EGU General Assembly 2022

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Applying a multi-method framework to analyze the multispectral acoustic response of the seafloor

Session GM6.6 – Advances in seabed mapping and classification

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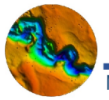

LaboGeo
Marine Geosciences Lab/UFES

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SEAM
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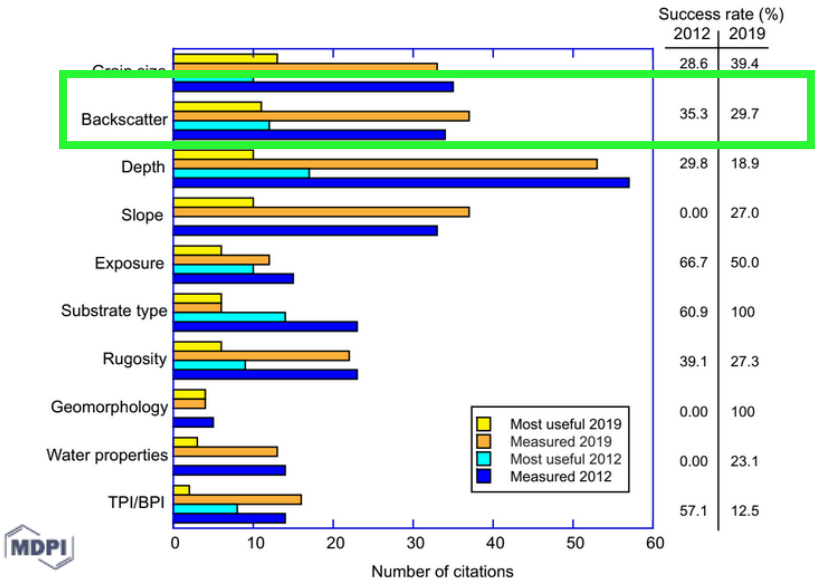
Introduction

- Backscatter is considered an important predictor of seabed classification and a surrogate for benthic habitats (Lurton, 2010; McGonigle et al, 2014; Montereale-Gavazzi, 2018);

- Multispectral MBES backscatter has been developed to characterize the seabed in greater detail, yet methods for the use of these data are still being explored.



Harris and Baker, 2020

United States Hydrographic Conference 2015
March 16th-19th
National Harbor, Maryland, USA

Multispectral Acoustic Backscatter from Multibeam, Improved Classification Potential

John E. Hughes Clarke

geosciences MDPI

Article

Multispectral Multibeam Echo Sounder Backscatter as a Tool for Improved Seafloor Characterization

Craig J. Brown [1,*], Jonathan Beaudoin [2], Mike Brissette [3] and Vicki Gazzola [1]

Journal of Coastal Research	35	5	1062–1079	Coconut Creek, Florida	September 2019

JCR www.JCRonline.org

TECHNICAL COMMUNICATIONS

www.cerf-jcr.org

Multispectral Acoustic Backscatter: How Useful Is it for Marine Habitat Mapping and Management?

Bryan Costa

geosciences

Article

Improved Interpretation of Marine Sedimentary Environments Using Multi-Frequency Multibeam Backscatter Data

Peter Feldens [1,*], Inken Schulze [1], Svenja Papenmeier [2], Mischa Schönke [1] and Jens Schneider von Deimling [3]

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Article

A Multispectral Bayesian Classification Method for Increased Acoustic Discrimination of Seabed Sediments Using Multi-Frequency Multibeam Backscatter Data

Timo C. Gaida [1,*], Tengku Afrizal Tengku Ali [1,2], Mirjam Snellen [1,3], Alireza Amiri-Simkooei [1], Thaiënne A. G. P. van Dijk [3] and Dick G. Simons [1]

remote sensing MDPI

Article

Examining the Links between Multi-Frequency Multibeam Backscatter Data and Sediment Grain Size

Robert Mzungu Runya [1,*], Chris McGonigle [1], Rory Quinn [1], John Howe [2], Jenny Collier [3], Clive Fox [2], James Dooley [4], Rory O'Loughlin [5], Jay Calvert [5], Louise Scott [1], Colin Abernethy [2] and Will Evans [6]

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Article

Probabilistic Substrate Classification with Multispectral Acoustic Backscatter: A Comparison of Discriminative and Generative Models

Daniel Buscombe [1,*] and Paul E. Grams [2]

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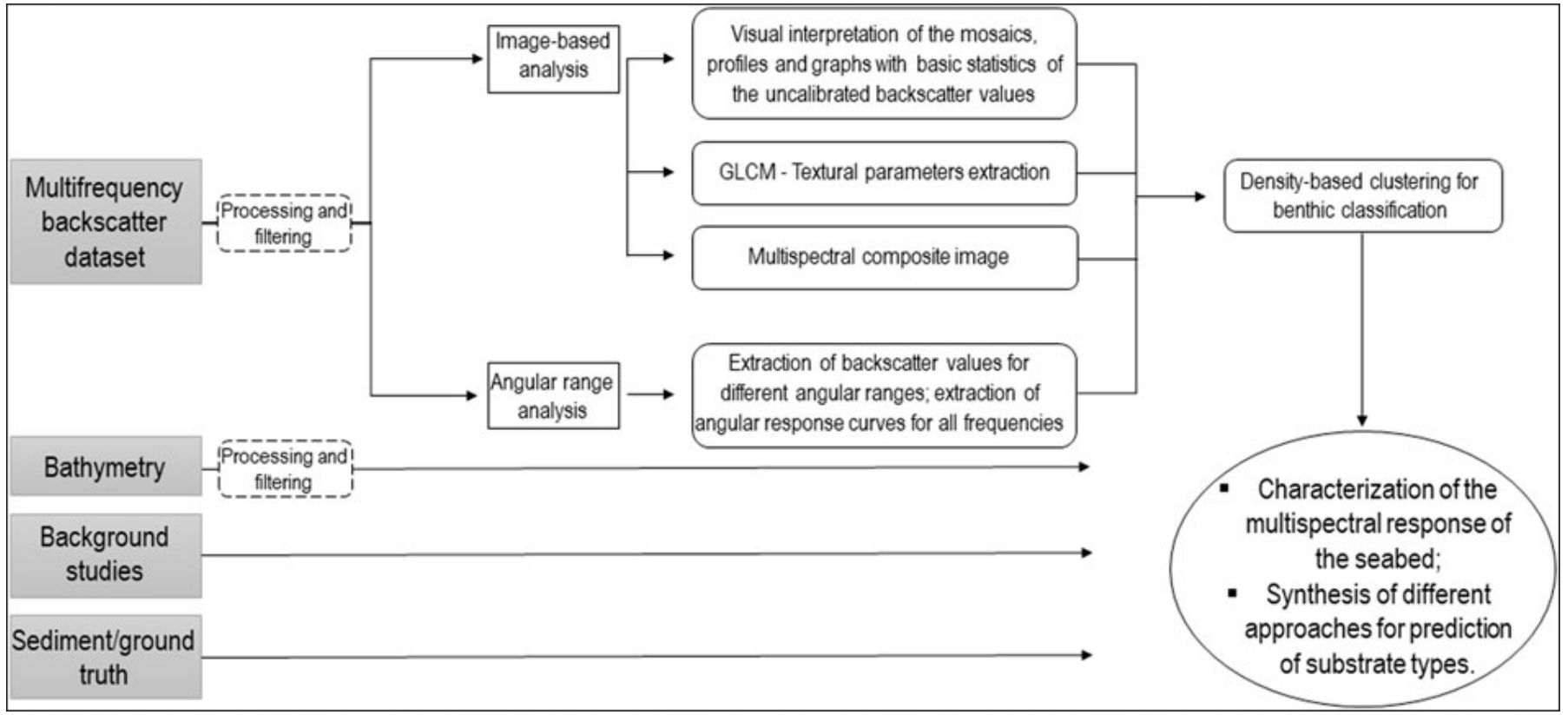
Methods



- Here, we evaluate the potential for seabed discrimination using multispectral backscatter data within a multi-method framework (image-based and angular dependence based methods). The data were therefore summarized using a combination of dimensionality reduction and density-based clustering, enabling hierarchical spatial classification of the seabed with sparse ground-truth.

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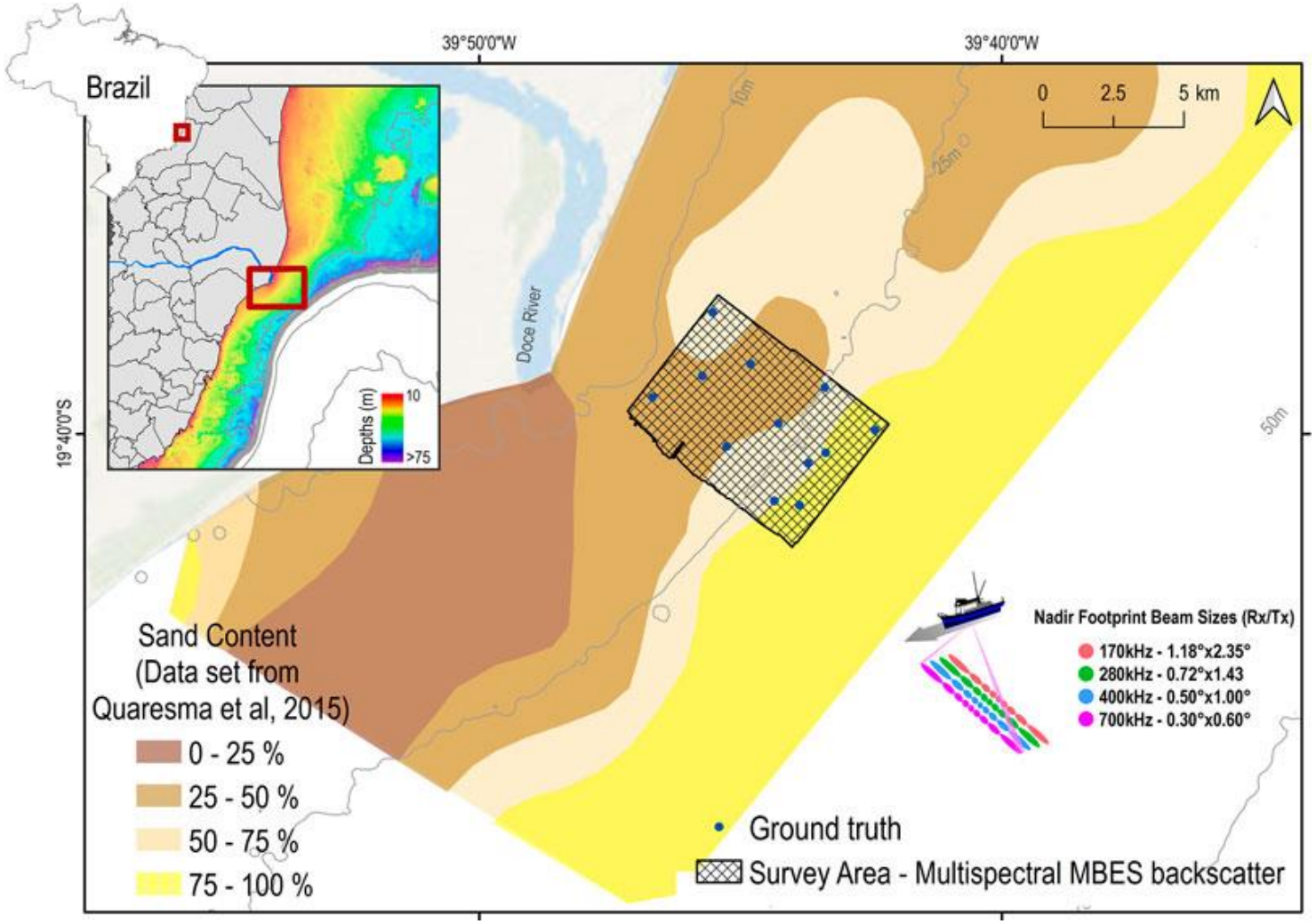
Data collected



- Bathymetry and backscatter were acquired by a R2Sonic 2024 echosounder;
- Operating frequencies: 170, 280, 400, and 700 kHz;
- All systems were integrated into the QPS QINSy software for the data acquisition;
- Post-processing was carried out using QPS Qimera and QPS FMGT.

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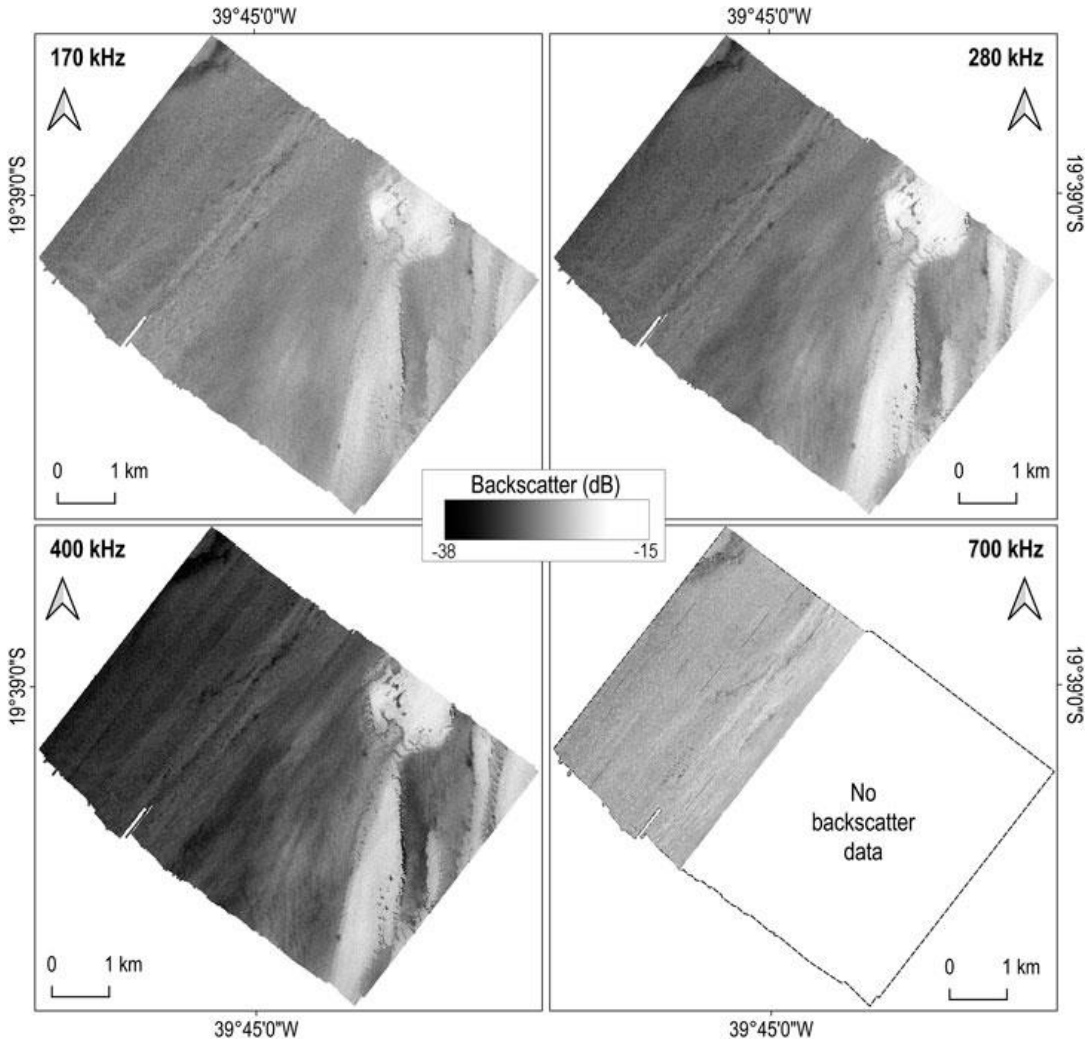
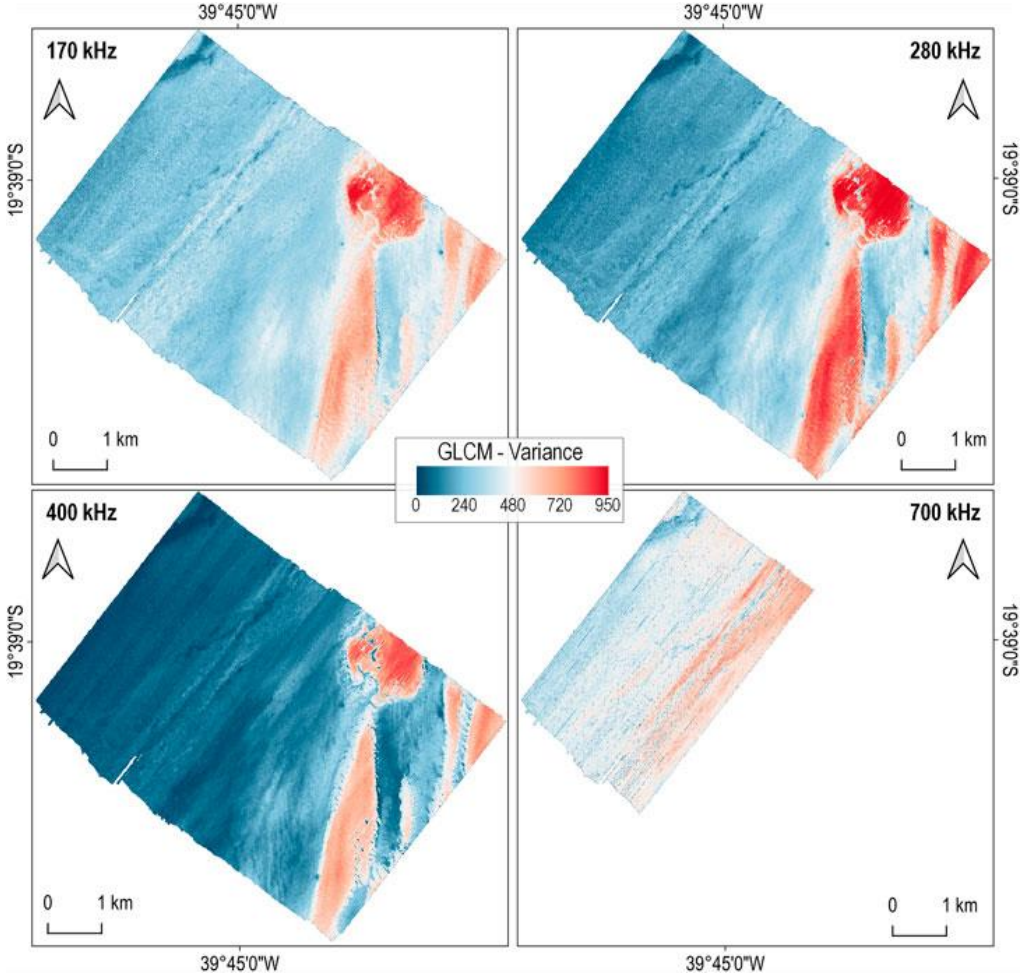
Results and discussion





- The general trend of textural variations can be visualized using the GLCM variance.

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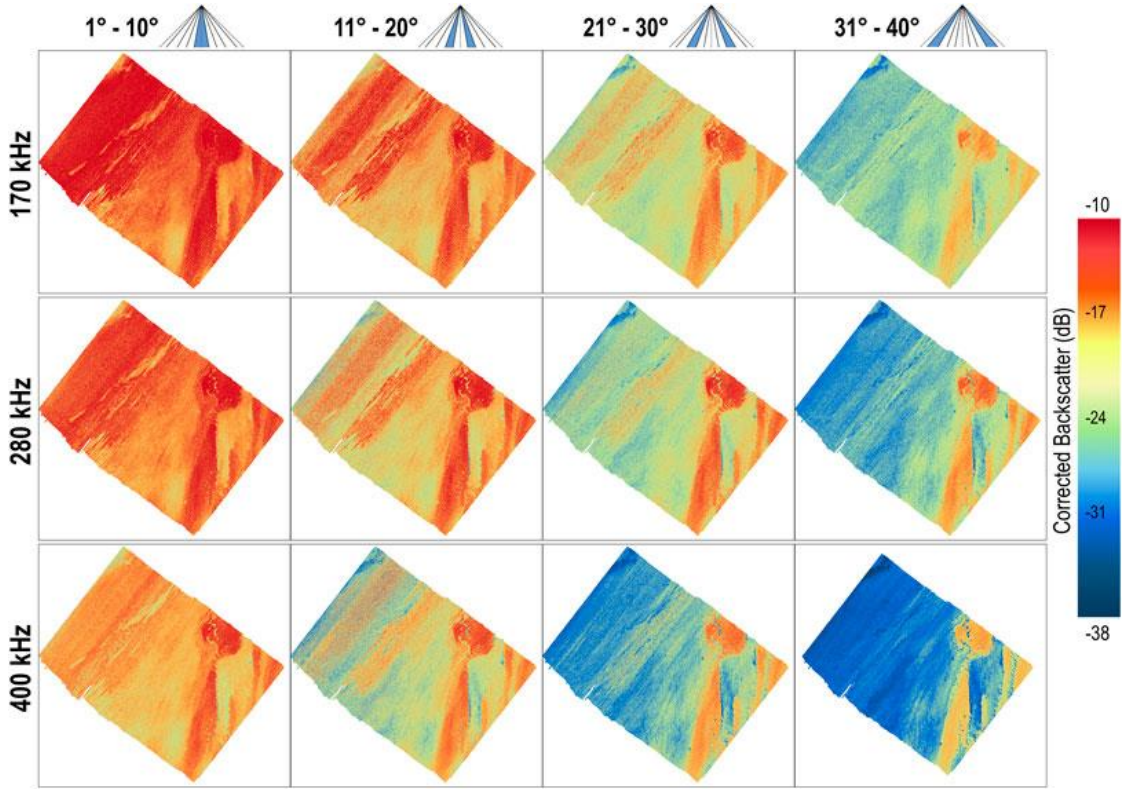
Results and discussion



BS ↓ Angle ↑

BS ↓ Frequency ↑

- The results demonstrated that, for most of the area, decreasing backscatter was associated with increased incidence angle and frequency. The exception occurs over the high-backscatter feature, which marks a region with high scattering across the entire swath.

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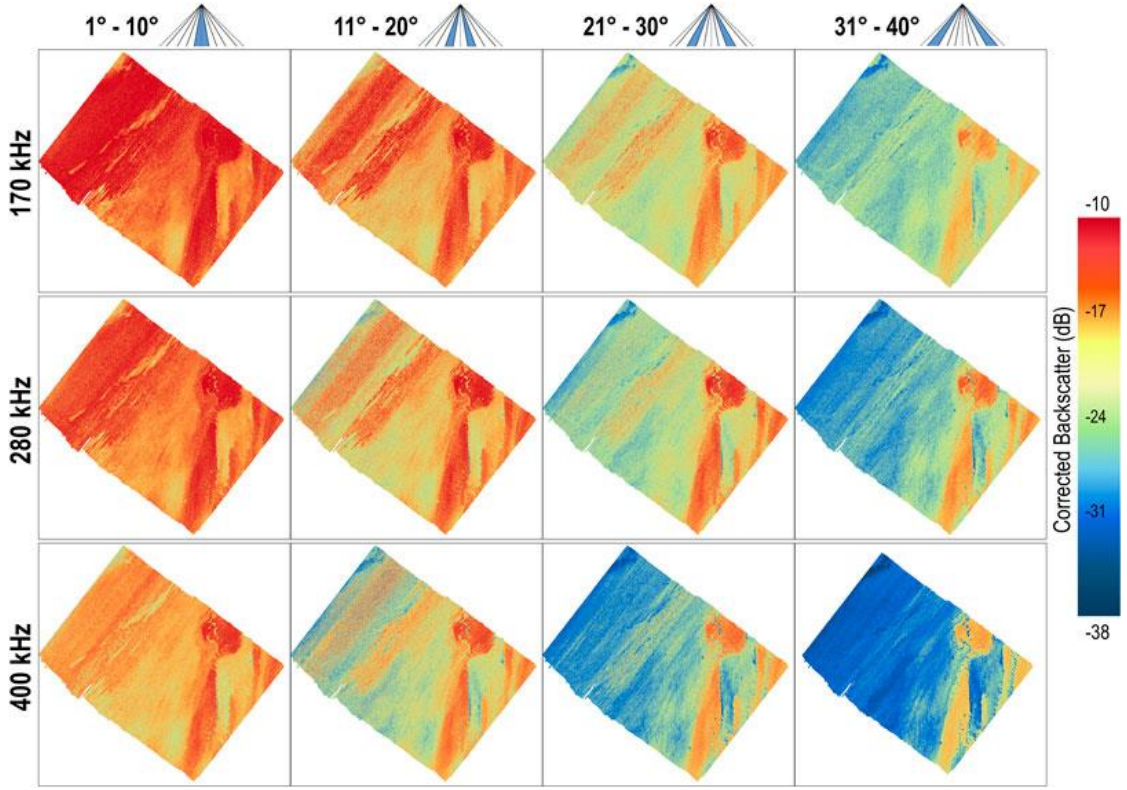
Results and discussion



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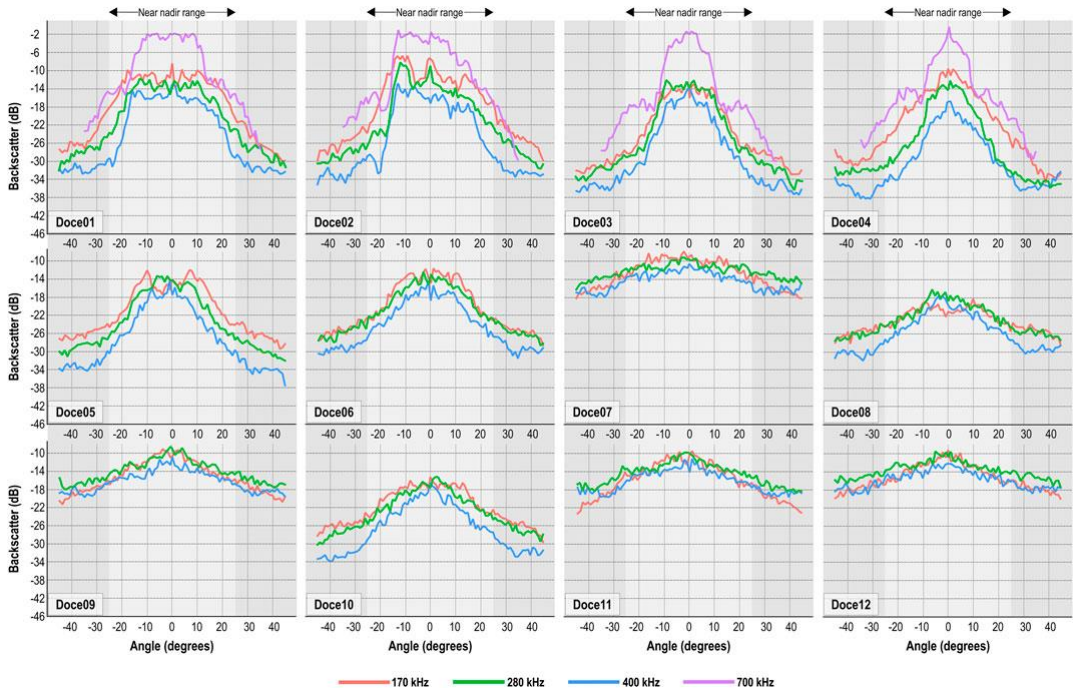

- The angular response curves can be broadly described in three main groups.

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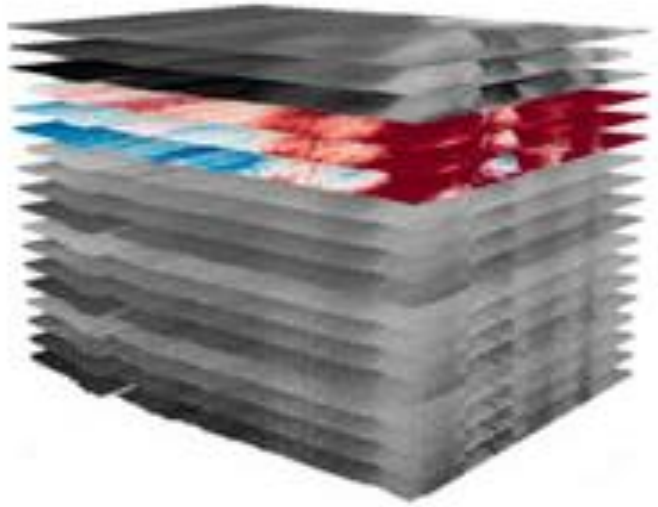
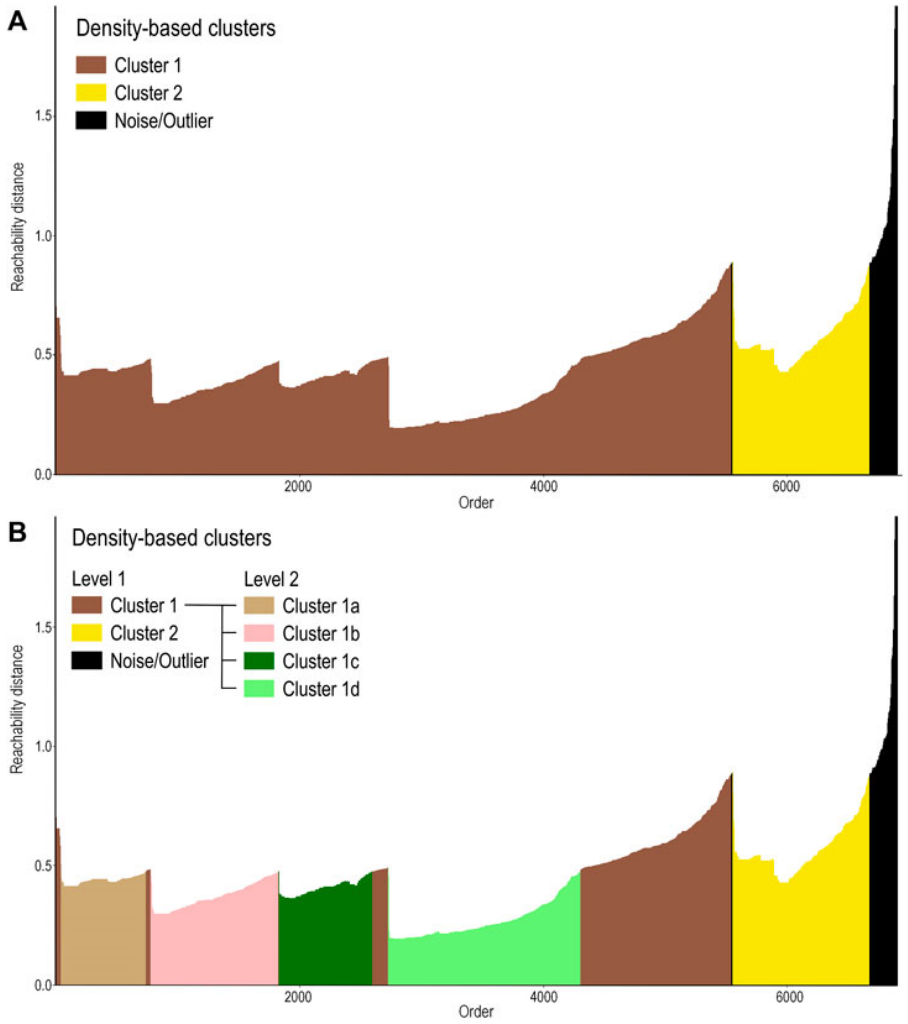
Results and discussion

- The combination of PCA and density-based clustering enabled synthesis of a large number of backscatter data layers to inform seabed classification.



- First, two broad, well-defined clusters were evident at a reachability distance of 0.88. These results agree with general trends observed for many of the backscatter layers.
- Cluster 1, which occurred across the full extent of the study area, could be further divided at a reachability distance of 0.48 to produce four sub-clusters



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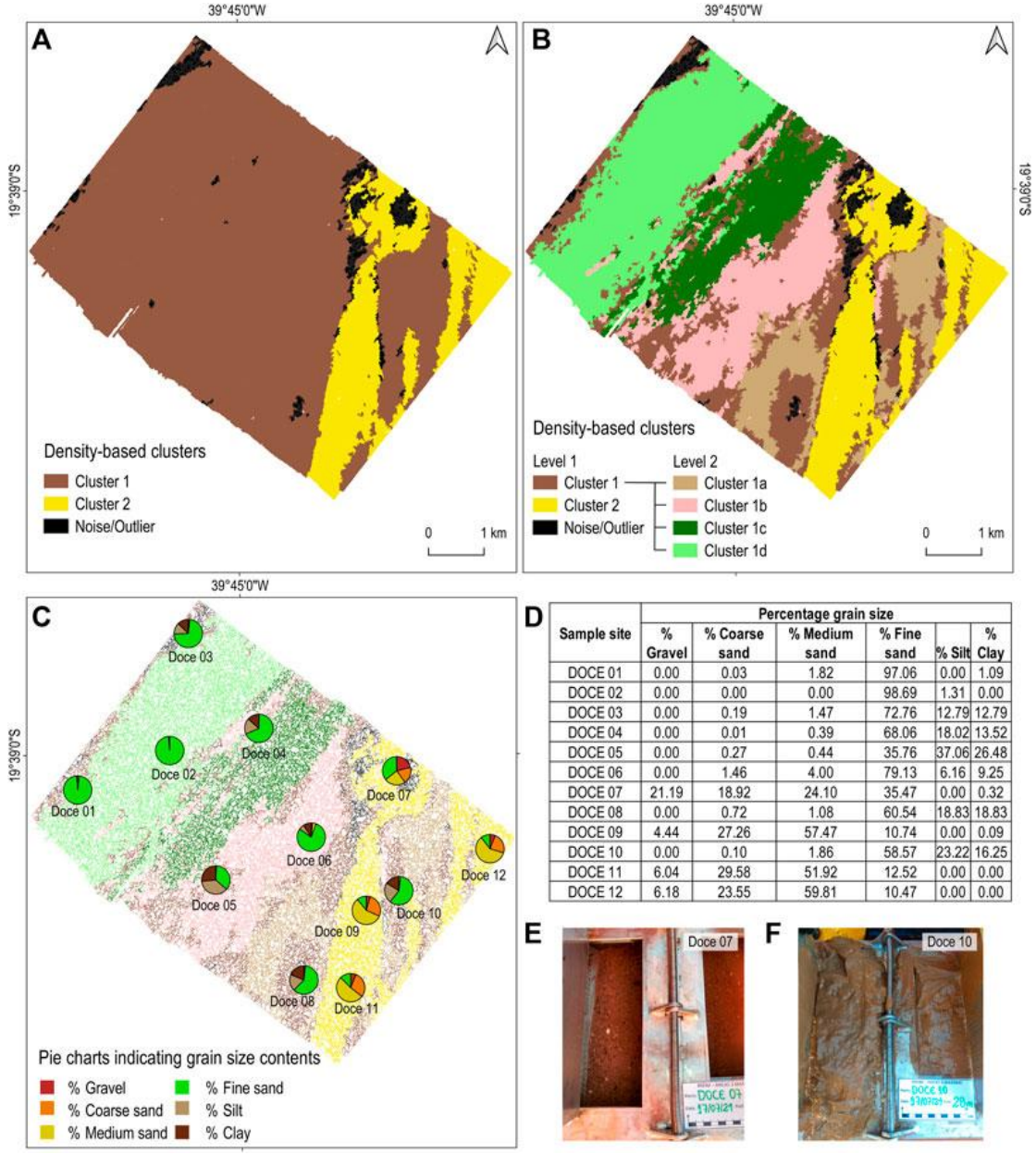
Conclusions

- Here, backscatter mosaics potentially suggest two or three seabed classes, while the angular response curves at the 12 sample sites suggest at least three classes.

- Density-based clustering enabled the integration of results from multiple approaches to produce a comprehensive unsupervised classification of the seabed using multispectral acoustic data. Both image-based and ARA approaches produced input components for the final classification, and the combined use of both helped to ensure that all relevant information was included.



Sample site	Percentage grain size					
	% Gravel	% Coarse sand	% Medium sand	% Fine sand	% Silt	% Clay
DOCE 01	0.00	0.03	1.82	97.06	0.00	1.09
DOCE 02	0.00	0.00	0.00	98.69	1.31	0.00
DOCE 03	0.00	0.19	1.47	72.76	12.79	12.79
DOCE 04	0.00	0.01	0.39	68.06	18.02	13.52
DOCE 05	0.00	0.27	0.44	35.76	37.06	26.48
DOCE 06	0.00	1.46	4.00	79.13	6.16	9.25
DOCE 07	21.19	18.92	24.10	35.47	0.00	0.32
DOCE 08	0.00	0.72	1.08	60.54	18.83	18.83
DOCE 09	4.44	27.26	57.47	10.74	0.00	0.09
DOCE 10	0.00	0.10	1.86	58.57	23.22	16.25
DOCE 11	6.04	29.58	51.92	12.52	0.00	0.00
DOCE 12	6.18	23.55	59.81	10.47	0.00	0.00

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frontiers in Remote Sensing | Acoustic Remote Sensing

ORIGINAL RESEARCH article

Front. Remote Sens., 30 March 2022 | https://doi.org/10.3389/frsen.2022.860282

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Thank you!

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