

Developing innovative mapping solutions for sustainable ocean management

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Integrated Ocean Mapping Technologies

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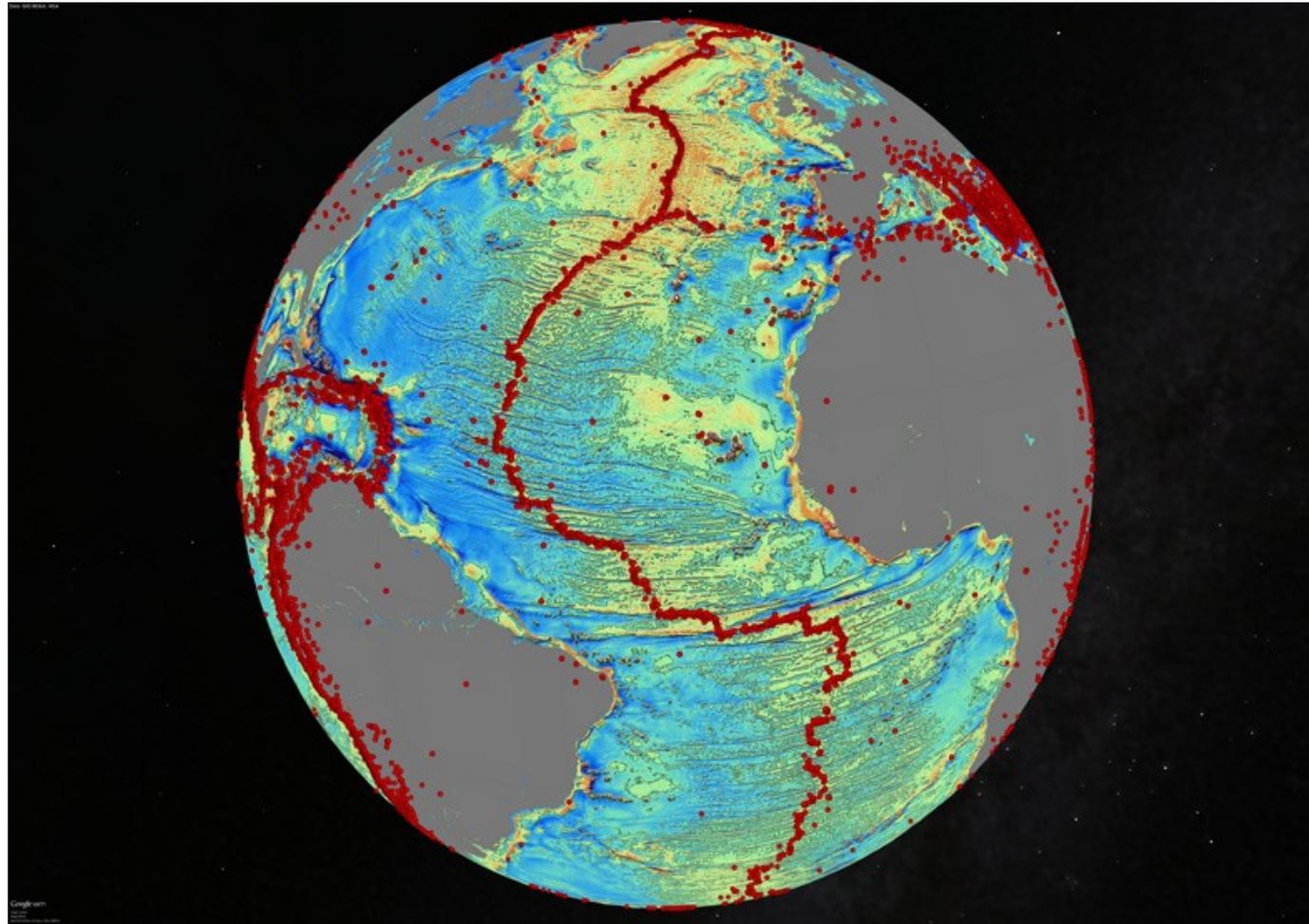
14th November, 2018



Overview

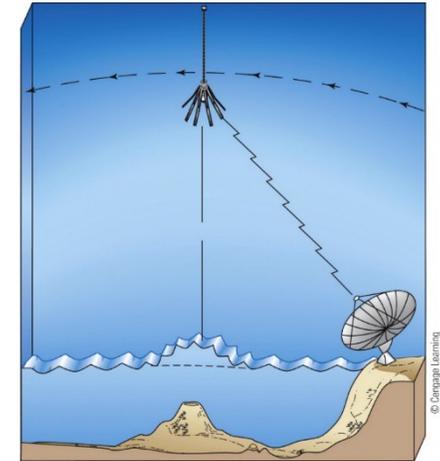
- Ocean floor mapping: The challenges...
- It's not all about bathymetry...
 - Case studies: The emerging role of backscatter
- Spatial scale, data resolution and evolving mapping technologies...
 - Case studies: A walk through scale and resolution from various projects for different applications
- Conclusions...
 - Thoughts and ramblings...

Challenges of Ocean Floor Mapping



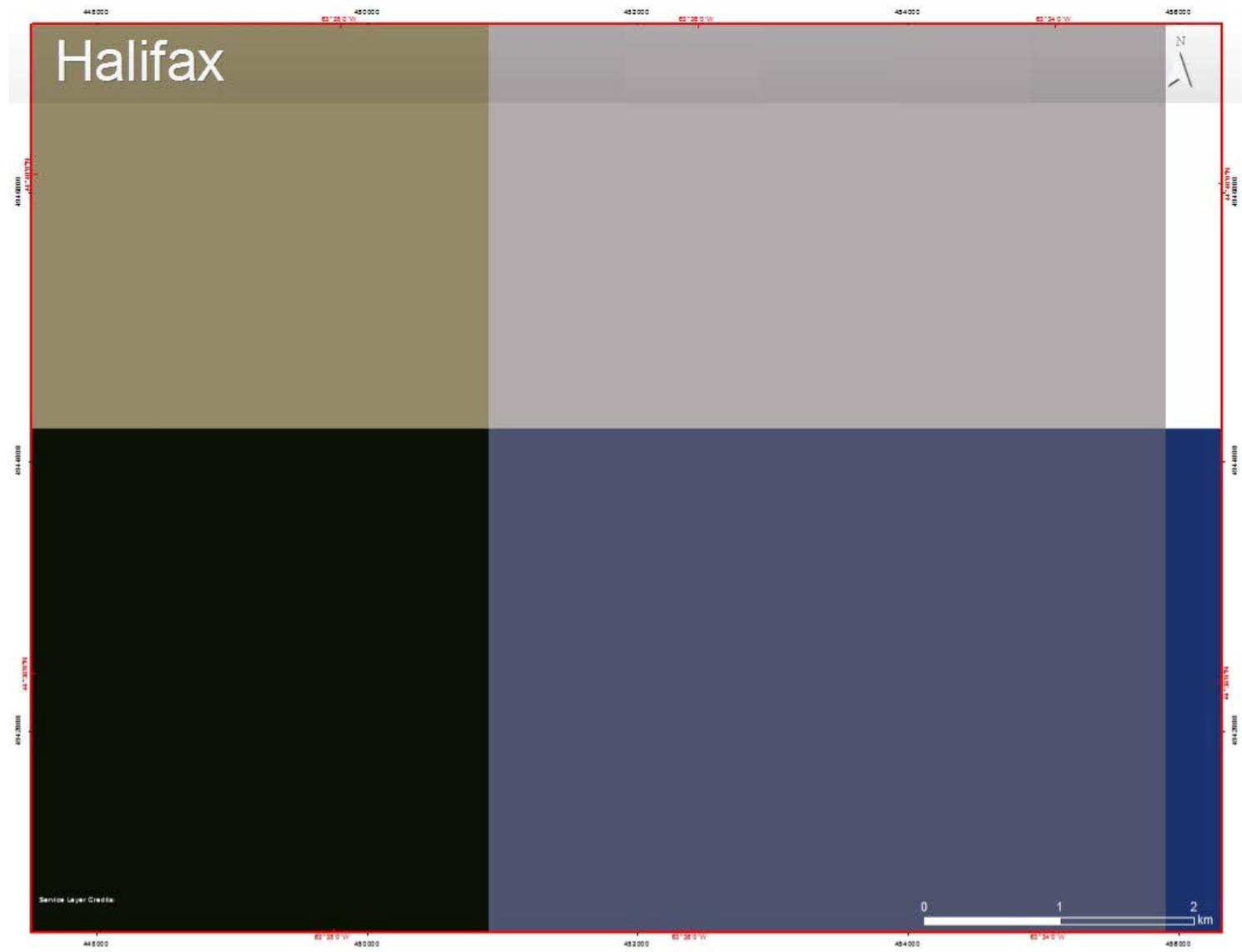
Remote sensing data - horizontal resolution: 5km

Sandwell et al. (2014)



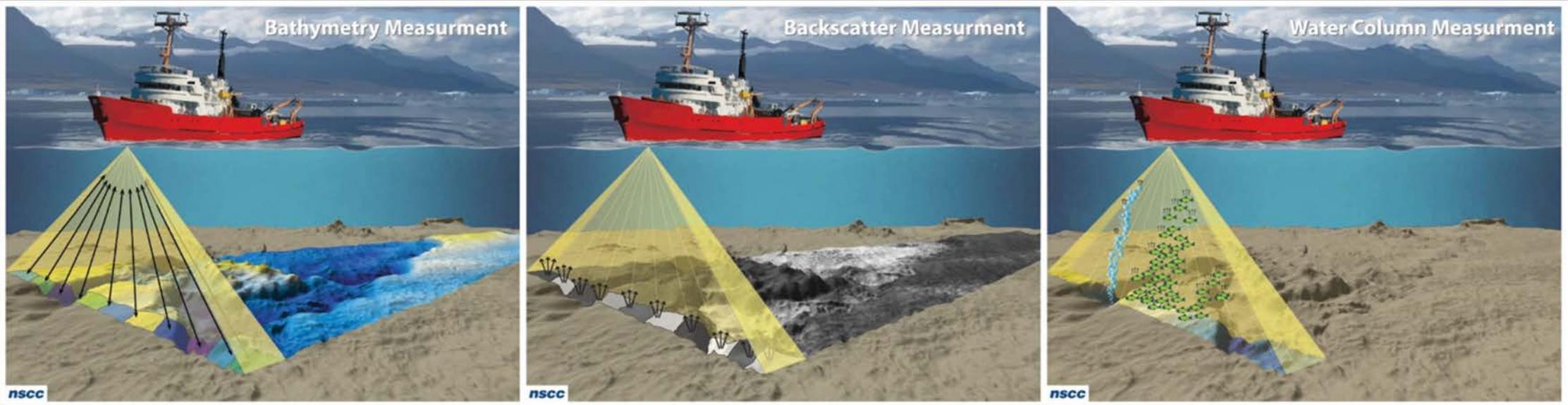
- Satellite altimetry - measures the sea surface height from orbit using radar pulses
- Measures sea floor features based on gravitational bulges in sea surface

Challenges of Ocean Floor Mapping



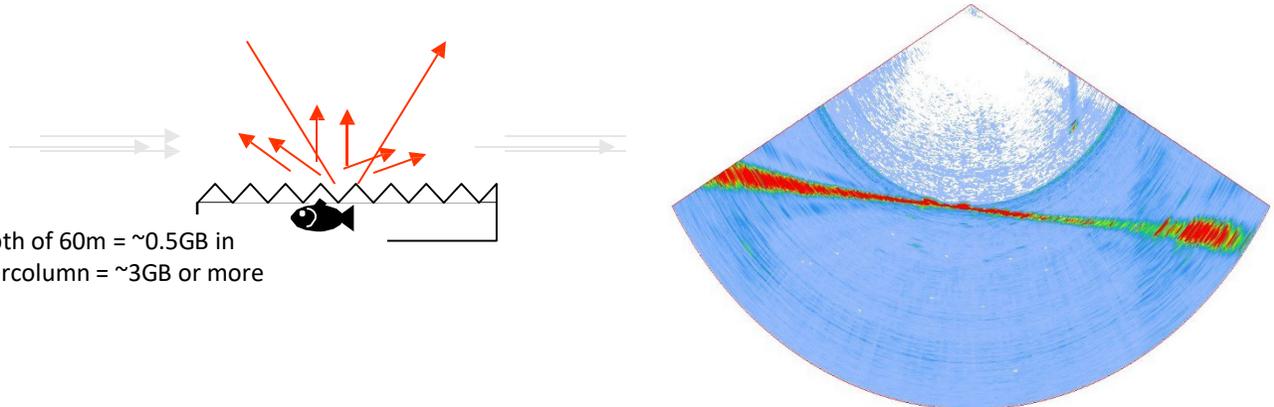
Advances in ocean floor mapping technologies

Bathymetry and backscatter

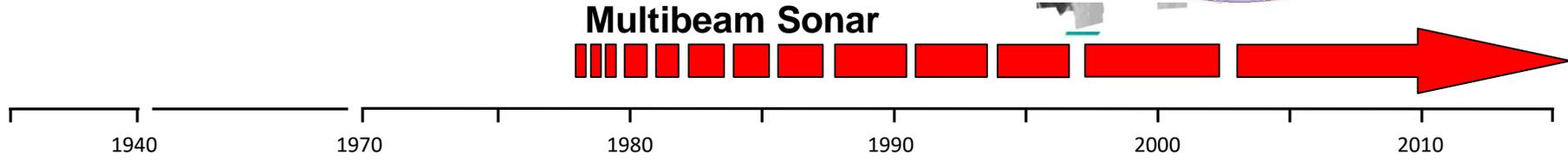


Watercolumn

2 square kilometers at a depth of 60m = ~0.5GB in bathymetry data. With watercolumn = ~3GB or more
6x increases data volume



Multibeam Sonar



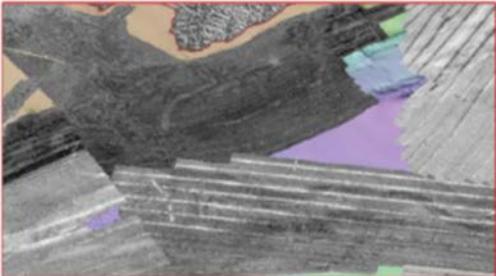
The importance of backscatter in seafloor mapping

Backscatter – the bridesmaid to the bathymetric bride



Backscatter measurements by seafloor-mapping sonars
Guidelines and Recommendations

*A collective report by members of the
GeoHab Backscatter Working Group*

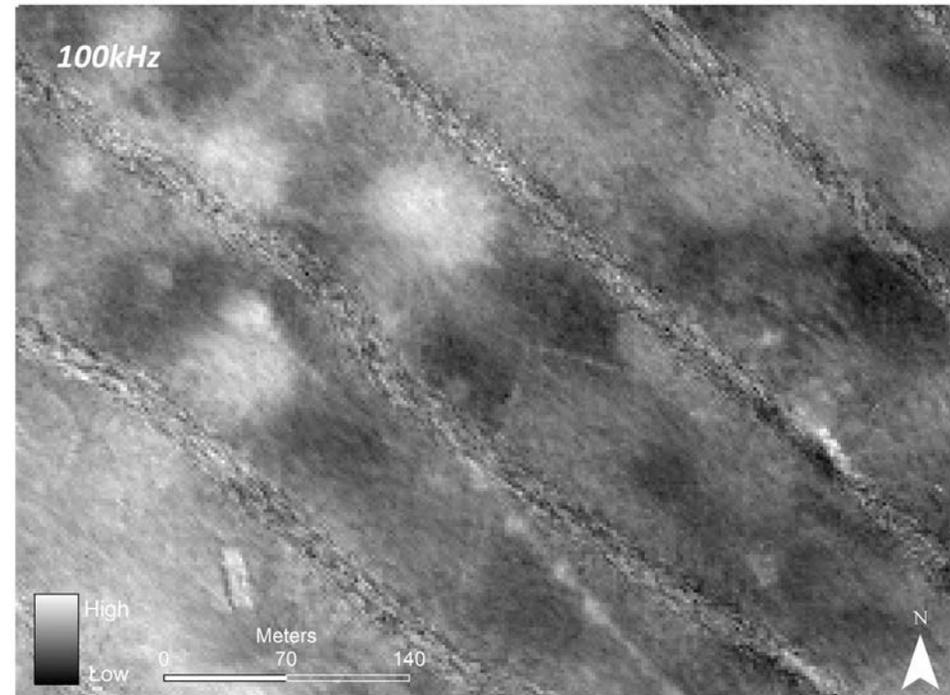
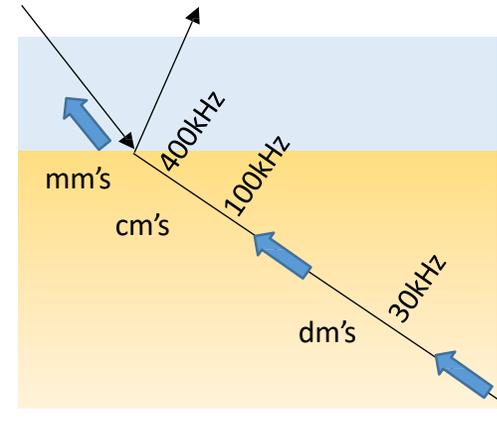


Editors
Xavier Lurton and Geoffroy Lamarche

May 2015

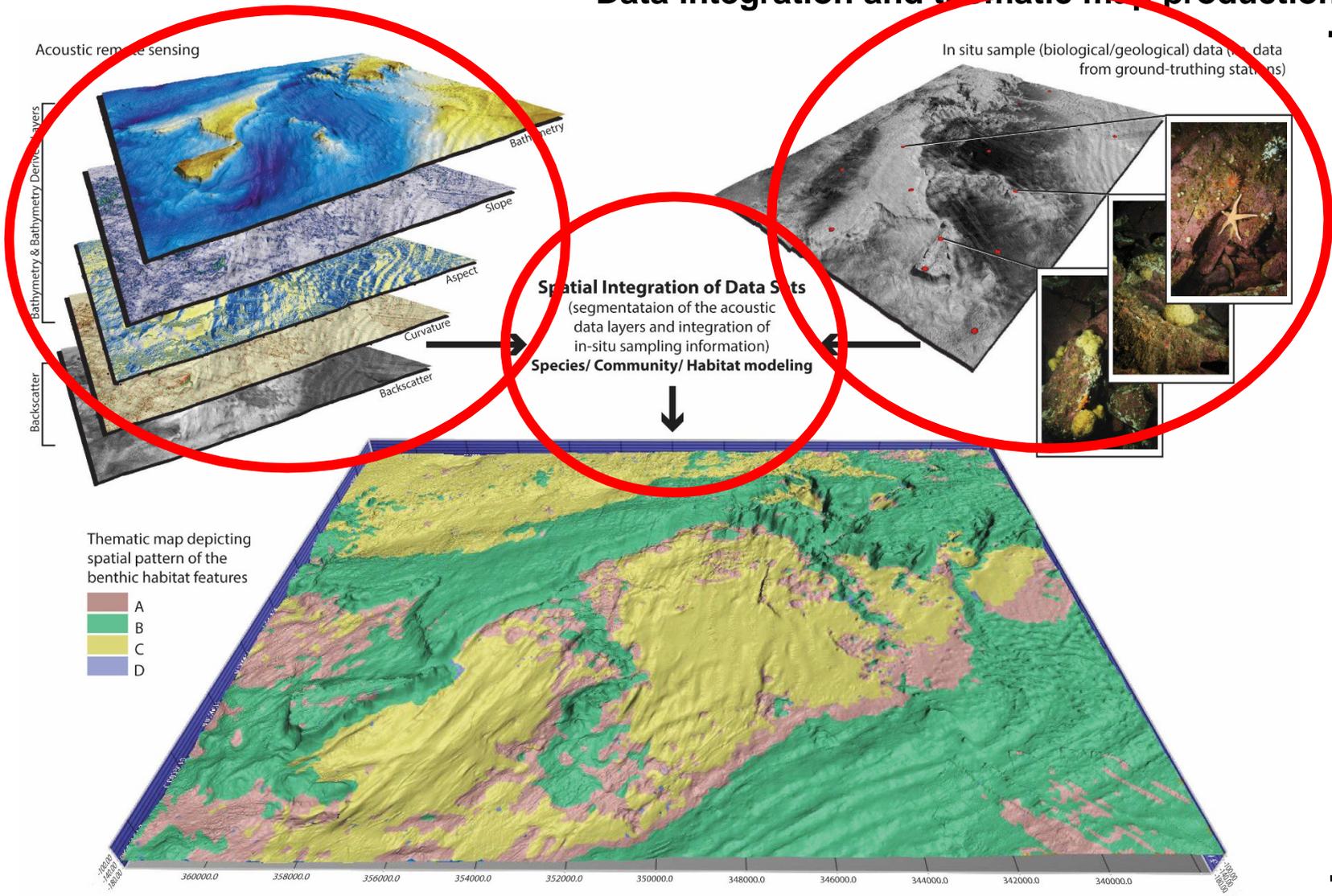


<http://geohab.org/publications/>



Spatial scale, data resolution and evolving mapping technologies

Data integration and thematic map production



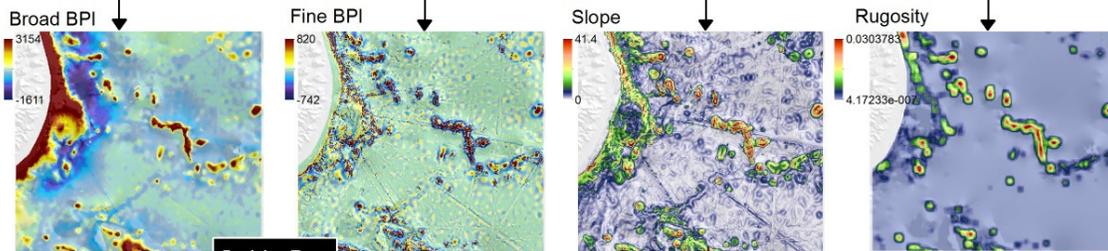
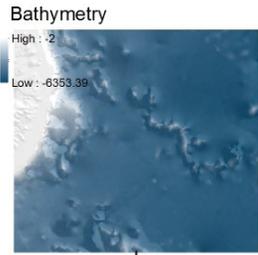
APPLICATIONS

- ➔ Nautical Charting
- ➔ Geology & Geomorphology
- ➔ Marine Protected Area
- ➔ Fisheries Management
- ➔ Oil and Gas
- ➔ Aquaculture
- ➔ Etc....

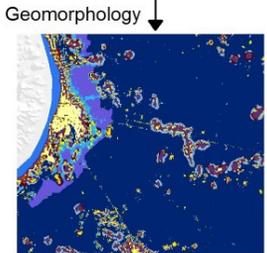
Spatial scale, data resolution and evolving mapping technologies

Broad-scale, low resolution mapping

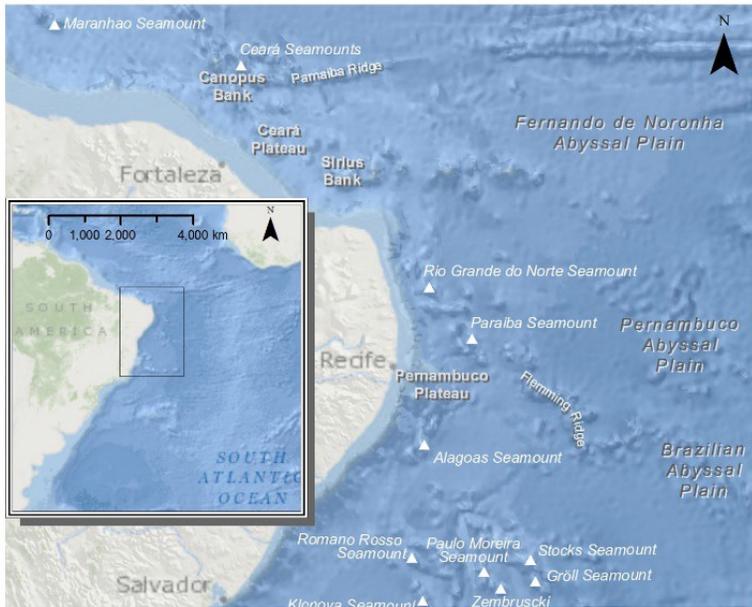
GEBCO – Geomorphology mapping



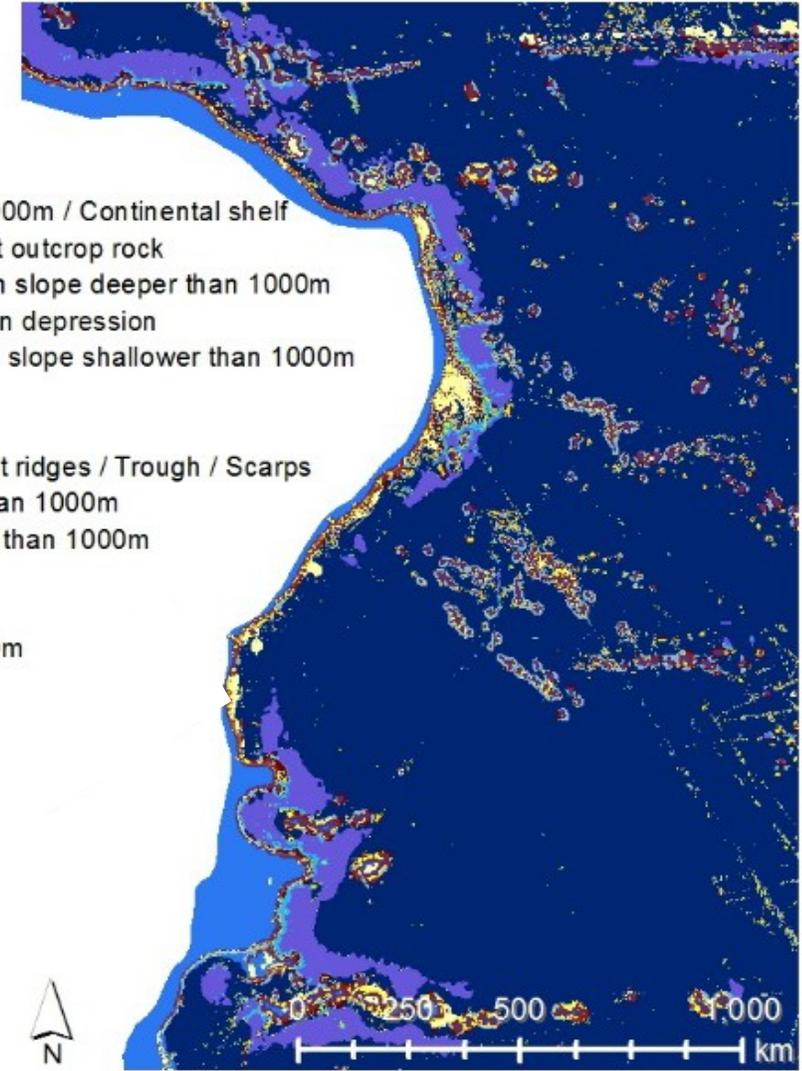
Decision Tree



- 1- Steep slope
- 2- Plain shallower than 1000m / Continental shelf
- 3- Narrow ridge seamount outcrop rock
- 4- Local ridge, pinnacle on slope deeper than 1000m
- 5- Local ridge pinnacles on depression
- 6- Local ridge pinnacle on slope shallower than 1000m
- 7- Local flat ridge tops
- 8- Local depressions
- 9- Local depression on flat ridges / Trough / Scarps
- 10- Gentle slope deeper than 1000m
- 11- Gentle slope shallower than 1000m
- 12- Depressions
- 13- Flat ridge
- 14- Plain deeper than 1000m



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- 12- Depressions
- 13- Flat ridge
- 14- Plain deeper than 1000m



1 km resolution

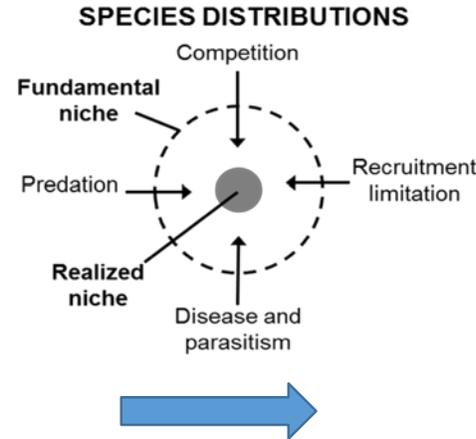
Spatial scale, data resolution and evolving mapping technologies

Regional-scale, high resolution mapping

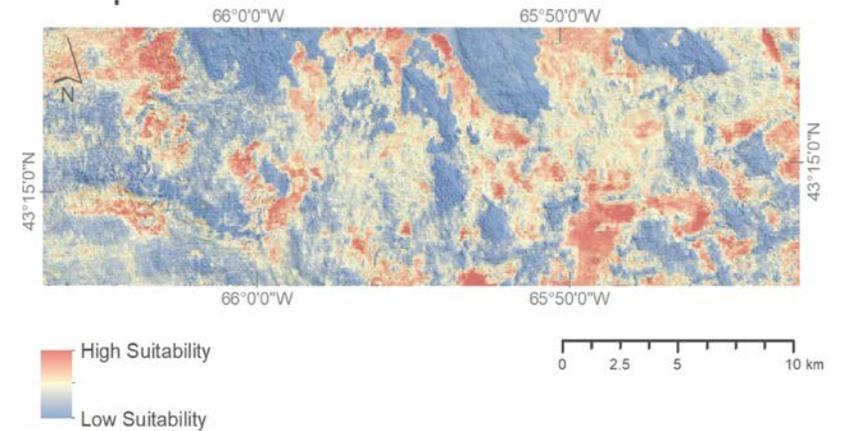
Single species data



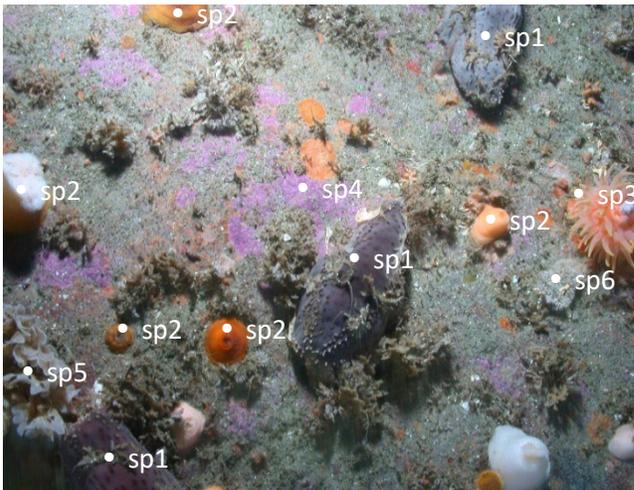
MBES – Fisheries applications



SDM (Habitat for a focal species)



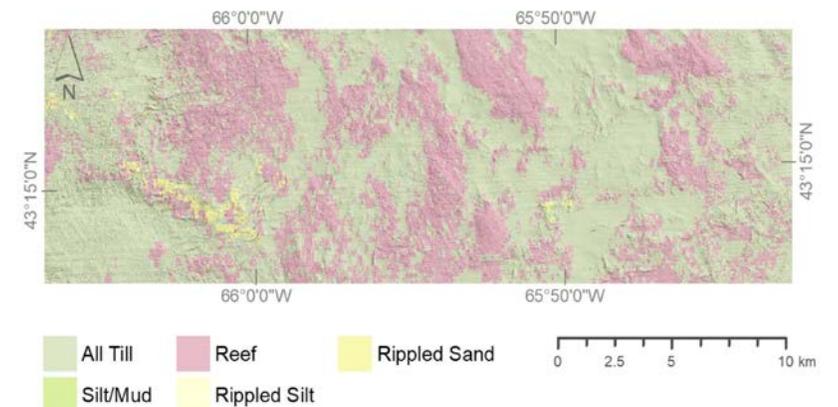
Substrate and community data



Substrate/Assemblage

Species	Count
Sp1	3
Sp2	5
Sp3	1
Sp4	20%
Sp5	1
Sp _x	...

Benthoscape (Biophysical patterns)

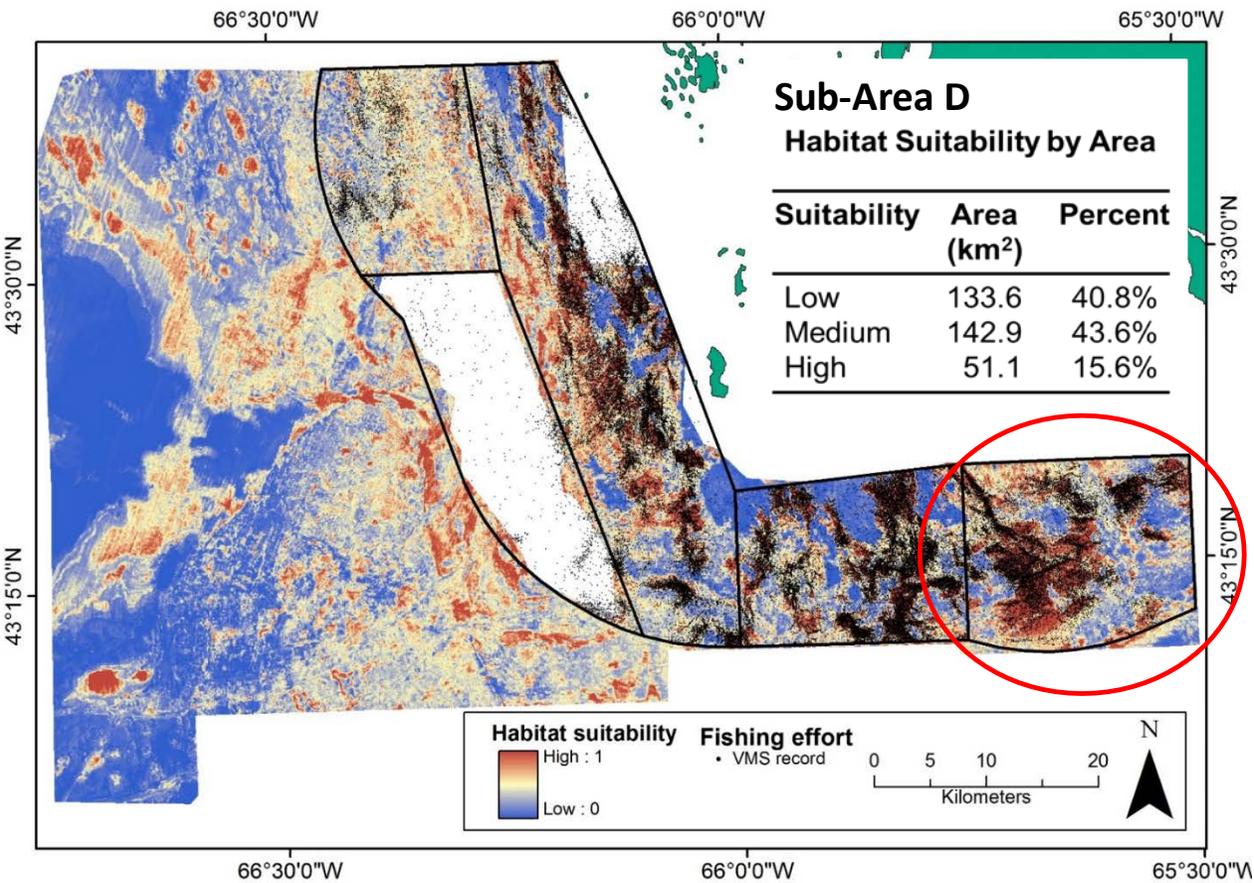


10m – 50m resolution

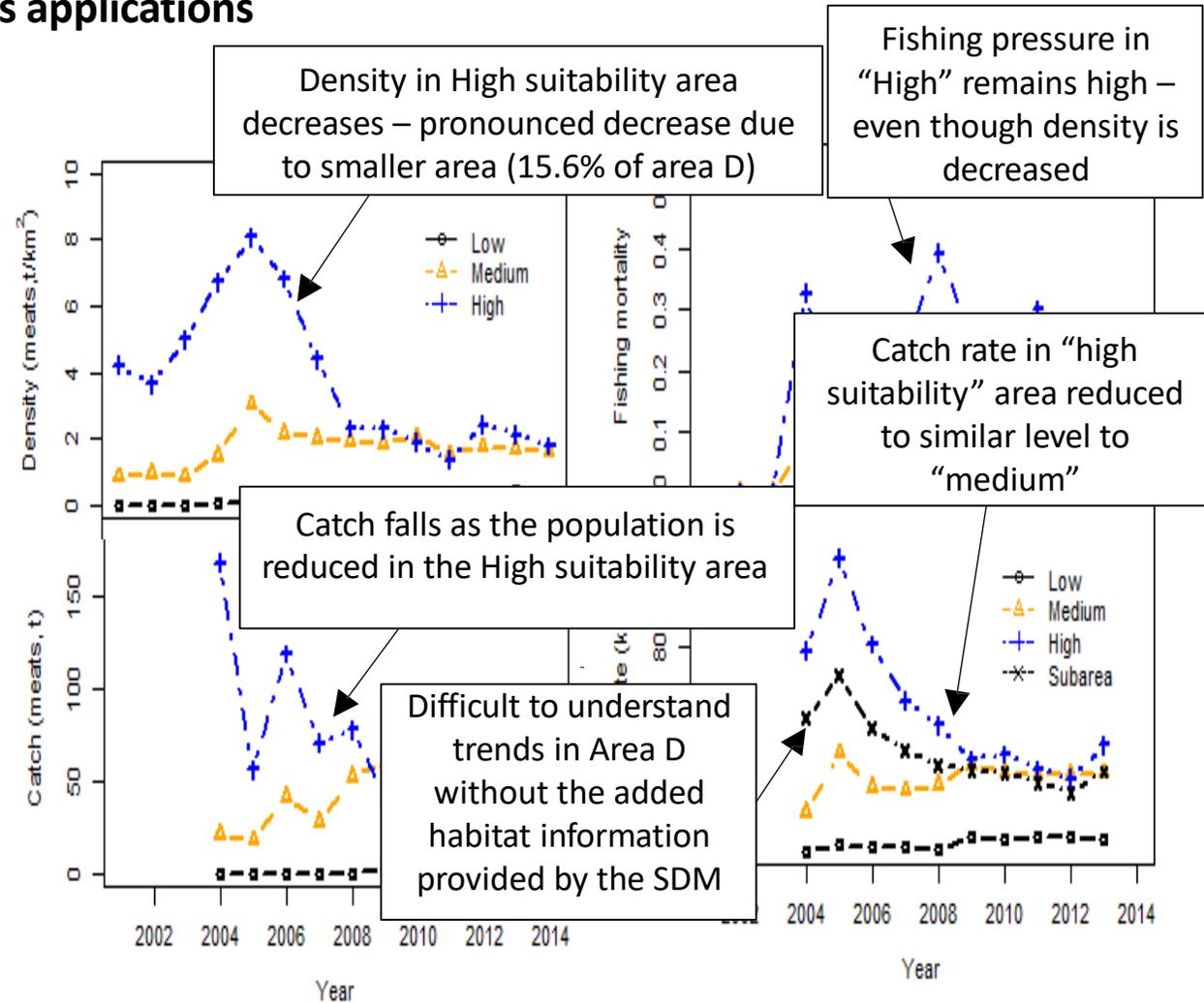
Spatial scale, data resolution and evolving mapping technologies

Regional-scale, high resolution mapping

MBES – Fisheries applications



Brown et al. (2012) Multiple methods, maps, and management applications: Purpose made seafloor maps in support of ocean management. *Journal of Sea Research* (72): 1-13. doi:10.1016/j.seares.2012.04.009

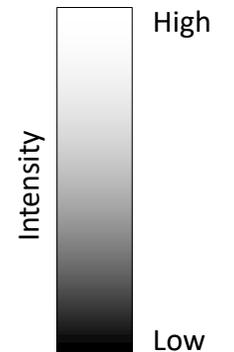
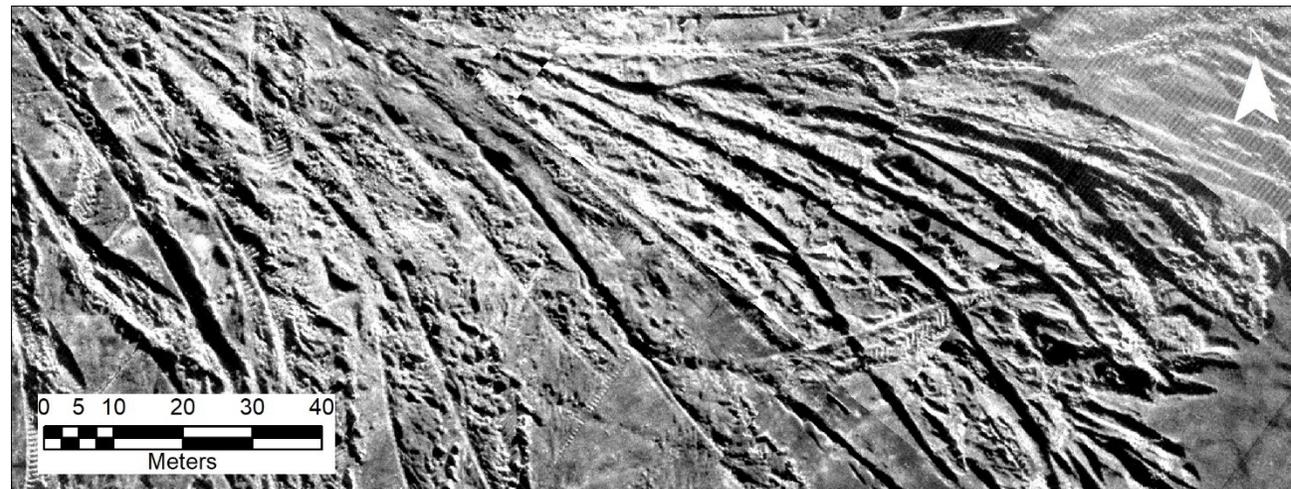
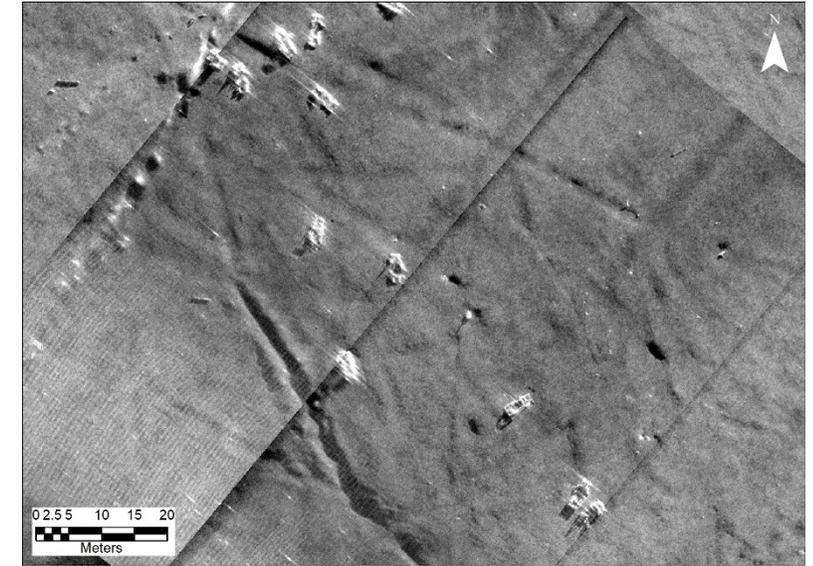
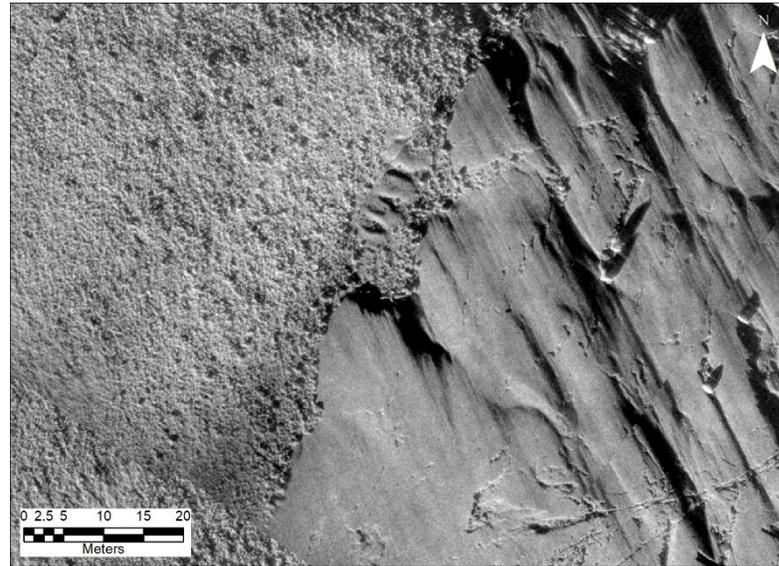


Smith S.J., Sameoto, J.A., & Brown, C.J. (2017) A novel approach to setting biological reference points for sea scallops *Placopectin magellanicus* that incorporates the spatial distribution of productivity. *Canadian Journal of Fisheries and Aquatic Sciences*. 74 (5): 650-667

Spatial scale, data resolution and evolving mapping technologies

Local-scale, high resolution mapping

Synthetic Aperture Sonar (SAS)



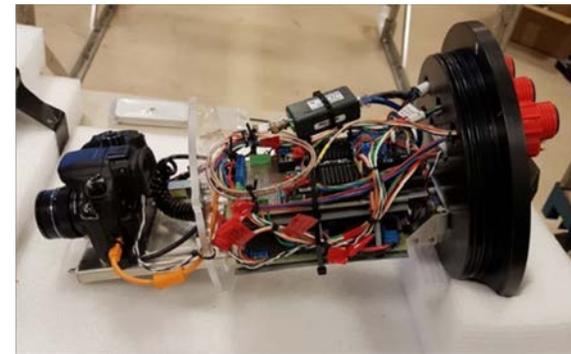
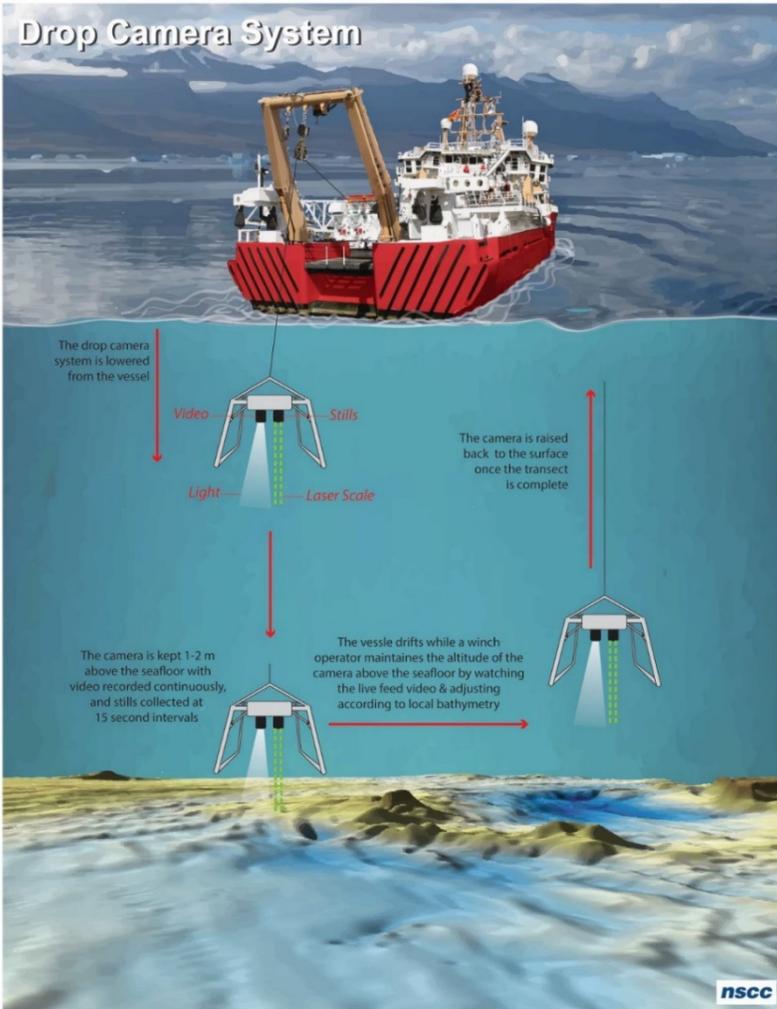
3cm resolution



Spatial scale, data resolution and evolving mapping technologies

Fine-scale, ultra-high resolution mapping

Photogrammetry (Structure from Motion)

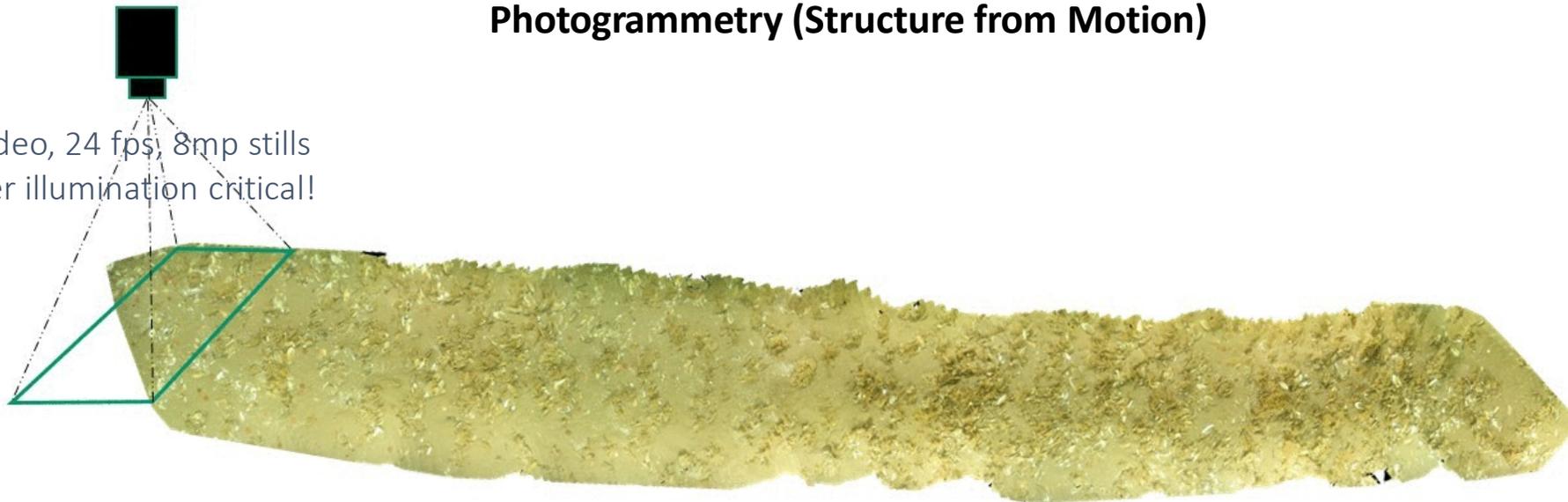


Spatial scale, data resolution and evolving mapping technologies

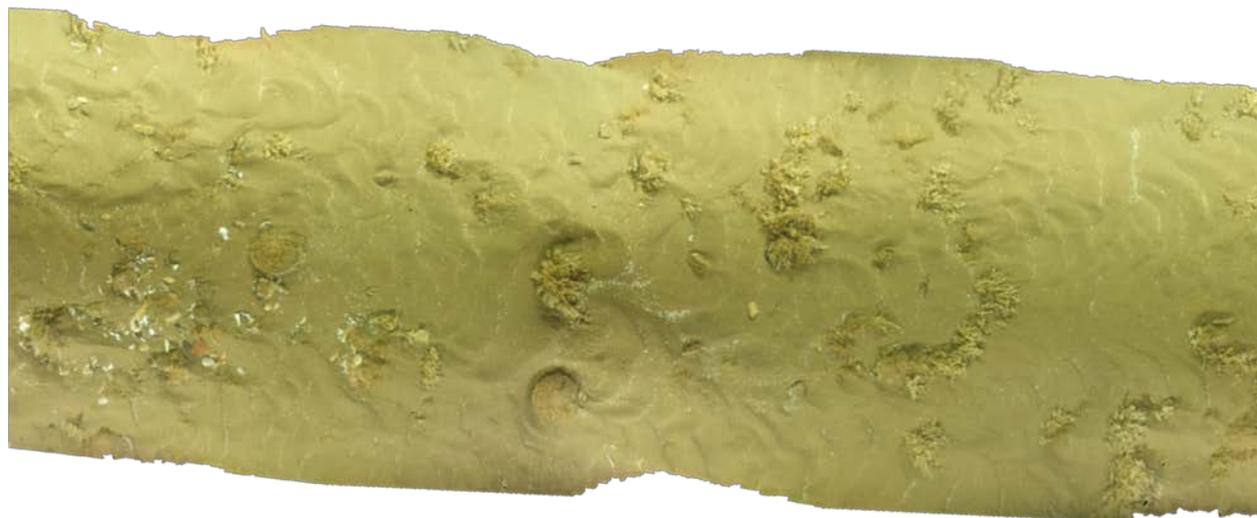
Fine-scale, ultra-high resolution mapping

Photogrammetry (Structure from Motion)

SfM: 4k video, 24 fps, 8mp stills
Underwater illumination critical!



Structure from Motion



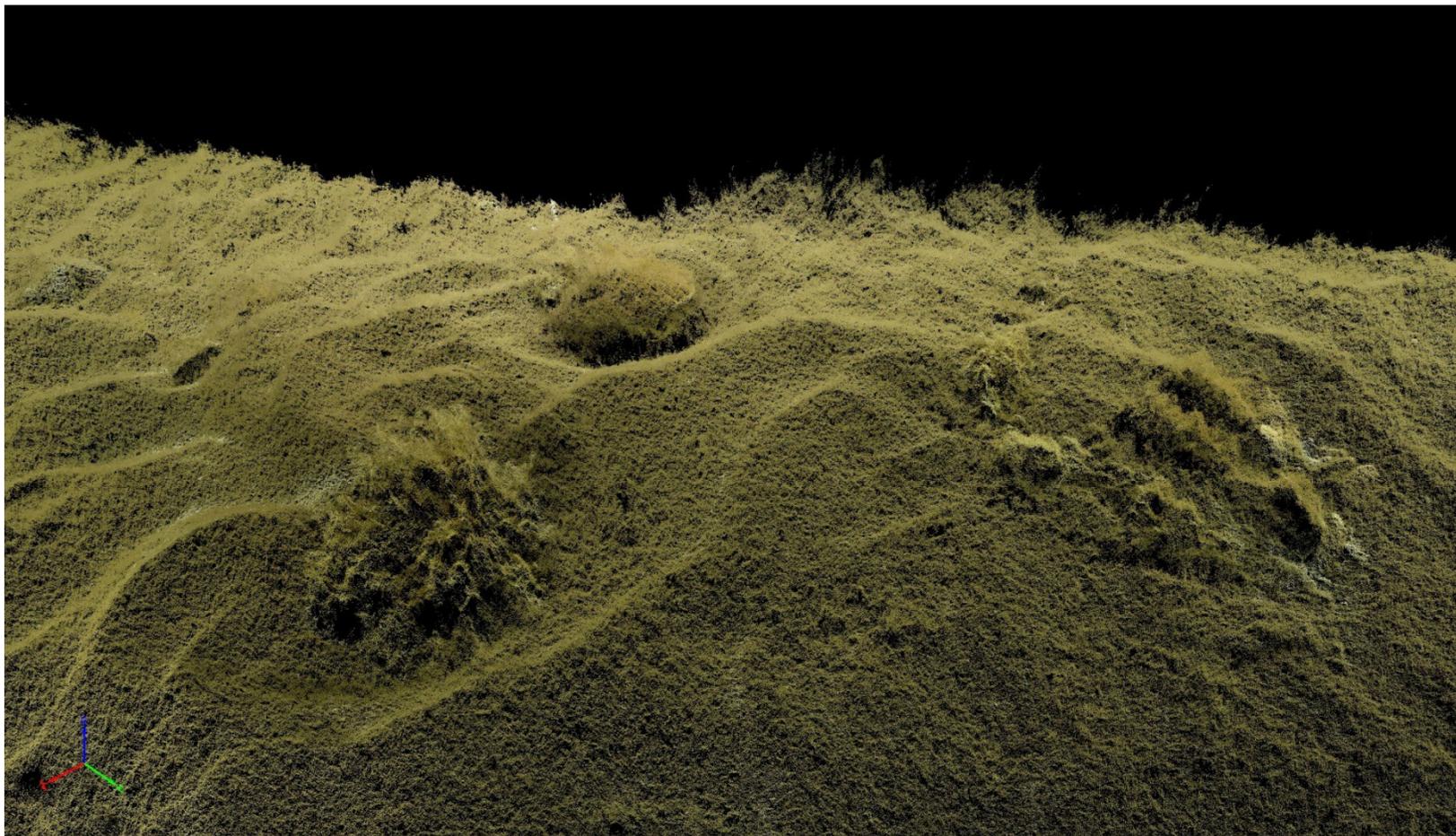
2D Mosaic

<1cm resolution

Spatial scale, data resolution and evolving mapping technologies

Fine-scale, ultra-high resolution mapping

Photogrammetry (Structure from Motion)



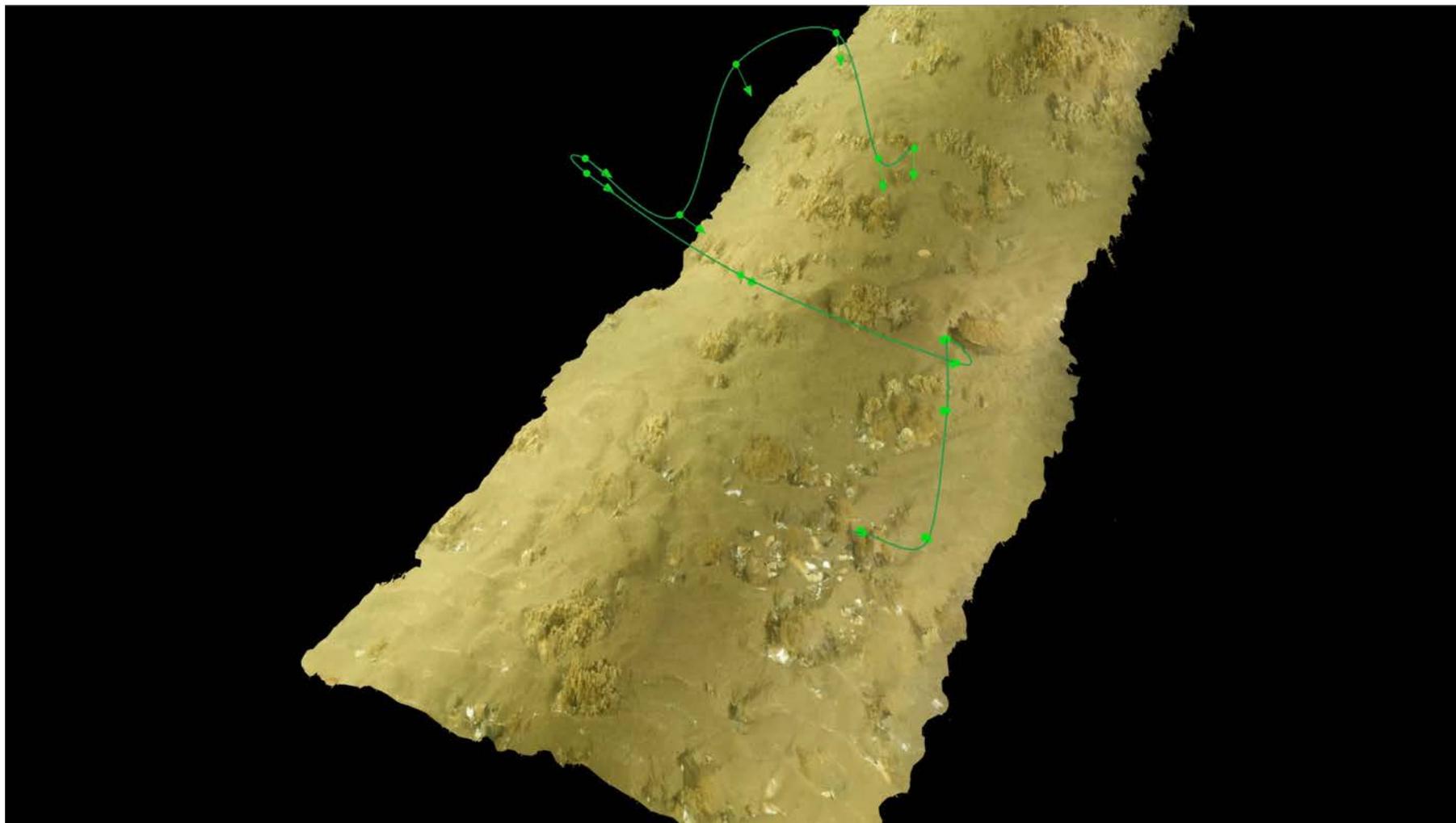
Point cloud

<1cm resolution

Spatial scale, data resolution and evolving mapping technologies

Fine-scale, ultra-high resolution mapping

Photogrammetry (Structure from Motion)



Conclusions

- Advancing technologies (e.g. MBES, SAS, underwater imaging systems) are significantly facilitating development of ocean floor habitat mapping methodologies
- Lack of data coverage is the main barrier to advancing science across a range of different applications.
- Spatial resolution of the data needs to be linked carefully with the application of the maps, and the methodology used to generate the thematic outputs
- Significant benefits for many applications for sustainable ocean management (e.g. fisheries, conservation)
- 3D imagery offers a novel way to easily quantify seafloor characteristics at a very fine scale (e.g. size and abundance of fauna, substrate characteristics and bedforms) – which could have seafloor monitoring applications (e.g. MPA monitoring; bottom impacts from fishing etc.)
- Still a long way to go before we have comparable “spatial” information and maps of the ocean floor to those available on land

Thank you!

Questions?

Acknowledgements:

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"Building a Window to a Transparent Ocean"