



2017
ACTIVITY
REPORT

Observing the ocean to save the earth

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EXECUTIVE SUMMARY

This Annual Report covers the EMSO ERIC activities in the period 1 January – 31 December 2017. It represents the major findings and results achieved from the work undertaken by the EMSO ERIC team.

The European Multidisciplinary Seafloor and Water Column Observatory (EMSO) is a European Research Infrastructure Consortium founded as of on 1 October 2016, becoming an international organization with its own autonomy and organization as for the Statutes published on the Official Journal of the European Union L268/113.

The overall goal of EMSO ERIC EMSO ERIC as distributed research infrastructure is promoting scientific excellence, coordinating and integrating European deep-sea observatories that provide interdisciplinary scientific investigations in marine geology, geophysics, physical oceanography, marine meteorology, geochemistry, biochemistry and linked topics. Furthermore, EMSO ERIC aims to optimise access to ocean observatory infrastructures and data, to make and sustain connections with international initiatives relevant to ocean observation.

The format of this Activity Report follows the structure below and it includes the list of annexes. It is divided into two sections. The first one, scientific and operational activities and the second one, financial activities.

Section I is a detailed report of action we have prioritised last year. We spent much of our time driving EMSO implementation and development in terms of governance and operations. The EMSO-Link project played a key role in that direction.

This section also illustrates the methodology to accomplish the first consolidated draft of EMSO ERIC Strategic Plan 2018-2020, that was published in late 2017. The document illustrates the EMSO mission and the current position of the infrastructure within the landscape of the environmental research infrastructure describing the master plan to achieve the main EMSO ERIC objectives in the environmental marine domain.

The finalization of EMSO ERIC Governance was an essential part of the activities carried out in 2017 as well the establishment of the dedicated EMSO Funding Task Group (FTG) aimed to explore investment and funding strategies for the medium and long-term sustainability of EMSO ERIC.

In 2017 a wide season was devoted to defining service priorities for the nodes, services (active and planned), service workflows have been established and fed into EMSO. The way to achieve full operation was set out as stages in the dynamic and interactive process to integrate activities of each Regional Facility within EMSO ERIC. The "EMSO ERIC All Regions Workshop - EU seafloor and water-column observatories - Challenges and Opportunities towards integration" was organised and hosted in Rome from 9th to 11th October 2017 in order to exchange knowledge and best practices related to the



progress in the framework of EMSO mission and objectives and provide the basis for an open stakeholder consultation. The workshop was organised within the activities of the EC project EMSO-Link, the key Project of EMSO ERIC, aimed to accelerate governance, rules & procedures and to facilitate the coordination, construction, operation, extension and maintenance of EMSO Infrastructure. Following the Workshop, EMSO-Link PMO has worked to harmonize the 'mapping activities' of EMSO ERIC Regional Facilities and to define the status of the System of distributed observatories and resources in EMSO ERIC. 2

EMSO ERIC continued to increase the technology development by the design and deployment of the EGIM. This is an instrument that integrates tested sensors, allows to acquire up to seven ocean variables in the first instance (temperature, conductivity, pressure, dissolved O₂, turbidity, ocean currents, passive acoustics), increasing the capacity of a common collection of oceanic series of essential ocean variables and that could easily be increased up to five more in the near future. EGIM was developed in the framework of the EMSODEV project.

In order to improve EGIM's interoperability and provide an end-to-end standardized framework, an SWE (Sensor Web Enablement) Bridge, a cross-platform software aimed to be a universal driver for scientific instrumentation, configurable

through SensorML files, was included in the EGIM. It decodes a SensorML file and configures itself to start gathering data from an instrument (described in that file) and stores the acquired data in O&M files, ready to be uploaded to an SOS server.

EMSO ERIC elaborated a communication plan in 2017, including a reorganisation of the website and social media communication, the set-up of an Instagram account. Several concrete actions were also carried out, including participation of the ERIC to conferences and exhibitions.

Section II of the Activity Report discusses the financial activities as accounting and costs control; in-kind contribution and other engagements, collection of the Member States 2017 and 2018 fee, staff recruitment; balance sheet and income statement approval.

Finally, the Appendices provide detailed information on activities and people involved. Appendix 1 contains the list of communication and dissemination activities. Appendix 2 provides the list of Delegates and Advisors of the Assembly of Members and Appendix 3 includes the list of the Regional Team members, carrying out the operational activities of EMSO ERIC, they are in charge of running the EMSO ERIC Regional Facilities and coordinating the research activities.

1. SCIENTIFIC AND OPERATIONAL ACTIVITIES

Strategic Plan

In October 2017, at the beginning of his mandate, the Director General (DG) has committed himself in the preparation of the Strategic Plan 2018-2020 as per the ERIC Statutes. Accordingly, the process to deliver the Plan has followed the steps below:

1. The DG, supported by the Central Management Office (CMO), prepares a comprehensive outline of the Plan in the form of a presentation;
2. The DG presents the Strategic Plan to the AoM;
3. The Assembly of Members (AoM) evaluates the Plan;
4. Upon approval of AoM, the DG prepares the Plan in the form of an extensive document;
5. The DG submits the Plan to the Executive Committee for approval;
6. The DG submits the Plan to the AoM for the final approval and ratification.

The steps from 1 to 3 were completed by January 2018 with the presentation of the Plan in the 7th AoM Meeting and the AoM approval to the presentation was obtained. Meanwhile, step 4 has been initiated in December 2017. At the time of this report

drafting, the textual document of the Plan has been almost concluded. The Plan is presented in a context that promotes the implementation and development of all the components and strategic aspects of EMSO from governance to operations and the long-term commitment service, and several levels of interest and scope from the scientific and technological community, to stakeholders and public in general. The Strategic Plan establishes the perspective of the position and the role that EMSO ERIC wishes to have in the next years in the scope of the Environmental Research Infrastructure.

The Plan has been intended as an overarching framework driving the implementation and development of all the components and strategic aspects of EMSO from the governance, to the long-term operation and service provisions, to the community outreach. The Strategic Plan also sets the perspective of the position and role that EMSO ERIC aspires to gain in the coming years in the Environmental Research Infrastructure landscape. The multi-domain nature and multidisciplinary have been remarked as peculiar and distinguishing features of EMSO, replying to the present need of a holistic approach to face the present environmental challenges.

The structure of the textual version of the Strategic Plan, set up by the DG with the support of the CMO, consists of the following main parts:

-  A description of EMSO mission, goals and positioning in the landscape of environmental research infrastructures at European and global level
-  The strategic vision built around the strength points, the challenges of the distributed model and the sustainability.
-  The governance structure and operation mode
-  An outline of Action Plan for 2018.

The Plan has to emphasize the role of the Services and identify the priority in the implementation of those Services expected to produce the major impact: the initial efforts has to focus in the implementation of the Data, Science, Engineering and Logistics, and

Communication Services. The position of the Services in the ERIC organogram and their relations with the statutory bodies of the ERIC have been analysed and defined.

The Strategic Plan aims to stimulate EMSO ERIC to become a world leader in Marine Environmental Science and Technology. To achieve this, it has designed a new type of large-scale distributed infrastructure, providing high-quality ocean data with an unprecedented temporal resolution to contribute to the understanding of the Marine Environmental Challenges of the 21st century. EMSO ERIC can also play a significant role in the European Oceans Observing System, supplying essential information (warming of sea surface, sea level rise and ocean acidification) to understand and assess the effects of climate change and other anthropogenic environmental impacts such as biodiversity and ecosystems, fisheries or sustainable extraction of resources.

Set-up EMSO ERIC Governance

The Commission Implementing Decision (EU) 2016/1757 of 29th of September 2016 set up EMSO ERIC. The handover ceremony took place in Rome on the 27th of January 2017, in the presence of the Director-General of the Directorate-General for Research and Innovation (RTD), European Commission, Robert-Jan Smits and the representative of the Italian Ministry of Education, University and Research, as well as the Representing Entities of EMSO ERIC Members.



Following the set-up of the EMSO ERIC Assembly of Members in 2016, the EMSO ERIC Director General was selected among a group of more than 85 candidates all over the world. A panel including a sub-group of AoM representatives and an external expert from a counterpart research infrastructure carried on the selection. The selection developed in two steps: 1) selection by CVs assessment; 2) selection by interview of finalist candidates. Juan José Dañobeitia Canales started his three-year term on 1 October 2017. The Interim Support Team and the EMSO-Link Project Management Office that carried out EMSO ERIC activity up to October 2017 converged in the EMSO ERIC Central Management Office once the Director General was in place.

In 2017, three Assembly of Members meetings were held:

1. 26th of January 2017 in Rome (Assembly of Members meeting number 3). This meeting was dedicated to the identification of

EMSO-Link Coordinator (Paolo Favali) and to the discussion of the Financial Status Report.

2. 10th of April 2017 in Paris (Assembly of Members meeting number 4) This meeting was organized to finalize the selection of the Director General.
3. 16th of June 2017 by videoconference (Assembly of Members meeting number 4). This meeting was dedicated to the approval of the 2016 Balance Sheet and Income Statement.

The finalization of EMSO ERIC Executive Committee was an essential part of the activity carried out in 2017. The Regional Facilities Leaders and the Service Groups Leaders, both belonging to one Regional Team, compose the Executive Committee. Regional Teams are in charge of running the EMSO ERIC Regional Facilities and coordinating the research activities. Hence, they carry out the operational activities of EMSO ERIC.

Service function, deriving from operational activities carried out by the Regional Teams, is provided by EMSO ERIC Service Groups (coming from RTs) in order to produce data, technology, expertise and scientific research relevant to environmental policies and to ensure that the Research Infrastructure has a positive socio-economic impact, in

accordance with the EMSO ERIC core mission. The integration of activities carried out by Regional Teams, Service Groups constitutes part of the value proposition for EMSO ERIC, and affects its sustainability.

EMSO RFs presently consists of

- 8 observatory-nodes operating across different environments (from sub-arctic to sub-tropical) equipped with a wide range of observations/instruments:

-  Porcupine Abyssal Plain,
-  Azores Islands,
-  Canary Islands
-  Iberian Margin

-  Ligurian Sea,
-  Western Ionian,
-  Hellenic Arc
-  Black Sea

- 3 Test Sites serving development and experimentation of new devices, systems and methodologies to improve observation capacity:

-  SMART Bay
-  Molènes Island
-  OBSEA



The setup of the Regional Teams was carried out in different steps to integrate the activities of each Regional Facility within the Research Infrastructure and to set up the EMSO ERIC Executive Committee. This process was concluded in the first half of 2018. The list of Regional Teams (Regional Team Leader and Service Groups members) is in Annex 3.

Long-term sustainability

A dedicated EMSO Funding Task Group (FTG) was established to explore investment and funding strategies for the medium and long-term sustainability of EMSO ERIC. The rationale for having this group is to focus and detail a critical aspect of EMSO ERIC long-term operation. The first FTG meeting was held as a side-session at the EMSO ERIC All Regions Workshop in Rome (October 2017). FTG reviews all calls relevant to EMSO ERIC and is

also be the body responsible to ensure that the EMSO ERIC does not go into calls, which may compete with EMSO ERIC Member's proposals. The FTG identifies opportunities for EMSO ERIC to engage with the private sector and provide recommendations for engagement with the private/commercial sector. The members of the EMSO Funding Task Group are listed in the table below.

Name	Institution
Juanjo Dañobeitia	EMSO ERIC
Paolo Favali	EMSO ERIC
Paola Materia	EMSO ERIC
Maria Incoronata Fredella	EMSO ERIC
Jean-François Bourillet	IFREMER
Valentina Tegas	INGV
Fabio Ugolini	INNOVA
Eduardo Silva	IPMA
Filipa Marques	IPMA
Michael Gillooly	Marine Institute
Henry Ruhl	NOC
Joaquin Del Rio Fernandez	UPC

Upgrade of resources and services

EMSO ERIC promotes collaborative research and links between excellent research with innovation and industry, the integrated services produced serve the science, the industry, the policy and the society. Moreover, EMSO ERIC aims to raise utilisation of the digital opening in science: open data and data re-use are the primary way to grow the circulation of culture and promote innovation on the different scale. It is shaping their expected actions towards its key principles, contributing to the framework programme that Europe needs.

To define the services that EMSO ERIC provides in relation to the Sustainable Development Goals, European Marine Strategy Framework Directive, GOOS and Deep Ocean Observing Strategy, a wide contest was dedicated to defining service priorities for the nodes, services (active and planned), service workflows be established and feed into EMSO, the role of the Service Groups in this view.

The way to achieve full operational is set out as stages in the dynamic and interactive process we have undertaken to integrate activities of each Regional Facility within the Research Infrastructure.

In order to exchange knowledge and best practices related to the progress in the framework of EMSO mission and objectives

and provide the basis for an open stakeholder consultation the "EMSO ERIC All Regions Workshop - EU seafloor and water-column observatories - Challenges and Opportunities towards integration" was organised and hosted in Rome from 9th to 11th October 2017. The Workshop was made within the activities of the EC project EMSO-Link, the key Project of EMSO ERIC, aimed to accelerate governance, rules & procedures and to facilitate the coordination, construction, operation, extension and maintenance of EMSO Infrastructure. The presentations can be downloaded [here](#). The poster session 33 contributions were received, the abstracts are collected [here](#). The conference was very successful with a large and qualified participation (127 attendees).



A wide session on the state of the existing EMSO ERIC Regional Facilities & Test Sites was arranged harmonising the information by templates that organiser sent to the speakers before the Workshop ([here](#) the model). The provisional Regional Team Leaders were requested to give an update on the status of the EMSO ERIC Regional Facilities (Azores Islands, Hellenic Arc, Ligurian Sea, Canary Islands, Porcupine Abyssal Plain, Western Ionian, Black Sea and Iberian Margin) as well as the EMSO ERIC Test Facilities (Molène, OBSEA and SmartBay).

Talks were devoted to correctly define the structure of the Regional Teams such as administration, maintenance of the Regional Facilities, and ending the SLA (Service Level Agreements) between EMSO ERIC and the owner(s) of the Regional Facilities, which are managing access to infrastructure and the use of data.

Moreover, the possibility to transfer some modules of FixO3 to EMSO ERIC was discussed, i.e.: Handbook for Best Practices; Metadata catalogue; FixO3 label; Description of observatories, the handbook on

instrumentations and Yellow Pages; Outreach and training materials.

To identify needs coming from the industry and to develop the relationships and the interest of the industry a dedicated session was organised based on preceding collaborations between industry and observatories, and using the oil industry as an example to comply with the requirements of D4.1. Key service issues have been: acquisition; environmental impact assessment and baseline assessment; exploration; appraisal; field development; production; decommissioning; emergency response and monitoring.

Additionally, the named "Advanced Facilities" (Fram/Arctic Ocean, Norwegian Margin, Marmara and Koljö Fjord) and other Facilities, which are in development (Malta and Mid/South Atlantic), were invited to present their activities, in order to have strategic outlooks linked to their future engagement as EMSO ERIC Regional Facilities.

A special session was devoted to implementing the links with sister initiatives at a global level (ONC-Canada, JAMSTEC Japan, OOI-USA and IMOS-Australia). To build up stronger relations with other ERICs, some of them (EURO-ARGO, LIFEWATCH and ICOS) were invited to show their activities, together with the presentation of the marine domain and the landscape of the EC supported environmental RIs inside the ENVRI PLUS project.

A Best Practises and Label Meeting was also held, the first of scheduled by year meetings aiming at teaming up and sustain the Engineering and the Data Management Service Groups of EMSO ERIC, and establishing consensus on recommendations

to be included in the EMSO Label. Here, the legacy of previous projects, such as ESONET-NoE, EMSO-PP and FixO3 (with input from KM3Net and JERICO), to EMSO ERIC was introduced in terms of Best Practices achievements. Then technical issues have been discussed for the EGIM and in parallel sessions for sensor calibration and metrology, sub-sea system architecture, maintenance and test, underwater intervention, sensor web enablement, data management.

Following, the EMSO ERIC DG chaired a separate session on the EMSO ERIC Services and the Service Groups. The main aim was to share with the Work Package Leaders of EMSO-Link, EMSO ERIC Regional Team Leaders, Central Management Office members, Assembly of Members & AoM advisors and Advisory Board (here before, STEAC) members, roadmap and methodology outlined to set up the EMSO ERIC Service Groups and optimise their activities. The necessity to upgrade resources and services related to each EMSO ERIC Regional Facility was pointed up, picking the present state (information collecting and collating phase) and the goals (knowledge of each vision and wishes: prevision of future landscapes) over.

The way proposed to achieve full operation and capturing value-creating new value is based on a 3-phase approach: the collection phase, to create a digital dashboard of Regional Facilities' Resources, Needs and Services (already running and planned services). The synthesis phase, to identify the value coming from the Regional Teams and gaps to be addressed. Performing the SWOT analysis and defining the Strategy. The development phase, to renew the EMSO ERIC Action Plan.

Following the All Regions Workshop, EMSO-Link PMO has been worked to harmonize the ‘mapping activities’ of EMSO ERIC Regional Facilities and to define the status of the System of distributed observatories and resources in EMSO ERIC. The information gathered were:

-  *Mapping and analysis of the status of the Regional Facilities in terms of Resources (information on the existing infrastructure) - Description (Instrument, Channel, Site info., Power, Communication, Time synchronisation, Deployment, Recovery) and Maintenance (Maintenance frequency, Duration of operation, Replacement, Cleaning, People involved, Costs of operations, Breakdown in the last years)- and Data Management (Acquisition and Storage, Management, Accessibility).*

-  *Mapping of planned activities already foreseen for science and technology development and services.*

The contributions collected from the Regional Facilities were stored in the [EMSO ERIC Content Management System](#).

The mapping of the activities of the Regional Facilities and the identification of the services they can offer have been the main aims of the following three documents; this knowledge was used by EMSO ERIC DG to plan future EMSO ERIC activities:

“Science and Technology Plan”;

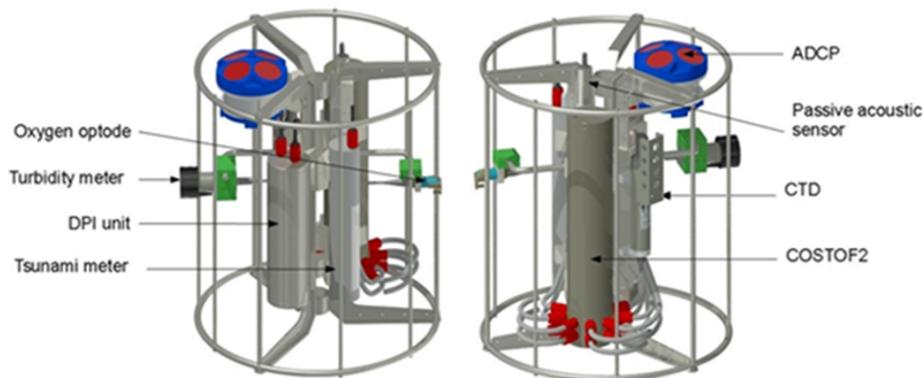
“Access and services roadmap”;

“First Draft of Training Plan”.

2. TECHNOLOGY DEVELOPMENT AND INNOVATION

EGIM - EMSO Generic Instrument Module

In the framework of the EMSODEV project, EMSO carried out the technological development of an instrument that integrates perfectly tested sensors, which allows us to acquire up to seven ocean variables in the first instance (temperature, conductivity, pressure, dissolved O₂, turbidity, ocean currents, passive acoustics) and that could easily be increased up to five more in the near future. The instrument, called EGIM, consists of the active integration of well-established sensor systems within a single operating module, with the advantage of allowing an effective and accurate comparison of the ocean variables acquired throughout different location facilities or nodes. This certainly benefits the greater interoperability of the EMSO nodes increasing the capacity of a common collection of oceanic series of essential ocean variables.



Frame structure of EGIM with sensors for seven ocean variables

The point of reference of this technological development has been the European Seas Observatories Network (ESONET, 2011), which included a set of seven generic oceanic variables and others valuable ones, but

perhaps too specific from a variety of perspectives (see also Ruhl et al., 2011a, 2011b). This required comparative evaluation has taken into account many EU projects, such as the Open Ocean Observatory of EuroSITES

and the Hotspot Ecosystem Research and Impact of Man in the European Seas (HERMIIONE) projects.

For the identification of the required scientific parameters, we have based on the science priorities and the potential of the sensors that meet the specific requirements. This has been done based on a wide use of existing sensors, their relevance in different scientific disciplines, and considering the commercial availability, including detailed specifications for depths of up to 6000 m and the level of technological readiness (TRL).

The EGIM acts as host of a set of instruments and sensors that provides all the necessary services with the required accuracy and quality of measurement and long-term availability:

-  Host the generic sensors and sequence the data acquisition
-  Provide all suitable services to the sensors: energy control, communication, anti-fouling, data time stamping
-  Perform monitoring and storage of technical parameters
-  Perform data storage
-  Manage energy from external source

-  Perform bi-directional communication with the user according to several modes (cabled, non-cabled and contactless)
-  Provide software and tools

The services provide could be as diverse as:

- Location and mechanical configuration of the sensor to ensure optimal performance
- Protection against external aggressions during deployment/recovery operations
- Energy distribution and control
- Measurement sequencing
- Clock synchronization with high precision
- Backup and data storage
- Antifouling Protection, where necessary
- Blank measurements
- External communication either locally, from underwater with a submersible, semi-remotely - from the sea surface with software and vessel help, or remotely - from underwater or sea surface, with a Land data center operator
- Recovery and return to human operators, on demand

Parameter	Measurement range	Accuracy	Sensitivity
Conductivity	0-7 S m ⁻¹	0.001 S m ⁻¹	0.00005 S m ⁻¹
Temperature	-5 to 35°C	0.005°C	0.0001°C
Pressure	0 to 625 bar	0.01% FSR	1.10 ⁻⁷ FSR
Dissolved Oxygen	0 to 465 µmol l ⁻¹	<8 µmol l ⁻¹	<1 µmol l ⁻¹
Turbidity & Optical Backscatter	0 to 150NTU	0.1 NTU	0.02 NTU
Current Velocity	1-100 m	1% ±0.5 cm s ⁻¹	0.1 cm s ⁻¹
Current Direction	1-100 m	±2°	0.01°
Passive Acoustics	20-200,000 Hz 0.1-100 Hz (geology specific)	1 V µPa ⁻¹	-190 dB (re 1V µPa ⁻¹)

Parameters measured by the EMSO Generic Instrument Module (EGIM)

The EGIM test plan was established to verify and guarantee that the equipment provides the services in accordance with its technical specifications, taking into account the diverse conditions in which it will be presented during its time life of the equipment.

Robustness tests		
	performed at sensor level	Performed on the complete system.
Solar radiation	X	
Exposure to fluids	X	
Thermal shock during immersion	X	
Hydrostatic pressure	X	
Quality of isolation / Electrical mass link	X	X
Vibrations		X
Mechanical shock		X
Functional tests		
Running tests through temperature range		X
Compatibility with anti-fooling protection	X	X
Sensor laboratory calibrations	LAB	
Sensor Inter calibrations		X
Acoustic interference		X
Connection test		X

The EGIM module can operate from any EMSO regional facility, both in cable mode and standalone mode, providing measurements of the seven central variables defined above, and can include some additional sensors that provide other generic variables of interest (eg pCO₂, pH, pCH₄, chlorophyll, and images). In the future EGIM could include more sensors in its configuration. A fundamental feature of EGIM is to take advantage of the different locations of the EMSO where a set of the seven defined ocean variables is recorded identically using the following equal procedures:



hardware
sensor references
qualification methods



calibration methods
data format and access
maintenance procedures

The benefits of EGIM are multiple, greater interoperability between nodes and variables, an improved performance in cost/benefit, greater reliability for a distributed infrastructure such as EMSO. The different tests carried out to date predict the great modularity of EGIM, so that different types of sensors could be easily accommodated in a similar way to the ones already performed. This will be a point of great importance for the modular distribution of EGIM being already possible to install in a) mooring line, b) cabled or standalone observatory, or c) surface buoy.

The main challenges in the design of EGIM are the diverse conditions of implementation maintaining as much as possible the generic design.

Implementation of Sensor Web Enablement (SWE) Standards

The SWE Bridge is a cross-platform software aimed to be a universal driver for scientific instrumentation, configurable through SensorML files. It decodes a SensorML file and configures itself to start gathering data from an instrument (described in that file) and stores the acquired data in O&M files, ready to be uploaded to a SOS server.

When integrating the SWE Bridge to the EGIM some aspects were taken into account:

- In order to improve EGIM's interoperability and provide an end-to-end standardized framework, the SWE Bridge will be included in the EGIM's middleware
- The strategy to share resources (mainly serial port) through different processes (SWE Bridge, serial to Ethernet converters) should be identified

- The Sensor metadata should be stored in SensorML files, which will be used to show metadata at the EGIM web page and will control also the SWE Bridge acquisition. The possibility of modifying these parameters at the SensorML files through the web page has to be studied
- It is necessary to schedule measurements from different instruments in order to avoid interferences (i.e. ADCP and hydrophone). In order to do so this scheduling based on system time has to be studied. This synchronization could also be added to the SensorML
- A strategy to power on / off the instruments to allow better power management. An option could be to specify the power sequences in the sensor's SensorML file
- The users should be able to switch between the EGIM built-in acquisition (SWE Bridge software) and transparent communications mode (serial to ethernet)

The activities can be grouped within two main groups, data and metadata management and software implementation. The data and metadata management cover how to generate, access, display and modify scientific as well as instrument and EGIM's metadata. The software implementation covers all the aspects related to the optimization and deploying the software to the EGIM.

Data and Metadata Management

- **Sensor Metadata Encoding:** A strategy to encode in a standard manner (i.e. SensorML) all the metadata from any kind of commercial sensor, including ASCII, Binary, instruments with array response type (ADCP, etc.) was put in place.
- **EGIM Metadata Encoding:** This describes the EGIM's metadata in a standardized metadata file.
- **Web configurator:** The EGIM is currently controlled through using its built-in web page. All the information from the SensorML should be displayed and synchronized with such a web. This should provide an easy way to administrate the EGIM as well as to display its metadata.

Software Implementation

- **Resources Optimization:** In order to port the code to the EGIM (a microcontroller-based platform) some optimizations were required in terms of CPU and RAM usage. The most important one is the amount of RAM memory used during the SensorML decoding process.
- **Support for multiple instruments:** Currently the SWE Bridge only supports one instrument. It should be expanded to provide capabilities to drive multiple instruments at a time. This

requires to manage several communications interfaces at a time as well as timing between processes.

- **SensorML generator GUI:** The main drawback of the SensorML usage to provide plug and play sensor integration is the lack of user-friendly tools to write SensorML documents. In order to facilitate the sensor integration procedure, the development of a software tool with a user-friendly GUI to generate SensorML documents is proposed.

Sensor Metadata

During the first period the focus has been put on analyzing how to model instruments in a coherent manner and how this description can be automatically processed by the acquisition chain (in this case the SWE Bridge Middleware). Keeping in mind the use of standards (specifically SWE Common Data Model and SensorML, the use Sensor Deployment Files (SDF) has been proposed.

A SDF is a SensorML file that contains all the necessary metadata to identify, describe, configure and operate an instrument. These files can be interpreted by software components in order to retrieve and process instrument's metadata. The metadata provided by SDF has to be sufficient to automatically allow the following operations:

- Interpret acquired data (i.e. uncertainty, sensitivity, calibration, etc.)
- Registering an instrument into a Sensor Observation Service (SOS)
- Model the Instrument's Interface and its communication protocol
- Define the mission of the instrument (set of operations, configuration parameters, etc.)

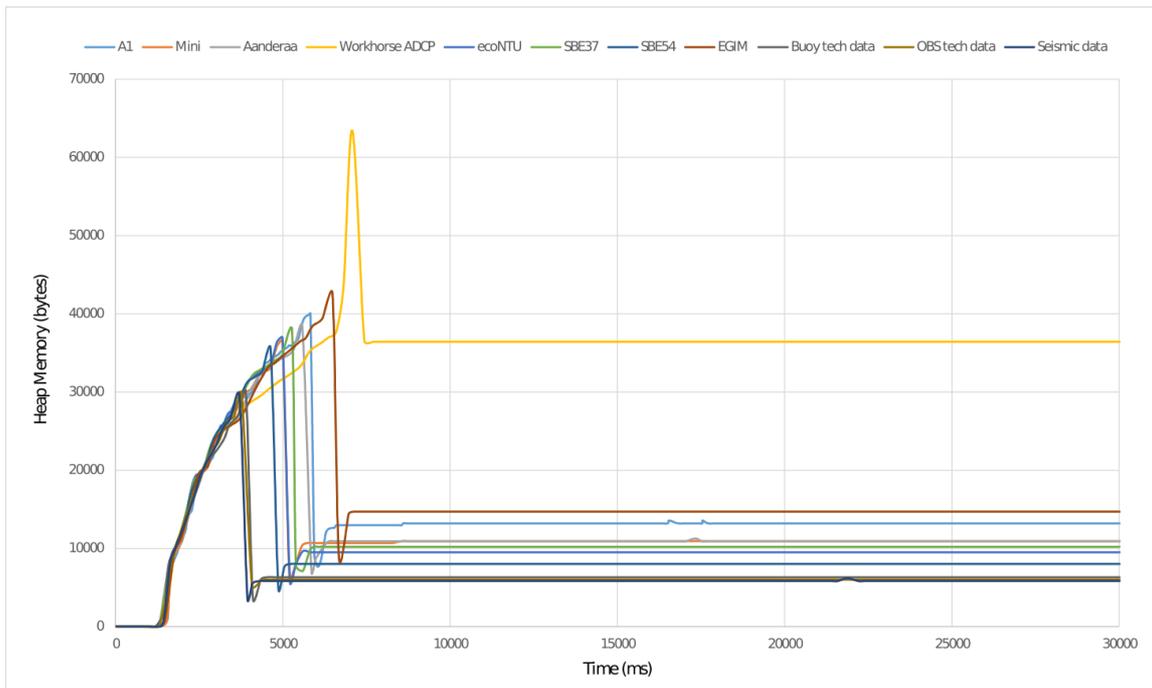
Considering the complexity of encoding all this metadata into a single SensorML file and attending the vast variety of instruments available at the market a set of SDF examples is being created. These examples intend to cover the maximum number of cases by encoding different interfaces (TCP, UDP, Serial...) and response types (ASCII, Hexadecimal, Variable arrays, etc.) among others. A git repository has been created to temporally store these files, it can be accessed at: <https://bitbucket.org/swebridgedevlopment/sdf-examples>

Resource Optimization

Before being deployed on the EGIM, a series of tests have been conducted with the SWE Bridge software in order to assess its performance. Due to the SensorML files nature, the SWE Bridge makes intensive use of dynamic memory. Therefore special emphasis has been put to analyze its RAM usage in different scenarios. As the EGIM controller is based on microcontroller the amount of available RAM and CPU may be significantly limited. A series of tests with the SWE Bridge interfacing 11 different instruments (2 serial, 5 TCP and 4 UDP) showed that the peak usage of RAM is around 40 Kbytes during the setup process and around 10-15 Kbytes in operating mode. Some singular instruments with large streams (such as ADCPs) significantly increment these values. The computational load presented by the SWE Bridge is relatively low (tens of Kilo Instructions per Second). The main dependence of this load is the used protocol. TCP protocol presents the major CPU demand, while the Serial protocol is the less CPU intensive.

Sensor Name	Protocol	Sensor Parameters			SWE Bridge Performance			
		Stream (bytes)	Period (s)	SDF size (bytes)	Max Heap (kBytes)	Avg Heap (kBytes)	Avg Stack (kBytes)	CPU Load (KIPS)
A1	Serial	61	1	3158	40.05	13.26	1.631	35.23
Mini.1	Serial	68	1	2451	36.63	10.96	1.568	34.50
Aanderaa 4831	TCP	80	1	3440	38.36	10.93	1.029	88.36
Workhorse	TCP	688	60	9431	63.66	36.43	0.830	78.23
Eco NTU	TCP	32	1	3290	36.93	9.53	0.892	78.26
SBE 37	TCP	72	10	3429	37.91	10.22	0.740	68.39
SBE 54	TCP	140	1	2769	35.56	8.05	0.895	87.35
EGIM	UDP	137	20	4477	42.57	14.70	0.691	68.03
Seismic Data	UDP	10	10	1728	29.96	5.84	0.692	63.61
OBS Technical	UDP	30	30	1764	29.76	6.02	0.683	63.75
Buoy Status	UDP	30	30	1764	29.96	6.32	0.685	63.89

In the memory profile it can be seen that the Setup phase is where the RAM peak value is registered, Around 30-40Kbytes on the majority of instruments (with the exception of the ADCP, which has a peak around 63 Kbytes). During the operating phase the use of dynamic memory is maintained low and stable.



In order to integrate the SWE Bridge into the EGIM special attention has to be put on the setup phase and reduce the usage of RAM memory. As the majority of sensors integrated in the EGIM are serial sensors, the computational load is not likely to be a problem.

EMSO ERIC - led Industry-liaison initiatives

In 2017, EMSO continued its active role of spurring closer collaboration between ENVRI research infrastructures and industry through the following initiatives:

In May 2017, EMSO ERIC co-organized the 1st successful EU Environmental Research Infrastructures – Industry Joint Innovation Partnering Forum held during the 4th ENVRIweek in Grenoble, France.

The following November, EMSO ERIC presented its proposal of an “Innovation-Readiness Roadmap” aimed at boosting RI-industry collaboration during the 6th meeting of the Board of European Environmental Research Infrastructures (BEERi) in Malaga, Spain. Following unanimous approval by the BEERi, EMSO presented the Roadmap to the ENVRIweek General Assembly the following day.

The Roadmap proposed 3 main actions:

1. Constitute, and appropriately fund, an ENVRIplus Innovation Task Force of RI commercialization/technology transfer specialists (Industry Liaison Officers) with proven business-science backgrounds and track records who are ready to work as a team on a pro-active, pan-EU, industry-liaison Action PLAN centred on communications and outcalls;
2. Establish a central, dedicated Innovation/Tech Transfer Services Unit or Hub

responsible for facilitating, promoting, training and advising on innovation/commercialization matters as a pooled, shared service available to interested ENVRIplus RIs;

3. Explore opportunities for structured RI collaboration on select industry partnering themes with the EU's #1 innovation delivery arm, the European Institute of Innovation and Technology (EIT) and specifically with EIT's Climate and InnoEnergy Knowledge Innovation Centres (KICs).

FixO3 - EMSO Legacy Migration

As the prime voice of European fixed-point ocean observation a key aim of EMSO is to integrate and expand existing open fixed point sub-sea observatories around Europe, facilitate their operation, ensure the continuity and quality of measurement time series acquisition and ensure a reliable and user-oriented data management.

Year 2017 also saw the acceleration in EMSO of initiatives to strengthen and broaden the EMSO community base begun a year earlier with the addition of the Water-column in the EMSO name and mandate. A new important move in this direction was undertaken at the EMSO All-Regions Workshop in 2017, which coincided with the conclusion of the 4-year FixO3 project. At the Workshop, participants agreed on an action plan to protect and maximize the FixO3 legacy by ensuring the efficient migration of key FixO3 achievements to EMSO over the coming months. 6 main Fixo3 modules were identified as those of greatest relevance for transfer and continued development in EMSO, namely:

Module 1. the FixO3 Handbook of Best Practices for operating fixed point observatories

The FixO3 Handbook collects the “best practices” in all phases of the system covering the entire infrastructural chain of data acquisition. It includes recommendations on how to produce high quality data aiming towards common methodologies and protocols on all stages of deployment and recovery within the network as well as on sampling, calibration, the latest anti-fouling measures and Q/C methods for high quality products.

Module 2. The FixO3 Standards & Services Registry, Metadata Catalogue, and Handbook of Instrumentation and Web Access to data

Two additional essential tools will be transferred to EMSO to facilitate data and metadata availability: a Standards & Services Registry complying with GEO to enable effective interoperability among data archives and a searchable Metadata Catalogue that collects and indexes the metadata of data hosted within data archives used by the ocean science community.

Module 3. The Earth Virtual Observatory (EarthVO) Data Portal for user-friendly, online data visualisation and comparisons

Open access to data & visualization of available parameters from all the observatories is enabled through the FixO3 EarthVO (Earth Virtual Observatory), a powerful and versatile tool that enables users to easily view and compare parameters and observatories on a variety of fixed and mobile devices.

Module 4. The FixO3 Open Ocean Observatory Yellow Pages (O3YP)

An online Marketplace and Industry Forum aggregating leading marine instrumentation and service SME providers first started in ESONET and further developed in FixO3 as a tool for strengthening cooperation with industry.

Module 5. The “Label” concept carried over to EMSO from ESONET and FixO3 for assessing and certifying quality and standards compliance of instrumentation, technologies and services tested and used on/by the infrastructure.

Work is ongoing in EMSO-Link

Module 6. The FixO3 Outreach and Training Materials collection of hardware, data and data products technical reference guides and instructional materials.

3.COMMUNICATION AND DISSEMINATION ACTIVITIES

The first EMSO ERIC communication and dissemination actions undertaken in 2017s have been aimed at increasing the ERIC visibility toward the scientific community, the policy makers and the business communities as well as to the wider public. To reach this goal an appropriate and effective Communication Strategy has been developed also as part of the activity of the EMSO-Link Project (deliverable D6.1).

Considering that Communication is a continuous process, the developed strategy has to be regularly updated to accomplish the goal. The communication activities are essential:

-  to guarantee the diffusion of information on the ERIC and its progresses;
-  to exchange information and updates among the members;
-  to keep engaged on the long-term a wider audience;
-  to increase the international visibility of the ERIC;
-  to boost the EMSO ERIC contributions to European economic growth and innovation;
-  to enable and identify new possible collaboration with sisters RIs.

The internal communication (among members, institutional bodies, representing entities, Regional Teams, etc...) is a critical aspect to create a successful organization of the actions of the ERIC. So direct mailing list, telephone and teleconference contacts are regularly used to drive and monitor the intermediate actions aimed at the tasks and smooth development and, most important, to speed up steps and decisions when necessary.

In order to set-up the Communication Strategy toward the outside world, we developed an analysis according to the 6W-approach: Why , hoW, What , Where , Whom, When. The identification of the targeted audience (Whom) have been recognised influencing the contents, the modes, the times and the tools of the communication. The following categories have been identified:

-  scientific community: important players to carry out the science and technology activities of the Regional Facilities;
-  business communities (including industry): to technically support the construction and the implementation of the nodes

-  Regional Facilities: to support to the growth of Infrastructure, fulfilment of cooperation with other International RIs;
-  general public: to reach a wider audience and enhance the awareness about the importance of the marine environment, spreading the messages) as technology and services providers; to use the products and services provided by Regional Facilities as users;
-  policy makers how it contributes to the overall health of the Planet.

The Communication Plan then has considered as crucial aspect, the adoption of a visual identity. This aspect is strategic to make the ERIC seamless and univocally recognizable. ERIC logo, specific templates (brochure, poster, standard presentation, video) and guidelines for their appropriate use have been planned and partially developed. All the members of the Consortium will use the material developed in all their communication/dissemination activities regarding EMSO ERIC.

The Communication Plan also foresees the use of different channels of communication such as:

- | | | | |
|--|-----------------|--|--------------|
|  | press releases |  | forum |
|  | direct contacts |  | social media |
|  | website |  | events |

In the Annex 1 it's reported the list of the communication and dissemination activities conducted during the 2017.

4. FINANCIAL ACTIVITY

Accounting and cost control

The Accounting and Control activities have been deployed during the January –December 2017 period has been centered on the elaboration and continuous updates of EMSO ERIC 2017-2018 Financial plans. Updated versions of the 2018 Financial Plan and the Report have been shared with the DG and the Assembly of Members.

The organisational structure in this development phase of EMSO ERIC is simple and based on 3 levels Auditing & Control reconciling the In-Kind contribution requirements (TS/Reporting), EC projects reporting and the expenses/ taxes recording process:

-  Internal accounting and coordination
-  External by an international auditing firm (BDO)
-  Internal : Studio Pinto (Accounting) and Studio Ferrari (Labour and Contracts)

More specifically:

-  Elaboration of EMSO ERIC 2017 activity Report published and distributed to the AoM on January 12th 2018 .
-  The 2017 balance sheet, the financial and economic reports have been reviewed by the International Auditing Advisor BDO with the full support of EMSO ERIC administrative staff.
-  Ordinary administration of the taxes, social security, social contribution payments and check of the economic and financial compliance to the Italian norms has been duly secured.

In-Kind contribution and other engagements

-  Elaboration of a procedure paper for the recording rules the in-kind contributions from the Member States and approval of the cost and TS submitted by INGV regarding the 2017 in-kind contribution.
 - Negotiating the 2017 In-kind contribution deliberation ruling the INGV in-kind contribution to EMSO ERIC. The in-kind contribution has a significant technical and legal complexity due to the juridical status of the ERIC and lack of previous cases ruling the matter.
 - Support to the 2018 in-kind contribution request to INGV and to the 2018-2019-2020 Framework agreement between EMSO ERIC e INGV which will include an additional cash contribution to cover the rent expenses
-  As of February 26th 2018, it was signed a rent contract for the new INGV premises which are operational by May 2018.

Collection of the Member States 2017 and 2018 fees

-  The payments of the 2017 membership fees are regular as of March 30th 2018.
-  The collection of the 2018 fees started during the first Quarter of 2018

Staff Recruitment

EMSO ERIC Personnel recruitment policy has been deployed through three main options:

-  Non permanent employment contracts
-  Specialised Consultancies
-  Staff In-kind contributions from European and International Marine research Institutions. This option will be continuously pursued as a main source of qualified and experienced staff for EMSO ERIC in future.

Strong interaction has been pursued with other ERICs in order to converge towards accounting and personnel policy standardisation.

More specifically:

-  EMSO ERIC has signed two temporary employment contracts until March 31st 2020 with Mrs Maria Fredella and Mrs Angela Vulcano, following the International Collective contract (CCNL) established for International Organizations.
-  Elaboration of the employment contract format applicable for EMSO ERIC (Public Entities and International Organizations).
-  The consulting contracts duration with Mr. John Picard and Mr. Paolo Favali has been extended until December 31st 2018.
-  The CFO, Mr. Aleardo Furlani has been renewed until March 31st 2020.

Balance sheet and Income Statement approval

Finalisation of the annual financial statements which have been compiled in conformity with the international accounting standards IAS/IFRS in force on 31 December 2013, issued by the International Accounting Standards Board (IASB) and adapted by the European Commission within the meaning of Regulation (EC) No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards, as well as with the related interpretations by the IFRS Interpretations Committee (IFRIC).

The annual financial statements have been compiled taking into account the legal and effective structure and scopes of EMSO. Among the various options allowed by IAS 1, it has been decided to present the layout of the balance sheet distinguishing between current and non-current items and the layout of the profit and loss account classifying expenses by their nature.

-  The items have been prudently evaluated, taking into account the perspective of the continuity of the activities, as well as the economic function of assets or liabilities;
-  Only incomes and expenditures related to the financial year have been accounted, independently of the day of encashment or payment;
-  The risks and losses related to the financial year have been accounted, on an accrual basis, even if known after the end of the financial year.

The 2017 Balance Sheet and Income Statement has then been approved by the Assembly of Members of EMSO ERIC on April 20th2018 and the international Auditing firm BDO expressed their *favourable opinion*. The 2017 Balance sheet and Income Statement will be published in EMSO website.

The 2017 Income Statement shows the following:

-  A total volume of revenues of € 496,954.00
-  The total 2017 cost for services: is € 377,643.00
-  The 2017 personnel cost is €230,866.00 (whose €115,433 have been provided as in-kind contribution)
-  The net result is: € 235,789.00

Key activities foreseen for the first Quarter of 2018

-  2018 Balance sheet and Income statement approval
-  Update of 2018 provisional Balance sheet and Income statement
-  Provisional 2019 budget
-  Elaboration, publication and forwarding to the EC of the 2017 Balance sheet and Income statement Report
-  Finalization of the 2018 In-kind contribution contract from the Host organization EMSO ERIC
-  Launch of new vacancies
-  Start of the Data Privacy compliance procedure and Quality ISO 9001 Certification

ANNEX 1 – LIST OF COMMUNICATION AND DISSEMINATION ACTIVITIES

The communication and dissemination activities, for the different target audience, are listed below:

Types of activity	Activity	Date	Place	Type of audience
Event	EMSO ERIC Launch	27 January 2017	Rome, Italy	
Press release	EMSO ERIC Launch	February	Rome, Italy	Media
Social Media	Post on Facebook and Tweeter LinkedIn			General Public
Organization of a conference	Kick off meeting EMSO-Link	March	Rome, Italy	Scientific Community (Higher Education, Research)
Press release	Kick off meeting EMSO-Link	March	Rome, Italy	Media
Participation to a Conference	Posters and Presentations EGU 2017	April	Vienna, Austria	Scientific Community (Higher Education, Research)
Participation to a Conference	INDIGO SUMMIT 2017	May	Catania, Italy	Scientific Community (Higher Education, Research)
Participation to a meeting	ISAB Annual meeting ONC	June	Victoria, Canada	Scientific Community (Higher Education, Research)
Participation to an Event other than a Conference or a Workshop	Deep Sea Resources and long-term ecosystem function monitoring, Building Capacity in Biological Ocean Observations to support the conservation and sustainable use of BBNJ (biological diversity beyond areas of national jurisdiction) event of	July	New York City, USA	Policy Makers

	the 4th Session of the Preparatory Committee Established by the UN General Assembly Resolution 69/292: Development of an International Legally Binding Instrument under the United Nations Convention on the Law of the Sea on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction, United Nations,			
Participation to a Conference	OCEANS '17 MTS/IEEE	June	Aberdeen, Scotland	Scientific Community (Higher Education, Research)
Participation to a Conference	Presentation IAPSO 2017	August	Cape Town, South Africa	Scientific Community (Higher Education, Research)
Participation to a Workshop	Existing and emerging autonomous underwater and surface vehicles, remotely operated vehicles, optical and acoustic sensor systems, and examples of how this technology can provide information useful for policy making and management. Managing Marine Protected Areas Showcasing event of the British Embassy Santiago, and UK Science and Innovation Network.	September	La Serena, Chile	Policy Makers
Participation to an Event other than a Conference or a Workshop	DOOS Biology and Ecosystems EOV Task Team, Deep Ocean Observing Strategy Workshop	September	Washington DC, USA	Scientific Community (Higher Education, Research)
Organization of a Workshop	EMSO ERIC ALL REGIONS WORKSHOP	October	Rome, Italy	Scientific Community (Higher Education, Research)

Participation to a Workshop	EMSO ERIC ALL REGIONS WORKSHOP - poster and presentations	October	Rome, Italy	Scientific Community (Higher Education, Research)
Participation to a Conference	Eurogoos conference	October	Bergen, Norway	Scientific Community (Higher Education, Research)
Participation to a Conference	MetroSEA	October	Naples, Italy	Scientific Community (Higher Education, Research)
Participation to a Conference	Romanian Research Expo	November	Bucharest, Romania	Scientific Community (Higher Education, Research)
Participation to an Event	3rd Atlantos General Assembly	November	Gran Canaria, Canary Island	Scientific Community (Higher Education, Research)
Organization of a Workshop	EMSO ERIC ALL REGIONS WORKSHOP: Announcement, roll-ups and EMSO ERIC Governance Structure	October	Rome, Italy	

ANNEX 2 – LIST OF ASSEMBLY OF MEMBERS DELEGATES AND ADVISORS

COUNTRY	NAME	AFFILIATION	AoM ROLE
FRANCE	Didier Marquer	MEESR	Delegate & Vice-Chairman
FRANCE	Alain Lagrange	MEESR	Alternate
FRANCE	Mathilde Cannat	IPGP	Advisor
FRANCE	Hélène Leau	IPEV	Advisor
FRANCE	John Picard	EMSO ERIC	Secretary
GREECE	Vasilios Lykousis	HCMR	Delegate
GREECE	Maria Koutrokoi	GSRT	Advisor
GREECE	George Petihakis	HCMR	Advisor
IRELAND	Michael Gillooly	MI	Delegate
IRELAND	Eleanor O'Rourke	MI	Advisor
IRELAND	Fiona Grant	MI	Alternate
ITALY	Salvatore La Rosa	MIUR	Delegate
ITALY	Laura Beranzoli	INGV	Advisor
PORTUGAL	Miguel Miranda	IPMA	Delegate
PORTUGAL	Pedro A. Gancedo Terrinha	IPMA	Advisor
PORTUGAL	Eduardo A. Pereira da Silva	INESC	Advisor
ROMANIA	Viorel Vulturescu	ANCS	Delegate
ROMANIA	Vlad Radulescu	GEOECOMAR	Advisor
SPAIN	Benjamín Sánchez Gimeno	MINECO	Delegate
SPAIN	José Joaquín Hernández-Brito	PLOCAN	Advisor
UK	Richard S. Lampitt	NERC	Delegate & Chairman
UK	Andrew Gates	NERC	Advisor
UK	Henry A. Ruhl	NERC	Advisor

ANNEX 3 – LIST OF THE REGIONAL TEAM MEMBERS

Regional Team	Role		Name
Azores	Team Leader	Sarradin	Pierre Marie
	Science SG	Cannat	Mathilde
	Data SG	Briand	Dominique
	Eng&Log SG	Blandin	Jérôme
	Comm SG	Sarrazin	Jozée
Black Sea	Team Leader	Radulescu	Vlad
	Science SG	Samoila	Ionela
	Data SG	Radulescu	Raluca
	Eng&Log SG	Rucihan	Ali Deversi
	Comm SG	Dinicoiou	Mirela
Canary Islands	Team Leader	Líñas	Octavio
	Science SG	Delory	Eric
	Data SG	Gonzalez	Javier
	Eng&Log SG	Monagas	Vidina
	Comm SG	Loustau	Josefina
Hellenic Arc	Team Leader	Petihakis	George
	Science SG	Perivoliotis	Leonidas
	Data SG	Sotiropoulou	Maria
	Eng&Log SG	Pagonis	Paris
	Comm SG	Christodoulaki	Sylvia
Iberian Margin	Team Leader	Marques	Filipa
	Science SG		
	Data SG		
	Eng&Log SG		
	Comm SG		

Ligurian Sea	Team Leader	Coppola	Laurent
	Science SG	Lefevre	Dominique
	Data SG	Carval	Thierry
	Eng&Log SG	Gojak	Carl
	Comm SG	Chavrit	Déborah
Porcupine Abyssal Plain	Team Leader	Hartman	Susan
	Science SG	Pabortsava	Katsiaryna
	Data SG	Snaith	Helen
	Eng&Log SG	Cardwell	Chris
	Comm SG	Pebody	Corinne
Western Ionian Sea	Team Leader	Embriaco	Davide
	Science SG	Lo Bue	Nadia
	Data SG		
	Eng&Log SG	Marinaro	Giuditta
	Comm SG	Giuntini	Alessandra
Molène	Team Leader	Lanteri	Nadine
	Science SG	Garziglia	Sébastien
	Data SG	Libes	Maurice
	Eng&Log SG	Viorel	Ciausú
	Comm SG	Keromnes	Murielle
OBSEA	Team Leader	del Rio	Joaquin
	Science SG	Mihai Toma	Daniel
	Data SG	Martinez	Enoc
	Eng&Log SG	Nogueras	Marc
	Comm SG	Neus	Vidal
Smartbay	Team Leader	Berry	Alan
	Science SG	Gaughan	Paul
	Data SG	Leadbetter	Adam
	Eng&Log SG	O'Malley	Conall
	Comm SG	O'Conchubhair	Diarmuid



ANNEX 4 – LIST OF THE CENTRAL MANAGEMENT OFFICE MEMBERS

DIRECTOR GENERAL – Juan José Dañobeitia

Laura Beranzoli

Paolo Favali

Maria Incoronata Fredella

Aleardo Furlani

Paola Materia

John Picard

Angela Vulcano