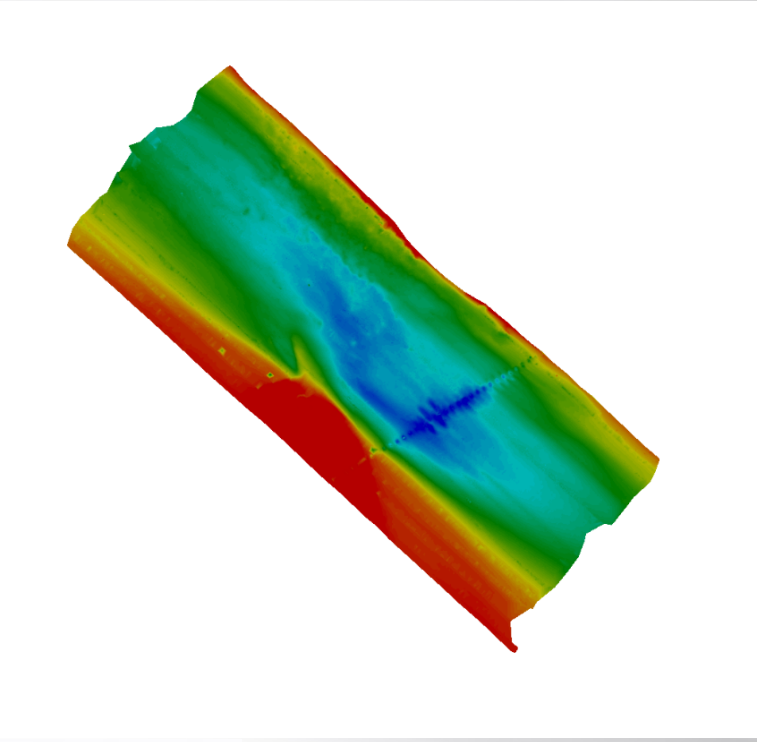
3rd Mexican Hydrographic Conference

Ciudad del Carmen, Campeche

April 27th-29th 2016



Who We Are

Industry leader in underwater acoustics

- EdgeTech (formerly EG&G Marine)
  - Started in 1966 by Doc Edgerton
  - Over 50 years making sonar systems
- ORE Offshore affiliated with EdgeTech over 10 years adopted the EdgeTech name in 2012
  - Formed in 1963
- Facilities in Massachusetts and Florida

EdgeTech
The Leader in Underwater Technology
50
1966 2016

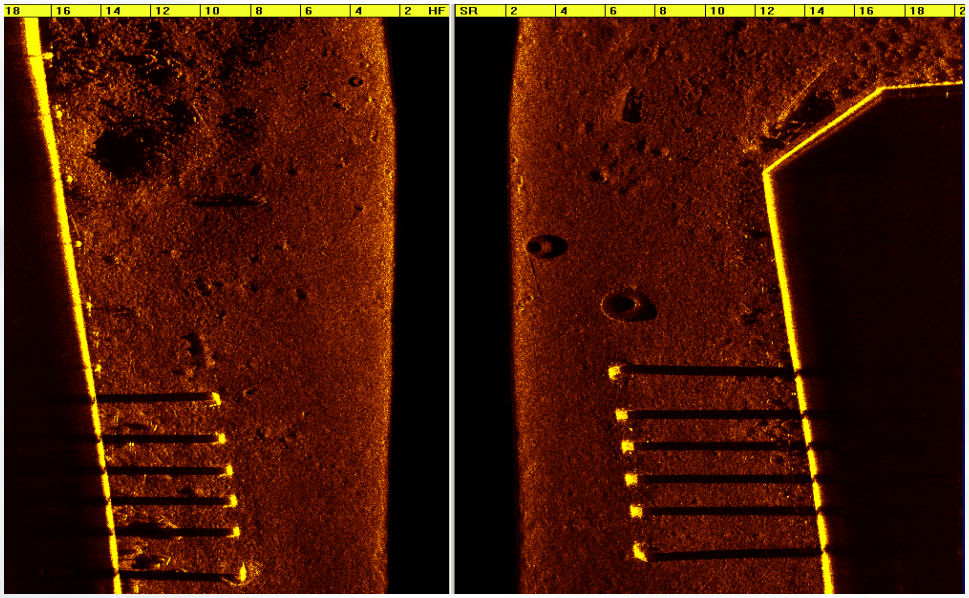
Core Competencies

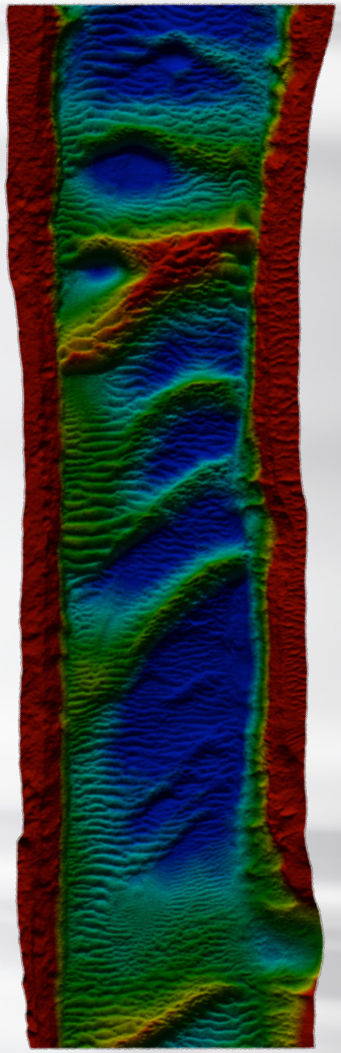
- Engineering
  - Acoustic
    - Ceramics, transducers, hydrophones, arrays
    - Algorithms
  - Mechanical
    - High level of experience with electronics, housing, array, packaging, cabling
  - Software
    - Firmware and user-level expertise
  - Test
  - Specials, custom solutions
  - New product development emphasis

The 6205 Combined Swath Bathymetry and Side Scan Sonar

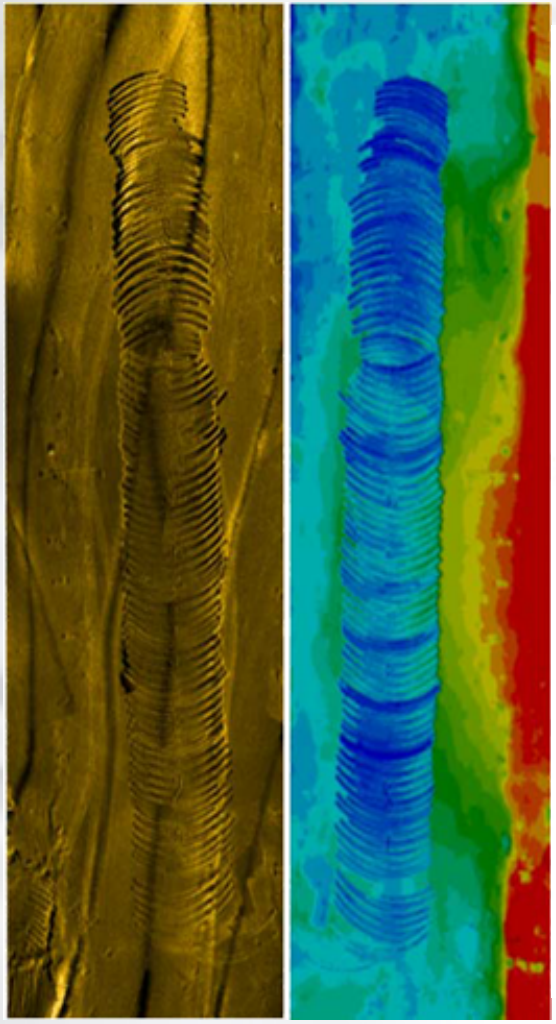
EdgeTech's MPES Technology

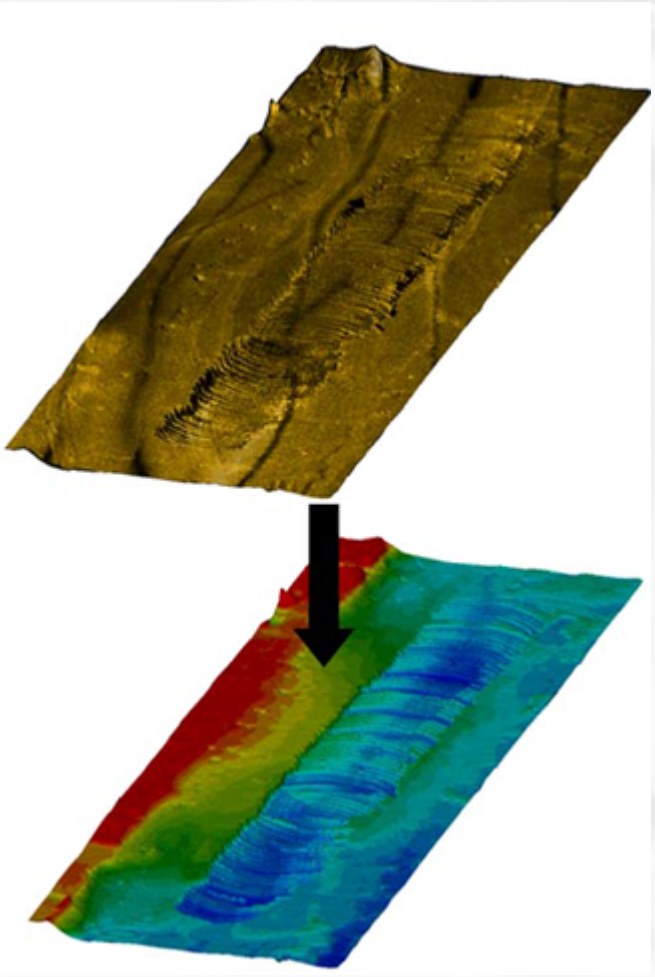
- Coverage of up to 12 x water depth.
- IHO Special Order compliant
- Over 200º Swath Coverage
- Co-registered Dual Frequency Side Scan Imagery
- Chirp pulses for higher accuracy and extended range
- Multipath and Wake Suppression
- Lightweight and modular package
- Superior Data Quality & Integrity





Co-Registered Bathymetry & Side Scan



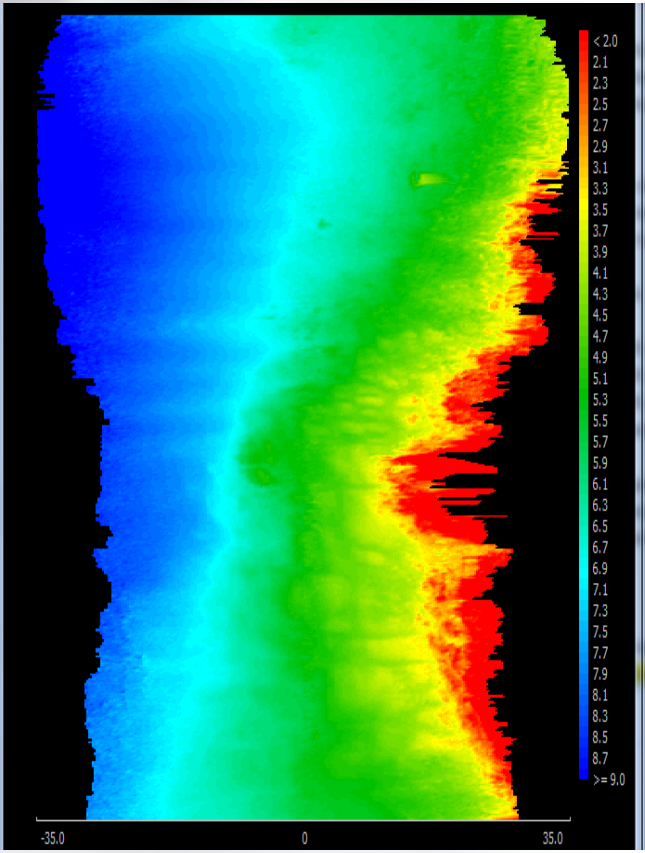


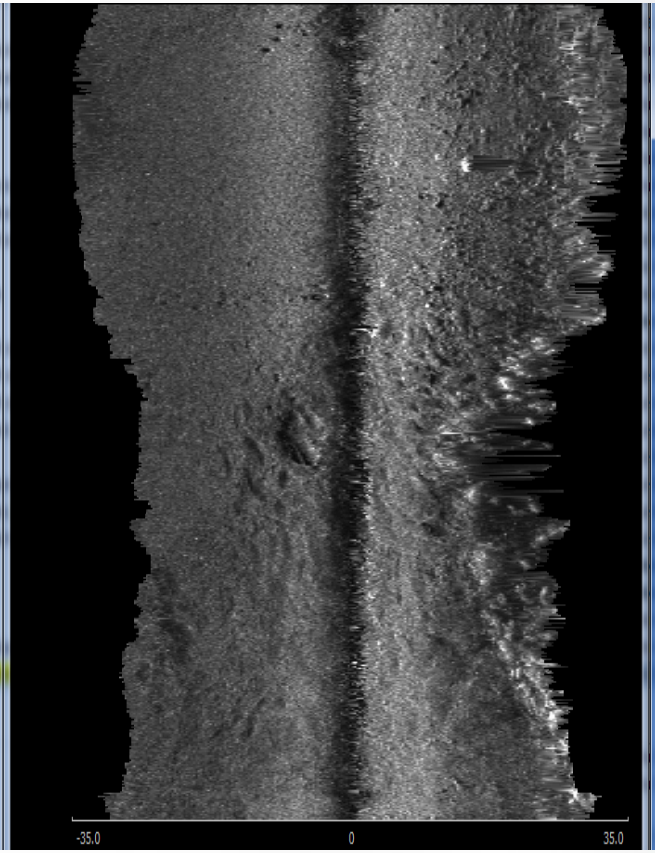
- Bathymetry & Simultaneous Dual Frequency Side Scan Sonar
- Precisely Co-Registered Bathymetry & Side Scan Imagery
- Longer Arrays for Higher Resolution Imagery
  - 1 to 3cm Range Resolution

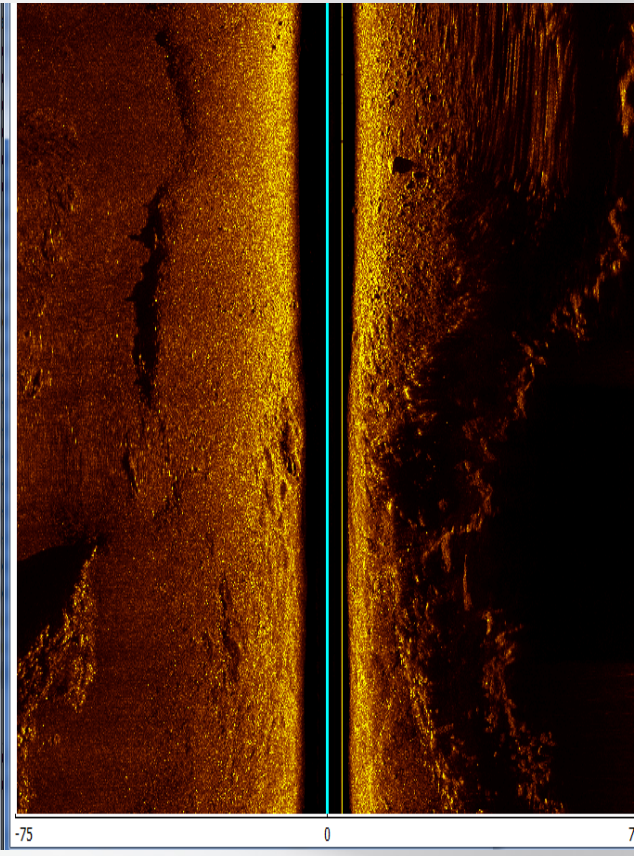
6205 Advantages

Three types of data collected:

- Bathymetry
- Backscatter
- Sidescan (Dual Frequency)







Technical Specifications

EdgeTech

SWATH BATHYMETRY & SIDE SCAN SONAR

KEY SPECIFICATIONS

BATHYMETRY			
Sonar Frequency	230 kHz	550 kHz	
Beamwidths*	1° x 0.7°	1° x 0.5°	
Max Sounding Depth**	225 m	120 m	
Max Swath Width***	400 m	200 m	
Max Swath Sector	200°		
Max Number of Soundings	800		
Sounding Patterns	Equidistant and Equiangular		
SIDE SCAN SONAR IMAGERY			
Frequency	230 kHz	550 kHz	1600 kHz
Horizontal Beamwidth (2-way)	0.54°	0.36°	0.20°
Range Resolution	30 mm	10 mm	6 mm
Max Range**	250 m	150 m	35 m
SYSTEM			
Pulse Modulation	CW & FM CHIRP		
Ping Rate (Range Dependent)	Up to 60 Hz		
Construction	FRP Composite / Stainless Steel Reinforced		
Dimensions	150 x 211 x 762 mm		
Deck Cable Length	20m (Standard)		
Depth Rating	50 m		
Weight (In Air)	19.9 kg (44 lbs)		
Input Voltage	48-60 VDC, 115-230VAC		
Power (Typical /Max)	55W / 70W		
Software	Windows based software included EdgeTech's Discover Bathymetric Acquisition and Sonar Control		
Data Products	Bathymetry, Backscatter and Side Scan Imagery, and Real Time Uncertainties		

* Across track resolution expressed as a beamwidth at nadir
** Dependent on environmental conditions (i.e. absorption, reverberation, sea noise, etc.)
*** Assumes a flat seafloor and dependent on environmental conditions

Acquisition Software

- EdgeTech's Discover Bathymetric
- Compatible 3rd Party Software for Acquisition:
  - QINSy
  - Hypack
  - SonarWiz
  - Fugro Winfrog (Starfix)
  - EIVA
- Coming Soon:
  - Triton
  - PDS2000
  - OIC CleanSweep
- Postprocessing via jsf:
  - QINSy QIMERA
  - Hypack
  - CARIS

Why MPES?

- Many MBES Systems on the Market
  - Not Suitable for Shallow Water
    - Limited Swath Angle (Typical 130^{o} or less)
    - No Side Scan Imagery (Limited to Backscatter)
- Typical Interferometry Systems Too Noisy w/ Nadir Gap
  - Efficiency Gains Lost due to Nadir Gap
  - Noisy Data = Lots of Data Cleaning
- Better Spatial Resolution than Beam Formers, but without the Nadir gap traditionally associated with Interferometers

SURVEYORS NEED SOLUTION FOR SHALLOW WATER SURVEY OPERATIONS!

Analysis of Data

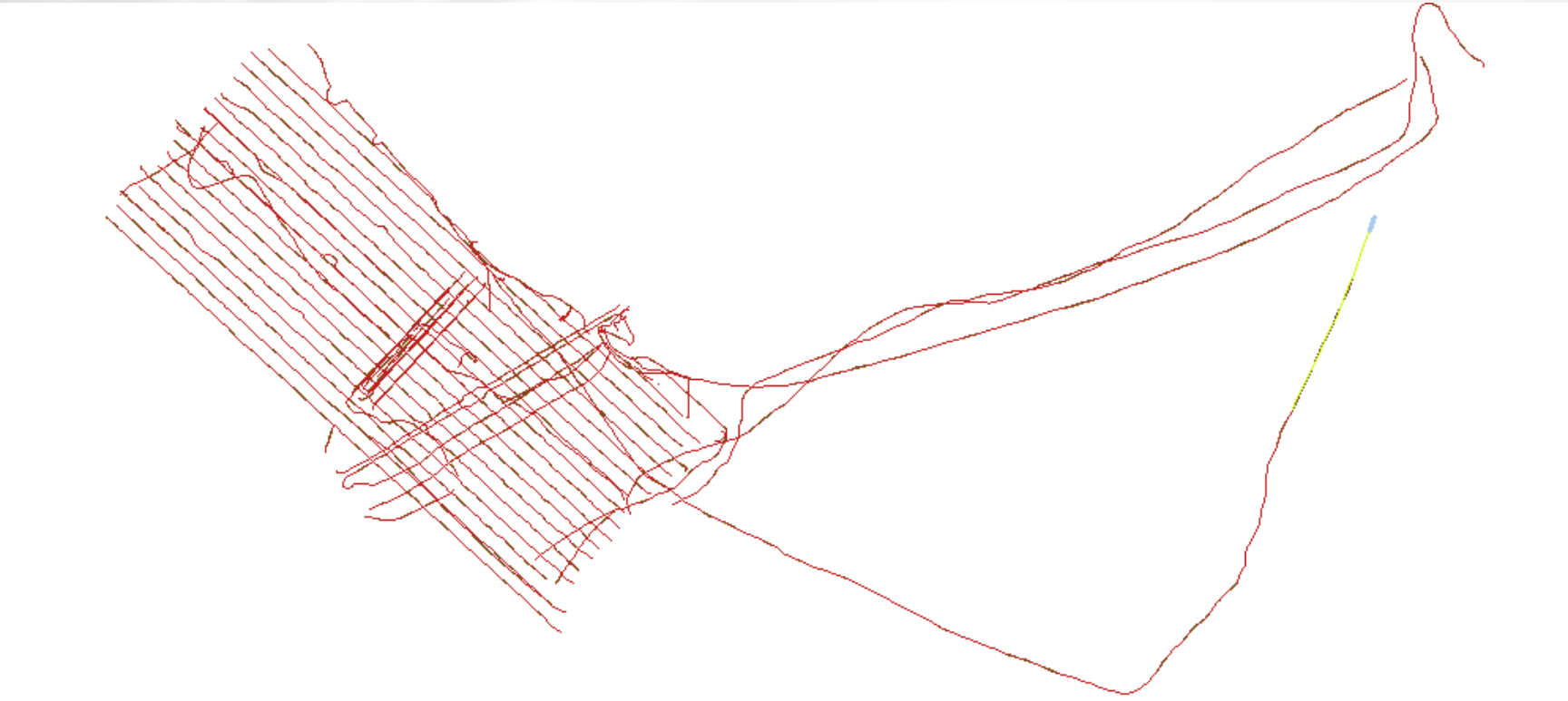
Survey Work Conducted in 2 days!

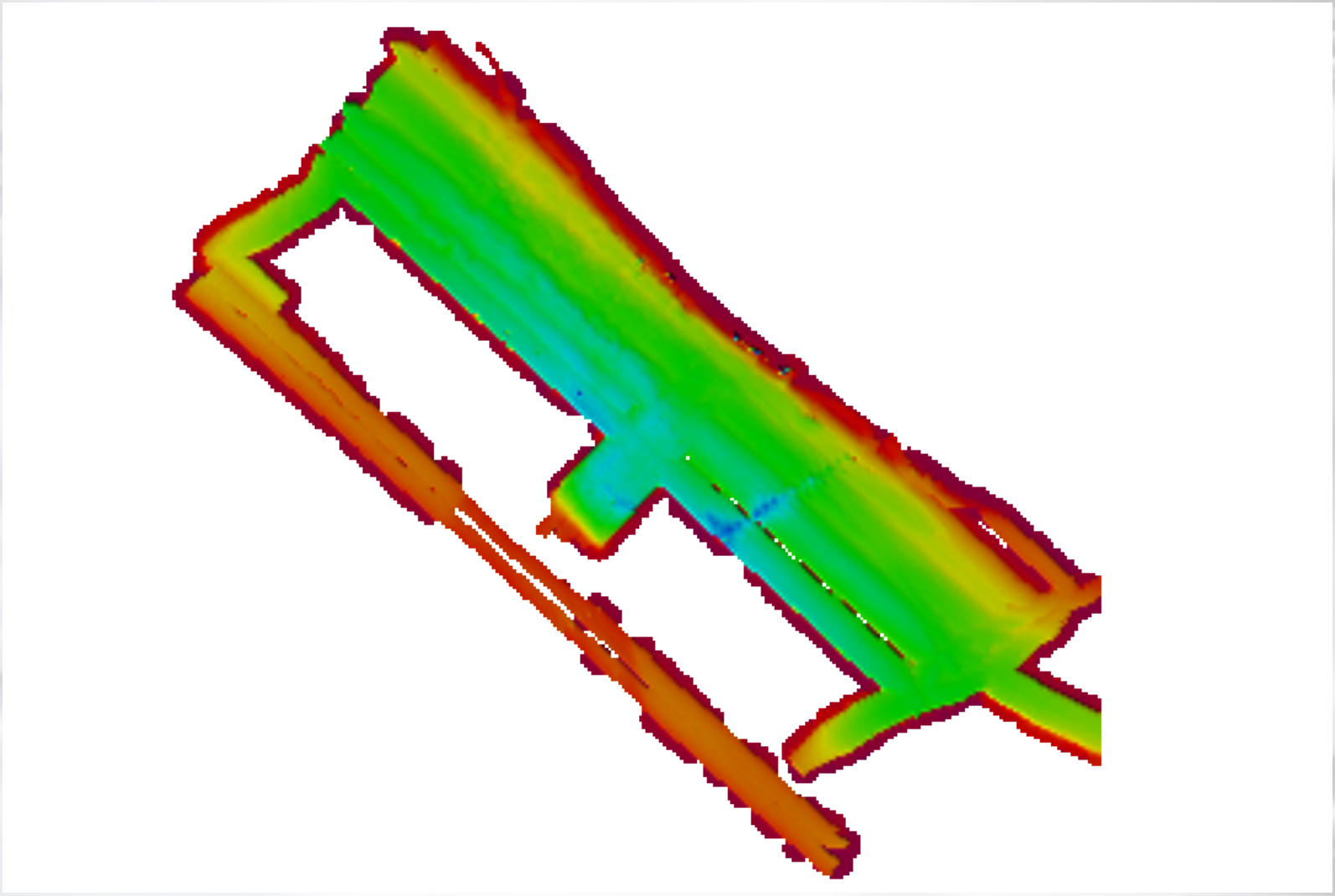
7 Hours on Day 1

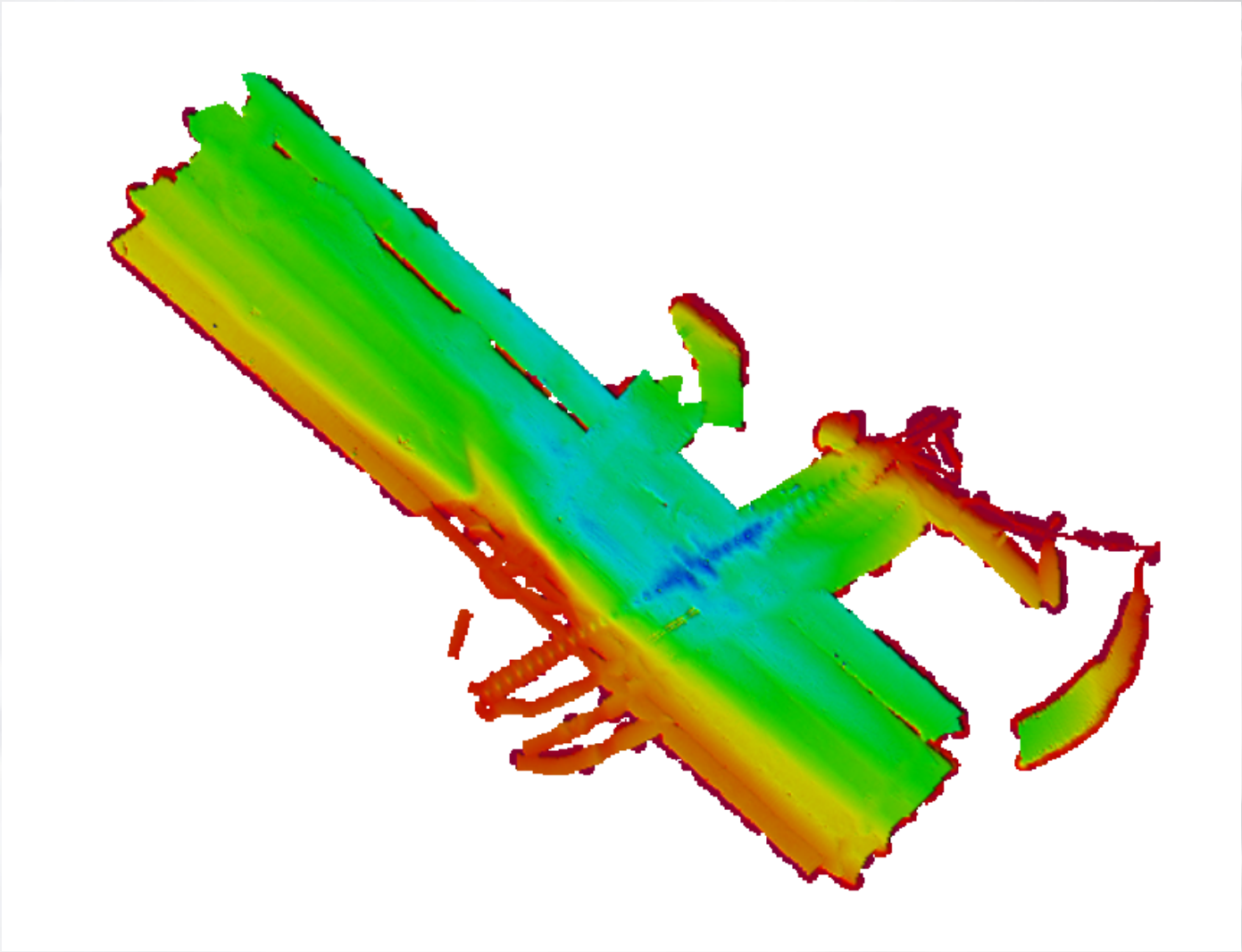
8 Hours on Day 2

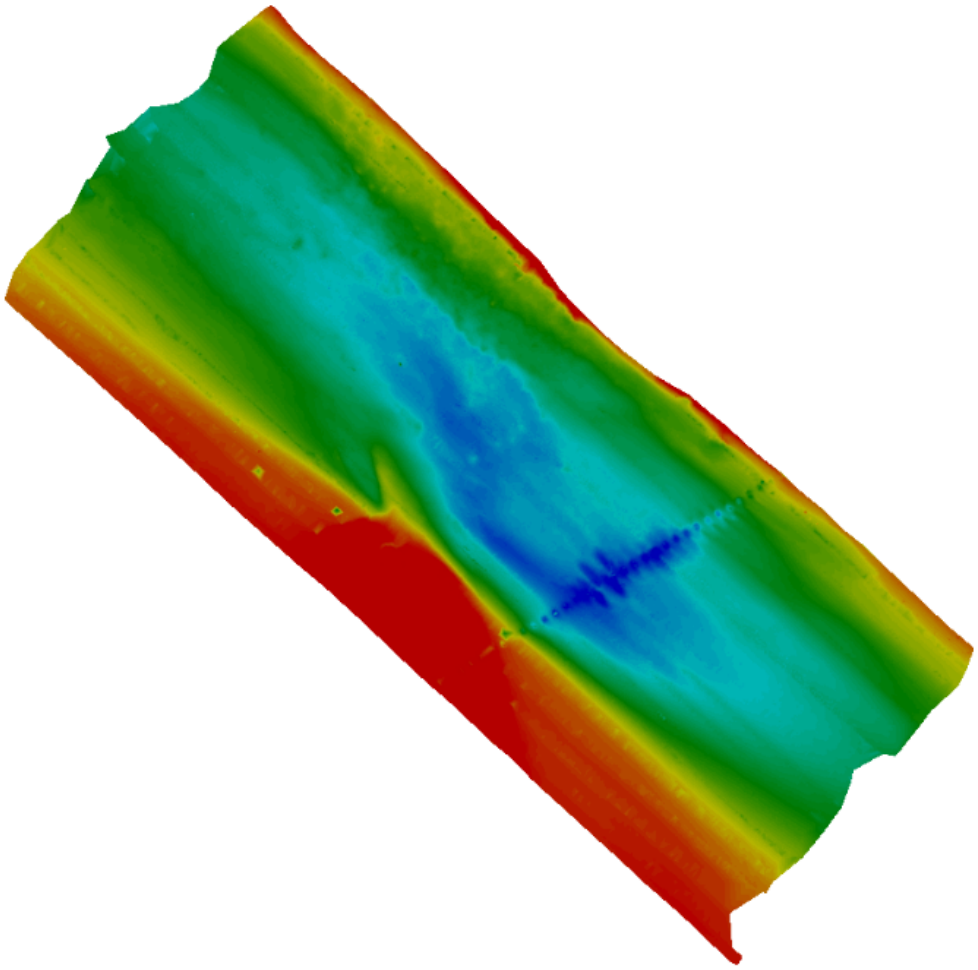
Survey Area

VERTICE	LATITUD	LONGITUD
A	18° 37' 56.23" N	091° 50' 36.74" W
B	18° 38' 14.43" N	091° 50' 22.37" W
C	18° 38' 15.98" N	091° 50' 11.75" W
D	18° 38' 01.89" N	091° 49' 57.25" W
E	18° 37' 52.84" N	091° 49' 44.50" W
F	18° 37' 50.14" N	091° 49' 26.27" W
G	18° 37' 30.73" N	091° 49' 27.93" W
H	18° 37' 23.49" N	091° 49' 59.97" W

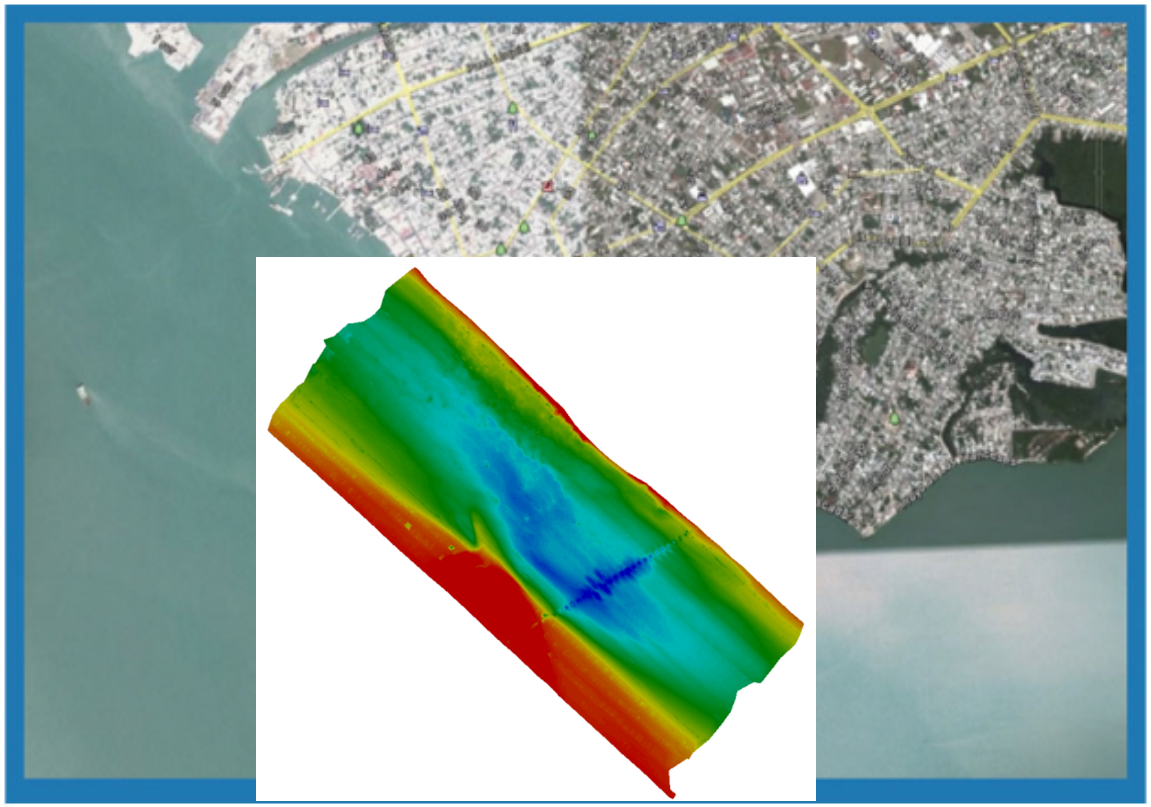








Survey Area



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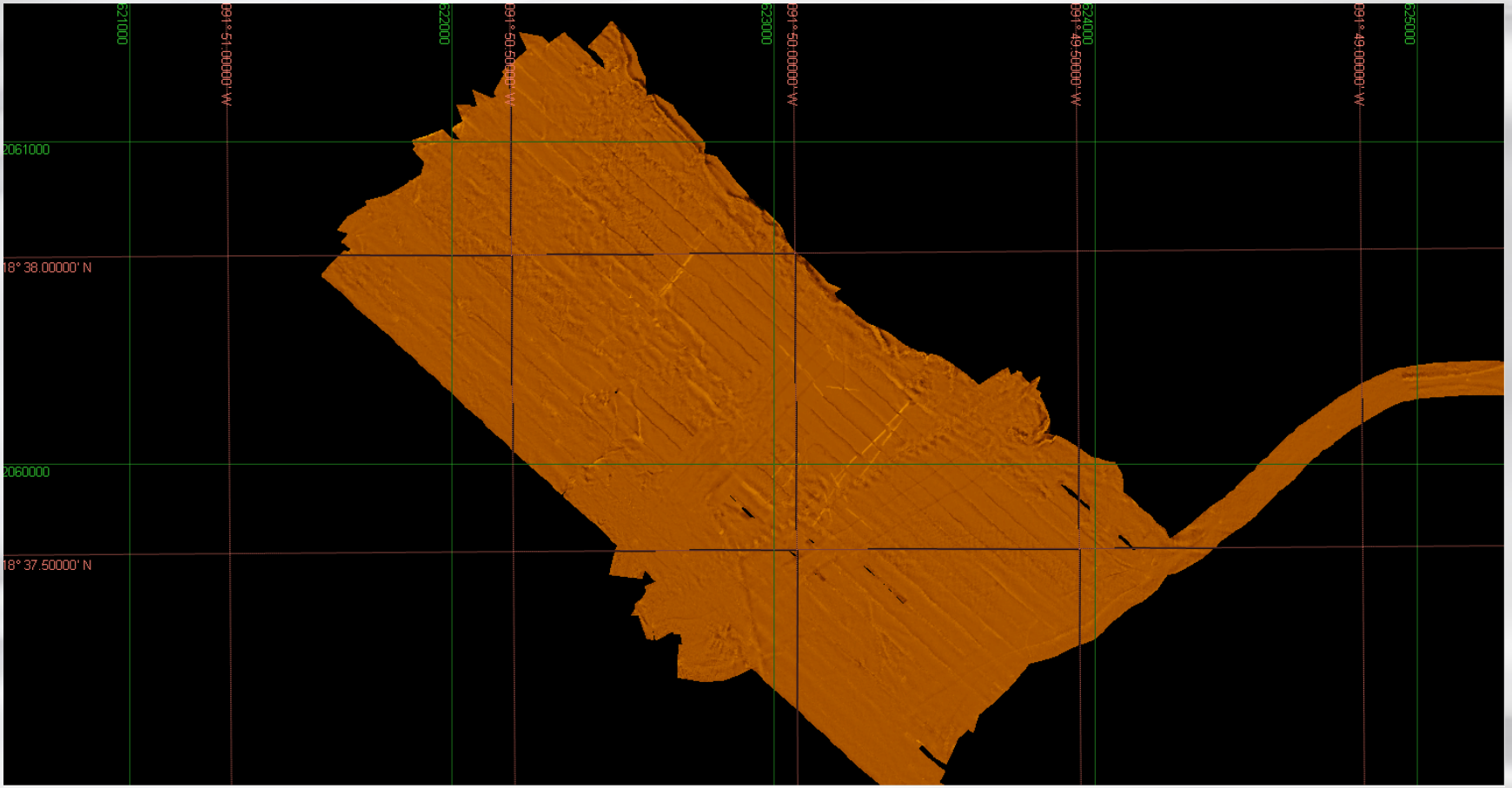
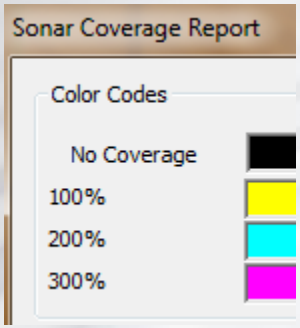
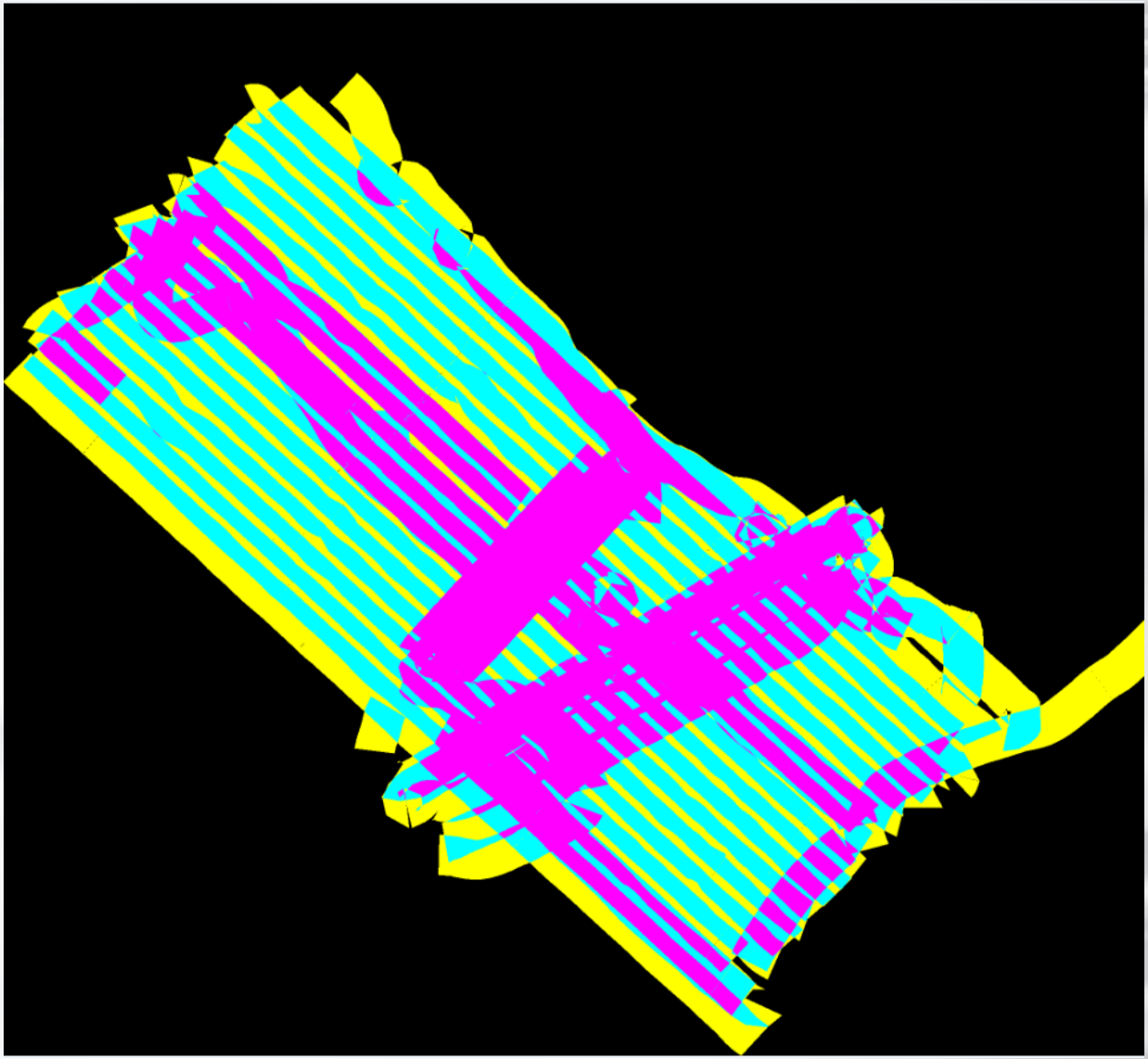
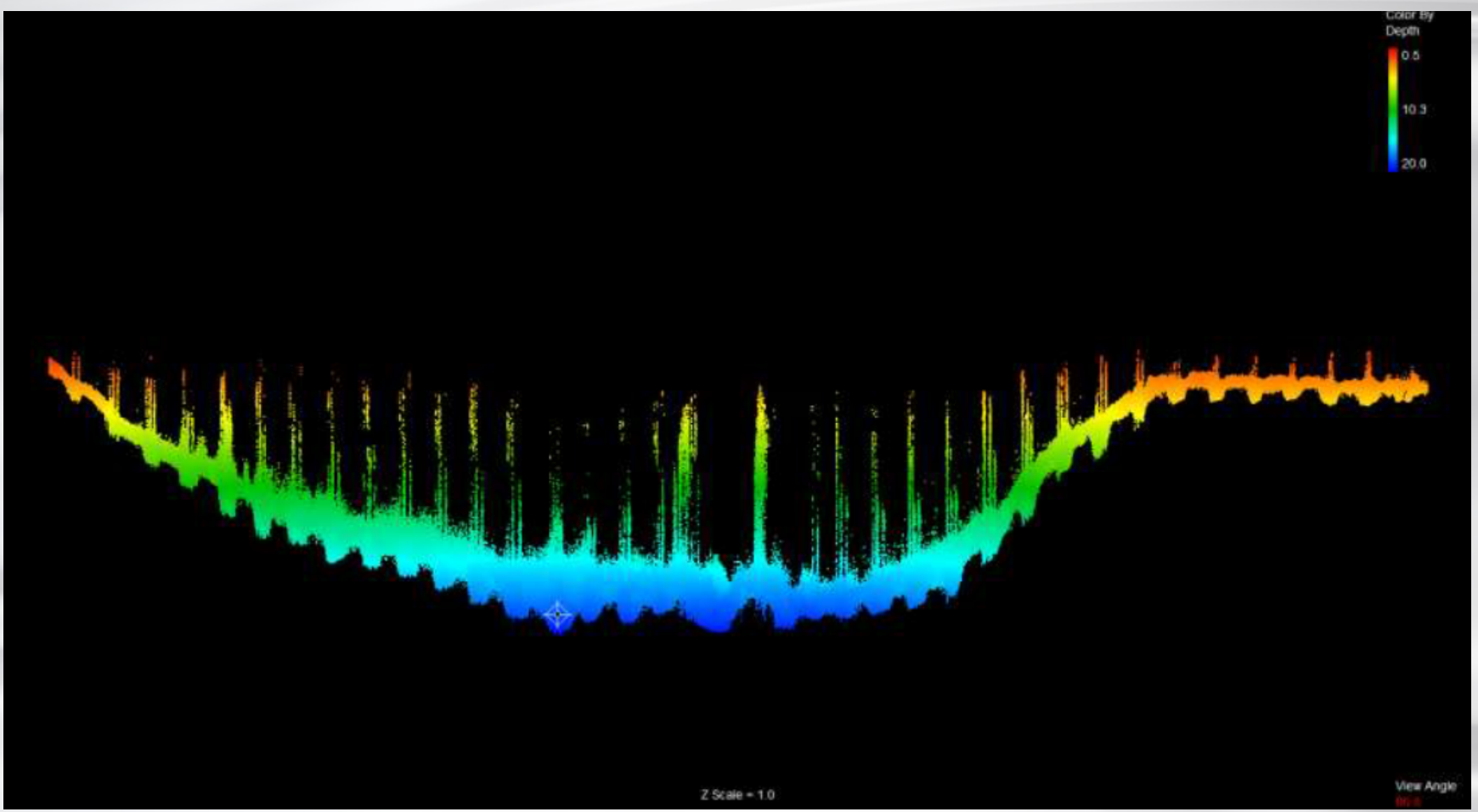

321000
091° 51.00000' W
322000
091° 50.50000' W
323000
091° 50.00000' W
324000
091° 49.50000' W
091° 49.00000' W
325000
2061000
18° 38.00000' N
2060000
18° 37.50000' N

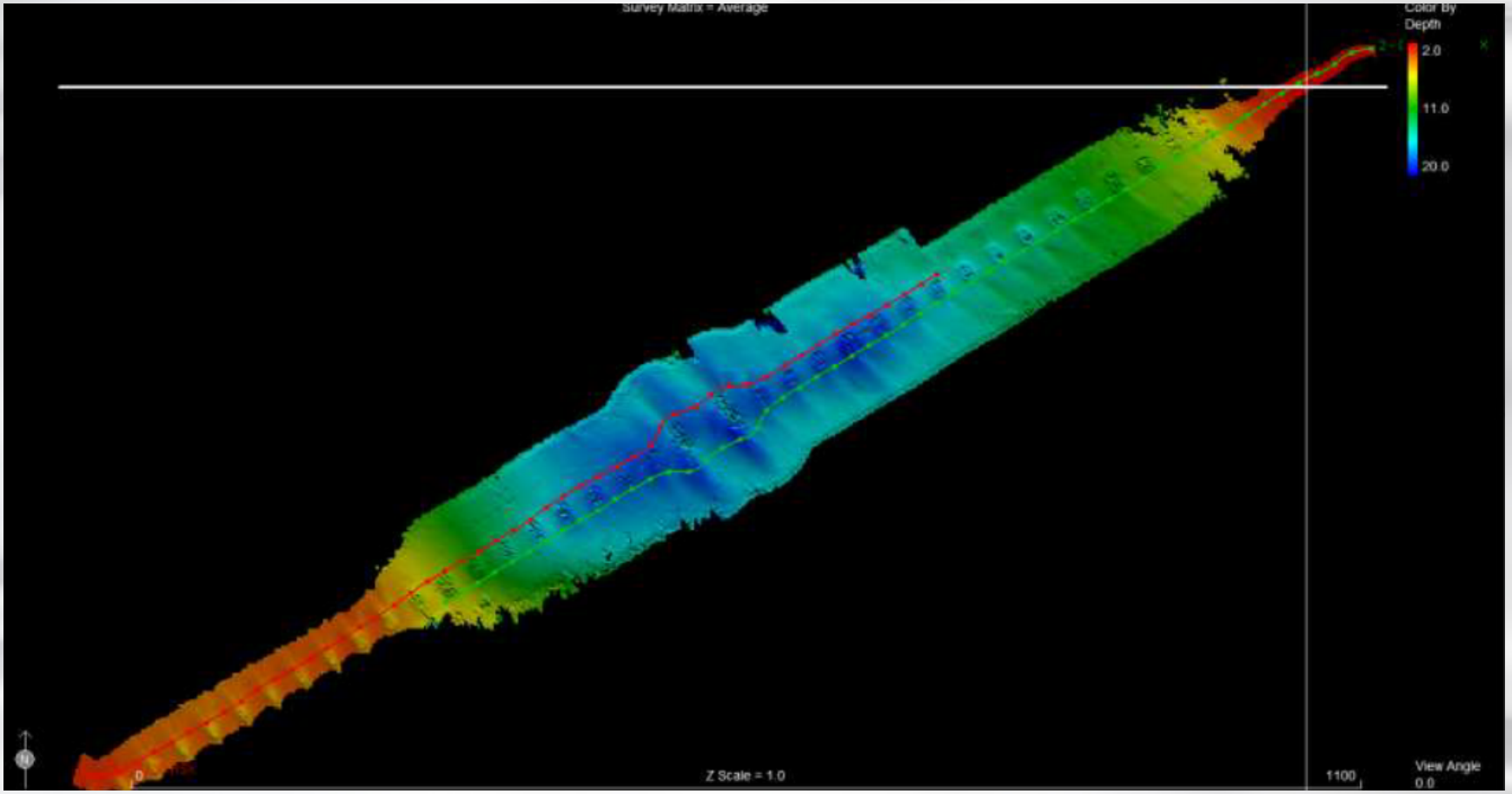
Sidescan Coverage Report



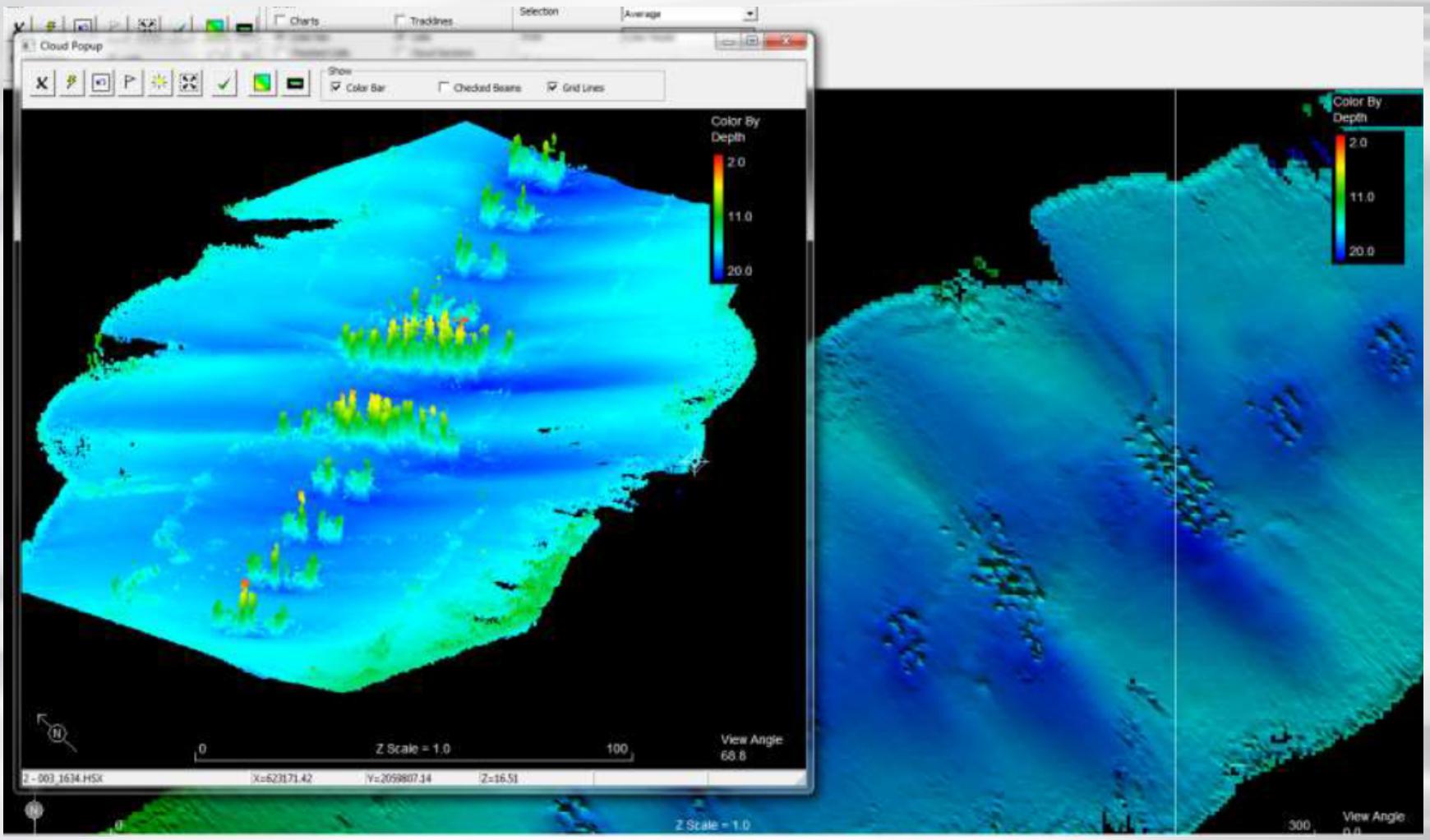


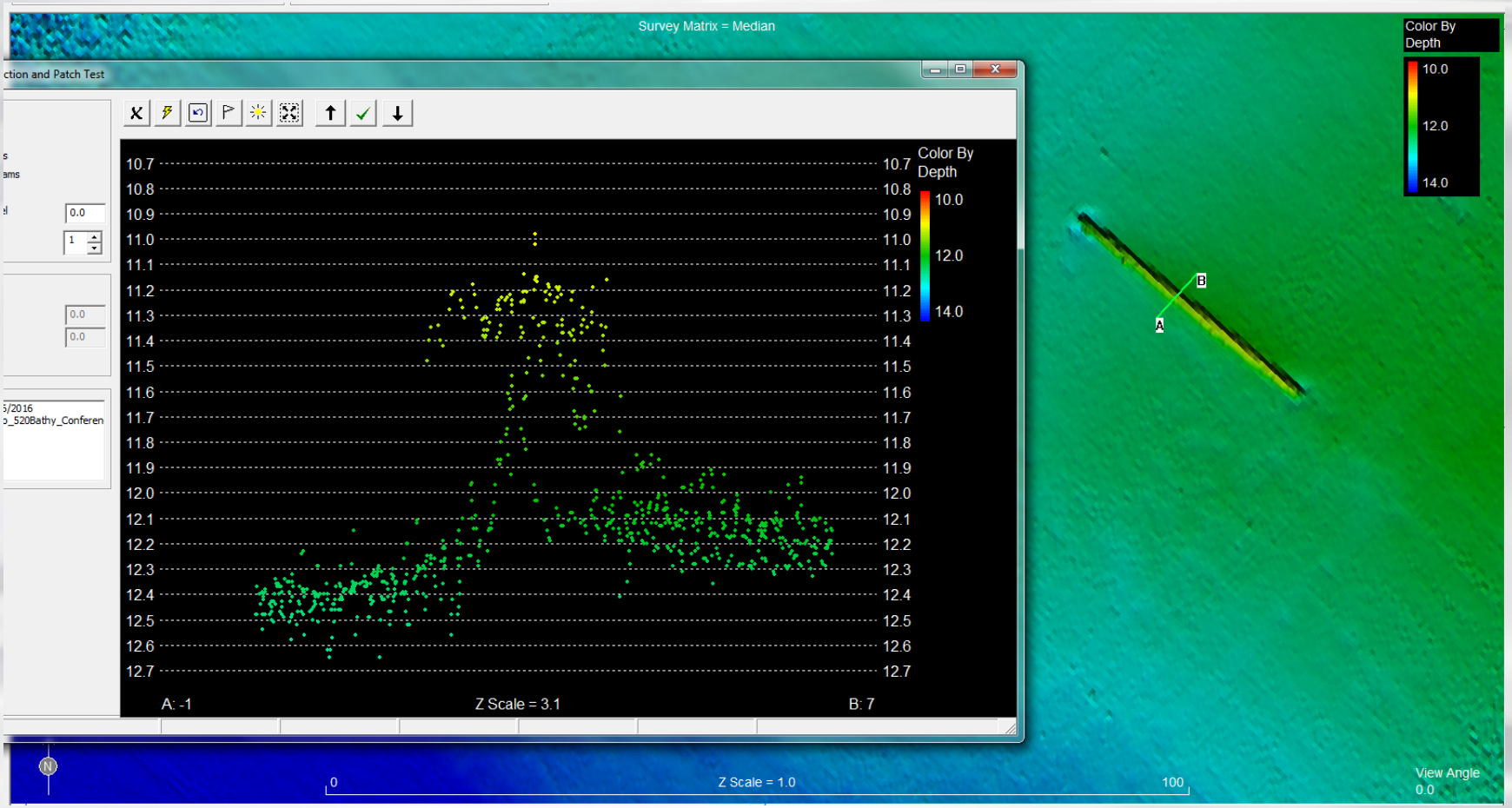

Color By
Depth
0.5
10.3
20.0
Z Scale = 1.0
View Angle

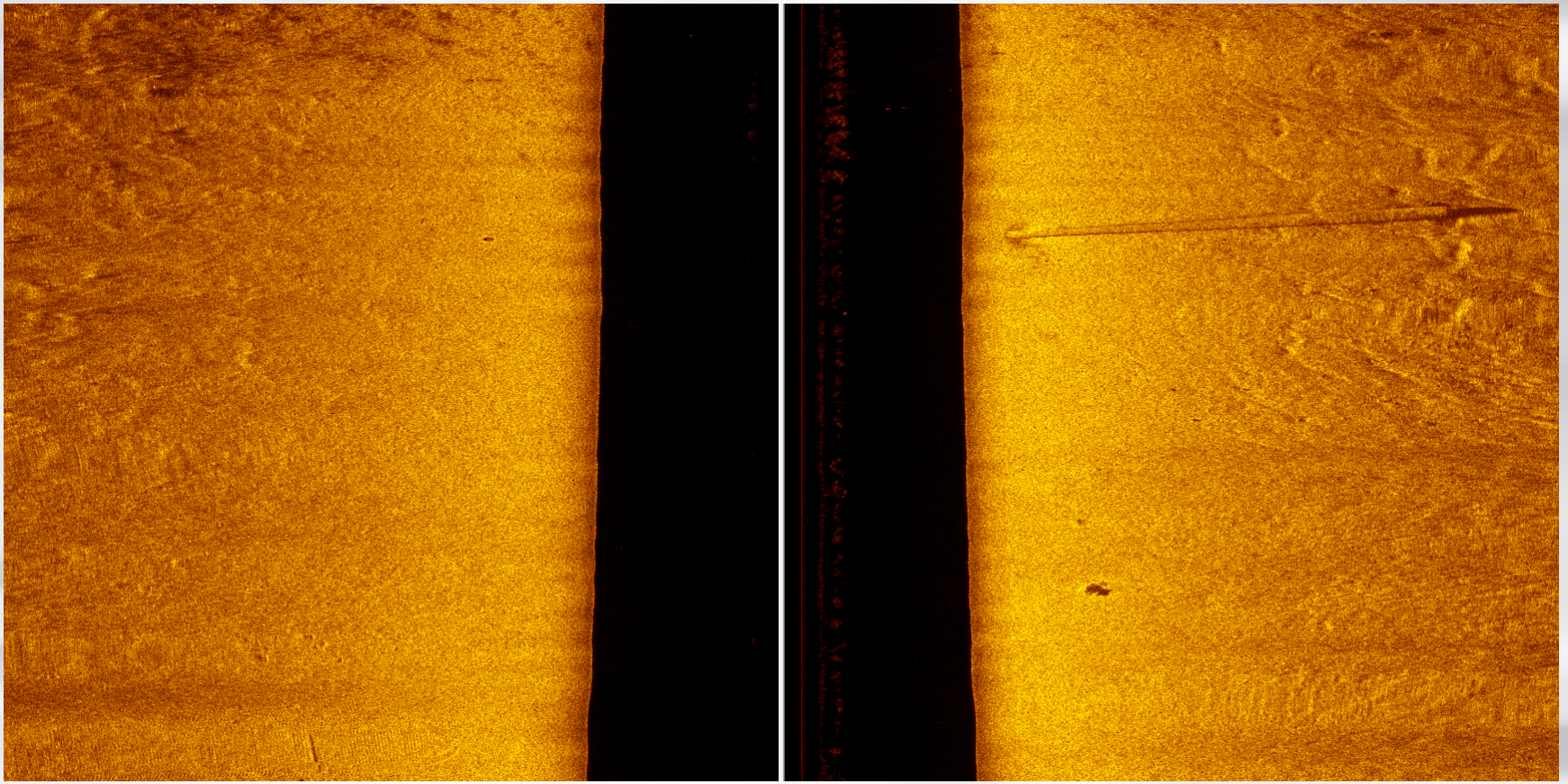
Bridge Survey (2 lines)

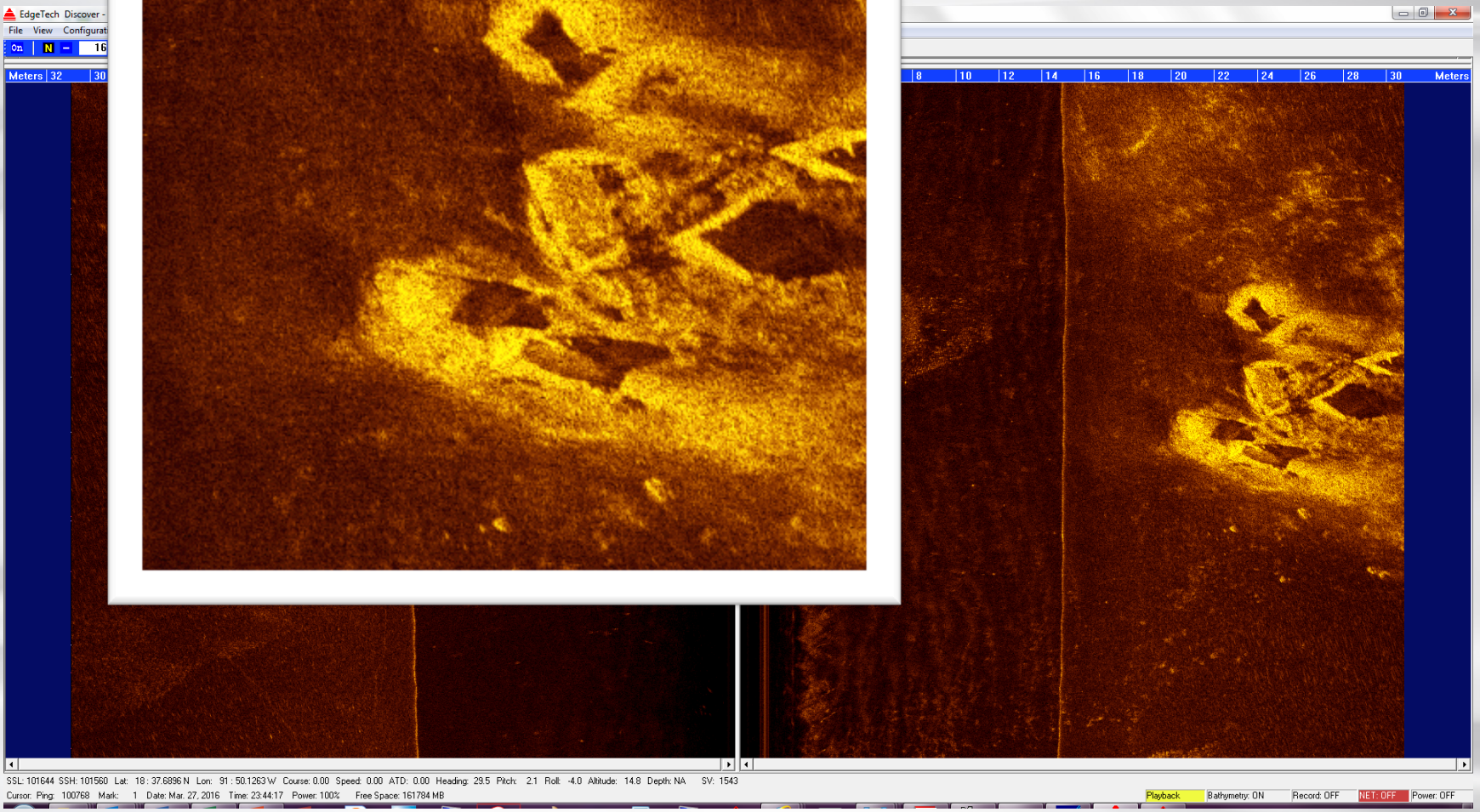


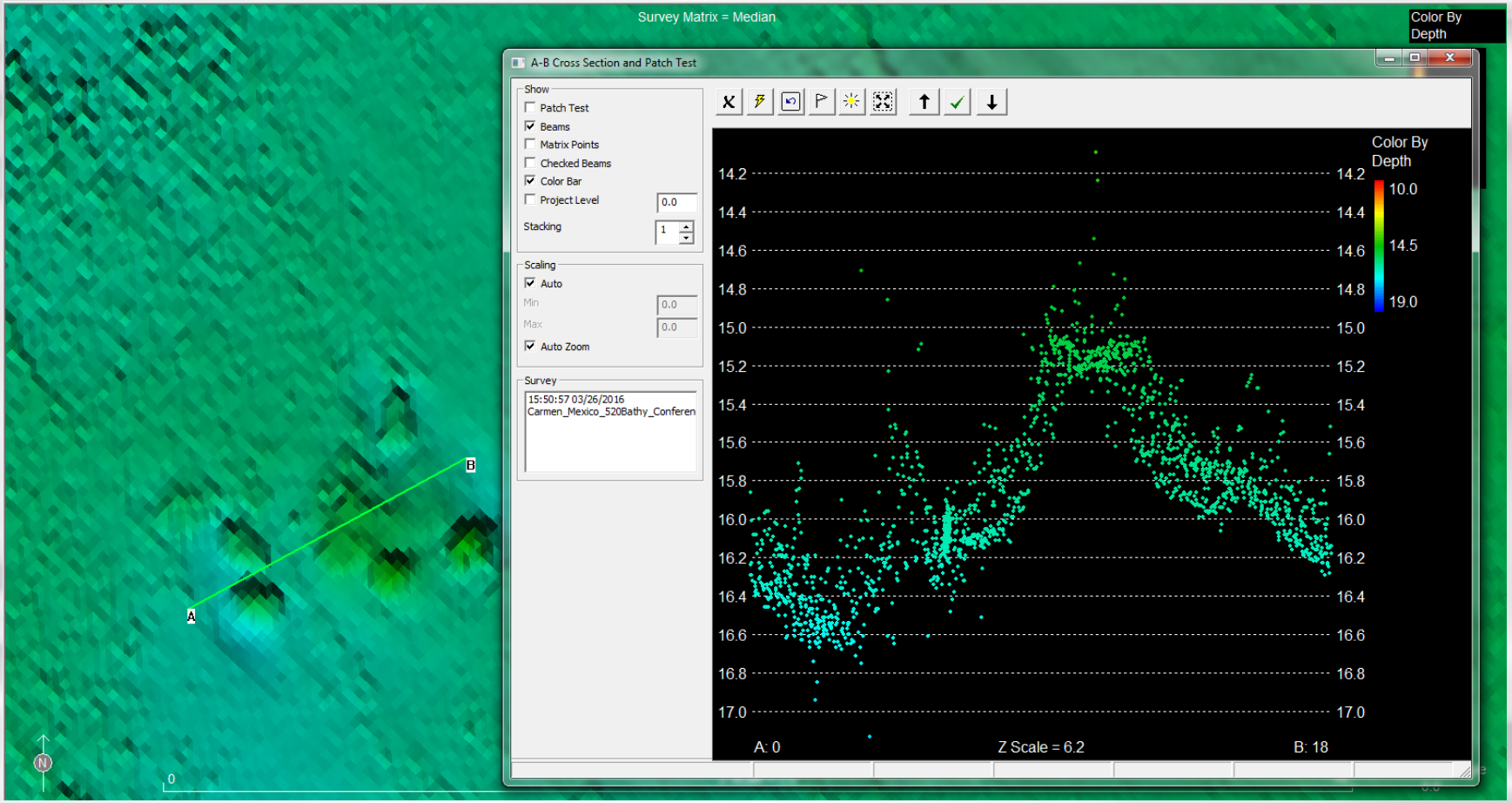
Bridge Survey (2 lines)

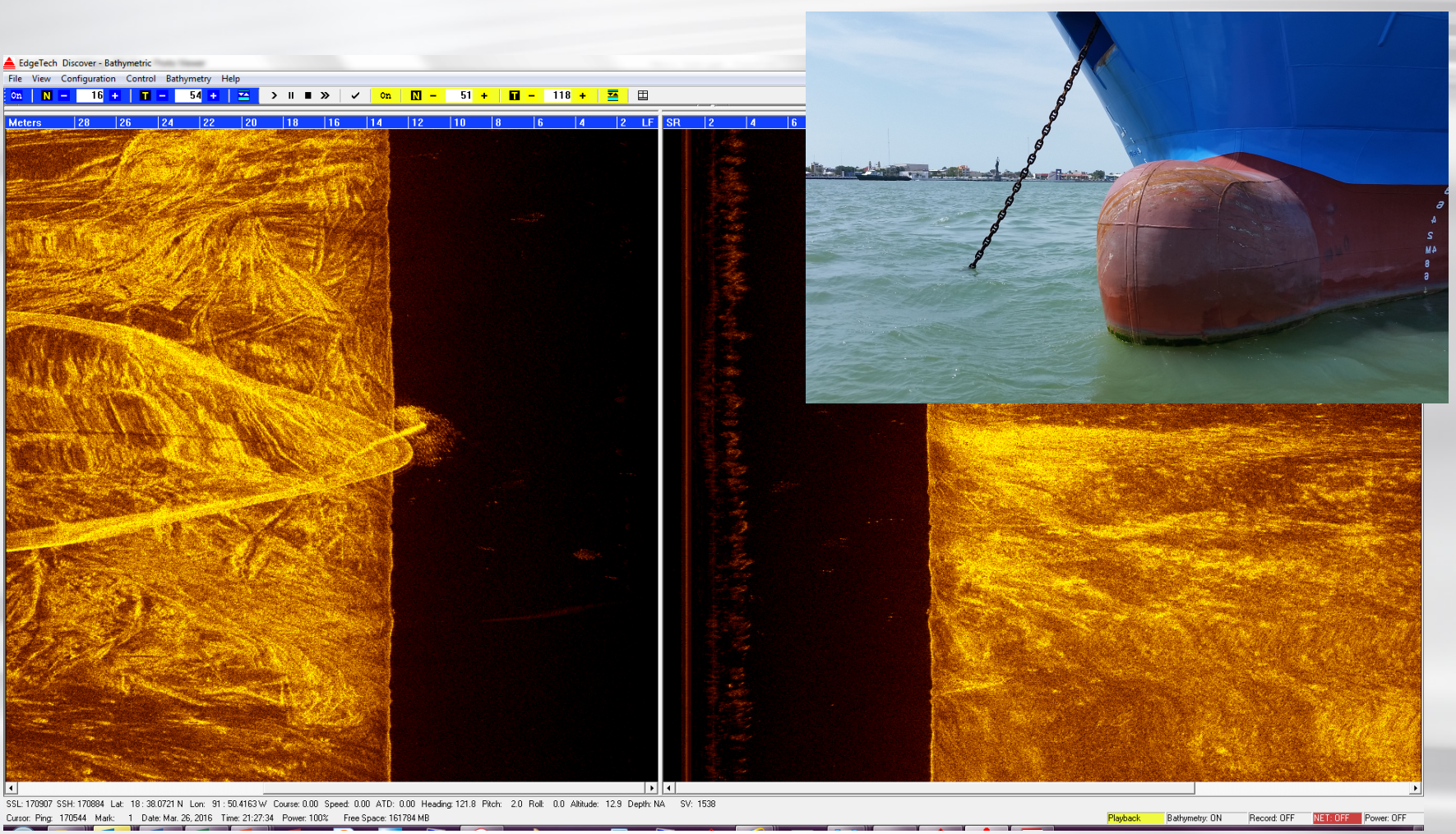



Survey Matrix = Median
ction and Patch Test
Color By Depth
10.0
12.0
14.0
10.7
10.8
10.9
11.0
11.1
11.2
11.3
11.4
11.5
11.6
11.7
11.8
11.9
12.0
12.1
12.2
12.3
12.4
12.5
12.6
12.7
A: -1
Z Scale = 3.1
B: 7
A
B
N
0
Z Scale = 1.0
100
View Angle
0.0

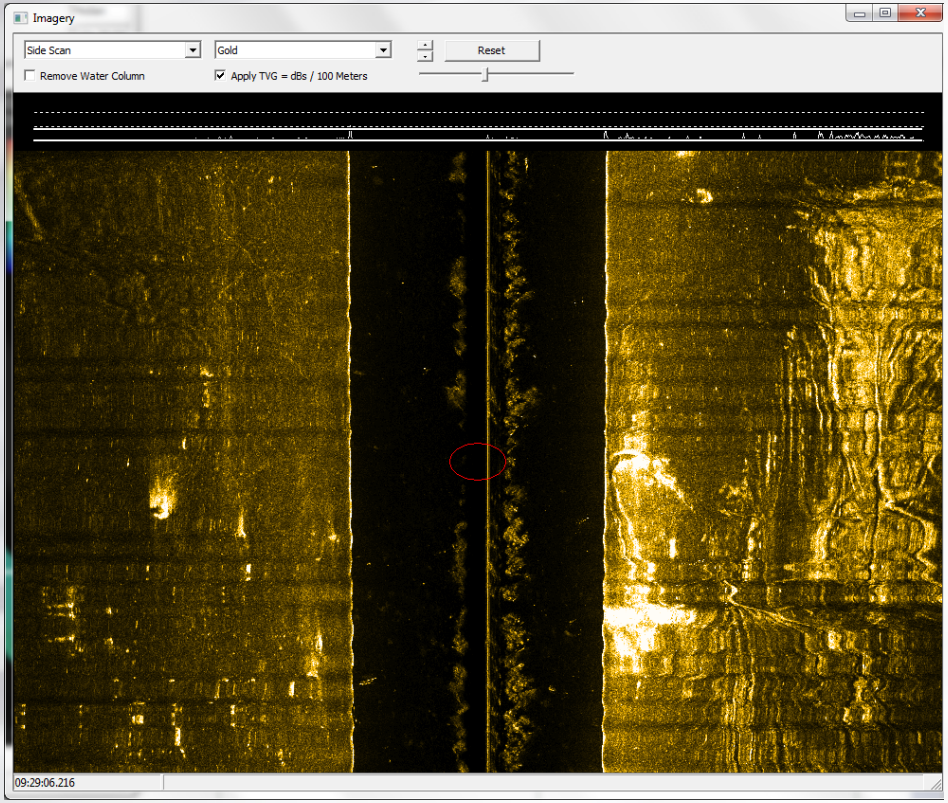


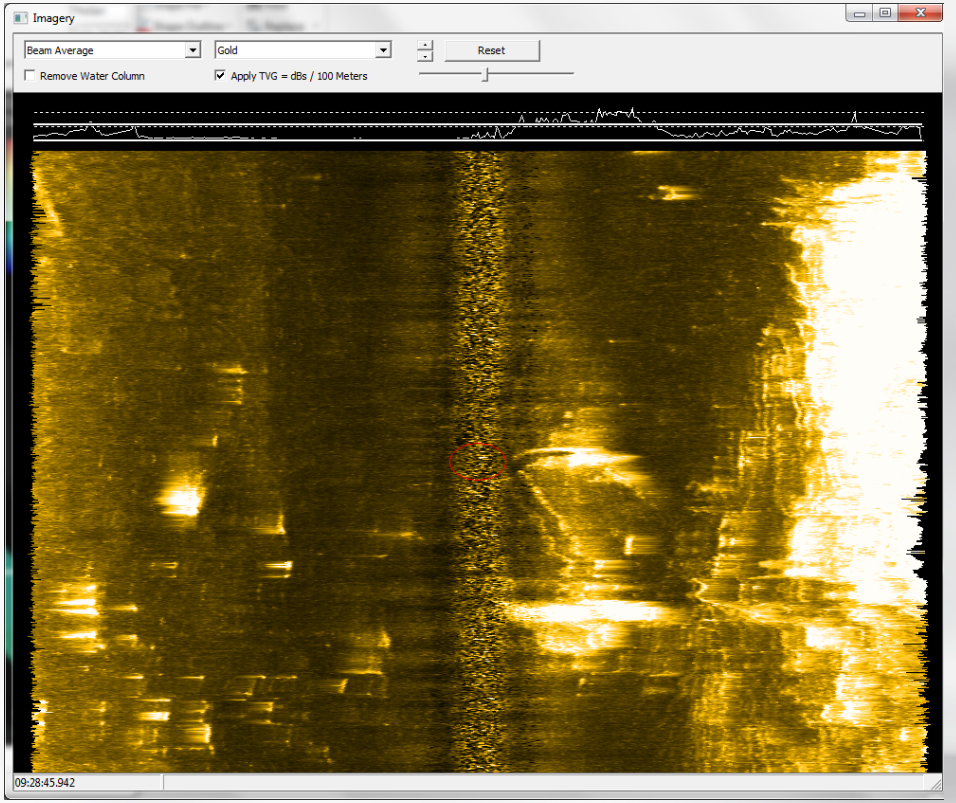

EdgeTech Discover -
File View Configurat
On
N
16
Meters 32 30
8 10 12 14 16 18 20 22 24 26 28 30 Meters
SSL: 101644 SSH: 101560 Lat: 18 : 37.6896 N Lon: 91 : 50.1263 W Course: 0.00 Speed: 0.00 ATD: 0.00 Heading: 29.5 Pitch: 2.1 Roll: -4.0 Altitude: 14.8 Depth: NA SV: 1543
Cursor: Ping: 100768 Mark: 1 Date: Mar. 27, 2016 Time: 23:44:17 Power: 100% Free Space: 161784 MB
Playback
Bathymetry: ON
Record: OFF
NET: OFF
Power: OFF

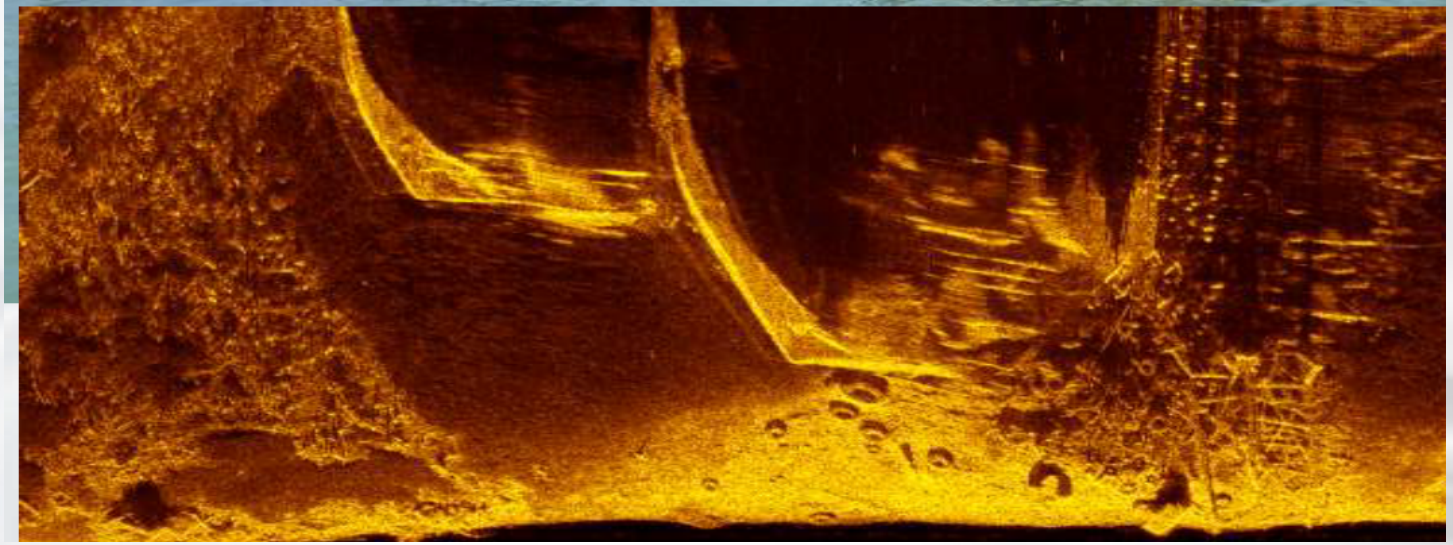

Survey Matrix = Median
Color By Depth
A-B Cross Section and Patch Test
Show
Patch Test
Beams
Matrix Points
Checked Beams
Color Bar
Project Level
0.0
Stacking
1
Scaling
Auto
Min
0.0
Max
0.0
Auto Zoom
Survey
15:50:57 03/26/2016
Carmen_Mexico_520Bathy_Conferen
Color By Depth
10.0
14.5
19.0
14.2
14.4
14.6
14.8
15.0
15.2
15.4
15.6
15.8
16.0
16.2
16.4
16.6
16.8
17.0
A: 0
Z Scale = 6.2
B: 18
A
B
N
0


EdgeTech Discover - Bathymetric
File View Configuration Control Bathymetry Help
Meters
SR
SSL: 170907 SSH: 170884 Lat: 18 : 38.0721 N Lon: 91 : 50.4163 W Course: 0.00 Speed: 0.00 ATD: 0.00 Heading: 121.8 Pitch: 2.0 Roll: 0.0 Altitude: 12.9 Depth: NA SV: 1538
Cursor: Ping: 170544 Mark: 1 Date: Mar. 26, 2016 Time: 21:27:34 Power: 100% Free Space: 161784 MB
Playback
Bathymetry: ON
Record: OFF
NET: OFF
Power: OFF

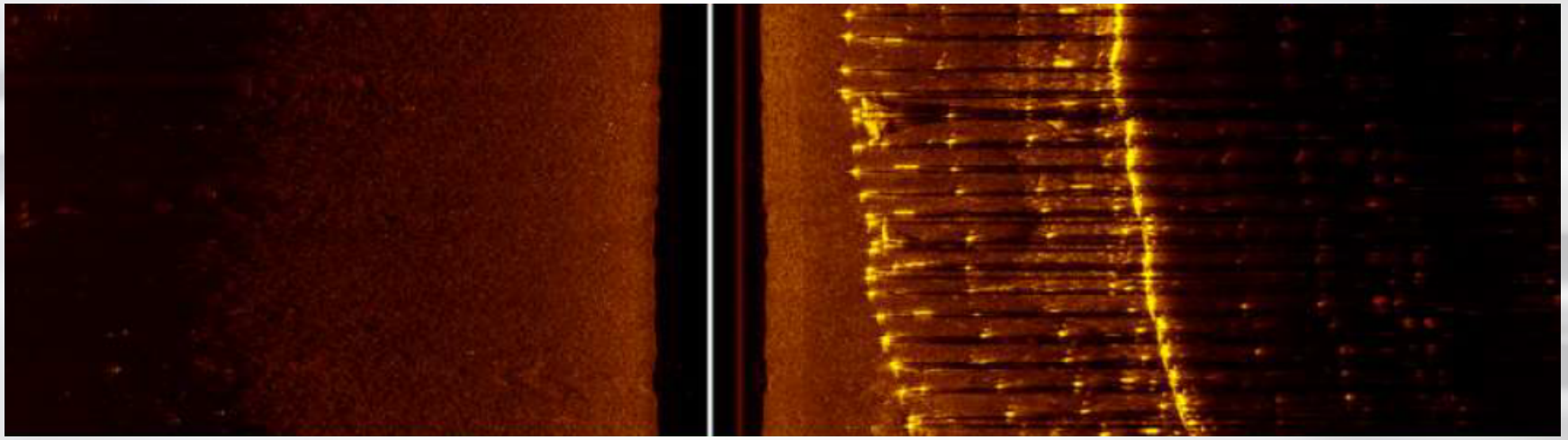
Motion Compensation (Beam Average)







EdgeTech



Description of Survey Process

Description of Survey Process

6205 Frequency Options

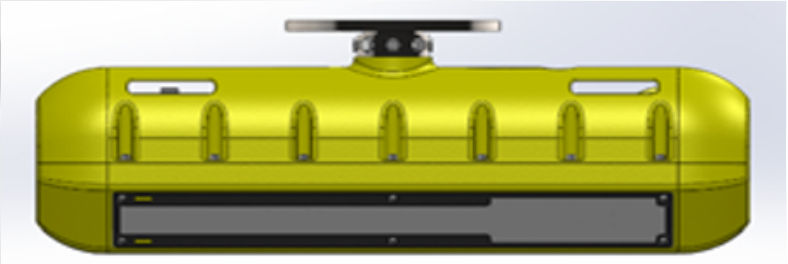
- The 6205 is available in three standard frequency options:

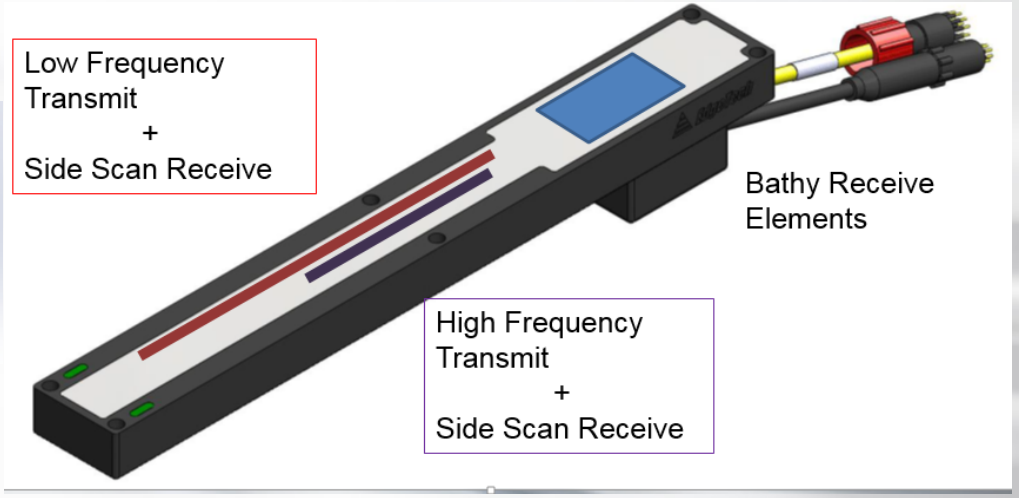
– 230 kHz Bathymetry : to 225m depth below transducers
With 230 & 550 kHz Dual Frequency Side Scan

– 550 kHz Bathymetry :to 120m depth
With 230 & 550 kHz Dual Frequency Side Scan

– 550 kHz Bathymetry :to 120m depth
With 550 & 1600 kHz Dual Frequency Side Scan

Also available: Exchangeable arrays.

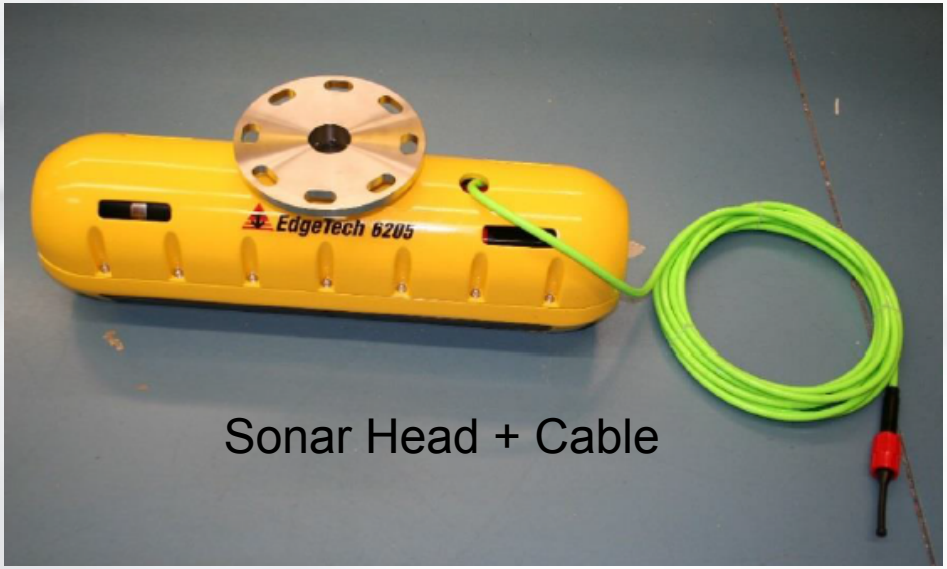




6205 components

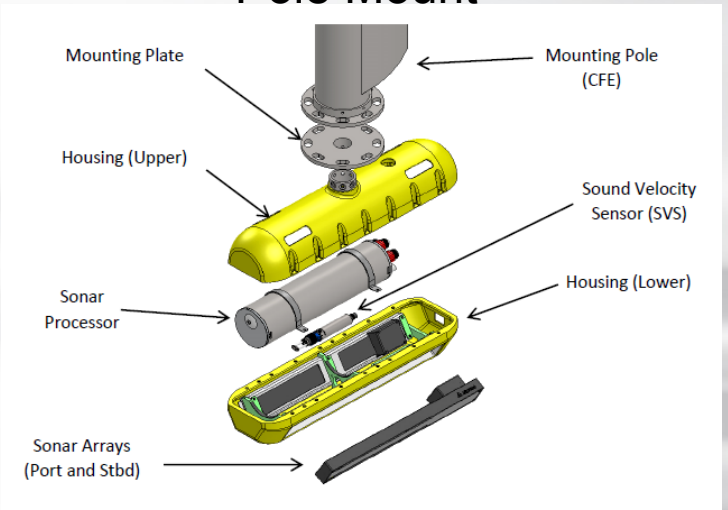
+ Ancillaries:
- Position
- Motion
- Heading
- Sound Velocity Profile

Topside: Portable or Rackmount
+ Laptop or customer PC
+ Acquisition Software



Sonar Head + Cable

+ Pole Mount



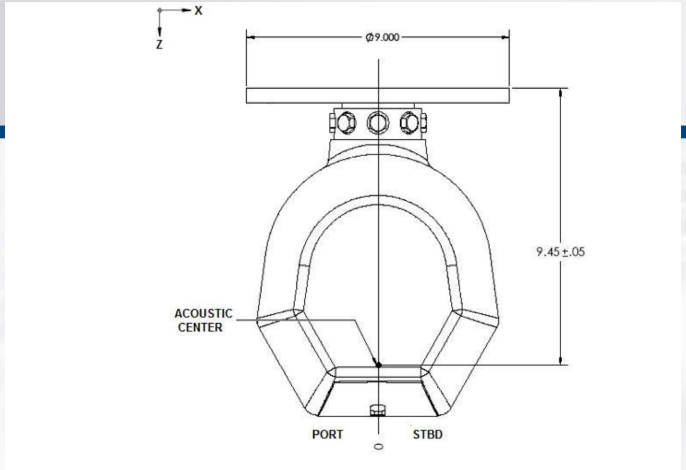
Inertial Navigation Unit

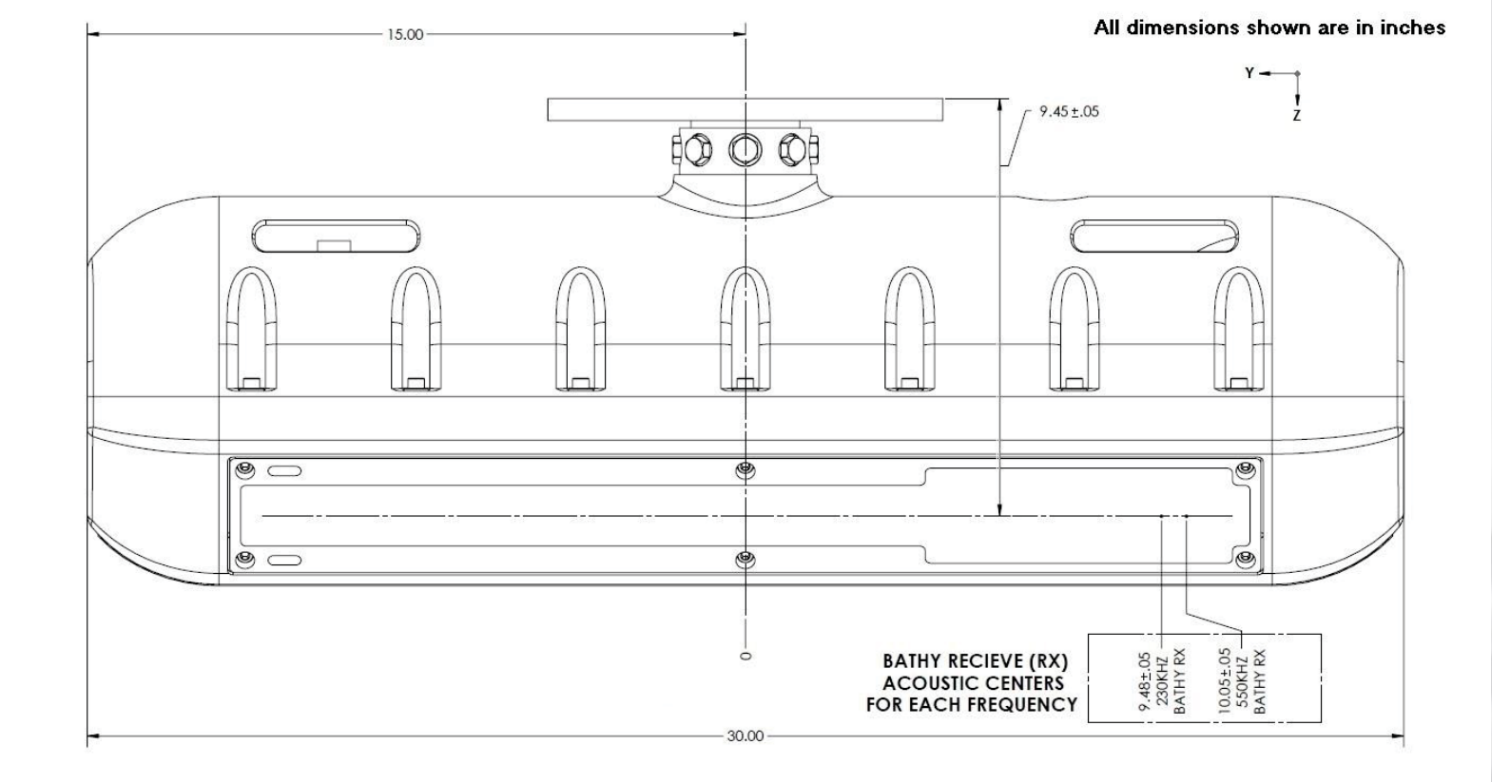
Radio Modem


ARMADA DE MÉXICO
ESTACIÓN NAVAL
DE BUSQUEDA
Y RESCATE
EMERGENCIAS
VHF CANAL 16


Handheld Player
4172106

GeoSurvey Mexicana Vessel


X
Z
Ø9.000
9.45±.05
ACOUSTIC
CENTER
PORT
STBD


All dimensions shown are in inches
15.00
Y
Z
9.45±.05
BATHY RECIEVE (RX)
ACOUSTIC CENTERS
FOR EACH FREQUENCY
9.48±.05
230KHZ
BATHY RX
10.05±.05
550KHZ
BATHY RX
30.00

Sound Velocity Profiler

Teledyne Odom Hydrographic

Digibar Pro

Profiling Sound Velocimeter

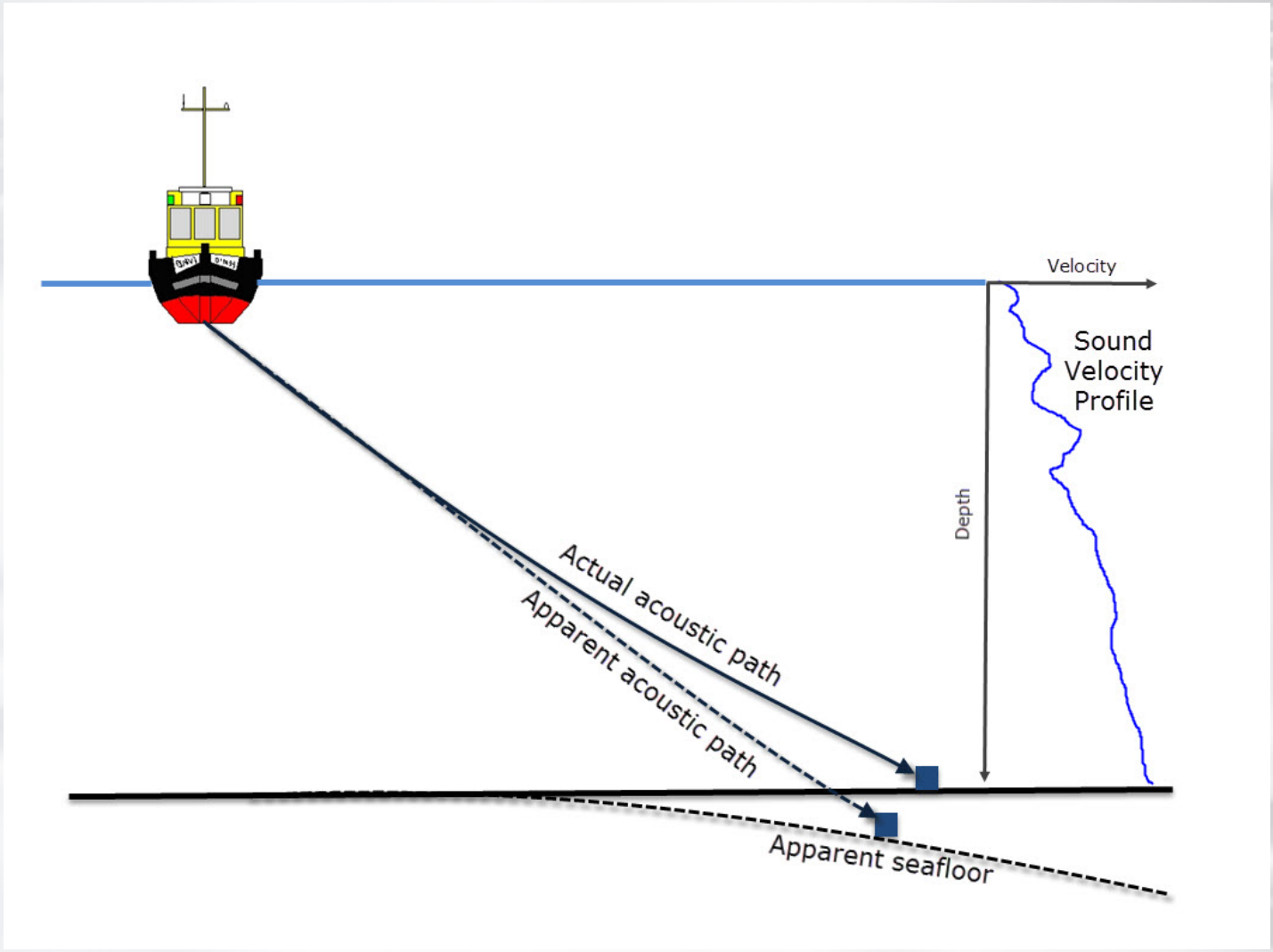
For Seafloor and Riverbed Surveys

The Digibar Pro is the most cost-efficient and accurate means of determining water column sound velocities. It quickly calibrates acoustic systems regardless of sea state or current and is faster and safer than the traditional bar check method.

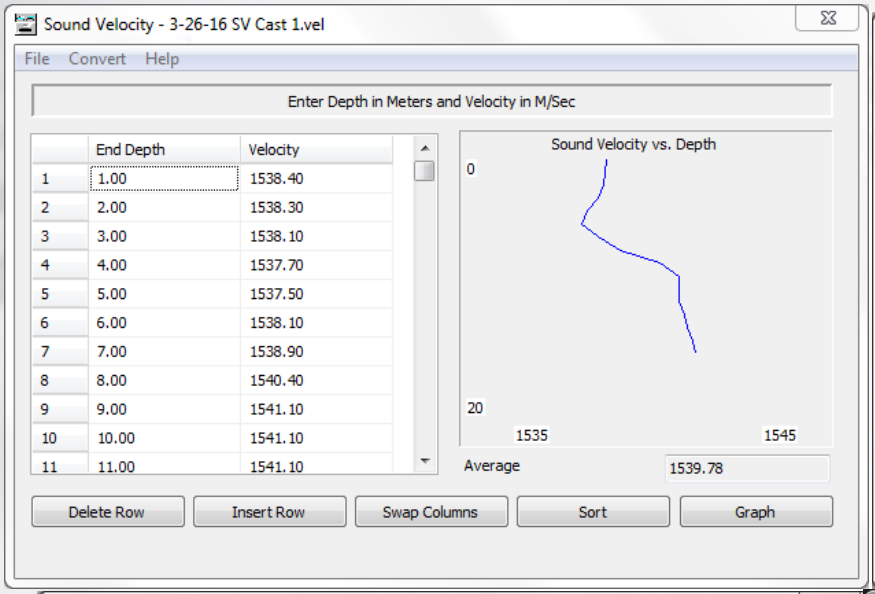
Digibar Pro uses "sing-around" technology, which automatically compensates for all factors influencing sound velocity, including salinity, depth, and temperature.

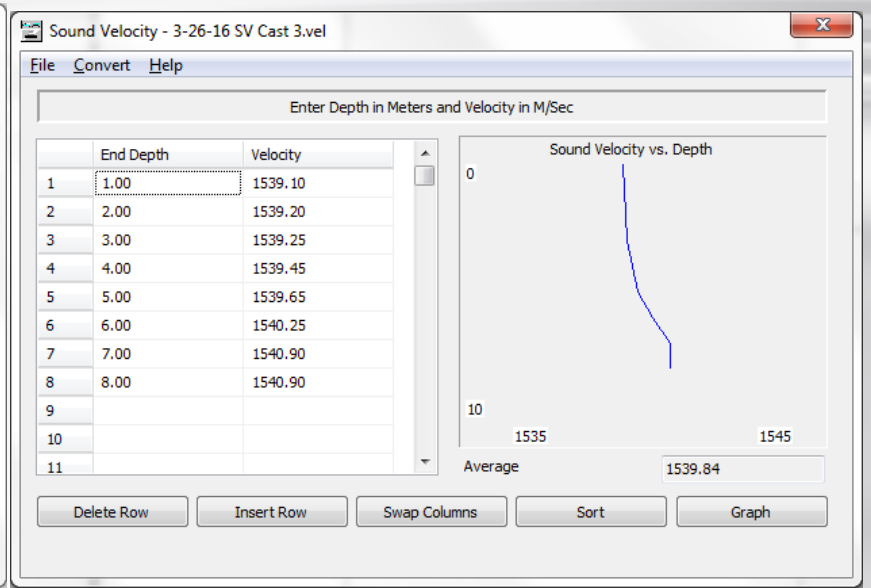
PRODUCT FEATURES

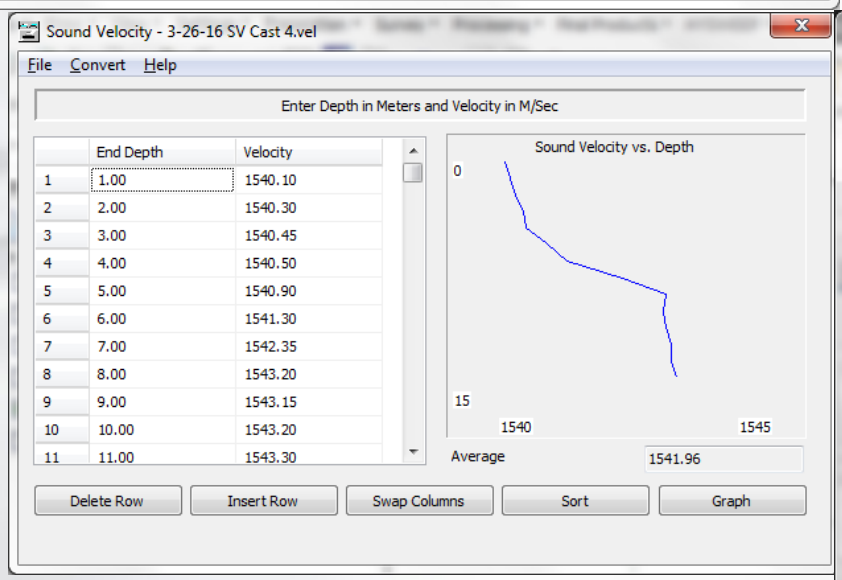
- Velocity profiles downloaded to a computer
- Handheld display/logger with computer interface
- Battery operated
- Detachable cable (in lengths up to 100 meters)
- Sampling by depth or time
- Stainless steel probe
- Waterproof
- Lightweight
- Portable
- Optional transit cases
- Optional Cable Reel
- Optional Kellems grip

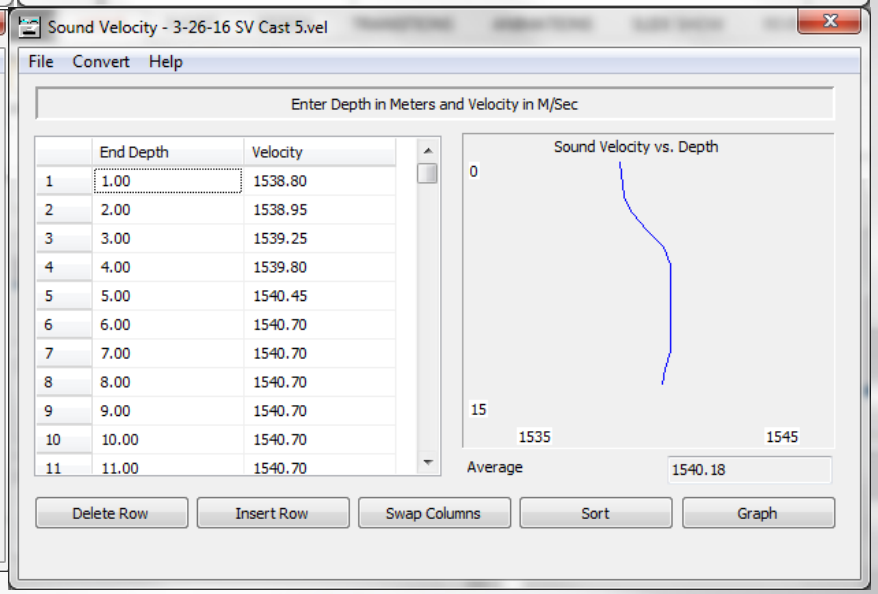

Velocity
Sound
Velocity
Profile
Depth
Actual acoustic path
Apparent acoustic path
Apparent seafloor

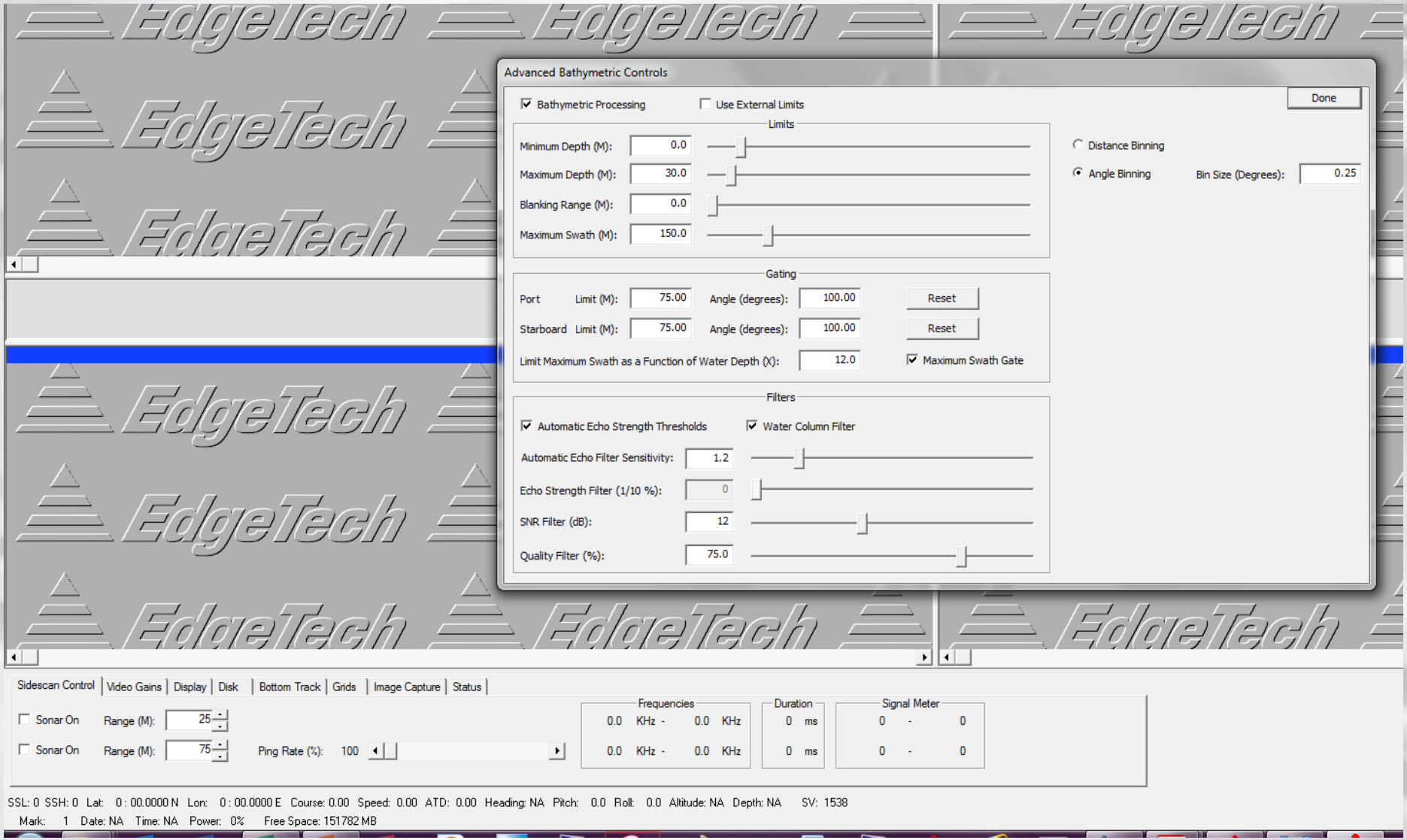
Sound Velocity Casts Day 1

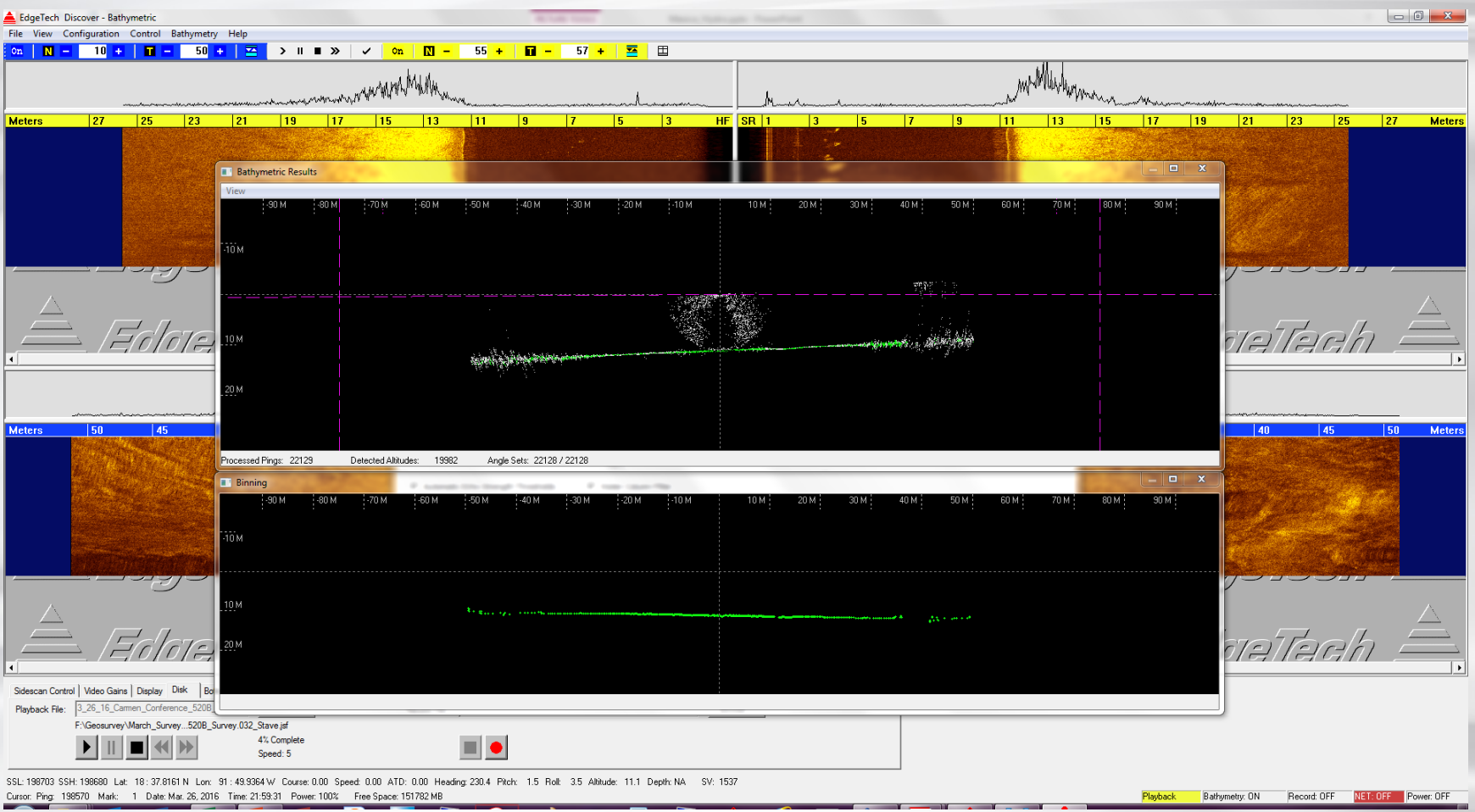






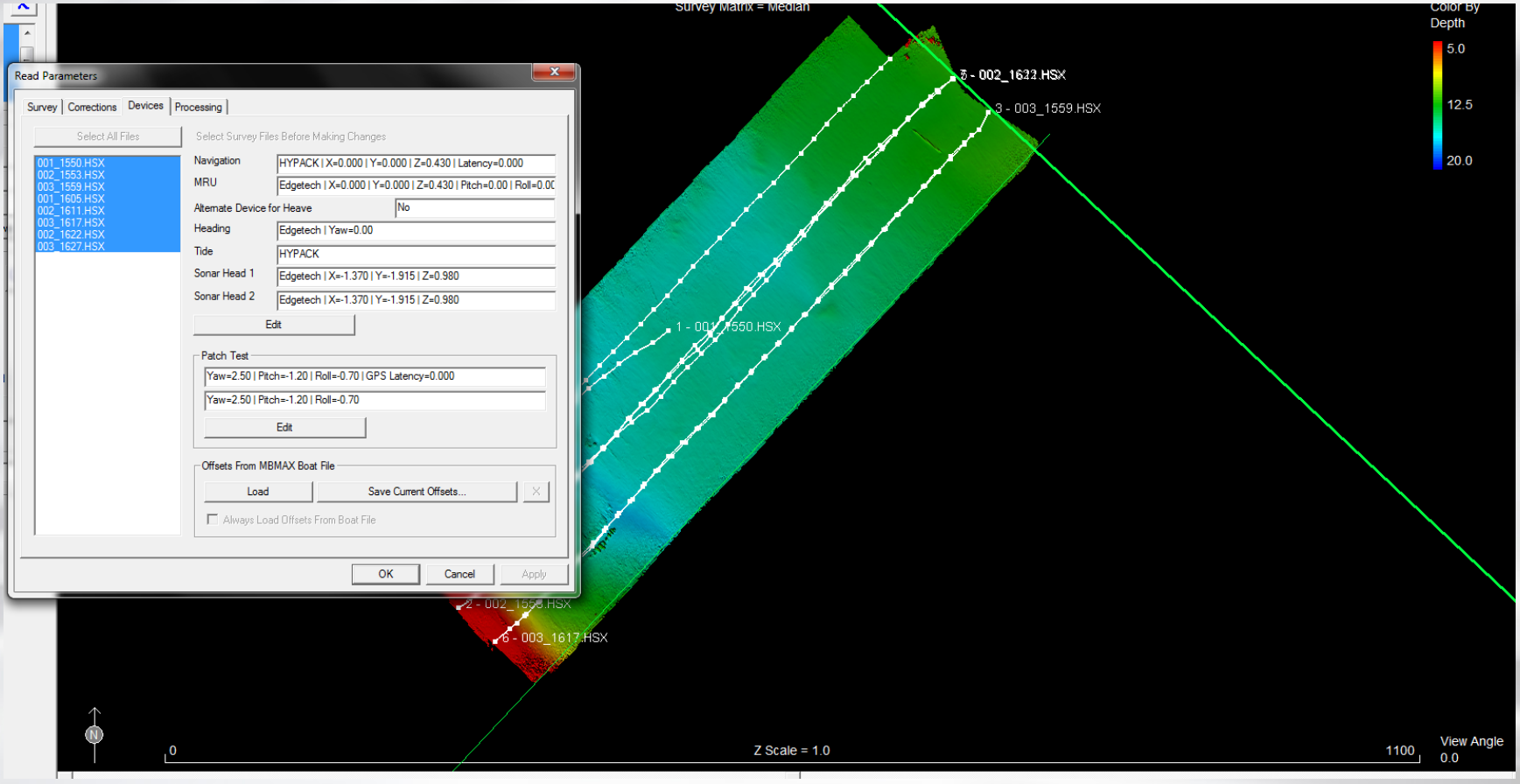



Advanced Bathymetric Controls
Done
Bathymetric Processing
Use External Limits
Limits
Minimum Depth (M): 0.0
Maximum Depth (M): 30.0
Blanking Range (M): 0.0
Maximum Swath (M): 150.0
Distance Binning
Angle Binning
Bin Size (Degrees): 0.25
Gating
Port Limit (M): 75.00
Angle (degrees): 100.00
Reset
Starboard Limit (M): 75.00
Angle (degrees): 100.00
Reset
Limit Maximum Swath as a Function of Water Depth (X): 12.0
Maximum Swath Gate
Filters
Automatic Echo Strength Thresholds
Water Column Filter
Automatic Echo Filter Sensitivity: 1.2
Echo Strength Filter (1/10 %): 0
SNR Filter (dB): 12
Quality Filter (%): 75.0
Sidescan Control
Video Gains
Display
Disk
Bottom Track
Grids
Image Capture
Status
Sonar On
Range (M): 25
Sonar On
Range (M): 75
Ping Rate (%): 100
Frequencies
0.0 KHz - 0.0 KHz
0.0 KHz - 0.0 KHz
Duration
0 ms
0 ms
Signal Meter
0 - 0
0 - 0
SSL: 0 SSH: 0 Lat: 0 : 00.0000 N Lon: 0 : 00.0000 E Course: 0.00 Speed: 0.00 ATD: 0.00 Heading: NA Pitch: 0.0 Roll: 0.0 Altitude: NA Depth: NA SV: 1538
Mark: 1 Date: NA Time: NA Power: 0% Free Space: 151782 MB


EdgeTech Discover - Bathymetric
File View Configuration Control Bathymetry Help
Bathymetric Results
View
Processed Pings: 22129
Detected Altitudes: 19982
Angle Sets: 22128 / 22128
Binning
Sidescan Control | Video Gains | Display | Disk
Playback File:
4% Complete
Speed: 5
Playback
Bathymetry: ON
Record: OFF
NET: OFF
Power: OFF

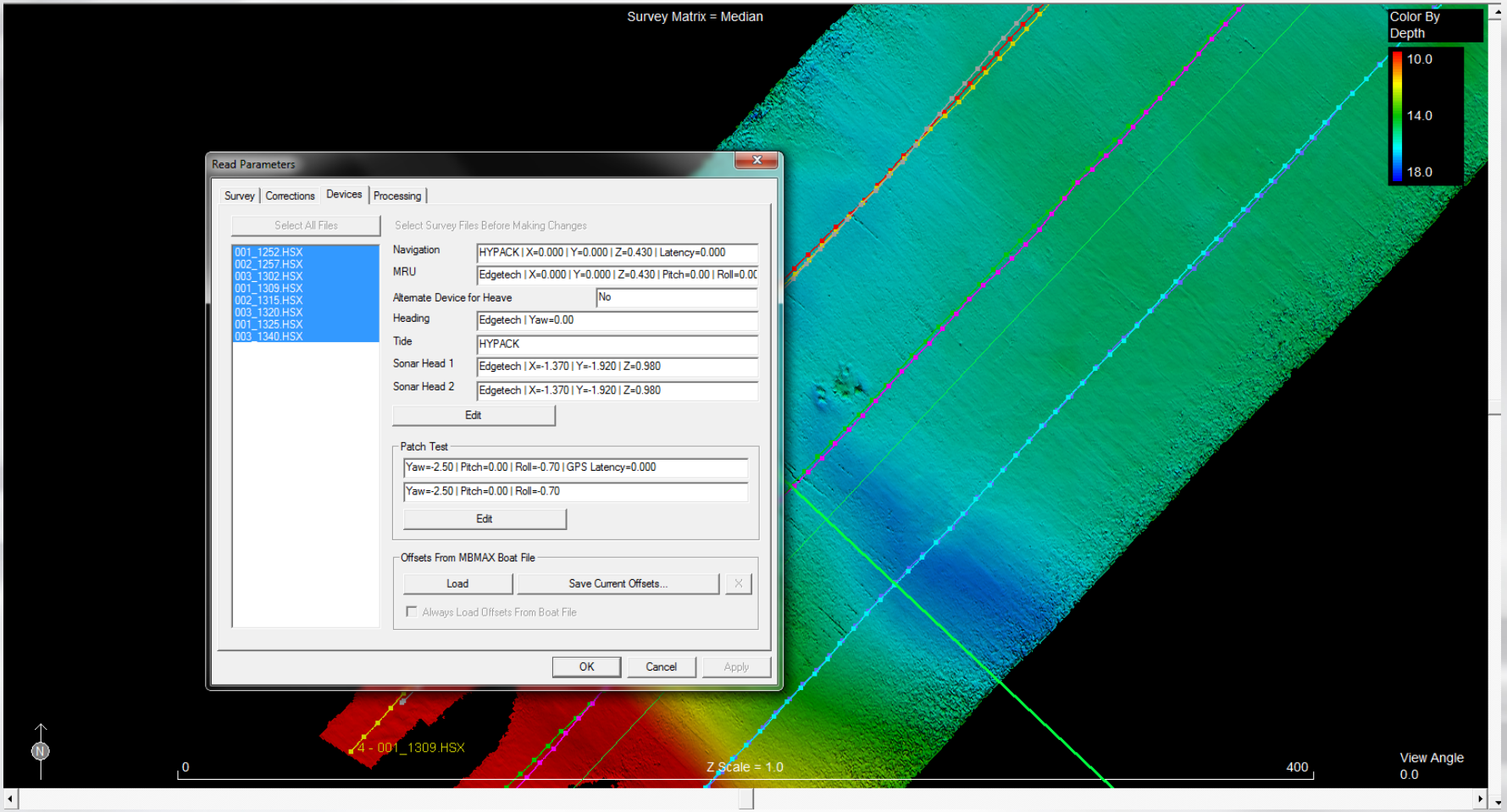
PATCH TEST Calibrations

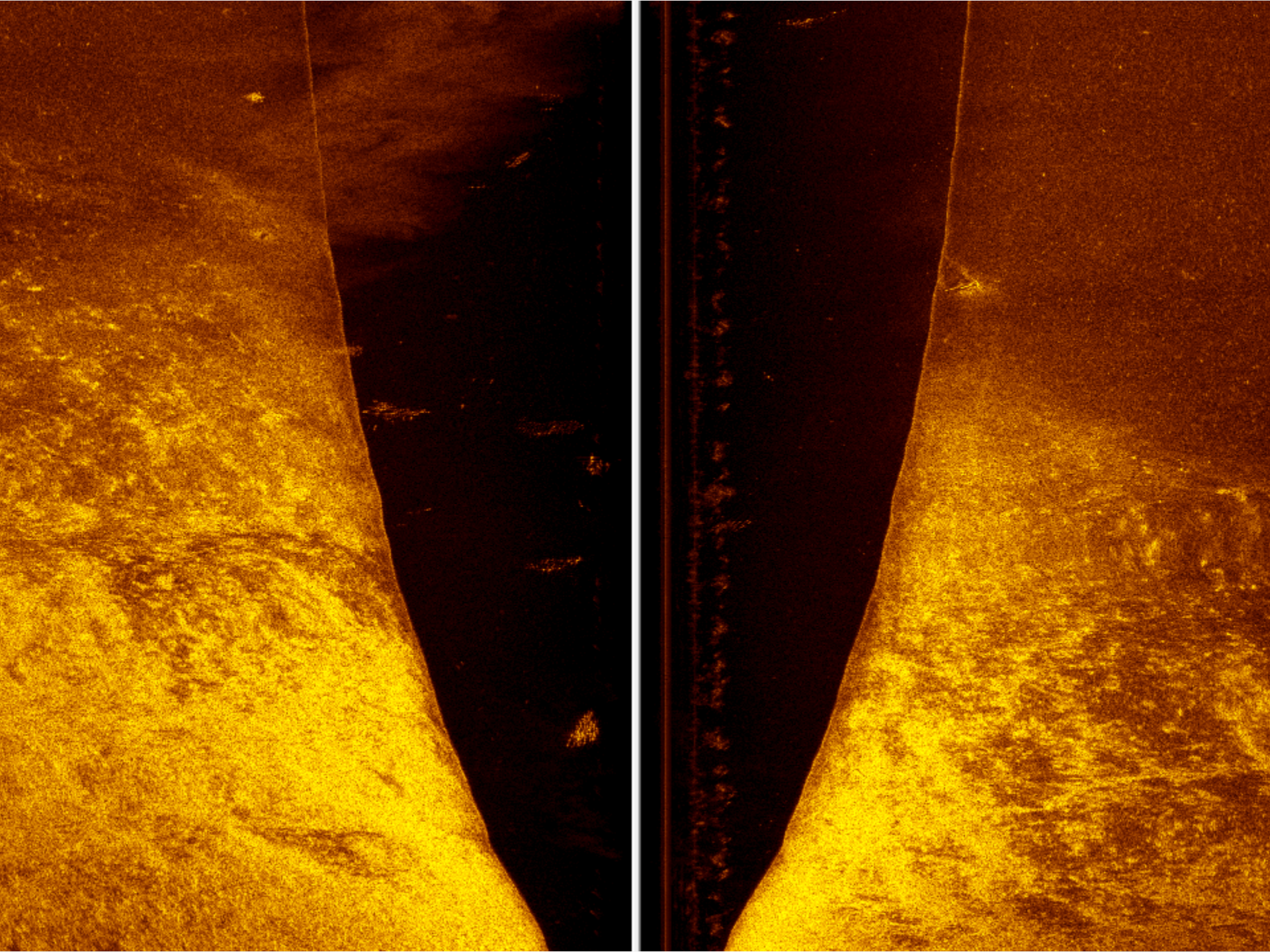
- Day 1

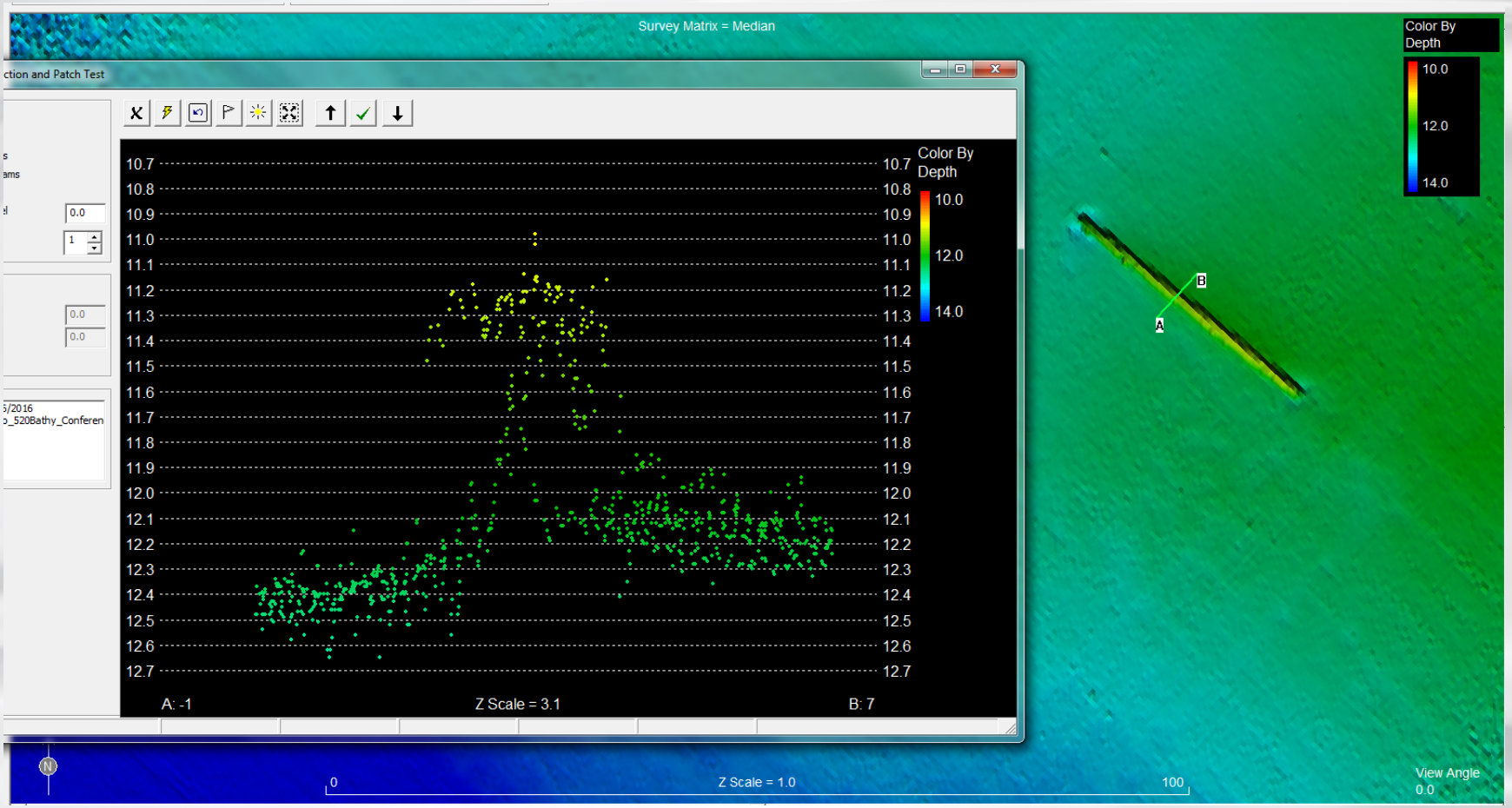


PATCH TEST Calibrations

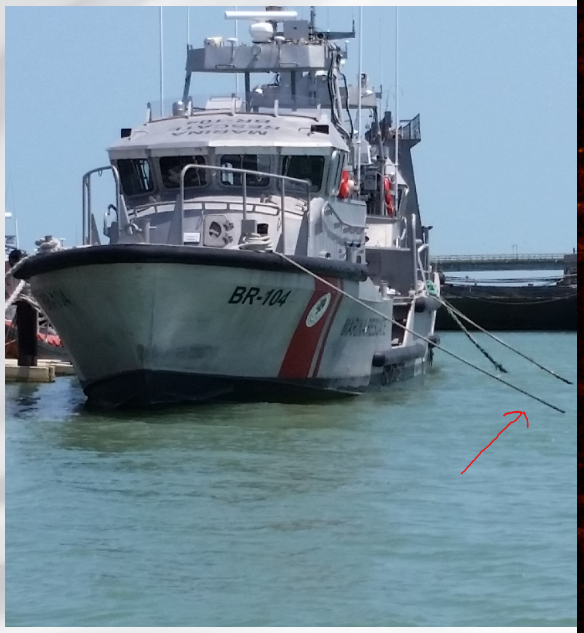
- Day 2.

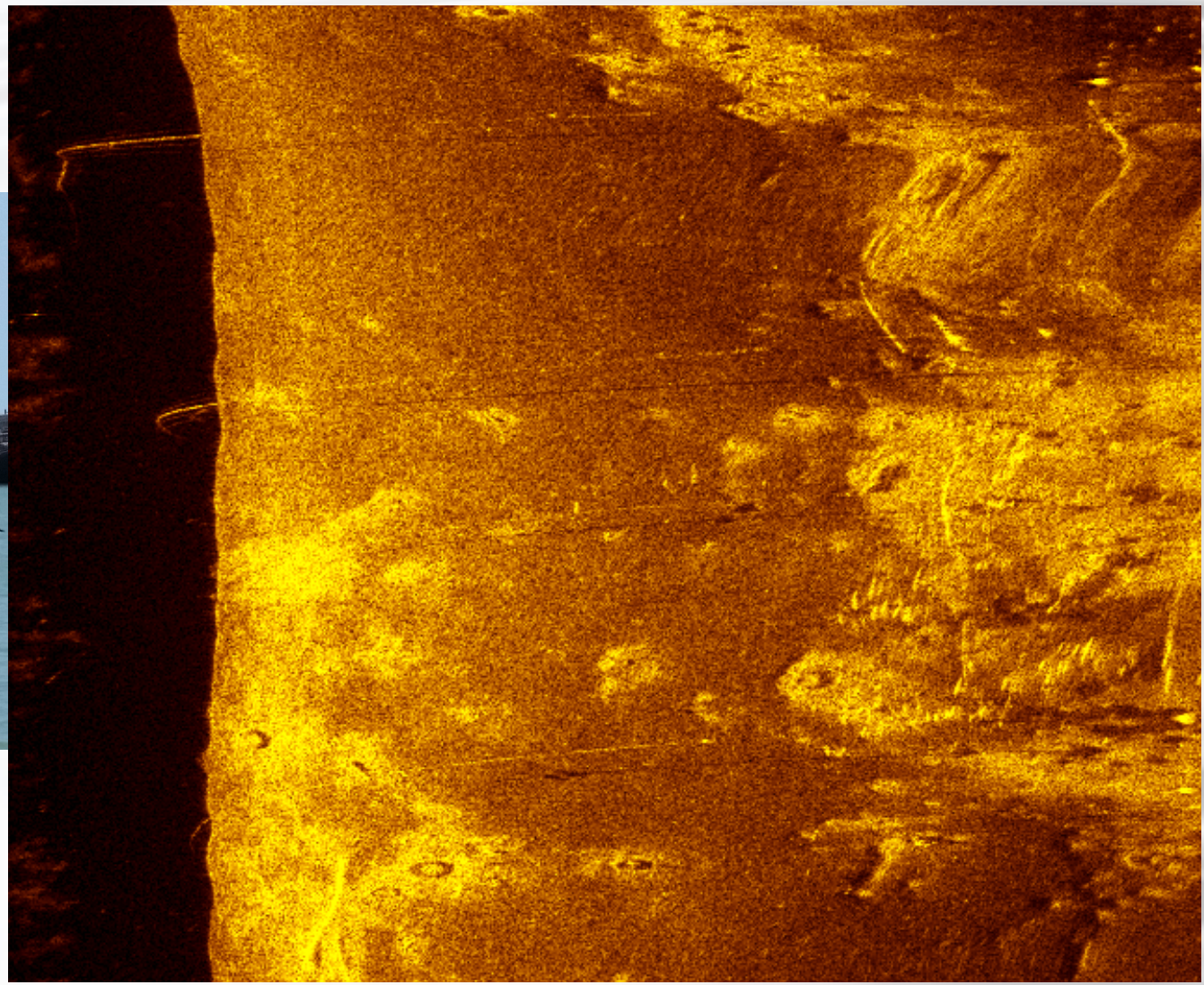


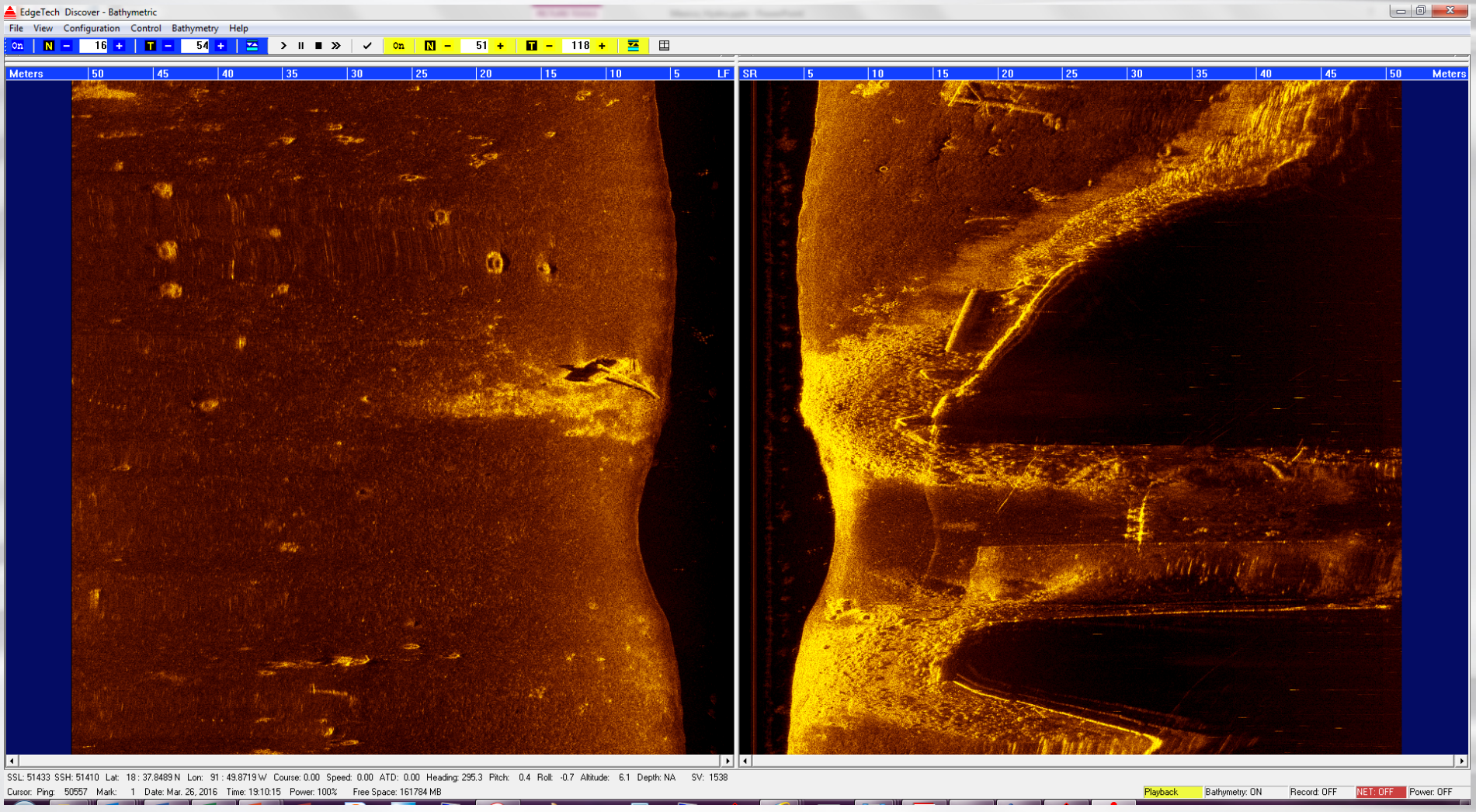


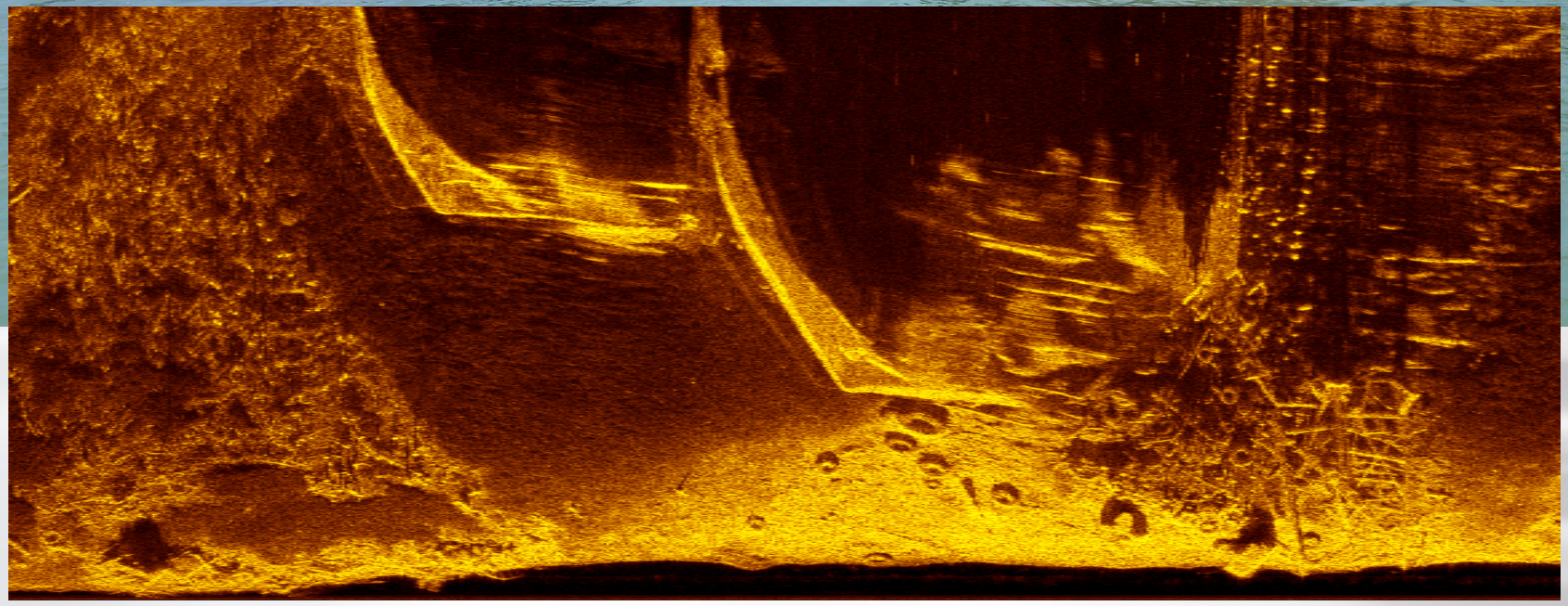

Survey Matrix = Median
ction and Patch Test
Color By Depth
10.0
12.0
14.0
10.7
10.8
10.9
11.0
11.1
11.2
11.3
11.4
11.5
11.6
11.7
11.8
11.9
12.0
12.1
12.2
12.3
12.4
12.5
12.6
12.7
A: -1
Z Scale = 3.1
B: 7
A
B
N
0
Z Scale = 1.0
100
View Angle
0.0

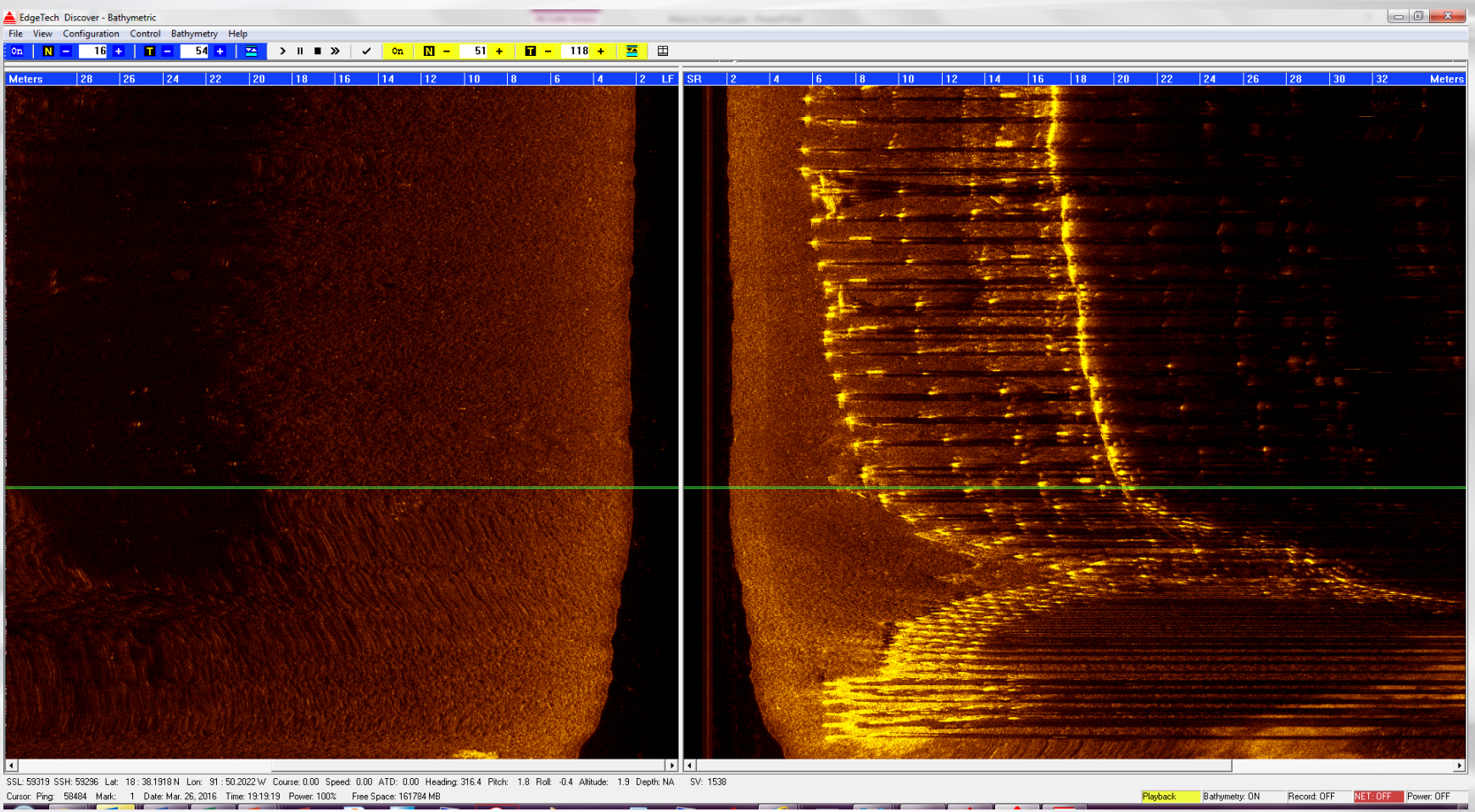
Mooring Lines






EdgeTech Discover - Bathymetric
File View Configuration Control Bathymetry Help
Meters 50 45 40 35 30 25 20 15 10 5 LF
SR 5 10 15 20 25 30 35 40 45 50 Meters
SSL: 51433 SSH: 51410 Lat: 18 : 37.8489 N Lon: 91 : 49.8719 W Course: 0.00 Speed: 0.00 ATD: 0.00 Heading: 295.3 Pitch: 0.4 Roll: -0.7 Altitude: 6.1 Depth: NA SV: 1538
Cursor: Ping: 50557 Mark: 1 Date: Mar. 26, 2016 Time: 19:10:15 Power: 100% Free Space: 161784 MB
Playback Bathymetry: ON Record: OFF NET: OFF Power: OFF

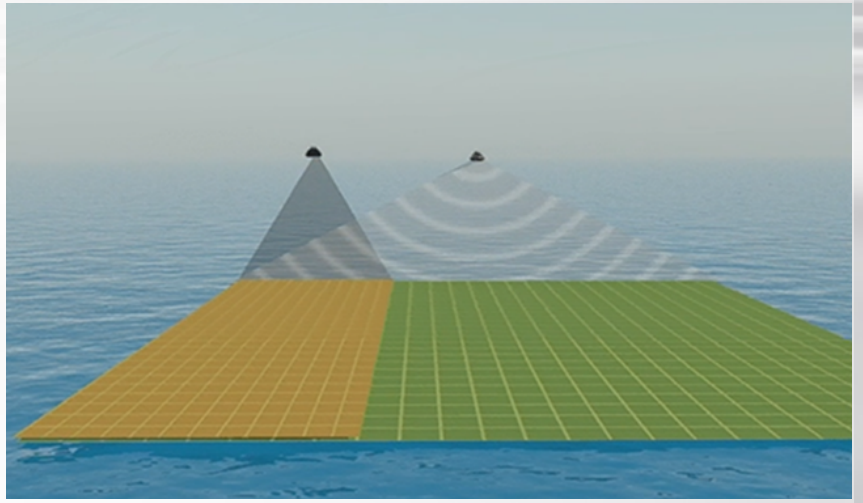


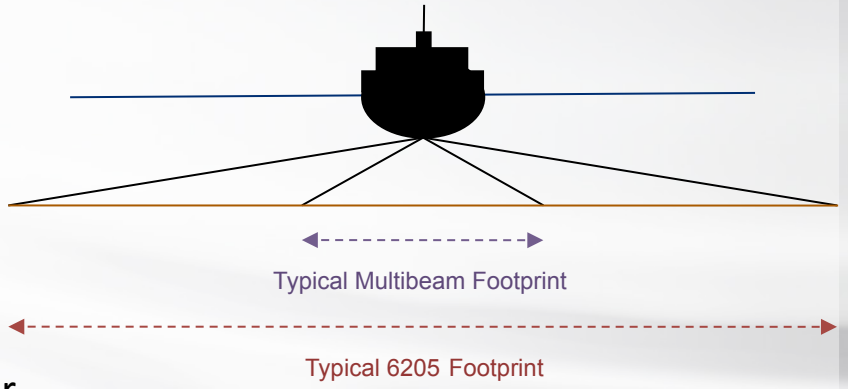

EdgeTech Discover - Bathymetric
File View Configuration Control Bathymetry Help
Meters
SR
Meters
SSL: 59319 SSH: 59296 Lat: 18 : 38.1918 N Lon: 91 : 50.2022 W Course: 0.00 Speed: 0.00 ATD: 0.00 Heading: 316.4 Pitch: 1.8 Roll: -0.4 Altitude: 1.9 Depth: NA SV: 1538
Cursor: Ping: 58484 Mark: 1 Date: Mar. 26, 2016 Time: 19:19:19 Power: 100% Free Space: 161784 MB
Playback
Bathymetry: ON
Record: OFF
NET: OFF
Power: OFF

Validation and Quality Control

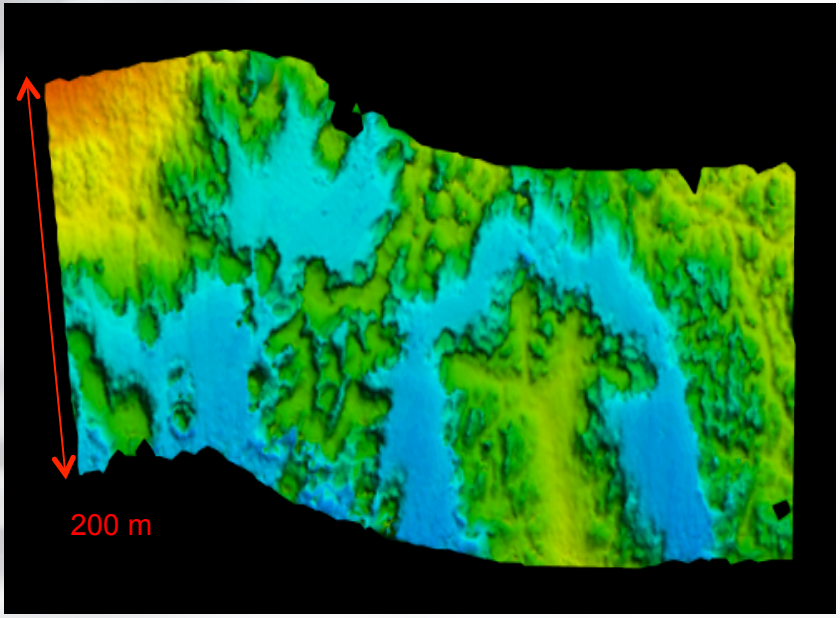
System Coverage – Shallow water

- Typical Single Head MBES
  - Multi-Beam Echo Sounder (MBES)
  - Coverage around 3.5 to 4 x water depth
  - Line Spacing typically 3 x water depth
  - Limited to 130º Swath Coverage
- Typical PDBS
  - Phase Differencing Bathymetric Sonar
  - Coverage of up to 10 x water depth.
  - Gap at Nadir means full overlap required
  - Line Spacing typically 4 x water depth
  - Noisy Data
- EdgeTech's New MPES Technology
  - Multi-Phase Echo Sounder (MPES)
  - Coverage of up to 12 x water depth.
  - IHO Special Order compliant coverage over 9x water depth
  - Over 200º Swath Coverage



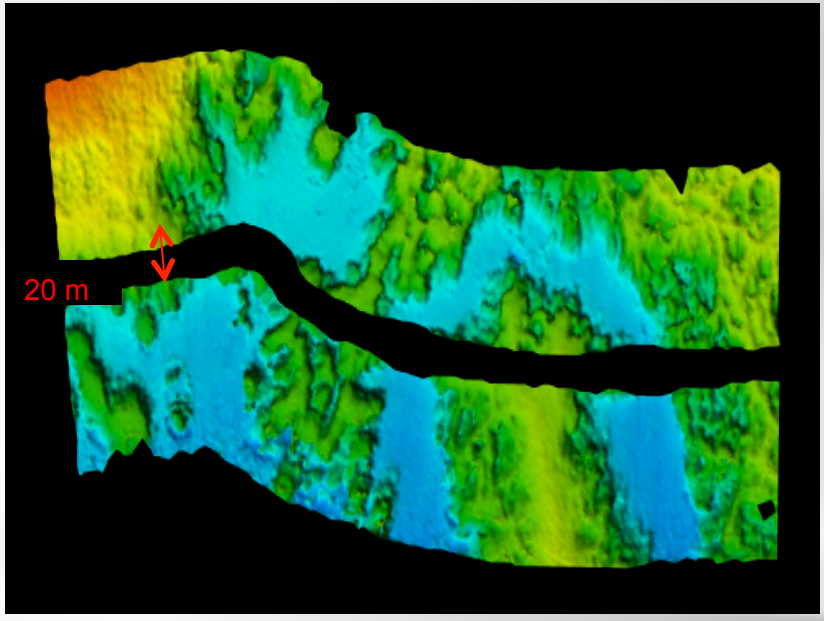


MPES vs. PDBS



Full Swath Coverage

Vs.



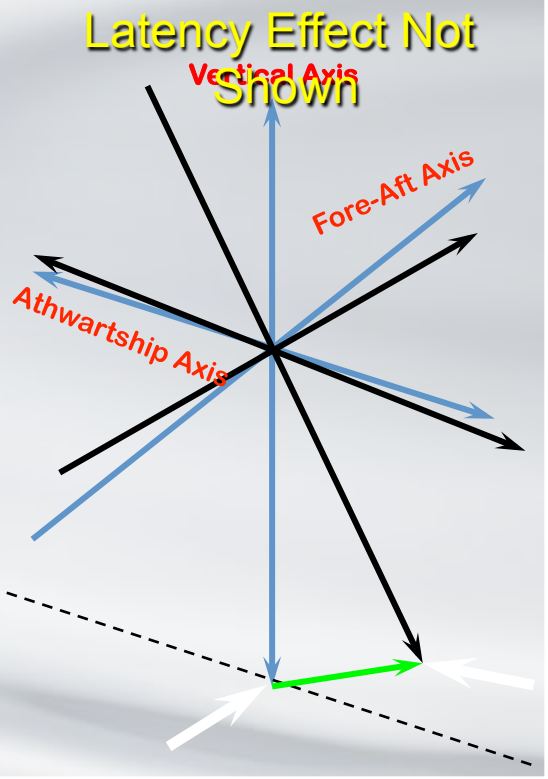
Nadir Gap

6205 Mounting Examples for Small and Large Vessels

EdgeTech

What is a PATCH TEST?

- Patch tests are performed after initial installation, and periodically thereafter if the sensors are modified, to quantify any residual biases from the initial system alignment.
- Five individual tests:
  - Four that determine the physical misalignments of the transducer (port roll, starboard roll, pitch, and yaw).
  - One that determines the latency, or lack of synchronization, between the position and depth data acquisition.
- Examples provided in QPS Software



When and Why We Do it

- After the installation of a new EdgeTech 6205 Sonar Head.
- When Performance Test data is poor.
  Maybe the Sonar Head was moved?
- Damage or Deterioration to your Mounting.
- Required by Project Specifications.
- For Quality Control, not Quality Assurance Test…
  (similar to bar check of single-beam system)

Survey Hints and Warnings

Hints:

- Test in the deepest section of the survey area.
- Except for Latency, run lines at your normal survey speed.
- Run each test twice to confirm results.
- Average multiple tests for final values.

DGPS Warning:

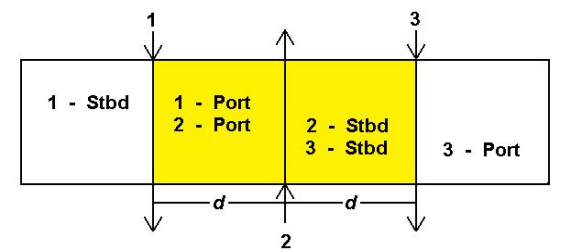
- Make sure you have good GPS positioning. RTK GPS is recommended. Slight position error may lead to Patch Test errors.
- If HDOP is high, perhaps best to perform Patch Test at another time.

Assuming 3ft DGPS shift in 40ft of water

- Latency Test: +/- 0.4 seconds.
- Pitch Test: +/- 4.4 degrees.
- Yaw Test: +/- 4.3 degrees.

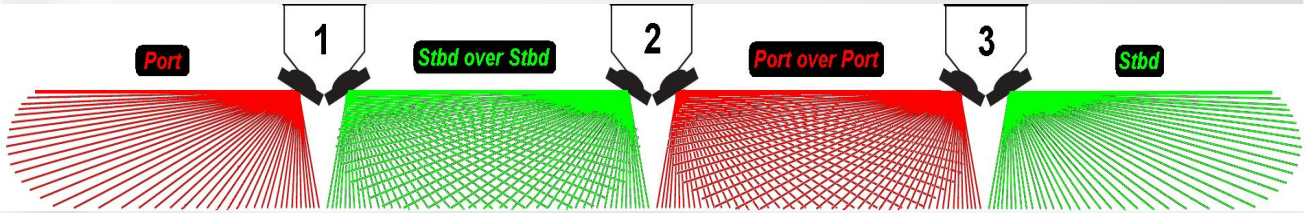
How to Perform a 6205 Patch Test

Roll:



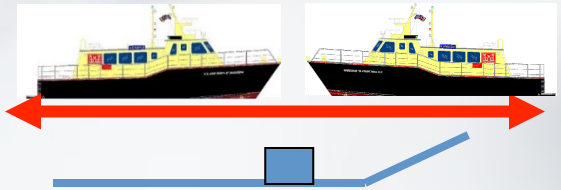
d = 3 to 4 x water depth

- One Value for Port, One Value for Stbd
- Need Flat / Smooth Deep Bottom
- Requires overlap for Port and Stbd Separately
- 3 Opposing Lines Spaced at 3 to 4 x Water Depth
- Same / Equal Speeds



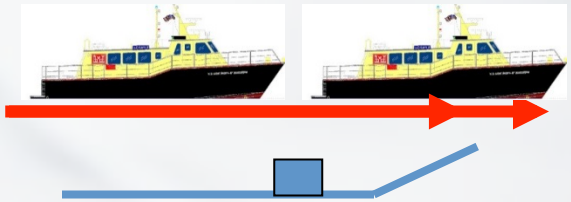
How to Perform a 6205 Patch Test

Pitch:



- One Value for both Port and Stbd
- Need Flat / Smooth Deep Bottom to an Object
  or Sloped Bank Feature
- Requires 2 Runs Over an Opposite / Reciprocal Line
- Same / Equal Speeds

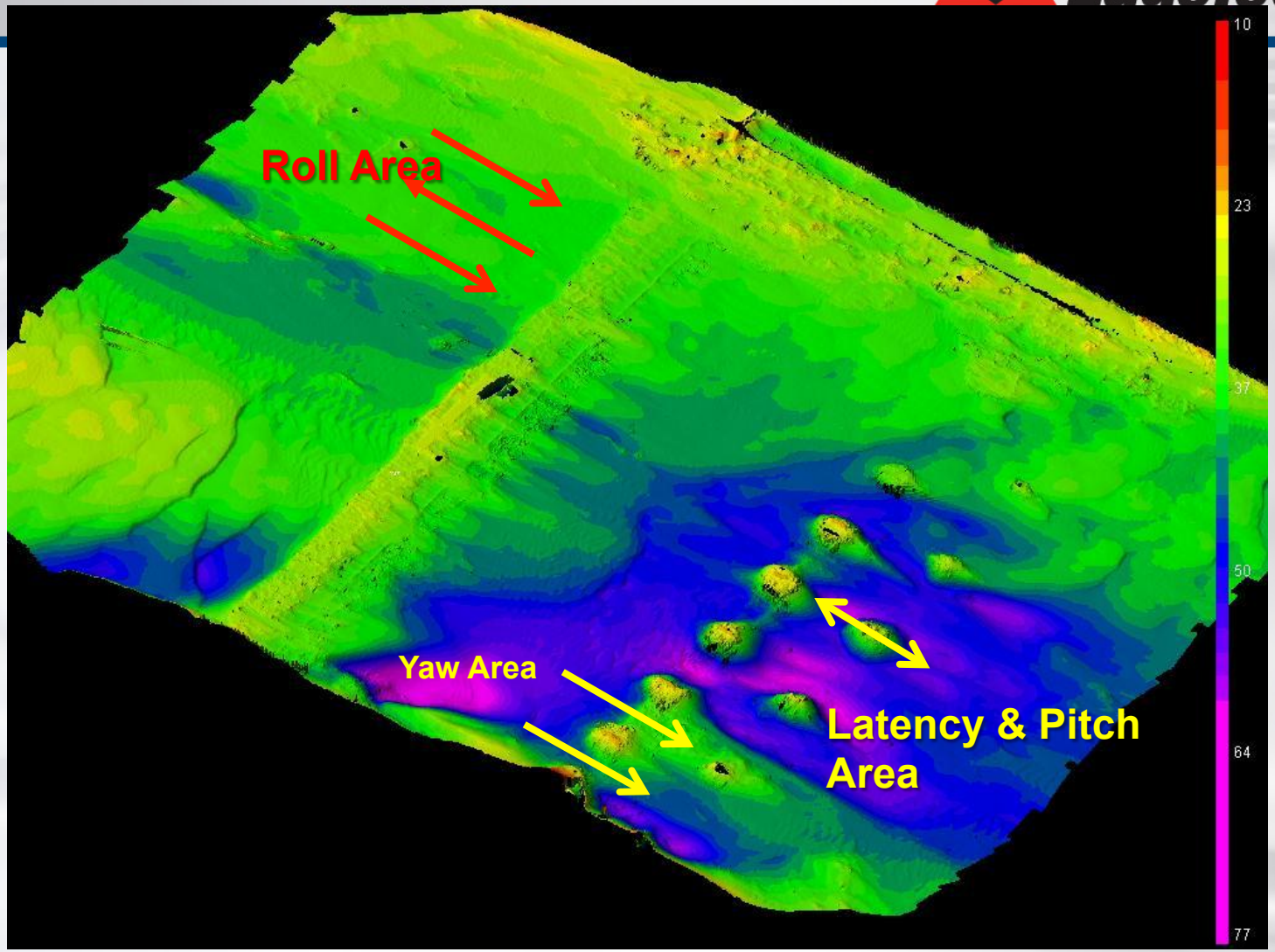
Latency:



- One Value for Time Latency
- Need Flat / Smooth Deep Bottom to an Object
  or Sloped Bank Feature
- Requires 2 Runs Over the Same Line in the Same Direction
- Unequal Speeds

Yaw:

- One Value for both Port and Stbd
- Need Flat / Smooth Deep Bottom to an Object
  or Sloped Bank Feature
- Requires 2 Parallel / Adjacent Lines Running in the Same Direction
- Same / Equal Speeds

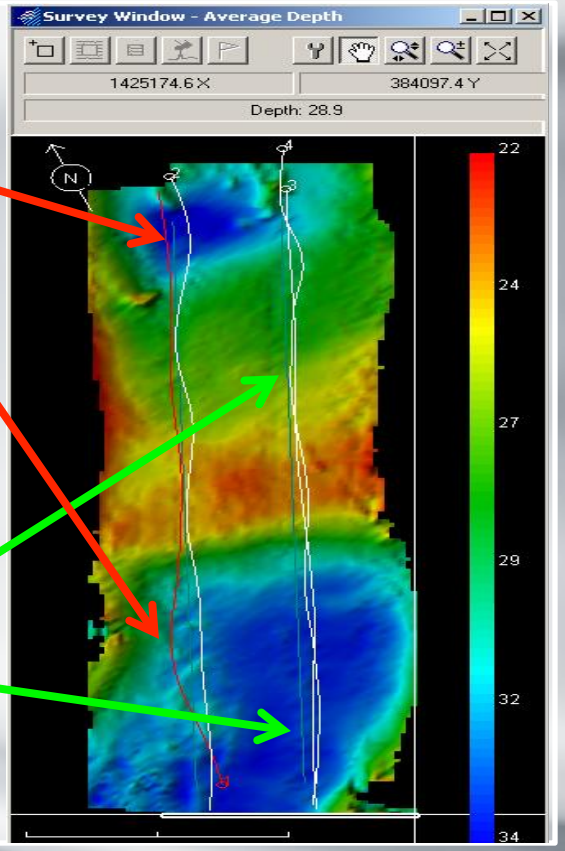

Roll Area
Yaw Area
Latency & Pitch Area
10
23
37
50
64
77

Keep in Mind…

Also keep in mind that your Boat Operator will make or **BREAK** your Patch Test.

The more precise the Boat Operator can run the Patch Test lines, the better the results will be.

Therefore, the Boat Operator should run the Roll, Pitch, Latency and Yaw lines as close as possible to the **Drawn Line**.



Patch Test Procedures

The order that you collect your Patch Test data does NOT make any difference, but the order in which you process it, DOES…

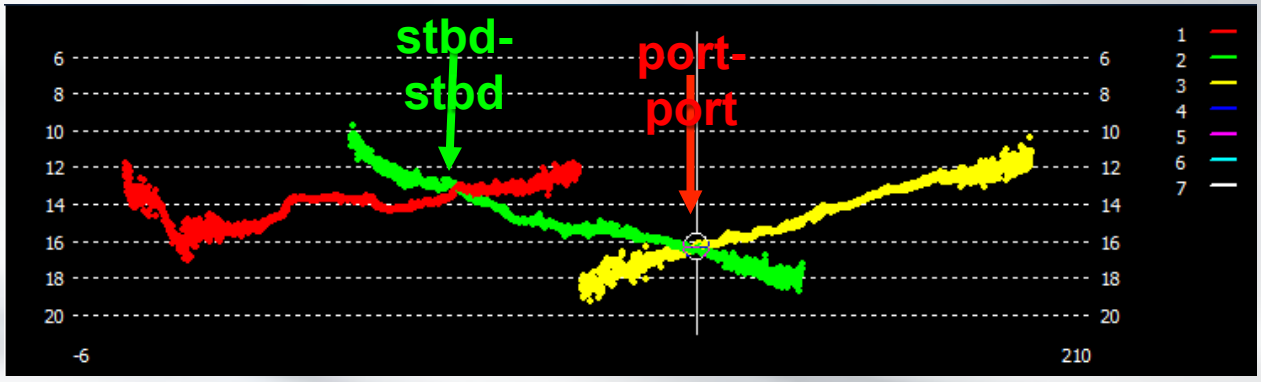
Order of Processing:

- Find the **Latency** offset first.
- Apply Latency, then do both **Roll** tests (port/stbd).
- Apply Latency and Roll, then do the **Pitch** test.
- Apply Latency, Pitch, and both Roll offsets, then finish with the **Yaw** test.

6205 Roll Test

Treat as a Dual Head Multibeam

- Different result for each transducer, port and stbd.
- Cut perpendicular to and in between the lines to analyze **port-port** / **stbd-stbd** overlap cross section.

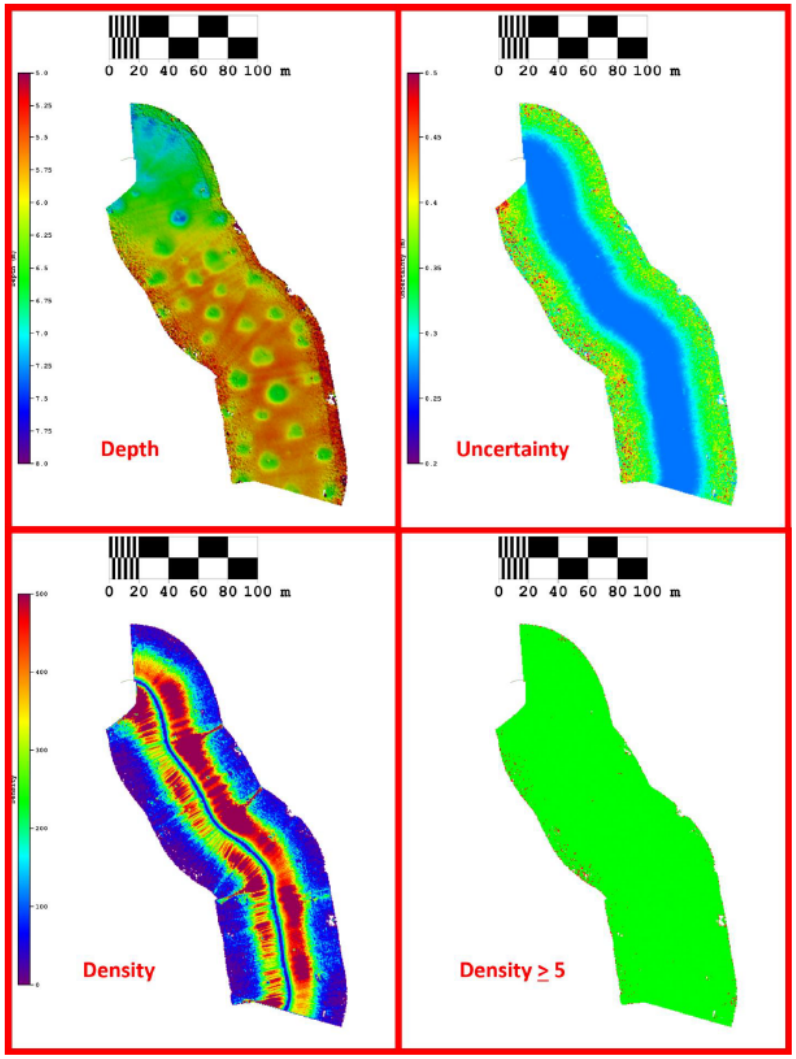


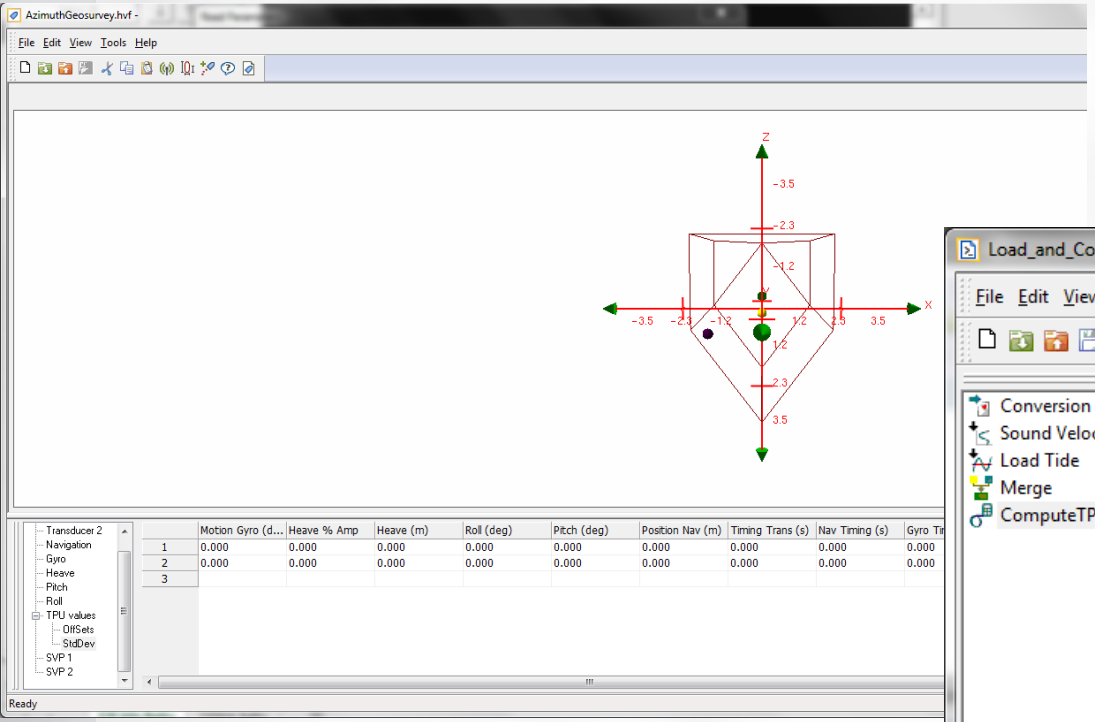
Results

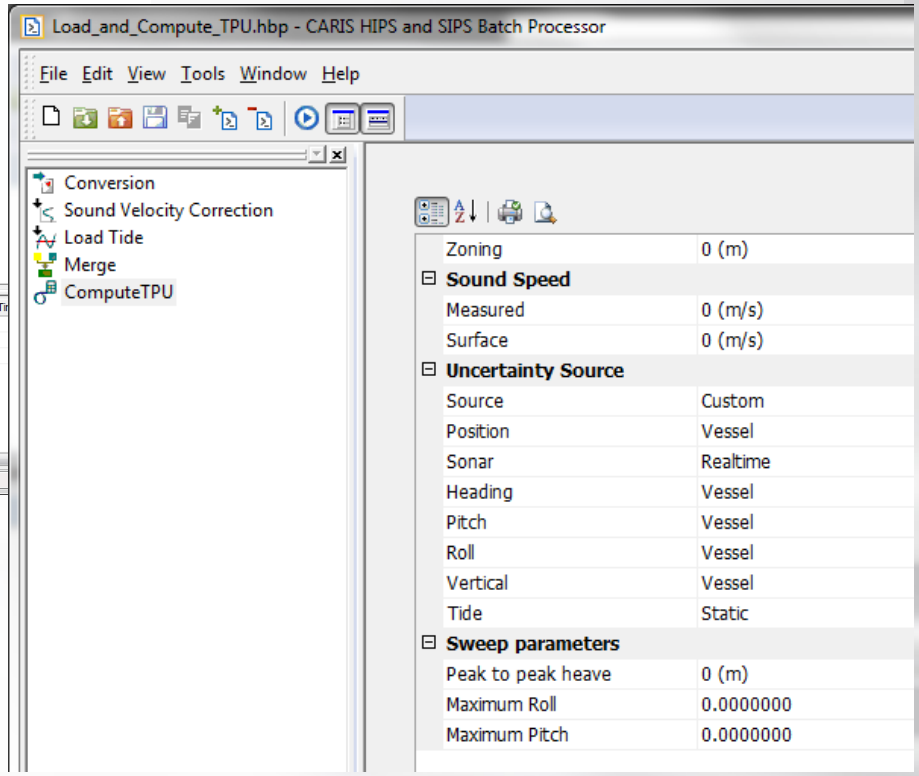
- After running the data thru all five (5) tests, then re-run them all again.
- This is done because you now have "rough" adjustments for all five (5) offsets, and the Patch Test can now produce "finer" results for each.
- After this second run-thru, repeat for a third time, but only use the smallest two (2) Step Increments and their respective # of Steps.
- This will produce your "Best Results".
- Keep a record of all past results, and use their Average.

Validation and Quality Control

- No data cleaning performed, 50 cm resolution (finest required by NOAA at this depth)
- 6205 meets IHO Special Order out to 10 x water depth, for uncertainty (≤ 50 cm at this depth)
- 6205 reports realtime uncertainty for sonar portion of Total Propagated Uncertainty (TPU)
- Sounding Density > 5 per cell (NOAA Spec)

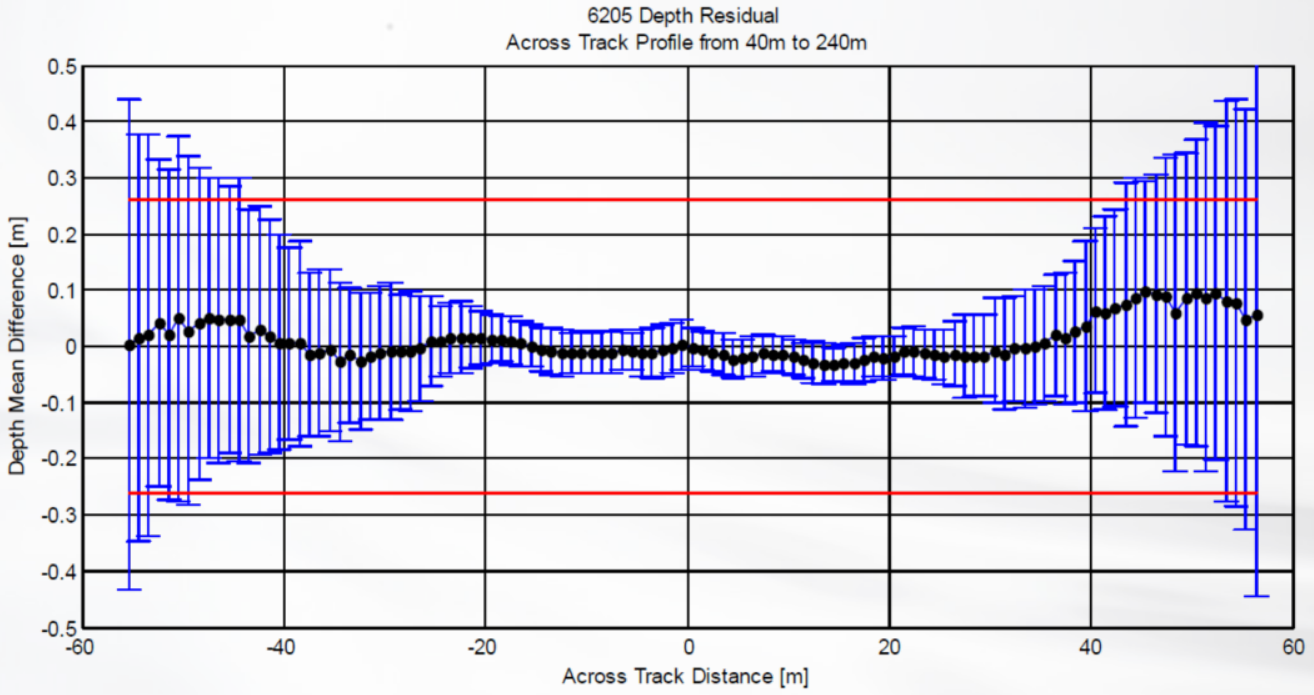



AzimuthGeosurvey.hvf -
File Edit View Tools Help
Z
X
-3.5
-2.3
-1.2
1.2
2.3
3.5
Transducer 2
Navigation
Gyro
Heave
Pitch
Roll
TPU values
OffSets
StdDev
SVP 1
SVP 2
Motion Gyro (d...
Heave % Amp
Heave (m)
Roll (deg)
Pitch (deg)
Position Nav (m)
Timing Trans (s)
Nav Timing (s)
Gyro Ti
Ready

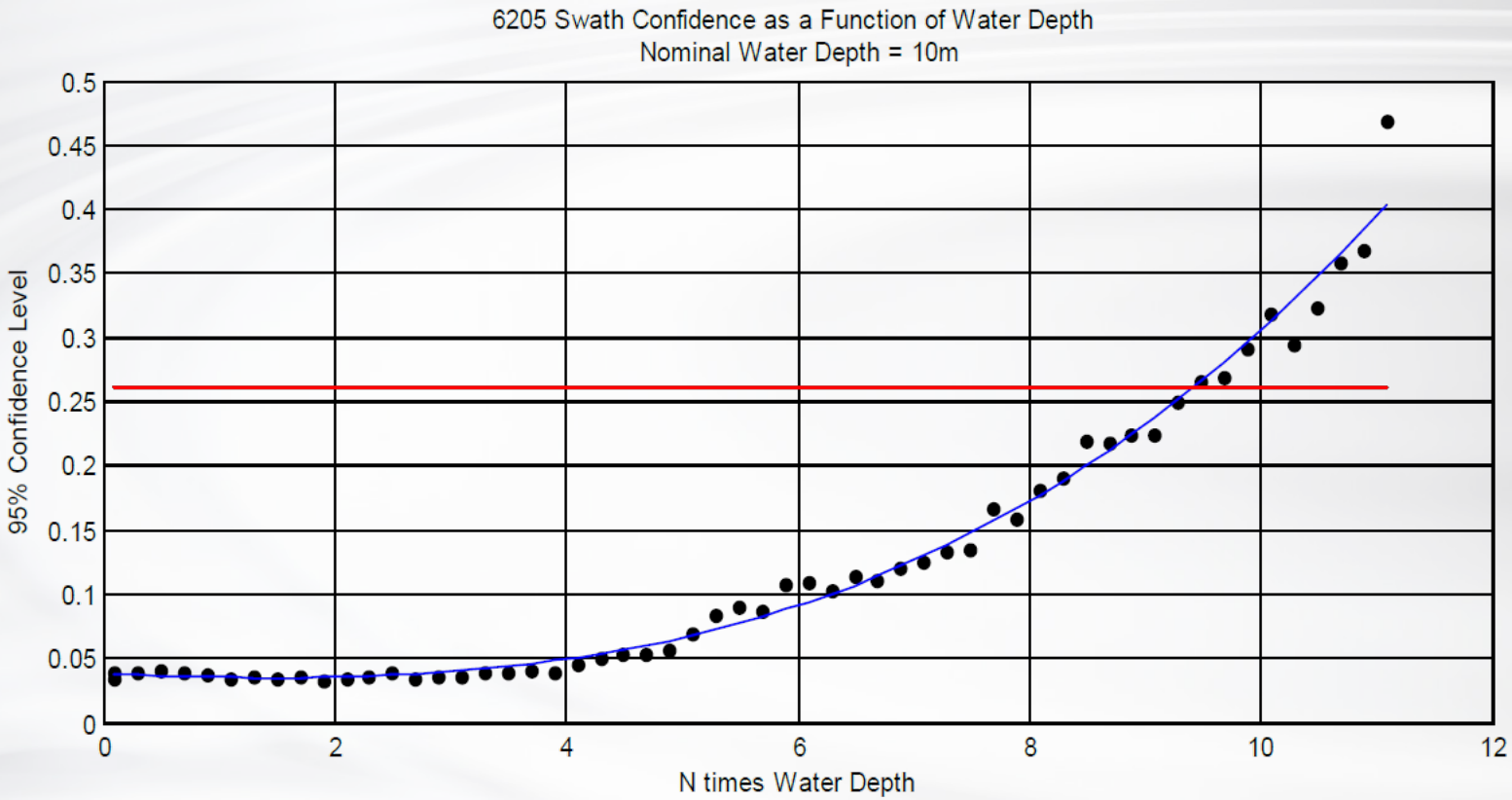

Load_and_Compute_TPU.hbp - CARIS HIPS and SIPS Batch Processor
File Edit View Tools Window Help
Conversion
Sound Velocity Correction
Load Tide
Merge
ComputeTPU
Zoning 0 (m)
Sound Speed
Measured 0 (m/s)
Surface 0 (m/s)
Uncertainty Source
Source Custom
Position Vessel
Sonar Realtime
Heading Vessel
Pitch Vessel
Roll Vessel
Vertical Vessel
Tide Static
Sweep parameters
Peak to peak heave 0 (m)
Maximum Roll 0.0000000
Maximum Pitch 0.0000000

System Performance – Results 1

- EdgeTech 6205 test line differenced from a reference surface
  - Approximate Depth = 10 m
- Results
  - Error bars show 95% confidence level



System Performance – Results 2

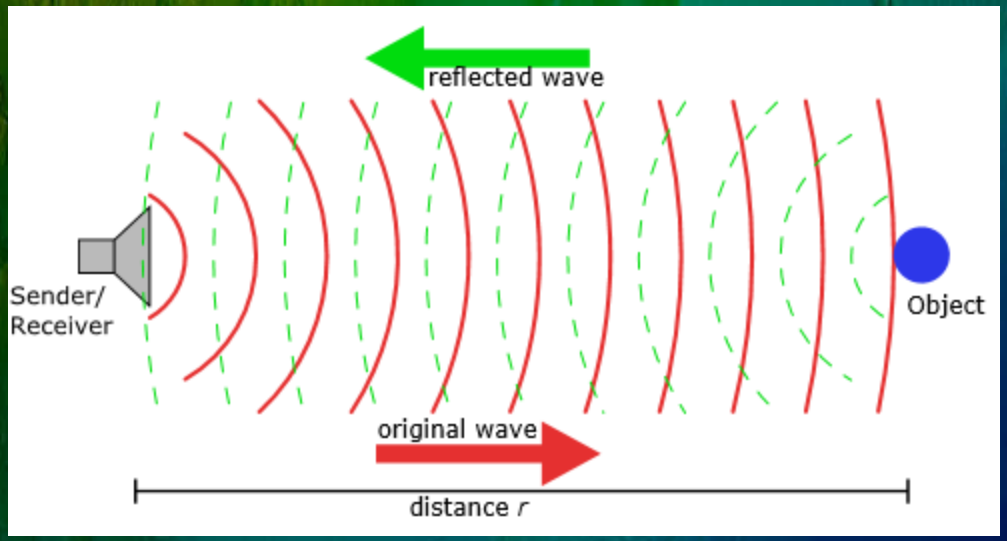


- Results
  - Approximate Depth = 10 m
  - Red line shows IHO S44 SO : 95% confidence level < 0.26m out to 9 x water depth!

- Physics / Acoustics and Functioning of deployed Equipment

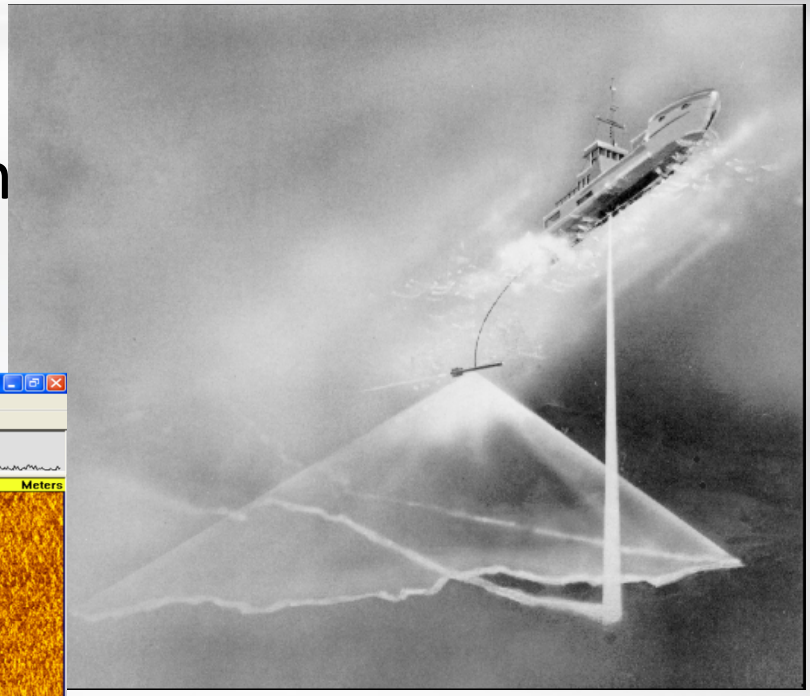
EdgeTech

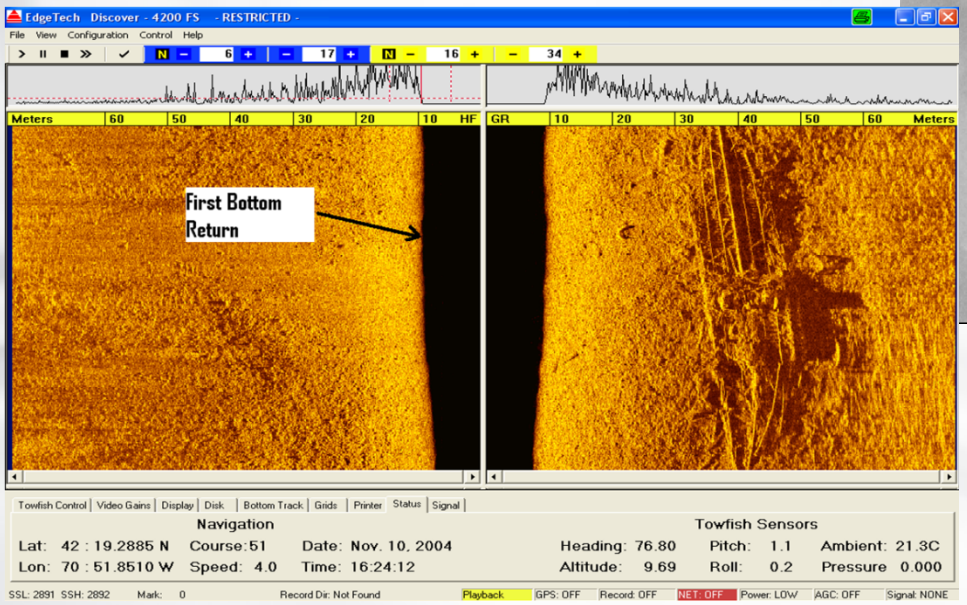
ACTIVE vs PASSIVE SONAR



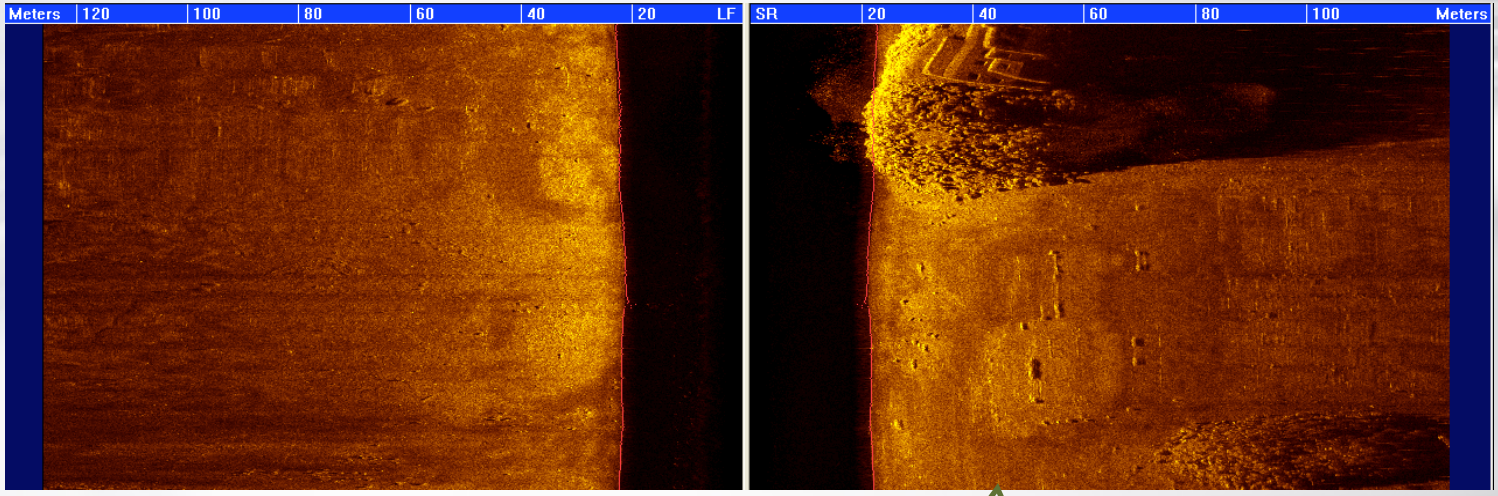
Side Scan Sonar

- Sideways looking ; 2 sides
- Wide vertical beam
- Narrow horizontal beam
- Towed body

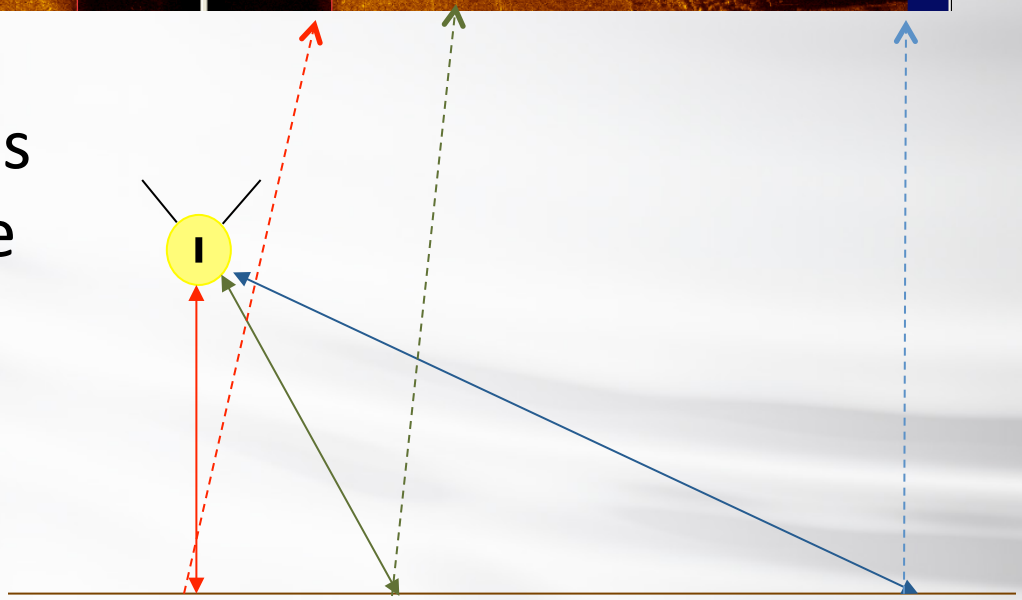




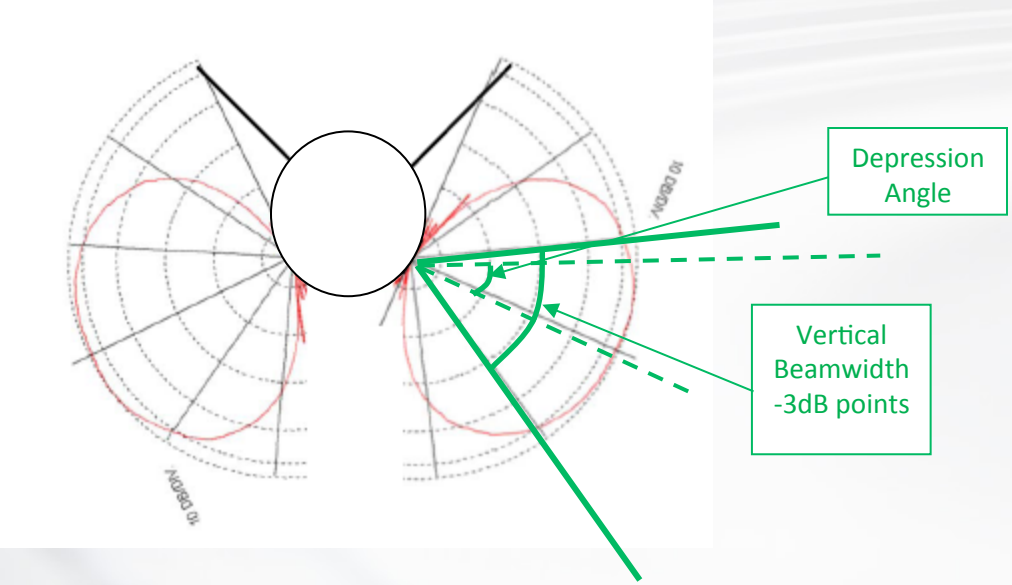
Side Scan Sonar : Time based

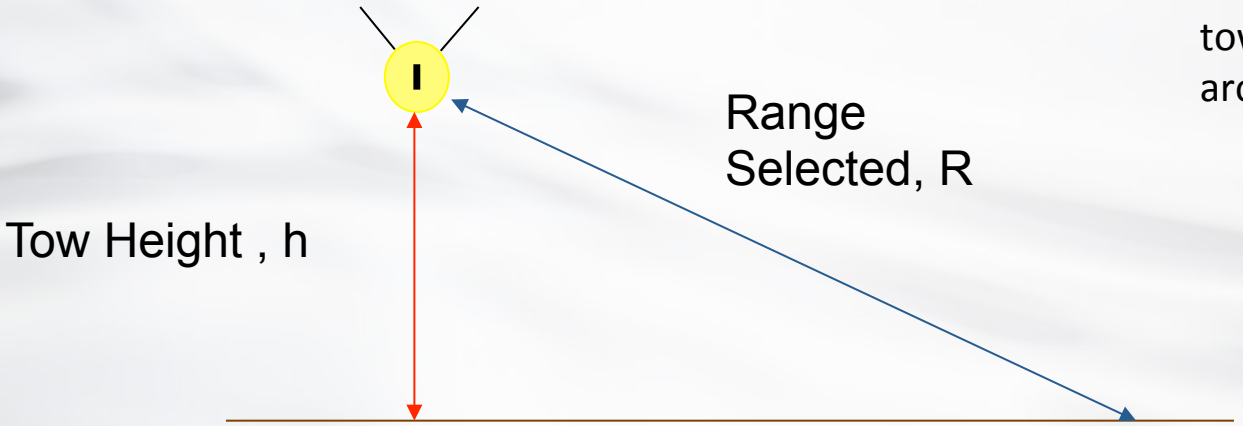


Side Scan Sonar is essentially a time based system



Wide Vertical Beam: Tow Height





- For Side Scan Sonar, the optimum tow height, h, is 10 – 20 % of the range selected.
- For deeper towed systems this will mean the use of a winch and cable.
  - For armoured tow cable the ratio of cable out to tow depth is typically around 3:1.

Performance

- Range
  - Better coverage
  - Fewer lines
- Resolution
  - Is that one object, or two ?
  - Better Imagery
- Speed
  - Faster Surveys

How to deliver improved performance, in real world conditions, at an affordable price ?

Range

- Definition of maximum Range?
  - See an echo from a target (and how large?)
  - Delineate shadows behind the target, so as to aid identification.

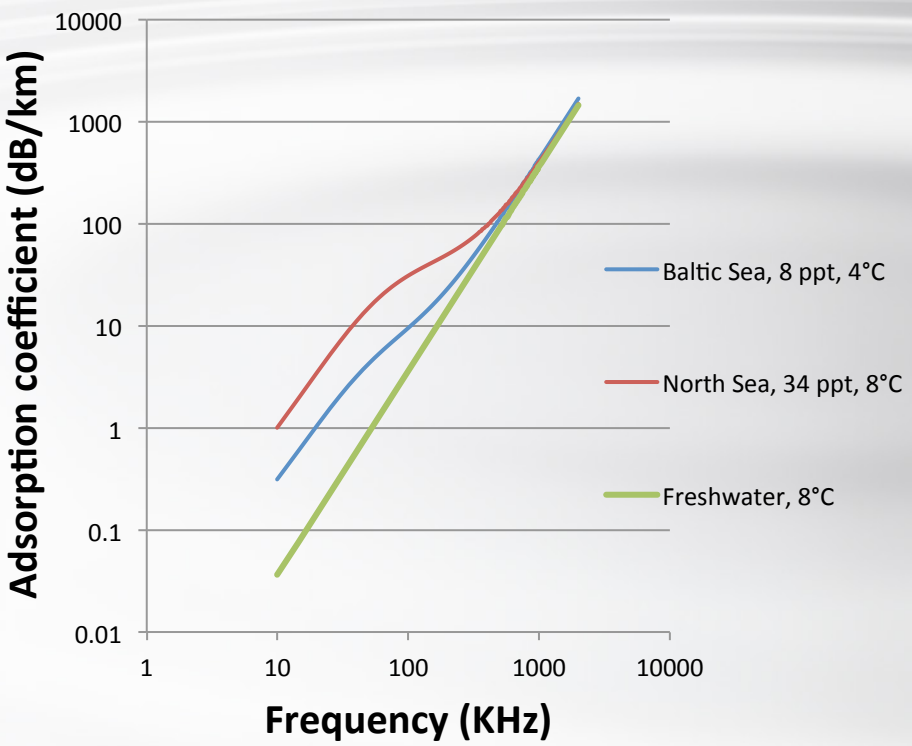
- Either way, it's a matter of signal strength and noise.

What affects Range ?

- Signal Strength
  - Absorption (depends on frequency, water temperature and salinity).
  - Altitude (grazing angle – reflected energy)
- Noise
  - Water Depth (surface noise /backscatter)
  - Ambient Noise
  - System Noise

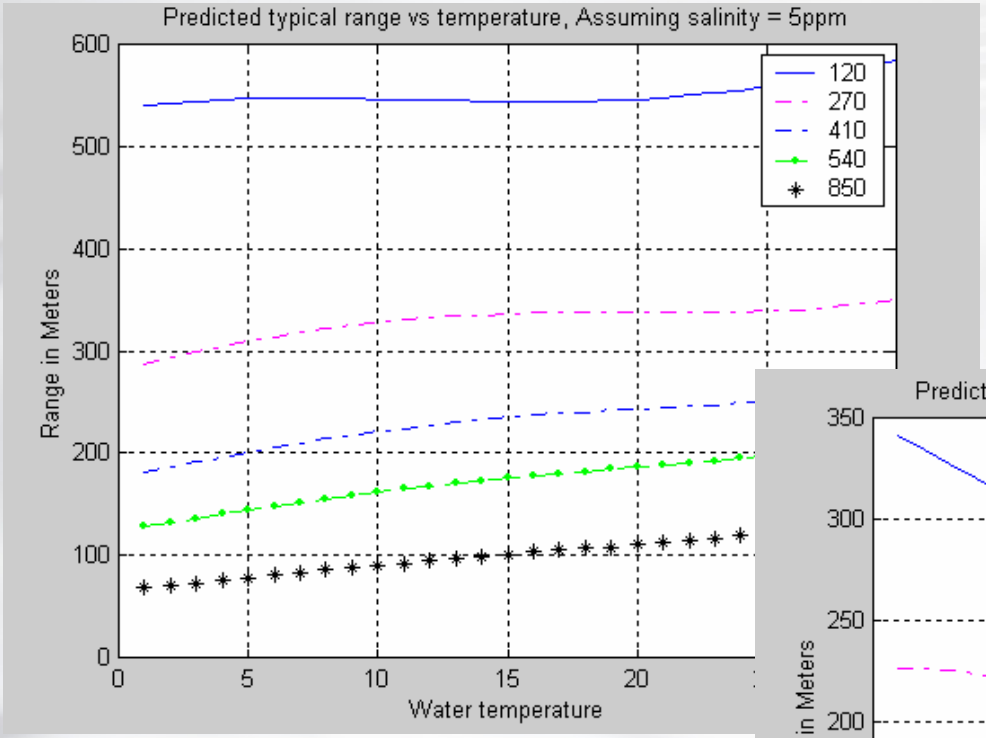
Absorption

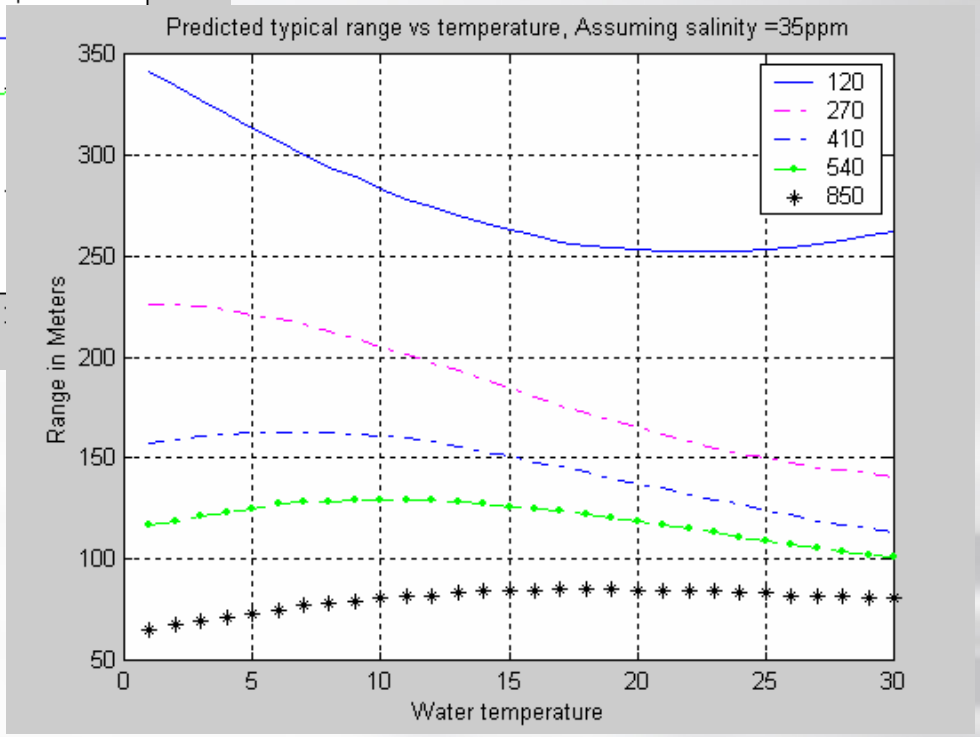
- Frequency
- Temperature
- Salinity
  - Magnesium Sulphate
  - Boric Acid



- Michael A. Ainslie and James G. McColm, “A simplified formula for viscous and chemical absorption in sea water”, Journal of the Acoustic Society of America, 103(3), 1671-1672 (1998).
- R. E. Francois and G. R. Garrison, “Sound absorption based on ocean measurements. Part II: Boric acid contribution and equation for total absorption”, Acoust. Soc. Am. 72, 1879–1890 (1982).

Absorption : Effect on Range

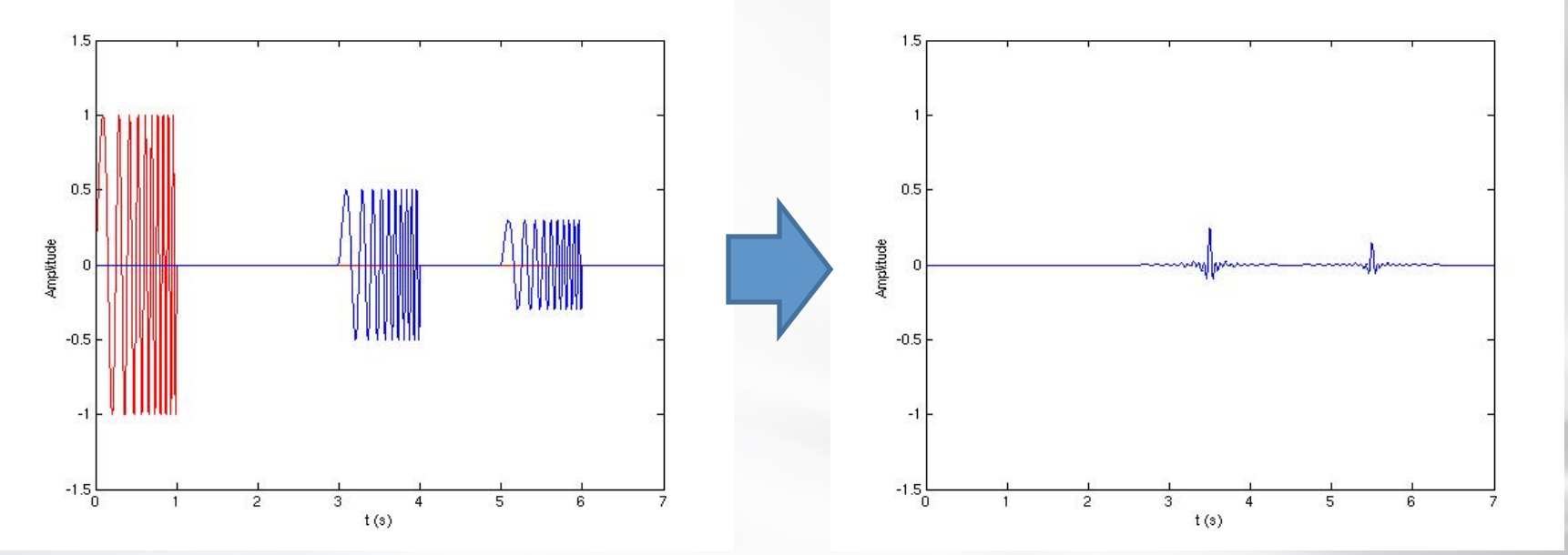




See Application Note on www.edgetech.com

CHIRP

- Compressed High Intensity Radar Pulse
- Linear FM chirp pulses
  - Provide high energy signals, with superior resolution
    - After match filtering the returns are shorter in time



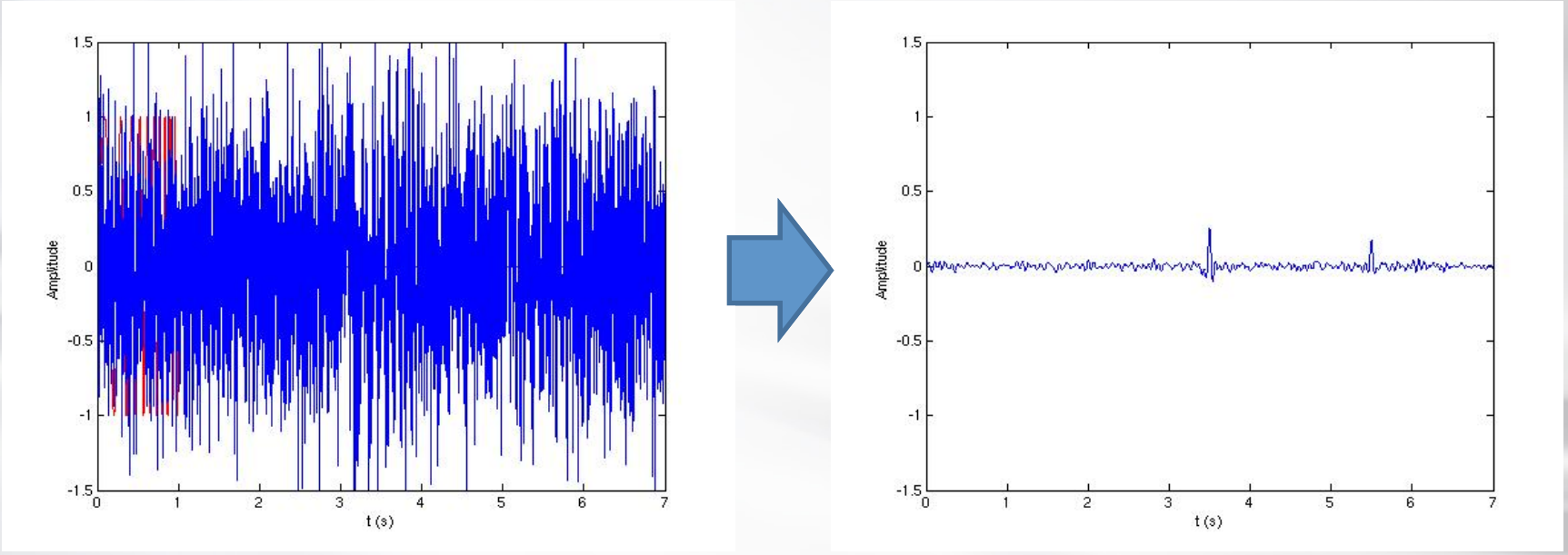
http://en.wikipedia.org/wiki/Pulse_compression

Improving Signal Strength

- Wideband, Low amplitude, linear FM chirp pulses
  - Provide high energy signals
  - CW: Tx power typ. 1kW, Pulse length ~ 50us
    - Energy = 1e3 * 50e-6 = 0.05 Joules
    - Resolution = 3.75cm (depends on pulse length)
  - CHIRP: Tx 200W, pulse length ~3ms, BW = 40Khz
    - Energy = 200*3e-3 = 0.6 Joules
    - Resolution = 1.8cm (depends on bandwidth)

Reducing Noise

- Digital Towfish – no cable noise
- Linear FM chirp pulses (again!)
  - Implementation of matched filter processing
    - As before, but with added white noise



http://en.wikipedia.org/wiki/Pulse_compression

More Signal…

Less Noise….

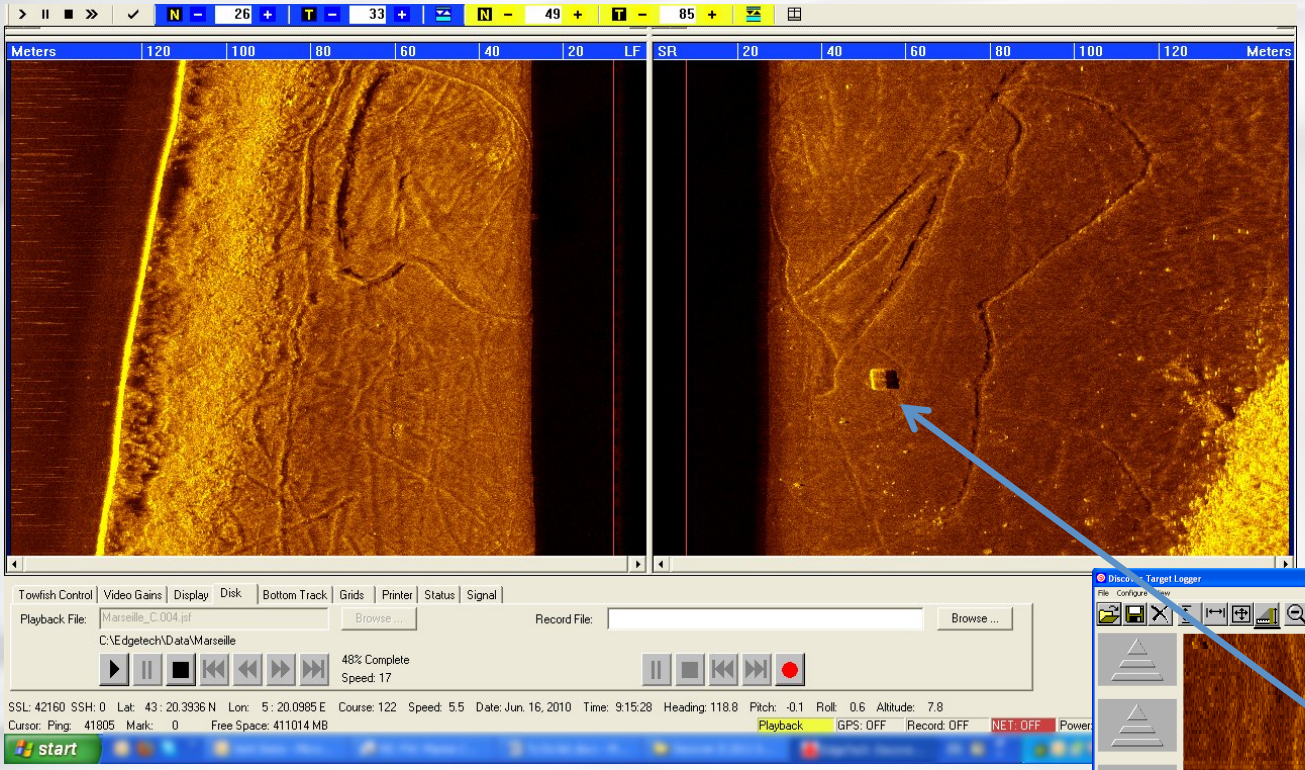
Better Range

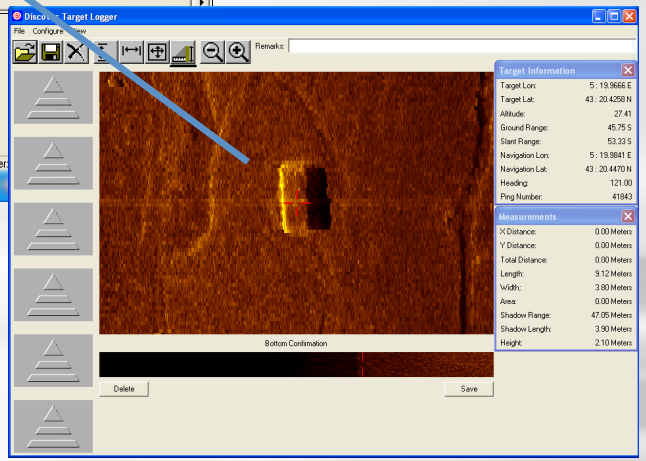
Real Ranges

Frequency	Range
100 (120) kHz	250 to 500m
300 (230) kHz	150 to 300m
400 (410) kHz	130 to >200m
600 (540) kHz	100 to 150m
900 (850) kHz	50 to 75m
1600 kHz	30 to 35m

- Shallow water (< 30m)
  - Range may be limited by noise from surface reflections, channel effects etc.

Range Performance





400 kHz Data

Data out to 150m

Questions?

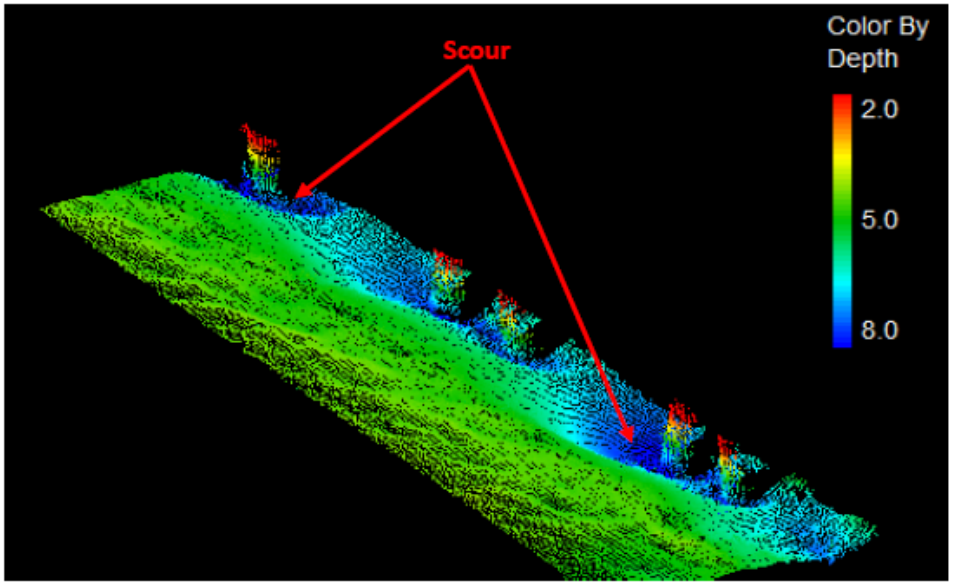
Applications of Equipment Deployed

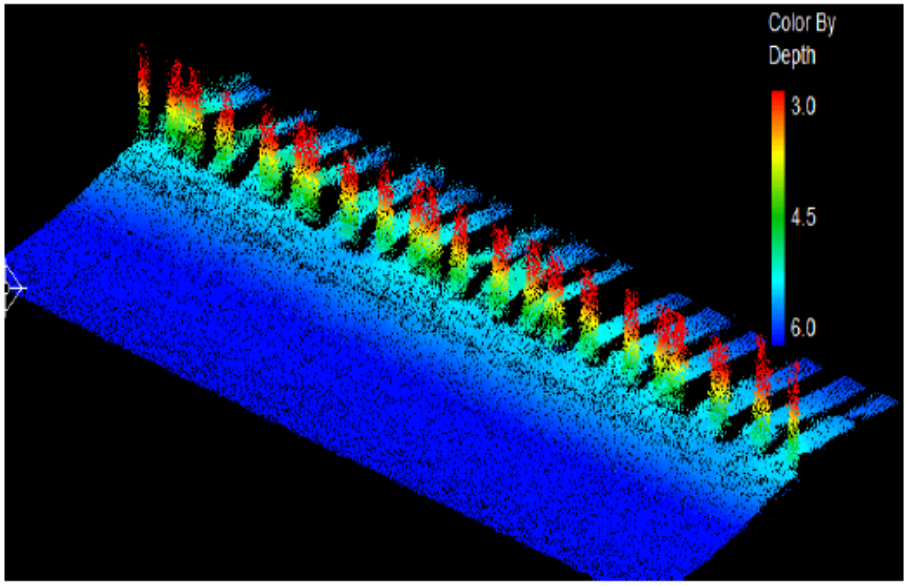
Example Customers

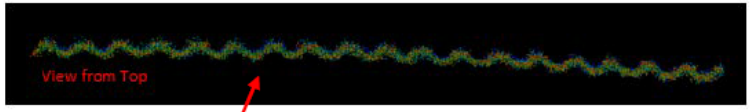
A far from complete listing:

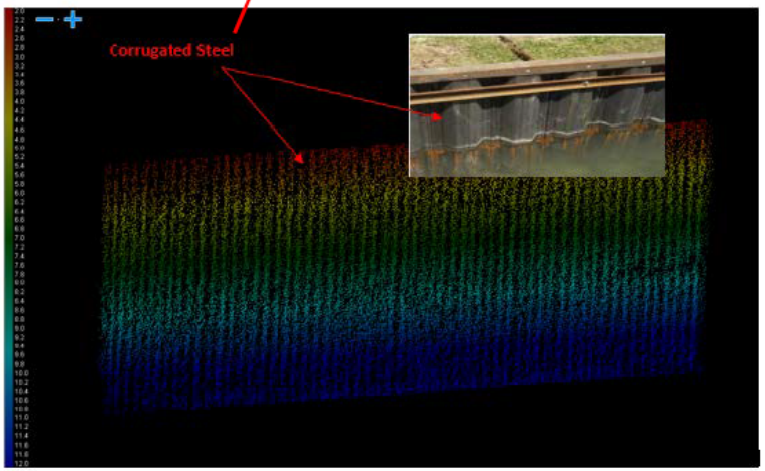
- Military / Hydro
  - United Kingdom MOD
  - France (SHOM)
  - India DSR/NHO
  - Canada
  - Sweden
  - Egypt
  - Atlas
  - Thales
  - Kongsberg
- Research
  - NOAA (USA)
  - Scripps Institute of Oceanography (USA)
  - CEFAS (UK)
  - KORDI (Korea)
  - Maritime Institute (Poland)
  - Institute of Marine Survey and Planning (China)
  - Geological Survey of Ireland
- Commercial
  - C&C Technologies
  - EGS Asia
  - Fugro Survey
  - Gardline Surveys
  - GSE Rentals (UK)
  - NCS Subsea (USA)
  - Odyssey Marine
  - Sonar Equipment Services (UK)
  - Survey Equipment Services (USA)
  - Watergate (Nigeria)

Scour and Inspection

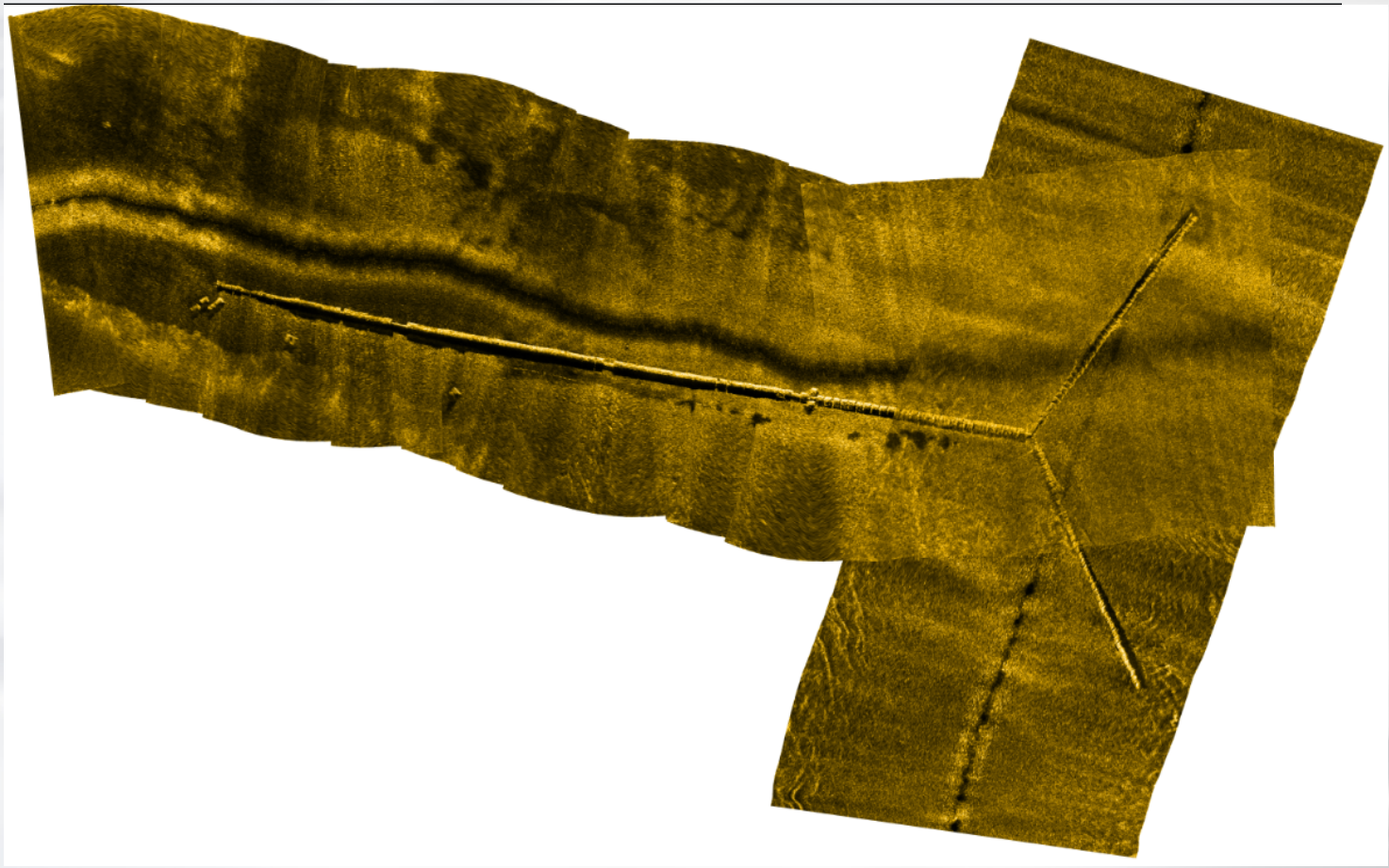




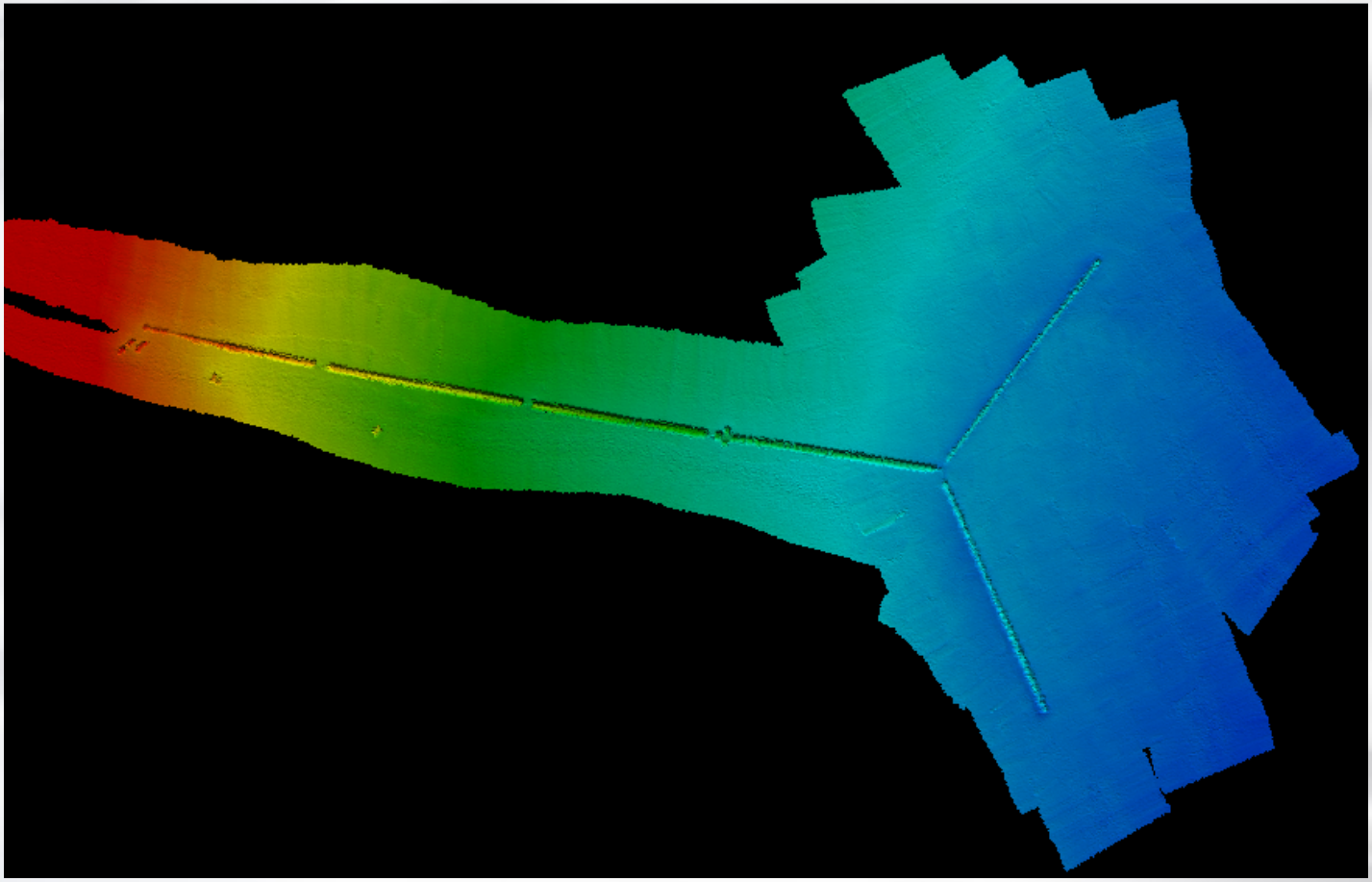




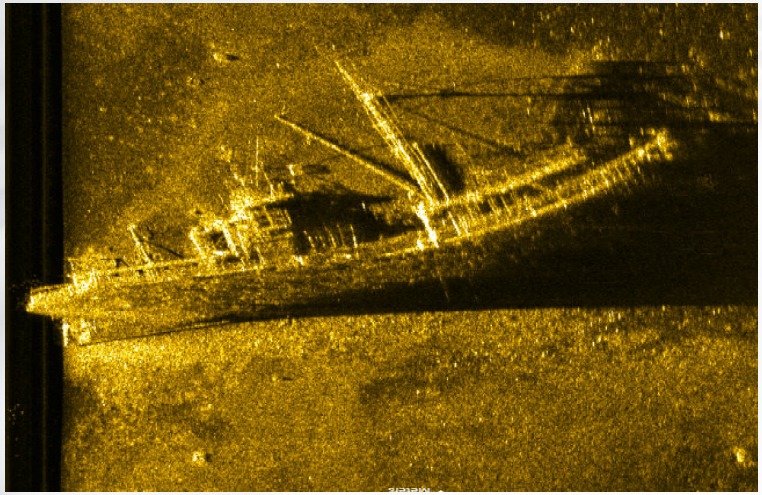
Pipeline Data Example

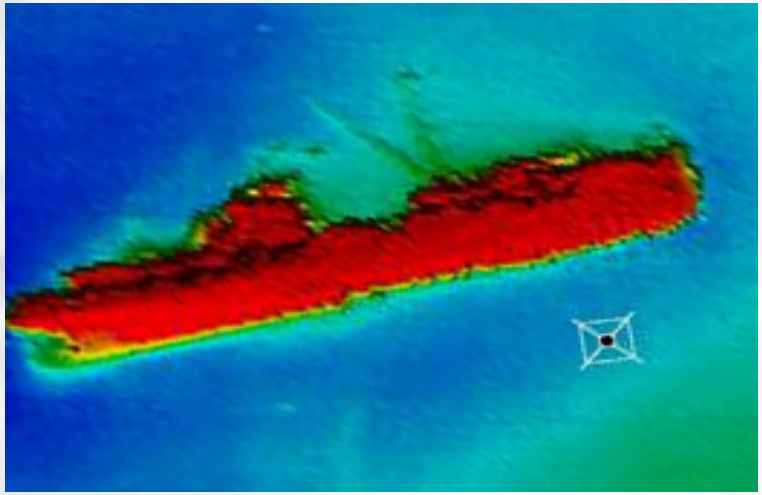


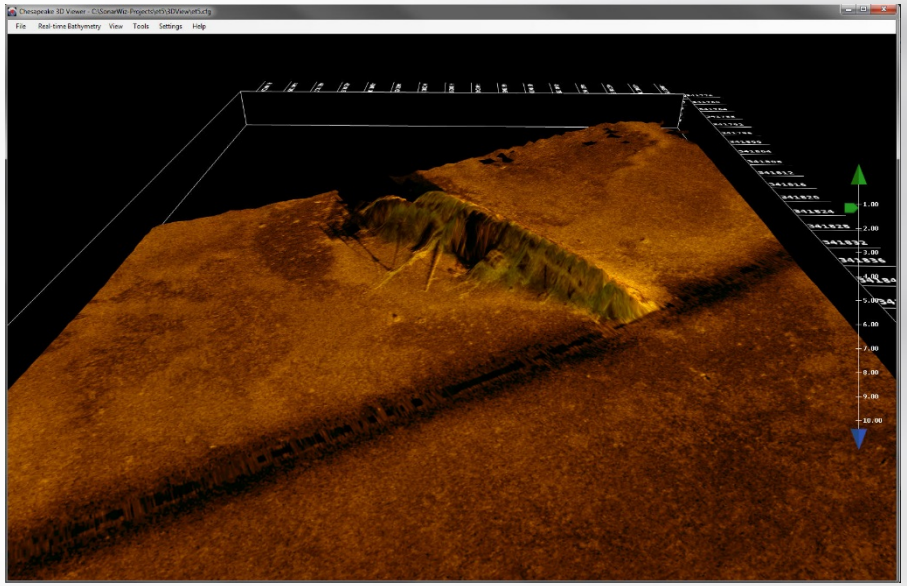
Pipeline Data Example



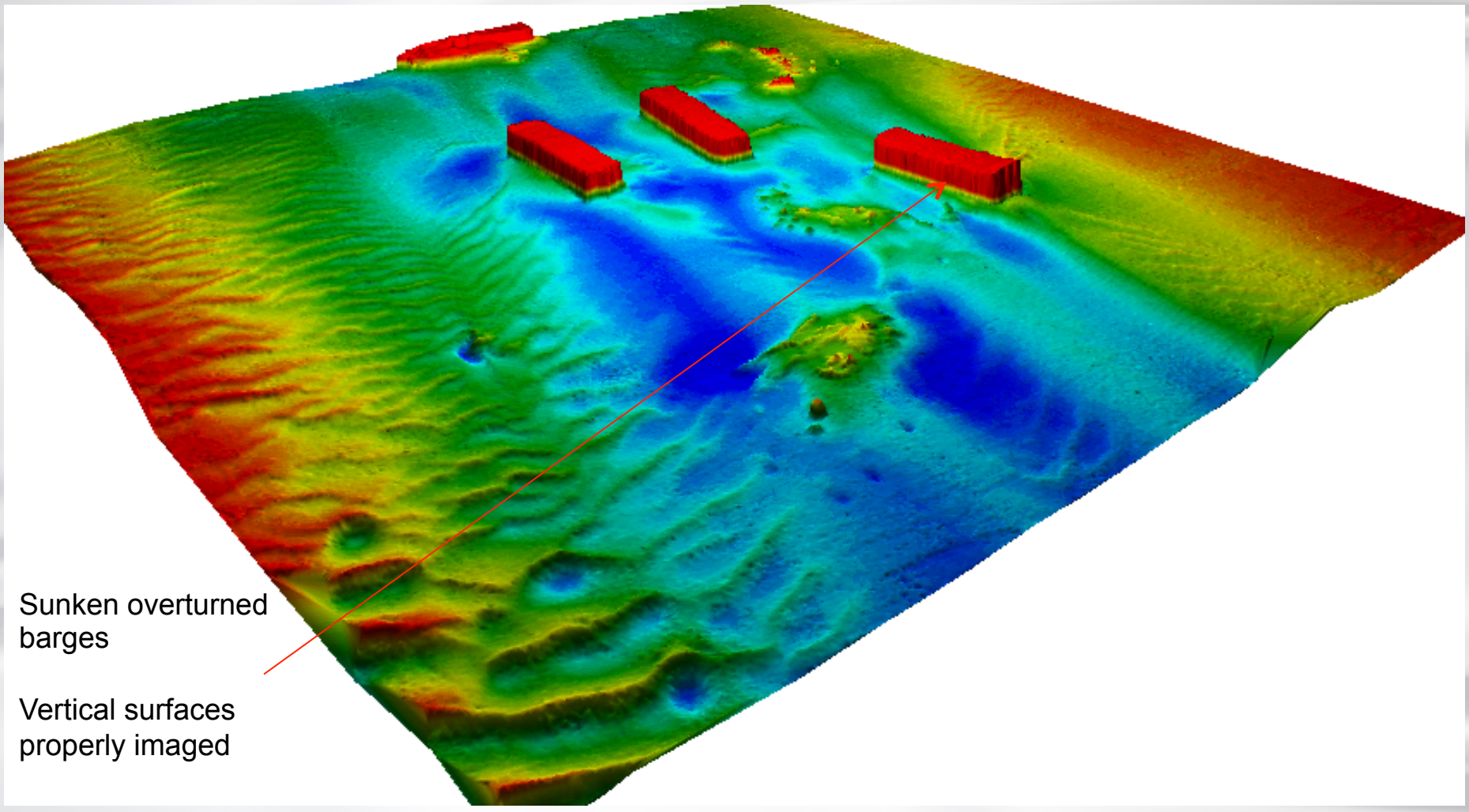
Salvage and Hazard Detection



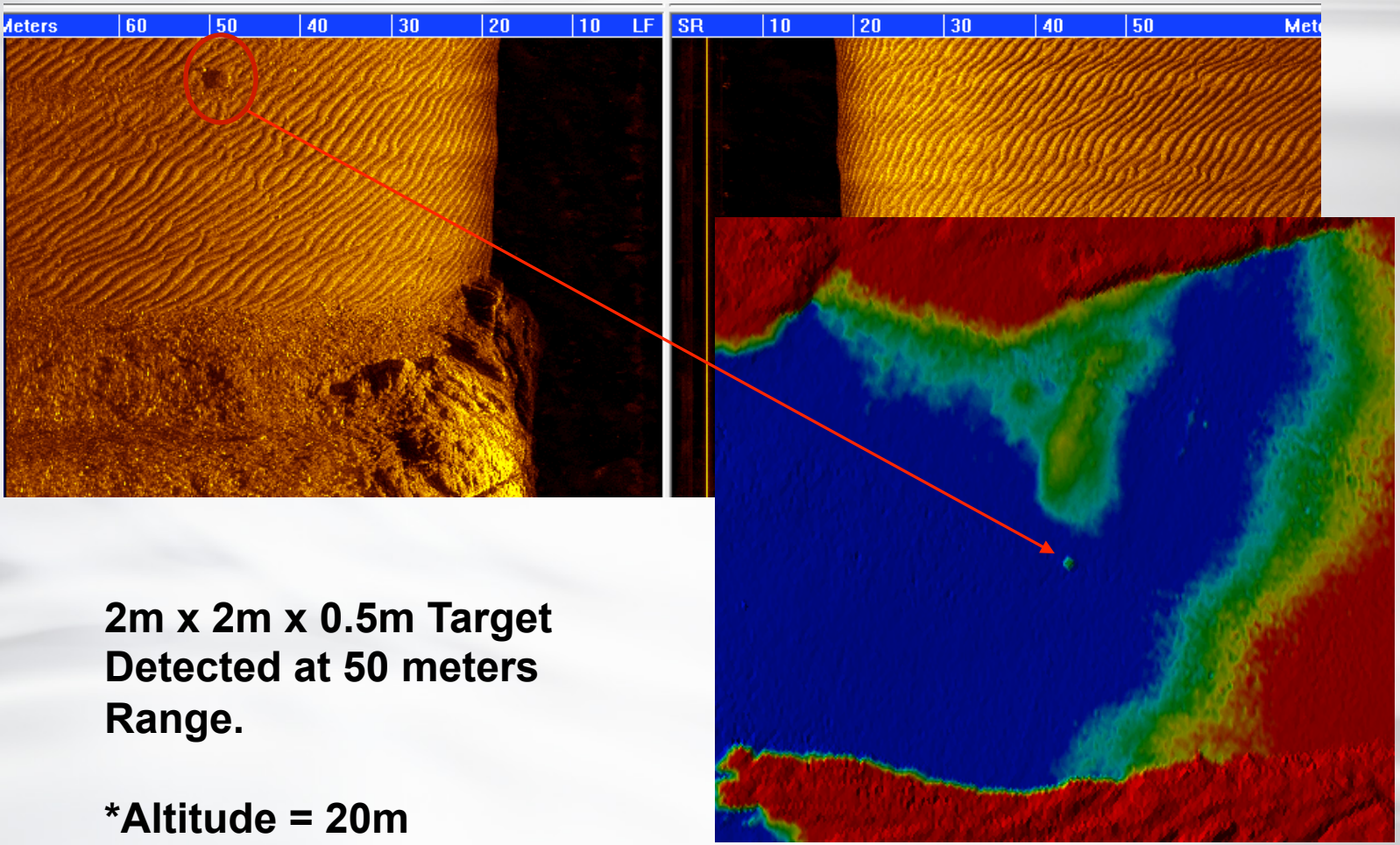




Salvage


Sunken overturned barges
Vertical surfaces properly imaged

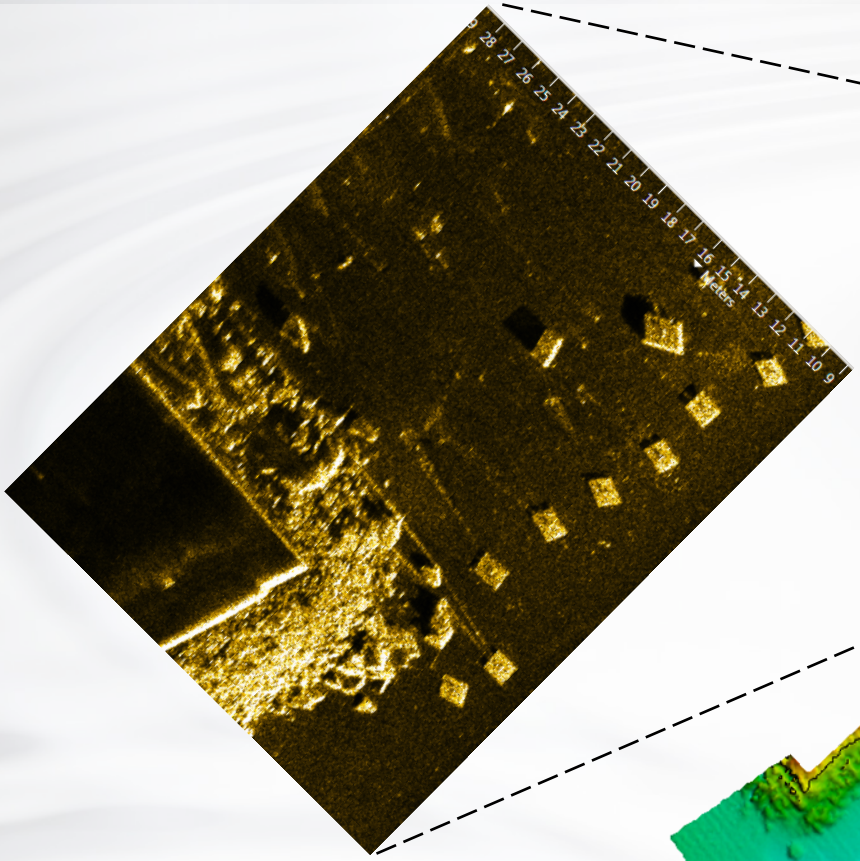
Target Detection

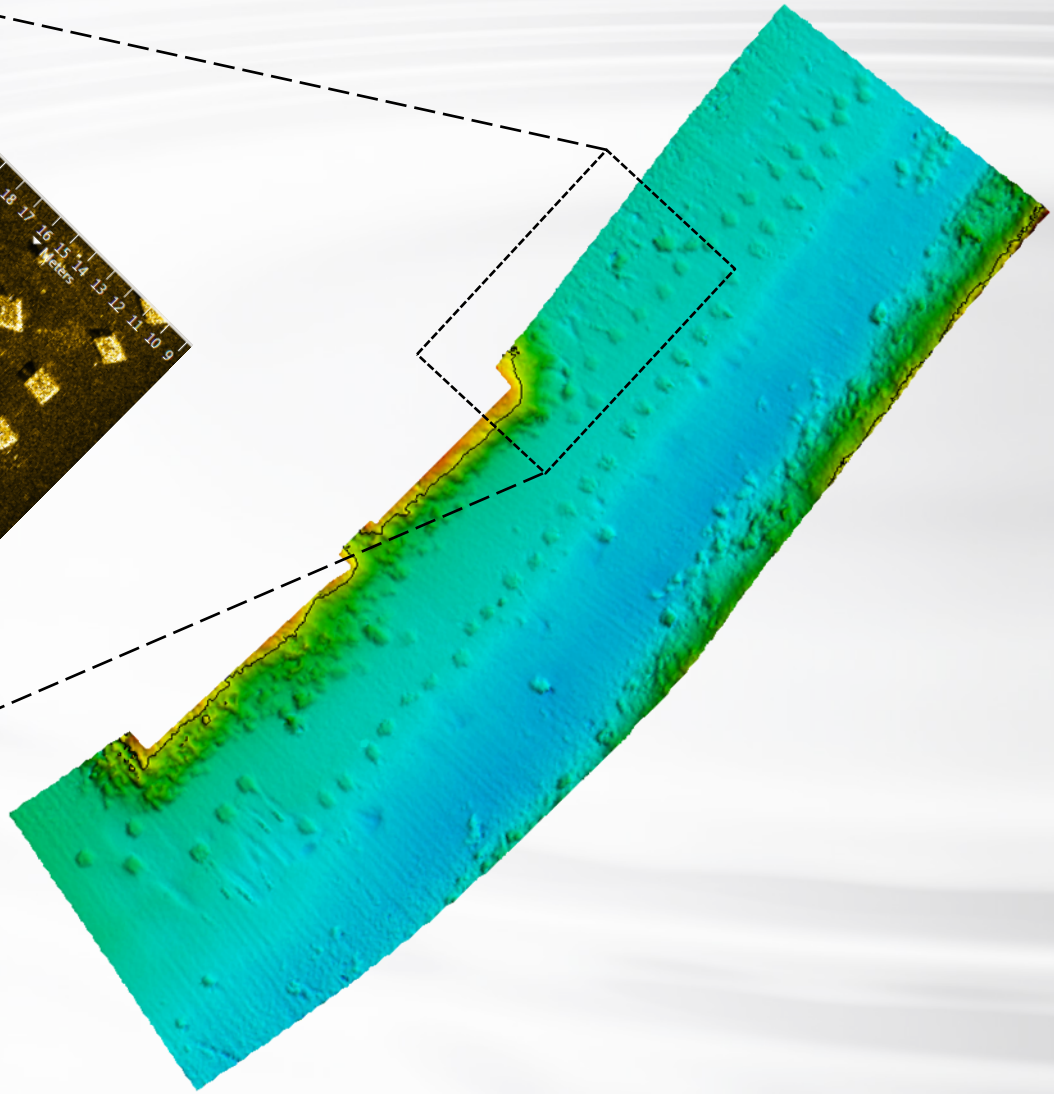


2m x 2m x 0.5m Target Detected at 50 meters Range.

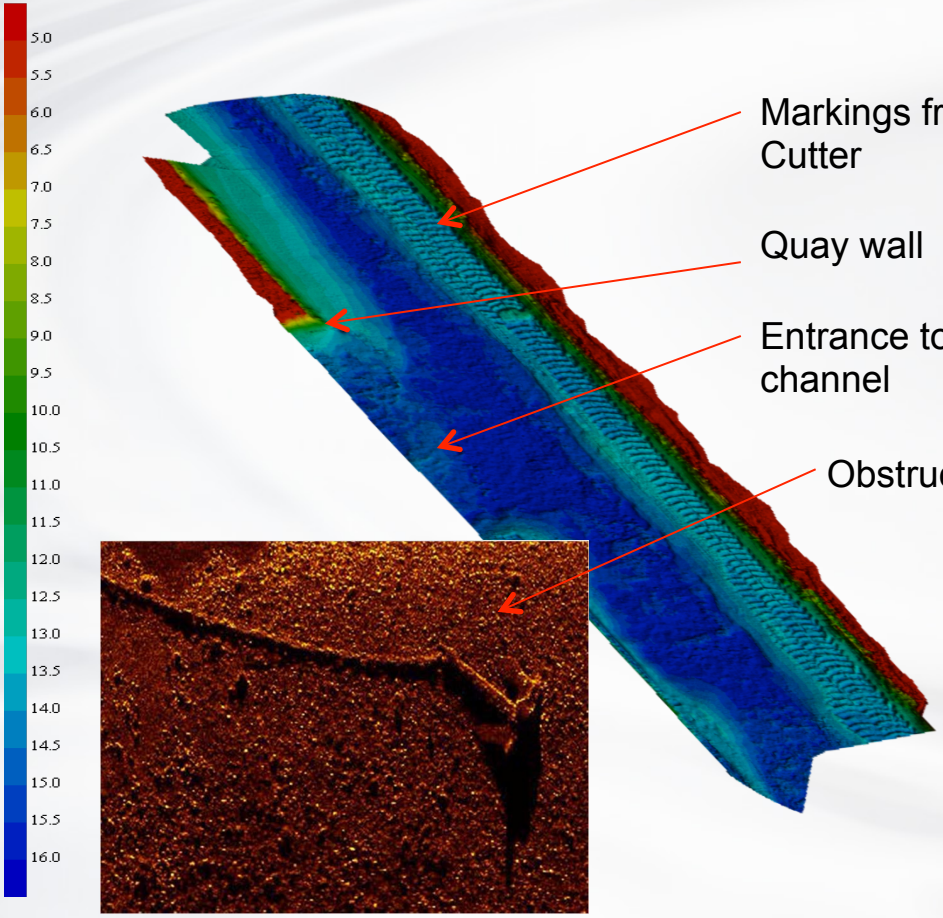
***Altitude = 20m**

Site Clearence

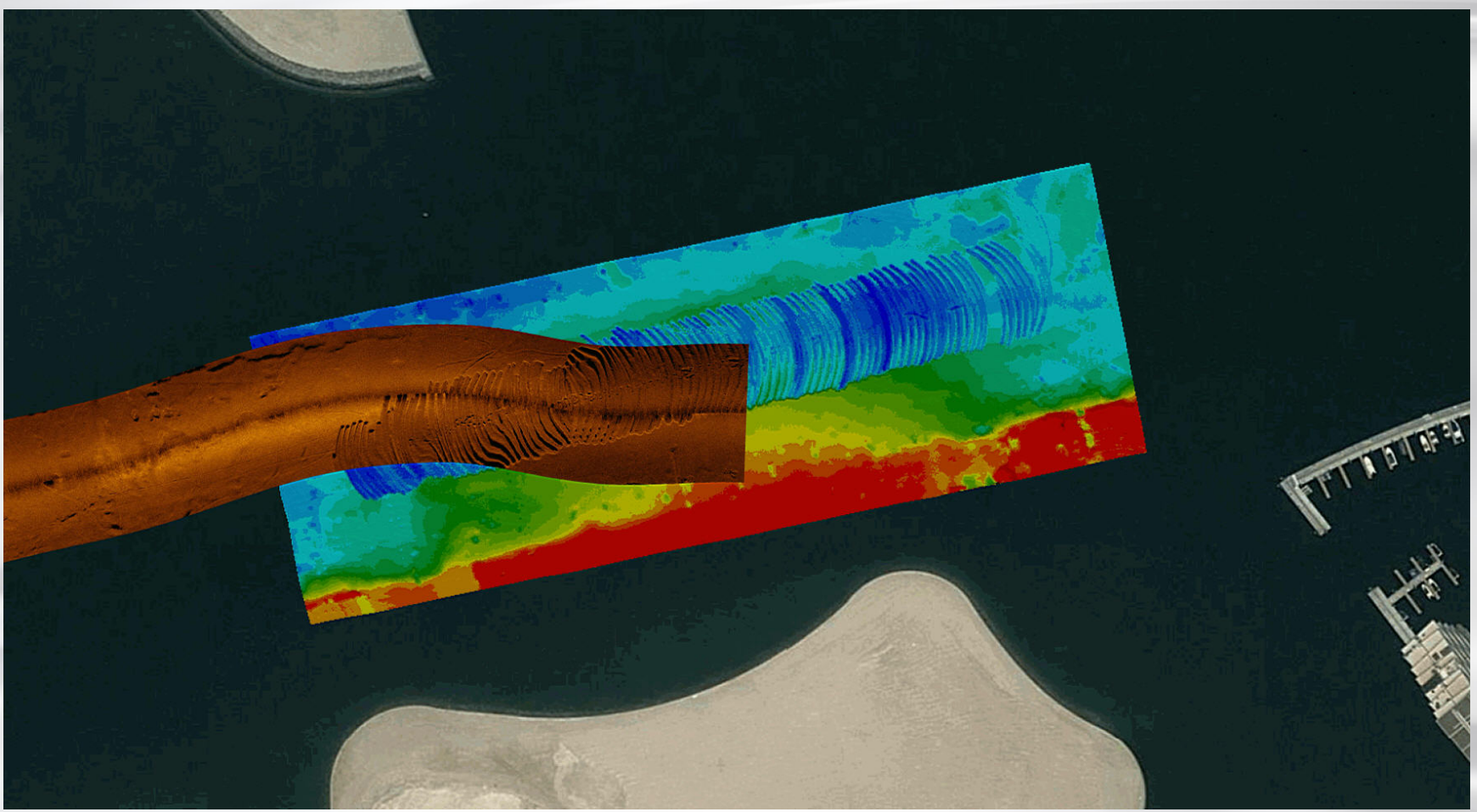




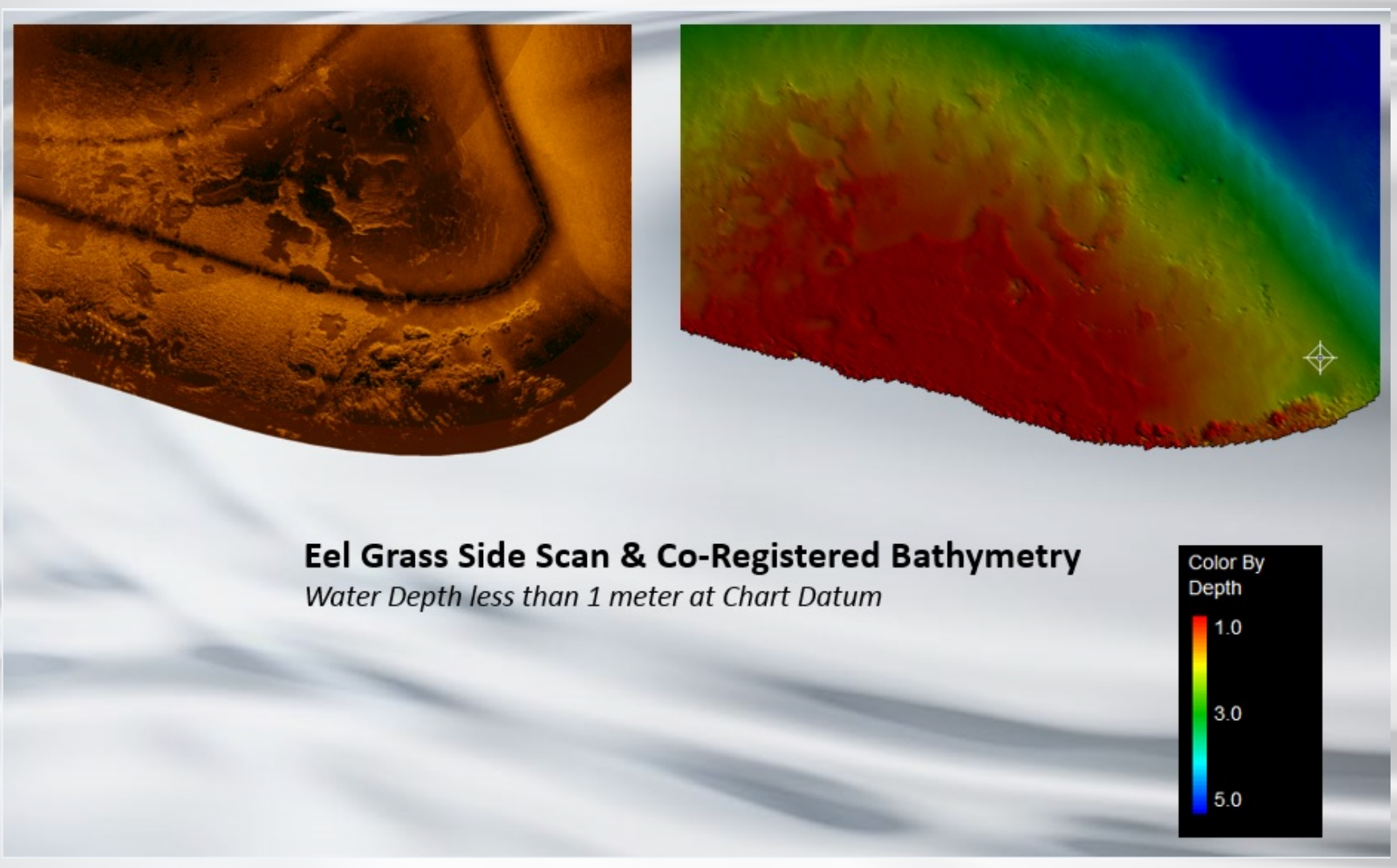
Pre-Dredged Channel



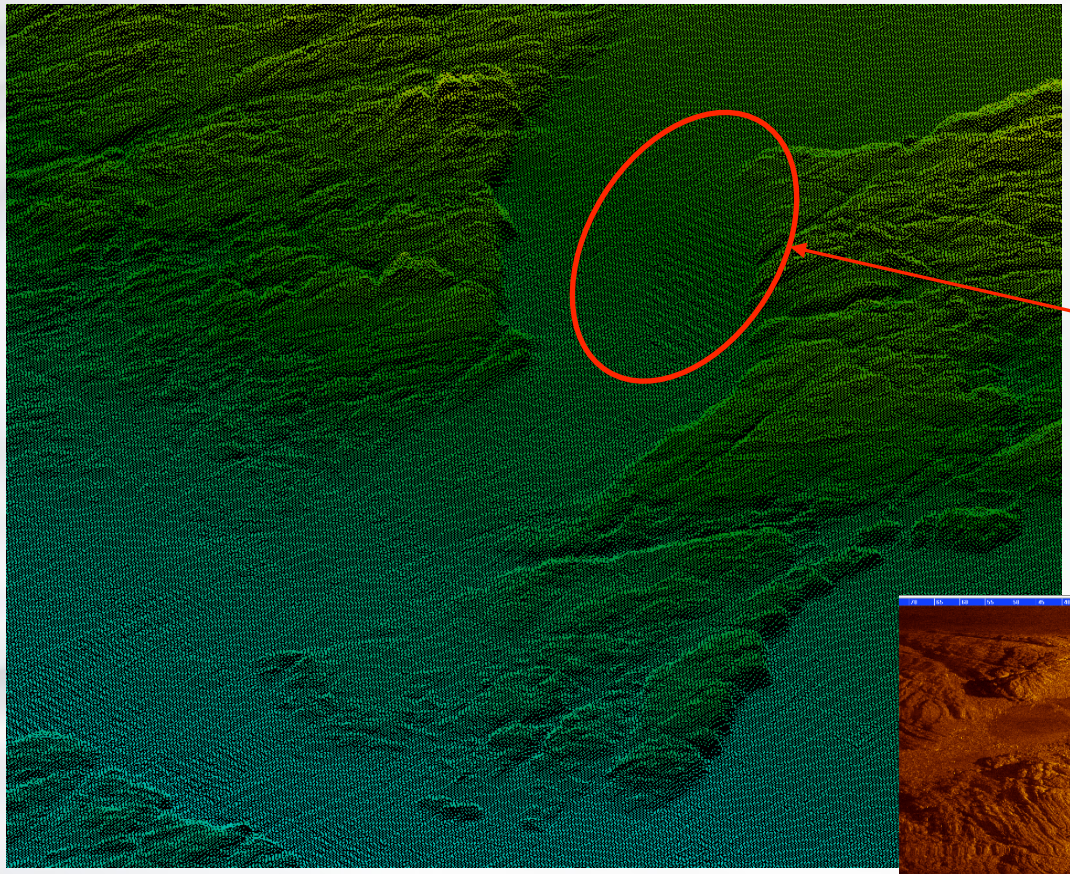
Post-Dredged Channel



Bottom Classification and Habitat Analysis

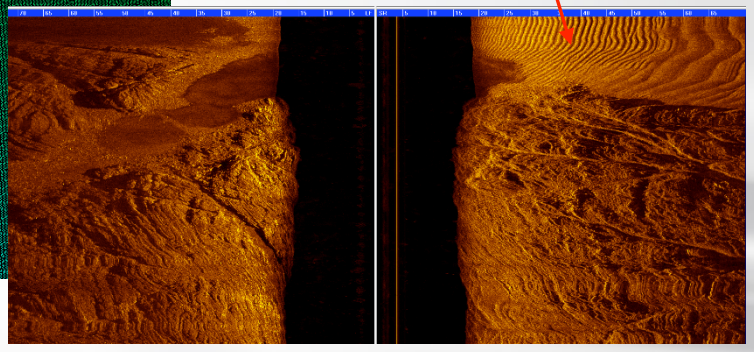


Bottom Classification and Habitat Analysis



High-Density Cloud View of Processed Bathymetry

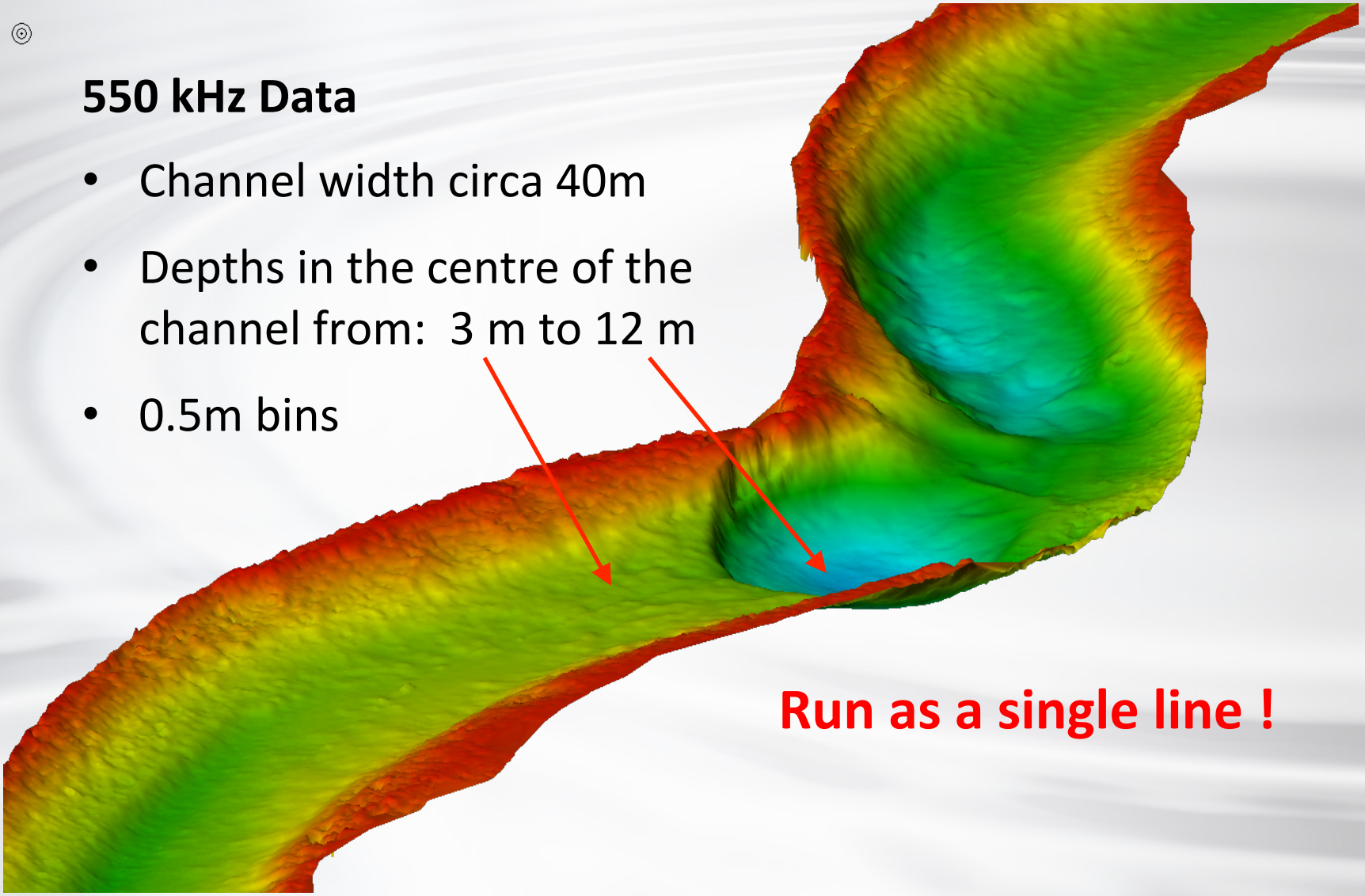
Sand Waves



Data: New River, FL - Swath

550 kHz Data

- Channel width circa 40m
- Depths in the centre of the channel from: 3 m to 12 m
- 0.5m bins



Run as a single line !

Data: New River, FL Overview

Run as a single line !

Acknowledgements

- Geosurvey Mexicana
- SEMAR
- NAVY

EdgeTech

Thank you and please come see us at the booth

EdgeTech