

# Stereophotogrammetry: a future-proof digital tool for the subsea industry

Martin Sayer BSc PhD MAE FSUT

Andrew Mogg BSc PhD

*Tritonia Scientific Ltd.*



# Disclaimer:

Whereas our company uses proprietary software licencing for this work, we do undertake stereophotogrammetrical modelling as a commercial service.



# Tritonia Scientific Ltd.

- 2018 start-up company
- Evolved from the UK National Facility for Scientific Diving
- Using stereophotogrammetry underwater since 2013



# Tritonia Scientific Ltd.

- Manages and owns the Scottish Underwater Photogrammetry Unit (SUPU)



# Stereophotogrammetry:

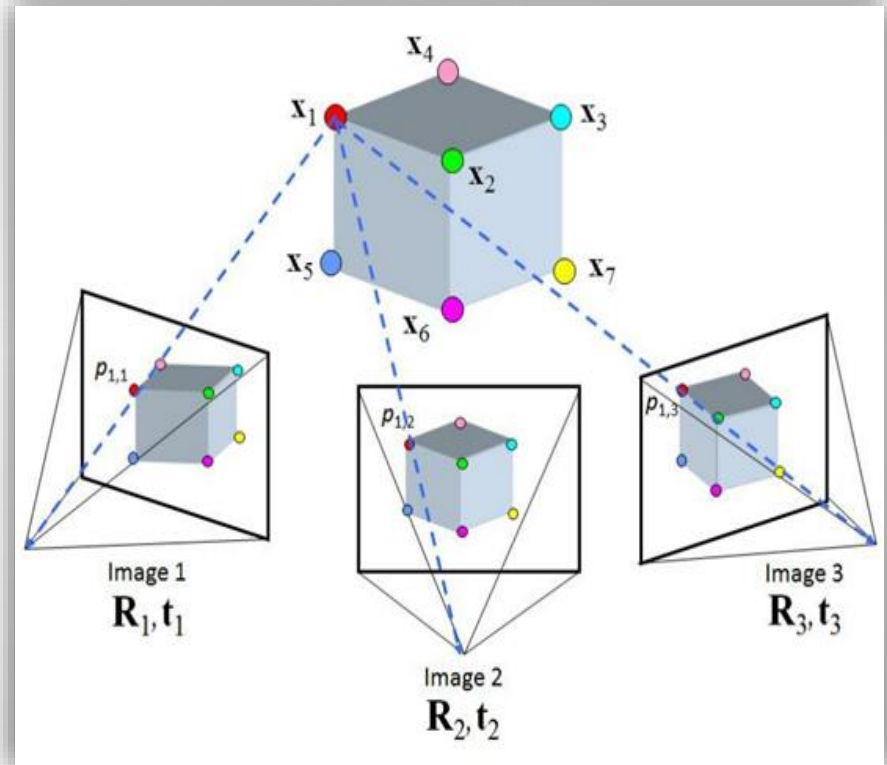
- Overview of the technique
- Underwater applications
- Limitations
- Case study from the subsea industry
- Future-proofing

(animations!)

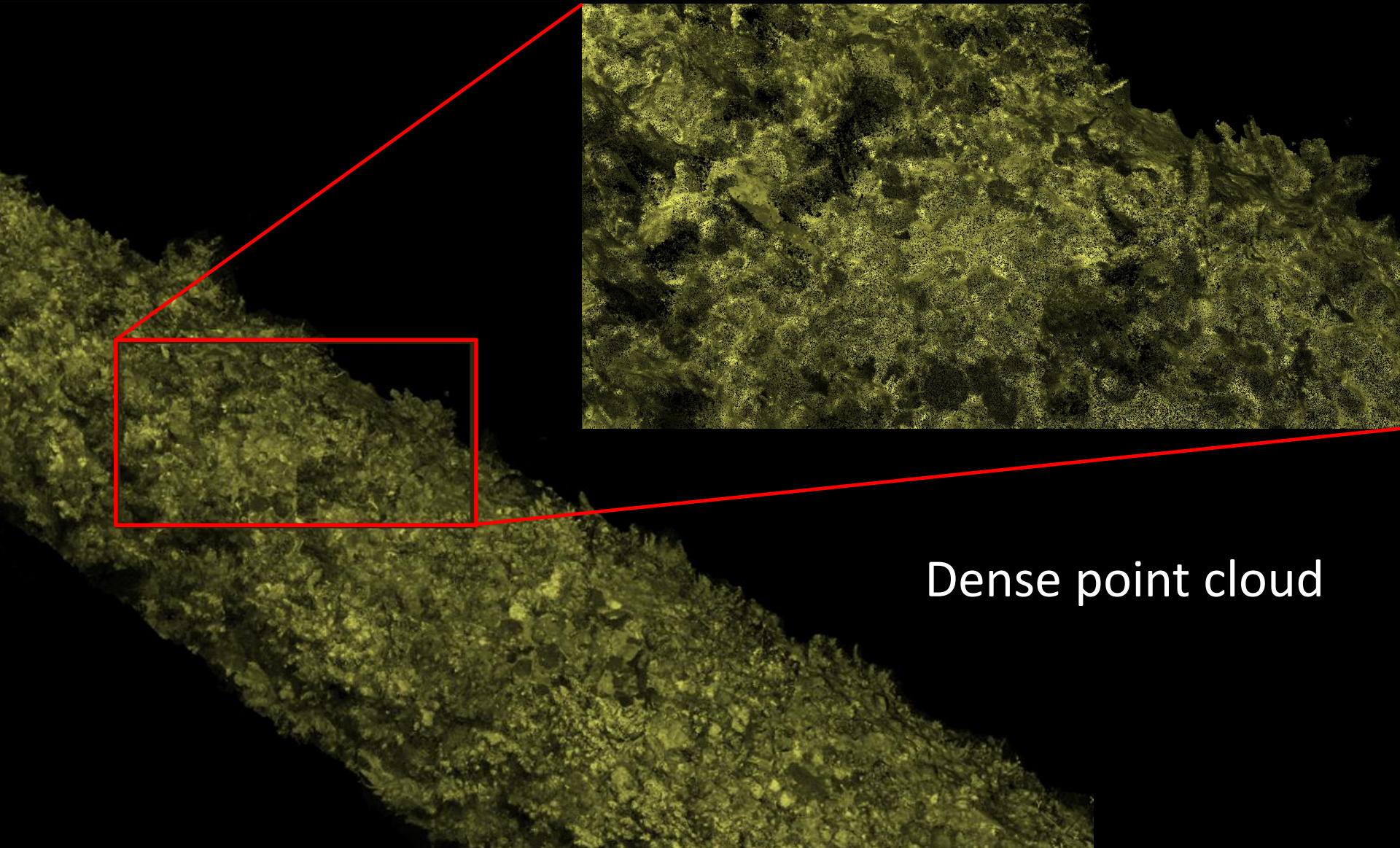


## “Structure from Motion” (SfM)

- Uses normal video or photos – no need for stereo cameras
- 10,000s of points per image
- Movement between images generates 3-D ‘point clouds’



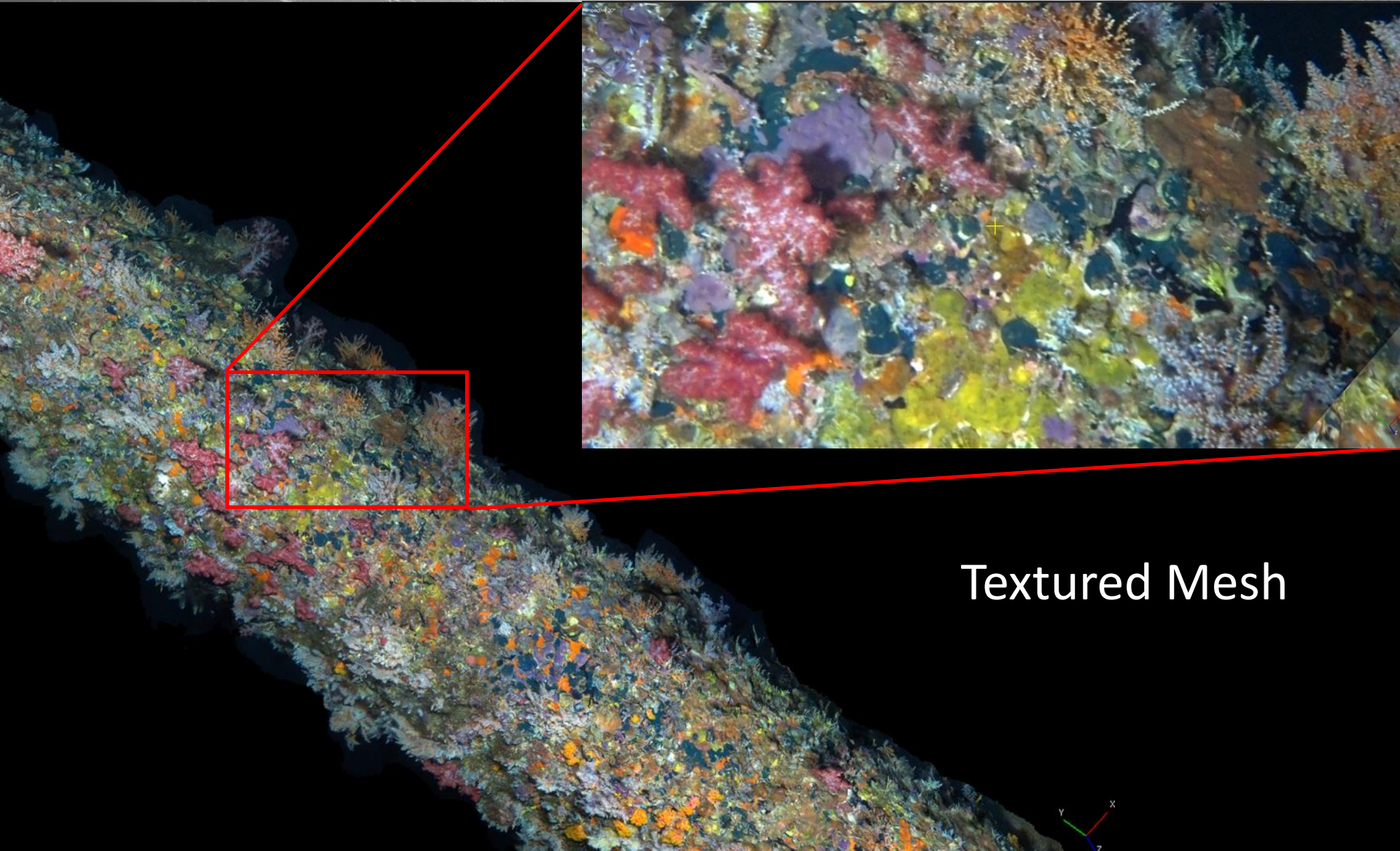
# Technique



Dense point cloud



# Technique



Textured Mesh





## “Structure from Motion” (SfM)

- Images (preferably contiguous)
  - Sampled from video
  - Time lapse video
  - Still images Divers, ROVs, u/w drones, AUVs



## “Structure from Motion” (SfM)

- Good overlap between images (*ca.* 50-75%)
- Optimise three-dimensional capture
  - Multiple passes
  - Multiple cameras
- Scaling, geo-referencing, orientation and accurate depth measurement



## “Structure from Motion” (SfM)

- Proprietary software / commercial licensing
  - Image processing
  - SfM
  - 3D data processing / viewing / analyses
- Enhanced computing power
- Dedicated operators



## “Structure from Motion” (SfM)

- Models/images - scale and resolution

LARGE SCALE	SMALL SCALE
10s of m / km	10s of cm / mm
Video images	Still images
0.4 – 8.4 MP	3.0 – 40.0+ MP
1000s of frames	10s to 100s frames



# Technique

## “Structure from Motion” (SfM)

- Image quality



# Technique

## “Structure from Motion” (SfM)

- Lighting - strobes or video



## “Structure from Motion” (SfM)

- Lighting - strobes or video



- Backscatter; day/night



# Applications:

- Scale / resolution
- Improved visibility
- Mapping / survey
- Bathymetry
- Measurement

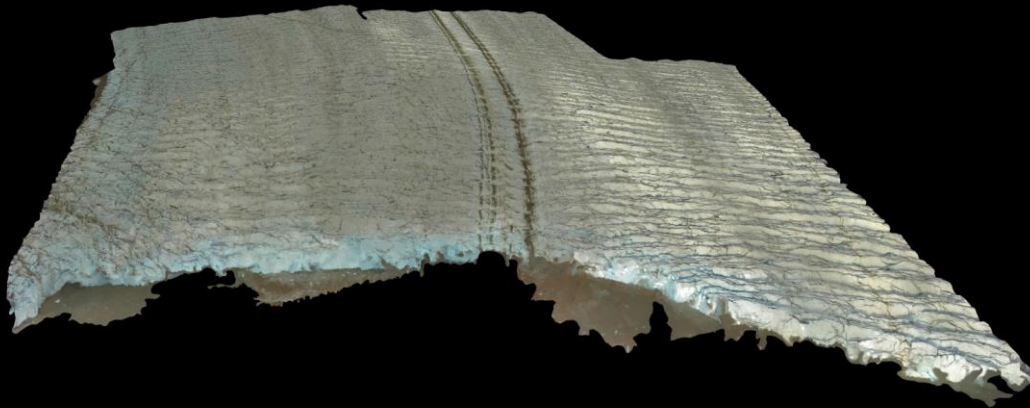




# Applications

## SCALE

- 5 km x 5 km
- Glacier
- Aerial drone
- GoPro video



# Applications

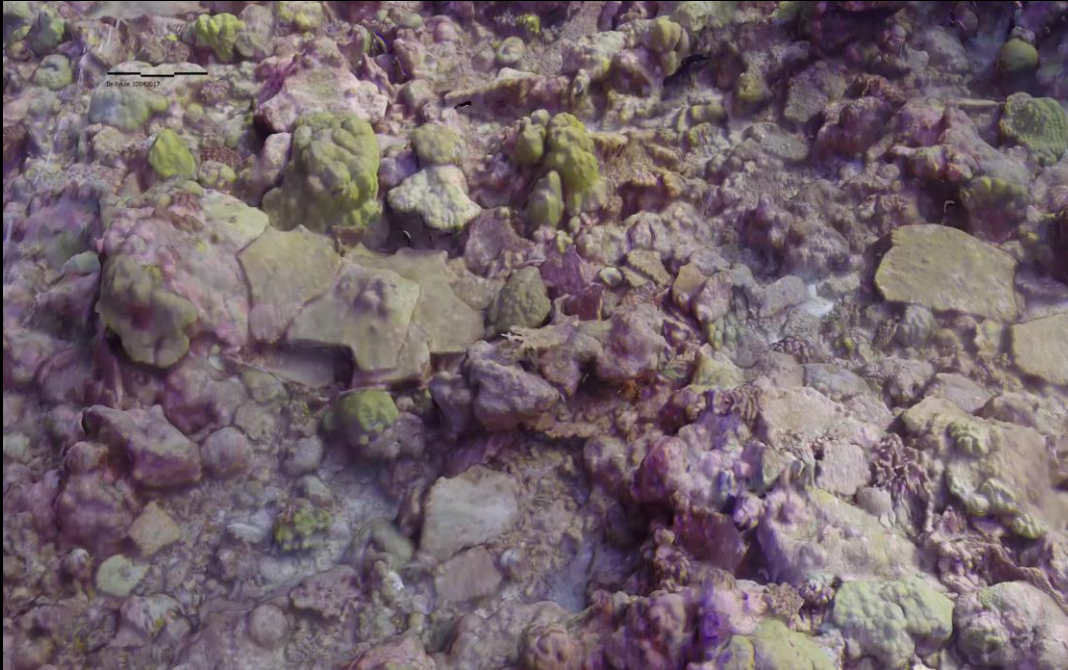
## SCALE

- <1 mm
- Marine microplastic
- Electron microscope
- SE micrographs



# Applications

## RESOLUTION



- 10 m x 10 m
- Coral reef
- Diver
- GoPro video (no lights)



# Applications

## RESOLUTION

- 5 m height
- Pier pile
- Diver
- dSLR & strobes

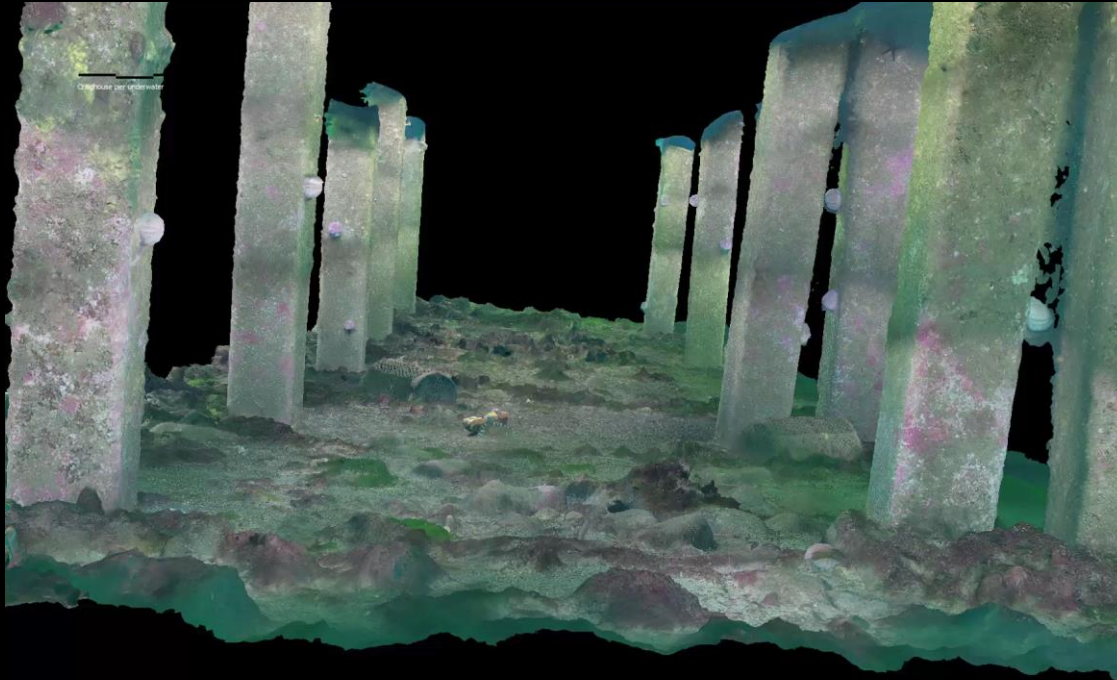


SW monopile



# Applications

## VISIBILITY



- 4 m x 15 m area
- <0.5 m visibility
- Pier piles
- Diver
- GoPro video & lights



# Applications



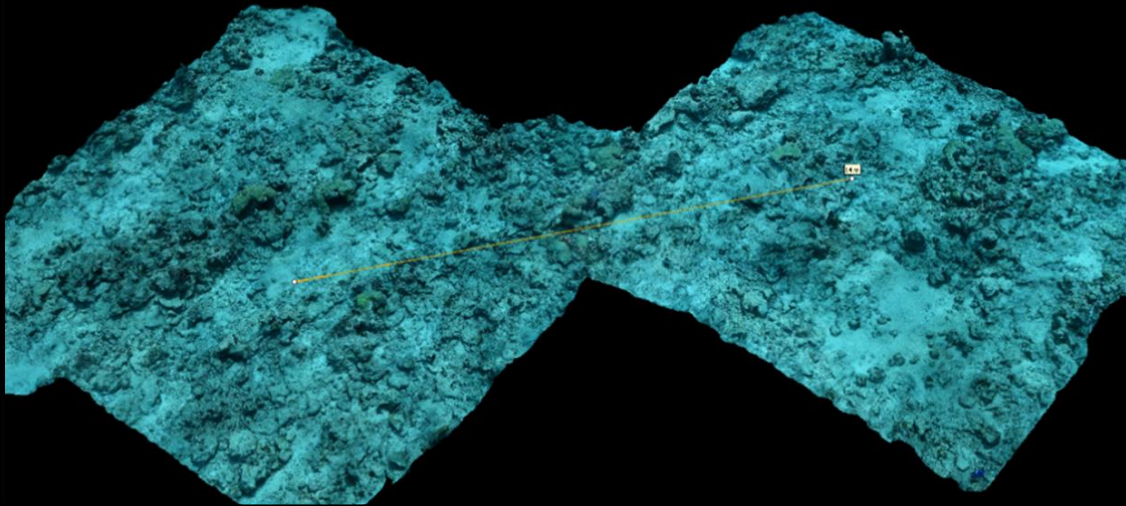
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# Applications

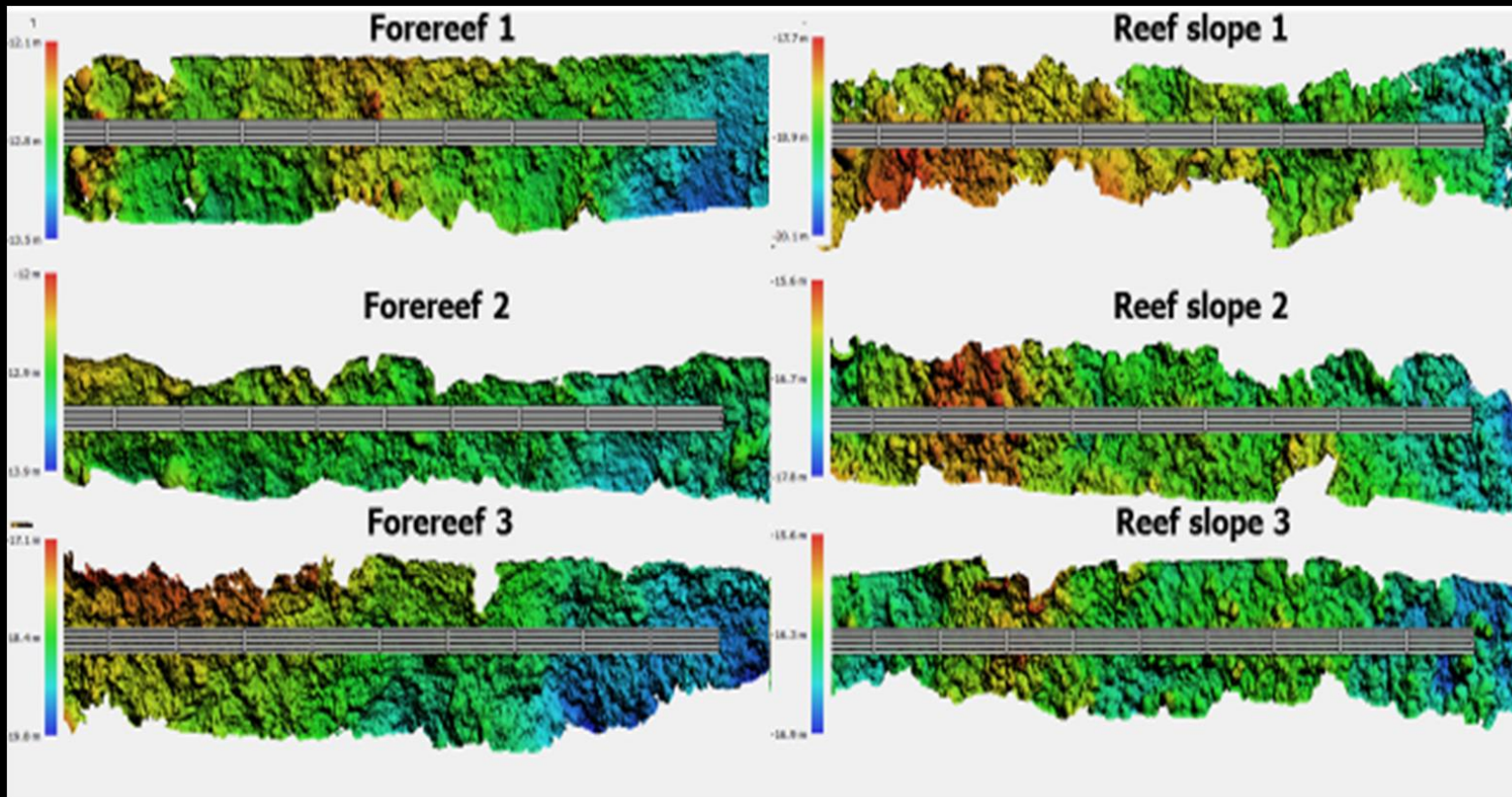
## MAPPING / SURVEY



- 100s m<sup>2</sup> area
- Permanent records
- Rapid to survey
- Rapid measurements

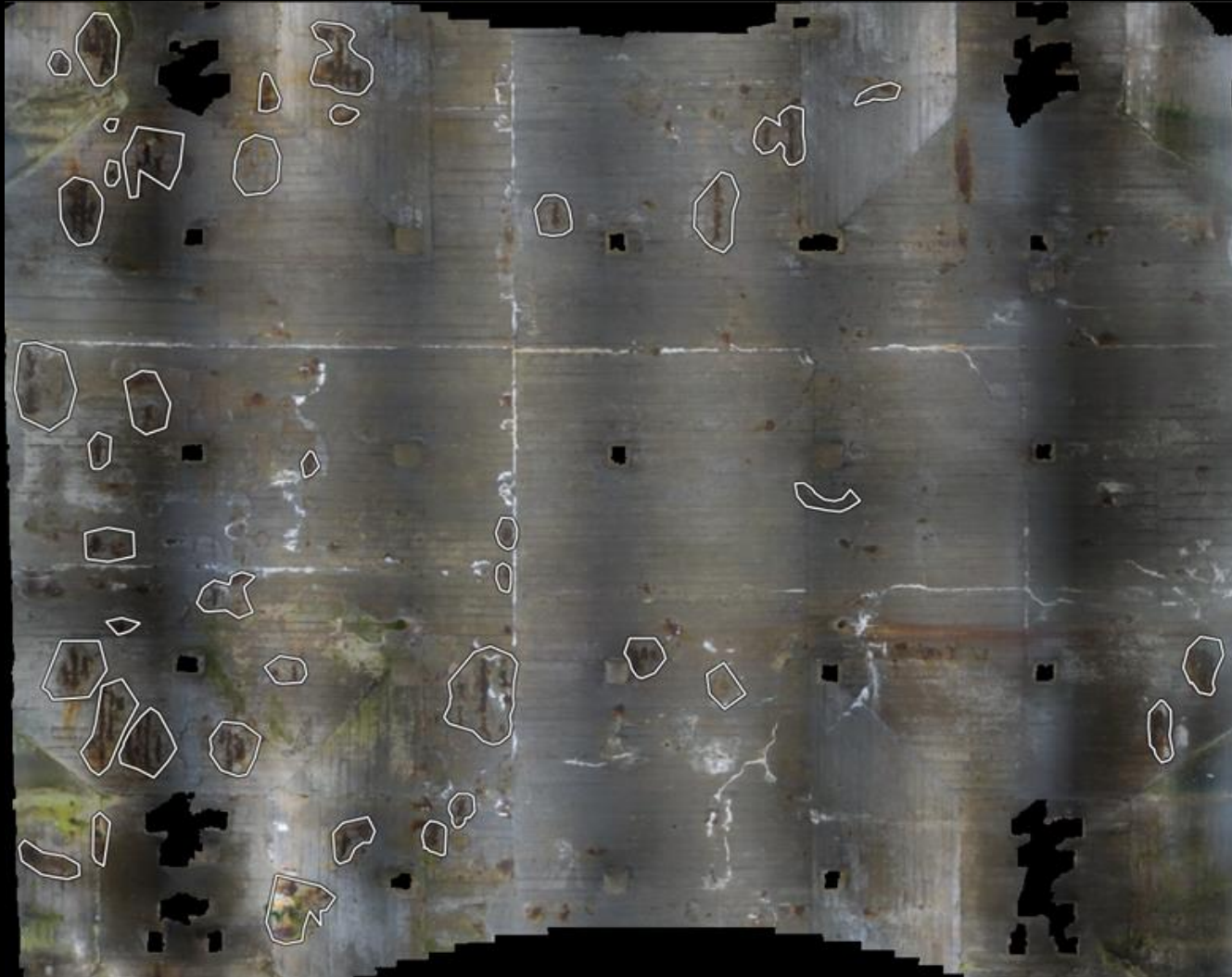


## BATHYMETRY





# Applications



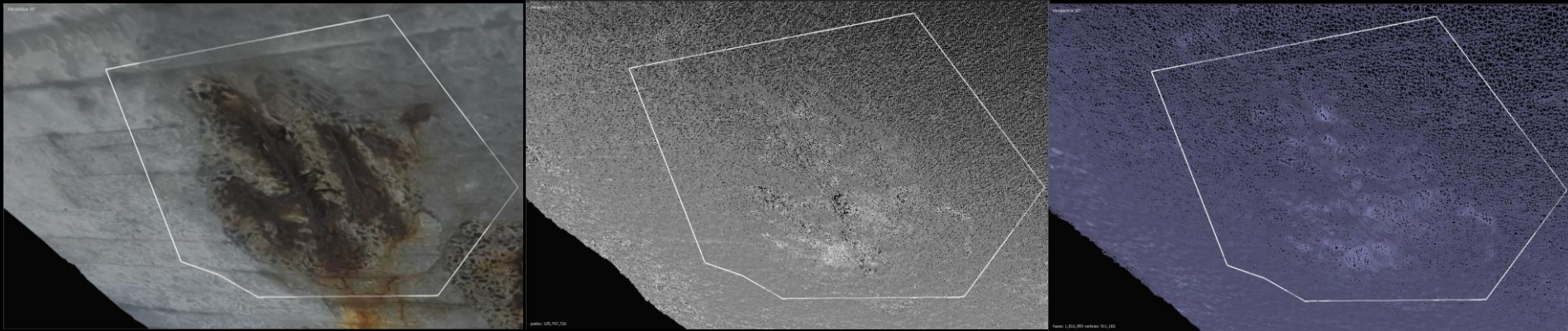
# Applications



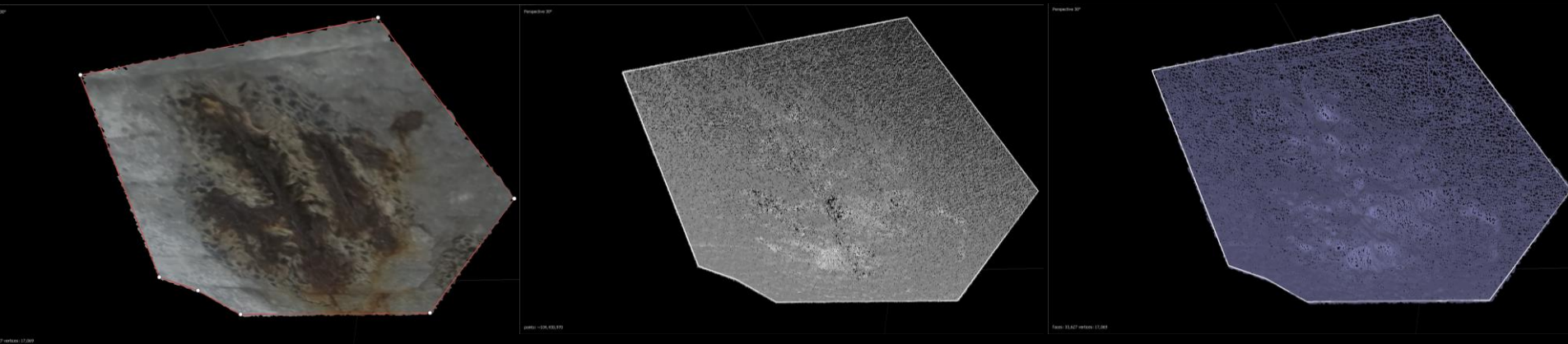
NB: Scaling!



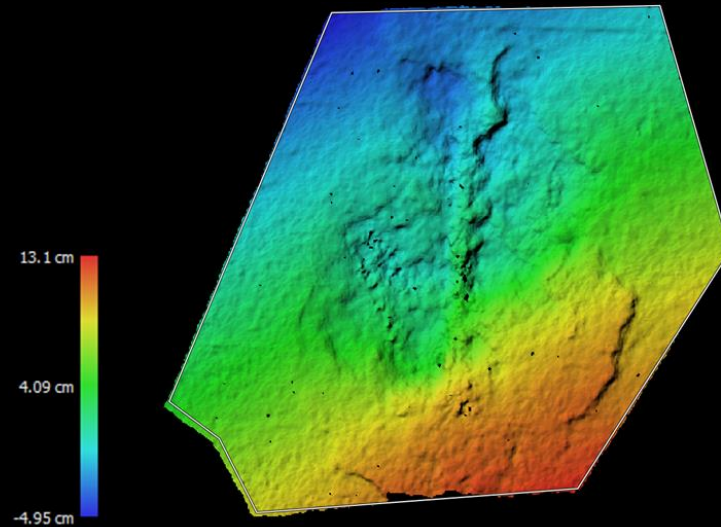
# Applications



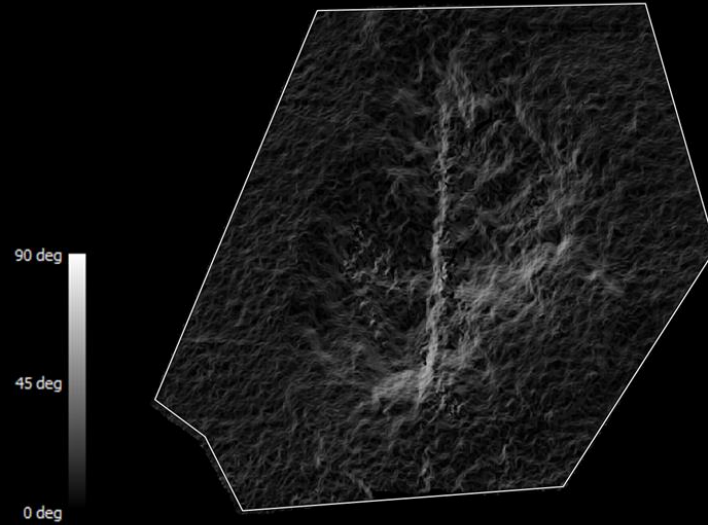
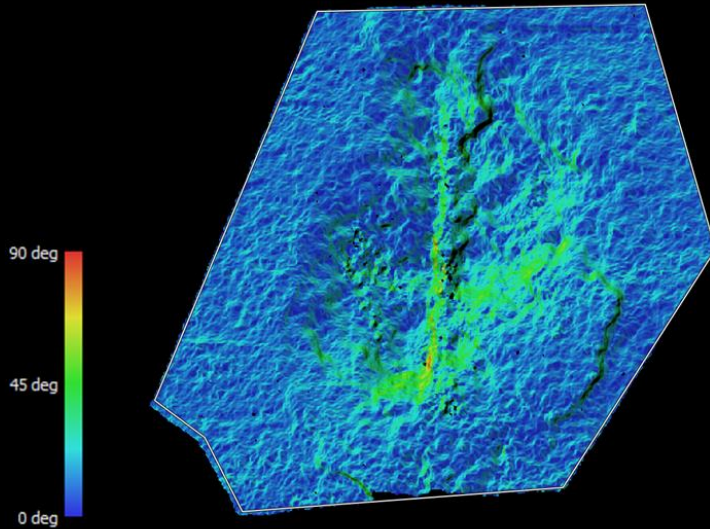
## Surface erosion identification



# Applications

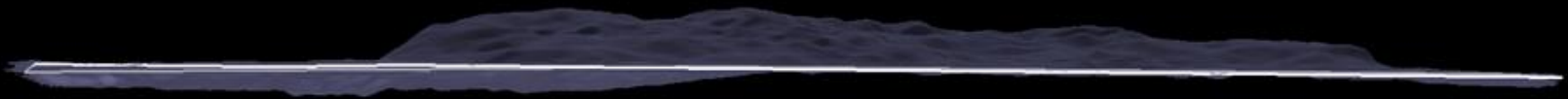


Surface erosion:  
depth and angle  
measurements



# Applications

Orthographic

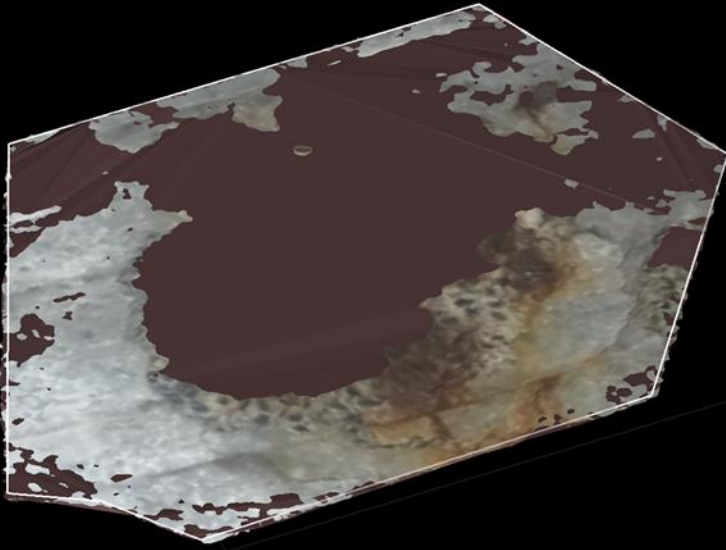


Surface erosion volumetric data

Faces: 33,627 vertices: 17,069

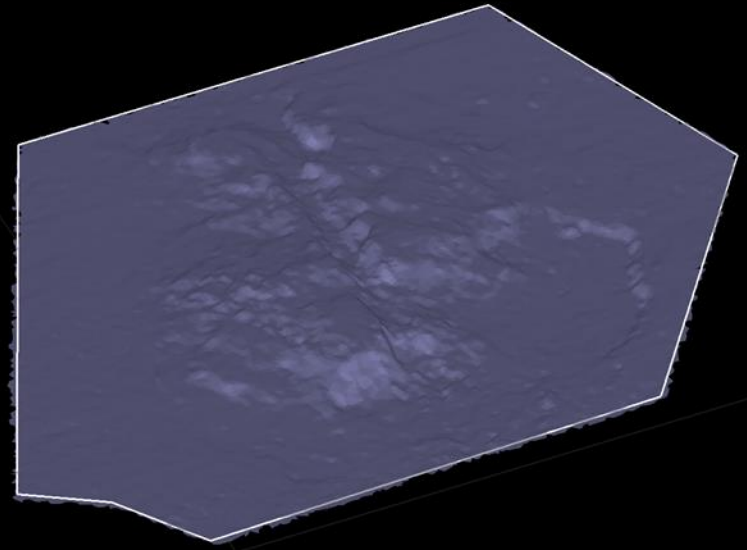


# Applications



Orthographic

faces: 33,627 vertices: 17,069



Surface erosion volumetric data

Measure Area and Volume



Area (m<sup>2</sup>): 1.470

Volume (m<sup>3</sup>): -0.001653

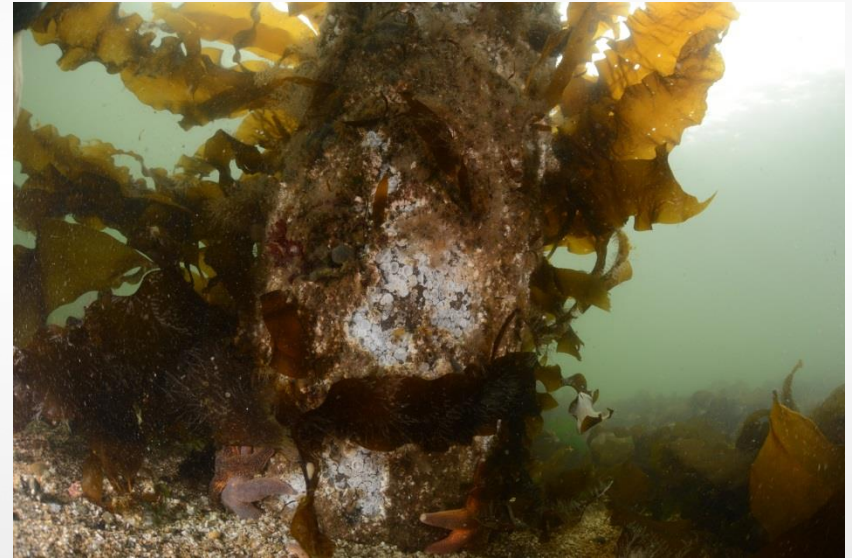
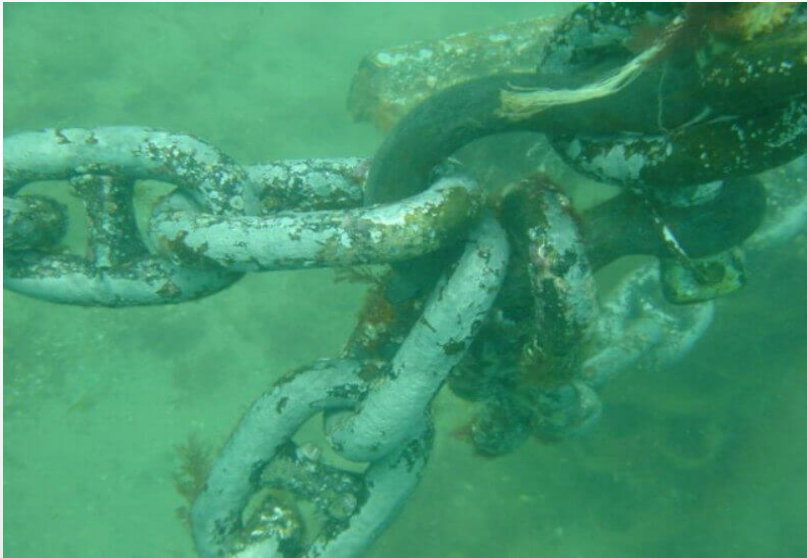
Close



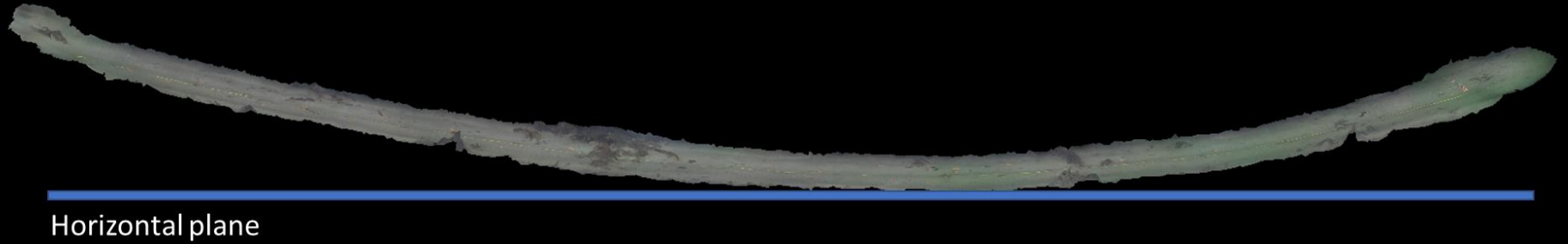
# Limitations

## “Structure from Motion” (SfM)

- Moving or soft structures



# Limitations



Artefactual kurtosis caused by non-georectified survey





# Case Study:



# Case Study:

- Jackets in an offshore tropical location
- Intended for decommissioning
- Possible option to create inshore artificial reefs
- Net Environmental Benefit Analysis (NEBA)
- Levels and types of biofouling (CITES; invasives; survival)
- Biofouling volumes
  - *Lifting weight*
  - *Planning for onshore disposal*



## Case Study:

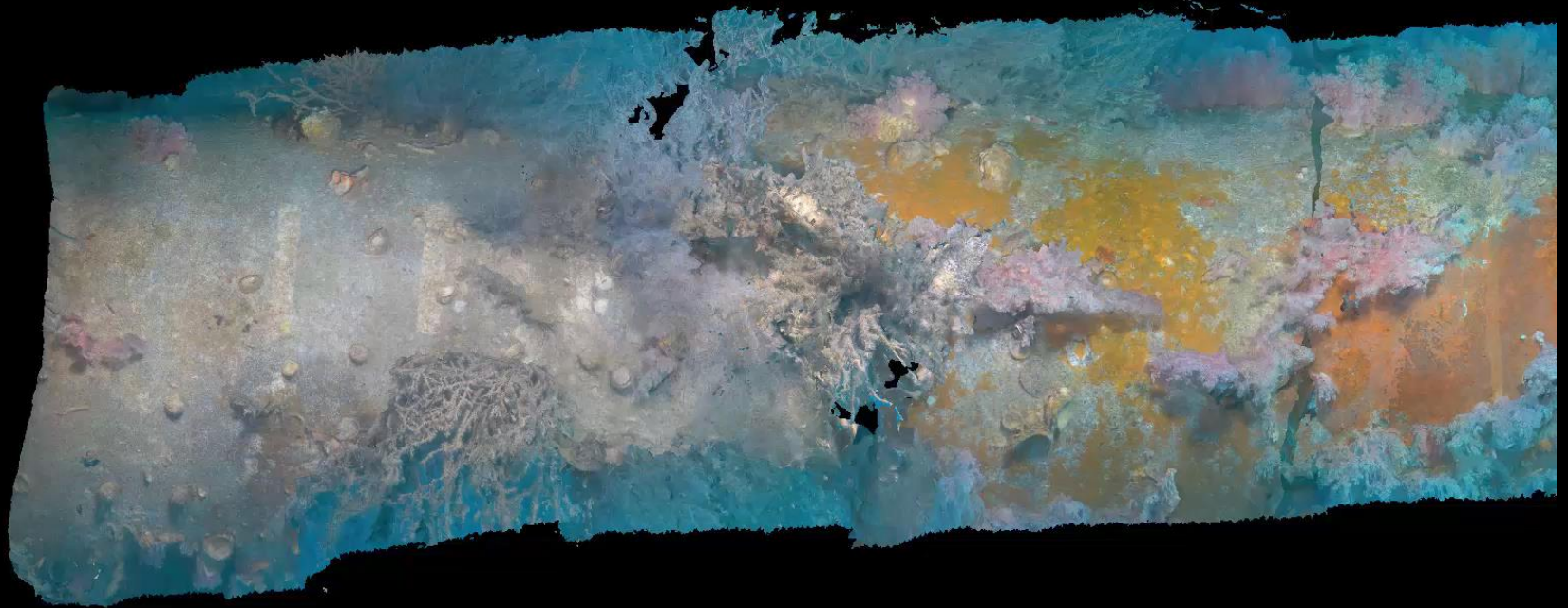
- Demonstration project based on pre-existing ROV footage
- Video was for fish surveys
- Not designed or intended for 3D modelling



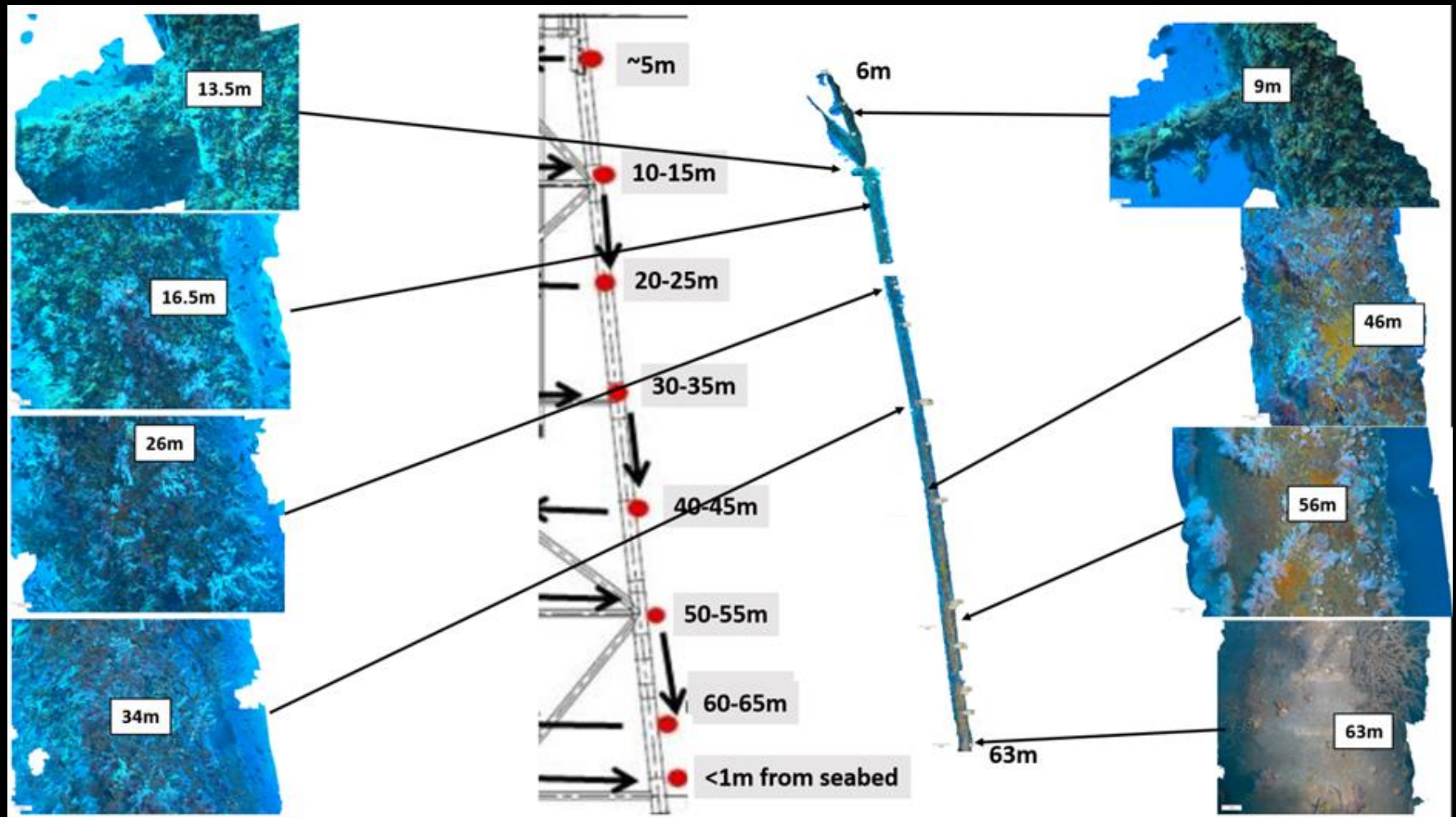
Left (HD), Central (ROV) and Right (HD) cameras



# Case Study



# Case Study



# Case Study



[www.tritonscientific.co.uk](http://www.tritonscientific.co.uk)

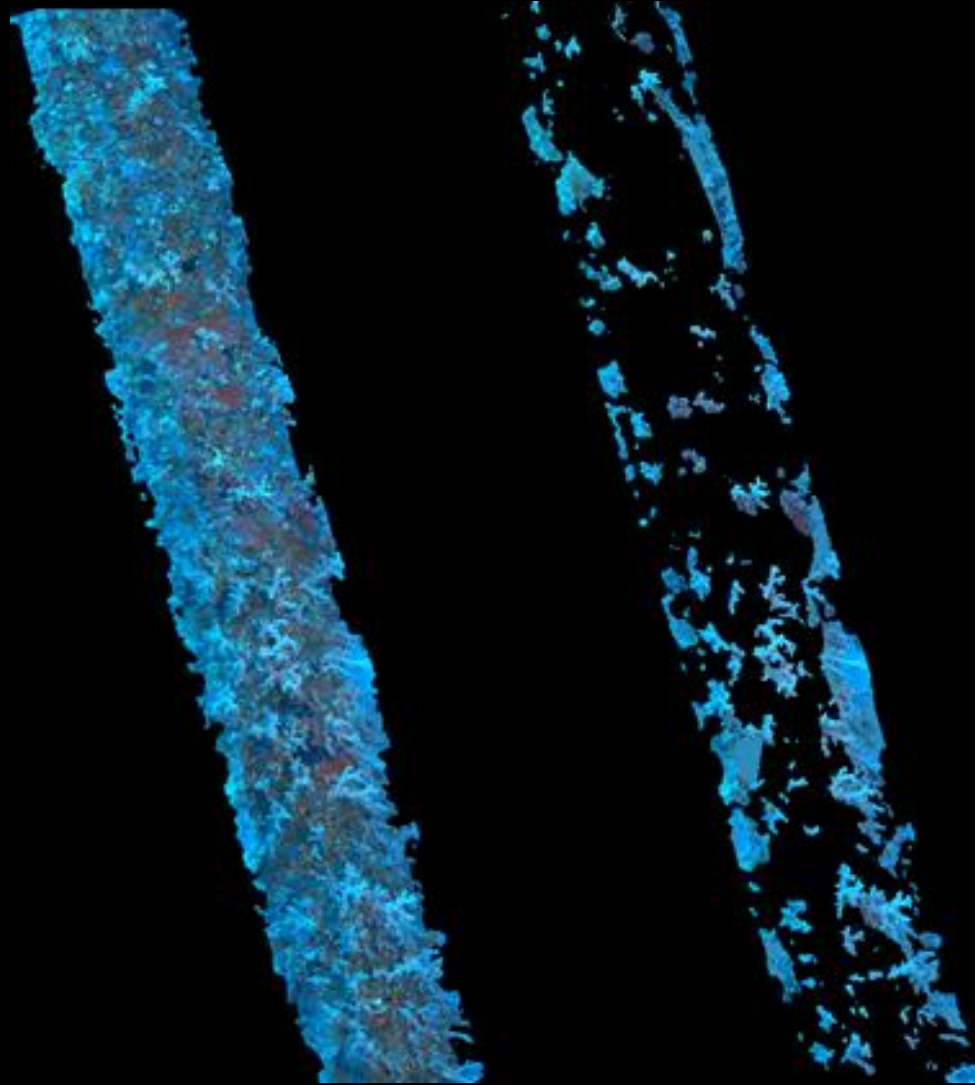
# Case Study



Near complete leg:  
67 m to 3 m

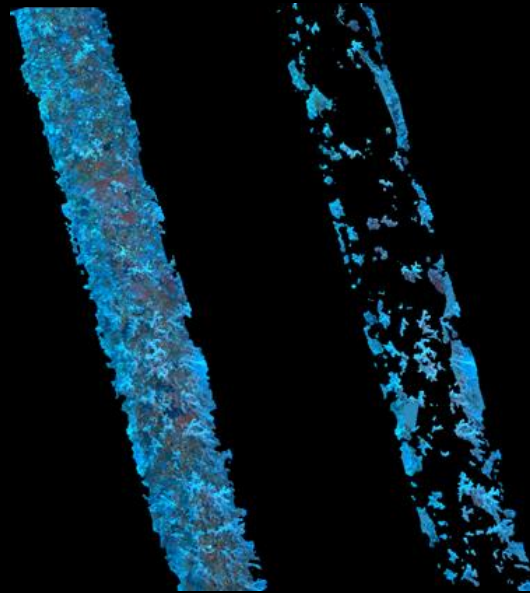


# Case Study





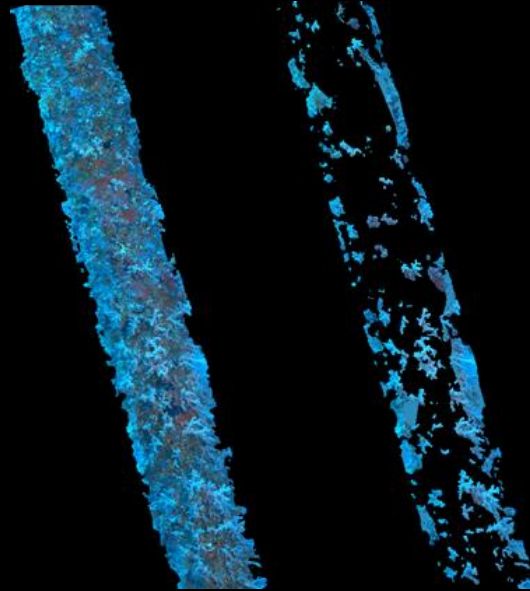
# Case Study



Depth	Biofouling surface area ( $\text{m}^{-2}$ ; n=3 platforms)	Biofouling volume ( $\text{m}^3 \cdot \text{m}^{-2}$ ; n=3 platforms)
50 m	1.30 – 1.79	0.005 – 0.028
30 m	1.55 – 2.08	0.013 – 0.029
5 m	1.51 – 1.57	0.000 – 0.040



# Case Study



- Biodiversity / community structure
- Linear rugosity



# Future Proofing:



# Future Proofing:

- Point clouds = basic xyz data
- XYZ data can be exported in ++ standard formats (ASCII, .OBJ, .PLY, .KMZ *etc.*)
- Re-imported into new/emerging interactive geometry software
- Mesh files – interpolated xyz data
- Permanent records
- Time series (+ “back to the future”)
- Virtual Reality



# Summary



# Summary

- Stereophotogrammetry generates 3D models using standard image source material
- Limited only by the quality and strategy of image capture (integrated project design)
- Model size dependent on water clarity, camera quality, scaling, georeferencing *etc.*
- Future-proof
- Rapidly developing – VR, multi-camera systems



# Questions?



[martin.sayer@tritoniascientific.co.uk](mailto:martin.sayer@tritoniascientific.co.uk)



[www.tritoniascientific.co.uk](http://www.tritoniascientific.co.uk)