EXPLORING KEY SCIENTIFIC QUESTIONS WITH THE EMSO REGIONAL FACILITIES OR GROUP OF REGIONAL FACILITIES

Western Mediterranean Sea regional facility

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EMSO Strategic Workshop
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WESTERN MEDITERRANEAN SEA RF IN A NUTSHELL

Location: Western Mediterranean
43° 50.0710’ N 009° 07.0898’ E

Distance from land: 80 km

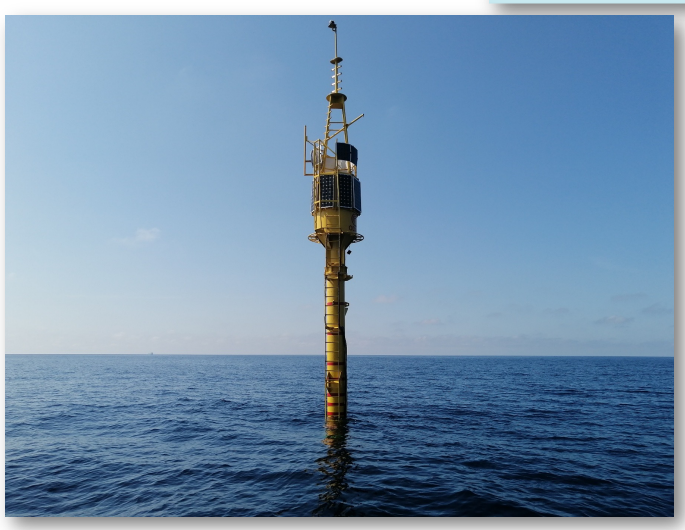
Max water depth: 1200 m

Date 1st deployment: 2000 (2022 last repositioning)

Supported by: Consiglio Nazionale delle Ricerche

Operated by: Consiglio Nazionale delle Ricerche

Regional Team Leader: Roberto Bozzano



WESTERN MEDITERRANEAN SEA RF IN A NUTSHELL

The W1M3A infrastructure supports the operational oceanography, i.e. the systematic and long-term routine measurements of the oceans and atmosphere, and their rapid interpretation and dissemination.

Two main installations form part of the in-situ component of the W1M3A research facility:

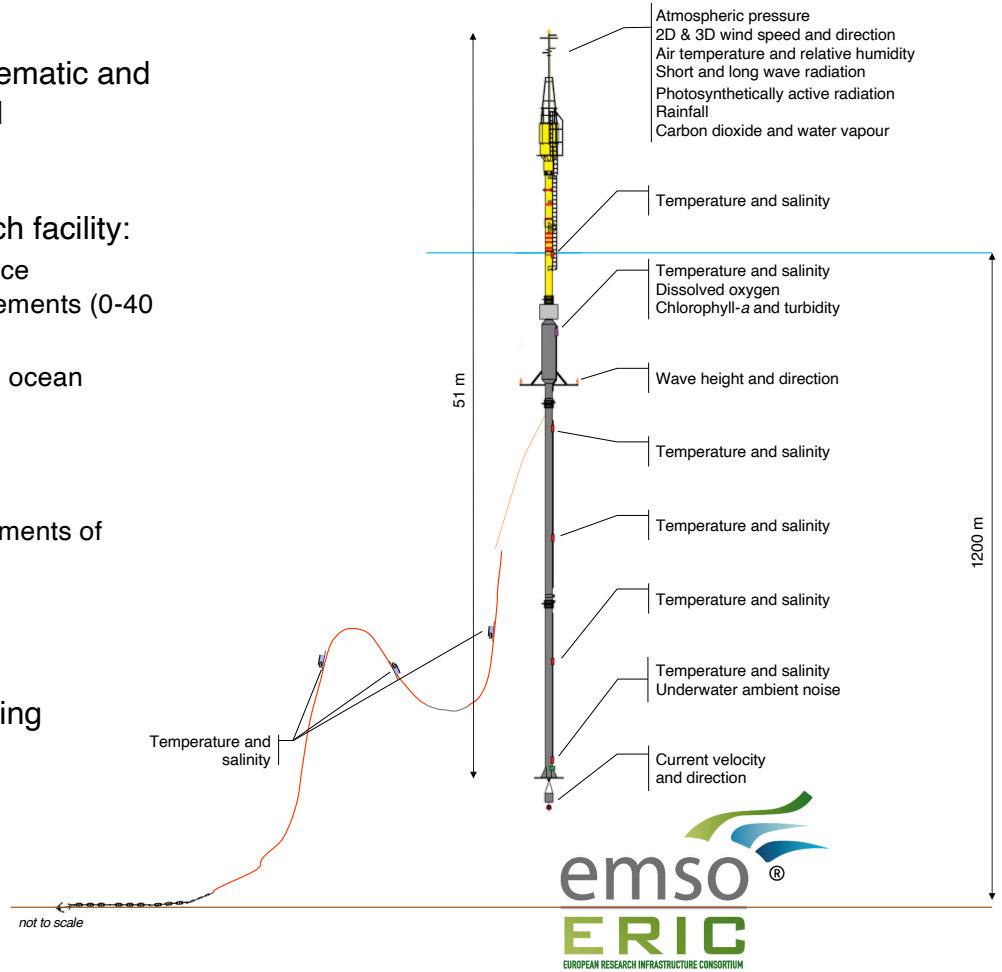
- a large spar buoy (known as "ODAS Italia 1", 51 meter long and 12 tons weight) held in place permanently by a long slack mooring and collecting atmospheric and upper ocean measurements (0-40 m);
- the mooring line (50-1200 m depth) hosting instruments for collecting measurements of the ocean interior.

Onshore facilities include

- a test site at the entrance of the Port of Genoa useful for performing short-term test deployments of instruments, calibrations, outdoor tests, etc.
- an electronic laboratory that offer basic tools to set-up instruments and to perform minor electrical/electronic developments.

The main expertise of the research staff addresses scientific topics in the following domains:

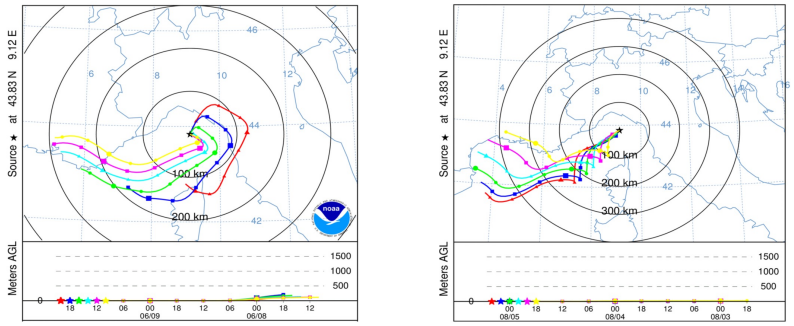
- Air-sea interaction studies.
- Ocean variability (physics and biogeochemistry).
- Acidification of the oceans.
- Underwater ambient noise characterization (wind, precipitation, ship traffic, mammals).
- Active & passive acoustics.



WESTERN MEDITERRANEAN SEA: SCIENTIFIC CHALLENGES

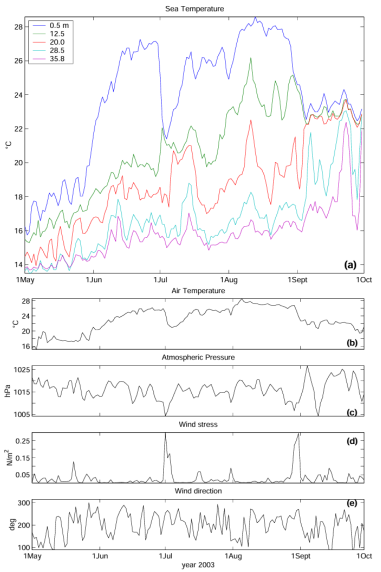
Key scientific question 1:
How does the temporal variability of open ocean EOVs impact and propagate from local to regional scales?

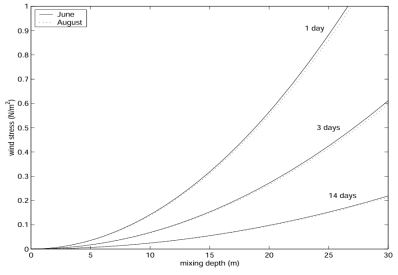
SCIENTIFIC SUB KEY CHALLENGES	HYDRODYNAMICS AND HYDROLOGY PROCESSES	BIOGEOCHEMISTRY, BIOLOGY AND ECOLOGY PROCESSES
KSQ 1.1: How do long-term trends influence the open ocean environment and lead to long-lasting (or irreversible) impacts at regional and local scales?	• Investigate how changing weather patterns and climate variability affect pollutant fluxes.	• Examine how radon progenies in the marine boundary layer are tracers for airborne pollutant deposition into the ocean. • Study the deposition of heavy metals, microplastics, and other airborne pollutants into the ocean.
KSQ 1.2: What are the effects of changes in the frequency of extreme events from regional to local scales?	• Monitor and analyze marine heat waves (MHWs) to assess their drivers, persistence, and impacts from open ocean to coastal regions.	
KSQ 1.3: How do regional-scale changes and extreme events interact with basin-scale variability in the open ocean environment?	• Investigate teleconnections between Mediterranean-wide anomalies and local-scale observations.	



(a) 8–10 June 2016, TCR: 15.2 s^{-1}. (b) 3–5 August 2016 TCR: 14 s^{-1}.

Aerial mass pathways in a total gamma-ray counting rate increase during rainfall, their back-trajectories were computed for the W1M3A mooring site by the HYSPLIT model with 2 h intervals, starting at the time of the rainfall event and a 48-h pathway at 0 m above the ground level.





Relationship between the wind stress and the mixing depth under different stratification conditions and different durations of the wind event.

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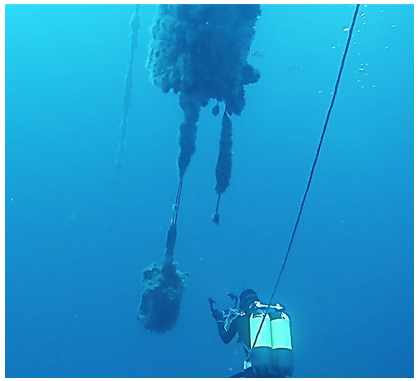
WESTERN MEDITERRANEAN SEA: SCIENTIFIC CHALLENGES

Key scientific question 3:
What are the impacts of geophysical dynamic events, climatic and anthropogenic changes on open ocean benthic and pelagic ecosystems?

SCIENTIFIC SUB KEY CHALLENGES	BIOCHEMISTRY, BIOLOGY, ECOLOGY
KSQ 3.2: What mechanisms drive ecosystem responses to environmental variability and disturbances, and how do local productivity and biogeochemical fluxes propagate through the surrounding benthic and pelagic ecosystems	• Examine potential stress responses (e.g., altered vertical migration, changes in metabolic rates, etc.)
KSQ 3.4: How does climate and anthropogenic changes influence ocean soundscapes, and how do these changes affect marine ecosystems at different spatial and temporal scales?	• Investigate how different sound levels and frequencies influence zooplankton movement, feeding, reproduction, and survival.



Scientific echosounder coupled to ADCP and multiple ultrasonic frequency recorders can quantify biomass and fish, or even plankton and/or krill, as environmental parameters vary.

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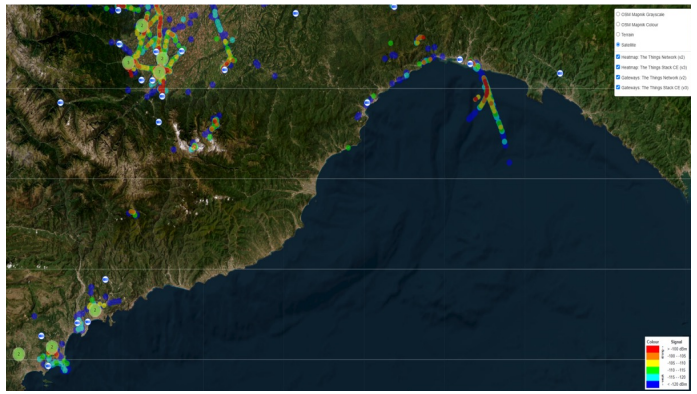
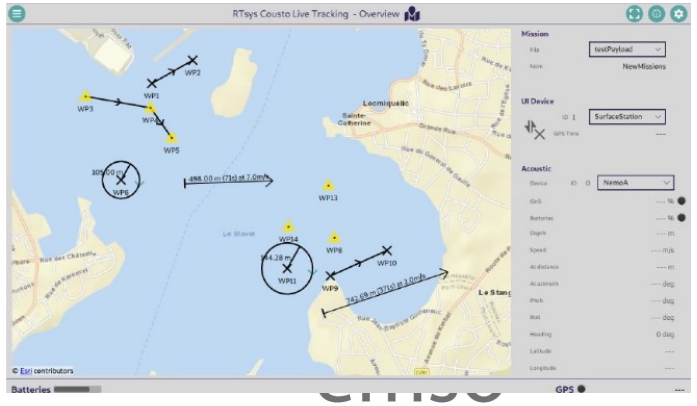
WESTERN MEDITERRANEAN SEA: SCIENTIFIC CHALLENGES

Key scientific question 5:
How to develop innovative observation technologies and strategies for the open ocean and increase EMSO observatory capabilities?

SCIENTIFIC SUB KEY CHALLENGES	ELECTRONICS
JSQ 5.1: What development can break through present technical limits of open ocean observation?	• Exploiting IoT as a backup system for low-power low-capacity telemetry. • Adaptive autosampler and semi-resident robot to address environment variability in near real-time.



Filling gaps in telemetry and determining the footprint of the regional facility.



WESTERN MEDITERRANEAN SEA: LOOKING AHEAD

- To maintain the observation capability at a high level of excellence making it possible for users (i.e., the scientific community, industry, policy-makers, etc.) to address their needs.
- To maintain a state-of-the-art focus on scientific marine research to ensure that the facility remains at the forefront of marine science, leveraging the latest technologies and methodologies to advance understanding and address emerging challenges.

	HYDRODYNAMICS AND HYDROLOGY	BIOCHEMISTRY, ECOLOGY
Future objectives	• Exploiting portable autonomous underwater vehicles (AUVs) for determining the footprint of the observatory.	• Monitoring fish populations and other marine organisms using acoustic sensors and underwater cameras. • Implementing automatic classification algorithms for power and memory rationing purposes.
Challenges/Technology that EMSO ERIC may provide to support	• Centralized procurement policy for instruments, tools, and services. • Upgrade the IT infrastructure to tackle computing power, distributed archiving, failure avoidance, and uninterrupted service provision.	

Thank you for your attention!

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Observing the ocean to save the earth