



**МАРИМЕТР**

EdgeTech

Sonar Systems

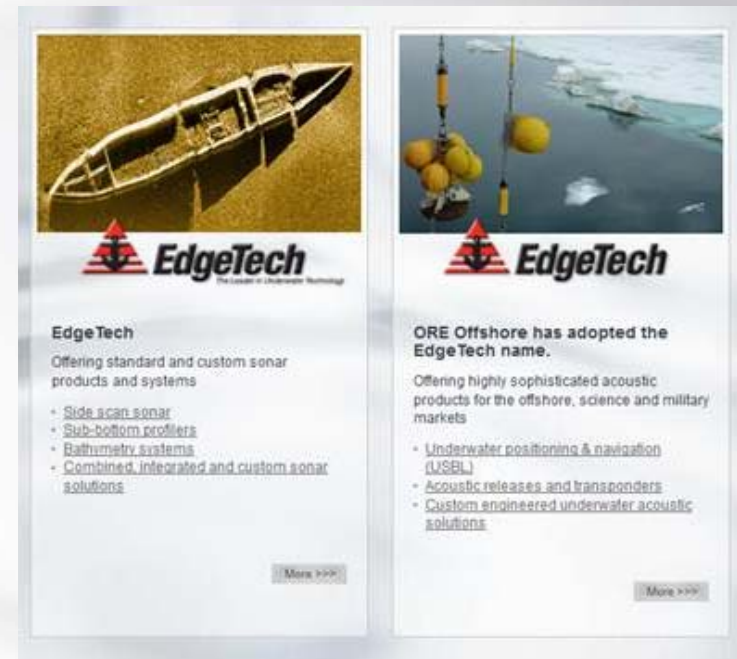
## Introduction : Who we are



- Industry leader in Underwater Acoustics
- EdgeTech (formerly EG&G Marine Instruments)
  - Started in 1966 by Doc Edgerton
- ORE Offshore
  - Formed in 1963

### Common Technologies

**Underwater Acoustics**  
**Digital Signal Processing**

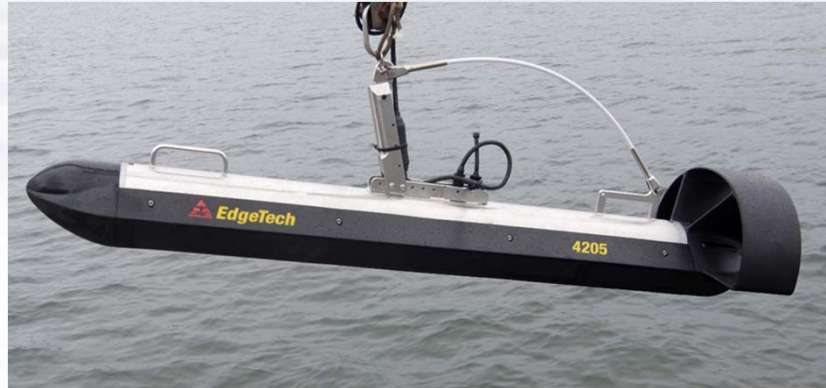


- Facilities in Massachusetts and Florida

# Introduction : Products & Solutions







- Sonar Systems
  - Side Scan Sonar
  - Sub-bottom Profilers
  - Bathymetry
  - AUV/ROV Systems
- Actuated Products
  - Acoustic Releases
  - Pop-up Systems
  - Acoustic Actuators
- Navigation & Positioning
  - USBL Acoustic Tracking Systems



# Products & Solutions : Sonar Systems






	4125 Ultra High Resolution Lightweight Portable	4205 Multipurpose Side Scan System	6205 <sup>S</sup> Bathymetry & Side Scan Sonar	3400 Portable Sub-bottom profiler
				
Side Scan Sonar	✓	✓	✓	
Sub-bottom Profiler				✓
Bathymetry (3-D)			✓	
Frequency options available	400 kHz & 900 kHz 600 kHz & 1600 kHz	Various permutations of 120 kHz, 230 kHz, 410 kHz, 540 kHz, and 850 kHz Tri-frequency and Dual Frequency	230 kHz (230 & 540 kHz SSS) 540 kHz (230 & 540 kHz SSS) 540 kHz (540 & 850 kHz SSS) 540 kHz (550 & 1600 kHz SSS)	2-16 kHz
Depth rating :	200 m	2000 m	Shallow water system	Shallow towed
Bathymetry :			✓	
Multi-Pulse option :		✓		
Dynamic Focusing :				
Configurations :				
Tow fish	✓	✓		✓
Ship or pole mount	✓		✓	✓
AUV/ ROV mount		Option		
Sample Applications:	<ul style="list-style-type: none"> <li>• Hydrographic Surveys</li> <li>• Geological Surveys</li> <li>• <b>Search &amp; Recovery</b></li> <li>• Channel/Clearance Surveys</li> <li>• Bridge/Pier/Harbor Wall Inspection</li> <li>• Hull Inspections</li> </ul>	<ul style="list-style-type: none"> <li>• Hydrographic Surveys</li> <li>• Archeological Surveys</li> <li>• Cable and Pipeline Surveys</li> <li>• Geohazard Surveys</li> <li>• <b>Geological/Geophysical Surveys</b></li> <li>• <b>Habitat mapping</b></li> </ul>	<ul style="list-style-type: none"> <li>• Benthic Habitat Mapping</li> <li>• Dredging Operations</li> <li>• Marine Debris Search</li> <li>• Military Rapid Environ. Assessments (REA)</li> <li>• <b>Shallow Water Hydrographic Surveys</b></li> </ul>	<ul style="list-style-type: none"> <li>• Geological Surveys</li> <li>• <b>Geohazard Surveys</b></li> <li>• Buried Object Location</li> <li>• Mining/Dredging Surveys</li> <li>• Bridge Scour Surveys</li> <li>• <b>Pipeline and Cable Location</b></li> </ul>



# Products & Solutions : Sonar Systems



	2300 Combined Side scan sonar & Sub-bottom	2200 / 2205 Sonars for ROV, AUV, USV	2400 / Specials Deep tows
			
Side Scan Sonar	✓	✓	✓
Sub-bottom Profiler	✓	✓	✓
Bathymetry (3-D)	Option	✓	✓
Frequencies options available	Tri-Frequency SSS 120/410/850 kHz or 230/540/850 kHz	all sub-bottom, side scan and bathymetry frequencies available	75 kHz -540 kHz 230 or 540 kHz (bathy)
	1 – 10 kHz SBP		1-10 kHz 2-16 kHz
Depth rating :	2000 m	options to 6000 m	options to 6000 m
Bathymetry:	Option	Option	Option
Multi-Pulse :		Option	
Dynamic Focusing :		Option	
Configurations :			
Tow fish	✓		✓
Ship or pole mount			
AUV/ ROV mount	✓	✓	
Sample Applications:	<ul style="list-style-type: none"> <li>• Archeological Surveys</li> <li>• Geological/Geophysical Surveys</li> <li>• Sediment Classification</li> <li>• Cable and Pipeline Surveys</li> <li>• Pre/Post Dredging Surveys</li> <li>• Scour/Erosion Investigation</li> <li>• Marine Construction Surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Geohazard Surveys</li> <li>• Geological/Geophysical Surveys</li> <li>• Cable and Pipeline Surveys</li> <li>• Route Surveys</li> <li>• Archeological Surveys</li> <li>• Military surveys</li> </ul>	<ul style="list-style-type: none"> <li>• Geohazard Surveys</li> <li>• Geological/Geophysical Surveys</li> <li>• Cable and Pipeline Surveys</li> <li>• Route Surveys</li> <li>• Archeological Surveys</li> </ul>

EdgeTech

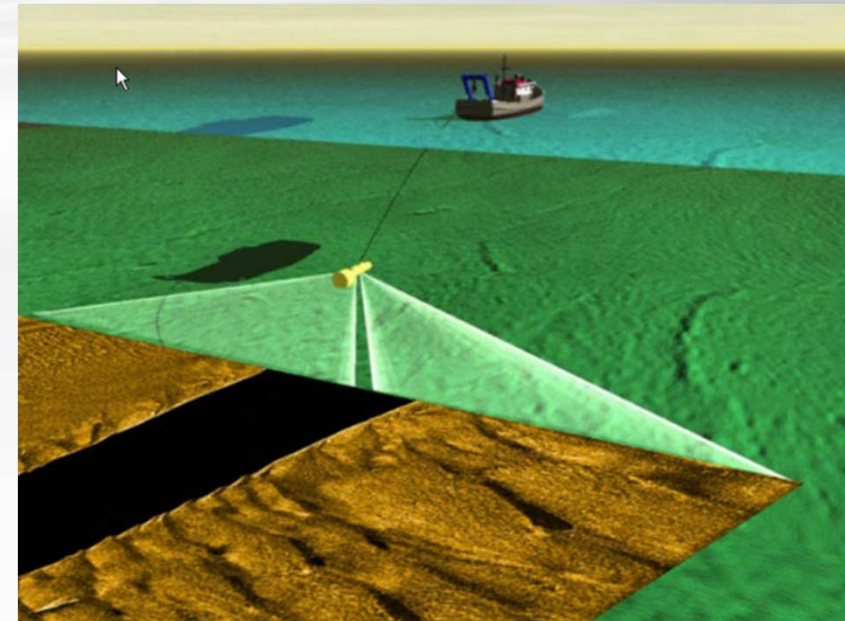
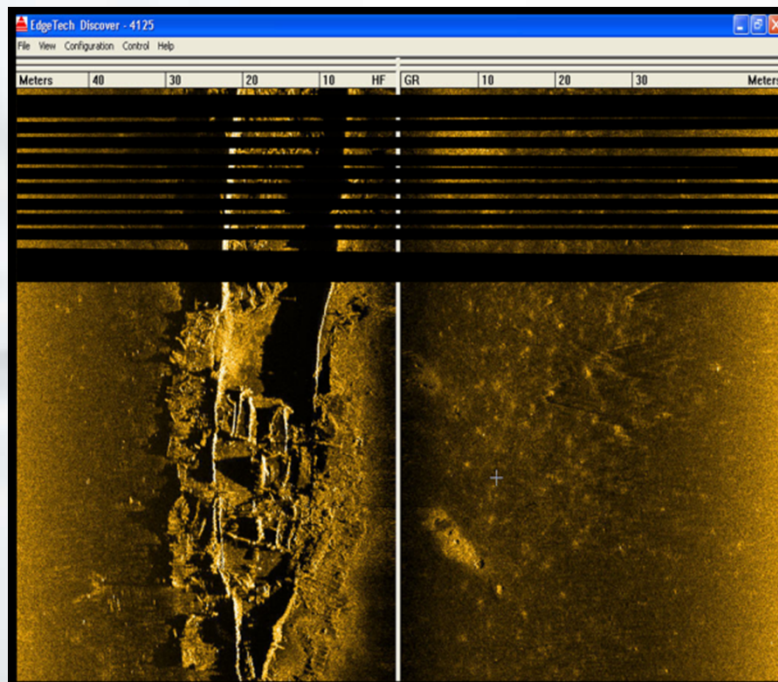
Side Scan Sonar Systems



# Side Scan Sonar



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

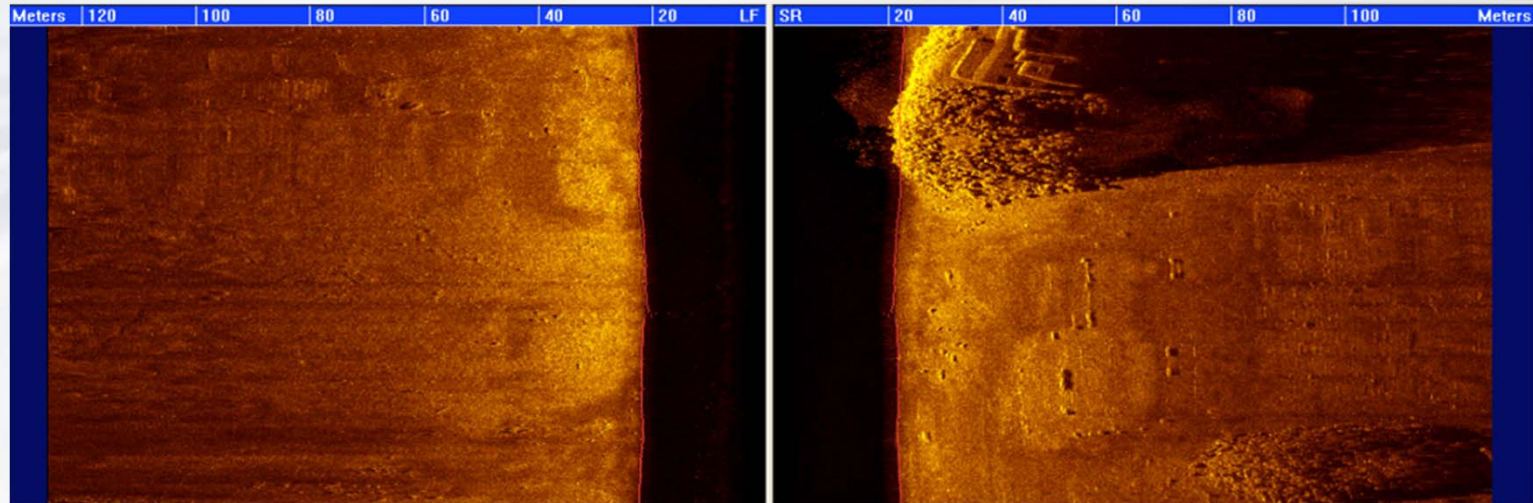


*Image courtesy of Black laser learning*

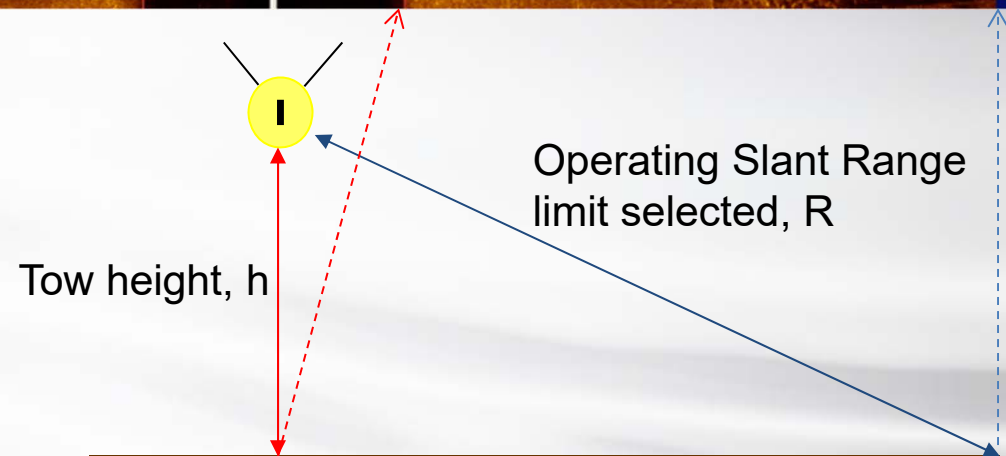
- The sonar sends out sound pulses or pings from each side of the tow fish and then receives or listens for the pulse to return.
- Each ping returns a line of imagery. These pings are combined together to create an image.



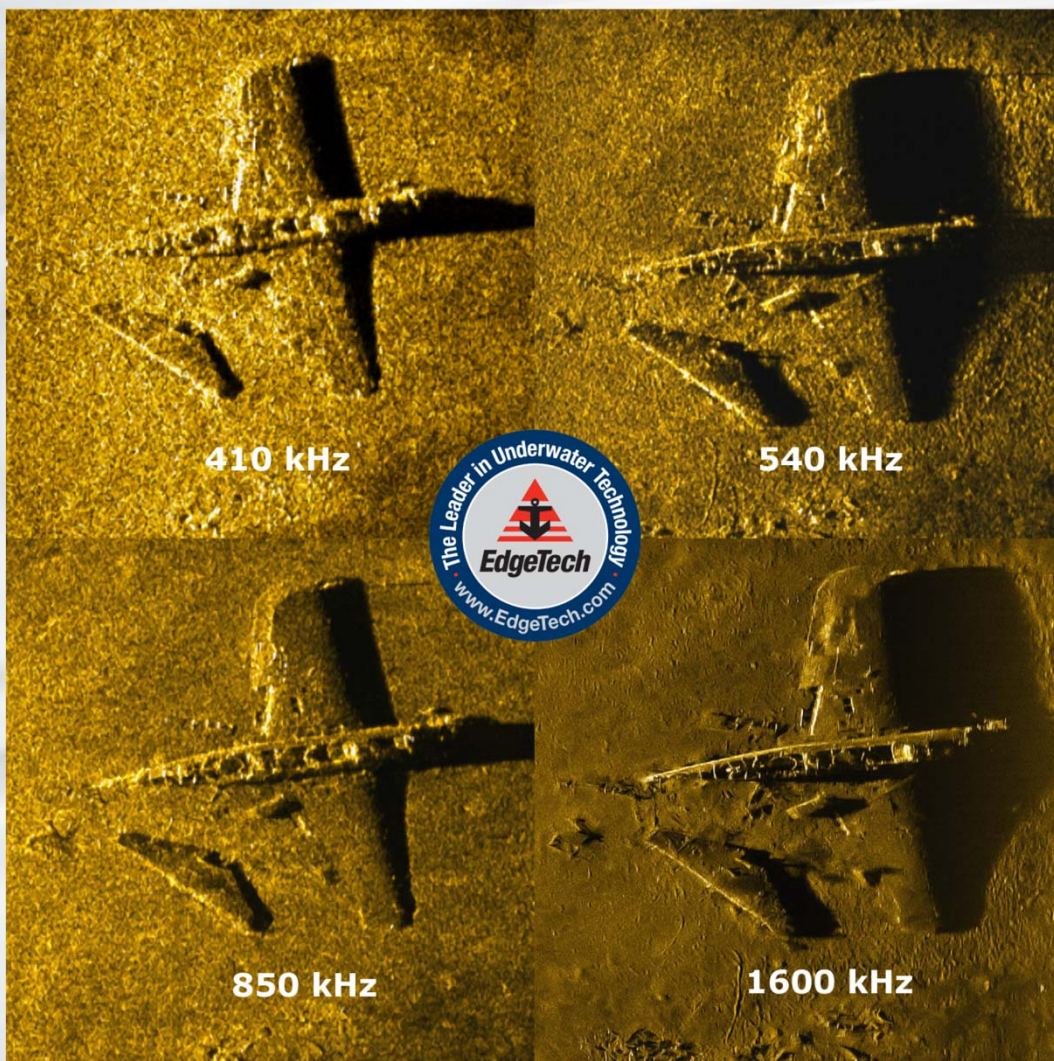
## Side Scan Sonar : Tow Height



- For Side Scan Sonar, the optimum tow height,  $h$ , is 10 – 20 % of the operating slant range selected.



# Side Scan Frequencies



The selection of the best side scan sonar frequency for any application is a compromise between range and resolution. Lower frequency systems provide longer range (allowing a larger area to be covered in each pass), whilst higher frequency systems provide a higher definition image

Chirp Centre Frequency	Nominal Frequency**	Range*
120 kHz	100 kHz	250 to 600m
230 kHz	300 kHz	150 to 350m
410 kHz	400 kHz	130 to >200m
540 kHz	600 kHz	100 to 150m
850 kHz	900 kHz	50 to 75m
1600 kHz	1600 kHz	20 to 35m

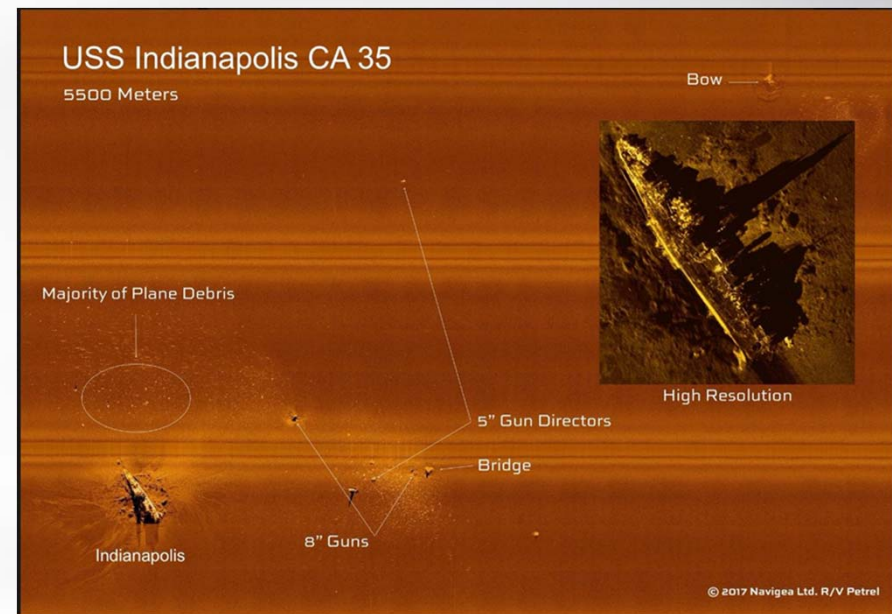
\*Range quoted is the range either side of the towfish, so the swath is approximately double this.

\*\*You will sometimes see the 'nominal' frequency quoted in specifications and marketing material.



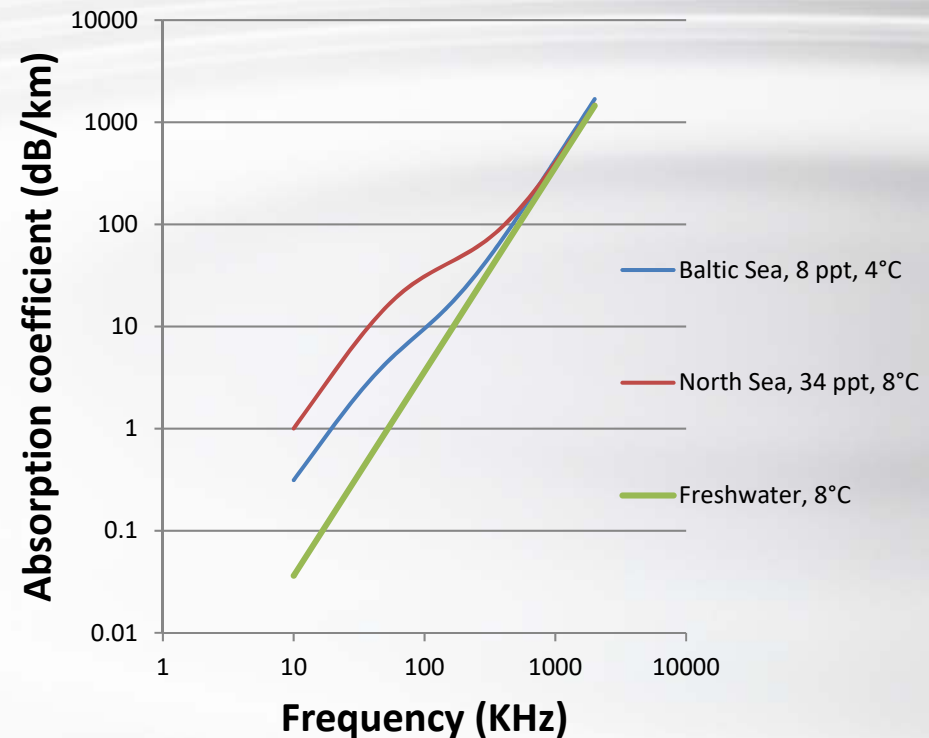
- Definition of maximum Range?

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



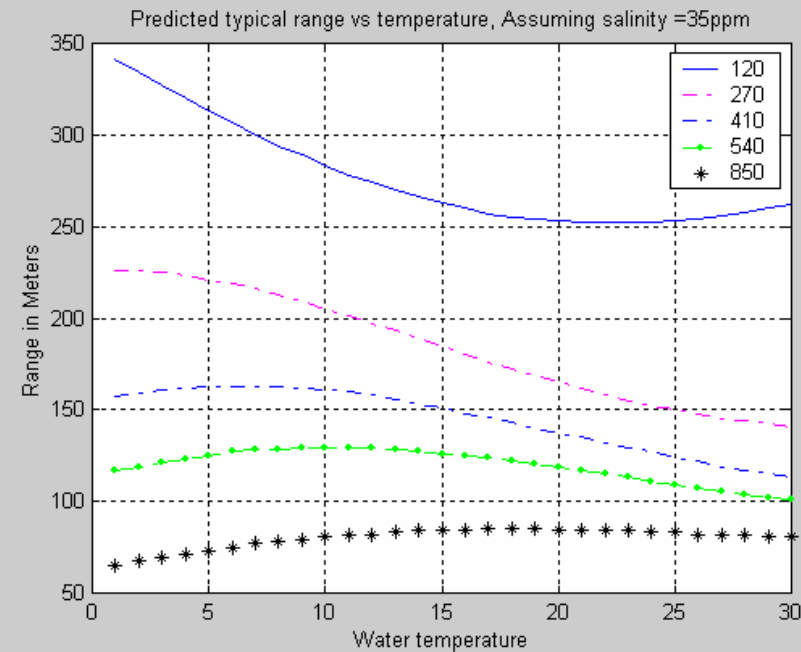
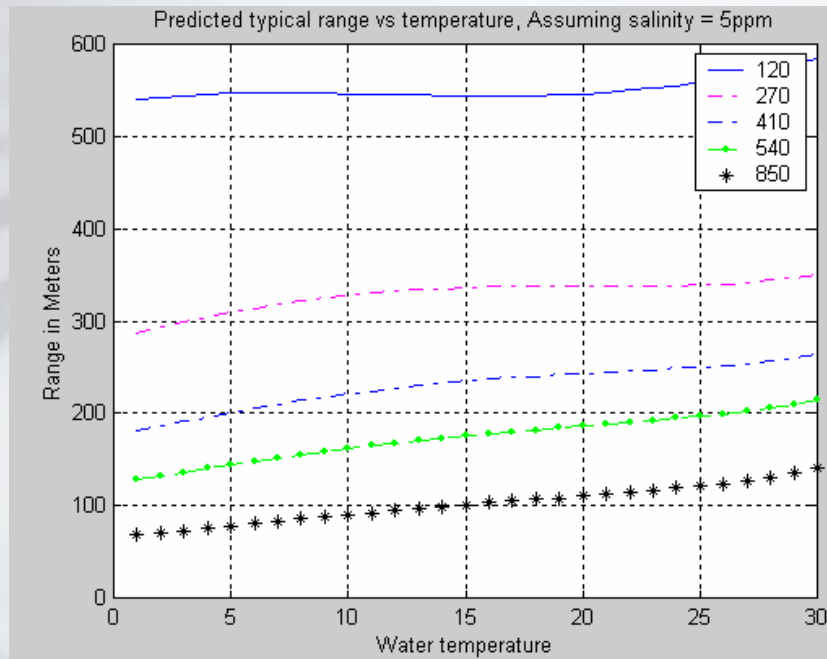
- Either way, it's a matter of signal strength and noise.

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



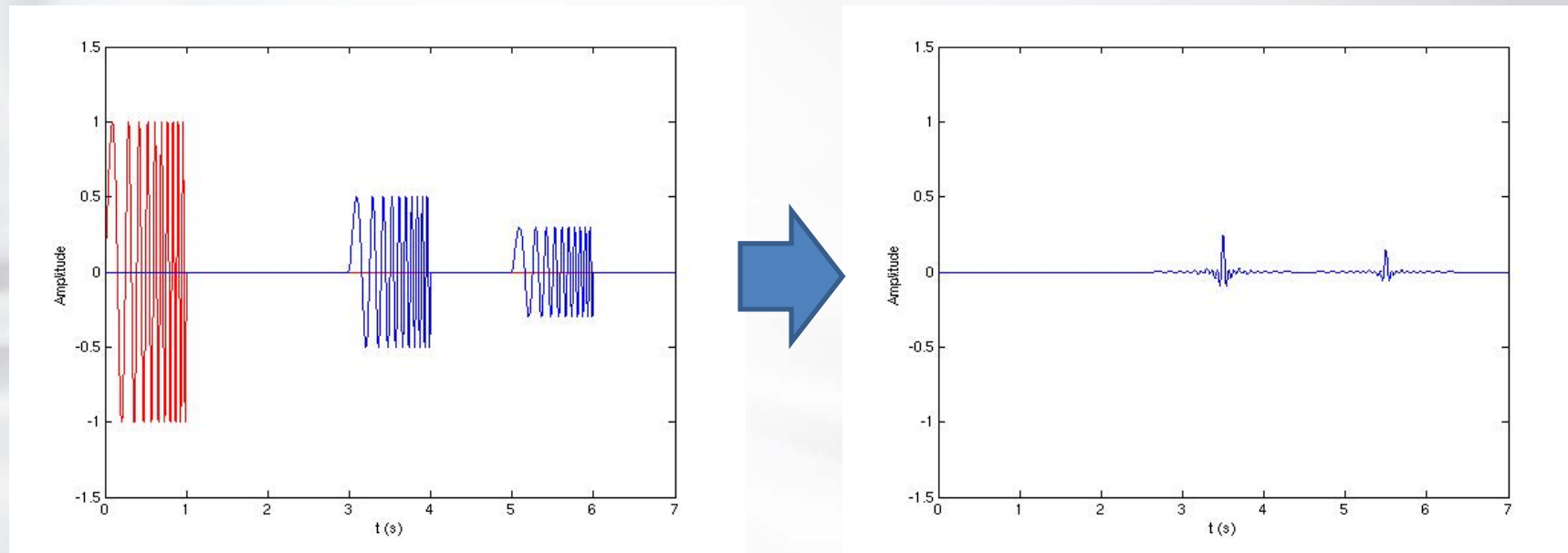
- Michael A. Ainslie and James G. McColm, "A simplified formula for viscous and chemical absorption in sea water", Journal of the Acoustic Society of America, 103(3), 1671-1672 (1998).
- R. E. Francois and G. R. Garrison, "Sound absorption based on ocean measurements. Part II: Boric acid contribution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

# Absorption : Effect on Range



- At lower frequencies (100 – 400 kHz) the predicted range increases at lower temperatures, for example in deep water.
- At higher frequencies (500 – 1600 kHz) it decreases at lower temperatures .
- For more detail see Application Note on [www.edgetech.com](http://www.edgetech.com).

- 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

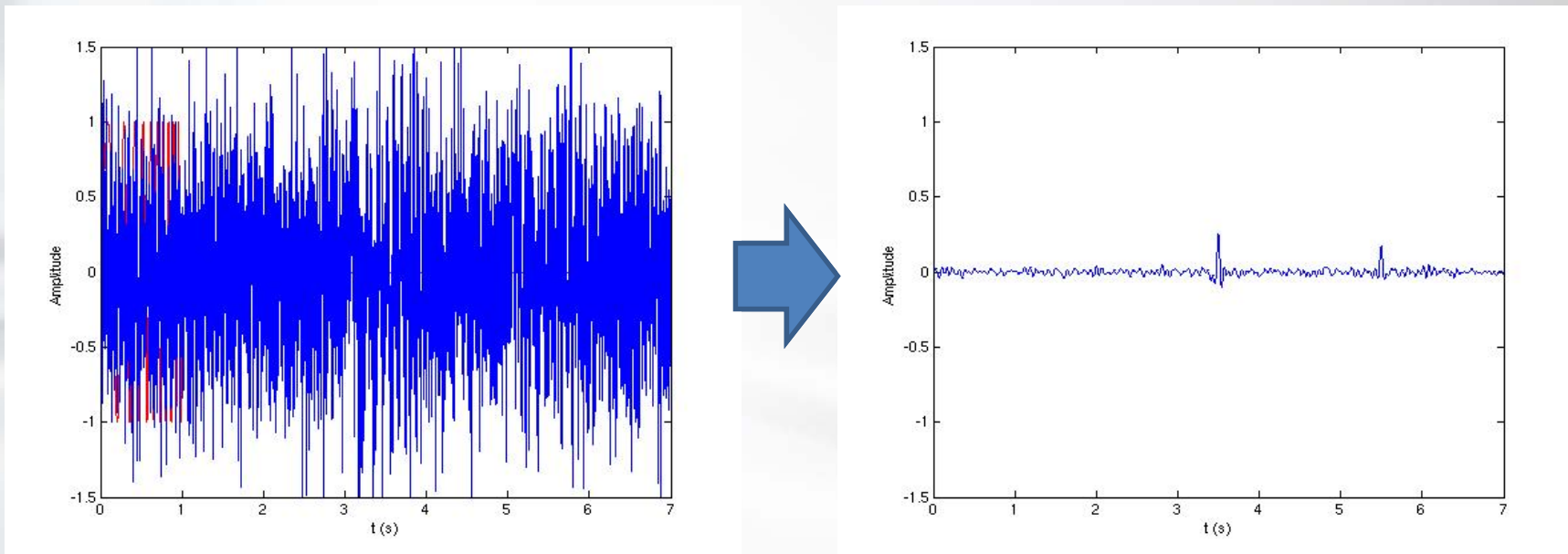


[http://en.wikipedia.org/wiki/Pulse\\_compression](http://en.wikipedia.org/wiki/Pulse_compression)

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



- Linear FM chirp pulses (again!)
  - Implementation of matched filter processing
    - As before, but with added white noise



[http://en.wikipedia.org/wiki/Pulse\\_compression](http://en.wikipedia.org/wiki/Pulse_compression)

More Signal...

Less Noise....

Better Range

## 4125i : Shallow water side scan



- Target Markets
  - SAR
  - Shallow water survey
- Features
  - CHIRP capability
  - Coax Cable operation



## 4125i Cable options



Portable topside processor  
or Rack mount topside processor

Coaxial Towcable

***Standard cable options***

<i>0.375" (9.5mm) Urethane jacketed cable</i>	<i>up to 300m max.</i>
<i>0.25" (6.5 mm) Steel armoured cable</i>	<i>up to 250m max.</i>
<i>0.322" (8.2 mm) Steel armoured cable</i>	<i>up to 400m max.</i>
<i>0.45" (11.4 mm) Steel armoured cable</i>	<i>up to 600m max.</i>

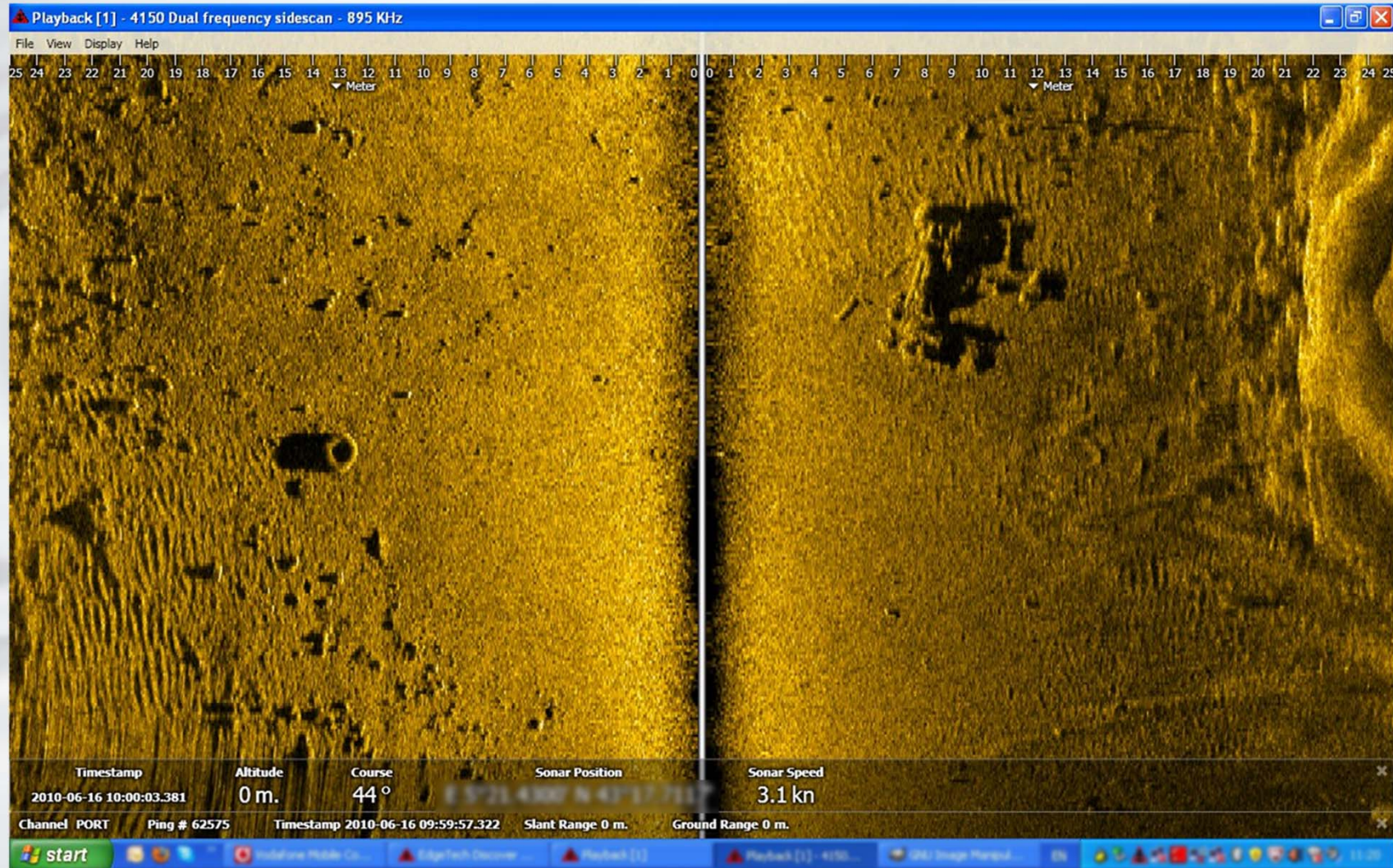
Digital Simultaneous Dual Frequency Towfish  
400 & 900 kHz or 600 & 1600 kHz

***Ranges***

<i>400 kHz</i>	<i>150m</i>	<i>600 kHz</i>	<i>120m</i>
<i>900 kHz</i>	<i>75m</i>	<i>1600 kHz</i>	<i>35m</i>



# 4125 Data Examples

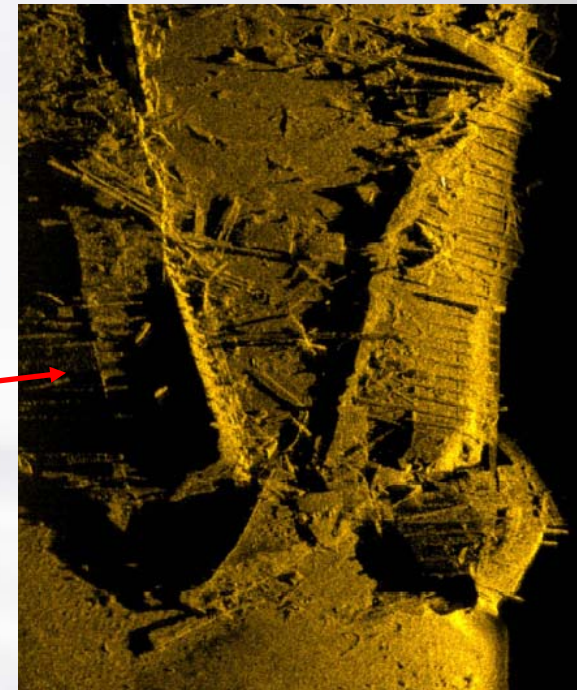




## 4125 Data Examples

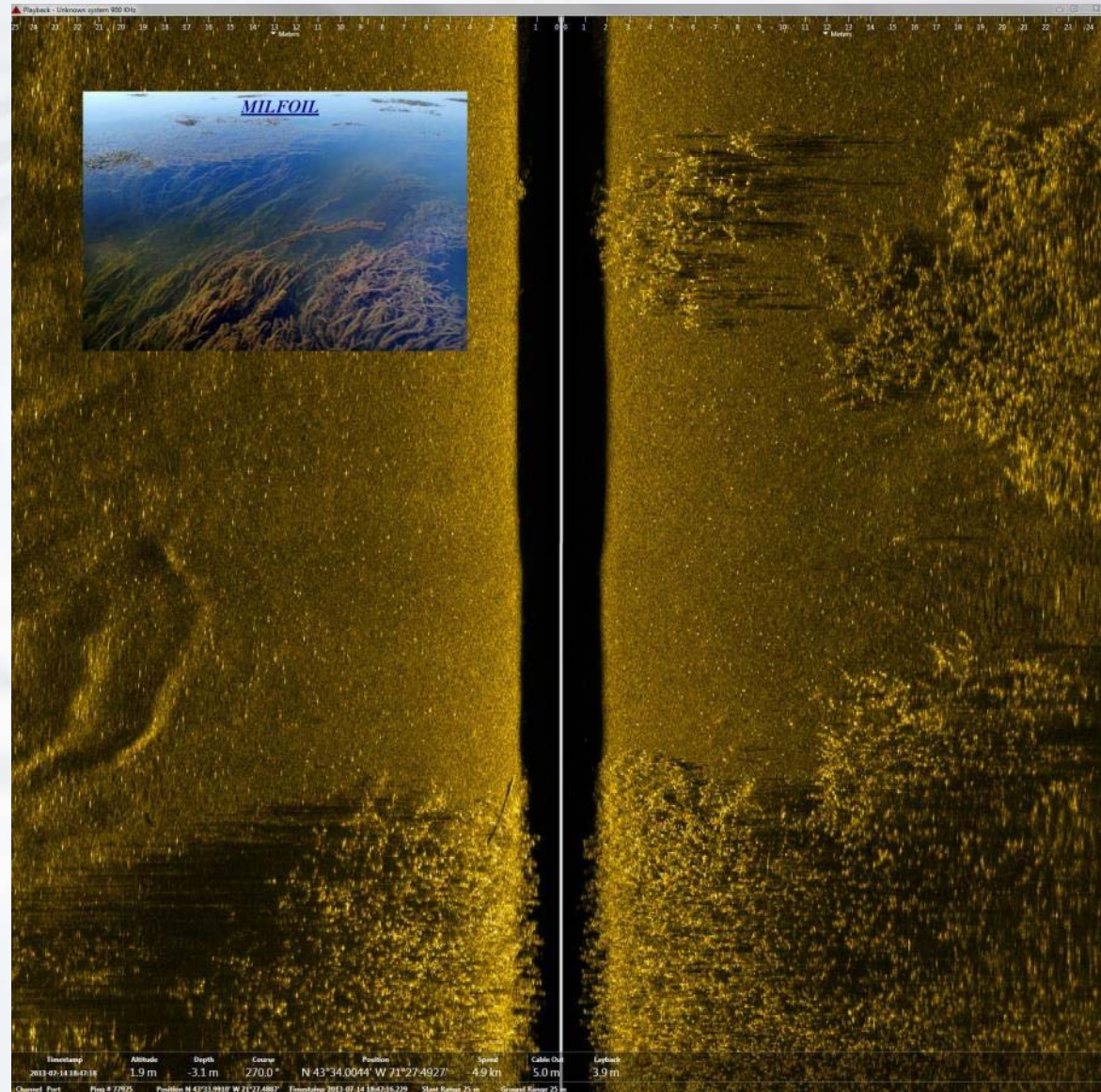


Wreck of the Yankee  
**1600 kHz data**  
from a 4125  
600/1600 System.

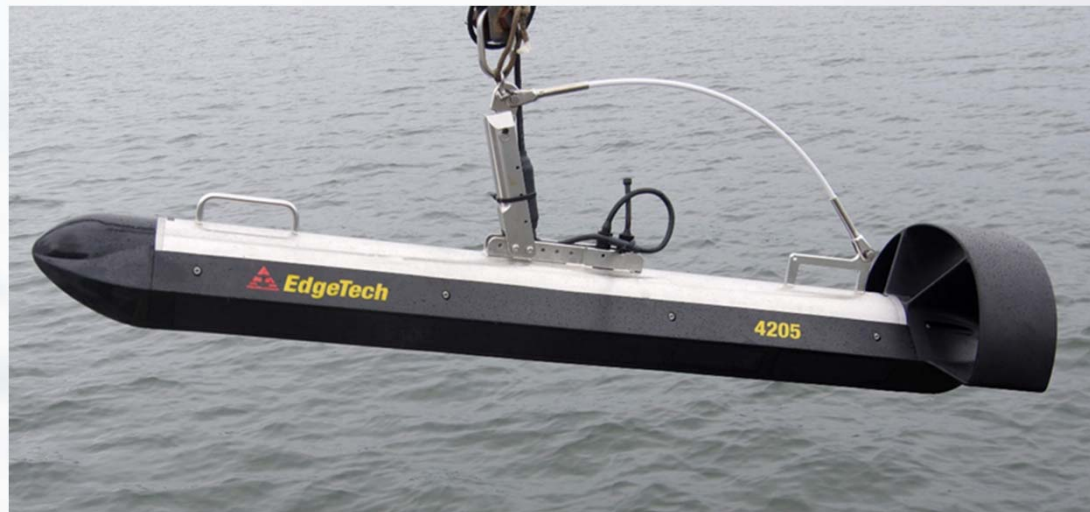




## Data Example – Habitat Mapping



- “The Workhorse”
  - General Survey Use



- Replaces the very successful 4200

- The EdgeTech 4205 builds on the success of the 4200, whilst providing improvements in a number of key areas :
  - ✓ Improved range performance
  - ✓ Improved resolution
  - ✓ Options for an improved Heading sensor
  - ✓ Increased power for external sensor
  - ✓ Backward compatibility with more recent 4200 topsides

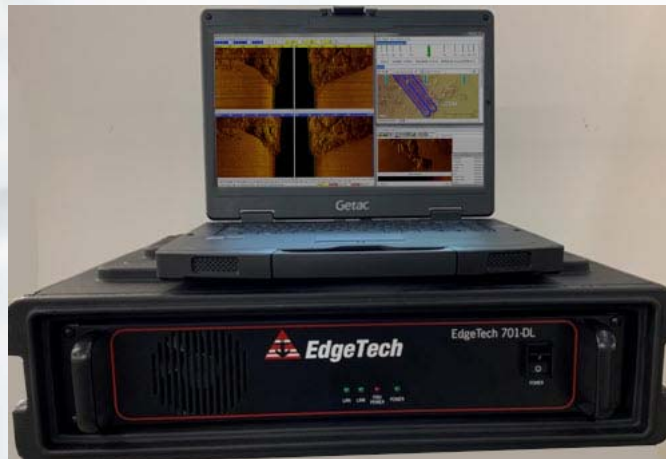


## 4205 Topside Options



### 701-DL

- 19" Rackmount (2U), for use with a customer supplied PC or
- Optional Semi-rugged Laptop
- Limits power that can be provided to external sensors from a 4205 towfish to 1 Amp (27W)



### StarMux IV

- 19" Rackmount (3U), for use with a customer supplied PC or
- With 2U Rackmount PC in case, complete with external monitors, keyboard and trackball
- Allows a 4205 towfish to provide the full 3 Amp (80W) to external sensors

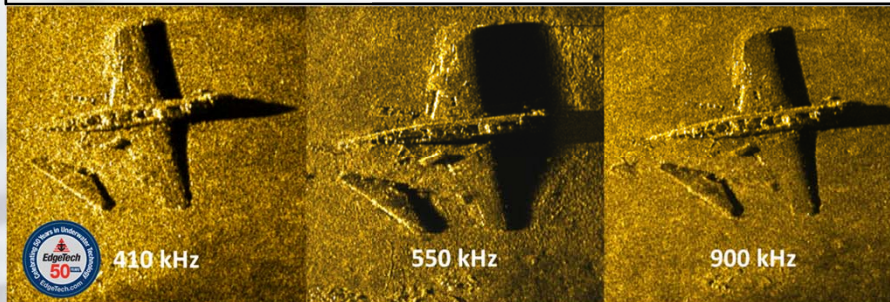




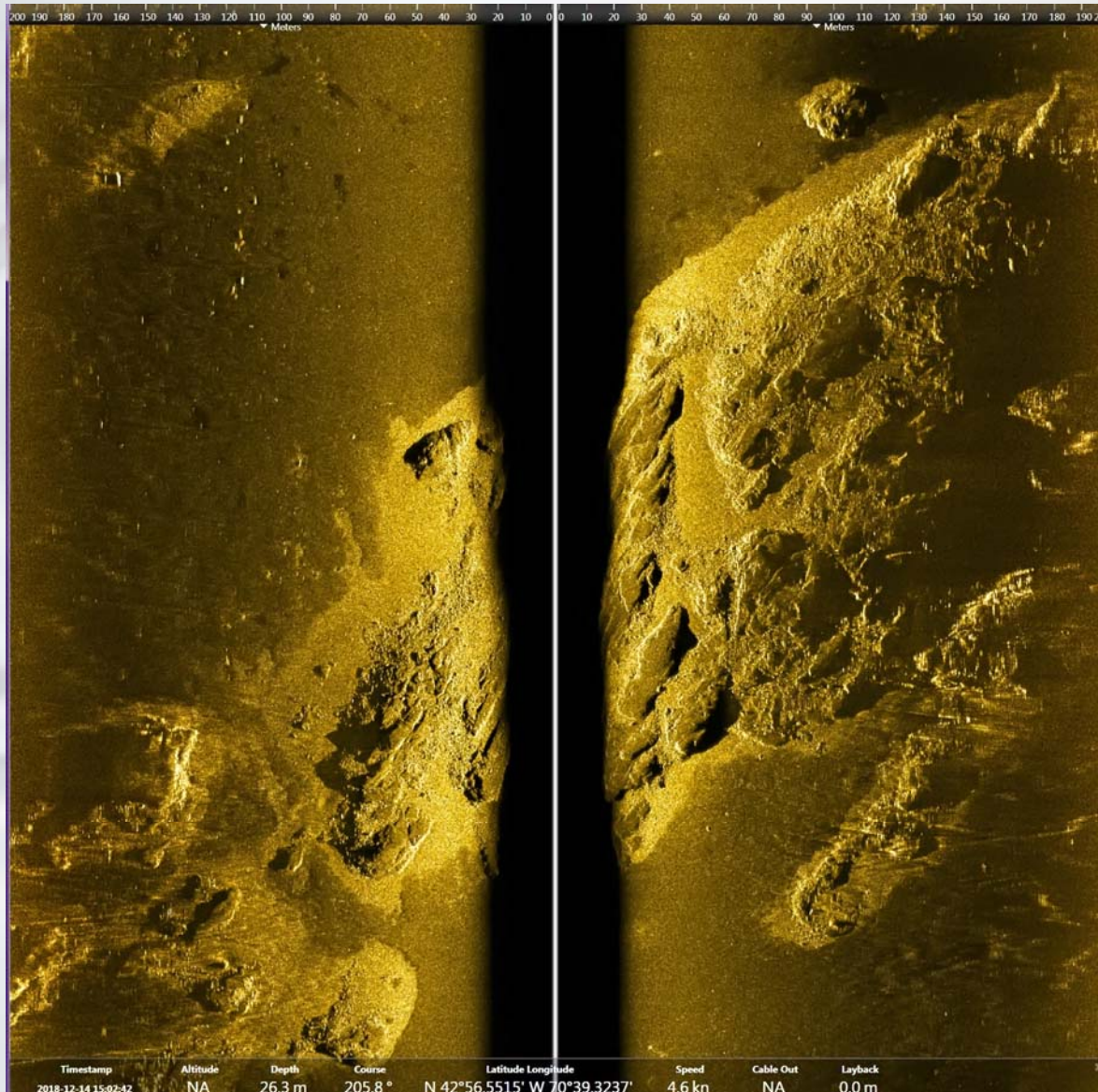
# 4205 Towfish Options



- 4205 Tri-Frequency
  - Simultaneous dual frequency
  - Same system can be used for multiple roles
  - On-the-fly re-configuration for user optimisation of range and resolution
  - 120 & 410 & 850 kHz
  - 230 & 550 & 850 kHz
- 4205 Dual Frequency MP / MT
  - 120 & 410 kHz Side Scan
  - 230 & 540 kHz Side Scan
  - 230 & 850 kHz Side Scan
- Operating modes
  - High Definition Mode
  - Multi-Pulse / Motion Tolerant Mode



## 4205 : Range Performance



200m range at 410 kHz

Frequency	4200	4205
120 kHz	500m	600m
230 kHz	230m	300m
410 kHz	150m	200m
540 kHz	120m	150m
850 kHz	75m	75 - 90m

- Why do we care ?
  - Better imaging with more ‘hits’ on a target
  - Specifications
    - IHO
      - Manual on Hydrography M-13 Ch 4
      - the minimum number of returns to make a discernible mark on the trace is taken as five
    - NOAA
      - The hydrographer shall tow the side scan sonar at a speed such that an object 1 m on a side on the sea floor would be independently ensonified a minimum of three times per pass.

The general rule is 3 ‘hits’ on a 1m target per pass



Aim is for 3 hits on a 1m target

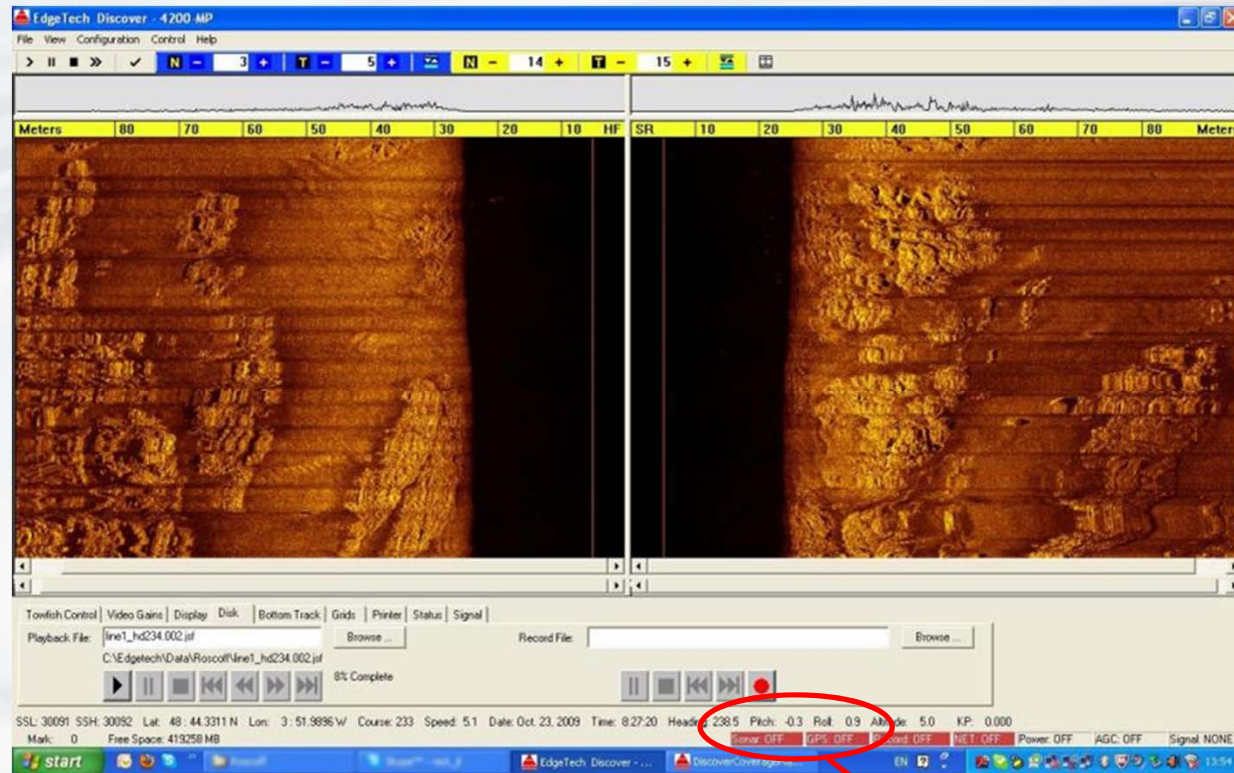
- Based on travelling a distance  $d$  between pings
  - Typical:  $d = 0.33$  m, Range  $R = 125$  m
  - $V_{1p}$  (single pulse)  $\leq 2$  m/s (3.9 knots)
  - $V_{2p}$  (2-pulse multipulse)  $\leq 4$  m/s (7.8 knots)
- Or more hits on the same target size, at the same speed....

## 4205 : Multi-Pulse in Practice



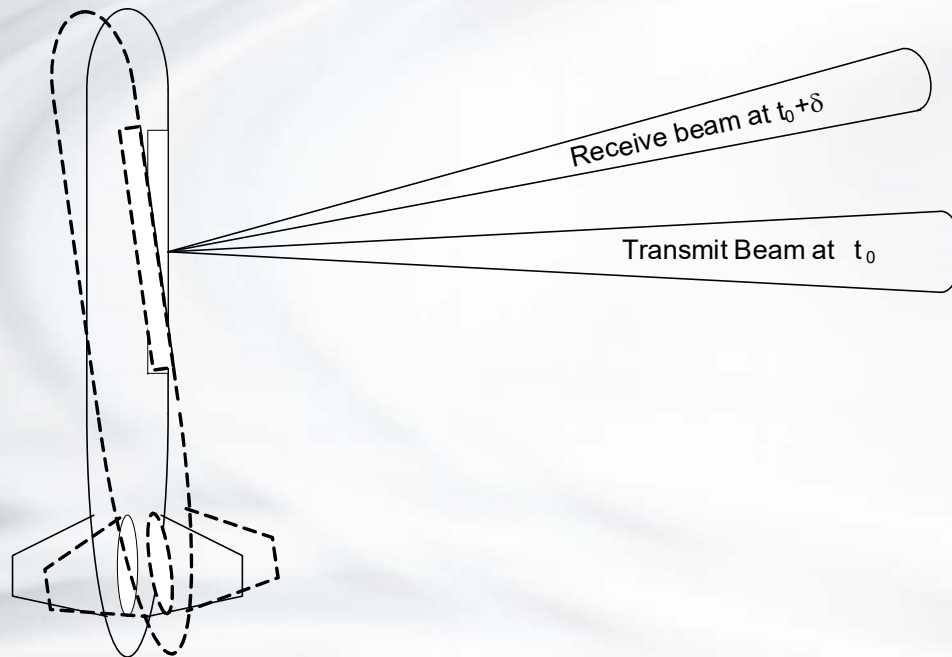
HDM High Definition Mode	HSM High Speed Mode
In HDM, the 4205 operates as a conventional 'single pulse' simultaneous dual frequency system.	In HSM, the 4205 uses EdgeTech's Multi-Pulse technology to operate as a 2 pulse 'multi-pulse' simultaneous dual frequency system.
Combines 2 sub-arrays into an extra long array.	Uses one sub-array for transmit and the other for receive.
<ul style="list-style-type: none"><li>Longer Arrays give narrower beam widths, so better resolution.</li></ul>	<ul style="list-style-type: none"><li>More pings on a target, or higher speed operations for the same number of pings on a target.</li><li>Motion Tolerance reduces weather dependency</li></ul>
Some customers prefer HDM.	Allows the system to be towed at speeds of up to 10 knots while meeting NOAA and IHO-44 requirements for minimum 3 pings on a 1 meter target.

# Motion Tolerance to Weather Effects



- 'Banding' becomes apparent in the data as the weather worsens
- Check the pitch and roll data from the towfish to see if towfish motion is worsening as well.





- Yaw and Pitch induce artefacts in the data
  - If Yaw motion is too rapid, the receive beam can end up with no signal
  - A function of the **Rate of change** of yaw / pitch

When does this happen ?



- Becomes apparent when:

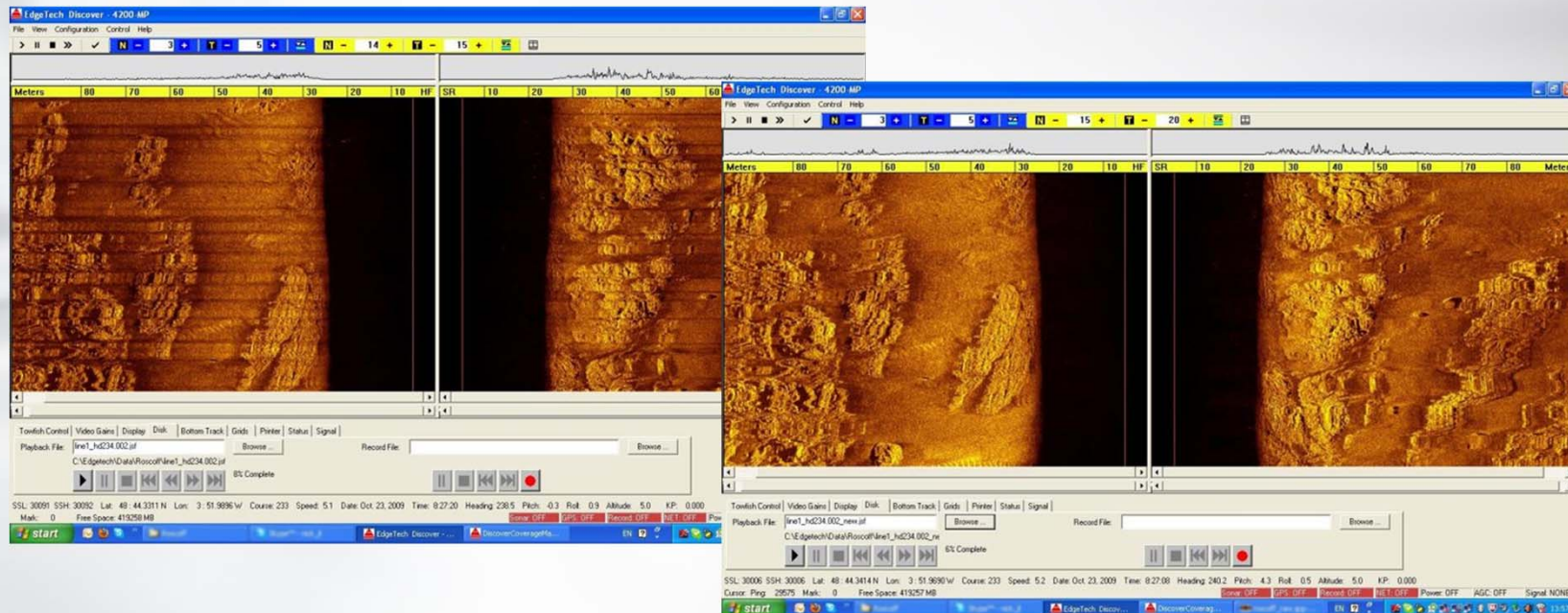
$$\text{YawRate} > \frac{0.5 * \text{BeamWidth}}{t} \quad \Rightarrow \quad \text{YawRate} > \frac{C * \text{BeamWidth}}{4 * R_{\text{max}}}$$

- Occurs when using longer ranges, when you have narrow beamwidths
- Most apparent in shallower water operations, in marginal weather
  - Ships motion transferred to the towfish
    - Motion is transferred as a damped wave down the towcable, so the shorter the cable, the more pronounced it is.

## Solutions tried



- Alternative Deployment Systems
  - Use an AUV
  - Passive Heave Compensation
- Software Solutions





- Alternative Sonar Hardware
  - Different transmit and receive beamwidths



- Increases 2-way beamwidth by 25-30% but allows for around 300% increase in the yaw rate at which the banding occurs.

# Motion Tolerant Mode



## Standard Mode

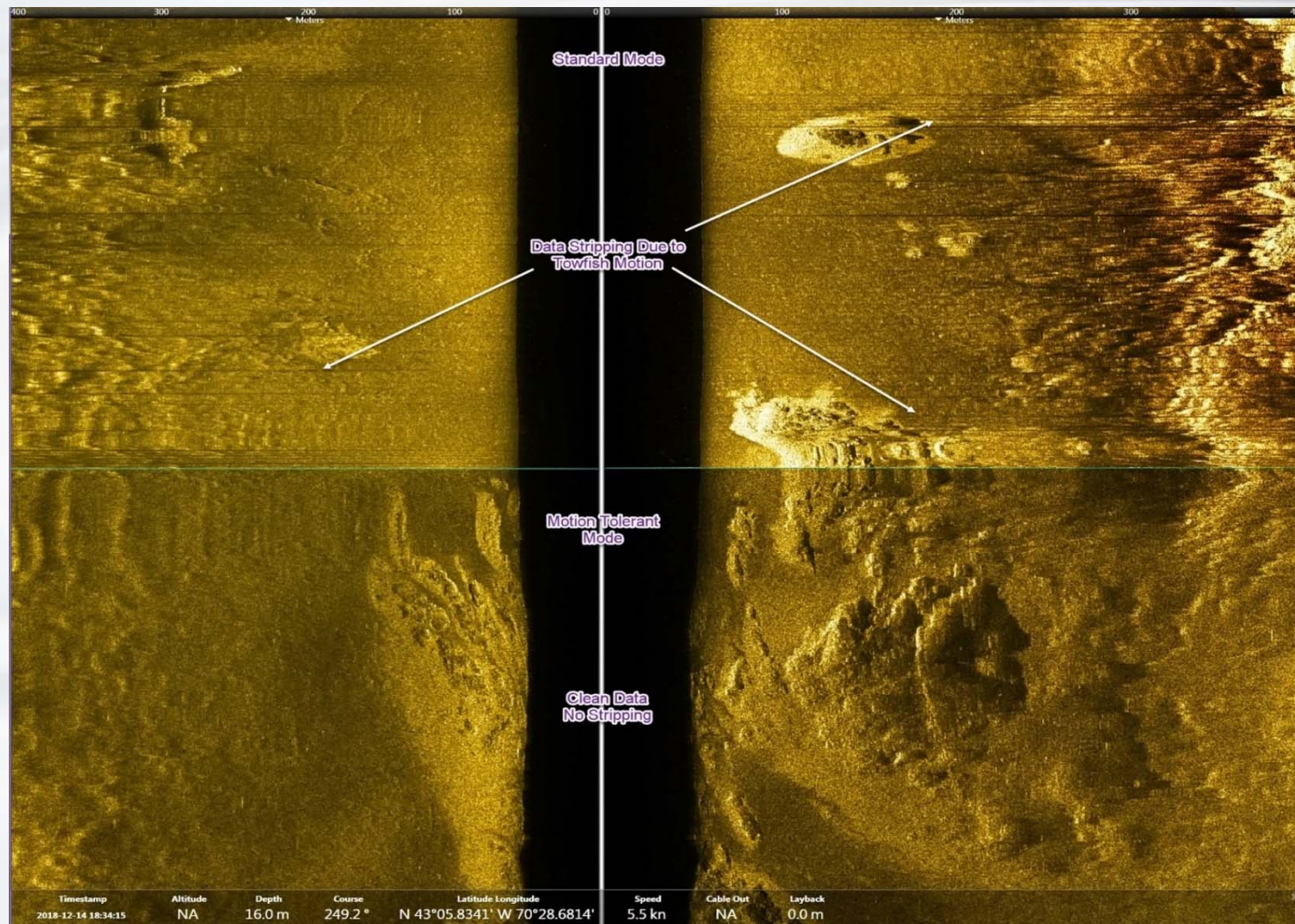


## Motion Tolerant Mode





## 4205 : Motion Tolerant & Multi-Pulse

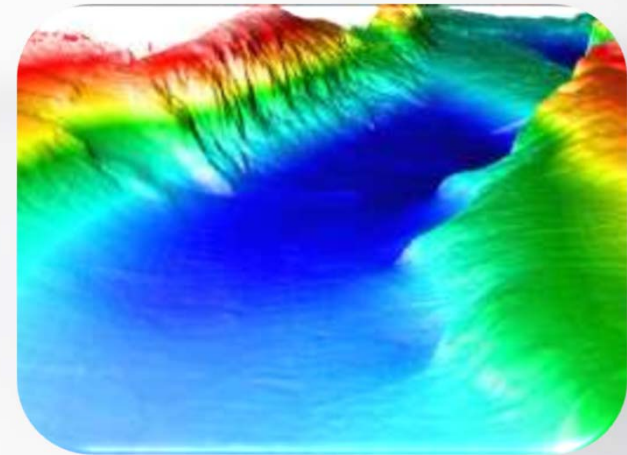




The **NEW** 6205<sup>s</sup> Combined  
Swath Bathymetry and Side  
Scan Sonar



- Multiple Stave Transducers
  - 1 transmit
  - 10 receive
    - Allows determination of the angle, as well as time, of arrival
    - Full acoustic dataset , no Nadir gap in Bathymetry
- Co-registered Side Scan data
  - Long arrays for high resolution imagery at range
- Processing in Subsea Electronics
  - Additional card



## 6205<sup>S</sup> – Improvements and Changes



- The EdgeTech 6205<sup>S</sup> is in a smaller, lighter package with additional features and functions that are sure to make on-water survey operations even more effective and efficient.
- More specifically, the 6205<sup>S</sup> incorporates some new features including:
  - ✓ Improved bathymetric algorithms that reduce the noise even further in the wider parts of the swath
  - ✓ Motion tolerant side scan, which reduces the banding seen in the data in adverse weather conditions
  - ✓ The switch to a central mounting frame has allowed us to use a lighter housing material that both reduces weight and also significantly reduces the manufacturing cost.
  - ✓ Mounting points for Applanix and SBG subsea sensors on top of the sonar head



## 6205<sup>S</sup> – Improvements and Changes

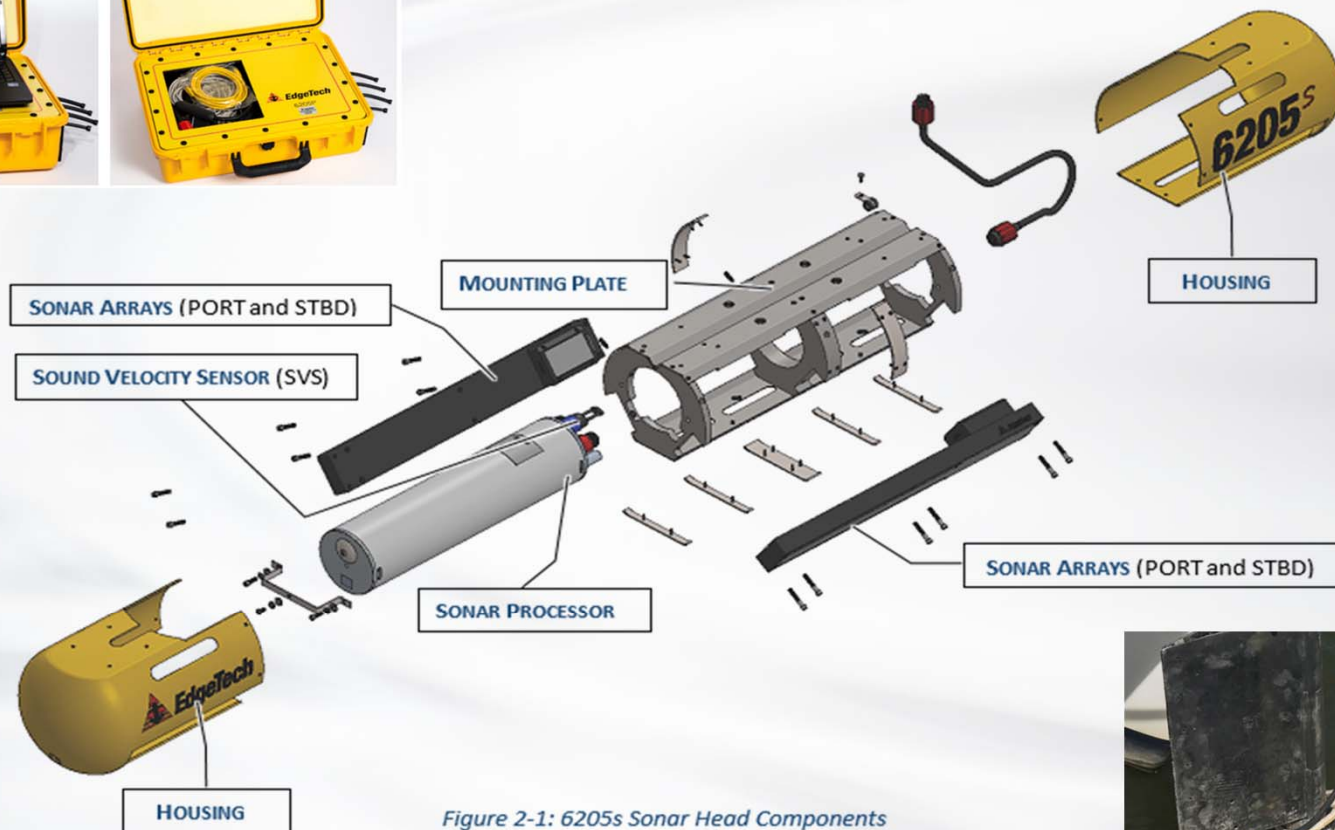


Figure 2-1: 6205s Sonar Head Components

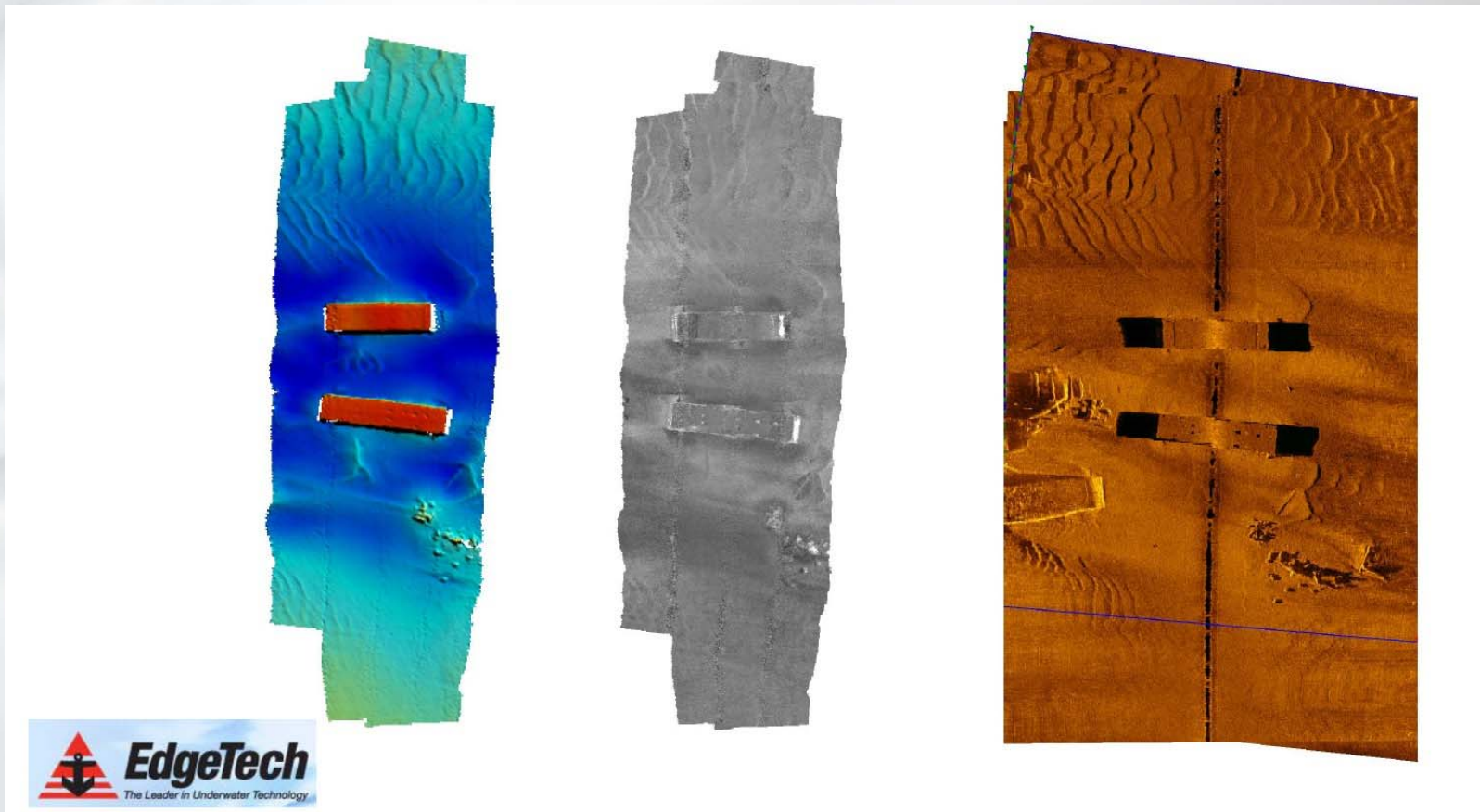


## Datasets collected



Three types of co-registered data collected:

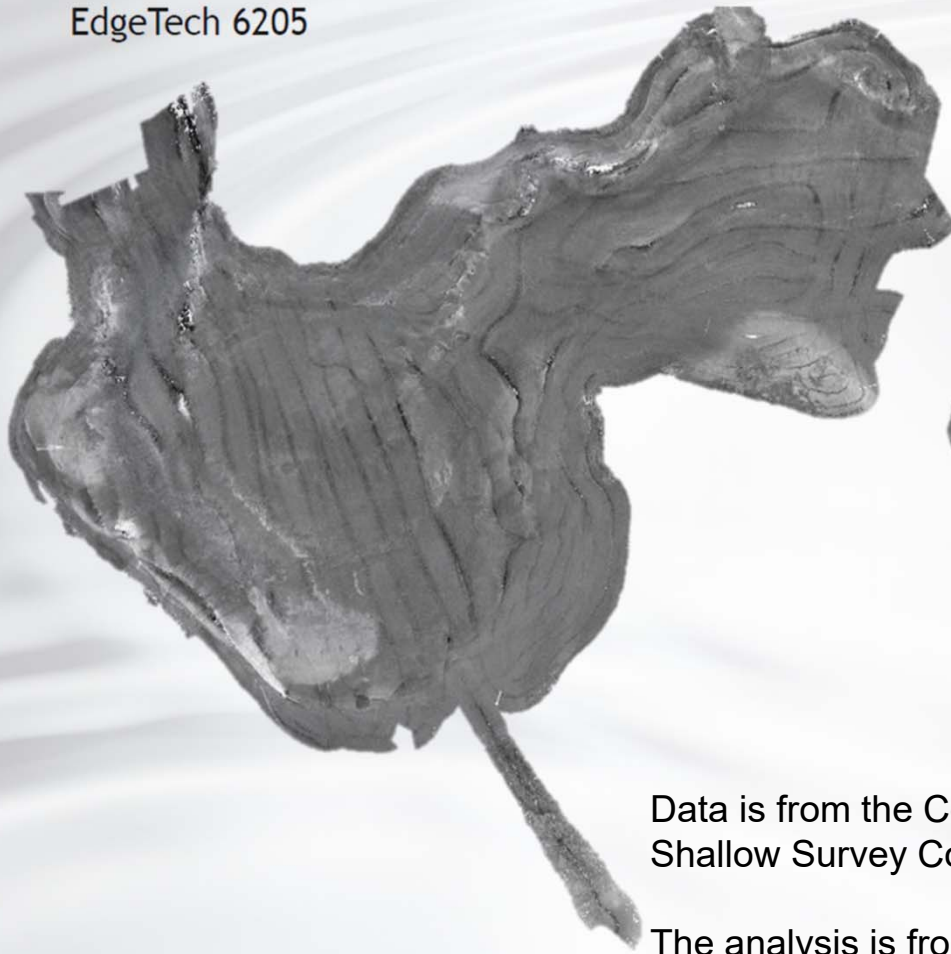
- Bathymetry
- Backscatter
- Sidescan (Dual Frequency)



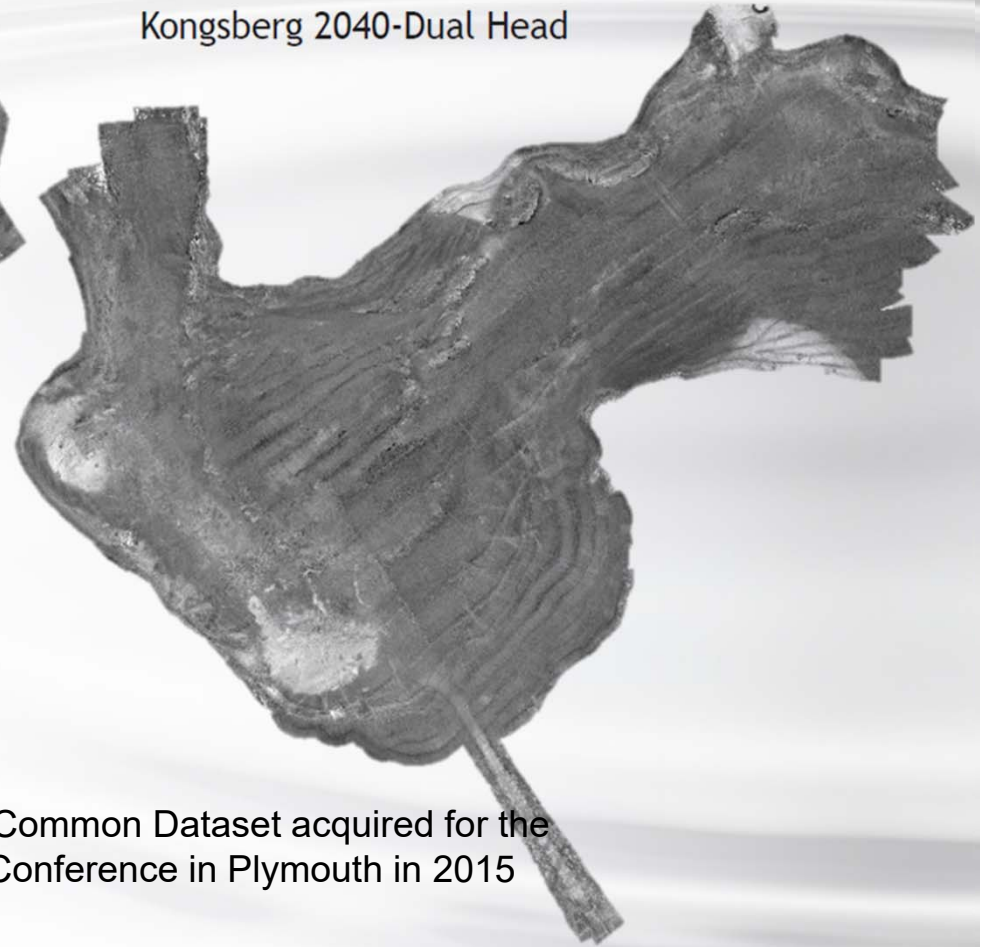
## Backscatter examples



EdgeTech 6205



Kongsberg 2040-Dual Head

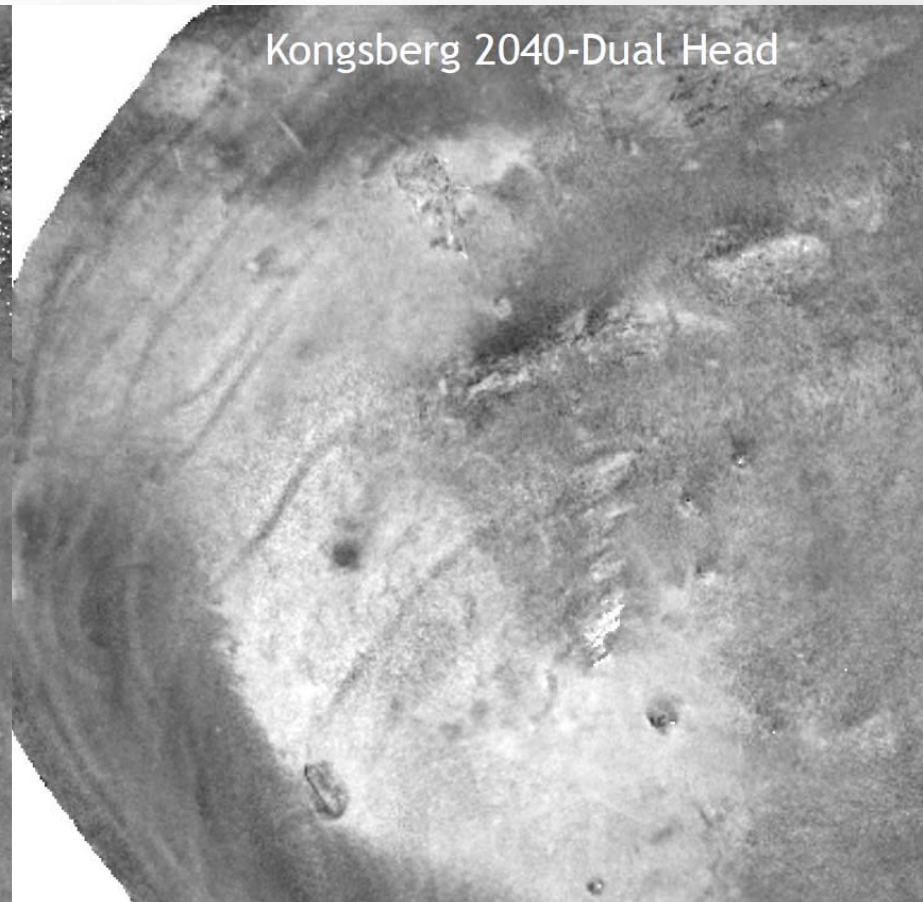
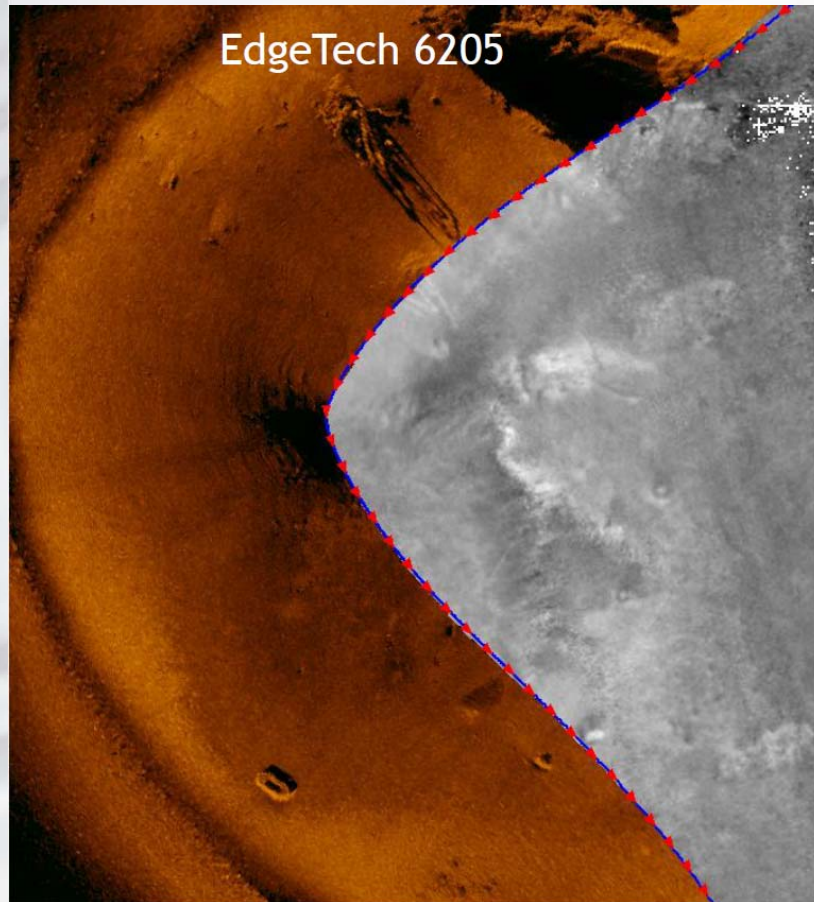


Data is from the Common Dataset acquired for the Shallow Survey Conference in Plymouth in 2015

The analysis is from  
"The Future of Sidescan Sonar for Marine GeoHab"  
David Finlayson, Chesapeake Technology  
GeoHab 2016 Conference



## Side Scan Sonar versus Backscatter

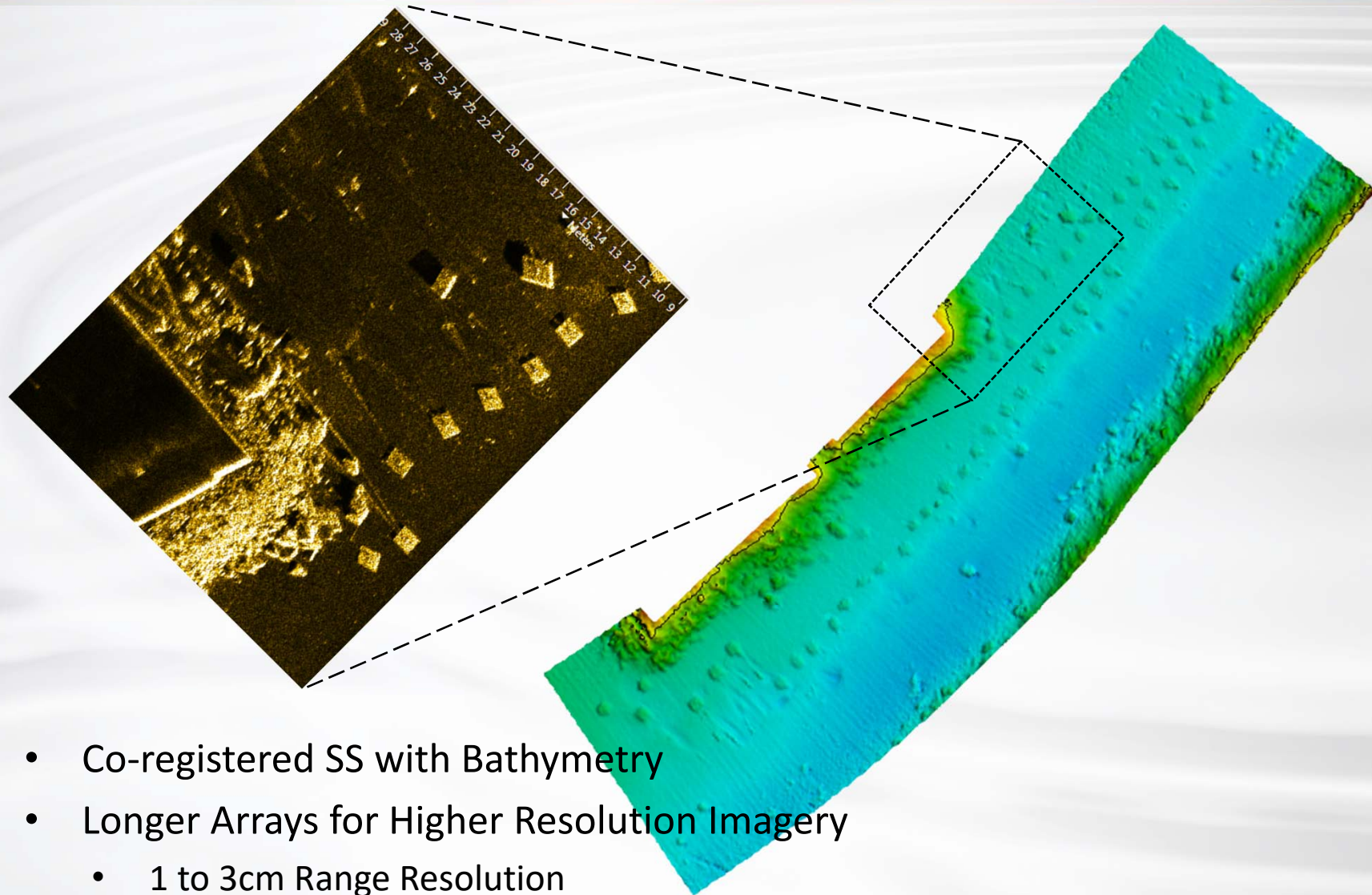


**"The Future of Sidescan Sonar for Marine GeoHab"**

*David Finlayson, Chesapeake Technology*

*GeoHab 2016 Conference*

## Swath Bathymetry : Co-registered Side Scan



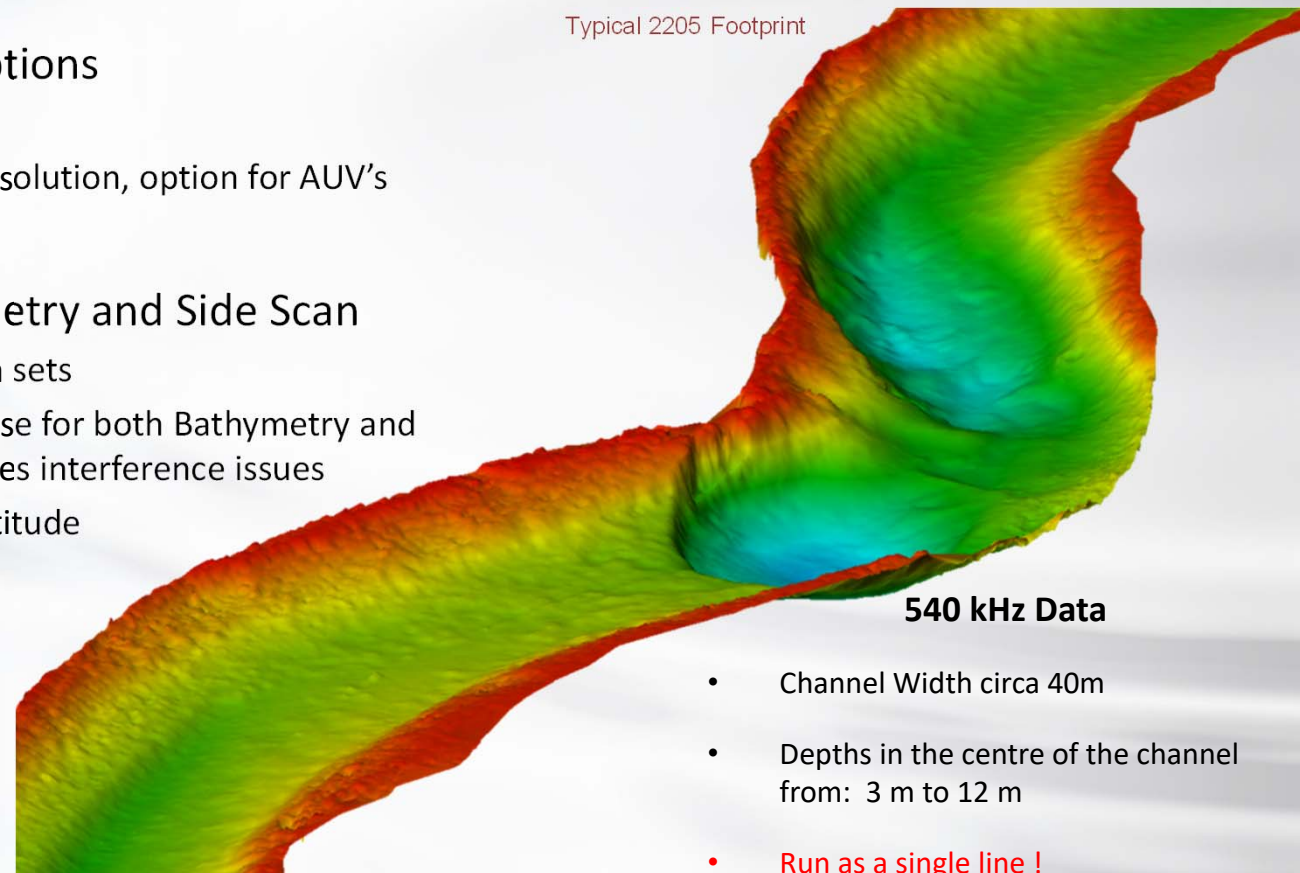
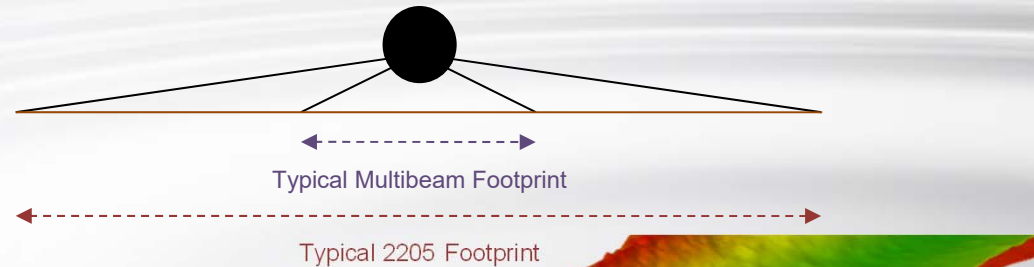
- Co-registered SS with Bathymetry
- Longer Arrays for Higher Resolution Imagery
  - 1 to 3cm Range Resolution



# Bathymetry : Benefits Summary



- Wide Swath Coverage
  - Swath up to 12 x water depth,
  - IHO SO to up to 9 x water depth.
- Two Frequency Options
  - 230 kHz
  - 540 kHz, higher resolution, option for AUV's
- Integrated Bathymetry and Side Scan
  - Co-registered data sets
  - Same transmit pulse for both Bathymetry and Side Scan eliminates interference issues
  - Same optimum altitude



- Channel Width circa 40m
- Depths in the centre of the channel from: 3 m to 12 m
- Run as a single line !



## 6205 Mounting Examples



## 6205 : USV Examples



### ASV : Camel Project

- 6205 Side Scan / Bathymetry system
- Added Sub-Bottom Profiler capability
- One of several modular packages that were fitted to the CAMEL project vehicle



### ECA Inspector

- 6205 Side Scan / Bathymetry system
- Automated Bow mount



## 6205 : USV Examples



### UAI

- 6205 Side Scan / Bathymetry system
- Aqueduct Surveys



### Sea Robotics

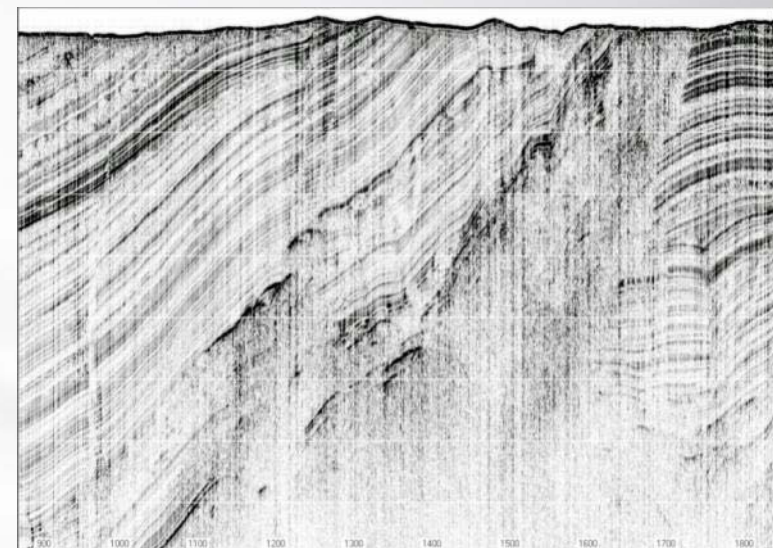
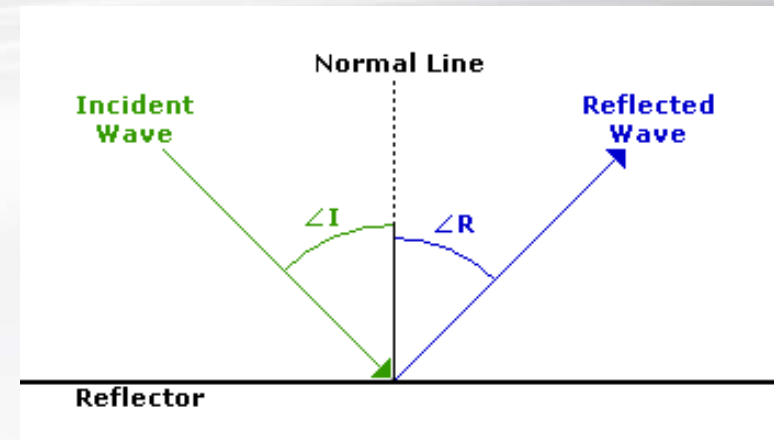
- 6205 Side Scan / Bathymetry system
- Added Sub-Bottom Profiler capability



EdgeTech

Sub-Bottom Profiler Systems

- Deflection of the path of a sound wave by an object or by the boundary between two media
- Acoustic properties of the boundaries...
  - Similar = less reflection
  - Dissimilar = more reflection
- Acoustic Impedance  $Z = V\rho$ 
  - $V$  is seismic wave velocity in the material
  - $\rho$  is the density of the material



- Map, measure and classify sediment layers within the sea floor
  - Locate and map possible hazards in the area
    - Faults
    - Shallow Gas
  - Locate and map bedrock
- Locate objects on or in the sea floor
  - Determine the depth of burial of an object – requires cross lines
    - Pipelines
    - Cables
- Map natural resources
  - Map dredging volumes for clearance
  - Map dredging volumes for extraction



## Penetration versus Resolution

### Low Frequency Sources provide Penetration

- For an oscillating bubble, frequency decreases with increased energy.
  - The larger the airgun, the lower the frequency
- For transducers, the lower the frequency, the larger they need to be
  - Very low frequency, high power transducers are difficult to build.

### High Frequency Sources provide Resolution

- High Frequency transducers can be smaller and lighter
  - Making the towfish easier to deploy
- But there is limited penetration
  - Especially in coarse sediments

# Pulse Options, and Pulse Selection



- *EdgeTech “Full Spectrum” pulse characteristics*

- *Bandwidth*

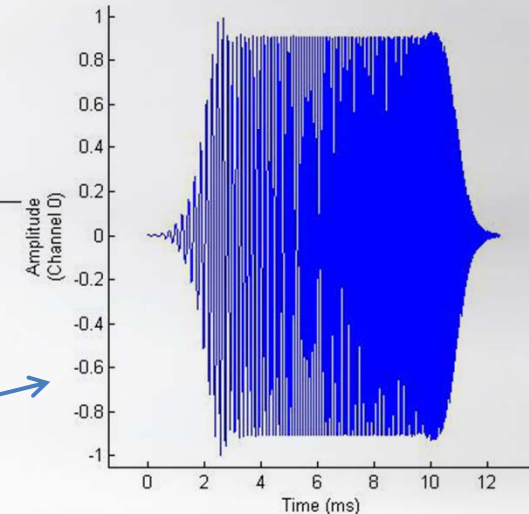
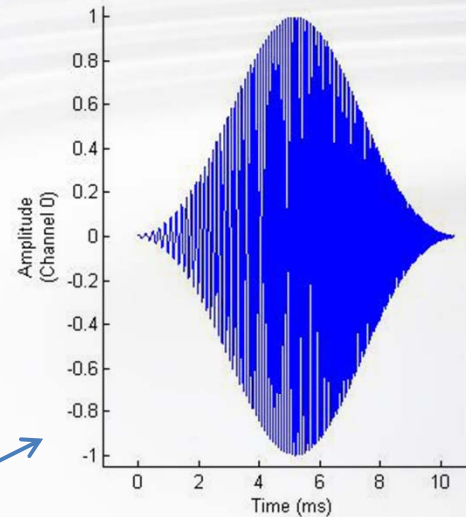
- *Chirp theory tells us the wider the bandwidth, the better the resolution*

- *Length*

- *Longer pulses provide more acoustic energy*

- *Waveform*

- *For “FM” shaped pulses the Full Spectrum wavelet is weighted in the frequency domain to have a Gaussian like shape (Blackman-Harris window) which provides a great rejection of the side lobes.*
- *Wideband (WB) pulses have a flat response over the entire pulse bandwidth, so more low frequency content.*
- *Sweep has a linear variation of frequency with time.*



## Pulse selection

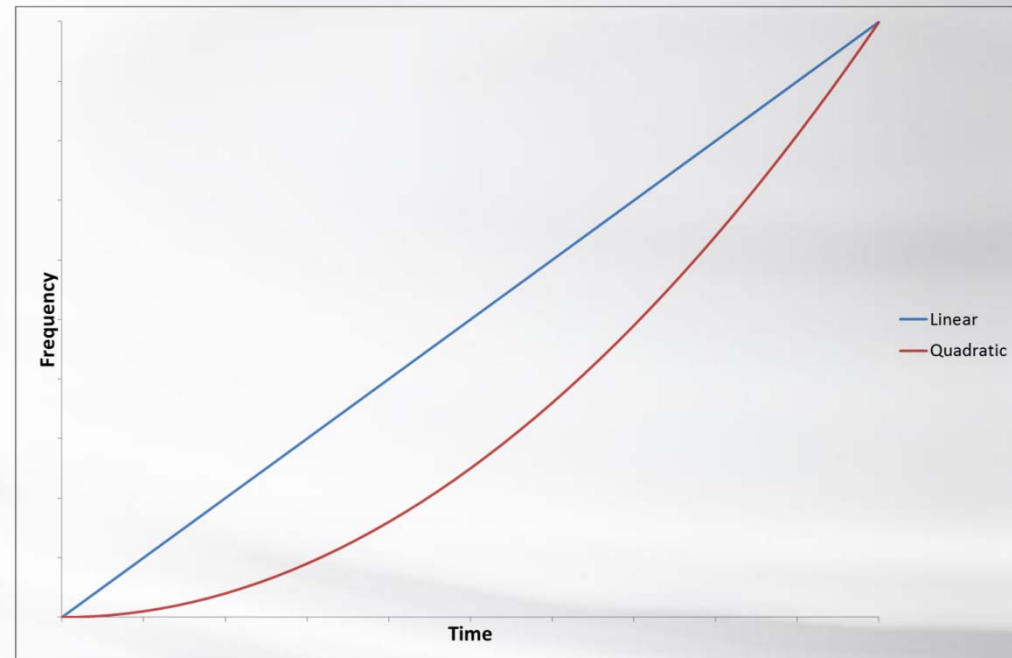
The selection of the pulse is made on-line by the operator while profiling to achieve the best imagery and taking into consideration

- The minimum required penetration depth
- Seafloor sediment type

# Pulse Shapes and Sweep function

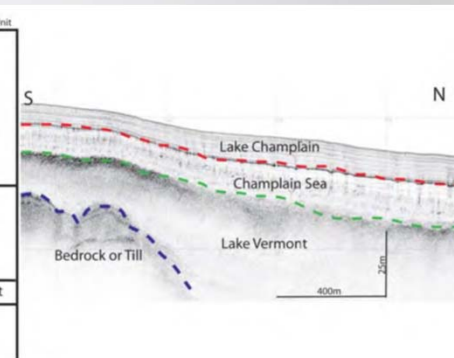
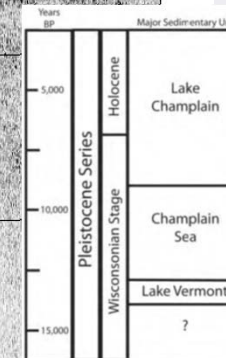
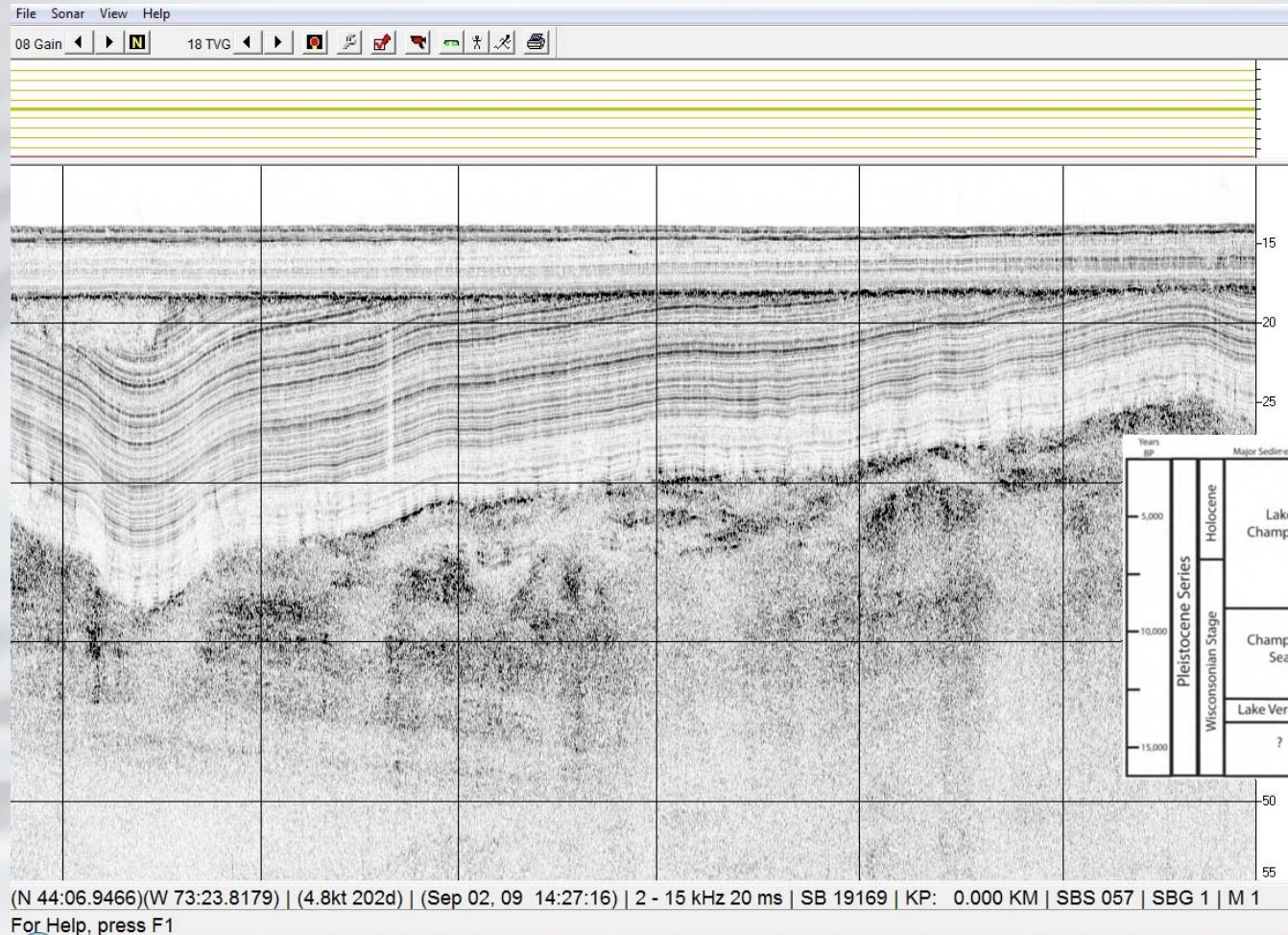


- *EdgeTech “Full Spectrum” pulse sweep functions*
  - *Linear*
    - *This is the standard Chirp pulse sweep function, where the frequency sweep varies linearly with time.*
  - *“Quadratic” or QS pulses*
    - *Sweep rate varies with time, with greater proportion of pulse length spent at lower part of the frequency range.*
    - *Designed to help improve penetration.*





# Applications : Geological Survey



*Analysis of the Four Brothers  
Slump,  
Lake Champlain  
Ghosh, Supriti J., 2012.*

*Unpublished Senior Thesis,  
Middlebury College, Middlebury,  
VT*

# 3400

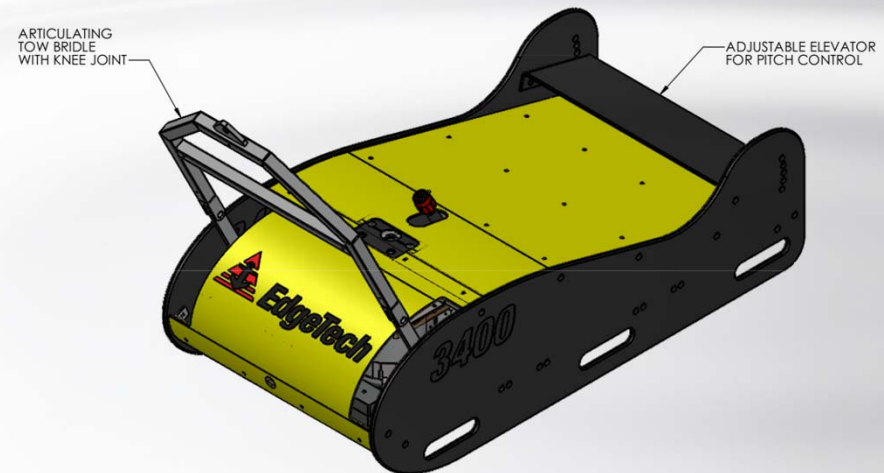


- ✓ Hydrodynamic Sonar configured primarily for towing
  - Pole Mount Option
- ✓ Dual 2-16 kHz Transmit Transducers
- ✓ Multi-Channel PVDF Receive Array
  - Pipeline Detection Survey Setting
  - Digitised data at towfish
- ✓ Surface Echo Attenuation
- ✓ Built-in Motion and Heave Sensor
- ✓ Light Tow Cable
- ✓ Easy to Carry Compact Topside
  - 200 W built-in amplifier
  - Can be boosted to 4 kW with external amplifier
- ✓ Pulse Library Tailored for Different Survey Applications





3400



TOWING CONFIGURATION

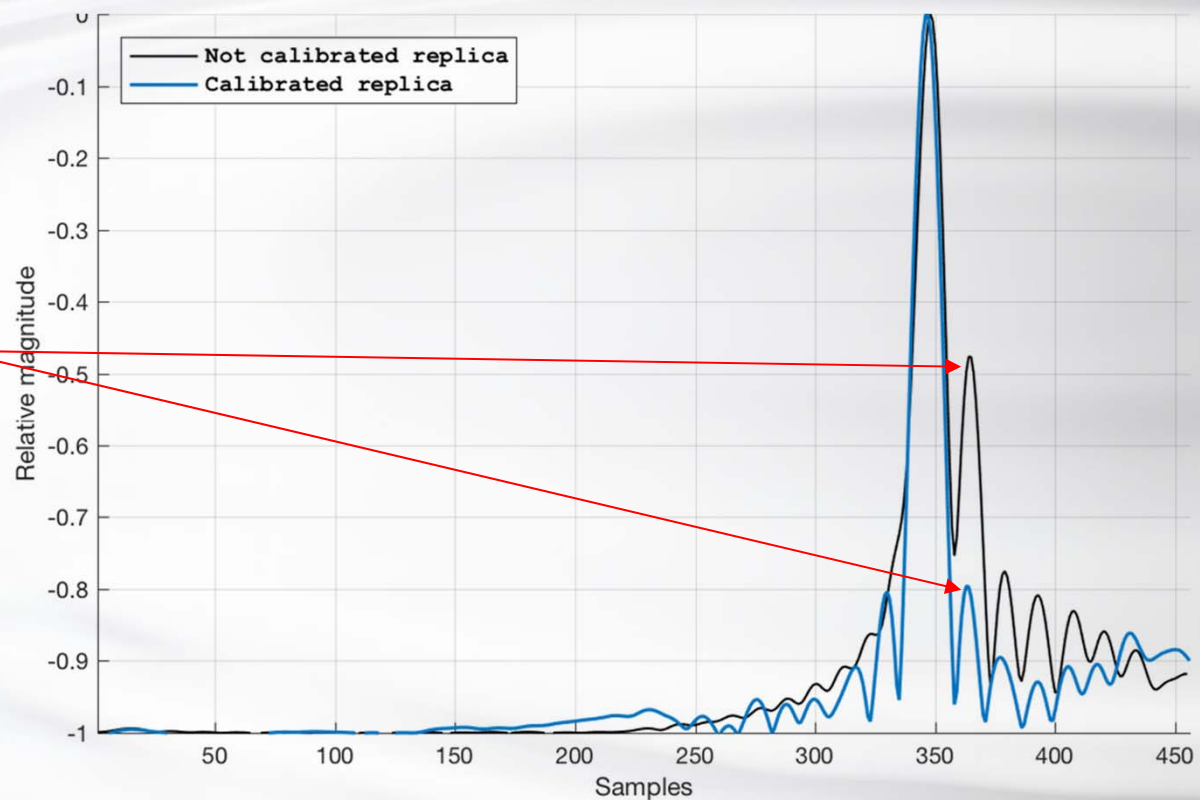
	Towed	Pole-Mounted
Length	114 cm	
Width	55 cm	
Height	30 cm	39 cm
Weight in air	65 kg	70 kg
Weight in water	33 kg	35 kg



# 3400 Calibrated pulse replica



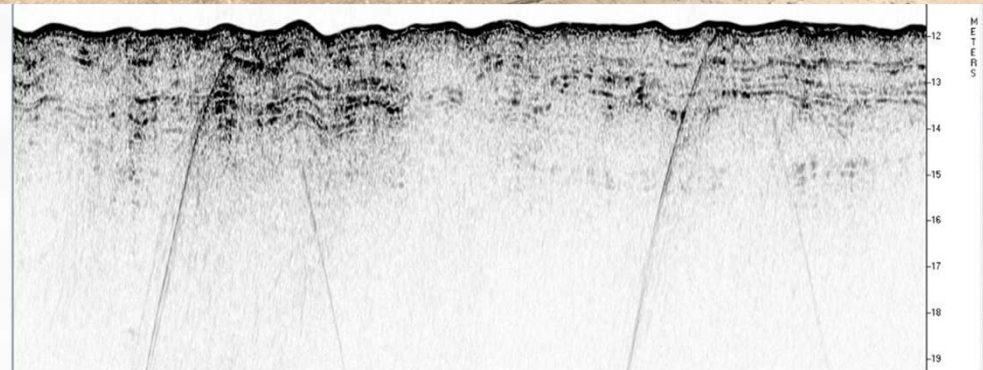
- ✓ Example Pulse
  - Linear Sweep
- ✓ Reduced side lobes
  - PSL (Peak Side Lobe) reduced by around 8 dB
- ✓ Improved SNR
  - c. 3 dB improvement



# 3400 PVDF Hydrophone



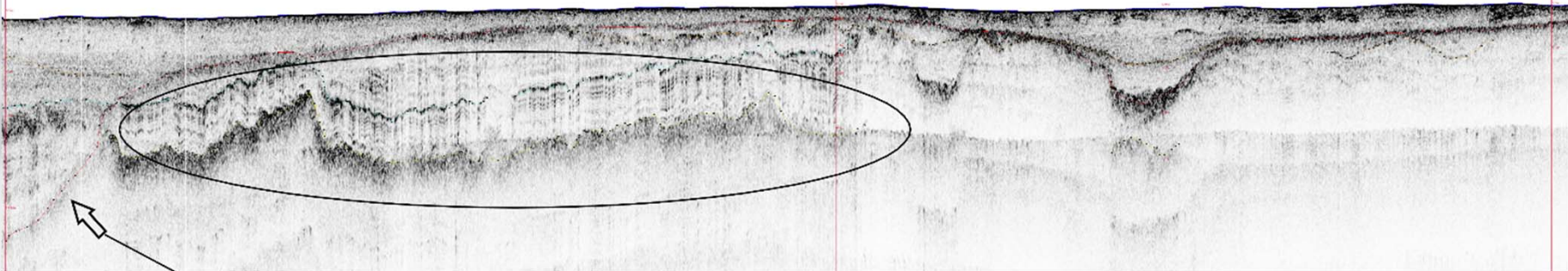
- ✓ Issues with historical hydrophone options :
  - Transmit and Receive on the same Transducer limits the pulse length that can be used when close to the seabed – need to stop transmit pulse, and eliminate ringing, before 1st receive.
  - Conventional PZT (piezoelectric) line arrays produce circular receive radiation patterns. The larger beamwidth can produce smearing and artefacts in the data.
- ✓ A large multi-channel PVDF planar array allows much better control of the beamwidth
  - Full aperture array give a narrower receive beam which in turn helps to reject unwanted features, and provide a better SNR.
  - A smaller sub-array gives a larger fore-aft beamwidth to provide a pipeline detection mode when running cross-lines.



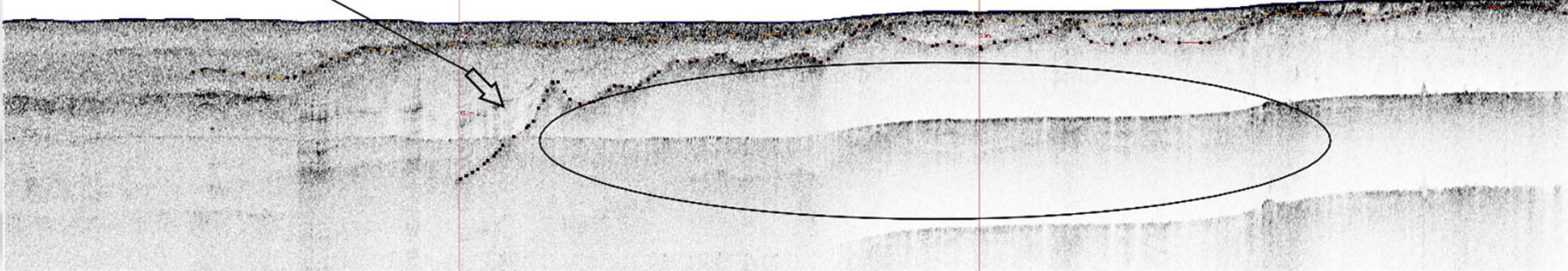
## 3400 compared to a 3100 SB-216



3400



3100



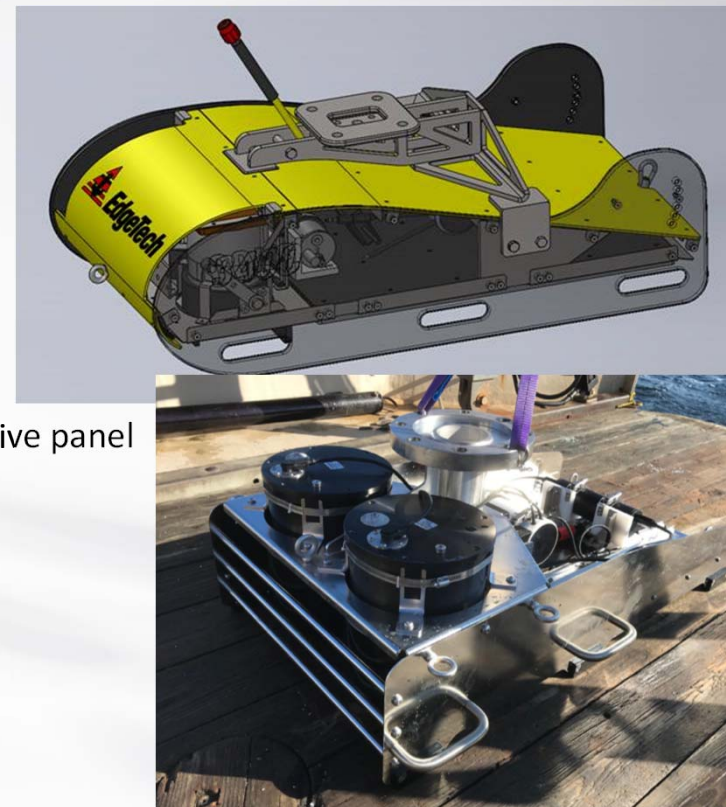
- ✓ Improved SNR
  - Cleaner data
  - Better Penetration in many circumstances



## 3400 : Pole Mount systems



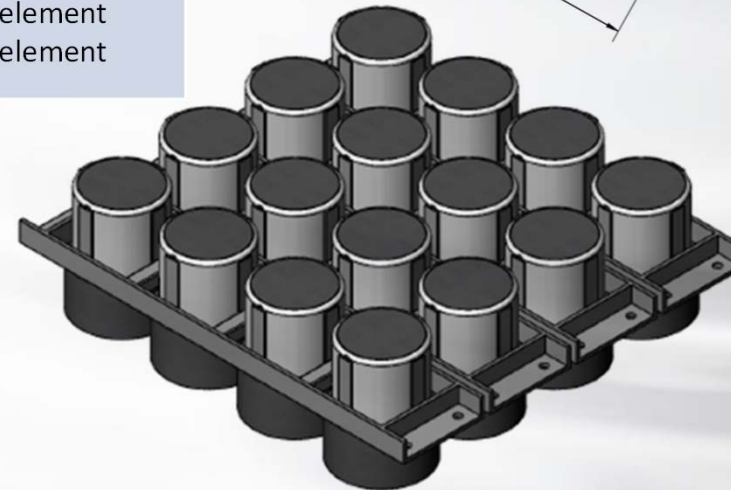
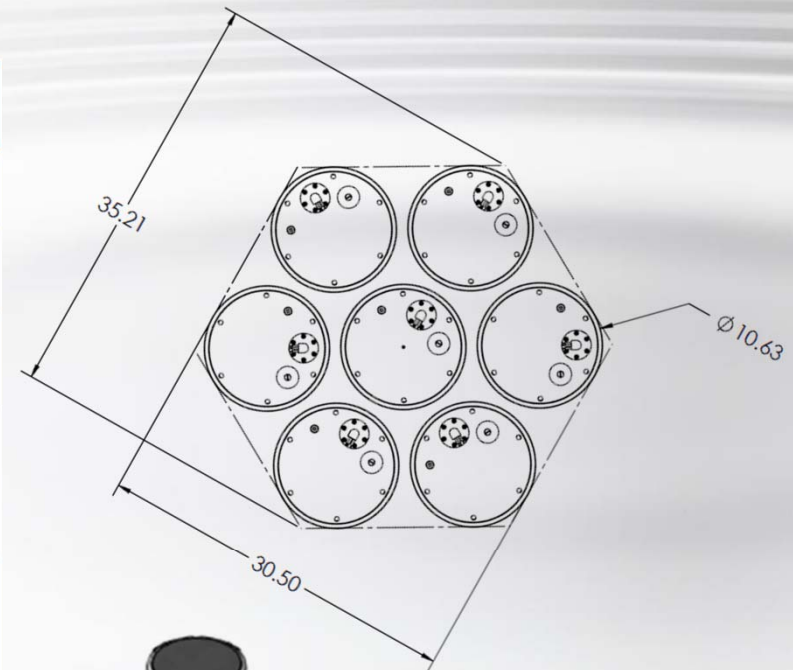
- ✓ Plan is to introduce 3400 Pole Mount versions during 2020
- ✓ Configurations designed for smaller boat operations
  - 1 x 2-16 kHz transducer, small PVDF receive panel
  - 1 x 4-24 kHz transducer, small PVDF receive panelFocus on easier deployment
- ✓ Configurations designed for larger vessels
  - Adapt the standard 3400 towfish for pole mounting
    - 2 x 2-16 kHz transducer, large multi-channel PVDF receive panel
  - 2 x 1-10 kHz transducer, large PVDF receive panel



# 3300 Hull mount Systems



	KT-216	KT-106
Frequency Range	2 – 16 kHz	1 – 8 kHz
Pulse Type	Full Spectrum chirp frequency modulated pulse with amplitude and phase weighting	
Vertical Resolution (depends on Pulse selected)	6 – 10 cm	15 – 25 cm
Penetration (typical) In coarse calcareous sand In clay	6 m 80 m	15 m 150 m
Hull Mount Array Configuration options	4 element (2 x 2) 9 element (3 x 3) 16 element (4 x 4) 25 element (5 x 5)	3 element 5 element 7 element



# 3300 Hull mount Systems - Enhancements

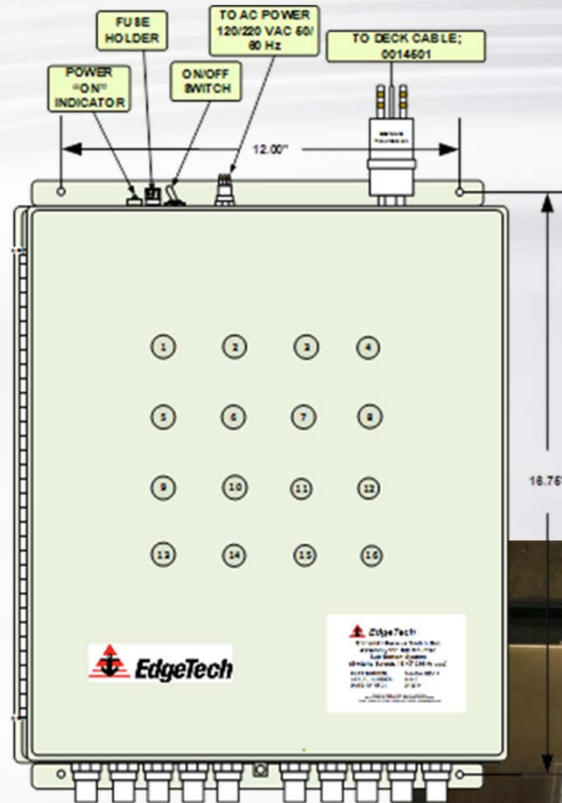


## Switchable array configuration

- Allows the operator to change the array beampattern, e.g. for pipeline crossing.
- The system can be set to transmit and receive on different transducers, which allows longer pulses to be used in shallow water operations

Transducer Selection	Receive Mode (Automatic)*	
	Mode A Transmit and Receive on the same transducers	Mode B * Transmit and Receive on different transducers
Transmit Bus	<b>Tx &amp; Rx</b>	<b>Tx</b>
Off	Off	Off
Receive Bus	Off	<b>Rx *</b>

\*Switching any transducer into receive only mode, automatically enables Mode B





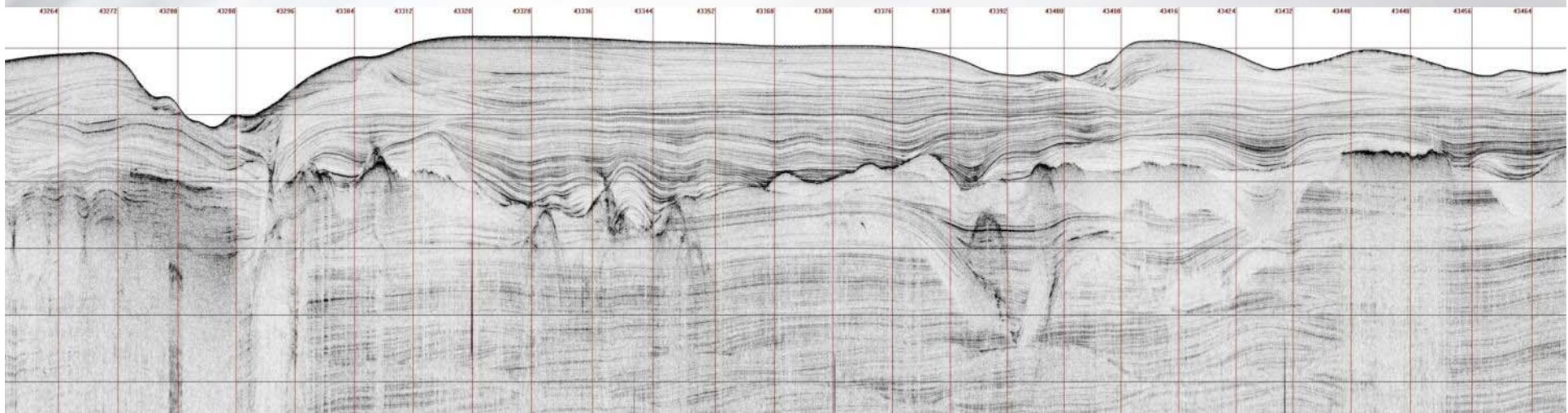
## 3300 Hull mount System : Data Example



EdgeTech 3300HM

4x4 Array of KT-216 transducers

Chirp operating at 1.5 - 9.0 kHz



Water depth = 200 - 300 m (approximately)

Time lines represent 16 m vertical depth (based on 1600m/s below seabed)

Navigation fixes are 50m per division

# EdgeTech

## Combined Systems

2300



- *Fully integrated turnkey system with flexible configurations*
- *Tri-frequency side scan sonar (simultaneous dual frequency)*
- *MPES Bathymetry option*
- *Enhanced sub-bottom profiling capabilities with multiple low frequency transducers and PVDF receiver*
- *Digital telemetry over single coaxial tow cables up to 6,000m*



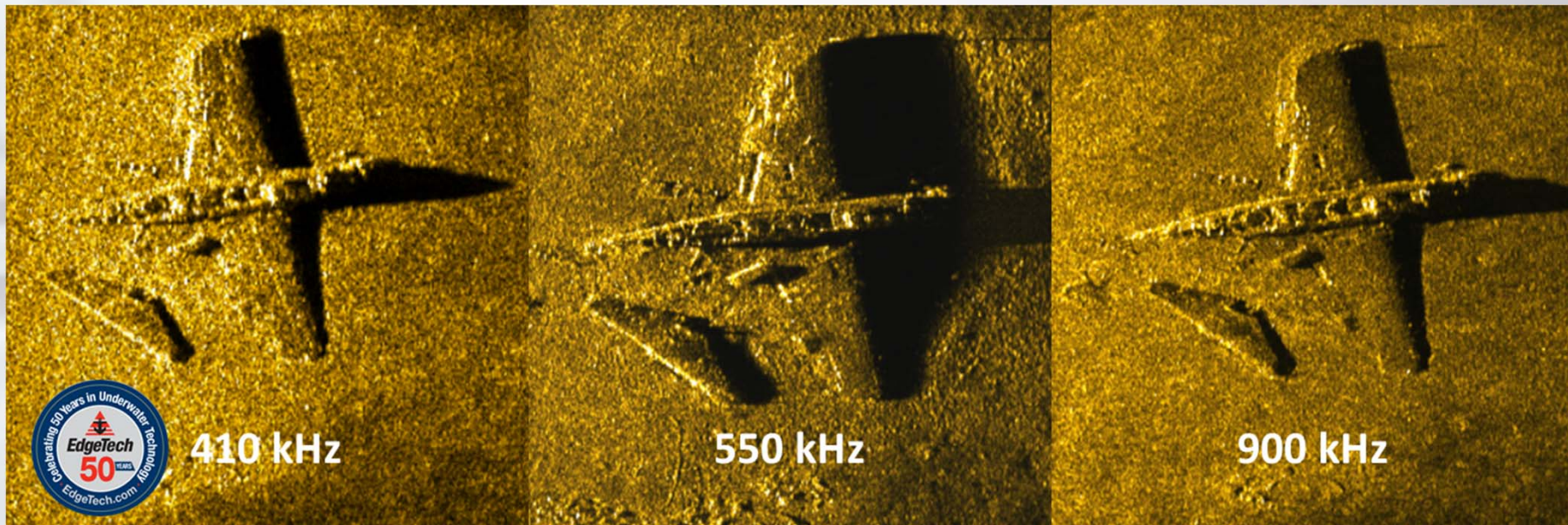


# New 2300 : Tri-Frequency Side Scan



- Tri-Frequency
  - Simultaneous dual frequency
  - Same system can be used for multiple roles
  - On-the-fly re-configuration for user optimisation of range and resolution
- 2300 Tri-Frequency Options
  - 120 & 410 & 850 kHz
  - 230 & 550 & 850 kHz

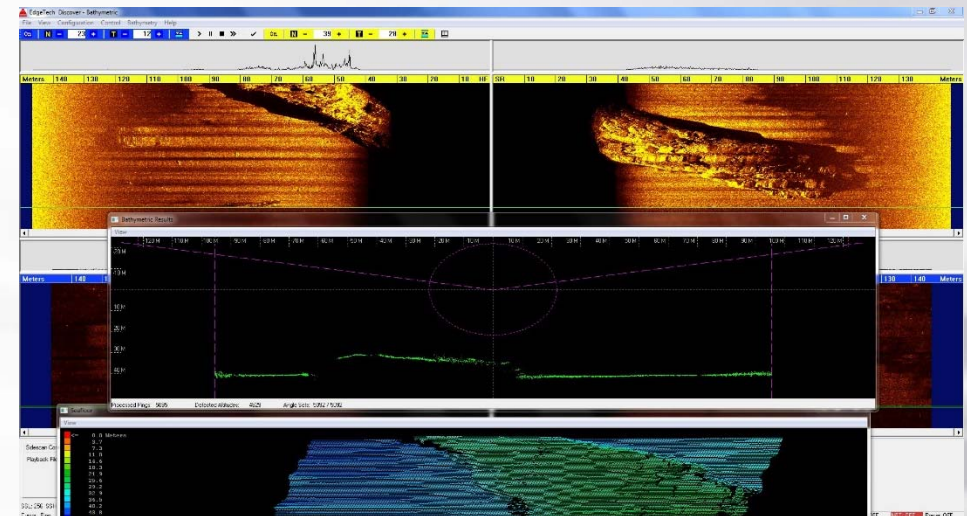
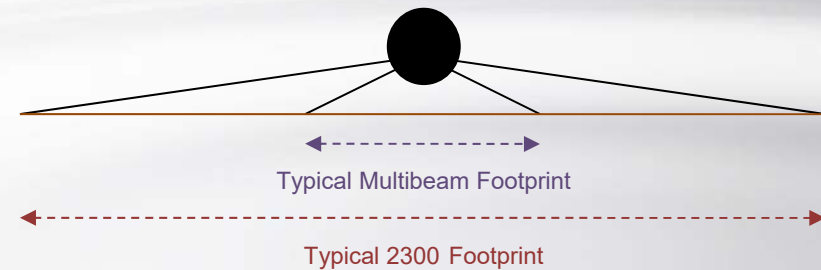
Chirp Centre Frequency	Range
120 kHz	600m
230 kHz	300m
410 kHz	200m
550 kHz	150m
850 kHz	90m



# New 2300 : Multi-Phase Echo Sounder



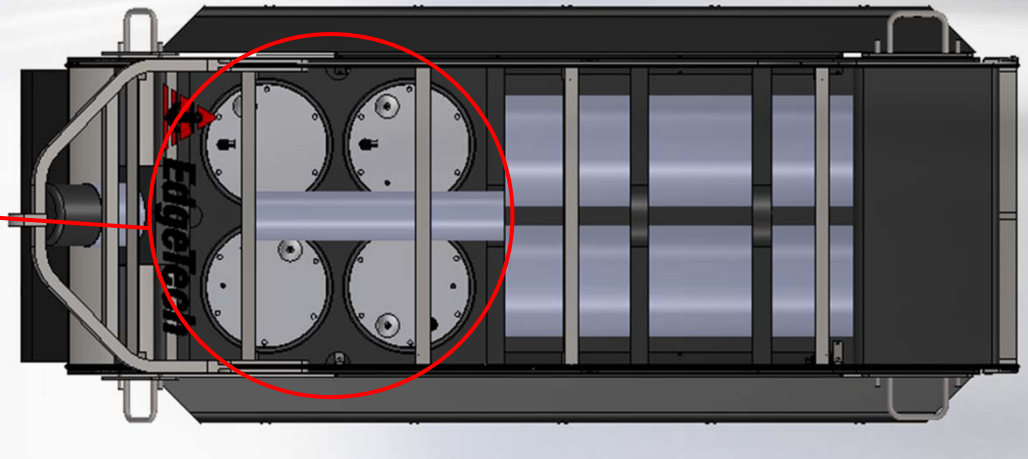
- Wide Swath Coverage
  - Swath up to 12 x water depth,
  - IHO SO to up to 9 x water depth.
- 2300 MPES Frequency Options
  - 120 kHz
  - 230 kHz
  - 550 kHz
- Integrated Bathymetry and Side Scan
  - Co-registered data sets
  - Same transmit pulse for both Bathymetry and Side Scan eliminates interference issues
  - Same optimum altitude



## New 2300 : Enhanced Sub-Bottom Profiler



- 2300 SBP Array
  - 4 x 1-10 kHz
- Multiple transmit transducers
  - Improved Directionality
  - Focusses power where needed
- Quadratic Pulses
  - Sweep rate varies with time, with greater proportion of pulse length spent at lower part of the frequency range.
  - Designed to help improve penetration.



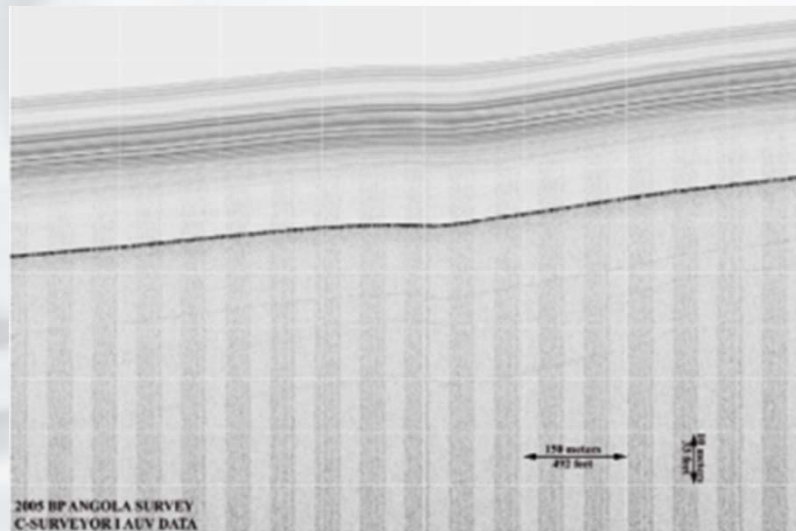
- PVDF Receive Panels
  - Area based arrays provide better receive directionality  
...so, less noise, and cleaner data
  - Arrays can be scaled to the area available
  - Single channel receive panels for general survey operations
  - Multi-channel systems can have separate arrays for different application



## 2300 : Enhanced Sub-Bottom Profiler

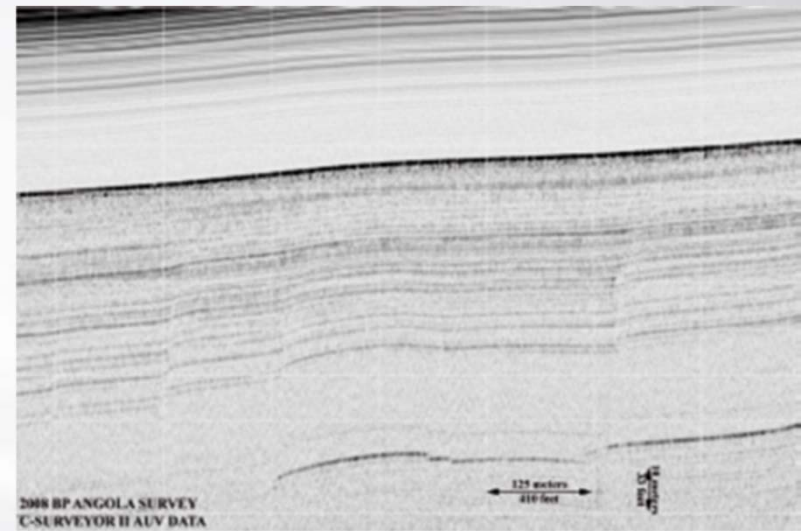


- Lower Frequency Transducers
  - Better Penetration, but less directionality
- Multiple transmit transducers
  - Improved Directionality
  - Focusses power where needed



**Data from 2005**

AUV originally supplied with a single DW-216 transducer



**Data from 2008**

Upgraded to 4 x DW-106 with additional amplifiers

## 2300 Telemetry / Multiplexor



WebRelay-10		
2205 SONAR (J8)	OFF	ON OFF
2205 SB AMPS (J8)	OFF	ON OFF
48v Beacon (J2)	OFF	ON OFF
reserved	OFF	
Option (J10)	OFF	ON OFF
Magnetometer (J3)	OFF	ON OFF
24v Beacon (J9)	OFF	ON OFF
Option (J5)	OFF	ON OFF
reserved	OFF	
reserved	OFF	
Mux Temp	25.1 °C	
Current Time: Thu, 01 Jan 1970 00:22:42		

- Web interface to Relays that control power to the sonar, sub-bottom amps, external sensors and option ports
- There are two 24v dc power supplies in the multiplexor
  - #3 powers 24v Transponder (J9) and Option (J5)
  - #4 powers Magnetometer (J3) and Option (J10)

The power to each connector is limited to 2A

- Web Interface to map multiplexor serial ports to the serial ports on the 2300 topside



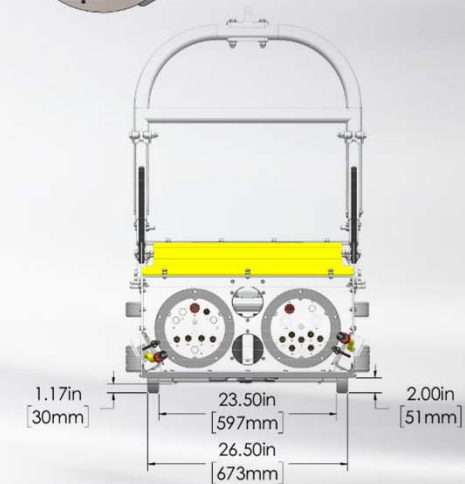
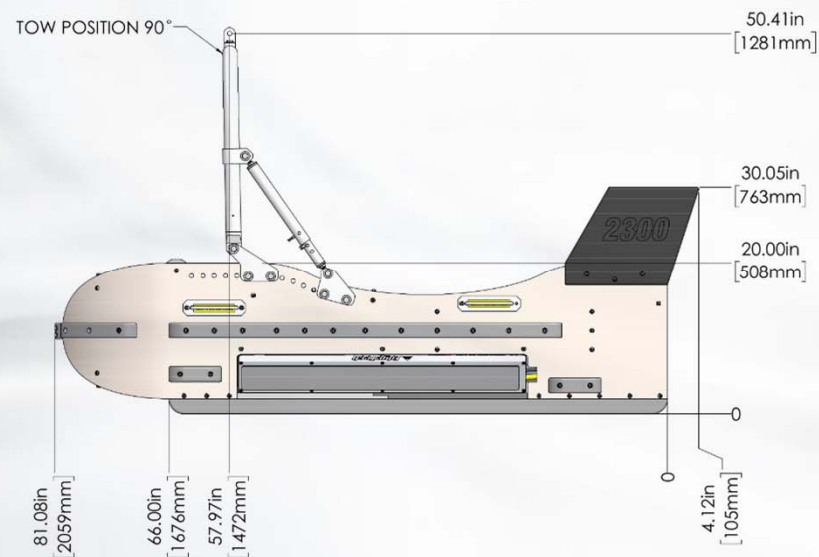
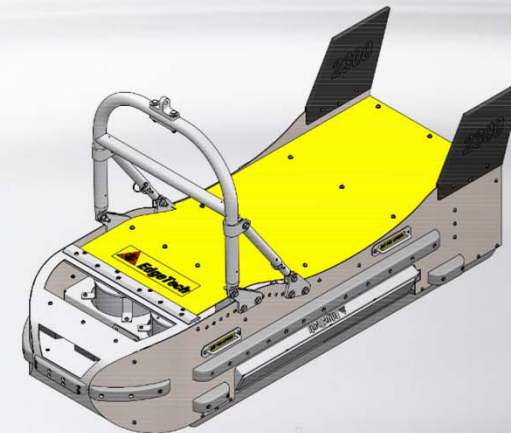
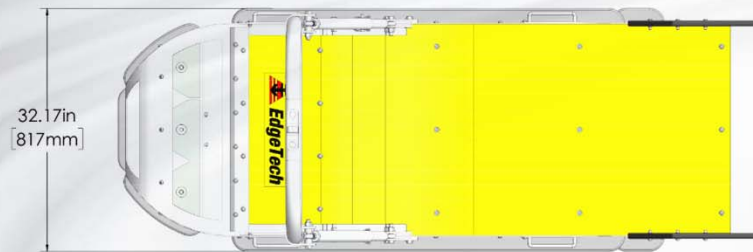
## 2300 : Example Transponder Interfaces



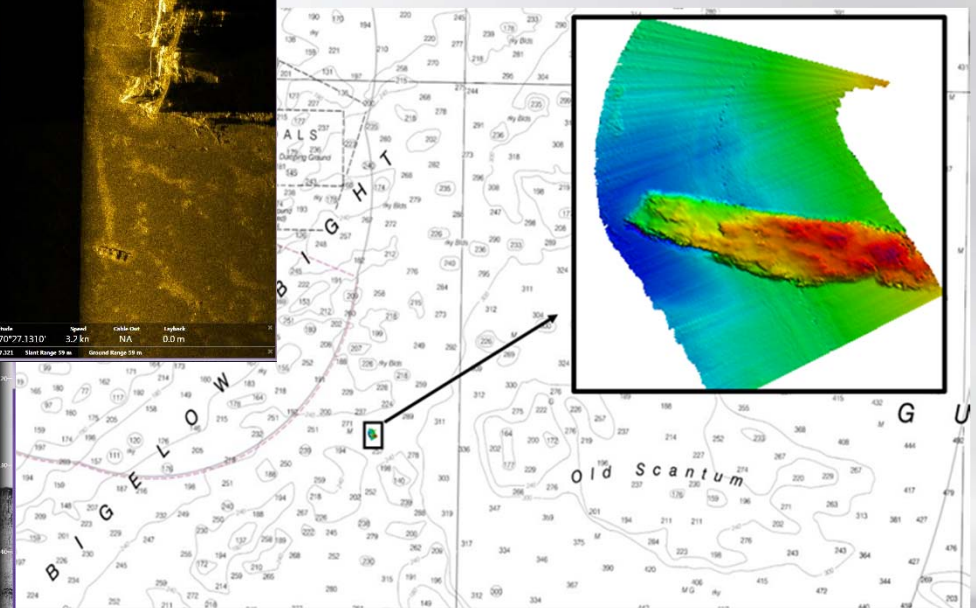
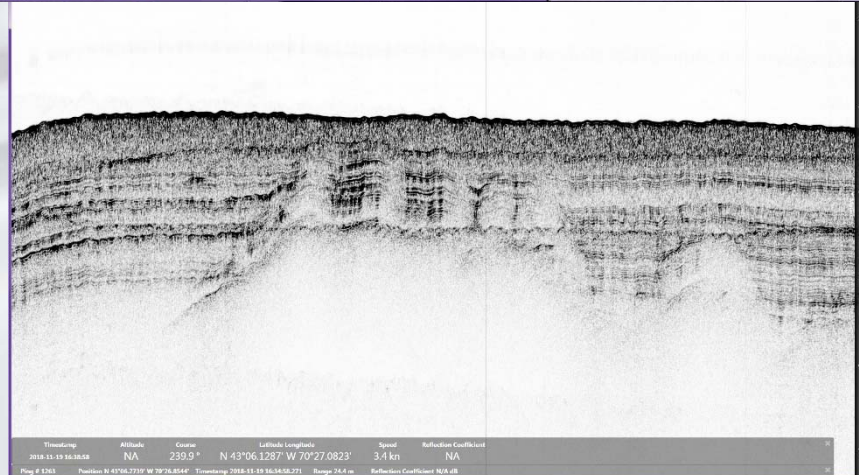
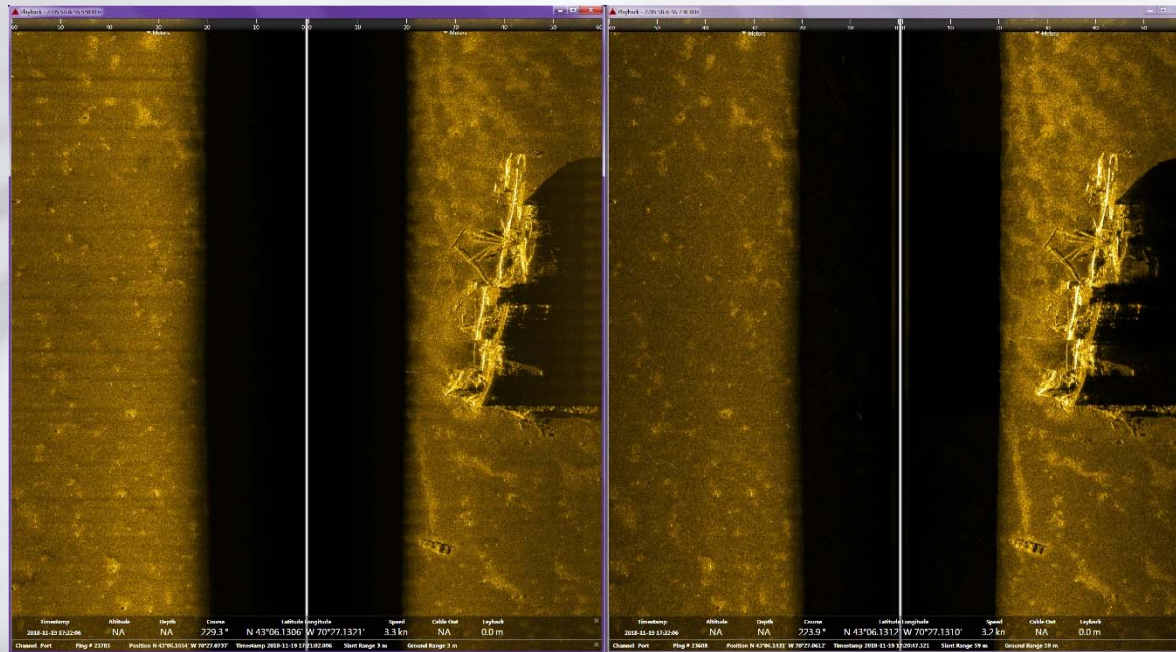
- Kongsberg Cnode MiniS 34 transponder
  - Responder trigger, positive going, 5v to 25v, 2 to 6 ms
  - External power 20 - 28v dc, draws 1A @ 24v dc
  - Please note that this applies to a MiniS and not the older Cnode Mini series.
- Applied Acoustics 1100 series beacon
  - Responder trigger, positive going, 5v to 25v, 2 to 10 ms. Trigger pulses longer than 10ms duration are ignored
  - External power 22 - 35v dc , connect to *External 24VDC Input*. 80mA trickle charge @ 24v dc
- EdgeTech 4380 multi-beacon
  - Responder trigger RS232 5v TTL input, optically isolated
  - External power 22 - 55v dc, 1 A – 2.1 A, 1 A is enough to keep the batteries topped up
- Sonardyne WSM Transponder
  - Responder trigger, positive going, <0.5v to >4v, 24v max, 3 to 25 ms.
  - External power 22.5 – 28v dc. Average 100mA when transmitting 1 pulse/sec, but max 5A for 10mS.
  - This peak power draw is NOT supported, and so a WSM transponder should be run off it's internal batteries and only the responder trigger connected.



## 2300 Tow fish dimensions



# New 2300 : Data Examples

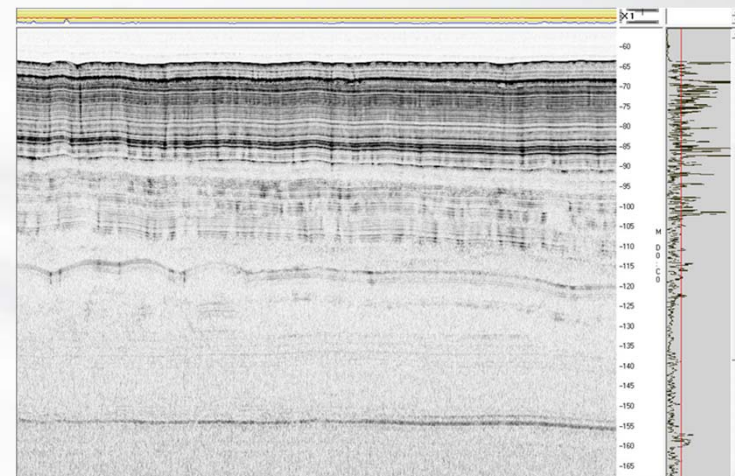




## 2205 : AUV Packages



- EdgeTech 2205 Systems
  - AUV or ROV configurations
  - Side Scan Sonar
  - Sub-Bottom Profiler
  - Bathymetry
  - Depth ratings to 6000m
- Side Scan Sonar
  - Dual frequency or Tri-Frequency side scan sonar
  - Frequency options from 75 kHz to 1600 kHz
  - Options for Dynamic Focussing
- Sub-Bottom Profiler
  - Frequency options of 1 – 10 kHz or 2-16 kHz
  - PVDF based receive arrays
- Bathymetry
  - Same transmit pulse for both Bathymetry and Side Scan eliminates interference issues, and optimises power consumption
  - Same optimum altitude





## EdgeTech 2000 / 2200/ 2300 : ROV Examples



Array on Flotation



Array on skid

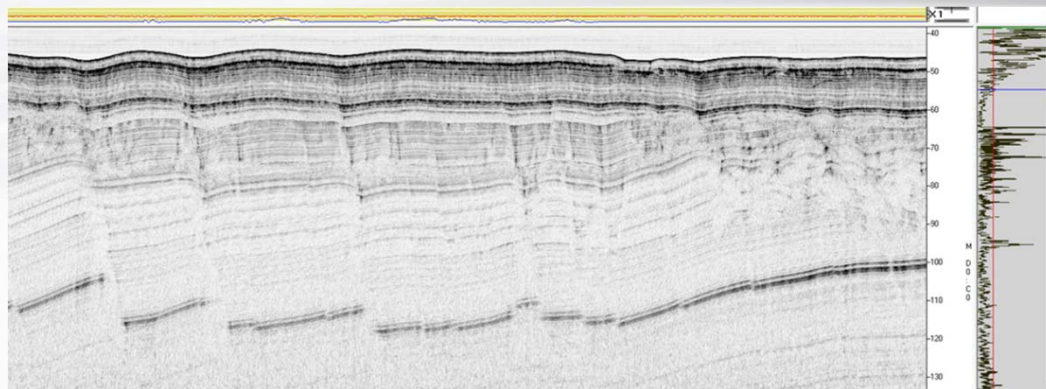


## EdgeTech 2205 AUV Examples

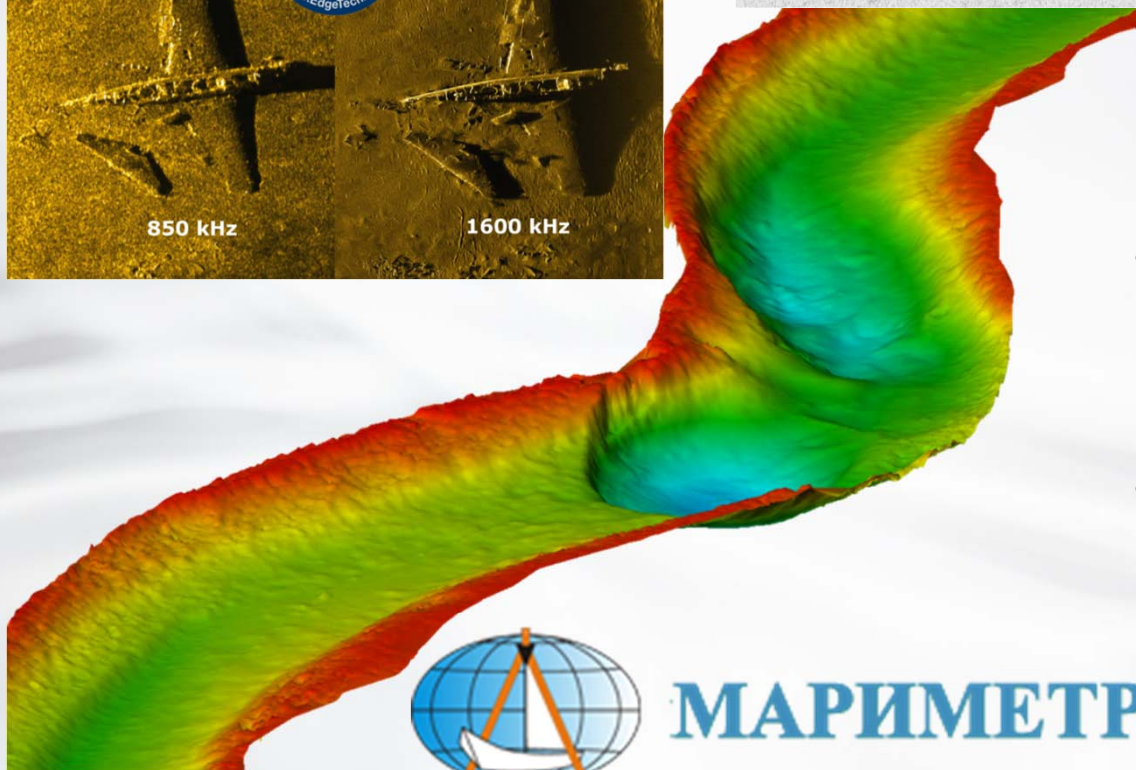




# Summary



- Multiple Sensor options
  - Side Scan Sonar
  - Sub-Bottom Profiler
  - Bathymetry
- Enhanced Technologies
  - CHIRP / Full Spectrum
  - Dynamic Focusing
  - Dual Sub-Bottom pulses
- Systems customization
  - Customized to application and host vehicle



МАРИМЕТР

