EMSO ERIC

The challenge to Deep Seafloor monitoring to understand fundamental process in Global Change

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LifeWatch ERIC Scientific Community Meeting

27-29 May, 2019 – Rome (Italy)

MISSION

To establish a comprehensive and smart sensor system in water column, seafloor, and sub-seafloor environments as part of the integrated and sustainable organization EMSO ERIC

REGIONAL FACILITIES AND TEST SITES

8 Regional Facilities and **3 Test sites** located at strategic sites from the North Atlantic through the Mediterranean, to the Black Sea

EMSO (European Multidisciplinary Seafloor and Water-column Observatory) is a strategic Marine European Research Infrastructure Consortium (ERIC), with the capacity to collect high quality environmental parameters

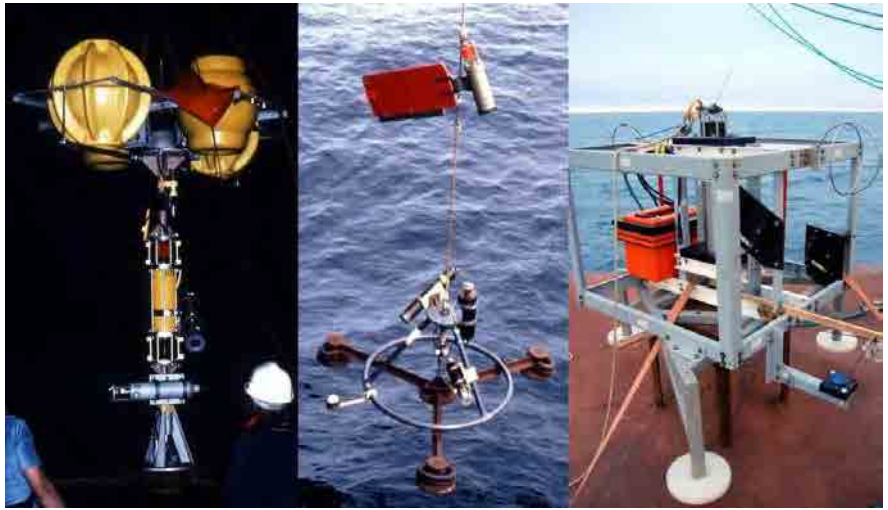
EMSO Porcupine Abyssal Plain (PAP)

The PAP is a **sustained, multidisciplinary observatory** in the **North Atlantic**

This site has being been studied for over 30 years. It is positioned between the North Atlantic current and the Azores Currents and it is crossed by clockwise and anticlockwise swirls and eddies. Its seabed hosts a rich living community, that is sampled and photographed.

Deep sea Abyssal Plain

Distance from land: 300 miles
Max water depth: 4850 m
Date 1st deployment:
Supported by: United Kingdom

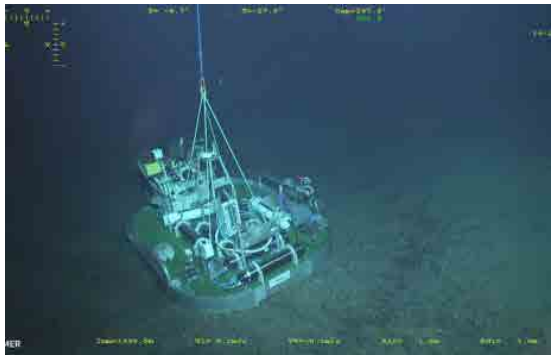


EMSO Azores

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.

Hydrothermal vents

Location: Mid-Atlantic ridge near Azores
Distance from land: 200 NM
Max water depth: 1700 m
Date 1st deployment: October 2010
Supported by: France



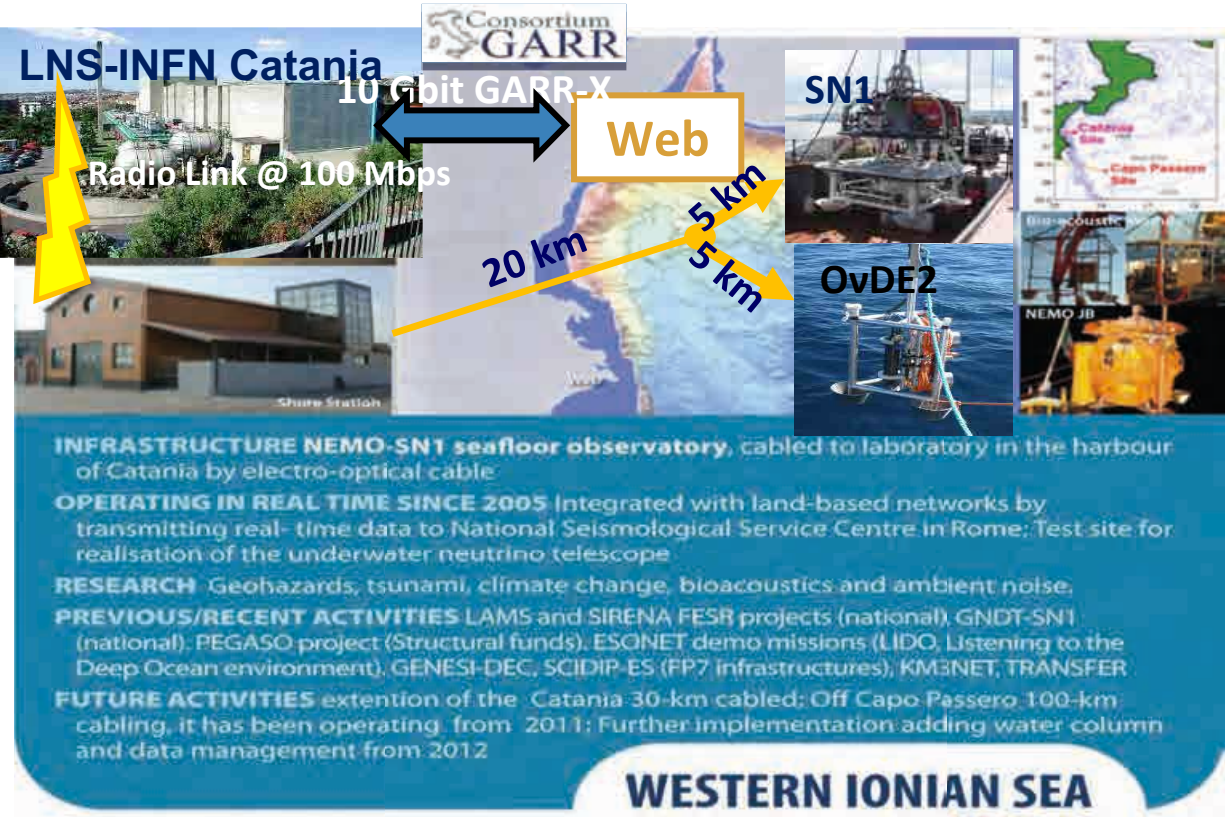
EMSO Obsea

OBSEA, a permanent underwater cabled seabed observatory located near Barcelona, at 20 m depth is used as a test site for different experiments related with marine sensors. 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.

Test site cable observatory

Location: : Northeast Med Spain coast
Distance from land: 4 km
Max water depth: 20 m
Date 1st deployment: 2009
Supported by: Spain
Operated by: U. Politècnica de Catalunya (UPC)
Website: http://www.obsea.es/
Status: test site running (updated Nov. 2017)
Regional Team Leader: Joaquin del Rio UPC

EMSO nodes: Western Ionian Sea



Stand-alone 2002-2003 - Cabled 2005-2008 &
2012-2013 real-time data

Geo-hazards

(earthquakes, tsunamis, volcanic activity)

Bio-acoustics

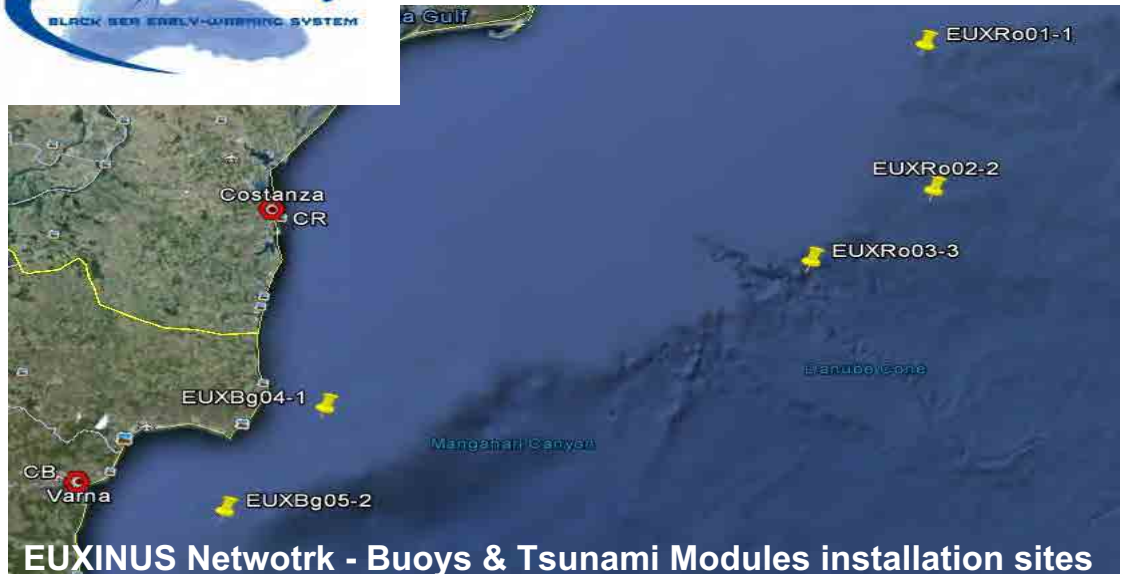
(mammal tracking)

Oceanography

(e.g., deep water circulation, current intensity and direction, temperature, salinity)

EMSO Black Sea

Romanian-Black Sea coastal area



EUXINUS Networtk - Buoys & Tsunami Modules installation sites

Joint regional early-warning system for protection of local communities, environment and assets within the cross-border area, from consequences of natural marine geo-hazards

Geo-hazards
(earthquakes, tsunamis)

Oceanography
(e.g., deep water circulation, current intensity and direction, temperature, salinity)

Structural funds:
CBC Romania-Bulgaria 2007-2013 Programme
Period of implementation:
December, 2010 - June, 2013
Total value: 6,5 M€

Landscape of the European Research Infrastructures in the Environmental sector

emso ERIC

EMSO ERIC essential scientific objectives are to observe, in real time and in the long term, key environmental processes related to the interaction between the geosphere, the biosphere and the hydrosphere.

EMSO facilities require, in the medium and long term, constant technological interventions and enhancement; EMSO members are committed to ensure the assistance of European oceanographic vessels.

WHY OBSERVE THE DEEP SEA?

Oceans play a crucial role in human wellbeing

- The ocean regulates climate system, storing a thousand times more heat than the atmosphere and fifty times more carbon. Most of this storage goes **to the deep ocean**.
- Degradation and loss of biodiversity impacts marine resource exploitation
- Ocean circulation affects climate change
- Natural hazards such as tsunamis, earthquakes and volcanic eruptions impacts human life

EMSO ERIC Support investigations in:

TO ACHIEVE

sustainable management and protection of marine resources

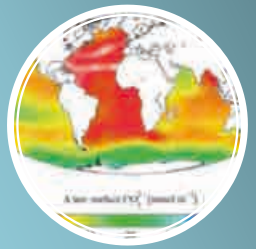
TO REACH

an efficient and reliable services

emso ERIC

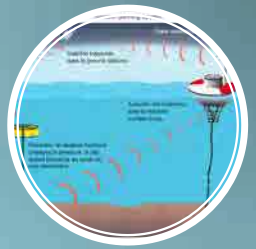
Research Infrastructure Challenges

To fulfil European societal scientific demands targeted in the EU´s H2020 Blue Growth Strategy



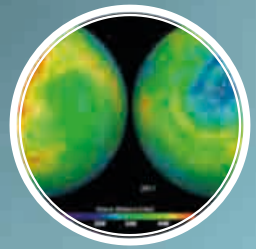
Global ocean warming and acidification

Impact and sustainability of Marine Resources exploitation



Real-time observations and early warning systems for earthquakes & tsunamis

Marine Ecosystems and Climate Change mitigation



Earth interactions hydrosphere, biosphere,

lithosphere, atmosphere

Access HIGH QUALITY MARINE ENVIRONMENTAL DATA

SERVICES

Services represent EMSO's capacity to address common needs:

Science

Climate Change, ecosystems interactions, Geohazards, gas hydrate releases, anthropogenic marine impact

Engineering & Logistics

Testing and demonstration, marine operations, sensor & platform development, maintenance

Data management

Data acquisition, storage, QC and validation, data processing and visualization

Communications

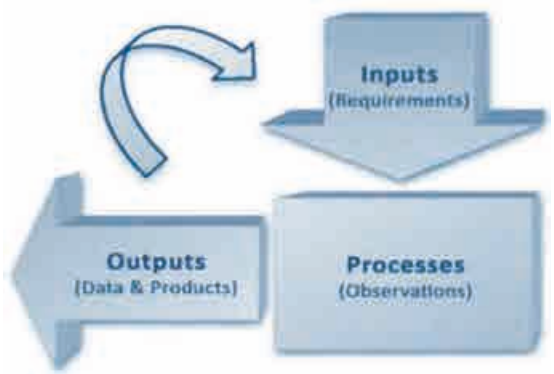
Brand development, organizational cohesion, media, publications, capacity building, education

Industry & innovation

Consultancy & management, commercialization, partnerships, technology transfer

SCIENCE SERVICES

Open, long-term recording, coordinated, real-time, high resolution, reliable, FREE access



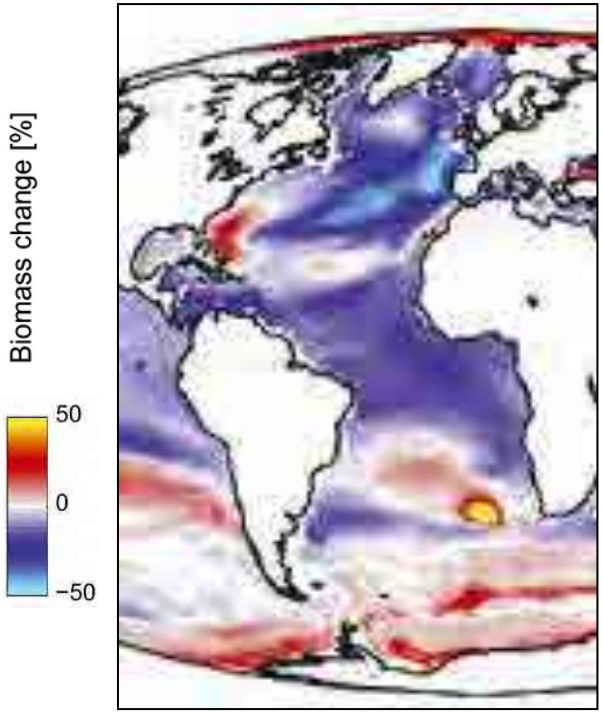
Geo-hazards: Tsunami, Seismic and Volcanic (real-time monitoring)

Oceanography: Seafloor and water column recording physical parameters (Temperature, Salinity, Pressure, Current, Turbidity, etc.

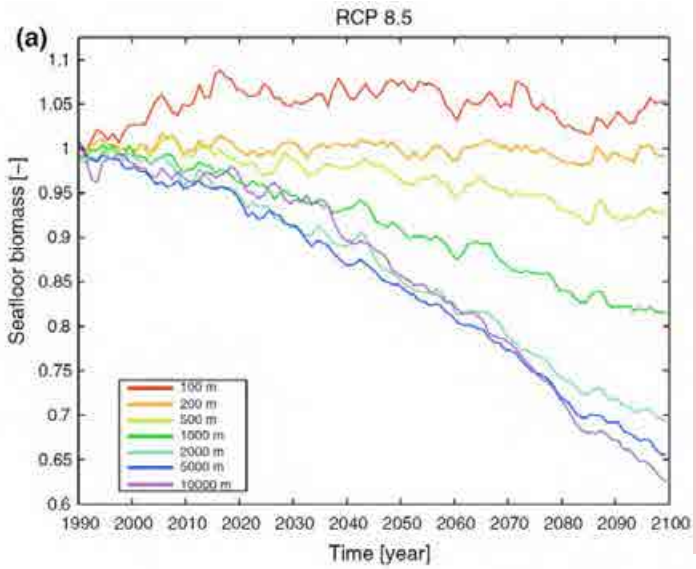
Environmental monitoring: Anthropogenic noise, Marine mammals tracking, Algal bloom episodes

- Seismicity, Early warning systems, Slope stability, Hydrothermal vents, Sea level rise
- Ocean acidification, Dynamic of water masses, Mesoscale eddies and topography, Deep underwater circulation
- Marine ecosystems, biodiversity, Ocean plastic pollution, sustainable fisheries

ECOSYSTEMS AND CLIMATE



Jones et al. 2014 *Global Change Biology*



Yool et al. 2017, *Global Change Biology*

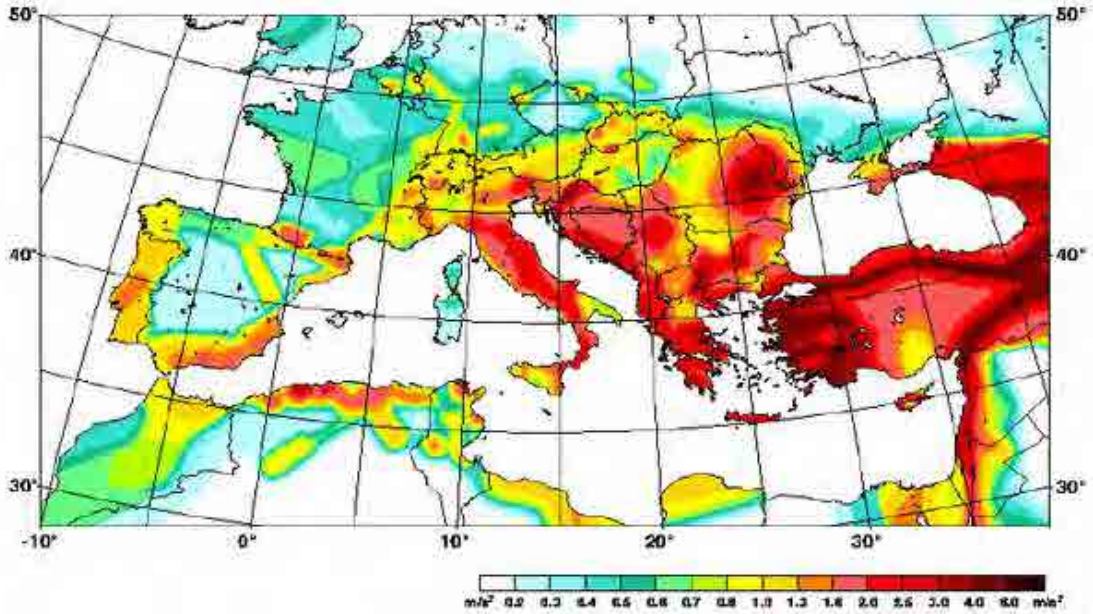
- Global warming is not just an environmental disaster but an economic one as well. “If we do nothing, if we do business as usual, by 2100 the median low income country will lose **9 per cent of its GDP**. (IMF Chief Economist Maurice Obstfeld)
- Ocean acidification will cost the world economy more than $1 trillion annually by 2100, according to the U. Nations Convention on Biological Diversity

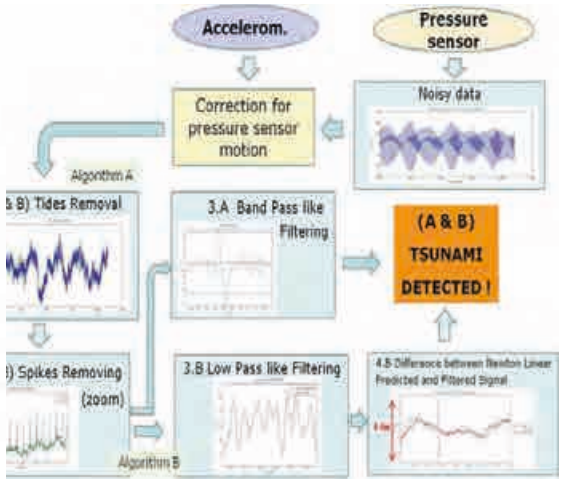
United Nations Educational, Scientific and Cultural Organization

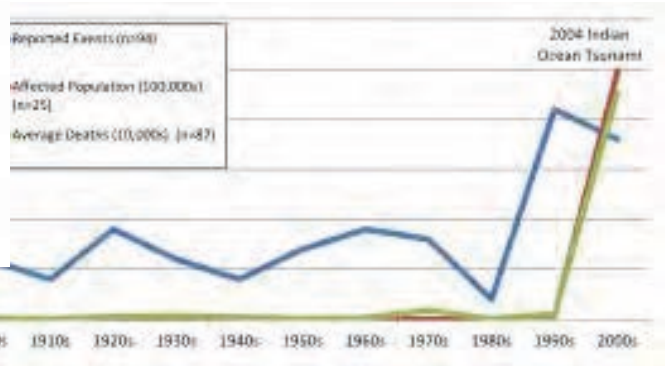
Intergovernmental Oceanographic Commission

North-Eastern Atlantic, Mediterranean and connected seas Tsunami Information centre

GEO-HAZARDS

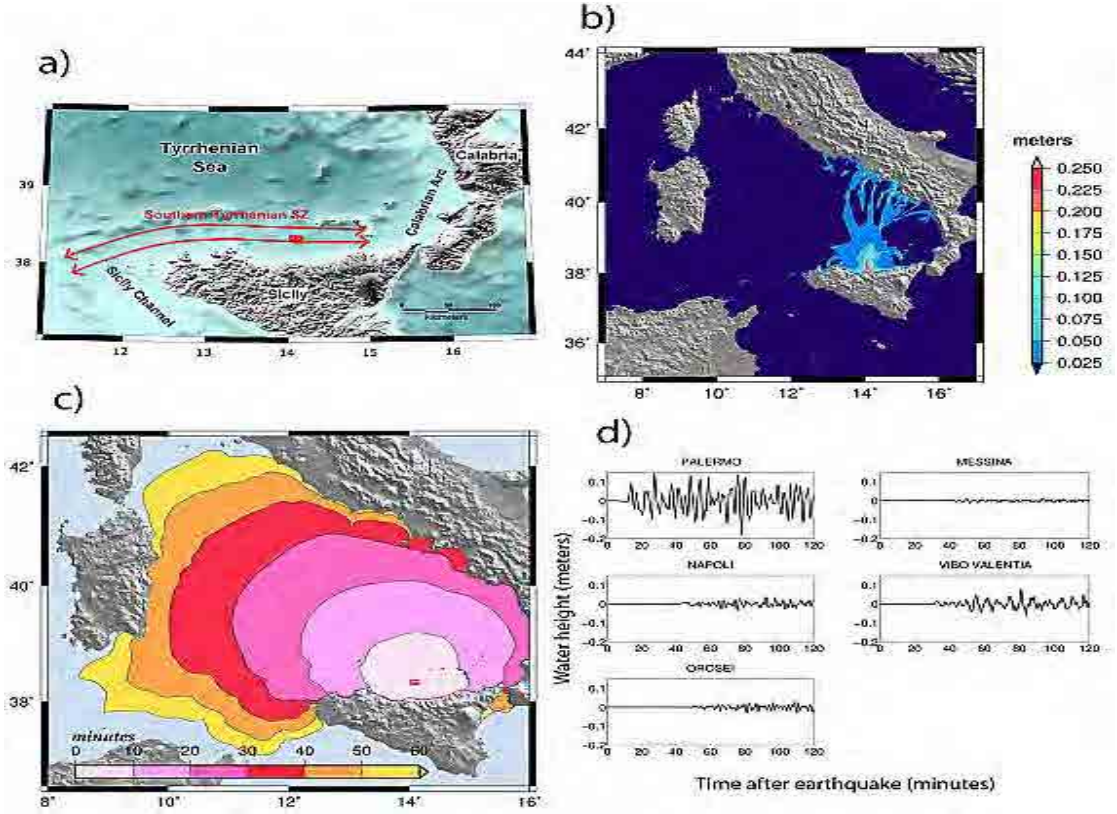






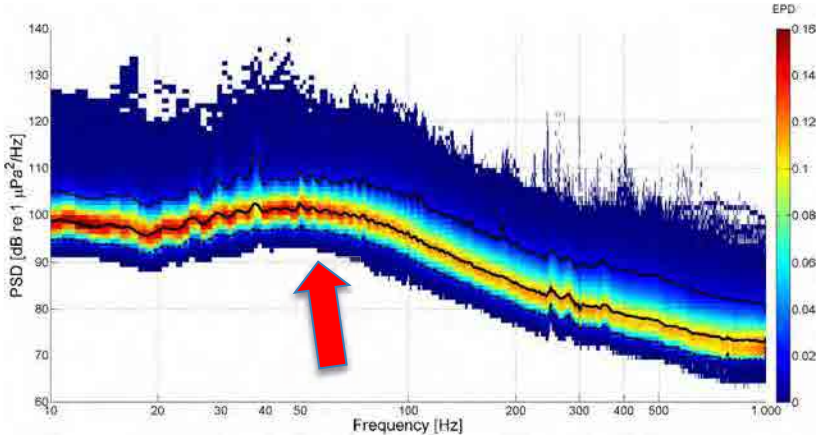
Tsunami events affecting human populations by decade

Earthquake-generated tsunamis in the Mediterranean Sea: Scenarios of potential threats to Southern Italy



Earthquake-generated tsunamis in the Mediterranean Sea: Scenarios of potential threats to Southern Italy, Volume: 113, Issue: B1, First published: 09 January 2008, DOI: (10.1029/2007JB004943)

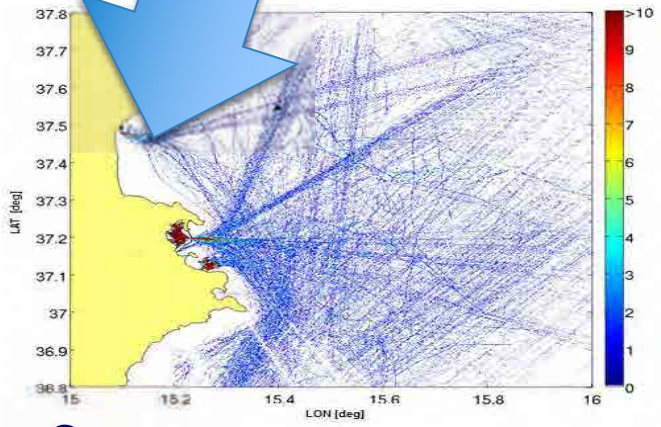
Marine traffic monitoring



Noise distribution showing average PSD (power Spectral Density) Up to about 70 Hz, the median of the average PSD often > 100 dB re 1 µPa2/Hz.

Acoustic noise and correlation with AIS data

Proprietary AIS data in real time on Google map web page (custom app)



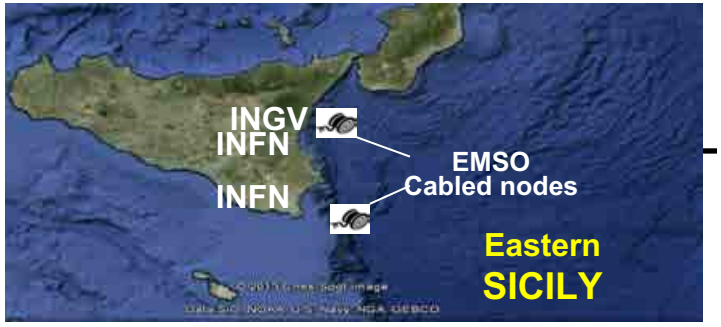
European Marine Strategy

Western Ionian Sea

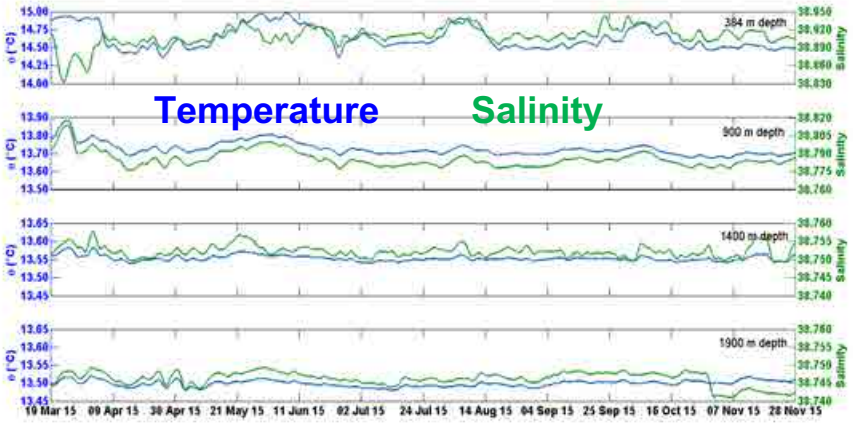
Global change and Ocean circulation

Water Column (mooring) - WC-SN1

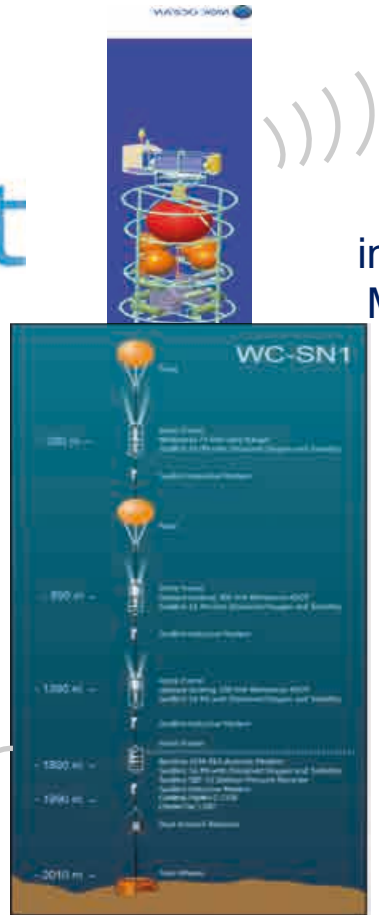
Physical and biogeochemical parametres



emso it



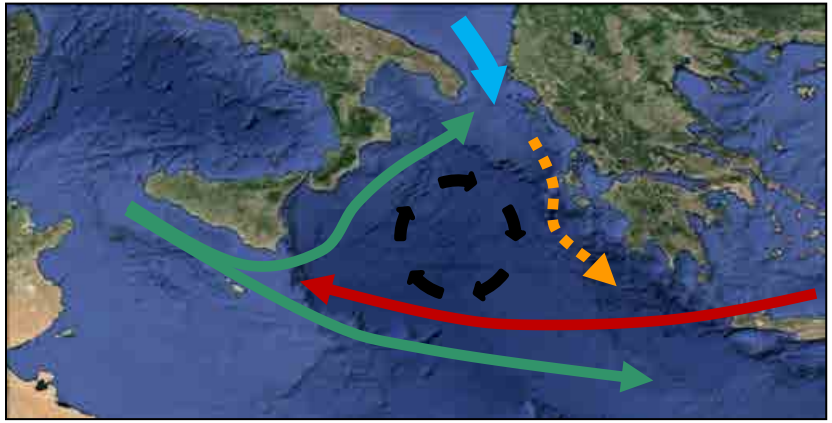
J.B.

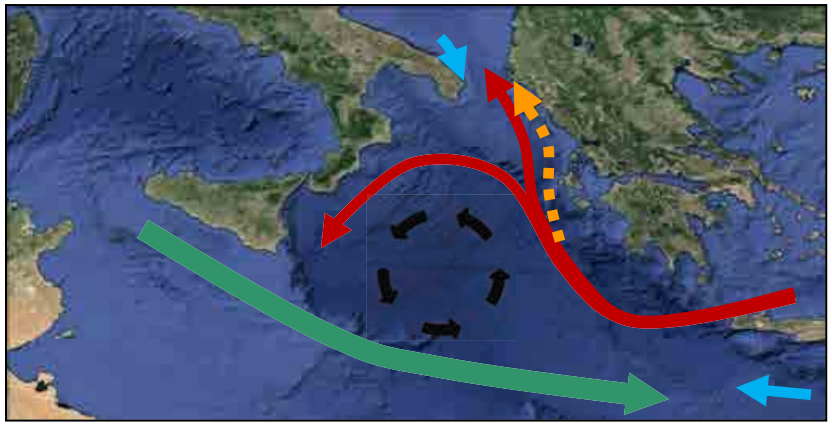


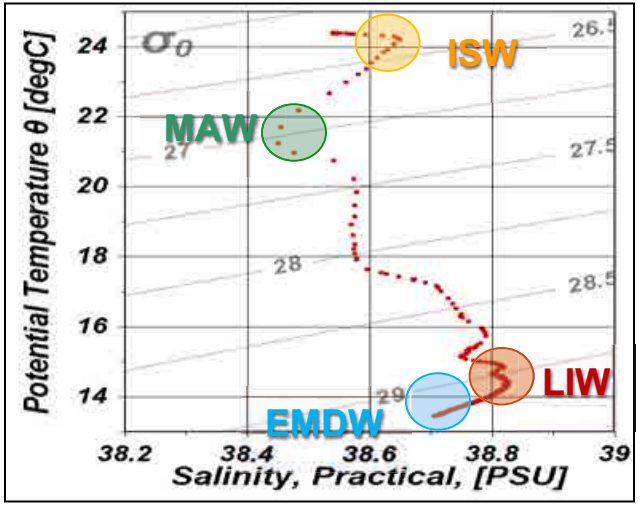
Phase 2
implemented
March 2016

Phase 1
implemented
March 2015

Global change and Ocean circulation







Modified Atlantic Water (MAW)

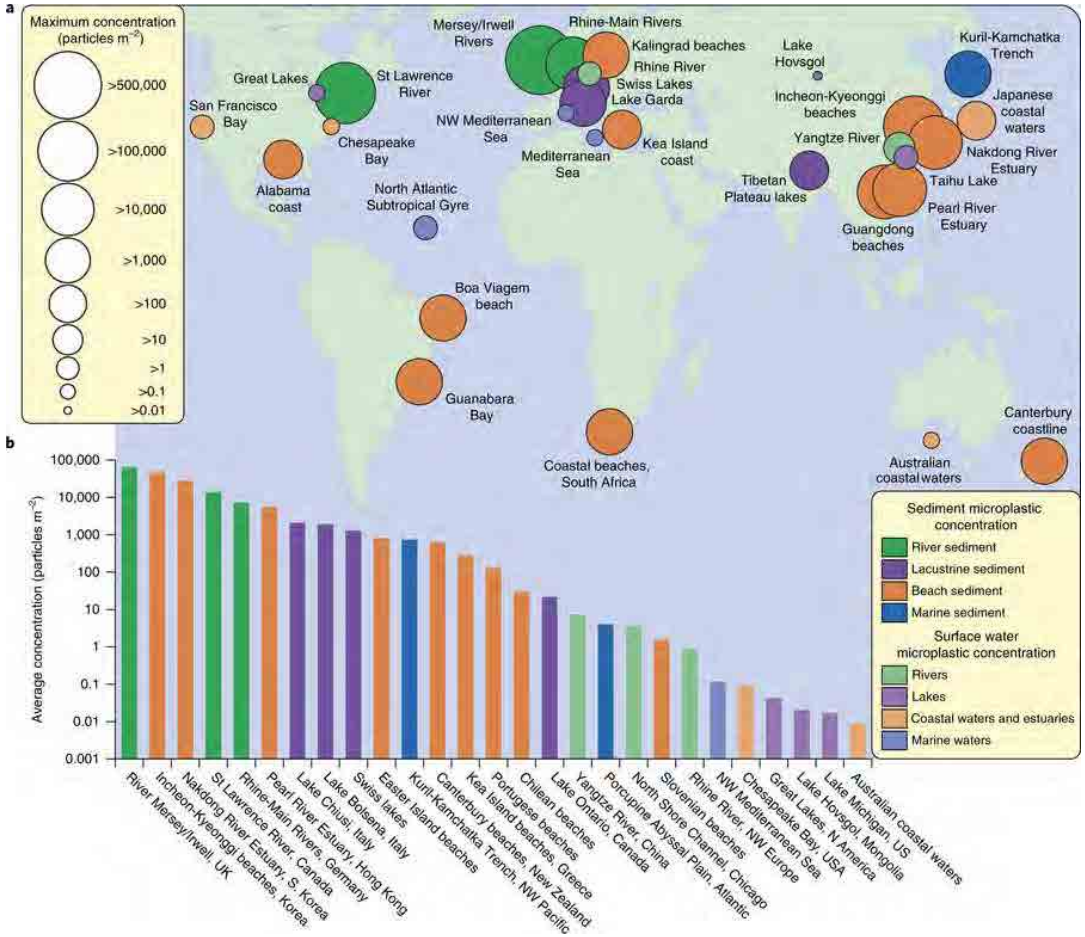
Levantine Intermediate Water (LIW)

Eastern Mediterranean Deep Water (EMDW)

Ionian Surface Water (ISW)

Bios decadal inversion

PLASTICS



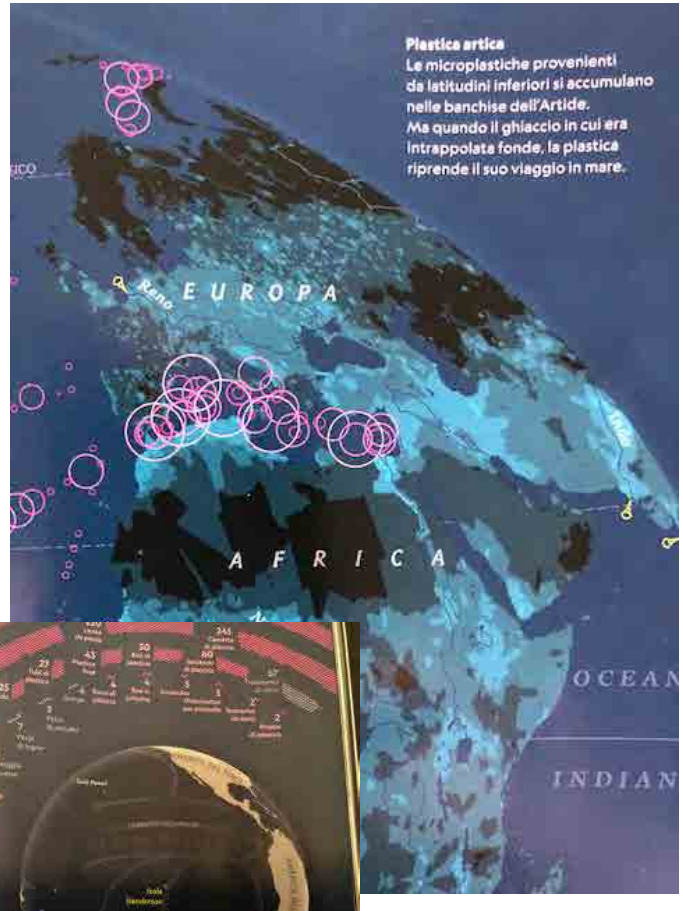
‘current estimate for the number of particles in the ocean – is a major underestimate.’

Hurley et al. 2018, *Nature Geoscience*

Micro plastics are highly bioavailable to marine organisms, either through direct ingestion, or indirectly by trophic transfer from contaminated prey (Sarah E.Nelms etal., 2018, Environ. .Pollut.)

PLASTICS

we are dumping around 10 tons of plastic to the oceans every year, ESA is already indirectly capable of measuring the large distribution of plastic, we are in the way to implement smart sensors capable to detect the "in situ" the volume of **microplastics** in the ocean



Henderson Island is a tiny, uninhabited island in the middle of the Pacific Ocean, 4,000 km from major population centers. It is half the size of Manhattan, more than 19 tons of garbage pollute its white sand beaches.

From Laura Parker & Randy Olson, National Geographic, June 2018

COPERNICUS SERVICE

- Copernicus Marine Environment Monitoring Service (CMEMS) provides regular and systematic reference information on the physical state, variability and dynamics of the ocean and marine ecosystems for both the global ocean and the European regional seas.

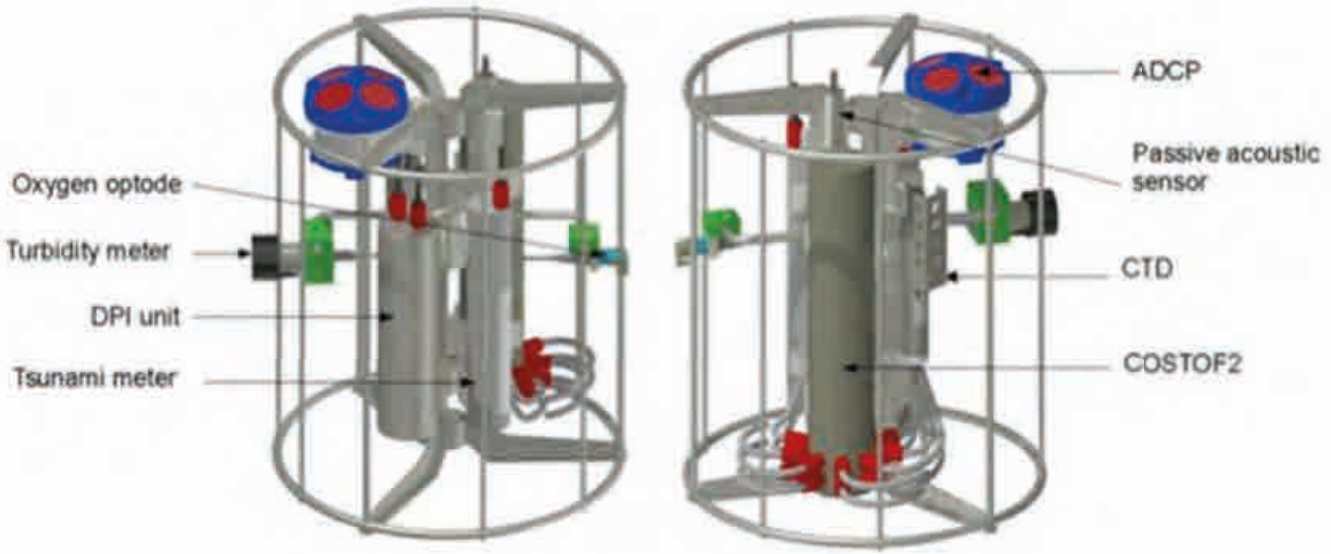
- Relies on the timely provision of both satellite and in-situ observations. While satellites provide a global view of the surface of the oceans, in-situ systems (i.e. OceanSITES locations, Argo floats via its fleet of ~3,800 in-situ floats) provide complementary data primarily by monitoring their interior.

- Themes include
  - marine safety,
  - marine resources,
  - coastal and ocean environment
  - weather, climate and seasonal forecasting

ENGINEERING & LOGISTICS

EGIM measurements:

- Temperature
- Conductivity
- Pressure
- Dissolved O_2
- Turbidity
- Ocean currents
- Passive acoustics

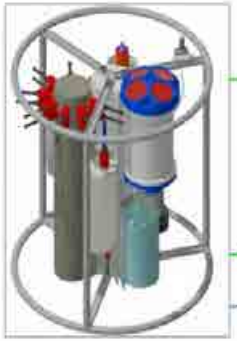


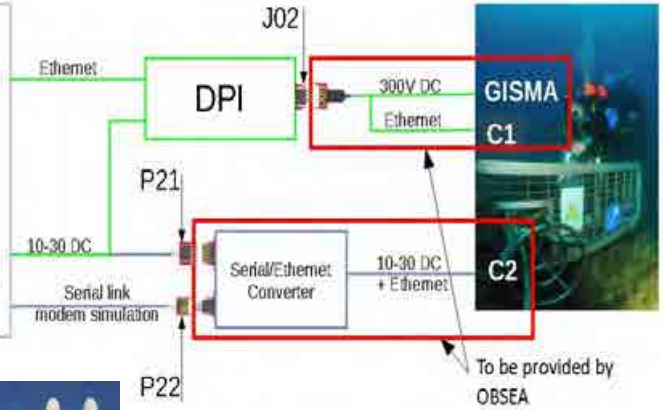
The development of EGIM is an example of the engineering services that EMSO can provide.

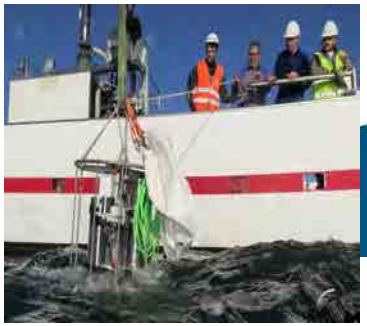
EGIM tests at OBSEA

european
multidisciplinary
seafloor and water-column
observatory development

emsodev







www.emsodev.eu

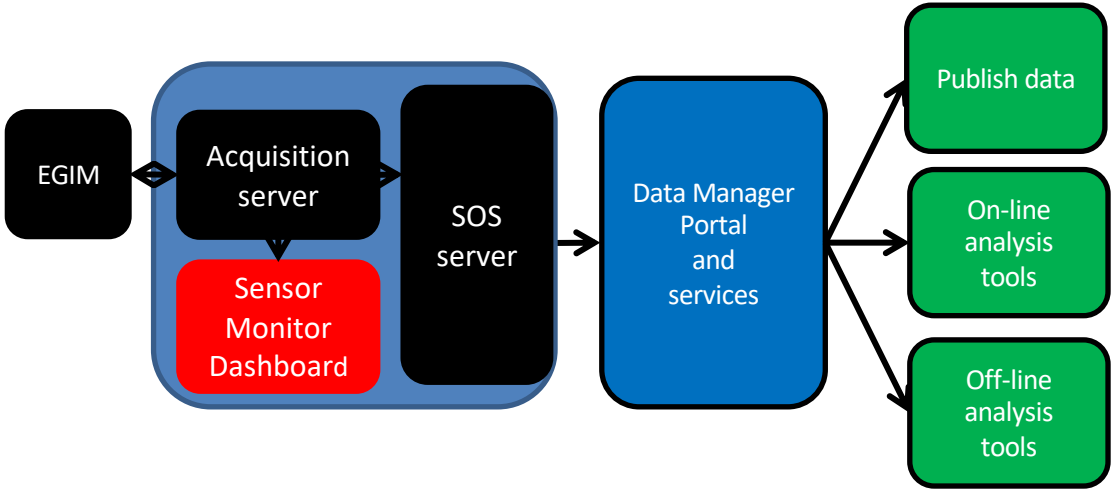
EGIM prototype was deployed on October 24, 2016 and recovered on April 24, 2017 (6 months)

emso ERIC

DATA MANAGEMENT

EMSO offers **data and services** to a large and diverse group of users, **from scientists and industries to institutions and policy makers**

It is an versatile infrastructure to provide relevant information for defining environmental policies based on scientific data

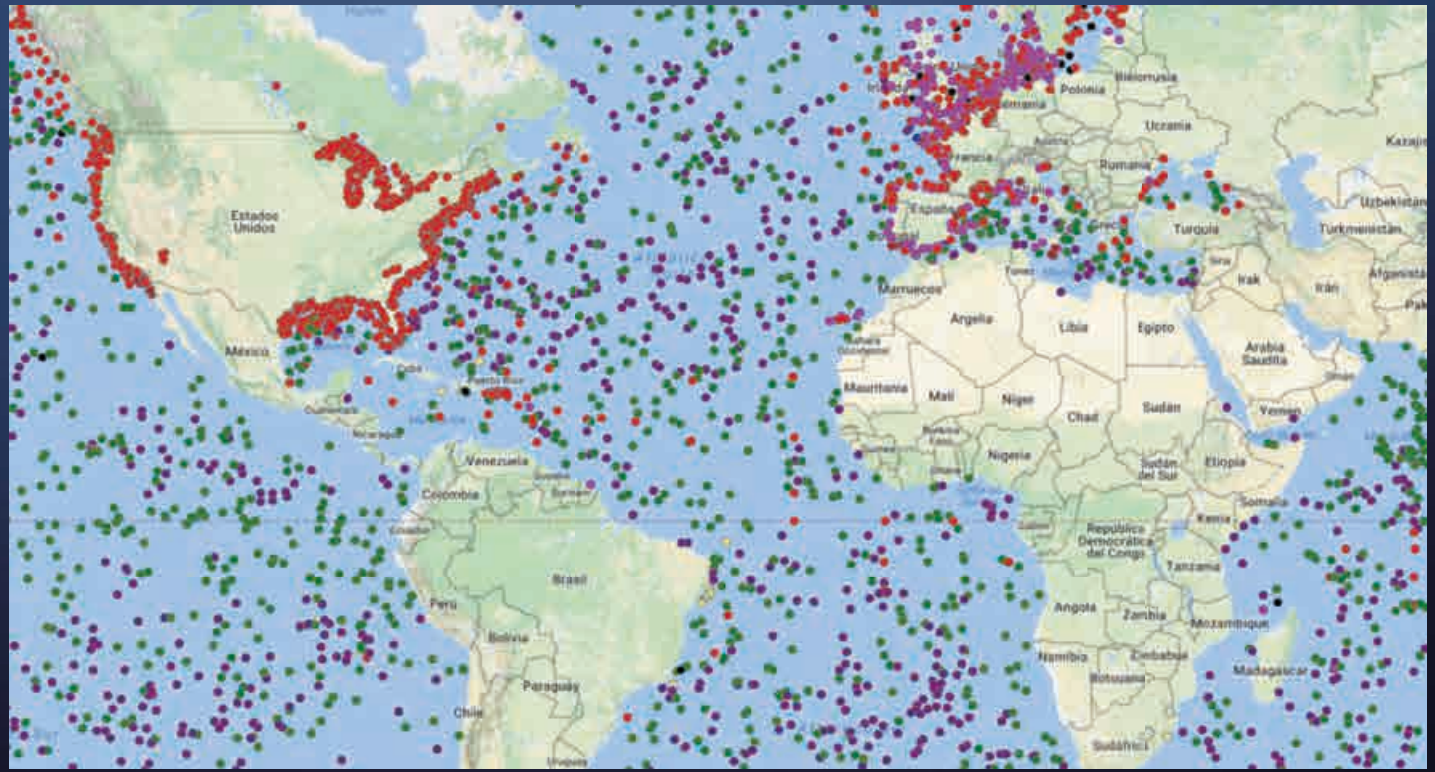


MOODA

An Python package to help scientist to analyze data from different ocean observatories.

Example of compatible data sources:

MOODA DATA SOURCES



PACKAGE OVERVIEW

Controlled via Python code

```
import oceanobs.emso as emso

path_data = “data.nc”
ob =emso.EMSO(data)

ob.plt_all()
```

EMODnet

JERICO next

OBSEA

emso

Other platforms, in the future…

Marine observatory input data

mooda Data access modules

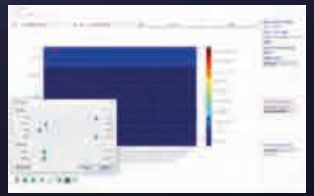
WaterFrame

mooda Analysis modules

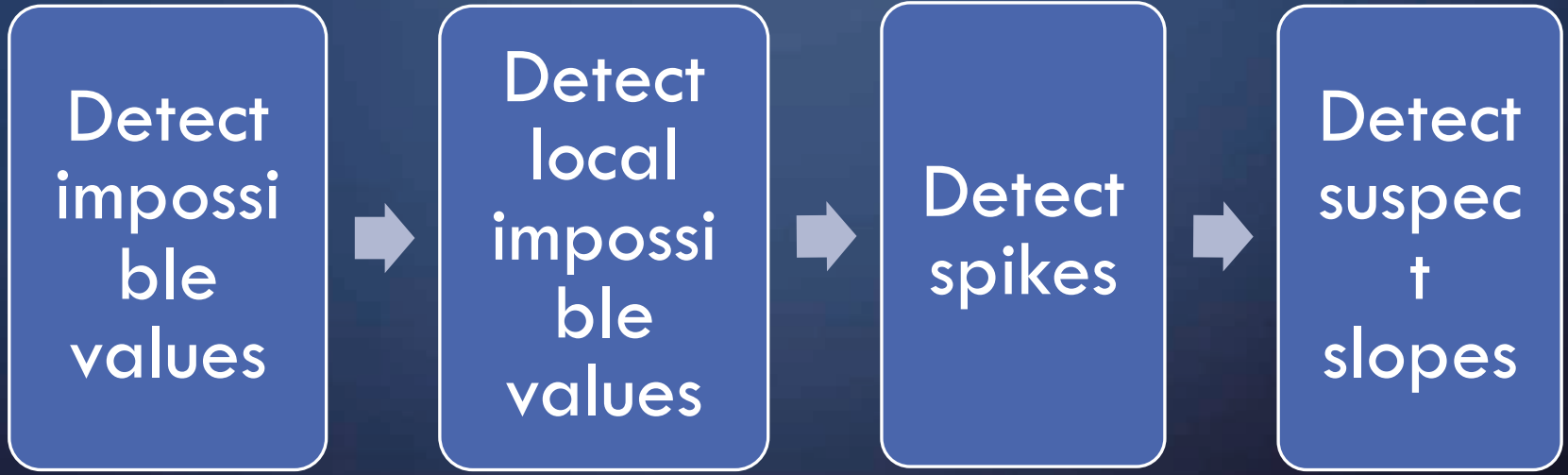
Controlled via GUI

Download data from observatory portals if it is possible

Other programs GUI modules



QC PROCEDURES



SUMMARY

- The development of Distributed RI at seafloor and water column of EMSO nodes (cabled or stand alone) provides a unique European operational capacity in collecting scientifically relevant datasets
- The use EGIM sensor developed within EMSO implements, common, standardized technologies based on architectures and interoperability, enabling EMSO observatories to serve the science community, industry and governmental organizations as well as other key stakeholders and even similar infrastructures

- **EMSO ERIC will provide** information and knowledge impact
- Climate Change & Ocean acidification
- How warming seas are forcing fish to seek new waters
- Appraisal of Economic Impact of Algae Blooms
- Mitigation of Natural disasters (i.e., submarine volcanoes, submarine landslides, earthquakes, tsunamis)
- Copernicus services, marine safety, marine resources, climate forecasting, etc.

Thank you for your attention

The EMSO-Link project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreements N° 731036.

www.emso-eu.org

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