



Arctic

Norwegian  
Margin

Nordic Sea

# European Multidisciplinary Seafloor and water column Observatory

<http://www.emso-eu.org/>

Porcupine  
Abyssal  
Plain

Ligurian  
Sea

Black Sea

Azores  
Islands

Iberian  
Margin

Marmara  
Sea

Paolo Favali  
on behalf of the EMSO  
Consortium

Western  
Ionian Sea

Hellenic  
Arc

PLOCAN

EMSO, a Research Infrastructure of the ESFRI Roadmap, is the European network of fixed seafloor and water column observatories constituting a distributed infrastructure for long-term monitoring of environmental processes

In the EC-FP7 EMSO Preparatory Phase (12 countries) started in April 2008 for 4 years with the aim to design and create the legal entity in charge of managing the infrastructure

A large European users community has been gathered around ESONET-NoE (2007-2011, [www.esonet-emso.org/](http://www.esonet-emso.org/)) which has been providing many inputs to the shaping of EMSO



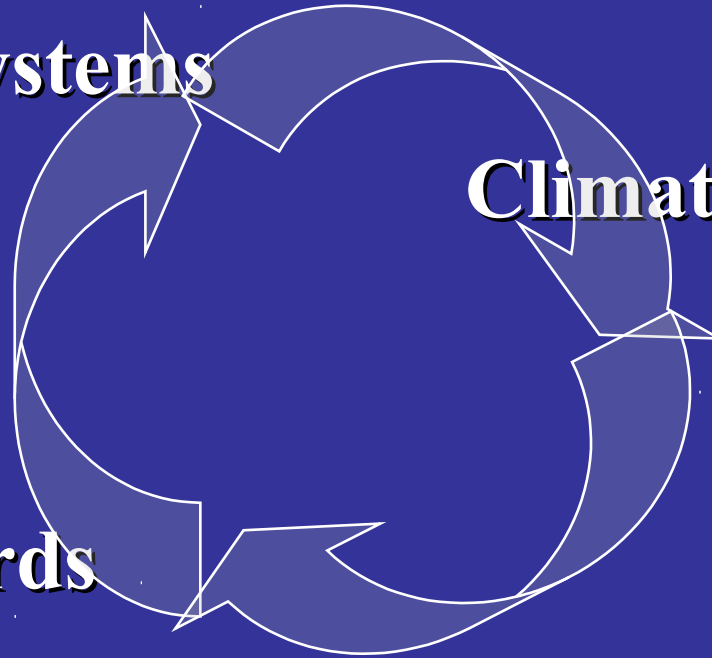
# EMSO is

A Marine Research Infrastructure: permanent, large-scale, deep-sea laboratory to observe and study

Marine Ecosystems

Climate Change

Geo-Hazards



# Needs for a European Network of Fixed Marine Observatories

- Sustained observations are essential with **appropriate frequency** to explore the time-scale of the changes of the oceanic environment
- Investigation of the complex interrelations between processes and properties **from the top of the ocean to the seabed beneath**

Short-time scales (seconds, minutes, hours, days)

Long-time scales (months, years, decades)



## Ostend Declaration

The European marine and maritime research community stands ready to provide knowledge, services and support to the European Union and its Member and Associated States, recognising that

*"The Seas and Oceans are one of the Grand Challenges for the 21<sup>st</sup> Century".*

**EMSO is essential  
to form the  
European Ocean  
Observing System**



### **Addressing the Seas and Oceans Grand Challenge**

The EuroOCEAN 2010 Conference identified priority marine and maritime research challenges and opportunities in areas such as food, global environmental change, energy, marine biotechnology, maritime transport and marine spatial planning, including seabed mapping. The Conference delivered an unequivocal message on the societal and economic benefits Europe derives from the seas and oceans and of the crucial role that research and technology must play in addressing the Seas and Oceans Grand Challenge.

The European marine science and technology community, building on existing achievements and initiatives, is ready to address this challenge in partnership with industry and the public sector, and call upon the European Union and its Member and Associated States to facilitate this response by delivering the following proactive and integrating actions:

#### **1. Joint Programming**

Develop an integrating framework, combining the assets of European programmes with those of Member States, to address the Grand Challenge of the Seas and Oceans, including the identification and delivery of critical marine research infrastructures. The Joint Programming Initiative on "Healthy and Productive Seas and Oceans" has the appropriate scale of integration and should be actively supported by the European Commission and Member States.

#### **2. European Ocean Observing System**

Support the development of a truly integrated and sustainably funded "European Ocean Observing System" to (i) re-establish Europe's global leading role in marine science and technology; (ii) respond to societal needs by supporting major policy initiatives such as the Integrated Maritime Policy and the Marine Strategy Framework Directive; and (iii) support European contributions to global observing systems. This could be achieved through better coordination of national capabilities with appropriate new investments, in coordination with relevant initiatives (e.g. ESFRI, EMODNET, GMES) and the engagement of end-users.

#### **3. Research to Knowledge**

Establish appropriate mechanisms to keep under review current marine and maritime research programmes and projects with a view to enhancing their impact by (i) exploiting the results of this research; and (ii) identifying existing and emerging gaps. This should be supported by a repository for the reports and findings of national and EU marine and maritime research projects, programmes and initiatives, with capacity for archiving, translating, analysing, reporting and developing integrated knowledge products to facilitate policy development, decision making, management actions, innovation, education and public awareness.

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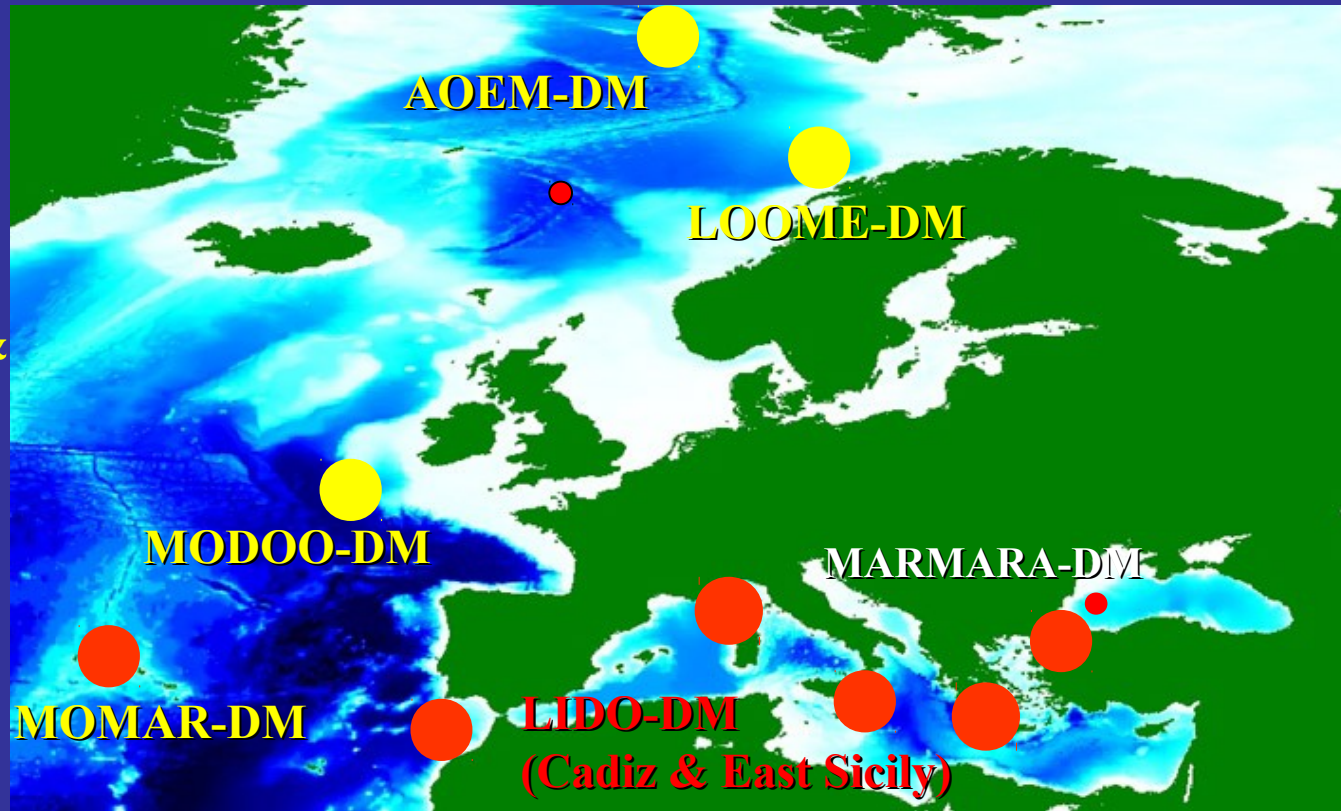
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# The ESONET Demonstration Missions (DMs) and S&T activities have progressed towards “permanent” installations thus paving the way towards of EMSO

## Mainly:

- Geo-Hazards
- Climate change & Ecosystem



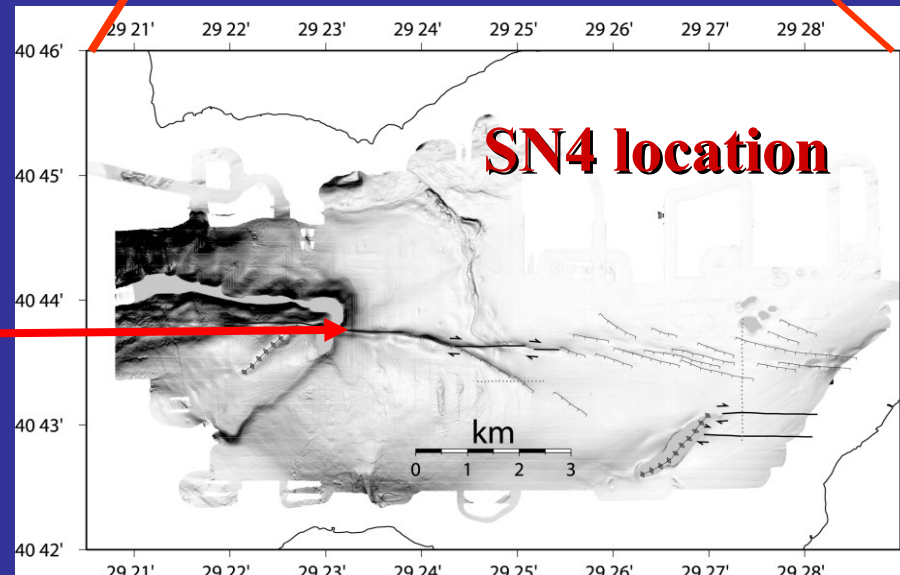
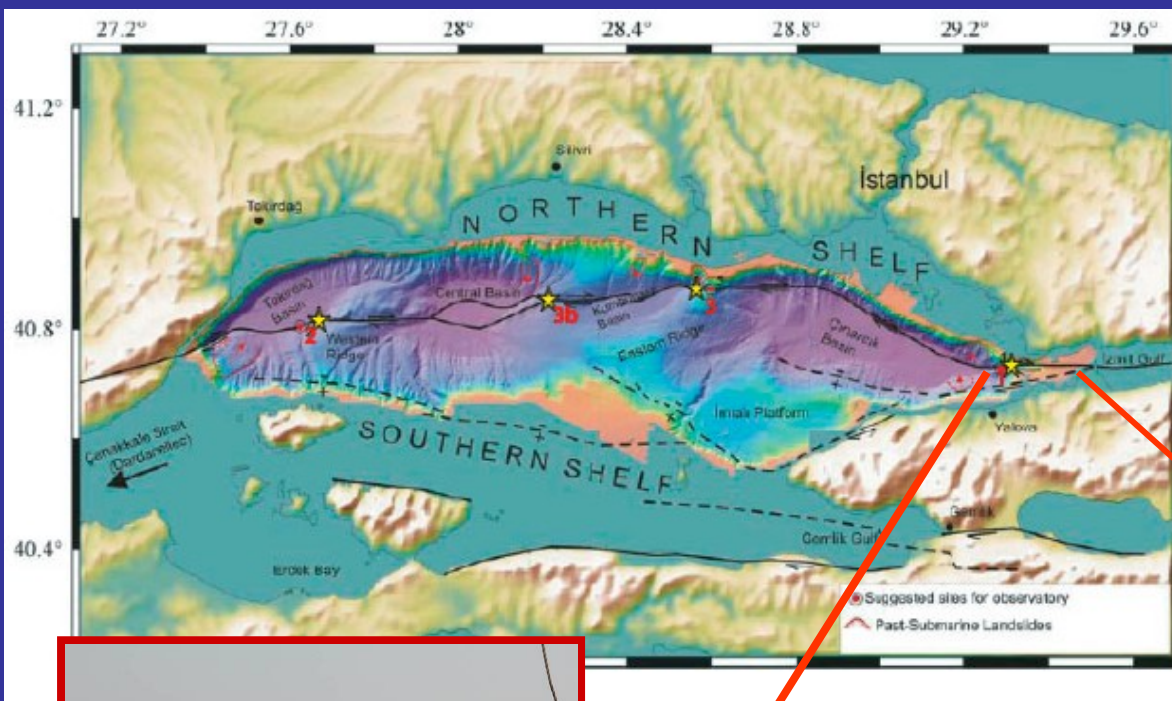
**EMSO nodes are located in ESONET key sites**



# Marmara Sea

Partners: Turkey, Italy, France

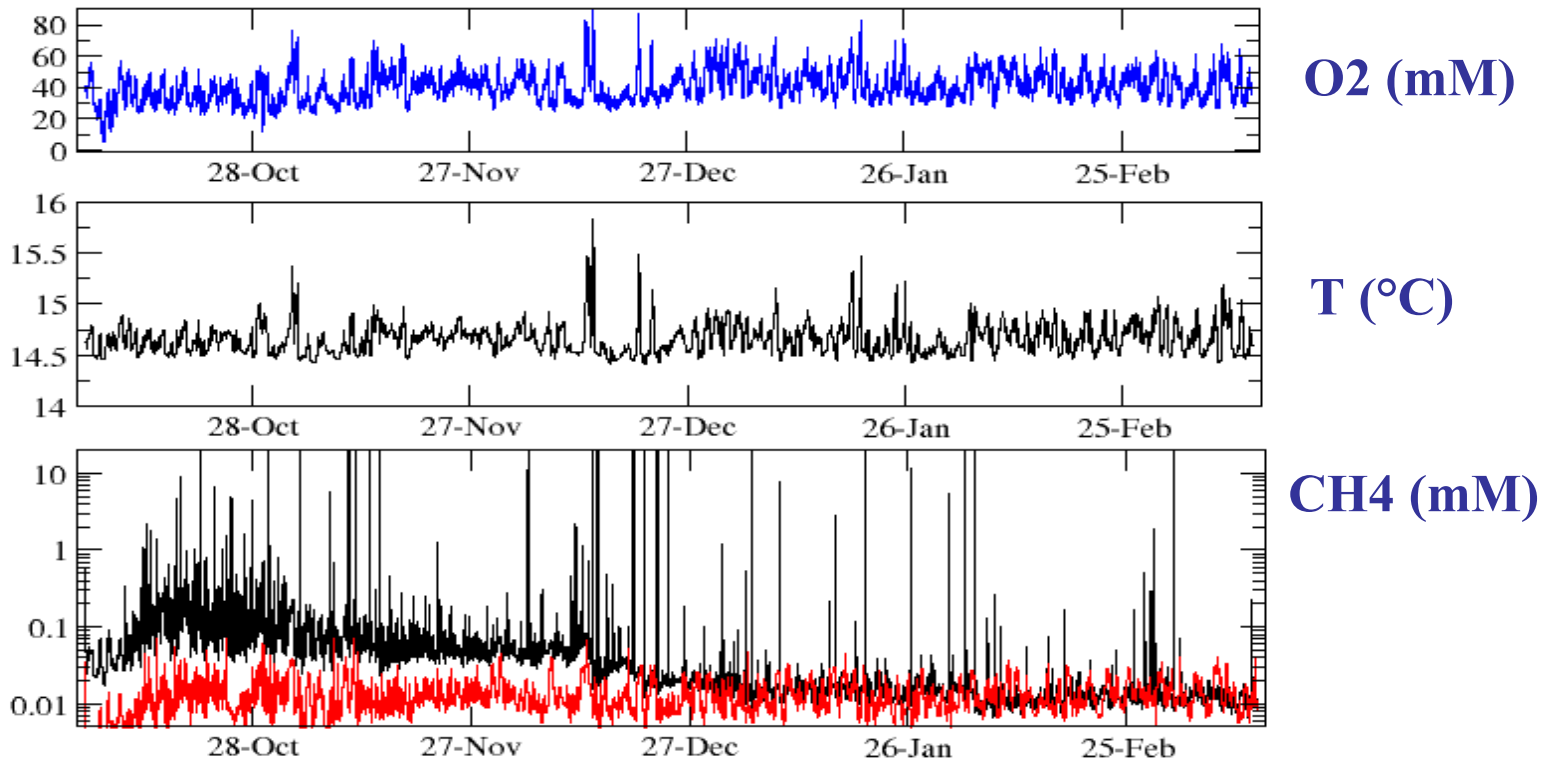
eastern part of the sea at the westernmost end of the fault rupture caused by the 1999 Izmit earthquake.



**Main goals: Relationship between Seismicity & Gas seepage**



# DEGASSING EVENTS: preliminary interpretation



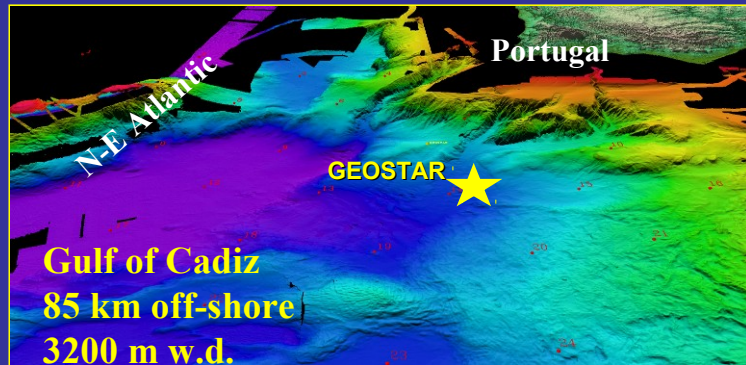
Apparently a “pulsation” of degassing by bubbles from the seafloor

Number of CH<sub>4</sub> peaks: at least 70 Frequency > 1 peak every 2 days

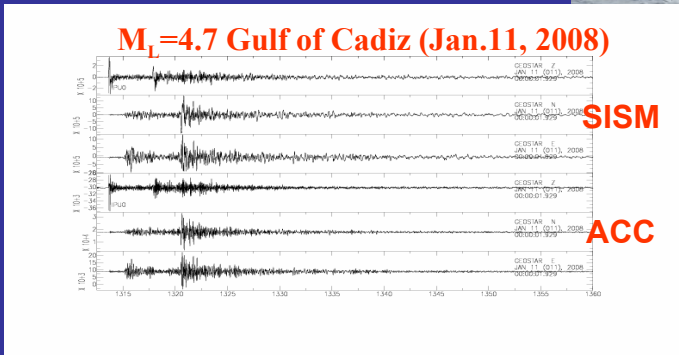
# Iberian Margin

## Acoustically linked observatory

Partners: Portugal,  
Spain, Italy, Germany,  
France, Morocco



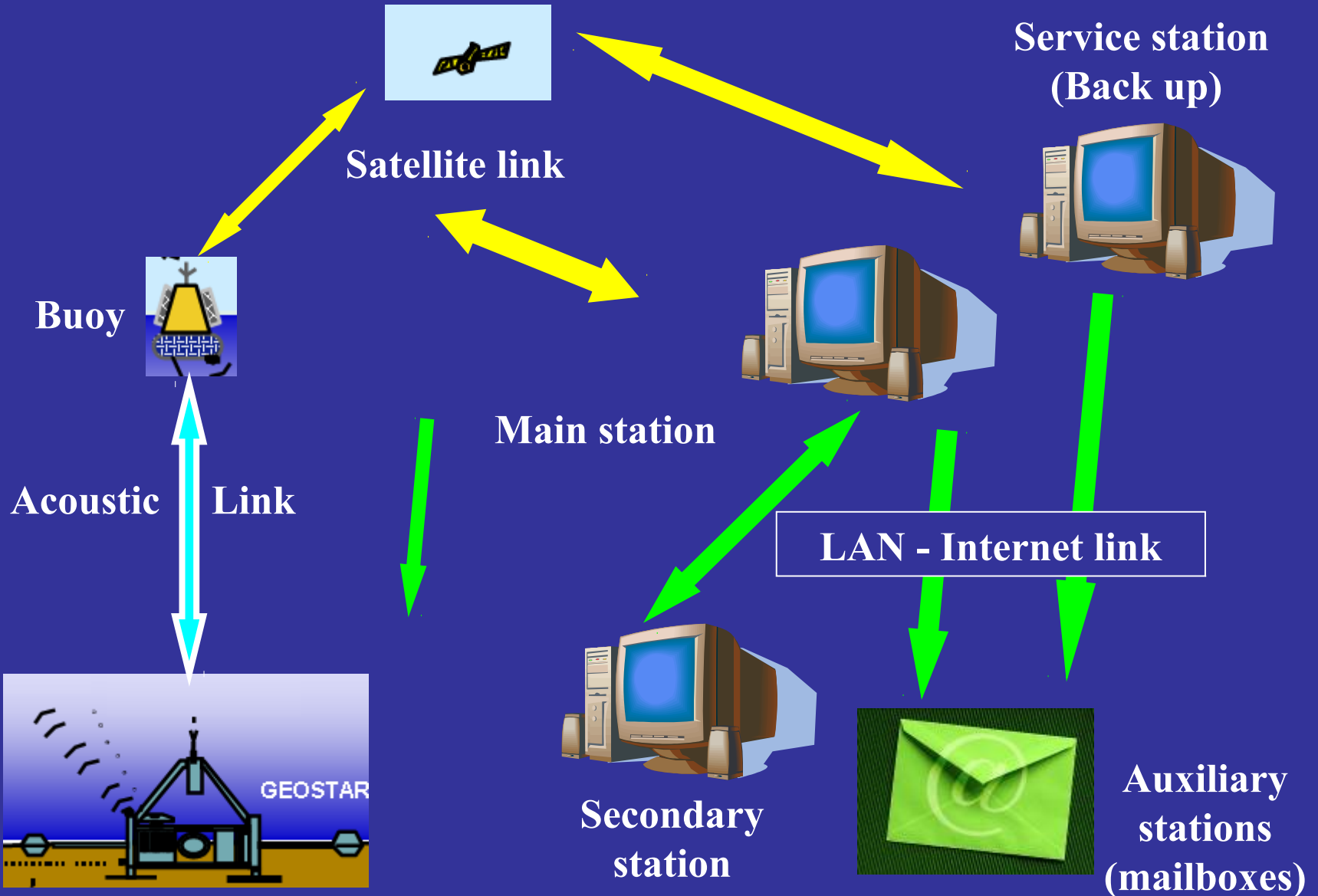
EC-NEAREST (exp. Aug.'07-Aug.'08)  
EC-ESONET-LIDO-DM (exp. Nov'09-ongoing)



R/V Sarmiento de Gamboa

**Main goals: Geo-Hazards & Bio-acoustics**

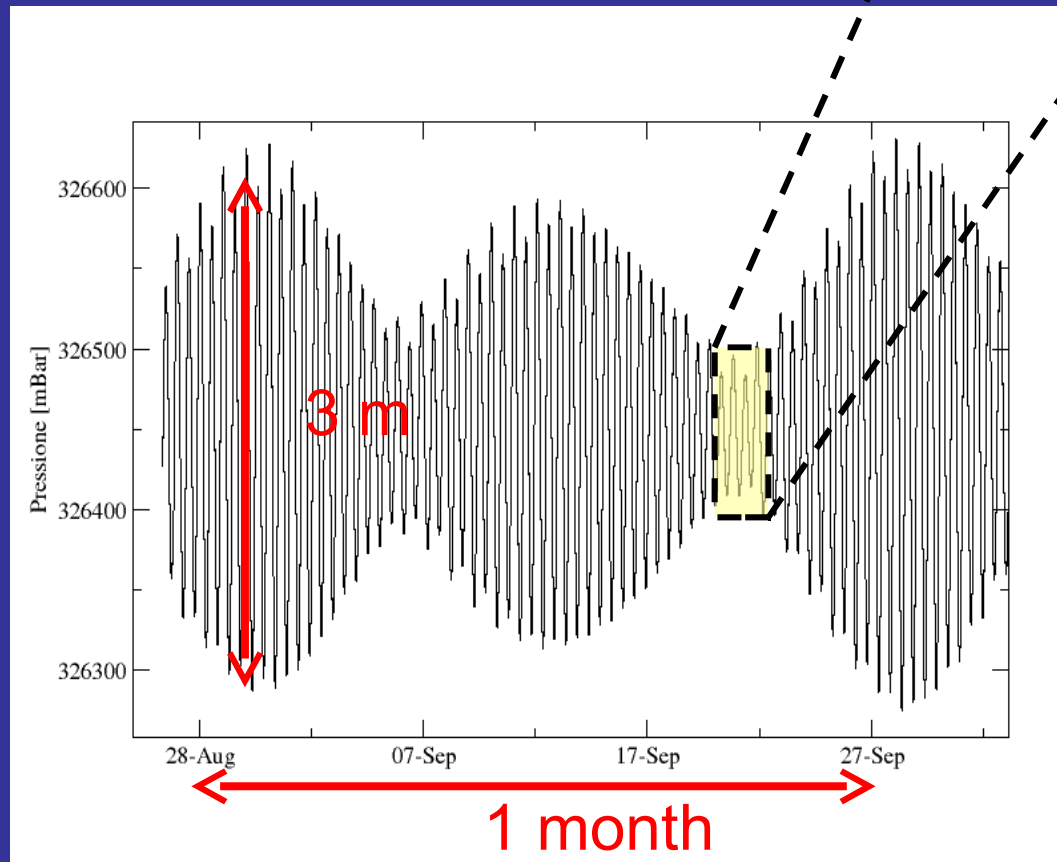
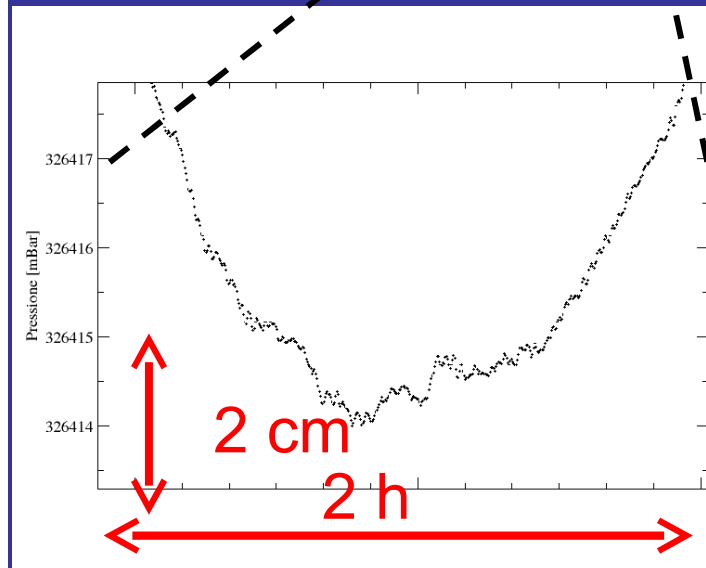
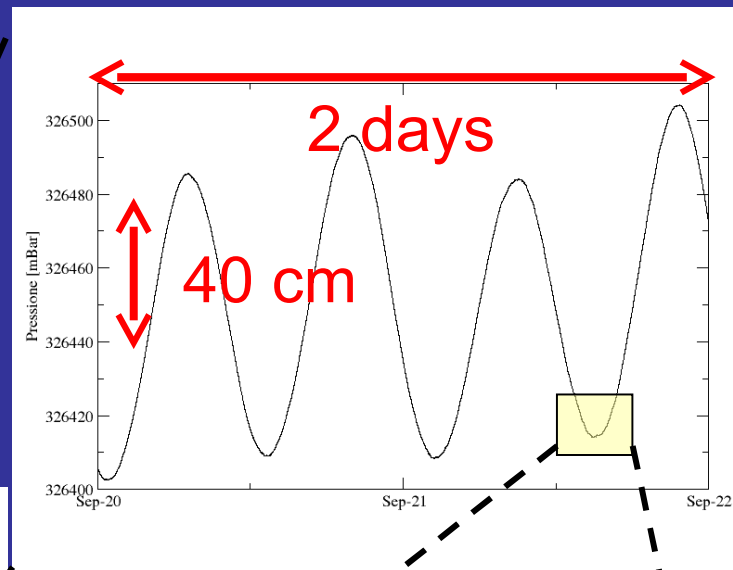
# Near real-time communication scheme





# Example of pressure signal recorded during NEAREST mission

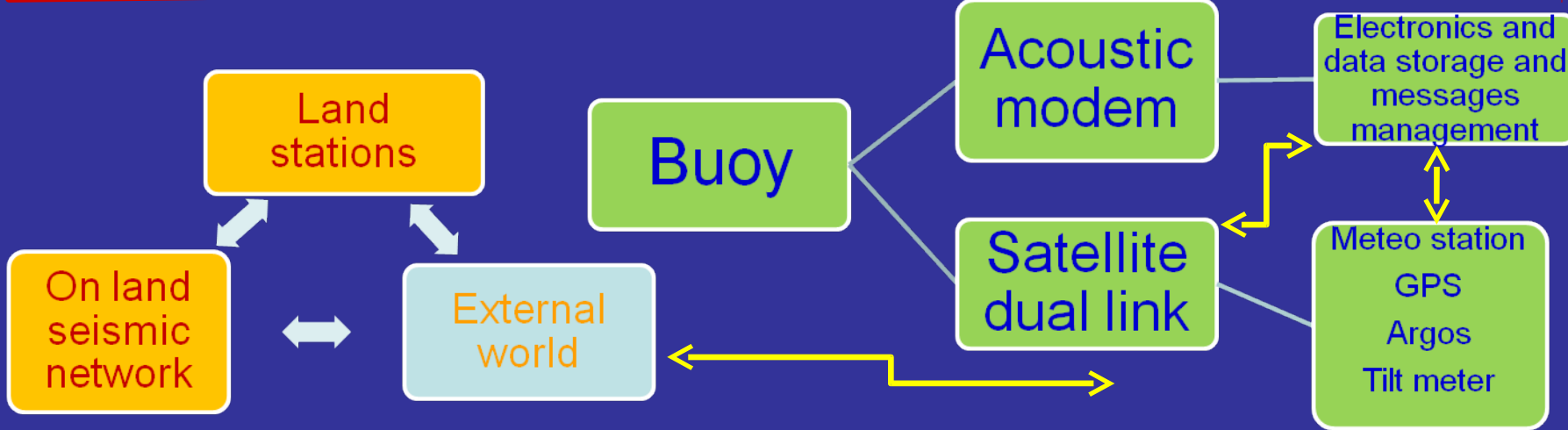
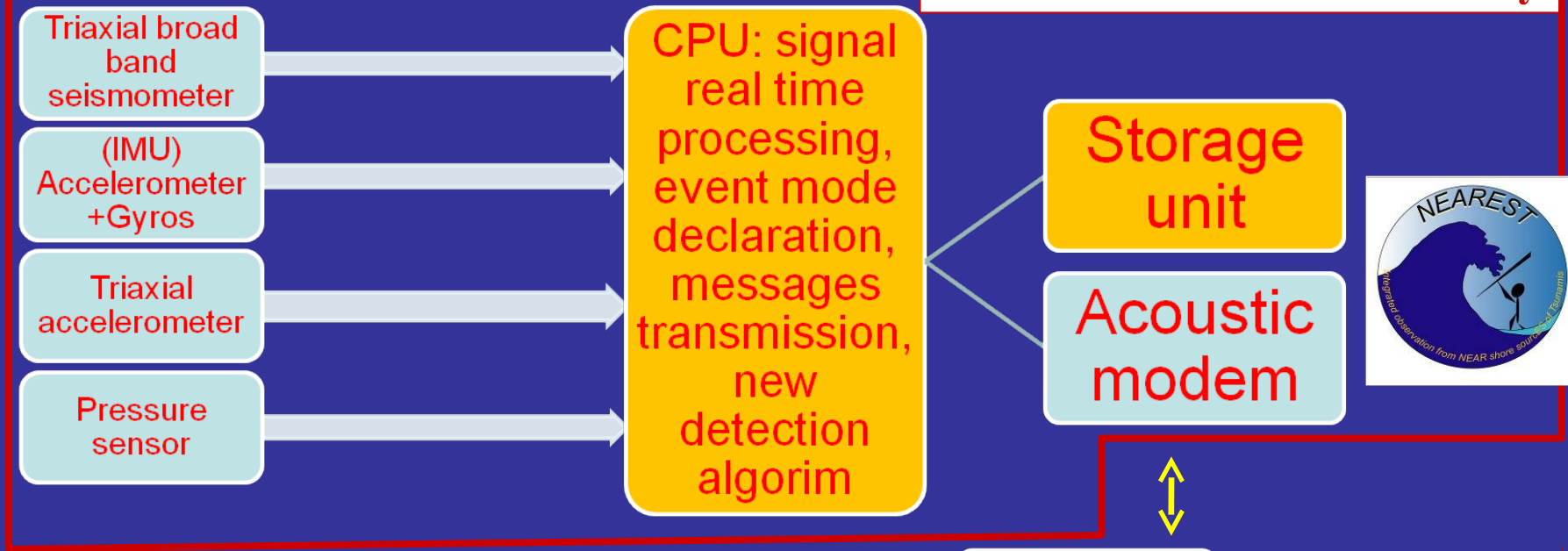
(1cm H<sub>2</sub>O ~ 1mbar)





# Tsunameter scheme

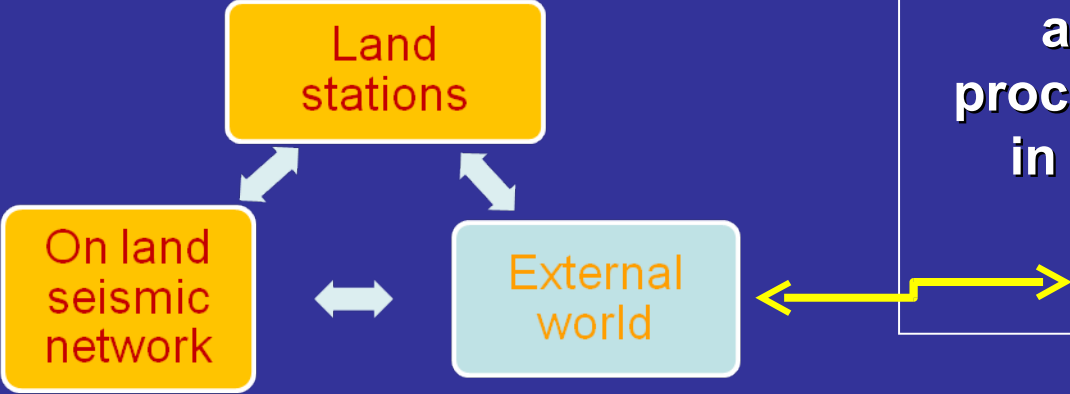
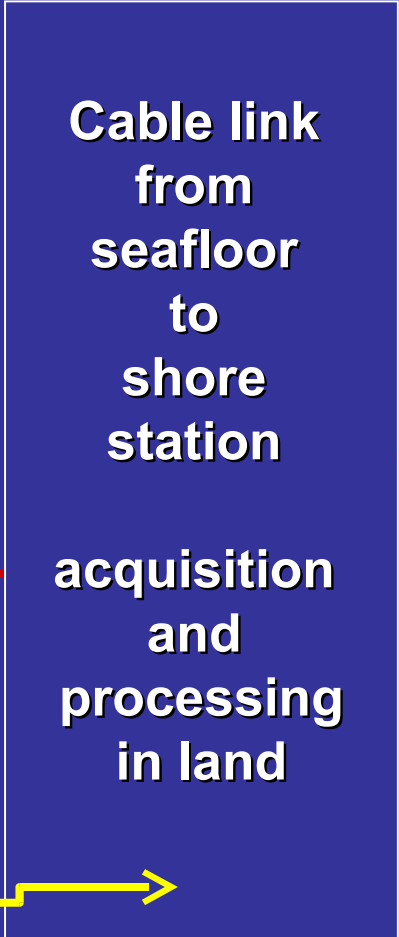
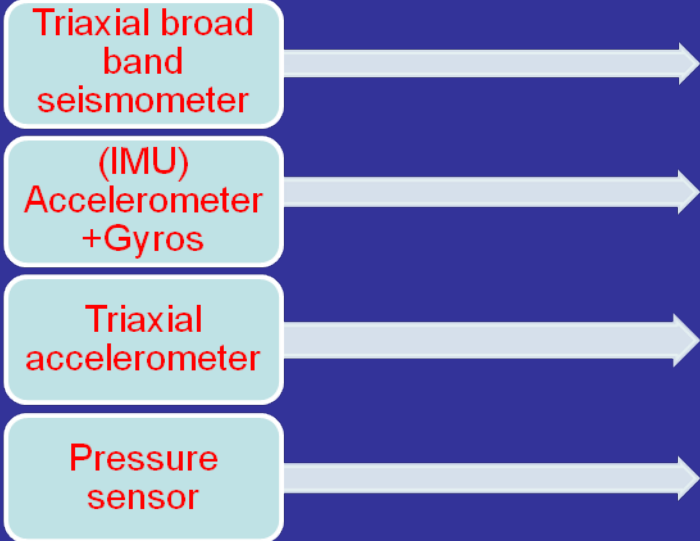
## Onboard seafloor observatory



Francesco Chierici, Luca Pignagnoli, Nevio Zitellini - CNR-ISMAR

# Tsunameter scheme

## Onboard seafloor observatory



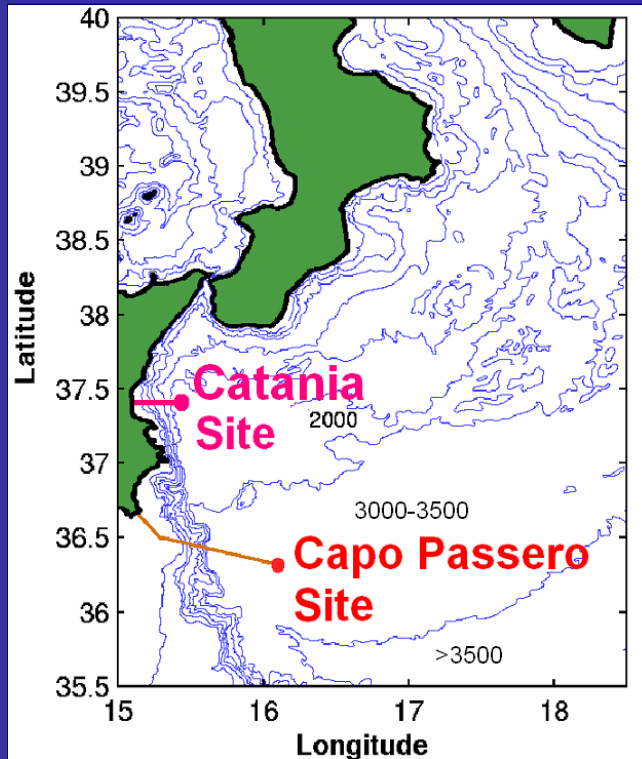
Francesco Chierici, Luca Pignagnoli, Nevio Zitellini - *CNR-ISMAR*

# Western Ionian Sea : Capo Passero infrastructure

85 km South East offshore Capo Passero, 3500-m depth  
(cable deployed 2007, junction box deployed 2009)



## Shore Station in Porto Palo Harbour



Submarine cable  
100 km - 20 fibres, DC-sea return

Submarine Infrastructure  
DC/DC Converter 10 kV-375 V  
NEPTUNE-like design  
ROV connectors to end users

# Western Ionian Sea (off Catania)

2005 Real-time data transmission  
 2008 Recovery for refurbishment  
 2011 **Re-deployment**

Main goals: Geo-Hazards & Bio-acoustics, Test site for Neutrino Telescope

Shore Station  
 Catania harbour



Geo-hazard  
 and bio-  
 acoustic  
 module



Bio-  
 acoustic  
 module



> 2000 m w.d.



NEMO JB



ROV (operative 4000 m)

Web

Synergy between the 2 ESFRI infrastructures: **KM3NeT** and **EMSO**



# Western Ionian Sea (off Catania) payload

Sensor	rate	Model
<b>3-C broad-band seismometer *</b>	100 Hz	Guralp CMG-1T (0.0027-50 Hz)
<b>Differential Pressure Gauge (DPG)</b>	10 Hz	Prototype Univ. California-St. Diego
<b>Hydrophone (Geophysics)</b>	200 Hz	OAS E-2PD
<b>Hydrophone (Geophysics)</b>	2000 Hz	SMID (0.05-1000 Hz)
<b>4+4 Hydrophones (Bio-acoustics)</b>	96 /192 kHz **	SMID (100-70000 Hz)
<b>Absolute Pressure Gauge (APG) *</b>	15 s	Paroscientific 8CB4000-I
<b>3-C Accelerometer + 3-C Gyro (IMU) *</b>	100 Hz	Gladiator Technologies Landmark 10
<b>Gravity meter</b>	1 Hz	Prototype IFSI-INAF
<b>Scalar magnetometer</b>	1 Hz	Prototype INGV
<b>Vectorial magnetometer</b>	1 Hz	Marine Magnetics Sentinel (3000 m)
<b>ADCP</b>	1 profile/h	RDI Workhorse Monitor (600 kHz)
<b>CTD + Turbidity meter</b>	1 s/h	SeaBird SBE-37SM-24835 + Wet Lab
<b>3-C single point current meter</b>	2 Hz	Nobska MAVS-3

\* tsunami early warning system

\*\* 96 kHz at TSN, 192 kHz at TSS

european  
multidisciplinary  
seafloor  
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emso



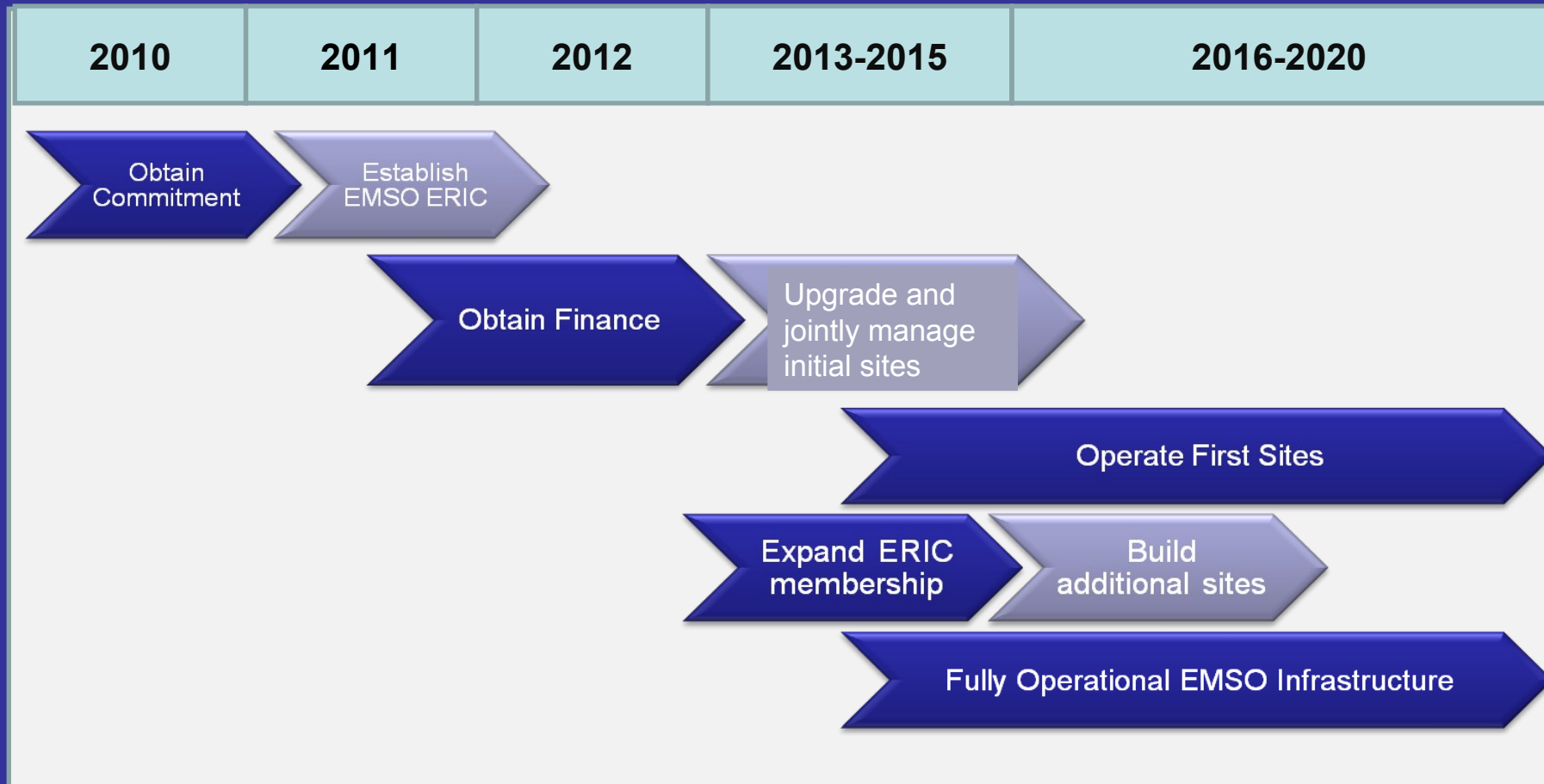
European Strategy Forum  
on Research Infrastructures

ESFRI

# EMSO-Preparatory Phase Partnership

- |                 |   |              |  |
|-----------------|---|--------------|--|
| <b>INGV</b>     | - Istituto Nazionale di Geofisica e Vulcanologia (Italy) Co-ordinator                   | <b>ITU</b>   | - Istanbul Teknik Universitesi (Turkey)                                  |
| <b>IFREMER</b>  | - Institut Français de Recherche pour l'exploitation de la MER (France)                 | <b>UiT</b>   | - University of Tromsø (Norway)  |
| <b>NOCS</b>     | - National Oceanography Centre Southampton (United Kingdom)                             | <b>HCMR</b>  | - Hellenic Centre for Marine Research (Greece)                           |
| <b>KDM</b>      | - Konsortium Deutsche Meeresforschung e.V. (Germany)                                    | <b>IMI</b>   | - Irish Marine Institute (Ireland)                                       |
| <b>NIOZ</b>     | - Stichting Koninklijk Nederlands Instituut voor Zeeonderzoek (The Netherlands)         | <b>UGOT</b>  | - Goteborgs Universitet (Sweden)   |
| <b>UTM-CSIC</b> | - Unidad de Tecnologia Marina - Consejo Superior de Investigaciones Cientificas (Spain) | <b>FFCUL</b> | - Fundação da Faculdade de Ciências da Universidade de Lisboa (Portugal) |

# EMSO Timeline



# The legal organisation

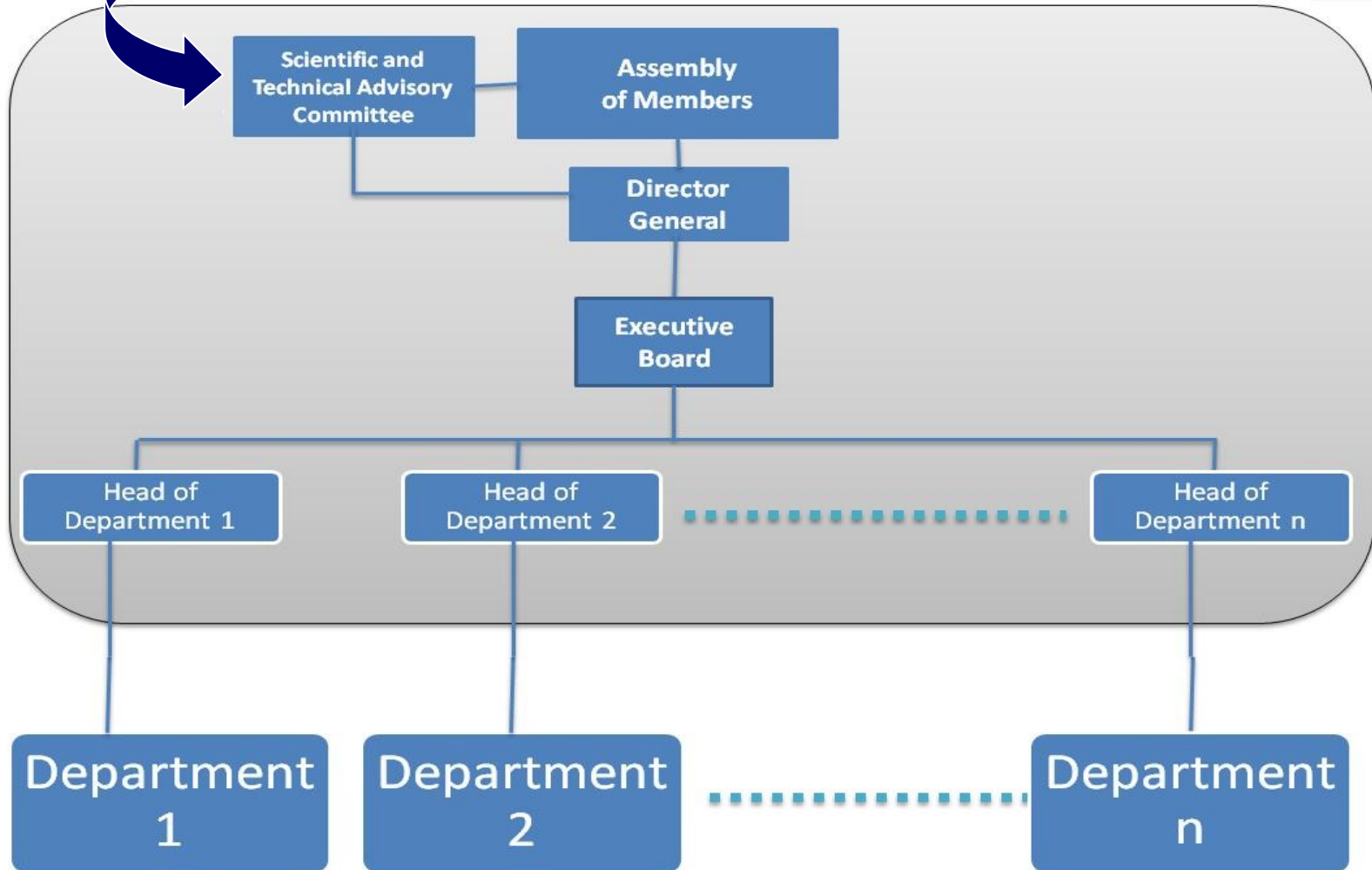
- The **ERIC** is considered a suitable **legal form** by the funding agencies and the community (ESF Strasbourg - 1<sup>st</sup> Funding Agencies meeting, February 2010)
- **EMSO-ERIC statute almost at the final version** and it will be soon presented to the Funding Agencies (Brest - 2<sup>nd</sup> Funding Agencies meeting, June 2011)
- Environmental laws at each EMSO site already reviewed
- Legal work for the next months will cover:
  - Model **agreements** for sites with **already-existing facilities**
  - Model sites: Arctic/Norway, Porcupine Abyssal Plain, Sicily



# Governance

Scientific community  
(e.g., ESONET-Vi)

EMSO-ERIC  
Boundary



## EMSO-ERIC mission (Statute)

**EMSO-ERIC will coordinate and facilitate access to open ocean fixed point observatory infrastructures** according to selection criteria defined by the participating members. The EMSO-ERIC will be the central point of contact for observatory initiatives in other part of the world to set up and promote cooperation in this field

**EMSO-ERIC will also integrate research, training, and information dissemination activities on ocean observatories in Europe and to enable scientists and other stakeholders to make efficient use of a future network of ocean observatories around Europe.** EMSO-ERIC will consist of contributing member states and observer member states and shall ensure maximum benefit by coordinating and focusing the use of the commonly available infrastructure resources

**EMSO-ERIC aims at integrating the existing open ocean fixed point sub-sea observatories (hereafter referred to as Infrastructures) around Europe, help coordinate their extensions, and in the planning and deployment of new ones.** The mission is also to facilitate the operation of the Infrastructures, ensure the continuity and quality of measurement time series acquisition and a reliable and user-oriented data management

# Interest Currently expressed by Member States

- EMSO is presently in the roadmap of the following Countries:
    - Italy, France, Germany, Ireland\*, Spain, Sweden, Greece, UK, Norway

\*"A" rating assigned to EMSO in terms of potential investment

  - The Prime Ministry of **Turkey** State Planning Organization (DPT) is considering EMSO to include in the roadmap
- Countries interested to participate to the ERIC since the beginning:
    - Italy, France, Germany, Spain, Greece, UK, Norway, Turkey

# Secretariat

EMSO-ERIC central management have to be light, agile, not too costly and will act as a coordinating body, facilitating and coordinating access to observatories

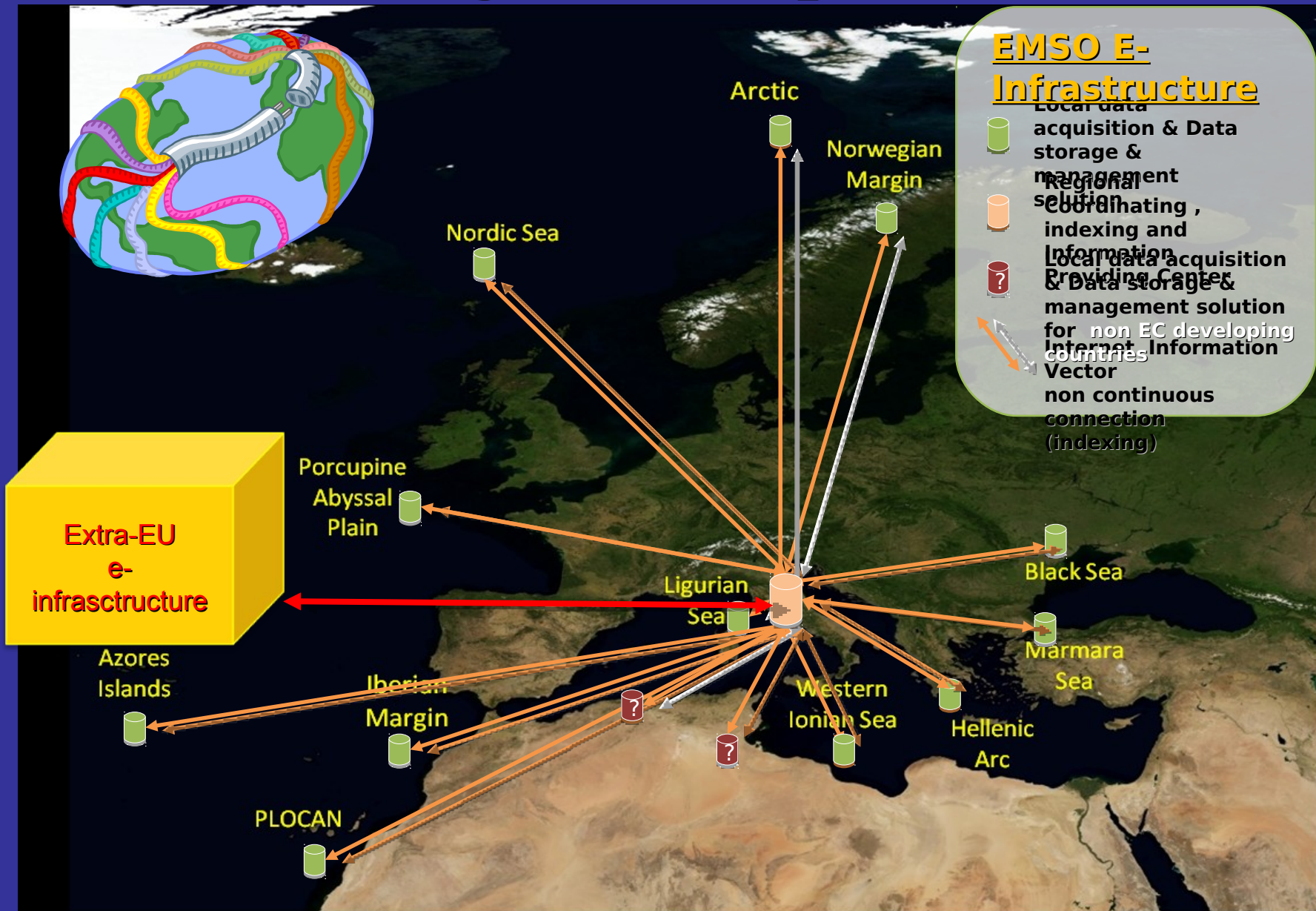
Ownership does not have to be an issue

Envisioned 2 phases:

- **Phase 1-Start-up** (2-3 years). Small structure (~200-300 K€ per year in average), with part-time personnel implementing the needed functionalities. Part (or all) of the costs can be covered by **Italy as hosting Country** to facilitate the start-up of the EMSO-ERIC
- **Phase 2-Regime**. Still small structure, with full-time and part-time staff, full functionalities. Personnel is recruited among Member Countries. It will facilitate the contribution in-kind to the secretariat costs

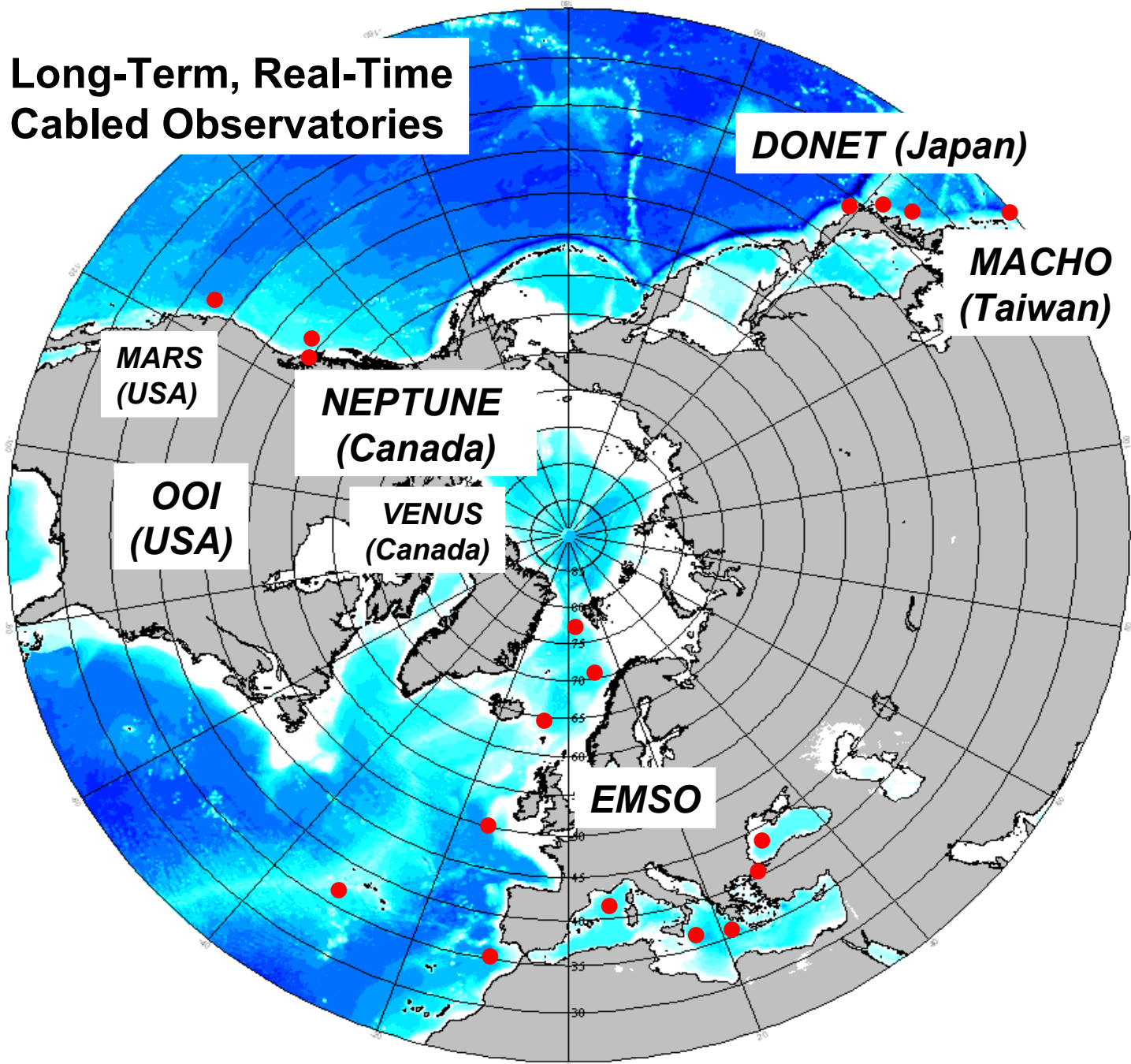
# Data Management (open access)

Orfeus workshop, 25-28 May 2011, IM Lisbon





# Long-Term, Real-Time Cabled Observatories



# Synergies with other European initiatives

• EMSO is complementary to other initiatives such as:

➤ EUROARGO as the Eulerian counterpart



➤ KM3NeT with respect to associate sciences



➤ SIOS as the marine component



➤ EPOS for marine and land data integration



➤ ICOS for marine data



➤ EUROSITES water-column community



➤ EUROFLEETS for the optimal share of ship resources



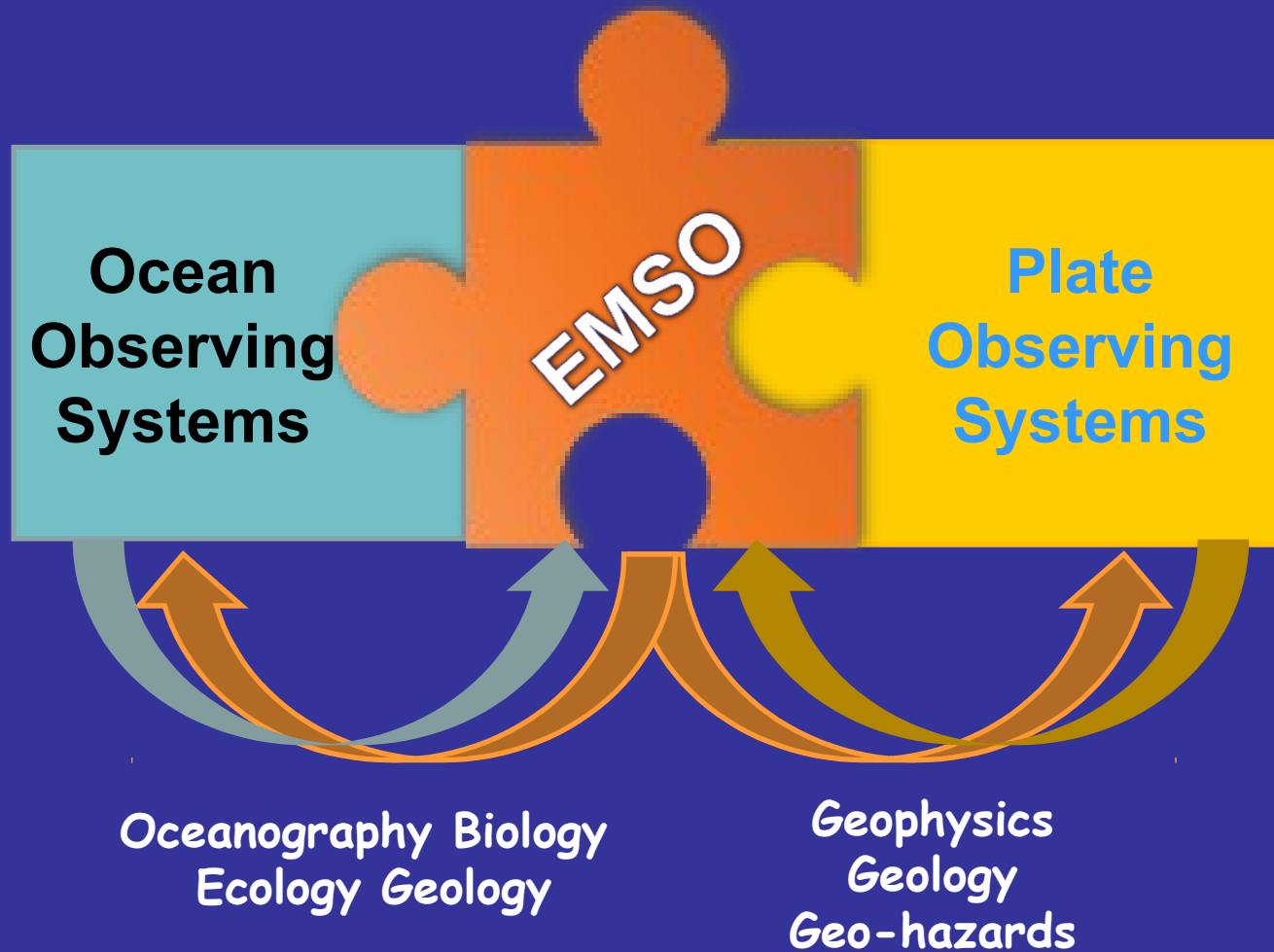
# Integration with other Research Infrastructures



# Integration with other Research Infrastructures



# Integration with other Research Infrastructures





# Integration into other Infrastructures

## GEOSS

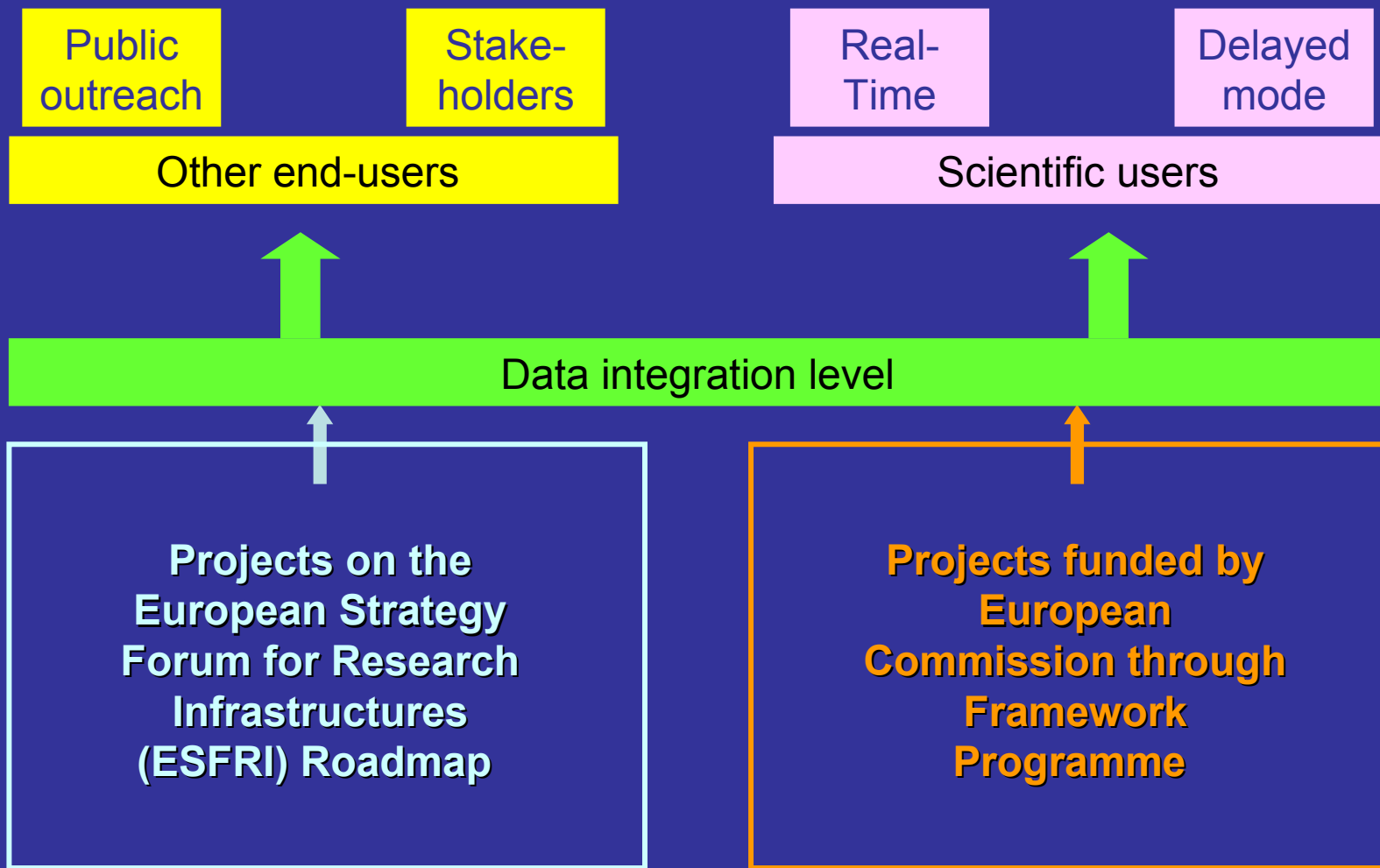


Ocean Observing Systems

EMSO

Plate Observing Systems

# European Approach to Observation Infrastructures





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