european multidisciplinary seafloor observatory emso

KM3NeT

I progetti Europei KM3NeT ed EMSO

Gli osservatori abissali al largo della Sicilia nuova frontiera per la ricerca e la tecnologia: sinergie tra Enti di Ricerca, Università e Autorità Marittime

Paolo Favali

Research Director INGV

EMSO Coordinator

INFN Istituto Nazionale di Fisica Nucleare

Istituto Nazionale di Geofisica e Vulcanologia

INFN-LNS - Portopalo di Capo Passero - 12 luglio 2013

european multidisciplinary seafloor observatory

emso

EMSO European Multidisciplinary Seafloor and water-column Observatory

Paolo Favali

on behalf of EMSO Consortium

European Strategy Forum on Research Infrastructures ESFRI

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

Science Objectives

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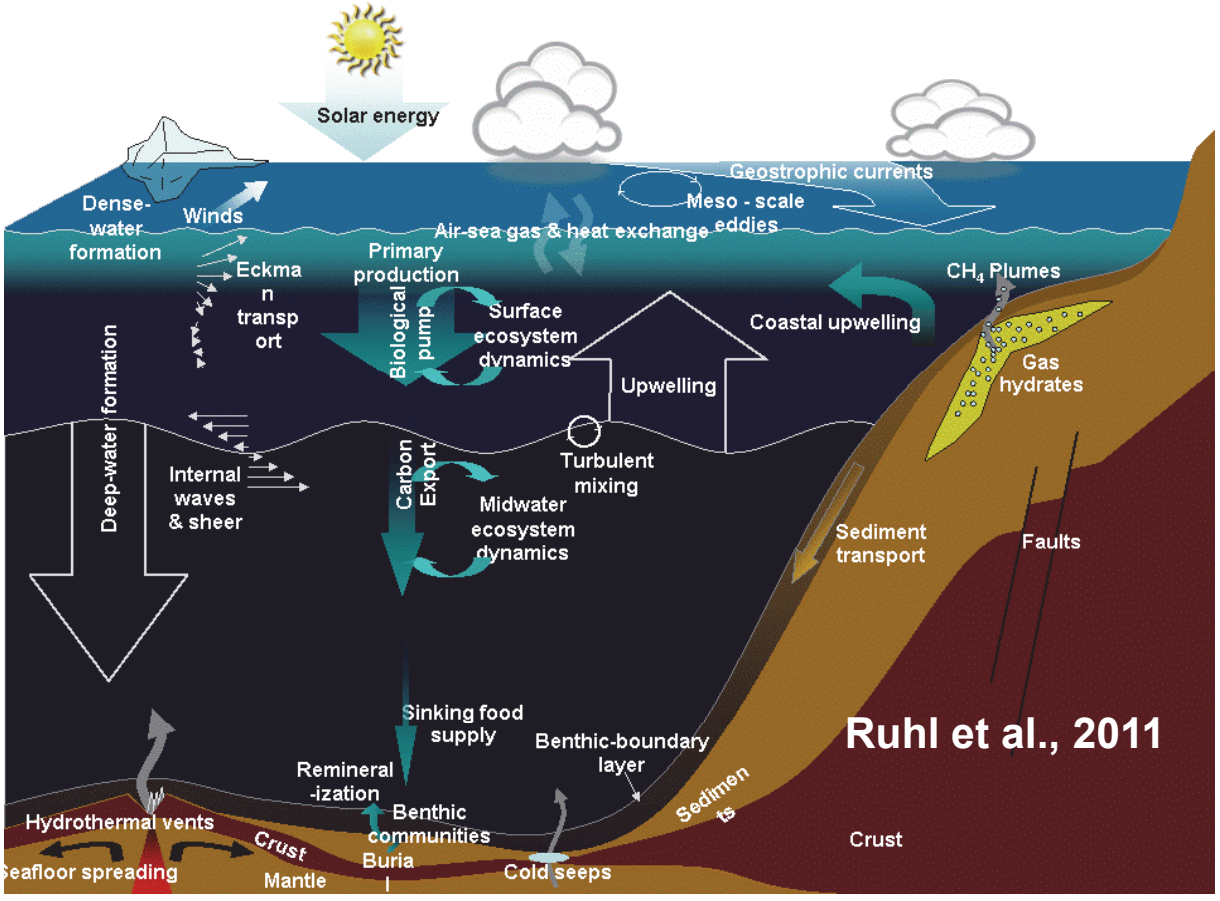
Geosciences

Seismicity
Gas hydrate stability
Seabed fluid flow
Submarine landslides
Geo-hazard early warning

Physical Oceanography

Ocean warming
Wind-driven circulation
Deep-ocean circulation
Benthic-water column interactions
Marine forecasting

MARINE ECOSYSTEMS
GEO HAZARDS
CLIMATE CHANGE



Biogeochemistry

Solubility pump & ocean acidification
Biological pump
Continental shelf pump
Deep-ocean biogeochemical fluxes

Marine Ecology

Climate forcing of ecosystems
Molecules to microbes
Fisheries
Marine noise
Deep biosphere
Chemosynthetic ecology

Fixed-point observatories

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In order to explore the time changing properties of the oceanic environment, sustained observations are essential at a sufficiently high frequency

These provide the means to examine complex interrelations between processes and properties:

- **Short-time scales (minutes, hours to days**
- **Longer-time scales (up to decades)**

A key attribute of many current fixed observatories is that they are real-time multidisciplinary interactive and some cover several environments from the top of the ocean to the seabed

What are fixed stationary platforms?

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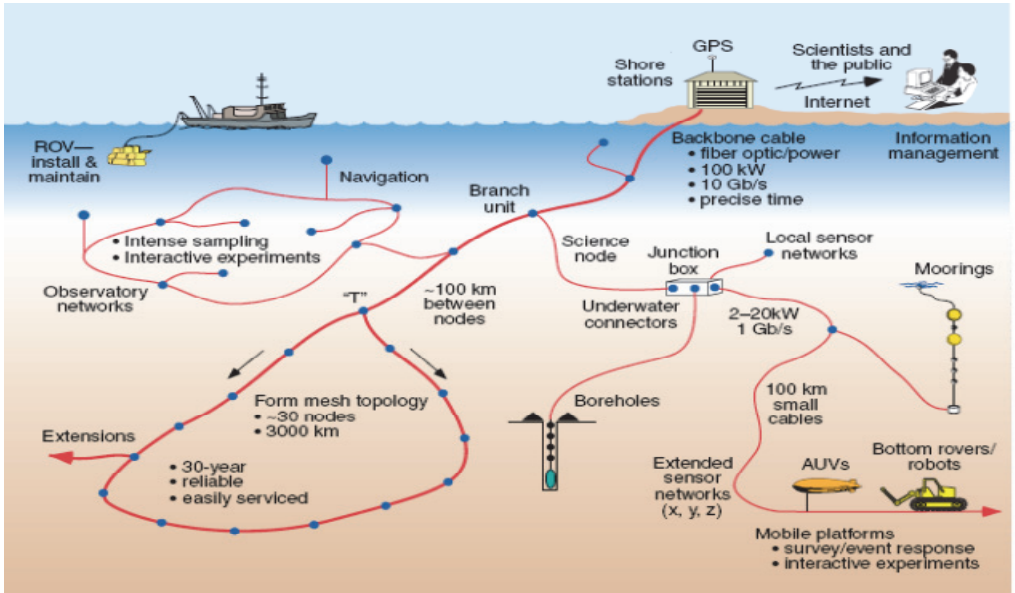
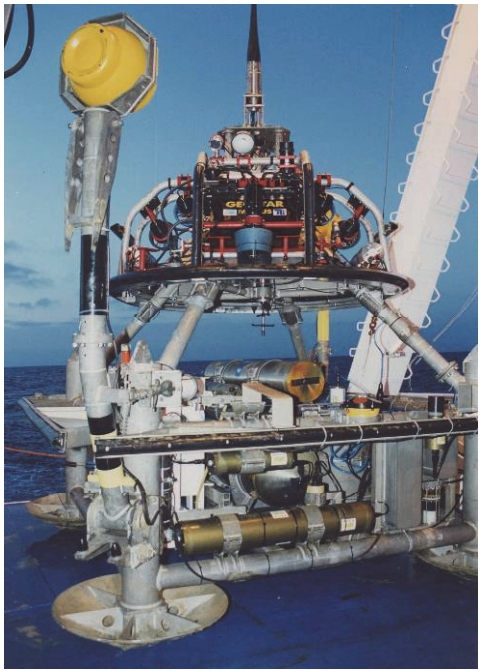
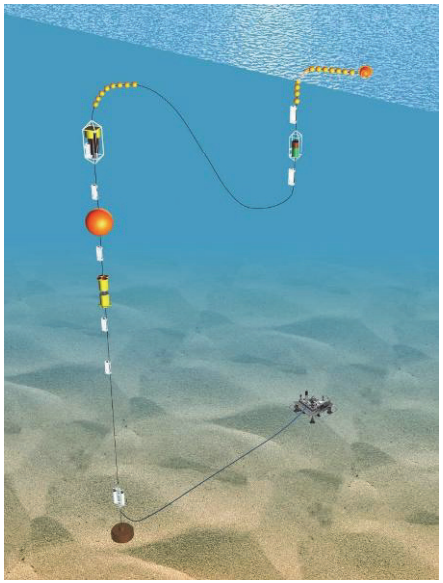
Unmanned, multi-sensor platforms to make measurements from above the air-sea interface to below the seafloor, and with different configurations related to the communications:

Stand-alone and delayed mode

Mooring and seafloor platforms with acoustic/cabled capabilities







EMSO & Society

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Socio-economically important topics which cross-cut the outlined science areas include themes spanning numerous spatial and temporal scales such as:

- **Natural and anthropogenic change**
- **Interactions between ecosystem services, biodiversity, biogeochemistry, physics and climate**
- **Impacts of exploration and extraction of energy, minerals and living resources**
- **Geo-hazard early warning capability for earthquakes, tsunamis, gas hydrate release and slope instability and failure**
- **Connecting scientific outcomes to stakeholders and policy makers**

EMSO Goals

- Develop a global system of multidisciplinary and interdisciplinary sustained observatory networks
- Integrate and enhance the existing infrastructures
- Expansion of observatories in critical, representative locations in particular environments
- Novel scientific achievements
- Technological innovation
- Data harmonisation and quality control so that data are in the public domain immediately after collection
- Develop links with data users: modelling, operational and civilian communities, etc.
- Outreach so that the public and funding bodies use and appreciate the value of observatories

EMSO Governance

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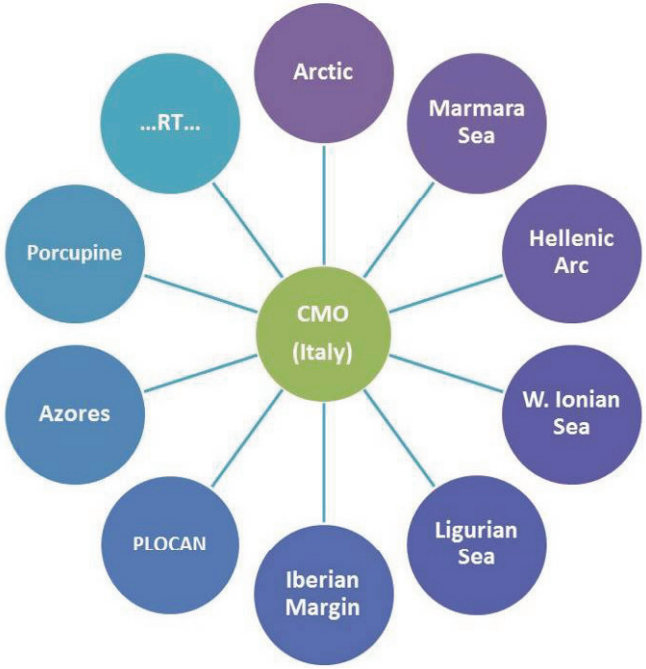
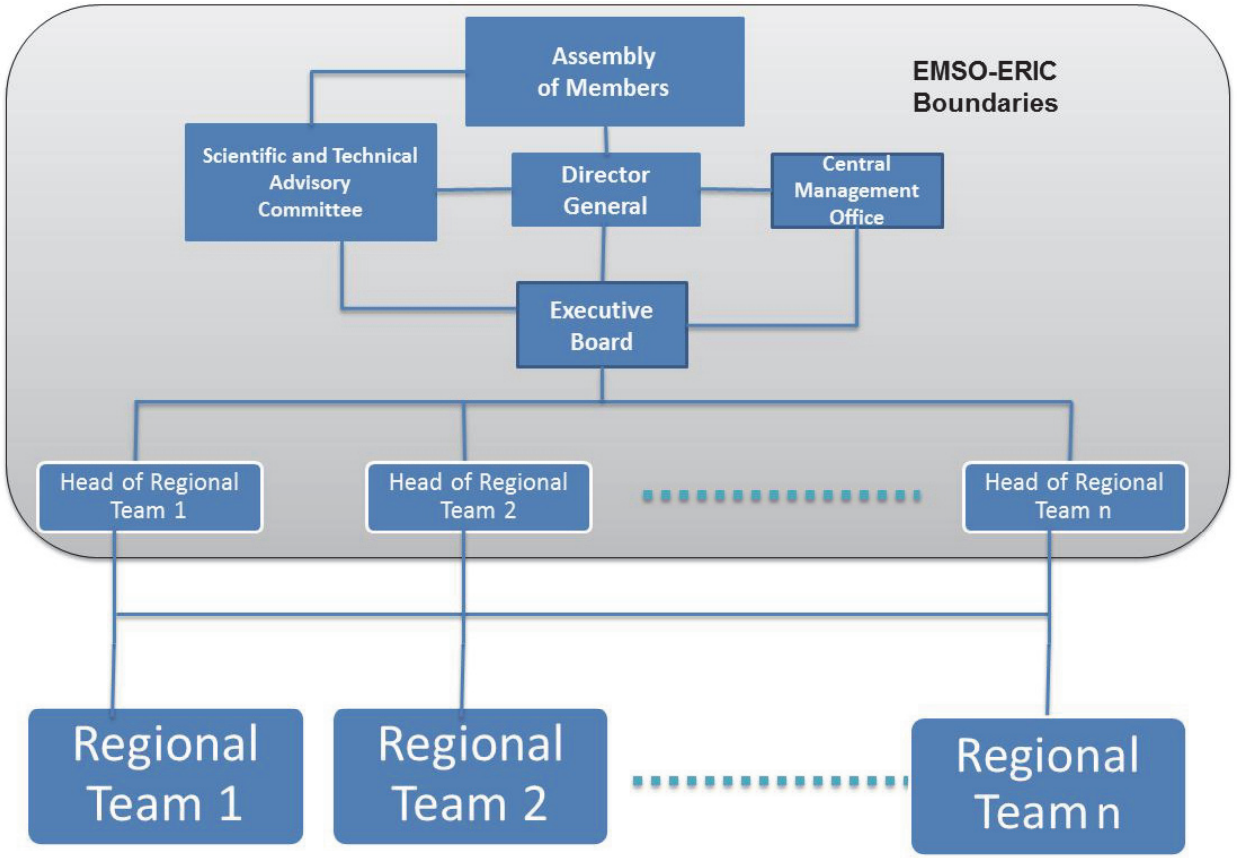
EMSO-ERIC will have:

- Central co-ordination (statutory seat with central management)
- Regional Teams (in charge of the EMSO nodes)





Assembly of Members: highest level decision body composed by Representatives of the Countries

Steps towards EMSO-ERIC

Italian Ministry Letter sent to the Funding Agencies	DONE
MoU Signature process	IN PROGRESS
Interim Office establishment	DONE
ERIC Application submission	ON-GOING
ERIC Application review process	NEXT
ERIC APPROVAL	NEXT

Signatory Countries:

Italy, UK, Portugal, Romania, Greece, The Netherlands, Ireland, Germany, France, Spain*

*officially announced

Foreseen:

Norway, Turkey

Postponed:

Sweden

International dimension

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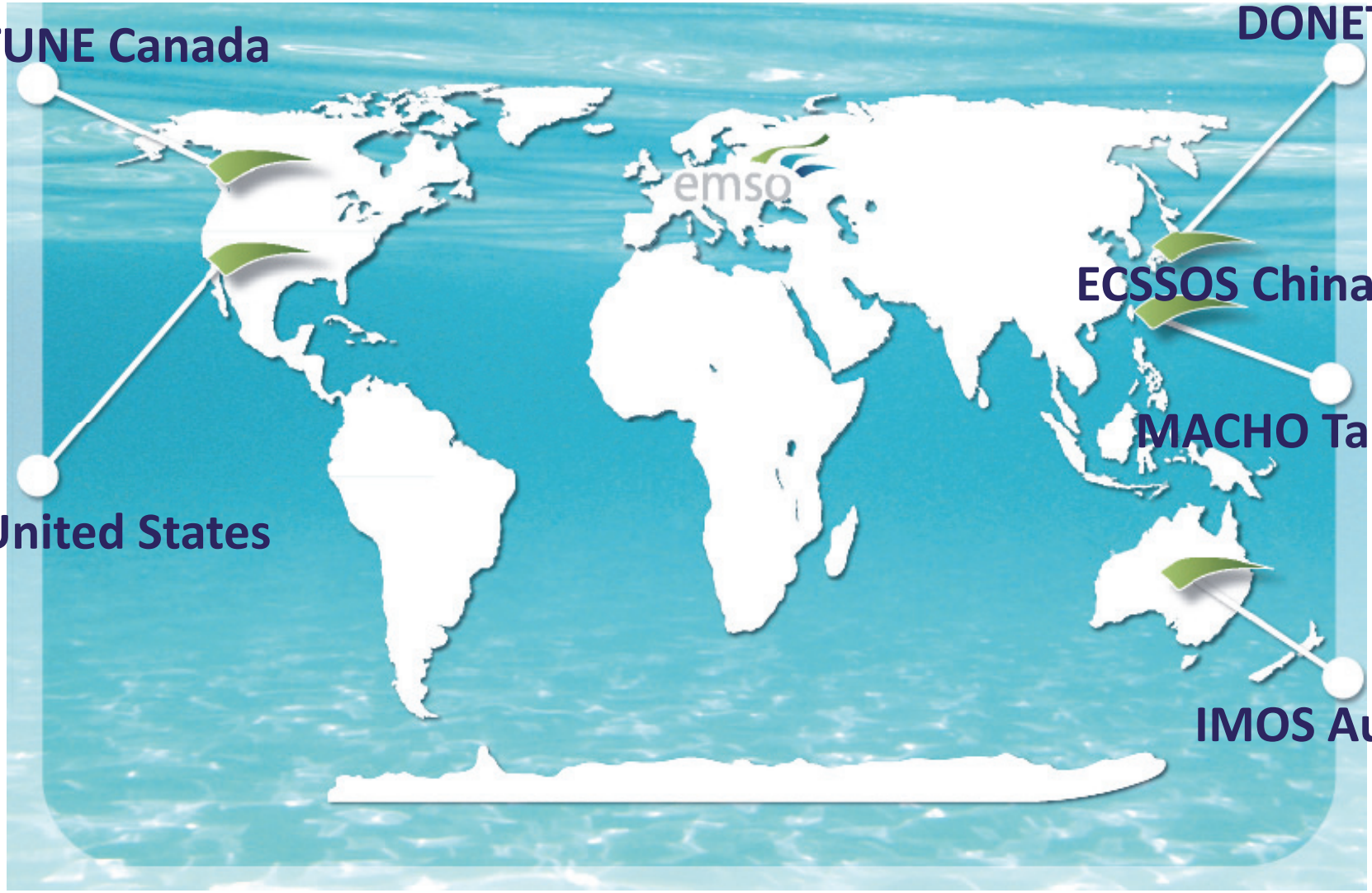

EMSO contribution to GEO

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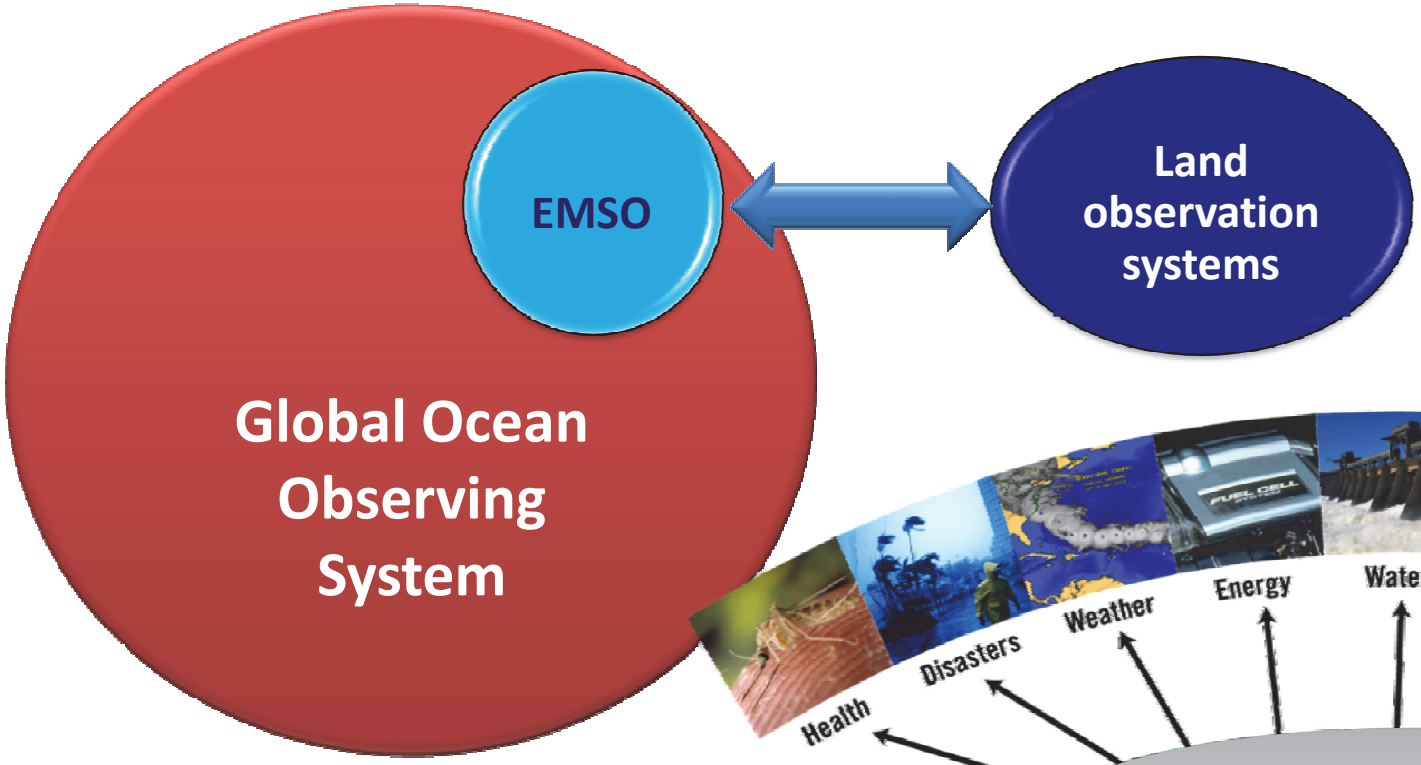
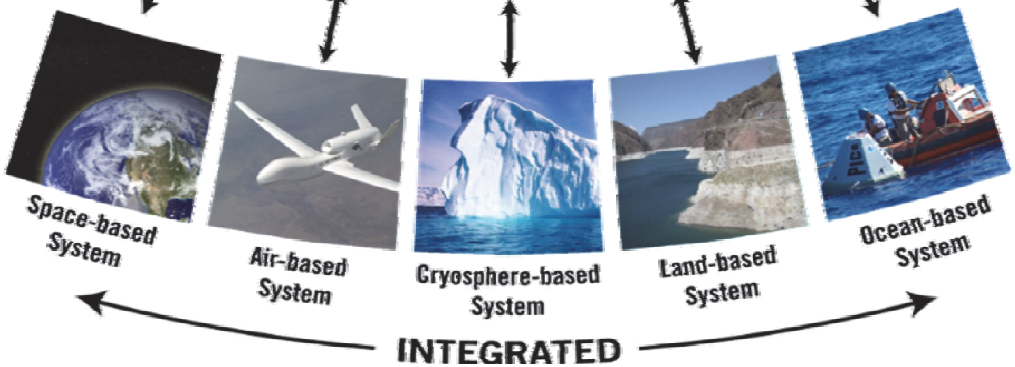


Land observation systems

GEOSS



Integration in GEOSS

EMSO nodes

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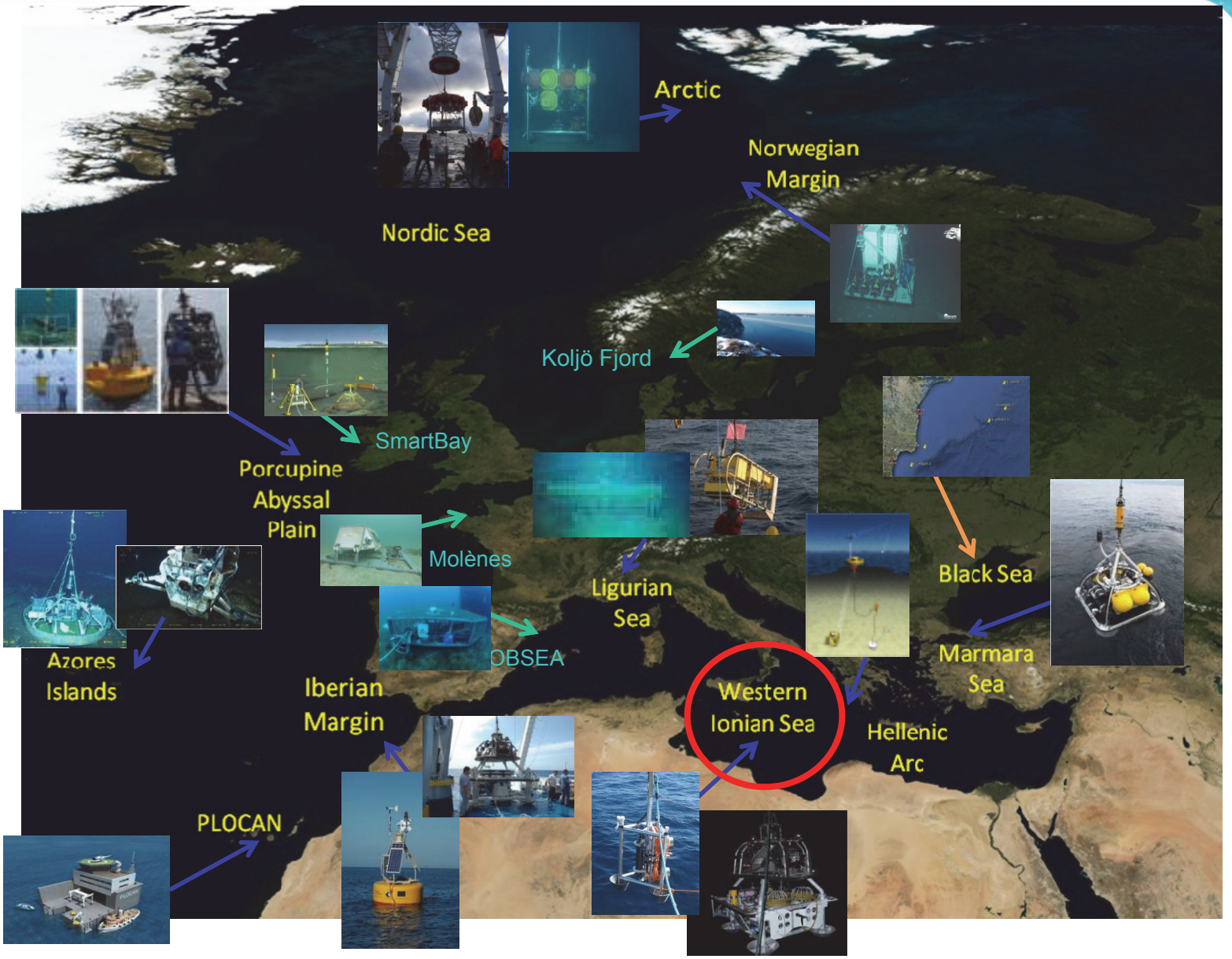

EMSO nodes: present status

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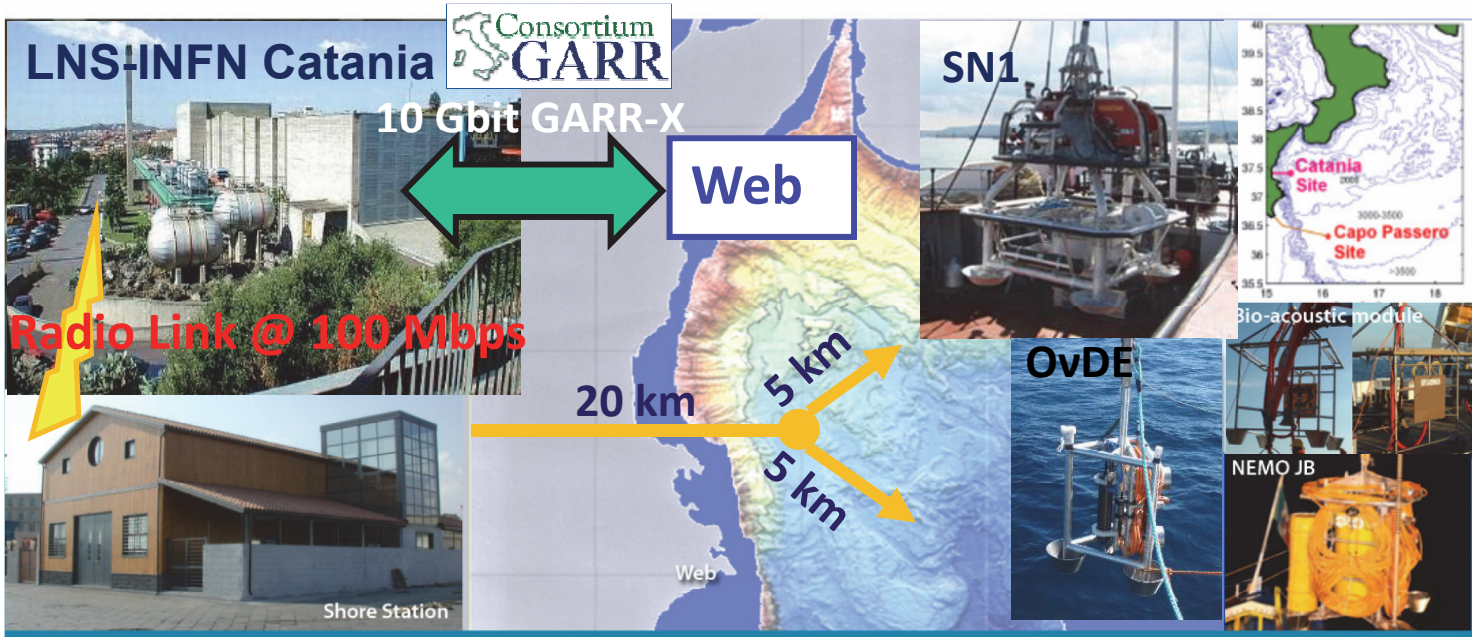


INFRASTRUCTURE **NEMO-SN1 seafloor observatory**, cabled to laboratory in the harbour of Catania by electro-optical cable

OPERATING IN REAL TIME SINCE 2005 Integrated with land-based networks by transmitting real- time data to National Seismological Service Centre in Rome; Test site for realisation of the underwater neutrino telescope

RESEARCH Geohazards, tsunami, climate change, bioacoustics and ambient noise.

PREVIOUS/RECENT ACTIVITIES LAMS and SIRENA FESR projects (national). GNDT-SN1 (national). PEGASO project (Structural funds). ESONET demo missions (LIDO, LIstening to the Deep Ocean environment). GENESI-DEC, SCIDIP-ES (FP7 infrastructures), KM3NET, TRANSFER

FUTURE ACTIVITIES extension of the Catania 30-km cabled; Off Capo Passero 100-km cabling, it has been operating from 2011; Further implementation adding water column and data management from 2012

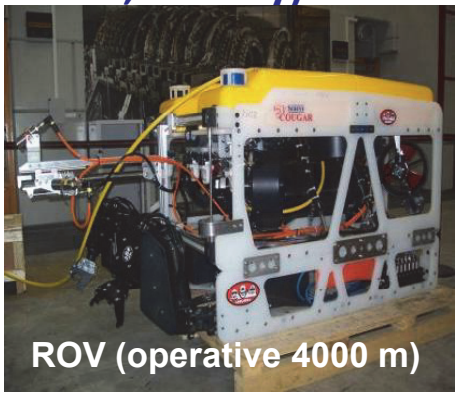
WESTERN IONIAN SEA

Geo-hazards
(earthquakes, tsunamis, volcanic activity)

KM3NeT

Bio-acoustics
(mammal tracking)

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


ROV (operative 4000 m)

NEMO-SN1 New equipment's

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

* tsunami early warning system - Geo-Hazard

** 96 kHz at TSN, 192 kHz at TSS - Marine Environment

Favali et al., 2011; 2012; Chierici et al., 2012

EMSO data examples

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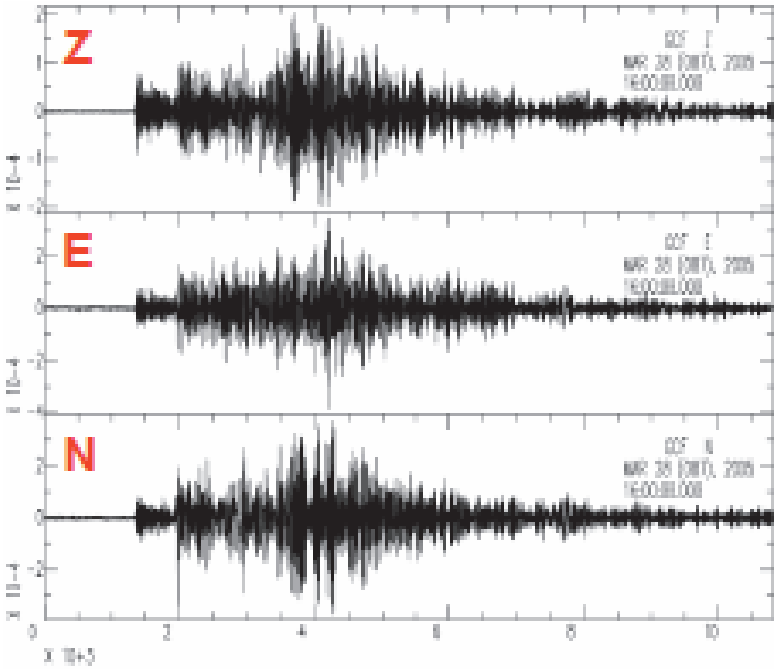
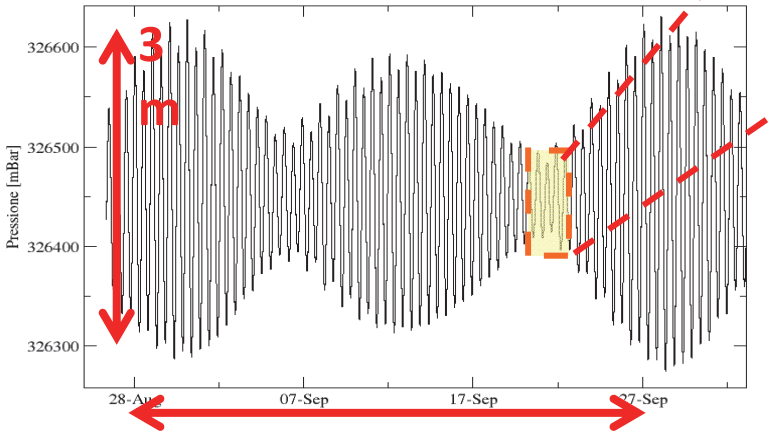
Western Ionian Sea

Multiparametric observatory for early detection of tsunamigenic events:

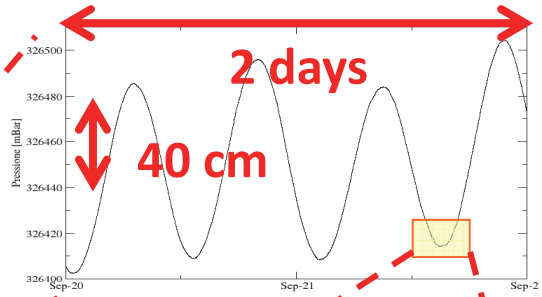
- Seismic waves
- Magnetic field change
- Absolute pressure
- Low *f* sound waves

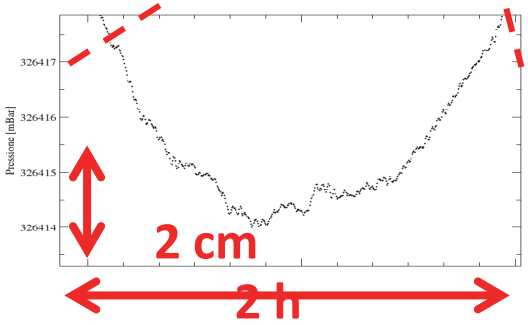


M_W 8.5 Sumatra (March 28, 2005)

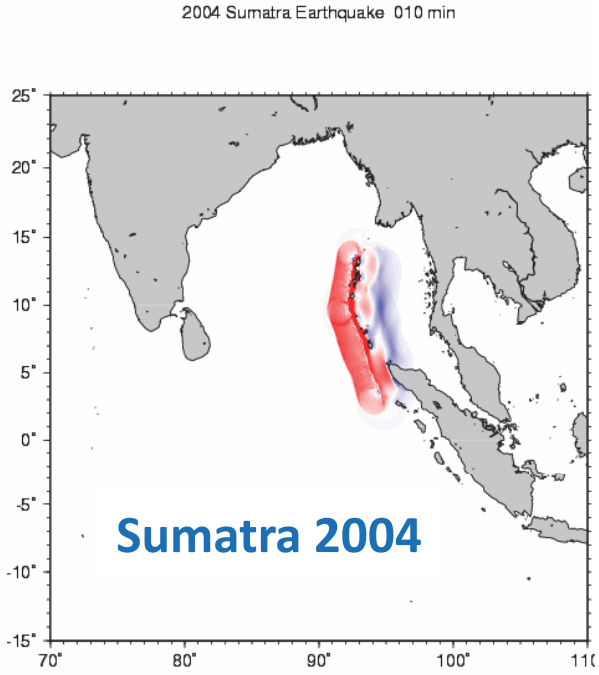


1 month





Pressure: 1cm H_2O ~ 1mbar



EMSO data examples

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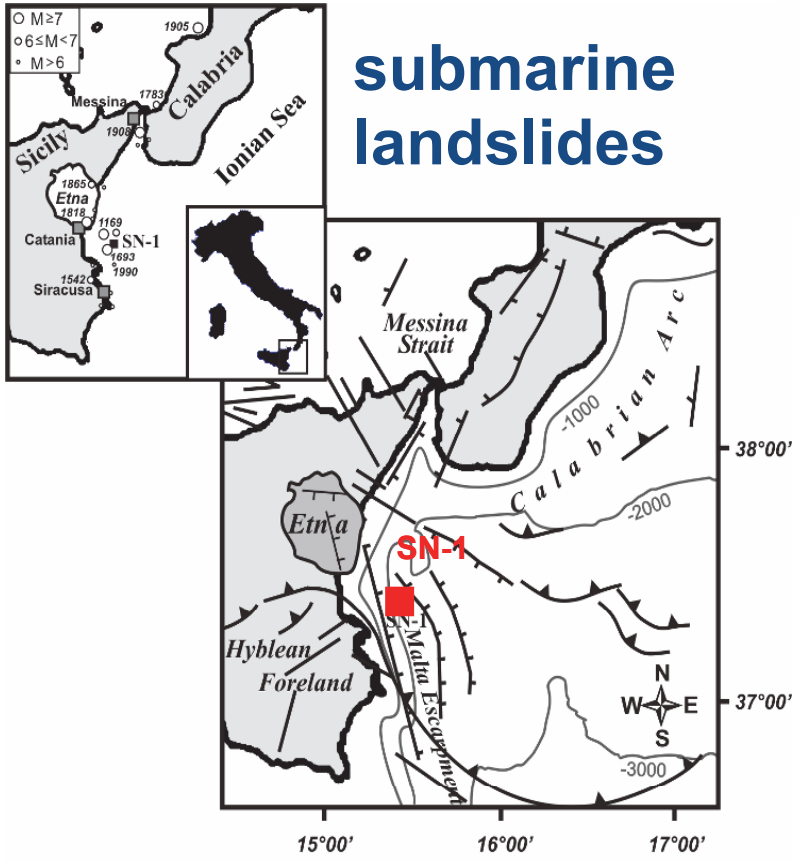
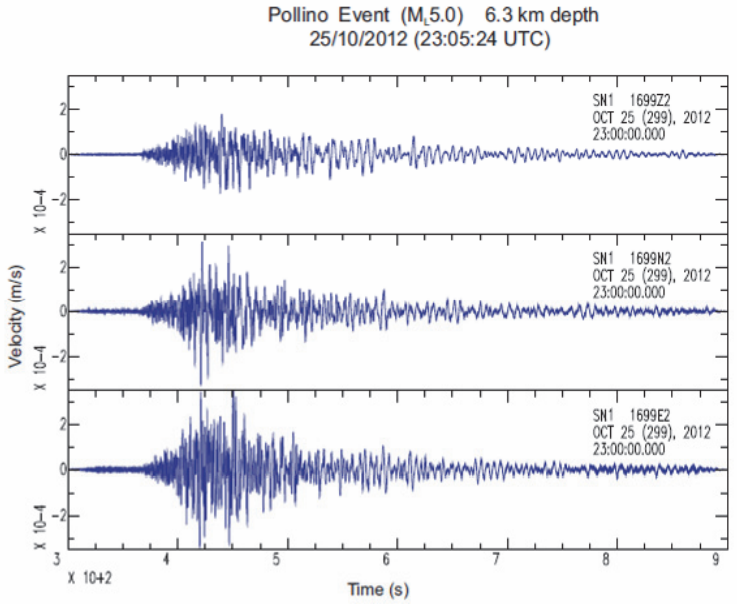
Western Ionian Sea

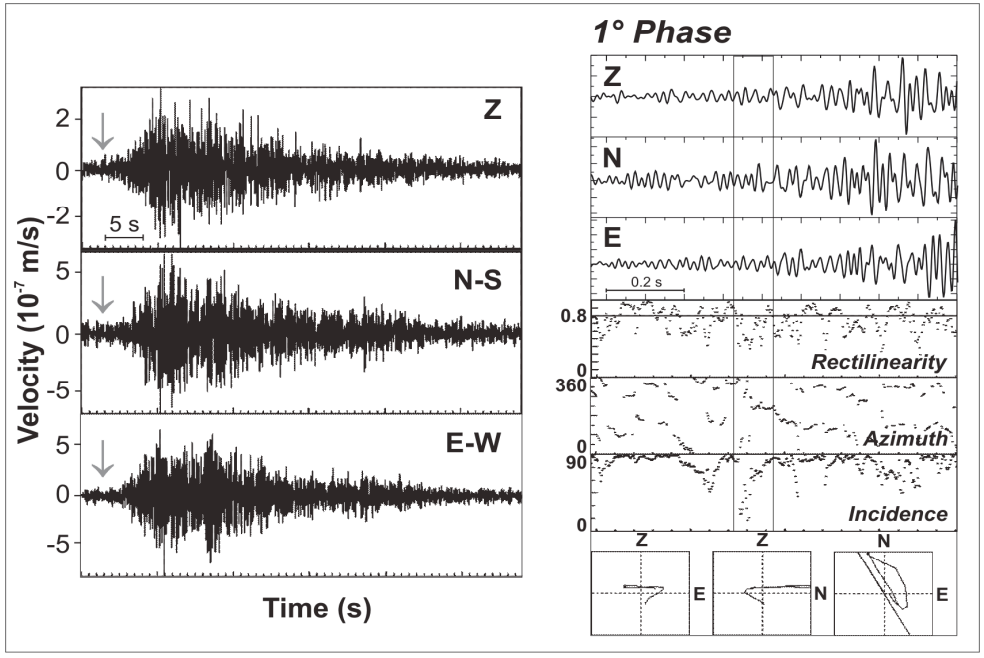
Geo-hazards:



submarine landslides



earthquakes



EMSO data examples

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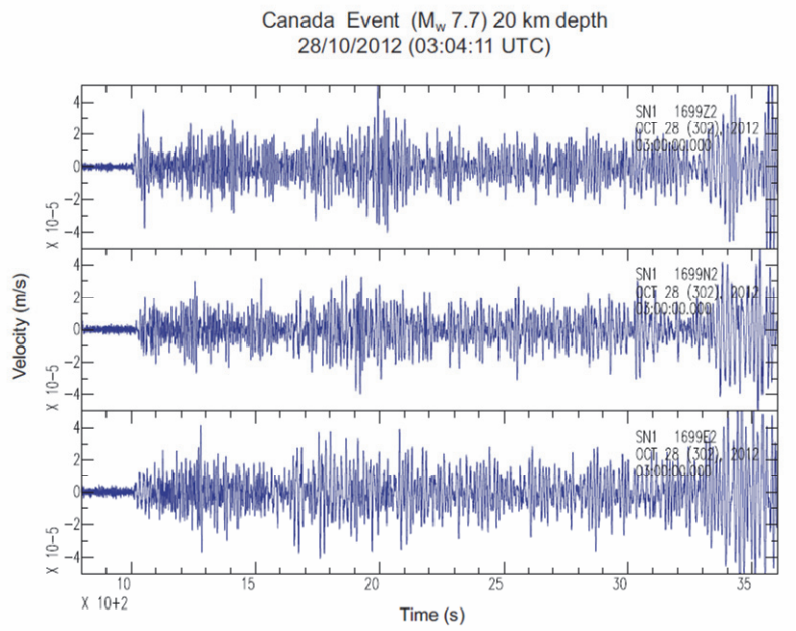
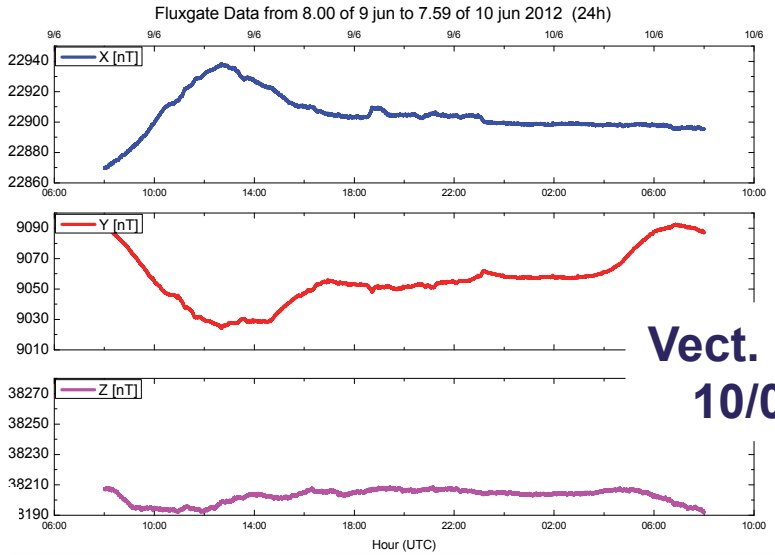
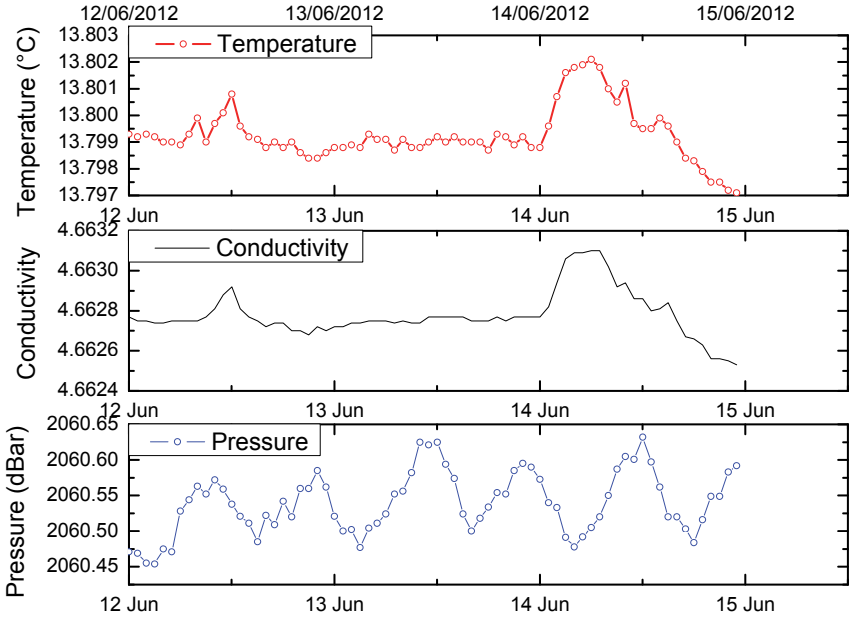


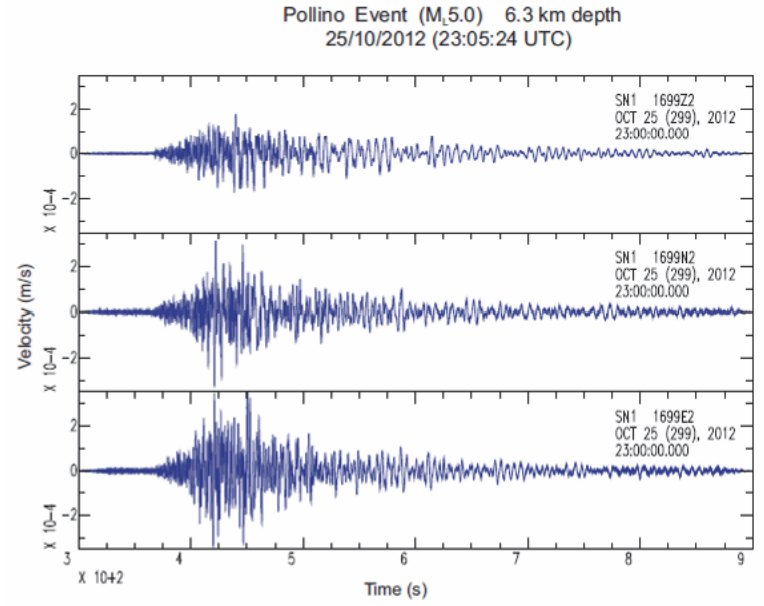
Western Ionian Sea



Vect. magnetometer 10/06/2012 (24h)



CTD 12-14/06/2012



EMSO data examples

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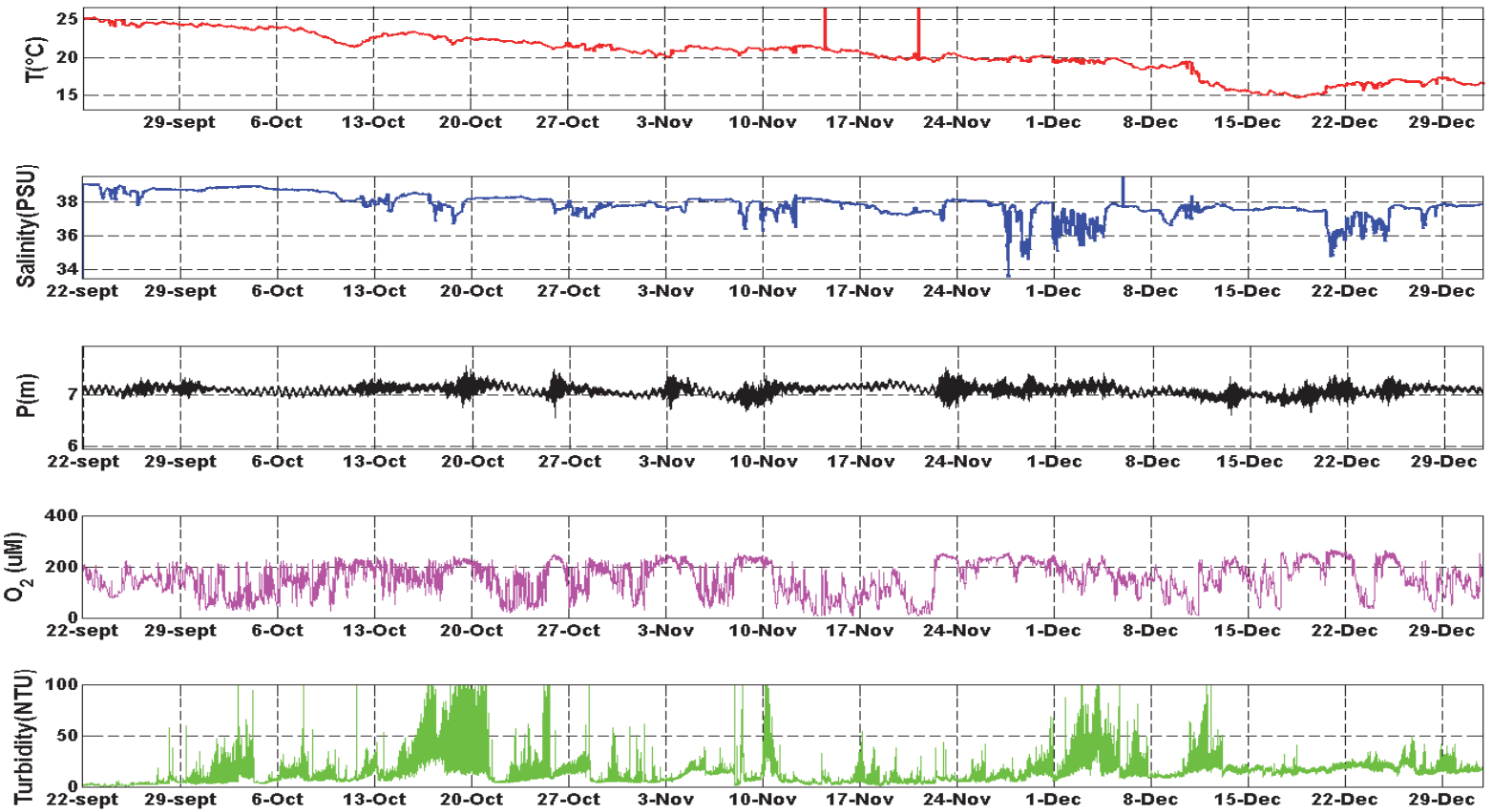
Western Ionian Sea

Oceanography:



temperature

salinity

pressure

oxygen

turbidity

EMSO data examples

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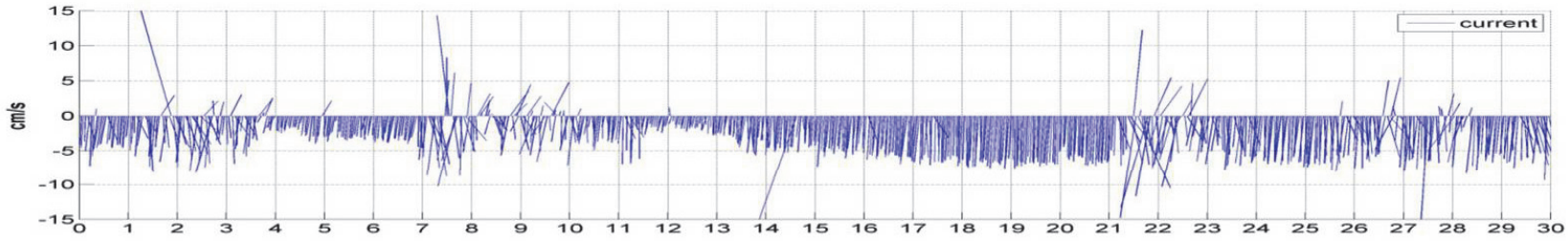
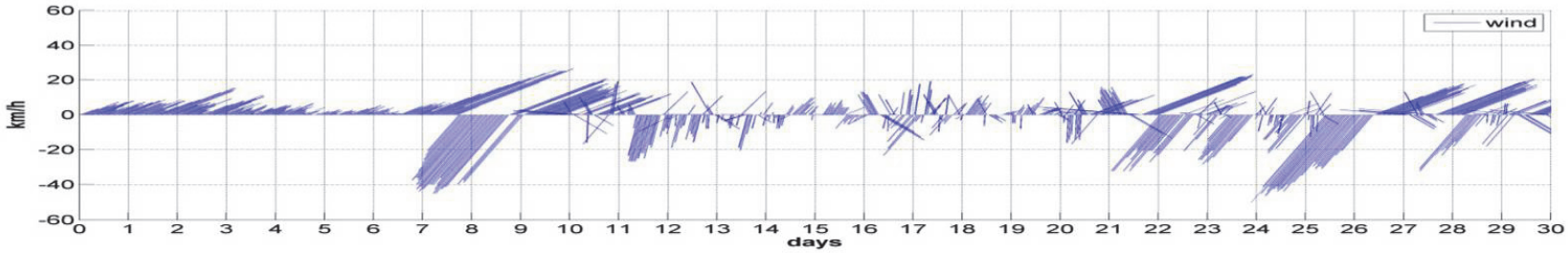
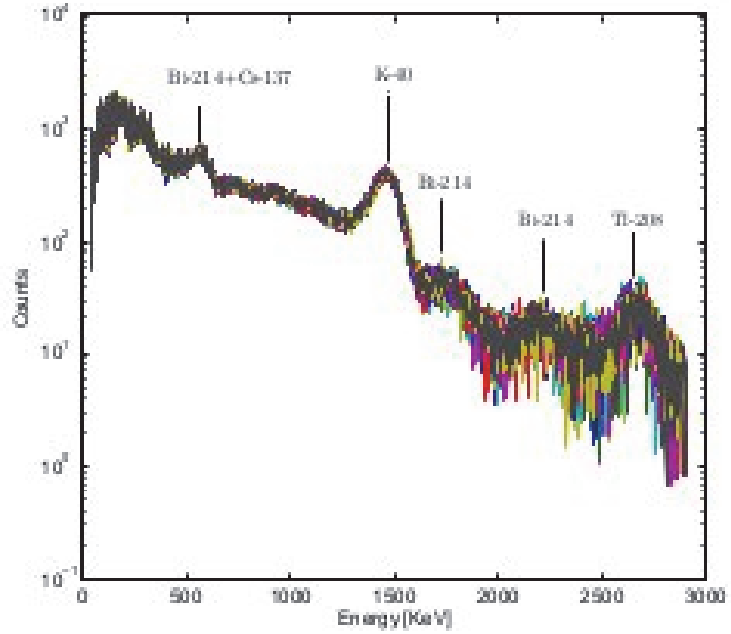
Oceanography: Western Ionian Sea





current



radioactivity

Gamma Energy Marine Spectrometer detects total gamma spectrum in ocean seawater

EMSO data examples

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Western Ionian Sea

NEWS FEATURE

The neutrino and the whale

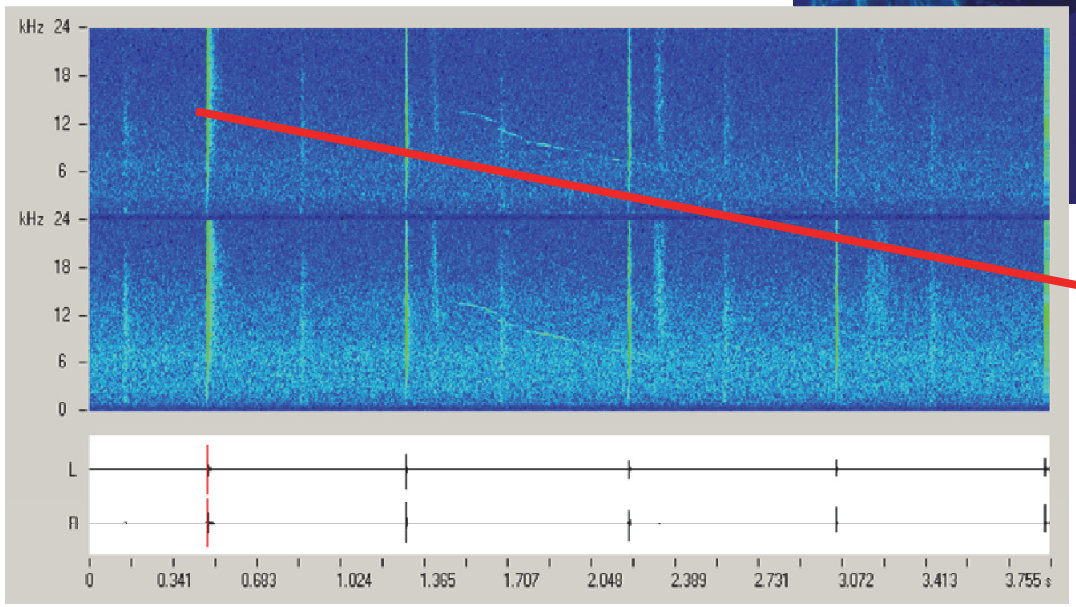
N. Nosengo, G. Pavan, G. Riccobene

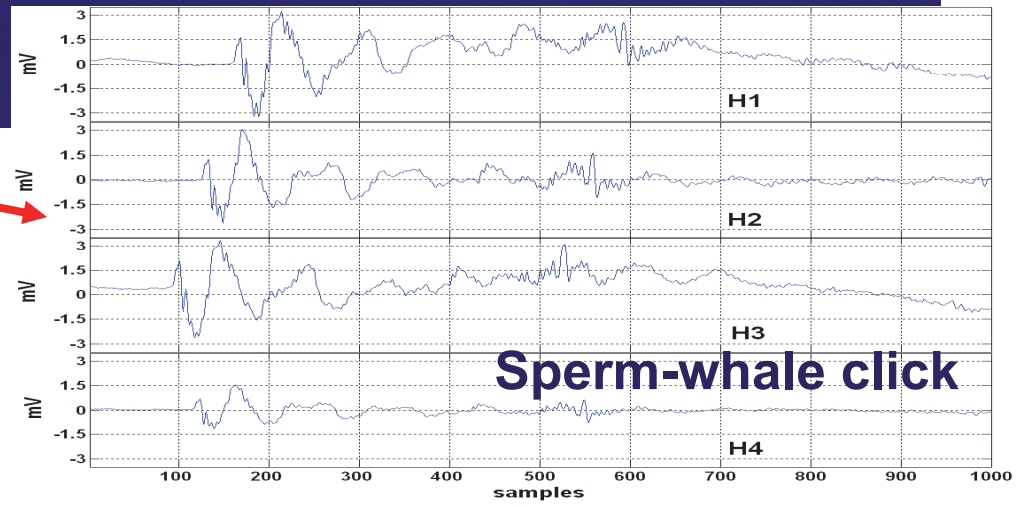
NATURE Vol 462 - 3 December 2009

Acoustic array

INFN

INGV





Sperm-whale click

CA.BI.RI.A.- CApodoglio, BIodiversità e RIschi Ambientali
Azioni urgenti per la conservazione di Capodoglio in Sicilia

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Program LIFE + Biodiversity 2013

Physeter Macrocephalus inserito nella Red List dell'IUCN, protetto a livello internazionale

Canale di Sicilia e Mar Ionio aree di intensa attività di navigazione

Partner: Università di Catania, Università di Messina, Università di Torino, Università di Pavia-CIBRA, CNR, ENEA, CTS-Green Factor

Enti di supporto: INFN, INGV, Capitanerie di Porto, Compagnie di navigazione

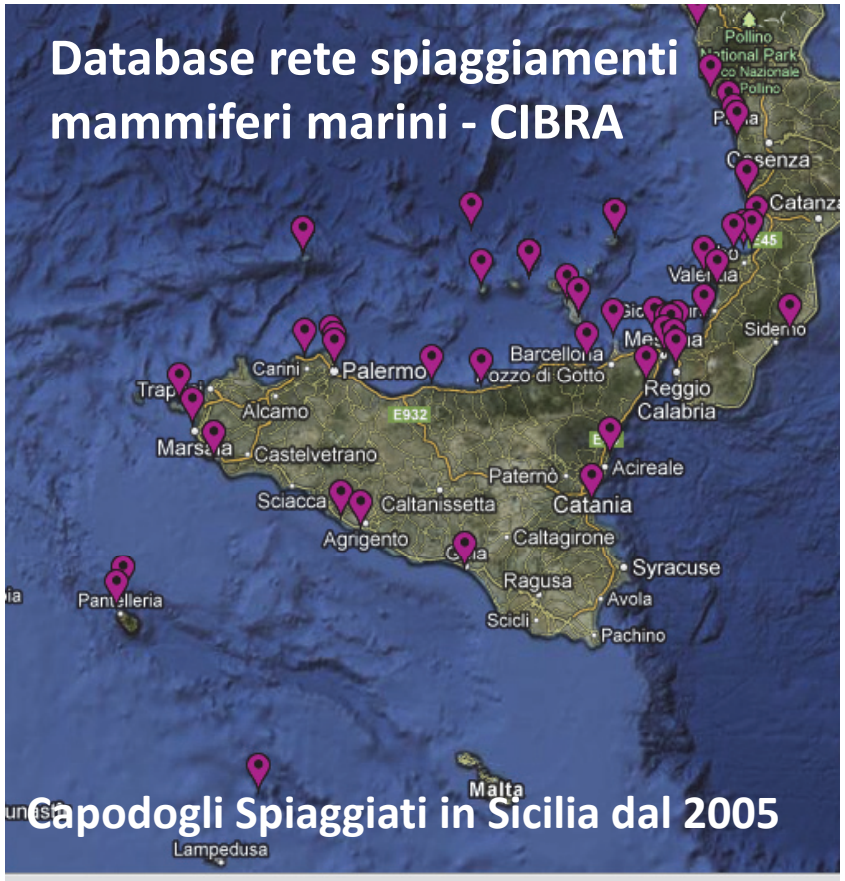
Infrastrutture Europee: KM3NeT, EMSO

Costo del progetto 4M€ Durata 5 anni

Primo network Italiano per la ricerca in bio-acustica sottomarina

Azioni di conservazione

1. Creare una rete di stazioni cablate e sonoboe in grado di identificare la presenza real-time di capodogli
2. Diminuire il rischio di collisione acustica e fisica tra gli animali e le imbarcazioni
3. Fornire una mappa di rischio nelle zone di maggiore presenza della specie



CA.BI.RI.A.- CApodoglio, BIodiversità e RIschi Ambientali
Azioni urgenti per la conservazione di Capodoglio in Sicilia

european multidisciplinary seafloor observatory emso

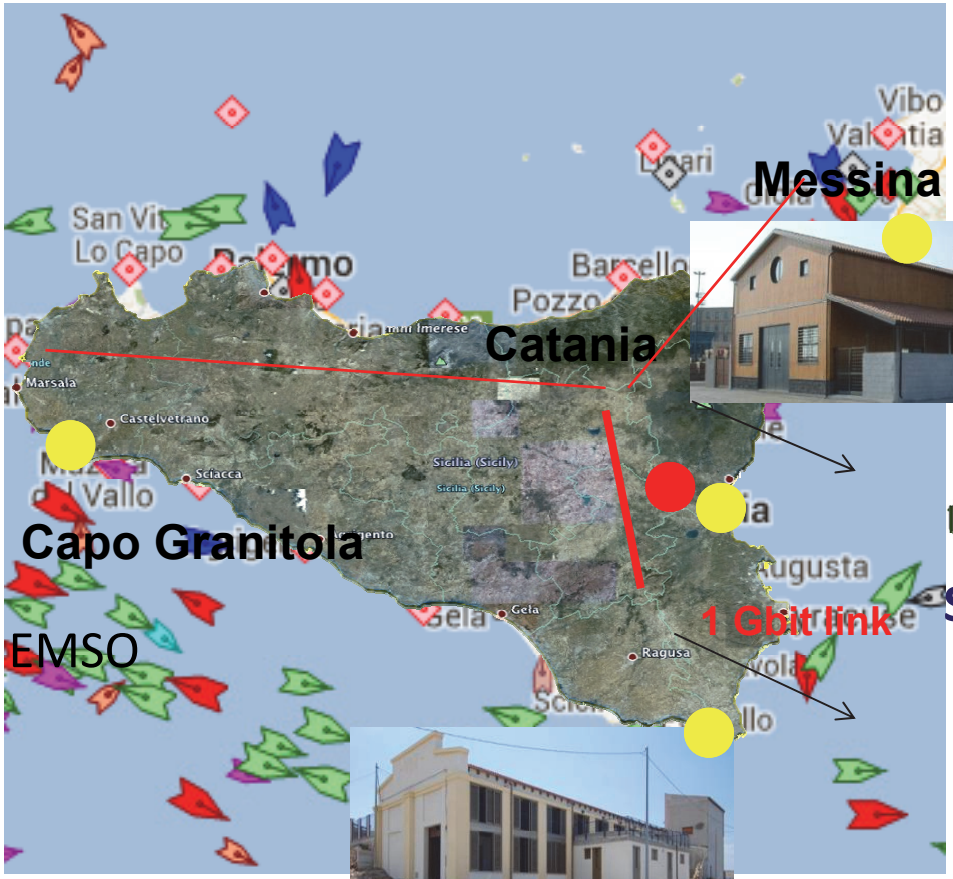
Program LIFE + Biodiversity 2013

Antenna acustica Sottomarina o sonoboa

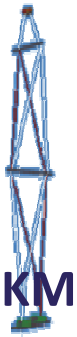
Laboratorio di terra: Analisi, identificazione e tracciamento

Sistemi AIS: tracciamento navi

Allerta: Capitanerie di porto e compagnie di navigazione



SN1 → EMSO



SMO → KM3NeT

Data Base: INFN GRID-GARR

CREEP-2 deep sea deformation lab

european multidisciplinary seafloor observatory emso

Time-Dependent Brittle Creep in Rocks: Bridging the Strain-Rate Gap From Laboratory to Crustal Time-scales

(CREEP-2)

Funded by NERC 2009-2014

Motivation

- Earthquake rupture and volcanic eruptions are the most dramatic manifestations of the failure of a critically stressed crust
- But these are actually rare events, both in space and time
- Most of the crust spent most of its time in a highly stressed but sub-critical state
- Our work therefore addresses the time-dependent sub-critical deformation that precedes dynamic failure

INFN Istituto Nazionale di Fisica Nucleare

Istituto Nazionale di Geofisica e Vulcanologia

ROCK AND ICE PHYSICS LABORATORY UNIVERSITY COLLEGE LONDON

CREEP-2 deep sea deformation lab

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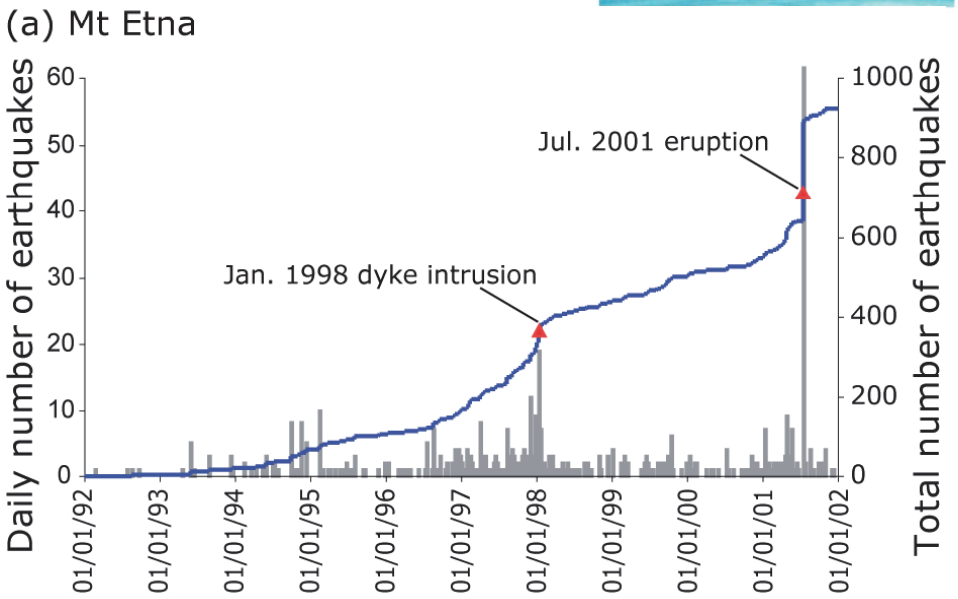
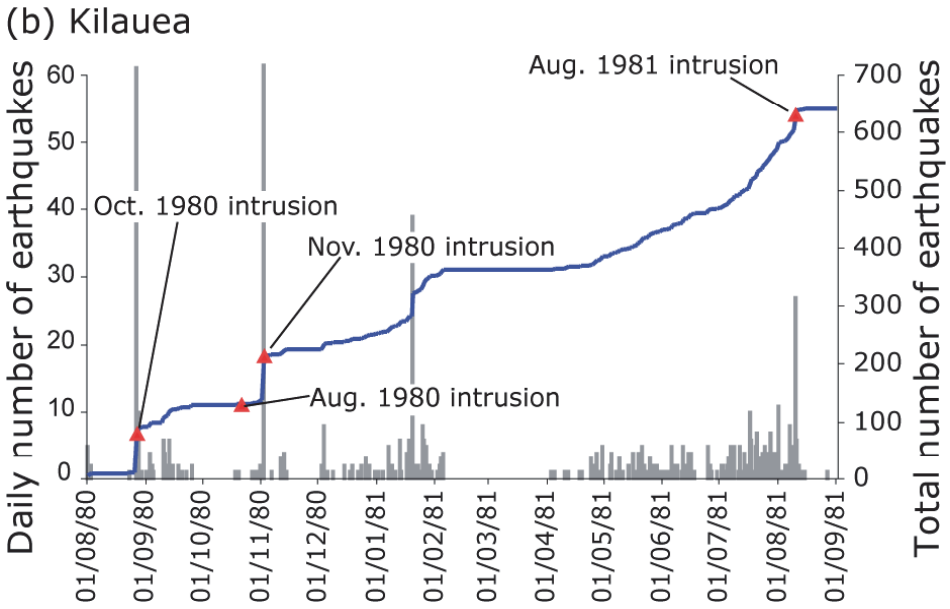
Accelerations preceding crustal failure

ROCK AND ICE PHYSICS LABORATORY
UNIVERSITY COLLEGE LONDON





CREEP-2 deep sea deformation lab

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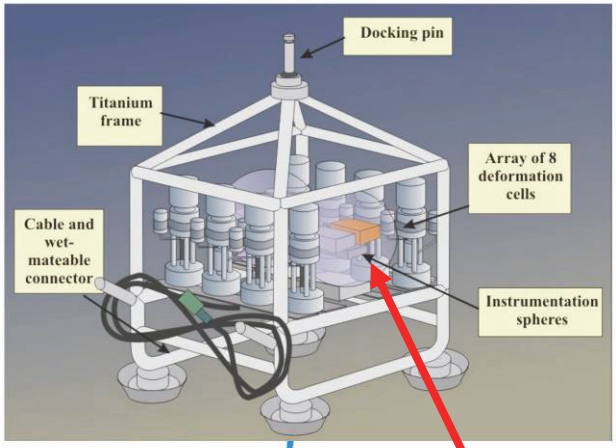
INFN-LNS laboratory

CREEP-2 (UCL)



SN-1 (INGV)

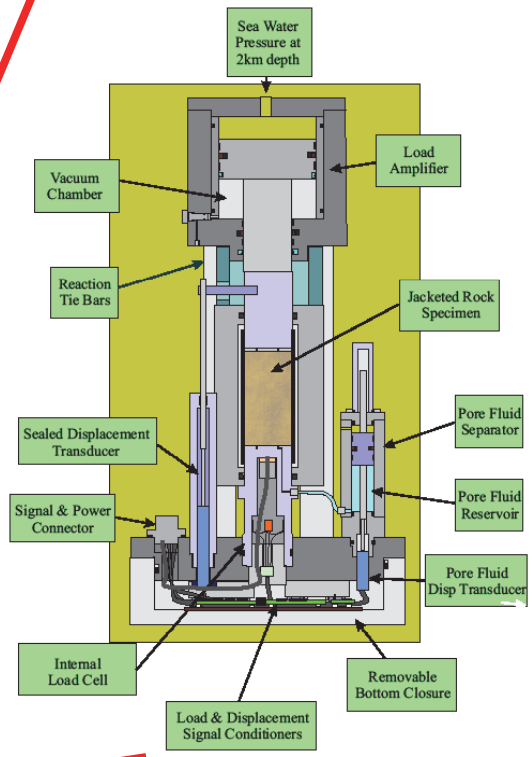
Observatory site, Sicily (2100m m. w. d.)

20.6km single-shield underwater cable

2.3km double-shield cable

Bridging the Strain Rate Gap: **Experiment durations from 3 months to 2 years Strain rates from 10-10 to 10-11 s-1**

Integrated Load Frame with Pressure Vessel and 20 MPa Pore Fluid Seperator



ROCK AND ICE PHYSICS LABORATORY
UNIVERSITY COLLEGE LONDON

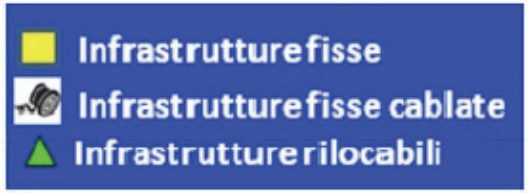
EMSO-MedIT

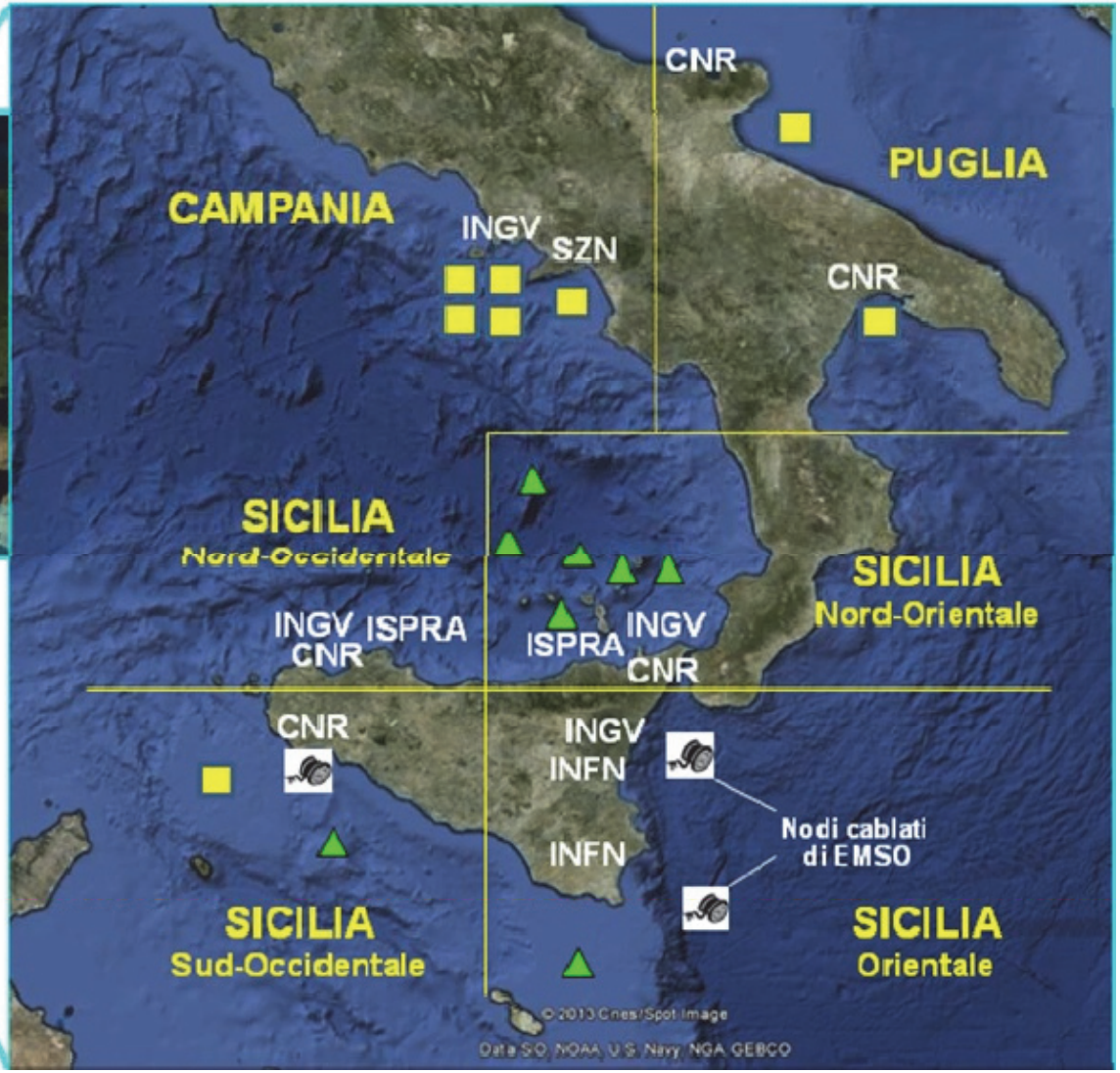
european multidisciplinary seafloor observatory emso

Potenziamento delle infrastrutture multidisciplinari di ricerca marina in Sicilia, Campania e Puglia quale contributo alla ESFRI EMSO (PAC - Piano di Azione Coesione D.D. n°1258-28/6/13)

EMSO-MedIT
nel contesto di EMSO e di EMSO-Italia

Finanziamento: 19.983 M€
Partner:
INGV (coord.), INFN, CNR, SZN, ISPRA





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- WP1: Coordinamento e Gestione del Progetto di Potenziamento e Governance (INGV)
- WP2: Potenziamento della Campania (Golfo di Napoli e di Pozzuoli) (SZN)
- WP3: Potenziamento della Puglia (Golfo di Taranto e di Manfredonia) (CNR)
- WP4: Potenziamento della Sicilia Orientale (Catania e Portopalo) (INFN)
- WP5: Potenziamento della Sicilia Sud-Occidentale (Capo Granitola) (CNR)
- WP6: Potenziamento della Sicilia Nord-Occidentale (INGV)
- WP7: Potenziamento della Sicilia Nord-Orientale (Messina, Milazzo, Isole Eolie) (ISPRA)

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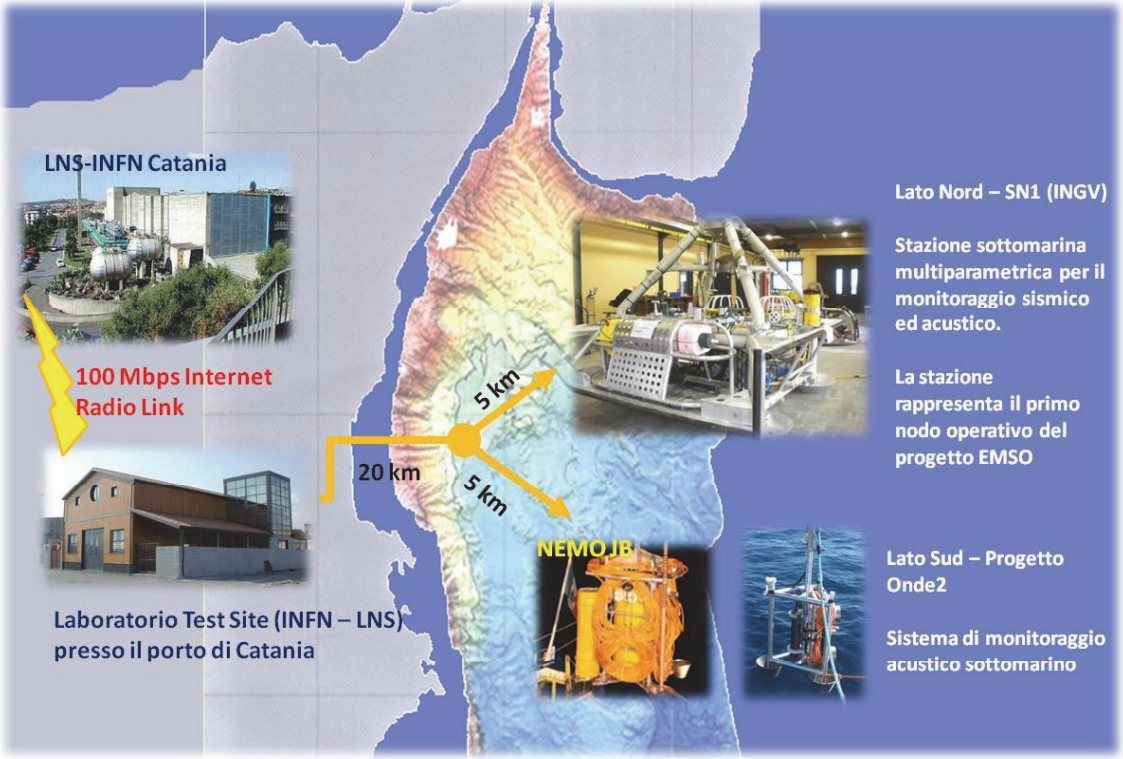
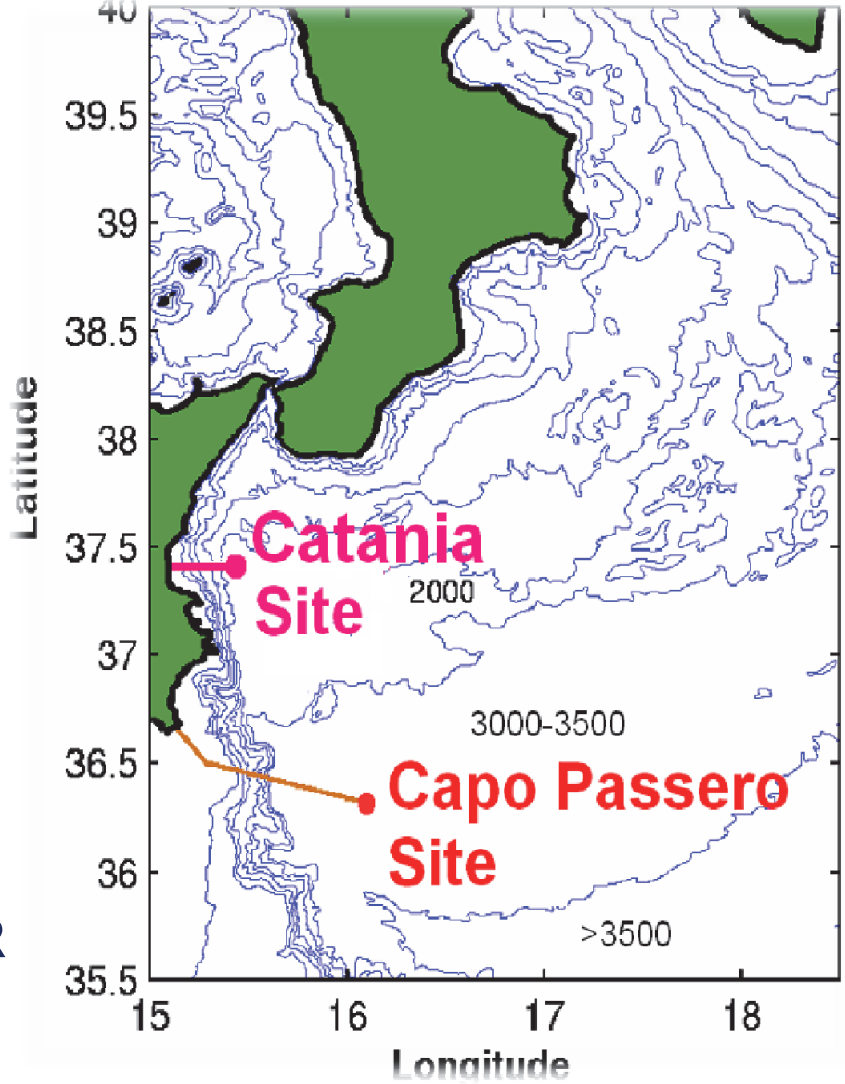
WP4
Potenziamento Nodo Sicilia Orientale
(Catania - Portopalo)





Enti coinvolti: INFN (WP4 coord.), INGV, CNR

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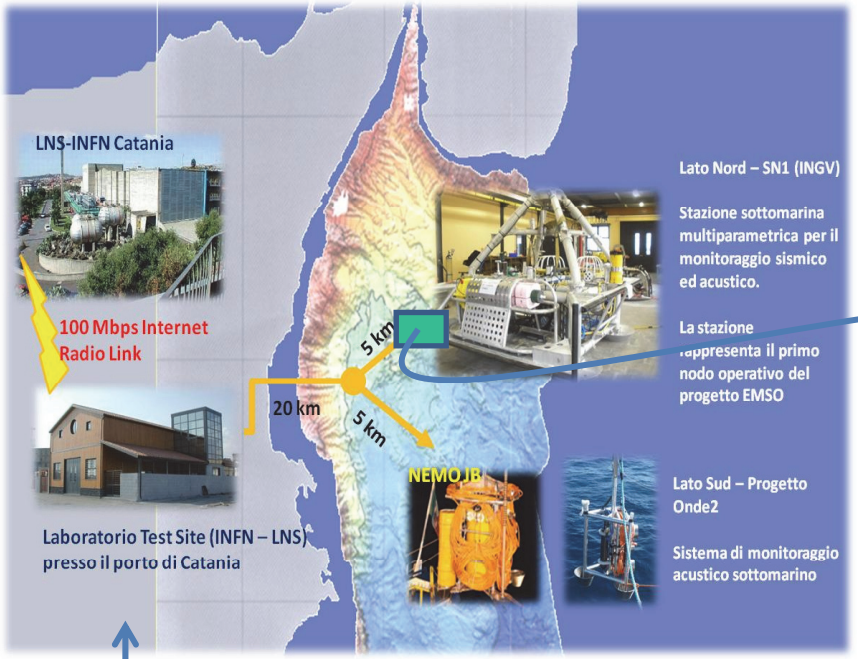
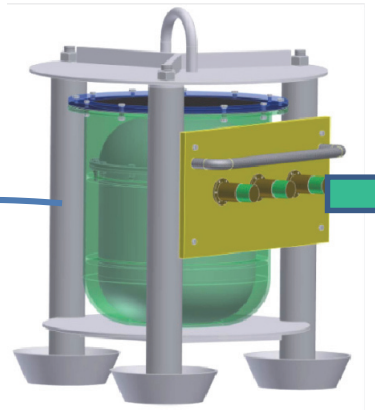
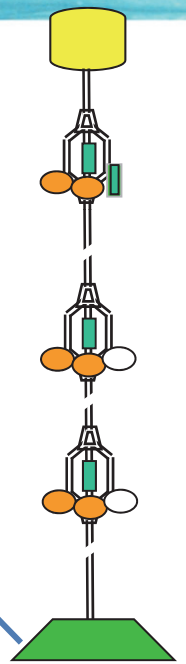
WP4 - Nodo di Catania







INGV

CNR

Storage
Computing
Connessione

INGV
INFN

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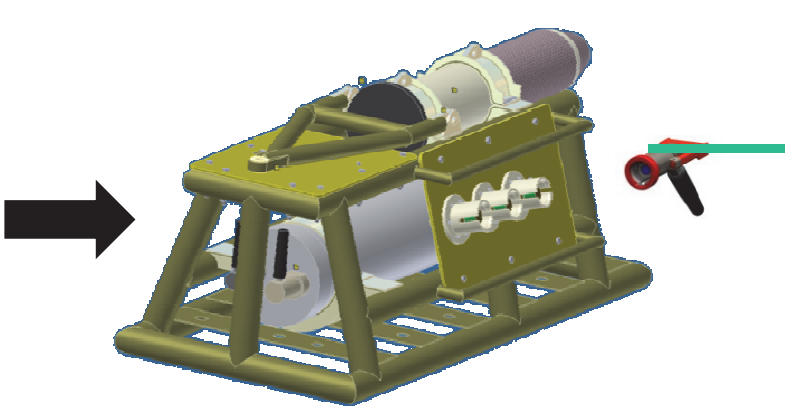
WP4 - Nodo di Portopalo
Infrastruttura sottomarina



INFN **INGV** **INGV**

Profondità 3500 m
Distanza dalla costa 80 km

Collaborazione INFN-INGV

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- 1996 - Inizio della collaborazione
- dal 2001 - Convezione Quadro (Comitato Paritetico e Accordi di Programma)
- 2005 - Operazioni marine congiunte per: terminazioni con frame dei 2 rami del cavo EO di Catania, deposizione e connessione real-time OvDE e SN1
- 2005-2008 - POR PEGASO, Regione Siciliana (INGV coord., INFN partner)
- 2006-2010 - EC KM3NeT Design Study (INFN e INGV partner)
- 2007-2011 - EC ESONET-NoE (INFN e INGV partner)
- 2009-2013 - FIRB SMO (INFN coord., INGV partner)
- 2013-2015 - PAC EMSO-MedIT (INGV coord., INFN partner)

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Grazie per l'attenzione

http://www.emso-eu.org
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