



Multibeam Acoustic Water Column Imaging: Fueling Real-time, Post-processing and Analysis Applications with Software

Jonathan Beaudoin, PhD
Managing Director &
Chief Scientist
beaudoin@qps.nl

John van der Marel
QINSy Product Manager
marel@qps.nl

Danny Neville
Fledermaus Product Manager
neville@qps.nl

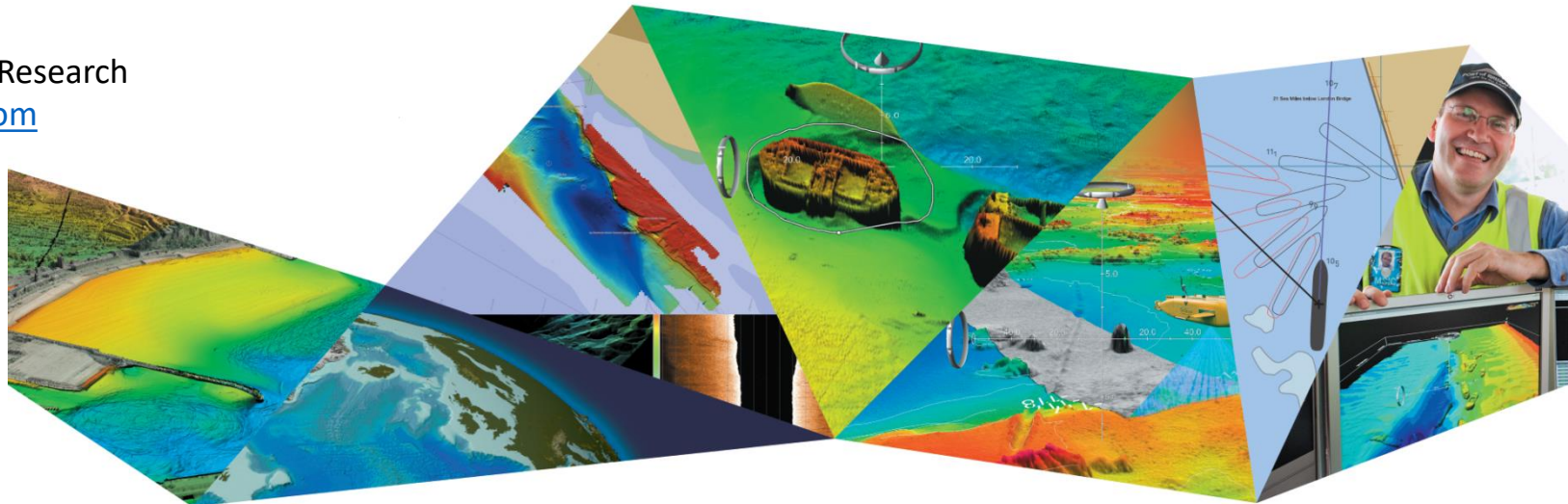
Maurice Doucet
Chief of Software Research
doucet@qps-us.com



www.qps.nl / www.qps-us.com

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

ACQUIRE
PROCESS
VISUALIZE
SHARE

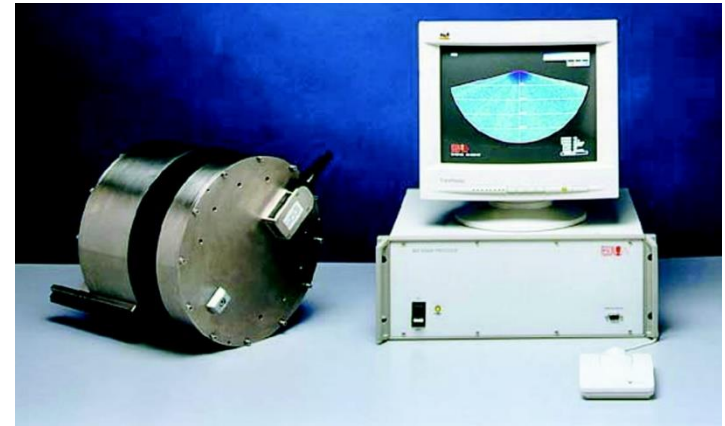


More than just points



Photo: Wolfgang Moroder, <https://commons.wikimedia.org/w/index.php?curid=22110567>

Early Hardware



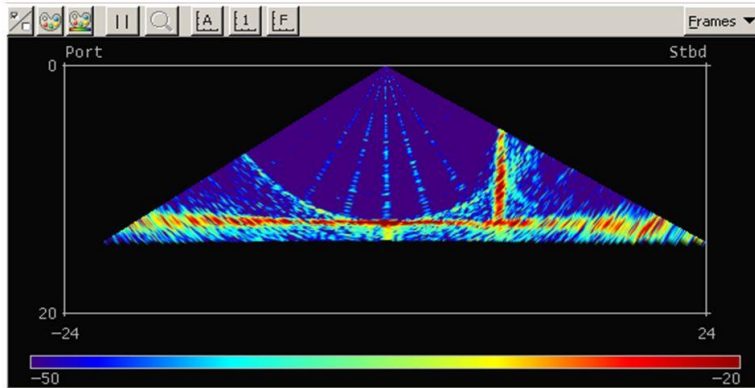
Transmission and storage limitations were limiting factors in early days. You could watch it in real-time but that's about it.

Could record it as early as 2004.

But what do we do with it?

It was a solution looking for a problem.

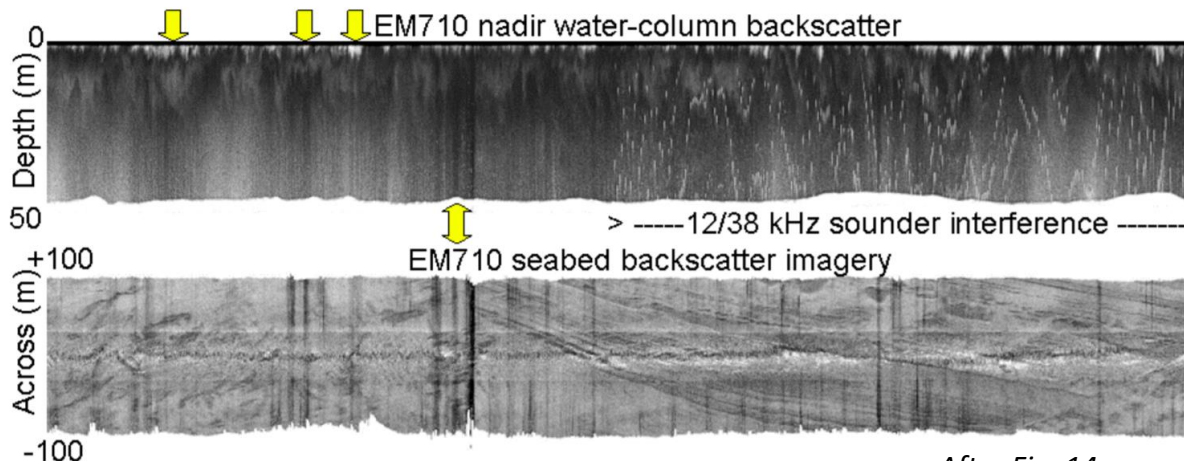
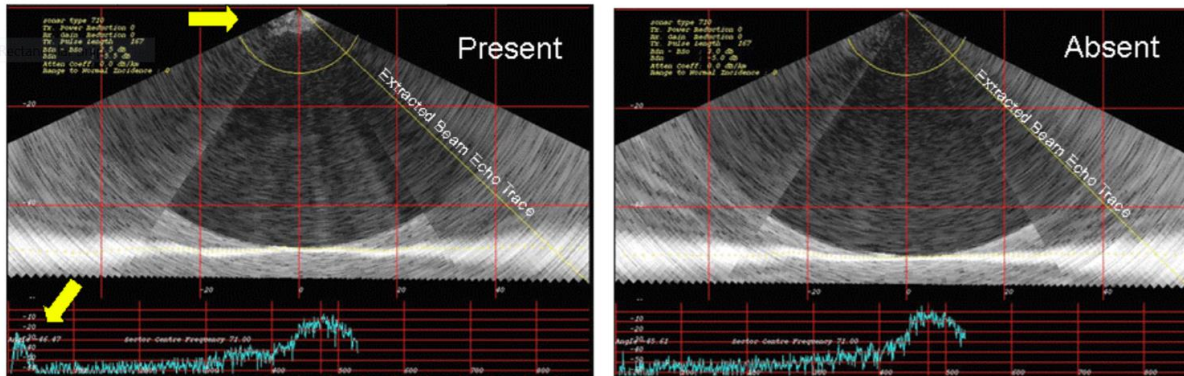
EM 3002 Real time Water Column display - 2004



Beamformed raw data can now be recorded and post processed

Early Insights

Bubble Wash-Down Masking



After Fig. 14

Applications of multibeam water column imaging for hydrographic survey.

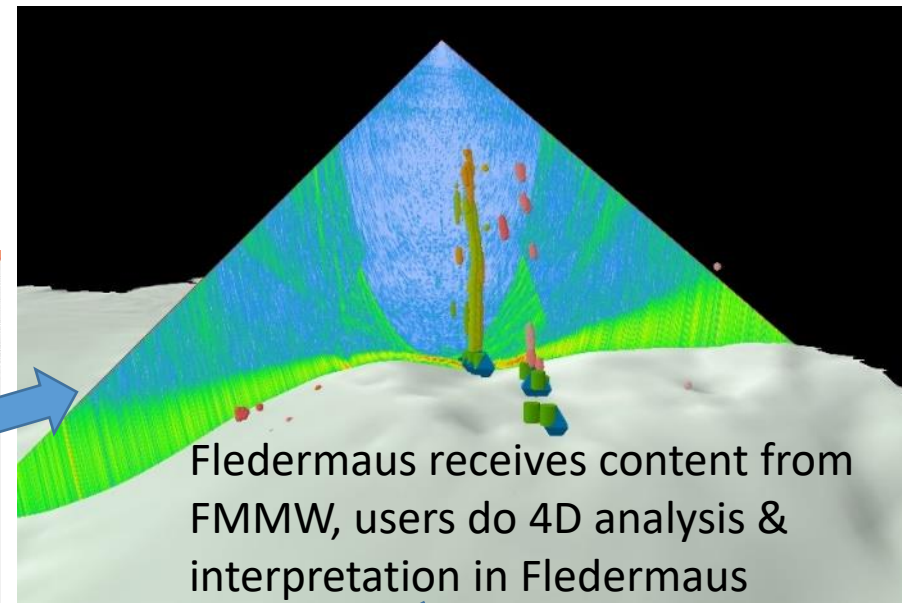
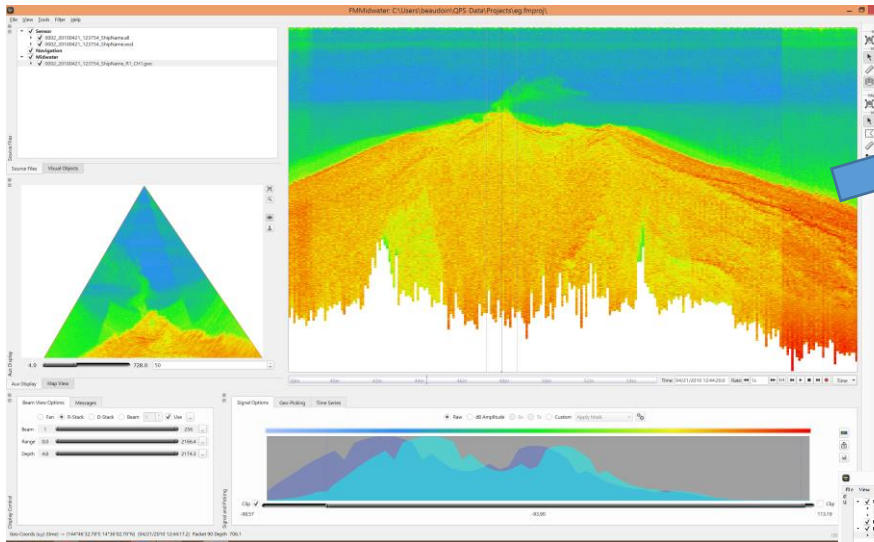
John E. Hughes Clarke
 Ocean Mapping Group
 Dept. Geodesy and Geomatics Engineering
 University of New Brunswick
 P.O. Box 4400, Fredericton, NB, E3B 5A3, Canada
jhc@omg.unb.ca

an imaging multibeam sonars are just now becoming widely available to the hydrographic community. Whilst originally developed to serve the fisheries community, multibeam sonar technology provides several significant advantages to the hydrographer in the role of water column imaging. To interpret the spatial patterns of echoes within the approximately two-dimensional cross-section for each ping, a complete understanding of the role of factors such as seabed angular response is needed. This paper reviews the imaging of synthetic examples of the echo character of typical seafloors, and examines real examples of mid water returns that impact on the quality of the data. It includes interference from other sonars, propeller and engine noise, bubble wash-down, bottom detection failures, false tracking on wreck-like targets, and natural and fish targets. Each example is explained to show how, with proper processing, increased confidence in the validity of spurious soundings or echoes may be achieved. It is expected that, in the near future, these data types will be routinely incorporated into the hydrographic quality control data stream. They provide both increased confidence in the quality of the data as well as timely indicators of the imminent decline in image quality. Furthermore, the data can provide a value-added product for the fisheries and hydrographic imaging community.

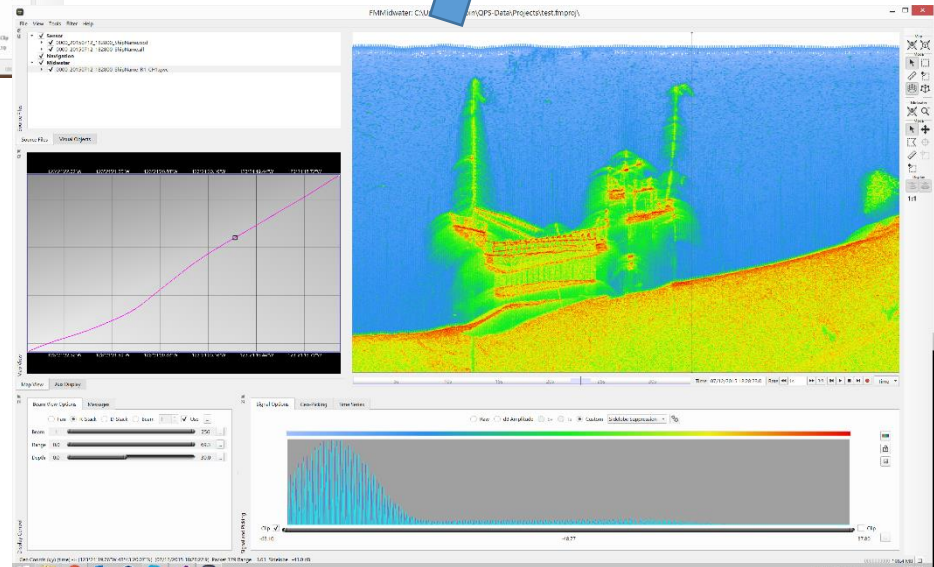
Water column imaging of the water mass and its contents using angle-discriminating sonars is a relatively new technology. Multibeam sonars, adapted for mid-water imaging, have been available to the hydrographic community for many years. The Simrad SM600, SR240, SP270 and SA950 are all designed to image within the hemisphere below the vessel using steered beam widths of about 12°. Examples of their use for scientific applications are given by Misund and Aglen, (1992), Misund, (1993), Hafsteinnsson and O. A. Misund, (1993).

Water column imaging multibeams that use a broad transmit (20+°) but with narrow receive beams have also been adapted for water column imaging. These included the RESON

Early Software



Fledermaus receives content from FMMW, users do 4D analysis & interpretation in Fledermaus



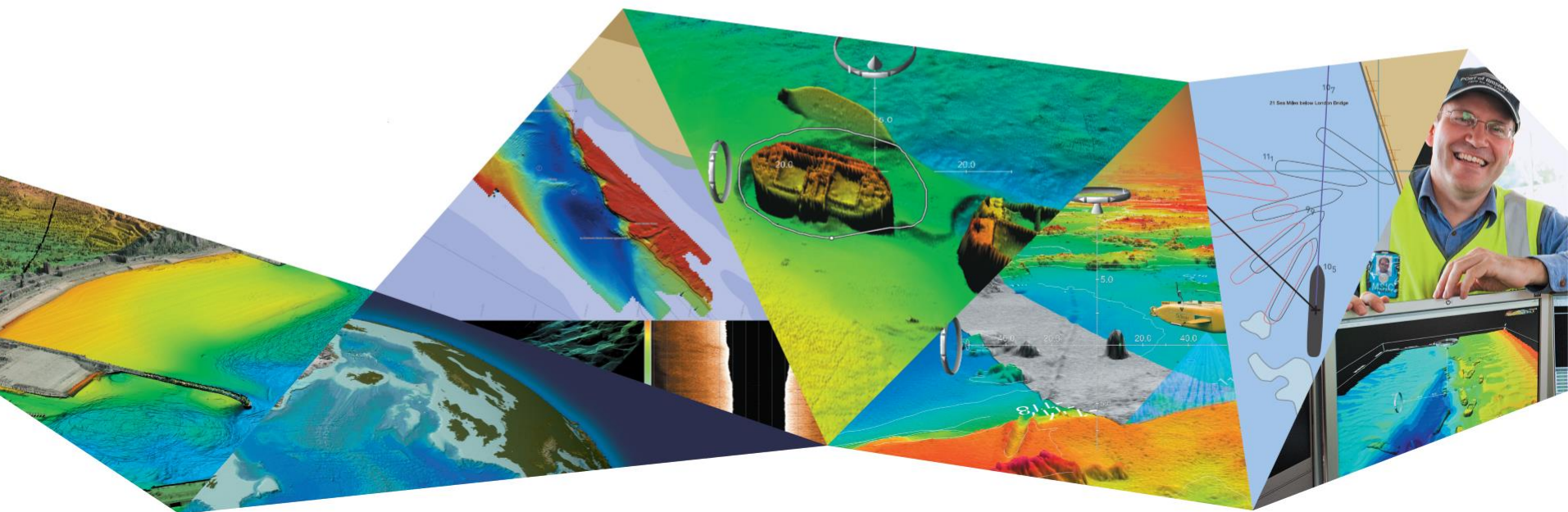
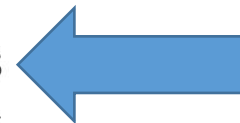
- FMMidwater (FMMW) released 2009
- Great for quick viz., signal extraction and approximate georeferencing
- Applications
 - Hydrographic Charting
 - O&G Applications
 - Fisheries
 - Oceanography



WWW.QPS.NL / WWW.QPS-US.COM

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

ACQUIRE
PROCESS
VISUALIZE
SHARE

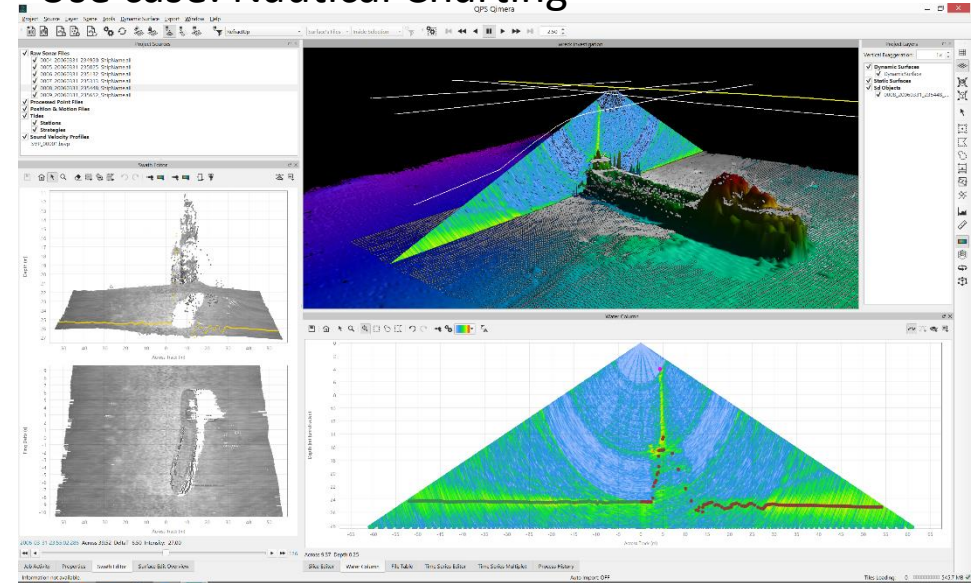


SAAB
Defence and Security

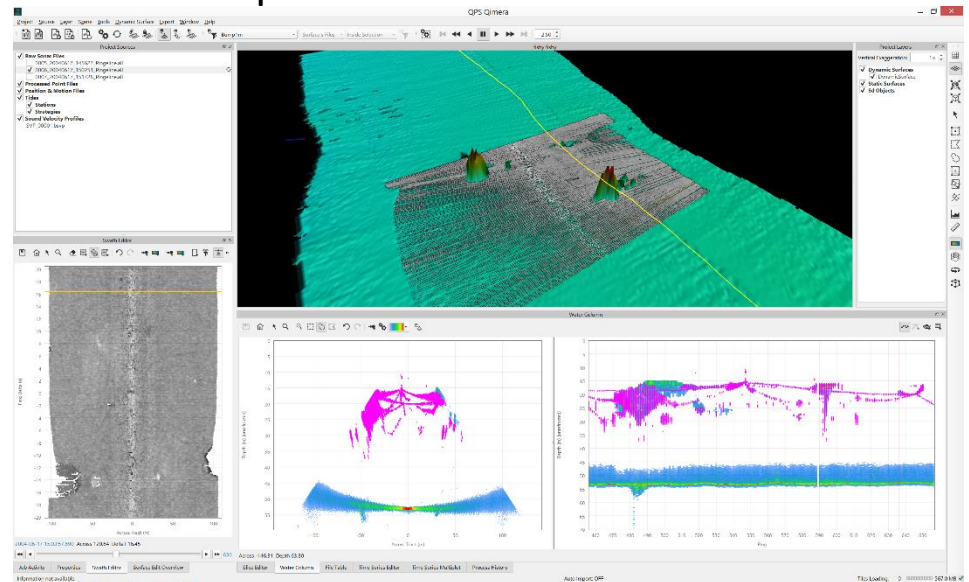
Qimera

- FMMW processing capabilities ported to Qimera in 2016
- Improvements over FMMW?
 - An “in-app” experience
 - Great geo-referencing (powered by QINSy)
 - Additional signal filtering and extraction tools
- Challenge: satisfying rapidly diversifying user needs as requirements emerge and shift
- Let’s examine some Use Cases

Use case: Nautical Charting

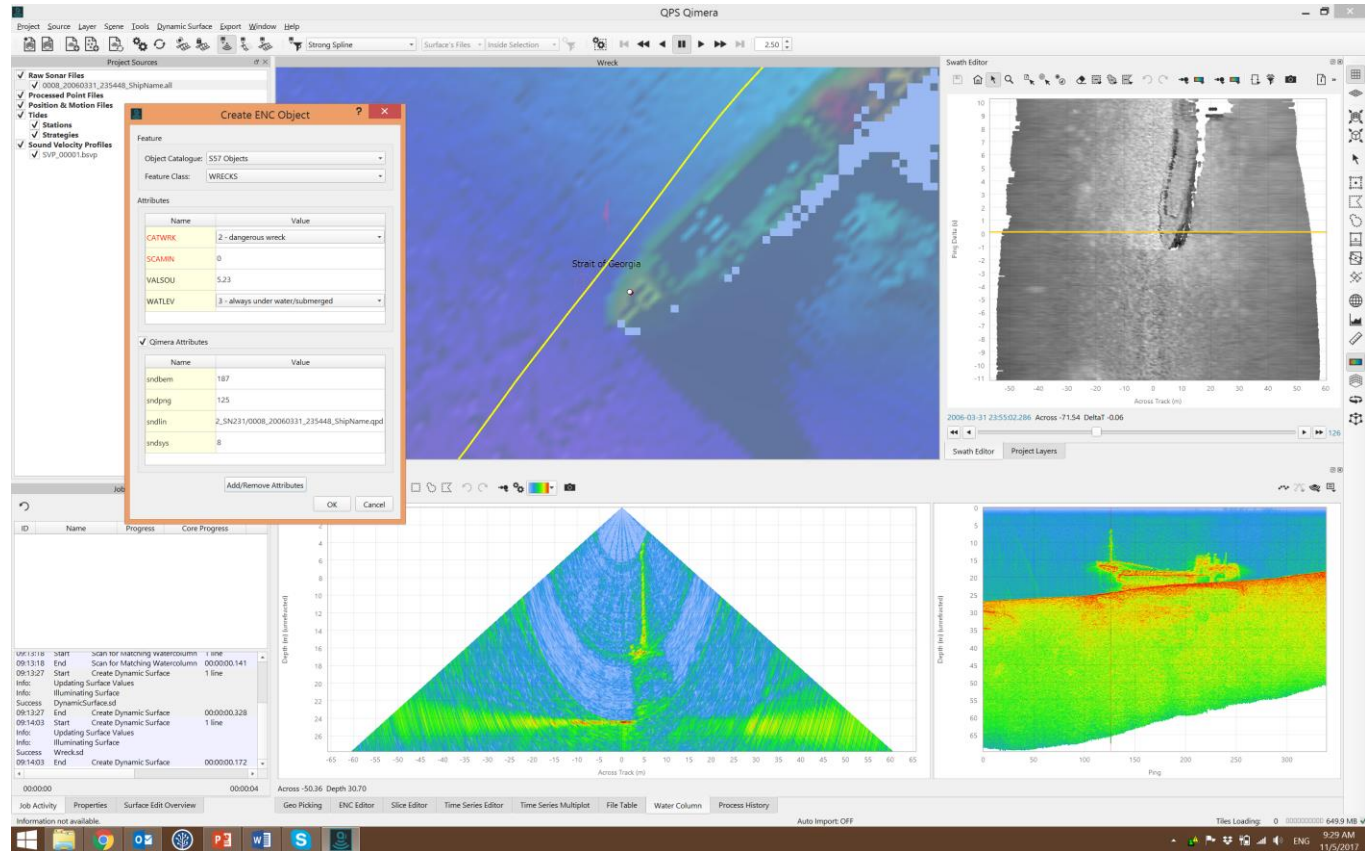


Use case: Aquaculture



Use Case: Nautical Charting

- Image wrecks, submerged objects, cables, lines, vegetation
- Identify features, create S57 features, export to ENC format



Coming soon with Qimera 1.6: S57 pick tool. Select point, get instant S57 object drawn by Qernel in the Scene (QPS ENC rendering engine). Export your objects in S57 format.



Use Case: Nautical Charting

The screenshot displays the QPS Qimera software interface, which is used for nautical charting and data analysis. The main window shows a 3D bathymetric chart of a shipwreck, with a yellow line indicating the ship's orientation. The interface includes several panels:

- Project Sources:** A list of data files including 'Raw Sonar Files', 'Processed Point Files', 'Position & Motion Files', 'Tides', 'Stations', 'Strategies', and 'Sound Velocity Profiles'.
- Project Layers:** A list of layers including 'Dynamic Surfaces', 'Static Surfaces', 'PFM Objects', 'Sd Objects', 'Background Charts', and 'Charts'.
- Swath Editor:** A panel with a grid and axes for editing swath data.
- Water Column:** A panel with a grid and axes for editing water column data.
- Process History:** A panel showing the sequence of operations performed.

The main chart area shows a 3D bathymetric view of a shipwreck, with a yellow line indicating the ship's orientation. The chart is color-coded by depth, with shallower areas in green and yellow, and deeper areas in blue and purple. The axes are labeled 'Across Track (m)' and 'Depth (m)'. The chart is titled 'new try without charts'.

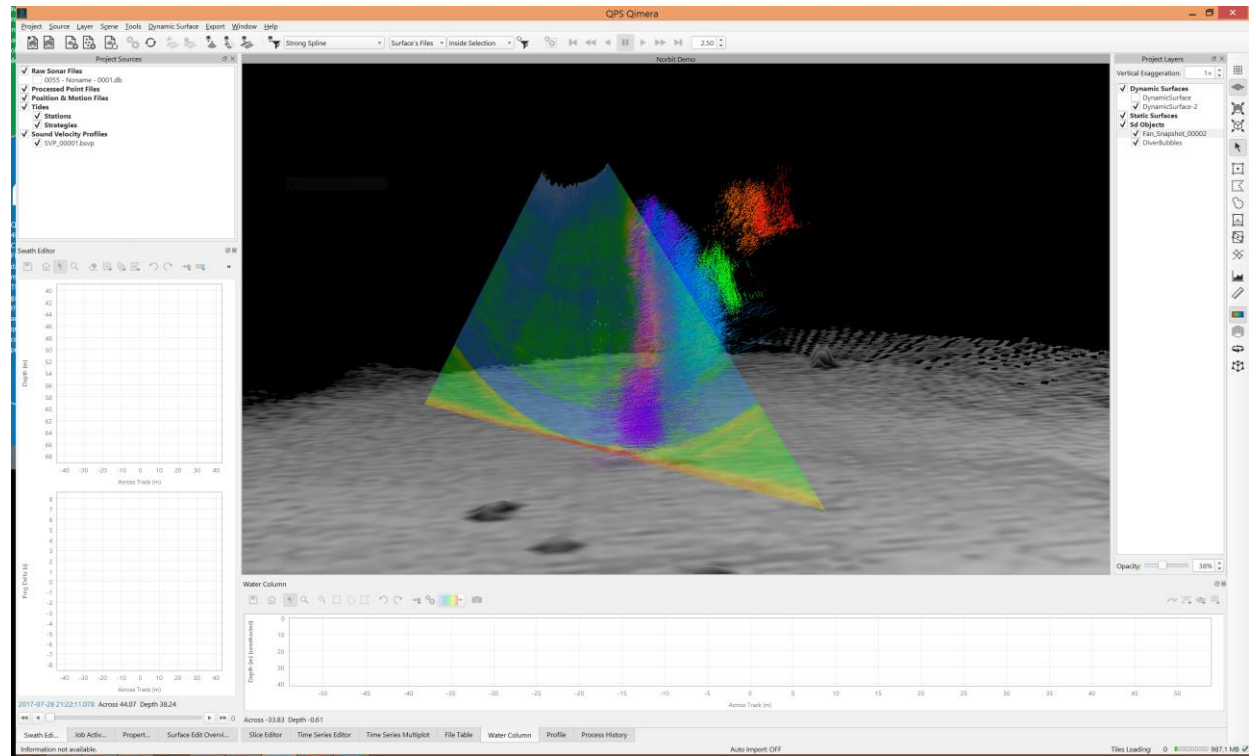
At the bottom of the interface, there is a status bar with the text 'Information not available.' and 'Auto Import OFF'. The bottom right corner shows 'Tiles Loading: 0' and a progress indicator.

Data Source: Ocean Mapping Group, University of New Brunswick



Use Case: Diver Detection

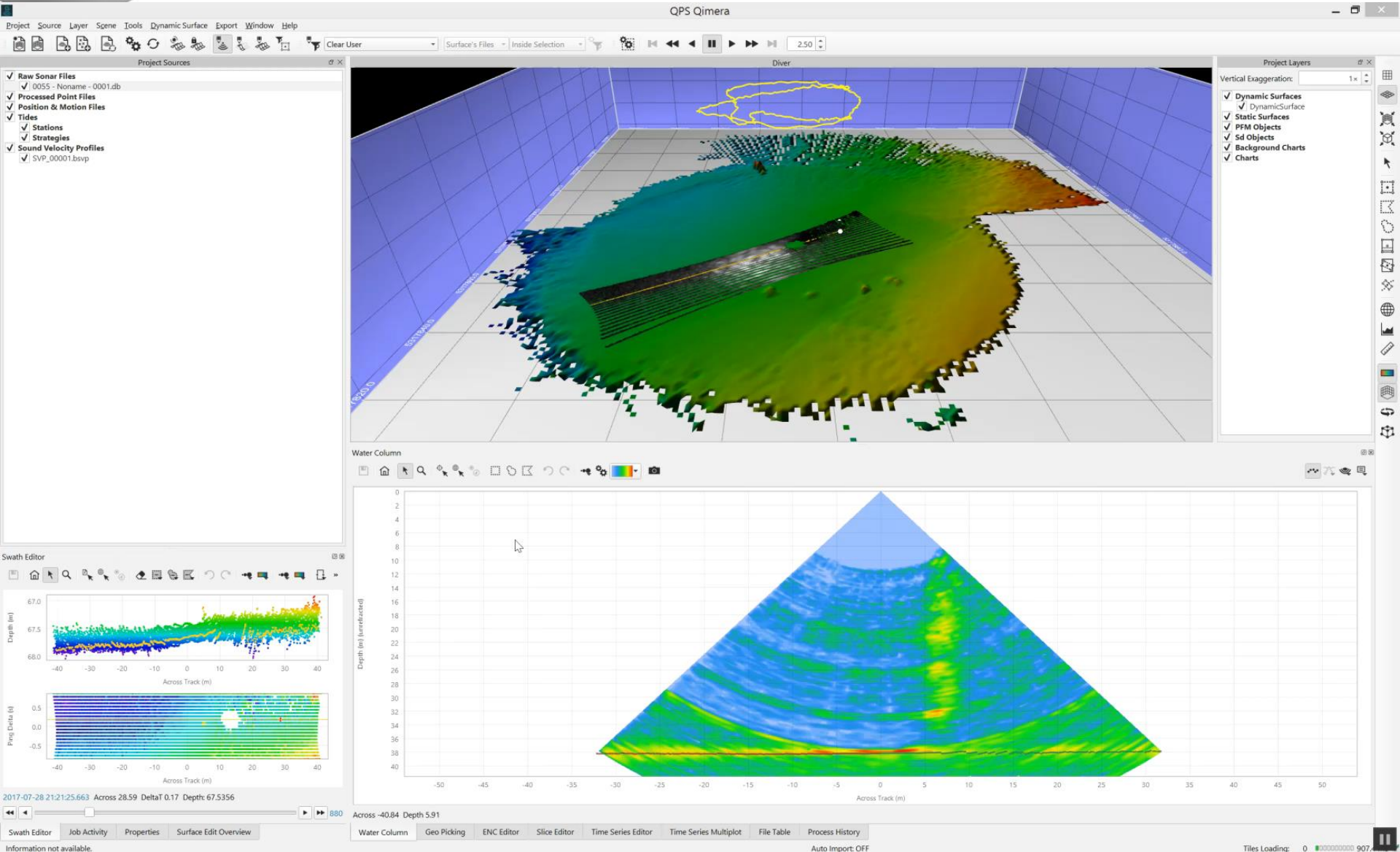
- Diver at 40m depth
- 3D bathymetry sonar (NORBIT 3D STX)
- Hardware and software could be used for leak detection as well



Completed with existing functionality in Qimera 1.5, but new features in Qimera 1.6 will speed up the process

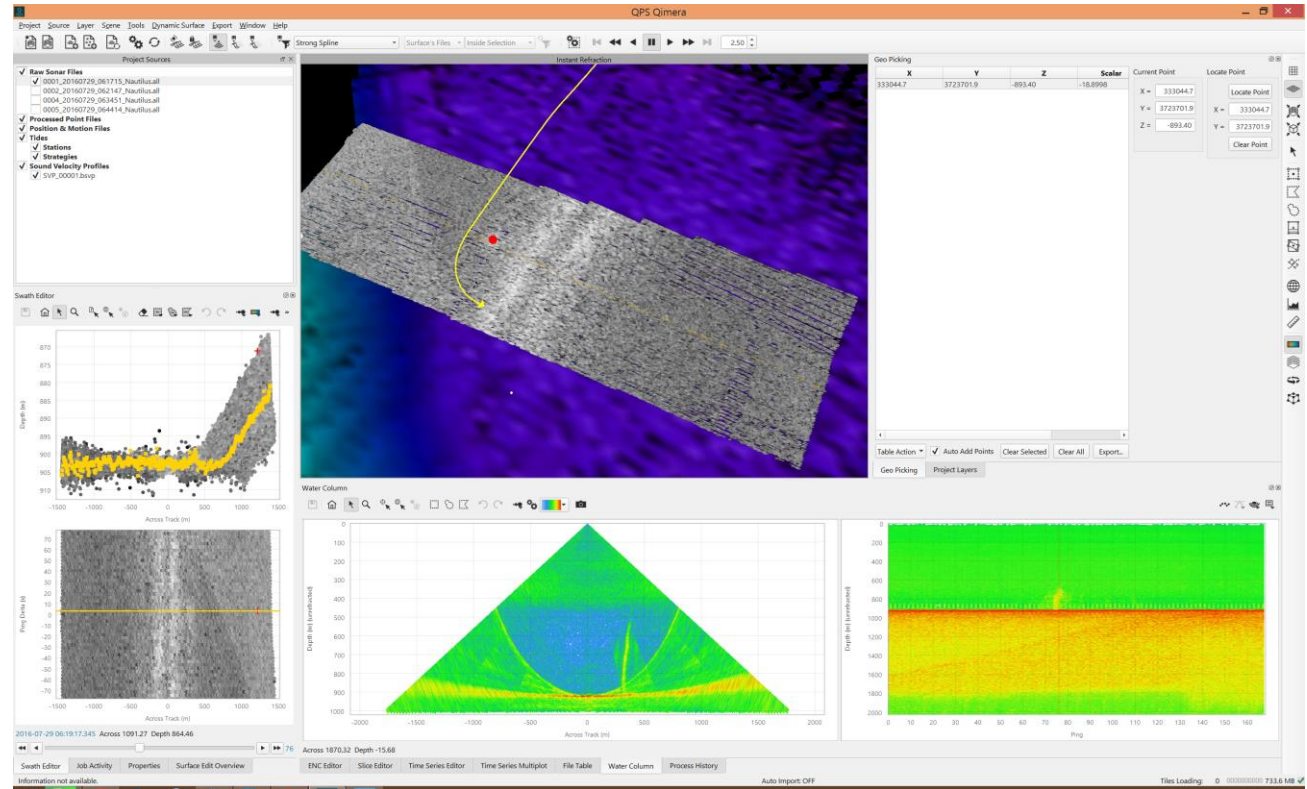
Learn more here: <https://norbit.com/norbit-launches-new-3d-sonar/>

Use Case: Diver Detection



Use Case: O&G Exploration

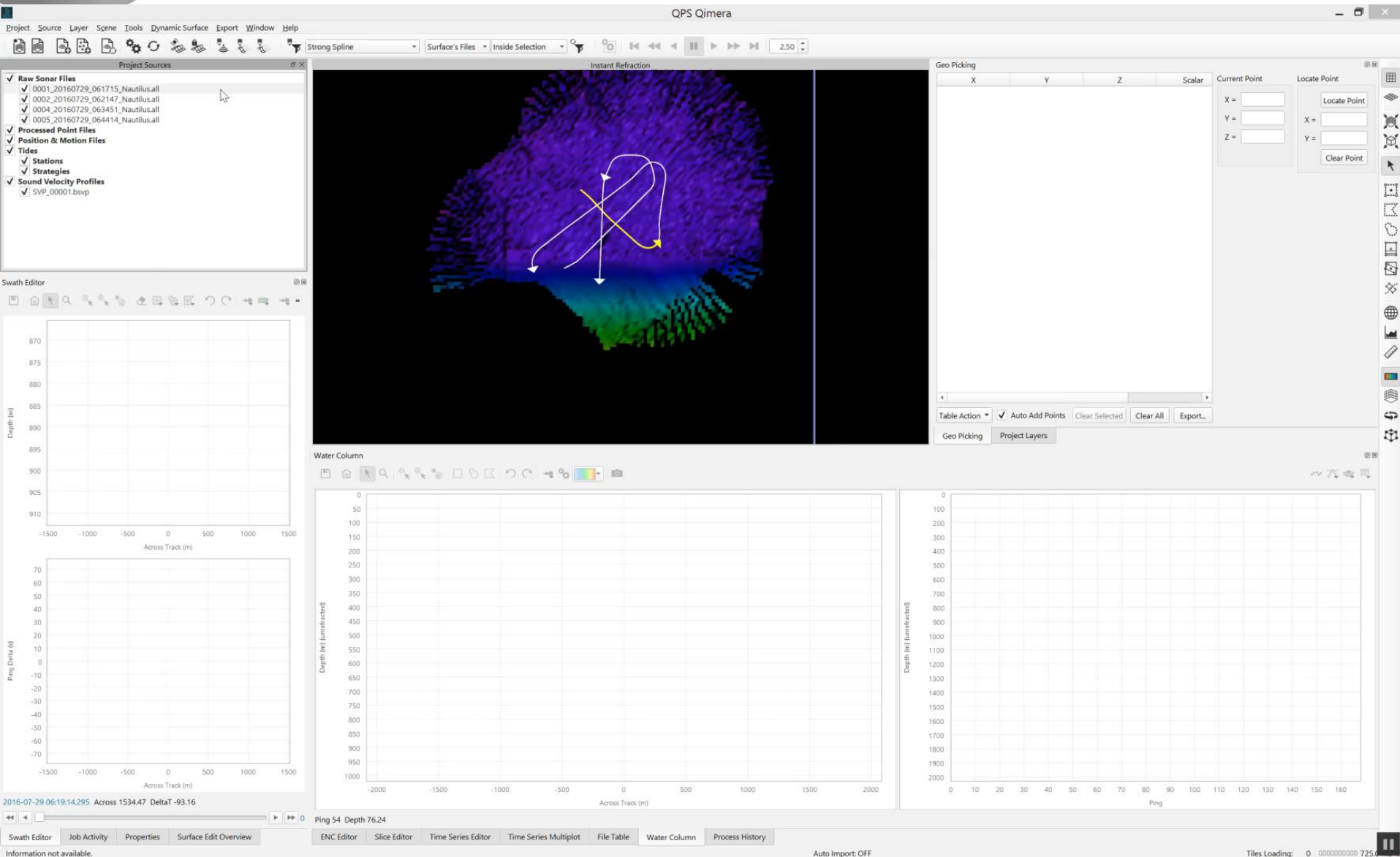
- MBE WC allows low cost exploration survey for O&G
- Clients use QPS WC software to target where to focus 3D Seismic work
- Time is money, need instant and accurate geo-referencing to support sampling operations



Coming soon with Qimera 1.6: Geo Pick tool, select point, get instant refraction corrected position for real-time ops.



Use Case: O&G Exploration

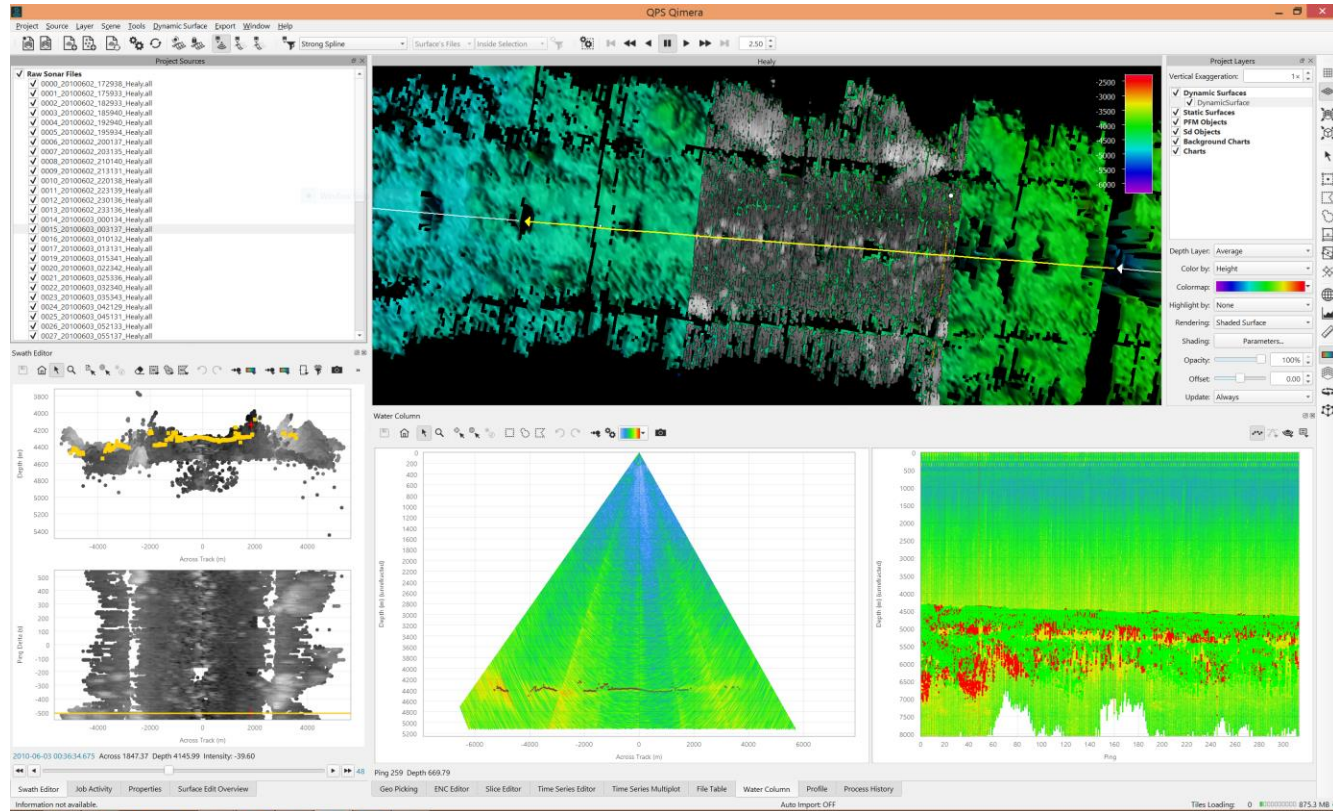


Data Source: Ocean Exploration Trust/E/V Nautilus



Use Case: Performance Diagnostics

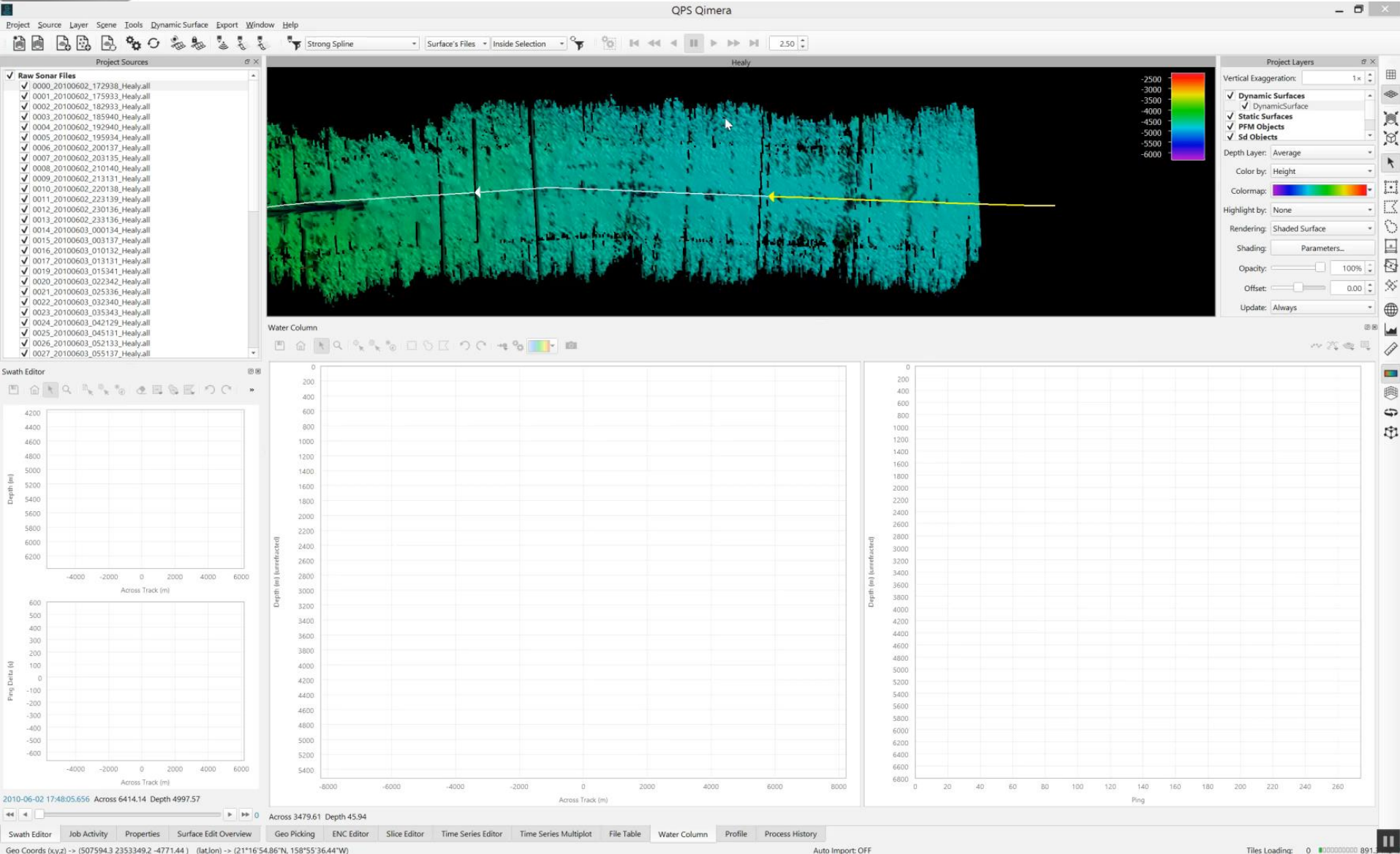
- Sometimes your MBE system is misbehaving. What is the cause?
- WC imagery often holds the answer
- Need to correlate WC imagery with bathymetry, backscatter to assess effectively



Coming soon with Qimera 1.6: Full side view trace, buffered and cached for speedier performance. Allows full polygon selection of targets, quick overview of entire survey line.



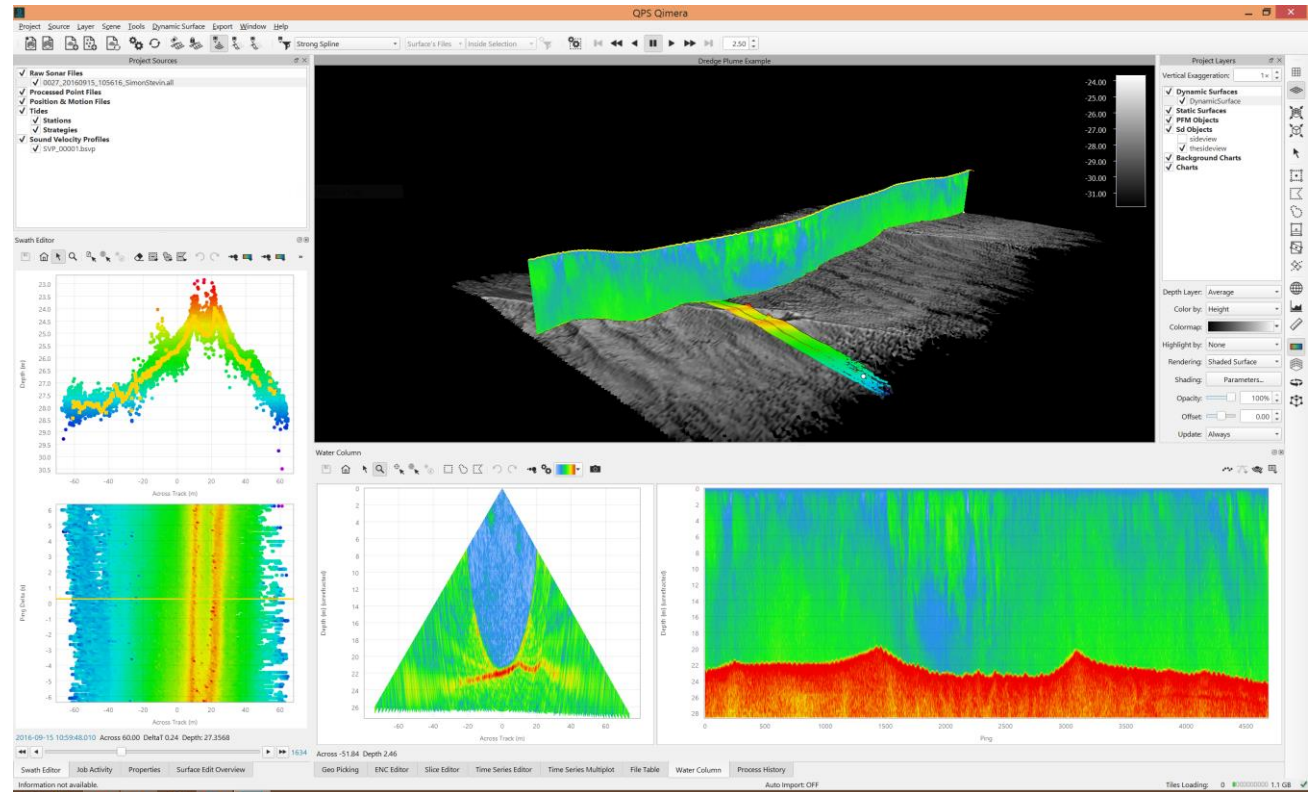
Use Case: Performance Diagnostics



Data Source: US Coast Guard Cutter Healy

Use Case: Imaging Dredging Plumes

- Sometimes you want to map what's in the water instead of the seafloor
- Perhaps you want to quantify what's in the water column?

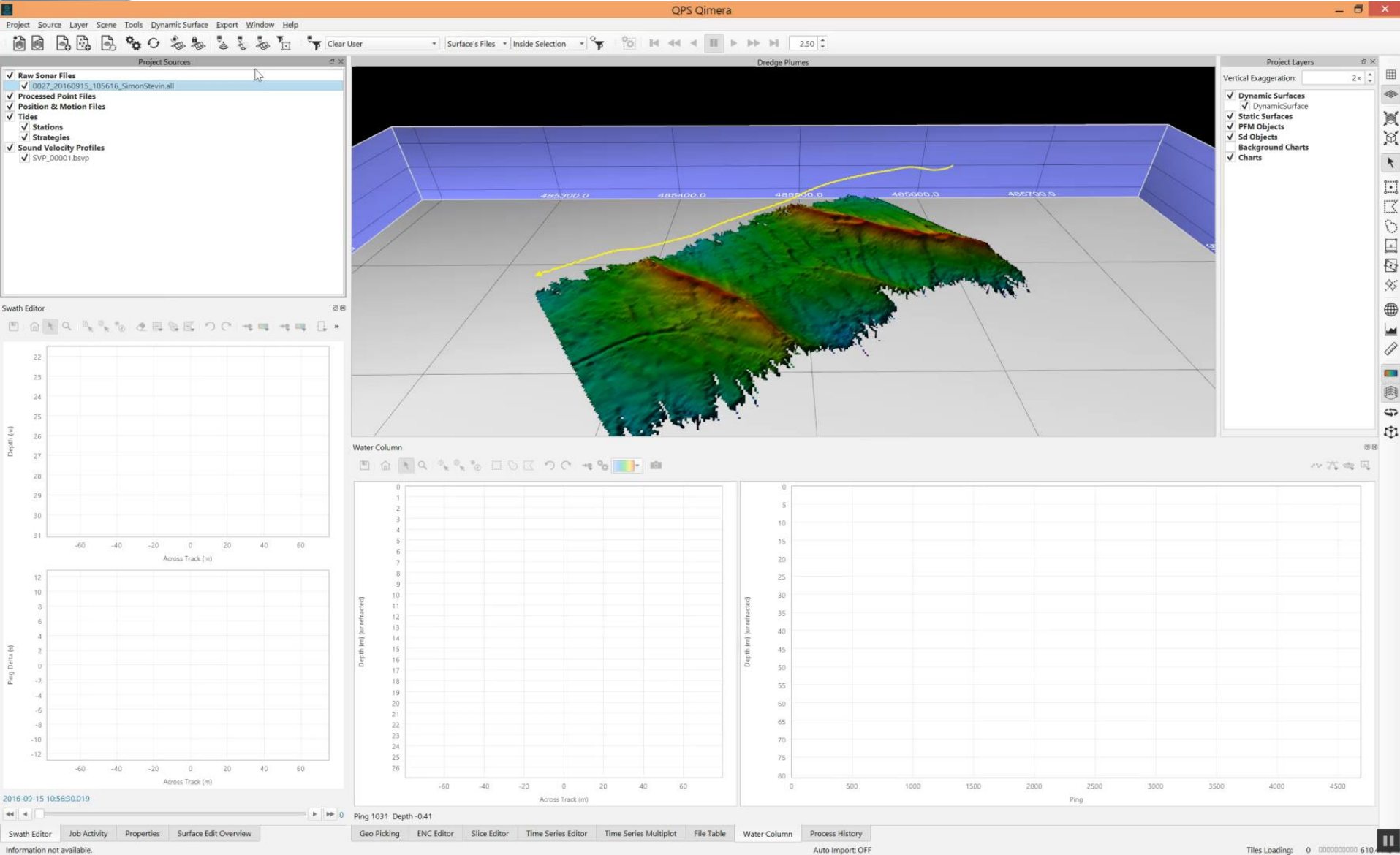


Coming soon with Qimera 1.6: Additional signal refinement to cut off data beyond first return for cleanest WC signal possible. Full side stack view allows for quick staging of WC curtain to the Scene.

Data from: Marc Roche & Koen Degrendele, Belgian Federal Public Service Economy Continental Shelf Service



Use Case: Imaging Dredging Plumes



Data Source: Belgian Federal Public Service Economy Continental Shelf Service

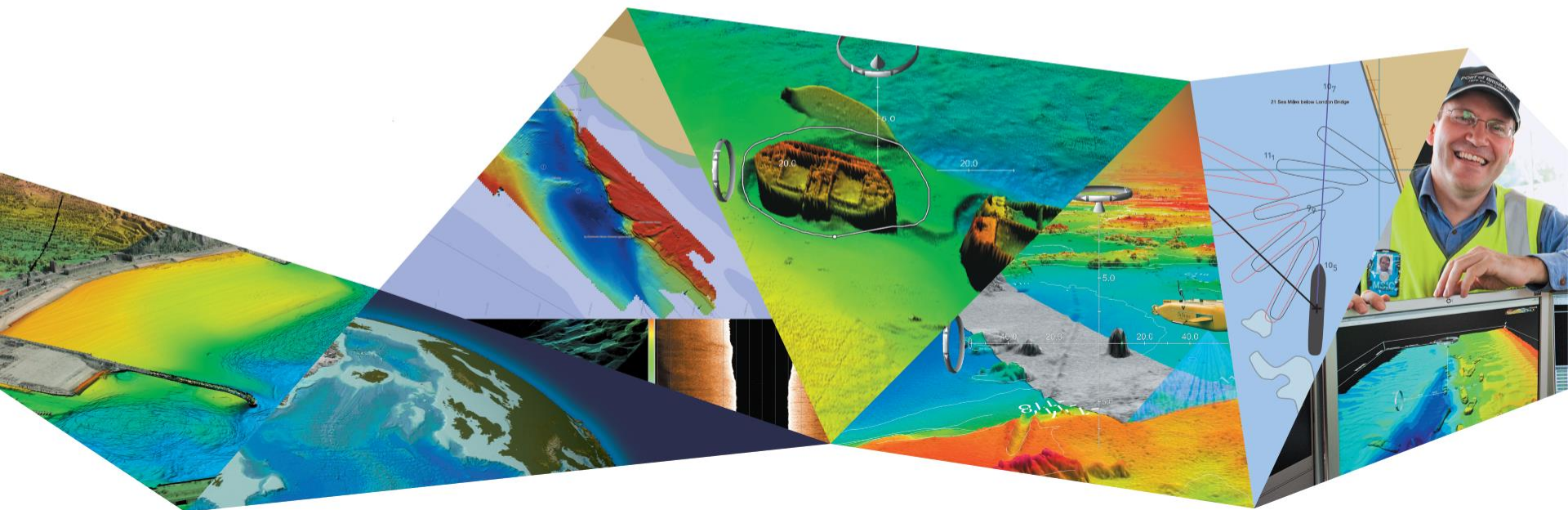




WWW.QPS.NL / WWW.QPS-US.COM

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

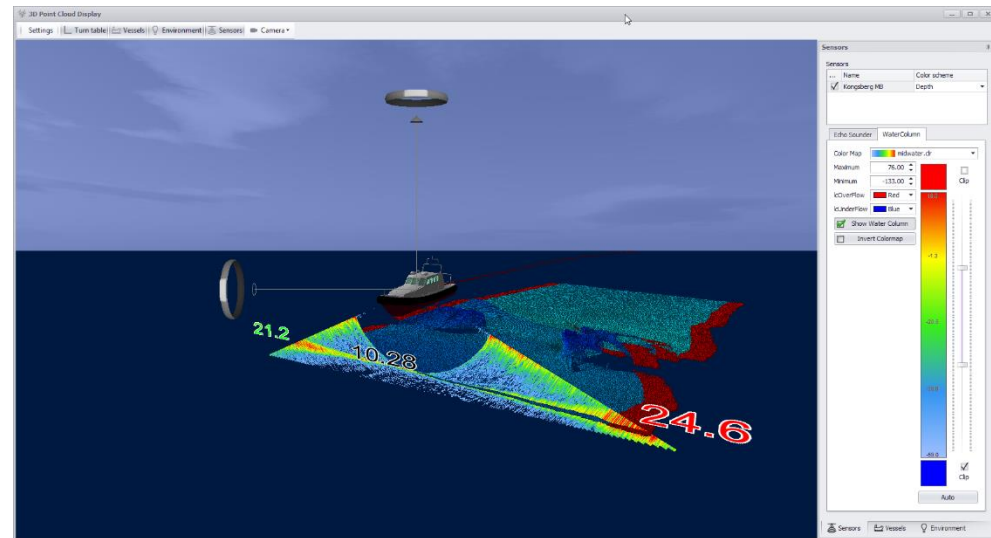
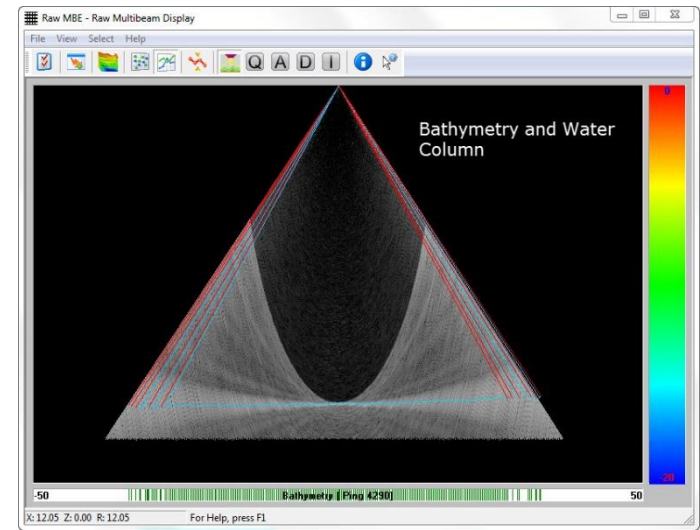
ACQUIRE
PROCESS
VISUALIZE
SHARE



SAAB
Defence and Security

QINSy

- Being able to just see WC is not going to be good enough for much longer
- Get it right during acquisition, don't get surprised in post-processing
- How?
 - Needs to look like it will downstream
 - Need some tools from downstream tools to allow QA in real-time

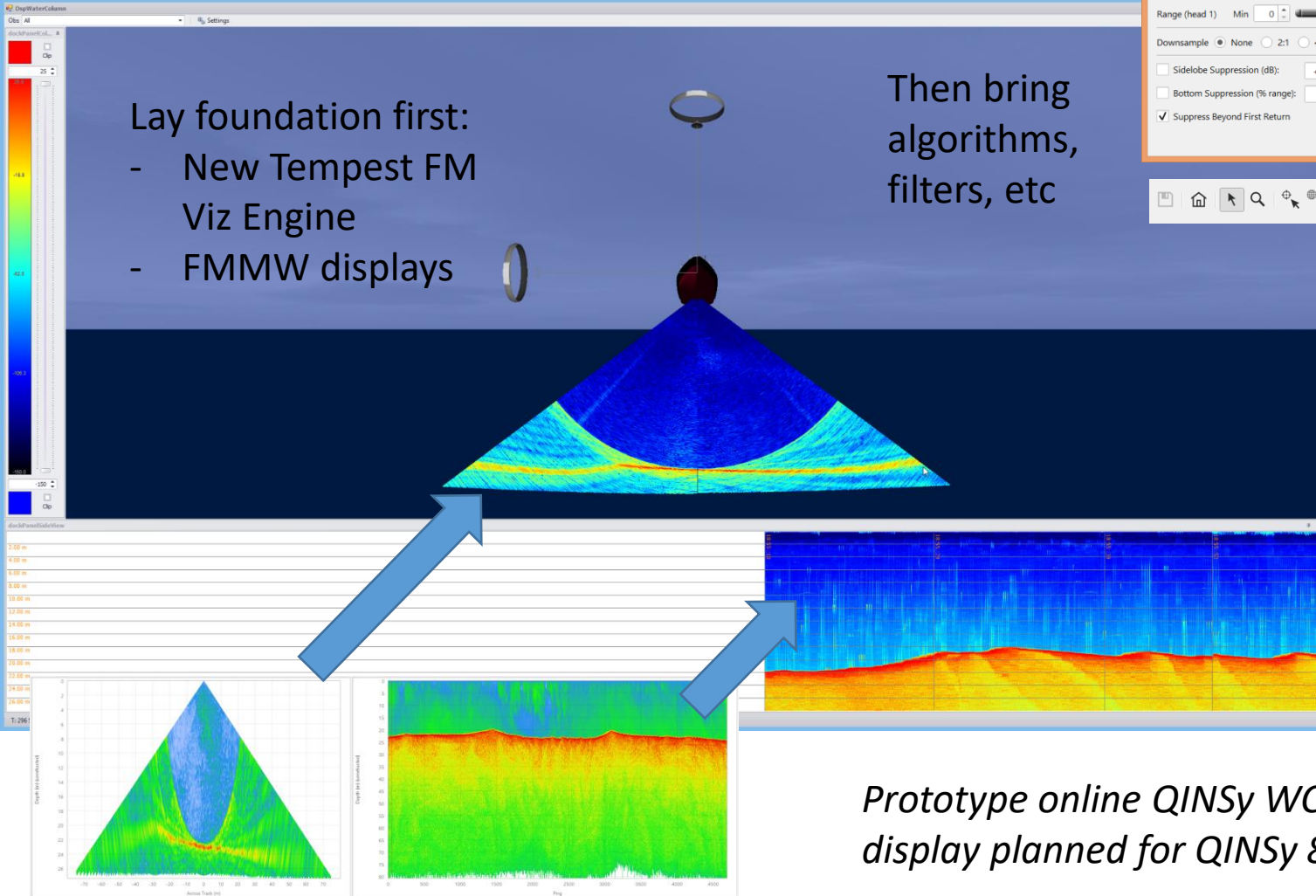
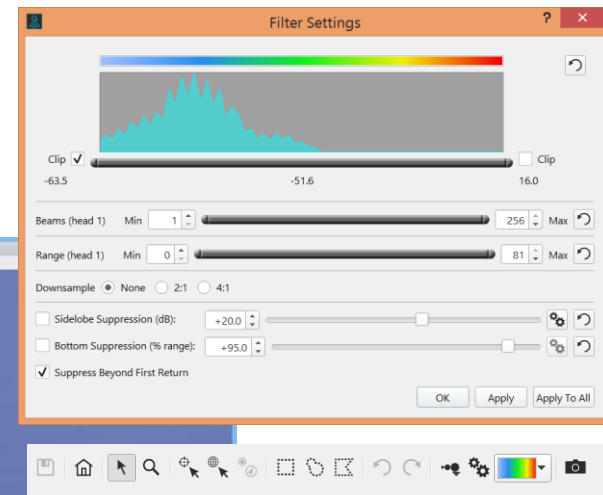


Prototype online QINSy WC display planned for QINSy 8.18

Bringing FMMW Online

- Lay foundation first:
- New Tempest FM Viz Engine
 - FMMW displays

Then bring algorithms, filters, etc



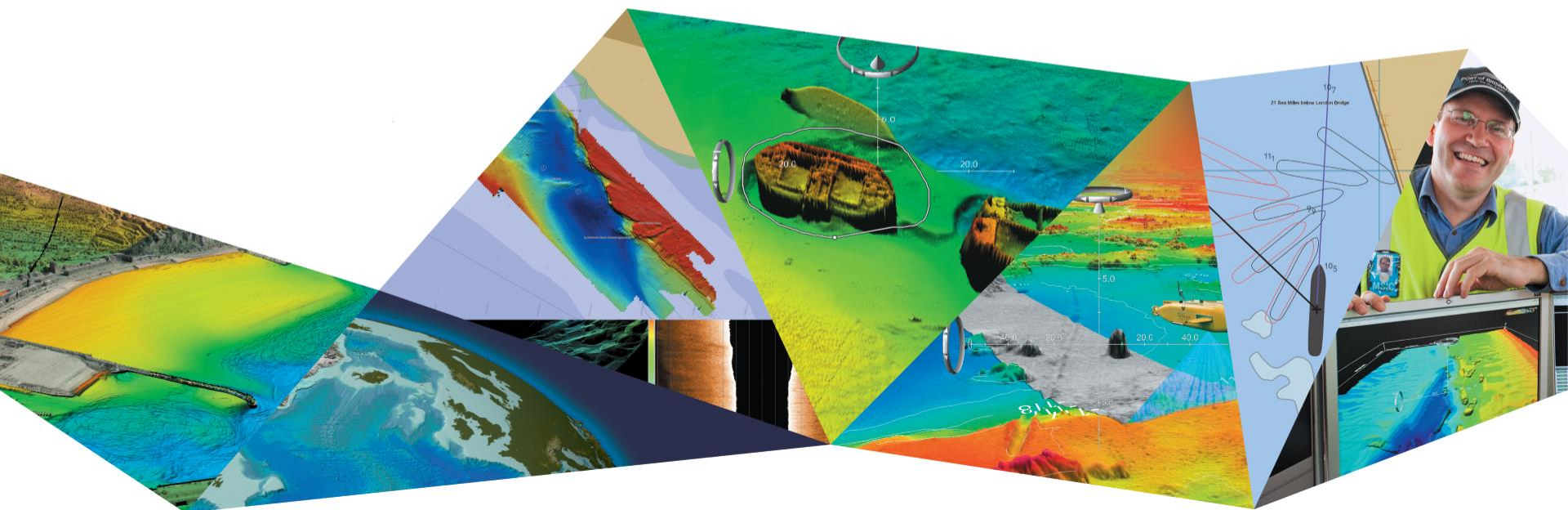
Prototype online QINSy WC display planned for QINSy 8.18



WWW.QPS.NL / WWW.QPS-US.COM

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

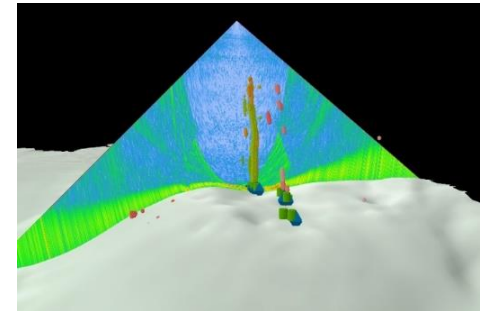
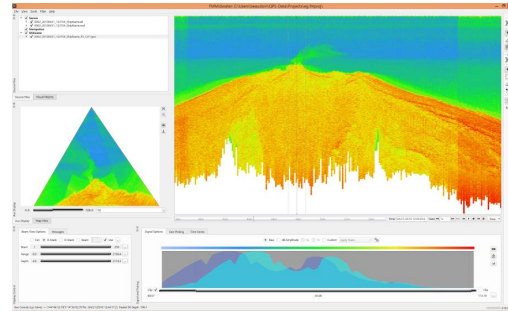
ACQUIRE
PROCESS
VISUALIZE
SHARE



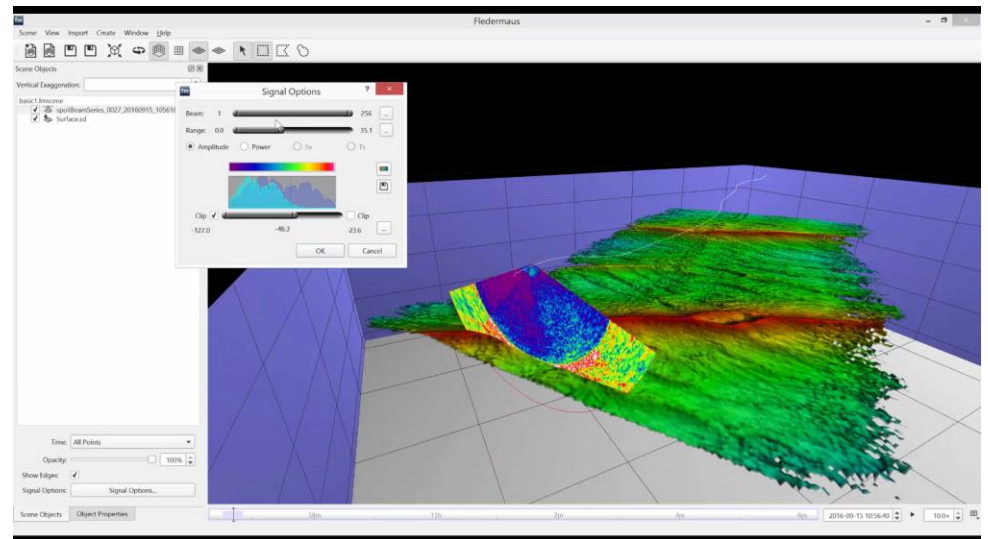
SAAB
Defence and Security

FMMidwater and Fledermaus 7 to 8

- FMMidwater becomes “in app”, like in Qimera
- Focus is on ‘soft target’ and geophysical users with FM8
 - Fisheries
 - Oceanography
 - Seismic
- FM8 will continue to be strong in data integration, video, photo mosaics, DTMs



FM7: FMMW is a gateway to Fledermaus



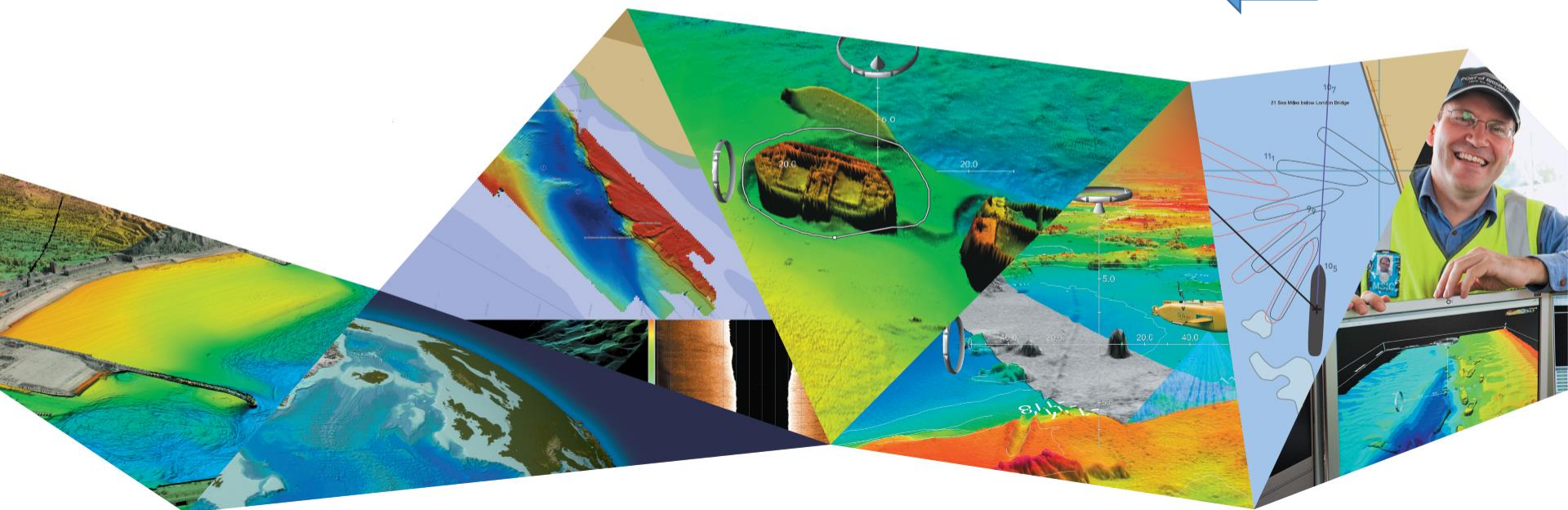
FM8: FMMW is inside Fledermaus, like with Qimera



WWW.QPS.NL / WWW.QPS-US.COM

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

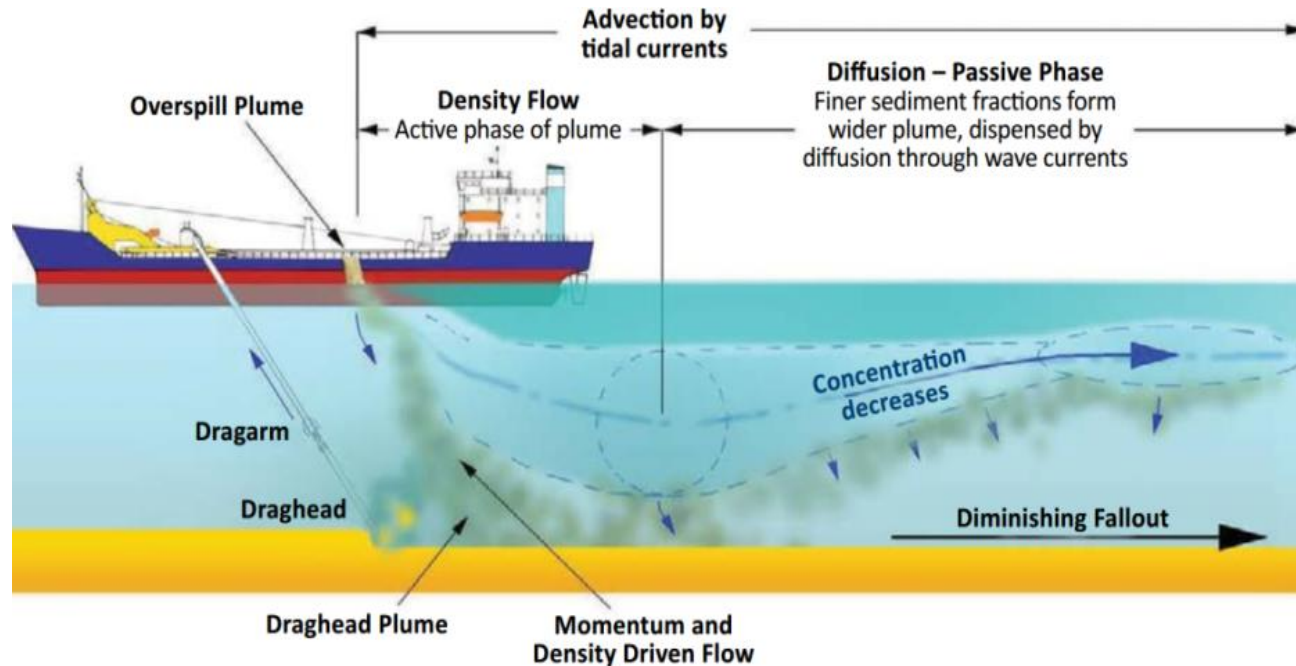
ACQUIRE
PROCESS
VISUALIZE
SHARE



SAAB
TECHNOLOGIES
Defence and Security

Share?

Share your ideas, your story, your message, your vision



MBES Echography of fine sediment plumes generated by sand dredging



Share: Presentation Mode in Fledermaus 8

fm Fledermaus

Scene View Import Create Window Help

Scene Objects

Vertical Exaggeration: 1.0x

basicScene.fmscene *

- Surface.sd
- thesideview.sd

Colormap: [Colorbar]

Rendering: Shaded Surface

Opacity: 100%

Render ShadowMap:

Scene Objects | Object Properties | Data Sources

Space Time Notes

+ Add Remove Associate Current View Add to Presentation >>

ID	X	Y	Z	Time	Has View	Label
----	---	---	---	------	----------	-------

Geo-Coords (x,y,z)-> (485546, 5.70538e+6, -inf)

Slides

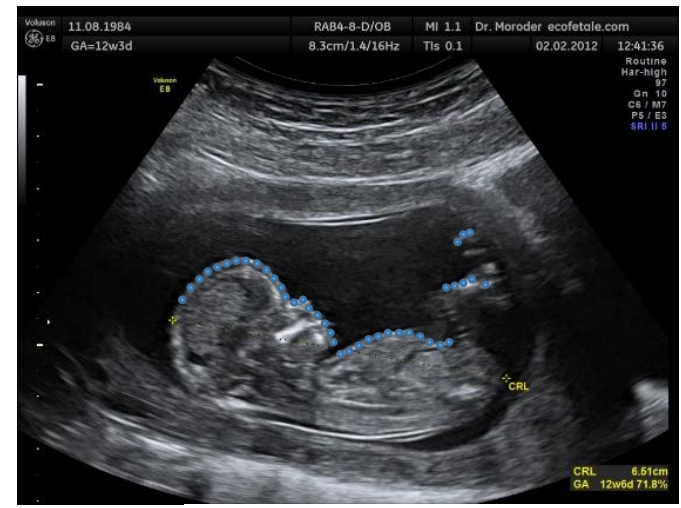
Transition In: None 0.0

On Slide: Do Nothing 0.0

Content:

Summary

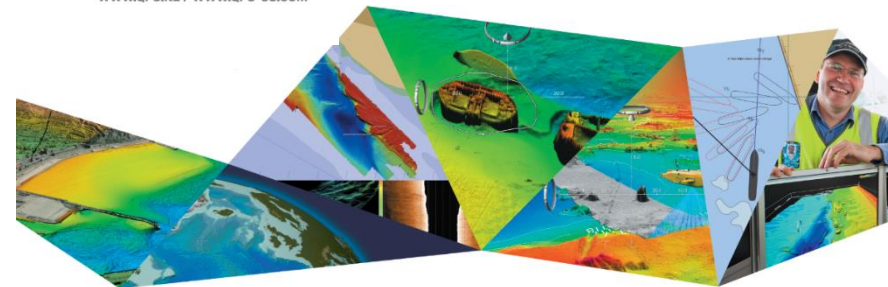
- MBE is more than just points
- Sometimes, the points don't even matter!
- Many emerging applications
- Users have new needs, they need new tools
- This is true across our software spectrum
 - Acquire
 - Process
 - Visualize
 - Share
- QPS is building these tools to meet the new needs



WWW.QPS.NL / WWW.QPS-US.COM

QPS - SPECIALISTS IN SOFTWARE FOR MARINE SPATIAL DATA

ACQUIRE
PROCESS
VISUALIZE
SHARE





**HYDROGRAPHIC AND
MARINE SOFTWARE SOLUTIONS**

Questions?