FixO^3

Fixed point Open Ocean Observatories Network

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Work Package 4

Data Management and Harmonisation

Deliverable 4.3

Agreement to Establish FixO^3 Data Dissemination to Marine Infrastructures

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Contents

1 INTRODUCTION

1.1. Background and objectives

A key objective of the data management task, specifically of Task 4.3, within FixO^3 is the integration of the observatory data into long-term marine infrastructures, to ensure the sustainability of the data flows into the future. This deliverable summarises the level of integration made towards this end, (particularly with OCEANSites, EMSO, EMODnet, SEADATANET, PANGAEA and COPERNICUS), and includes information on the agreements made to establish FixO^3 data dissemination to such marine infrastructures.

FixO^3 has engaged, at the data manager level, with a range of projects such as COPERNICUS, OCEANSites & EuroSITES, JERICO, EMSO and ICOS. Each initiative has its own distinctive focus, yet all have a great deal of common interest. Some of these projects have now developed into long-term marine infrastructure initiatives, providing a basis for integration of data, including that from FixO^3, that is ensured for the foreseeable future.

1.2. Organisation of this report

This report will first outline the existing marine infrastructure initiatives, and their specific remits, with a focus on their long-term sustainability. The following section will then summarise the progress made within FixO^3 to engage with these initiatives, primarily at a data manager / observatory level. The final section will summarise the formal agreements made with some of these initiatives to ensure the continued delivery of FixO^3 observatory data.

2 Existing Marine Infrastructures

2.1 OceanSITES

The mission of OceanSITES is to collect, deliver and promote the use of high-quality data from long-term, high-frequency observations at fixed locations in the open ocean. It is an integral part of the Global Ocean Observing System.Since 1999, the international OceanSITES science team has shared both data and costs in order to capitalise on the potential of long-term moorings and ship-based time series. The growing network now consists of about 30 surface and 30 subsurface arrays. Satellite telemetry enables near real-time access to OceanSITES data by scientists and the public.

The future of OceanSITES is dependent on the continued shared cost model for the programme, in particular the provision of the Global Data Centres (GDAC) by IFREMER CORIOLIS and the US NDBC.

2.2 PANGAEA

The World Data Center PANGAEA (https://pangaea.de) provides an alternative archive and delivery service across European and worldwide networks.

The information system PANGAEA operates as an Open Access Library aimed at archiving, publishing and distributing georeferenced data from earth system research. PANGAEA is hosted by the Alfred Wegener Institute, Helmholtz Center for Polar and Marine Research (AWI), and the Center for Marine Environmental Sciences, University of Bremen (MARUM). The system guarantees long-term availability of its content through a commitment of the hosting institutions.

Archiving follows the European Commission Guidelines on Open Access to Scientific Publications and Research Data in Horizon 2020 and the DFG recommendations for safeguarding good scientific practice. PANGAEA is further aligned with the OECD Principles and Guidelines for Access to Research Data from Public Funding as well as with the FAIR Guiding Principles for scientific data management and stewardship.

2.3 EMODNET

The European Marine Observation and Data Network (EMODnet) consists of more than 160 organisations assembling marine data, products and metadata to make these fragmented resources more available to public and private users relying on quality-assured, standardised and harmonised marine data, which are interoperable and free of restrictions on use. EMODnet is currently in its third development phase with the target to be fully deployed by 2020. During this phase EMODnet will work towards providing a seamless multi-resolution digital map of the entire seabed of European waters providing highest resolution possible in areas that have been surveyed, including topography, geology, habitats and ecosystems; accompanied by timely information on physical, chemical and biological state of the overlying water column, as well as oceanographic forecasts.

2.4 SEADATANET

SeaDataNet is a standardised system for managing the large and diverse data sets collected by oceanographic fleets and automatic observation systems. The SeaDataNet infrastructure networks and enhances the extant infrastructure of national oceanographic data centres of 35 countries.

The second phase of SeaDataNet (SeaDataNet 2 project, started on October 1st, 2011 for a duration of 4 years) aims to upgrade the present SeaDataNet infrastructure into an operationally robust and state-of-the-art Pan-European infrastructure for providing up-to-date and high quality access to ocean and marine metadata, data and data products by :

- setting, adopting and promoting common data management standards
- realising technical and semantic interoperability with other relevant data management systems and initiatives on behalf of science, environmental management, policy making, and economy

2.5 Operational Services

Across Europe, there are a number of initiatives related to the Global Ocean Observing System (GOOS) designed to allow provision of near real time, and delayed mode, data to the operational marine sector: primarily to ocean modelling and forecasting community, although many other interested.

The COPERNICUS marine environment monitoring service provides regular and systematic reference information on the state of the physical oceans and regional seas. FixO^3 data streams are currently incorporated into the COPERNICUS marine services.

Regional components of GOOS: IBI-ROOS (Ireland-Biscay-Iberia Regional Operational Oceanographic System http://ibidataportal.puertos.es) and MONGOOS (The Mediterranean Operational Network for the Global Ocean Observing System http://www.mongoos.eu) provide more tailored access to data and services for their regions of interest. These regional GOOS services also feed data through to the COPERNICUS Marine Environment Monitoring Service.

2.5.1 European Multidisciplinary Seafloor and water-column Observatory (EMSO)

EMSO is a large scale, distributed, marine Research Infrastructure (RI) that consists of ocean observation systems for long-term, high-resolution, (near) real-time monitoring of environmental processes including natural hazards, climate change, and marine ecosystems. EMSO observatory nodes have been deployed at key sites around Europe, from the Arctic to the Atlantic, through the Mediterranean to the Black Sea.

The developing EMSO system, linking existing infrastructure (nodes), using standardised data interfaces, is seeking to provide a sustainable infrastructure for observatories.

2.5.2 MOIST (Multidisciplinary Oceanic Information SysTem)

MOIST is a data provider initiated within the ESONET NoE project and now under development in the frame of ESFRI (European Strategy Forum on Research Infrastructures) and EMSO. This system actively harvests metadata and data from seafloor observatories.

2.6 Carbon Observation Community Interaction

FixO^3 aims to foster the cooperation with the marine carbon observation community by disseminating FixO^3 data via relevant international infrastructures and data centres such as the Carbon Dioxide Information Analysis Center (CDIAC) and the ICOS Ocean Thematic Centre.

2.6.1 CDIAC

CDIAC is located at the U.S. Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) and is the primary climate change data and information analysis centre for DOE. The service provides a single portal for estimates of carbon dioxide emissions from fossil-fuel consumption and land-use changes; records of atmospheric concentrations of carbon dioxide and other radiatively active trace gases; carbon cycle and terrestrial carbon management datasets and analyses; and global/regional climate data and time series.

The current provision of CDIAC at ORNL is due to cease on 30th September 2017, and data transition plans are being developed to ensure preservation and availability of the data and service beyond 2017.

2.6.2 ICOS

ICOS (Integrated Carbon Observing System) is a pan-European research infrastructure for quantifying and understanding the greenhouse gas balance of the Europe and its neighbouring regions. Near real time data streams for carbon dioxide are handled through the ICOS Ocean Thematic Centre. It will receive data from a number of platforms, including instruments deployed on voluntary observing ships (VOS lines) fixed buoys, and repeat sections carried out at extended intervals. There are currently 18 VOS lines (or fixed buoys) measuring surface CO_2 registered to participate in the ICOS project.

The ICOS Carbon Portal is part of the ICOS ERIC (European Research Infrastructure Consortium) and offers access to research data concerning greenhouse gases and carbon cycling in oceans, ecosystems and atmosphere throughout Europe. The basic design principle of the Carbon Portal is to use linked open data, semantic web ontology, scalable and containerised services, all based on open source software.

3 Integration with Existing Marine Infrastructures

This section will summarise the existing relationships between FixO^3 and the marine infrastructures described in section 2.

3.1 OceanSITES

OceanSITES has provided the core data management protocols adopted by FixO^3, particularly in terms of data format standards, giving a strong foundation for data interoperability as many of the other marine infrastructures also adopt these standards.

All observatories listed in Table 1 are providing data to the OceanSITES Global Data and Archive Centres.

Table 1. Summary of FixO^3 Observatory data held at the OceanSITES GDAC

Number	Observatory	Site Code	Data held (DM: delayed Mode, RT: Real Time)
1	FRAM	FRAM	DM (1997-2013)
3	STATION M	STATION-M	DM (1948-2009)
4	CIS	CIS	DM (2002-2009) RT (2010, 2011, 2014)
5	PAP	PAP	DM (2002-2014) RT (2007-2015))
7	W1-M3A	W1M3A	RT (2004-2015)
8	DYFAMED	DYFAMED	DM (1995-2015) RT (2007-2015)
9	ANTARES	ANTARES	DM (2005-2010) RT (2010-2011)
10	LION	LION	DM (2007-2014)
11	E2-M3A	E2M3A	DM (2002-2009) RT (2004)
15	PYLOS	PYLOS	DM (2010-2015)
16	E1-M3A	E1-M3A	RT (2007-2015)
17	ESTOC	ESTOC	DM (1994-2010) RT (2004)
18	NOG	NOG	DM (2012-2014)
19	TENATSO	TENATSO	DM (2006-2008)
22	SOG	SOG	DM (2008)

OceanSITES data can be accessed using either of the GDAC locations, at CORIOLIS (IFREMER) or NDBC (NOAA) using either the thredds catalogues:

- http://tds0.ifremer.fr/thredds/catalog/CORIOLIS-OCEANSITES-GDAC-OBS/<site_code>/catalog.html
- http://dods.ndbc.noaa.gov/thredds/catalog/oceansites/DATA/<site_code>/catalog.html

or via ftp at

- ftp://ftp.ifremer.fr/ifremer/oceansites/DATA/

Data are mirrored between the two locations 6 times daily. The <site_code> for each FixO^3 site is provided in Table 1, along with the data held in the OceanSITES GDAC at the end of December 2016.

3.2 PANGAEA

The observatories not providing data to OceanSITES or COPERNICUS (DELOS A & B), as well as FRAM, have data archived at PANGAEA. The data are available in a standard ascii format, as agreed in the data management workshops and stated in the data policy **[1]**.

3.3 EMODnet

As a result of the collaboration between FixO^3 and EMODnet, FixO^3 data are available in the EMODnet Physics Portal.

3.3.1 SEADATANET

Each contributing data centre has its own responsibility regarding contribution to SEADATANET, requiring creation and uploading of Common Data Index (CDI) metadata records for each data set. The input required for additional resource beyond that needed for the best practise of the FixO3 data policy, although encouraged, will be limited by centre resource. The relationship of the SEADATANET records to other data sources (eg OceanSITES) is not simple, with a change in data granularity often occurring.

The data observatories that currently upload CDI records to SEADATANET are: DYFAMED, E2-M3A, E1-M3A, MOMAR and PYLOS. Other data centres are working to deliver their data to SEADATANET as part of wider commitments to the SEADATANET project.

3.4 Operational Services

All the data provided through the OceanSITES GDAC, both in near real time and delayed mode are also provided to the COPERNICUS marine service and the GOOS regional components. In addition, some data are provided directly to COPERNICUS.

3.4.1 European Multidisciplinary Seafloor and water-column Observatory (EMSO)

The current EMSO node network is illustrated in **Error! Reference source not found.** and is comprised of 11 deep-sea observatories plus four shallow water test nodes, including the FixO^3 Observatories: Balearic Sea (OBSEA), Canary Islands (ESTOC), Hellenic Arc (Pylos and E1-M3A), Ligurian Sea (DYFAMED, ANTARES), Porcupine Abyssal Plain (PAP), Svalbard Islands and Western Ionian (NEMO-SN1).

Figure 1. Current EMSO node locations

3.4.2 MOIST (Multidisciplinary Oceanic Information SysTem)

This system actively harvests metadata and data from seafloor observatories. The harvesting mechanism allows the relevant data to be collected from FixO^3 observatories, using their existing data

acquisition systems and databases. A number of FixO³ observatories provide data through the MOIST data portal.

3.5 Carbon Observation Community Interaction

3.5.1 CDIAC

Several of the FixO³ observatories provide their carbon data to CDIAC directly, or allow access through the OceanSITES portal to appropriate CO_2 data, as shown in Table 2.

Table 2. Summary of FixO³ Observatory data recorded in CDIAC

Observatory	CDIAC Information URL	Data Availability
CIS	http://cdiac.ornl.gov/oceans/Moorings/CIS.html	no data, link to EuroSites
TENATSO	http://cdiac.ornl.gov/oceans/Moorings/TENATSO.html	no data, link to EuroSites
PAP	http://cdiac.ornl.gov/oceans/Coastal/PAP.html	no data, link to EuroSites
ESTOC	http://cdiac.ornl.gov/oceans/Coastal/ESTOC.html	time series data available / mooring data n/a (link to EuroSites)
STATION M	http://cdiac.ornl.gov/oceans/Moorings/Station_M.html	limited data available (2001-2007, some data from 2011)
DYFAMED	http://cdiac.ornl.gov/oceans/Coastal/DYFAMED.html	data available
W1-M3A	Listed on http://cdiac.ornl.gov/oceans/Moorings/Atlantic.html	No data
E2-M3A	Listed on http://cdiac.ornl.gov/oceans/Moorings/Atlantic.html	No data
E1M3A	Listed on http://cdiac.ornl.gov/oceans/Moorings/Atlantic.html	No data

3.5.2 ICOS

The ICOS Station table (https://www.icos-cp.eu/node/83) includes E2-M3A, W1-M3A and PAP observatories. However, the data portal prototype (https://data.icos-cp.eu/portal/#search) that provides a map interface to the expected data sources for ICOS, does not yet contain data for these observatories.

4 Formal Agreements

Two of the most important long-term infrastructure arrangements now in place are EMODnet and EMSO. Both have legal status within Europe ensuring long-term maintenance of data. FixO³ has established agreements with both of these infrastructures; designed to ensure the longevity of the existing observatory data, as well as a framework for future funding and delivery of continuing measurements.

4.1 EMODnet

In accordance with the FixO^3 data dissemination policy, EMODnet and FixO^3 have agreed to work towards the ongoing integration of FixO^3 observatory data into the EMODnet Physics portal. The written agreement between EMODnet Physics and FixO^3 is provided in **Error! Reference source not found.**, signed by the EMODnet Physics coordinator, Antonio Novellino.

4.2 EMSO

The EMSO ERIC (European Research Infrastructure Consortium) is a new formal infrastructure and is in the process of appointing a Chief Executive officer to take responsibility for formal management of the infrastructure. However, the Chair of the EMSO Assembly of members (Professor Richard Lampitt) has recommended that EMSO takes on responsibility for the long term stewardship and ongoing delivery of FixO^3 observatory data. On appointment of the CEO of the EMSO ERIC, it is expected that an agreement will be generated to make this official.

5 REFERENCES

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6 ACRONYMS

AGL	Augusto González de Linares
ANTARES	Astronomy with a Neutrino Telescope and Abyss environmental RESearch
AWI	Alfred Wegener Institut
CDIA	Carbon Dioxide Information Analysis Center
CIS	Central Irminger Sea
CNR	Consiglio Nazionale delle Richerche
CNRS	Centre National de la Recherche Scientifique
CSIC	Consejo Superior de Investigaciones Científicas

CVOO	Cape Verde Ocean Observatory
DELOS	Deep-ocean Environmental Long-term Observatory System
DYFAMED	Dynamique des Flux Atmospheriques en MEDiterranee
EMSO	European Multidisciplinary Seafloor and water column Observatory
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
ESONET	European Seas Observatory NETwork
ESTOC	European Station for Time-series in the Ocean, Canary Islands
FixO^3	Fixed point Open Ocean Observatories Network
FRAM	Frontiers in Arctic Marine Monitoring
HCMR	Hellenic Centre for Marine Research
IBI-ROOS	Ireland-Biscay-Iberia Regional Operational Oceanographic System
ICOS	Integrated Carbon Observing System
IEO	Instituto Español de Oceanografía
IFREMER	Institut français de recherché pour l‟exploitation de la mer
INDP	Instituto Nacional de Desenvolvimento das Pescas
INGV	Istituto Nazionale di Geofisica e Vulcanologia
LION	Gulf of Lion Observatory
MOIST	Multidisciplinary Oceanic Information SysTem
MoMAR	Monitoring the Mid-Atlantic Ridge
MONGOOS	Mediterranean Operational Network for the Global Ocean Observing System
NEMO-SN1	NEutrino Mediterranean Observatory-Submarine Network 1
NERC	Natural Environment Research Council
NOG	Northern Oligotrophic Gyre
OBSEA	Expandable Seafloor Observatory
OGS	Istituto Nazionale di Oceanografia e di Geofisica Sperimentale
PAP	Porcupine Abyssal Plain
PLOCAN	La Plataforma Oceánica de Canarias
QC	Quality Control
SOG	Southern Oligotrophic Gyre
TENATSO	Tropical Eastern North Atlantic Time-Series Observatory
UiB	Universitetet I Bergen
UNIABDN	The University Court of the University of Aberdeen
UNIRes	Uni Research
UPC	Universitat Politècnica de Catalunya

7 ANNEXES

7.1 Formal Agreement between EMODnet Physics and FixO^3

EMODnet Physics and FIXO3

To whom it may concern

EMODnet Physics provides a combined array of services and functionalities (facility for viewing and downloading, dashboard reporting and machine-to-machine communication services) to obtain, free of charge data, meta-data and data products on the physical conditions of European sea basins and oceans. Moreover, the system provides full interoperability with third-party software through WMS services, Web Services and Web catalogues in order to exchange data and products according to the most recent standards. EMODnet Physics is built on and it is working in coordination and cooperation EuroGOOS-ROOSs, CMEMS and the SeaDataNet network of NODCs. By means of joint activities with its three pillars and with the most relevant marine Organizations and associations, EMODnet is undergoing significant improvements and expansion.

The portal (www.emodnet-physics.eu/map) is providing access to data and products of: wave height and period; temperature and salinity of the water column; wind speed and direction; horizontal velocity of the water column; light attenuation; sea ice coverage and sea level trends. EMODnet Physics is continuously enhancing the number and type of platforms in the system by unlocking and providing high quality data from a growing network. Nowadays the system does integrate information by more than 12.000 stations. EMODnet Physics was also updated with two ready-to-use data products: Ice Map and Sea Level Trends. EMODnet Physics will continue to further extend the number and type of data and platforms feeding the system; improve the capacity of the system producing data and products that could match the market needs of the current and potential new end and intermediate users; to connect with other initiatives at European and global scale as to stimulate international exchange of oceanographic data and products and by this encourage the development of a coordinated network.

In this framework, in accordance with the FixO3 data dissemination policy, EMODnet Physics and FixO3 have agreed to work towards the ongoing integration of FixO3 observatory data into the EMODnet Physics portal.

The majority of FixO3 data are already available from EMODnet physics

EMODnet Physics coordinator

Antonio Novellino

EMODnet Physics

EMODnet