emso ERIC

EUROPEAN RESEARCH INFRASTRUCTURE CONSORTIUM

ANNUAL REPORT 2023

Observing the ocean to save the earth

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EMSO ERIC
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European Multidisciplinary Seafloor and water-column Observatory
European Research Infrastructure Consortium (EMSO ERIC)

Observing the Ocean to Save the Earth

FOREWORD

The core of EMSO ERIC actions is to acquire and provide a variety of quality multidisciplinary and harmonized datasets, Essential Ocean Variables (EoV), to respond to both scientific and societal demands as well as to major environmental challenges with significant socio-economic impacts. In that context, EMSO ERIC works in a global international domain to advance key issues related to geohazards arising from earthquakes, tsunamis and slope stability, on biodiversity loss in different ecosystem settings and more precisely on the investigation of increasing globalization due to human travel, migration flows and persistent pollution that are accelerating marine biological invasions through several pathways such as: maritime transport, through ballast water and biofouling of ship hulls. Deep seafloor monitoring is becoming essential to understand multiple processes that affect the Earth globally, such as increasing ocean acidification, ocean heat content, rising sea levels, and worrying changes in temperature and salinity that can greatly affect ocean currents and strongly influence climate change.

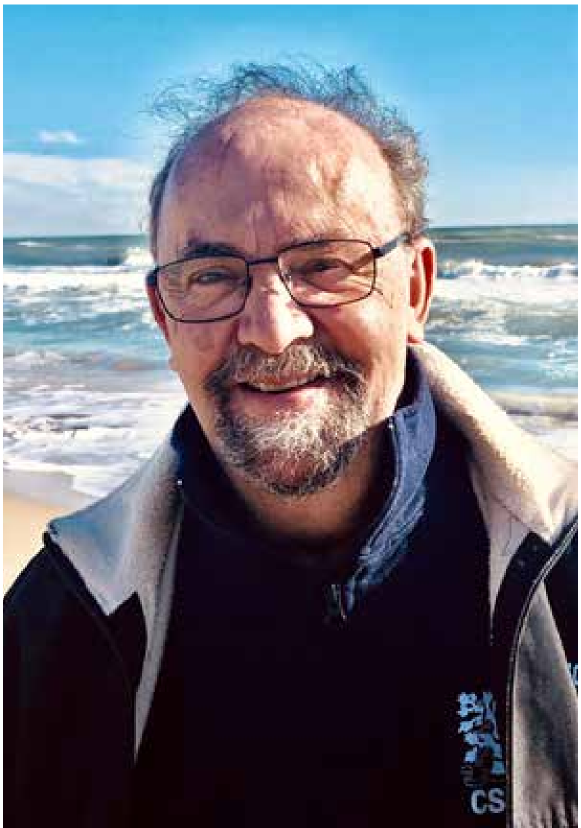
The knowledge gained on environmental variables is crucial to improve our understanding and capacity to manage ocean health, to understand and/or mitigate biological invasions, their rapid expansion, distribution and behaviour in the seas, especially in the Mediterranean, to understand the marine microbiome in the context of ocean circulation and the presence of marine pollutants, and to understand the characteristics of ecosystems in unique sites (e.g. the Black Sea).

EMSO ERIC is a key player in advancing the understanding of the interaction between the geosphere and the hydrosphere, as addressed in marine geohazards, improving nearby earthquake relocation, and tsunami and earthquake (early) warning systems, in the field of ocean noise research/monitoring by extending the frequency range to discriminate sources, and assessing the impact of anthropogenic noise on marine life.

To achieve these objectives, EMSO ERIC promotes the integration of the capabilities and extensive knowledge existing in the consortium and provides resources to successfully address the designed challenges.

In 2023, the operation of observations in Regional Facilities was successful and delivered the expected data sets. The progress of EMSO ERIC's activities continue at an excellent rate. For the second consecutive year, the access service to the facilities for users, not only scientific but also small and medium-sized enterprises (SMEs), is consolidated as an crucial element. This is in a certain way revitalising the actions of the different EMSO sites, in the Atlantic and Mediterranean, and helping the internal synergy of the organisation. Another element to highlight is the increase in the commitment of the service groups to the harmonisation and standardisation of the recorded EOVs reaching in some cases a compatibility in fairness of 90%.

The World Oceans Day 2023 event was an excellent opportunity for EMSO ERIC to engage with the general public and promote ocean knowledge and outreach by organising an EMSO ERIC-led panel discussion, "The risks of ocean acidification, between challenges and solutions to turn the tide", with a good participation of international experts and with media representation.
Finally, it is worth highlighting that EMSO ERIC has completed the year 2023, presenting in a comprehensive manner all the documents and information on the requirements of the panel of the European Strategic Forum on Research Infrastructure (ESFRI) for the 2024 ESFRI landmark monitoring exercise. As an essential element of the Environment Domain of the European infrastructure landscape, EMSO ERIC has to maintain its viability and sustainability over time by providing efficient management of knowledge regarding the European ocean domain, supplying quality data and delivering services in line with European Commission policies and public awareness on Research Infrastructures.



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1. MISSION IMPLEMENTATION

1.1 SCOPE AND MISSION

EMSO ERIC aims at promoting the advancement in knowledge of the deep ocean and water column processes, through the monitoring, analysis and dissemination of data retrieved by EMSO observatories, thus ensuring long-term ocean observations monitoring.

The overarching goal is to better understand the complex interactions between the geosphere, the biosphere, the hydrosphere and the atmosphere, and to address the major environmental challenges in the thematic areas of Climate Change, Marine Ecosystems and Geo-hazards.

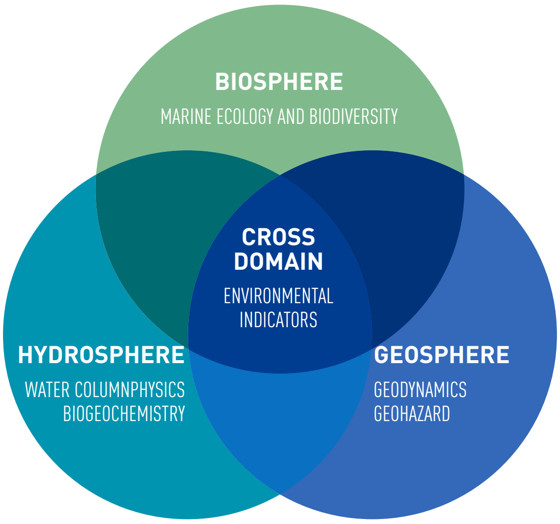


Figure 1| EMSO domains and data-related services categories and SSG thematic leaders

The EMSO ERIC approach is based on the generation of high-value data by a distributed network of regional facilities operated and maintained by its partners, but sharing the same quality level and a harmonised set of observables.

As a primary and essential outcome, EMSO distributes observations of Essential Ocean Variables (EOVs), Essential Climate Variables (ECV) and other physical and environmental variables. EMSO data follow the FAIR data principles (Findable, Accessible, Interoperable and Reusable).

EMSO ERIC continuous multidisciplinary time-series, going from the sea surface to the sub-seafloor address many key processes that affect the entire ocean. The volume of data and information provided by EMSO ERIC allows the description of processes ranging from extreme episodic events to slow trends, difficult to distinguish from the underlying variability of short-term processes.

1.2 COORDINATION ACTIVITIES FOR SERVICES DEPLOYMENT AND OPERATION

The EMSO mission is mainly implemented in the EMSO Service Groups (SGs) that are gathering diverse experts from the EMSO Regional Facilities (RFs) grouped according to their particular area of expertise. The Service Groups (SG) are as follows:

- Science
- Engineering & Logistics
- Data Management
- Communications

EMSO ERIC organised the competencies and capacities within and across the SGs as follows:

- The Science SG elaborates on the parameters the most suitable to answer the EMSO scientific questions and on the corresponding scientific strategy.

- In collaboration with the Science SG, the Data Management SG prepares the implementation of recommendations for data and metadata standardisation. It also develops procedures for the harmonised data integration into the existing data portal

- The Science and the Engineering and Logistics SGs integrate their respective competencies to develop new equipment and methodologies for generating new observations.

- The Science SG and the Communications SG frequently collaborate in dissemination and communication events to promote the most relevant scientific results achieved at all EMSO Regional Facilities (further details in the Communication section).

The EMSO ERIC service functions, derived from the operational activities carried out in Regional Facilities, are provided by the EMSO ERIC SGs under the leadership of Service Group Leader (SGL) and supported by the Central Management Office (CMO). CMO officers provide the integration and coordination of activities in EMSO ERIC helping the Director General to align the specific objectives and activities of the SGs with the objectives of the Strategic Plan (2021-2023).

Figure 2| Distribution of the EMSO ERIC - Regional Facilities and test sites across Europe

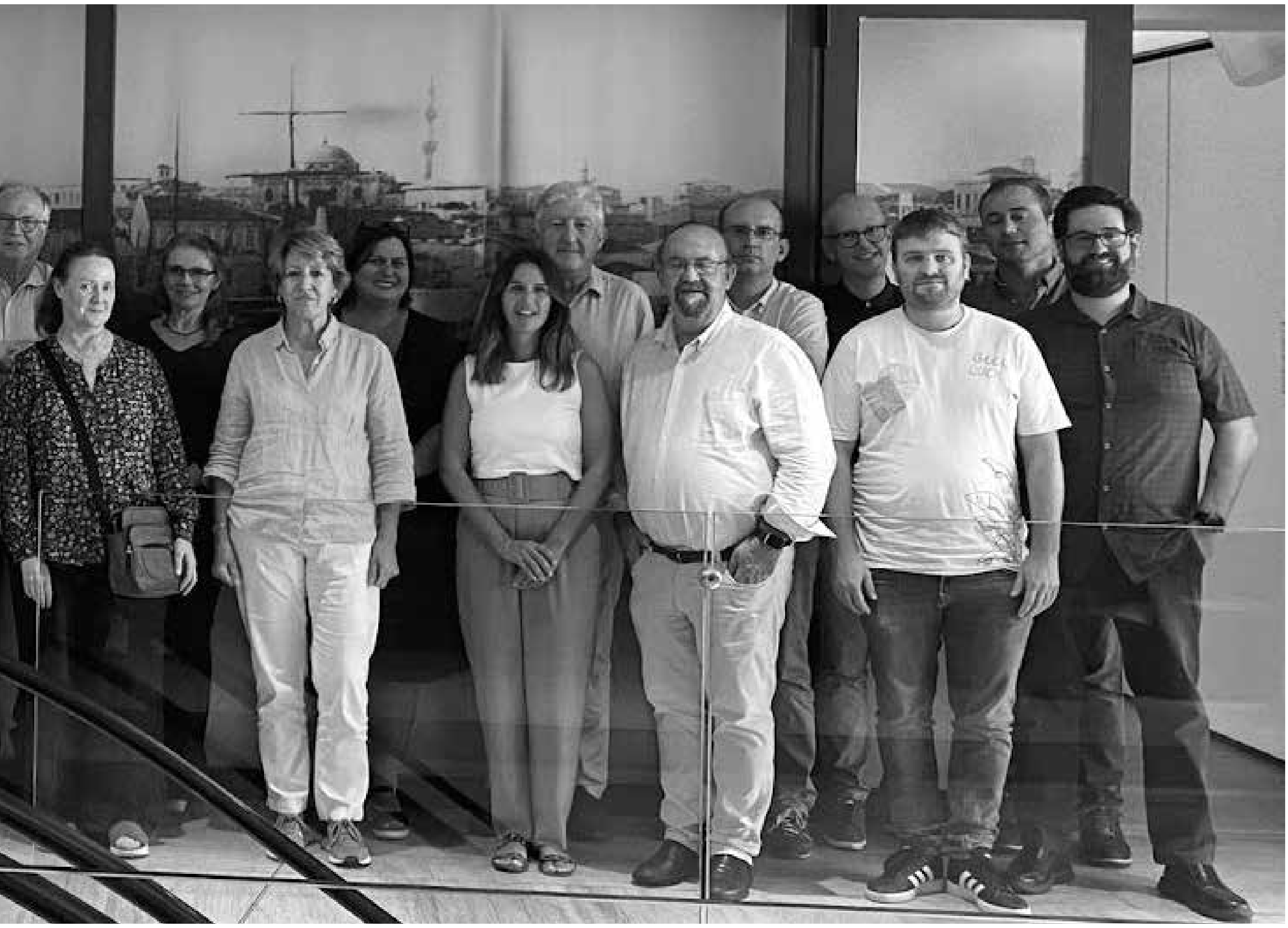
Figure 3 | Group picture of the EMSO Office with Member Delegates, Regional Facilities representatives and Service Group Leaders during the EMSO AoM-ExCom joint meeting in Heraklion, Greece, in October 2023

To pursue its objectives, EMSO ERIC has created the necessary conditions and promoted appropriate actions such as:

1. Streamline and integrate the existing competencies and capacities;

2. Provide its community with the necessary resources,

According to the EMSO Statutes, the initial phase of EMSO before being an operational Research Infrastructure is expected to complete by end of 2024. Consequently, years 2023 and 2024 are crucial to step ahead towards the operation phase. As an adaptation process, the leadership has been revised in some key sectors and efforts have been driven to align the visions between members and partners acting at different organ-



isation levels. In 2023, the appointment of new SG Leaders to guide the annual work programme of each EMSO Service Group well strengthened the cohesion of the EMSO community to progress on the achievement of both short and long-term objectives of the ERIC and contribute to the development of the new EMSO Strategic Plan. Moreover, a joint in-person meeting was dedicated to gather the key EMSO actors working at the Decision level, the EMSO Assembly of Members (AoM), and at Executive level, the Executive Committee Members (ExCom) and the Central Management Office (CMO) of the ERIC, headed by the Director General.

This event marked a significant milestone, crucial for the work commenced and further developed on the EMSO long-term vision.

2. PROGRESS IN THE OPERATION OF EMSO SERVICES

EMSO ERIC offers a suite of services designed to support marine research and innovation, based on long-term ocean observations in EMSO sites. Thanks to these services, harmonised data and metadata are flowing to EU data aggregators and their high quality is serving researchers and stakeholders primarily in Europe, but also worldwide via an open and interoperable access system.

5

NEW SERVICE GROUP LEADERS
Science
Data Management
Engineering and Logistics
Industry
Communication

> 80

PERSONNEL INVOLVED
among the Regional Facilities
and the Central Management Office

FEDERATED DATASETS

11 of 13 MESO ERIC Regional Facilities successfully set up an ERDDAP server and federated their data with the central ERIC data services.

ENHANCED DATA QUALITY

EMSO ERIC has developed an extensive Data Management Plan and data Policy documents, offering clear guidelines and frameworks for data collection, storage, access and sharing within its network.

PHYSICAL ACCESS

New 4 projects funded by EMSO started in 2023 involving users from different Europen countries. The Physical Access Programme has seen also the increase of RFs avaible for hosting projects (further details in section "Engineer and logistic").

EXPANDED SPATIAL COVERAGE

The deployment of new observational platforms and sensors enable the generation of larger and more diverse datasets across various research areas, including Ocean Acidification, Biological and Ecological Monitoring.

14 LIFE BELOW WATER

The EMSO community works around several multidisciplinary scientific objectives recognised as paret of the United Nations SDG-14 (Life below water) for ocean sustainability:

- Understand the distribution and behavior of incresing invasive species in European seas, especially un the Mediterranen:
- Provide data to understand the structure and function of the marine microbiome in the context of persistent pollutants, micro and nano plastics, oil spills, etc.;
- Understand the ecosystem characteristic in sites with strong environmental stress (e. g. the Black sea);
- Understand the interaction between the geosphere and the hydrosphere in the scenario of marine geohazards with the significant socio-economic impact, i.e. earthquakes, submarine landslides and tsunamis;
- Investigate anthropogenic oceanic background nise following the Eurpean Commission's marine Strategy Framework Directive (MSFD) included the long-term monitoring of low frequency underwater sound, and to broader frequency range to discrimante between different generating sources (Offshores platform, cargoships,public works) and evaluate the impact of anthropogenic noise on marine life and proposeappropriate mitigation measures according to the cases.

2.1 SCIENCE

The driving force behind EMSO ERIC is to provide high-quality data for excellent science, and to respond to the most urgent scientific needs in ocean observations as identified by its scientific community. Efforts and actions were undertaken with the ultimate goal of providing a service portfolio useful for deep ocean research and ocean sustainability.

In 2023, the Science SG's work focused on the survey of the quality control procedures adopted in the RFs, assessing the data quality level, and on the harmonization of quality control procedures across the different thematic areas. This work is a key aspect for identifying the basic data products to be offered to users.
EMSO ERIC also strongly encourages and supports networking with other RIs in the marine environmental domain, to promote harmonization and compliance with international standards and best practices for metadata monitoring.

From climate change and marine ecosystems to oceanographic phenomena, our network of observatories has provided valuable data and information, facilitating significant advancements in our understanding of the ocean and contributing to ground-breaking research across a wide range of disciplines. Below are some highlights of EMSO's scientific findings.

- High-frequency data from the new components of the South Adriatic Sea system made it possible to determine **the arrival of gravity waves in the deepest part of the Adriatic Sea.**
- A colonization experiment and repeated sampling in EMSO Azores revealed that **iron-rich microbial mats composition changed** between 2016 and 2020 as a response to a regional geological event and changes in fluid chemistry (Astorch-Cardona et al. 2024). A metabarcoding approach indeed highlighted

distinct communities depending on the fluid chemical composition.

- Fine-scale current measurements conducted during the Momarsat maintenance cruises uncovered high variability linked to tidal currents and mesoscale circulation. An energetic internal tide beam, generated by a steep abyssal hill, was associated with enhanced kinetic energy dissipation and mixing. While such tidal beams are crucial for material dispersal, their dynamic nature often eludes regional models lacking sufficient resolution.

- A decrease in freshwater transport with the East Greenland Current, observed until late 2019, has since reverted to normal or above-normal levels as of 2020 in the Nordic Sea Fram Strait.

- Data from Nordic Sea Station M in 2023 provide valuable insights into the short-term variability of pCO_2 and ocean acidification in the mixed layer, extending the existing long-term carbon and hydrographic time series.

- Observations from the Svinøy mooring off Norway contributed to the description of fluctuating Atlantic inflows to the Arctic Ocean and how these modulate the atlantification of the Arctic.

- The Hellenic Arc RF team realized **the first marine CO_2 time-series in the Eastern Mediterranean.**


Deep-Water Dynamics along the 2012–2020 Observations on the Continental Margin of the Southern Adriatic Sea (Mediterranean Sea)

Geophysical Research Letters
Multi-Approach Analysis of Baroclinic Internal Tide Perturbation in the Ionian Sea Abyssal Layer (Mediterranean Sea)

Moho depths beneath the European Alps: a homogeneously processed map and receiver functions database

Seismic T Phases in the Western-Central Mediterranean: Source of Seismic Hazard?

Marine Geology
Sediment resuspension and transport processes during dense water cascading events along the continental margin of the southern Adriatic Sea (Mediterranean Sea)

A New Coastal Crawler Prototype to Expand the Ecological Monitoring Radius of OBSEA Cabled Observatory

A Review of Arctic–Subarctic Ocean Linkages: Past Changes, Mechanisms, and Future Projections

Fluctuating Atlantic inflows modulate Arctic atlantification

Figure 4| A selection of the high-quality publications realized by our research community

2.2
DATA MANAGEMENT AND INFORMATION TECHNOLOGIES

SERVICE FOR THE ADVANCEMENTS IN THE HARMONISATION AND FEDERATION OF REGIONAL FACILITIES' DATA

Recognising the pivotal role of data within the organisation and the need to enhance data management practices and leverage data assets to drive scientific discovery and impact, EMSO formulated a comprehensive Data Management plan and supporting Data Policy documents. These documents provide clear guidelines and frameworks for data collection, storage, access, and sharing within the ERIC network. By establishing standardised protocols, EMSO aims to ensure transparency, integrity, and accessibility across its data management practices.EMSO ERIC's data infrastructure operates on a distributed model, with a focus on the federation of ERDDAP server[1], as shown in Figure 5.

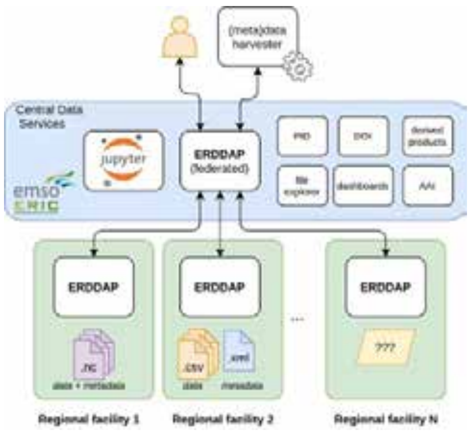
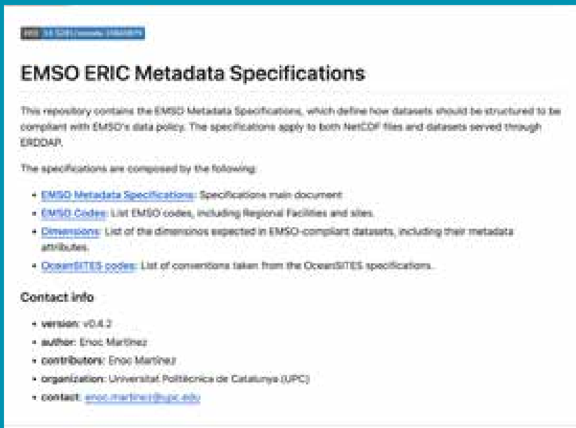


Figure 5 | EMSO ERIC data services diagram

This approach enables seamless access to data assets hosted across Regional Facilities, consolidating them under a unified entry point at the central ERDDAP server. The rest of the EMSO ERIC data infrastructure, such as the Data Portal (dashboard), and data products, relies on ERDDAP as its data source.

[1] EMSO ERIC central ERDDAP available at: https://erddap.emso.eu

Being the backbone of the EMSO virtual infrastructure, in 2023, fundamental efforts of EMSO ERIC were dedicated to progress the federation of data flows from Regional Facilities into the central ERDDAP service. Indeed, as the knowledge and/or the human resources were lacking in some Regional facilities to deploy and maintain the regional ERDDAP service, the Data Management Service Group (DMSG) leader prepared and implemented the ERDDAP Playground[2] thus providing an out-of-the-box ERDDAP setup to facilitate the ERDDAP deployment in RFs. Since all the components are packed and ready to go, the deployment time of the tool is estimated to be below 30 minutes.



EMSO ERIC Metadata Specifications

This repository contains the EMSO Metadata Specifications, which define how datasets should be structured to be compliant with EMSO's data policy. The specifications apply to both NetCDF files and datasets served through ERDDAP.

The specifications are composed by the following:

- EMSO Metadata Specifications: Specifications main document
- EMSO Codes: List EMSO codes, including Regional Facilities and sites.
- Dimensions: List of the dimensions expected in EMSO-compliant datasets, including their metadata attributes.
- OceanSITES codes: List of conventions taken from the OceanSITES specifications.

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Figure 6 | Screenshot of the EMSO ERIC Metadata Specifications document available on GitHub

Accordingly, in 2023, 11 of 13 regional facilities had successfully set up an ERDDAP server and federated their data with the central EMSO ERIC data services. Only two facilities still need to deploy an ERDDAP: The Canary Islands and the Black Sea. However, their respective IT teams, with the support of the Data SG, are working on setting up an ERDDAP server to integrate their harmonised data.

Another area that EMSO ERIC has put a lot of focus on in 2023 is metadata harmonisation.
The organisation acknowledges and advocates the importance of standardizing metadata formats and procedures to ensure coherence and interoperability across its data nodes. Without metadata harmonization, effectively finding, processing, and visualizing data is challenging.

The aim to have a coherent metadata policy across all Regional Facilities is the driving force behind the EMSO ERIC Metadata Specifications[3] document (Figure 6).
EMSO ERIC metadata specifications build on previous initiatives such as EMODnet, OceanSITES, SeaDataNet, and according to standardized NERC Vocabulary Server, in collaboration with the Blue Cloud 2026 EU funded project community. A detailed list of the metadata requirements can be found in the specifications document, mentioned previously. Furthermore, the metadata specifications are written in a way that can be easily read and processed by software.

EMSO ERIC has developed a suite of tools to support metadata harmonization efforts. These tools empower data managers to streamline metadata

[2] Available at https://github.com/emso-eric/erddap-playground
[3] Available here at https://github.com/emso-eric/emso-metadata-specifications

Figure 7 | Screenshot of an example of the results produced by the Metadata Report tool

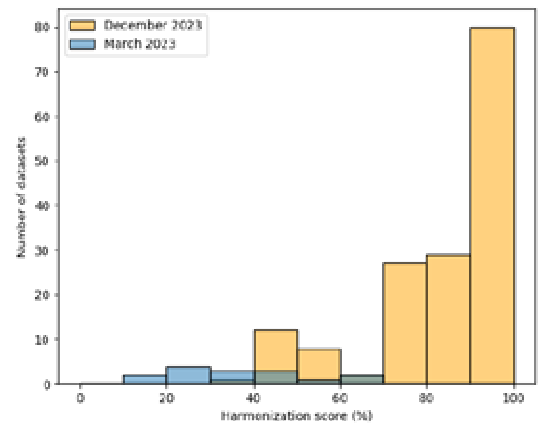


Figure 8 | Harmonization status in March and December 2023. The x-axis represents the harmonization score, while the y-axis displays the number of datasets that achieve this particular score (grouped in bins of width=10)

alignment processes, enhance dataset quality, and automate ERDDAP server configurations.
The tools are available in the EMSO ERIC GitHub repository[4]. It's worth mentioning the tool "Metadata Report" (Figure 7), which assesses the alignment of a dataset with the EMSO ERIC Metadata Specifications.
This tool checks if the metadata of a dataset are aligned with EMSO ERIC's Metadata specifications and provides a summary with a harmonization score. Additionally, it also offers tips to improve each of the individual metadata terms. It can check standalone NetCDF files and datasets hosted in ERDDAP services.

The Metadata Report tool was used to analyse the evolution of the harmonisation status from March to December 2023. As illustrated in Figure 8, the quantity and quality of data federated at the central ERDDAP have significantly improved. From around 50 datasets with an average score of 30%, we increased to 160 with an average score of about 90%.

The year 2023 marked notable progress in EMSO ERIC's data management initiatives. The organisation witnessed improvements in the quantity and quality of federated datasets, laying a solid foundation for future data-driven activities. Future work will focus on refining the EMSO ERIC metadata specifications addressing any RF facility inconsistencies.

The final aim is to be able to generate data products and visualisations from the datasets archived in the different ERDDAP servers.

[4] Metadata harmonizer toolbox: https://github.com/emso-eric/metadata-harmonizer

EMSO ERIC DATA ACCESS

In 2023, EMSO ERIC's services maintained close to 100% up-time without significant incidents. During this time, the EMSO ERIC data portal received over 15K visits and more than 600K requests (from the API and ERDDAP federation) from 8,647 distinct users in 105 countries.

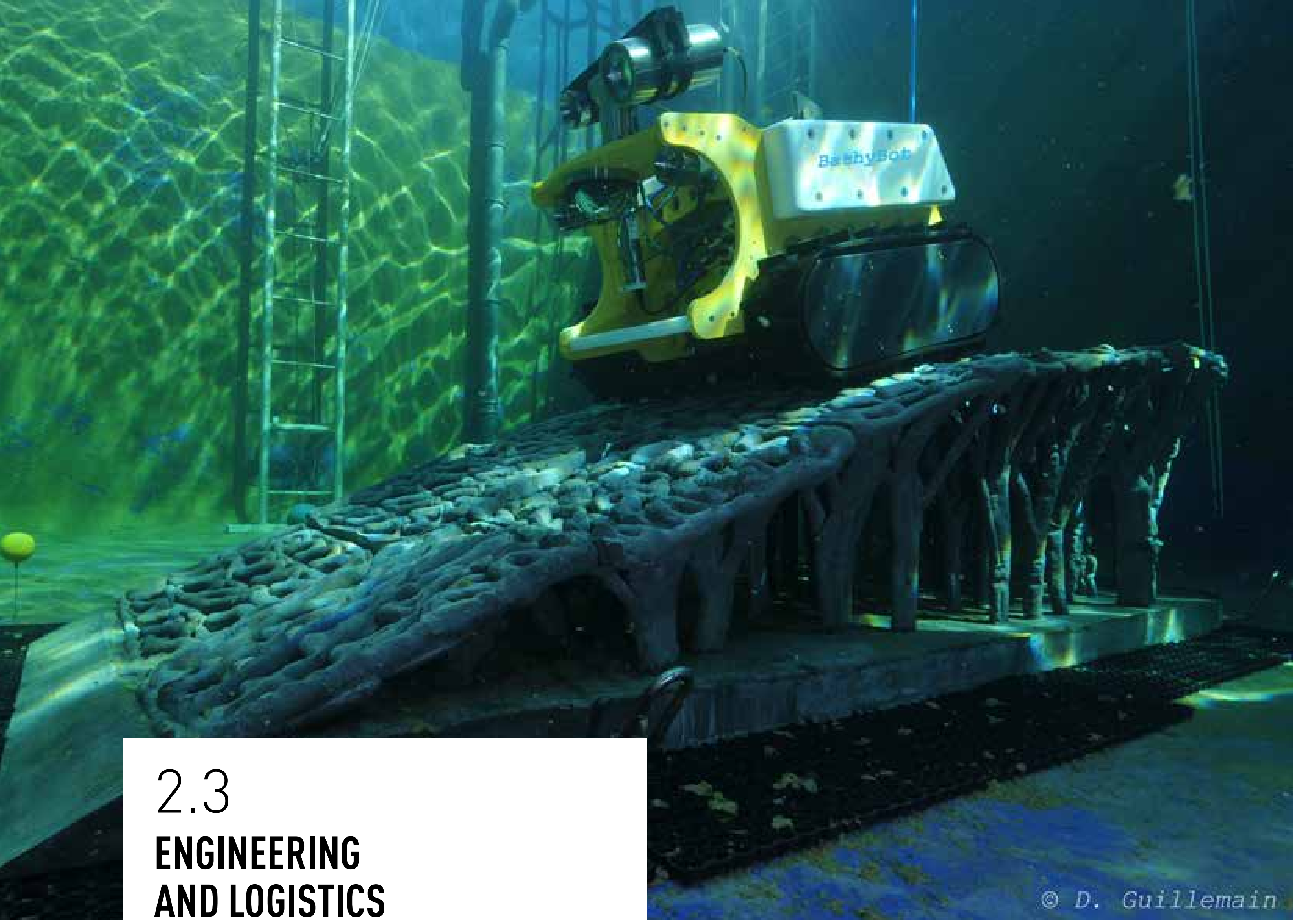
It represents the consolidation of EMSO ERIC's primary services specially ERDDAP as a data delivery method.
Table 1 summarises the statistics from 2020 to 2023. The countries with the most visits include Canada, United States, China, Germany, United Kingdom, Belgium, Singapore, Netherlands, India, and Russia, as illustrated in Figure 9.

METRIC	2020	2021	2022	2023
Number of countries reached	85	115	110	105
Number of distinct users	1.010	1.883	1.413	8.647
Data portal page views	4.038	4.625	5.226	15.379
API and ERDDAP federation requests	4.005	62.780	154.730	607.039

Table 1 | Statistics related to EMSO data access

Figure 9 | Distribution of accesses per country and continent

It is important to note these accesses are accounting for only those measured by the analytics of the EMSO portal. An issue shared with other marine and environmental research infrastructures stands in the difficulty to track the access to the EMSO data given by the EU data aggregators on one side and by the National Data portals on the other side. Consequently, these numbers are not the total representing the actual interest of the user community to the EMSO data. It is there strongly under estimated and hardly quantifiable.



2.3 ENGINEERING AND LOGISTICS

SERVICE FOR THE ENGINEERING, STANDARDS AND INTEROPERABILITY IMPLEMENTATION

The Engineering and Logistics Service Group (ELSG) has set up several Working Groups (WGs) of systems or sensors experts that held regular meetings to discuss and implement harmonisation questions from the engineering point of view and to agree technical decisions. In 2023, mainly two WGs were active: one dedicated to a generic module of instruments and another one for ADCPs (Acoustic Doppler Current Profiler), a particular type of current-meter.

The EMSO Generic Instrument Module (EGIM) is a key component for the future of EMSO ERIC as it will help harmonize the data collected at the different Regional Facilities, providing a set of common Essential Ocean Variables that are key to study the ocean. The design of the EGIM (Lantéri et al., 2022) took the following parameters into consideration: conductivity, temperature, pressure, dissolved oxygen, turbidity and optical backscatter, currents velocity and direction, and underwater sound. In 2023, the short-term future of the EGIM was discussed in the corresponding WG, from a technical and operational point of view as the EGIM will be deployed several times in the framework of the TRIDENT[5] and GEORGE[6] EU funded projects where EMSO ERIC is partner. In the former, the EGIMs, operated by INESC TEC and IPMA, will be deployed at the Tropic Seamount, North Atlantic Ocean, to monitor the deep sea exploration impact. For the latter, UPC and Ifremer will upgrade the EGIMs to measure variables to observe and assess the carbon cycle. Ifremer will design a lander system and new rechargeable batteries in order to improve the logistics and reduce the environmental footprint of the monitoring (Table 2). The up-

[5] https://deepseatrident.eu/
[6] https://george-project.eu/

NEW PARAMETERS	NEW FEATURES
pH, TA, DIC, TADIC, pCO2, CH4	Lander, Rechargeable battery packs

Table 2 | EGIM upgrades to be performed within the GEORGE project and validated to TRL8 by 2026

graded system will be deployed in different areas (Nordic Seas, Porcupine Abyssal Plain and NW Mediterranean Sea) throughout the project.

The EGIM may also be deployed temporarily at specific locations to capture or monitor transitory events of high relevance, such as heatwaves, volcanic eruptions and other extraordinary events. In marine technical terms, current meters are referred to according to the technology embedded in the system. A well-known technology is based on the so-called Doppler effect that is used to measure the frequency disturbance induced on an active acoustic signal by a moving system. These marine current meters are so called Acoustic Doppler Current Profilers (ADCP).

Figure 10 | EGIM recovered in 2022 after being deployed in waters offshore the Cumbre Vieja volcanic eruption of La Palma island. Credit: PLOCAN

A well-known technology is based on the so-called Doppler effect that is used to measure the frequency disturbance induced on an active acoustic signal by a moving system. These marine current meters are so called Acoustic Doppler Current Profilers (ADCP).

The Working Group on ADCPs was created in 2023 and convened several meetings throughout the year. In the framework of the MINKE EU funded project[7] , the group was successfully awarded grant-aid for a TransNational Access (TNA) to access the SHOM[8] facilities in Brest, France, to learn about ADCP maintenance and operation. The access project will have two stages, one in Spring 2024 in which a 300 kHz Teledyne Workhorse (ADCP that is usually mounted on the EGIM) will be tested and have its compass calibrated. In Autumn 2024, another visit at SHOM will be devoted to the post deployment tasks on three Nortek Signature instruments, two recovered from the North Sea and one from the Rockall Trough. This TNA action will further consolidate the group that will deliver a best practices document on ADCP for the EMSO community.

Building on the success of these dedicated Working Groups (WGs), the ELSG will develop several additional WGs related to specific instruments or sensors, such as the ADCP, and on platforms, such as moorings or cabled observatories (Figure 11). These groups will be very specialised and will share their knowledge within the ELSG group

[7] https://minke.eu/
[8] https://www.shom.fr/

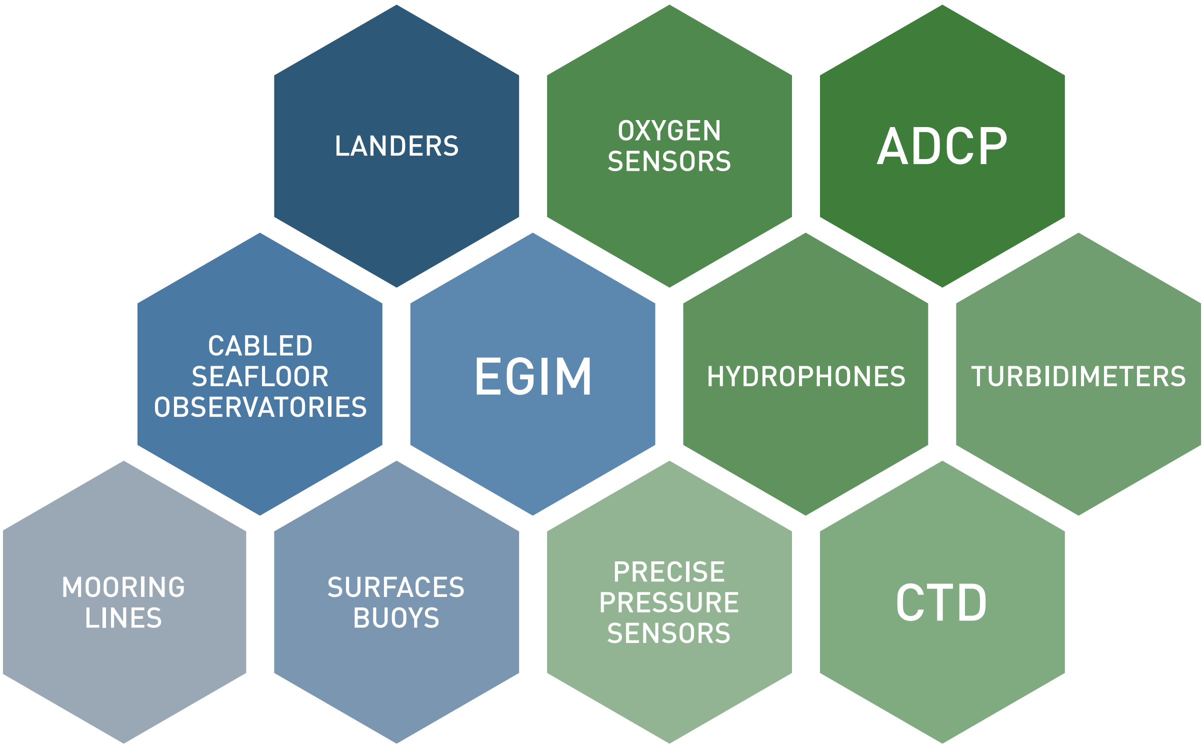


Figure 11 | Creating Working Groups specialized in Platforms (left, in blueish colours) and Instruments/Sensors (right, in greenish colours) will allow the Engineering and Logistics Group to advance in the knowledge and operational excellence of the different technologies

but also the entire EMSO community and beyond. They will elaborate documents on how to best maintain and operate the instruments and platforms, raising the overall quality and homogeneity of the data provided by EMSO ERIC to the stakeholders.

SERVICE FOR THE PHYSICAL ACCESS TO THE EMSO FACILITIES

The second year of the EMSO Physical Access program highlights a significant increase in thnumber of facilities available for access, from four in 2022 to seven in 2023, provided by the Atlantic Ocean facilities (SmartBay and Iberian Margin), aside from the Mediterranean Sea facilities which were already offered in 2022 (Figure 12). The TNA Application procedures included minor improvements to make the process easier and better adapted to the user and access provider needs. Five access projects were granted during the year, providing new collaborations and ideas to the host facilities. One of the projects is to be carried out fully remotely, which is a novelty in the short history of EMSO's physical access program. The users asked for a total of 590 Access Units with a cost

Figure 12 | Regional Facilities offered for Physical Access in 2023

PROJECT TOPIC	USER	COUNTRY	HOST FACILITY	ACCESS TYPE	ACCESS UNITS	GRANTED FUNDS
CTD intercomparison	Marine Institute	Ireland	Cretan Sea	On Site and Remote	93	10222 €
Noise measurement with optical fiber	NOC	United Kingdom	Western Ionian Sea	On Site and Remote	49	10745 €
Persistent organic pollutants	Masaryk University	Czechia	Cretan Sea	Fully Remote	182	1200 €
Low cost landers	IEO-CSIC	Spain	Iberian Margin	On Site and Remote	186.5	10700 €
Low cost acoustic recorders	University of Valencia	Spain	OBSEA	On Site and Remote	80	11000 €

Table 3| In 2023 a total of five physical access projects were granted

Figure 13 | RISE cables with 3 different painting configurations installed on the Western Mediterranean Sea Regional Facility spar buoy

to be able to perform the experiments at the EMSO regional facilities. These are diverse: CTD intercomparison, noise measurement with optical fibre, measurement of persistent organic pollutants, deployment/test of low cost landers, and low cost acoustic recorders (Table 3).

The four physical access projects in receipt of grnt-aid in 2022, commenced in 2023 due to the need for thorough preparation and coordination between the user and the host regional facility. SEASNAKE, the project that RISE (Research Institutes of Sweden[9]) carried out at the Western Mediterranean Sea Regional Facility, required the redeployment of the spar buoy with the RISE dynamic umbilical cables attached to it (with 3 different paint configurations) in order to evaluate their durability, corrosion and biofouling resistance (Figure 13).

CUPIDO, a BAS project of the British Antarctic Survey[10], required the access to R/V DALLAPORTA to deploy the BAS systems at the South Adriatic Sea mooring to study the degradation of microplastics and their effects on the biological carbon pump (Figure 14).

[9] https://www.ri.se/en
[10] https://www.bas.ac.uk/

Figure 14 | Team on board of R/V DALLAPORTA (left) and British Antarctic Survey's Ocean Plastic Incubator Chamber, OPIC (right)

The project proposed by ANB Sensors Ltd[11], a SME from the UK, experienced some logistical issues in 2023 and will undertake a second stage in 2024. The aim will be to test a new generation of pH sensors capable of reducing the effects of biofouling on the measurements. This will improve pH data quality and greatly reduce operational and maintenance costs for users. While these three projects are due to complete in 2024, project TRIPLE-VTESTS by MARUM[12] was completed at OBSEA during two weeks in February 2023. MARUM engineers tested several features of their mini AUV including deep learning techniques to improve the endurance of the surveys (Figure 15).

The physical access programme is a good opportunity for users and hosts alike, as it allows for the exchange of ideas and knowledge and opens options to new collaborations.

EMSO ERIC are further enhancing the access policy taking into account the feedback of all stakeholders involved, and thereby improving the experience for all. New facilities will be incorporated to offer access and a new web-based access platform to manage the projects and the interactions among the different stakeholders will be considered. The following years will be key to consolidate and streamline the service that provides unmatched opportunities for users in Europe and beyond.

Figure 15 | MARUM engineers preparing their mini AUV (Autonomous Underwater Vehicle) to test a miniaturized Ultra Short Baseline System (USBL) and new algorithms at OBSEA

[11] https://www.anbsensors.com/

[12] https://www.marum.de/en/index.html

2.4
INDUSTRY & INNOVATION

The achievements of 2023 represent a significant step forward in EMSO's effort to engage with the industry and drive innovation in Marine Science. A fundamental milestone has been the finalisation of the EMSO Industry Partnership Strategy 2023. The year was marked by a series of initiatives aimed at enhancing EMSO's industry engagement, aligned with the three-pillar approach of this strategy as illustrated in Figure 16: Training, Collaboration in EU-funded projects, and Access to Data and Facilities.

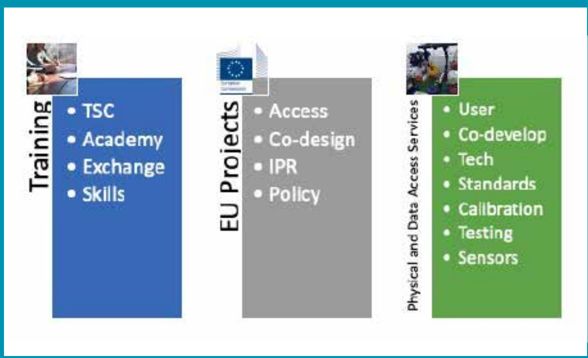


Figure 16 | The three-pillar approach of the Industry Strategy

TRAINING IN COLLABORATION WITH THE PRIVATE SECTOR

On the Training pillar, the launch of EMSO On the Training pillar, the launch of EMSO Academy which was planned for 2023, started its implementation for the offering of internship and fellowship opportunities.

This platform will further provide hands-on experience with cutting-edge oceanographic research and technology, creating a bridge between EMSO and industry professionals seeking to advance their expertise. A series of workshops and training sessions are the next step to attract significant participation from diverse sectors such as marine biology, environmental monitoring, and maritime technology. EMSO is in the process of developing tailored training programs to enhance the skill set of professionals in the private sector. These programs will provide industry participants with a deeper understanding of oceanographic data and technology.

ACCESS SERVICE OPEN TO SMES AND INDUSTRIES

On the Access service pillar, EMSO significantly enhanced the accessibility of its data repositories and research facilities for industry use. The EMSO Data Portal was improved to provide a more user-friendly experience, ensuring that industry partners could easily access high-quality data and the level of FAIRness in EMSO Data has remarkably increased towards a full compatibility with the European Open Science Cloud (EOSC). This move facilitated the adoption of EMSO data by a wider array of stakeholders, contributing to advancements in environmental monitoring and compliance with regulatory standards.
Through the Physical Access Service, EMSO provided users of the private sector with the opportunity to utilise its facilities for R&D activities. The operation of this service supported the testing of innovative marine technologies, fostering an environment where the private sector could benefit from EMSO's state-of-the-art infrastructure and expertise.

ACTIVITIES DEVELOPED WITHIN THE HORIZON EUROPE FRAMEWORK

As part of the collaborative partnership based on EU funded projects (central pillar), EMSO promoted public-private joint actions and tasks. Indeed, EMSO served as a testbed for innovative technologies, facilitating the development and testing of new methodologies through the EMSO Physical Access Programme promoting innovation in marine and environmental sciences also within the projects. These partnerships helped leverage EMSO's expertise and resources, fostering a co-development and knowledge exchange culture. This resulted in enabling the design of new services and products tailored to address industry needs.

Of note, the following deliverables developed by EMSO in ENVRI-FAIR since the specific focus was the relationships with the private sector (deliverables D3.1 and D3.5).
The D3.1: "A Strategic Action Plan for Enhancing Uptake of ENVRI Data by the Private Sector", led by EMSO, is essential for defining and implementing strategies to enhance cooperation with private sector clients and users. It outlines specific approaches to raise awareness about the innovation potential of the ENVRI RIs, emphasizing the development of partnerships between the RIs and industry to promote the uptake of ENVRI services in line with FAIR standards.

The action plan focuses on:

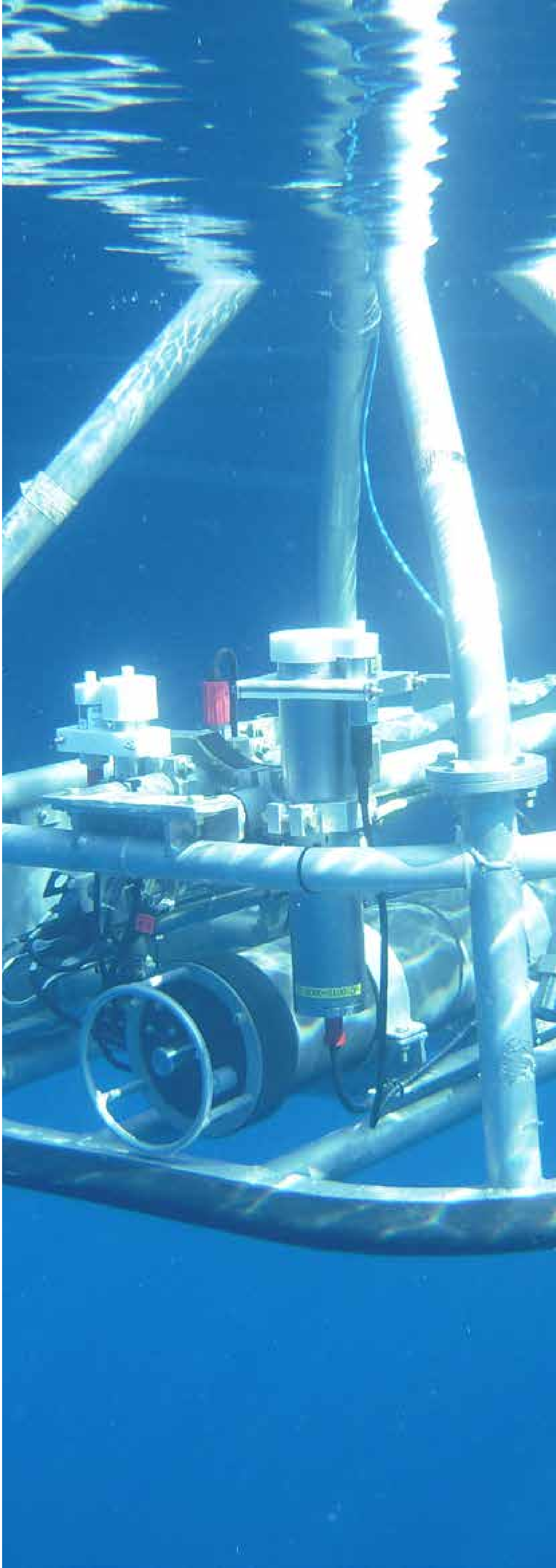
- Creating stronger connections between research infrastructure operators and private industries by improving communication channels and collaboration opportunities.
- Defining the benefits of FAIR data services for industry applications, including improved efficiency and productivity for innovation-driven companies.
- Enhancing industry awareness of the high-quality data and services offered by the ENVRI community and promoting their application in real-world scenarios.

Additionally, D3.5 "Catalogue of Services Targeted for the Private Sector" is another critical deliverable that EMSO developed the guidelines to create a dedicated catalogue of services designed to cater to the private sector's needs. It starts from the services offered by the ENVRI research infrastructures and proposes ways to promote them to external users, specifically targeting industry partners.

The deliverable includes the results of a survey that analyses the current relationship between ENVRIs and the private sector, offering recommendations on how to strengthen this collaboration.

The catalogue is structured to:

- Improve the visibility of the services available from the ENVRI RIs for industrial partners, ensuring that industry players can easily access and use these services.
- Encourage the adoption of advanced scientific tools and data platforms within industrial R&D processes, promoting innovation and co-development.
- Present real examples of successful collaborations between RIs and industry, fostering further engagement and trust.



JOINT COMMUNICATION AS A TRANSVERSAL APPROACH

As a transversal approach, collaboration with industry has been reinforced also in the organisation of events. A noteworthy example has been the World Oceans Day[13] event organized by EMSO and INGV at the Santa Severa Castle near Rome where a successful collaboration with Fugro[14] brought an impressive interest from the general public with several hybrid sessions carried out during the three-day event.

These accomplishments not only amplify EMSO's impact but also underscore its commitment to advancing marine science and supporting industry-led solutions to environmental challenges.

Consequently, EMSO ERIC made significant strides in implementing its strategic plan towards strengthening relationships with the industry and fostering innovation within marine research. The ensemble of these actions in 2023 enabled EMSO to position itself as a key player in the marine innovation ecosystem, fostering a culture of partnership and shared growth.

Figure 17 | Frugo at the EMSO World Ocean Day 2023

[13] https://emso.eu/2023/06/08/join-our-world-oceans-day/
[14] https://www.fugro.com

2.5
COMMUNICATION

For effective communication and outreach, EMSO ERIC implemented a multi-faceted communication strategy focused on four main objectives to enhance awareness and to increase public understanding of the value of ocean science research infrastructures, as follows:

- Raising public awareness about the importance of fostering ocean health by providing knowledge and information.
- Highlighting EMSO ERIC´s role in marine research by disseminating knowledge to share cutting-edge research discoveries, technological advancements, and ongoing projects while promoting meaningful dialogue and connections with various stakeholders.
- Ensuring active participation and collaboration across different domains related to the EMSO ERIC´s mission;

Figure 18 | The main goals of the EMSO's communication and outreach activities

- Promoting gender equality by fostering an inclusive work environment for women in ocean science and inspiring future generations to pursue research careers in the wide-ranging ocean field.

COMMUNICATION CHANNELS

EMSO ERIC has made significant progress in leveraging communication channels to effectively follow its communication, dissemination, and exploitation objectives and goals. This progress is the result of the successful collaboration between the Central Management Office, headquartered in Rome and the five Service Groups, where partner colleagues from various Regional Facilities across Europe work together in the respective service fields (science, data, engineering, industry, and communication).

By prioritizing diverse communication channels and engaging contents, EMSO strives to connect with a wider audience, promote the value of ocean science research infrastructure, and inspire the next generation of ocean explorers.

EMSO increased its visibility by publishing over 20 news items on the website, enhancing the availability of communication materials, releasing two newsletter issues and promoting its activities and results in major conferences through booths, posters and oral presentations.
The social media channels (Facebook, X, LinkedIn) were continuously updated to share information about consortium activities, updates on observatories' initiatives, scientific results achieved by the EMSO community, job opportunities, events and other topics of interest for the community.

For the website, the viewers' and sessions' numbers (interaction's numbers with the web pages) and average duration grew compared to the previous year (as summarised in Figure 19).
Also, the social media channels followed a positive trend during 2023 confirming the efficiency of the synergies and cooperation among the Consortium partners. There has been a positive trend in the EMSO ERIC community on ZENODO, the European multidisciplinary data repository. This indicates an increasing commitment to guaranteeing free and traceable access to key published documents. The number of DOIs assigned to uploaded documents on ZENODO is steadily increasing. DOIs provide a unique and persistent identifier for each document, facilitating monitoring, citation, and accessibility for scientific publications involving EMSO ERIC research. This represents a powerful tool for managing and showcasing our scientific contributions.

WEBSITE

117.082 visitors
+50% respect to 2022

130.903 session
+50% respect to 2022

40" Average session duration
+4% respect to 2022

SOCIAL MEDIA

+6% new followers on Facebook

+7% new followers on X

+26% new followers on Linkedin

NEWSLETTER

2 issue released

46% open rate

Figure 19 | KPI on communication

EVENTS AND OUTREACH

IMMERSING THE PUBLIC IN OCEAN SCIENCE: EMSO ERIC AT WORLD OCEAN DAY 2023

World Oceans Day 2023 was an opportunity for EMSO ERIC to raise awareness of the importance of the oceans to society and to spark public interest and curiosity in marine science and technology. In collaboration with Istituto Nazionale di Geofisica e Vulcanologia (INGV), EMSO ERIC co-organized an engaging three-day series of events entitled "World Oceans Day: Knowing, Understanding, Living Together" at Santa Severa's Castle (Italy) on June 8th-10th.

Through a wider offer of activities and educational materials, including exhibitions,film forums, workshops, theatrical performances and roundtables, guided by experts dedicated to the study and protection of the oceans, the threats and challenges to a healthy ocean were discussed, highlighting the importance of maintaining ecosystems and their extensive biodiversity on our planet. EMSO set up an informative booth with engaging interactive presentations and displays by our team members that showcased the capabilities and features of the research infrastructure. Visitors learned about the diverse types of services and data collected by EMSO observatories, how this data contributes to scientific understanding, and the ultimate impact on ocean conservation efforts.

ENHANCING AWARENESS ON OCEAN ACIDIFICATION

On June 8th, during the World Ocean Day, EMSO led the roundtable "The risks of ocean acidification, between challenges and solutions to change course", inviting leading scientists to discuss on the growing threat of ocean
acidification. The panel featured prominent figures like Prof. Juanjo Dañobeitia (EMSO Director General), Marco Galeotti (EMSO ERIC Programme and Industry Relations Officer), Marco Oliverio (Professor of Zoology, Head of Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome), Vanessa Cardin (Senior Researcher, National Institute of Oceanography and Experimental Geophysics – OGS, Trieste), and Jaume Piera (Coordinator of European Projects Minke -Horizon 2020- and Aneris -Horizon Europe-, Institute of Marine Sciences - ICM-CSIC -, Barcelona, Spain). Together with panel moderator Marco Motta, science journalist and host of Radio3 Scienza, they explored the biological, environmental, and social consequences

Figure 20 | Panel organized by EMSO on ocean acidification together with international experts

of ocean acidification on marine ecosystems and discussed ongoing efforts by scientists, technologists, and various stakeholders to mitigate this impactful phenomenon.

EMSO PARTICIPATION IN THE DOCUMENTARY 'PREPARED FOR THE TSUNAMI?'

'Prepared for the Tsunami?' is a documentary that explores science, technology and safety measures related to earthquakes and tsunamis, with the participation of specialists from different research centres, among which EMSO ERIC representatives. They discuss the causes and reveal new evidence about the recurrence at which these phenomena occur, identify existing prevention measures and explore new innovations that can keep us safe. The film was produced by Goat Knight and written and directed by Erik Martínez-Westley. It was first premiered at the Instituto de Ciencias del Mar (ICM) – CSIC in Barcelona on December 15th, 2023, with the participation of Enrique Álvarez López and María Belón Bordes, survivors of the 2004 Indian Ocean earthquake and tsunami, and renowned seismologists, geologists, marine geoscientists, geophysicists, and mathematicians among them Joaquin Del Rio, who heads the EMSO OBSEA Regional Facility

Figure 21 | Sara Pero and Gabriella Quaranta of the EMSO ERIC Office at EGU2023 in April

HIGHLIGHTING THE EMSO INTERNATIONAL COLLABORATIONS

In April, EMSO ERIC joined the EGU (European Geosciences Union) General Assembly 2023, which gathered ~21.000 geoscientists from all over the world in Vienna. The EMSO team presented the ERIC and two key EU projects in which it is involved, MINKE and Geo-INQUIRE, during the Lunch Talks session at the ENVRI Community booth. The talk entitled **"Observing the ocean from sea-surface down to seafloor: EMSO ERIC and the crucial role of European and international cooperation in a nutshell"**, was focused on the crucial role that Oceans play for life on Earth and its climate and on the importance of cooperation when it comes to developing solutions for the different crisis which currently affect all of us (e.g., climate change, pollution, etc.). Furthermore, EMSO ERIC participated in the poster session **"Research Management: Challenges and Solutions for Successful Research Projects and Programmes"** with a work dedicated to the added value of cooperation and successful project management within EU funded research projects, many of which include partners from the EMSO ERIC community.

SHOWCASING INNOVATION AT MAJOR CONFERENCES

The EMSO Regional Facility SmartBay played a prominent role in two major events in Ireland during the UN Decade of Ocean Science for Sustainable Development:

- Oceans 2023 (Limerick, June 3-5)
- 10th EuroGOOS International Conference (Galway, October 3-5)

These conferences brought together over 400 participants from the European operational oceanography and ocean observing communities. They served as valuable platforms to highlight the relevance of EMSO ERIC and SmartBay, fostering collaboration and discussions on advancements in operational oceanography.

On March 4th, 2023, Galway Atlantaquaria, in collaboration with SmartBay and Argo-Ireland, celebrated Engineers Week by dedicating the day to advanced marine technologies. Scientists from the SmartBay Observatory and the Marine Institute's Argo-Ireland showcased various technologies essential for ocean observation and monitoring. The event aimed to highlight the importance of marine engineering to the next generation of marine scientists, with interactive displays and demonstrations throughout the day. On May 27th, 2023, the Marine Institute and BlueWise Marine hosted the SmartBay Observatory Open Day in Spiddal, Co. Galway, as part of the European Maritime Day celebrations. The local community was invited to explore the SmartBay Observatory, view live footage from 27 meters below the sea, and learn about Ireland's only underwater cabled observatory. Visitors also enjoyed a 360° virtual tour of the SmartBay facilities, enhancing their understanding of marine life and technology. Throughout 2023, the SmartBay Virtual Tour served as a key component of a comprehensive social media campaign. This interactive audio-visual tour of the SmartBay Facility and significant areas in Galway Bay provided panoramic views and a remarkable sub-sea virtual experience. The tour, featuring 360° aerial photographs, underwater simulations, and drone videography, aimed to educate and promote the EMSO SmartBay Facility. For the virtual tour, visit SmartBay Virtual Tour. Looking ahead, EMSO intends to implement a comprehensive Virtual Tour for the operative sites across Europe to disseminate the valuable contribution of the Regional Facilities.

PROMOTING THE EMSO PHYSICAL ACCESS PROGRAMME

Throughout 2023, communication played a pivotal role in promoting the Physical Access Programme, a unique program which offers a gateway to deep ocean knowledge and testing, allowing users to conduct ground-breaking research and test innovative technologies in a real-world marine environment, levering on its observatories and test sites (further information available in the chapter "Engineering and logistics"). Several news arti-

Figure 22 | OCEANS 2023

Figure 23 | Promotion of the Physical Access Call 2023 with some examples of the granted project in 2022 and disseminated through the EMSO channels

cles[15] have been published and spread through the main EMSO channels (website, newsletter and social media) to promote Physical Access and showcase the objectives of the ERIC funded research projects[16] with captive contents as displayed in the figure below.

AN EDITORIAL ARTICLE ON FRONTIERS

The ocean depths hold a symphony of sounds, and researchers are increasingly turning their ears towards this hidden realm. The topic was at the core of the EMSO Time Series Conference (TSC) held in Gran Canaria, Canary Islands, in October 2021, organized with additional support of the CNRS (France), Marine Institute (Ireland), INGV (Italy), PLOCAN (Spain), Universidade do Algarve (Portugal), and Universitat Politècnica de Catalunya (Spain). The conference served as a springboard for groundbreaking research, with a dedicated Frontiers Research Topic launched in the journal Frontiers in Marine Science. This initiative aimed to stimulate discussion and showcase cutting-edge findings on the emerging role of ocean sound as a vital indicator of marine health.

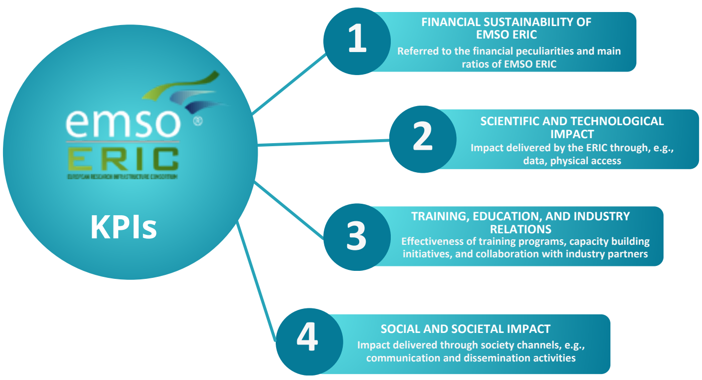
The published editorial by Delory et al. (2023)[17] offers a compelling overview of this exciting field. It highlights the ocean sound's emerging role as a key health indicator of marine ecosystems and a useful parameter for environmental and industrial purposes like the detection of greenhouse gas seeps from pipelines and deep-sea carbon storage, gasification of methane clathrates, detection of low-frequency seismic events, and ice-cracking.

Figure 24 | Deployment of an EMSO EGIM in stand-alone mode, equipped with ocean sensors including a digital hydrophone (Lantéri et al., 2022). Photo courtesy: Plataforma Oceánica de Canarias

[15] EMSO Physical Access 2023. News: https://emso.eu/2023/01/16/emso-eric-2nd-call-for-physical-access-is-now-open/
[16] EMSO news on CUPIDO project: https://emso.eu/2023/12/01/emso-physical-access-cupido-project-at-south-adriatic-sea/
[17] Editorial: Observing ocean sound, Frontiers. https://www.frontiersin.org/journals/marine-science/articles/10.3389/fmars.2023.1205835/full

3. KEY PERFORMANCE INDICATORS

This chapter explores the performance of EMSO ERIC in 2023, utilizing a set of predefined Key Performance Indicators (KPIs) to evaluate progress towards achieving strategic objectives across four key areas (summarized in the picture over and described within this chapter). Being a distributed Research Infrastructure, the information included has been completed also thanks to the close cooperation of the different Research Organizations that are part of EMSO ERIC.



EMSO in numbers

11 cable and stand-alone observatories

3 test sites

> 25 Institutions involved

4 pillars (Marine ecosystem, Climate change, Geohazard, Technological challenge)

3 domains (Hydrosphere, Geosphere, Biosphere)

3.1 KPI ON THE FINANCIAL SUSTAINABILITY OF EMSO ERIC

The central financial support break-down for the EMSO ERIC consists of financial contributions from the host country and 7 Members, in addition to EU projects revenues and significant in-kind contributions from Italy and Spain (until 2023). While EMSO ERIC relies on the core budget from the member-ship contributions for its management and continuous operation, EC research funding frameworks (for example, Horizon Europe), contributions from Member Countries supplement its development. Nevertheless, in order to guarantee that the ERIC runs smoothly in terms of services offered and scientific development, human resources are a key element that, furthermore, represents an index of growth of the organisation and, for this reason, this section of Key Performance Indicators also takes into account this fundamental issue. These KPIs are related to the above-mentioned aspects and document the number of performance results, along with our rating of accomplishment and feasibility to implement. The main purpose is to enhance employees' engagement, aligning the central Management Office with the EMSO ERIC mission and improving accountability.

The selected KPIs are related to the following key items:

- Financial Sustainability Plan as requested by the ESFRI Panel;
- The ratio between EU Projects revenues and total 2023 Revenues to show the balance between the sources of cash;
- Cash-carry-over, in order to show the number of own resources that are not used in a specific year, in order to be used in later/subsequent years;
- The ratio between Personnel costs and Total cost to show the relative weight of HR cost compared to the overall running cost;
- The ratio between operational Personnel costs and Total costs allocated to EC projects to show the engagement of Personnel in EC projects;
- The ratio between administrative costs (net of DG cost) and total cost, in order to assess the overhead weight on total cost.

EMSO ERIC Financial and Sustainability Achievements:

- Robust Financial Management: Secured a significant cash carry-over of €589,714 in 2023, positioning EMSO ERIC for continued financial stability and future growth, even if slightly below the €600,000 target;
- Efficient resource allocation: Personnel costs were maintained below 65% of total costs, and administrative costs (net of Director General costs) were maintained at a reasonable level (15%), ensuring efficient operations as well;
- Maximized EU Project Impact: Allocated over 77% of operational personnel costs to EU projects, demonstrating effective utilization of EU funding.

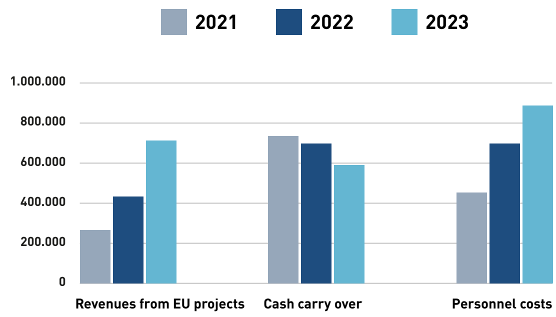


Figure 25 | Financial sustainability of EMSO ERIC (Revenues from EU projects, Cash carry over and personnel costs, in Euros, during 2021-2023)

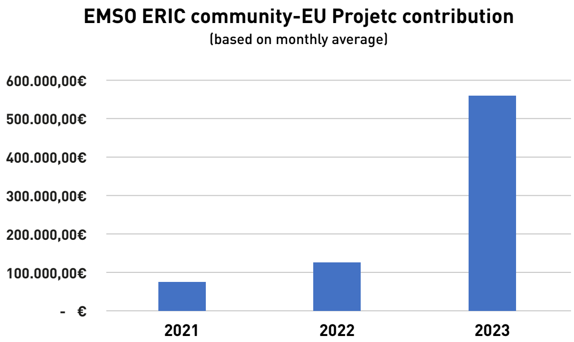


Figure 26 | Evolution of total grant allocated to the EMSO ERIC partners (CMO excluded) within the EU projects

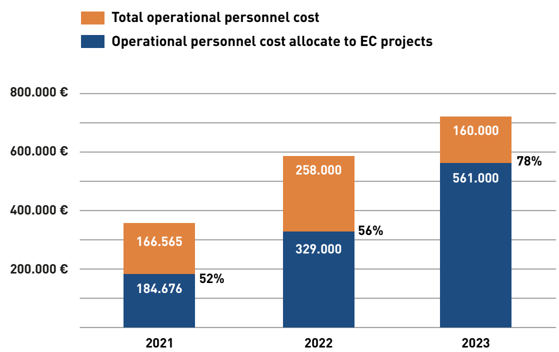


Figure 27 | Financial Sustainability: Percentage of Operational Personnel cost of the CMO allocated to EU projects during the period 2021-2023

3.2 SCIENTIFIC AND TECHNOLOGICAL IMPACT

Within the framework of our mission and in accordance with the strategic plan and vision, EMSO ERIC aimed at enhancing scientific and technological impact through the different activities and the provision of services.

The scientific and technological impact is one of ´EMSO ERIC´s core objectives, and this impact can be achieved in different ways, firstly through very high quality delivery of data and information, then through EMSO ERIC homogenized and standardisation of data and metadata, through new scientific or technological developments, etc. Here is a summary of KPIs that are strictly related to scientific and technological impact.

INDICATOR	TARGET	DELIVERY DATE	STATE OF THE ART IN 2023	% OF ACCOMPLISHMENT
EGIM rollout (install EGIMS)	2	2023	2	100%
Registered users of services (approx. 1000 users in August 2020)	+20% of 2020 (approx. 1200)	2023	8.647	720%
Number of countries reached (approx. 80 in 2020)	+20% of 2020 (approx. 96)	2023	105	109%
Data portal page views (approx. 4000 in 2020)	+20% of 2020 (approx. 4800)	2023	15.379	320%
API and ERDDAP requests (approx. 4000 in 2020)	+20% of 2020 (approx. 4800)	2023	607.039	12646%
Physical access calls (0 in 2020)	2	2023	6	300%
Number of projects funded through the physical access calls (0 in 2020)	1	2023	5	500%

Table 4 | List of indicators related to the growth of EMSO ERIC in terms of use of its data and products and of its physical access calls

3.3 KPIS ON TRAINING, EDUCATION AND INDUSTRY RELATIONS

Training and education represent valuable tools through which, not only enhance knowledge and capacity building but, likewise, make an organisation even more successful, investing in the improvement of staff skill set and professional development. Education and training are critical to develop and improve trainee expertise and abilities and, in the case of EMSO ERIC, being a distributed Research Infrastructure, training and education can be delivered internally through EMSO and its different Research Organisations, or externally through specific Research Infrastructure (RI) projects, or within other scientific communities. Another important element is represented by the relations with industries, especially SMEs. There is a clear and non negligible interaction between research and entrepreneurship when creating innovation and possible co-design devices or tools that aim at delivering a strong and concrete societal impact. The following KPIs mainly refer to these issues.

INDICATOR	TARGET	DELIVERY DATE	STATE OF THE ART IN 2023	% OF ACCOMPLISHMENT
Number of publications somehow related to EMSO ERIC	65	2023	94	144%
Industry contacts	10	2023	17	140%
Training courses delivered somehow related to EMSO ERIC	4	2023	> 4	> 100 %
Hours devoted to staff training	10	2023	620	6200%

Table 5 | List KPIs focused on educational aspects and on relations with industries

3.4 KPIS ON SOCIAL AND SOCIETAL IMPACT

Nowadays, the most common expectation is that scientific research should provide answers to societal issues and support policy-making processes. Governments, organizations, universities, and private businesses supporting research demand is evident, proving how the research they support aims at influencing society whilst also attracting the attention of a wider audience to the research benefits.
EMSO ERIC, and the associated research organizations are trying to make the change as well, in this sense, by increasing and carefully addressing messages and activities on social media, improving communication through the website, joining or organizing tailored events, etc.

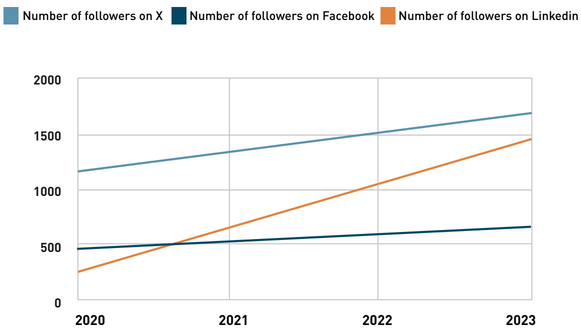


Figure 28 | Social Media Engagement Index

INDICATOR	TARGET	DELIVERY DATE	STATE OF THE ART IN 2023	% OF ACCOMPLISHMENT
EVENTS (organized or participated)	210	2023	>50	>25%
Number of participants in the events	250	2023	>1000	>400%
MEDIA COVERAGE (newspaper, radio, TV, etc.)	10	2023	>10	>100%
Number of followers on Facebook (463 in 2020)	+ 15% than in 2020, approx. 532	2023	650	122%
Number of followers on X (1177 in 2020)	+ 20% than in 2020, approx. 1400	2023	1701	121%
Number of followers on LinkedIn (256 in 2020)	2 + 15% than in 2020, approx. 300	2023	1460	486%

Table 6 | List of indicators related to the ERIC's visibility and to the maximisation of the impact through events, media and social media

4. ADMINISTRATIVE AND FINANCIAL MANAGEMENT

© Michael Doleis on Unsplash

Established in 2016, EMSO ERIC is a not-for-profit legal entity/international organization undertaking mainly non-economic R&D activities. Since then, EMSO ERIC has shown a continuous growth of activities essentially due to the increase of the number of EC funded projects (See Table 7). while the contributions from the Member States have been stable.

4.1 EFFORT DRAWN IN PROJECT ACTIVITIES AND REVENUE GENERATED BY EU FUNDED PROJECTS

The participation in proposals and projects, including those funded by the European R&I Framework Programmes like Horizon Europe, is one of the means through which EMSO ERIC and its research organizations cooperate and reach common objectives.

The participation of EMSO ERIC in EU-funded projects for the year 2023 and the activities performed within the project management domain are summarised as follows.

- **Management of proposal phase** for the following proposals:
- Proposals funded: ERIC FORUM 2, AMRIT, ENVR'INNOV, AQUARIUS,
- Proposals rejected: MIMEXIS, ELASTIC

- **Management of third parties/affiliates in EU projects:**
- AtlantEco (PLOCAN)
- ENVRI FAIR (PLOCAN, MI, HCMR, CCMAR)
- Imagine (IFREMER, MI, UPC)
- GeoInquire (HCMR, MI, UPC, PLOCAN)
- ANERIS (MI, UPC)
- GEORGE (UPC, INGV, MI, PLOCAN)

- **EMSO ERIC coordination and management service**
  The EMSO ERIC coordination and management service aims at ensuring smooth coordination of the activities implemented in the frame of externally funded projects while increasing cooperation between the EMSO ERIC CMO and all its EE Regional Facilities. CMO organizes meetings for starting projects with the RFs involved.

- **Management of the EMSO ERIC external projects' portfolio**
  To reach the objective of supporting the technological development of the EMSO observatories and enhancing EMSO visibility, the consortium continues to exploit the fruitful collaboration with other environmental RIs both in the frame of already funded projects (such as GEORGE and ANERIS) and in the new initiatives designed during the year 2023 and which were successfully evaluated, officially commencing in March 2024, such as AQUARIUS and AMRIT.

AQUARIUS- Aqua Research Infrastructure Services for the health and protection of our unique, oceans, seas and freshwater ecosystems- will provide a highly comprehensive suite of integrated research infrastructures appropriate to addressing significant challenges for the long-term sustainability of our unique oceans, seas and freshwater ecosystems.
For the first time, diverse research infrastructures will be combined to facilitate the work of researchers and key stakeholders focused on challenges and opportunities for both marine and freshwater systems.

AMRIT project - Advance Marine Research Infrastructures Together - aims at gathering all the core Marine Research Infrastructures (MRIs) together with OceanOPS/WMO international coordination experience to:
- ensure seamless operation of marine observation platforms;
- ensure the full nominal use of sensors and accelerate their evolution;
- exploit the complementarity of the various observation platforms;
- ensure the overall coherence of the ocean data value chain.

Moreover, EMSO ERIC, gaining from the experience of being part of the ENVRI community and aiming at reinforcing the innovation capacity of the environmental RIs, was involved in a new project proposal named ENVRINNOV's- ENVironment Research infrastructures INNOVation Roadmap, which was positively evaluated and funded, and which officially started in January 2024:

ENVRINNOV's overarching goal is to approach innovation aspects in a harmonized manner, by coordinating the co-design, co-development, test, and validation of a common ENVRI Innovation Roadmap. To achieve this goal, ENVRINNOV will develop the necessary tools, mechanisms, environment, and community to enable the roadmap's successful implementation, and the sustainability of its results.

Table 7 shows remarkable results in terms of newly achieved European projects by the EMSO ERIC. Percentage of new projects achieved in 2023 and others are in the pipeline which led to a substantial increase of the portfolio (+100% in 2023 with respect to 2022). The new projects achieved in 2023 are: Trident, ERIC Forum 2, ANERIS, BLUE Cloud 2026, GEORGE.

ACRONYM	BUDGET EMSO ERIC	REVENUES 2019	REVENUES 2020	REVENUES 2021	REVENUES 2022	REVENUES 2023	REVENUES 2024-2025
EMSO link	711.647	234.284	171.721-	-	-		-
DANUBIUS-PP	58.279	22.972	11.091	-	-		-
ENVRI plus	66.644	43.403	-	-	-		-
ERIC Forum	49.588	3.680	21.424	9.751	14.733		-
ERI ITC	111.577	-	25.720	35.123	50.734		-
ENVRI FAIR	659.660	148.380	145.464	91.708	120.796	53.311	-
Eurofleet+	137.938	45.198	35.778	20.131	2.914	13.917	-
Eurosea	28.720	355	1.841	2.746	9.387	14.392	-
Egi-ACE	143.385	-	-	-	70.144	73.241	-
ATLANTECO	17.000	-	1.965	2.721	76	669	11.570
MINKE	186.750	-	-	4.006	41.027	992.381	49.336
eRIMOTE	160.875	-	-		24.399	84.583	51.893
Doors	140.000	-	-	3.703	680	15.330	120.287
IMAGINE	46.875	-	-		6.642	14.424	25.809
EOSC FUTURE	175.844	-	-		75.233	100.611	-
GEO INQUIRE	290.250	-	-		7.153	30.188	252.909
TRIDENT	306.525	-	-		-	49.319	257.206
ANERIS	190.000	-	-		-	39.916	150.084
BLUE CLOUD 2020	127.438	-	-		-	42.247	85.190
ERIC FORUM	136.250	-	-		-	16.412	119.838
GEORGE	525.625	-	-		-	73.583	452.042
OTHER NEW PROJECTS							200.000
TOTAL	**2.400.780**	**498.272**	**415.004**	**269.887**	**443.920**	**714.523**	**1.776.163**

Table 7 | Evolution of on-going funded EC Projects as of December 31st 2023.
*Note: in the GEORGE project, 200,000 Euros are available for ship-based scientific assessment

4.2 INCOME STATEMENT 2023 AND 2024 BUDGET

Table 8 shows a number of key aspects:

- The 2023 Income statement and the 2024 provision in a simplified format, highlight the consolidation of the Physical access investment carried out by EMSO ERIC to promote the access to regional facilities services, as a key RI deployment activity started in 2022 (+68%);

- The In-kind contributions decreased in 2023 (-40% with respect to 2022) from 172.000 euros to 136.140 Euros in 2023 and it is going to further decrease (-71%) in 2024. This is a warning since the reduced mobilization of domestic resources reflects (i) the reduced commitment by the Member States through in-kind contributions to support EMSO ERIC implementation and (ii) the need to seek additional sources of funding, through parallel co-financing of European Projects;

- Therefore, the sustainability of EMSO ERIC to face its current and medium-term obligations and carry out its institutional activities requires

REVENUES	2023 in €	2024 in €
INGV	**220.00**	**220.000**
INGV additional cash contribution (rent)	**35.000**	**35.000**
Member states fees	**280.000**	**245.000**
In-kind	**172.033**	**142.689**
- CSIC	95.168	95.168
- INGV	76.865	47.521
Revenues generated by the projects	**443.920**	**714.523**
Other revenues		**4.966**
Total revenues	**1.150.953**	**1.362.178**
Operational costs		
Personnel	**870.256**	**1.031.392**
-In kind contributions	172.033	142.689
-Personnel*	698.223	888.703
Services (utilities, events, professional services)	**68.272**	**85.332**
Travel and promotional expenses	**40.435**	**87.603**
Other Expenses (including IRAP,office rent, DG indemnities)	**205.603**	**236.899**
*Physical access to Regional facilities service***	7560	**35800**
Total operational costs	**1.184.566**	**1.477.025**
Net result	**-33.613**	**-114.847**
Cash carry over	**704.561**	**589.714**

Table 8 | 2023 Income Statement as of December 31st 2023 and comparison with 2022 fiscal year

*) 2P/M allocated to the GENDER EQUALITY PLAN deployment for 2022 and 2023

**) The Physical Access Services are being deployed sincer 2022 increased in-kind contributions to be provided by the Member States to avoid increase of the direct Personnel cost.

- In addition, the summary of EMSO ERIC economic results for 2023 income Statement shows for the second time a reduction of the cash carryover as a consequence of (i) the physical access investment and (ii) the increase of running cost due to the inflationary rate.

- The working capital guarantees adequate reserves (cash carry-over of 589.714 Euro by the end of 2023) which allows EMSO ERIC to finance the growth without engaging the ERIC in undertaking debts and obligations towards third parties. However, the cash carry over should get stabilized the following years at the level of 500.000 Euro.

4.3 ESTIMATED BUDGET FOR 2024

REVENUES	2022 in €	2023 in €
INGV	**220.000**	**220.000**
INGV additional cash contribution (rent)	**35.000**	**35.000**
Member states fees	**245.000**	**245.000**
In-kind	**142.689**	**41.000**
- CSIC	95.168	
- INGV	47.521	41.000
Revenues generated by the projects	**714.523**	**770.000**
Other revenues	**4.966**	
Total revenues	**1.362.178**	**1.311.000**
Operational costs		
Personnel	**1.031.392**	**892.667**
-In kind contributions	142.689	41.000
-Personnel*	888.703	851.667
Services (utilities, events, professional services)	**85.332**	**90.000**
Travel and promotional expenses	**87.603**	**70.000**
Other Expenses (including IRAP,office rent, DG indemnities)	**236.899**	**170.000**
*Physical access to Regional facilities service***	**35.800**	**60.000**
Total operational costs	**1.477.025**	**1.282.667**
Net result	**-114.847**	**28.333**
Cash carry over	**589.714**	**618.047**

Table 9 | 2024 Budget as of December 31st 2023

*) 2P/M allocated to the GENDER EQUALITY PLAN deployment for 2022 and 2023

**) The Physical Access Services started in 2022.

4.4 FINANCIAL SUSTAINABILITY STRATEGY

EMSO ERIC has worked diligently over the past few years to review the budget forecast and have determined that both cost containment measures and revenue increase measures were necessary for EMSO ERIC to continue to provide its statutory research services. EMSO ERIC Service Level Agreement (SLA) provisions are already established in the interinstitutional agreements, and the respective roles and duties of EMSO ERIC and its members, are outlined in the EMSO ERIC Work program (2021-2023).
The three objectives and related activities carried out by the EMSO ERIC CMO and the Regional Teams of the participating organizations, in continuity with the Strategic Plan are:

- **To progress toward the ordinary operational delivery of the fundamental services (Data, Training, Access).**
- **To consolidate the Central Management Office role to operate as 'singular entry point' for the users (service workflow) and to coordinate the data services.**
- **To expand the European collaborative dimension by:**
  - Promoting the Physical access services

YEAR	CASH-CARRY-OVER (Euro)	REVENUES (Euro)	CASH-CARRY-OVER REVENUES (ratio)
2016	104.124	125.999	0,83
2017	235.788	496.954	0,47
2018	129.299	754.625	0,17
2019	75.052	998.319	0,08
2020	133.919	880.478	0,15
2021	59.992	841.756	0,07
2022	-33.613	978.919	-0,03
2023	-114.847	1.219.489	-0,09
Total	**589.714**		

Table 10 | Evolution of cash-carry-over (2016-2023)

- Giving visibility of the progresses and measuring the impact, providing an assessment of socio-economic impact
- Keeping high profile in quality and efficiency management.

During 2023 EMSO ERIC finalised important implementation steps:

1. The year 2023 has marked a key milestone in EMSO ERIC growth since the Data and Information services are almost fully operational and the Physical access program has been launched.
2. The completion of the mandate of the DG Prof. Juanjo Dañobeitia on December 31st 2023 was acknowledged by the AoM for the contribution provided by the DG during the 2017-2023 period. In January 2024, the AoM finalized the selection procedure of the new DG following the DG vacancy publication in May 2023.
3. The launch of the ISO 14000 protocol started in December 2023 as well as the procedure to ensure the communication of EMSO ERIC standing to the public (full transparency criteria ex Law 231).
4. Deployment of the licensing Agreement with IFREMER granting to EMSO ERIC the rights to use and to exploit the joint results of the EU Horizion 2020 EMSODEV Project. EMSO ERIC will have the rights to use and exploit the results of EMSODEV including the EGIM submarine data collection equipment. EMSO members States have the rights to use and exploit the results of EMSODEV to achieve the standardized acquisition of oceanographic variables among the research institutions that manage the regional facilities.
5. A Terms of Reference document ruling the engagement of the Service Group Leaders has been drafted highlighting, tasks, possible compensation and duties.
6. A Terms of Reference document ruling the engagement of the Central Procurement Group has been developed.
7. EMSO is strengthening its policies for more inclusive work practices to guarantee that all genders can access the same rewards, resources, and professional growth. EMSO Gender Equality Plan (GEP) foresees an explicit budget dedicated to gender equality policies, which is needed to promote accountability and transparency in fiscal planning, increase gender-responsiveness in the budget process, and promote gender equality and women's rights.
8. EMSO ERIC allows the use of smart working practices to carry out the employees' performance, allowing them to conduct it partly at the employer's premises, and in part outside them (for instance at home). EMSO ERIC simplified the conditions to apply the smart working regime (lavoro agile) to the workforce in order to encourage employees to ensure, when possible, work continuity(for instance at home). EMSO ERIC simplified the conditions to apply the smart working regime (lavoro agile) to the workforce in order to encourage employees to ensure, when possible, work continuity.

Russia's invasion of Ukraine is not – for the time being - a potential source of instability for EMSO ERIC. The RI analysed the likely impacts to the Seafloor and Water Column Observatory and the data access in the Mediterranean Sea, though for the time being no major impact is expected for the on-going activities for Regional Facilities in the eastern Mediterranean Sea nor the other Regional Facilities locations.The financial statements have been compiled in accordance with the principles of clarity and transparency and provide a correct and exhaustive framework of information on ownership relations, as well as economic and financial relations implemented by the Consortium in carrying out its activities. They have been compiled taking into account International Public Sector Accounting Standards (IPSAS), according and conforming to the legal characteristics of a not-for-profit international institution and the specific scope of EMSO.

4.5 EMSO RECRUITMENT ACTIVITIES

EMSO ERIC adopted sustainable staff management of personnel to consolidate its growth and success. During 2023, the ERIC launched five key positions in the following roles (displayed in Figure 29). By the end of the year, all open positions with the exception of the Director-General position had been filled, signalling further expansion of the EMSO staff team. The selection and appointment of the Director-General was completed in 2024.

4.6 HUMAN RESOURCES AND GENDER POLICY

An ambitious Gender Equality Strategy that EMSO ERIC began to define already in 2017, and which led, at the end of 2021, to the elaboration of the official document "EMSO ERIC Gender Equality Plan (EE GEP)", a precise action plan to promote gender balance. EE GEP was signed by the EMSO ERIC Director-General and duly approved by the 17th EMSO ERIC Assembly of Members on the 8th of March 2022.

With GEP approved and published, EMSO ERIC started implementing the recommendations set out in the plan, both internally to the EMSO organization and externally, in the main international initiatives and projects in which the ERIC is involved.
Based on an active action for gender equality in recruitment and professional progression and with the scope of supporting the gender equality dimension in EMSO ERIC recruitment procedures, gender balance is promoted in all selection procedures for the positions

opened in 2023 for EMSO ERIC Central Management Office (CMO). In the frame of the work-life balance dimension, EMSO ERIC actively supported the reconciliation of private life and work times, through smart working agreements between DG and the permanent staff of the CMO.

EMSO ERIC encouraged gender balance in the related organizational research culture, both in EMSO transnational access programme and in EU-funded projects. In the frame of the recently completed (2019-2022) ERIC Forum project (GA n. 823798), where EMSO ERIC participated as a beneficiary, in June 2021 it was established a Gender Equality Working Group (GE WG), initiated by the newly established GEP eligibility in Horizon Europe. Through the GE WG, the Forum offered an open environment for personnel, mostly unfamiliar at the time with gender equality and GEP development, to exchange good practices and support each other with their plan development. At the end of January 2023, a new proposal was submitted that included the follow-up of the GEP action and, in the case of funding, the intention is to continue the work already done to strengthen a strong commitment to existing gender equality. ERIC Forum 2 project started in September 2023, with a dedicated task for Gender issues named "T9.1 Implementation of Gender Equality Plans and Gender Mainstreaming among the ERICs".
The aim of the task is to provide a supportive environment that encourages personnel from ERICs and ERICs-to-be to exchange on gender equality strategic topics. As part of the eRImote project (GA n. 101057557) an Equal Opportunity Officer was appointed during the kick-off meeting with a defined role involved in monitoring board member appointments, outreach to experts, and disseminating the project to improve gender balance. In the frame of the EMSO transnational access programme, in 2023 calls, the gender balance was set as the first prioritization criteria in case of applicants being otherwise of equal scoring.

FINANCIAL OFFICER
Open date: December 21st, 2022
Application deadline: January 14th, 2023
Estimated starting date: April 1st, 2023
Number of applicants: 1

CHIEF INFORMATION OFFICER
(CIO)
Open date: December 20th, 2022
Application deadline: January 14th, 2023
Estimated starting date: February 1st, 2023
Number of applicants: 1

IT ANALYST
Open date: March 28th, 2023
Application deadline: April 7th, 2023
Estimated starting date: May 2nd, 2023
Number of applicants: 2

DIRECTOR GENERAL
CHIEF EXECUTIVE OFFICER AND LEGAL REPRESENTATIVE
Open date: April 20th, 2023
Application deadline: May 15th, 2023
Estimated starting date: by Ocotber 2023
Number of applicants: 7

DATA OFFICER
Open date: March 16th, 2023
Application deadline: Open call until 31st December 2023, subject to quarterly assessment of the received candidatures
Estimated starting date: June 1st, 2023
Number of applicants: 2

Figure 29 | - EMSO open positions published in 2023

5. SPOTLIGHT ON EMSO MEMBERS' MAIN ACHIEVEMENTS

After the withdrawal of the United Kingdom from the EMSO consortium, looking at the actual configuration of EMSO RFs, in the Atlantic, there are four open-ocean facilities (Nordic Seas, Azores, Iberian Margin and Canary Islands) and shallow-water testbed sites (SmartBay and Molene). In the Mediterranean, there are six facilities (Ligurian Sea, Western Mediterranean Sea, South Adriatic Sea, Cretan Sea, Western Ionian Sea and Hellenic Arc), each of which has multiple sites and one shallow water testbed facility at OBSEA. A detailed description of the Regional Facilities provided by Member countries is included in ANNEX 1.

EMSO ITALY

- **Upgrade of the Southern Adriatic Sea RF**
  - Installation of new instruments to enhance experimental capabilities (8 SBE37 ODO and 2 pCO2 PROCEANUS sensors) at the E2M3A site (PNRR ITINERIS project);
  - Addition of 2 state-of-the-art Oceano R5 acoustic sensors from iXblue and 4 WiSens TD temperature and pressure sensors to the E2M3A site;
  - Installation of a new Oceano R5 sensor, along with new SBE 37 and SBE 39 probes at the BB site;
  - Deployment of an acoustic recorder, RTSys

- **Upgrade of the Western Ionian Sea RF**
  - Deployment of a new cable termination frame and a new Junction Box to improve the facility underwater power and communication;

  - Enlargement the operational area at deep site and supply instrument redundancy through the deployment of 3 new cabled deep sea observing system, Calipso and Dione (multidisciplinary Observatories) and a Smart Cable hosting 3 repeaters for seismic and tsunami monitoring

- **Organization of MonGOOS annual Meeting and Workshop (Morocco)**

- **Organization of World Oceans Day: Know, Comprehend, Coexist (Italy)**

EMSO FRANCE

- **In Ligurian Sea Regional Facility**
  - Annual maintenance of the mooring of DYFAMED mooring, deployment of a sediment trap with UVP, optical sensor and genomic sampling for Biological Carbon Pump study https://www.seanoe.org/data/00326/43749/
  - On the Ligure Ouest site, connection of the BathyFamily the instrumentation. New highfrequency data on temperature, salinity, currents and diversity of plankton organisms complement the information acquired by the ALBATROSS instrumented mooring line. Dataset of these instruments accessible herehttps://doi.org/10.17882/97948
  - On Nice, a piezometers dataset standardisation is carried out in the scope of the project Geo-inquire. https://www.emso-fr.org/fr/Nice/Data-from-Ligurian-Sea-Nice

- **In Azores**

  All the objectives of the maintenance cruise (doi.org/10.17600/18002419) were achieved. Because ageing, the BOREL surface buoy was removed to be redesigned and rebuilt.The oceanographic mooring was temporarily removed too. The seabed stations,Seamon West, served by an EGIM since 2022, and Seamon East were serviced and redeployed. https://www.emso-fr.org/fr/Azores/Data-from-Azores

Test Facility in the Iroise Sea,

EMSO Molène equipment was refurbished and long term tests are ongoing. The deployment in the bay of Brest, offshore Lanvéoc, opposite Ifremer site in St Anne is scheduled for 2025. The RF will provide permanent access for DFOS experiment in addition to the classical ports available for sensors. https://www.emso-fr.org/fr/Molene/Data-from-

- **Activities related to the EGIM within GEORGE Project**

- Refurbishment and upgrade of EMSODEV units of the EGIMs
- Integration of new sensors to the EGIM, namely
- 4H-Jena pCO2 and CH4 and CWS pH
- Establishment of the specification of a lander to deploy the EGIM in standalone situation
- Organization of the 2024 training project (engineers and technicians from ICOS, EUROARGO and EMSO) with one day training for EGIM users.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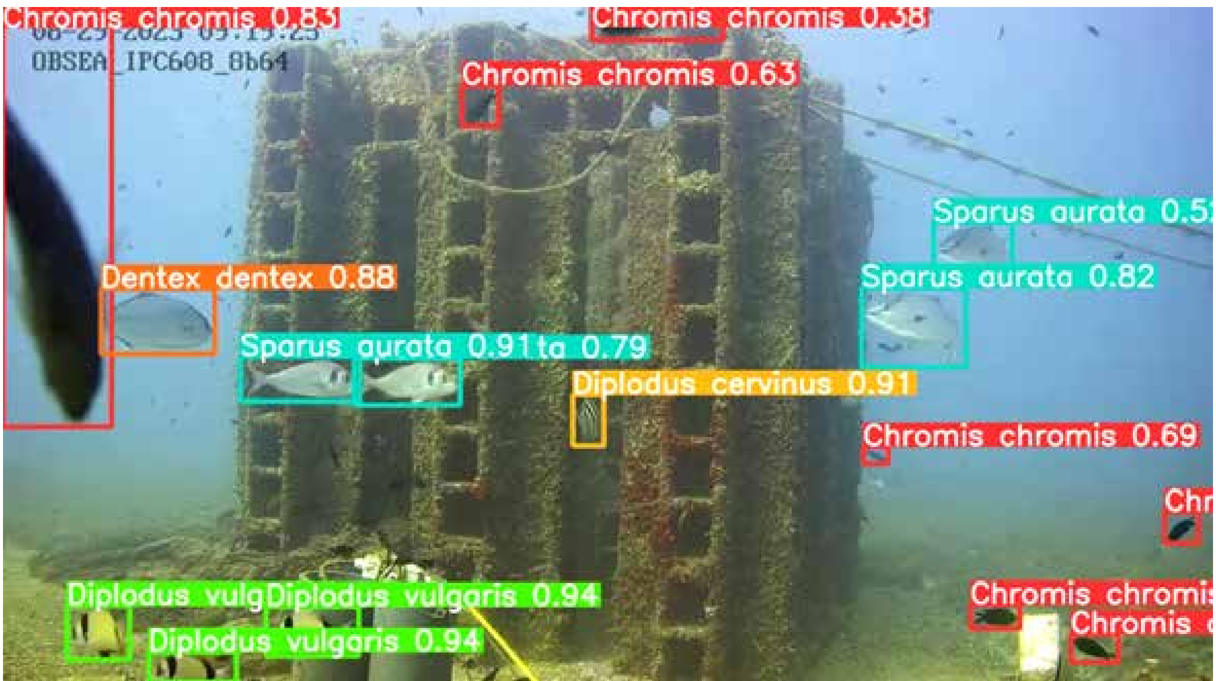
EMSO SPAIN

- Deployment of new cameras and AI tools for macrofauna monitoring, UPV6 and Cytosub for zooplankton and phytoplankton monitoring, and pH sensors in OBSEA RF;
- OBSEA team interviews were included in "Ready for the Tsunamis?" documentary (realized by Erik Martínez Westley);
- Introduction of the Fish detection and classification tool developed at EMSO-OBSEA within the iMagine project, as part of the ANERIS project workshop "AI basics for image processing";
- Organization of Martech Conference



EMSO IRELAND

- Deployment of Distributed Acoustic Sensing system on SmartBay cable and Acoustic array
- Glider campaign
- The SmartBay Observatory was recovered from Galway Bay for maintenance. It aims to be redeployed in the summer of 2024 with additional sensors on board to support the EU project ANERIS
- Outreach -STEPS-Engineers Week Celebration: Scientists from the SmartBay Observatory and the Marine Institute's Argo-Ireland showcased various technologies essential for ocean observation and monitoring
- SmartBay Community Event for European Maritime Day: the Marine Institute and BlueWise Marine hosted the SmartBay Observatory Open Day where the 360° virtual tour of the facility was showcased
- SmartBay was prominently featured at two major UN Decade of Ocean Science for Sustainable Development events in Ireland in 2023: Oceans 2023 (Limerick, June 3-5) and 10th EuroGOOS International Conference (Galway, October 3-5)

EMSO GREECE

- Glider campaign in the Cretan Sea
- Four daily visits to the Cretan Sea/ E1-M3A with the inflatable for in situ cross-reference sampling and buoy sensors maintenance
- EMSO ERIC and Cretan Sea were presented at three events:

- Ocean observing gaps – Next Steps for an integrated and sustained ocean observing in Europe. EUROSEA SYMPOSIUM ON OCEAN OBSERVING AND FORECASTING 21 September 2023 IOC/UNESCO Headquarters, Paris
- Observations for ocean forecasting in the Mediterranean Sea. Joint MonGOOS & OceanPrediction DSS meeting on ocean forecasting and its applications, 15-16 November 2023 Tangier, Morocco.
- Vision for EOOS. Operational Oceanography for the ocean we want – addressing the UN Ocean Decade Challenges, 10th EuroGOOS International conference European 3-5 October 2023 Galway, Ireland.

EMSO PORTUGAL

- Processed and published dataset from the 2022 pilot deployments were made available in newly created ERDDAP (https://erddap.ccmar.ualg.pt/):

- EGIM dataset at 200m depth - Jun-Oct 2022, in front of Cape St. Vincent, Sagres, PT;
- ADCP dataset at 150m depth - Jun-Oct 2022, in front of Cape St. Vincent, Sagres, PT;
- Vertical Wave Profiler dataset from 0 to 150m depth - Jun-Oct 2022 in front of Cape St. Vincent, Sagres, PT;
- Vertical Wave Profiler dataset from 0 to 10m depth - April 2022 at Cacela Velha Artificial Reef, PT;

- Pilot deployments datasets were presented at EGU2023

- Support land laboratories (Pressurized Bioreactor and EMSO-GOLD Lab) were crucial to improve knowledge in the deep-sea, namely in microbiology and paleoenvironments.

EMSO NORWAY

- Started the Deployment plan for the EGIM and acoustic instruments and for bottom pressure equipment at Station M;

- Station M dataset is published at the Norwegian Marine Datacentre (2020-2021 https://doi.org/10.21335/NMDC-1279886544; 2021-2022 - https://doi.org/10.21335/NMDC-1462157858);

- Newly serviced Sunburst (SAMI) instruments for pH and pCO_2 measurements at the Fram Strait site to monitor ocean acidification;

- Retrieved and deployed the mooring at Station M to close the data gaps coped earlier;

- Recovered both lander and mooring deployed at South Cape;

- Near-real time glider data are continuously delivered to Copernicus, and integrated into the product, Arctic Ocean- In Situ Near Real Time Observations, https://doi.org/10.48670/moi-00031;

- Fram Strait dataset is published at the Norwegian Polar Data Centre. DOI: 10.21334/npolar.2021.c4d80b64.

EMSO ROMANIA

- Deployment of 3 offshore buoy
- Deployment of 3 coastal buoy

ANNEX 1
DETAILED DESCRIPTION OF THE REGIONAL FACILITIES BY MEMBER COUNTRIES

FRANCE

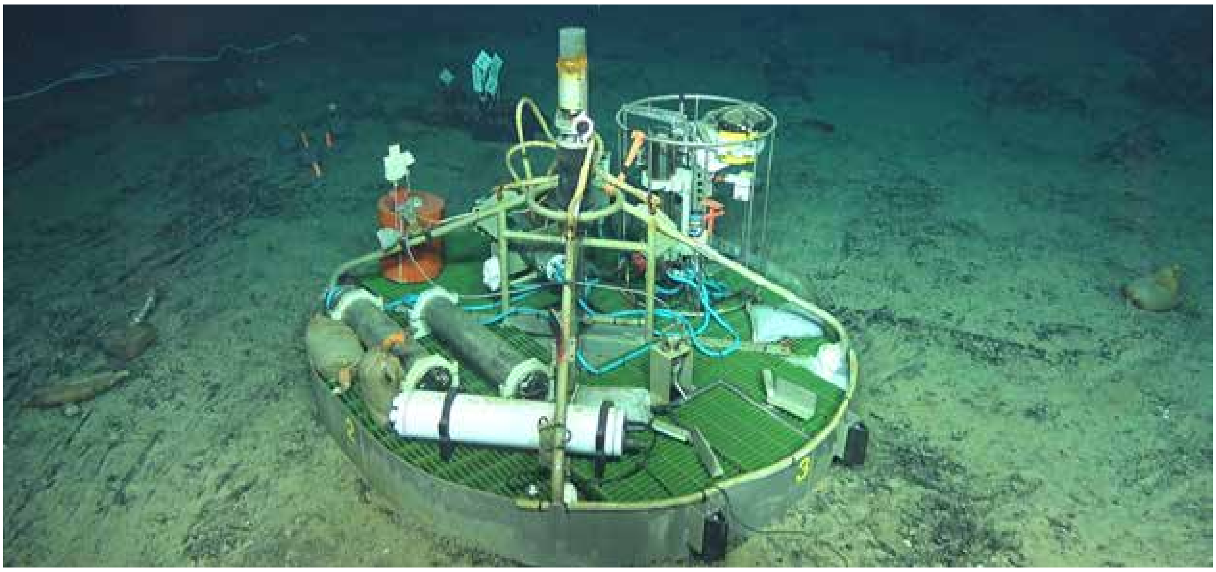
REPRESENTING ENTITIES:

Institut Français de Recherche pour l'exploitation de la Mer IFREMER
Centre National de la Recherche Scientifique CNRS

3 REGIONAL FACILITIES

Emso Azores - Emso Molène - Ligurian Sea

EMSO AZORES



GENERAL INFORMATION

Location: Mid-Atlantic ridge near Azores
Distance from land: 200 NM
Max water depth: 1700 m
Date 1st deployment: October 2010
Operated by: IFREMER, CNRS
Website: http://www.emso-fr.org/
Regional Team Leader: Pierre-Marie Sarradin, Ifremer

Set atop an active volcano, the Lucky Strike, and its hydrothermal field, EMSO-Azores observatory gives unique research opportunities. The hydrothermal vent, which is a fissure in Earth's surface from which hot water come out, can be investigated with a multidisciplinary approach. The hosted peculiar fauna and microbial communities, the water composition and circulation are studied. Being at the Mid-Atlantic ridge, where tectonic plates diverge, the site allow to study closely tectonic and volcanic activities.

SCIENTIFIC OBJECTIVES

Understand the links between geological, physical and chemical processes and their effects on the dynamics of the hydrothermal fauna at different spatial and temporal scales at the Lucky Strike vent field.

EMSO MOLÈNE

GENERAL INFORMATION

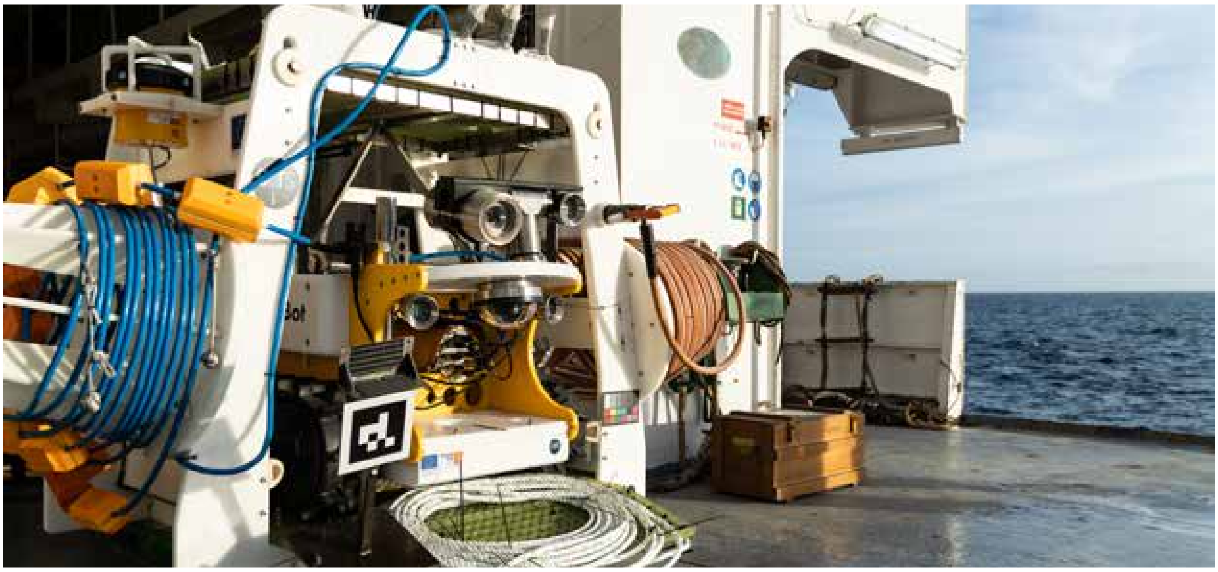
Location: Near Molène Island*
Distance from land: 2 km
Max water depth: 1 m
Date 1st deployment: 2012
Operated by: IFREMER
Website: www.emso-fr.org
Regional Team Leader: Nadine Lantéri, Ifremer

*This site is currently under an intense readaptation with the aim of finding another location.

SCIENTIFIC OBJECTIVES

Seafloor environmental parameters Test of marine sensors to help manufacturers, platform operators and scientists to validate instruments.

LIGURIAN SEA



GENERAL INFORMATION

Location: Mediterranean Sea, South of France
Distance from land: 42 km (LO), 1 km (Nice), 50 km (Dyfamed)
Max water depth: 2400 m (LO), 20-35 m (Nice), 2300 m (Dyfamed)
Date 1st deployment: October 2015 (Nice), 1998 and 1999 (Dyfamed), 2007 and 2010 (Western Ligurian)
Operated by: CNRS, IFREMER
Website: www.emso-fr.org
Regional Team Leader: Laurent Coppola, CNRS/UPMC

EMSO-Ligurian Sea consists of three sub-nodes, which from east to west are: DYFAMED, Nice, and Western Ligurian. EMSO-LO (European Multidisciplinary Seafloor Observatory and water column, Western Ligurian Site) is a second generation permanent submarine observatory deployed offshore of Toulon, France. This submarine network is part of the LSPM (Laboratoire Sous-Marin Provence Méditerannée, https://www.cppm.in2p3.fr/web/fr/LSPM/index.html), close to a neutrino telescope KM3NeT (https://www.km3net.org/) which has a modular topology designed to connect up to 120 neutrino detection units. The Earth and Sea Science (ESS) instrumentation connected to KM3NeT is based on two complementary components: an Instrumented Interface Module (MII), an autonomous mooring line (ALBATROSS) and a Scientific Junction Box (BJS, developed by Ifremer). On the ocean floor, instruments and platforms can be connected to the BJS whose role is to supply energy and internet connection to the instruments of the site. EMSO-Nice is on the narrow continental shelf that borders the Nice airport at 0.5 NM off the coast. The deployment of the observatory complements the diversity of tools and techniques that have been employed over decades to assess the range of factors contributing to the precarious stability of the area. Most of them are thought to be directly related to the geological setting at the mouth of the Var River. They include the occurrence of steep slopes at the border of the continental shelf along with the presence of high permeability, coarse-grained sediments confined beneath low permeability, organic rich sediments. The area has thus long been considered as a natural laboratory where much can be learned about the activity of destabilizing processes associated with these factors through long term monitoring. DYFAMED, Dynamique des Flux Atmospheriques en MEDiterranee, comprises surface and deep sea measurements. It is devoted to the observation of the water mass property evolution, of the carbon export changes and of the variability of the biological species relative to climate force in the passage between Eastern and Western Ligurian Sea.

SCIENTIFIC OBJECTIVES

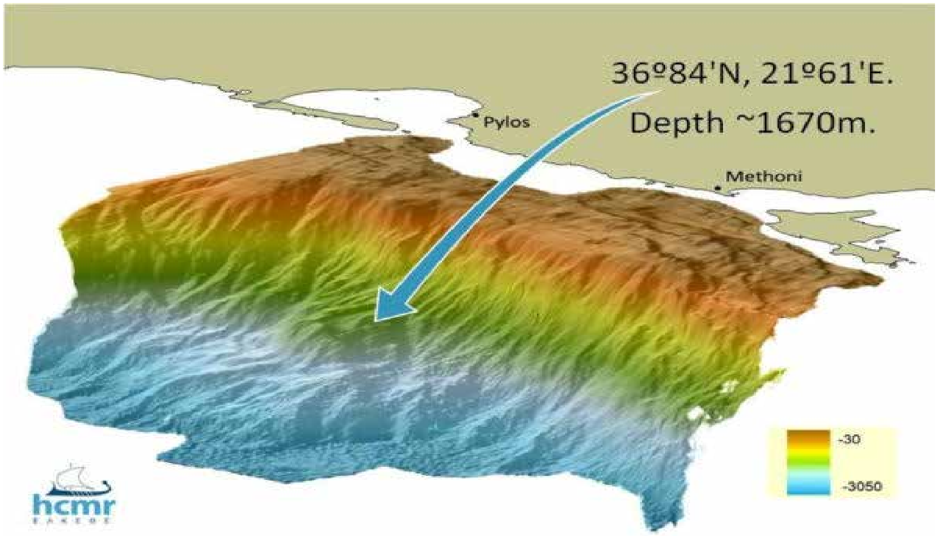
Multidisciplinary long-term eulerian monitoring to study the slope failure processes on the continental slope (Nice site), water mass properties, biogeochemical cycles and biological communities' modifications in response to climate change and anthropogenic pressure (open sea platforms) and geo-hazards assessment with the monitoring of earthquakes and tsunamis.

GREECE

REPRESENTING ENTITY:
Hellenic Centre for Marine Research | HCMR

2 REGIONAL FACILITIES
Hellenic Arc - Cretan Sea

HELLENIC ARC



GENERAL INFORMATION

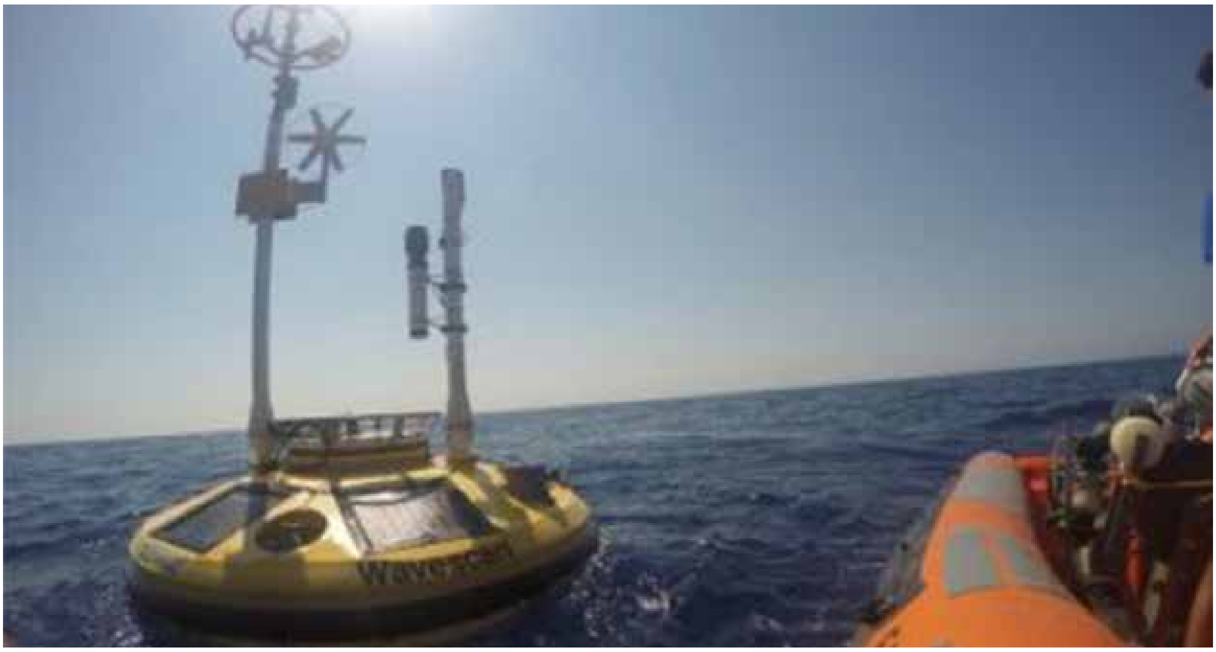
Location: Mediterranean Sea, Hellenic Arc
Distance from land: 12 NM
Max water depth: 1700 m
Date 1st deployment: May 2007
Operated by: HCMR
Website: poseidon.hcmr.gr
Regional Team Leader: George Petihakis, HCMR

The Hellenic Arc is a subduction zone, that is where one tectonic plate "sink" under another one. It is the most tectonically active region in Europe, with a variety of geo hazards, such as high seismicity, slope instabilities and tsunami. The deep ecosystem is poor in nutrients (oligotrophic) and sensitive to climate change. The region is also on the routes of many cetaceans that can be monitored through bioacoustic sensors, which are part of the EMSO Regional Facility equipment.

SCIENTIFIC OBJECTIVES

Real-time long-term monitoring of oceanic circulation, deep-sea processes and ecosystems evolution. Study of episodic events such as earthquakes, submarine slides, tsunamis, benthic storms, biodiversity changes, pollution. Simultaneous data are relative to: seismology, geodesy, sea level, fluid and gas vents, physical oceanography and biodiversity imaging at different scales.

CRETAN SEA



GENERAL INFORMATION

Location: Mediterranean Sea, Hellenic Arc
Distance from land: 24 NM
Max water depth: 1400 m
Date 1st deployment: January 2000
Supported by: HELLAS
Operated by: HCMR
Website: http://poseidon.hcmr.gr
Regional Team Leader: George Petihakis, HCMR

The E1-M3A marine observatory is a pioneer station, the first open-ocean buoy in the Mediterranean deployed in January 2000 and currently part of the POSEIDON network since 2007. The Poseidon system operates a network of fixed measuring floats, which are moored at various locations in the Aegean and Ionian seas delivering near-real-time observations on important marine and atmospheric parameters. The oceanographic buoys constitute the backbone of the POSEIDON system and they are linked to both global and regional networks such as the OceanSITES and M3A's respectively. In particular the POSEIDON E1 M3A buoy (WMO 61277) is the founder component of the Cretan Sea observatory complemented with several other platforms such as glider, FerryBox and a coastal buoy and is currently the most heavily equipped physical–biogeochemical observing site of the POSEIDON system.

SCIENTIFIC OBJECTIVES

The E1-M3A is considered a reference point for monitoring open-ocean biogeochemical processes (including air–sea interactions) of the Eastern Mediterranean and part of the operational oceanography observing system developments supporting the WFD and the MSFD implementation in the Mediterranean Sea. Consolidating on the long experience of physical variables monitoring, the objective of the observatory has been expanded in the last few years to include regular monitoring of the epipelagic ecosystem and the associated biogeochemistry.

IRELAND

REPRESENTING ENTITY:
Marine Institute | MI

1 REGIONAL FACILITY
Smartbay

SMARTBAY

© Christine Loughlin Marine Institute

GENERAL INFORMATION

Location: Galway Bay, Ireland
Distance from land: 1.5 km
Max water depth: 25 m
Date 1st deployment: August 2015
Supported by: Sustainable Energy Authority Ireland
Operated by: Marine institute
Website: www.smartbay.ie
Regional Team Leader: Alan Berry, MI

The SmartBay cabled observatory is connected to a shore station via a 5km long subsea fibre optic power cable. This cable provides power to the observatory and facilitates high speed communication with the various instruments and sensors deployed. The observatory operates a core suite of sensors which measure several EOVs and other relevant environmental indicators. These instruments include CTD, Ph, dissolved oxygen, pCO2, hydrophones, HD camera, flow cytometer and ADCP. These instruments are cabled to a central electronics node. This node also includes several additional ports and cables with multiple power and communications configurations which are available to host other novel sensors and instruments. The testing and demonstration of new and novel equipment is one of the main drivers behind the SmartBay facility, allowing researchers and industry the ability to trial their technology in the marine environment whilst also being in real time communication with their equipment at all times. Environmental data recorded by the various infrastructures at the SmartBay facility is streamed in real time to Marine Institute servers and subsequently to various online platforms and databases. The online data currently includes live video and audio, currents, wave data and feeds from the several instruments currently deployed.

SCIENTIFIC OBJECTIVES

The SmartBay facility comprises the SmartBay test site which includes the SmartBay Buoy and SmartBay cabled observatory These platforms provide real time environmental data and allow for the testing and validation of novel marine sensors and instruments.

ITALY

REPRESENTING ENTITY:

Istituto Nazionale di Geofisica e Vulcanologia | INGV

3 REGIONAL FACILITIES

Western Ionian Sea - Southern Adriatic Sea - Western Mediterranean Sea

WESTERN IONIAN SEA

GENERAL INFORMATION

Location: Mediterranean Sea, East of Sicily
Distance from land: 25 km
Max water depth: 2100 m m
Date 1st deployment: 2001
Supported by: Italy
Operated by: INGV, INFN
Website: https://westernioniansea.ingv.it/
Regional Team Leader: Davide Embriaco, INGV

The multidisciplinary observatory is located in an area (25 km out of Catania, Sicily) which is prone to numerous natural hazard issues due to high seismicity and the presence of Mount Etna, one of the biggest and active volcanoes in Europe, whose roots possibly sink down to the seafloor. Seismicity is linked to the collision between African and European plates and the region experienced large historical earthquakes and some of these strongest earthquakes (the most recent in 1908) caused also very intense tsunami wave. The area is also a key site for studying oceanographic dynamics governing exchanges between Eastern and Western Mediterranean basins through the Messina Strait and the Sicily Channel. Acoustic detectors, installed on the observatory, are used for undersea noise monitoring, considering that acoustic pollution affects the well-being of several ecosystems. In the latest version of the observatory, thanks to an electro-optical cable that connects it to a ground station, the continuous power supply of the instruments installed on the observatory is guaranteed as well as the real-time transmission to the ground station of the data recorded at sea. This therefore also allows their immediate ingestion in a dedicated database and their use by researchers. Thanks to a GPS receiver installed in the ground station, all data from the observatory are synchronized in time. The infrastructure has been enriched with water column data recorded by an oceanographic mooring, installed near the observatory, to integrate the information of the water column in the study of the processes that characterize the deep dynamics and their variability.

SCIENTIFIC OBJECTIVES

Geo hazards assessment with the real-time monitoring of earthquakes and tsunamis. Physical oceanographic monitoring at the seafloor and along the water column of seawater EOVs. Time variations of terrestrial potential fields and electrical properties. Marine acoustic noise characterization and bio-acoustic tracking. Rheological properties of solid matter.

SOUTHERN ADRIATIC SEA

GENERAL INFORMATION

Location: Southern Adriatic Pit
Distance from land: 60 NM
Max water depth: 1200 m
Date 1st deployment: November 2006
Operated by: National Institute of Oceanography and Applied Geophysics – OGS and Istituto di Scienze Polari ISP – CNR
Website: www.ogs.it/en/european-multidisciplinary-seafloor-and-water-column-observatory-emso-eric
Regional Team Leader: Vanessa Cardin, OGS

The E2-M3A observatory is located in the Southern Adriatic Pit. Oceanographically, it is positioned in the centre of the cyclonic gyre where deep convection processes take place, involving both the atmosphere and the ocean dynamics forming new dense and oxygenated waters. It comprises two sites:

• the South Adriatic Trench Observatory (E2M3A)
• the Shelf-slope Observatory site (BB and FF) located in the western part of the basin.

SCIENTIFIC OBJECTIVES

The interdisciplinary laboratory for oceanographic research in the Southern Adriatic "EMSO-ERIC Regional facility" is dedicated to studies on characterising long-term changes in the Adriatic Sea in response to local climate forces. The objective is to study the processes of dense water formation, water mass properties, biogeochemical cycles and cascading in the Southern Adriatic Sea, and to understand the ecosystem function especially in relation to carbon sequestration dynamics and acidification processes in deep waters.

WESTERN MEDITERRANEAN SEA

GENERAL INFORMATION

Location: Western Mediterranean Sea (009.118163° E 43.834516° N)
Distance from land: 80 km
Max water depth: 1200 m
Date 1st deployment: February 2000
Operated by: Consiglio Nazionale delle Ricerche
Website: http://www.w1m3a.cnr.it
Regional Team Leader: Roberto Bozzano, CNR

The observatory is located in the more inland basin of the Mediterranean Sea: in this area, the particular orographic constraints and the thermal contrast between land and sea give rise to specific local effects that influence the general circulation of both atmosphere and ocean. The area is also part of the Pelagos Sanctuary for Mediterranean Marine Mammals that is a special marine protected area extending about 90.000 km2 between Italy, France, and the Island of Sardinia. The W1M3A observing system is composed of two sub-systems:

1. a large spar buoy, nominally known as "ODAS Italia 1"to acquire EOV in the upper 40 m of water column.
2. a sub-surface mooring acquiring data in the ocean interior. The surface buoy represents one of the few examples in the world of large spar meteo-oceanographic buoy.

The overall structure is 51-meter-long with a dry-weight of about 12 tons. The observatory is permanently moored on the seabed through a 2000 m long slack polypropylene mooring cable terminated by ship chains and an anchor. The buoy spans a watch circle of 3 km of diameter to sustain ocean currents, winds, and waves. The pole emerges about 15 meters above sea level, whereas the remaining 36 meters remain submerged. On the upper mast, the meteorological instruments are installed. At about 7 meter above the mean sea level, a small, closed space hosts the electronic systems for data collection. Along the underwater pole, at several depths, instruments are deployed. All electronic systems and most sensors are powered by a wind/solar system that recharges two separate batteries. Acquired data are stored on board but a subset of the data is transmitted ashore through a satellite link. The sub-surface mooring is a standard oceanographic mooring composed of pieces of Kevlar rope with floats kept in position by a ballast on the sea bottom which can be detached using a pair of acoustic releasers. Along the mooring line, several CTDs are deployed at different depths.

SCIENTIFIC OBJECTIVES

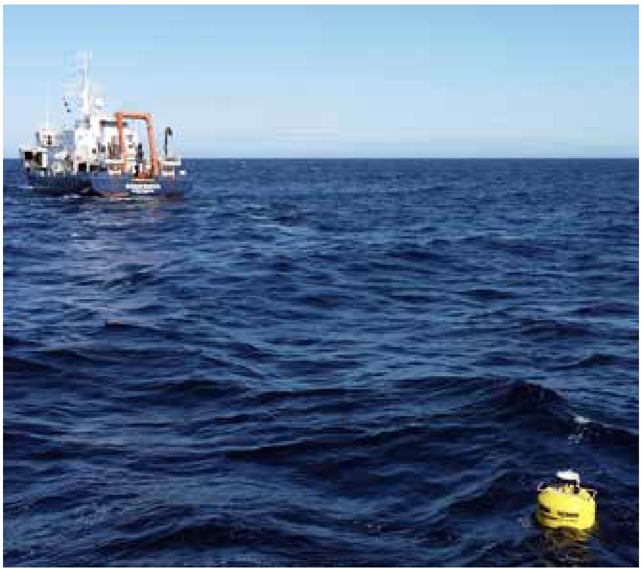
EMSO-Western Mediterranean (W1M3A) RF provides time-series to investigate air-sea interactions and connection between physics and bio-geo-chemistry along the water column on the long-term for assessing climate changes and ocean acidification. The RF allows also the monitoring of underwater ambient sound to identify anthropogenic, geophysical and biological sound sources.

PORTUGAL

REPRESENTING ENTITY:
Fundação para a Ciência e a Tecnologia | FCT

1 REGIONAL FACILITY
Iberian Margin

IBERIAN MARGIN



GENERAL INFORMATION

Location: SW Iberian Margin
Distance from land: 20 km
Max water depth: 1200 m
Date 1st deployment: May 2021
Operated by: EMSO Portugal
Website: emso-pt.pt
Regional Team Leader: Carlos Sousa, IPMA

The area of Gulf of Cadiz is very important for geo-hazards. It was the site where one of the worst earthquakes that hit Europe occurred in 1755, coupled with a destructive tsunami. Here African and European tectonic plates converge. It is a seismic volcanic region. The Iberian Margin is also a pivotal ocean region where Atlantic and Mediterranean exchange waters, with the later spreading at intermediate levels playing a key role in the salt and heat budget and AMOC (Atlantic Meridional Overturning Circulation). The Iberian Margin is the northernmost region of the productive CCUS (Canary Current Upwelling System), one of the four EBUS (Eastern Boundary Upwelling Systems) of the global ocean, where a highly variable upwelling regime dominates along with a strong mesoscale activity. The geologic and oceanographic features of this region favour the presence of highly diverse benthic communities and have also a central role in the distribution of several marine mammals and fish species.

SCIENTIFIC OBJECTIVES

To know the physical and biogeochemical characteristics of the Iberian Margin waters and their variability in a wide range of timescales to understand and predict the ecosystem functioning in global change scenarios. To establish references for model validation, to feed models with near real time data, and improve model parametrizations towards better forecasting. To construct long-term oceanographic time series as a scientific patrimony and a legacy for future marine research and management.

The Iberian Margin is currently composed of two sub-systems, deployed in the proximity of Cape St. Vincent (IbMa-CSV), tailored to measure EOV's (CTD, dissolved oxygen, turbidity, total chlorophyll-a, CDOM, PAR, currents) at different depth ranges:

1. A wave powered water column vertical profiler (Wirewalker), delivering ~5 profiles/hour from the near surface to 150m depth, scalable to reach 500m depth, depending on travel wire;
2. A subsurface moored platform (EGIM), currently planned to be deployed ~1100 m depth (pilot dataset from ~200m depth).

ROMANIA

REPRESENTING ENTITY:
Institutul National de Cercetare Dezvoltare Pentru Geologie si Geoecologie Marina GEOECOMAR

1 REGIONAL FACILITY
Black Sea

BLACK SEA

GENERAL INFORMATION

Location: Three sites in the Black Sea
Distance from land: 180 km
Max water depth: 95 m
Date 1st deployment: June 2013
Supported by: Romania
Operated by: GeoEcoMar
Regional Team Leader: Vlad Rădulescu, GeoEcoMar

The Black Sea is one of the largest regional seas of the Eurasian continent and unique in many of its geographical, geological, biological, hydrographical and socio-political characteristics. With anoxic conditions in the deep, problems with invasive species and high sediment loads delivered to the system, this area has unique problems requiring long-term stations. The Black Sea is located in a geological complex area, where three major tectonic plates (Eurasian, Anatolian, Arabian) interact. Geo hazards, such as earthquakes, submarine landslide, displacement along active faults, are present and are possible triggers of tsunami, together with extreme meteorological events.

SCIENTIFIC OBJECTIVES

Long-term environmental monitoring and for the prevention/mitigation of the marine geo hazards.

SPAIN

REPRESENTING ENTITY:
Plataforma Oceánica de Canarias | PLOCAN

2 REGIONAL FACILITIES
Emso Canarias - OBSEA

EMSO CANARIAS

GENERAL INFORMATION

Location: Atlantic Ocean near Canary Islands
Distance from land: 112 km
Max water depth: 3630 m
Date 1st deployment: 1994
Operated by: PLOCAN
Website: plocan.eu/en/open-ocean-observatory
Regional Team Leader: Eric Delory, PLOCAN

EMSO Canarias, a.k.a. ESTOC (29°10' N, 15°30' W) is a monitoring time-series program. The station is located within the weak southward return flows on the Eastern side of the North Atlantic subtropical gyre. ESTOC is an open ocean site, located well outside of the highly variable Eastern boundary with its strong coastal upwelling regime (although interaction with this regime exists). The site is sufficiently deep to encompass the Eastern subtropical North Atlantic's major water masses including the North Atlantic Deep Water (except the AABW). ESTOC is windward of the Canary Islands to avoid wake effects of both the major currents and winds (Canary Current and Northeast Trade Winds), and is far enough from coasts and islands to serve as reference for satellite images and altimetry.

SCIENTIFIC OBJECTIVES

Long-term changes of stratification and circulation on seasonal and inter-annual times scales of the subtropical Central-Eastern waters of the Atlantic Ocean.

OBSEA

GENERAL INFORMATION

Location: Balearic Sea, South of Spain coast
Distance from land: 4 km
Max water depth: 20 m
Date 1st deployment: 2009
Operated by: Universitat Politècnica de Catalunya, UPC
Website: www.obsea.es
Regional Team Leader: Del Rio Joaquin, UPC

OBSEA, a permanent underwater cabled seabed observatory located in front of the Catalan's coast near Barcelona, at 20 m depth is used as a test site for different experiments related with marine sensors. It has a sea station and a ground station, which include a surface buoy equipped with a weather station and camera and a coastal cabled system (seabed platform). A meteorological station is also available. Obsea offers power supply, Ethernet and serial communications, and synchronization over PTP IEEE Std 1588. A continuous real-time communication allows the tracing along the full experiment. A small boat and scuba divers are available in order to reach OBSEA, deploy the instrumentation and plug it to OBSEA. The Informatics team will support the communication with your instrument and the data quality control and several output formats for archiving.

SCIENTIFIC OBJECTIVES

Test of marine sensors to help manufacturers, platform operators and scientists to validate instruments.

NORWAY

REPRESENTING ENTITY:
University of Bergen

1 REGIONAL FACILITY
Nordic Sea

NORDIC SEAS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GENERAL INFORMATION

Location: Norwegian Sea, Greenland Sea, Iceland Sea, Fram Strait

Distance from land: Distributed, 50– 1000 km

Max water depth: 3050 m

Date 1st deployment: Fall 2020

Supported by: Norway

Operated by: University of Bergen, Institute of Marine Research, NORCE, Norwegian Polar Institute, University of Tromsø, and Norwegian Meteorological Institute

Website: https://www.uib.no/en/noremso/

Regional Team Leader: Ilker Fer, University of Bergen

The Nordic Seas regional facility is a distributed infrastructure, member of the EMSO consortium and comprises multiple ocean glider sections, 4 oceanographic mooring sites, and one seabed-water-column-coupled observatory. Glider transects are in the Norwegian Sea (Svinøy: 62.7°N, 4.4°E - 64.7°N, 0.0°E; Gimsøy: 68.8°N, 13.0°E- 70.2°N, 8.8°E), Fram Strait (78.8°N, 9.0°E - 78.8°N, 7.0°W), the Greenland Sea (73.5°N, 2.0°E – 76.4°N,7.8°W) and the Iceland Sea (70.6°N, 10.0°W – 71.0°N, 19.6°W). All gliders measure temperature, salinity, pressure, and depth-averaged velocity. Gliders are in operation since 2021. Fram Strait section is discontinued in October 2022.

Mooring sites are Svinøy (63°N 4°E in the southern Norwegian Sea at 500 m isobath; ocean currents, temperature and salinity; running since 1948 and within EMSO since 2020); Station M (66°N 2°E in the Norwegian Sea at 2050 m isobath; temperature, salinity and pCO2; running since 1994 and within EMSO since 2020), South Cape (76.107°N 15.967°E, off South Cape of Svalbard at 390 m isobath near a gas hydrate Pingo; temperature, salinity, pH, CH4 and CO2 sensors), and the central Fram Strait (78.83°N 2°W in Fram Strait at 2655 m isobath; ocean currents, temperature, salinity, dissolved oxygen, pH and pCO2; running since 1997 and within EMSO since 2020).The fixed-point seabed-water-column-coupled and wireless observatory is at the Mohn Ridge (72.756°N 3.834°E, Fåvne vent field at 3050 m isobath; in development). The observatory is composed of one deep-ocean water-column mooring coupled with a seafloor node, with sensors to measure pressure, temperature, turbidity, and ocean currents. EMSO scientific disciplines: geosciences, physical oceanography, biogeochemistry, marine ecology (planned).

SCIENTIFIC OBJECTIVES

Better understand the drivers for the temporal and spatial changes of water mass transformations, ocean circulation, acidification, and thermo-chemical exchanges at the seafloor in the Nordic Seas, and contribute to improvement of models and forecasting by collecting and making available high-quality data.

ANNEX 2
LIST OF PUBLICATIONS IN CONFERENCE and EVENTS, SCIENTIFIC ARTICLES AND OUTREACH

CONFERENCES, EVENTS, OTHERS

European Geosciences Union General Assembly 2023, 23-28 April 2023, Vienna, https://www.egu23.eu/

- **Jirka, S.; Autermann, C.; Del Rio, J.; Konkol, M.; Martinez,** E. Harmonising the sharing of marine observation data considering data quality information. 25/04/2023. https://meetingorganizer.copernicus.org/EGU23/EGU23-9291.html.

- **Giambenedetti, B., Lo Bue, N., Artale, V., and Falcini, F.:** Role of stratification in vorticity propagation throughout the entire water column: a Mediterranean example (Ionian Sea), EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-13857, https://doi.org/10.5194/egusphere-egu23-13857, 2023.

- **Lo Bue, N., Giambenedetti, B., Embriaco, D., Marinaro, G., Bagiacchi, P., and Vagni, R.:** A new release of deep ocean datasets for a better understanding of ocean dynamics, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-16889, https://doi.org/10.5194/egusphere-egu23-16889, 2023.

- **V. Cardin & L. Ursella, F. De Luca Lopes De Amorim, M. Batistić, F. Brunetti, R. Garić, J. Le Meur, G. Siena, M. Ure,** University of Dubrovnik, 8-02-2023 Preliminary results from recent time series acquired at the EMSO E2M3A Observatory (Southern Adriatic).

- **V. Cardin, F. de Luca Lopes de Amorim, L. Ursella, A. Wirth,** EGU23-2871, https://doi.org/10.5194/egusphere-egu23-2871, EGU General Assembly 24- 28 Aprile 2023. EMSO E2M3A Southern Adriatic Regional Facility: Interconnectedness of a variety of processes at different spatial and temporal Scales, their interaction and recurrence.

- **Gabriella Quaranta, Valentina Tegas and Juanjo Dañobeitia,** EMSO ERIC support, coordination and management service for the benefit of a distributed consortium, April 2023, Conference: EGU 2023.

- **Oikonomou, C. L. G., Denaxa, D., and Korres, G.:** Validation of the Copernicus Marine Med-WAV modelled spectrum with available buoy measurements in the Mediterranean Sea, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-13365, https://doi.org/10.5194/egusphere-egu23-13365, 2023

- **Hodell, D., Abrantes, F., Zarikian, C. and the IODP Expedition 397 Scientists (incl. E. Salgueiro)**: Benchmark sedimentary records recovered from the Iberian margin during IODP Expedition 397, EGU

General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-16019, https://doi.org/10.5194/egusphere-egu23-16019, 2023

- **Rautenbach, S. A., Mendes de Sousa, C., and Relvas, P.:** High resolution observations of the ocean upper layer south of Cape St.Vincent, western Gulf of Cadiz: What they reveal, EGU General Assembly 2023, Vienna, Austria, 24–28 Apr 2023, EGU23-6430, https://doi.org/10.5194/egusphere-egu23-6430, 2023.

- **Meyer, F., Relvas, P., Cravo, A., and de Sousa, C.:** Short-term high-resolution physical-chemical-biological coupled observations on the inner shelf of the Northern Margin of the Gulf of Cadiz, EGU General Assembly 2024, Vienna, Austria, 14–19 Apr 2024, EGU24-8384, https://doi.org/10.5194/egusphere-egu24-8384, 2024.

Oceans 2023 MTS/IEEE Limerick. 5-8 June 2023 https://limerick23.oceansconference.org/

- Experience OBSEA: a web-based 3D virtual environment of a seafloor observatory. **Llorach-Tó, G.; Martinez, E.; Del Rio, J.; Garcia,** E. https://ieeexplore.ieee.org/document/10244688.

- An e-infrastructure for FAIR data management of underwater observatories. **Martinez, E.; Garcia, A.; Toma, D.; Carandell, M.; Nogueras, M.; Del Rio, J..** https://ieeexplore.ieee.org/document/10244451.

- Multiparametric benthic landers for monitoring fishing-impacted deep-sea ecosystems. **Toma, D.; Aguzzi, J.; Carandell, M.; Nogueras, M.; Martinez, E.; Francescangeli, M.; Chatzievangelou, D.; Bahamón Rivera, Nixon; Company Claret, Joan Baptista; Grinyó, J.; Carreras, M.; Floeghel, S.; Del Rio, J..** https://ieeexplore.ieee.org/document/10244542.

- Resource pulse in shallow waters: characterization of the scavenger community associated with a dolphin carcass. Francescangeli, M.; Carandell, **M.; Toma, D.; Martinez, E.; Nogueras, M.; Santin, A.; Chatzievangelou, D.; Grinyó, J.; Robinson, N. J.; Navarro, J.; Aguzzi, J.; Del Rio, J..** https://ieeexplore.ieee.org/document/10244271.

- Expanding the underwater communication capabilities of seafloor ecosystem monitoring stand-alone platforms using pop-up buoys. **Carandell, M.; Hernández, S.; Toma, D.; Martinez, E.; Nogueras, M.; Aguzzi, J.; Del Rio, J.**. https://ieeexplore.ieee.org/document/10244428.

- Engineering a testbed for bidirectional acoustic tag development. **Batet, G.; Masmitja, I.; Sarria, D.; Gomariz, S.; Del Rio, J..** https://ieeexplore.ieee.org/document/10244649.

- Trainable dynamical estimation of above-surface wind speed using underwater passive acoustics. **M. Zambra et al.**, OCEANS 2023 - Limerick, Limerick, Ireland, 2023, pp. 1-6, doi: 10.1109/OCEANSLimerick52467.2023.10244715

- TRIDENT – Technology based impact assessment tool foR sustaInable, transparent Deep sEa miNing exploraTion and exploitation: A project overview. **E.Silva, D.Viegas, A.Martins, J.Almeida, C.Almeida, B.Neves, P.Madureira, A.J.Wheeler, G. Salavasidis, A.Phillips, A.Schaap, B.Murton, A.Berry, A.Weir,**

G.Dooly, E.Omerdic, D.Toal, P.C.Collins, M.Miranda, C.Petrioli, C.Barrera Rodríguez, D.Demoor, C.Drouet, G.El Serafy, S.M. Jesus, J. Dañobeitia, V. Tegas, S.Cusi, L. Lopes, B.Bodo, L. Beguery, S. VanDam, J. Dumortier, L. Neves, V. Srivastava, T.G. Dahlgren, J. Thomassen Hestetun, R. Eiras, R. Caldeira, C. Rossi, J. Spearman, L. Somoza, F.J. González, R. Bartolome , P. Bahurel., 7 pp, Ocean 2023, Limmerick. DOI: 10.1109/OCEANSLimerick52467.2023.10244429.

- The Marine Research Infrastructure in the European Marine Observation landscape, **J. J. Dañobeitia, Sylvie Pouliquen, Nicolas Pade, Christos Arvanitidis, Richard Sanders, Adrian Stanica, Claire Gourcuf, G. Petihakis, Valentina Tegas. Alan Berry and Paolo Favali**. 4 pp, Ocean 2023, Limerick. . DOI: 10.1109/OCEANSLimerick52467.2023.10244564

MarTech 2023, Castellón de la Plana, 19-20 June 2023 https://sarti.webs.upc.edu/martech/martech-editions/2023/proceedings/

- **Batet, G.; Sarria, D.; Nogueras, M.; Gomariz, S.; Del Rio, J.; Masmitja, I..** Modular acoustic platform to develop underwater bidirectional tags. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 19~19. https://upcommons.upc.edu/handle/2117/392117.

- **Carandell, M.; Toma, D.; Holmes, A. S.; Martínez, E.; Gasulla, M.; Del Rio, J.**. Consumption evaluation of a relaxation oscillator as a control sampling circuit for fast-tracking FOCV-MPPT circuits in wave energy converters. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 23~23. http://hdl.handle.net/2117/392099.

- **Falahzadehabarghouee, A.; Toma, D.; Le Bris, M.; Martínez, E.; Carandell, M.; Nogueras, M.; Aguzzi, J.; Del Rio, J.**. Calibrating the movement of an underwater crawler using pulse width modulation (PWM). Instrumentation viewpoint. 2023. Número: 22. Pàgs: 51~51. https://upcommons.upc.edu/handle/2117/391836.

- **Flix, R.; Carandell, M.; Carbonell, M..** Optimization of a small-scale, N-pendulum, wave energy converter for drifter applications based on OrcaFlex simulation. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 11~11. http://hdl.handle.net/2117/392128.

- **Francescangeli, M.; Martínez, E.; Carandell, M.; Nogueras, M.; Chatzievangelou, D.; Toma, D.; Del Rio, J.; Aguzzi, J..** The video-based EGIM development. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 29~29. http://hdl.handle.net/2117/39201.

- **Idiondo , A.; Toma, D..** Long baseline (LBL) positioning system for the crawler tele-operated underwater vehicle in OBSEA observatory. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 64~64. https://upcommons.upc.edu/handle/2117/391483.

- **Martínez, E.; García, A.; Toma, D.; Carandell, M.; Nogueras, M.; Del Rio, J..** A data management e-infrastructure for the OBSEA cabled observatory. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 77~77. https://upcommons.upc.edu/handle/2117/391330.

- **Oliver, M.; Toma, D..** Automatic system for 3D photogrammetry of small artificial biotopes using the crawler remote operating vehicle at OBSEA observatory. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 66~66. https://upcommons.upc.edu/handle/2117/391427.

- **Toma, D.; Aguzzi, J.; Carandell, M.; Nogueras, M.; Martínez, E.; Francescangeli, M.; Chatzievangelou, D.; Bahamón Rivera, Nixon; Company Claret, Joan Baptista; Carreras, M.; Del Rio, J..** Multisensor acoustic tracking benthic landers to evaluate connectivity of fishes in marine protected areas. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 53~53. https://upcommons.upc.edu/handle/2117/391833.

- **Carandell, M.; Nogueras, M.; Hernández, S.; Toma, D.; Martínez, E.; Del Rio, J..** Enhancing marine ecosystem monitoring through the integration of pop-up buoys with wireless communication an satellite connectivity. Instrumentation viewpoint. 2023. Número: 22. Pàgs: 59~59. http://hdl.handle.net/2117/391801

28th IUGG General Assembly, 11-20 July 2023

- **N. Lo Bue, D. Embriaco, S. Sparnocchia, T. Sgroi, D. Andronico;** "Abstract number: IUGG23-4667: Using EMSO multidisciplinary facility for observing the Etna volcanic ash dispersion into the deep marine environment" https://c-in.floq.live/event/iugg2023berlin/search?objectClass=timeslot&objectId=649483f664c73802ac7457c5&type=detail

10th EuroGOOS International Conference, Galway, 3-5 October 2023 -

- **Juanjo Dañobeitia, Raúl Bardají, Andreu Bautista, Alan Berry, Laura Beranzoli, Roberto Bozzano, V. Cardin, Simo Cusi, , Laurent Coppola, Eric Delory, Davide Embriaco, Ilker Fer, Joaquín del Rio, Enoc Martínez, George Petihakis, Ivan Rodero, Pierre-Marie Sarradin, Carlos Mendes de Sousa, Beatrice Tomasi.** EMSO ERIC progress in data harmonization and physical access for the benefit of marine science and technology, European Operational Oceanography for the ocean we want -, 142-149, Proceedings of the 10th EuroGOOS International Conference. Volume: 10th EuroGOOS International Conference Session E Strategic developments in ocean observing Addressing the UN Ocean Decade challenges. 3-5 October 2023, Galway, Ireland Eparkhina, D., Nolan, J.E. (Eds), EuroGOOS. Brussels, Belgium. 2023. https://marineinstitute.clr.events/attachment/651b2d220fcd3059611081.

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- **Raul Bardají, Ivan Rodero, Andreu Fornós, Enoc Martinez and Juanjo Dañobeitia,** Advances in EMSO Data Portal: Data Harmonization through ERDDAP and API Enhancements for Efficient Scientific Visualizations, AGU23, San Francisco, 12th December 2023

OTHER RELEVANT INTERNATIONAL MEETINGS AND WORKSHOPS

- EMSO ERIC - sustainable access scheme, ATMO-Access General Assembly 2023, 29-30-31 March 2023 – **Valencia, Juanjo Dañobeitia and Simo Cusi.**

- Why EMSO Ocean Observations are crucial to understand climate impact, Towards Global Earth Observatory workshop, 8-10 May 2023, Hyytiälä, Finland, **Juanjo Dañobeitia**

- Inverse estimates of volume, heat and freshwater fluxes in the Arctic gateways, Arctic Subarctic Ocean Fluxes (ASOF) Workshop, 10-12 May, Spain, **H.-B. Fredriksen and L. de Steur**

- Why EMSO Ocean Observations are crucial to understand global environmental changes ?, Geo-inquire- seminar, 11 May 2023, online, **Juanjo Dañobeitia**, on behalf of EMSO ERIC

- Enhancing Seafloor Observation using Subsea Smart Cables, Smart Cable, Science and Society, 22-23 May 2023, Aveiro, Portugal, **Juanjo Dañobeitia, Giuditta Marinaro, Simo Cusi, Davide Embriaco, Massimo Chiappini, Christos Arvanitidis, Angelo De Santis, Paolo Favali and Norman Albi**

- The impact on sedimentation if the Adriatic Sea becomes meromictic due to global climate change, International Conference on Radiation Applications, 29 May-2 June 2023. **J. Obhodas, A. Vinkovic, U. Tinivella, M. Giustiniani2, V. Cardin, M. Bensi, D. Joksimović, C. Tsabaris, B. Radun, T. Legović**

- Strengthen collaboration in Ocean Observation to preserve "Ocean health and resources", 1st Bilateral EC-ERICs meeting, Online Brussels, 13th September 2023 , **Juanjo Dañobeitia**

- Description of EMSO Mohn observatory and the deployment, USF Bergen. Science by the Sea 2023 event organized by GEO department on 28th September 2023, **B. Tomasi**

- Oceanographic measurements using underwater gliders in Fram Strait, 3rd SIOS Marine Infrastructure Workshop, 4 Oct 2023, online, **Ilker Fer**

- Decadal trends from the Ocean Weather Station M, Bjerknes Annual Meeting, 19 October, Bergen, **I. Skjelvan**

- Driving Industry Through Innovation, OEE2023 25-26 October 2023. SmartBay test site and environmental monitoring. **Alan Berry**, Research Infrastructures Manager, **MI Galway**

- Explaining and Predicting the Ocean Conveyor (EPOC), EC-ESA Joint System Science Initiative, 22-24 November, ESA-ESRIN Frascati, Italy (https://essi2023.esa.int/). **L. de Steur and the EPOC consortium**

- Decadal trends from the Ocean Weather Station M and outreach using Story Map NORCE Ocean Observation Science Day, Bergen 13 November, , **I. Skjelvan**

- Decadal trends from the Ocean Weather Station M, ICOS Nordic Conference, 21-22 November, Bergen, **I. Skjelvan**

- "Ocean Acidification Program", Seminar on monitoring programs at the Norwegian Environment Agency, 28 November 2023, Oslo, **I. Skjelvan**

- EMSO Strengthening collaboration in Ocean Observation to preserve "Ocean health and resources" Achievements and Challenges, L'osservazione del mare profondo: la Joint Research Unit EMSO Italia come comunità inclusive, Workshop, Bologna, 1st December 2023, **Juanjo Dañobeitia**

- Strategy meeting 'Our marine power center creates future-oriented solutions.', 7 December 2023, UIB-MatNat faculty, Marine Oceanography Infrastructure, **Ilker Fer**

- Activities of the Norwegian Glider Facility (NorGliders), and the structure of the Lofoten Basin Eddy from gliders during the SWOT Cal/Val phase, EGO Webinar "Glider collaboration at global level", 14 Dec 2023, online, **Ilker Fer**

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ANNEX 3
EUROPEAN PROJECTS IN WHICH EMSO IS INVOLVED

In 2023, EMSO ERIC actively participated in and contributed to 15 projects, funded by Horizon 2020 and Horizon Europe programmes. Among them, 4 projects beginning this year: GEORGE, TRIDENT, ANERIS, BlueCloud2026 (in the picture below, an overview of the state of the projects along 2023).

MAIN EMSO ACHIEVEMENTS WITHIN THE EU PROJECTS IN 2023

ENVRI-FAIR

ENVironmental Research Infrastructures building Fair services Accessible for society, Innovation and Research
2019 - 2023
Coordinated by FORSCHUNGSZENTRUM JULICH GMBH (Germany)

EMSO CONTRIBUTION
In the ENVRI FAIR project, EMSO ERIC played a crucial role within the WP3. EMSO led Task 3.4 "Fostering ENVRI data-driven innovation", aimed at boosting innovation and strengthening cooperation with industry, particularly in the development of RI's data services. Within this framework, EMSO was responsible for delivering two key reports: D3.1 titled "A Strategic Action Plan for Enhancing Uptake of ENVRI Data by the Private Sector" (https://zenodo.org/records/8081074), which reports the strategic plan for strengthening RI innovation-cooperation awareness and preparedness and promoting industry uptake of ENVRI data services in compliance with FAIR principles, and D3.5 titled "Catalogue of Services Targeted for the Private Sector" (https://zenodo.org/records/6532029#.YpiF56hByUk).

EMSO successfully submitted the milestone **"MS11 - REPORT on RI Innovation-Related Cooperation Roadmap and Action Plan launched"**, which reports the set of activities implemented to promote and launch the Plan among the Environmental Research Infrastructures, such as the promotion towards the BEERI- Board of European Environmental Research Infrastructures- and the focused communication campaign via the ENVRI communication channels.
In addition, EMSO collaborated to define and promote the uptake of common strategies to enhance innovation across the ENVRI community network, participating in the realization of **the project proposal "ENVironment Research infrastructures INNOVation Roadmap (ENVRINNOV)"**, in the Horizon Europe call HORIZON-INFRA-2023-DEV-01-05, then accepted for funding: EMSO will be the leader of the WP6 titled "ENVRI Roadmap for sustainable Innovation".
In the frame of WP4 EMSO edited and published its **"Terms and Conditions for the EMSO ERIC website"**.
EMSO also led task 9.5 to the maintenance and operation of data services for continuous FAIRness improvements.
In collaboration with all RIs from the marine subdomain an opinion paper on **"The role of the marine research infrastructures in the European marine observation landscape: present and future perspectives"** was published in Frontiers.
EMSO actively contributed to the success of the ENVRI WEEK 2024, by participating in person as well as through the publication of a poster ***"EMSO ERIC: a unique eye on deep-sea observation"***.

EMSO contributed to other deliverables as it follows:
- "D9.10: Marine subdomain white paper for sustainable data management."
- "D10.3: Report on coordination, prioritisation, and harmonisation in the Solid Earth subdomain."
- "D10.5: Final Report on Implementation Activities"

Geo-INQUIRE

Geosphere INfrastructures for QUestions into Integrated REsearch
2022-2026
Coordinated by HELMHOLTZ ZENTRUM POTSDAM DEUTSCHES GEOFORSCHUNGSZENTRUM GFZ (Germany)

EMSO CONTRIBUTION
Within the GeoInquire project, EMSO collaborates with EPOS and EIDA to enhance the availability of multidisciplinary deep ocean data, promoting its sharing for scientific research. This collaboration facilitates seamless access to geoscientific data, such as seismic waveforms and sea bottom pressure data, from EMSO's Regional Facilities to the wider scientific community. By supporting cross-disciplinary research, this effort improves the accessibility of vital

geoscientific data and strengthens EMSO's data services, further contributing to the global Earth sciences community.

eRImote

European Research Infrastructures - Pathway to Improved Resilience and Digital and Remote Access
2022-2024
Coordinated by DEUTSCHES ELEKTRONEN-SYNCHROTRON DESY (Germany)

EMSO CONTRIBUTION
In the eRImote project EMSO ERIC is involved in many activities and in particular is leading the task aiming at evaluating remote access by five pre-defined use cases of Research Infrastructures networks from three domains (ENV, LS, PS).
In 2023, EMSO ERIC worked on elaborating the methodology to be followed to detect, analyze and disseminate best practices adopted for common aspects as well as to have all the information related to the specific features of each use case **("MS10- Remote access use case procedures and technologies" and then "MS11- Intermediate report on use cases")**. Management processes and technologies were decided to be analyzed for each use case in different aspects, including common and specific aspects. Two phases were planned: A survey to collect information and to understand commonalities, and a set of bilateral interviews to investigate specific aspects of each use case. At the end of 2023, EMSO ERIC elaborated and submitted the survey to the related recipient.

EurofleetsPlus

An alliance of European marine research infrastructure to meet the evolving needs of the research and industrial communities
2019 - 2023
Coordinated by Marine Institute (Ireland)

EMSO CONTRIBUTION
EMSO ERIC strongly collaborated for the success of the **EurofleetsPlus project**, by leading WP5 on Stakeholders' Engagement in particular.
In 2023, EMSO ERIC collaborated with WP5 participants to develop and present the **"Strategic Agenda for Future Stakeholder Engagement, D5.6."** The document served as a significant milestone in shaping the strategic direction of stakeholder engagement within the project. This second release of the Strategic Agenda (First release D5.1 at M12) was updated based on stakeholder needs identified through the interactions both remotely and with virtual contacts.
In addition, many stakeholder dialogue activities were performed and described in two deliverables, the updated D5.3 and the D5.5, both named **"Map of User Needs for Research Vessel Infrastructure"** D5.3 has described in detail how to engage the different categories of stakeholders and some results obtained, while D5.5 represents an update and the completion of the process of the map of the user needs.
EMSO supported the promotion of the **EurofleetsPlus Access programme** by participating in the dissemination campaign.

For the **EurofleetsPlus Final Conference** held on 13/09/2023, EMSO ERIC actively supported the consortium in the organization.

MINKE

Metrology for Integrated marine maNagement and Knowledge-transfer nEtwork (MINKE)
2021 - 2025
Coordinated by CSIC (Spain)

EMSO CONTRIBUTION
EMSO, as co-leader of the project WP4 Networking and Engagement with Stakeholders, contributed to the project, ensuring that all the tasks and activities were properly established and implemented. During the year, it contributed to the:

- Realization of the perspective article "Proposed synergies between Oceanography and Metrology" (Frontiers in Marine Science, 2023), based on the activities developed particularly in Task 4.3 - Connection with EU and Global Observing Networks.

- Realization of the Deliverable 4.4 - Report on Stakeholder Engagement, led by EMSO, in cooperation with CNR, focused on the stakeholder analysis, strategy, methodology and action to engage the MINKE stakeholders; and contribution for the Deliverable 4.5 - "A roadmap describing the long-term engagement between the EURAMET EMN on climate and ocean observation and the oceanographic community".
- Preparation of the MINKE satellite event "A dialogue between stakeholders of the ocean observation community identifying common priorities and challenges to respond to global objectives 2030 for the 2024 Ocean Decade Conference

GEORGE

Next generation multiplatform Ocean observing technologies for research infrastructures
2023 - 2027
Coordinated by ICOS ERIC (Finland)

EMSO CONTRIBUTION
The project represents an opportunity to improve and harmonize data collection methods and ocean observation technologies through collaboration with other two RIs, ICOS and Euro-Argo.
In this project EMSO aims to advance the capability of the EGIM system with planned validation tests regarding the introduction of a rechargeable battery and the development of a lander system, both developed by Ifremer. It will also add new sensors to measure carbon cycle parameters such as pH, pCO_2 and CH_4. All these improvements will be tested in real ocean conditions and will achieve TRL8.
Furthermore, EMSO, as leader of the WP5 - Implementation and demonstration, worked along Ifremer and UPC during the the entire year to develop D5.1 - Technology validation and prototyping SOP and trials project plan (due by January 2024), the road map for the WP and project leaders, presenting the method and successive steps established to carry out the validation of WP2, WP3 and WP4 developments (platforms, sensors and data management) short description of each development carried out and tested at sea during the project and an in-depth description of each deployment (objectives, coordination, equipment provision, operation at sea, expected results and risk assessment).

ERIC FORUM 2

Second implementation project for the ERIC Forum
2023 - 2027
Coordinated by BBMRI-ERIC (Austria)

EMSO CONTRIBUTION
In the framework of the second edition of the ERIC FORUM project, EMSO, among many other tasks and WPs, is involved in Task 9.2 "Assessment of strategies and best practices for developing fruitful relationships with the Industry". The task will build upon the outcomes of the work done by several ERICs in past EU projects, to assess and tune strategies and best practices, already drafted, for engaging the industry as a full partner of the ERICs.
The main outcome of the task is to improve coordination among the ERICs and their capacity to collaborate with the private sector by having a common approach that will reinforce their sustainability and socio-economic impact. Specifically, the main output of the task will be the creation of a toolbox (D9.2) that will contain tailored recommendations and strategies, training materials and webinar recordings, as well as concrete success stories of past and ongoing collaborations between ERICs and the industry to showcase the width of opportunities and potential collaboration models. This task will also explore the possibilities offered by innovation procurement mechanisms as a possible instrument to engage with the industry.

Designed by Francesca Di Laura | Istituto Nazionale di Geofisica e Vulcanologia (INGV)

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EMSO ERIC

European Multidisciplinary Seafloor and water-column Observatory
European Research Infrastructure Consortium (EMSO ERIC)

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