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Mappatura e monitoraggio in acque basse: nuove tecnologie e applicazioni

Fantina Madricardo
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CONOSCENZA E FUTURO DEI BASSI FONDALI
Udine, 20 Marzo 2026

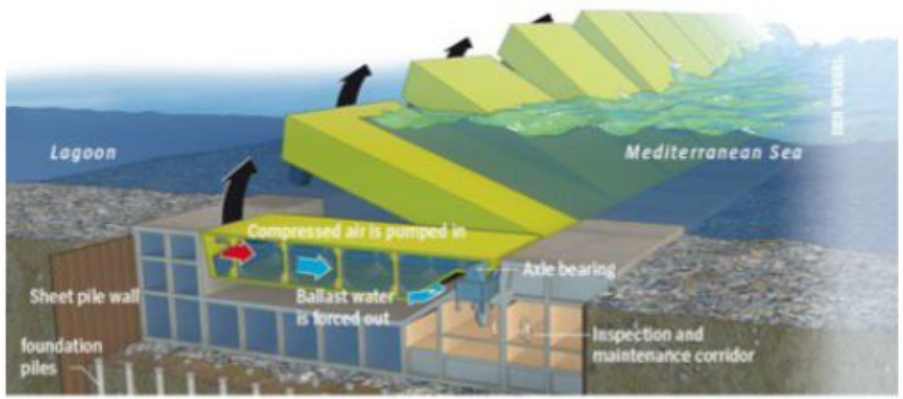
LA LAGUNA DI VENEZIA LABORATORIO NATURALE

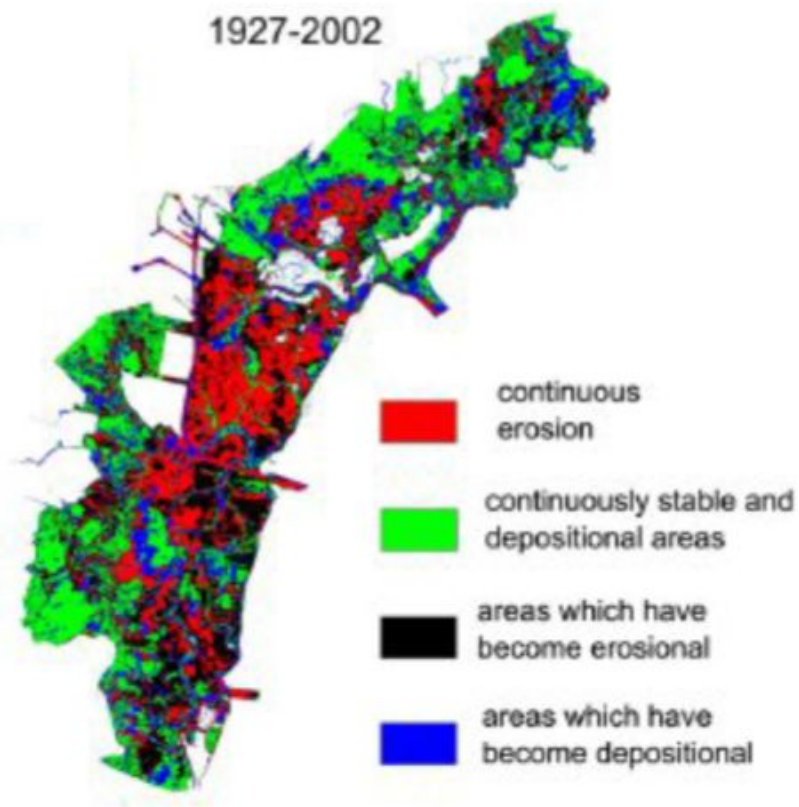
- La Laguna di Venezia è il risultato di processi naturali e di intense attività umane
- *Subsidenza, variazioni del livello medio del mare, diversione dei fiumi, dragaggio di canali, modifiche alle bocche, ecc.*

La Laguna di Venezia è un esempio paradigmatico dell'Antropocene

LA LAGUNA DI VENEZIA E' IN RAPIDA EVOLUZIONE

- Le barene sono diminuite di oltre il 50% nell'ultimo secolo
- Erosione in alcune parti della laguna
- Grandi interventi ingegneristici alle bocche di porto (progetto MoSE)



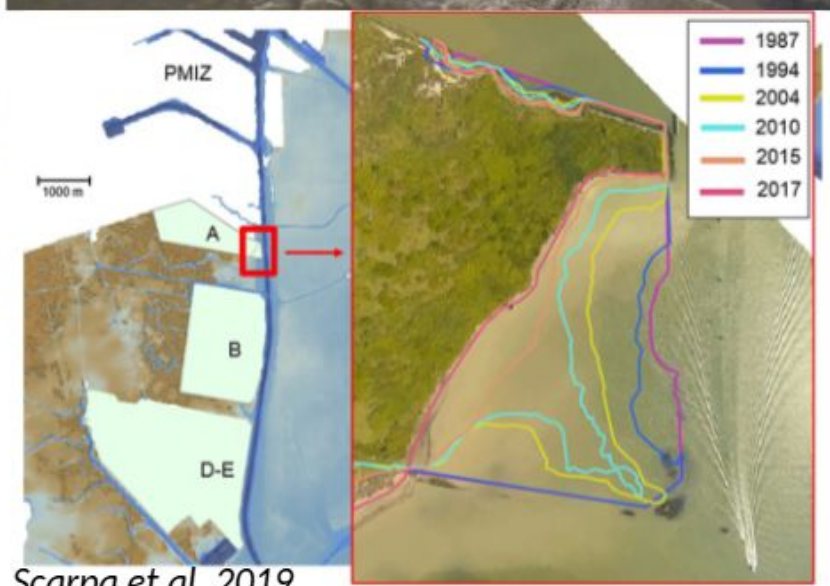


From Sarretta et al. 2010.

LA LAGUNA DI VENEZIA E' IN RAPIDA EVOLUZIONE

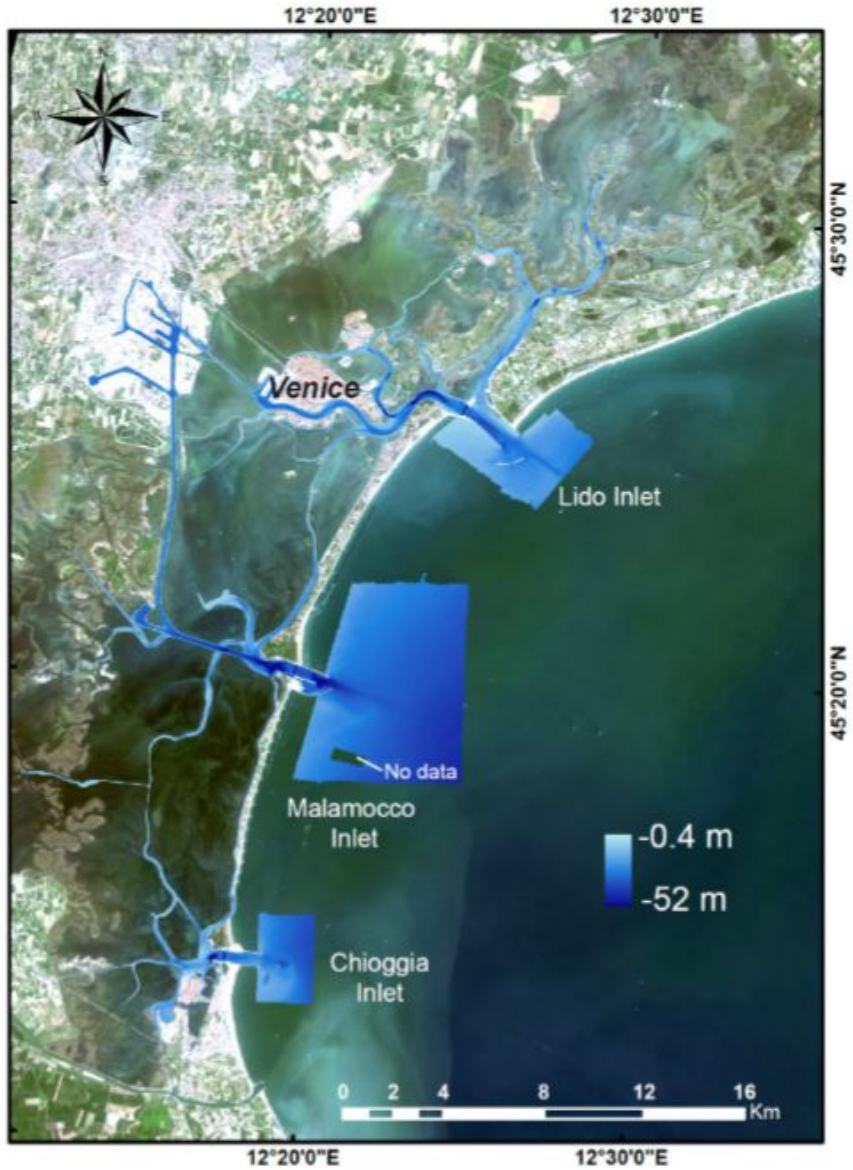
IMPATTO DEL TRAFFICO MARITTIMO ALL'INTERNO DELLA LAGUNA

Zaggia et al. 2017

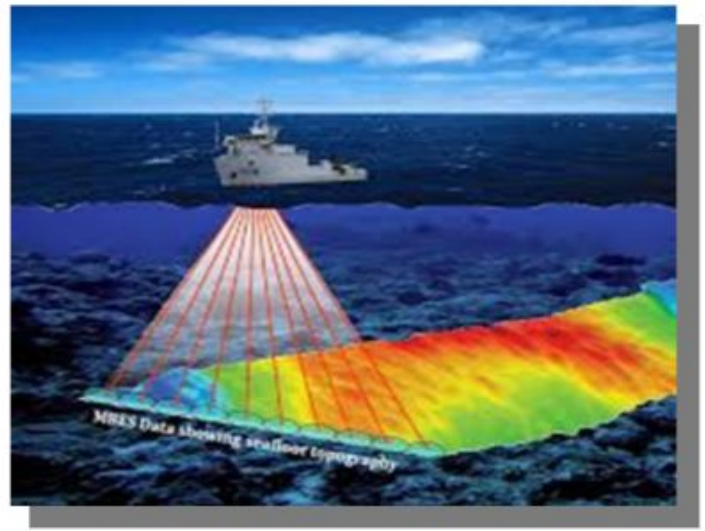


Scarpa et al. 2019

MAPPATURA AD ALTISSIMA RISOLUZIONE DEI FONDALI DEI CANALI TIDALI



Madricardo et al., Scientific Data, 2017



NEL 2013

2500 KM LINEARI

AREA DI 50 KM^2

RILIEVI RIPETUTI NELLE AREE PIÙ DINAMICHE

2014, 2016, 2019, 2020, 2021, 2024, 2025 E 2026

MAPPATURA AD ALTISSIMA RISOLUZIONE DEI FONDALI DEI CANALI TIDALI

- GEOMORFOLOGIA DEI FONDALI
- IMPATTO ANTROPICO
- ARCHEOLOGIA SUBACQUEA
- BENTHIC HABITAT MAPPING

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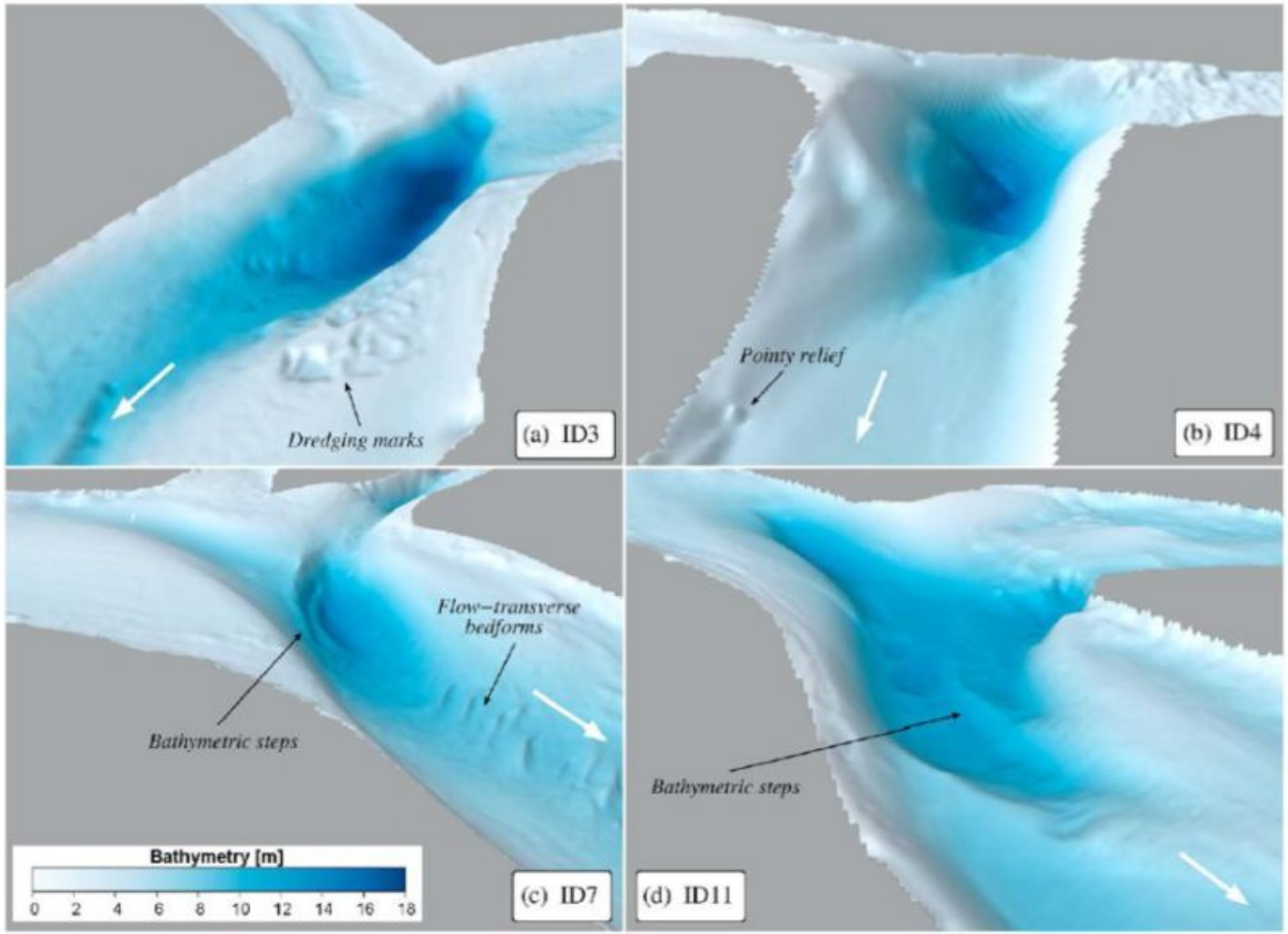
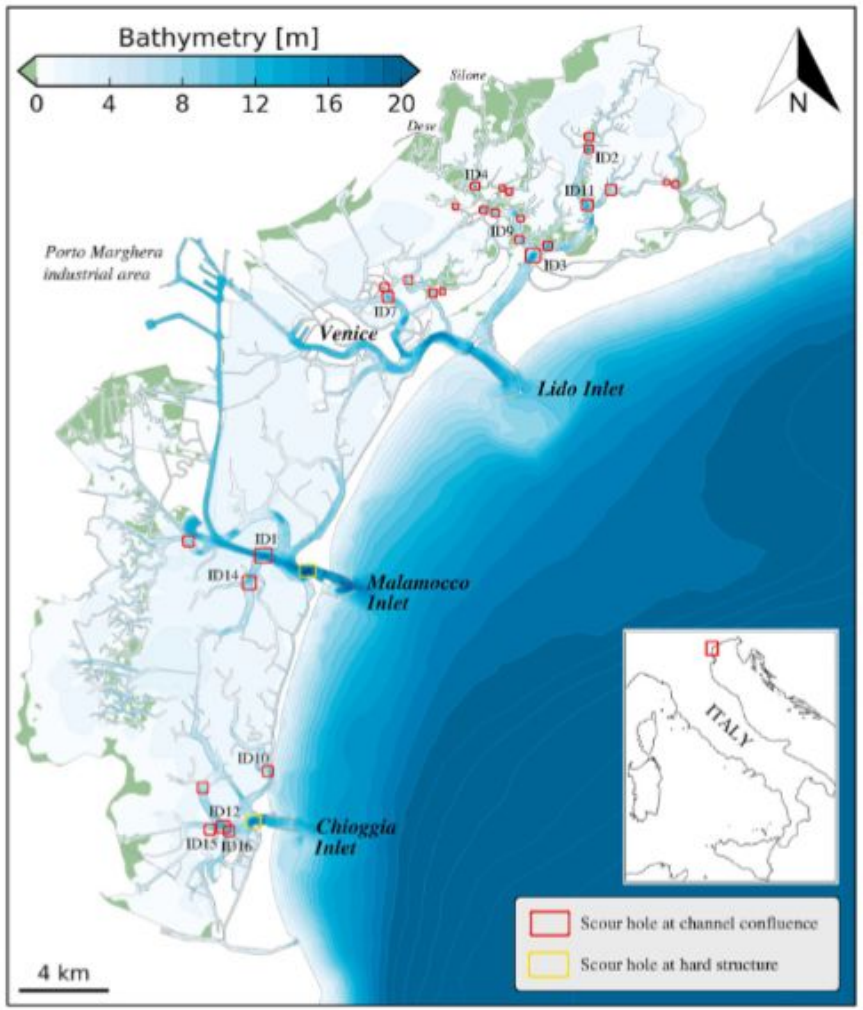
GEOMORFOLOGIA DEI FONDALI

GEOMORFOLOGIA DEI FONDALI DEI CANALI TIDALI

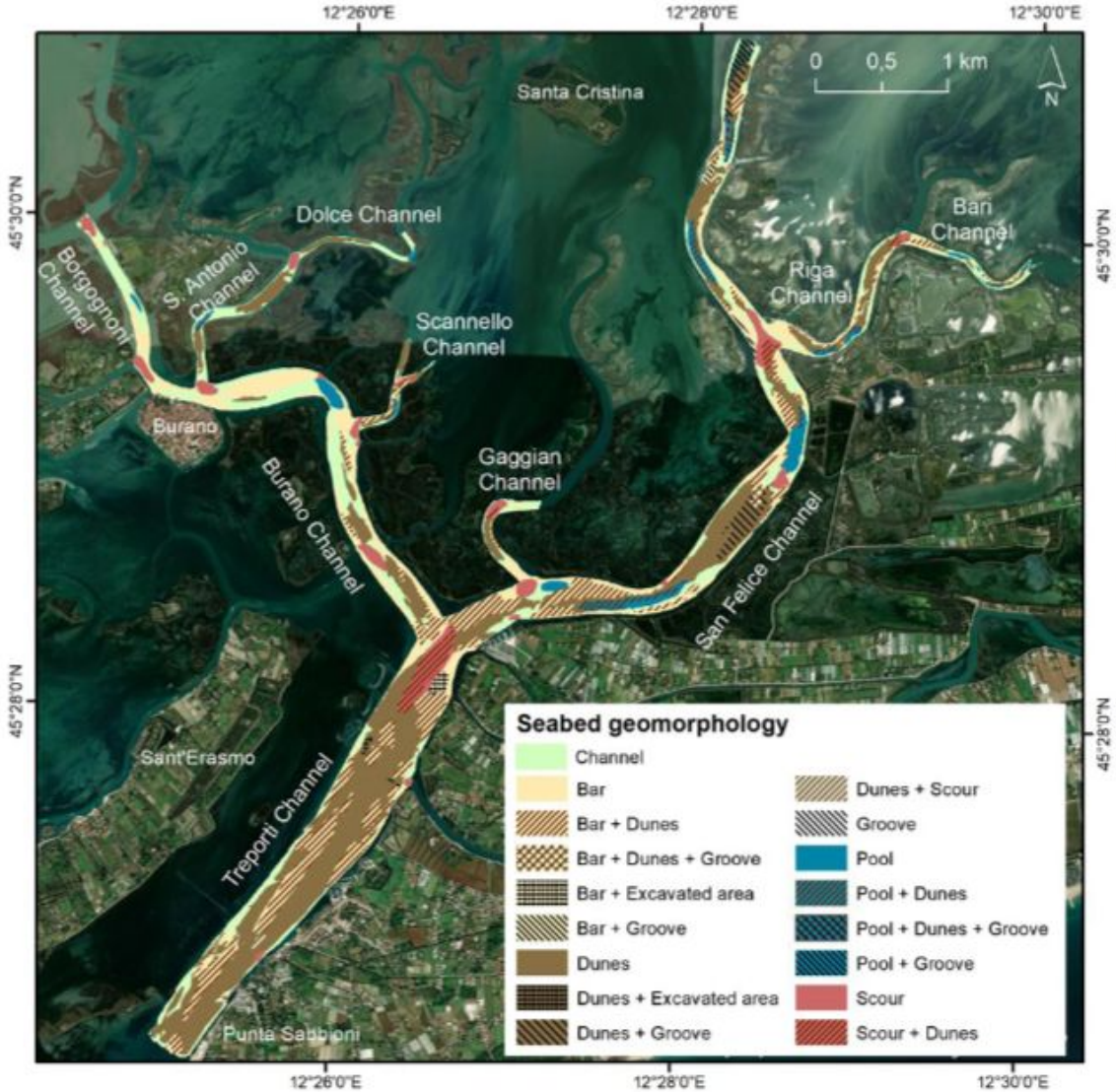


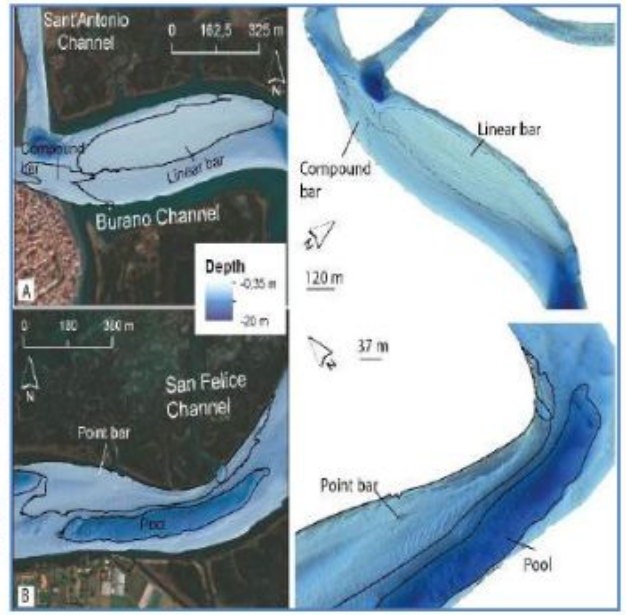


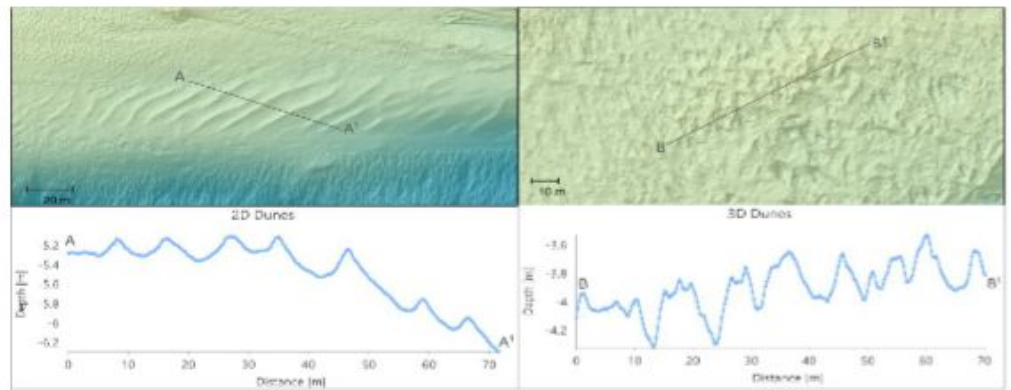
Ferrarin et al. JGR-ES 2018

Forti depressioni che si creano alla confluenza tra più canali

SEA FLOOR GEOMORPHOLOGY



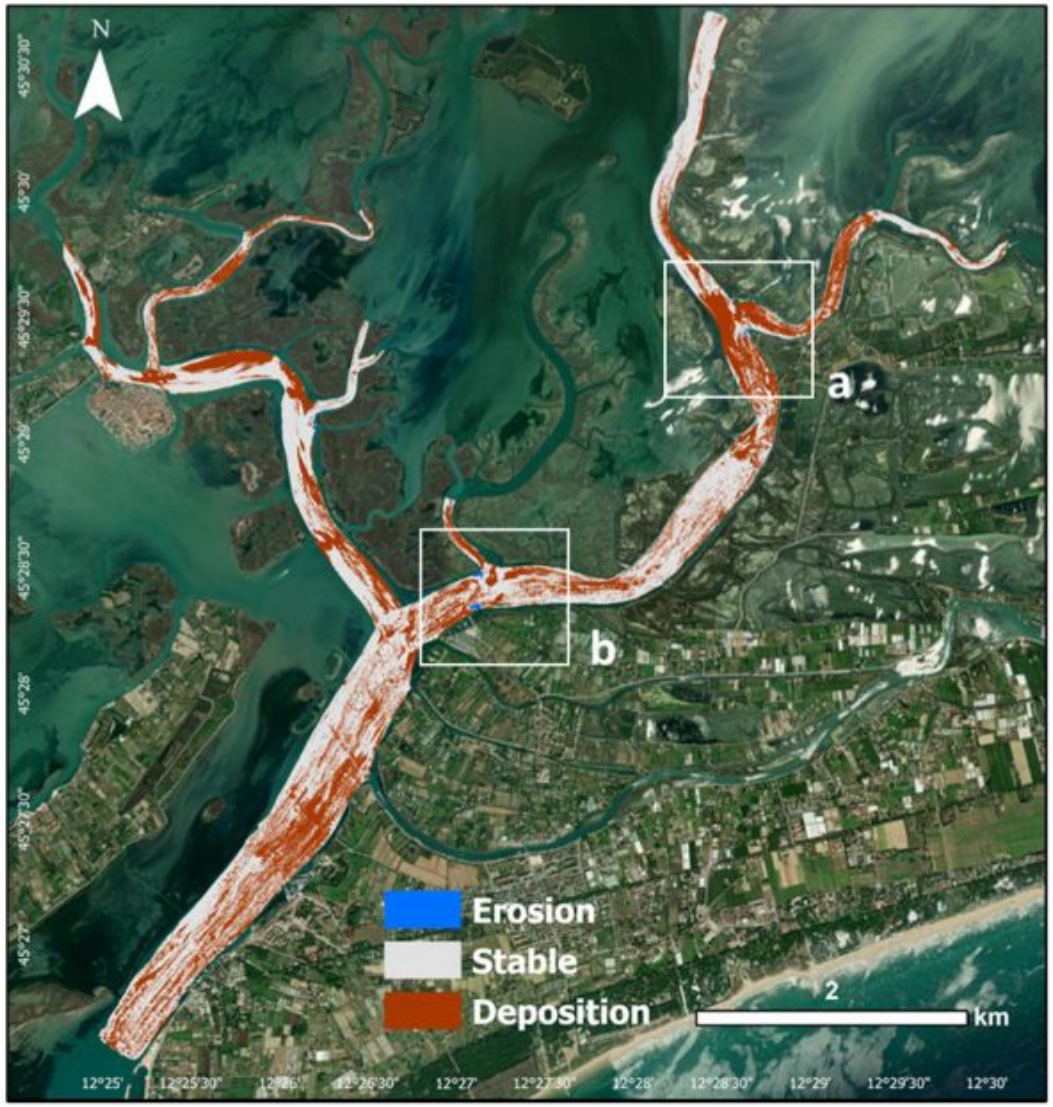


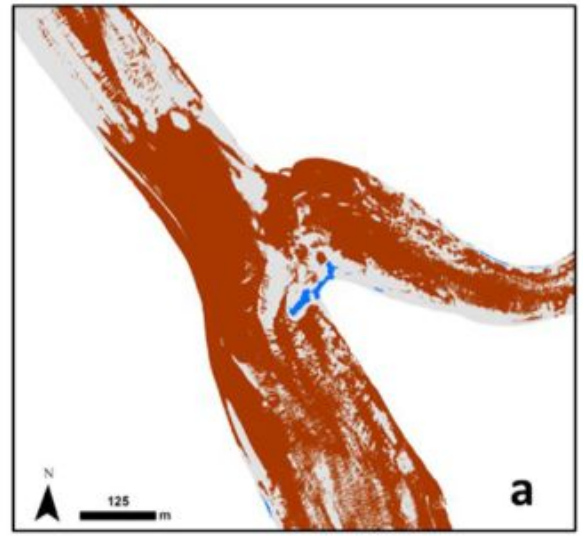


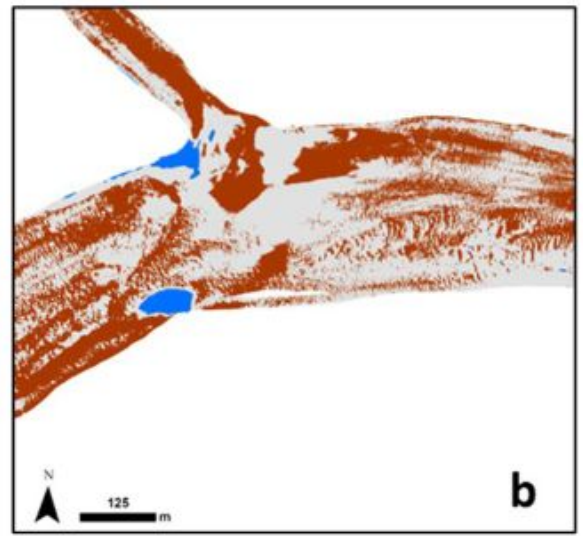
Prampolini et al., Geomorphology 2026

CAMBIAMENTI NEL TEMPO

I CANALI SONO IN DEPOSIZIONE (2013-2021)







Deposizione

$566.9 \cdot 10^3\ m^3$

Erosione

$-24.7 \cdot 10^3\ m^3$

Lahami et al. , 2026 in prep.

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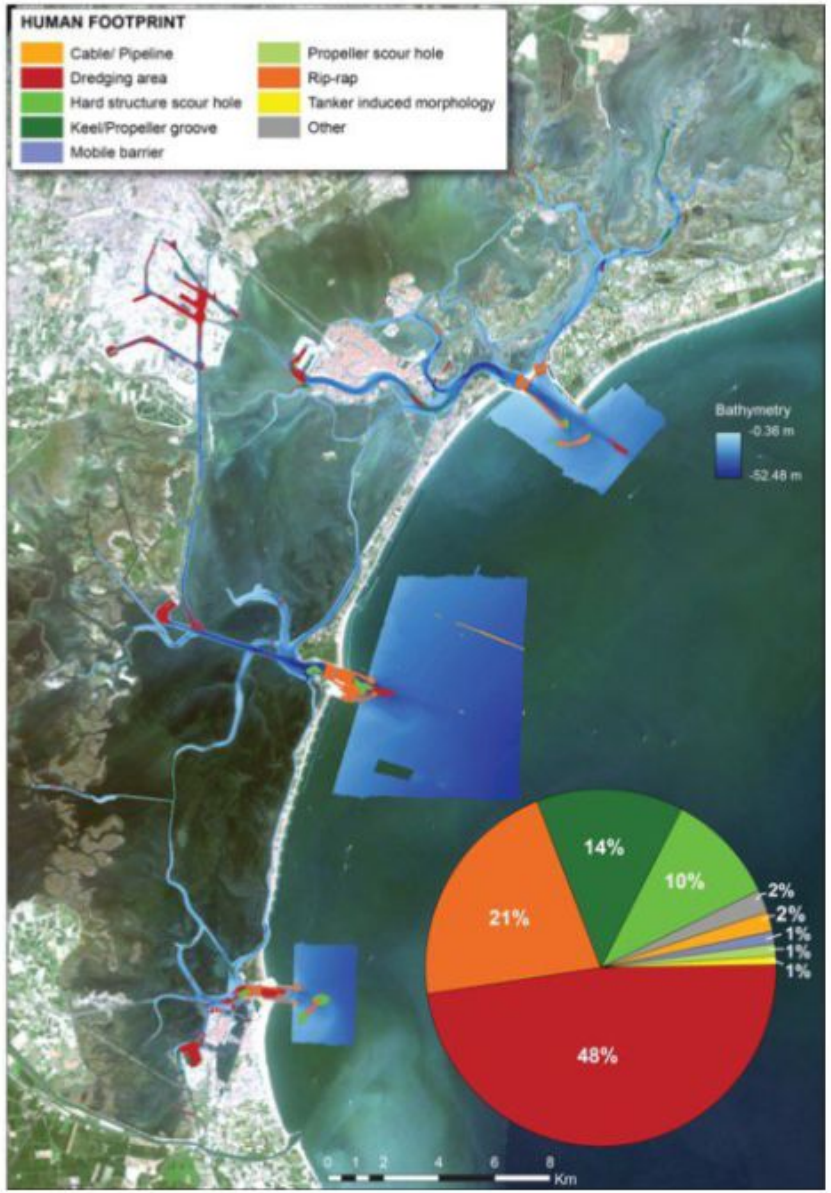
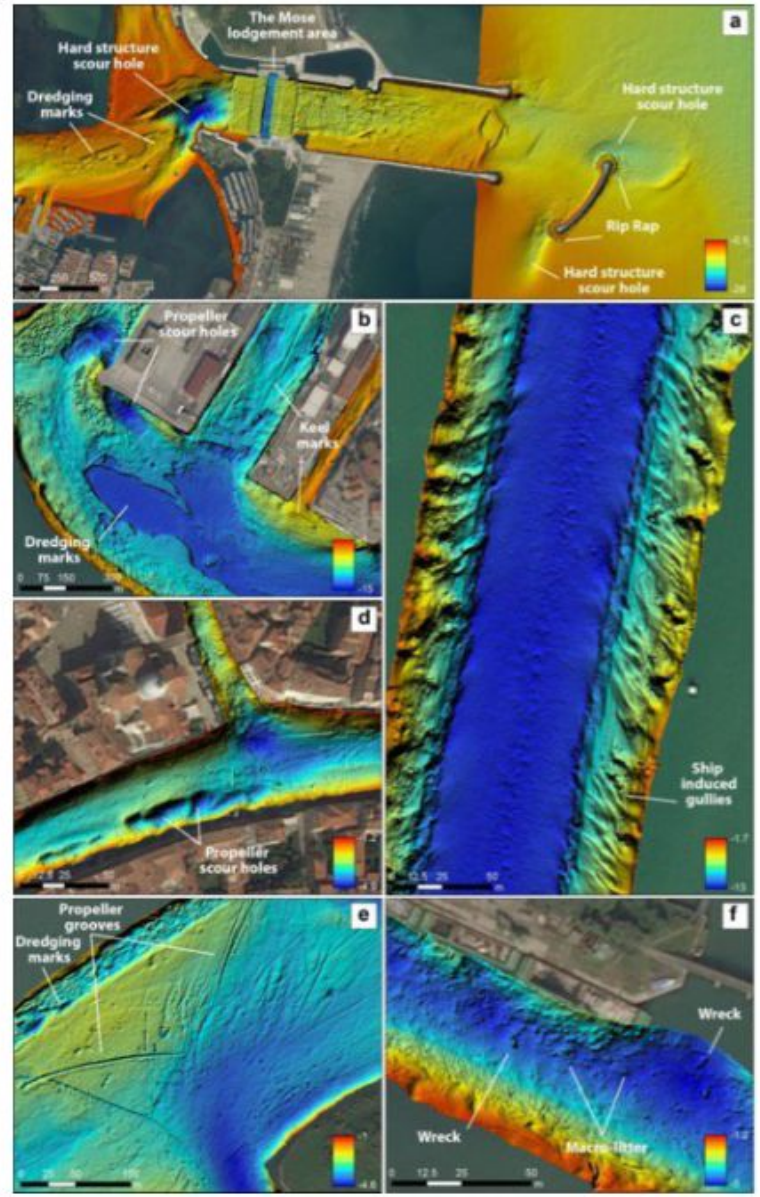
IMPATTO ANTROPICO

IMPATTO ANTROPICO





www.nature.com/scientificreports

SCIENTIFIC REPORTS

OPEN

Assessing the human footprint on the sea-floor of coastal systems: the case of the Venice Lagoon, Italy

Fantina Madricardo[1], Federica Foglini[1], Elisabetta Campiani[2], Valentina Grande[1], Elena Catenacci[2], Antonio Petrizzo[1], Aleksandra Kruss[1], Carlotta Tosi[1] & Fabio Trincardi[2]

Received: 4 October 2018
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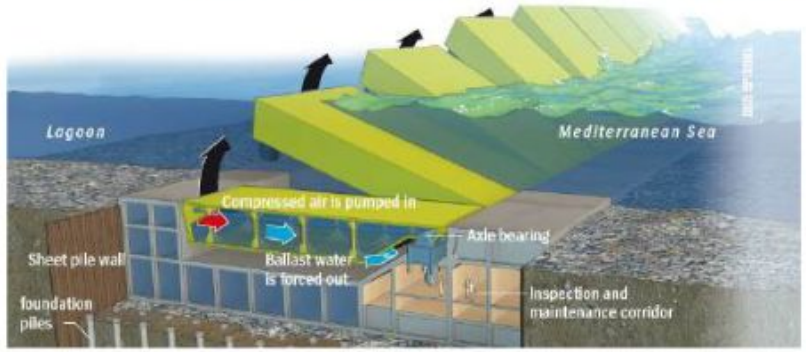
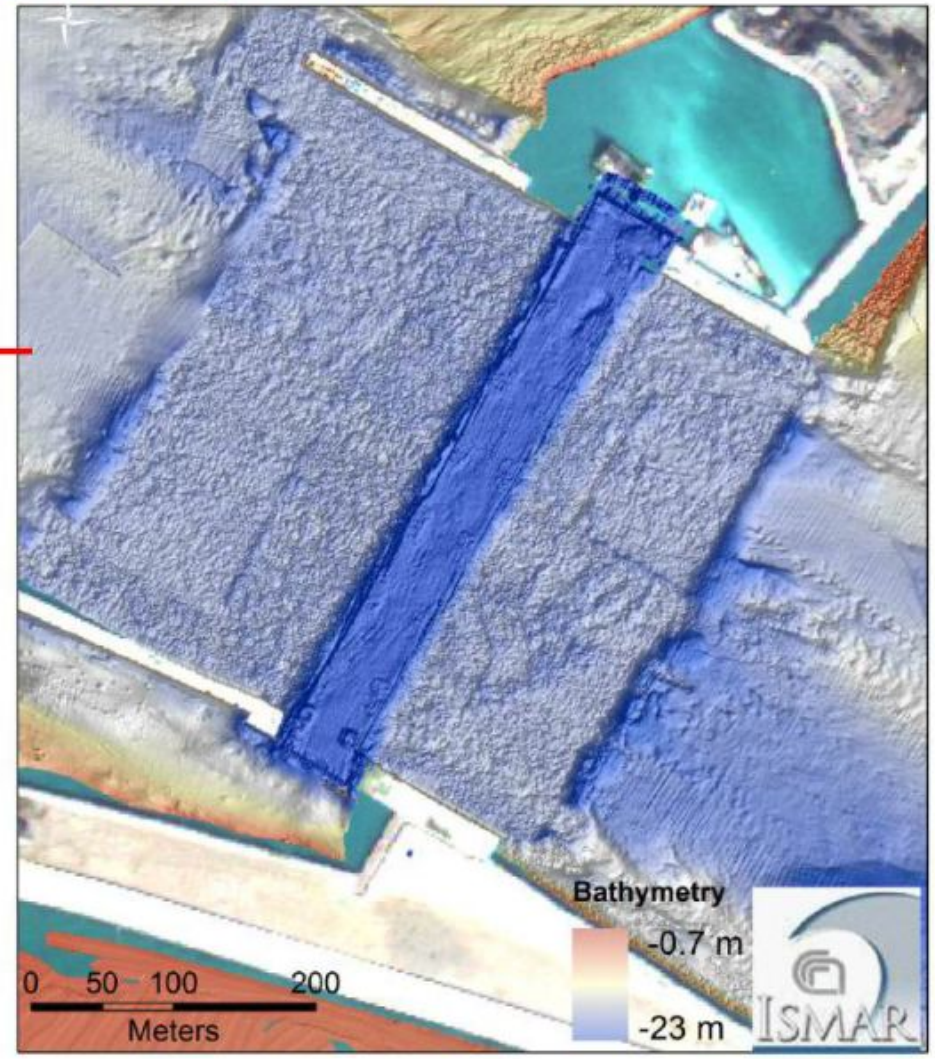
Published online: 29 April 2019

Coastal systems are among the most studied, most vulnerable, and economically most important ecosystems on Earth, nevertheless, little attention has been paid, so far, to the consequences of human activities on the shallow sea-floor of these environments. Here, we present a quantitative assessment of the effects of human actions on the floor of the tidal channels from the Venice Lagoon using 2500 kilometres of full coverage multibeam bathymetric mapping. Such extended dataset provides unprecedented evidence of pervasive human impacts, which extend far beyond the well known shrinking of salt marshes and artificial modifications of inlet geometries. Direct and indirect human imprints include dredging marks and fast-growing scours around anthropogenic structures built to protect the historical city of Venice from flooding. In addition, we document multiple effects of ship traffic (propeller-wash erosion, keel ploughing) and diffuse littering on the sea-floor. Particularly relevant, in view of the ongoing interventions on the lagoon morphology, is the evidence of the rapid morphological changes affecting the sea-floor and threatening the stability of anthropogenic structures.

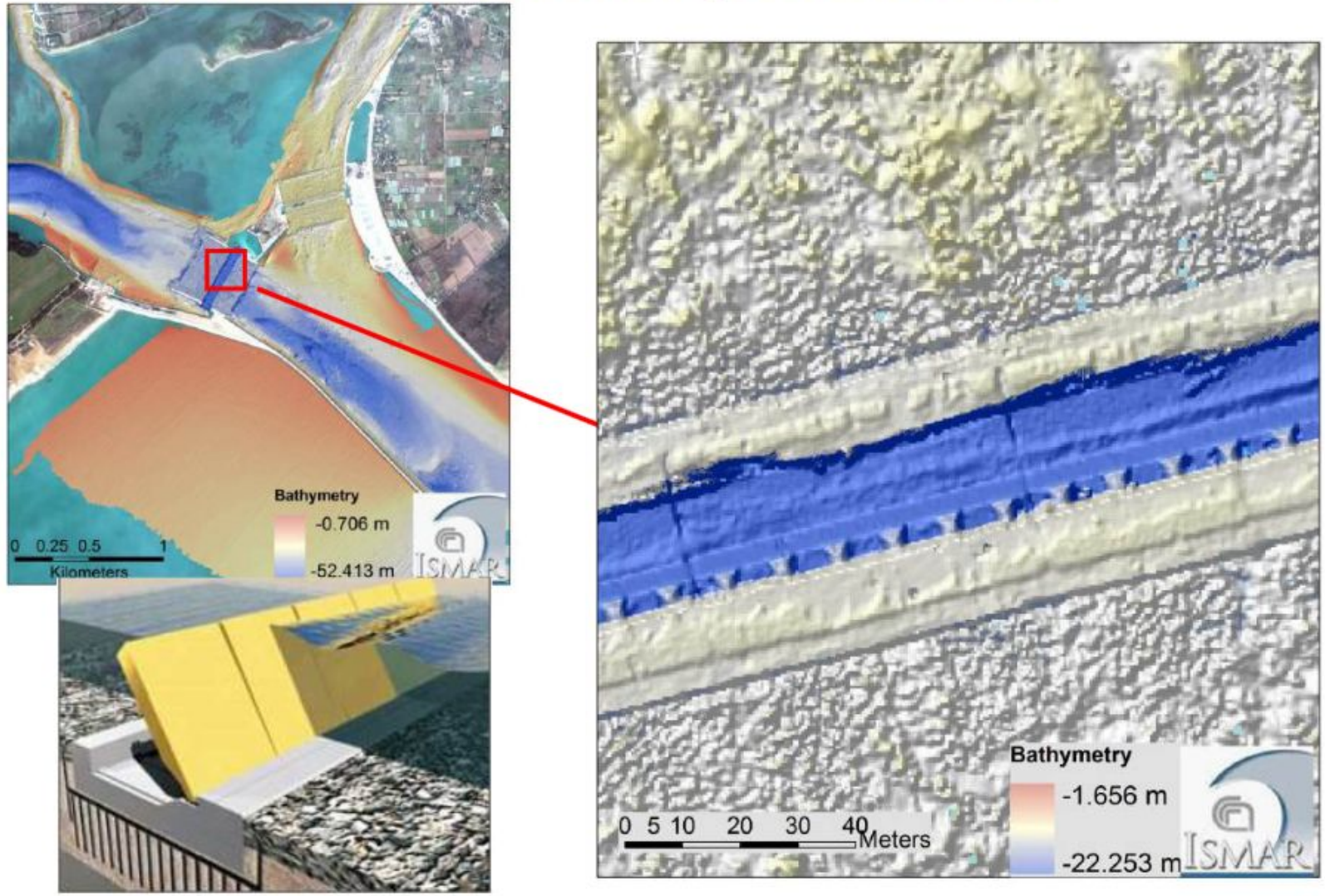
Madricardo et al., Sci. Rep. 2019

Il MOSE alla bocca di porto del Lido

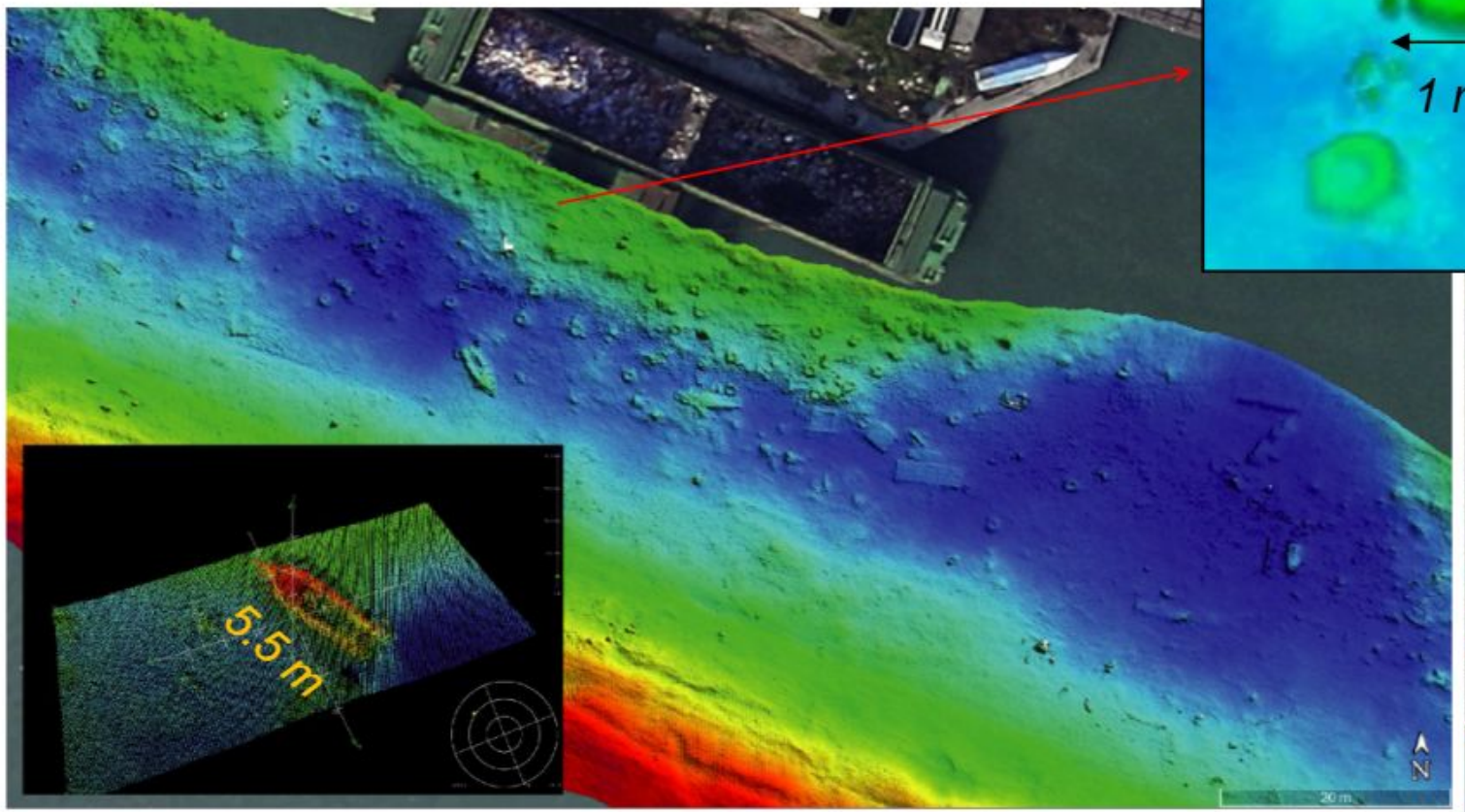


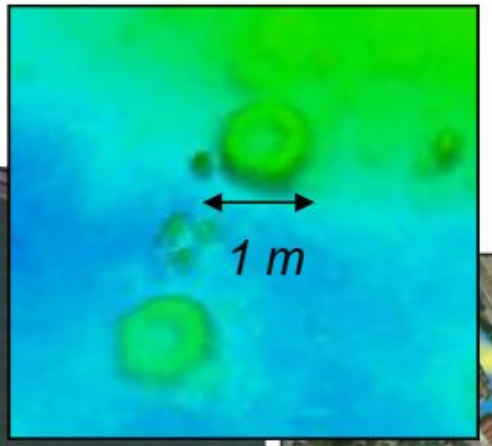


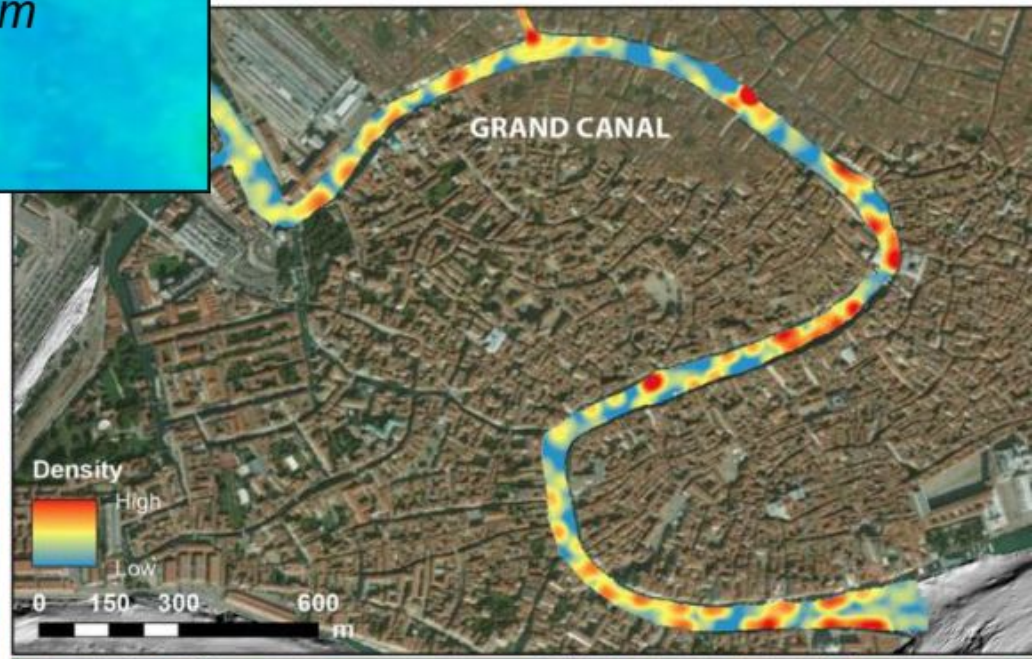
Il MOSE alla bocca di porto del Lido

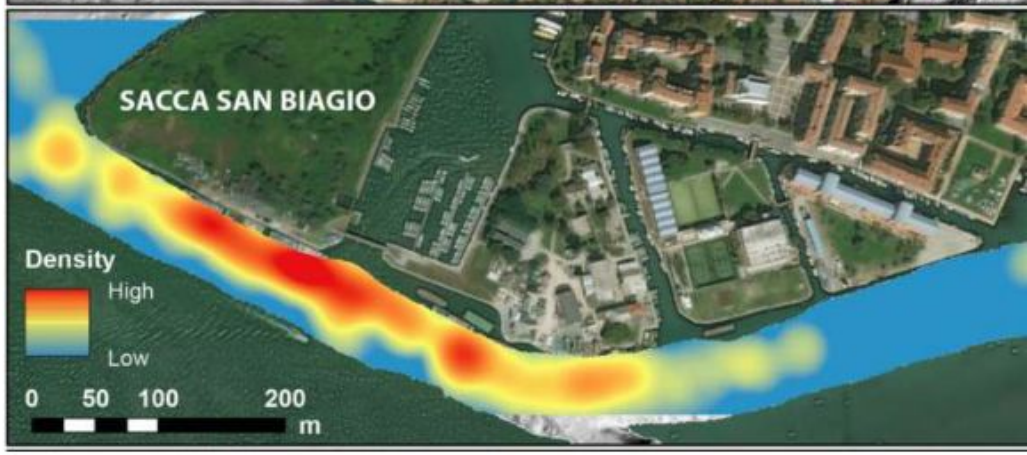


MARINE LITTER HOTSPOTS



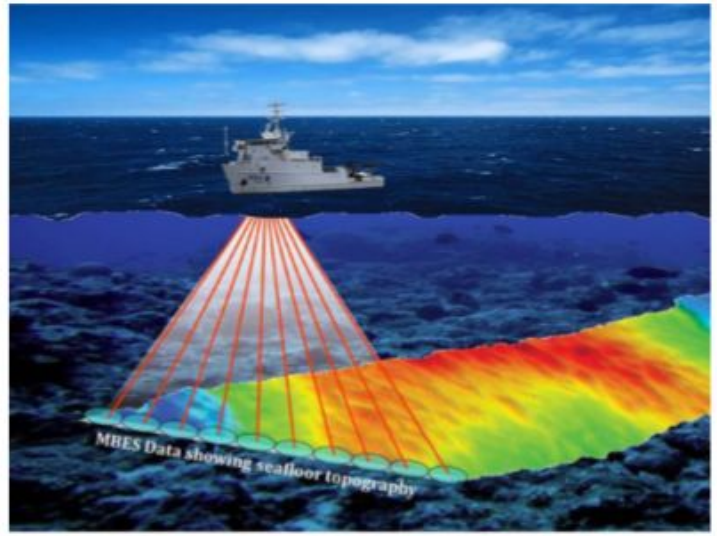


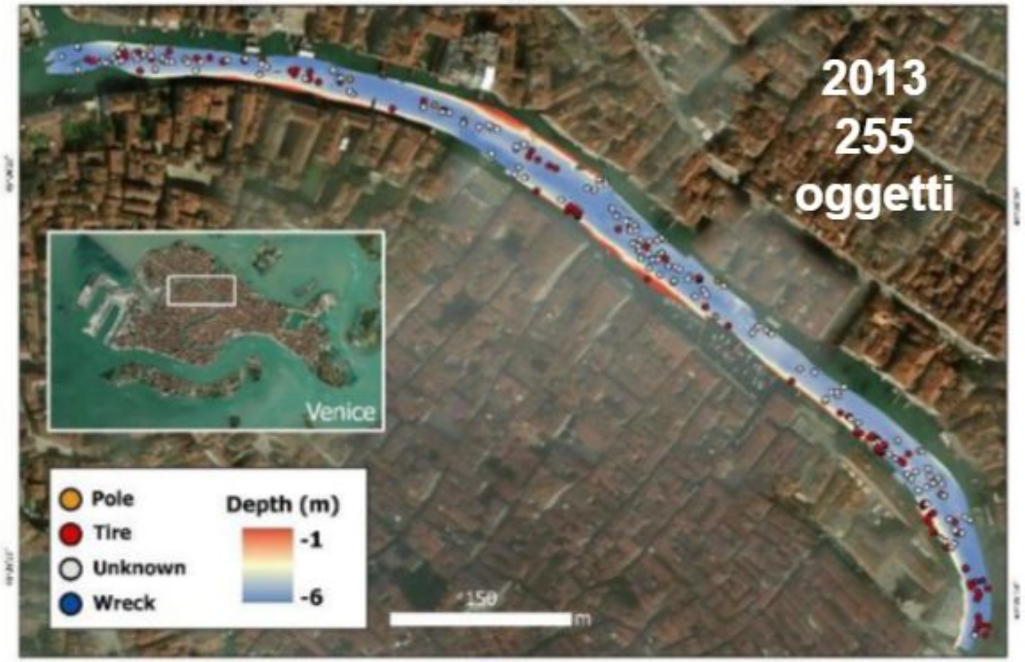


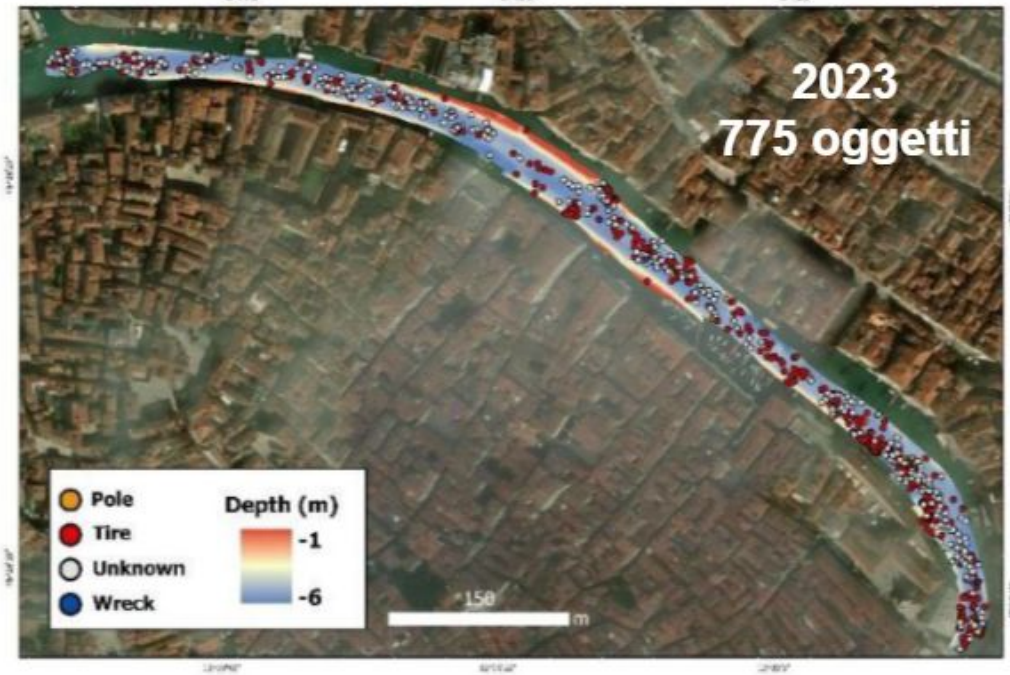


MAELSTROM

Smart technology for MArinE Litter SusTainable RemOval and Management







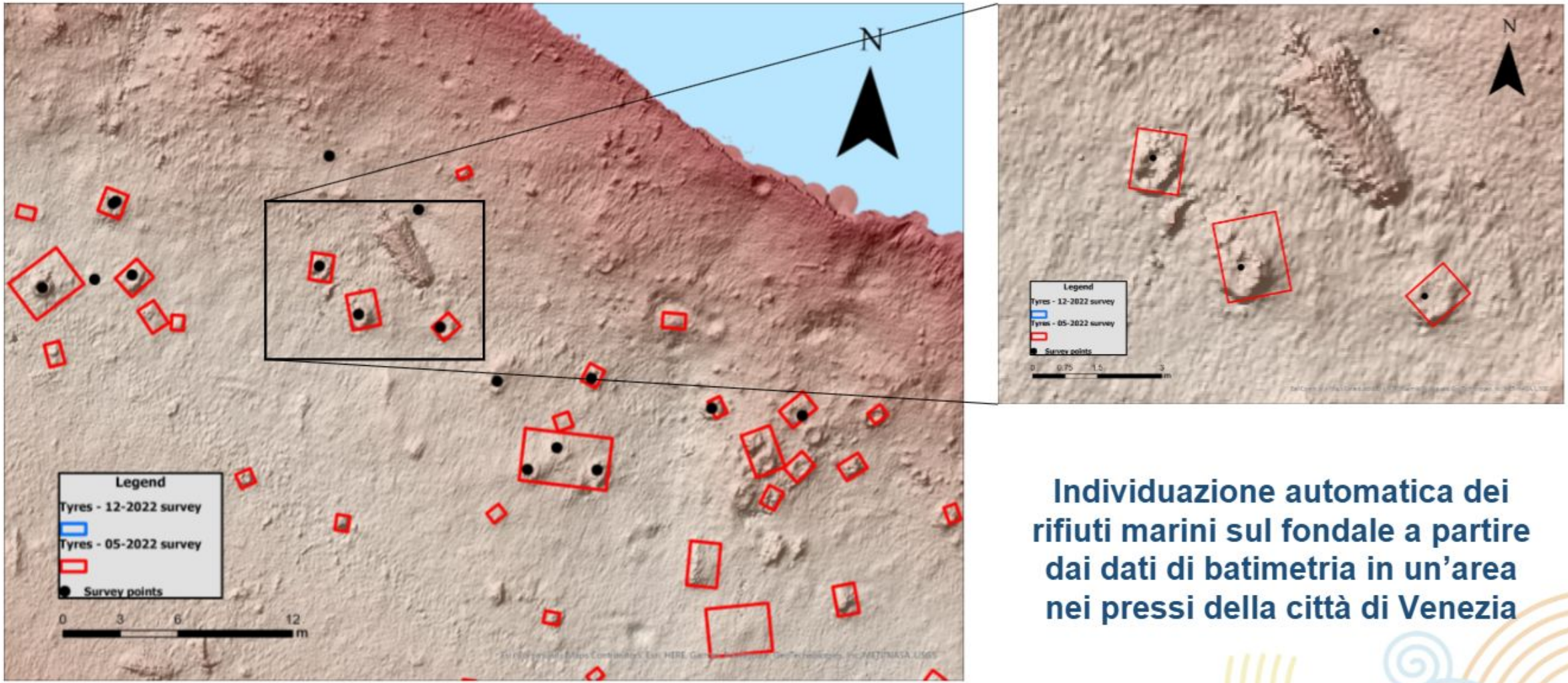
Mesghez et et al., 2026 in prep.

MARINE LITTER - SOLUZIONI

MAELSTROM

Co-funded by
the European Union

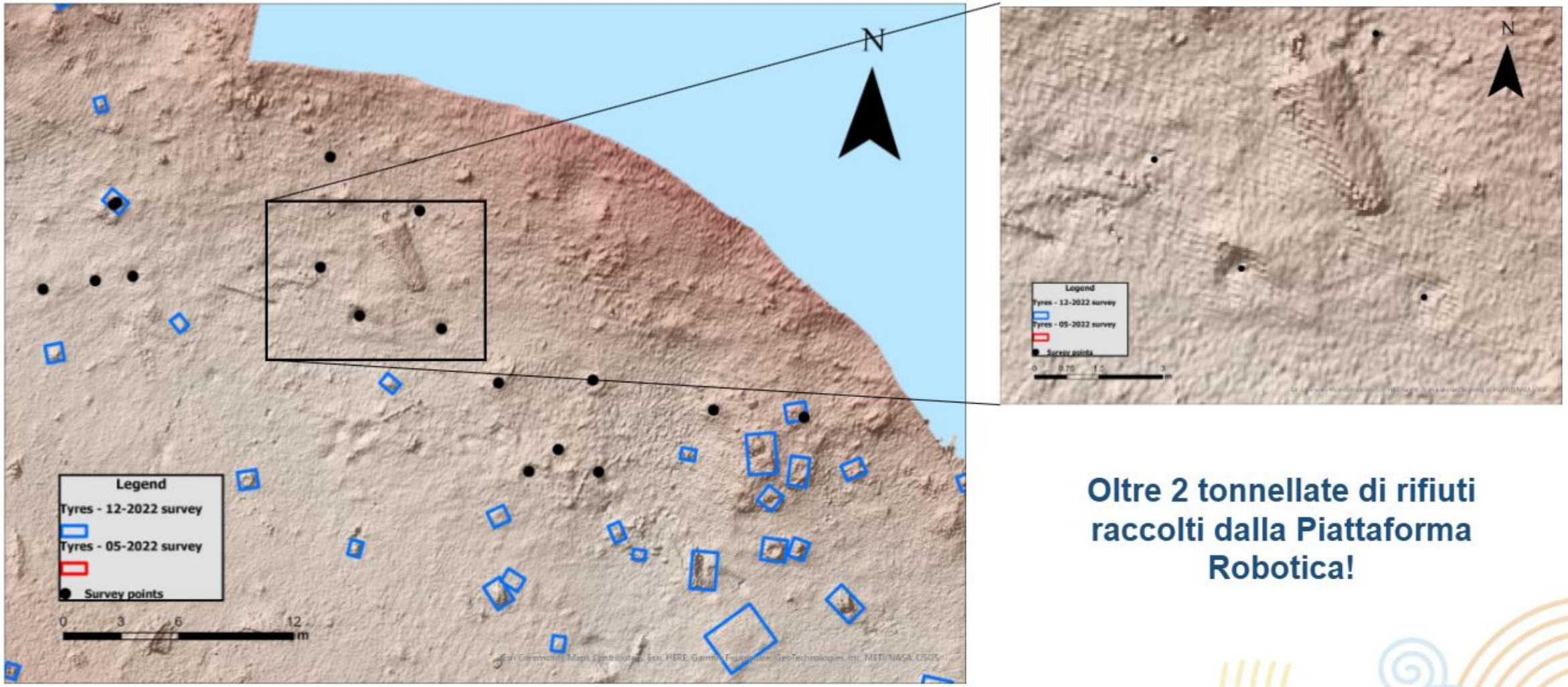
Mappatura prima della pulizia



Individuazione automatica dei rifiuti marini sul fondale a partire dai dati di batimetria in un'area nei pressi della città di Venezia

Co-funded by the European Union

Mappatura dopo la pulizia



Oltre 2 tonnellate di rifiuti raccolti dalla Piattaforma Robotica!

Co-funded by the European Union

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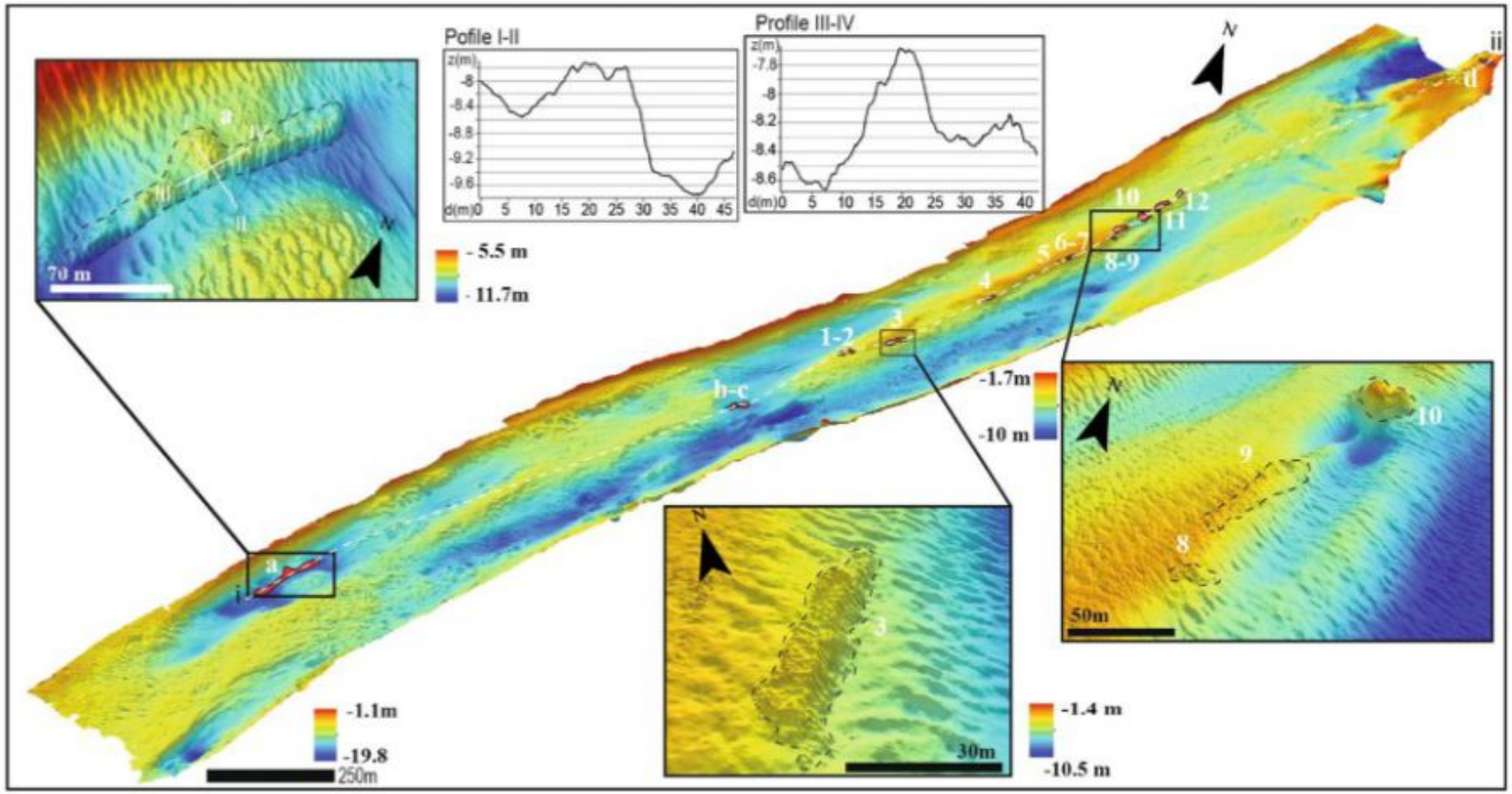
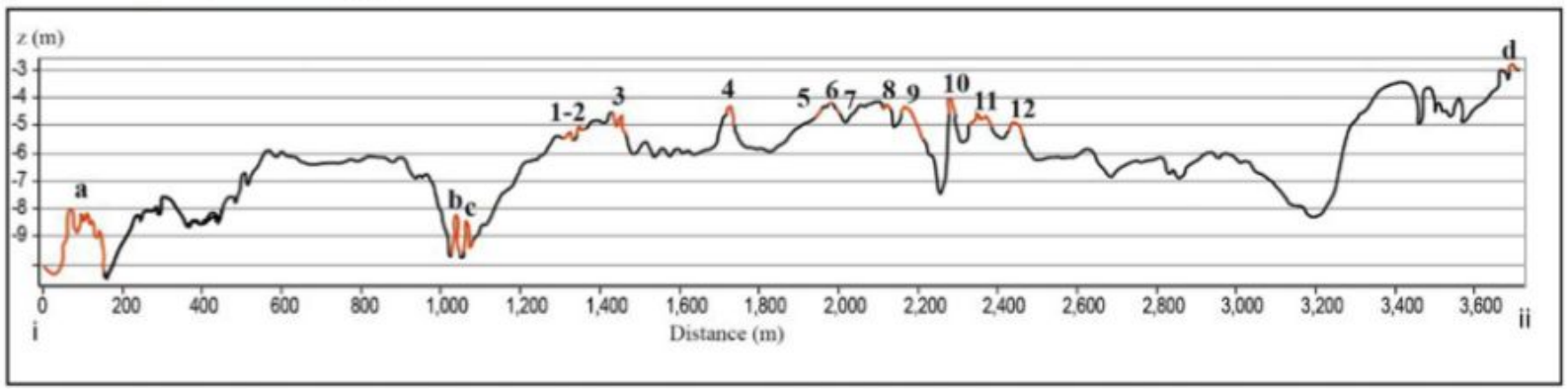
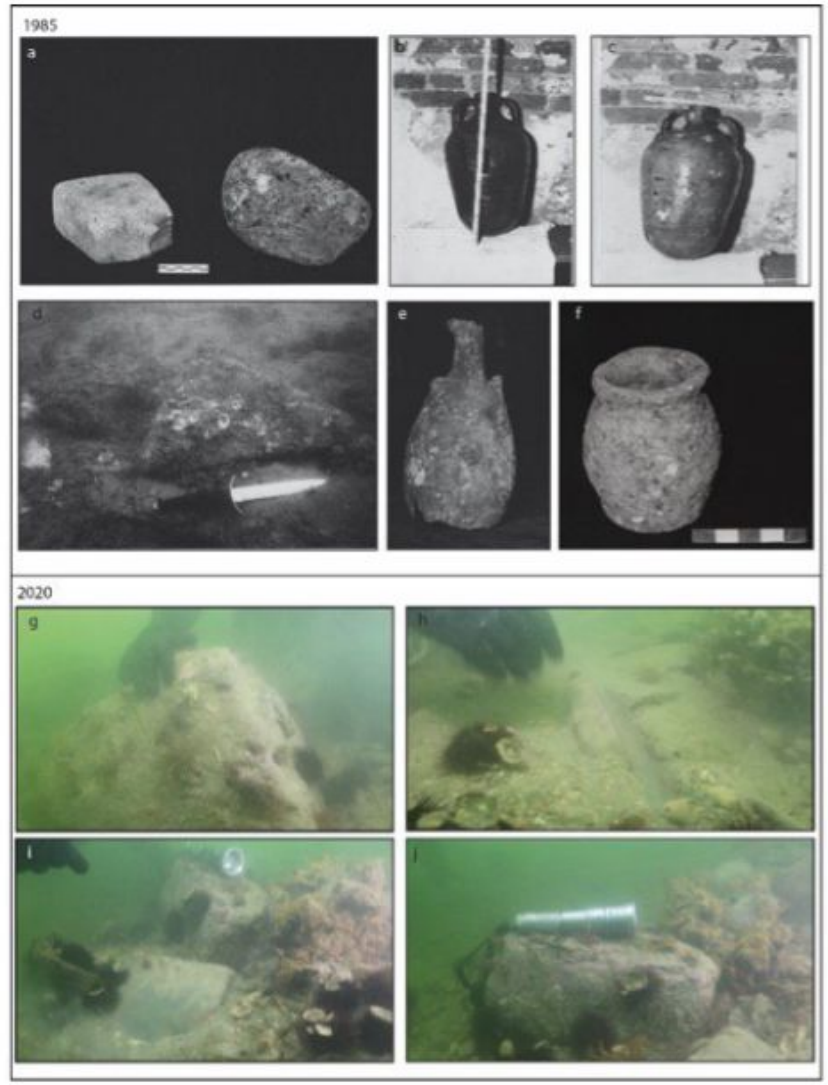
ARCHEOLOGIA SUBACQUEA

ARCHEOLOGIA SUBACQUEA



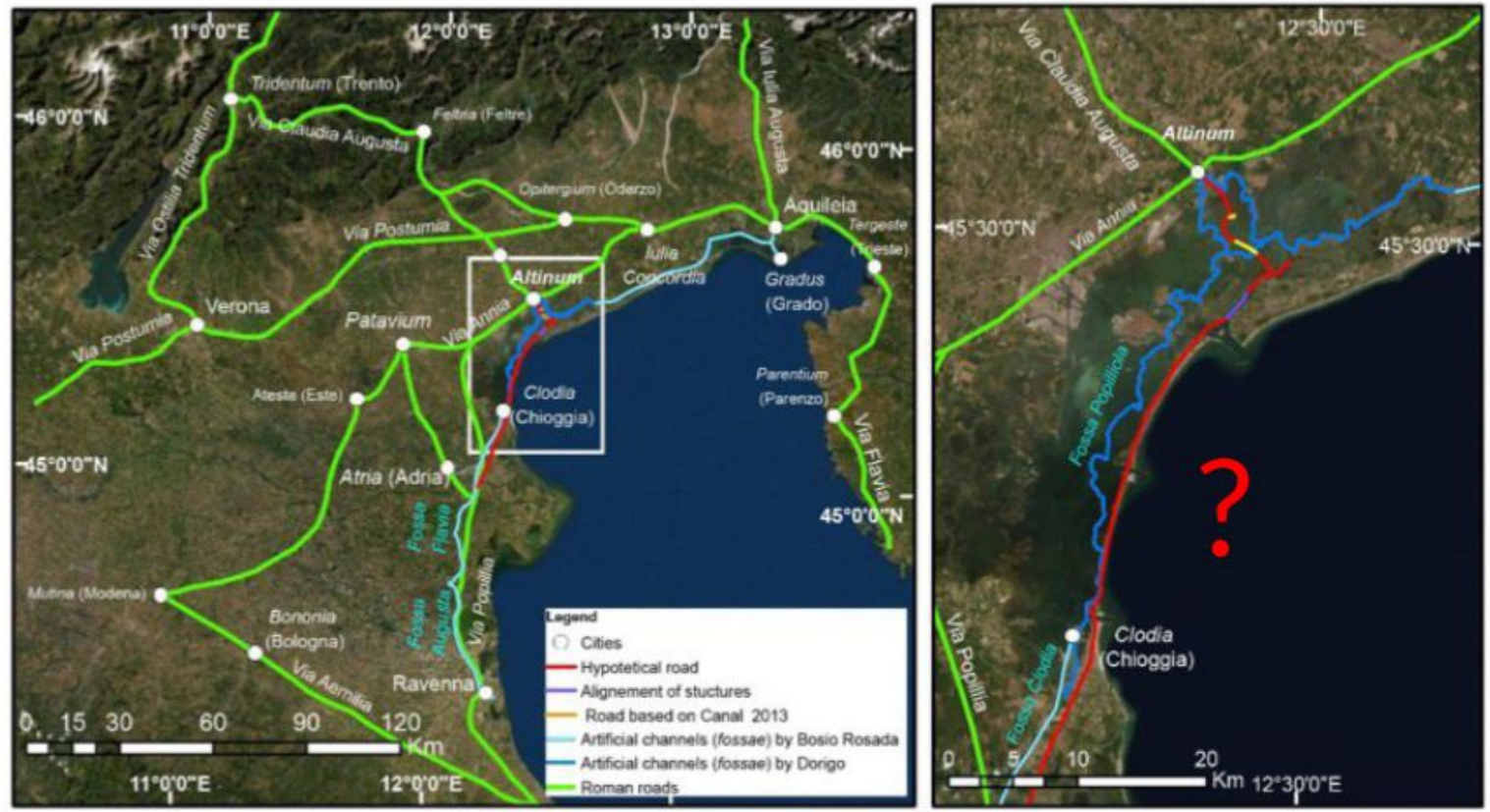


ALLINEAMENTO DI STRUTTURE
POSSIBILE STRADA ROMANA SOMMERSA?



Madricardo et al., Sci.Rep. 2021

ARCHEOLOGIA SUBACQUEA



Madricardo et al., Sci.Rep. 2021

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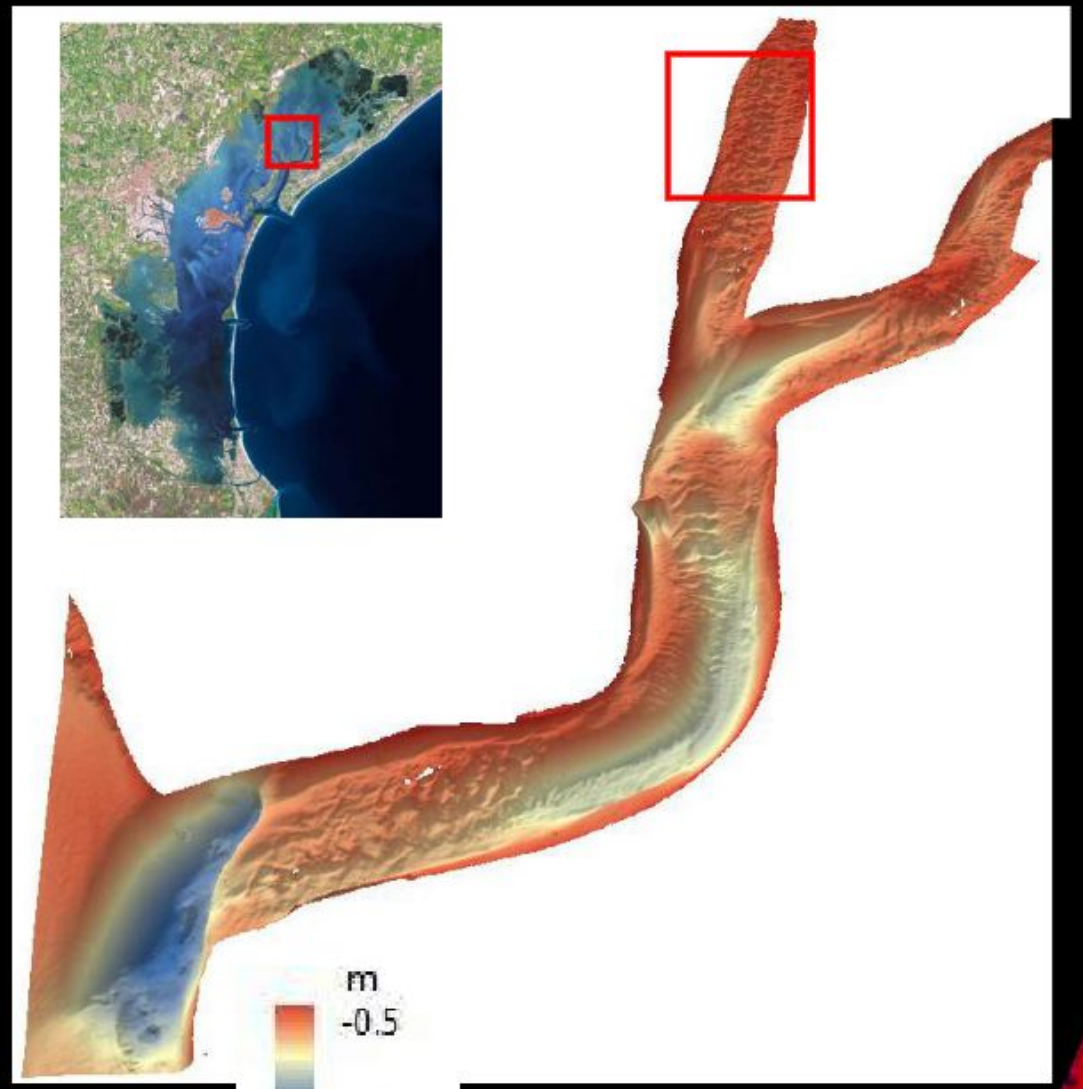
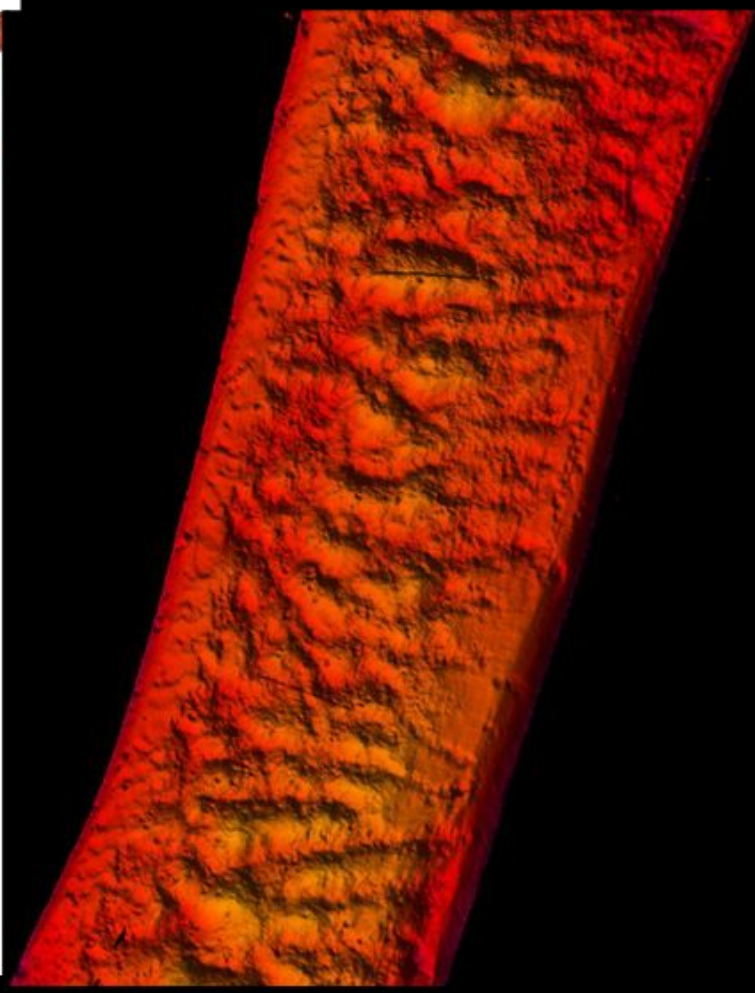
BENTHIC HABITAT MAPPING

BENTHIC HABITAT MAPPING

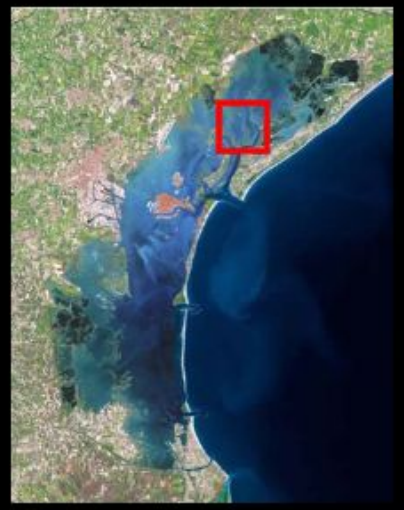




100 m

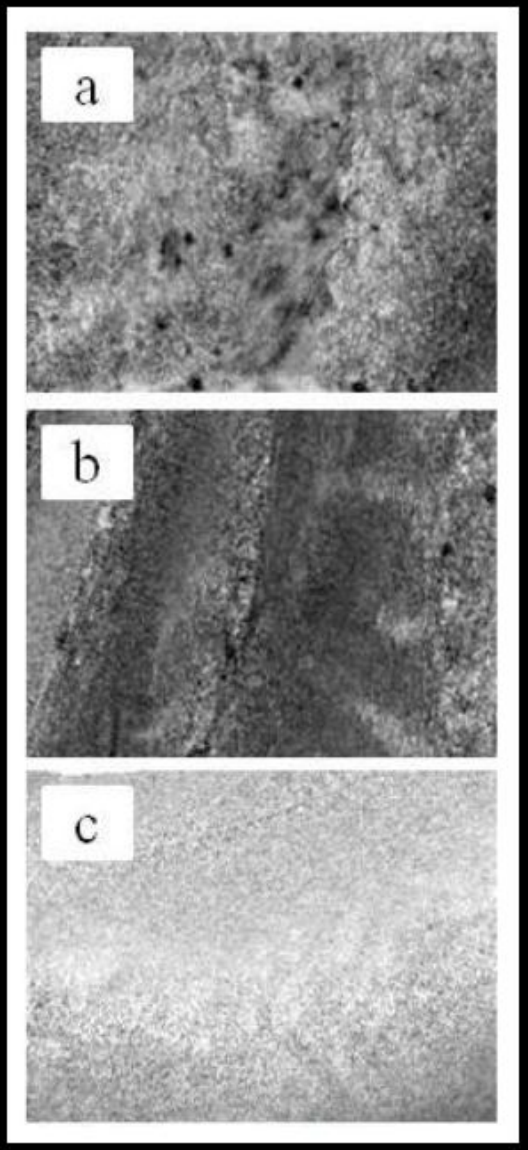
Risoluzione: 5 cm

ANALISI DEL BACKSCATTER

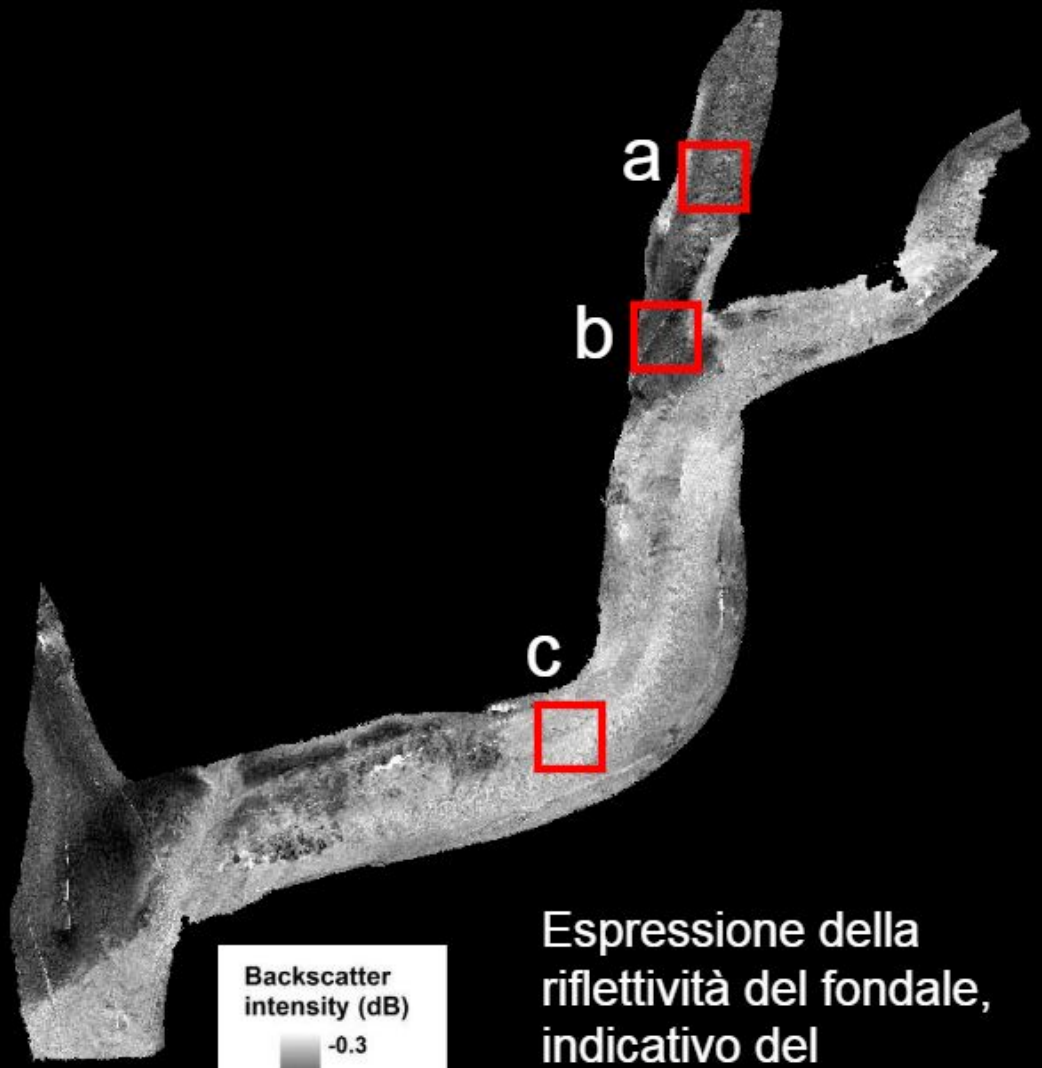


Espressione della riflettività del fondale, indicativo del substrato e della copertura

Risoluzione: 5 cm

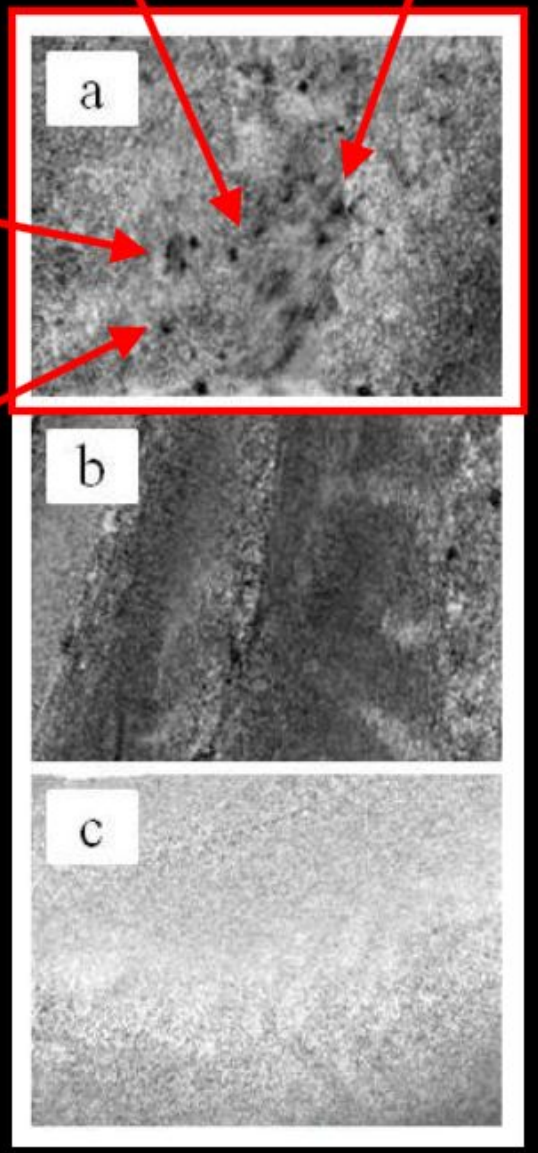


ANALISI DEL BACKSCATTER



Espressione della riflettività del fondale, indicativo del substrato e della copertura

Risoluzione: 5 cm

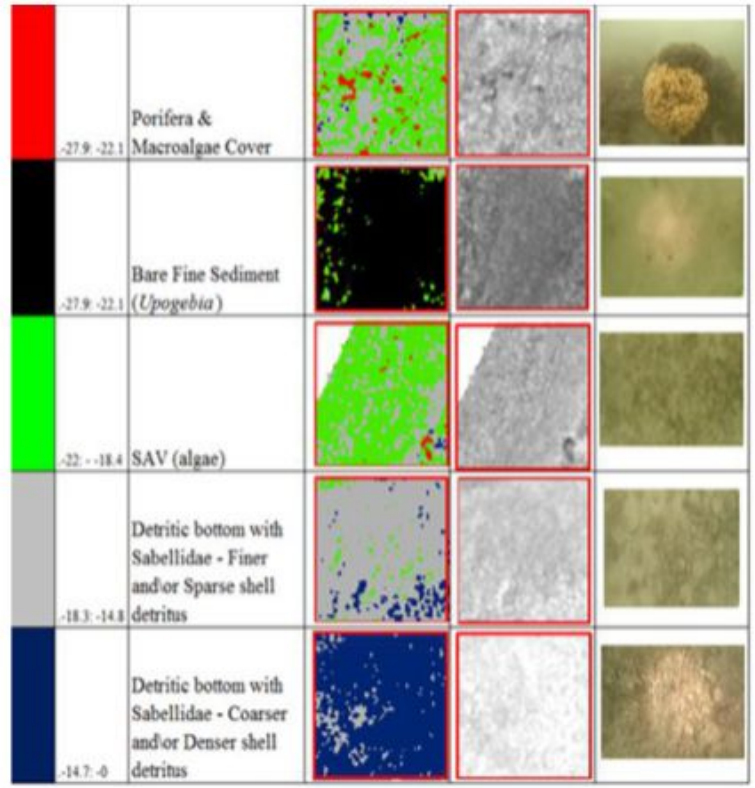


“Campi di spugne”

Courtesy of Marco Sigovini

BENTHIC HABITAT MAPPING

Montereale-Gavazzi et al. ECSS 2016.



MAPPE DEGLI HABITAT BENTONICI VALIDATE CON CAMPIONI IN SITU

SCOPERTA DI NUOVI HABITAT!

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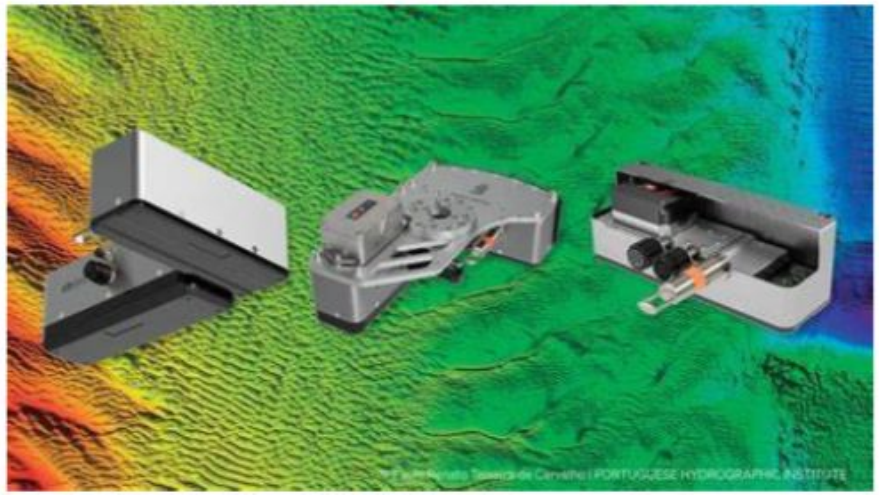
SVILUPPI FUTURI

INTEGRAZIONE DATI



Kongsberg 2042 Multibeam echosounder

DJI Matrice 350 RTK
con Lidar Zenmuse L2

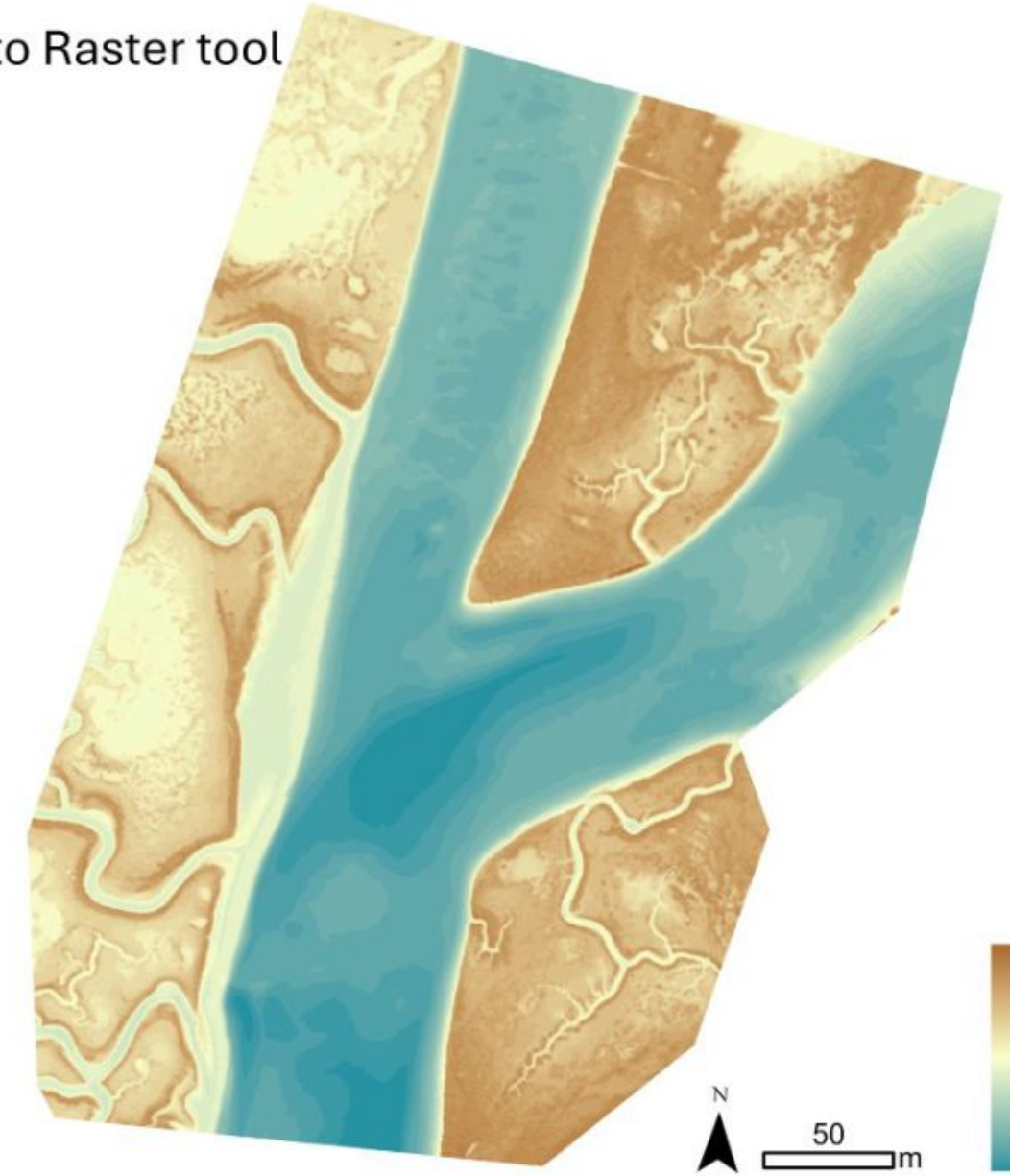
Innomar Compact:
Parametric Sub Bottom Profiler

INTEGRAZIONE DELLA MAPPATURA DELL FONDALE, DELLA COLONNA D'ACQUA, DEL SOTTOFONDO OF GROUND, DELLA SUPERFICIE, DEI SUONI SOTTOMARINI E DEI DATI VIDEO

Interreg
Co-funded by the European Union

ArcGIS Pro: Topo to Raster tool

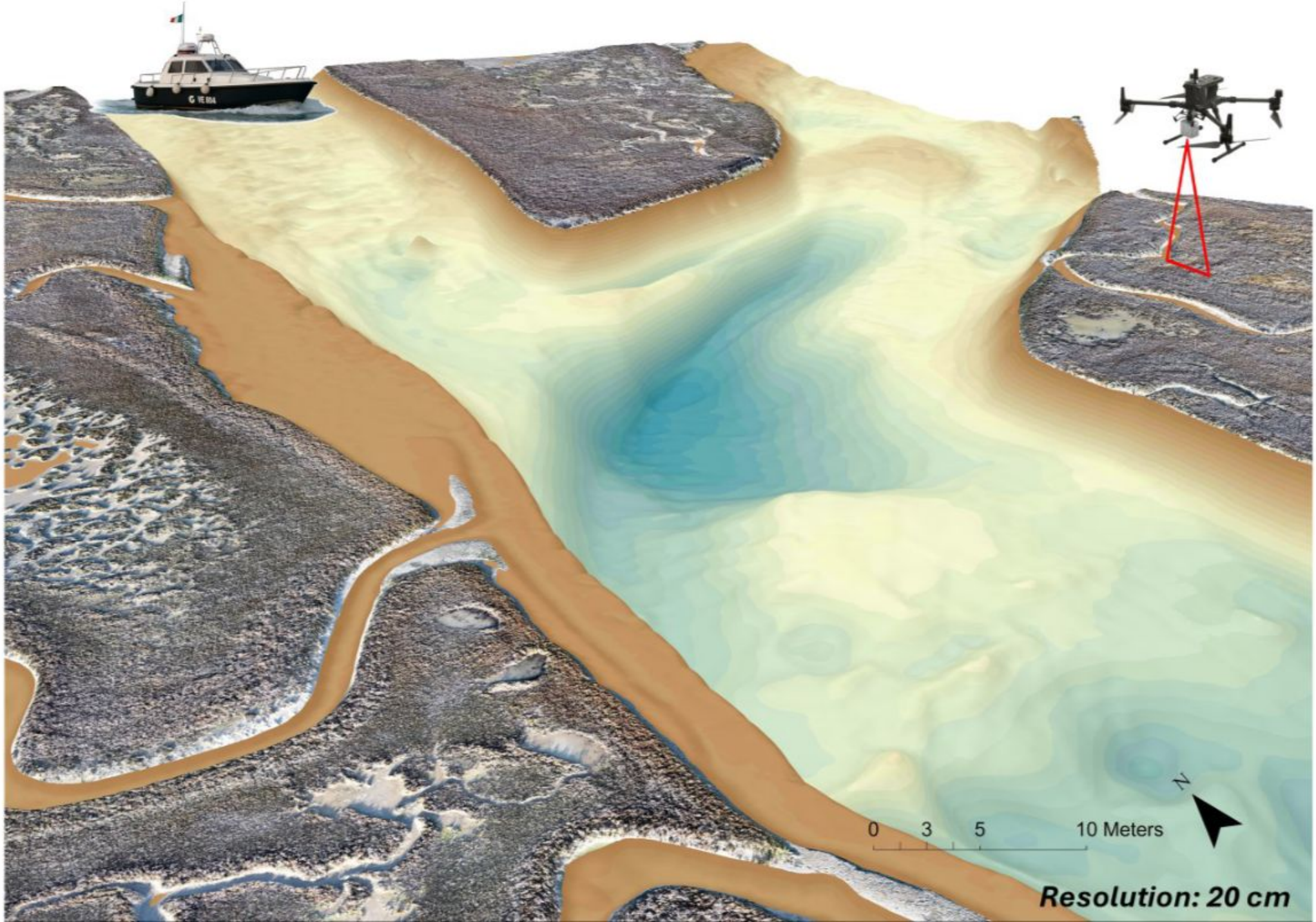
DJI Matrice 350 RTK with
LIDAR Zenmuse L2



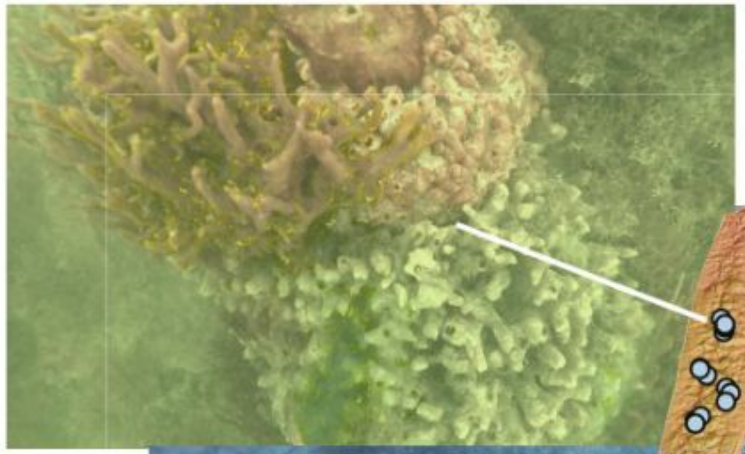
EM2042
MultiBeam EchoSounder

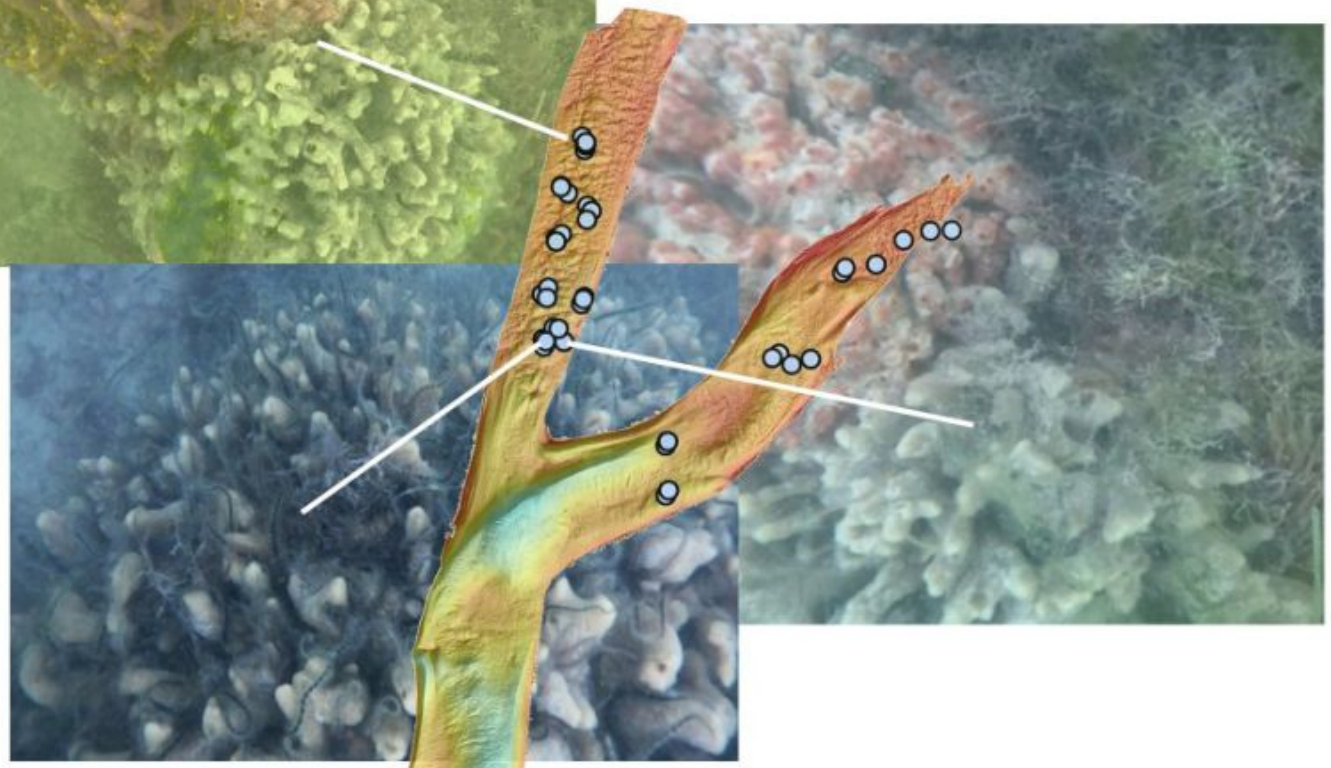
Lahami et al. 2026 in prep.

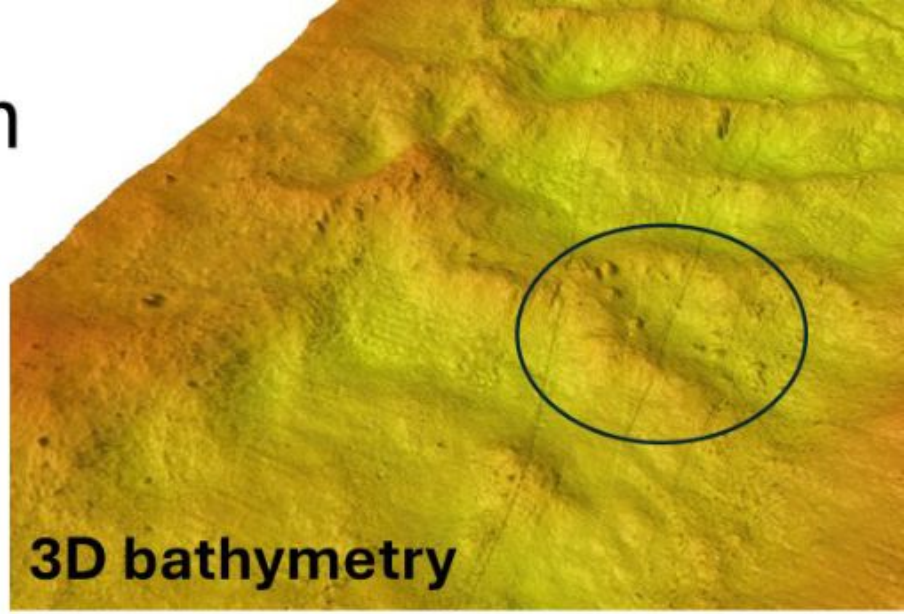
Resolution: 20 cm

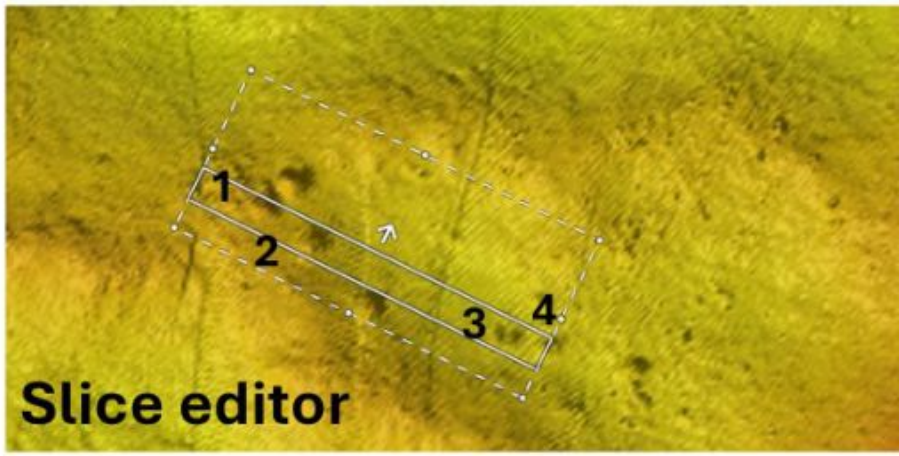

0 3 5 10 Meters
N
Resolution: 20 cm

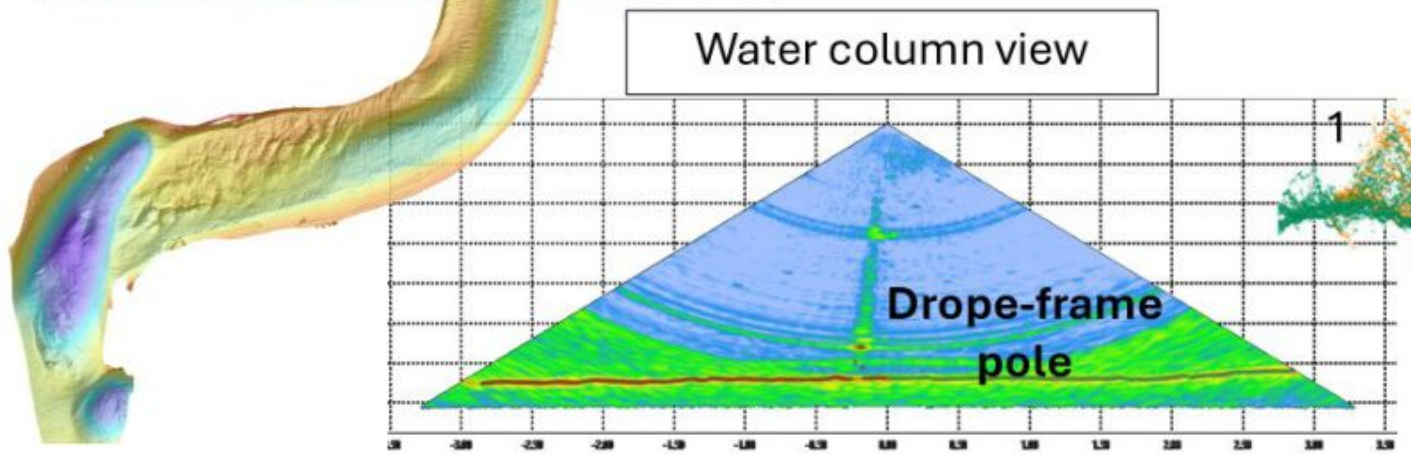
Seabed investigation



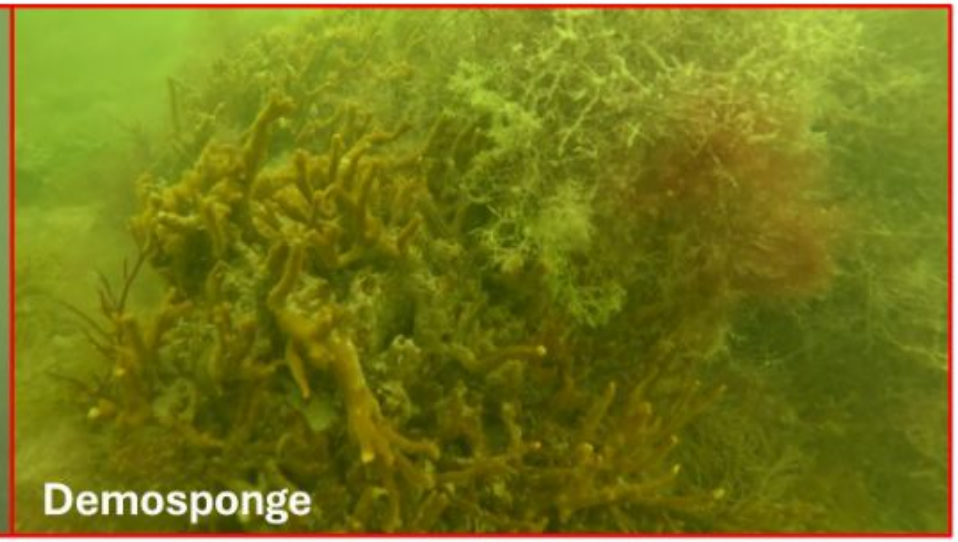




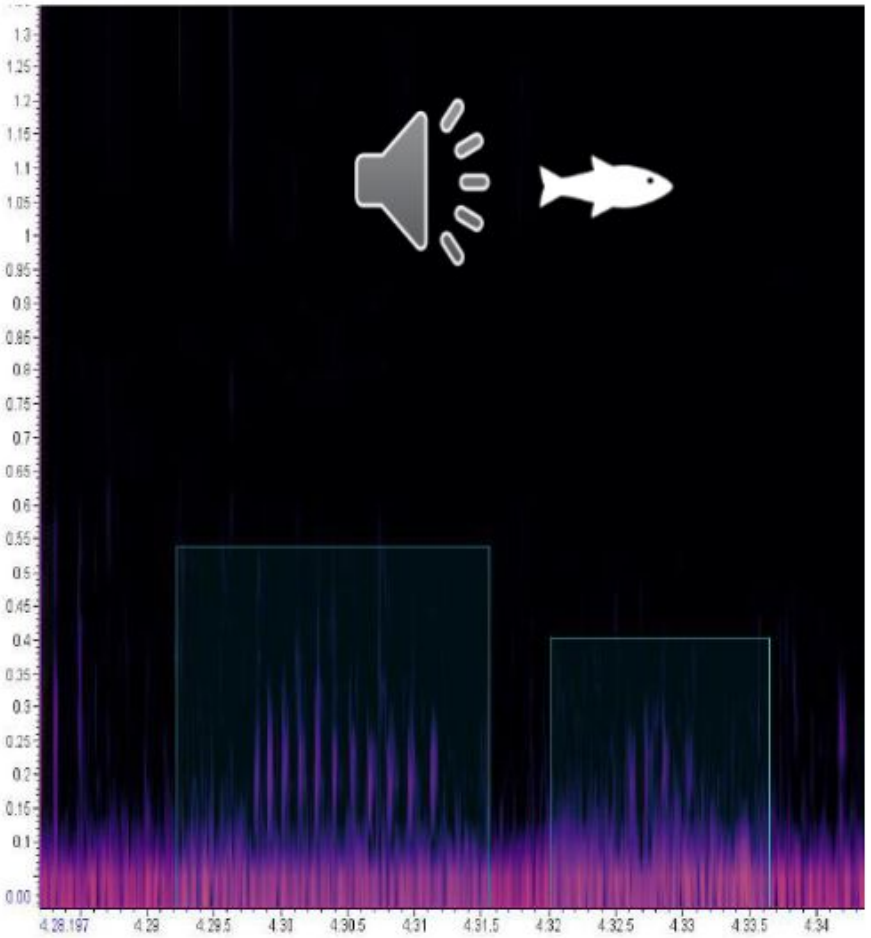


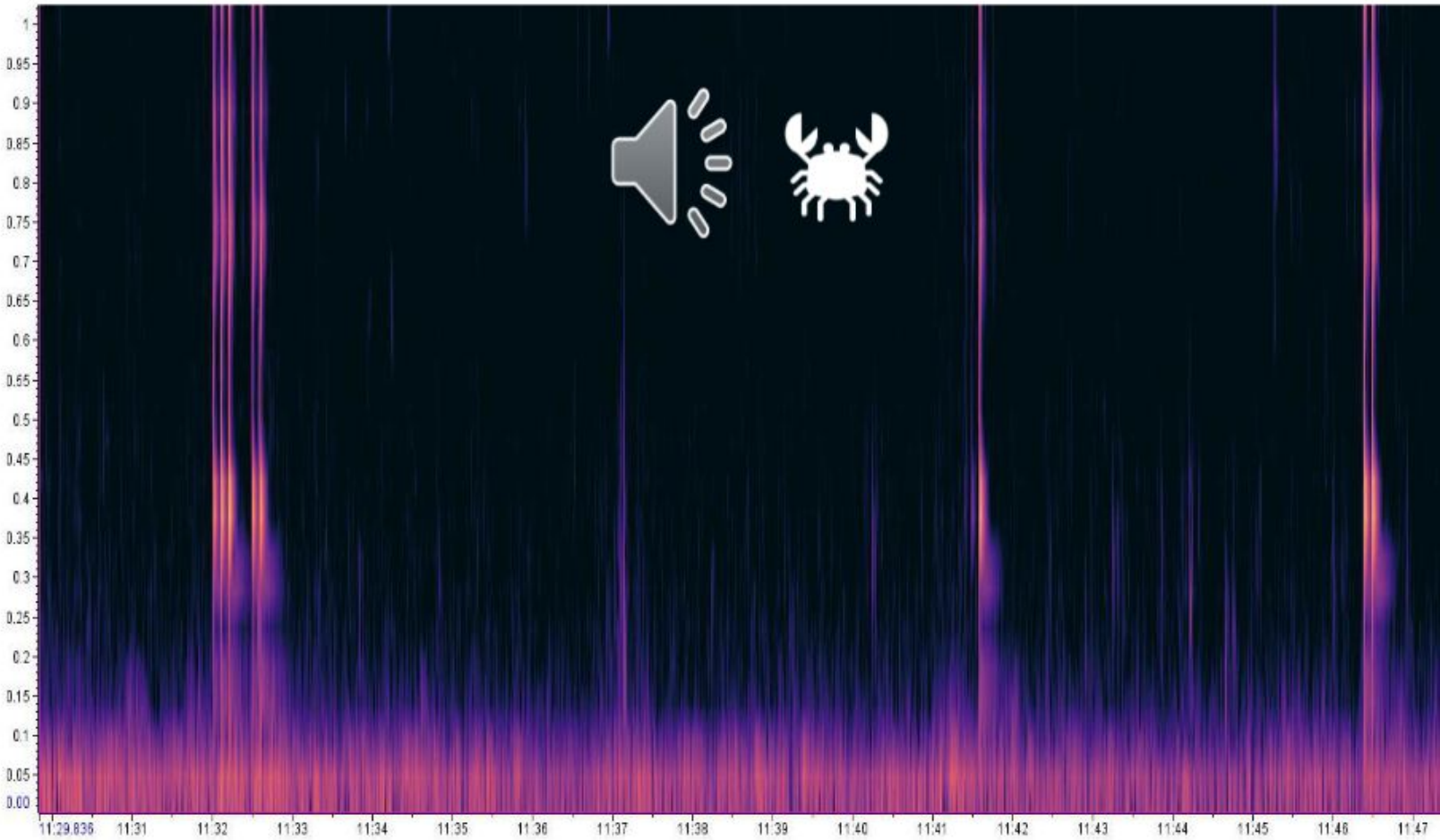


Passive Acoustic Monitoring



Biological sounds





UNDerwatER Soundscape bEyond Ais (UNDERSEA)

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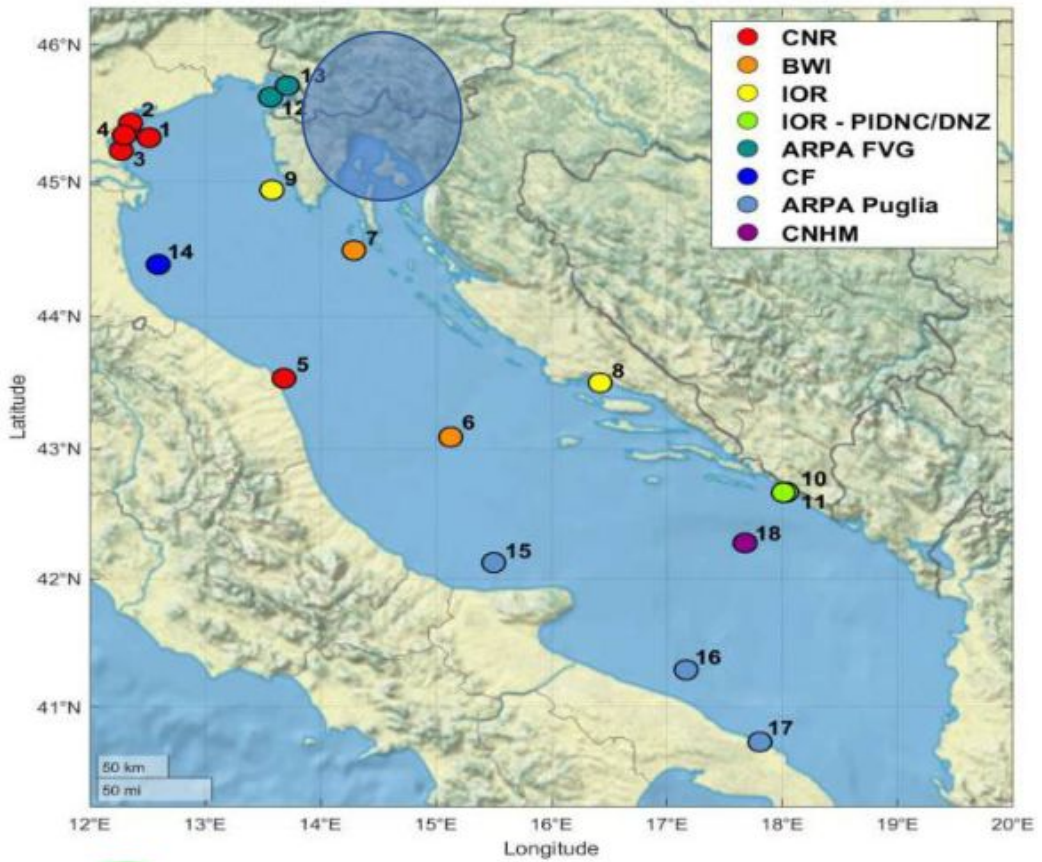

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scientific data

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DATA DESCRIPTOR

First assessment of underwater sound levels in the Northern Adriatic Sea at the basin scale

Antonio Petrizzo, Andrea Barbanti, Giulia Barfucci, Mauro Bastianini, Ilaria Biagiotti, Sofia Bosi, Michele Centurelli, Robert Chavanne, Antonio Codarin, Ilaria Costantini, Marinela Cukrov Car, Vlado Dadić, Francesco M. Falcieri, Raffaela Falkner, Giulio Farella, Mario Felli, Christian Ferrarin, Thomas Folegot, Roger Gallou, Daphnie Galvez, Michol Ghezzo, Aleksandra Kruss, Iole Leonori, Stefano Menegon, Hrvoje Mihanović, Stipe Muslim, Alice Pari, Sauro Pari, Marta Picciulin, Grgur Pleslić, Marko Radulović, Nikolina Rako-Gospić, Davide Sabbatini, Giulia Soldano, Jarosław Tęgowski, Tihana Vučur-Blazinić, Predrag Vukadin, Jakub Zdroik & Fantina Madricardo

Le 14 stazioni di monitoraggio del rumore sottomarino di UNDERSEA – post

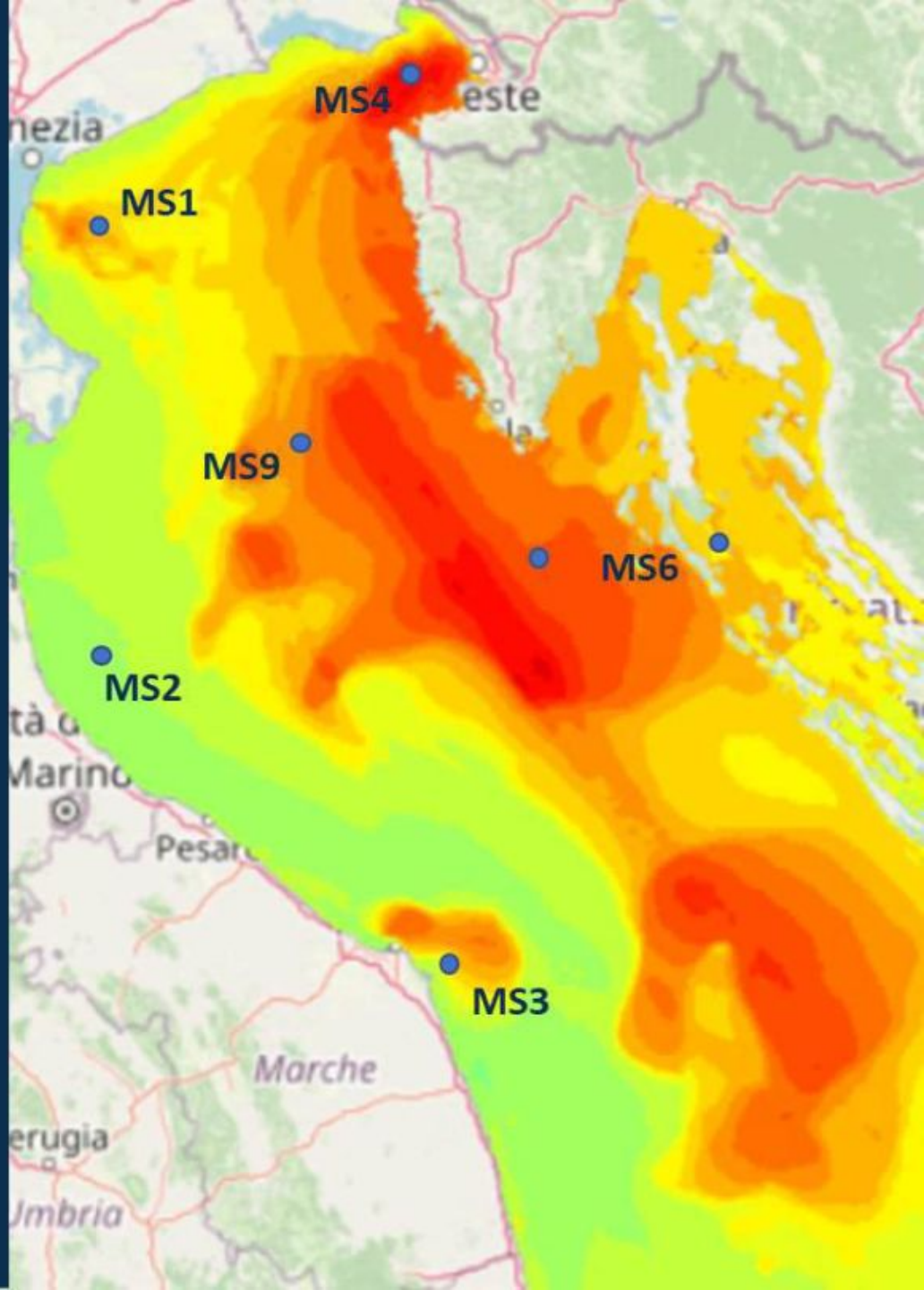
RISULTATI DI SOUNDSCAPE

- MONITORAGGIO: Registrazioni acustiche in continuo per un anno in 9 stazioni fisse nell'Adriatico settentrionale, da marzo 2020 a luglio 2021

  Petrizzo et al. Scientific Data, 2023

- MODELLIZZAZIONE: catalogo di mappe del paesaggio sonoro sottomarino

  Ghezzo et al. Marine Pollution Bullettin, 202)



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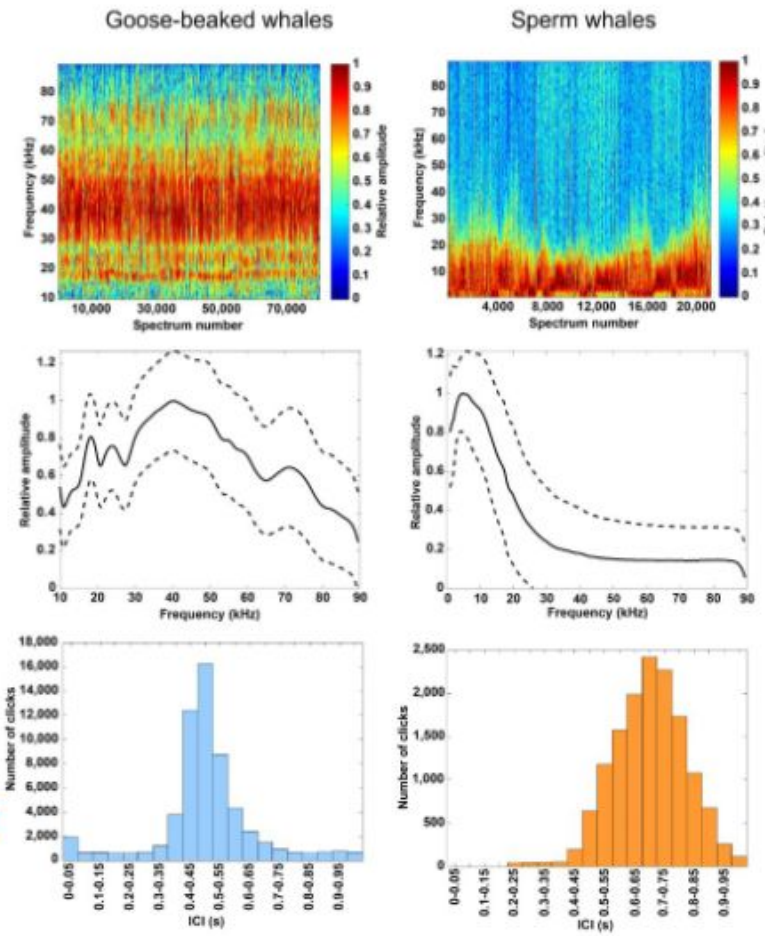
Caratterizzazione della presenza di mammiferi marini nelle registrazioni acustiche



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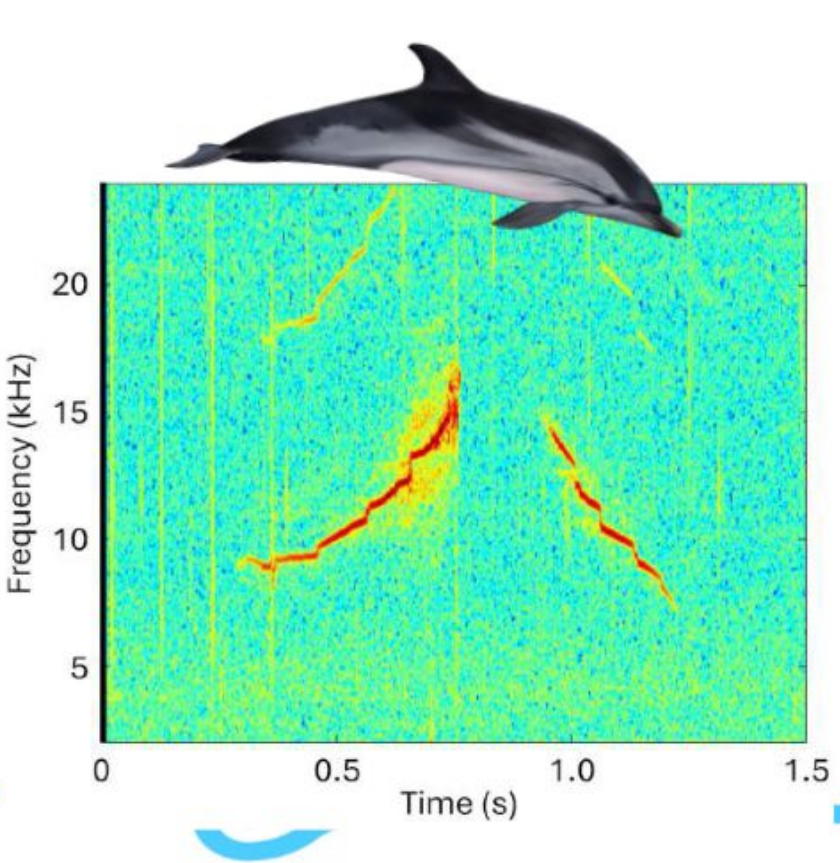
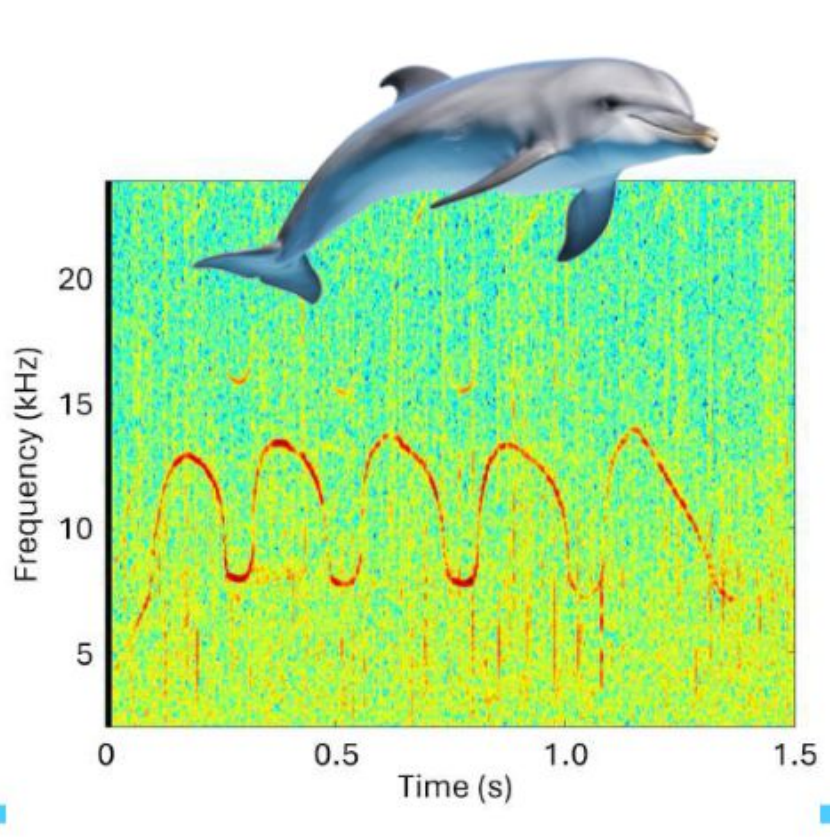
Caratterizzazione della presenza di mammiferi marini nelle registrazioni acustiche

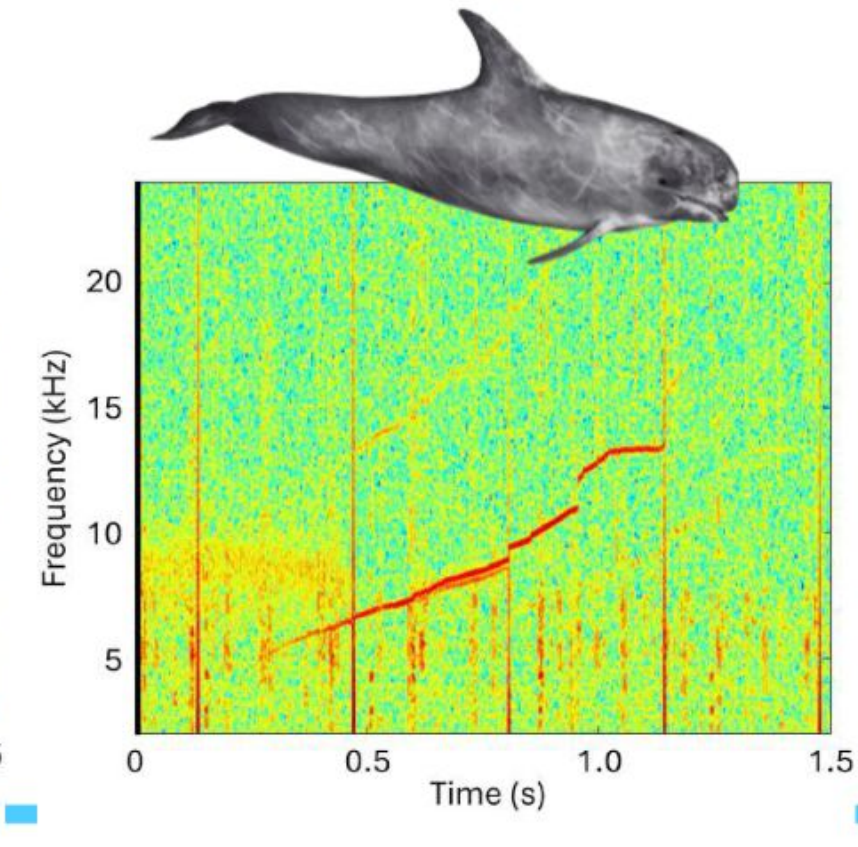
Stenella
(*Stenella coeruleoalba*)



Tursiope
(*Tursiops truncatus*)



Grampo
(*Grampus griseus*)



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