “Add” to the INSTALLED section.

Note: Some multibeam systems may include MRU and Heading within their driver



No HYPACK® Navigation device under the HYSWEEP Survey section.

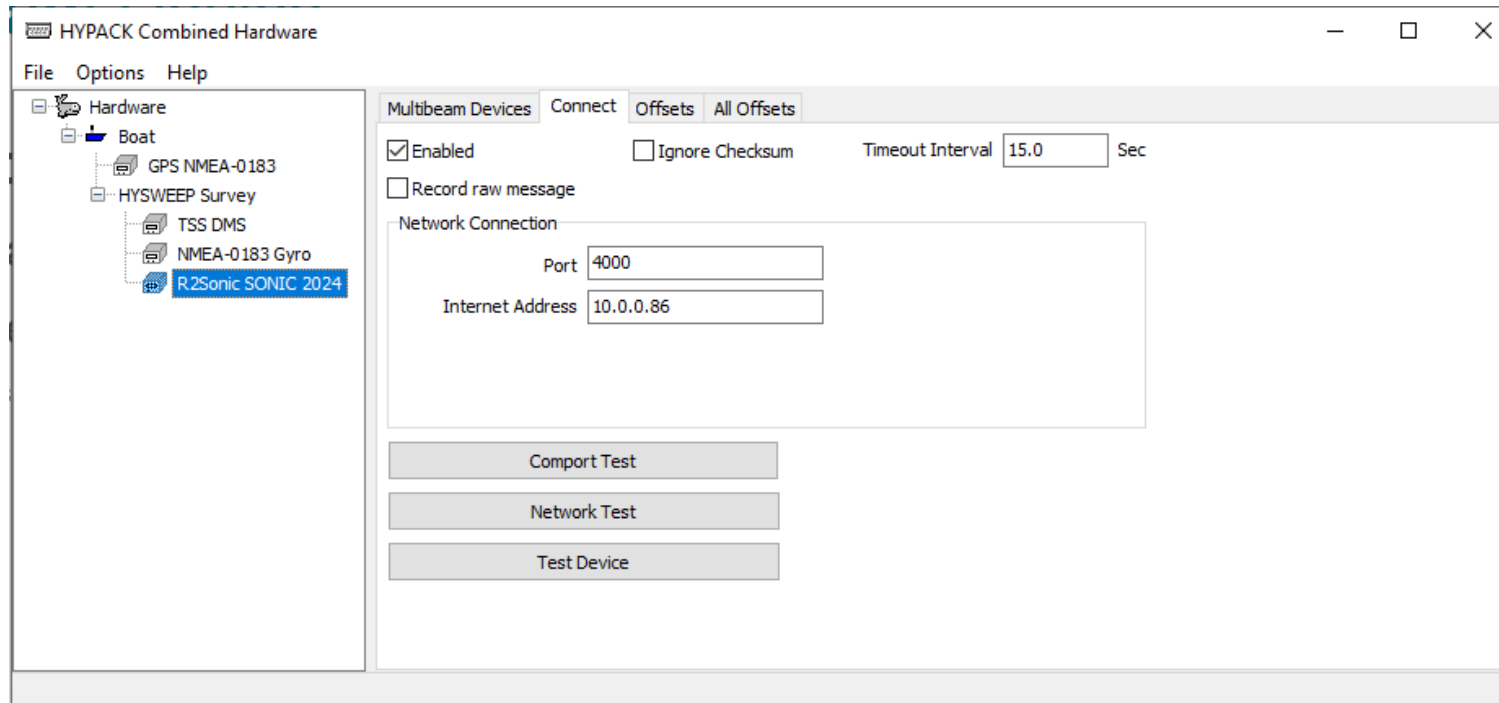
It is automatically included in the Hardware program.



Multibeam Device

Connect:

- Most sonars are network. (Enter the correct Port # and Internet Address, if not correctly defaulted)
- TCP/IP devices 'require' the specific IP Address
- Refer to “HYSWEEP Interfacing.pdf” for details (C:\Hypack 20xx\Documentation)



Multibeam Device – Offsets Tab

- Select **Sonar Head 1** or **2**.
- Enter **Location** offsets (Starboard, Forward, Vertical) as measured from Boat Reference Point.
- Enter **Rotation** offsets (Yaw, Pitch, Roll) from Patch Test.
- **Latency** should be 0.00.
(Navigation Latency is entered in the Positioning Device's Offsets)

The screenshot shows the HYPACK software interface. The title bar reads "HYPACK Combined Hardware". The menu bar includes "File", "Options", and "Help". The left-hand pane shows a tree view under "Hardware" with the following items: "Boat", "GPS NMEA-0183", "HYSWEEP Survey", "TSS DMS", "NMEA-0183 Gyro", and "R2Sonic SONIC 2024". The "R2Sonic SONIC 2024" item is selected and highlighted in blue. The main window has tabs for "Multibeam Devices", "Connect", "Offsets", and "All Offsets". The "Offsets" tab is active, and "Sonar Head 1" is selected in a dropdown menu. The "Position" section contains the text: "Enter Device Offset From Boat Reference Point (Center of Mass). The Vertical Offset is Positive Downward and Measured From Waterline." Below this are three input fields: "Starboard" with value "0.000", "Forward" with value "0.000", and "Vertical" with value "0.000". The "Rotation" section contains the text: "Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch) Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll." Below this are three input fields: "Yaw" with value "0.00", "Pitch" with value "0.00", and "Roll" with value "0.00". Below the rotation fields is a section titled "Enter the Latency Time (Positive) in Seconds" with an input field containing "0.000". There is a "Multiple Transducers" button. At the bottom, there is a "3D View Options" section with three buttons: "Reset View", "Device 3D Shape Options", and "Lighting Options".



Multibeam Device – Offsets Tab (continued)

For multibeam sonars that include the Motion Sensor data embedded in their data packets, select **MRU Offsets** from the pulldown menu:

- Enter **Location** offsets (Starboard, Forward, Vertical) as measured from Boat Reference Point.
- Enter **Rotation** offsets (Yaw, Pitch, Roll) from Patch Test.
- **Latency** should be 0.00, unless otherwise stated by the manufacturer.

The screenshot shows the 'Offsets' tab in the 'Multibeam Devices' software. A dropdown menu is open, showing 'Sonar Head 1' selected, with other options including 'MRU Offsets'. Below the menu, there are input fields for 'Starboard', 'Forward', and 'Vertical', all set to 0.000. A 'Rotation' section contains instructions and input fields for 'Yaw', 'Pitch', and 'Roll', all set to 0.00. At the bottom, there is a 'Latency Time' input field set to 0.000.

Multibeam Devices Connect Offsets All Offsets

Sonar Head 1

Sonar Head 1

Sonar Head 2

MRU Offsets

Heading Offset (Yaw)

Downward and Measured From Waterline.

Starboard 0.000

Forward 0.000

Vertical 0.000

Rotation

Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch) Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.

Yaw 0.00

Pitch 0.00

Roll 0.00

Enter the Latency Time (Positive) in Seconds

0.000



Motion and Heading Sensors

Devices:

Select the driver, if listed. If not...

- The “TSS1” message is standard for Heave, Pitch and Roll (**TSS DMS** driver).
- The NMEA “HDT” message is standard for Heading (**NMEA-0183 Gyro** driver).
- The **Generic Attitude** driver can be configured to parse ASCII datagrams

Connect:

Enter Network or COM settings. (Consult the “HYSWEEP Interfacing.pdf”.)

Offsets:

MRU Location offsets measured from boat reference.

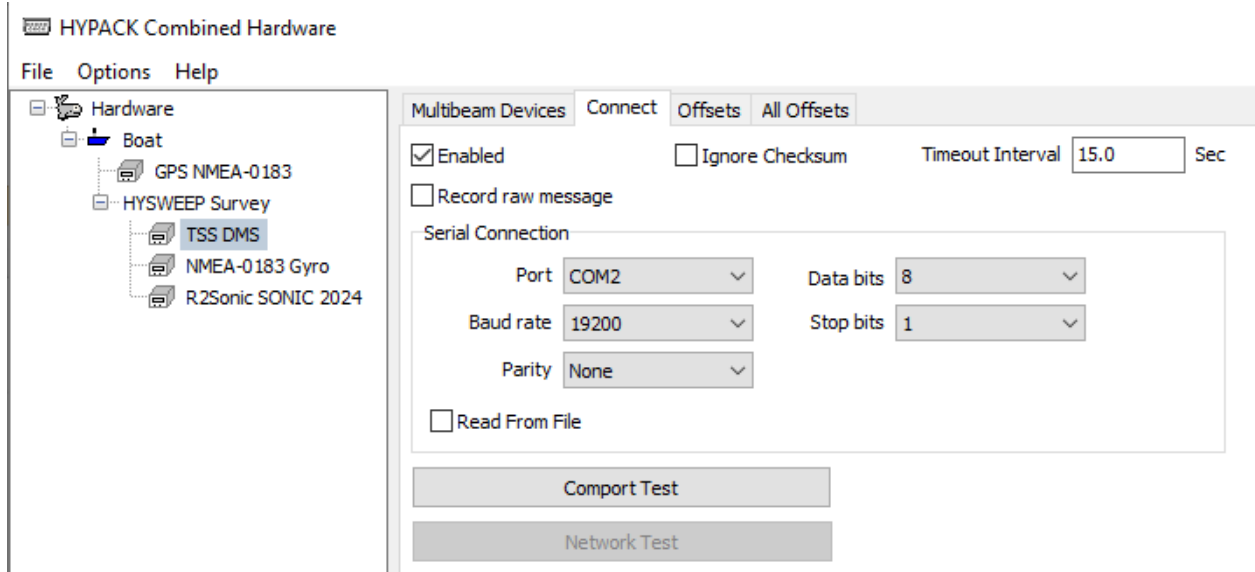
MRU Rotation offsets can be used to “zero” Pitch and Roll.

https://www.hypack.com/File%20Library/Resource%20Library/Technical%20Notes/11_2017/HYSWEEP-Angular-Offsets---Static-Pitch-and-Roll.pdf

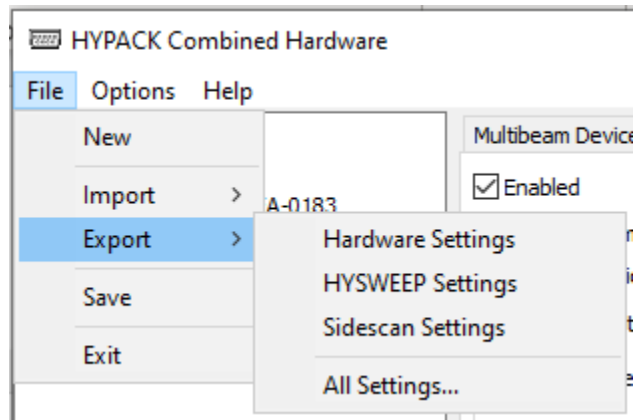
Heading Rotation (Magnetic Declination) offset (Yaw) can be used to correct to Grid North.



Testing and Saving...



CONNECT Tab: Use COM Test and Network test to verify sensor is sending data



Alternate Hardware Configurations:

Open and Save alternate configurations using the IMPORT and EXPORT



Calibration Tools

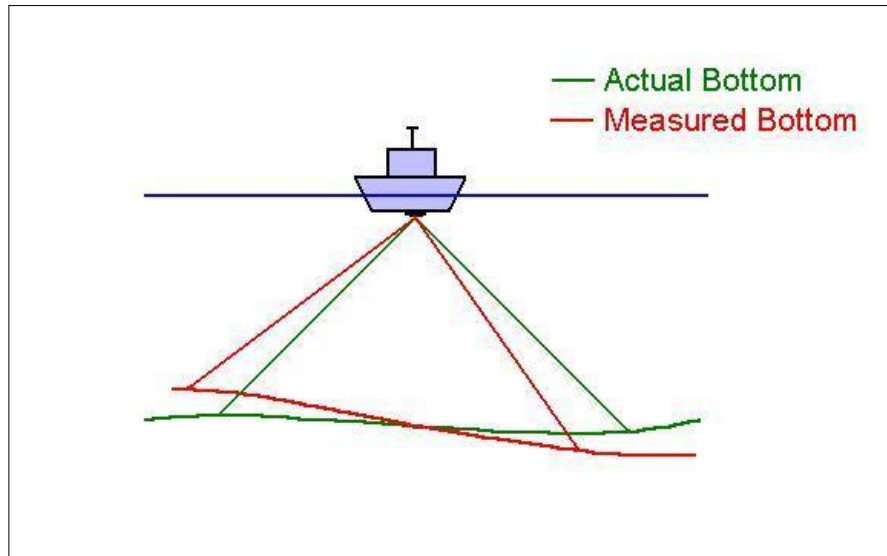
Multibeam systems need calibration!

HYSWEEP® Patch Test

Roll, Pitch, and Yaw angular alignments.

Determine the orientation of the sonar, with respect to the MRU and Heading devices.

Account for GPS Latency, if needed.



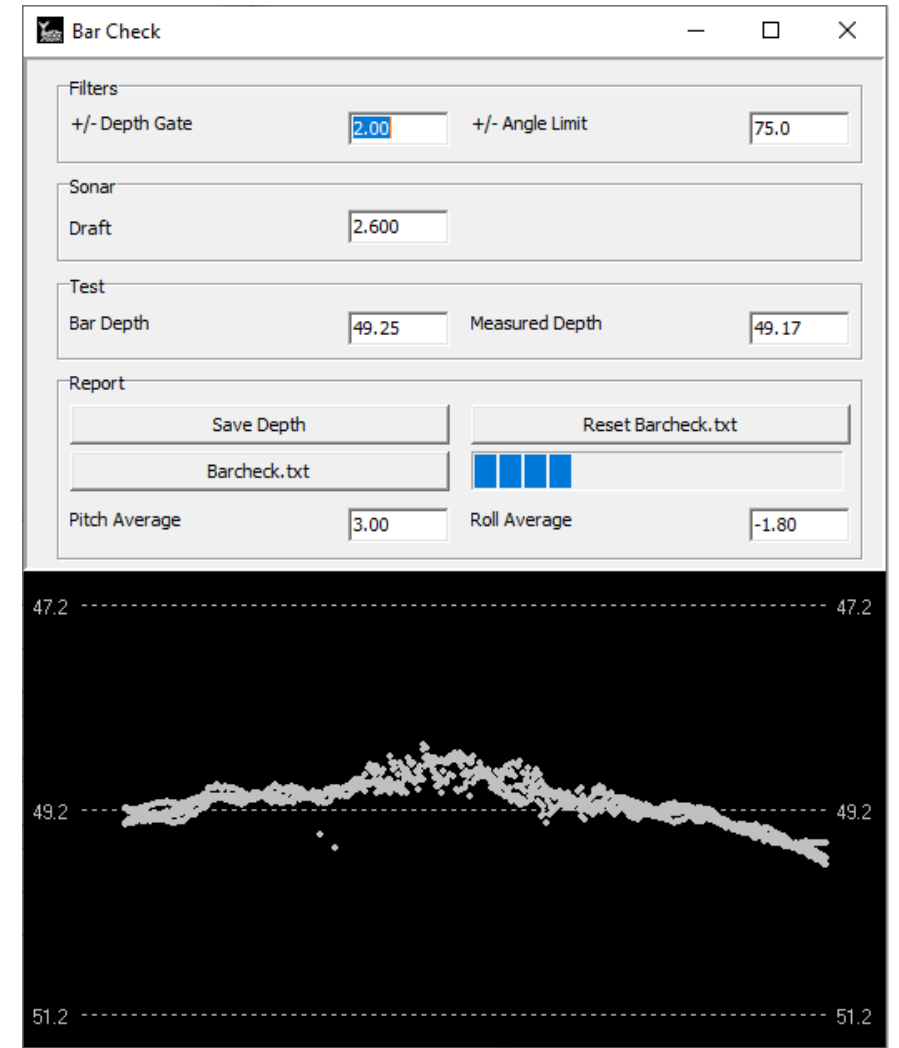
Why we need to Patch test.



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HYSWEEP® Bar Check

Much like single beam - verify draft measurement.



Bar check window.

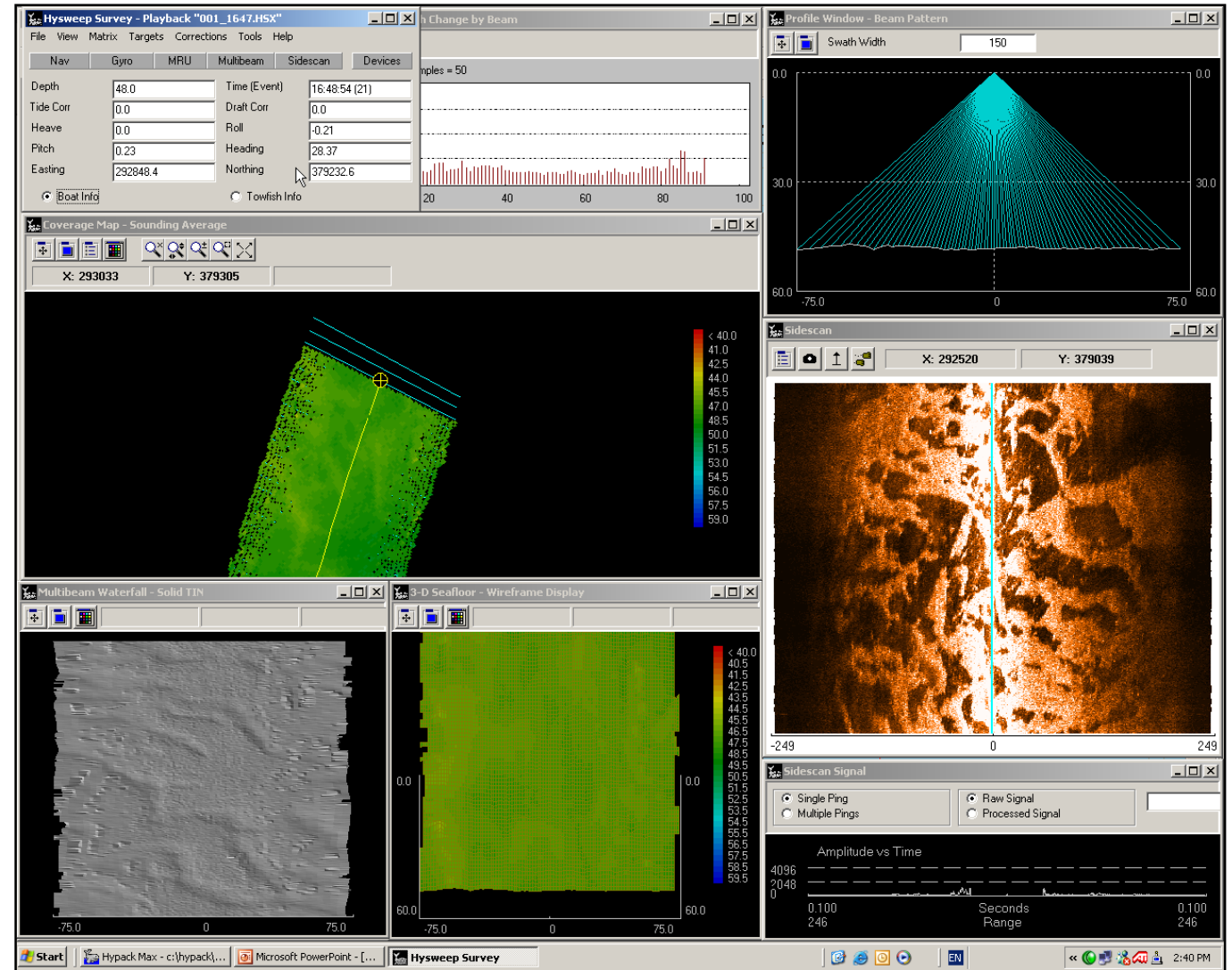
HYSWEEP® SURVEY



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Multibeam Survey Program

- Collects and logs multibeam and support sensors.
- Displays are Real-time corrected and provide QC info.



For Simulation and Survey Practice:

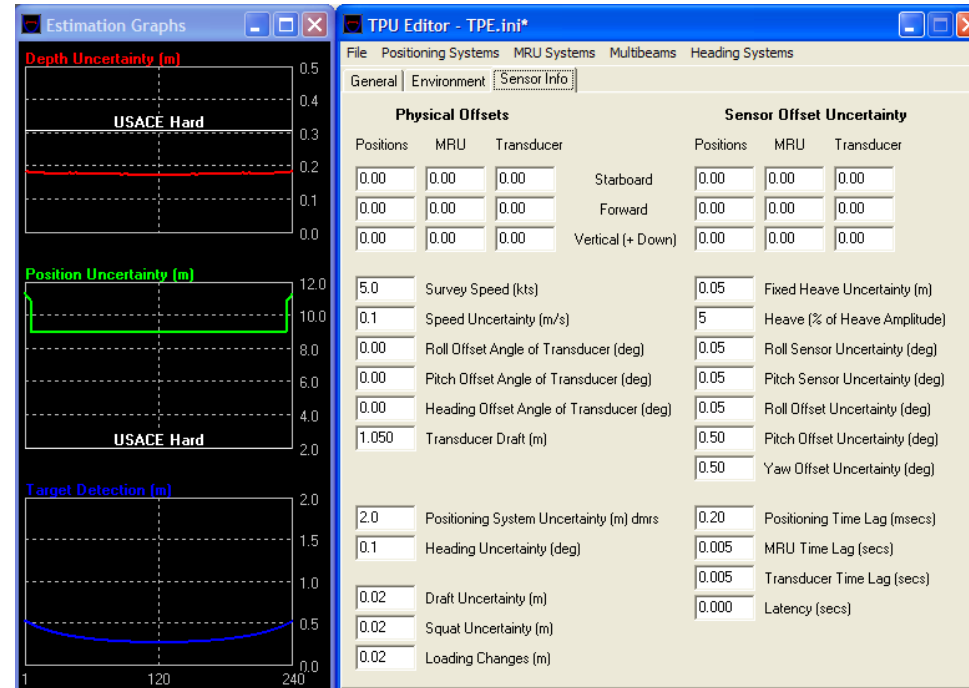
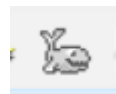
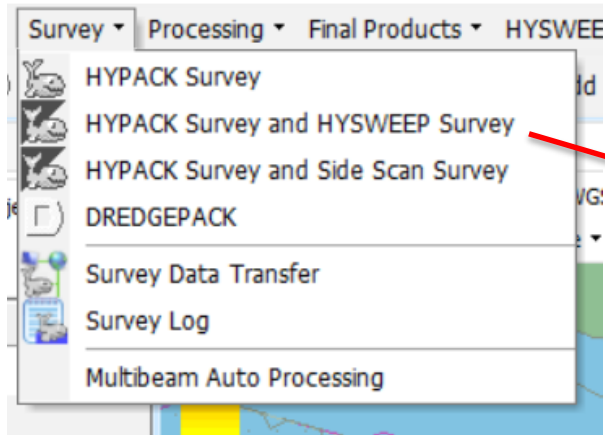
https://www.hypack.com/File%20Library/Sounding%20Better%20Newsletter/2014/MB-Simulation_Playback_Automtx.pdf



HYSWEEP® Survey

Survey Preparation:

- Geodetic parameters and HYPACK® and HYSWEEP® hardware configuration
- Planned lines or matrix for navigation
- Pre-set TPU parameters in the TPU EDITOR if you want to use Total Propagated Uncertainty
- Create Sound Velocity and Tide file to be used during survey



TPU setup

Launch Survey:

- Use menu to run HYPACK® SURVEY and HYSWEEP® SURVEY together.
- Use Smart Launch icon to run both.



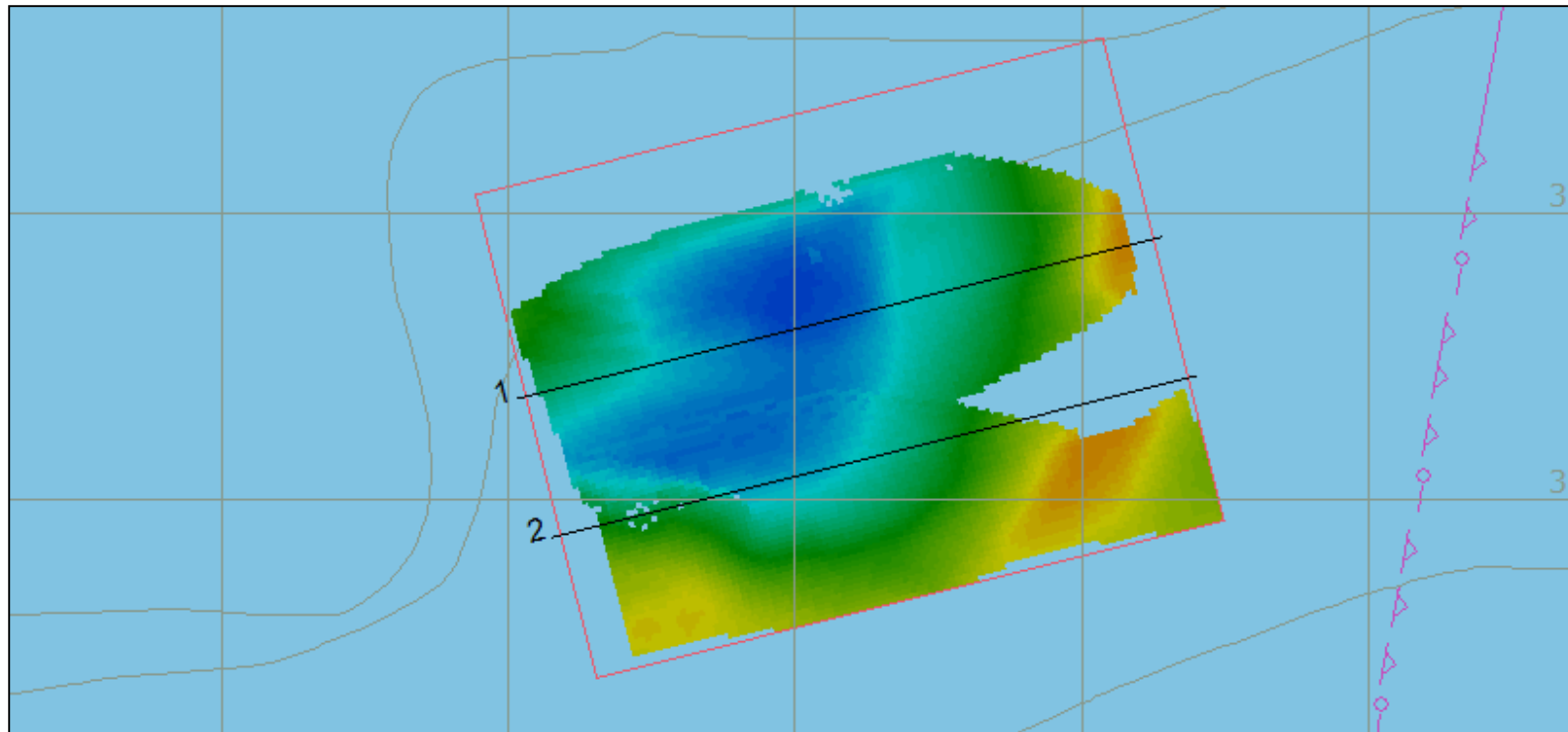
Survey Preparation

Planned Survey Lines

- Make parallel lines spaced for target coverage.
- Sometimes difficult with multibeam, as coverage changes with depth.

Coverage Matrix

- Alternative to planned lines.
- “Mow the Grass” and ‘paint the bottom’ to assure proper overlap and 100% ensonification is achieved.

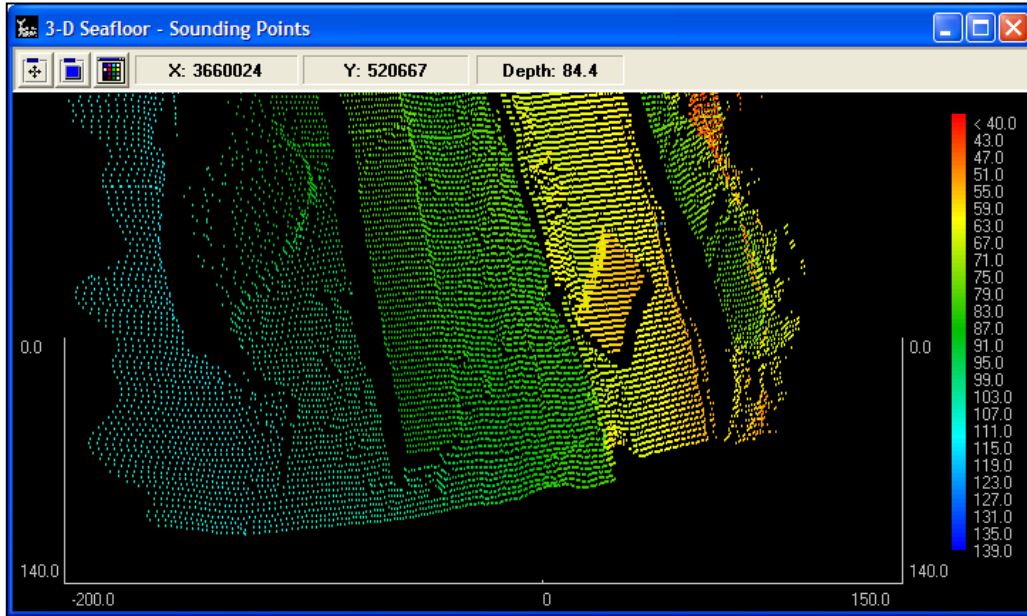


Large depth changes make line planning difficult. Alternative is “Mowing the Grass”.



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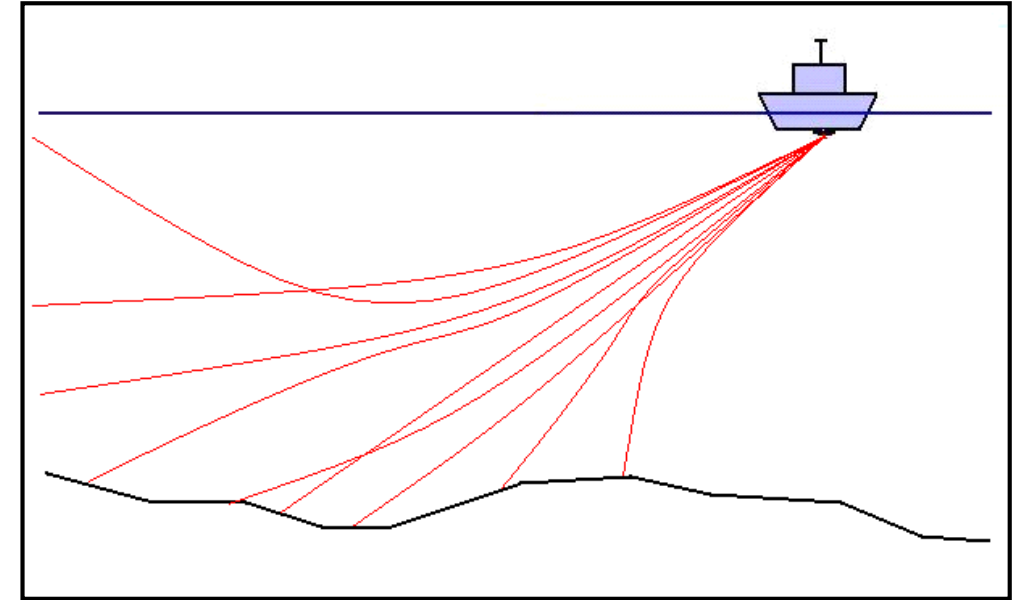
HYSWEEP® Survey



HYSWEEP® 3-D Seafloor

Features

- Data collection and logging.
- Targeting and coverage mapping.
- TPU and other QC checks visible in over 30 real time displays



Same take-off angle, different ray paths.

Refraction Errors seen in real time

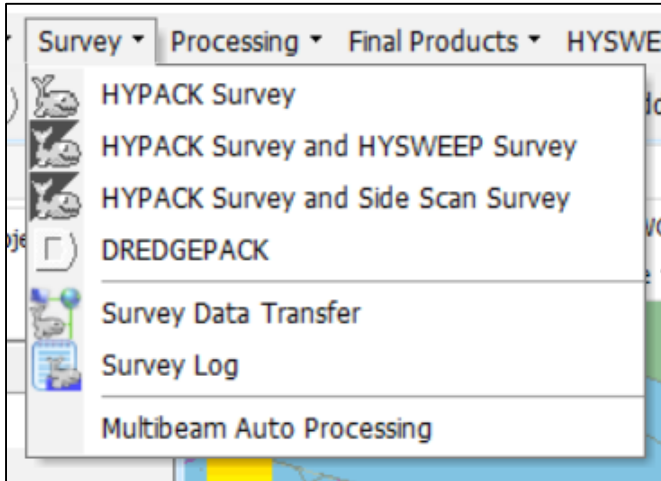
- Refraction occurs at changes in sound velocity.
- Errors when SV profile doesn't match conditions – estuaries can be troublesome.
- Look for 'smiling' or 'frowning' sweeps.



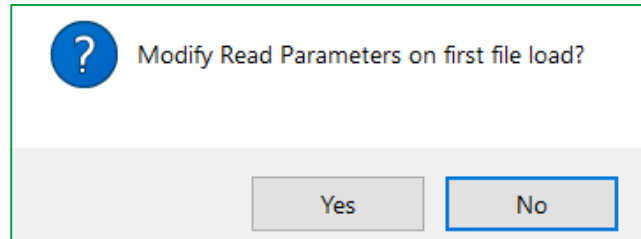
HYPACK 2022 – Training Event

Multibeam Auto Processing

Allows surveyor to 'set' pre-filtering processing parameters, so that a preliminary, Final data set can be ready, immediately after the Survey has been collected.

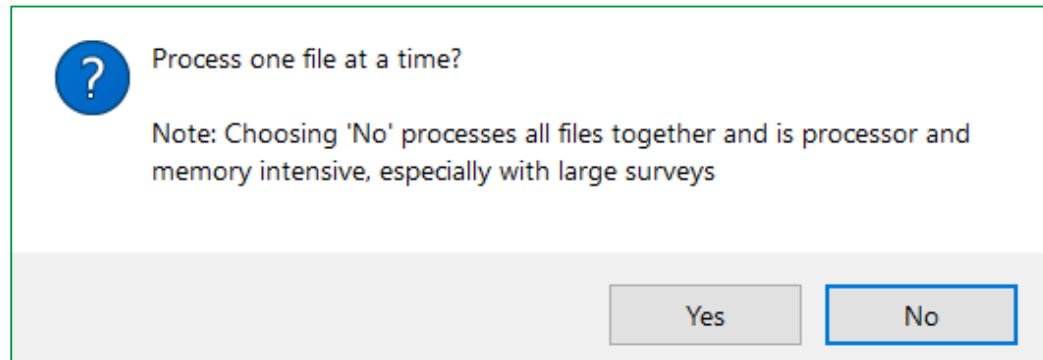


Launch Auto Processing before data collection begins, preferably before launching SURVEY.



Yes: Use this first time to select devices and setup filters.

No: Use when there are no changes in device or filter settings.



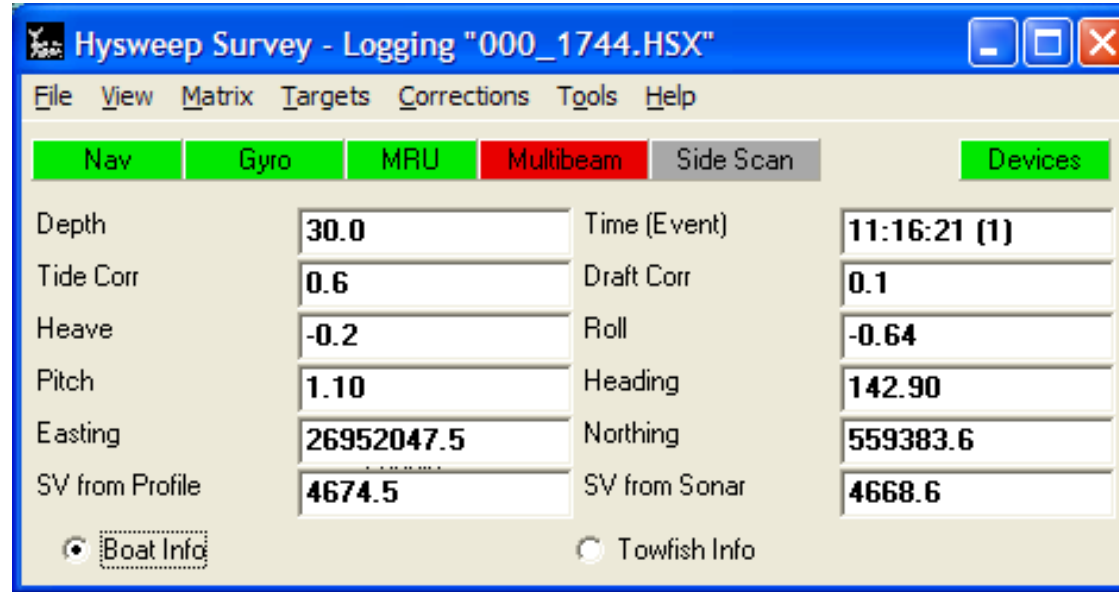
Yes: Loads, filters and saves survey files on end logging. Resets memory for the next file.

No: As above except files are retained in memory for coverage mapping.



HYSWEEP® Main Window

Data Filename or "Offline" in title area.



Alarm Indicators

- **Green** = OK.
- **Yellow** = Something's not right here.
- **Red** = Look Out!



(Click on the 'button' to read the Alarm details)

Various system measurements updated once a second.

Select Boat or Towfish for display of sensor data.

Typical Alarms:

- Devices: Timeout, COM or Network port open error, checksum error.
- QC: Heave drift, SV profile no longer valid (doesn't match the sensor).



View Options (F9)

- Set Depth and Angle Limits.
- Select Different Window Displays.
- Select and Set Different QC Tests and Alarms.

The screenshot shows the 'View Options' dialog box with the 'Ranges' tab selected. It contains two sections: 'Work Units' with radio buttons for 'Meters', 'U.S., Survey Foot', and 'International Foot'; and 'Multibeam' with input fields for Minimum Depth (0.00), Maximum Depth (60.00), Port Offset Limit (75.00), Starboard Offset Limit (75.00), Port Angle Limit (60.00), Starboard Angle Limit (60.00), and Depth Range for Overlap Colors (5.0). A 'Topographic Laser' section has input fields for Minimum Depth (-50.00), Maximum Depth (0.00), Port Offset Limit (100.00), Starboard Offset Limit (100.00), Maximum Range Offset (100.00), and Minimum Range Offset (3.00). Buttons for 'Defaults', 'Apply', 'OK', and 'Cancel' are at the bottom.

The screenshot shows the 'View Options' dialog box with the 'Multibeam Display' tab selected. It contains several sections: 'Profile Window' with radio buttons for 'Sweep Profile', 'Beam Pattern', and 'Wavefront', and a checkbox for 'Fix Vertical = Horizontal Scale'; '3-D Seafloor' with radio buttons for 'Wiggle Display', 'Wireframe Display', and 'Solid TIN', and a 'Color TIN' section with a 'Sounding Points' checkbox and a 'Point Size' input field (4); 'Multibeam Waterfall' with radio buttons for 'Solid TIN', 'Color TIN', and 'Intensity'; 'Nadir Depth' with a 'Font...' button and an 'Alarm Depth' input field (0.0); and 'Dual Head Calibration' with checkboxes for 'Show Head 1 Only' and 'Show Head 2 Only'. Buttons for 'Defaults', 'Apply', 'OK', and 'Cancel' are at the bottom.

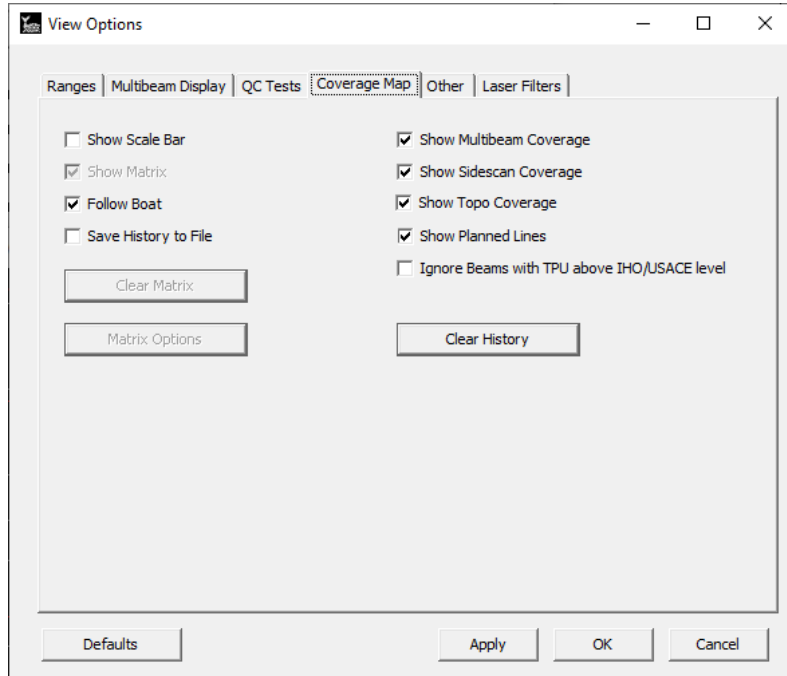
The screenshot shows the 'View Options' dialog box with the 'QC Tests' tab selected. It contains two sections: 'Display' with radio buttons for 'Depth Change by Beam', 'Estimated Standard Deviation by Beam', 'Multibeam vs. Single Beam', and 'Multibeam Sounding Overlap (Requires Coverage Matrix)', and a '# Sweeps in Sample Set' input field (5); and 'Alarm Limits' with checkboxes for 'Heave Drift', 'Multibeam - Single Beam Difference', 'Multibeam Overlap Difference', 'SV Profile-Sensor Difference', 'Show Warning Until SV Profile is Entered', 'Minimum SV Limit', and 'Maximum SV Limit', each with an associated input field and unit (Meters/Sec). Buttons for 'Defaults', 'Apply', 'OK', and 'Cancel' are at the bottom.

Important NOTE: The 'View Options' ONLY affect the 'display of the Real Time data'. It does NOT affect the 'actual data' that is being collected. Even if you incorrectly set one of these options, you will NOT affect the data being stored in the files.

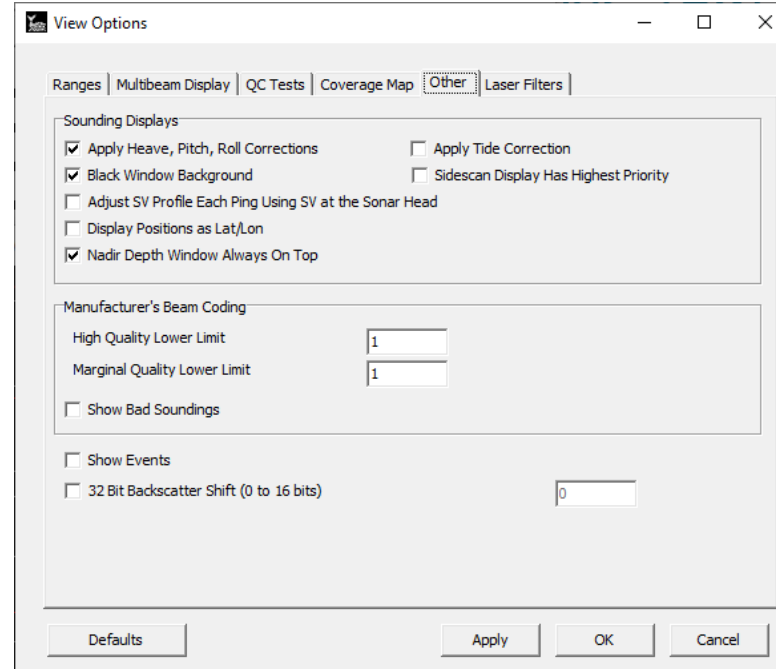


View Options (F9) (Continued)

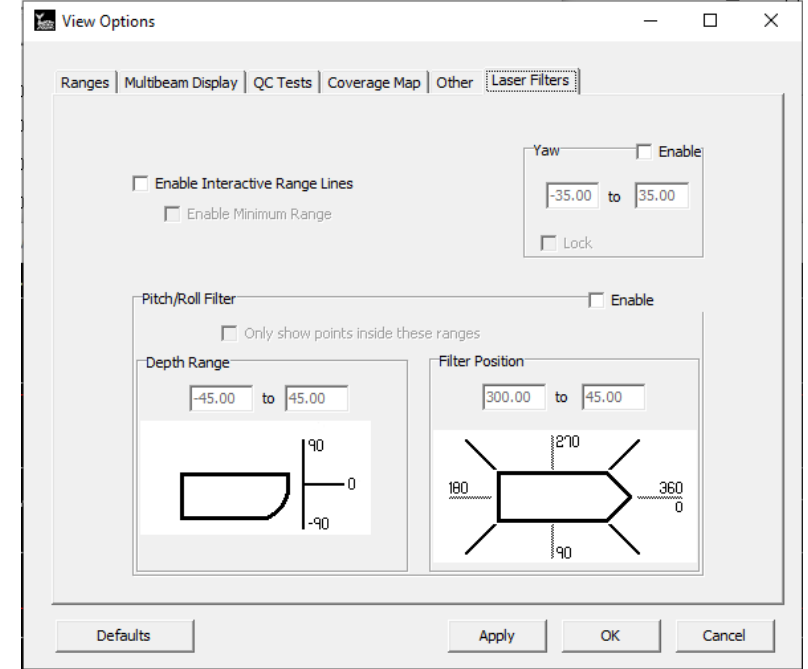
- Select which Coverages to Display.



- Select which corrections to apply in Real Time.



- Select and Set Different Laser Filters



Important NOTE: The 'View Options' ONLY affect the 'display of the Real Time data'. It does NOT affect the 'actual data' that is being collected. Even if you incorrectly set one of these options, you will NOT affect the data being stored in the files.

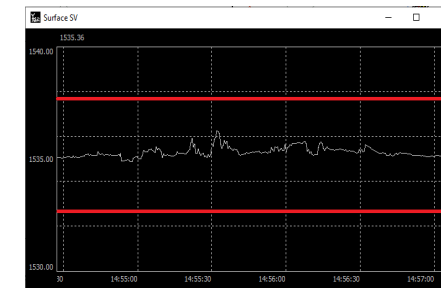
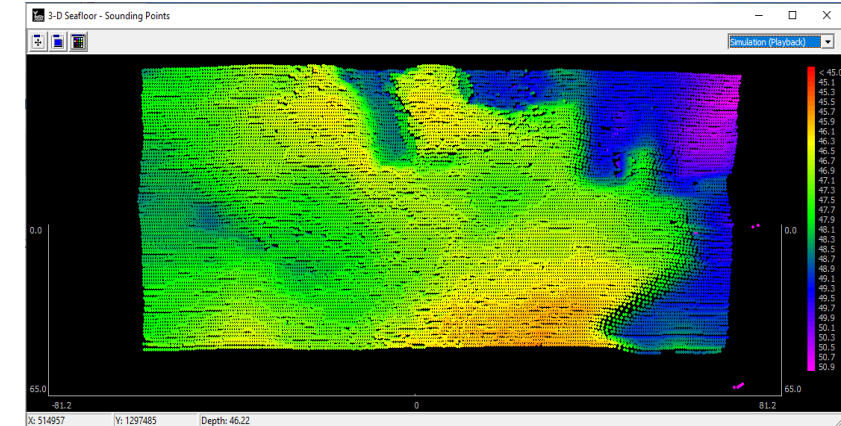
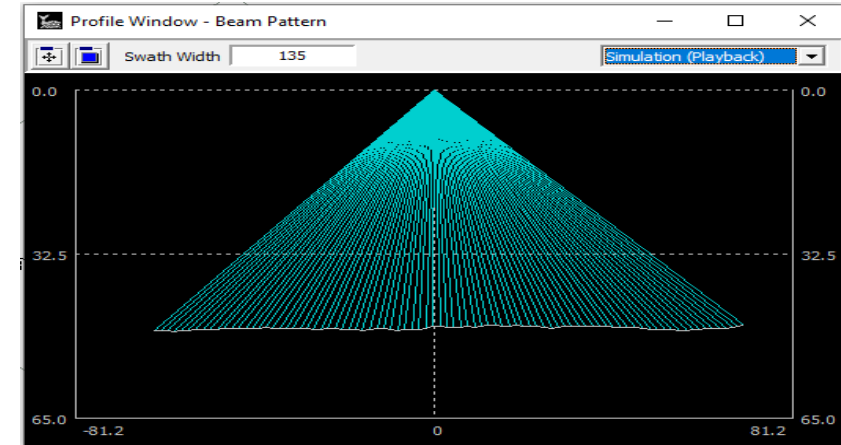
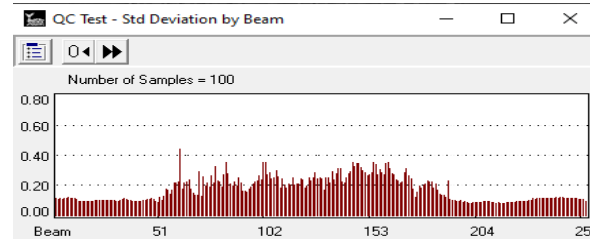
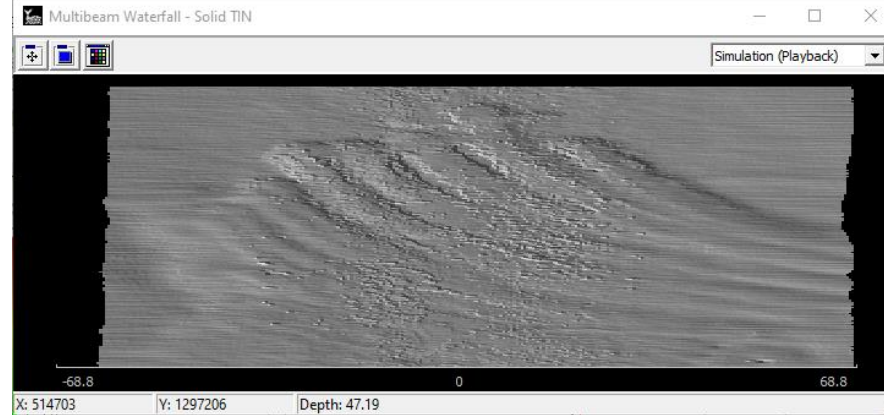
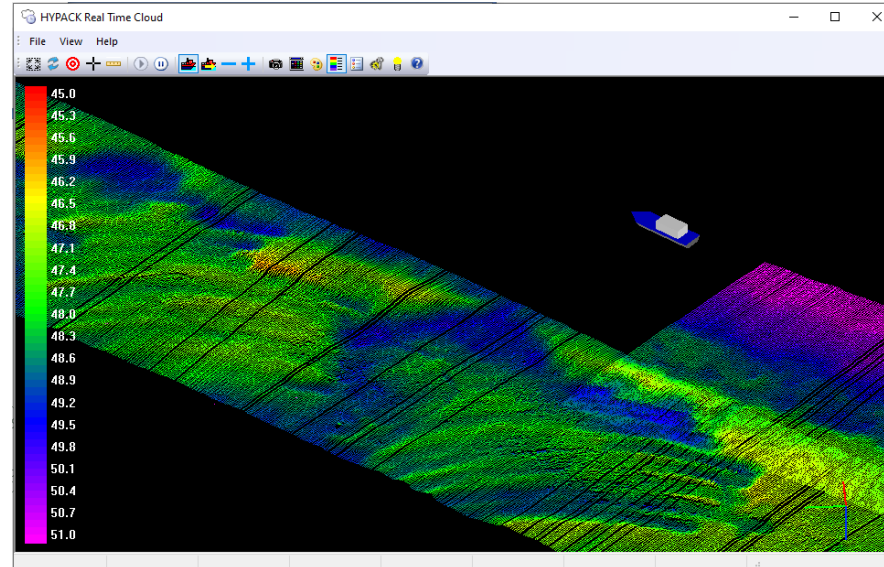


HYSWEEP® Survey (over 30 Display windows)

HYSWEEP Survey - Offline

File **View** Matrix Targets Corrections Tools Patch Test Help

- New Window
- Remove Window
- Profile Window
- 3-D Seafloor
- Multibeam Waterfall
- Intensity Waterfall
- Topographic Laser
- Shore View
- Limits
- Side Scan Waterfall
- Side Scan Signal
- Heave
- Surface SV
- Tide Corr
- Depth
- Position
- Target
- Contract Depth Range F2
- Expand Depth Range F3
- Device Selections...
- Options... F9
- Show Toolbars F10
- Stop Scrolling F11
- Tile Windows Ctrl+F9



Nadir Depth (Uncorrected)

47.33



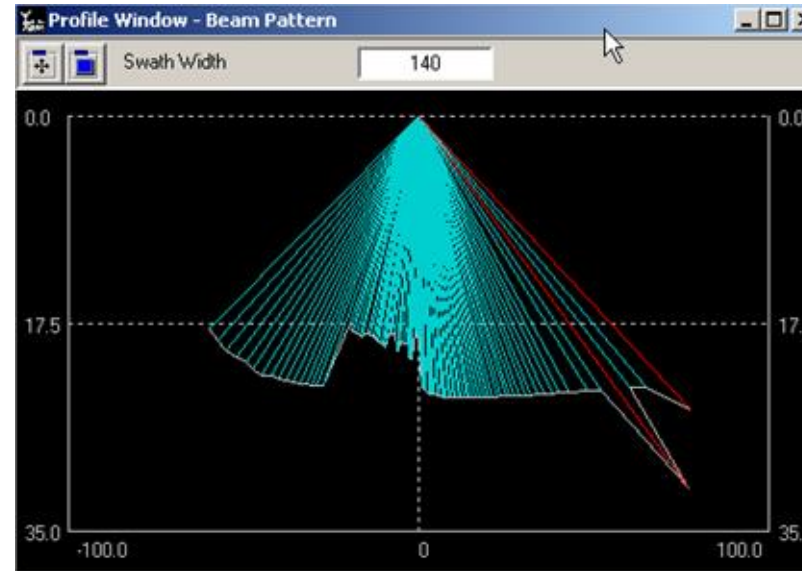
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xylem
Let's Solve Water

Profile and 3-D Seafloor

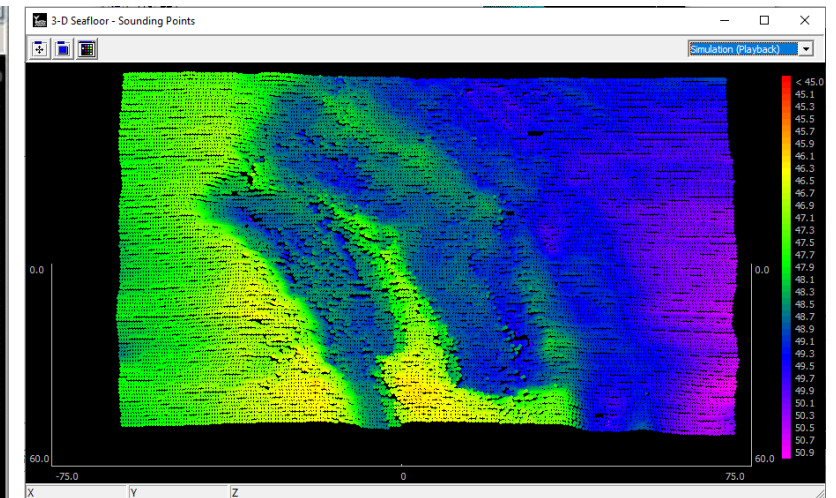
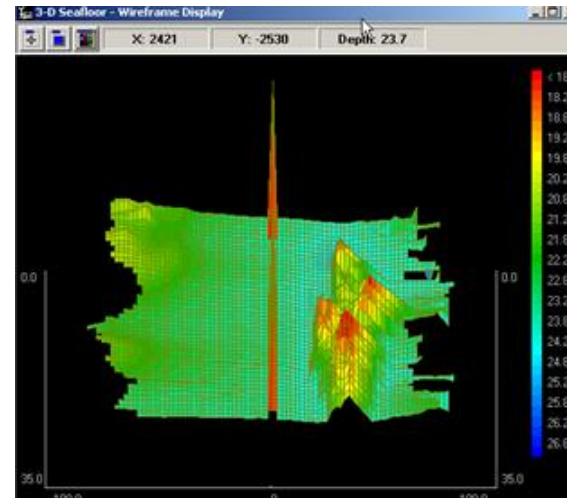
Profile Window

- Single sweep from aft looking forward.
- Color coding can be based on beam quality.
- Useful QC.
- Swath Width at top.
- User defined scale for depth and swath



3-D Seafloor Window

- Styles: Wire frame + solid / color TIN
- Individual Sounding Points
- Mouse targeting and measurement.
- Great tool for bottom visualization.



Waterfall Windows

Multibeam Waterfall

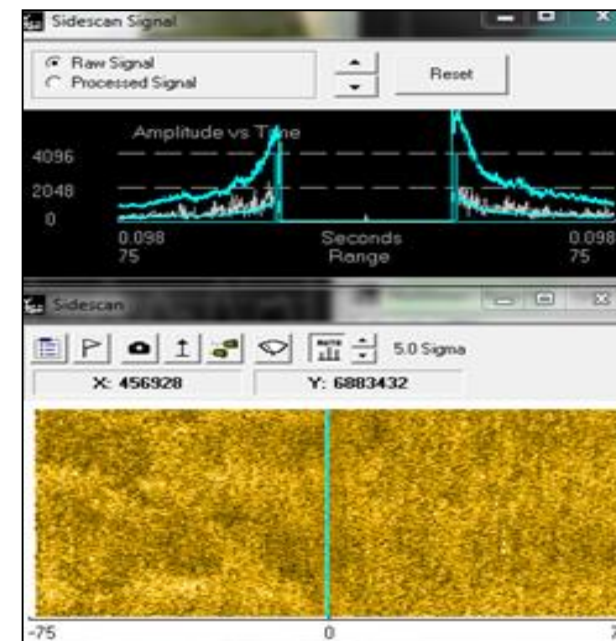
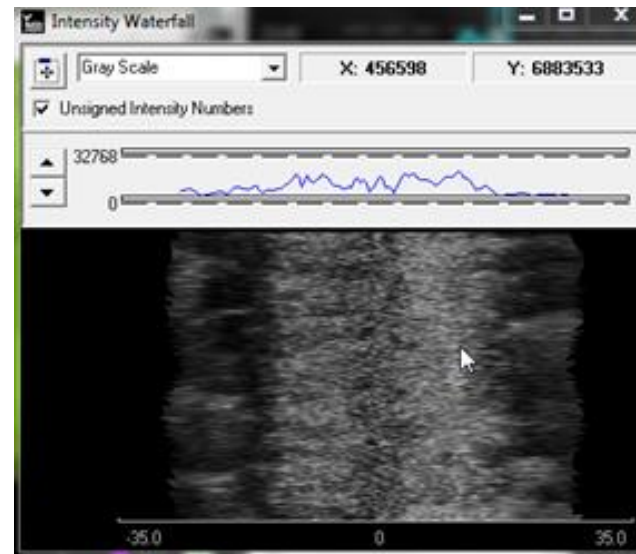
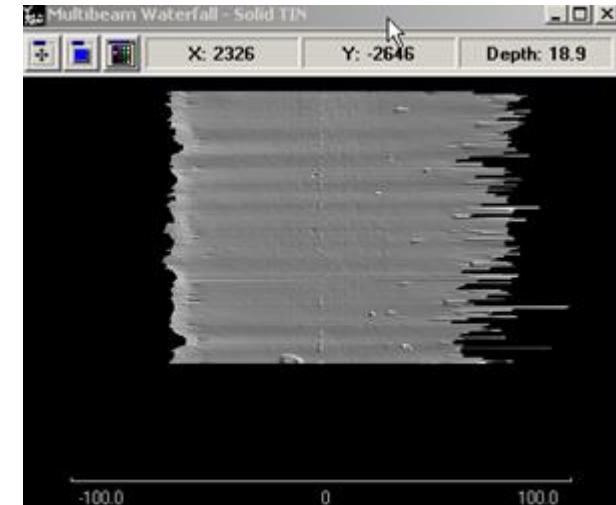
- Color or solid TIN display.
- Good for visualization, targeting and comparison to sidescan.

Intensity Waterfall

- Imagery. No depth info.
- Average backscatter (one sample per sounding) or snippets (many samples).
- Apply TVG Gains

Sidescan Waterfall

- Sidescan data from the multibeam.
- Full image control; colors, gains, bottom tracking, etc.



Interferometry

Processing the raw data from interferometry (bathymetric sidescan) systems

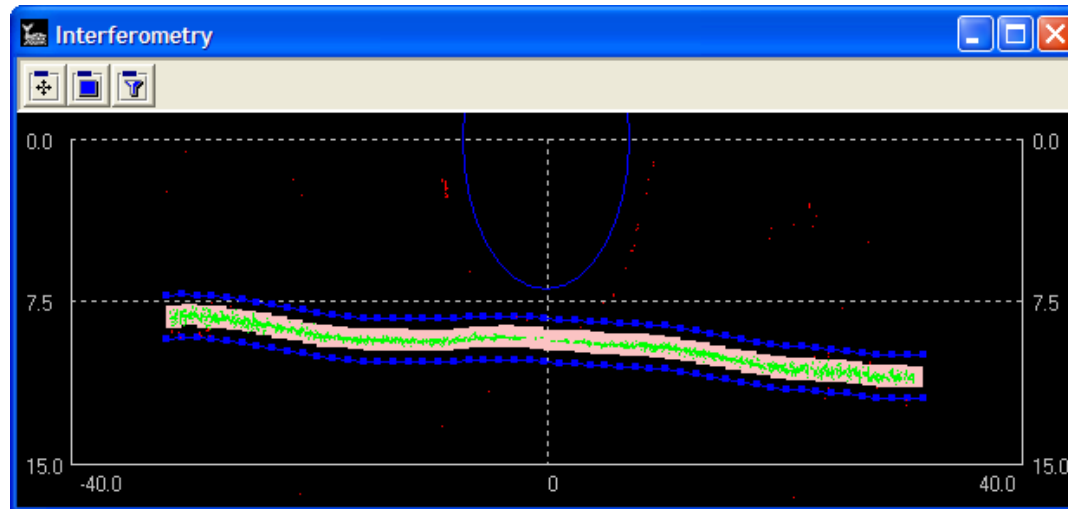
Select from many raw data filters. For example:

- Filter by Intensity: Simple filter - rejects data outside intensity limits.
- Filter Along Track: More complex – gating filter based on along track history.

Select beamforming method and settings

- Bin size and Max Width: Beam footprint and total swath width. Use this to manage file size and edit time.

Alternately, you can use simple downsample and store a maximum of 1440 points per ping - very large files.



The Interferometry Options dialog box contains the following settings:

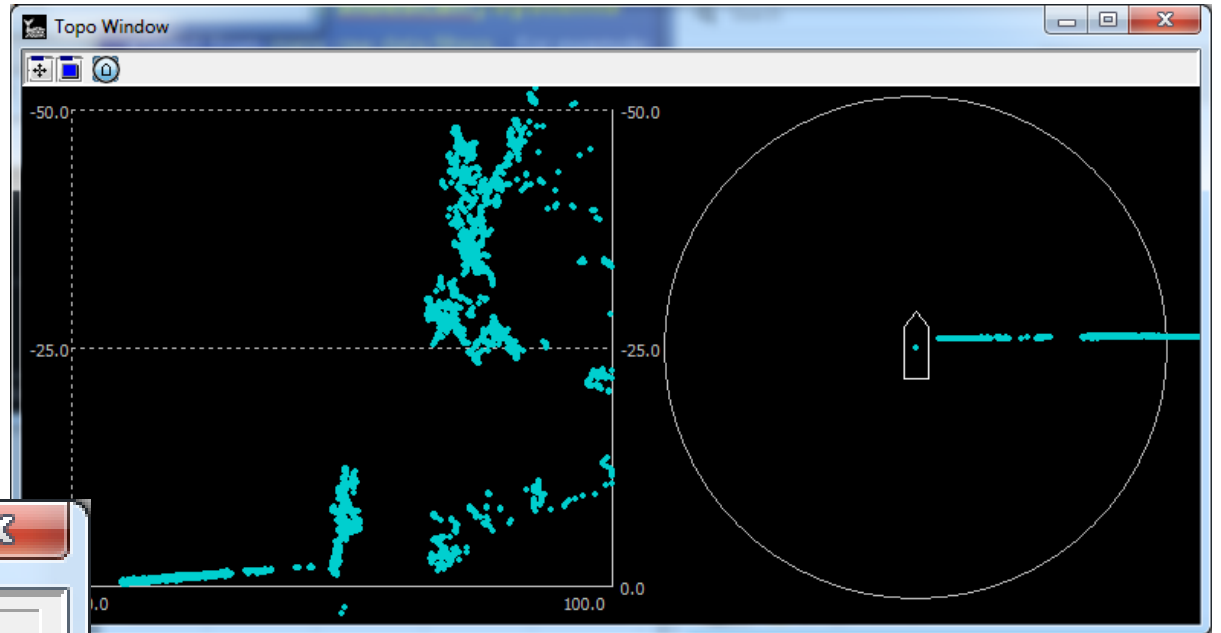
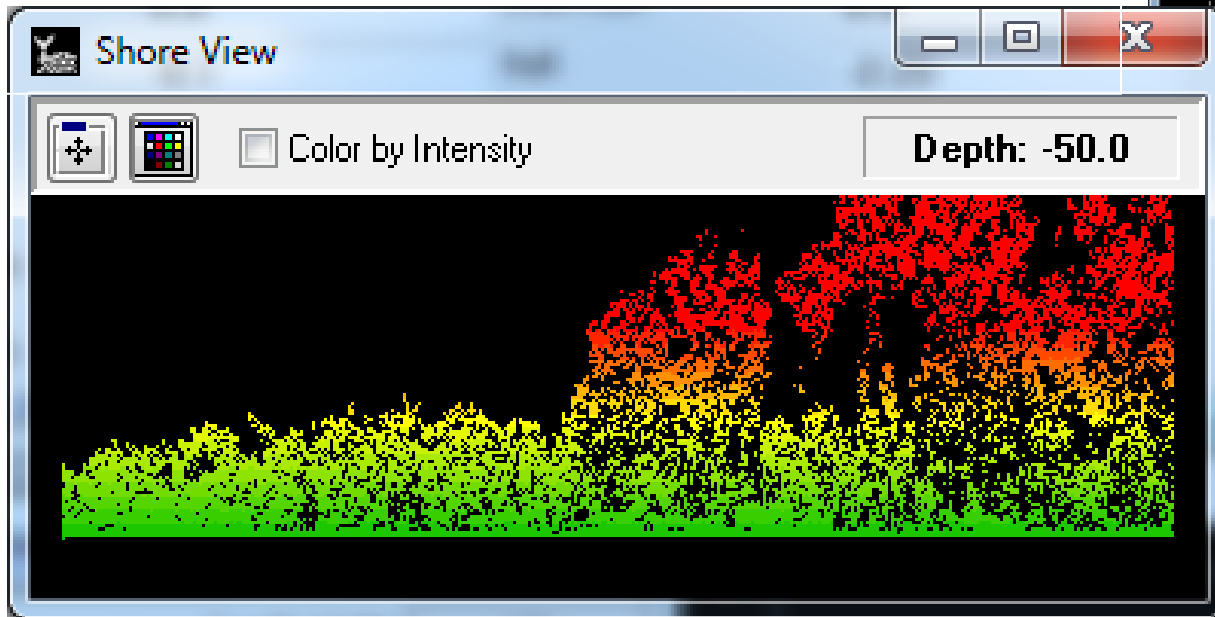
- Avoid: Any Processing
- Filtering**
 - Ignore manufacturer flags
 - Filter by display limits
 - Filter by manual limits
 - Filter by intensity: (0 - 32767) Min / Max: 500 / 32767
 - Filter by quality code
 - Filter water column
 - Auto: Offset / Depth: 10 / 7.00
 - Filter along track: # Bins: 50, Height / Weight: 2.00 / 0.50
 - Filter across track: # Bins: 50, Height: 1.00
- Beamforming**
 - Mode: Bin by Horizontal Offset
 - Weighting Mode: By Intensity
 - Bin Size: 2.00, Max Width: 2880.00
 - Enable Std. Deviation Test
 - Enable Colinearity Test

Interferometry Window:
Combines filter limits, raw data and beams.



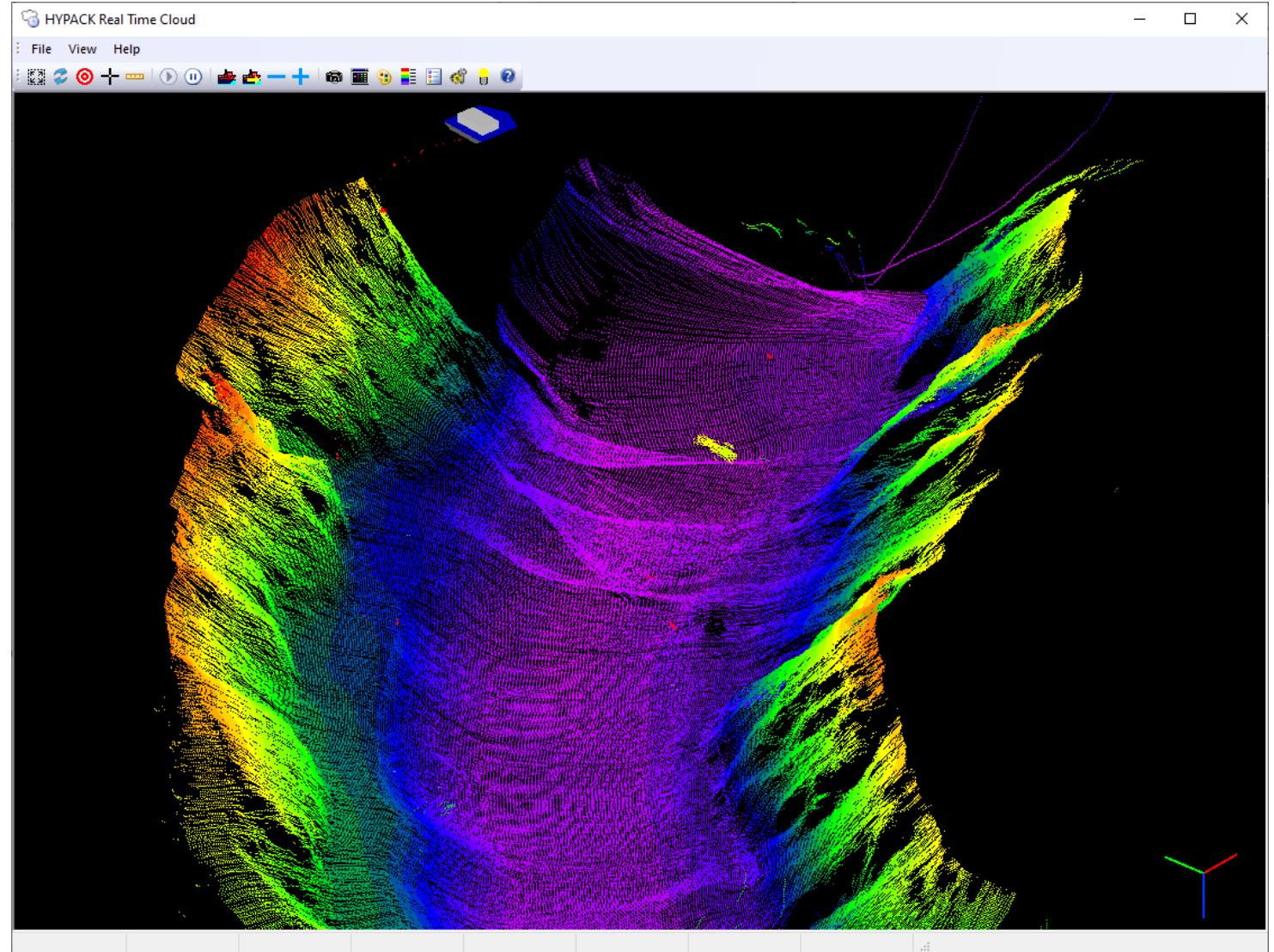
Laser Scanner Data (Topo)

- Inside HSX data is stored in new message type (TOP)
- Can run concurrent with a multibeam sonar
- Works with Velodyne, Optech, Leica, Carlson/Merlin, RIEGL and more



HYPACK® Real Time Cloud

- Fully corrected – sound speed, tide, motion, etc.
- Simultaneous Multibeam + Topo Laser data.
- Selectable 3D boat shapes
- User defined number of points, (default is 4,000,000)
- Tilttable and Rotatable
- Take 'still shot' BMP's
- Create Targets of objects
- Measure between points



HYSWEEP® SURVEY QC Tests

Some Useful Alarms

- **Heave Drift:** Alarm if average heave exceeds threshold.
- **SV Profile Minus Sensor Difference:** Alarm if difference exceeds threshold.
- **Min/Max Sonar SV Probe Limits**

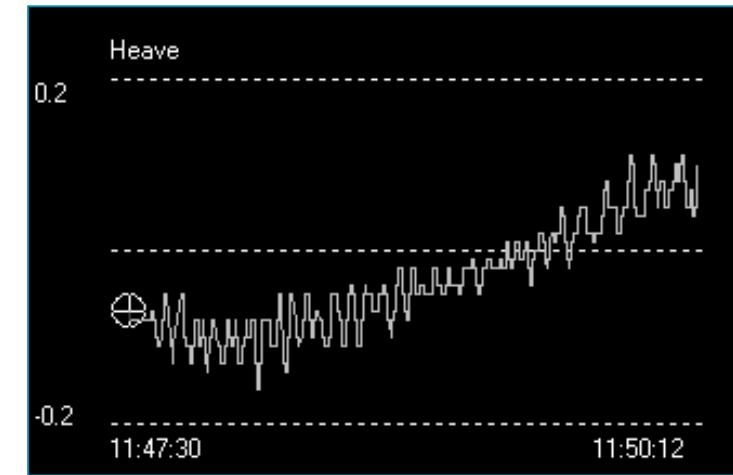
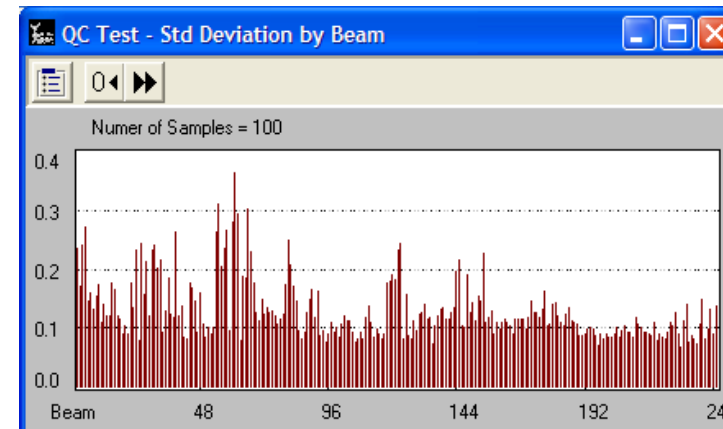
(Warning that your Probe may be fowled with debris or reading a significant SV change)

Alarm Limits	
<input type="checkbox"/> Heave Drift	0.30
<input type="checkbox"/> Multibeam - Single Beam Difference	0.50
<input type="checkbox"/> Multibeam Overlap Difference	1.00
<input type="checkbox"/> SV Profile-Sensor Difference	5.0 Meters/Sec
<input type="checkbox"/> Show Warning Until SV Profile is Entered	
<input type="checkbox"/> Minimum SV Limit	0.0 Meters/Sec
<input type="checkbox"/> Maximum SV Limit	0.0 Meters/Sec



QC Test Window

- Select from four test displays.
- **“Std. Deviation by Beam”** is a nice estimation if the bottom is reasonably flat.



Evidence of heave drift.



TPU – What is it?

Total Propagated Uncertainty

- A method to account for all sources of measurement uncertainty in a sounding
- Echosounder uncertainties
- GPS accuracy
- Motion sensor accuracy
- Offset measurements
- Sound velocity profile corrections

Three major components

- TVU – Vertical only
- THU – Horizontal only
- Target Detection Size Limit
 - Smallest target that can reliably be detected

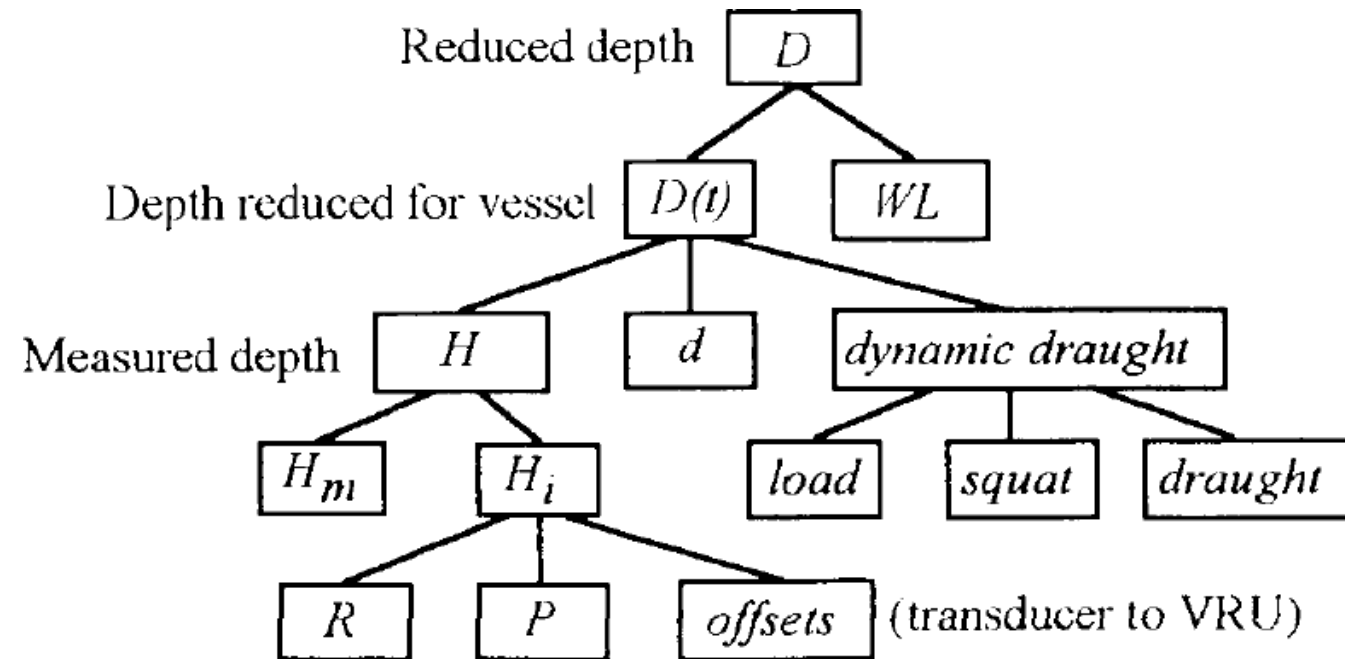
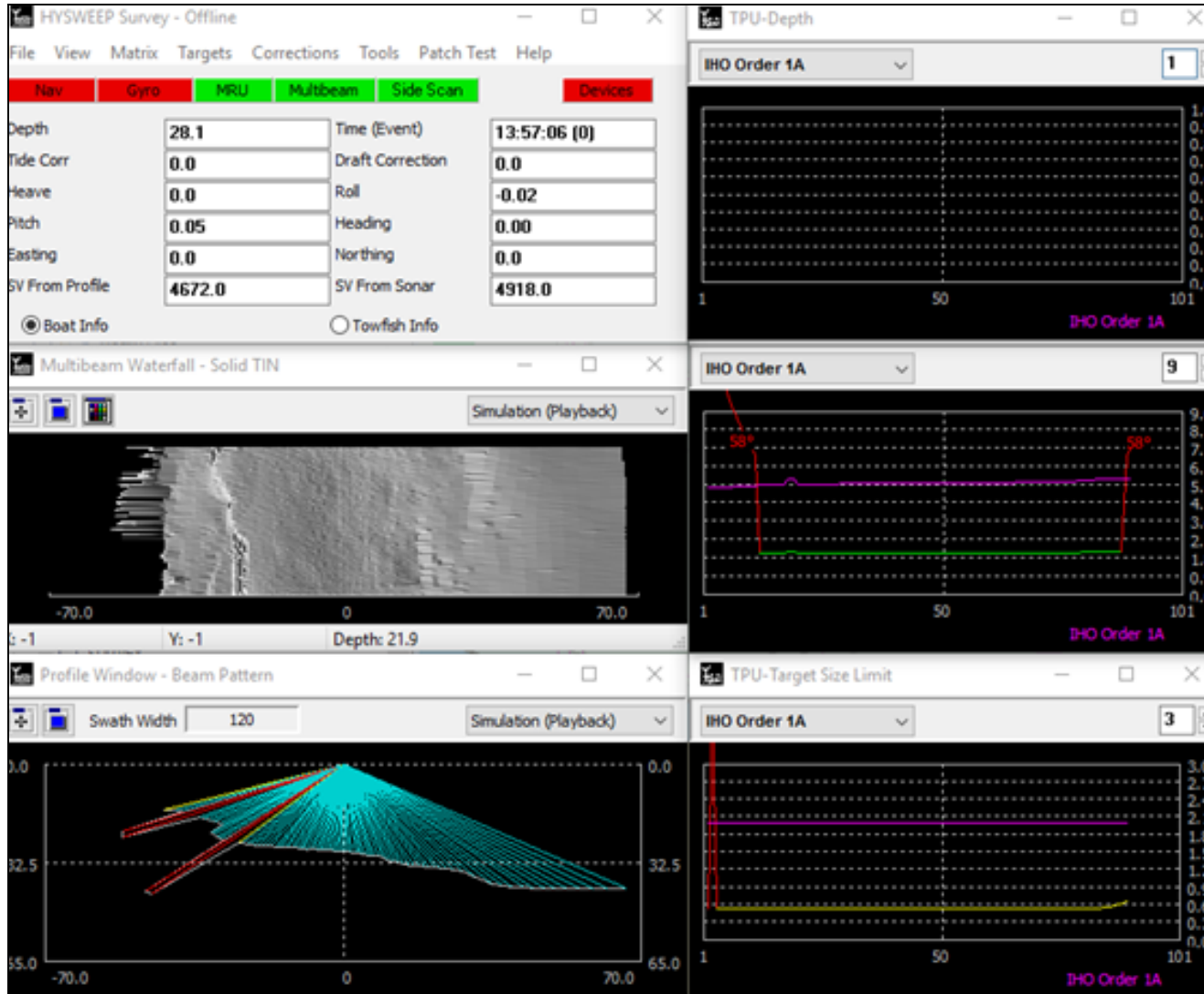


FIG. 8.- Flow diagram of contributions to reduced depth error.

Hare, Rob. "Depth and Position Error Budgets for Multibeam Echosounding." *The International Hydrographic Review* 72.2 (2015).



TPU in Real Time



In real time, HYSWEEP® SURVEY can display graphs of the Depth and Position Uncertainty, along with the Minimum Target Detection Size.

Non-compliant soundings can be excluded from the coverage matrix



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TPU Windows

Parameters are entered in the HYPACK SHELL under:

- EDITORS – TPU Editor

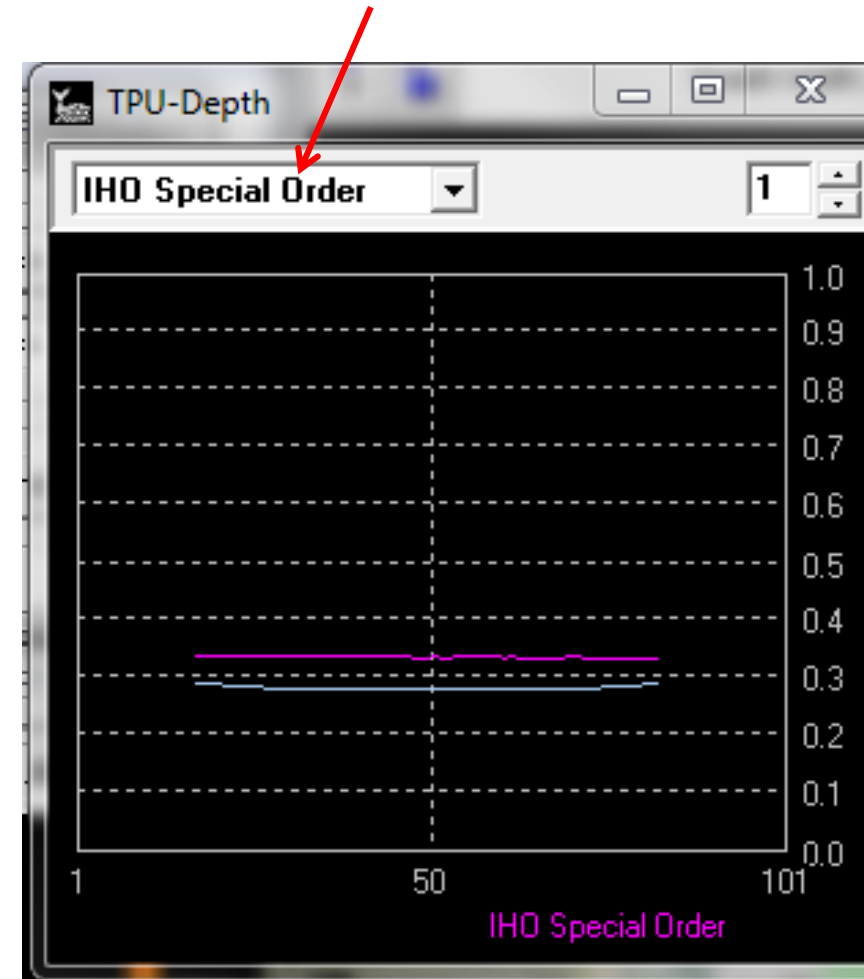
Based on the TPU Parameters and real time sounding info, you can calculate and display:

- Total Sounding Uncertainty (Vertical)
- Total Positioning Uncertainty (Horizontal)
- Target Size Limit Value

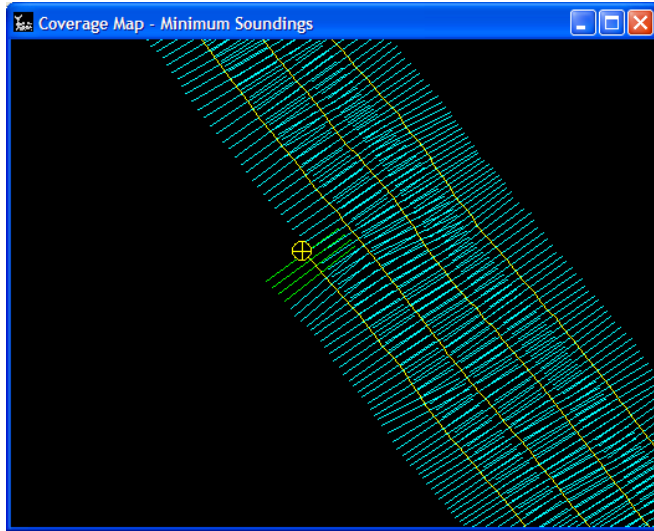
Can display against:

- IHO Special Order Requirements
- IHO 1st Order Requirements
- USACE Hard Bottom Requirements
- USACE Soft Bottom Requirements

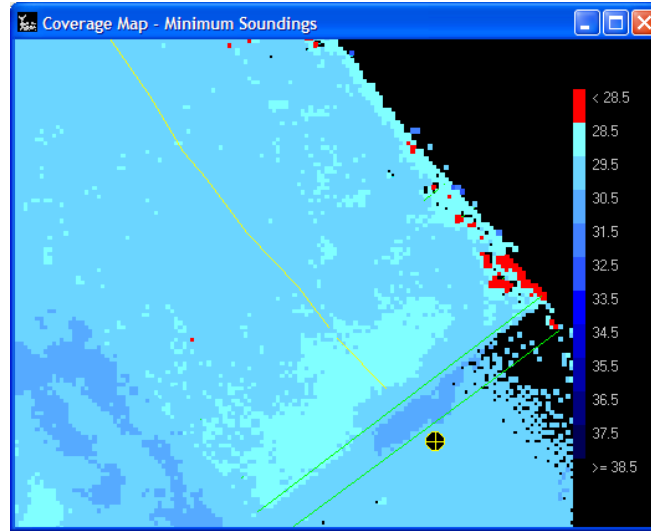
Select survey criteria



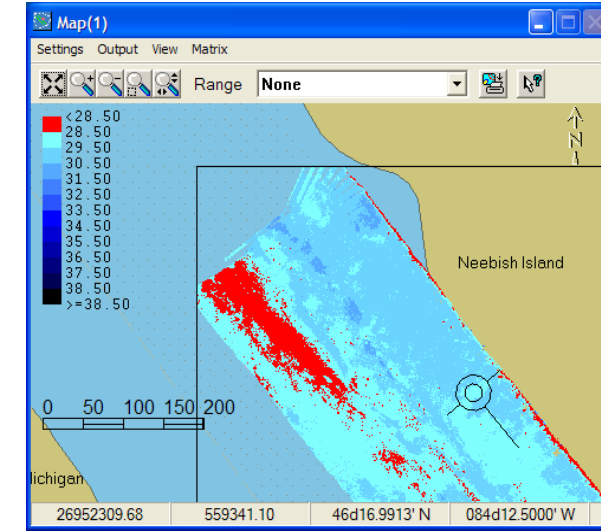
Coverage Map



(1) HYSWEEP® Coverage



(2) HYSWEEP® Filled Matrix



(3-4) HYPACK® Filled Matrix

Show Multibeam Coverage Four Ways

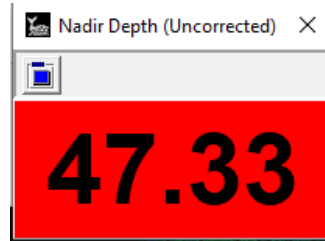
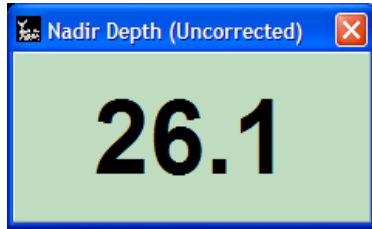
1. Multibeam Coverage in HYSWEEP®: Fast and easy 'stick' plot. No setup is required. Great for showing overlap.
2. Filled matrix in HYSWEEP®: Cut cross sections through the matrix and track overlap QC.
3. User-defined matrix in HYPACK®: Overlay on background files. No sections or QC.
4. Auto matrix in HYPACK®: Automatic matrix creation in HYPACK SURVEY. No need to create a Matrix before starting survey. MTX files will only be shown in HYPACK SURVEY.

(Use View Options and Matrix Options to configure the coverage map.)



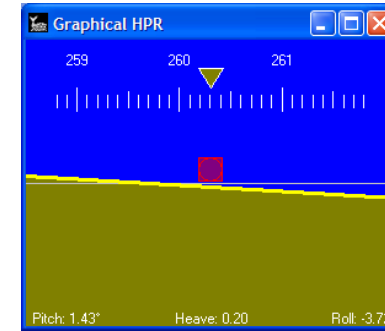
Other Windows

(ENLARGE SCREEN CAPS)



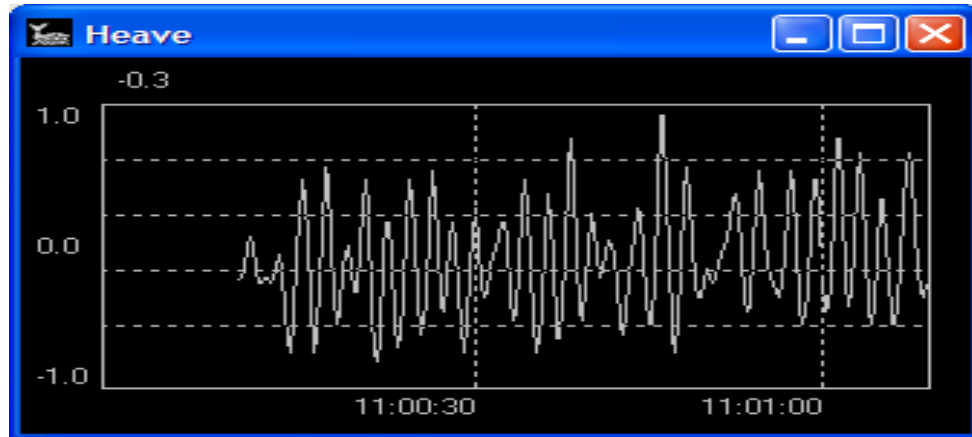
Nadir Depth 1 and 2

Distance between your expensive sonar head and the bottom - turns **RED** when too shallow.



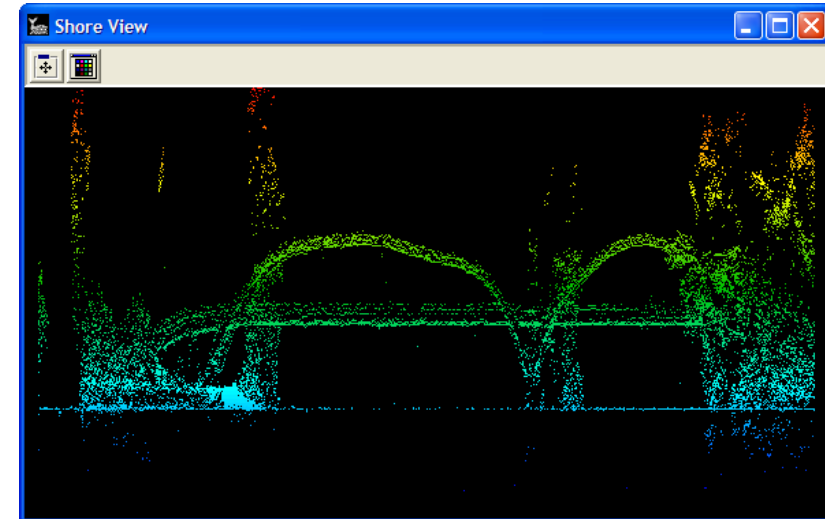
Graphical HPR:

Heading, Pitch, Roll and Heave. Cockpit style display.



Time Series:

Track Heave, Surface SV and RTK Tide in Real Time. Great for showing problems, as they happen.



Shore View

Laser scanner topographic display.



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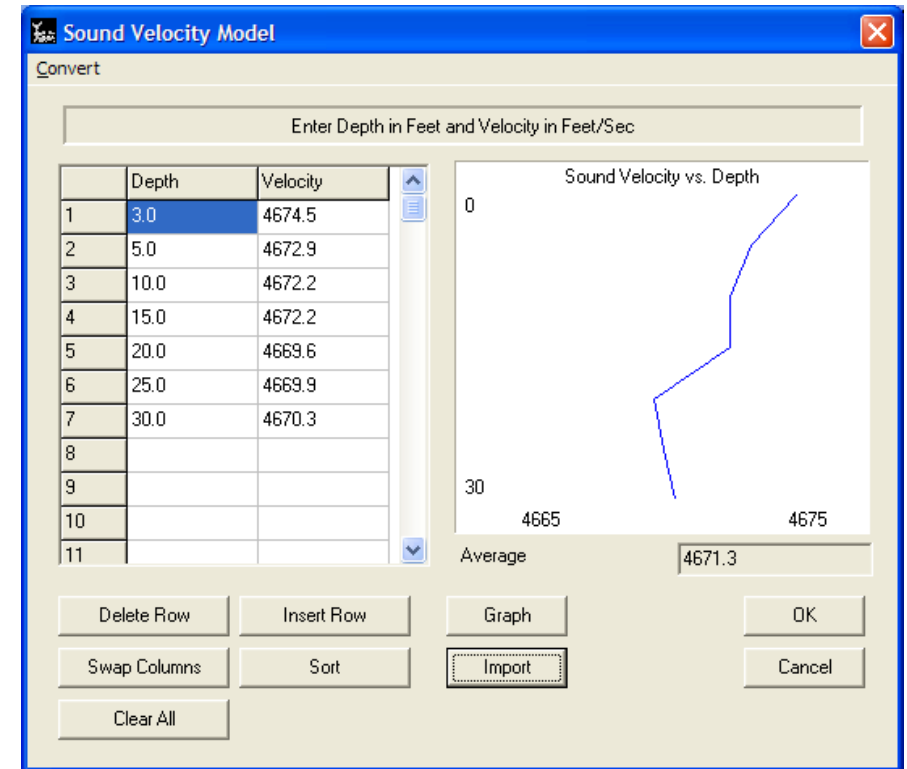
Corrections

Sound Velocity

- Type in depth and sound speed data or,
- Import the profile from file or
- Receive automatically from MVP.
- The profile is applied in Survey for real time QC. Also saved for post-processing.



SONTEK CASTAWAY SV Probe.
Simplified Bluetooth Upload.



HYSWEEP® Sound Velocity Editor

Squat and Settlement

- Enter a table of draft adjustment vs. speed.
- Draft lookup is based on speed over ground, which does not account for current



Logging Data

HYPACK® Commands

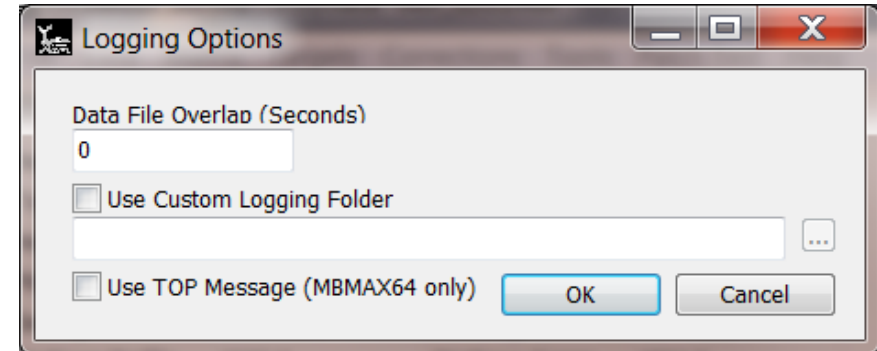
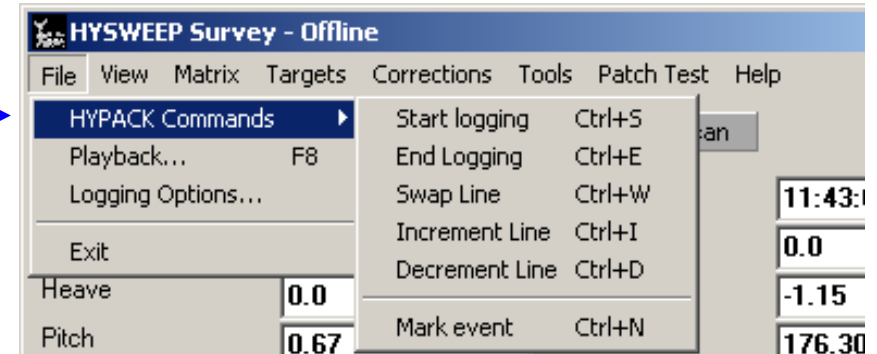
- Ctrl-S to Start, Ctrl-E to End logging.
- Data logged to ASCII *.HSX file by HYSWEEP® Survey.

Logging Options

- File Overlap to avoid gaps between files..
- Custom Logging folder selection.
- TOP message. For logging > 1440 shots per topo laser scan.

Two Data Files per Survey Line

- Same root name (e.g., 002_1116), different extension (HSX and RAW).
- HSX logged by HYSWEEP® Survey: All data required to process multibeam. Offsets, soundings, positions, motion and heading data, tide, draft, SV ...
- RAW logged by HYPACK® Survey: Navigation and detailed position information.



HYSWEEP® Bar Check



Bar Check averages depths for three seconds then saves and graphs the result.

Setup

+/- Depth Gate: Soundings outside bar depth +/- the gate are ignored.

+/- Angle Limit: Soundings with beam angle outside limits are ignored.

Running The Test

Run Bar Check from the Tools menu.

Click “Reset Barcheck.txt” to clear the report.

- Lower the bar and enter Bar Depth.
- When Measured Depth stabilizes, click “Save Depth”.
- Repeat for each bar depth.
- Adjust Sonar Draft if needed.

When done, click “Barcheck.txt” to view or print the report.

Option to save Sonar Draft to HYSWEEP.INI on exit.

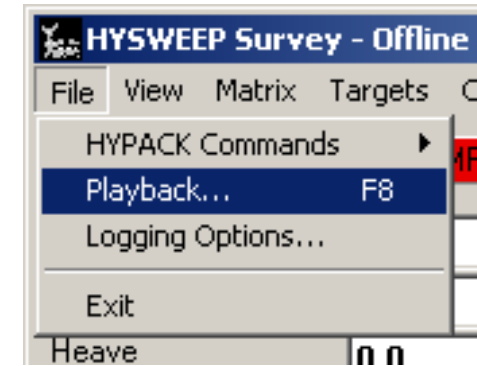
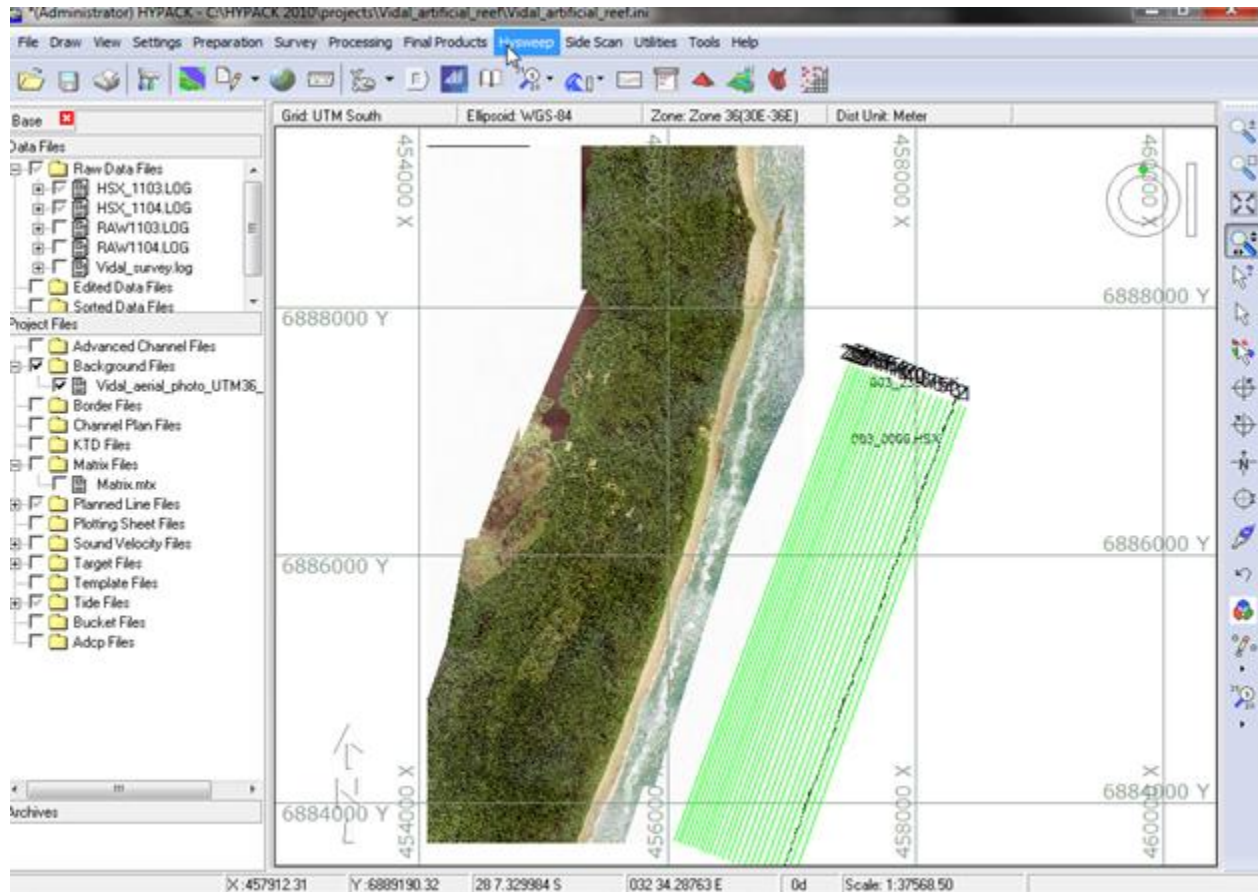
Important NOTE: Takes Pitch and Roll of the Vessel into account, which is why the ‘Pitch Average’ and ‘Roll Average’ are displayed, so that you can figure out what ‘Offset values’ to plug into Hardware, for the MRU device.



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xylem
Let's Solve Water

HYSWEEP® Playback



HYSWEEP® SURVEY can replay HSX files by clicking 'File – Playback'

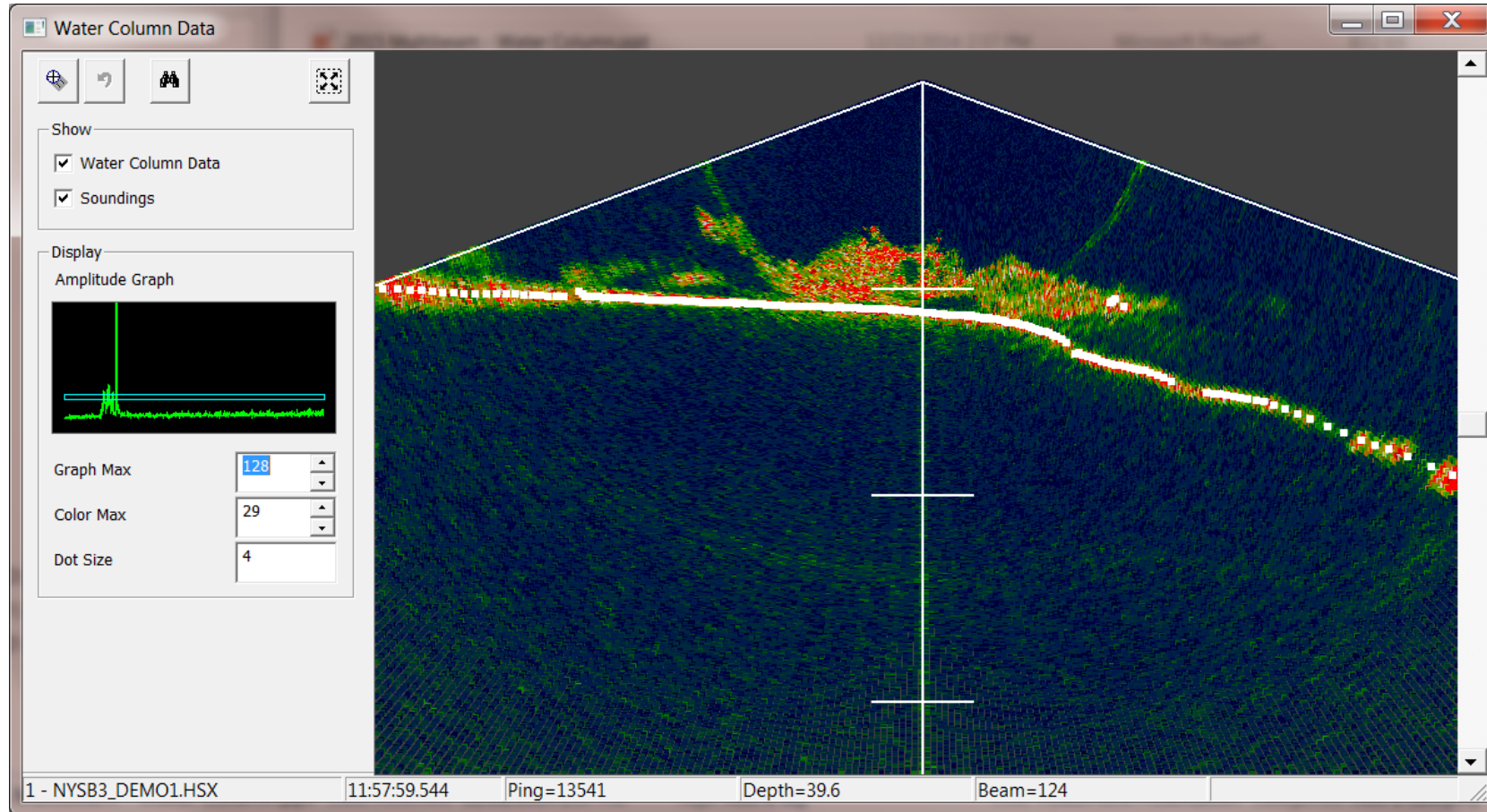


HYPACK 2022 – Training Event

HYSWEEP® Water Column



Water Column Data



Multibeam Backscatter Throughout the Water Column.

- Use HYSWEEP® Water Column Logger to log the data.
- Playback Program for quick replay and exam.
- You can re-digitize soundings in MBMAX64.



HYPACK 2022 – Training Event

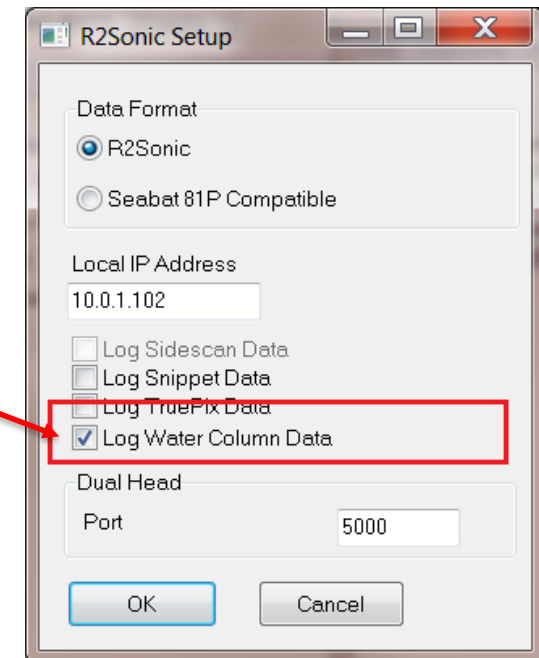
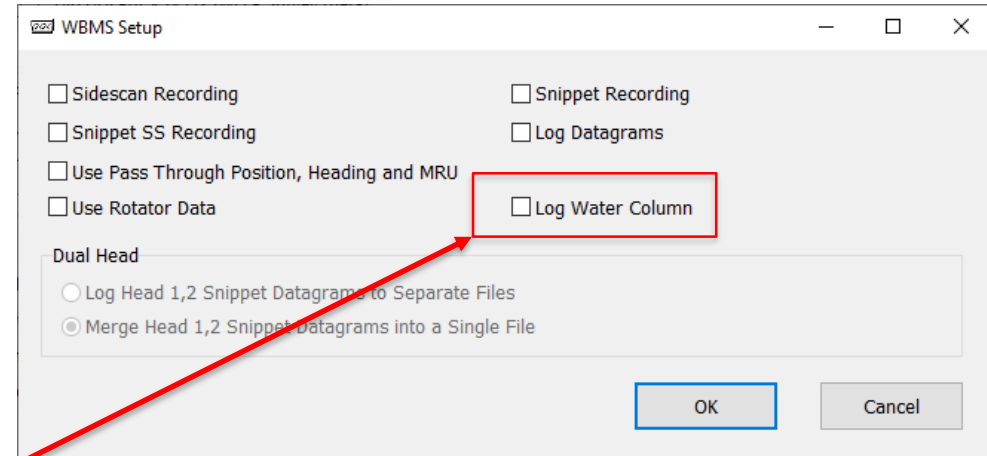
Hardware Configuration

HYPACK® Hardware Setup

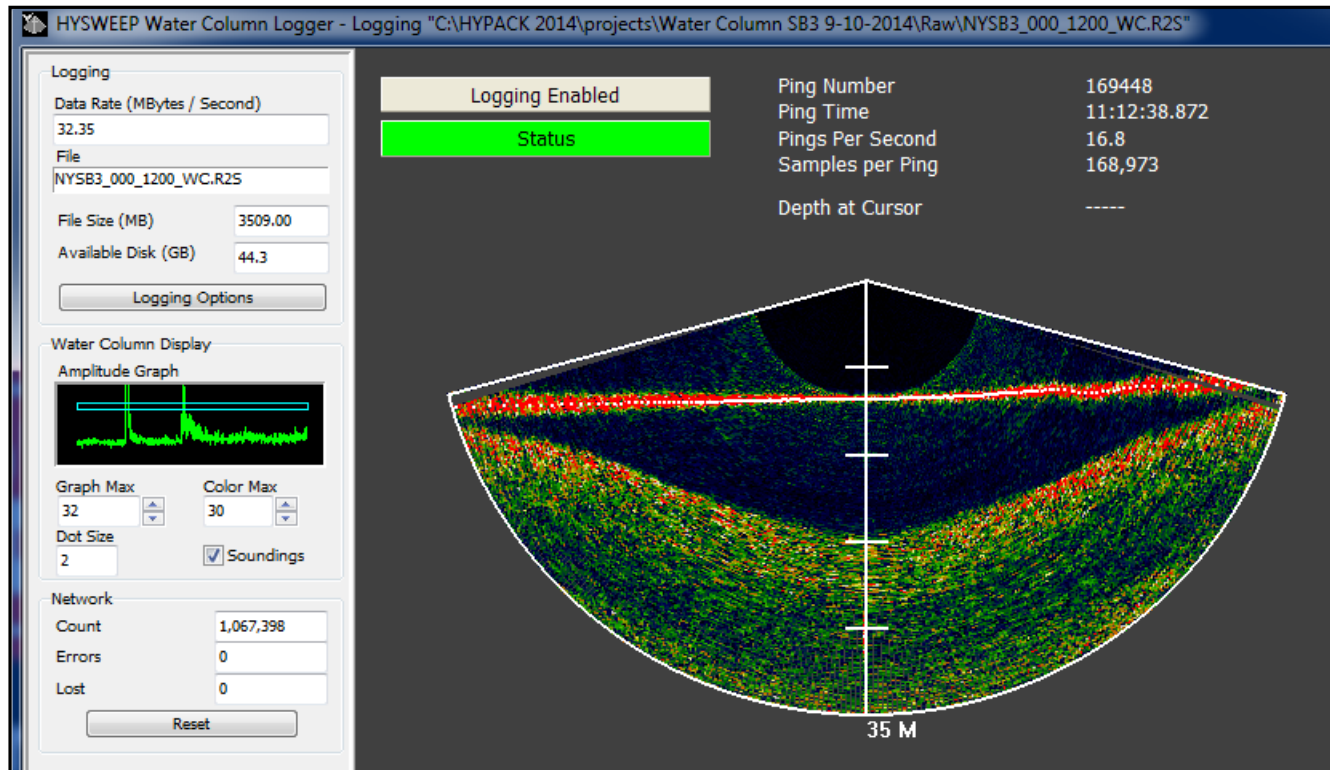
- Water Column is Supported for R2Sonic, Reason, and NORBIT Multibeam Systems.
- Configure Sonar for Normal Bathymetry then,
- Check the Box in Driver Setup.

Logging File Types:

- R2Sonic: *.R2S
- Reson, NORBIT: *.7K



HYSWEEP® Water Column Logger



Typical Data Rate
= Two Giga Bytes
per Minute.

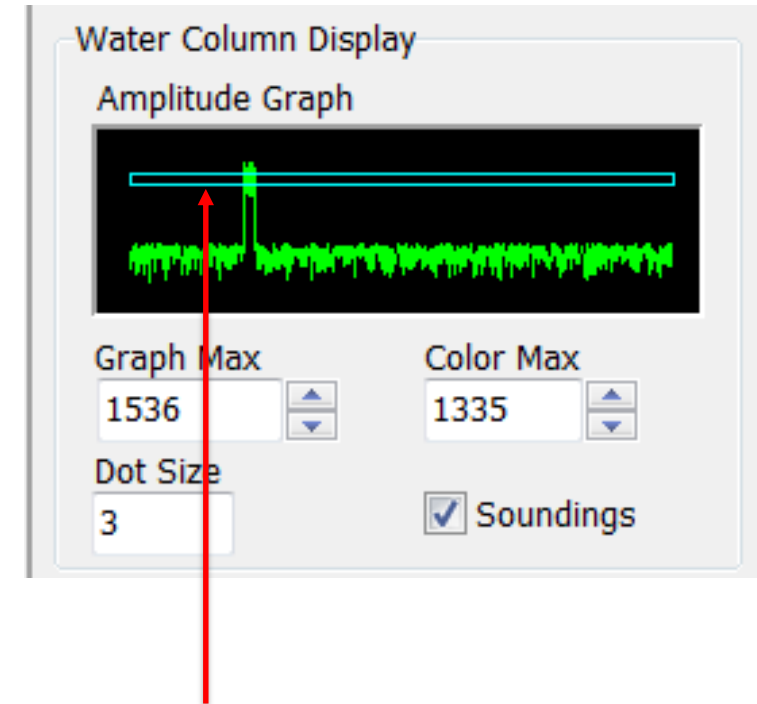
- Logger Runs Automatically with HYPACK® and HYSWEEP® Survey.
- Real Time Display and Color Configuration.
- Continuous and On Demand Logging.
- Alarms. (For Example; *Low Disk Space*)



HYPACK 2022 – Training Event

WC Logger – Color and Display Settings

- **Amplitude Graph:** Backscatter Amplitude of the Nadir Beam.
- **Graph Max:** Set scale limit of the amplitude graph.
- **Color Max = Color Saturation Limit:** Any amplitude > this setting is shown in Red.
- **Dot Size:** Of individual samples.
- **Soundings:** Check this to overlay soundings in white.



Click and Drag the Blue Bar to quickly change the Color Saturation limit.



WC Logger – Ping Buffering

- Find this in Logging Options
- Number of seconds of WC data saved in program memory.
- Gives the surveyor some leeway with On Demand Logging.
- Equals the number of seconds between (1) spotting a feature and (2) clicking the Logging button.

Ping Buffering

Pings Per Second	Bytes Per Ping	Buffer Size (MB)
<input type="text" value="14"/>	<input type="text" value="569902"/>	<input type="text" value="75"/>
<input type="button" value="Calculate"/>		
Buffer Time in Seconds	<input type="text" value="9.9"/>	

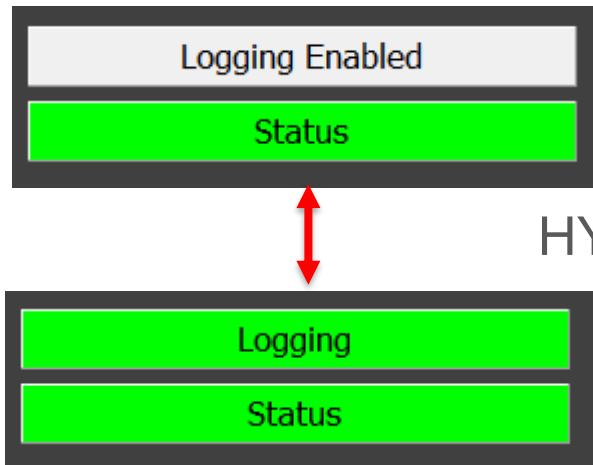
- Pings per Second: Filled in by program.
- Bytes per Ping: Filled in by program.
- Buffer Size (MB): Entered by the surveyor.
- Buffer Time in Seconds: Calculated by the program.



WC Logger – Data Logging

Automatic Mode

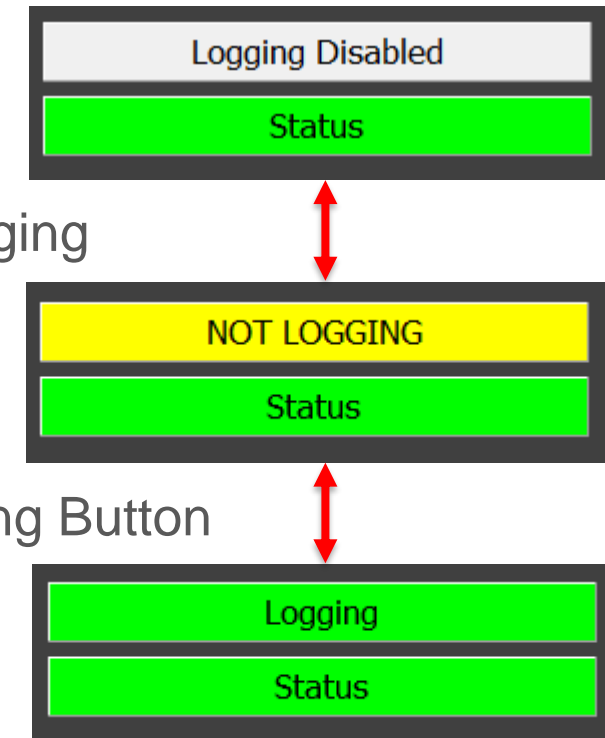
- WC Logging mirrors HYPACK® Survey.



HYPACK® Start / End Logging

On Demand Mode

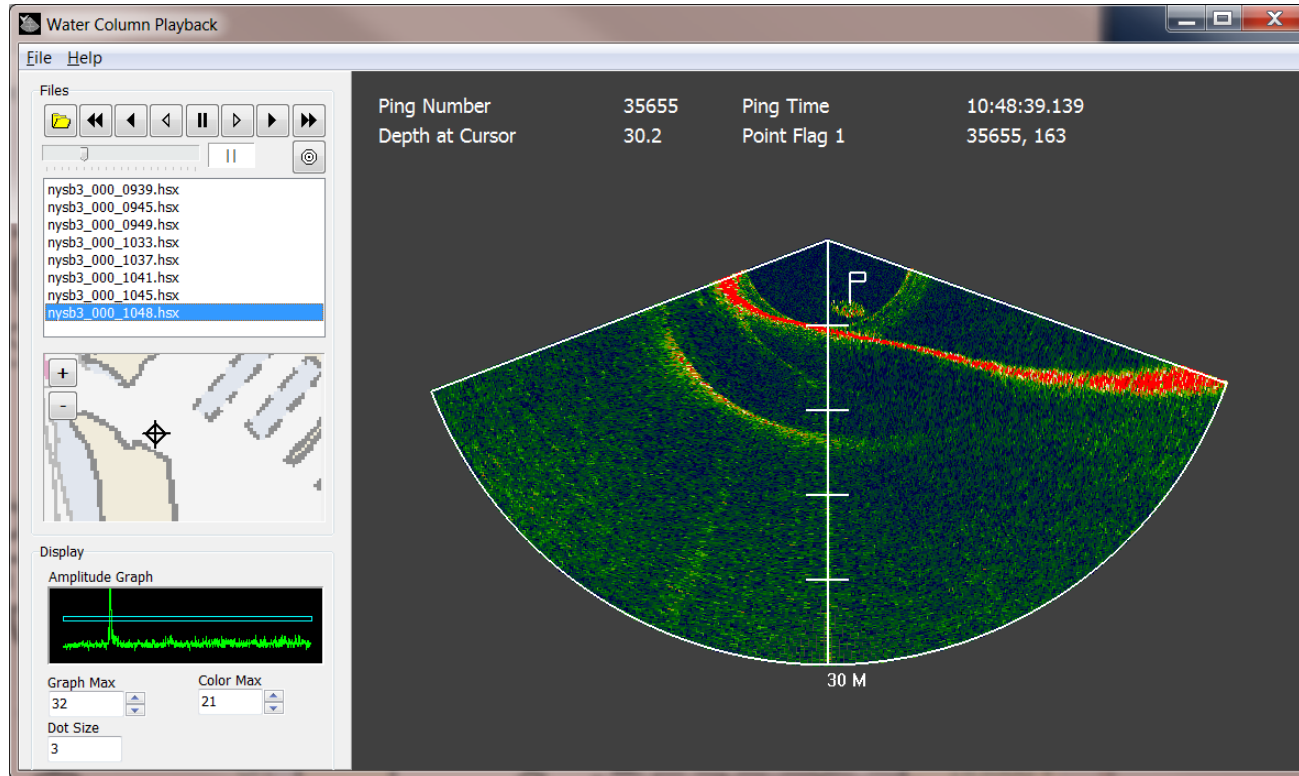
- Only Logs areas of interest.



WC Logging Button



Water Column Playback



- Quick survey review.
- Play / Pause / Fast buttons and shortcut keys.
- Display setup like WC Survey.
- Thumbnail map for referencing.
- HYPACK® Targets.
- Flag points for MBMAX64 editor search.



Thank You !

Links to more information:

[HYPACK on Youtube.com](#) (Historical Sessions)

[HYPACK on Youtube.com](#) (Newer Sessions)

[HYPACK SUPPORT Site](#)

[HYPACK Live Chat](#)

[HYPACK Ustream](#)

[HYPACK Website](#)

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