

A new multidisciplinary observatory in the Eastern Ligurian Sea (NW Mediterranean Sea): a combination of deep-sea and coastal measurements

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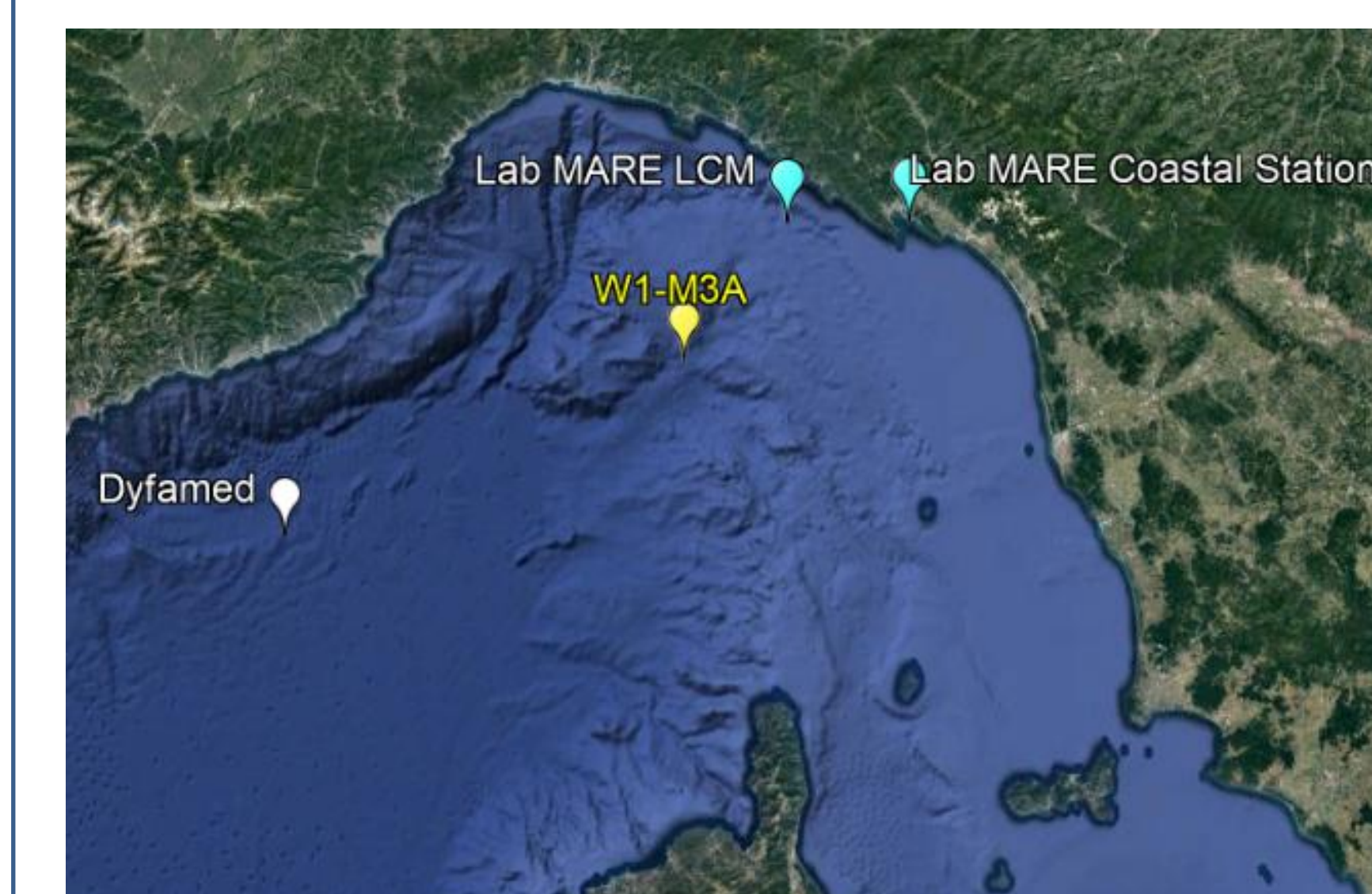
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1. Introduction

The European Multidisciplinary Seafloor and Water-Column Observatory (EMSO, <http://www.emso-eu.org>) is a large-scale European Research Infrastructure devoted to fill the gap about deep-sea environments. It is aimed to the installation of real-time and long-term ocean observatories to study geo-hazards, climate change and marine ecosystems, from the Arctic, through



the Atlantic and the Mediterranean to Black Sea (Dañobeitia et al., 2019). This contribution presents the implementation of **Lab MARE**, a new multidisciplinary observatory, outside the EMSO network, in the Eastern Ligurian Sea (NW Mediterranean Sea). Lab MARE is born as a combination of **2 stations**: an **offshore site (Levante Canyon Mooring - LCM)**, and a **shallow water cabled site (Coastal Station)**. The project, co-financed by the Liguria Region (PAR-FSC resources 2007-2013), is coordinated by the DLTM in strict collaboration, in terms of human resources, infrastructures and instruments with the associated public research bodies (CNR-ISMAR, ENEA, INGV) and IIM.



Lab MARE sites together with already existing Observatories in the Ligurian Sea (Dyfamed, <http://www.emso-fr.org> and W1-M3A, <http://www.w1m3a.cnr.it>)

2. Scientific Objectives

- ✓ Multidisciplinary long-term eulerian monitoring to study the morphodynamic processes on the continental margin (LCM), water mass properties, fluxes of sediments, nutrients, organic matter and biological communities modifications connected to climate change and anthropogenic pressure;
- ✓ Study of hydrodynamic processes, physical and biogeochemical conditions of the Levante Canyon, which hosts valuable and vulnerable ecosystems, such as the deep-living Cold-Water Corals (CWC), identified by IIM and ENEA in 2014;
- ✓ Analysis of turbidity currents and sedimentary deposits in the Levante Canyon and their force factors;
- ✓ Long-term ocean monitoring (LCM) to assess any environmental impacts in case of extreme events, pollution or severe accidents;
- ✓ Exploration of deep sea (LCM) and coastal biodiversity (coastal station);
- ✓ Validation and calibration of oceanographic models, from mesoscale to sub-mesoscale;
- ✓ Test site for innovative marine technologies and sensors to be used by different stakeholders for field tests and inter-comparison experiments related with metrology (coastal station);
- ✓ Ocean Science for sustainable development supporting conservation and management activities and coastal communities by predicting Ocean hazards preventing and mitigating disaster risks;
- ✓ Citizen Science.

3. Study Area



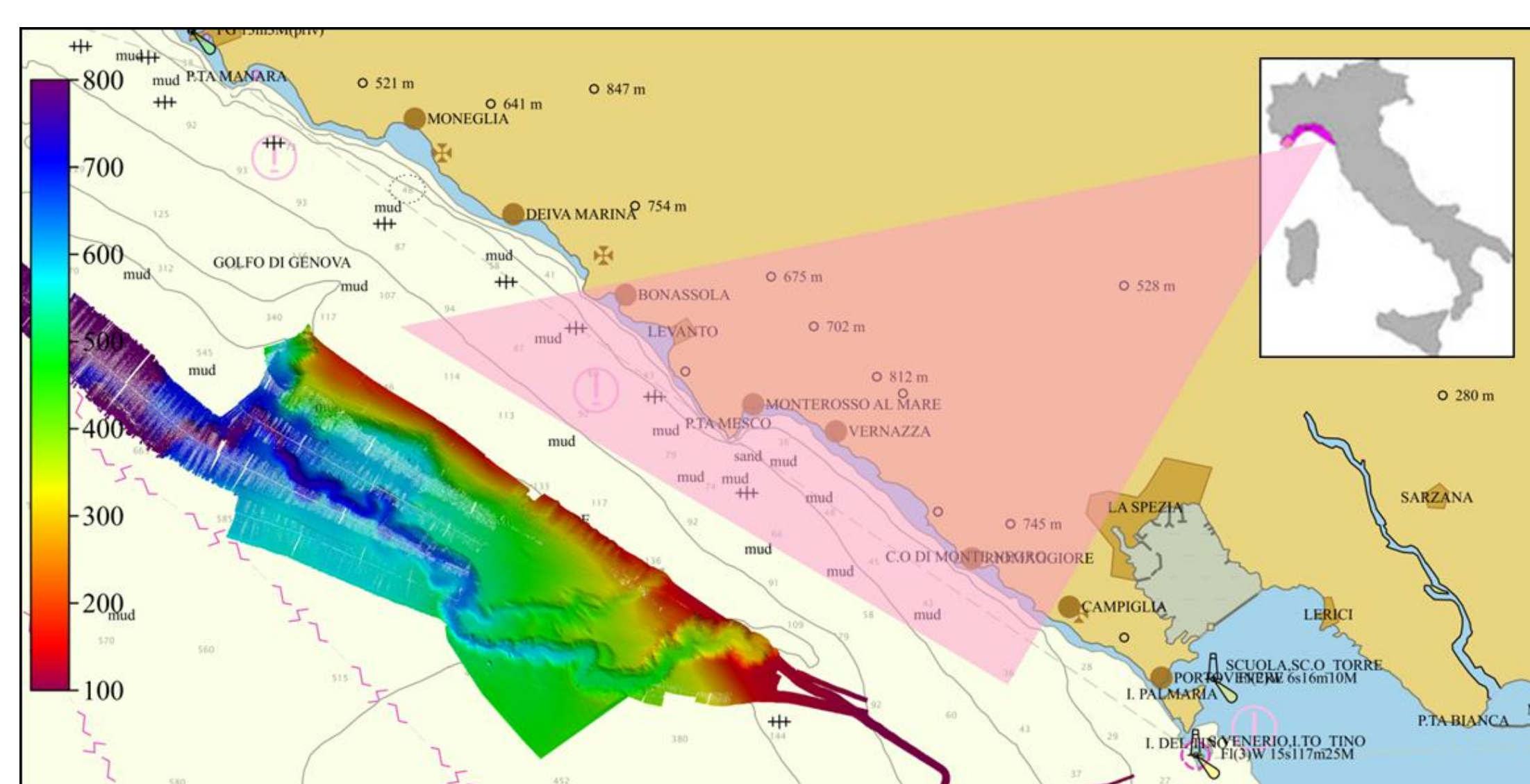
The observatory is located in the Eastern Ligurian Sea, nearby natural hotspots, such as *Cinque Terre Marine Protected Area (MPA)* and falls within the *Pelagos Sanctuary for Mediterranean Marine Mammals*, a transboundary MPA for cetaceans, represented by different species with high abundances (<https://www.sanctuaire-pelagos.org>).

The study area is characterised by the Levante Canyon, very close to the coast.

Surface currents in the area are also monitored in near-real time by the CNR's High Frequency Radar network, allowing data integration from multiplatform observations (<http://radarhf.ismar.cnr.it/>).

4. Infrastructure Description

LCM (standalone)



Date of Deployment:

23 September 2019

Site: 44°05.44'N-09°29.90'E

Depth: 608 m

Distance from land: 12 km

- CTD (83 m)
- ADCP (325 m)
- CTD (335 m)
- ADCP (406 m)
- CTD, Turbidimeter, Sediment Trap (580 m)



Short description: LCM is a standalone mooring offshore Cinque Terre MPA dedicated to the long term monitoring of hydrological properties of water masses. It operates in delayed-mode and is equipped with sensors that measure physical and biogeochemical parameters along the water column from 83 m to 580 m. Two acoustic current profilers provide long-term time series of current vertical profiles throughout the water column, in order to monitor the link of near-surface waters with the deep ones.

Coastal Station (cabled observatory)



Date of Deployment:

4 March 2020

Site: 44°04.92'N-09°52.83'E

Depth: 10 m

Distance from land: 50 m

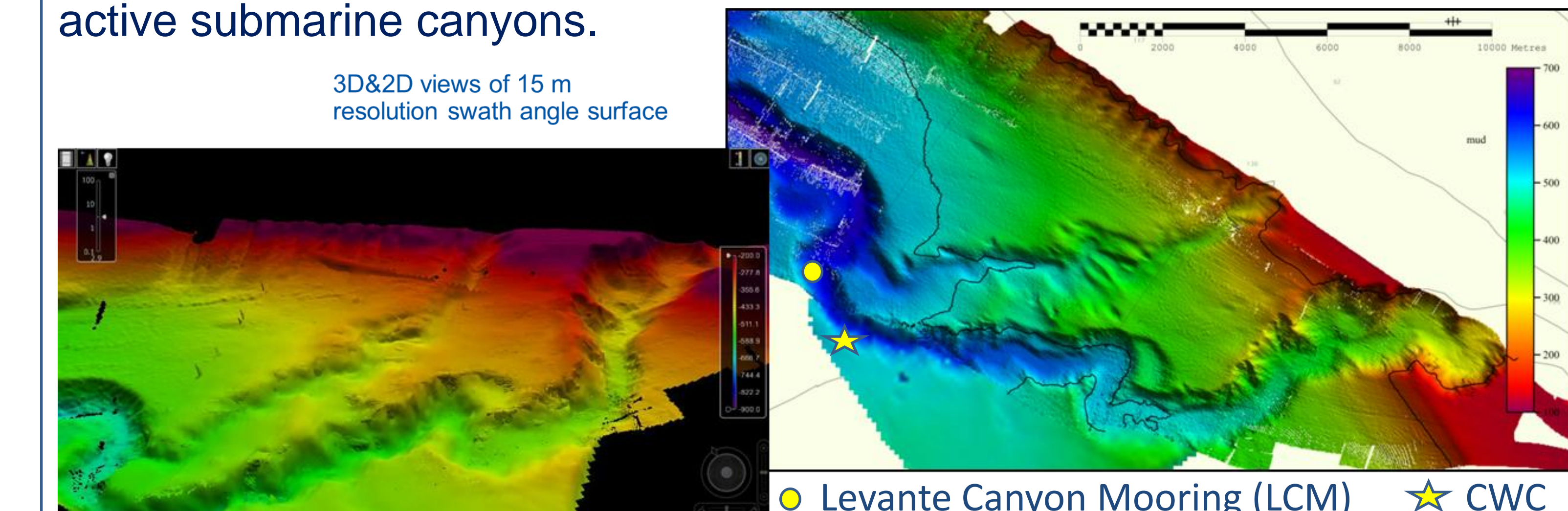
- CTD
- Gravimeter
- Digital camera
- Currentmeter

Short description: The coastal station is a cabled observatory in the bay of S. Teresa (La Spezia), next to the ENEA Marine Research Center and a mussel farm. It is dedicated to test innovative technologies and underwater sensors and to study plastic degradation and absorption of pollutants. Data are archived in near-real time and accessed through online interface.

5. Physical and ecological features

Ligurian Sea represents a challenging area for geological, geophysical, oceanographic and ecological research.

Submarine canyons are dynamic structures, "fast corridors" for the transport of organic matter and sediments from the continental shelf to deep environments. Fast turbidity currents are found to frequently occur in active submarine canyons.



Submarine canyons host a wide range of undersea features, hydrodynamic processes and consequently high biodiversity.

Historical reports and fishermen's maps from the 1960s document the occurrence in this area of extensive banks of living CWC, mostly *Madrepora oculata*, between depths of 200 and 500 m.

In 2013-2018, Italian Navy high resolution Multibeam (MBES), Side Scan Sonar (SSS), Remotely Operated Vehicle (ROV) surveys and sediment samplings were carried out in the Levante Canyon (Delbono et al., 2014; Fanelli et al., 2014; Pratellesi et al., 2014) to assess the occurrence, distribution and conservation status of CWC. The MBES and SSS mapping showed numerous trawl tracks and the detection of coral colonies at 300-600 m. The ROV seafloor images showed small (10 cm high), dead, buried colonies at 300-500 m.

Deeper (> 500 m depth) dense populations of living, 1 m high colonies of *Madrepora oculata* were found on the flanks of Levante Canyon, with some colonies overturned or entangled by long-line fishing activities (Fanelli et al., 2017).



Further studies and long term series of geophysical and hydrological data are necessary to better understand the recent bottom dynamics, the seabed and water column interaction and the ecological conditions of valuable ecosystems in Levante Canyon.

6. Bibliography

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