

Seafloor characterization with acoustic imaging

Delft University of Technology

DISCLOSE Symposium

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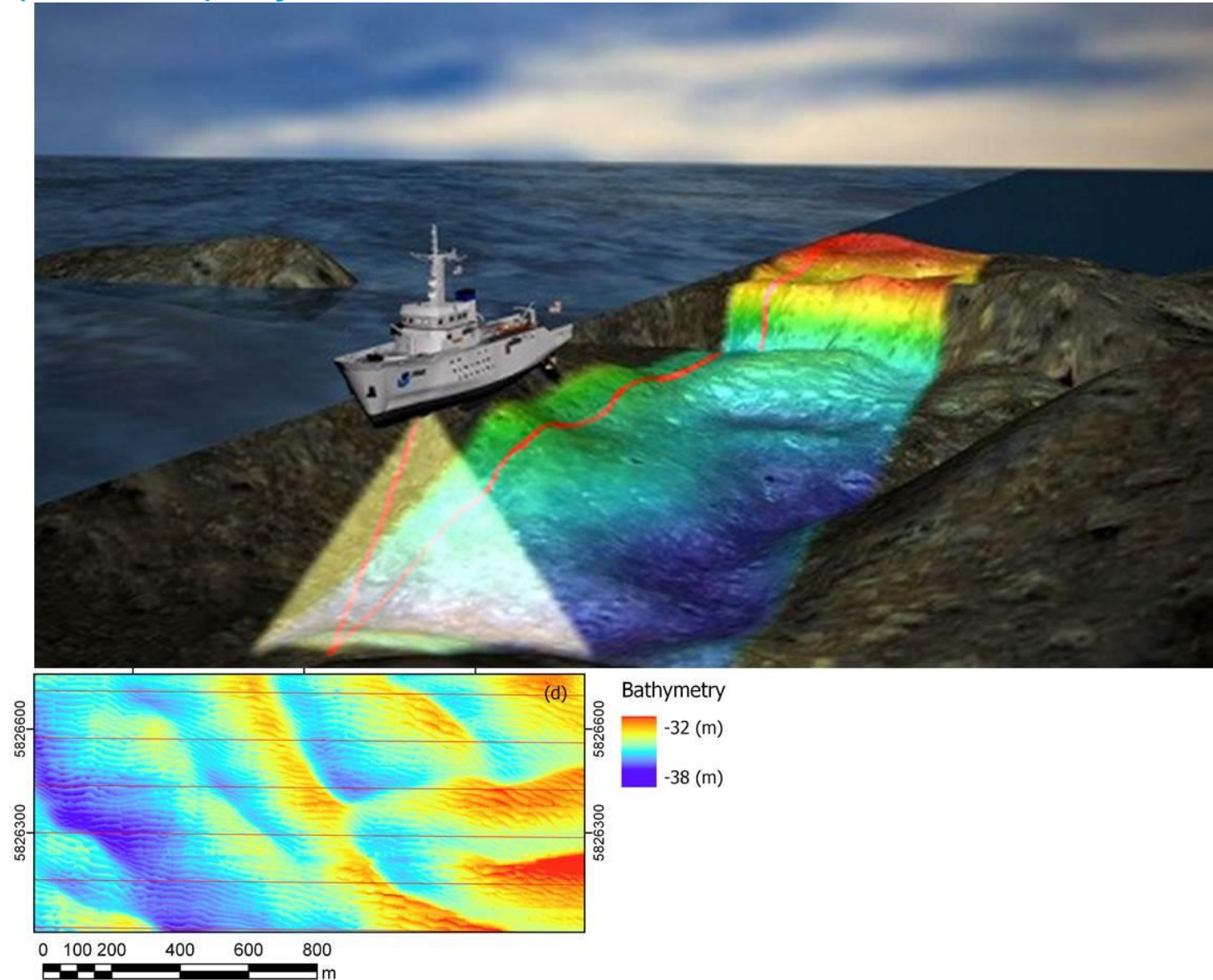
Overview

- Background
 - The multi-beam echo-sounder (MBES) system for imaging sea- and river-floors
 - The sediment backscatter strength as a proxy for sediment type
- Sediment classification with the MBES
 - Overview of approaches for sediment classification
 - Findings within DISCLOSE
 - Examples
- Use of acoustic classification in the DISCLOSE approach
- Outlook

Background

The multi-beam echo-sounder (MBES) system

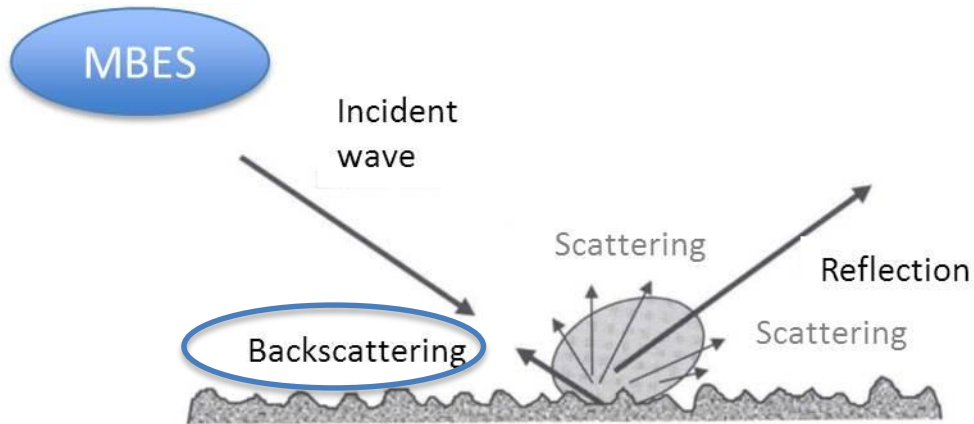
- The MBES emits a signal (ping) in a wide swath perpendicular to the sailing direction, but narrow in the sailing direction
- Beamsteering at reception provides travel time t as a function of angle $\theta \rightarrow R, y, z$
- Systems are in widespread use: provide high resolution depth data over extended areas



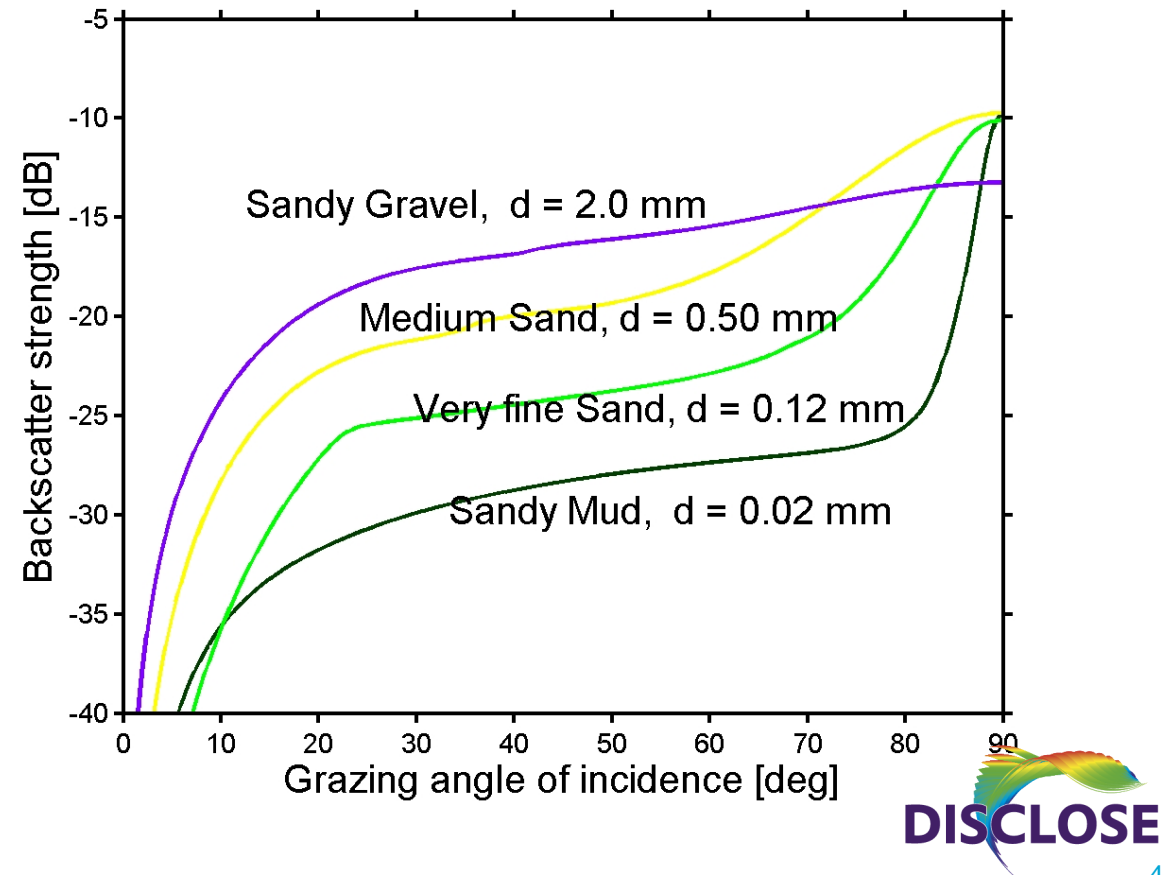
Background

The backscatter strength

- The interaction of sound with the sediment depends on the properties of the sediment



- From the MBES signals the so-called backscatter strength can be derived: a sediment parameter

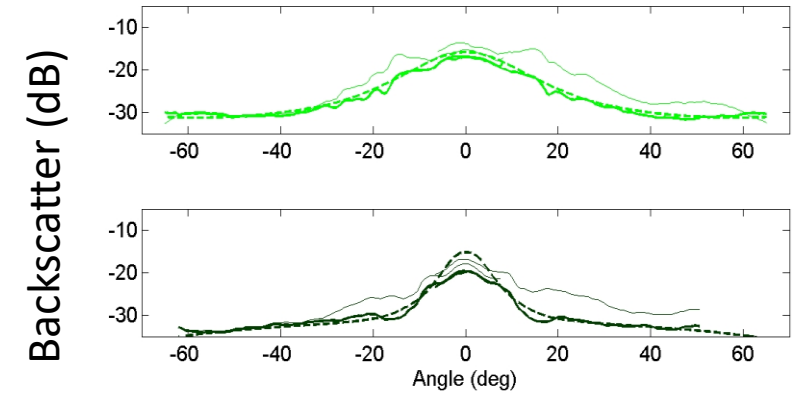


Sediment classification with the MBES backscatter

Methods

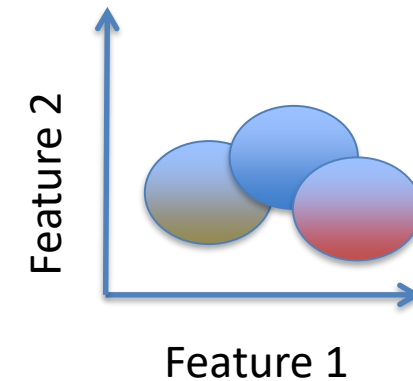
1. Model-based Method

- Classification based on backscatter curve
- Find sediment parameters that give the measured curve



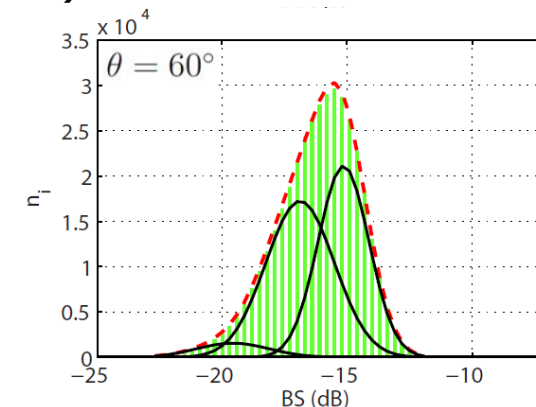
2. Classification based on features of the signal

- Classification based on backscatter and bathymetric features
- Find clusters



3. Bayesian classification method

- Classification per beam, with backscatter strengths per beam and sediment type assumed to be normally distributed (model-based)
- Estimate for the number of sediment types in surveyed area
- Sediments classified as a number of acoustic classes
- Applicable to current systems



Sediment classification with the MBES backscatter

Methods

DISCLOSE findings:

1. Model-based Method

- Classification based on backscatter curve
- Find sediment parameters that give the measured curve



- New method for MBES BS calibration
- Detailed insights in the sediment parameters
- Current research: link of estimated parameters to presence of e.g. Sabellaria?

2. Classification based on features of the signal

- Classification based on backscatter and bathymetric features
- Find clusters

Should not be used for classification based on backscatter only

3. Bayesian classification method

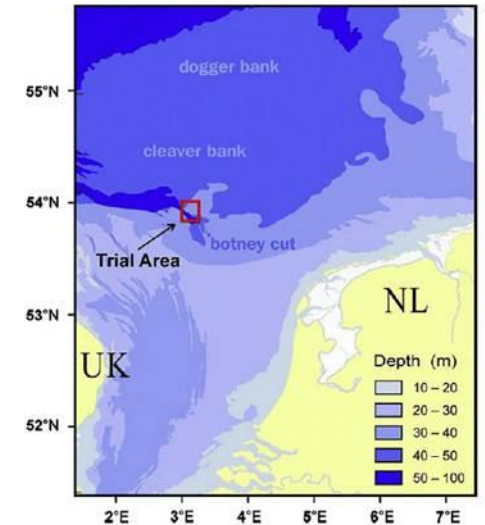
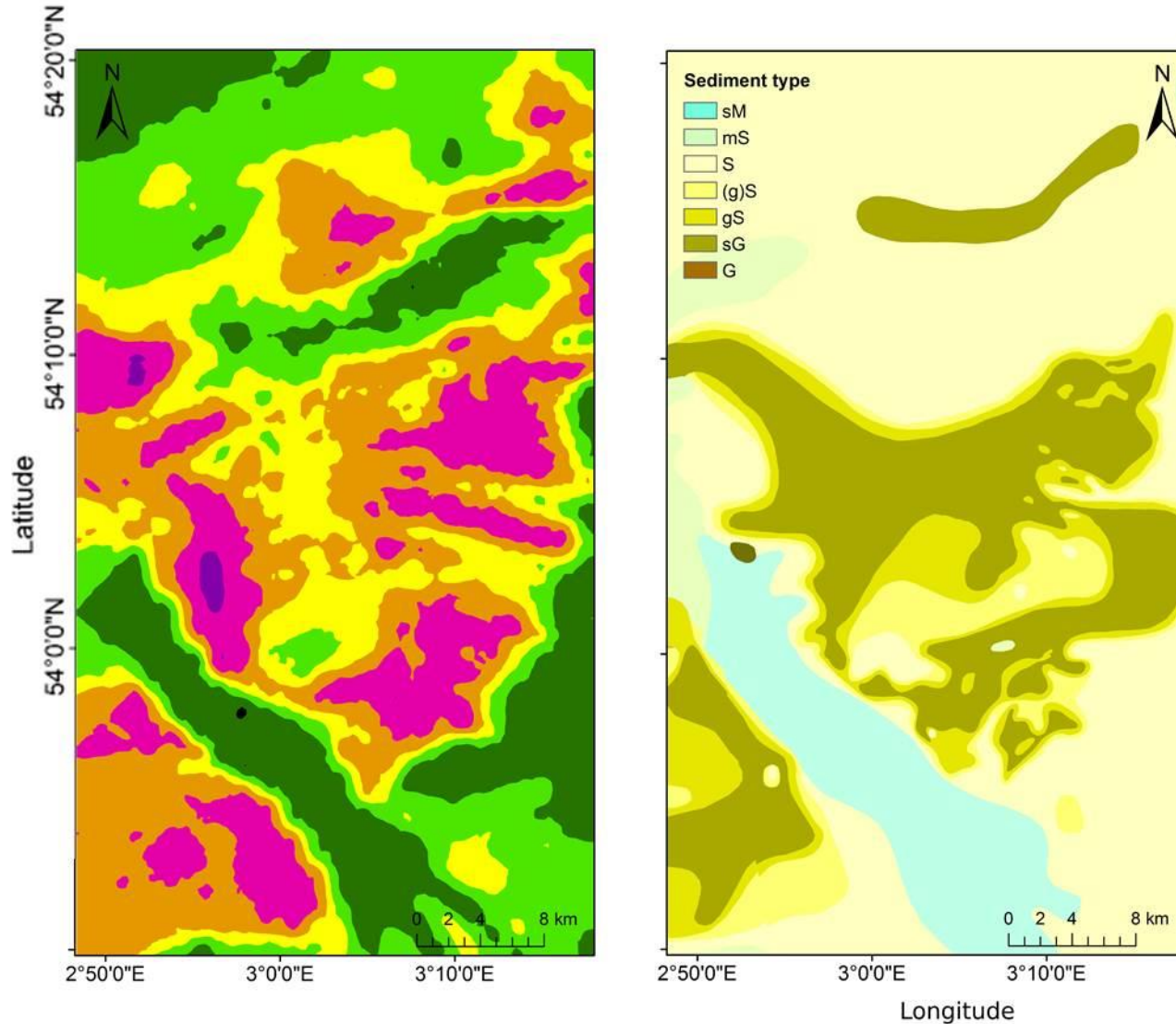
- Classification per beam, with backscatter strengths per beam and sediment type assumed to be normally distributed (model-based)
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- Sediments classified as a number of acoustic classes
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- Good discrimination between sediment types
- Good spatial resolution
- Physics based estimate for number of sediment types

Sediment classification with the MBES backscatter

Examples - **Use of Bayes method**: high resolution over large areas

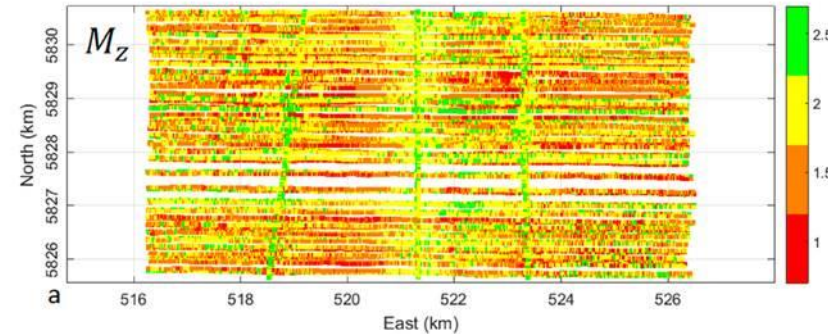


Sediment classification with the MBES backscatter

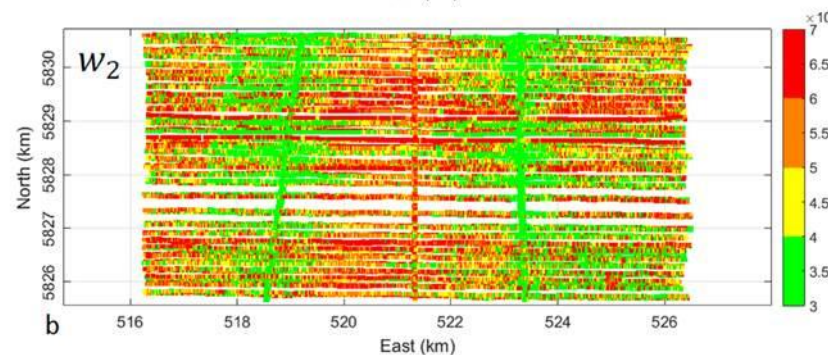
Examples -Model based method: detailed insight in sediment properties

No longer acoustic classes, but:

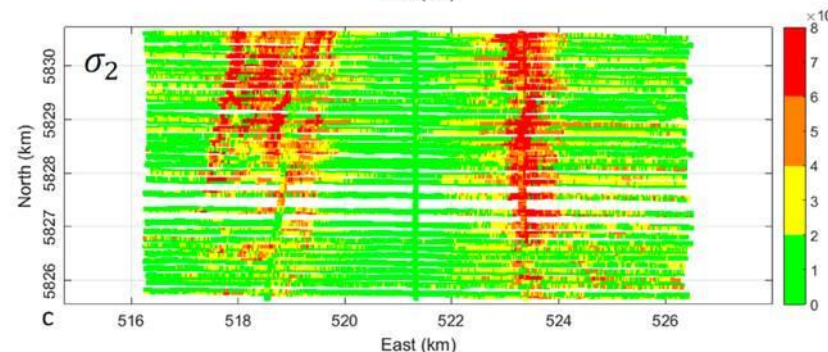
Mean grain size



Sediment roughness



Volume scattering



Use of acoustic classification in the DISCLOSE approach

1. **Acoustics** based maps

- Fast, large areas, good

2. Find re

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Communication towards all stakeholders regarding findings, maps and methodology developments (crucial building blocks) essential to ensure their application and as such work towards a sustainable use of the North Sea DISCLOSE!

Map presenting the habitats

- Lower MBES frequencies to look into the sediment

Thank you

