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Acoustic techniques for seabed mapping in MAREANO, using ships, ROVs and AUVs

Terje Thorsnes and the MAREANO team

HydroCen seminar 9.1.2018

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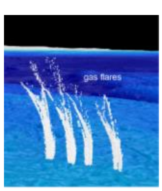
Ecosystem based advice



Science

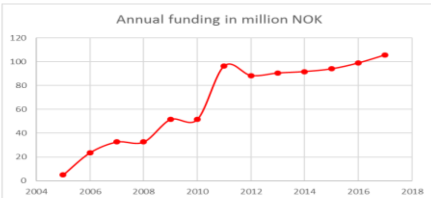
MAREANO

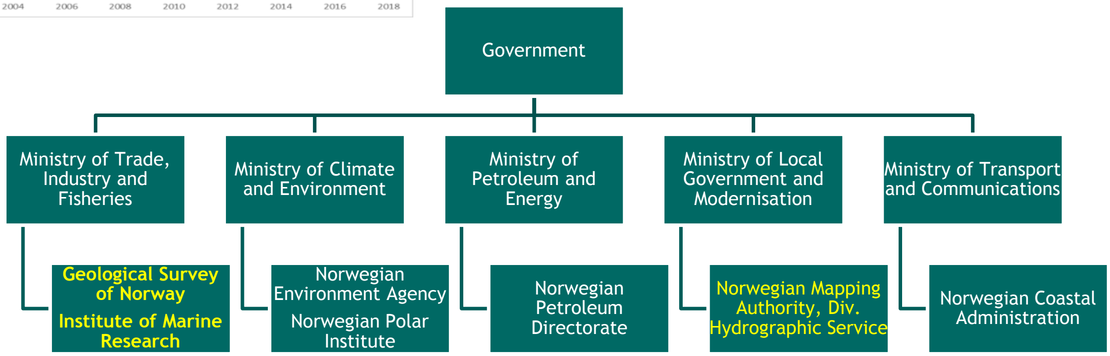
SDG 14

Industry

Innovation

MAREANO organisation and budget





Products

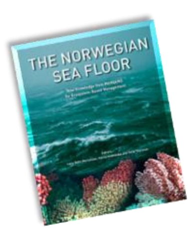
www.mareano.no - maps and descriptions

Downloadable datasets from www.mareano.no

- terrain models
- geological and biological maps as shape-files, wms or pdf
- chemical and sedimentological data
- biological data

Books, brochures, conferences

Scientific and popular papers and articles



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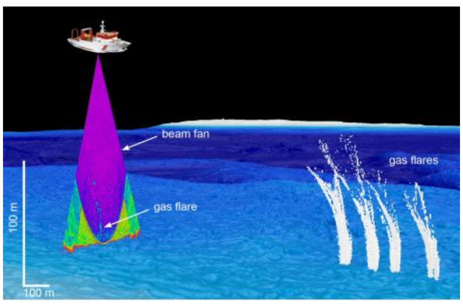
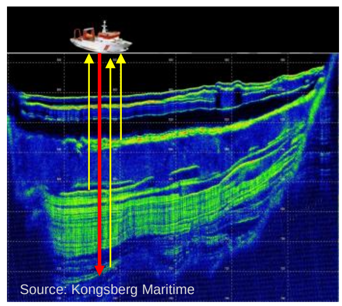
Selected acoustic sensors and platforms

Shipborne multibeam echosounder



Shipborne and AUV-borne sub-bottom profiler



AUV with SAS

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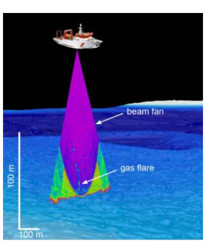
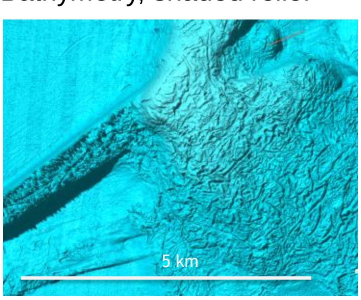
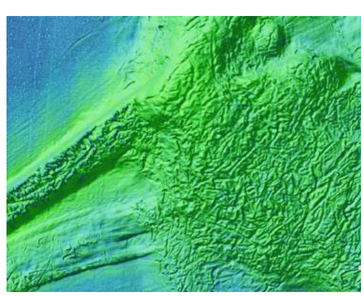
Shipborne multibeam echosounder – bathymetry and backscatter



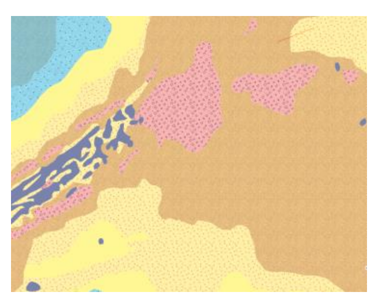
Bathymetry, shaded relief



Backscatter, colour coded



Interpreted sediment map, after ground truthing with video and samples



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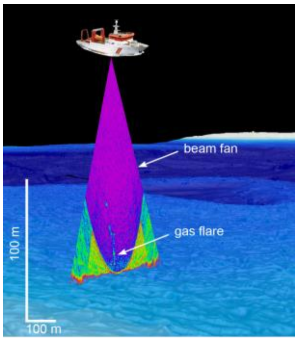
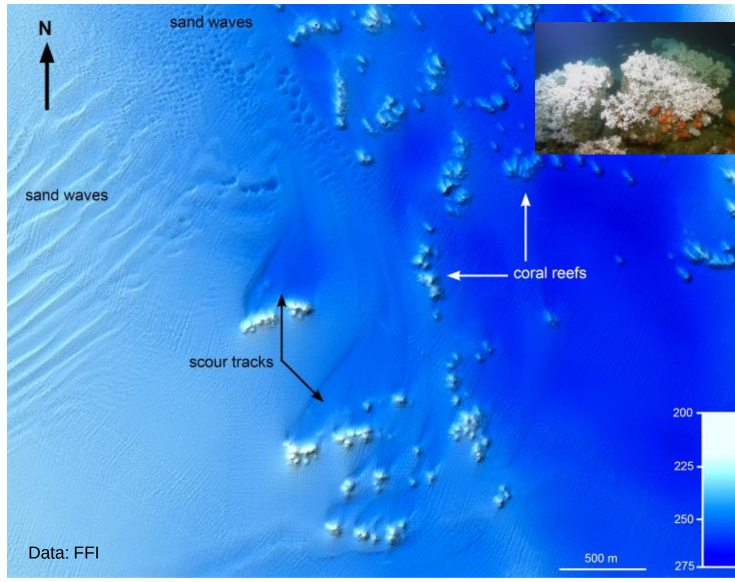
Shipborne multibeam echosunder – morphology reveals processes and features



Bathymetry (shaded relief) showing sand waves and coral reefs



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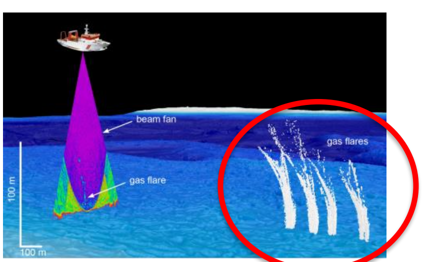
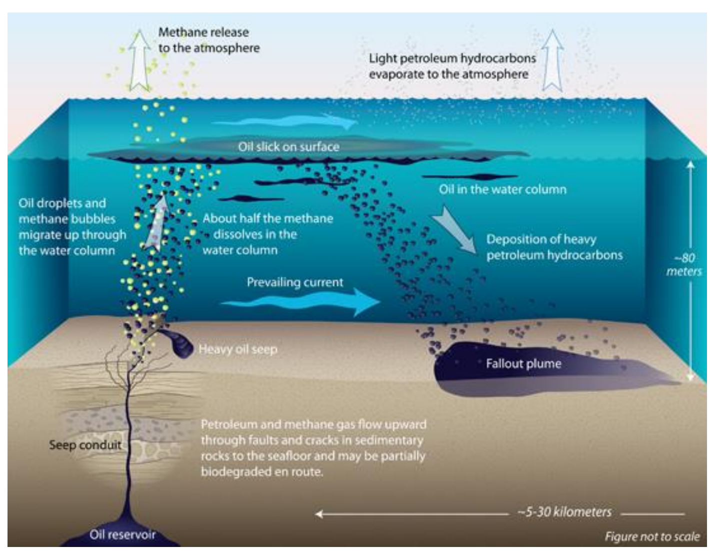
Shipborne multibeam echosunder – water column data



Water column data

Geohazards – blow-outs, slides
Climate – methane emissions
Pollution



Source: Wood s Hole Oceanographic Institution

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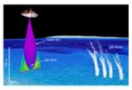
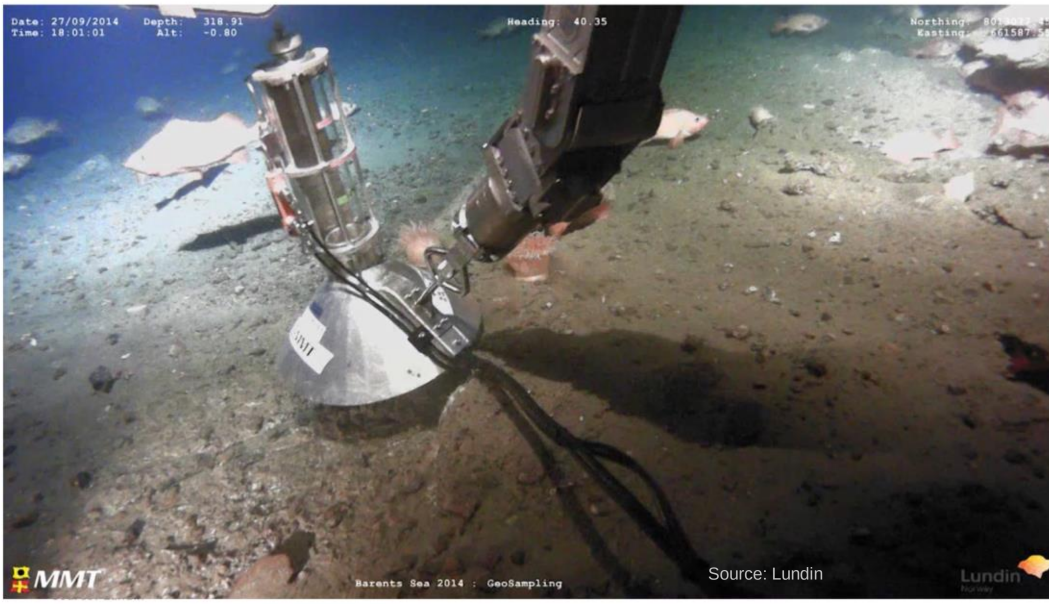
Shipborne multibeam echosounder – water column data





Source: Lundin

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AUV (autonomous underwater vehicle) with SAS (synthetic aperture sonar)

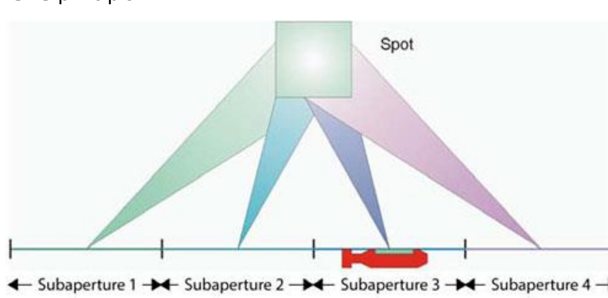
- 7 m long and 0.75 m wide (HUGIN 1000)
- Typical operation time – 12 hours
- Can be fitted with a wide range of sensors – sonars, sniffers, temperature, salinity, plankton+++
- Many different sizes and capabilities

HUGIN HUS AUV

Source: Kongsberg Maritime

- Range-independent resolution
- 5x5 cm – 2x180 m swath
- Max resolution – 2x2 cm
- 60 Gb/hr
- Coverage 2 km2/hr
- Bathymetry

SAS principle



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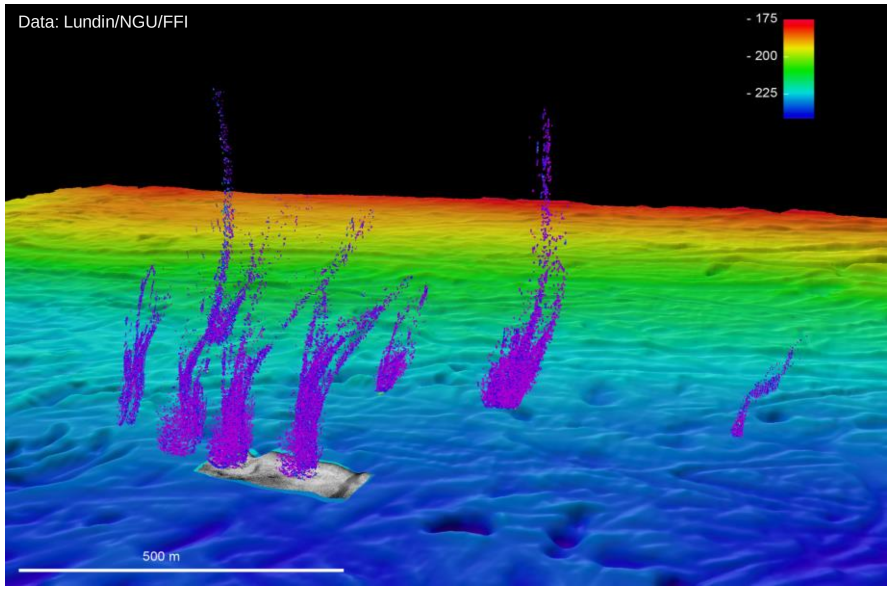
Why use AUV instead of ship? Multiscale RS…



3D model of shipborne bathymetry (2m grid), with gas flares (violet) and draped SAS image (grey)

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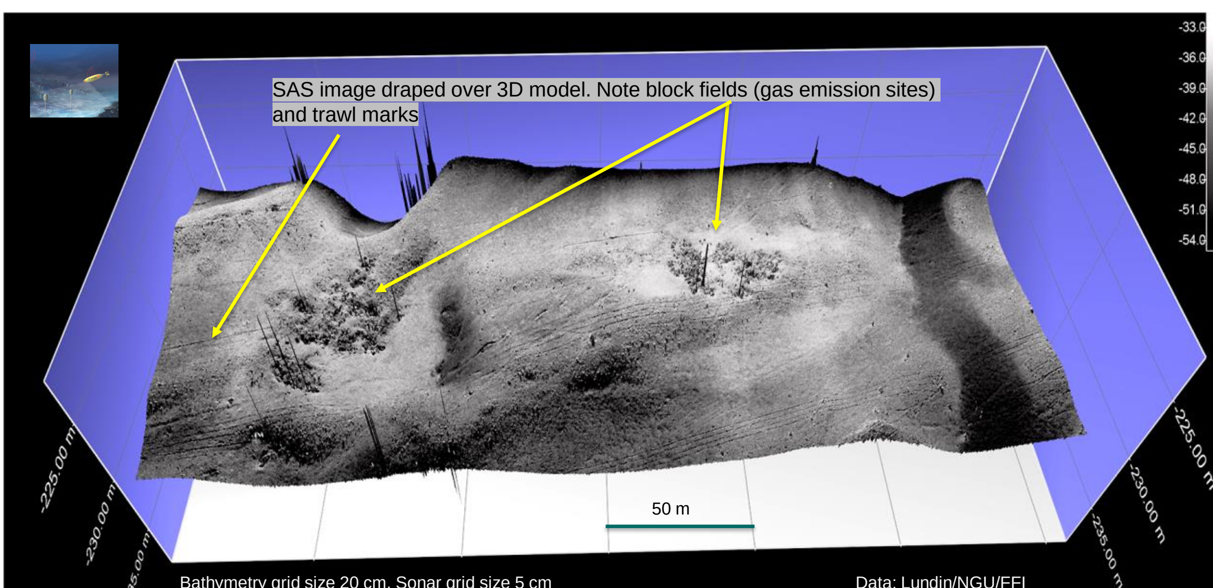
AUV-borne synthetic aperture sonar (SAS)



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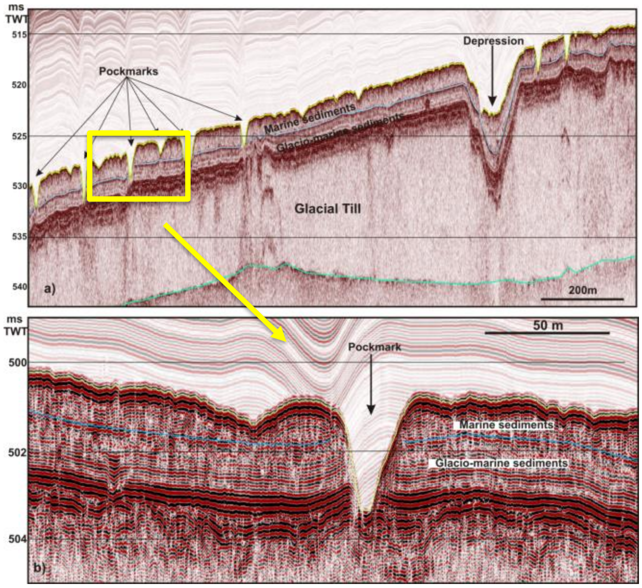
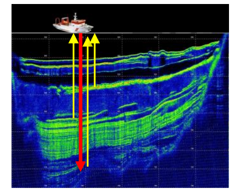
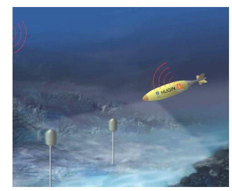
Shipborne and AUV-borne sub-bottom profiler



Shipborne sub-bottom profiler



AUV-borne sub-bottom profiler



Data: Lundin/NGU/FFI. Illustration: Shyam Chand, NGU

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What about LIDAR backscatter for substrate and habitat?

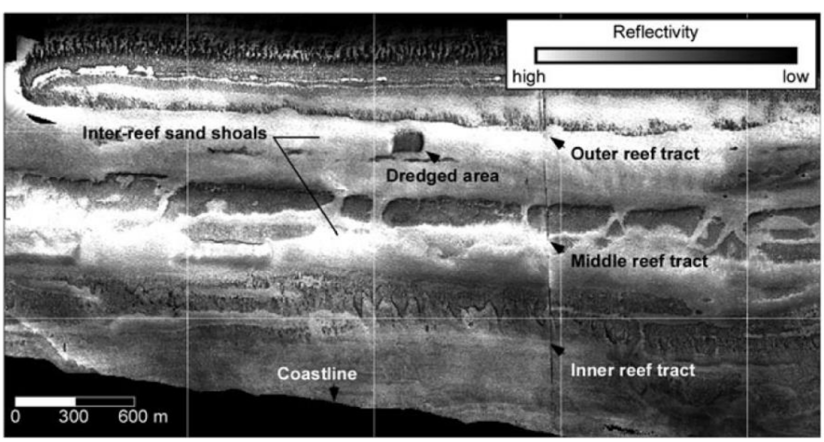

Fig. 5.4 Intensity image of a section of the Florida reef tract (offshore Dania Beach) obtained at 532 nm from the SHOALS-3000 LiDAR instrument, a component of the CHARTS instrument array. In addition to water depth, SHOALS is able to provide two additional products that have been unavailable with previous LiDAR instruments: seafloor reflectance and water column attenuation. Credit: Optech International

From Purvis and Brock, 2013

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Conclusions

- Acoustic sensors can be mounted on various platforms, such as ships, AUVs and ROVs
- Shipborne sensors are easy to operate, and can cover large areas
- AUV- and ROV-borne sensors operate closer to the bottom, and gives more detail, but smaller areas
- The bottom morphology visualised as shaded relief images reveals processes and features
- Backscatter provides information of the acoustic hardness of the bottom, and can be used for substrate classification (e.g. gravelly areas versus mud or bedrock)
- Water column data can detect gas flares, or fish shoals
- Sidescan or synthetic aperture sonars provide very high details, down to cm-level