

EXPLORING KEY SCIENTIFIC QUESTIONS WITH THE EMSO REGIONAL FACILITIES

South Adriatic RF

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*EMSO Strategic Workshop
Rome, 11-13th March 2025*


EMSO South Adriatic IN A NUTSHELL

Location: South Adriatic Sea
(4 sites: E2M3A-B, E2M3A-M, BB, FF)

Distance from land: 20 nM - 60 nM

Max water depth: 600 m – 1200 m

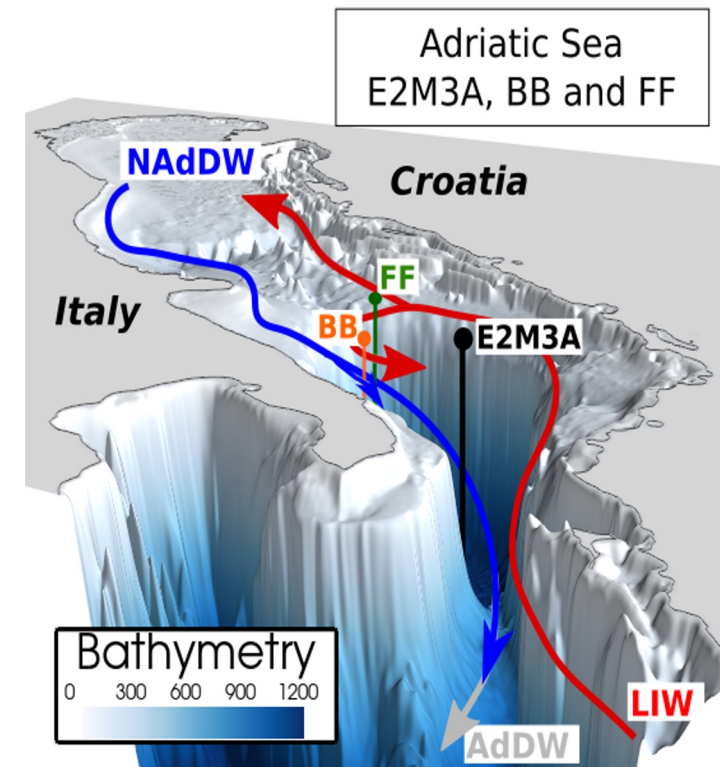
Date 1st deployment: 2006

Supported by: 

Operated by:  

Regional Team Leader: V. Cardin (OGS)

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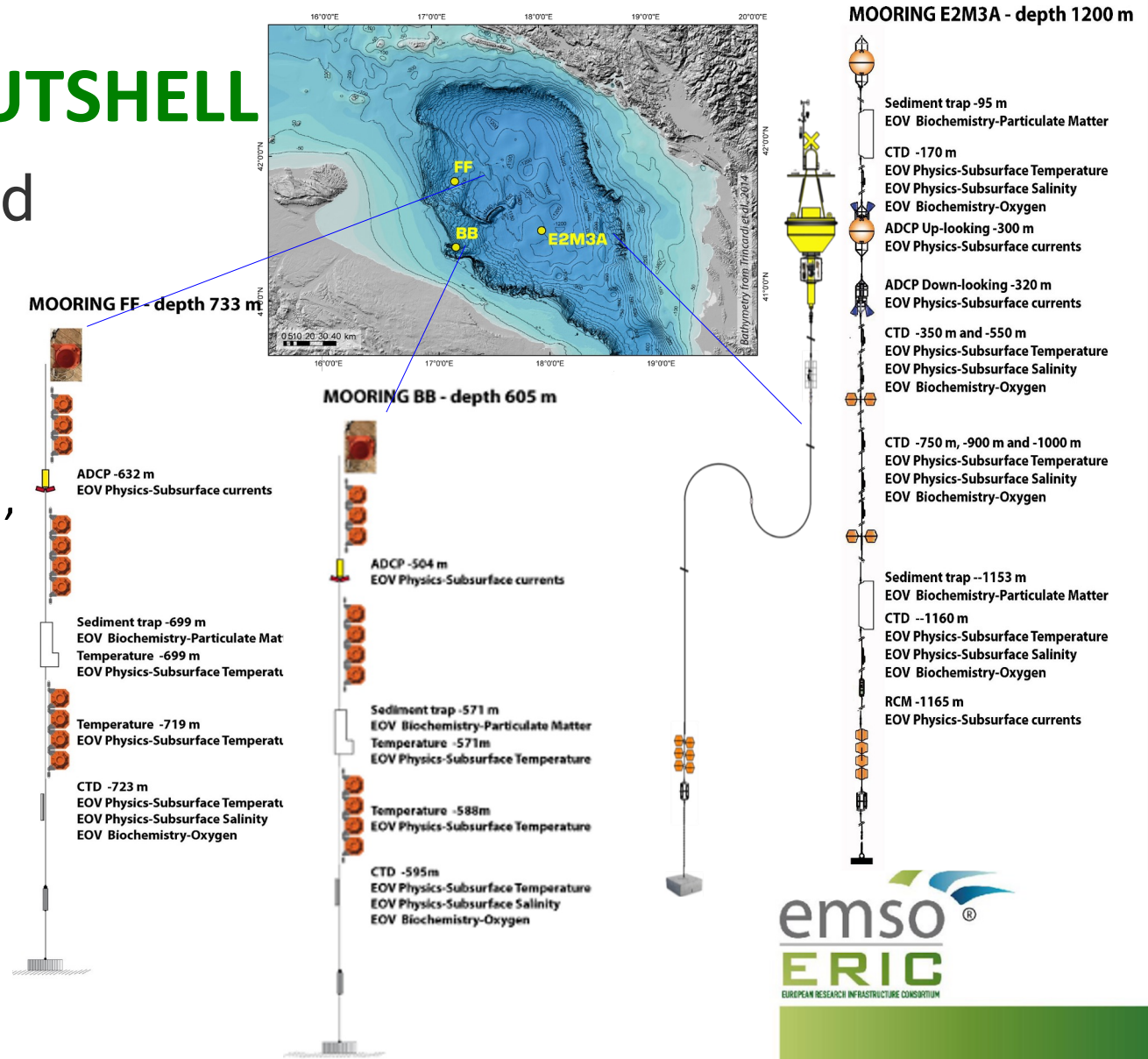

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South Adriatic IN A NUTSHELL

RF specificity Science and technology

- Mooring and buoy operation, instrument configuration
- Sensors: integration, preparation, testing and calibration
- Data analysis
- Glider campaigns
- Physical Oceanography, biogeochemistry, biodiversity
- Ocean Sound

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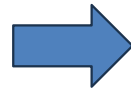


Scientific Challenges 1: EMSO - SOUTH ADRIATIC

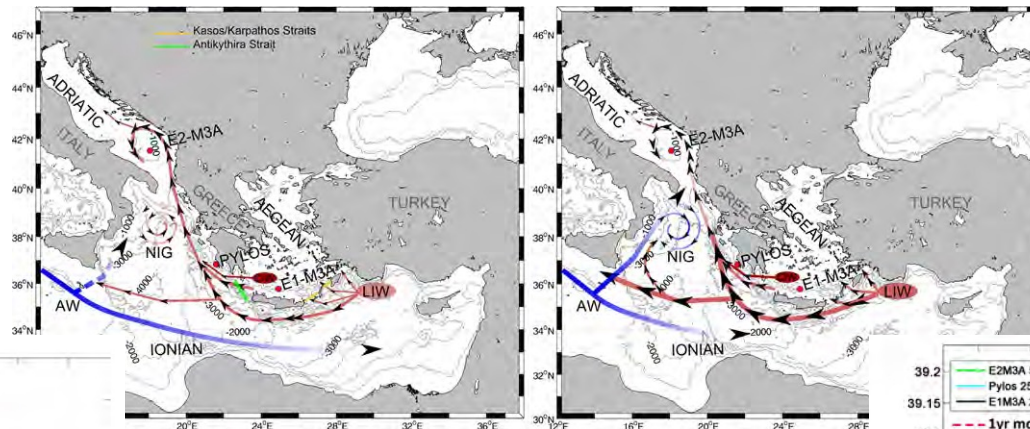
How does the temporal variability of open ocean EOVs impact and propagate from local to regional scales?

How do long-term trends influence the open ocean environment and lead to long-lasting impacts at regional and local scales?

General circulation of the Eastern Mediterranean associated with North Ionian Gyre (NIG) during the cyclonic (left) and anticyclonic phases (right)



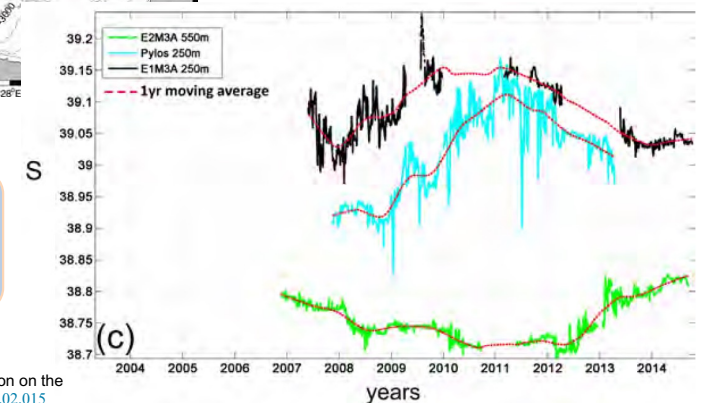
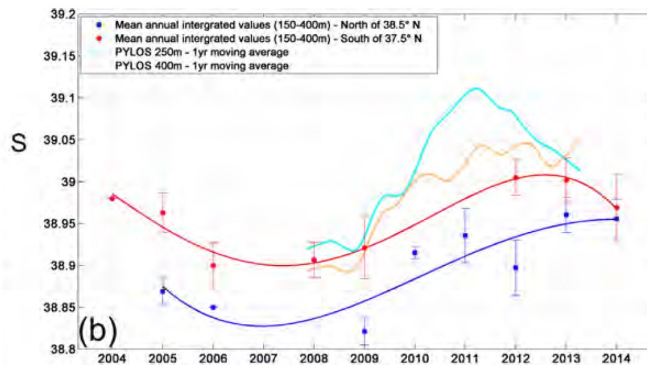
Travel time between the Cretan and Adriatic Sea is roughly 1.5 years



Color shading indicates the strength of the Salinity signal associated with the water masses flow

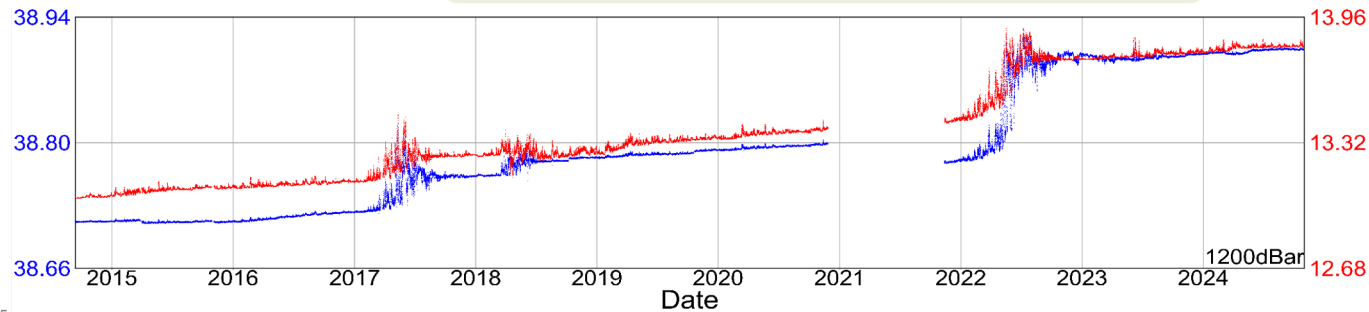
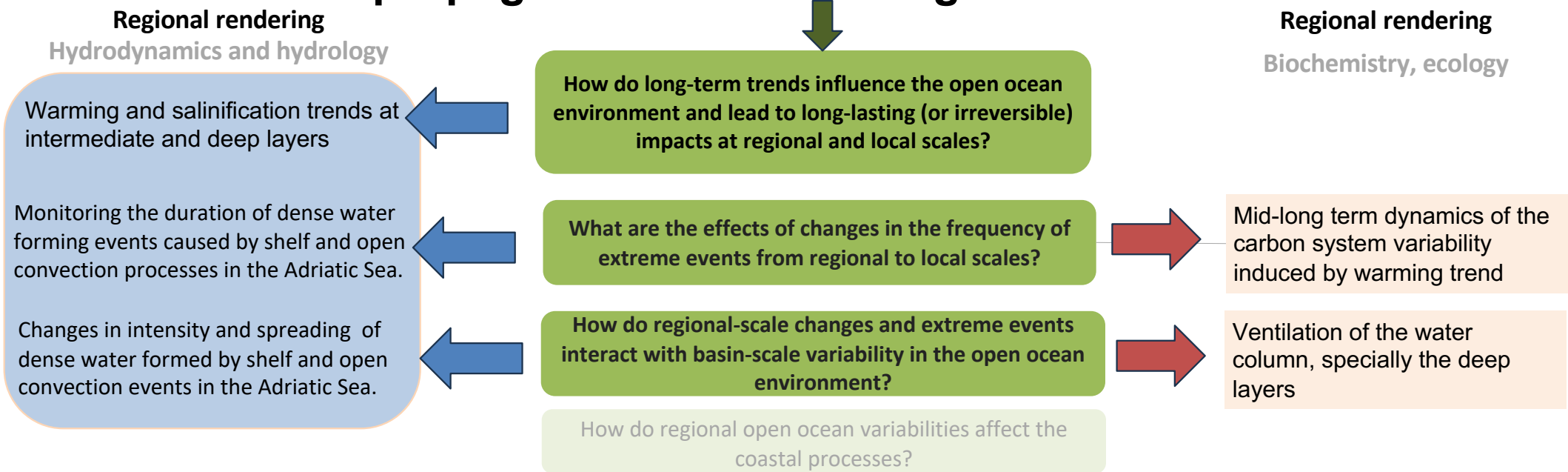


Changes in the Northern Ionian Gyre (NIG) circulation and its impact in the SA and Mediterranean.



Bensi M, Velaoras D., Meccia V.L., Cardin V. (2016). Effects of the Eastern Mediterranean Sea Circulation on the thermohaline properties as recorded by fixed deep-ocean observatories. <http://dx.doi.org/10.1016/j.dsr.2016.02.015>

How does the temporal variability of open ocean EOVs impact and propagate from local to regional scales?



Time series of θ (A) and S at the E2M3A regional facility (1200m deep) showing a positive trend in both parameters (Le Meur et al., 2024)

Scientific Challenges 2: EMSO - SOUTH ADRIATIC

What are the spatiotemporal scales and variability of the processes preconditioning and triggering natural hazards events

Regional rendering
Hydrodynamics and hydrology

Better understand how air-sea interactions trigger meteotsunamis, and their consequences on the dynamics of the water column

How do climate change, sedimentary and geodynamic processes interact at local and regional scales ?

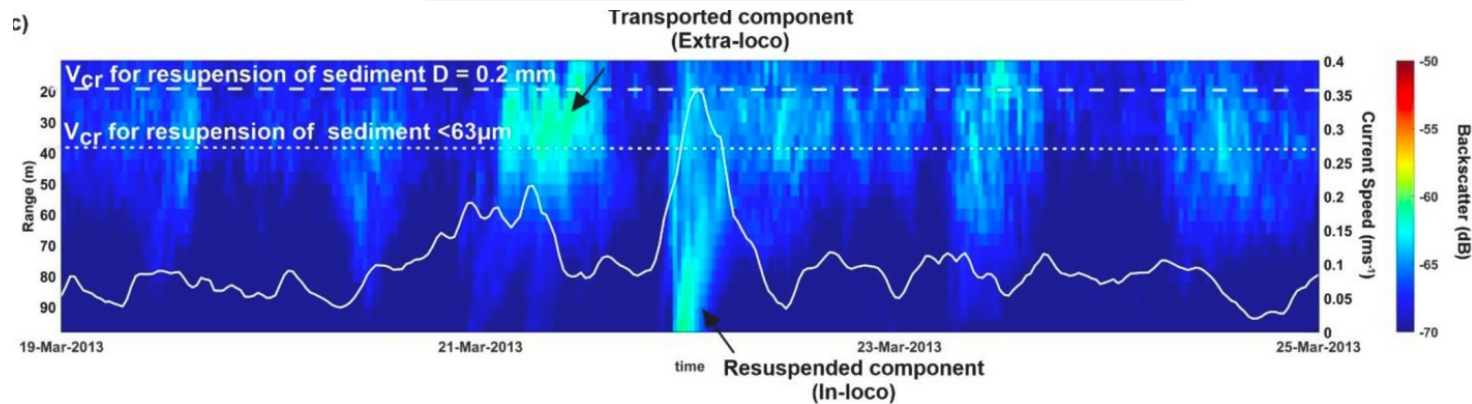
How water column resonances can be detected and their consequences better anticipated ?

What are the processes and scales of variability that affect fluid flow and seepage to the water column ?

How to resolve the various processes leading to catastrophic events?

Regional rendering
Biochemistry, ecology

Changes in sediment export from shelf to deep basin.



Sediment transport detection using ADCP ECHO records (Paladini de Mendoza et al., 2023)

Scientific Challenges 3: EMSO - SOUTH ADRIATIC

What are the impacts of natural environmental variability, geophysical dynamic events, and anthropogenic changes on open ocean benthic and pelagic

ecosystems?

Regional rendering
Hydrodynamics and hydrology

Regional rendering
Biochemistry, ecology

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?

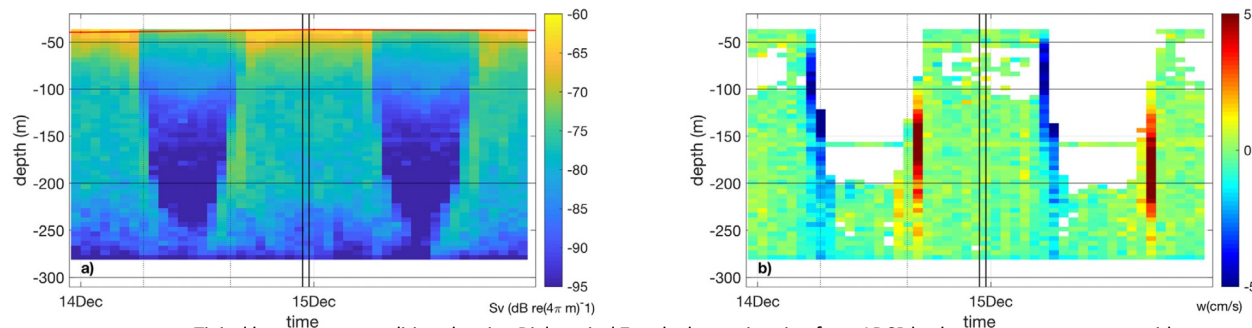
How do scales of environmental variability affect biological processes and ecosystem functioning such as larval dispersal, colonization processes, species growth, distribution and behavior, biotic interactions, microbial activity and trophic interactions?

How do anthropogenic pressures such as climate change, deep-sea mining, fisheries, and pollution influence (or may influence) the functioning, connectivity and resilience of benthic and pelagic communities across different spatial scales?

How can integrated, long-term observational data from EMSO infrastructures improve predictions of ecosystem shifts in response to natural and human-induced changes?

Mixed depth dynamics variability influences vertical zooplankton migration
Assessment of mesozooplankton assemblages.
Knowledge on fin whale acoustic occurrence

Provide in situ hydrological data for forecast and reanalysis models



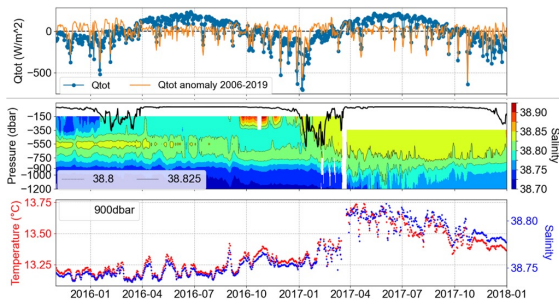
Typical late-autumn condition showing Diel vertical Zooplankton migration from ADCP backscatter measurements with negative (downward) velocity at sunrise and positive velocity (upwards) at sunset- *Ursella et al. 2018*

Scientific Challenges 4: EMSO - SOUTH ADRIATIC

How does climate change affect the carbon storage in the open ocean along the water column?

Regional rendering Hydrodynamics and hydrology

Air sea interactions and convection events, mixed layers development, meteorological regimes



Thermohaline circulation, mixing and convection

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How is the physical pump affected by medium and long term variability of the atmospheric forcing?

How are the biological pumps (organic and carbonate/inorganic) affected by variability at different time scales?

How does marine biodiversity and ecosystem dynamics influence carbon cycling through the biological carbon pumps?

Carbon deep storage assessment with respect to thermohaline variability?

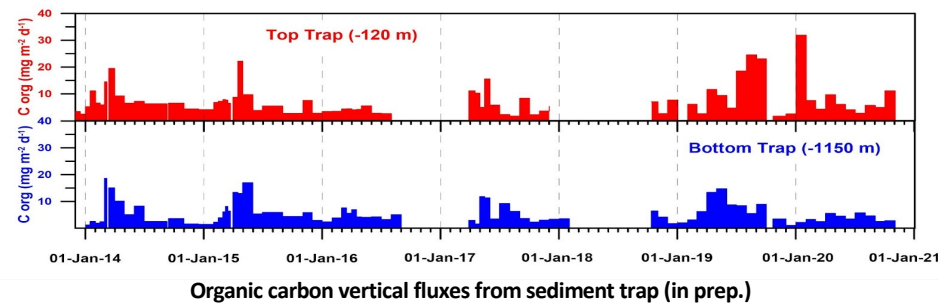
Regional rendering Biochemistry, ecology

Dissolved Carbon fluxes variability

Nutrients availability, biodiversity, phenology, vertical carbon fluxes by sediment trap

Biodiversity from mesozooplankton assemblages and carbon fluxes connection through the biological carbon pump

Dissolved component of carbon



EMSO-SA: LOOKING AHEAD

Electronics

Improve RT data transmission along the water column for moorings through the use of inductive cables

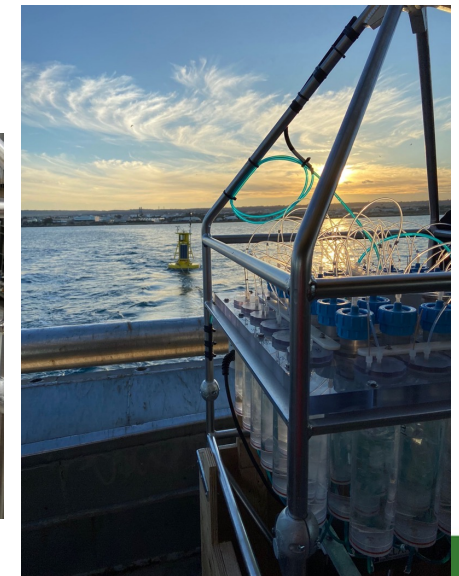
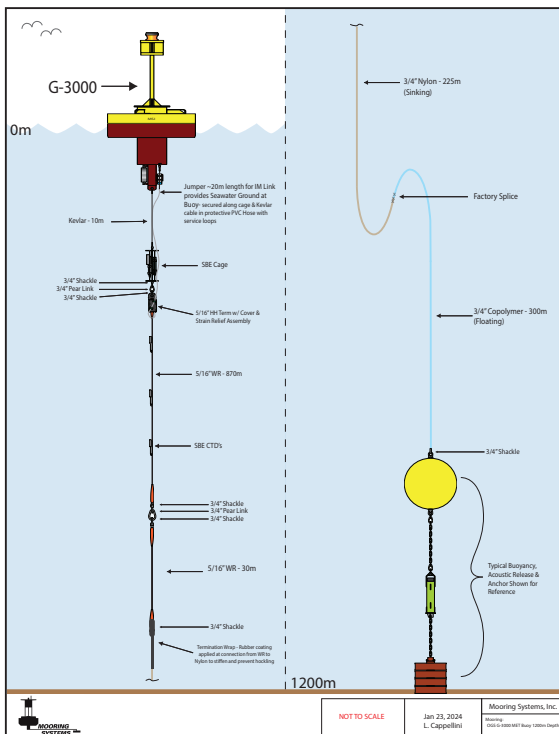
Sensing (chemistry, optics and biology)

Deployment of a Remote Access-Sampler (RAS) to collect samples for biological and biogeochemical parameters

What key innovations should EMSO focus on to improve technological harmonisation across its observatories?

Mechanics

Find the right balance between new observations and cost effective management.



EMSO-SA: LOOKING AHEAD

The EMSO-South Adriatic operates at a regional scale being formed by 4 representative sites.

- **Cross-infrastructure data integration** (both Eulerian and Lagrangian data) that will provide an overview (spatially and temporally) of all available observational variables (i.e temperature, salinity and oxygen) and provides integrated and multidisciplinary information to improve knowledge of the Adriatic open sea.
- **Contribution to service/product catalogue:** Re-analysis of data produced by the regional facility to make oceanographic time series more comprehensible, adopting an approach that simplifies complexity without compromising scientific value.

	Hydrodynamics and hydrology	Biochemistry, ecology
Future objectives	Increase collaboration with other observational systems to validate regional-scale processes (GLIDER, AUV, fixed-sites, satellite observations)	Deployment of a Remote Access-Sampler (RAS) to collect samples for biological and biogeochemical parameters
Challenges/Technology that EMSO ERIC may provide to support	<p>Improve RT data transmission along the water column for moorings through the use of inductive cables</p> <p>Develop wireless underwater networking (e.g. acoustic modems, optical communication) between moorings and gliders/AUV</p>	Try to reduce the environmental impact of RF by using disposable ballast that promotes the settlement of benthic and pelagic fauna.



Thank you for your attention!





Observing the ocean to save the earth

