Machine Learning as a tool for efficient subsea structure inspection

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Presented by:

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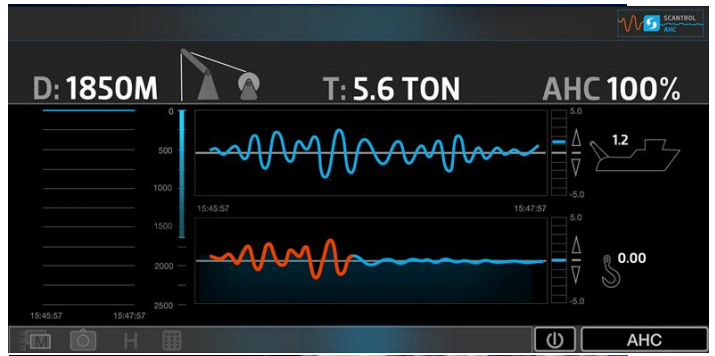
Control Systems and winch control:

- Seismic streamer cable control
- Trawl control for fisheries and Marine science
- Active Heave Compensation



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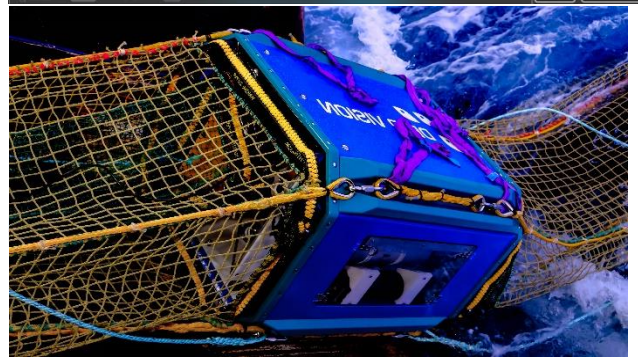
Embedded systems for Marine science and Fisheries:

- FishMeter – Digital fish measurement board
- Deep Vision RV – Vision system for marine science
- Deep Vision Fisheries – Vision system for fisheries



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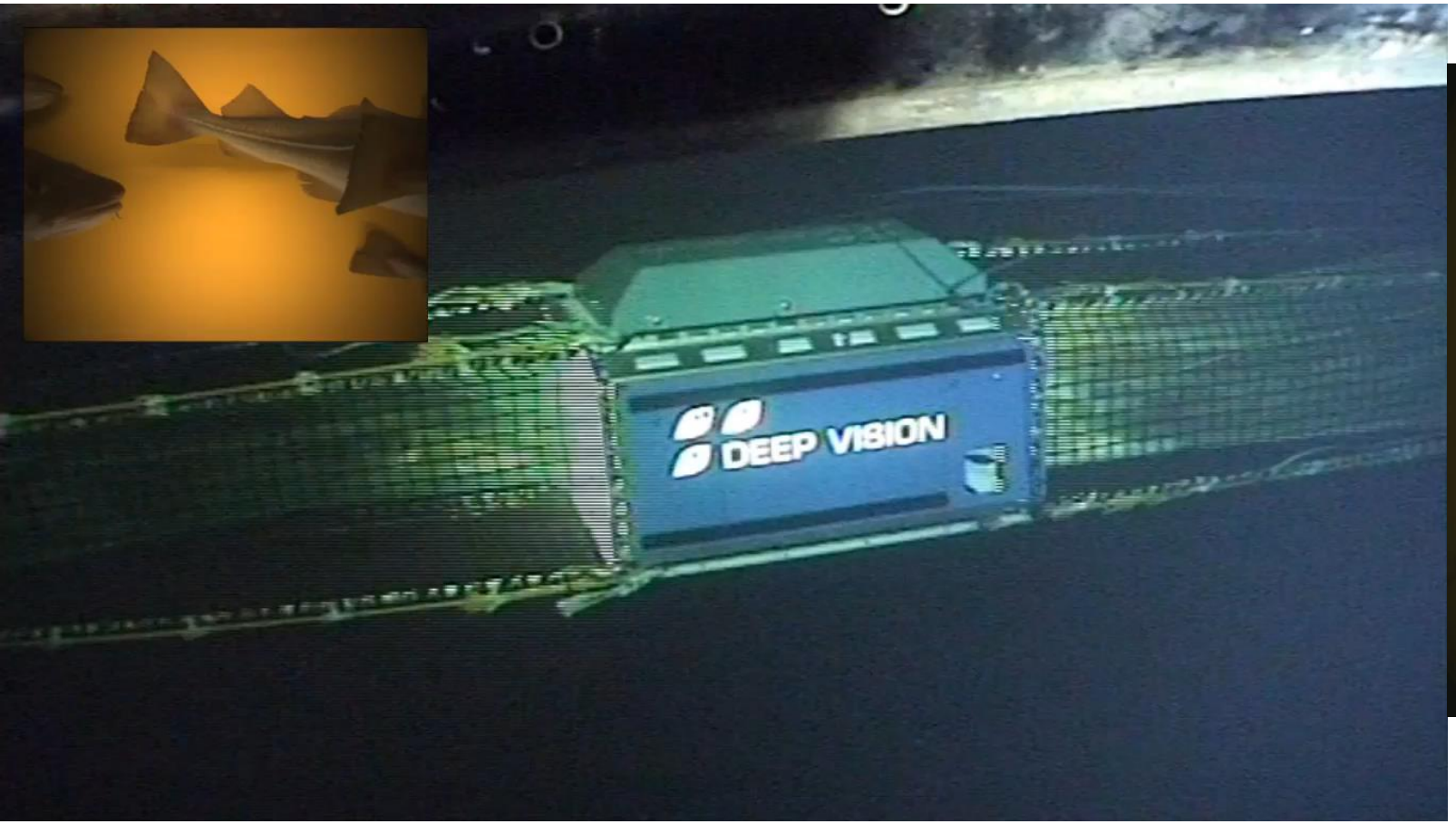
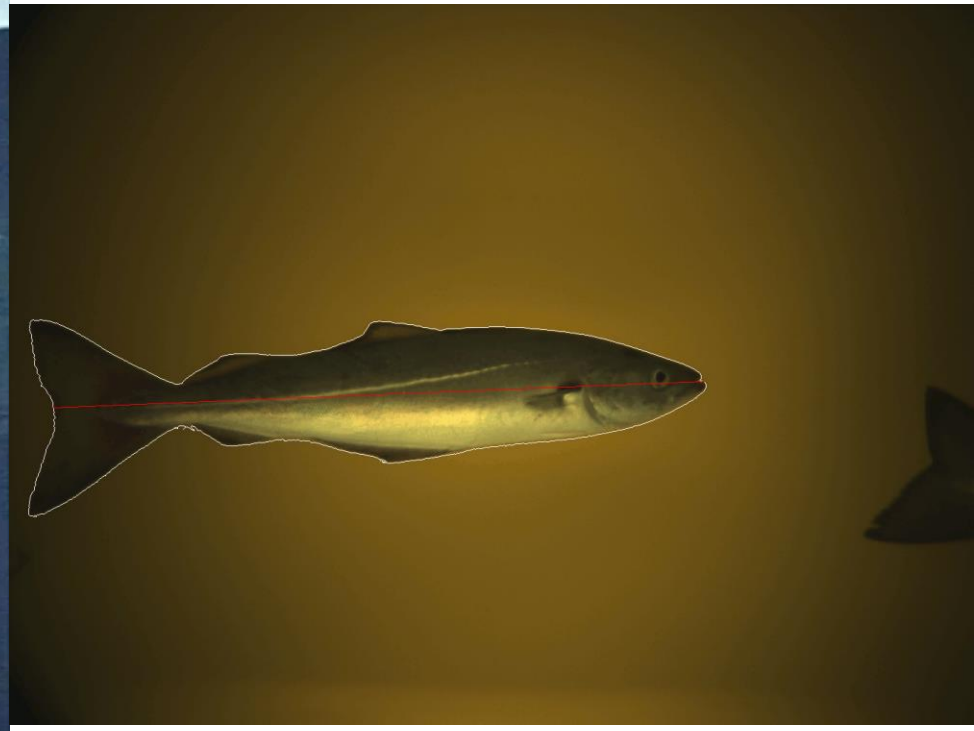
Classical computer vision and Machine learning:

- Embedded software and GUIs
- Subsea imagery processing
- Tools for machine learning

How did we end up at subsea innovation day?





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How did we end up at subsea innovation day?

How many objects are going through the trawl?

What are these objects?

What is the size distribution?

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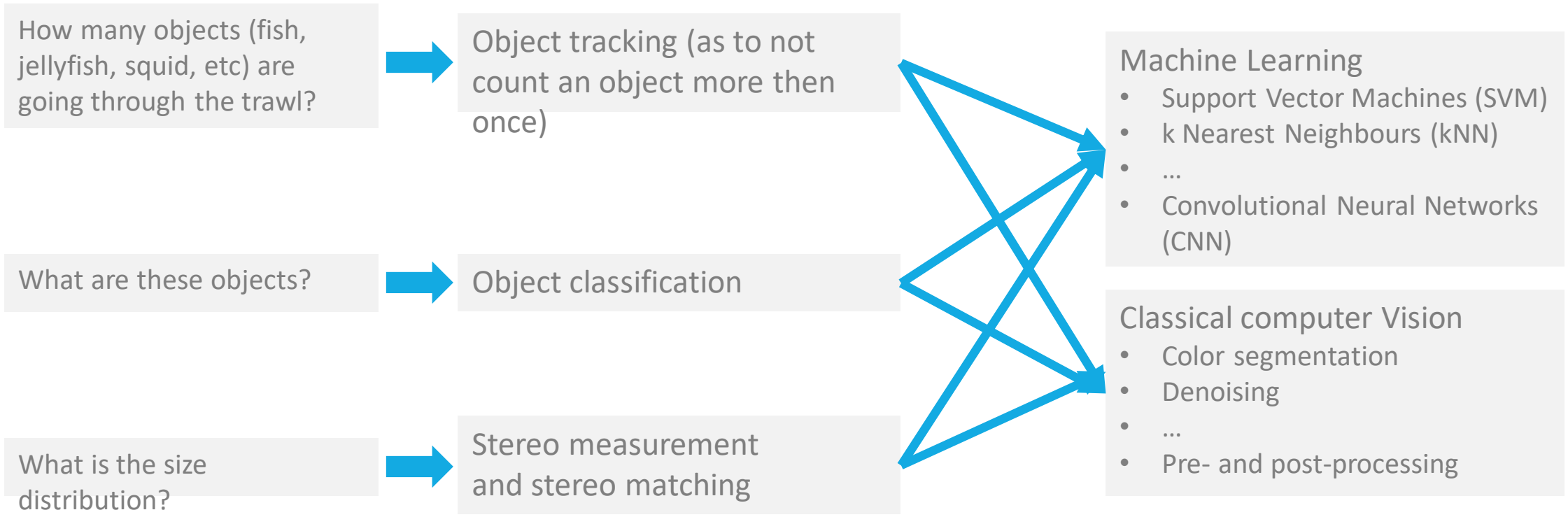
How did we end up at subsea innovation day?



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How did we end up at subsea innovation day?

Machine Learning

Classical computer Vision

→ Subsea Imagery →

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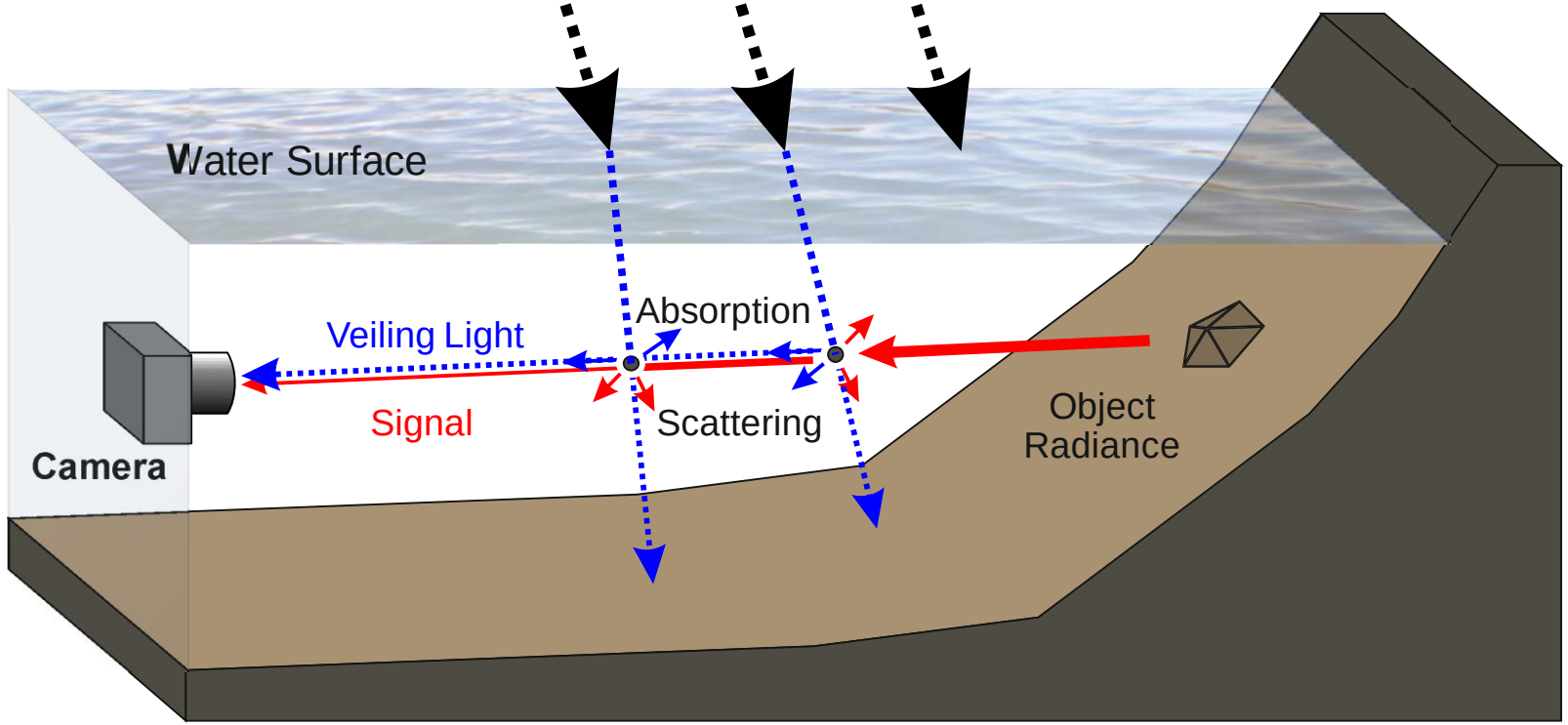
Understanding underwater imagery

Scene radiance · transmission;

Airlight constant



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Underwater Dehazing

Original image

Enhanced/Dehazed image

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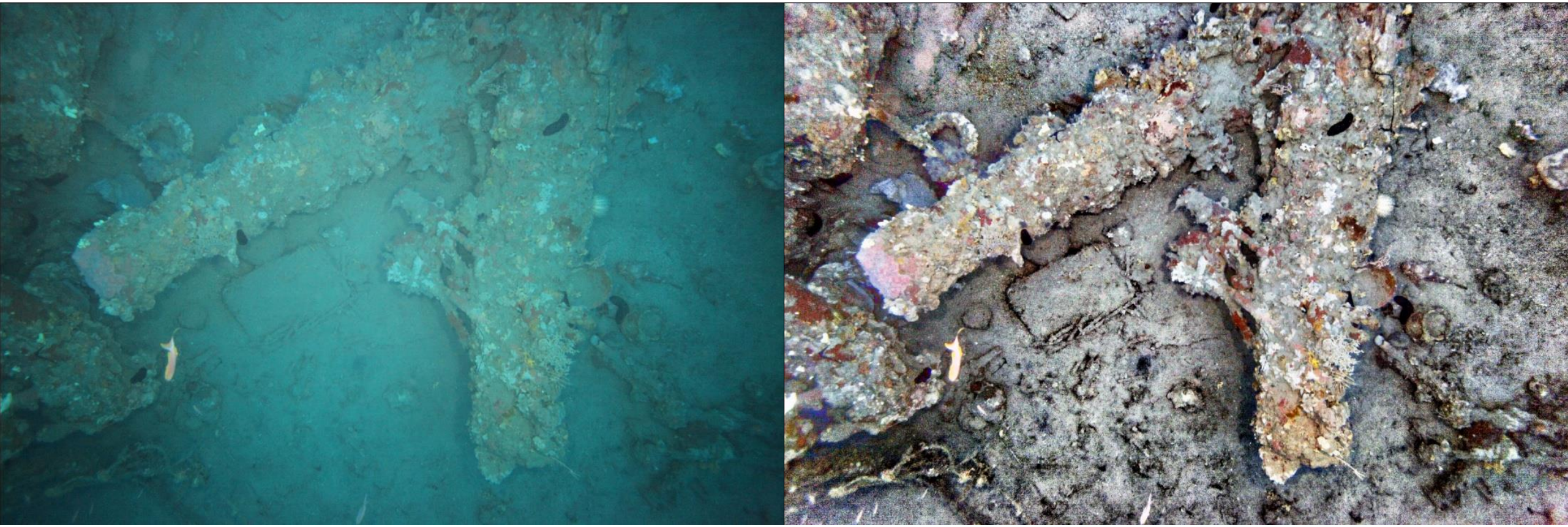
Underwater Dehazing

France (Toulon)



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Underwater Dehazing

Can be applied to existing videos – source video taken from YouTube

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Underwater Dehazing

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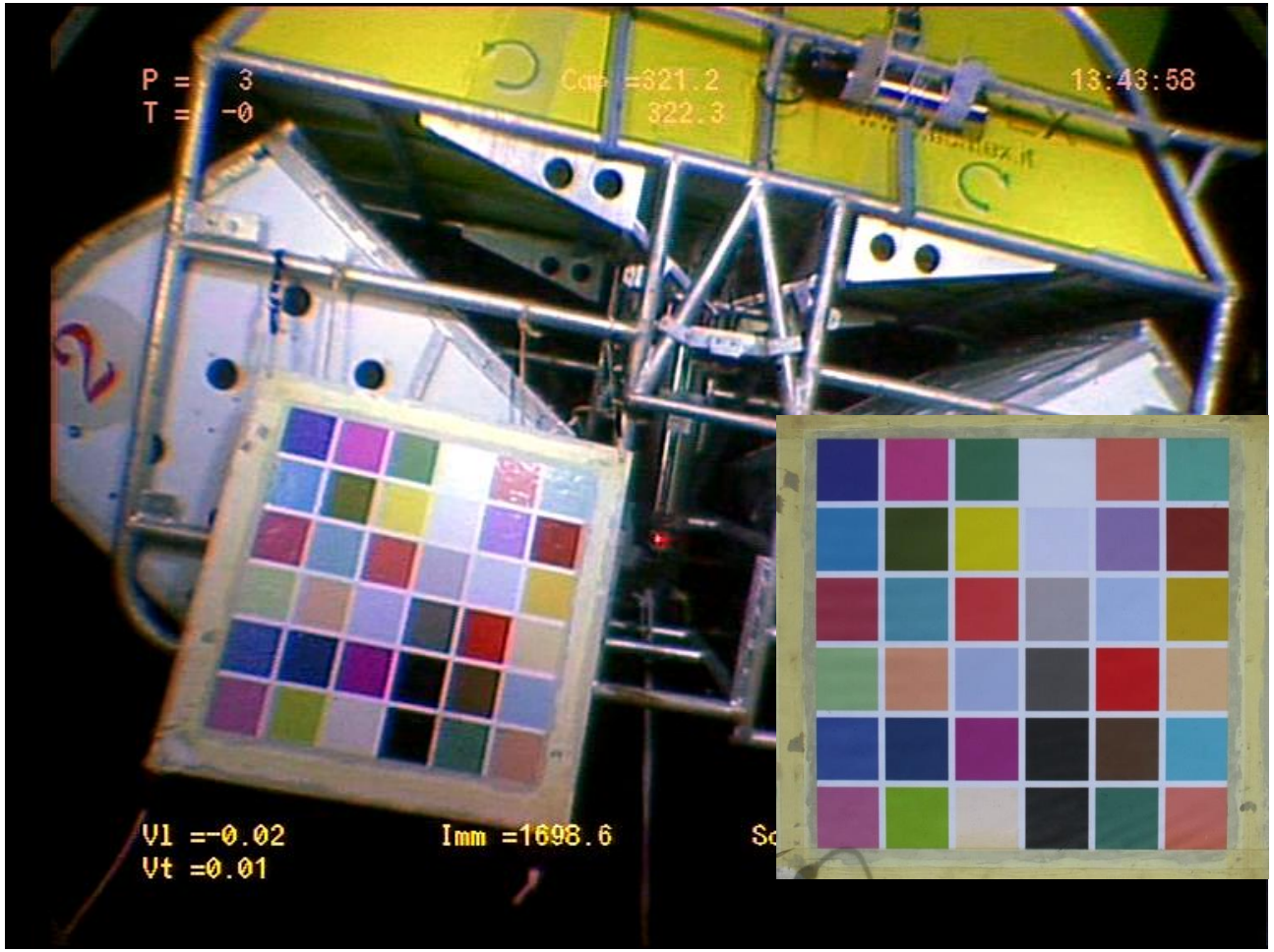
Color correction



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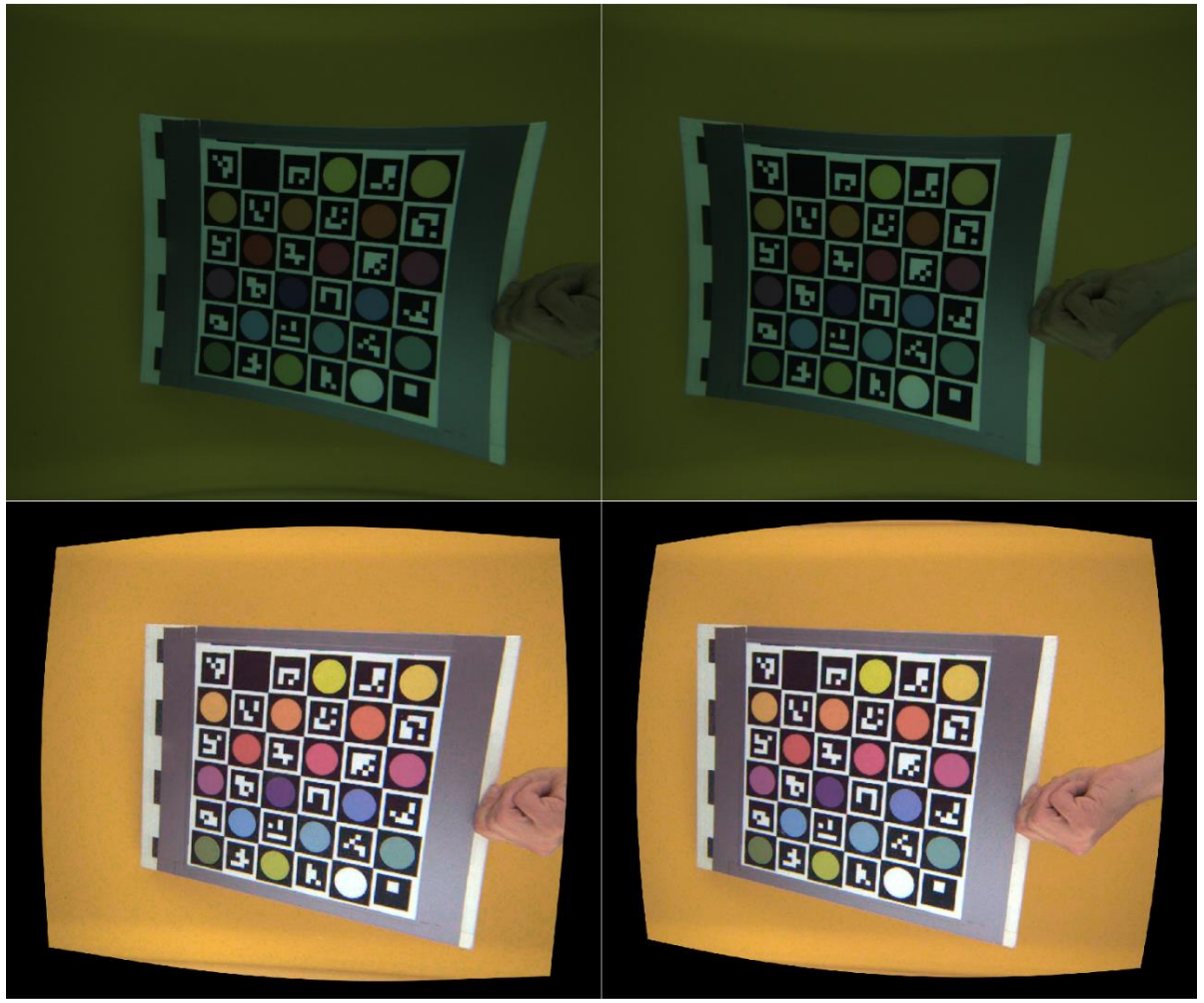
Color calibration, camera calibration and stereo calibration



Photometric parameters

Intrinsic parameters

Extrinsic parameters

Geometric and Photometric Calibration Tool

Load calibration and survey datasets

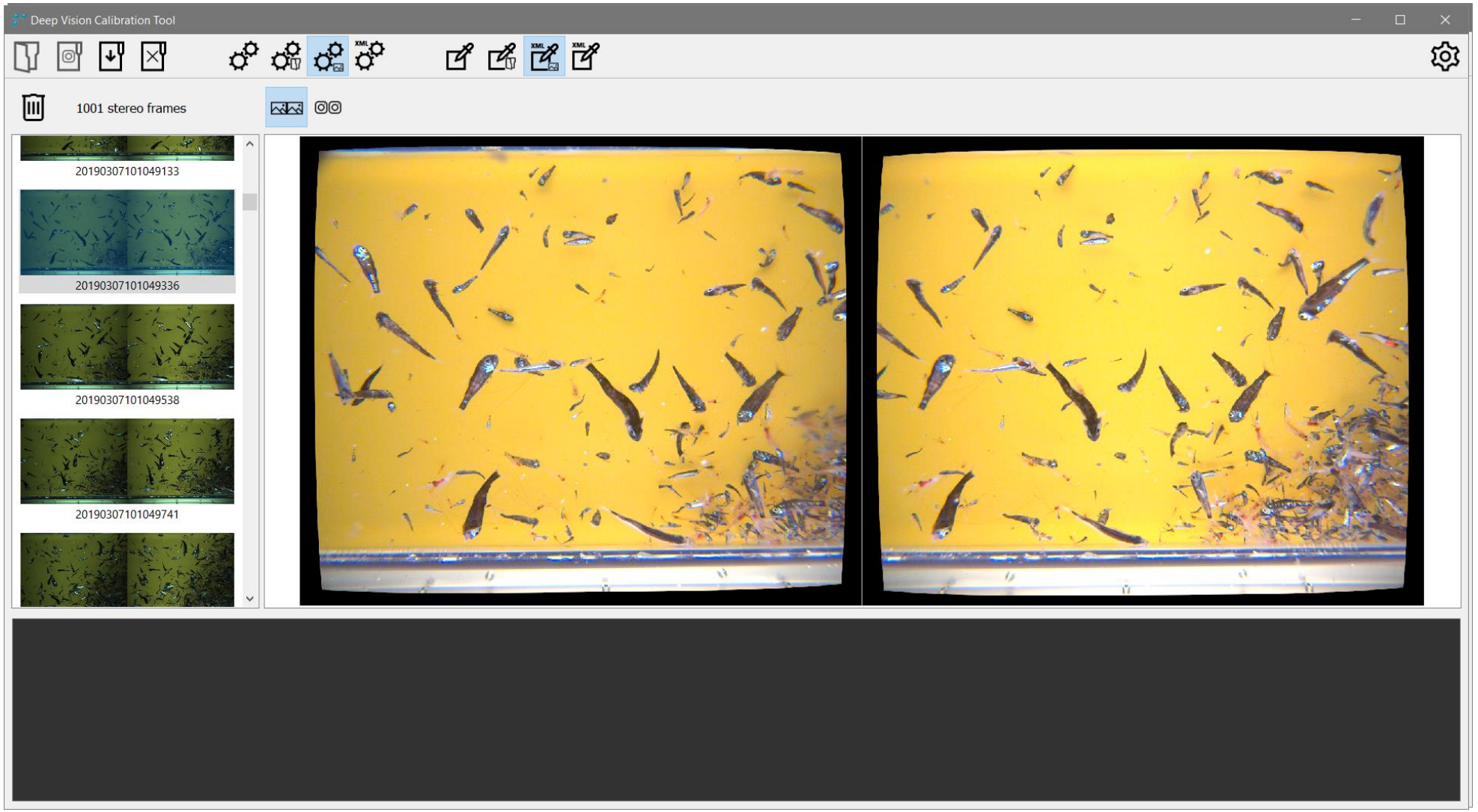
Edit images set

Perform geometric stereo calibration

Perform photometric calibration

Preview stereo rectification

Preview color correction



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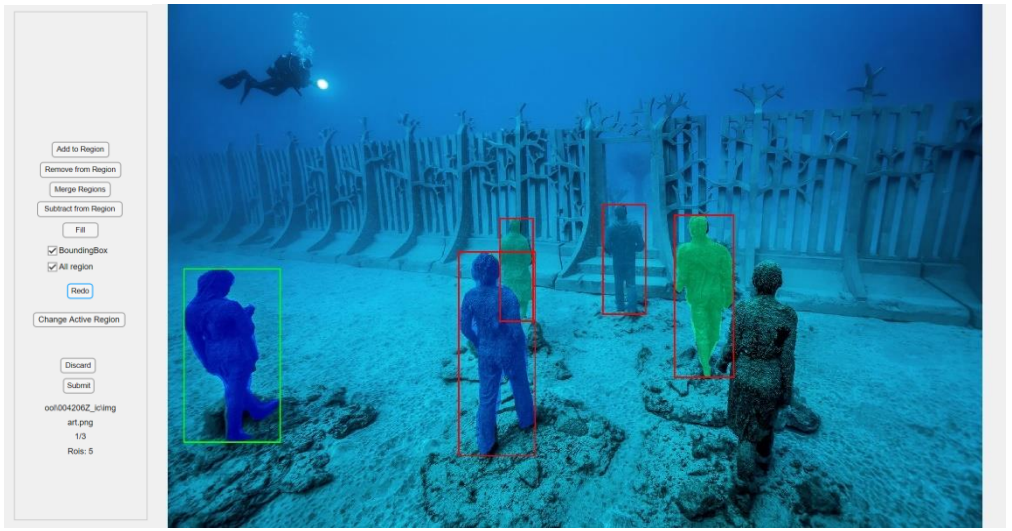
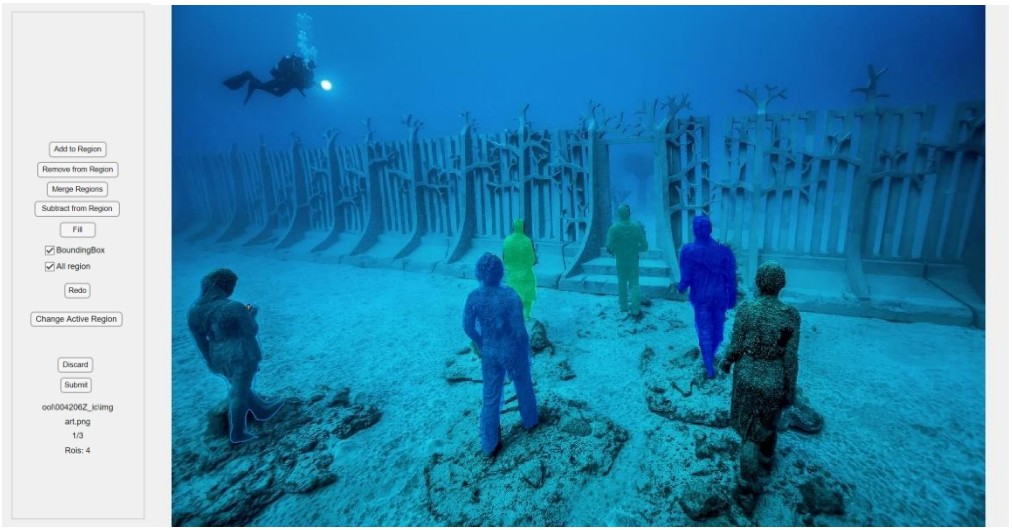
Segmentation and labelling Tool





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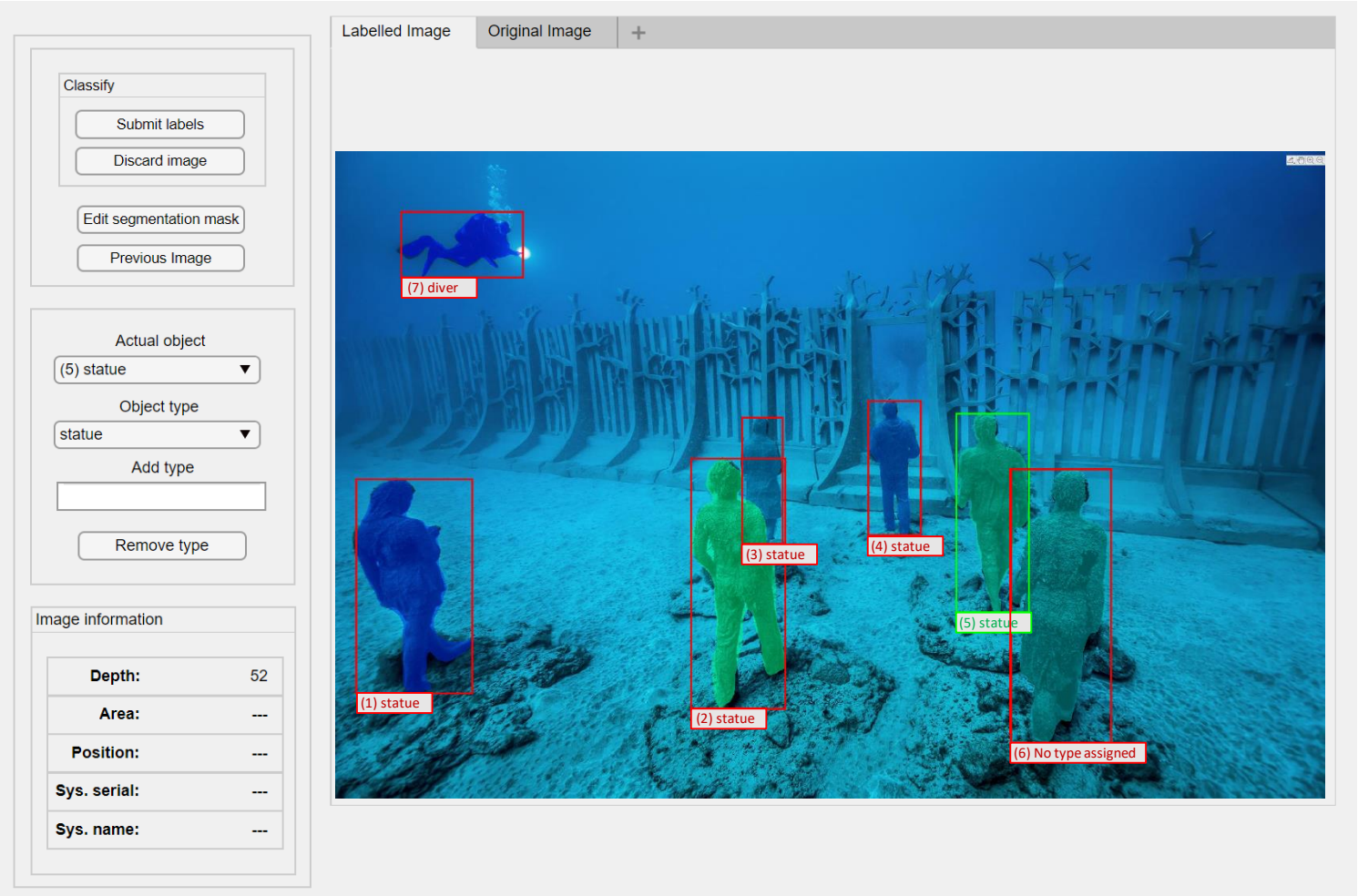
Segmentation and labelling Tool



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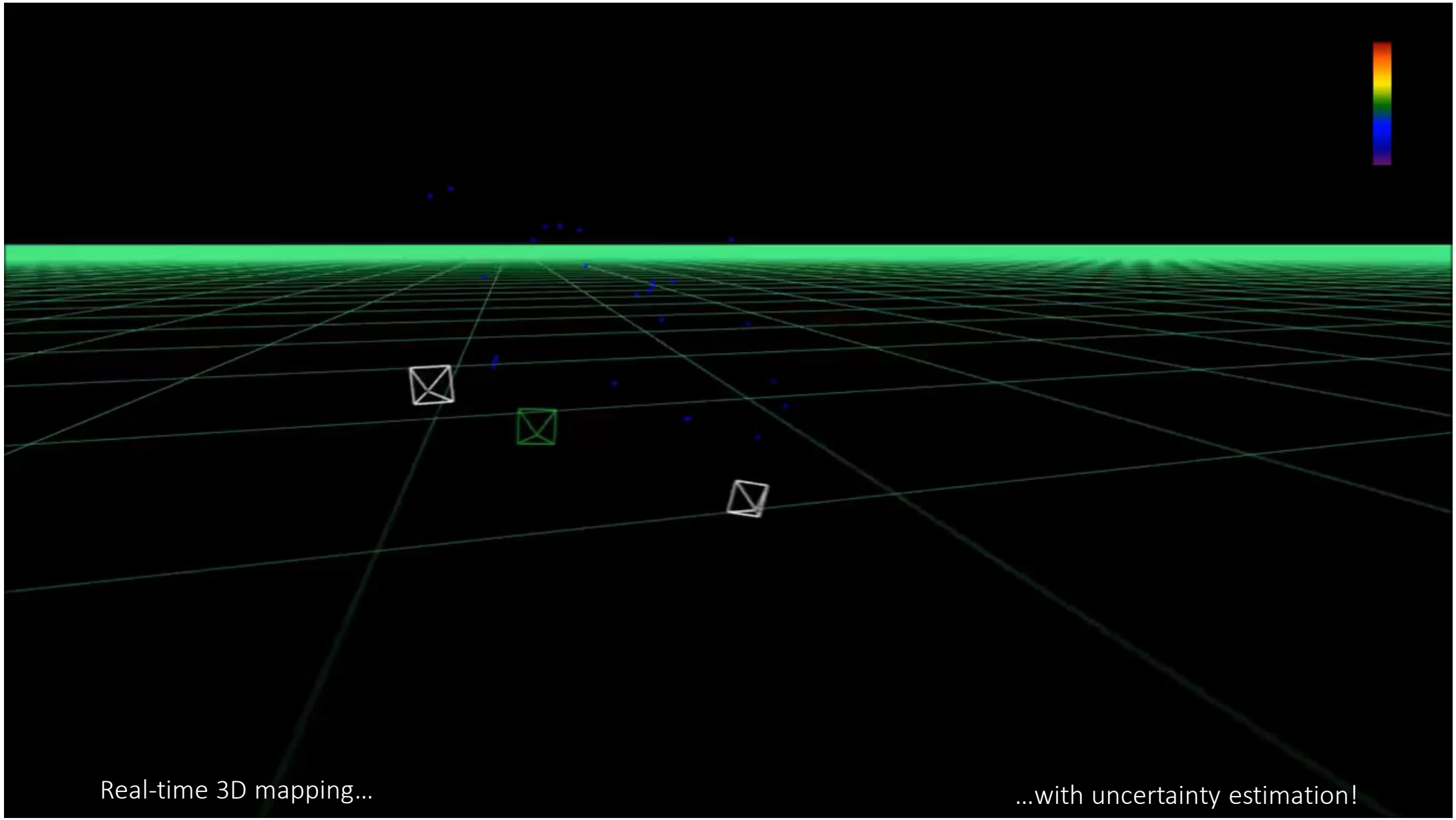

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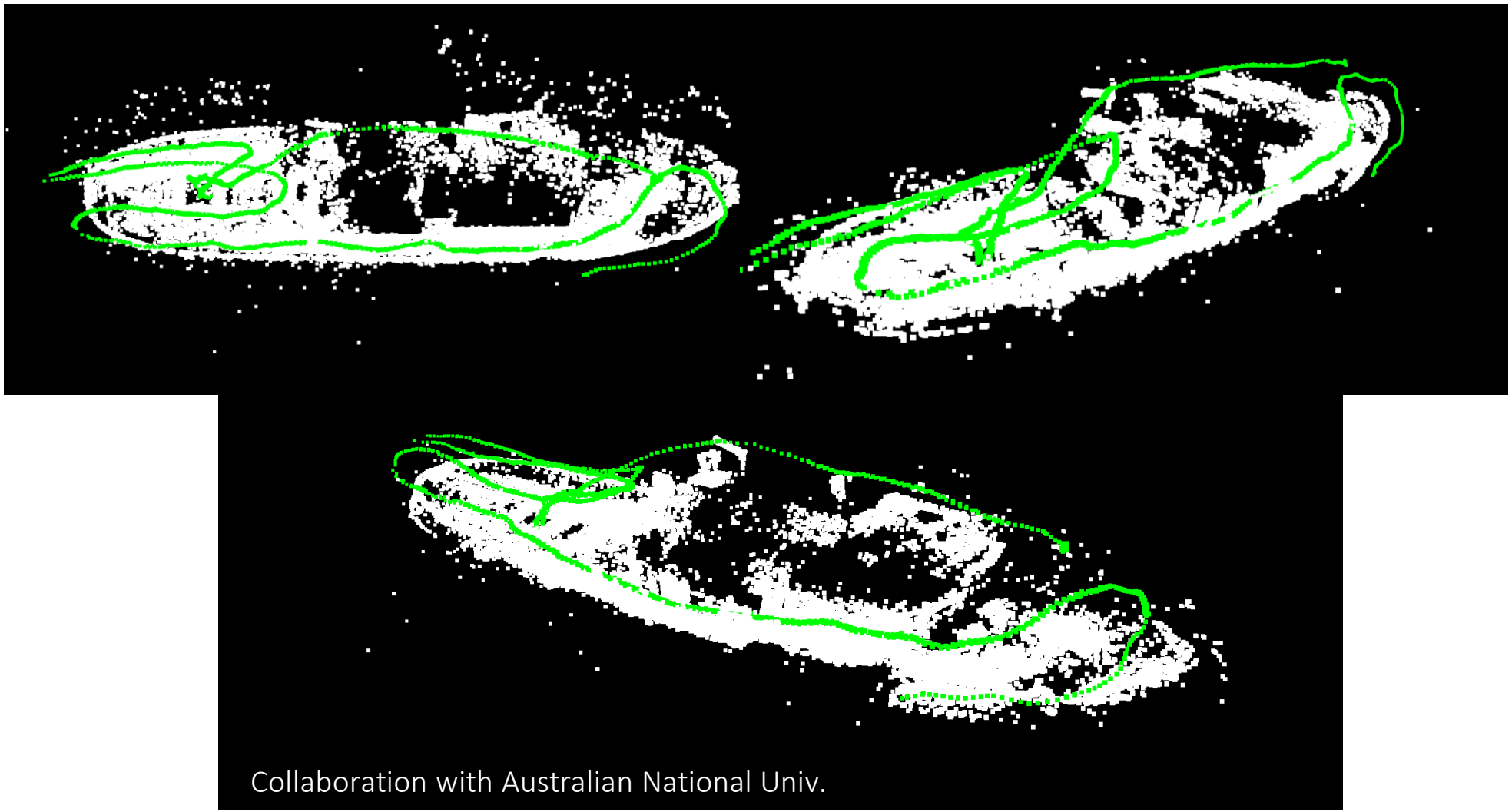
Realtime 3D mapping



Collaboration with Australian National Univ.

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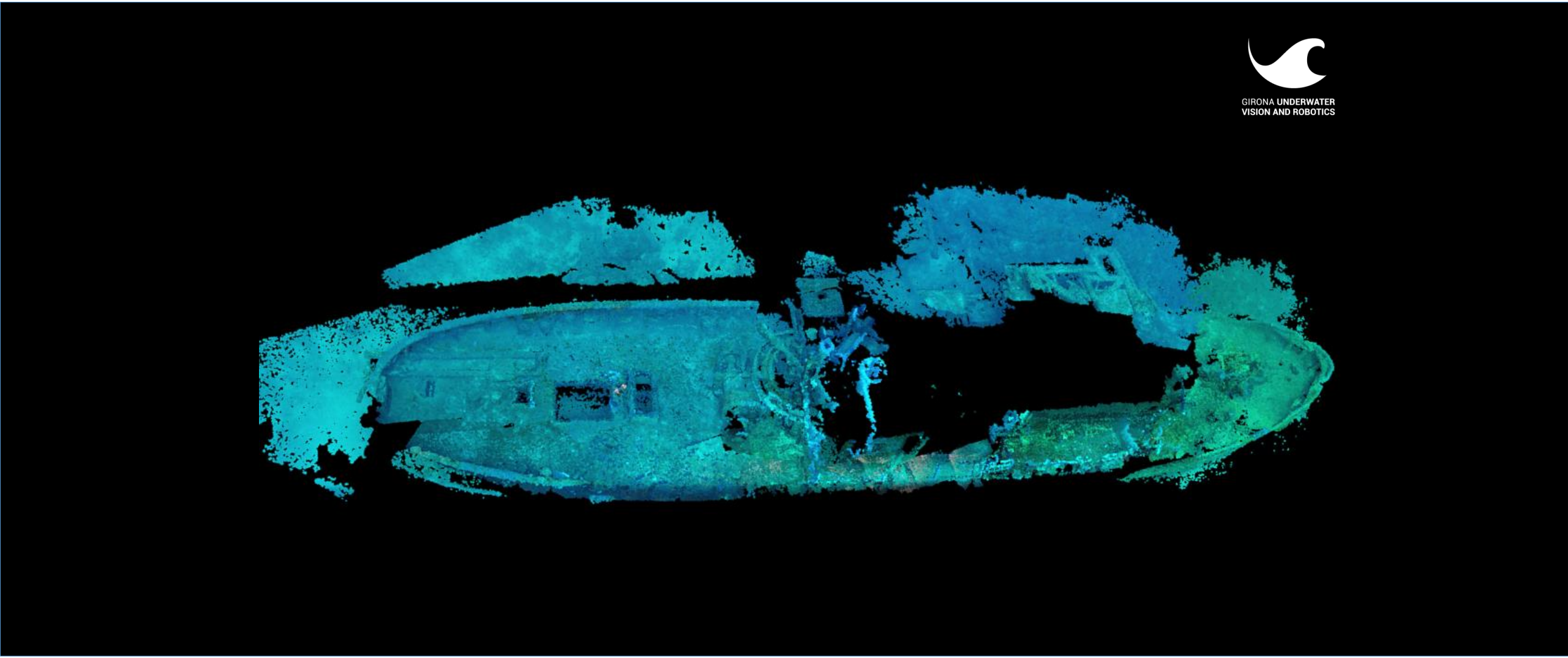
3D mapping example



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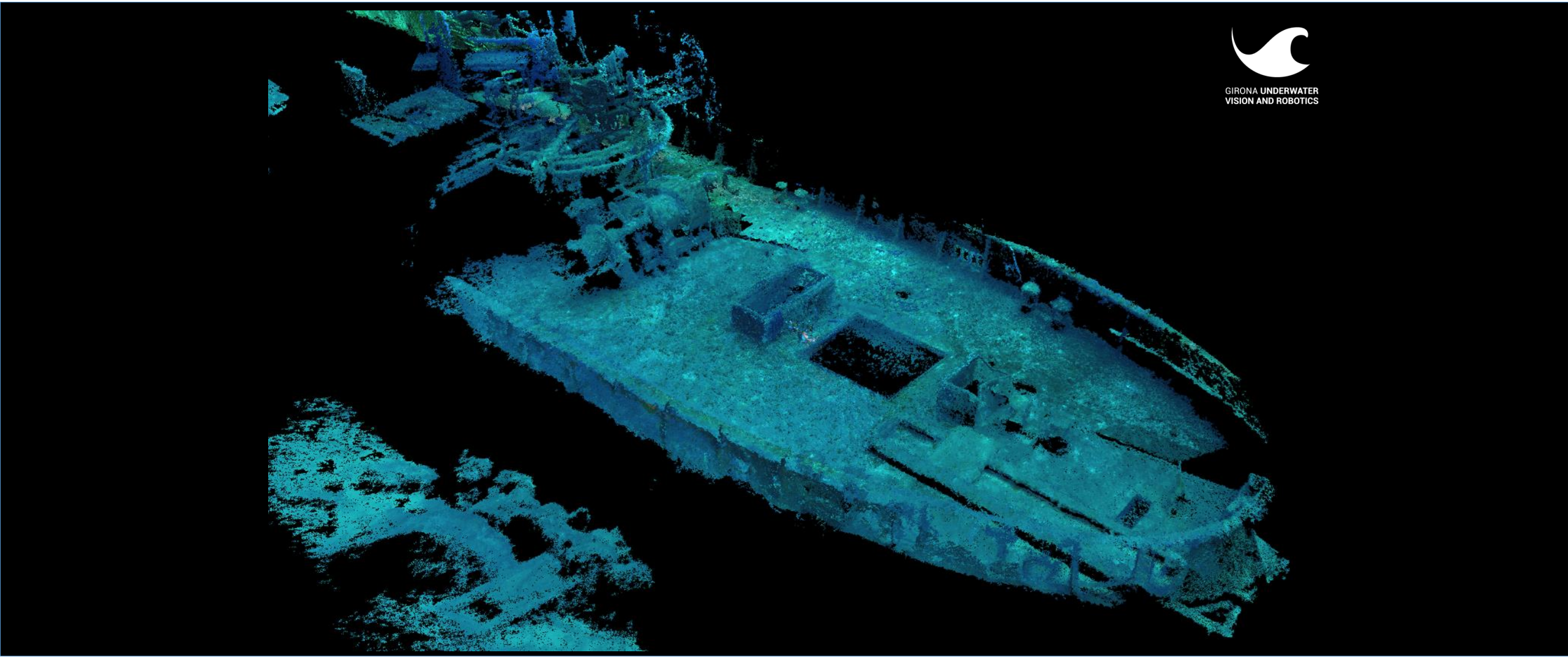

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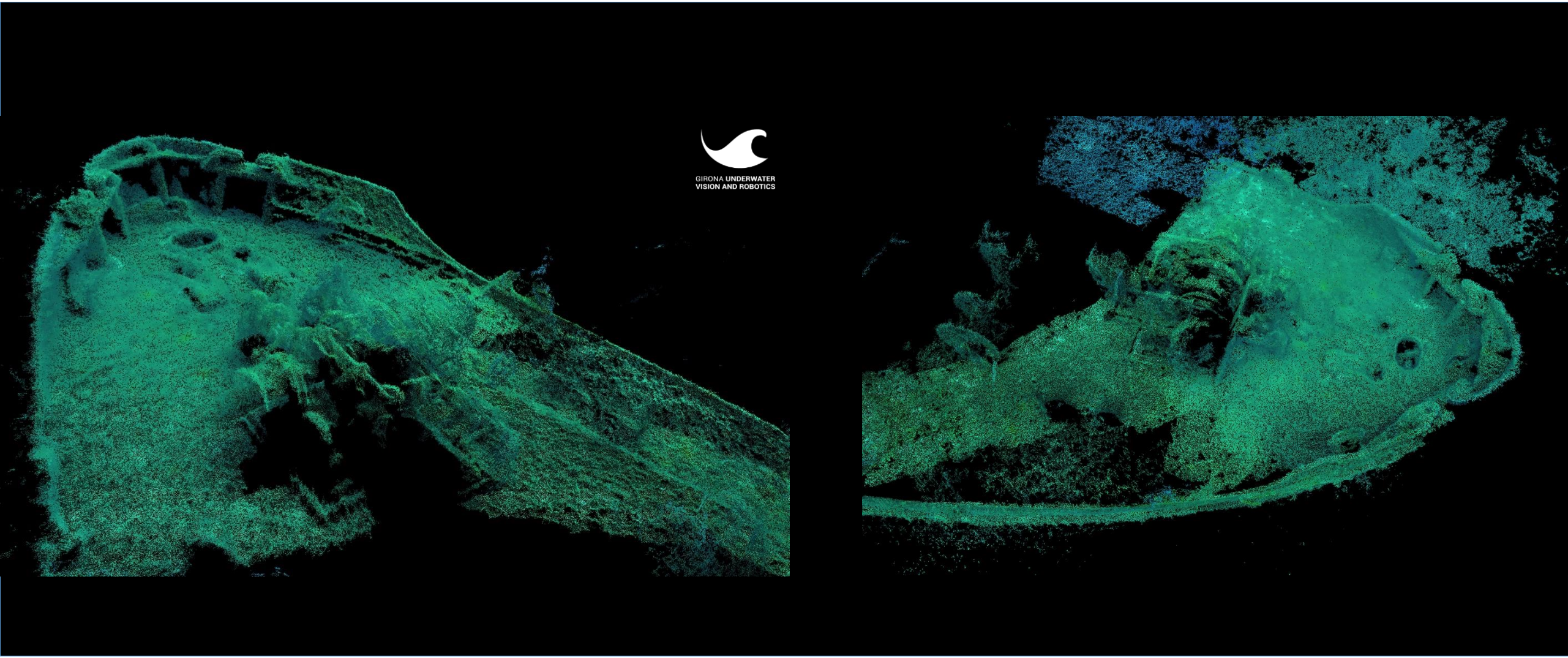

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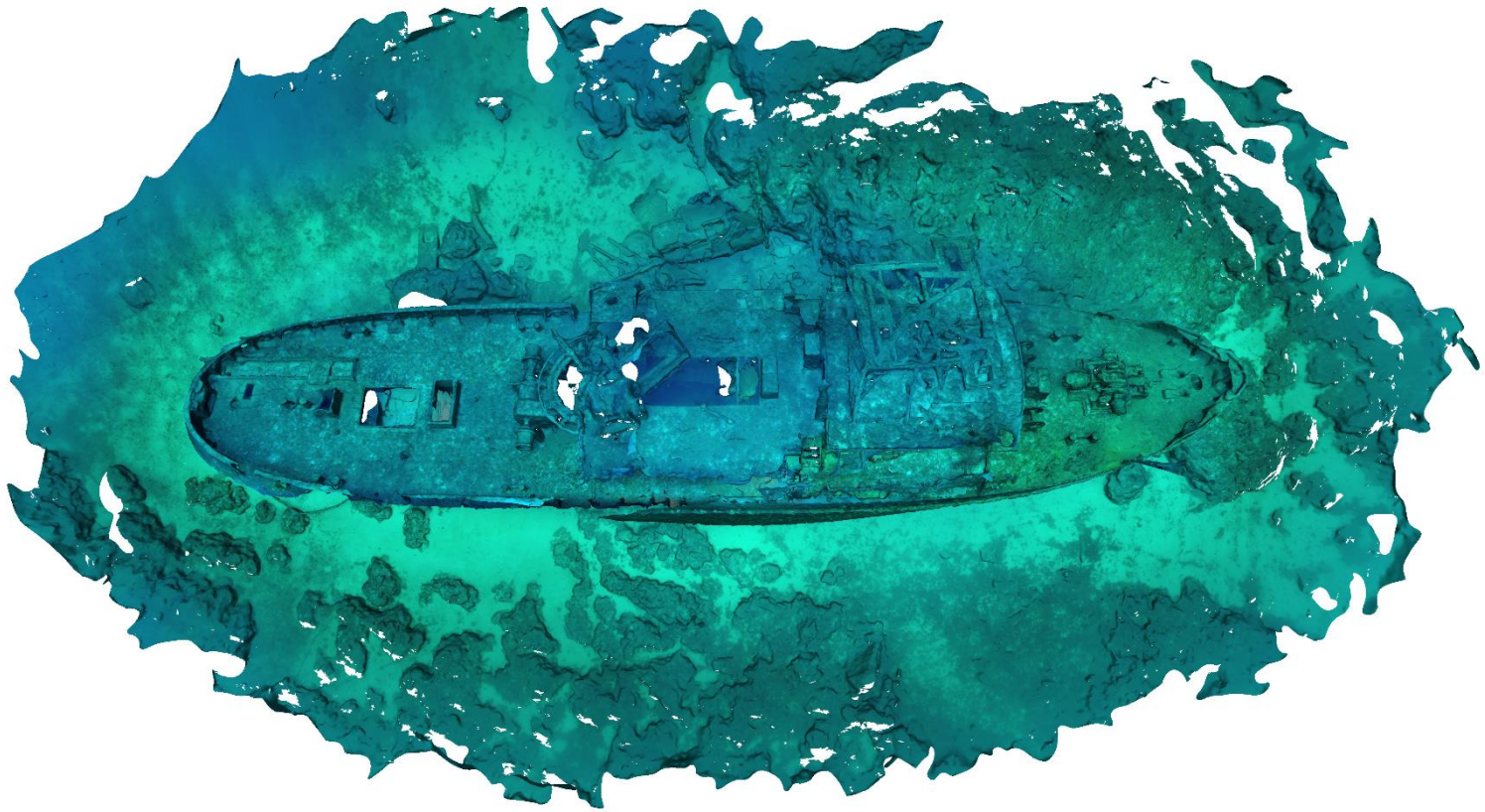

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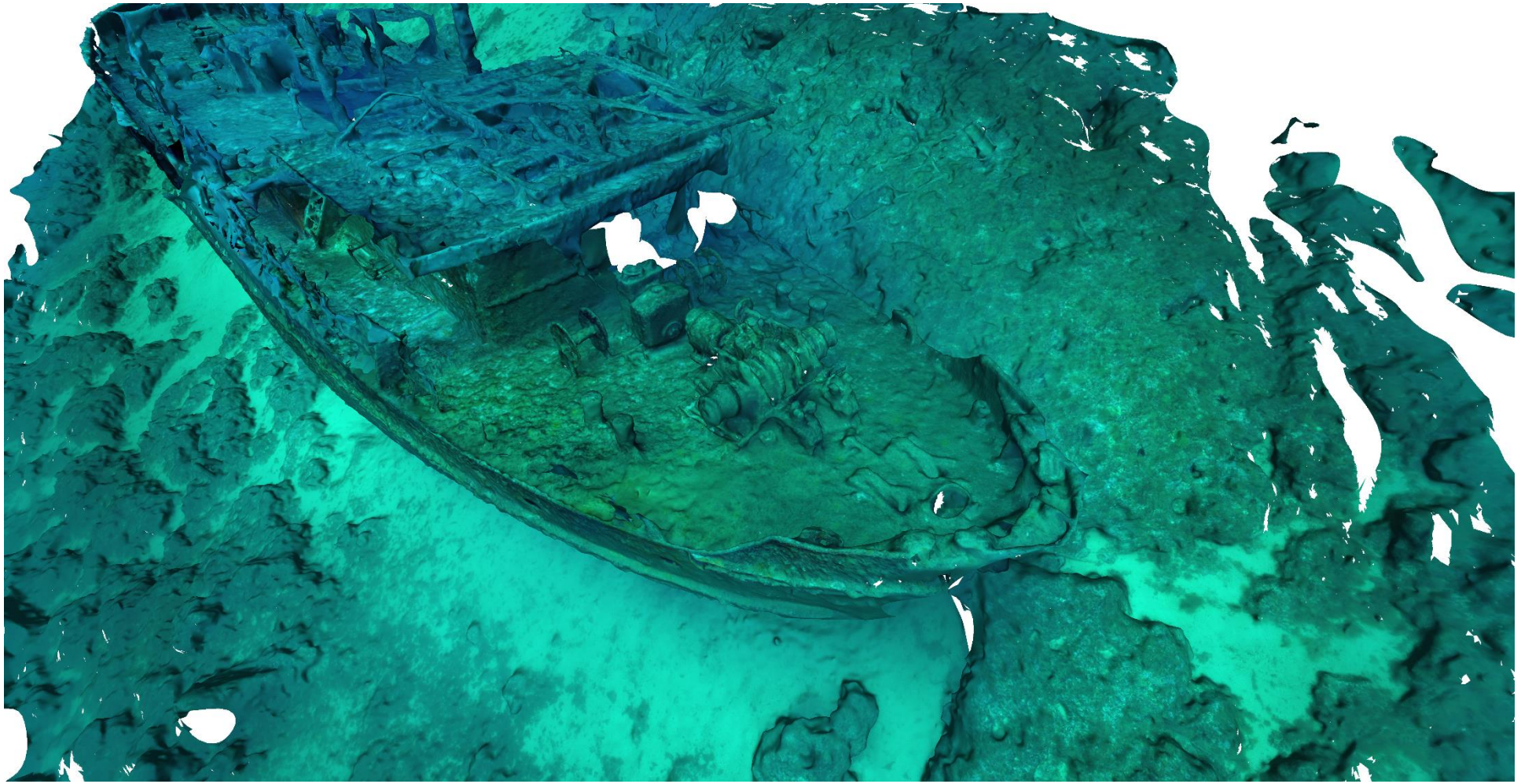

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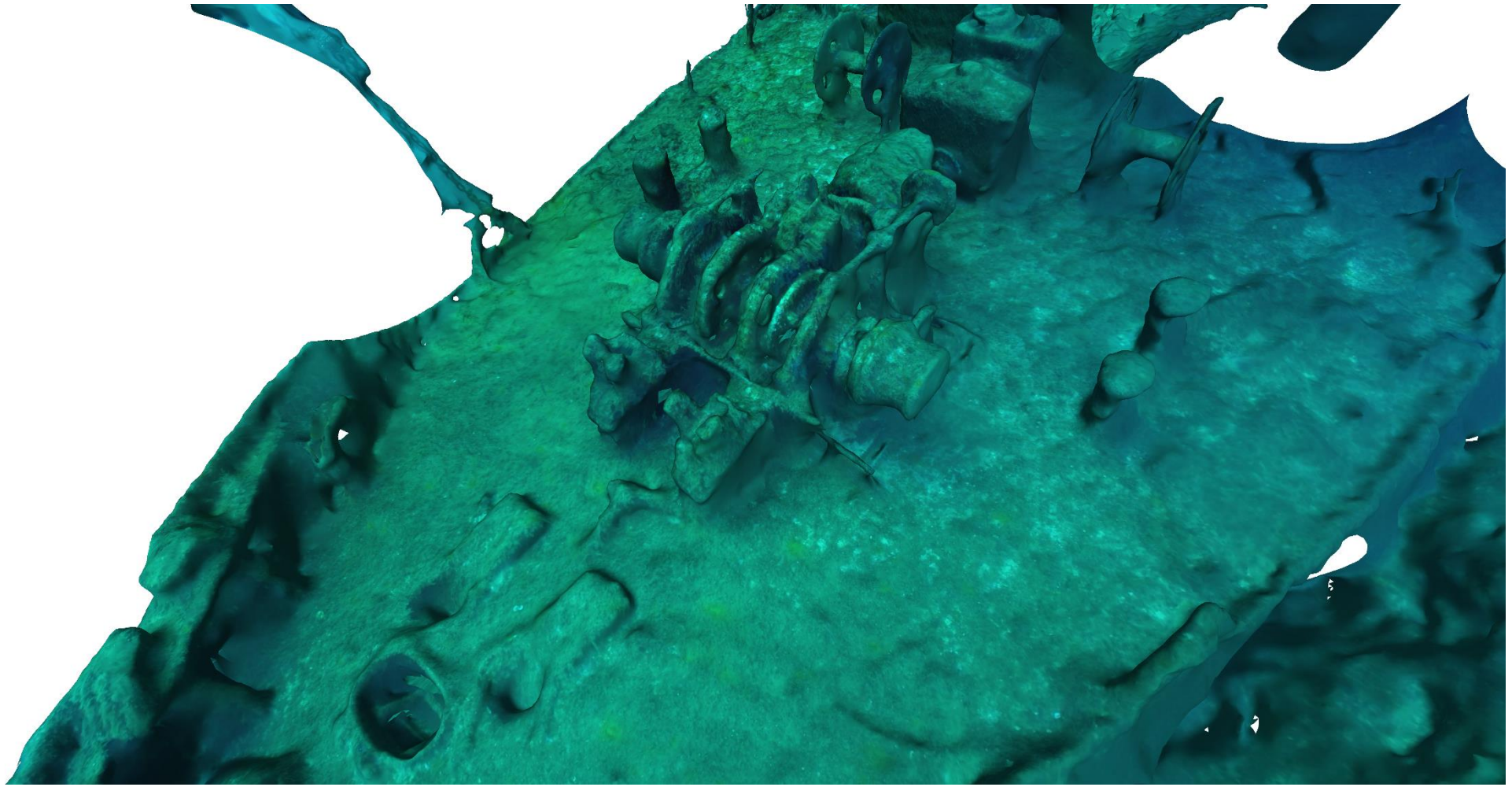

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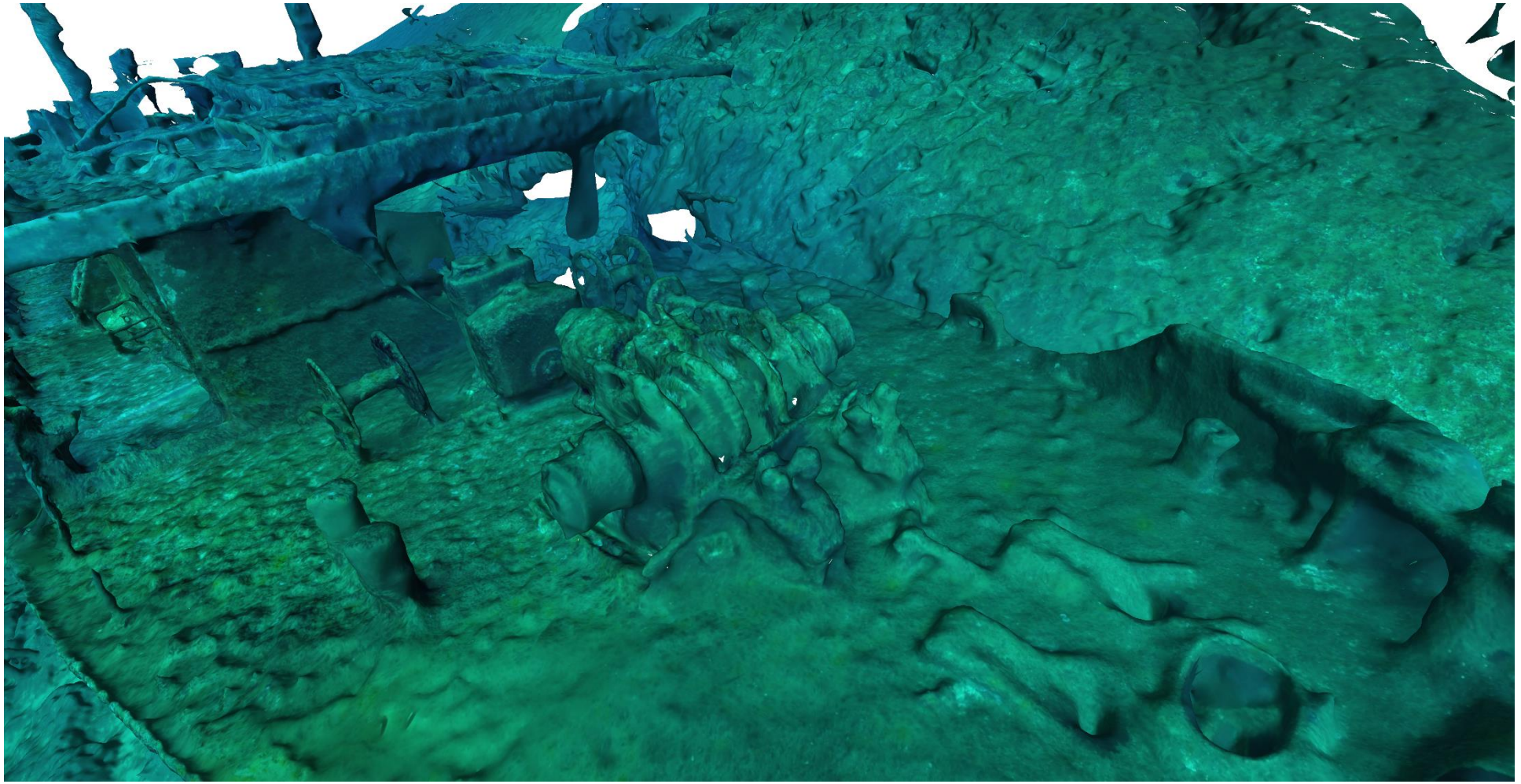

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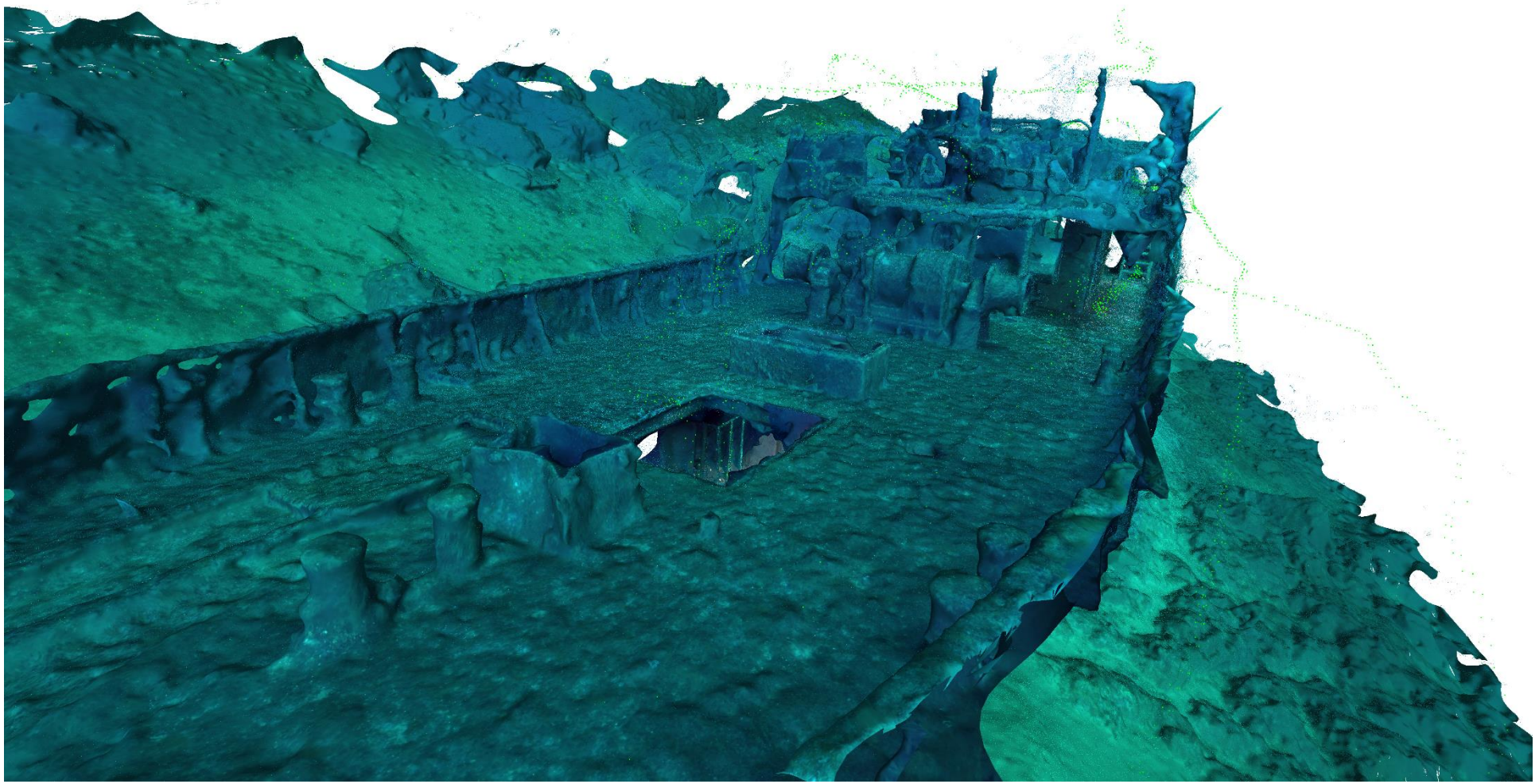

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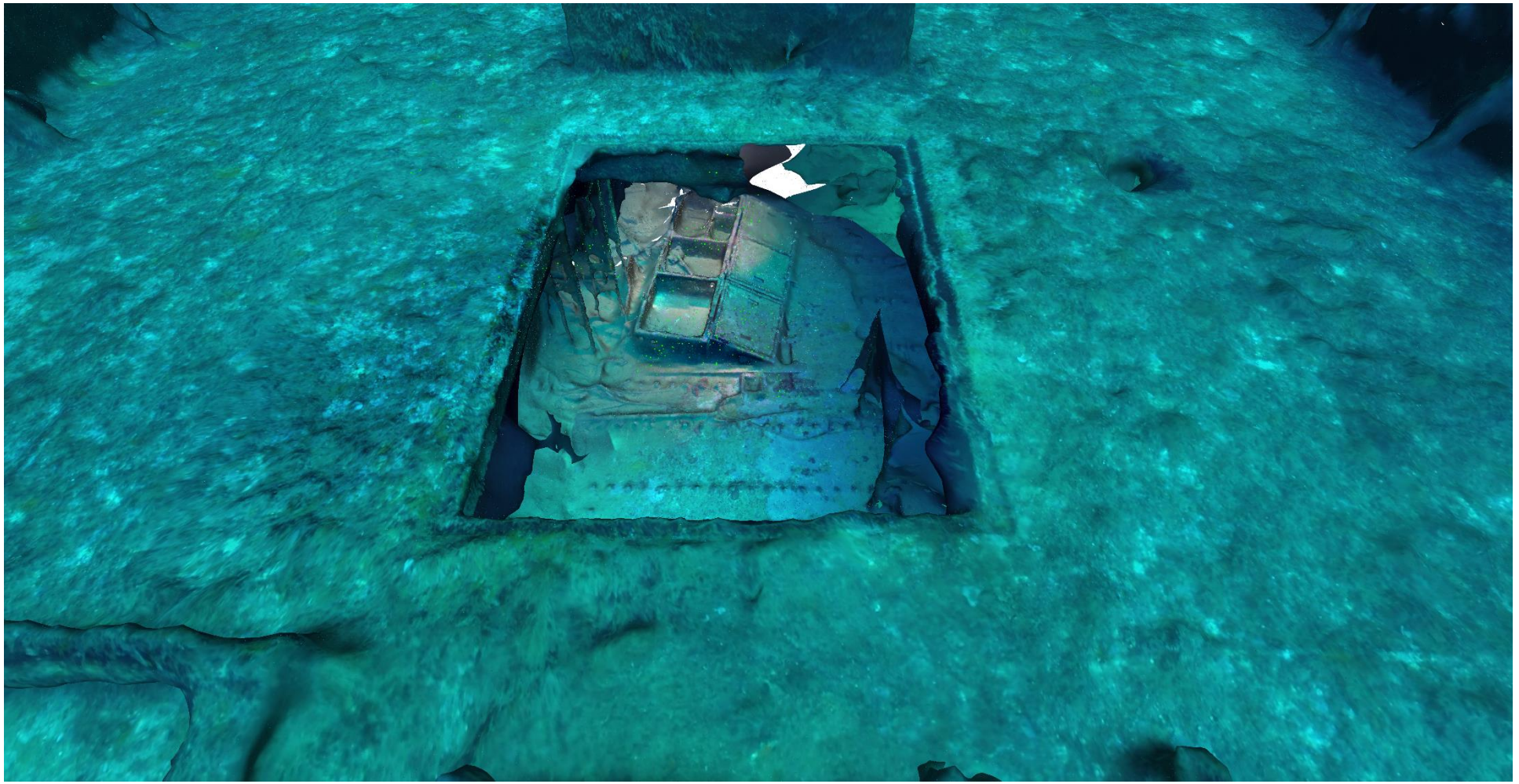

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Surface Reconstruction

30x playback speed

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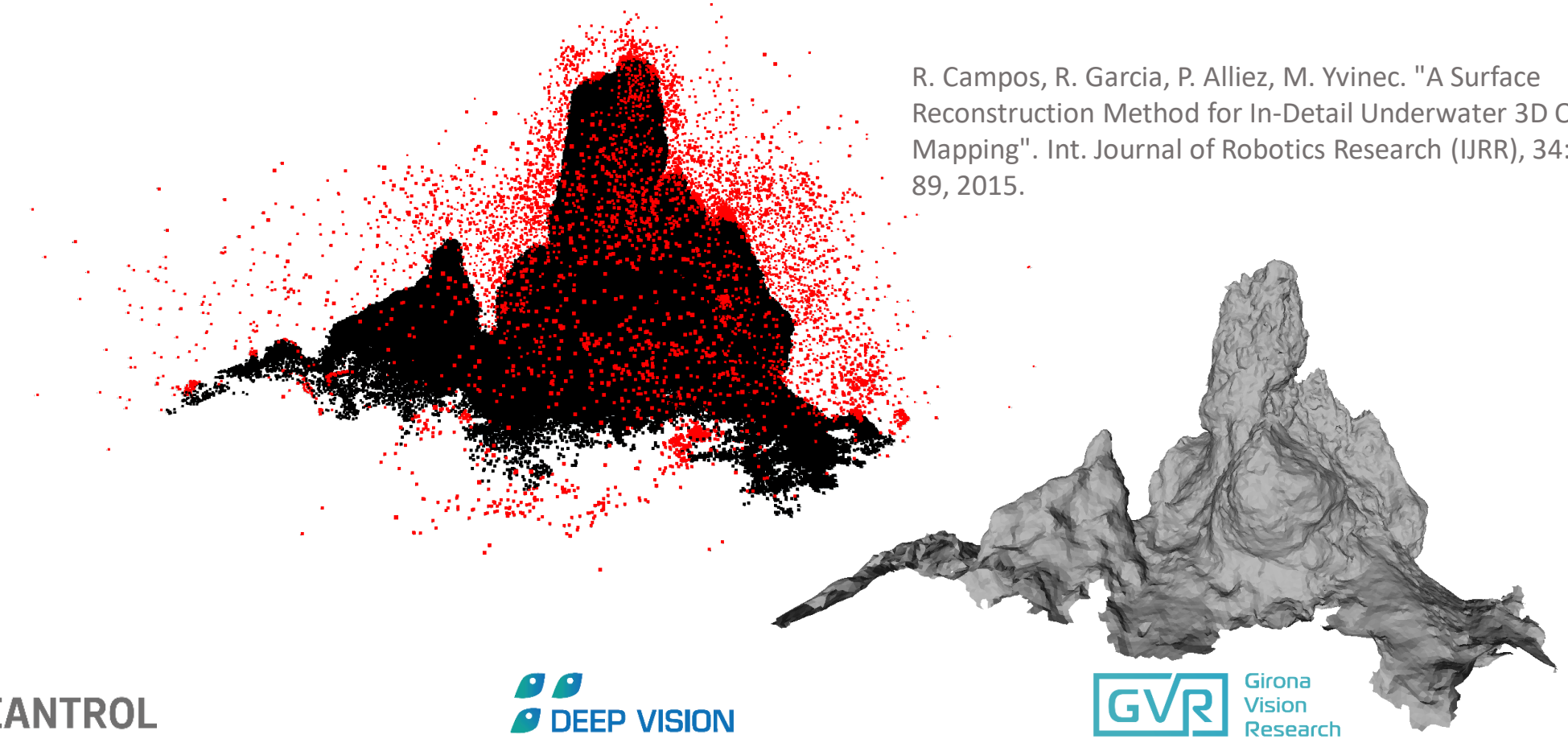
Surface Reconstruction

- Underwater datasets normally contain noise and outliers.
- A surface reconstruction method dealing with these aberrations allows to reveal the shape of the object:



R. Campos, R. Garcia, P. Alliez, M. Yvinec. "A Surface Reconstruction Method for In-Detail Underwater 3D Optical Mapping". Int. Journal of Robotics Research (IJRR), 34:1, 64-89, 2015.

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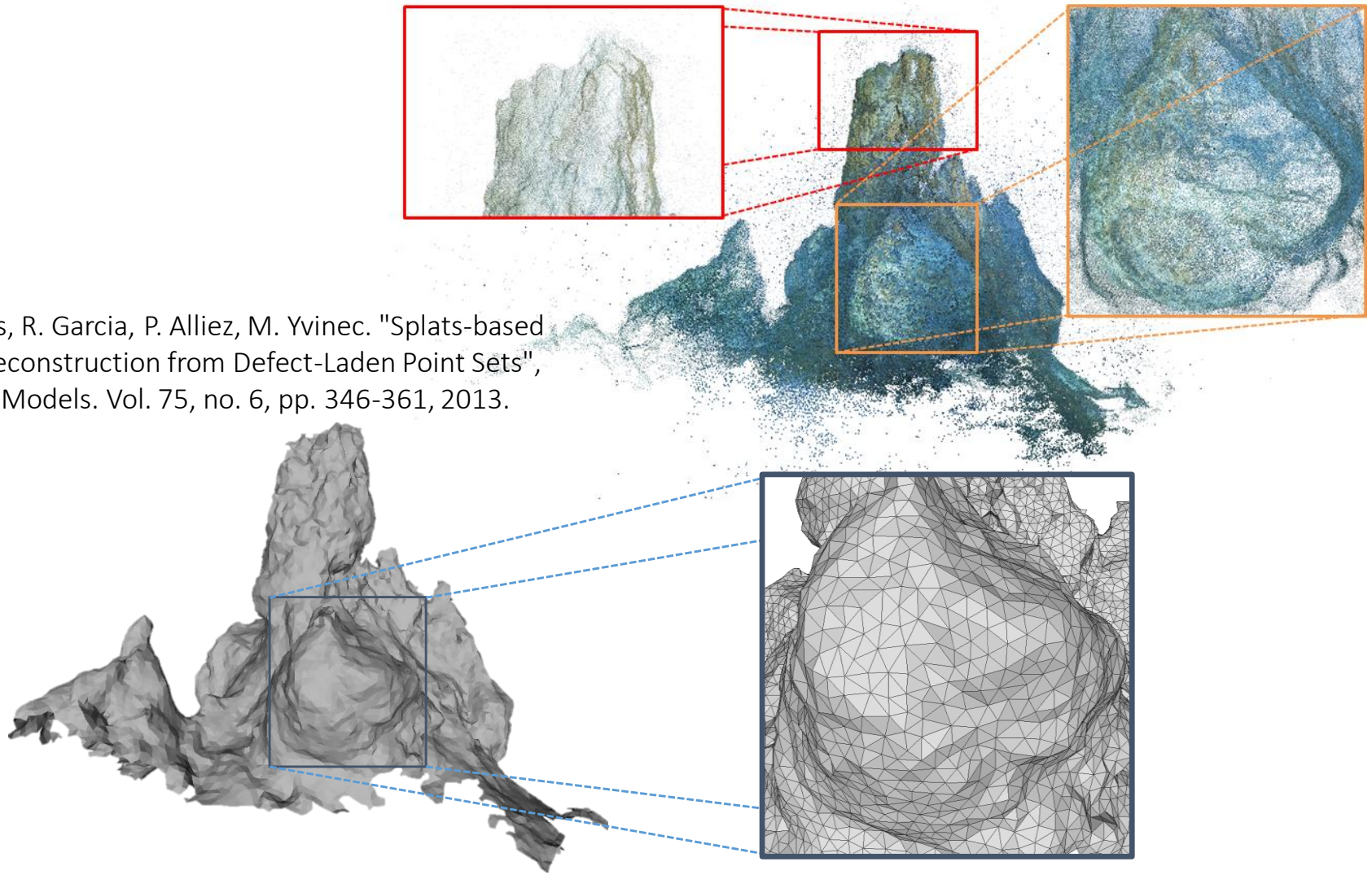
Surface Reconstruction



R. Campos, R. Garcia, P. Alliez, M. Yvinec. "Splats-based Surface Reconstruction from Defect-Laden Point Sets", Graphical Models. Vol. 75, no. 6, pp. 346-361, 2013.

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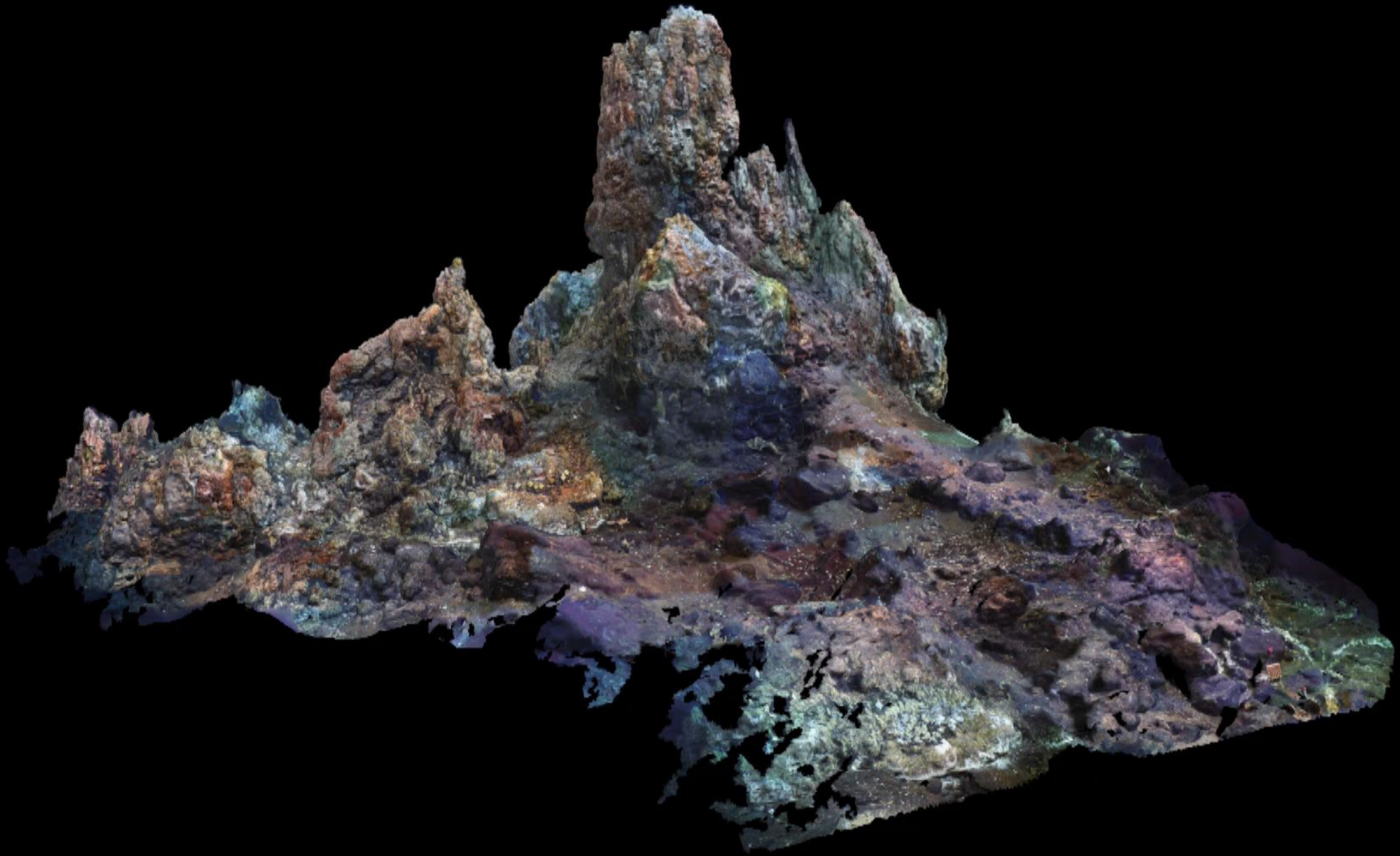
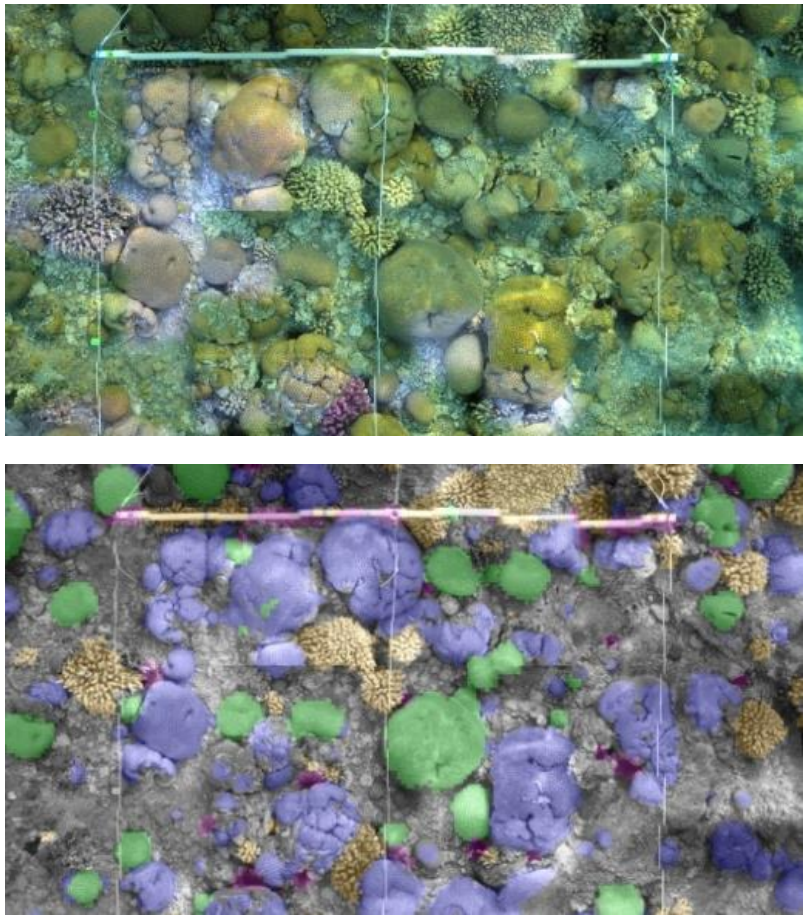
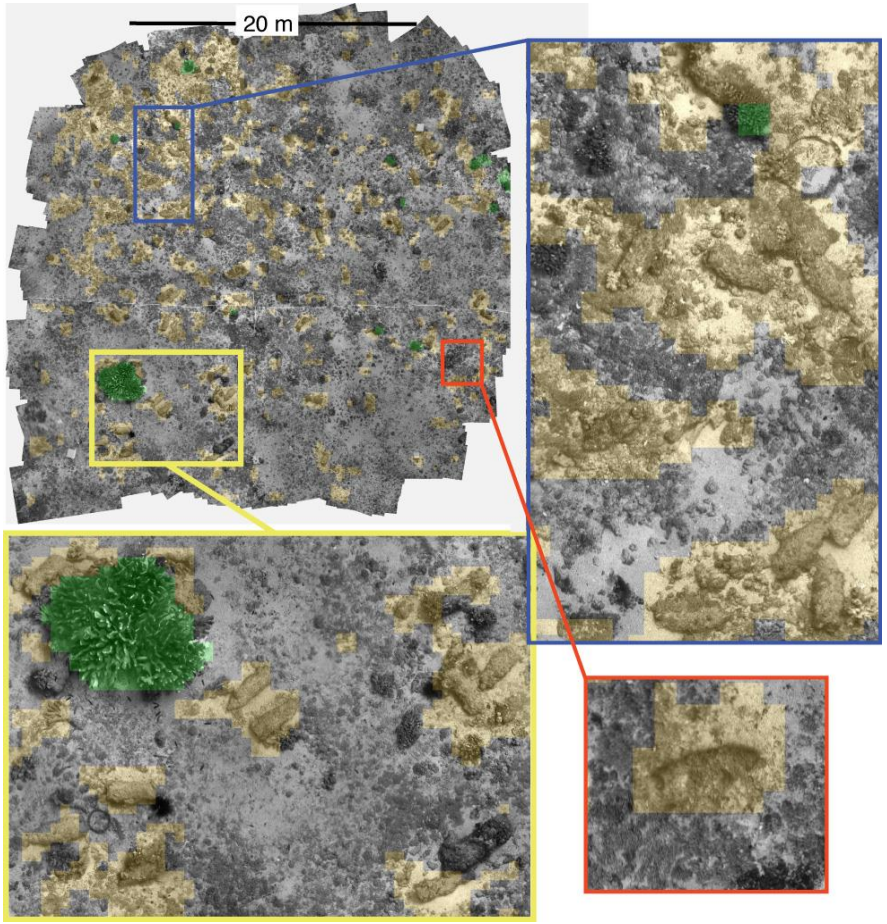


Classification

Coral reef classification



Munitions classification



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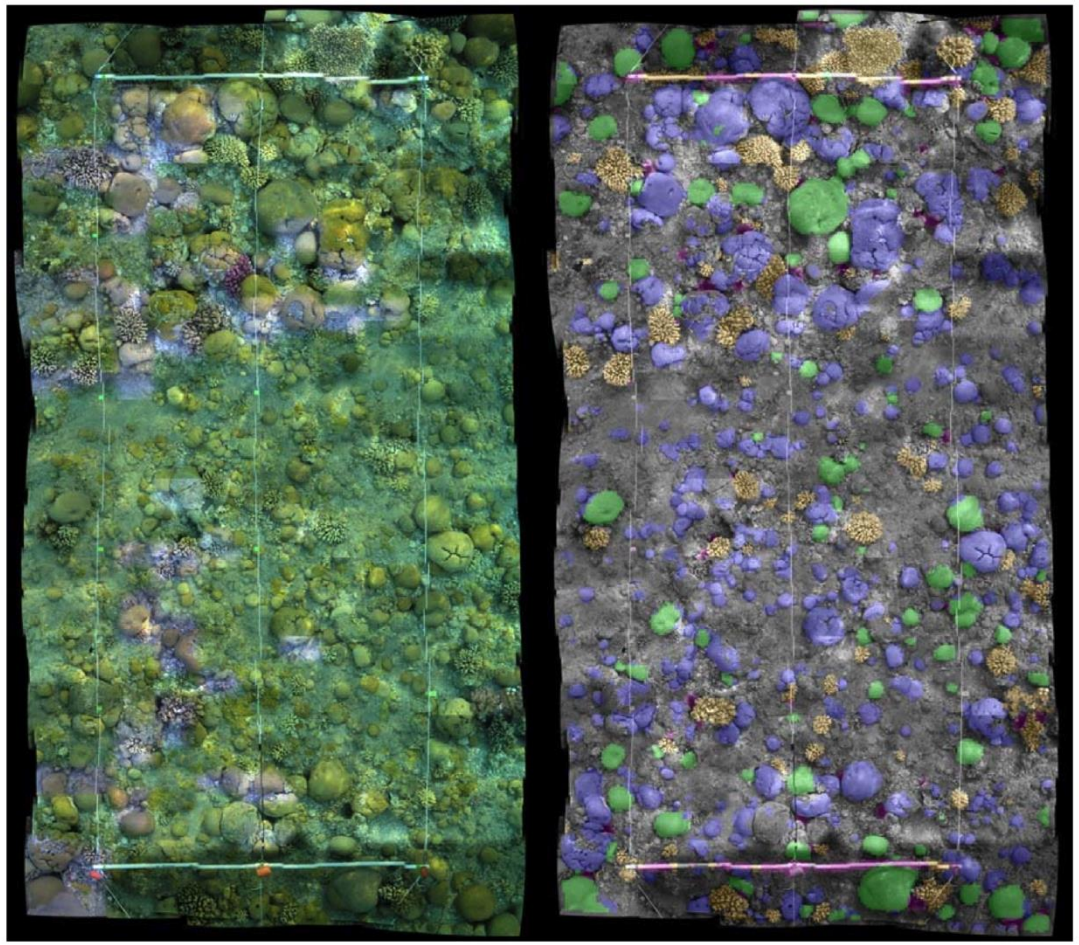
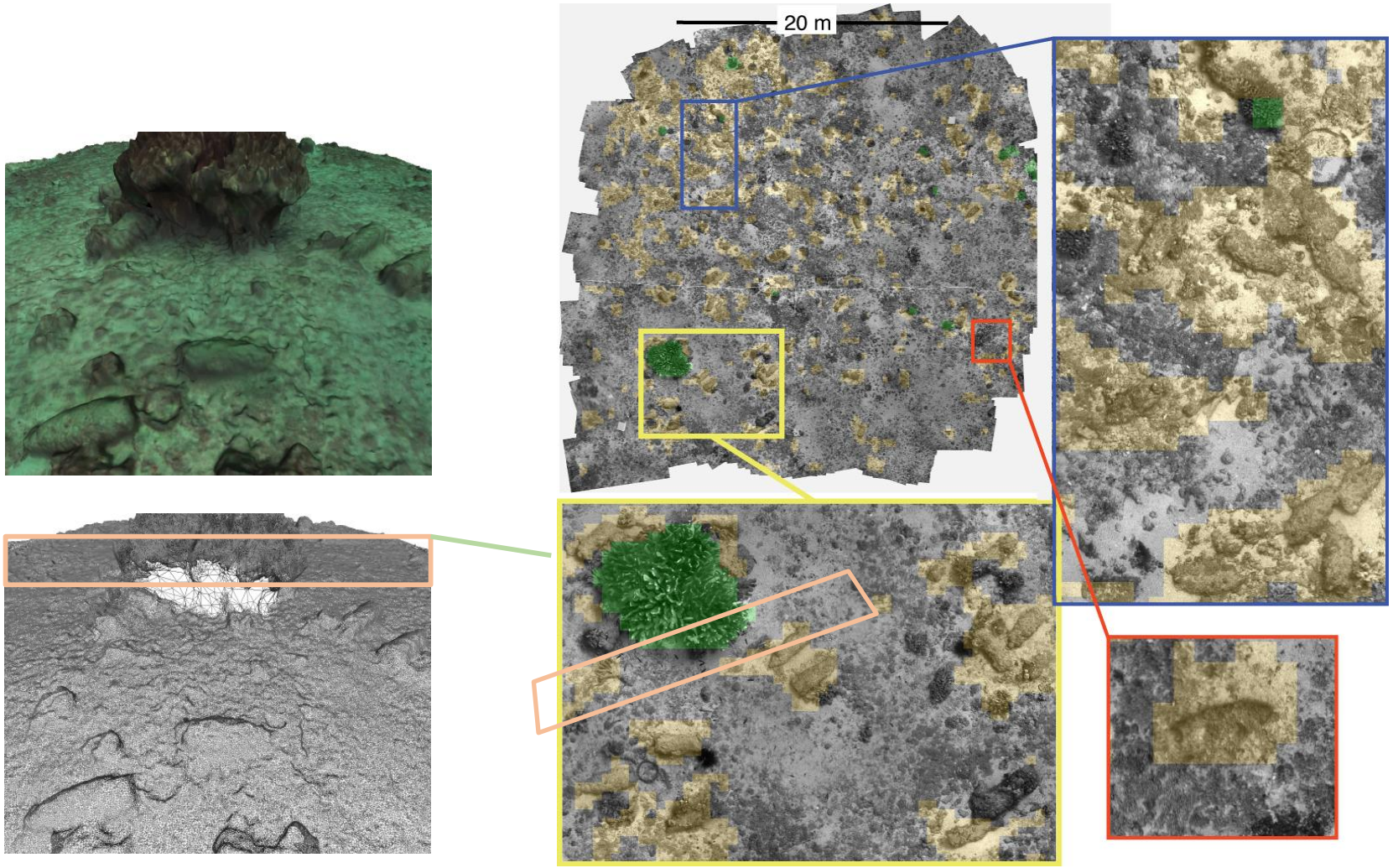
Classified mosaic: Red Sea Survey
(Directly done on the map)



The segmented images are color coded as:

- favid in violet,
- brain coral in green, branches I, II and III in orange,
- urchin in pink,
- dead corals and pavements are in grey.

Munitions classification: using photometric + 3D features



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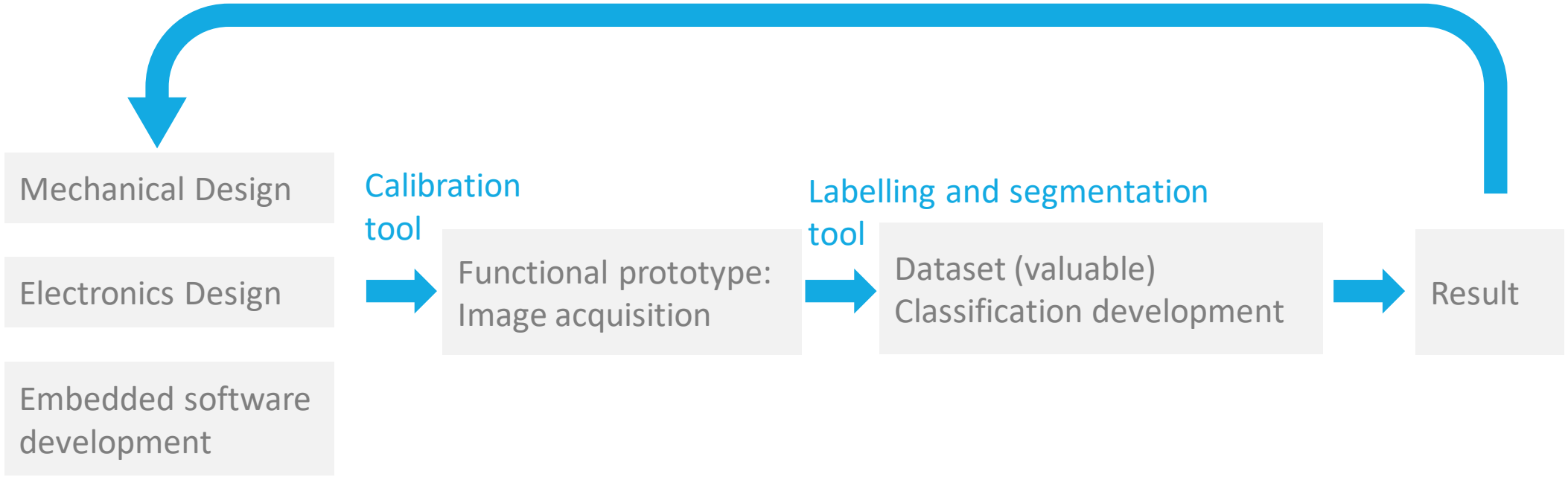
Putting it all together



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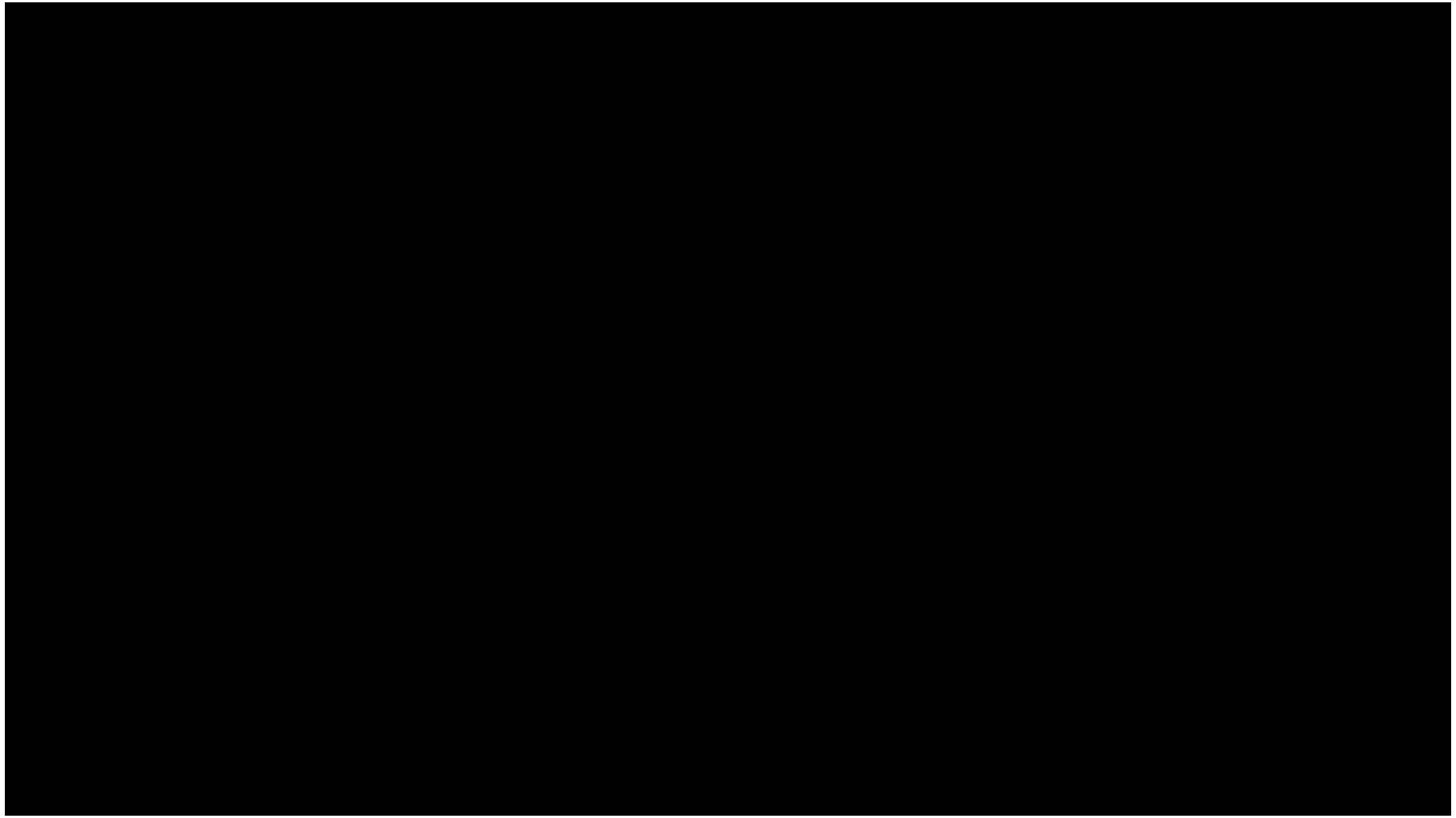
Subsea mining technologies

CORONIS COMPUTING
Computer Vision and Machine Learning



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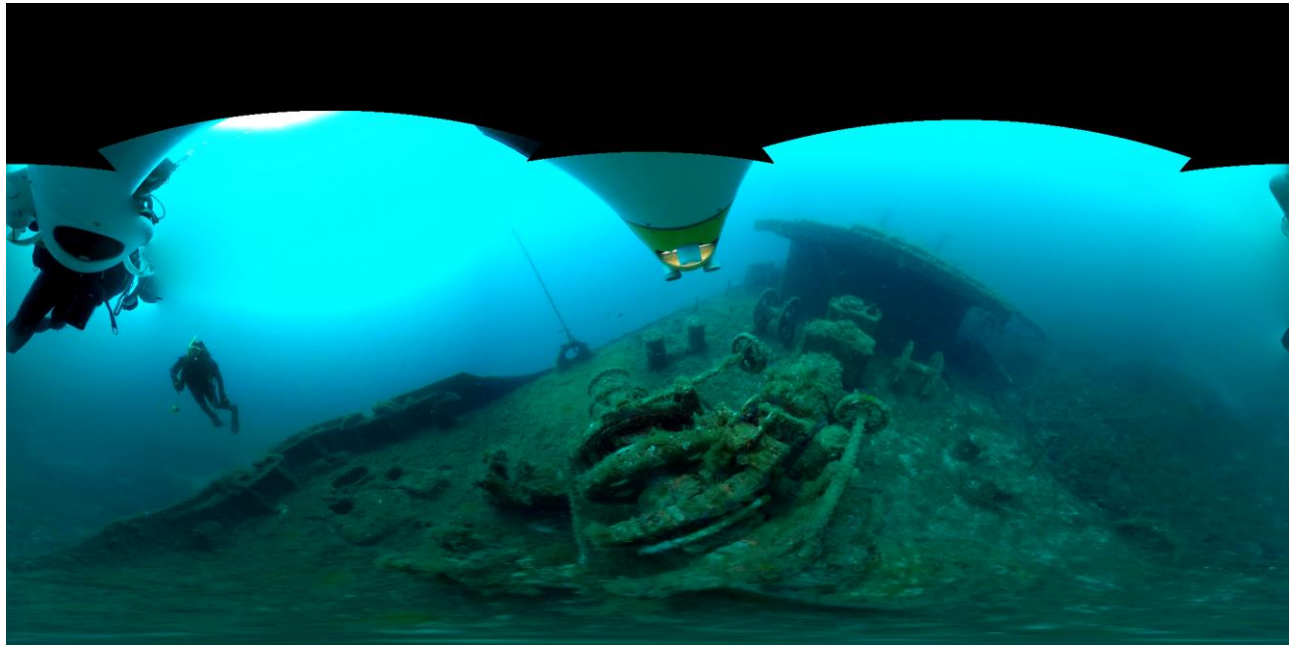

YouTube - search for: “Boreas 360”
(omnidirectional video that uses your phones accelerometer)

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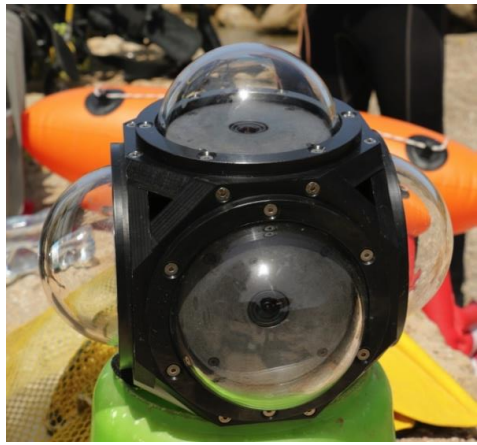

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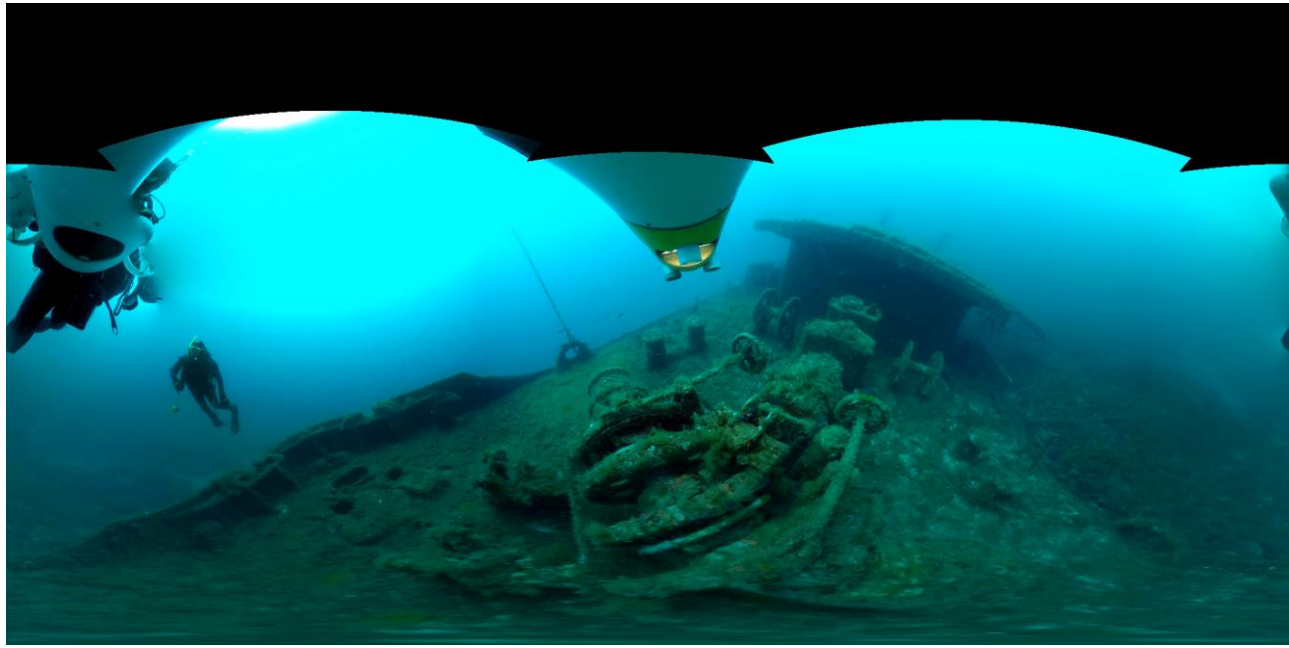

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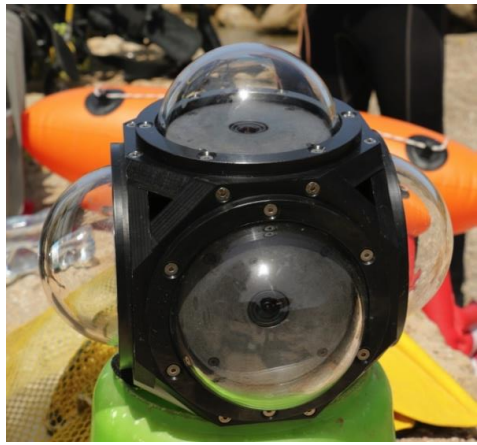

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