



Kongsberg Maritime

14th CHAtO Cádiz October 2016

Miguel Angel Lleches



KONGSBERG

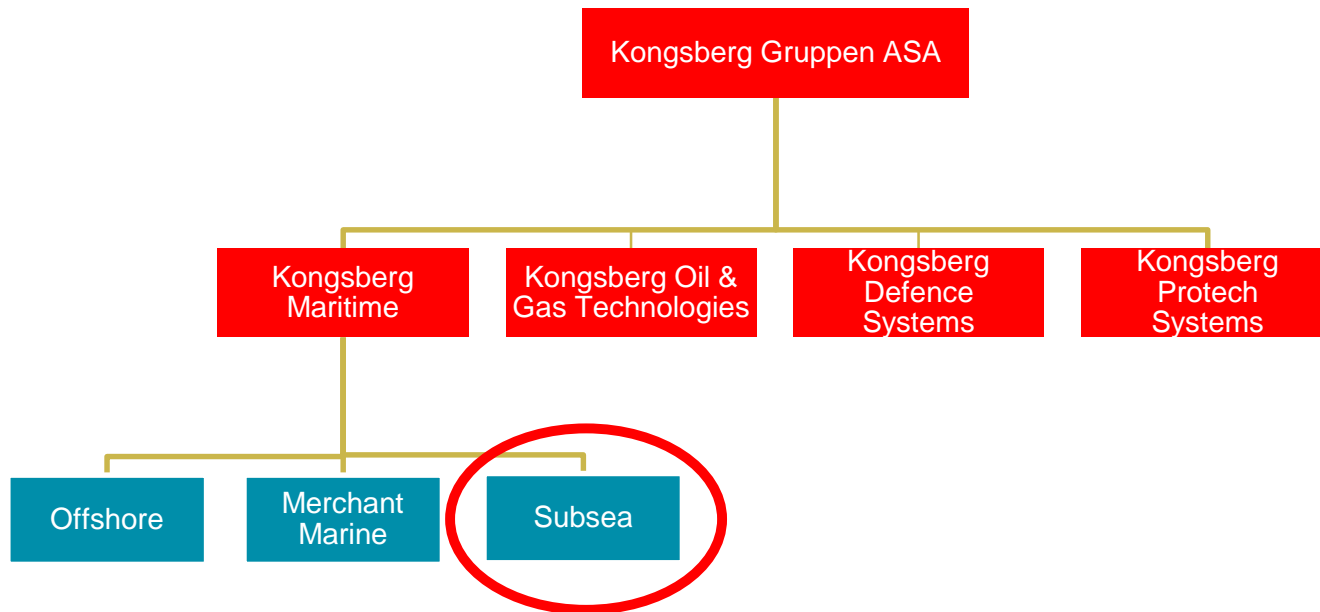
WORLD CLASS – through people, technology and dedication

Kongsberg Group ASA



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Company Protected



24/10/2016

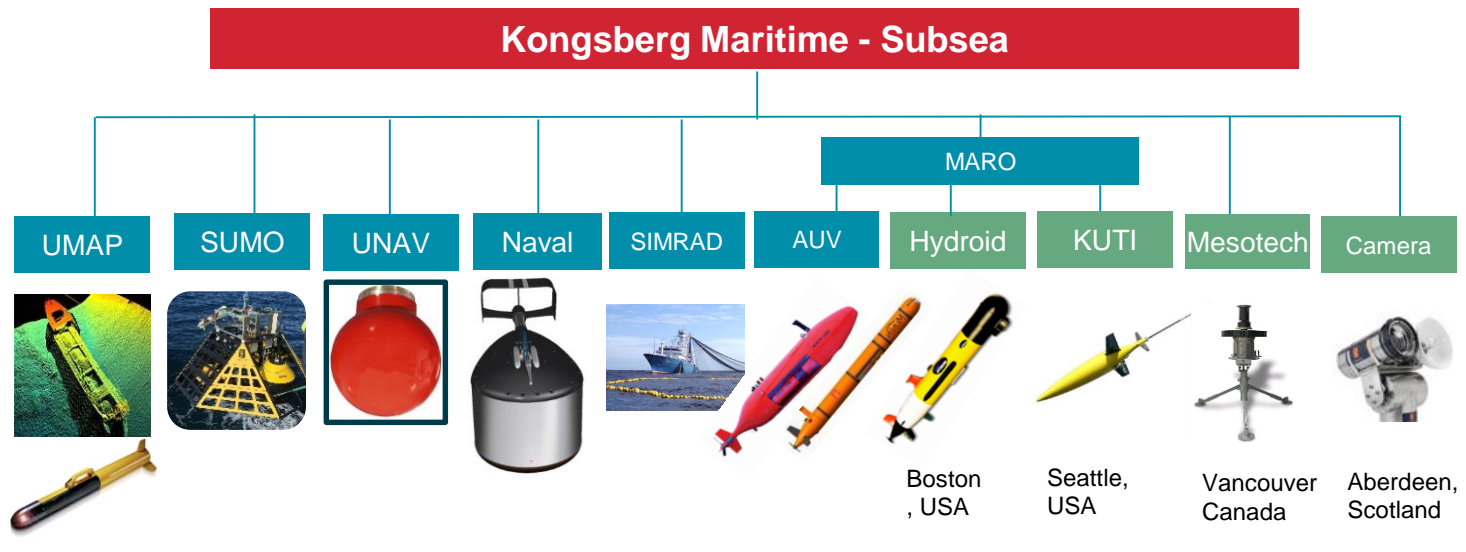
WORLD CLASS - through people, technology and dedication.

Subsea Organization



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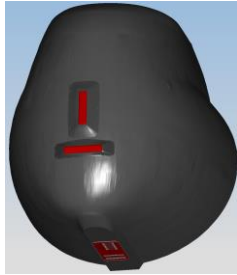


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Technology Platform

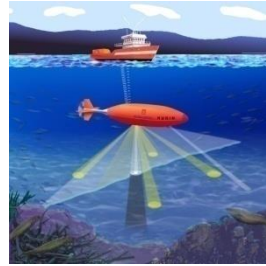
Application:



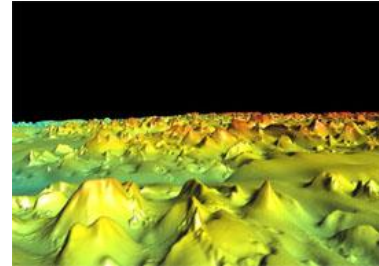
Naval Sonars



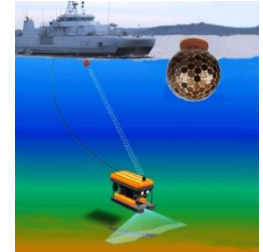
Fishery & Fishery Research



AUV

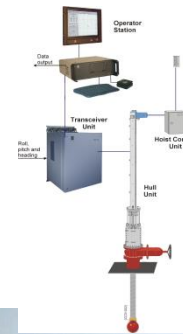
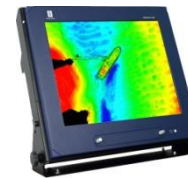
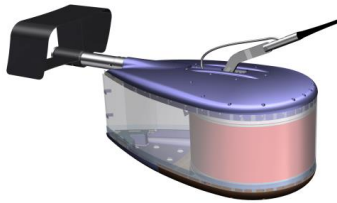


Hydrography

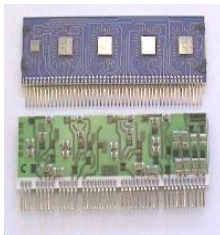


UW Nav.

Products:



Common Technology:



Multibeamson - The complete range



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THE COMPLETE MULTIBEAM ECHO SOUNDER RANGE



From the shallowest waters to full ocean depth, we've got it covered.

M3	50 m
GeoSwath Plus	200 m
EM [®] 2040C	500 m
EM [®] 2040P	550 m
EM [®] 2040	600 m
EM [®] 712	3600 m
EM [®] 302	7000 m
EM [®] 122	11000 m



UMAP Product Range

Survey tools for shallow to full ocean depth

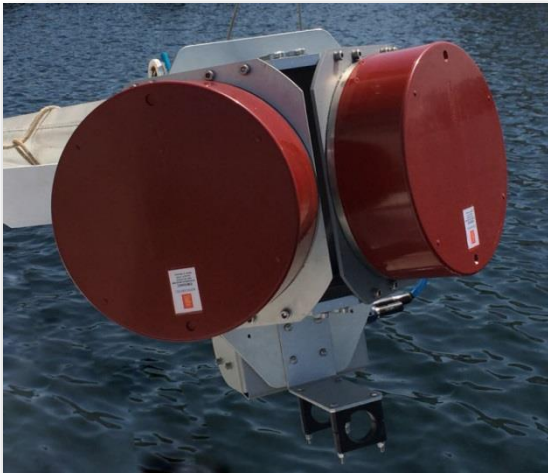
Product	Frequency	Depth	Features and installation methods
MULTIBEAMS & WIDE SWATH GeoSwath Plus EM [®] 2040C EM [®] 2040P EM [®] 2040 EM [®] 712 EM [®] 302 EM [®] 122	125/250/500 kHz 200 – 400 kHz 200 – 400 kHz 200 – 400 kHz 40 – 100 kHz 30 kHz 12 kHz	0.5 – 200m 0.5 – 500m 0.5 – 550m 0.5 – 600m 3 – 3600m 10 – 7000m 20 – 11000m	Very shallow wide swath, hull mount/bow/ROV/AUV Very high resolution, hull mount/bow/retractable/in gondola Very high resolution, portable/hull mount/bow/retractable/in gondola Very high resolution, hull mount/bow/ROV/AUV/retractable/in gondola Very high resolution, hull mount/retractable/gondola High resolution, hull mount/in gondola High resolution, hull mount/in gondola
SINGLEBEAMS EA 440/EA 440SP EA MCU EA 640	30 – 500 kHz 200 kHz 10 – 500 kHz	0.5 – 3000m 0.5 – 10m 11000m	Vessel of opportunity, splash proof/hull mount/bow Very shallow wide swath, hull mount Hull mount/in gondola
SIDESCANS EA Sidescan Sonar 2094 Digital	200/500 kHz 114/410 kHz	200m 250m	Hull mount/bow Towed/Vessel of opportunity
SAS SONARS HiSAS 1032	100 kHz	300m	AUV (1000m, 3000m and 4500m), ROTV (to be tested)
SUB-BOTTOM PROFILERS SBP 120 SBP 300 TOPAS PS 18 TOPAS PS 40 TOPAS PS 120 GeoPulse Plus	2.5 – 7.5 kHz 2.5 – 7.5 kHz 0.5 – 6 kHz 1 – 10 kHz 2 – 20 kHz 1.5 – 13 kHz	200m 200m 200m 60m 30m 30m	Full ocean depth. Hull mount/in gondola. Shares RX with EM [®] 122 Full ocean depth. Hull mount/in gondola. Shares RX with EM [®] 302 Full ocean depth, parametric system. Hull mount/in gondola. Medium water (2000m), parametric system. Hull mount/in gondola. Shallow water (500m), parametric system. Hull mount/in gondola. Hull mount, over-the-side, towed



Multibeam Echo Sounders

Transducer Size vs Frequency and Beam Width

EM[®] 2040C (1 x 1)
Ø 300mm



200 – 400 kHz

Range 0,5m – 500m

EM[®] 2040P (1 x 1)
560 x 300 x 166 mm



200 – 400 kHz

Range 0,5m – 550m

EM[®] 2040-04 (0,4 x 0,7)
727 x 142 x 150mm



200 – 400 kHz

Range 0,5m – 600m



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Multibeam Echo Sounders

Transducer Size vs Frequency and Beam Width

EM[®] 712 (2 x 2)
~0.5m x 0.5m



40 – 100 kHz

Range 3m – 3600m

EM[®] 302 (1 x 2)
~3m x 1,7m



30 kHz

Range 10m – 7000m

EM[®] 122 (1 x 1)
~8m x 7m



12 kHz

Range 20m – full ocean depth

EM[®] 2040P NEW Portable Multibeam Echo Sounder

Key features

- 800 soundings (dual swath) (option)
- Extra Detections (option)
- Transducer depth rating 30m (1500m option)
- Processing Unit DC voltage input
- Processing Unit IP rated (IP67)



Portable Processing Unit

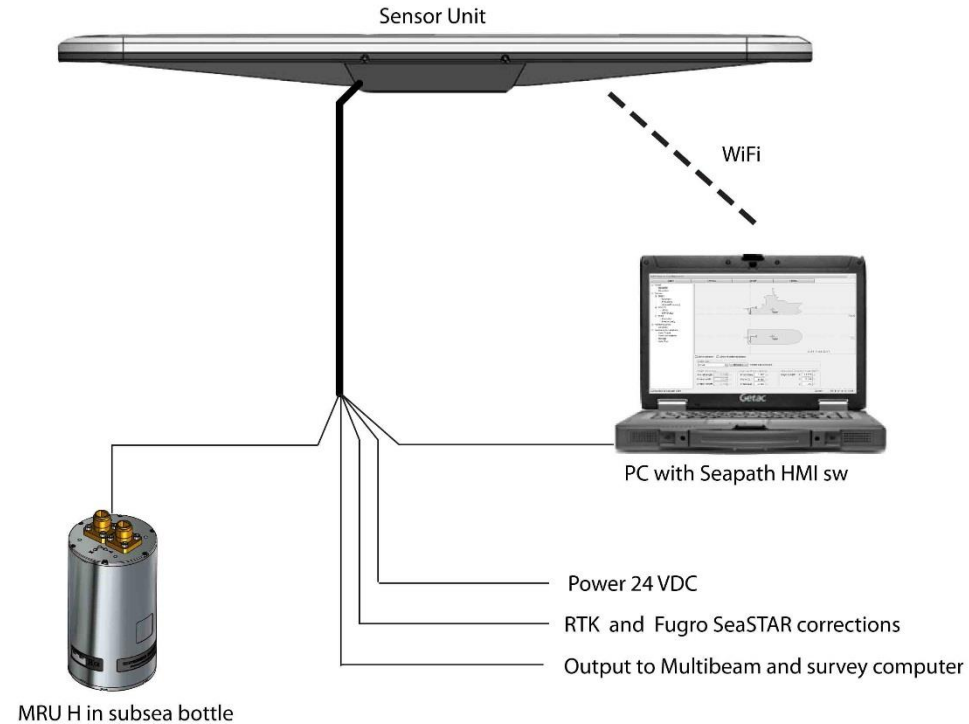
Sonar Head



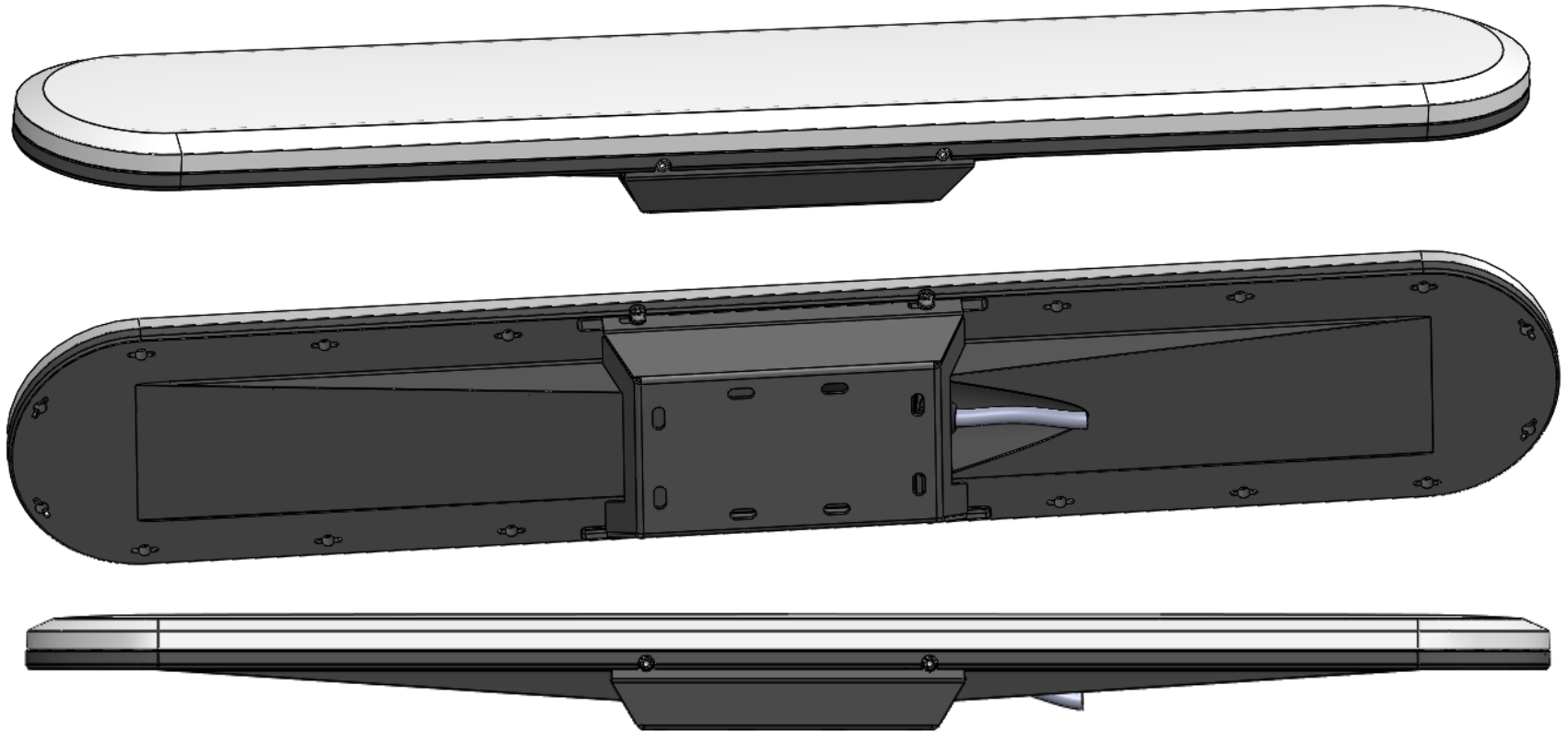
Weight Sonar Head:
18.9 kg in air
1.7 kg in water

Seapath 134 – Product Components

- Sensor Unit that include:
 - GNSS antennas and receivers
 - Processing and I/O board
 - Mounting arrangement
 - WiFi for connection to external PC with Seapath configuration through a Web browser
- A configuration interface is available through a Web server in Seapath. In addition Seapath HMI sw can be run from a PC (PC is not part of the product)
- MRU H mounted in subsea bottle
- Spider interface cable with MRU connection, two configurable serial lines, DGNSS correction input, PPS output, network and power



Sensor Unit housing



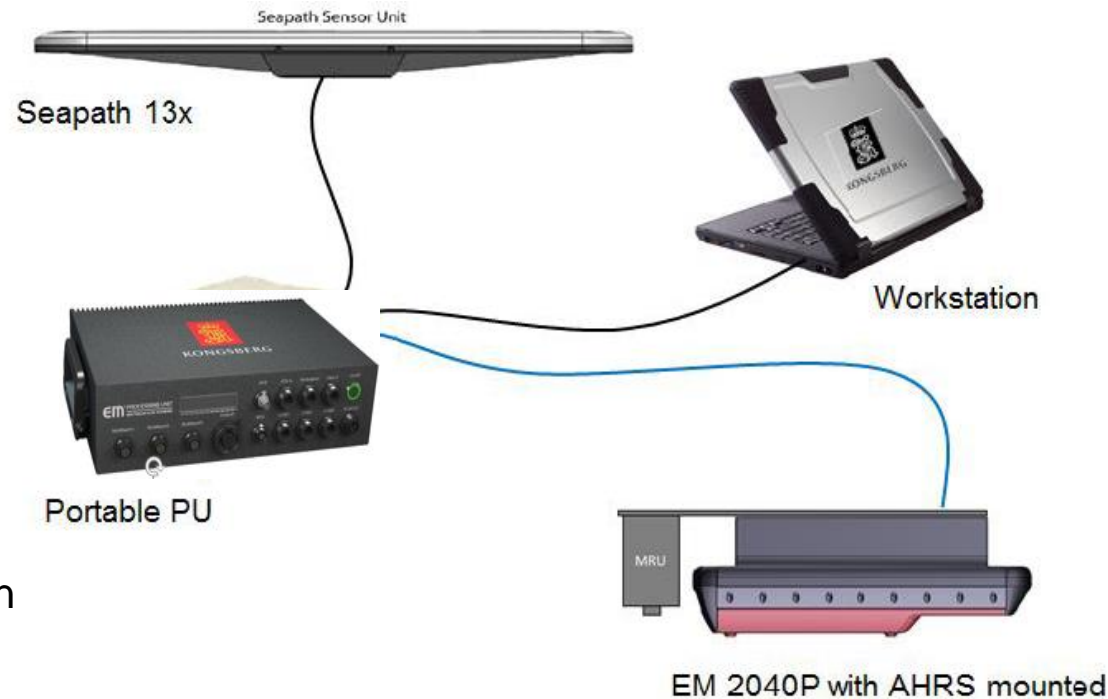
- Dimensions: Length = 1.2 m, Width = 0.2 m, Height = 0.1 m, Weight = 6.8 kg
- Power consumption: 10 W

EM[®] 2040P NEW Portable Multibeam Echo Sounder

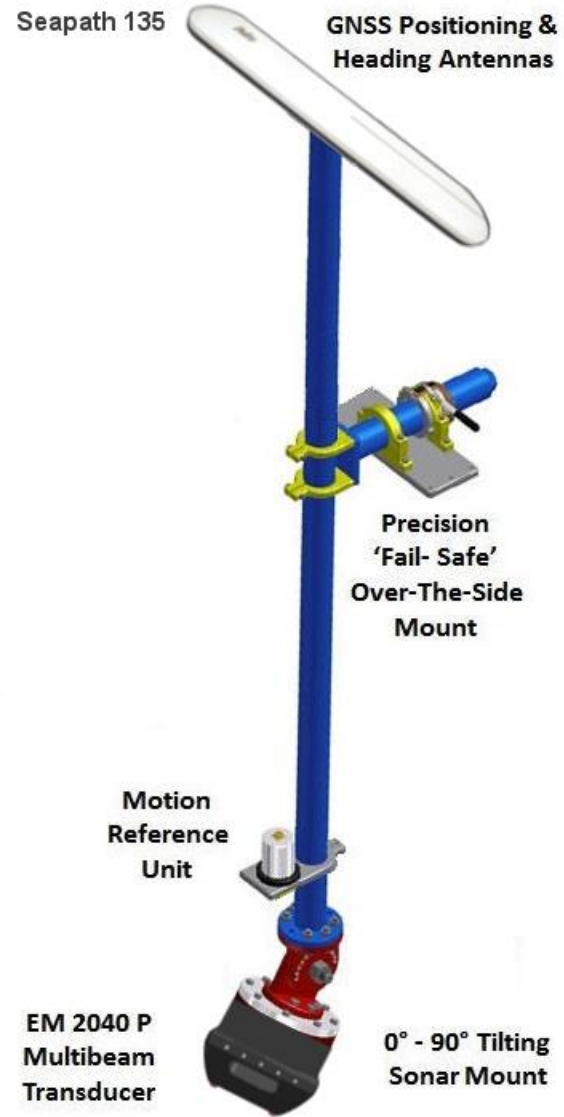
Applications from very high resolution inspection to shallow water surveys

Key features

- Frequency 200 – 400 kHz
- Range 0,5m – 550m
- Swath 140°
- Sector transmitting, 3 sectors
- Near field focusing on TX and RX
- 400 soundings (single RX)
- Roll, pitch and heave compensation
- Active roll, pitch, yaw stabilization



**A full picture portable hydrographic
mapping system**





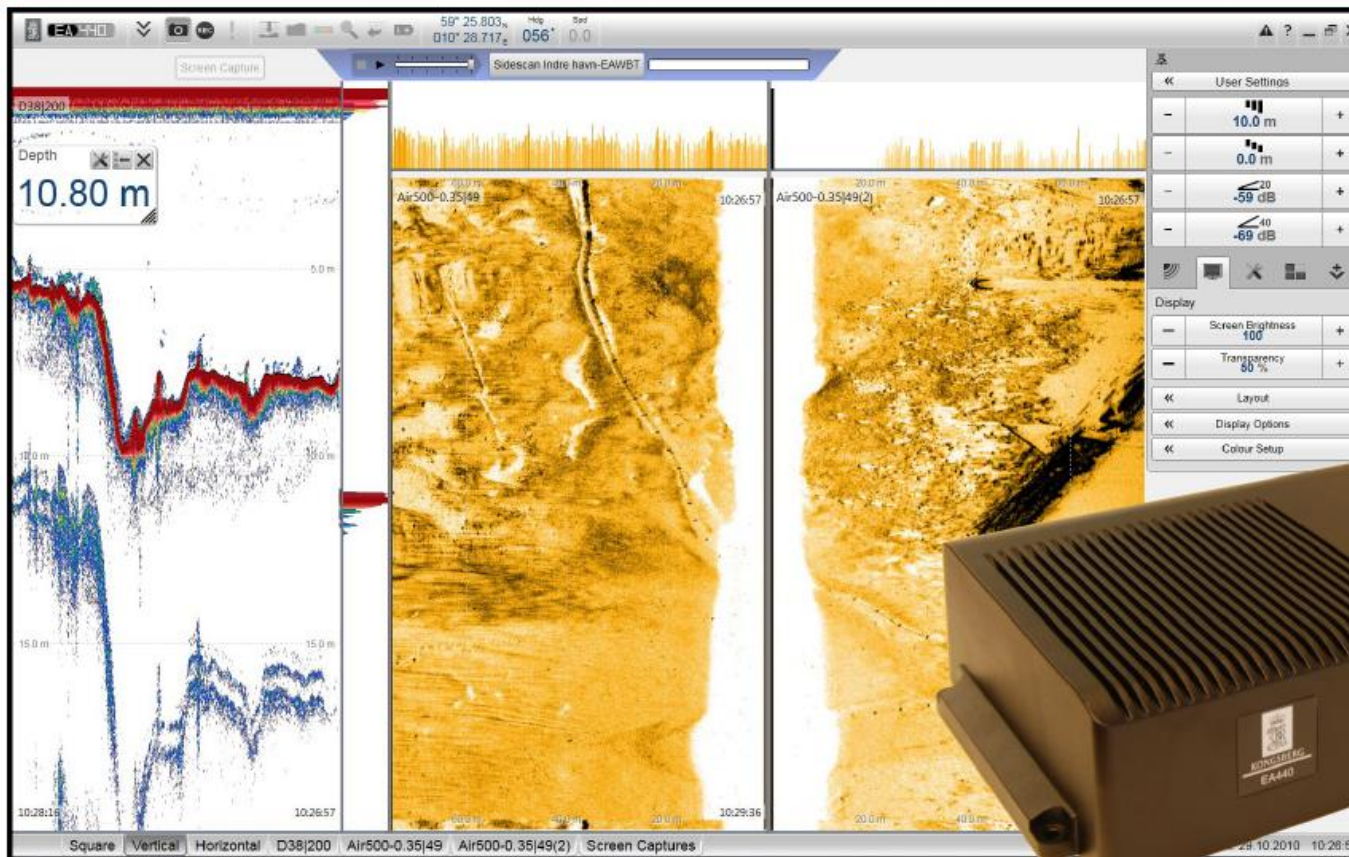
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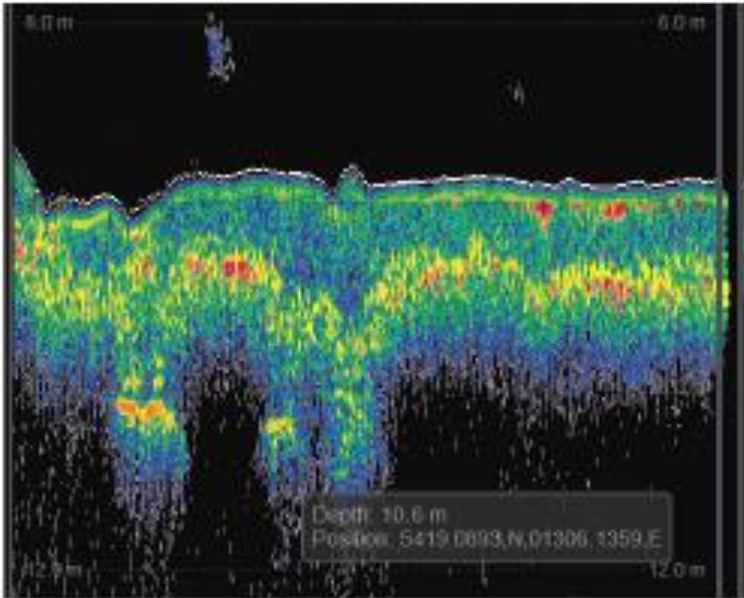
EA440



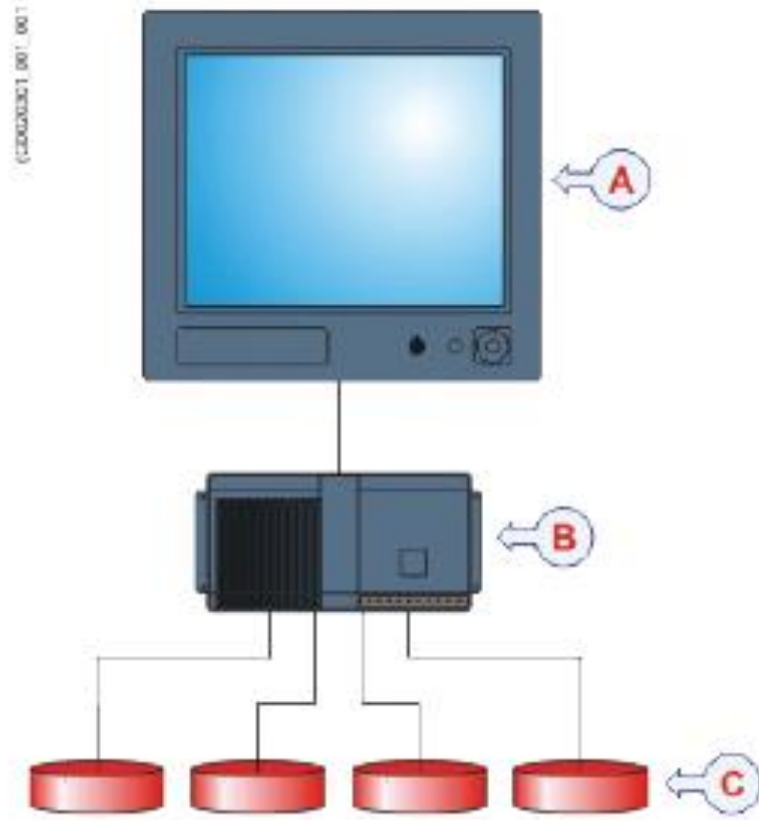
KONGSBERG



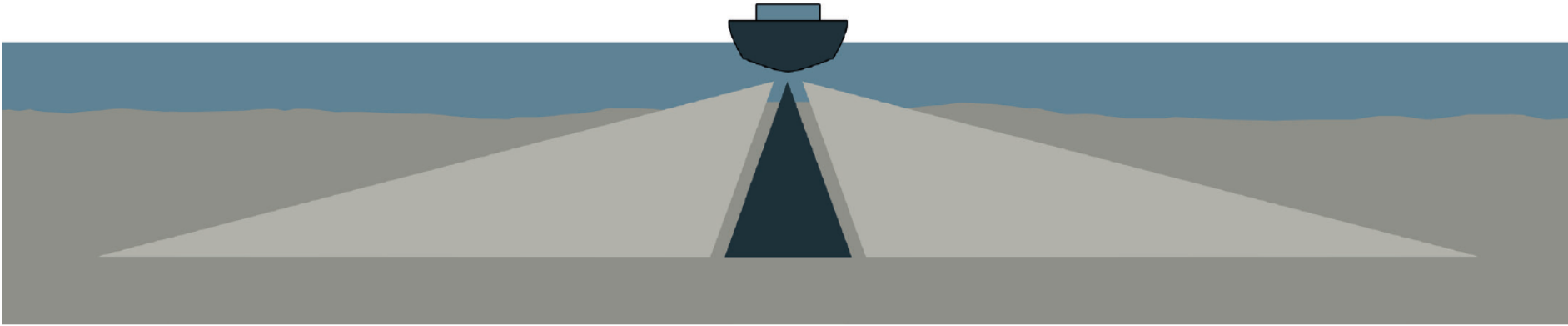
NEW GENERATION WIDE BAND HYDROGRAPHIC ECHO SOUNDER



Echogram with 15 kHz, CW Pulse, 2,5m sub-bottom (Döker)



- A. Hydrographic Operator Station (panel computer with integrated display)
- B. Transceiver Unit (Wide Band Transceiver (WBT))
- C. Transducer(s)



The EA440 high resolution sidescan function is well suited for:

- Object detection
- Morphology of bottom
- Dredging control
- Obstacle and wreck detection

Objects in the side-scan view can be marked by a mouse click and the position information will be stored. This data can then be exported real time to external software if connected to a GPS positioning and heading device.

With an extra zoom function interesting targets or objects can be scaled up for detailed inspection. The zoom area is freely adjustable and the window can be positioned as an overlay on any part of the side-scan echogram.

FM chirp is a powerful tool for high frequency high resolution side scan. A 500 kHz side scan with a CWC of 32 μ s gives high resolution but short range, typically 50 - 75 m. Switching to a 1 ms FM chirp will increase the range to typically 125 - 150 m, while keeping the resolution. There is no longer any need to sacrifice resolution for range.



EM 712 New features and performance

EM 712 will have the same functionality as the EM 710-MK2, but with new hardware, better performance and new features.

- The performance will exceed the EM 710-MK2
- Lower self noise with preamplifier in RX transducer
- 0.5 degree receiver
- 0.25 degree transmitter
- State of the art hardware

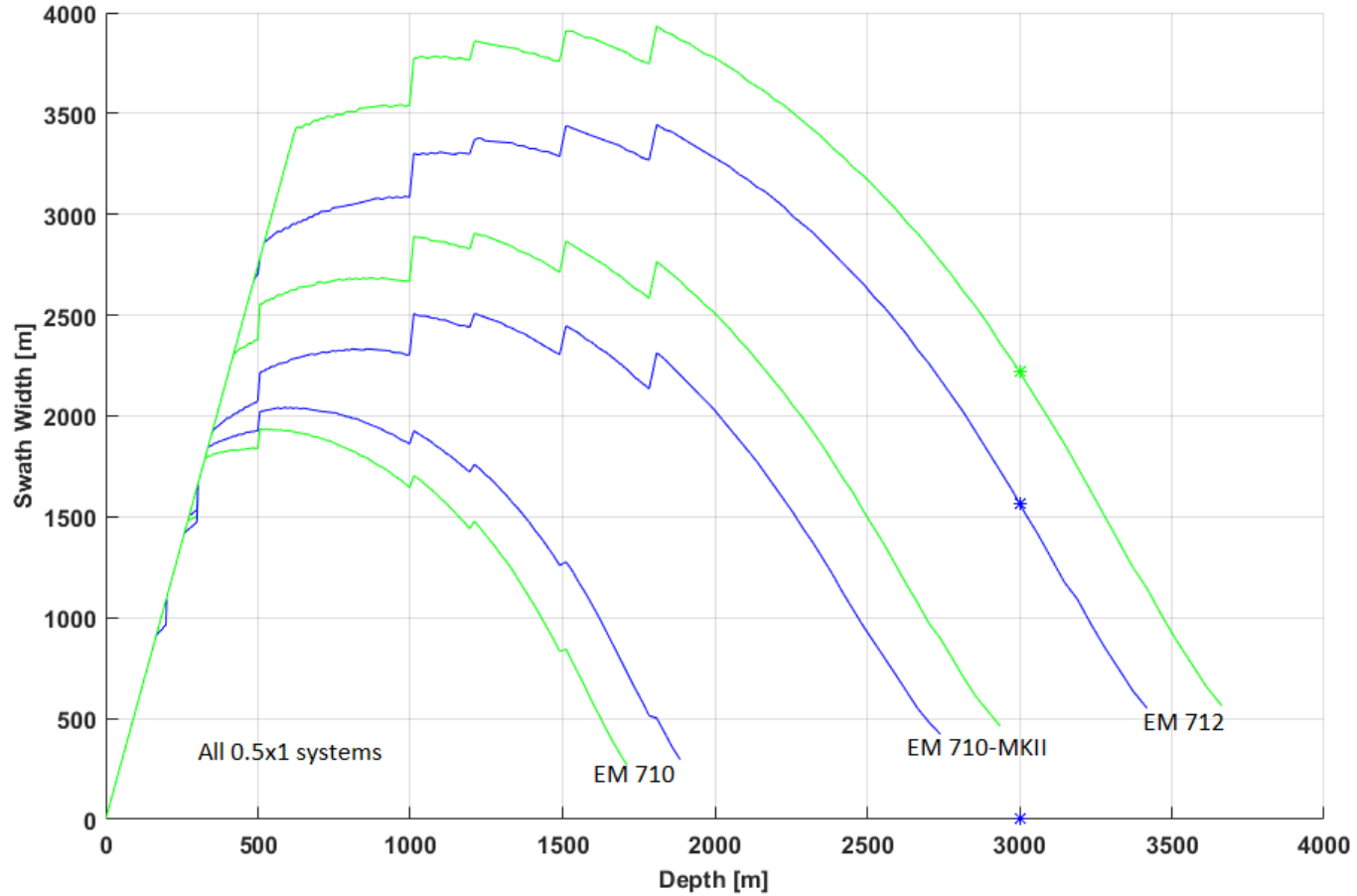
Options

- Extra detections



EM 712 - Specifications

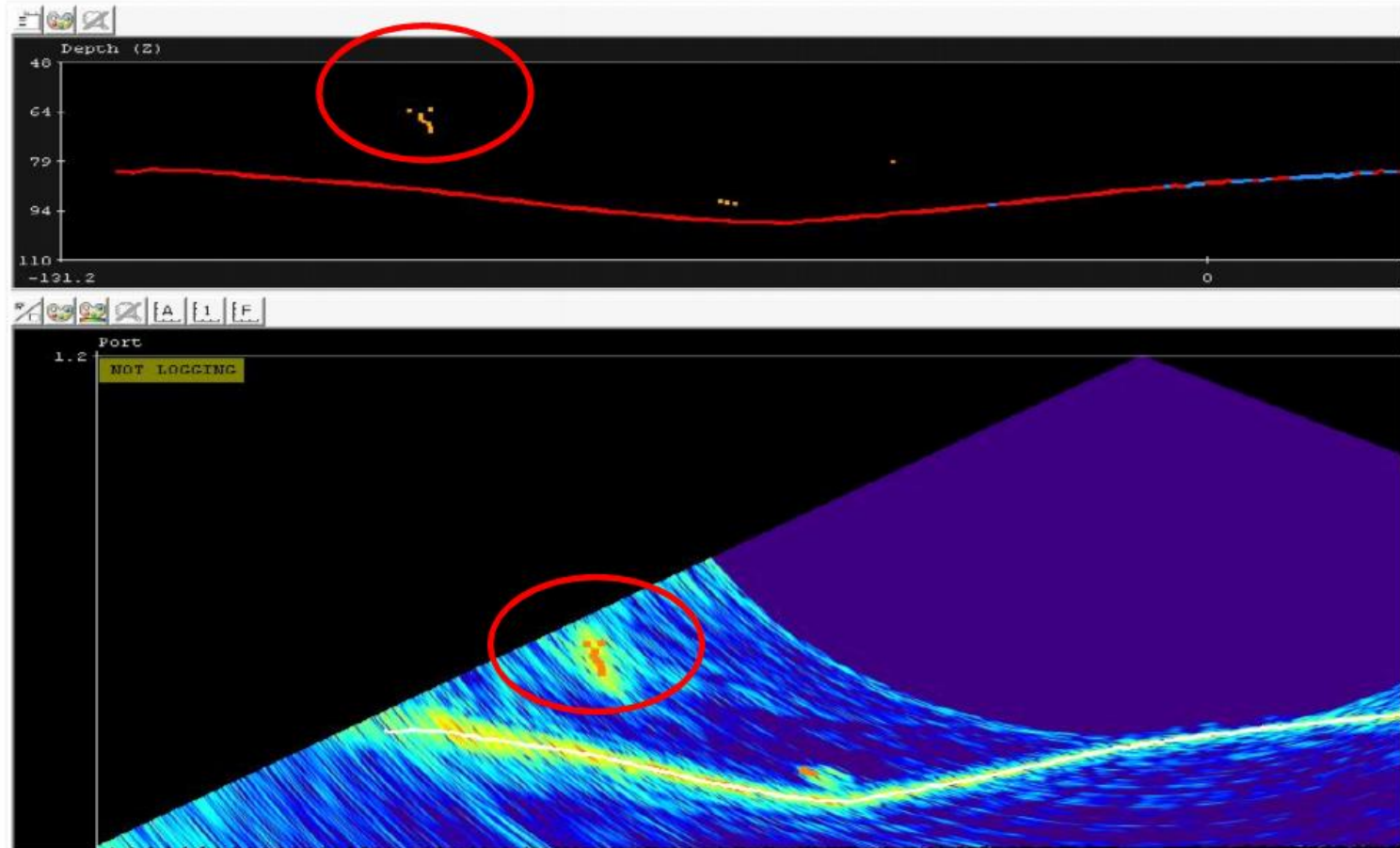
Coverage plot for all systems, EM 710, EM710MKII and EM712



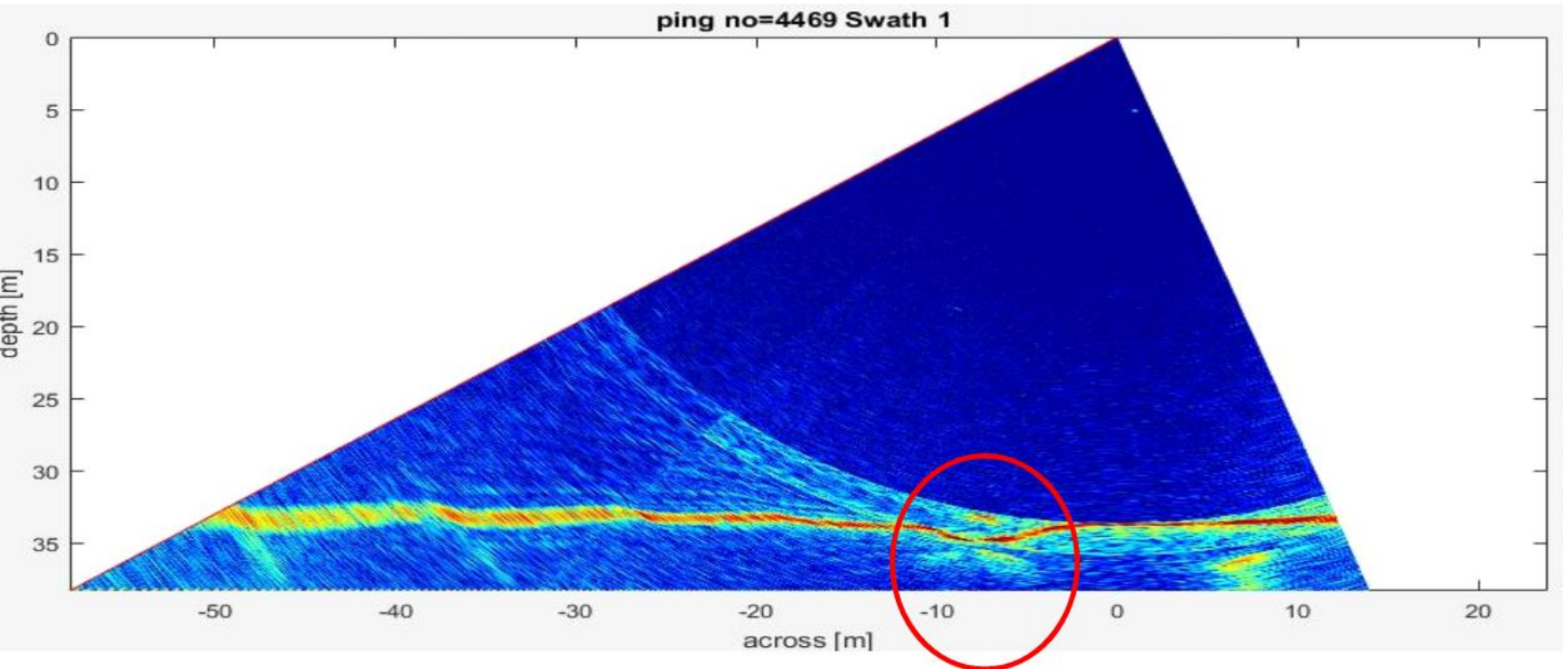
Water Column – Echoes to data



Extra-detections

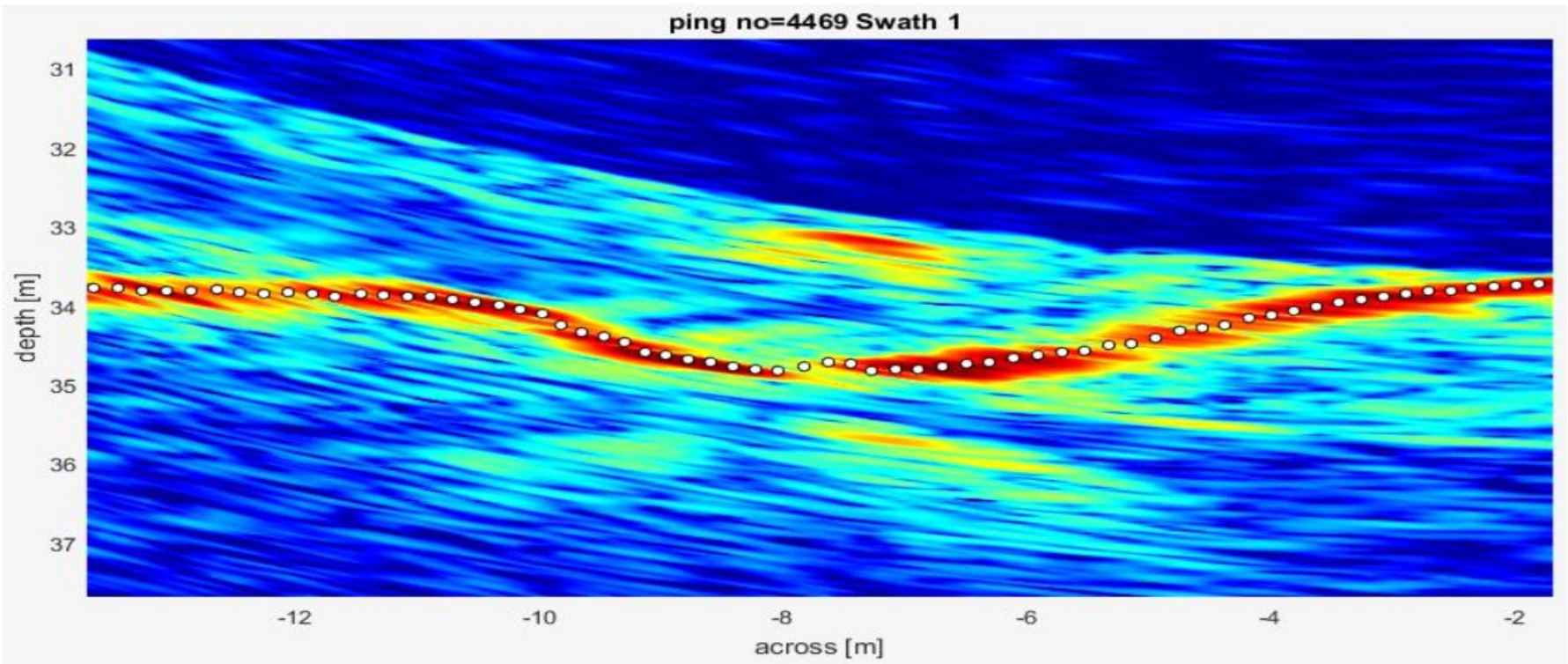


Pipe at 35 m, Water column data



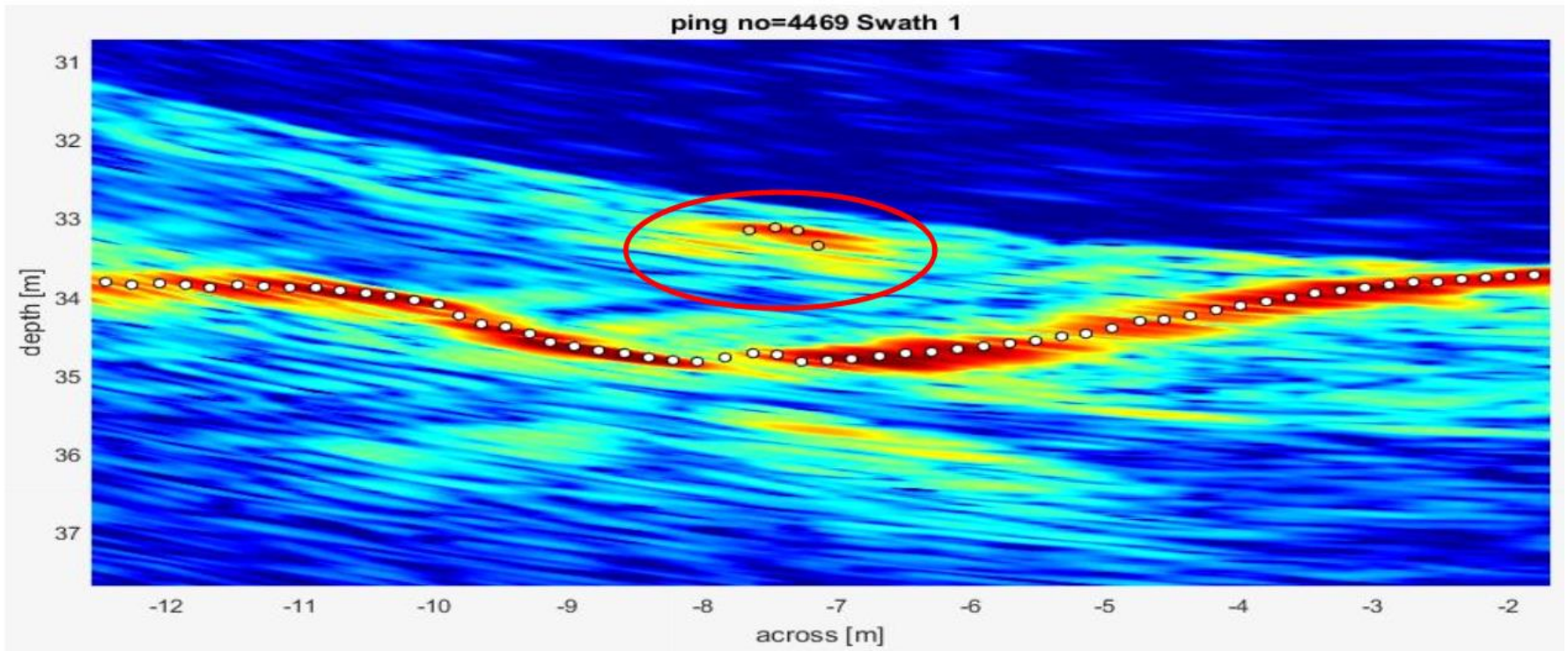
Bottom and pipe echo together

Pipe at 35 m, Water column data



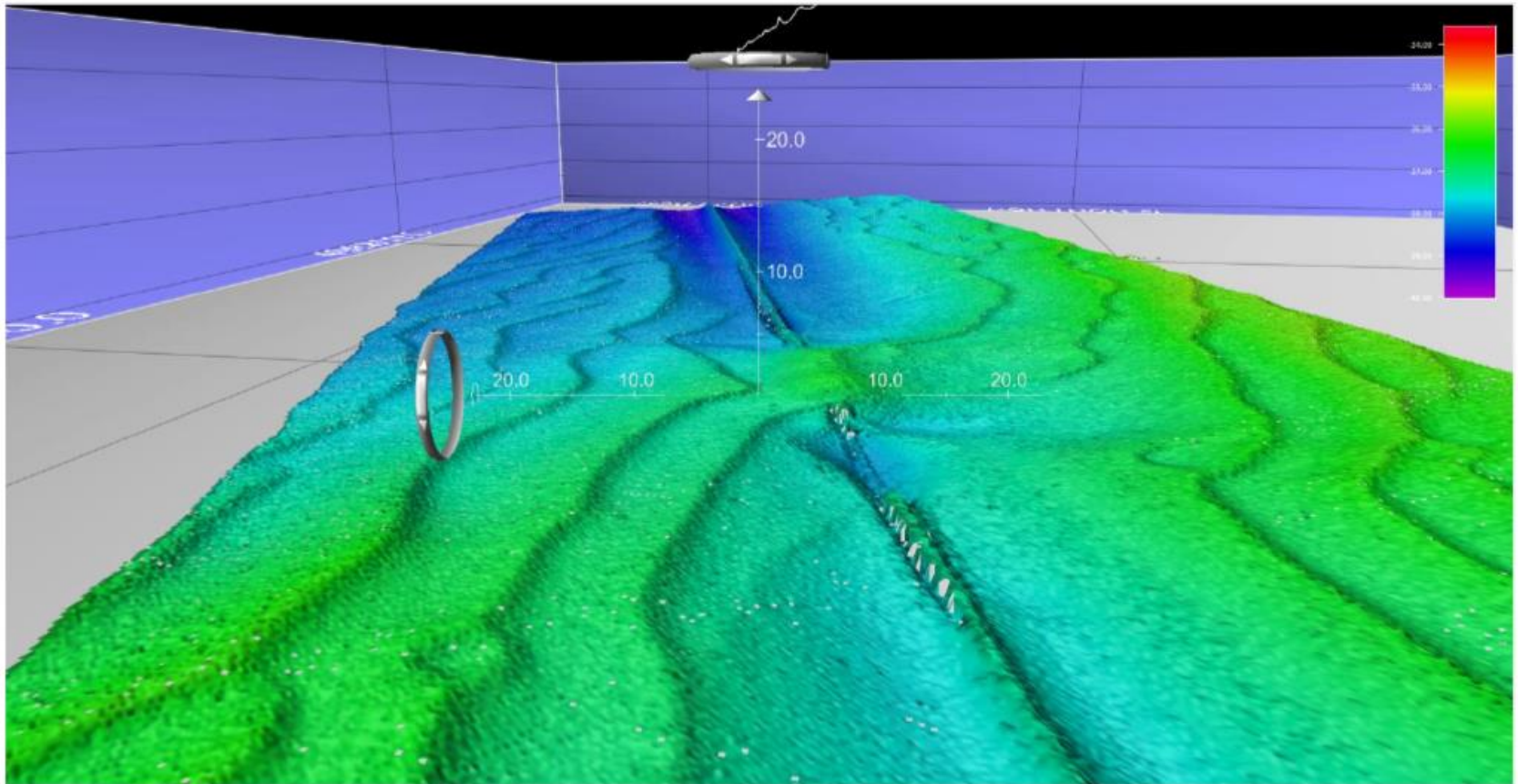
Good detections on bottom, and no detection on the pipe

Pipe at 35 m, Water column data



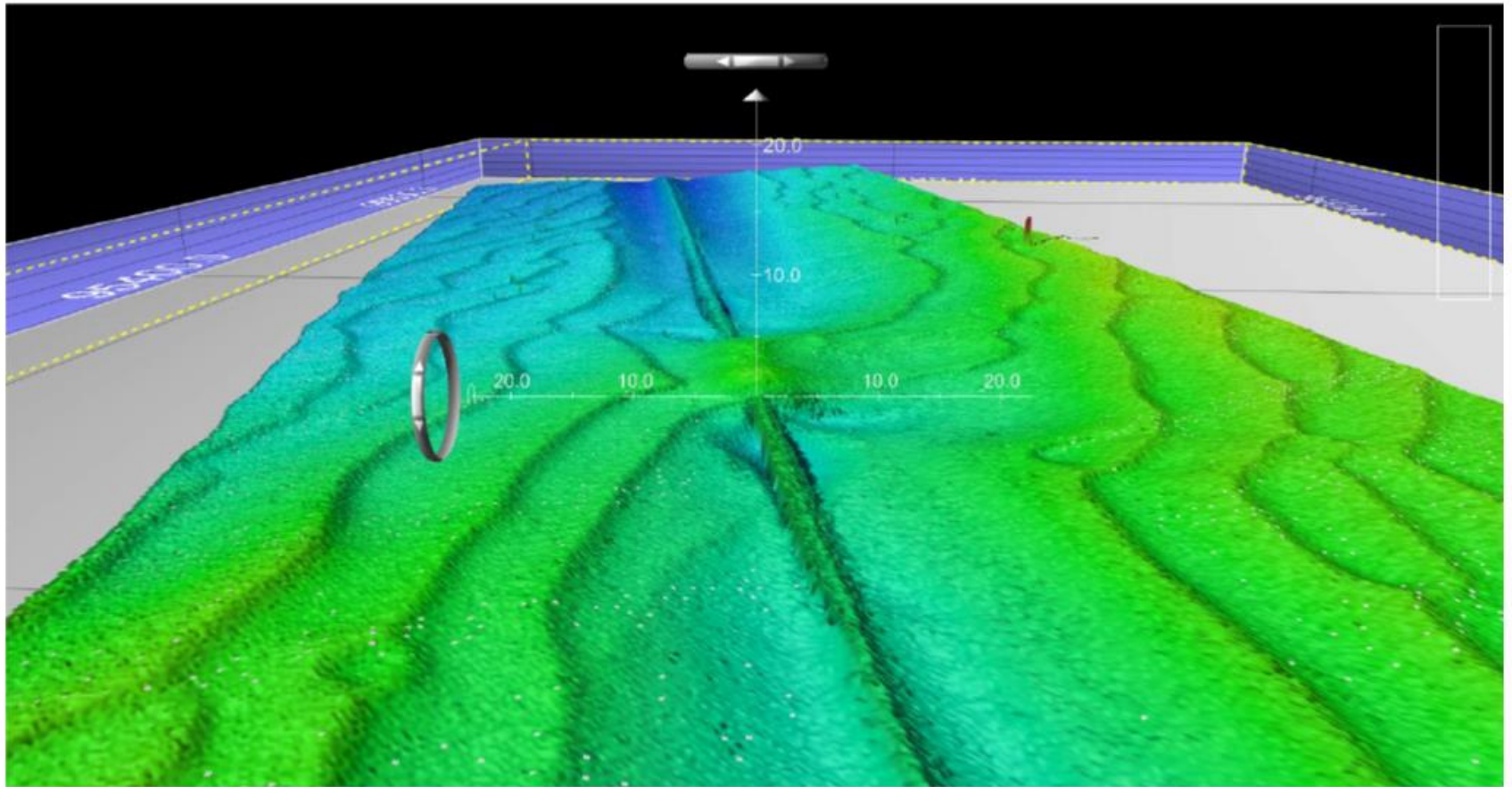
Good detections on bottom, and extra detection (class 5, Yellow) on the pi

Pipe at 35 m,



Without Extra Detect

Pipe at 35 m,



With Extra Detect

AUTONOMOUS UNDERWATER VEHICLES FOR HYDROGRAPHY

HISAS 1032/2040 – High resolution Interferometric Synthetic Aperture Sonar



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State-of-the-Art Survey Class AUV: HUGIN AUV System



Dimensions:

- Length: 5.2 to 6.5 m
- Diameter: 75 cm

Depth Ratings:

- 3000, 4500 and 6000 m

Power Supply:

- Rechargeable and swappable
Lithium Polymer batteries

Endurance:

- 24-70+ hours with payload sensors
running

Typical Payload Sensors:

- HISAS Synthetic Aperture Sonar
- EM2040 Multibeam Echosounder
- EdgeTech SSS & Sub-Bottom Profiler
- CathX Ocean Colour Still Image Camera
- CathX Ocean Laser Profiler
- OFG Magnetometer
- Contros HydroFlash CH4
- Franatech METS
- WetLabs Turbidity



MUNIN 600 AUV Specifications

Dimensions:

- Length: < 4 m
- Diameter: 34 cm
- Weight: <350 kgs

Depth Ratings:

- 600 m

Power Supply:

- Rechargeable Lithium batteries

Endurance:

- 12 to 24 hours

Communications:

- cNODE
- HiPAP USBL
- Command Link
- Data Link



Payload:

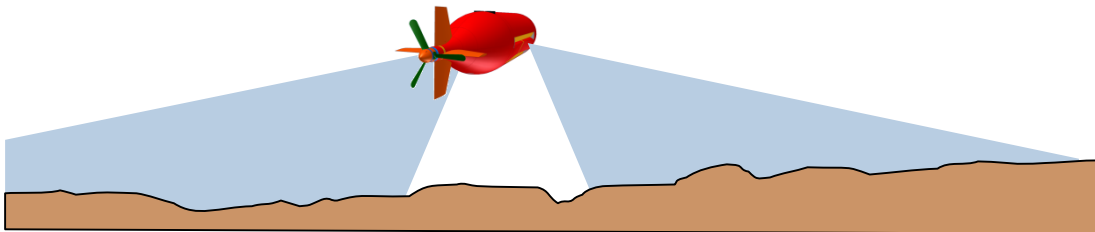
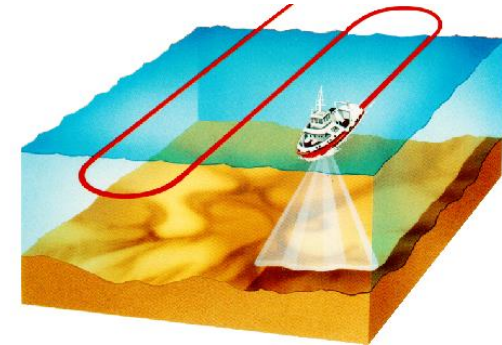
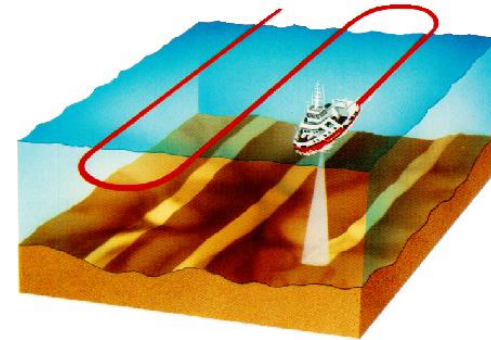
- EM2040 MBES
- SSS
- CT Sensor
- SBP option
- Camera option

Navigation:

- Honeywell HG9900 IMU
- NavP
- Forward looking sonar
- Novatel L1/L2 GPS
- DVL
- DigiQuartz depth sensor
- UTP & Terrain navigation options

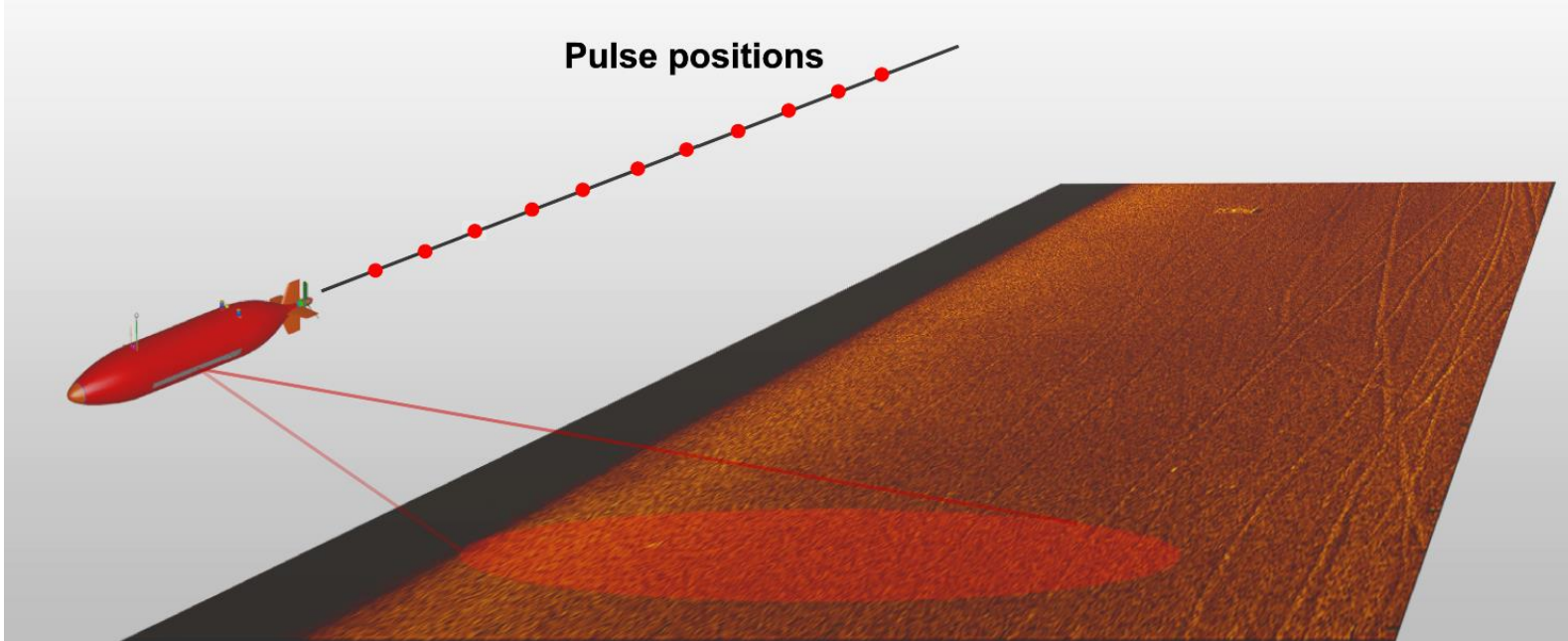
Existing technology

- Single beam Echo-sounder
 - Limited beamwidth around vertical
- Multibeam Echo-sounder (MBE)
 - Multiple narrow beams across track. Trade-off between coverage rate and resolution
- Sidescan sonars (SSS) & Interferometric sidescan
 - Limited along track resolution
 - Trade-off between resolution and range



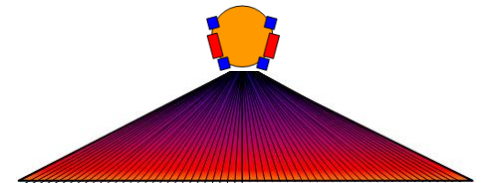
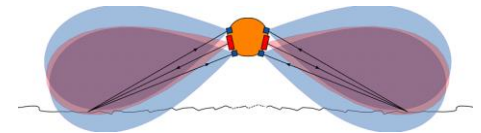
SAS - Synthetic Aperture Sonar

- Makes it possible to effectively synthesise a long antenna
 - By coherent combination of pings taken at interval along the line of platform motion
- As opposed to side scan...
 - The resolution is given by the receiver element size
 - The area coverage rate is given by the receiver length



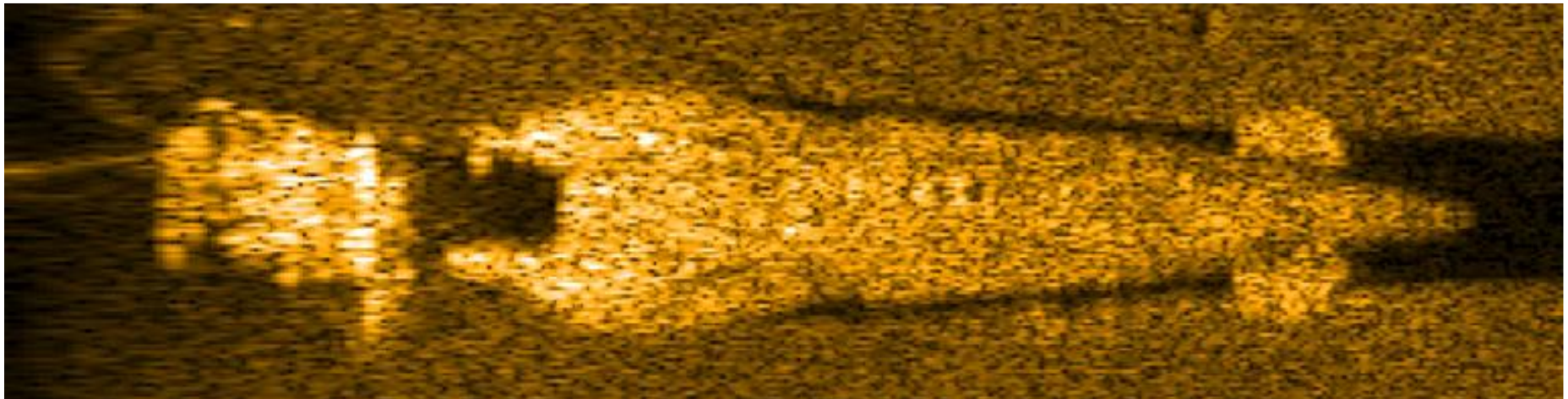
HISAS 1032 & MBE for Hydrographic mapping

- HISAS 1032
 - High area coverage, typically $2\text{km}^2/\text{hr}$, depending on overlap between adjacent survey lines
 - But blind zone directly below the vehicle (nadir gap)
- MBE (EM2040) provides
 - High quality bathymetry with a resolution matching that of HISAS SSS bathymetry
- Combining HISAS 1032 and the MBE provides
 - Coverage of up to $20 \times$ the AUV's altitude above the seafloor
 - Combined area coverage of up to $2.8\text{km}^2/\text{hr}$



Resolution matters

Multi-ping Sidescan Sonar, (370 - 420 kHz) - Range 10-50 m

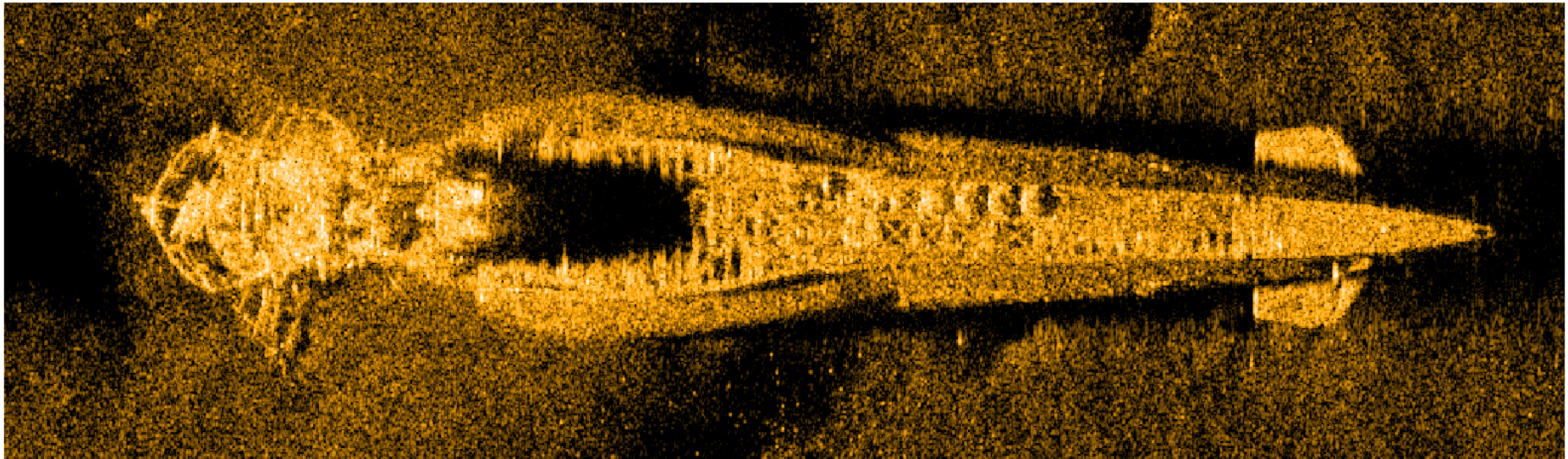
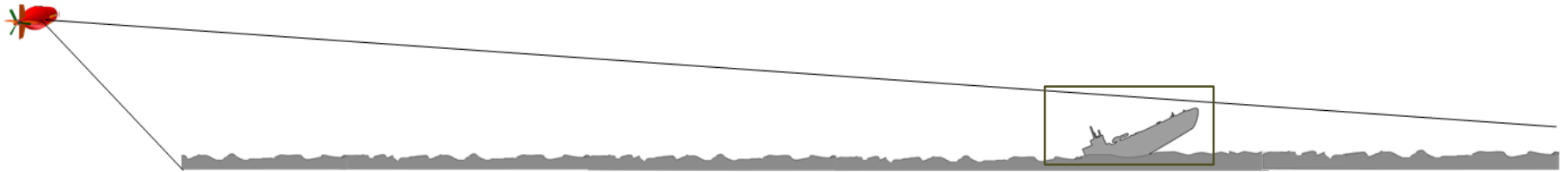




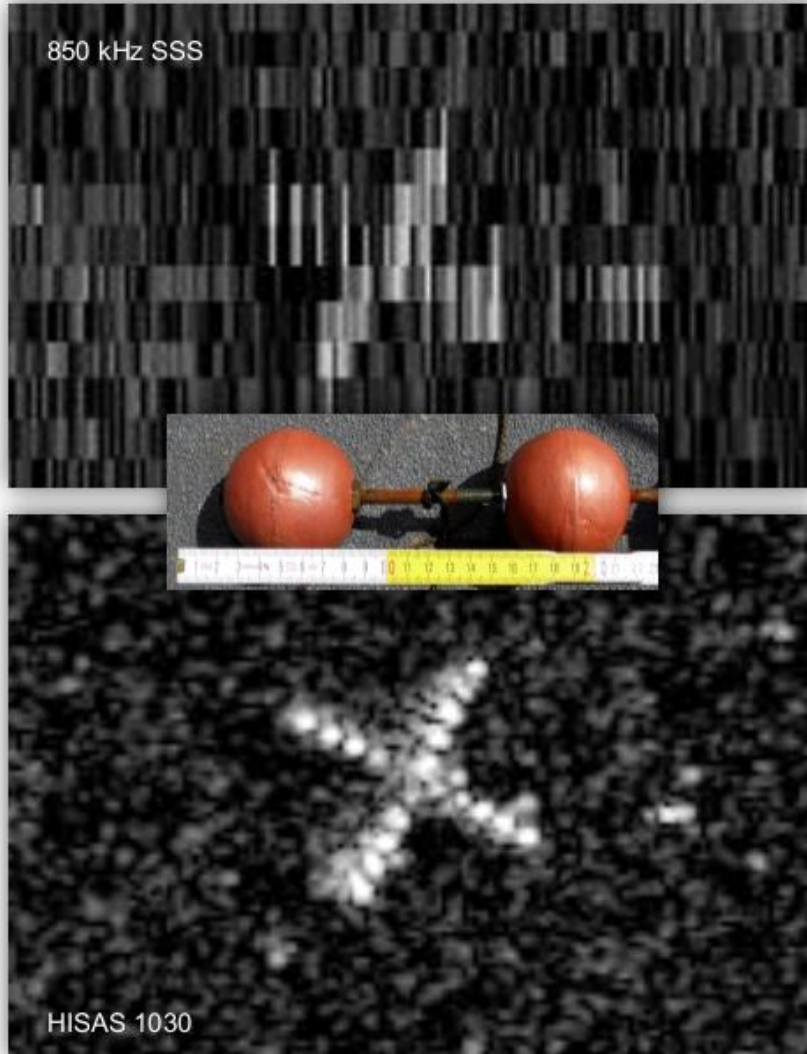
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Resolution matters

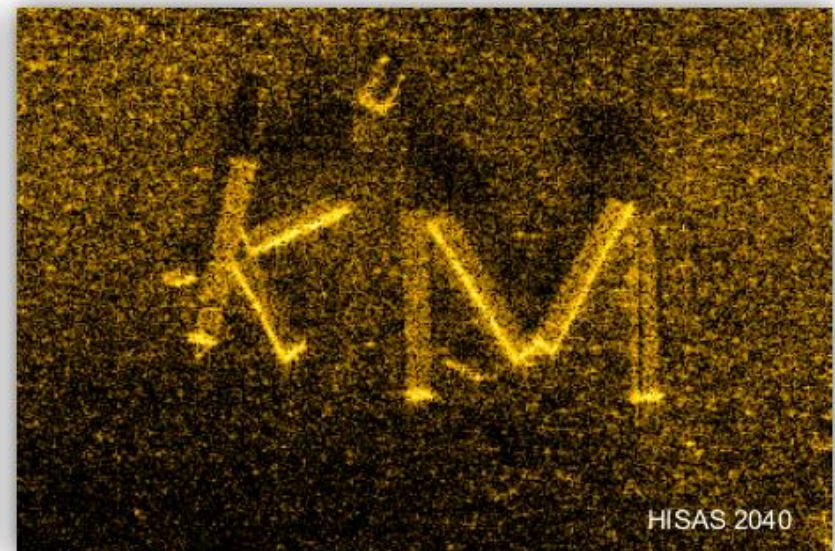
HISAS 1030 (85 – 115 kHz) - Range 205 - 245 m



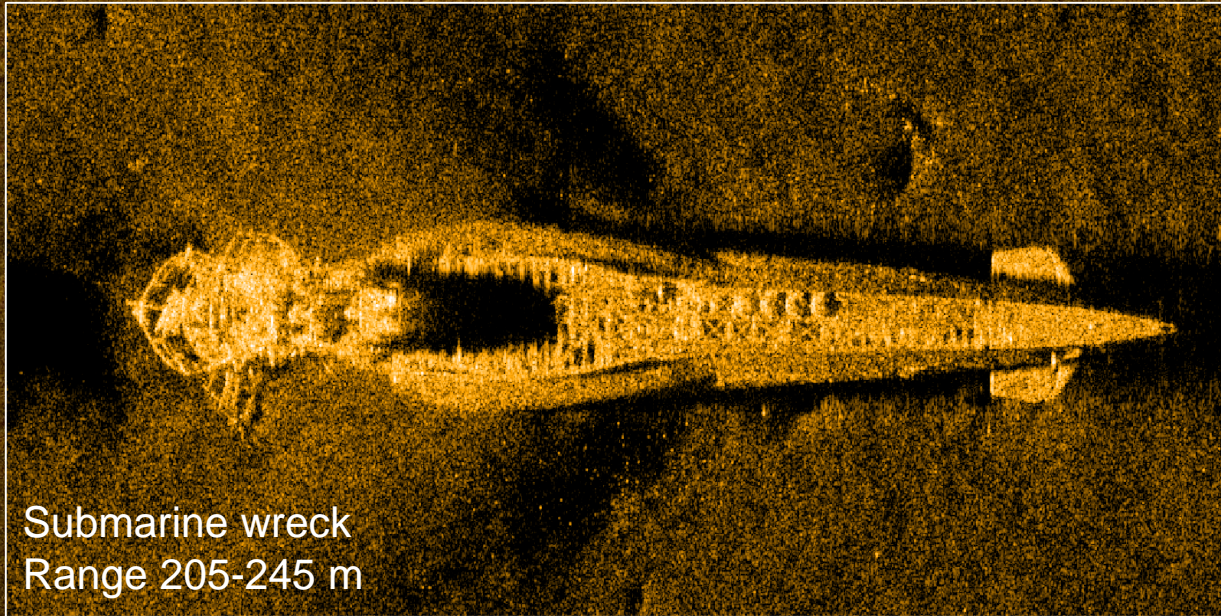
Data Products - HISAS



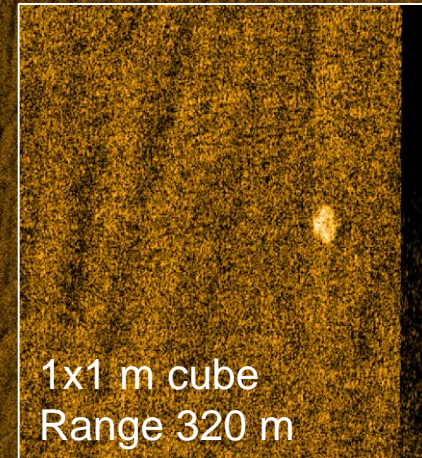
- Synthetic Aperture Sonar
- HISAS 1030 theoretical resolution 2 x 2 cm
- HISAS 2040 theoretical resolution 1.2 x 1.3 cm
- Practical resolution 4 x 4 cm
- Range independent resolution
- HISAS 1030 range: 300 m either side
- HISAS 2040 range: 150 m either side
- In-Mission SAS and Bathymetry processing



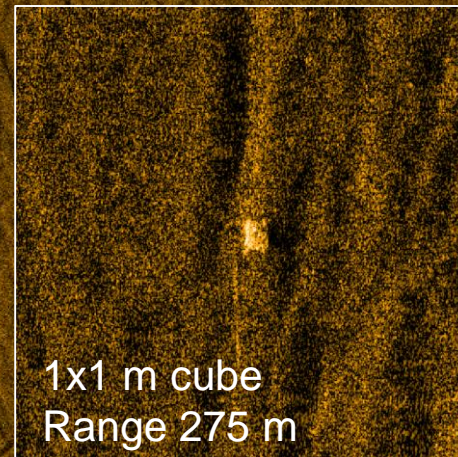
HISAS long range example



Submarine wreck
Range 205-245 m



1x1 m cube
Range 320 m

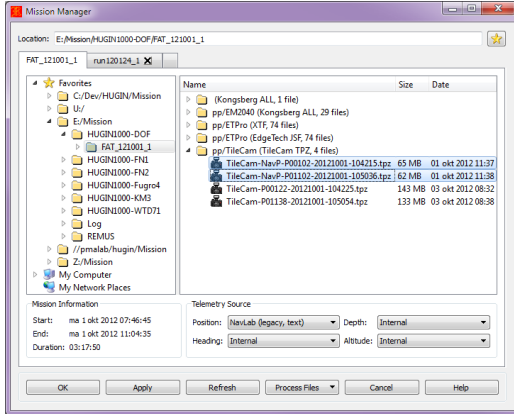


1x1 m cube
Range 275 m

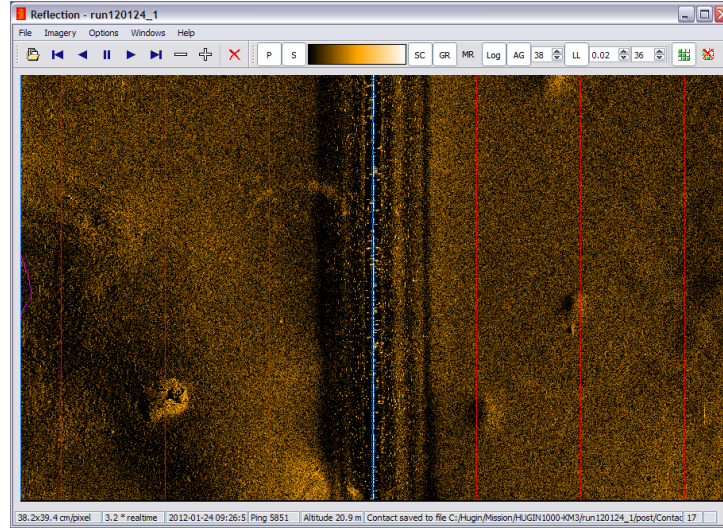
HISAS 1030 on HUGIN 1000-MR
Range 25-325 m
AUV altitude 40 m
Speed 2.3 knots



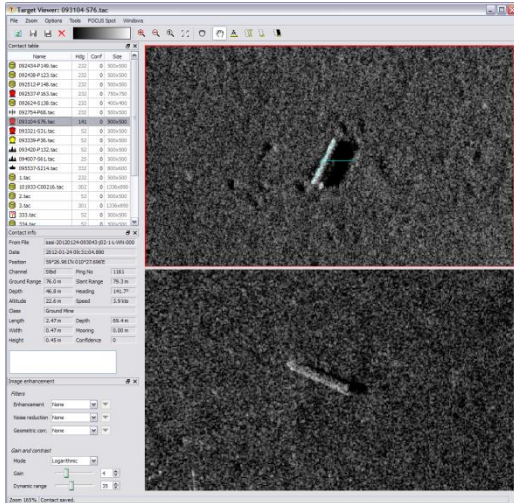
Reflection components



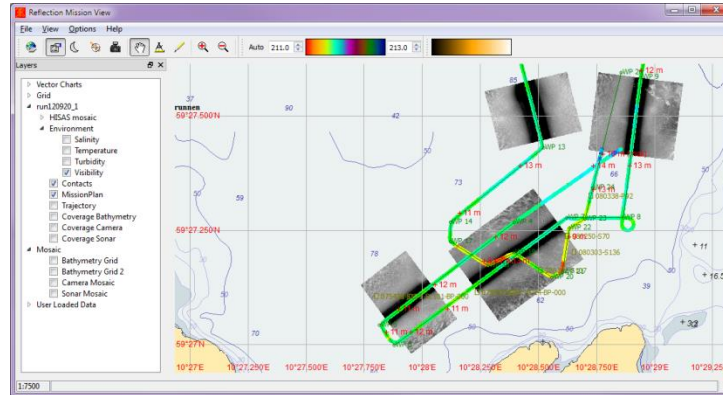
Mission Manager



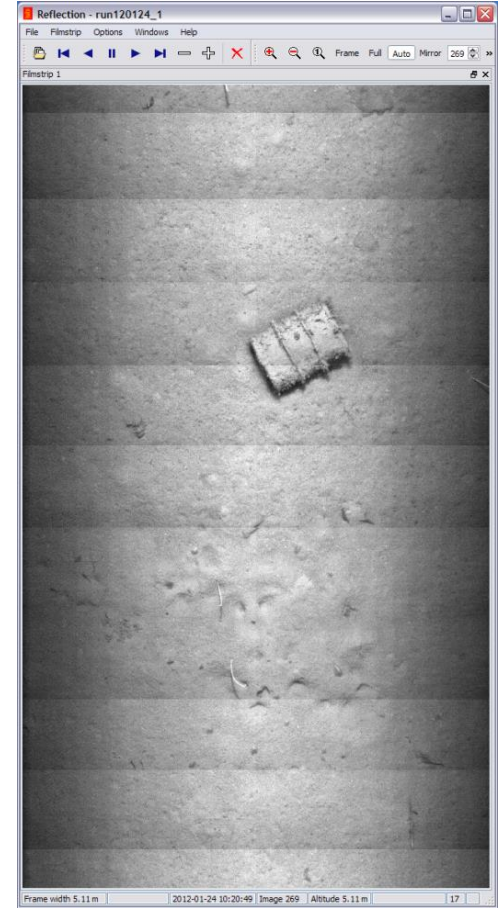
SSS/SAS waterfall



Target View

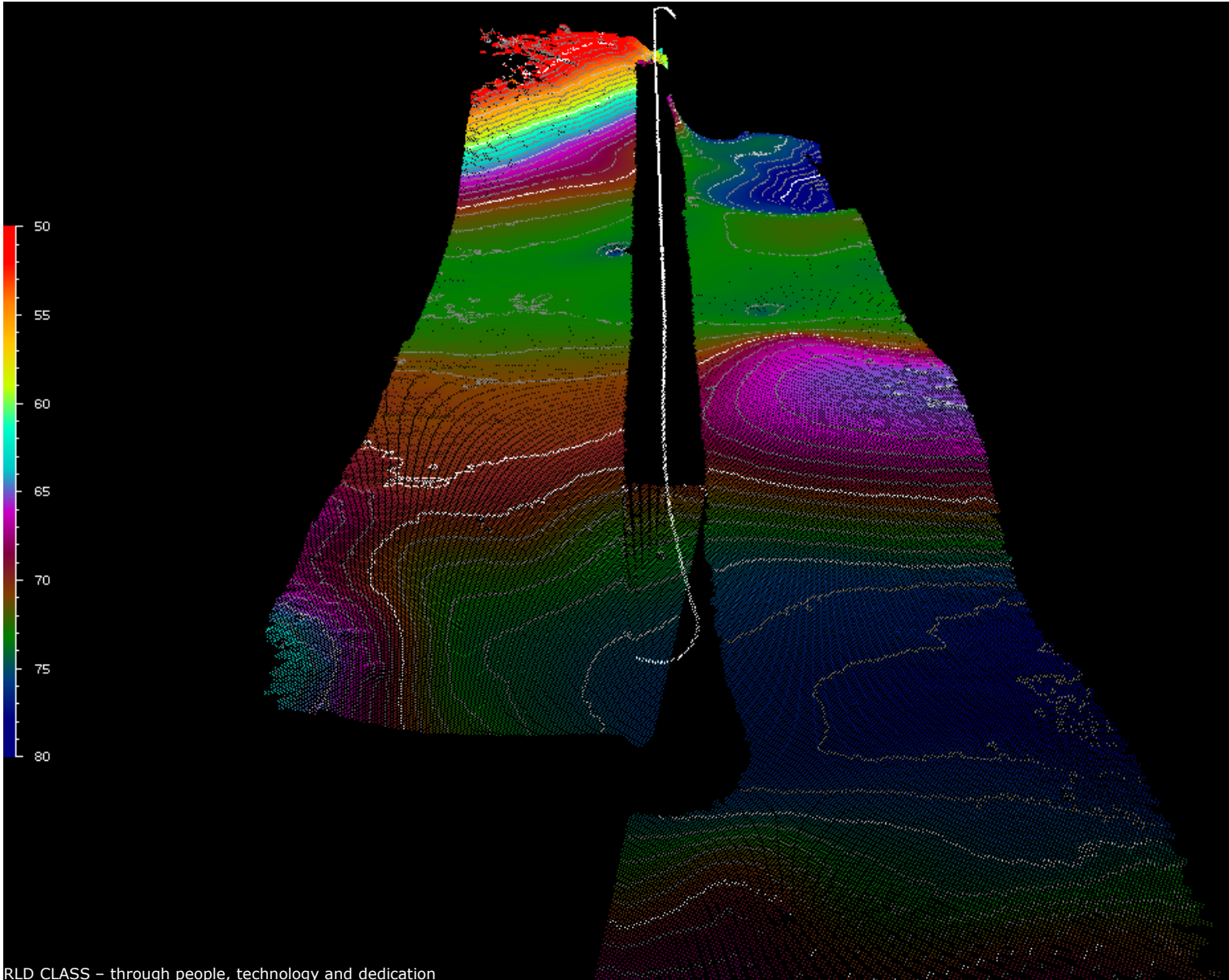


Georeferenced Mission View

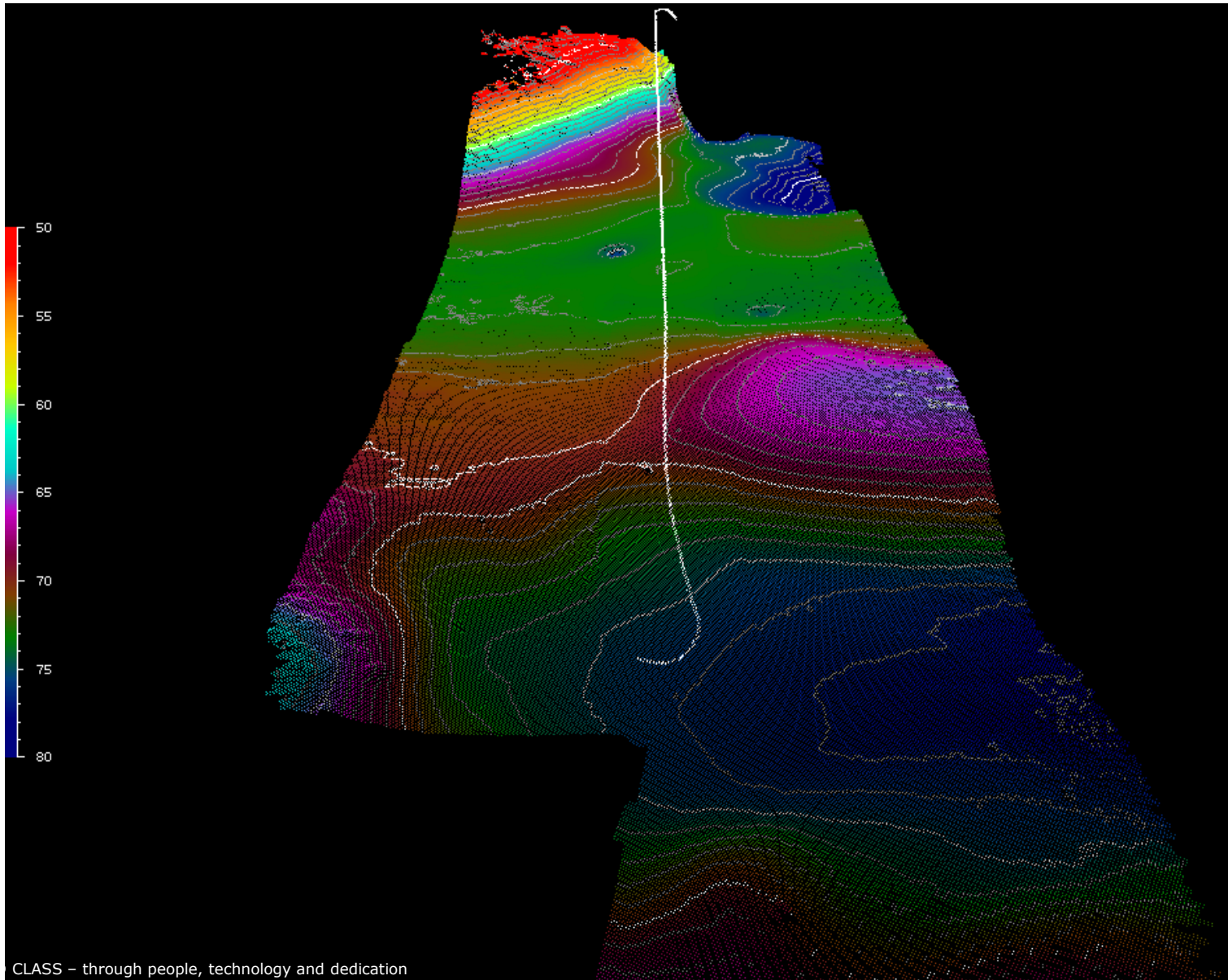


Still image camera "filmstrip" view



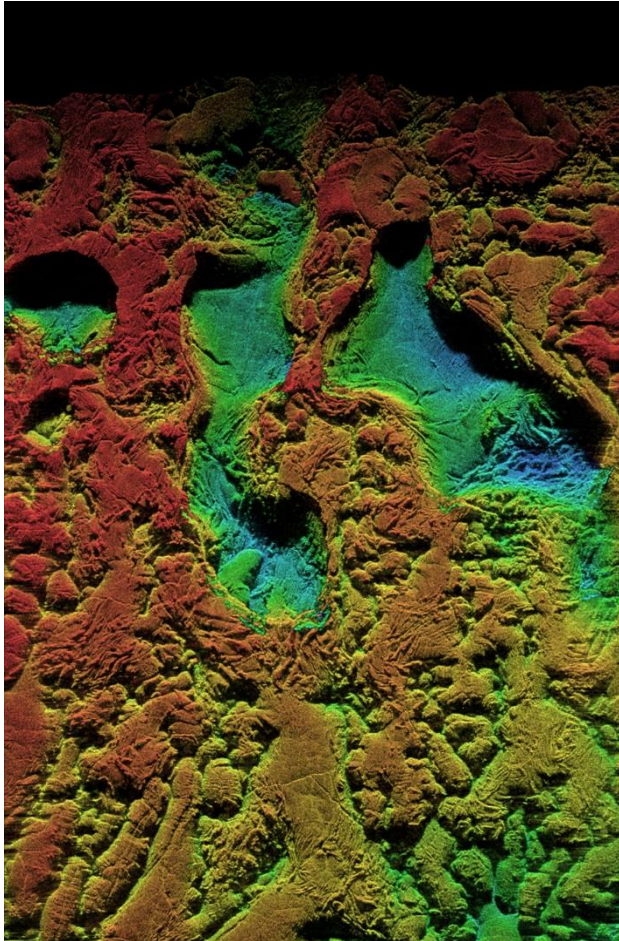


Total coverage 20 times depth





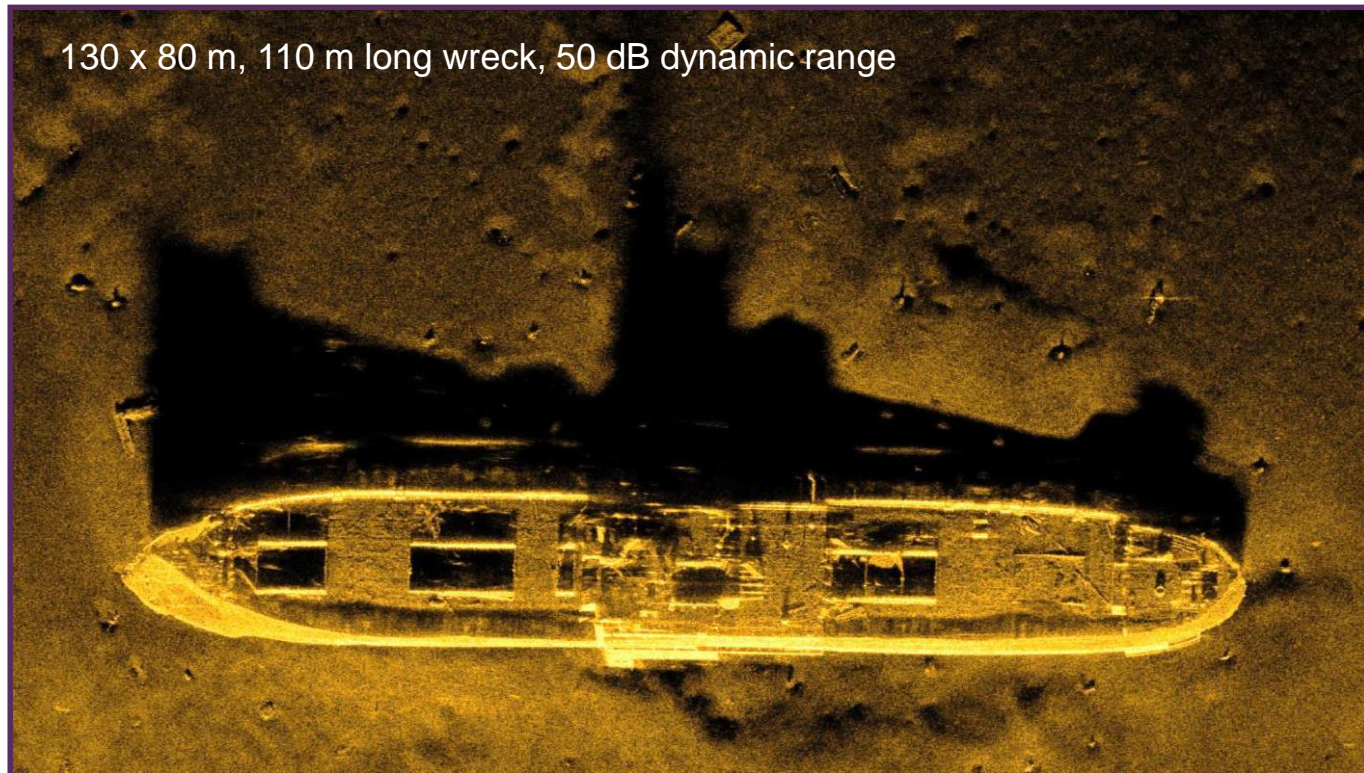
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HISAS combined SAS image and SAS bathymetry of a field of pillow lava from a trial in June 2011. Area 100m x 60m, range 30-130m seafloor, color mapped to depth from 830m to 836m.

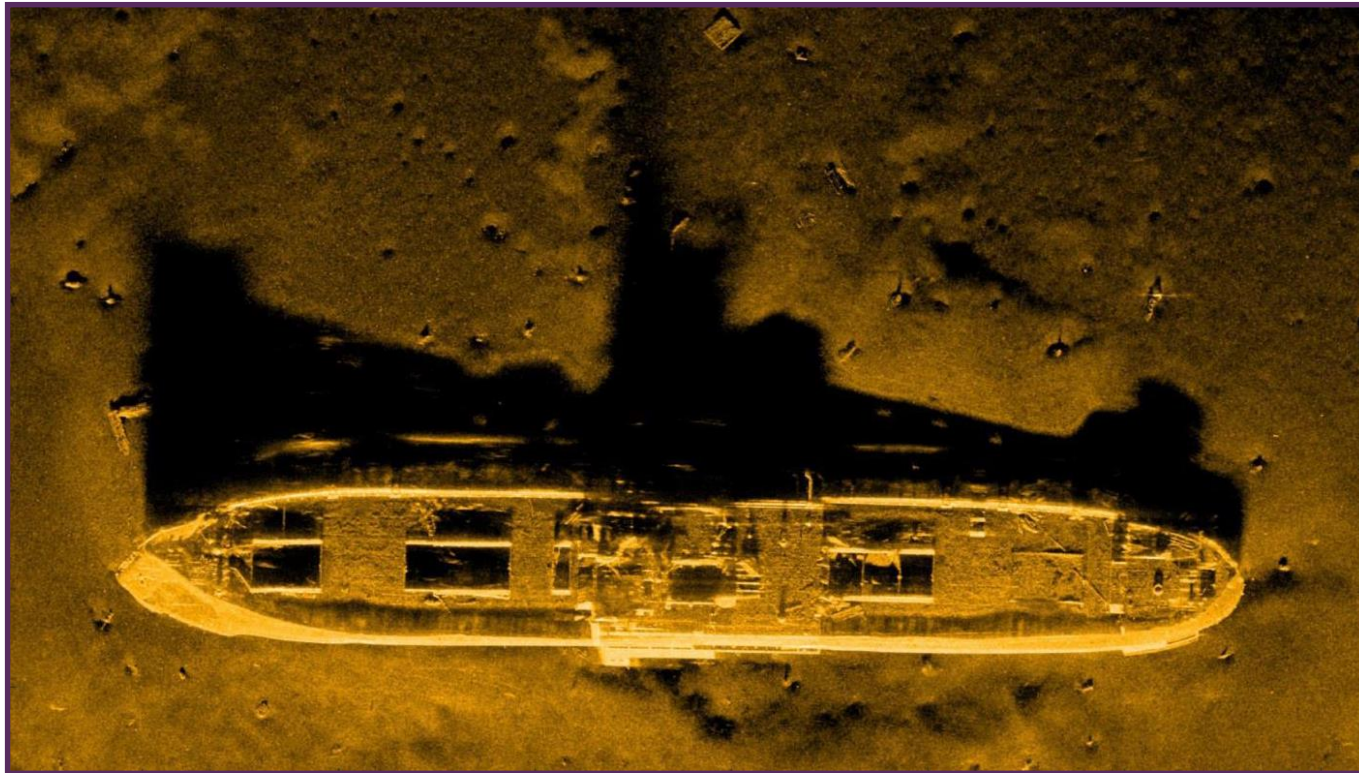
Data used courtesy of University of Bergen and Norwegian Defense Research Establishment (FFI).

Example processing: Original SAS image



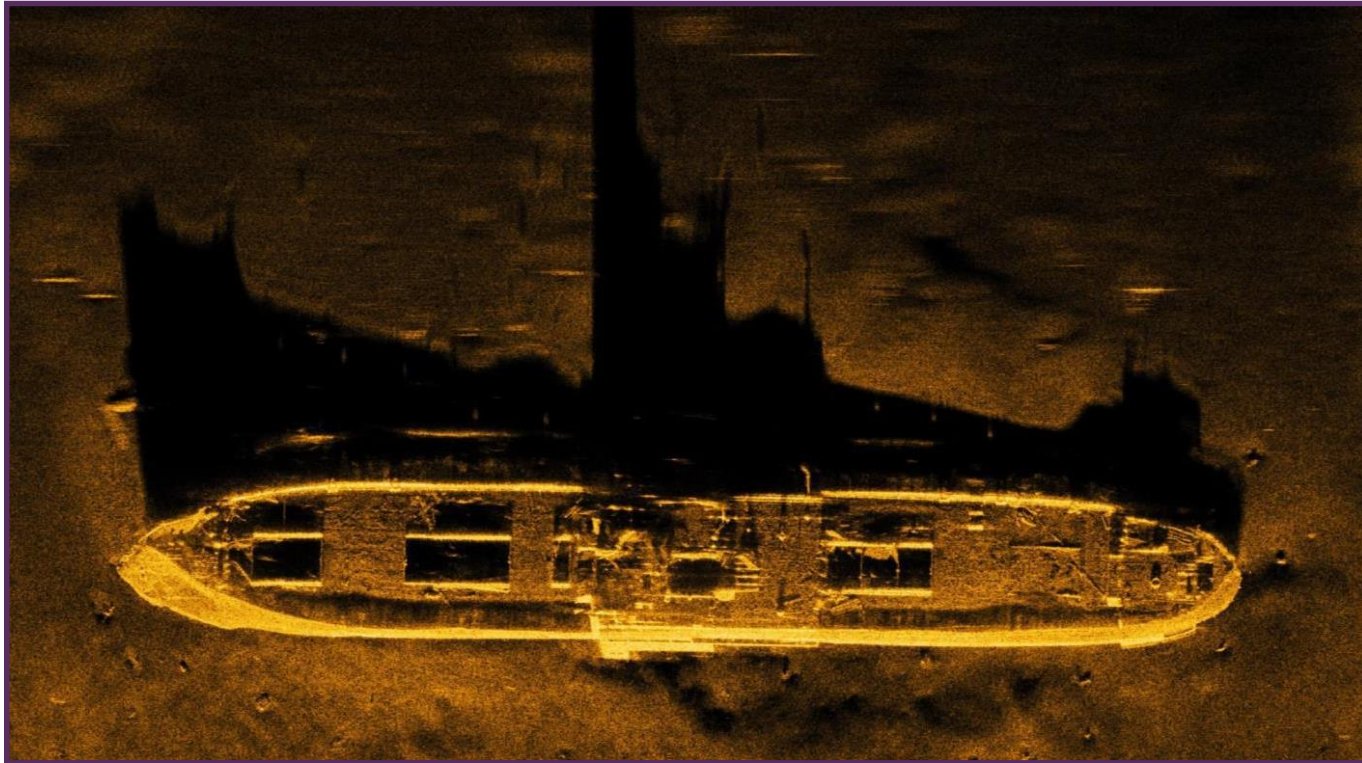
Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

Despeckled image



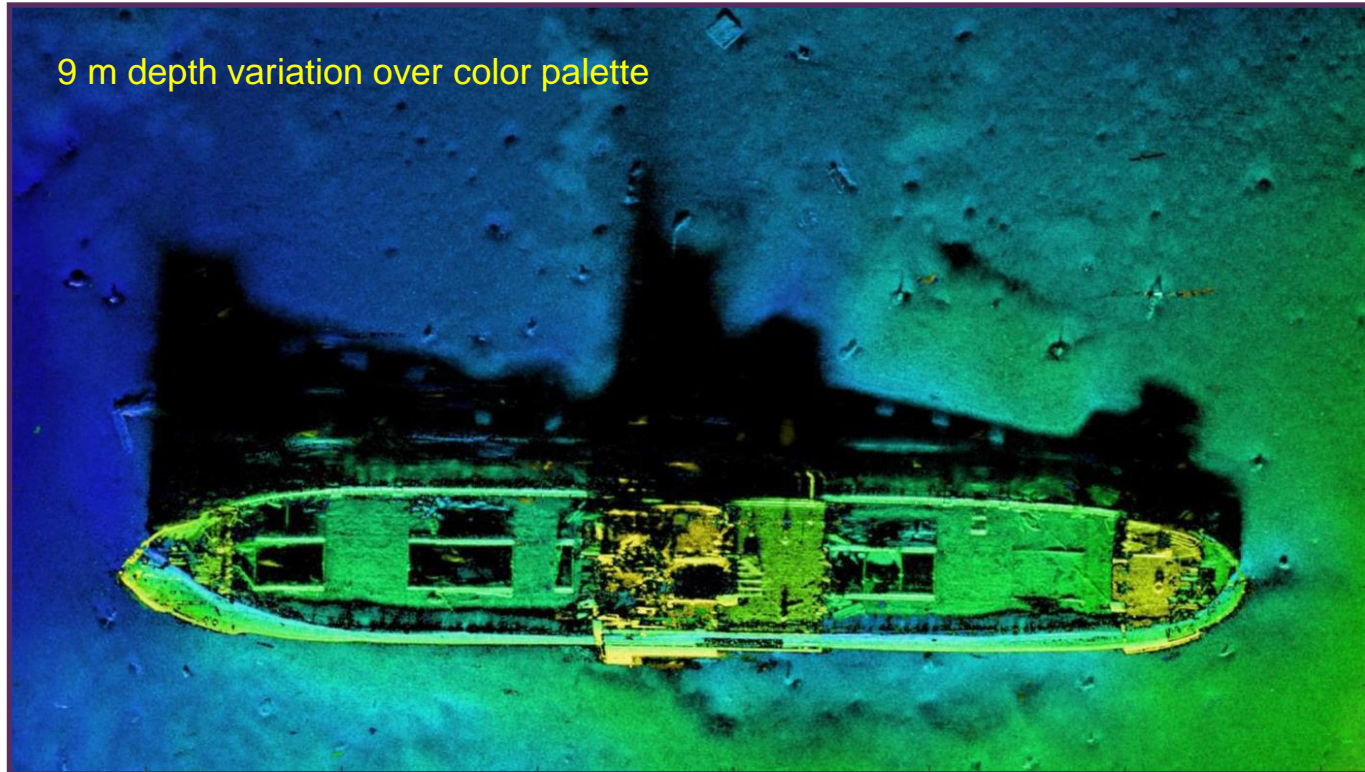
Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

Shadow enhanced image

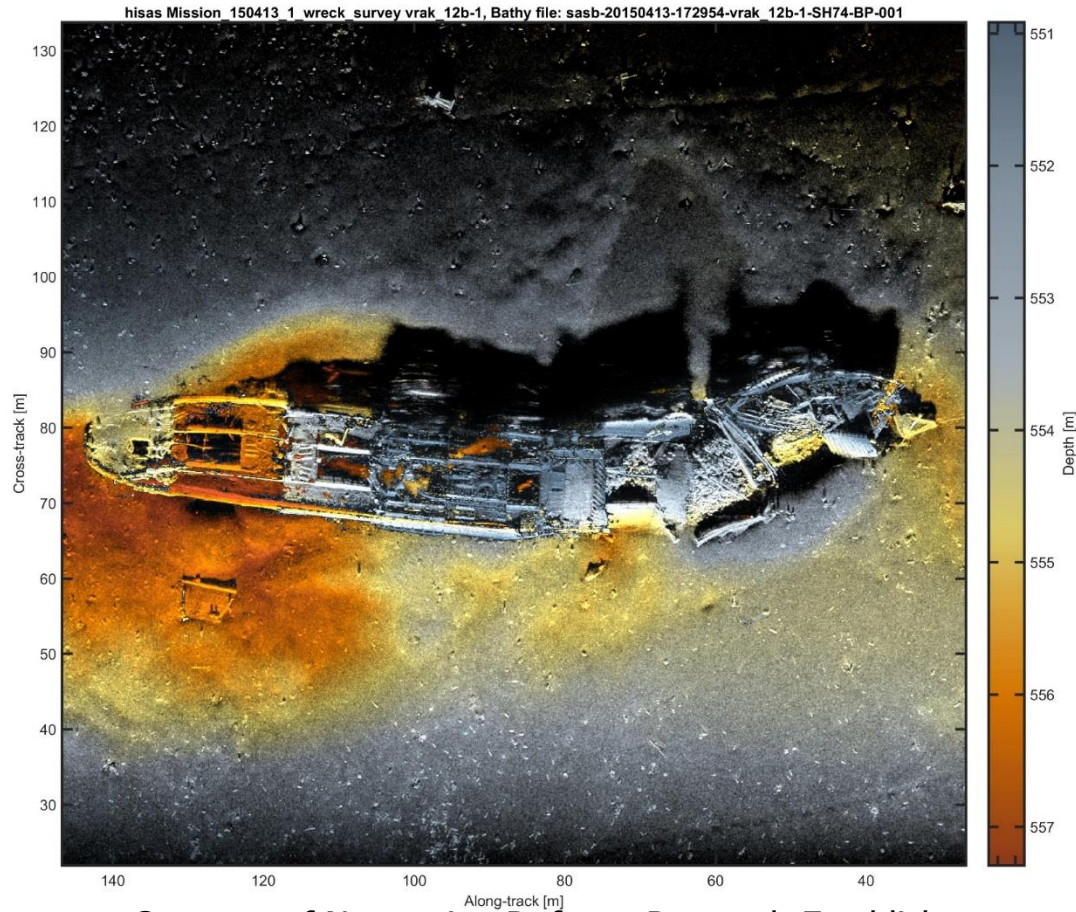


Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

Fusion of interferometry and image

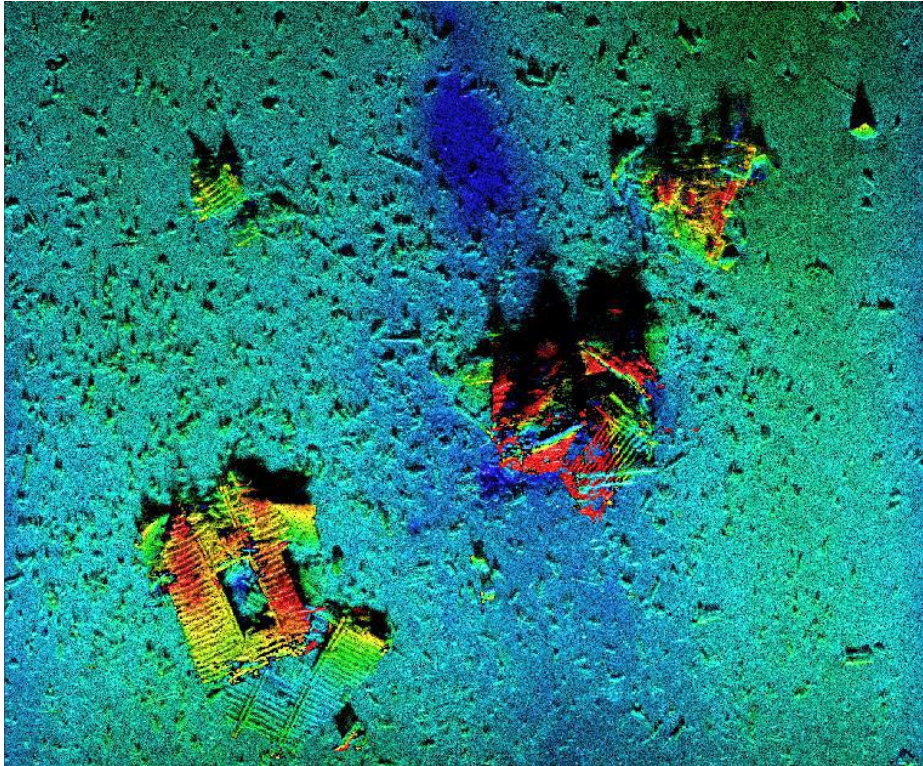


Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

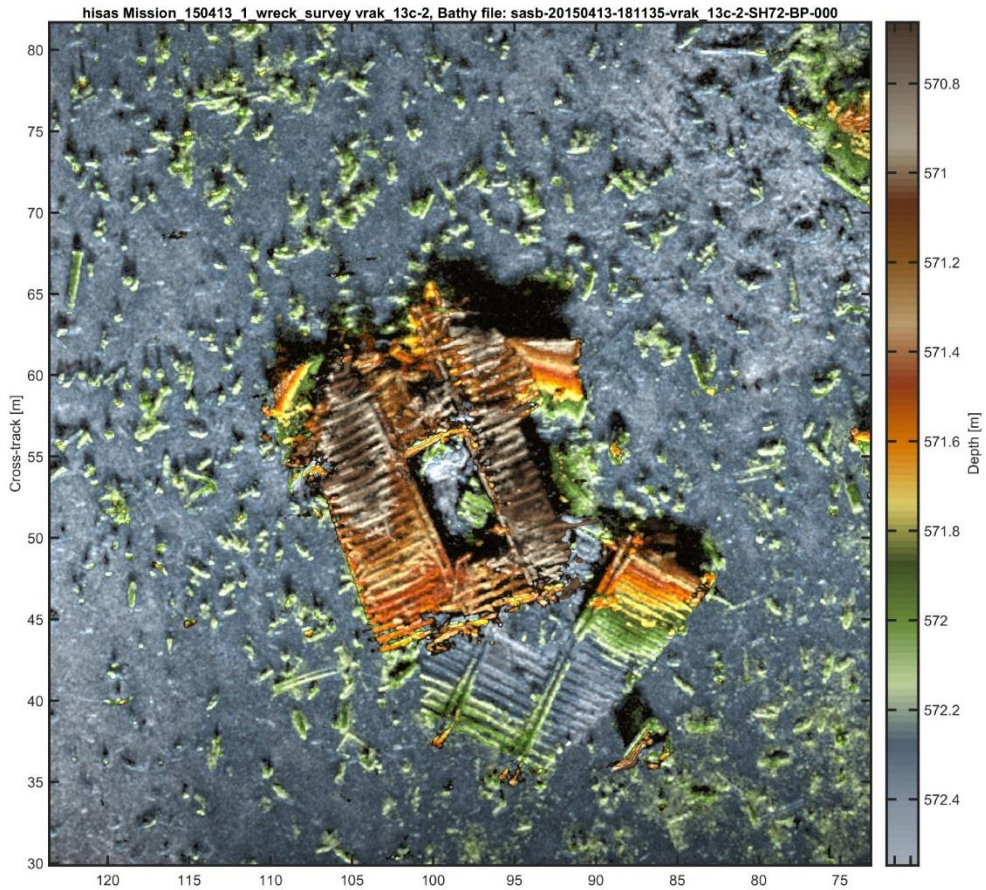


Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

100 x 80 m scene, 2 m depth variation



Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration



Courtesy of Norwegian Defence Research Establishment (FFI) and the Norwegian Coastal Administration

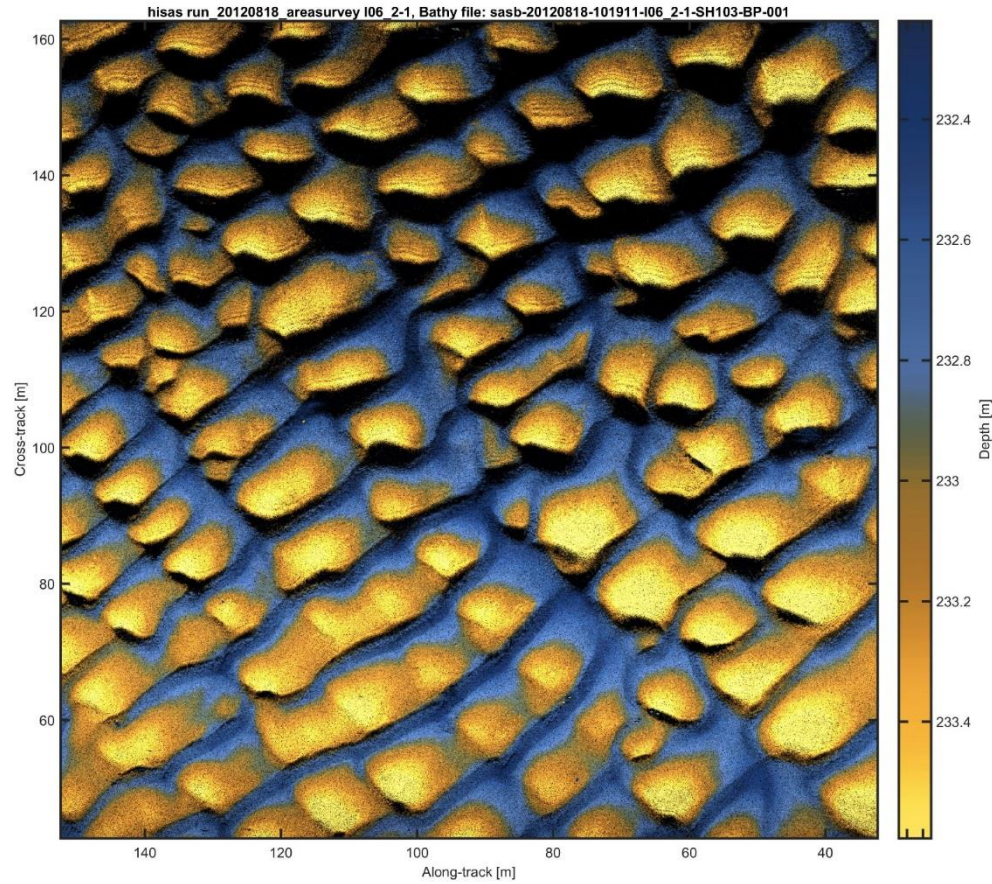
End-of-life management



Life-cycle management



Thanks for your attention



Data used courtesy of University of Bergen and Norwegian Defense Research Establishment (FFI).