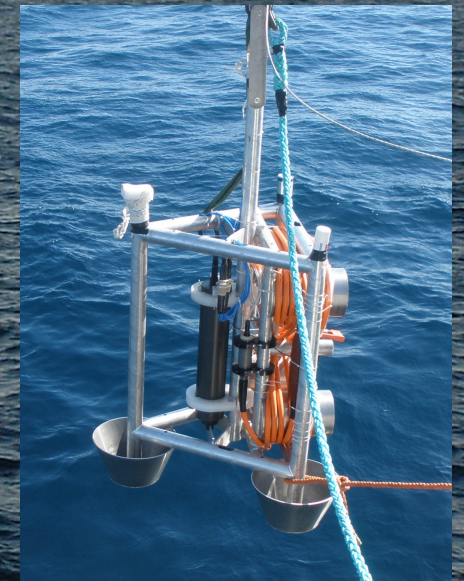


VLVNT 2018



The Italian Site for KM3NeT ARCA

Giorgio Riccobene
INFN –LNS



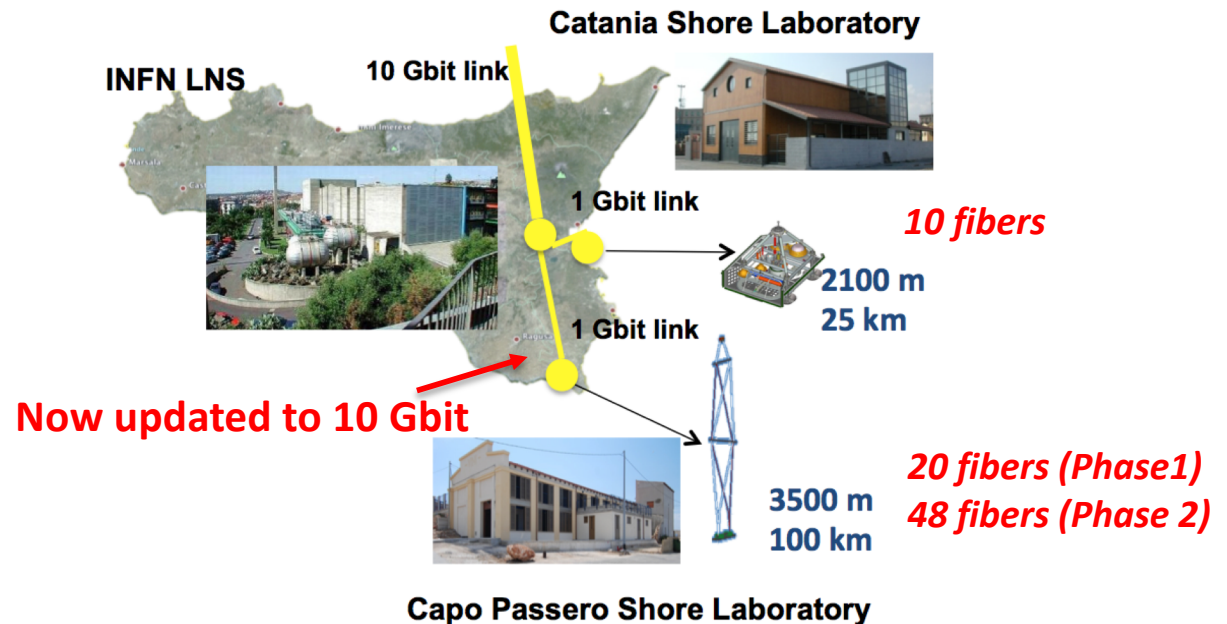
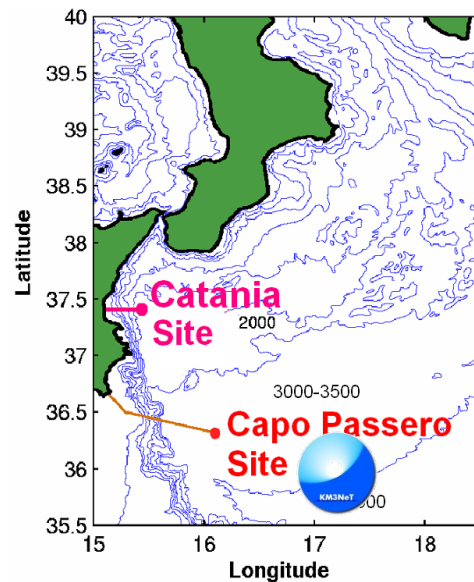
Two deep sea infrastructures built by INFN-LNS in Sicily

Capo Passero Site (KM3NeT-ARCA):

90 km South East offshore Capo Passero, 3500 m depth

Catania Test Site (deep Sea laboratory, first node of EMSO):

25 km East offshore the port of Catania, 2100 m depth



Capo Passero Site:

Abyssal Site

Oligotrophic environment

Gate to the Sicilian Channel

Catania Test Site (with INGV, first cabled node of EMSO):

Coastal Site, Close to ports and shipping lanes

East flank of the Etna Volcano, On the Sicilan-Maltese shelf break

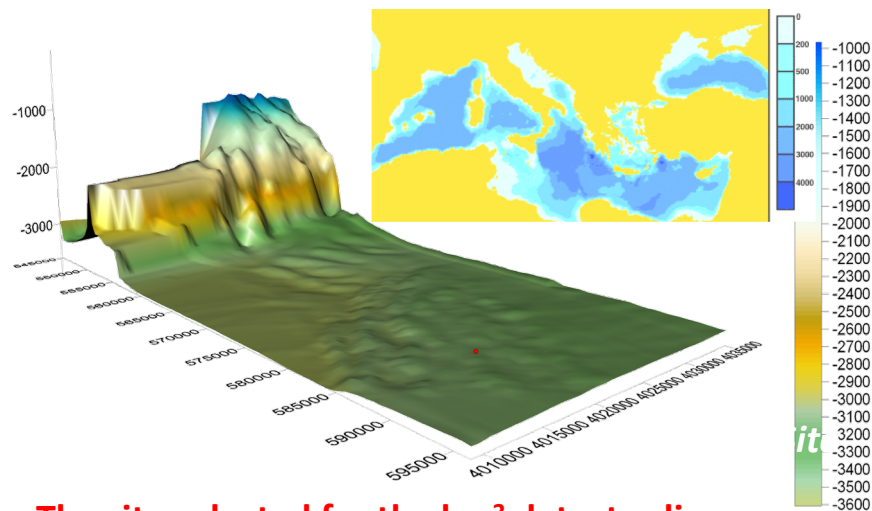
Gate to the Messina Strait

More than 30 naval campaigns seeking deep sea sites in the Mediterranean Sea. Capo Passero is an optimal site.

- Depth >3500 m, 90 km distance from the shore
- Excellent water optical properties ($L_a \approx 70 \text{ m @ } \lambda = 440 \text{ nm}$)
- Optical background from bioluminescence extremely low
- Deep sea water currents are low and stable (3 cm/s, 10 cm/s max)
- Wide abyssal plain: large extension of the detector



Shore Laboratory in Capo Passero harbour



The site selected for the km³ detector lies on a flat and wide plateau far from the shelf break (reduced risks)

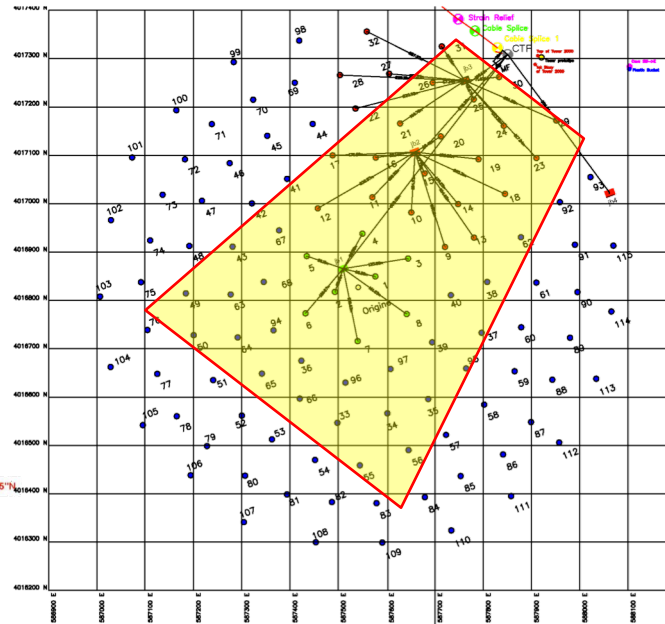
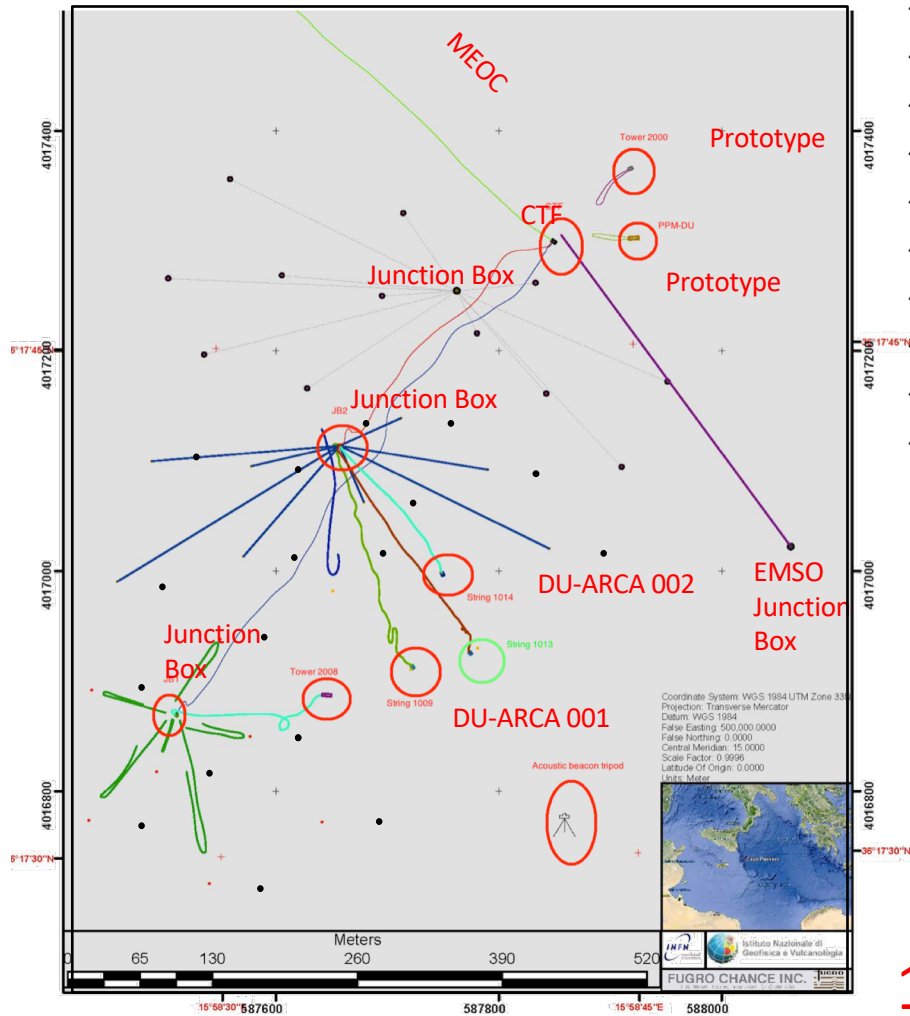
Shore Laboratory:

- Electronics Labs
- Data Acquisition Room, Control Room
- Guest House
- Power Feeding Equipment (UPS protected)
- 10 Gbps direct Optical-fibre link GARR-X

Submarine cable and infrastructure:

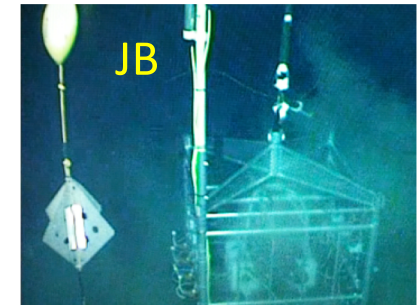
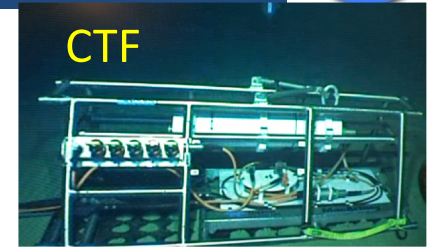
- 96 km - 20 fibres ITU655-NZDSF
- Single conductor with DC-sea return
- Cable Termination Frame (5 hybrid outputs to JBs)
- Medium Voltage Converter: 10kV to 375V
- Second cable for ARCA Phase 2: tender assigned**

24 KM3NeT DUs (Phase 1)



Access to “Associated science”:
 1 acoustic sensor per DOM
 1 hydrophone at the base
 1 Instrumentation Line
 (2 CTD, 2CM, 2SV)
 EMSO JB

115 DUs in 2020 (Phase 2)



Study of deep seawater optical and oceanographic properties. More than 30 marine campaigns

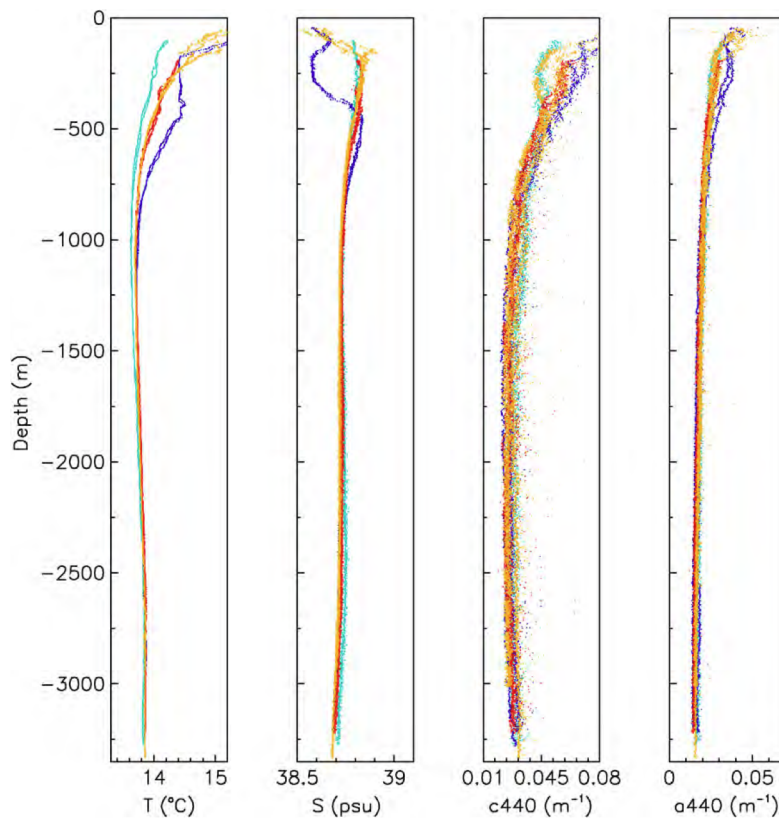
Mooring lines: current meters, sediment traps, CTDs, biofouling and bioluminescence devices

Profiler (CTD +AC9), Niskins bottles + DNA analysis

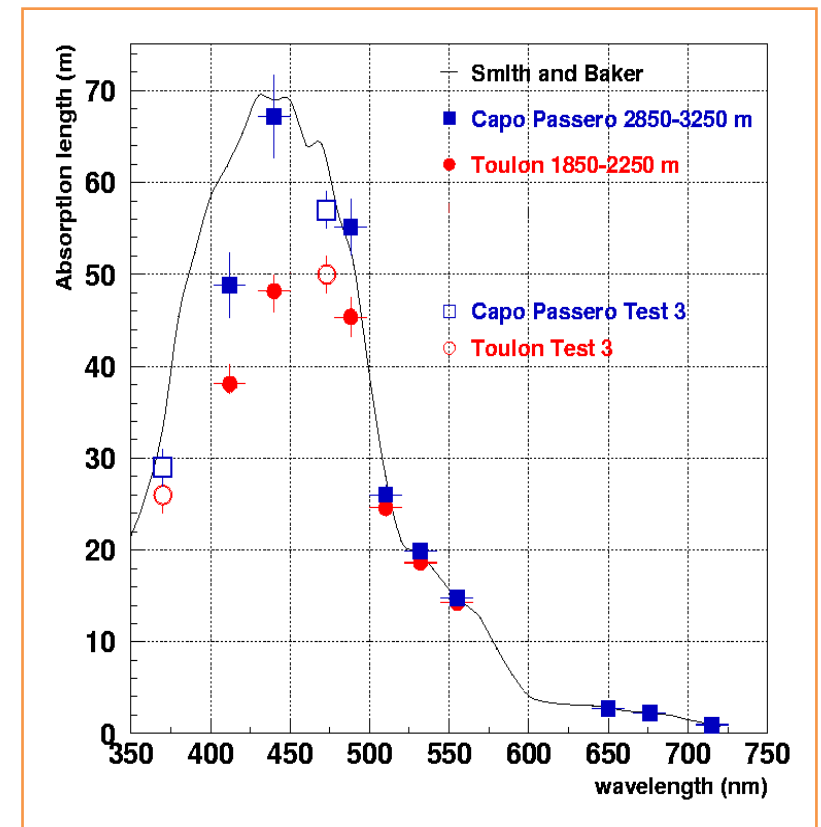
In Collaboration with INOGS, CNR and Univ. of Messina



Astroparticle Physics 27 (2007) 1–9



Ligh transmission (absorption, attenuation) vs depth

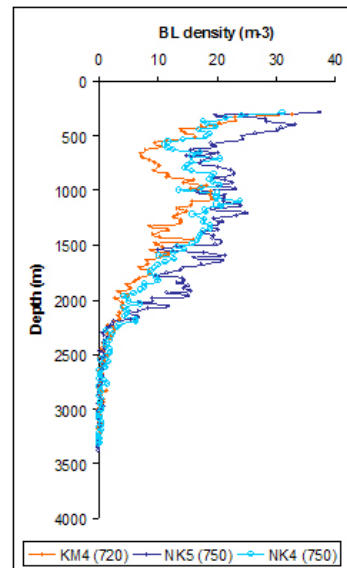
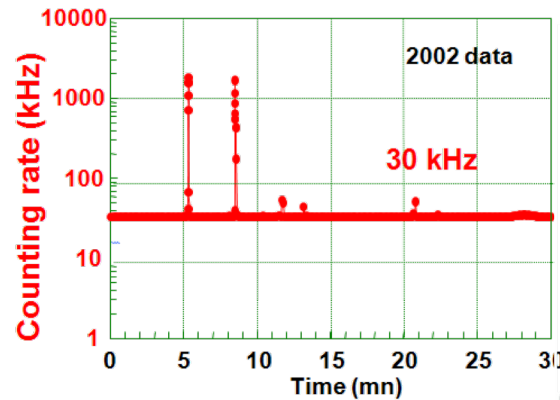


Data collected since 2000 with different instruments and methods

Stand alone device: 2 x 8'' PMTs

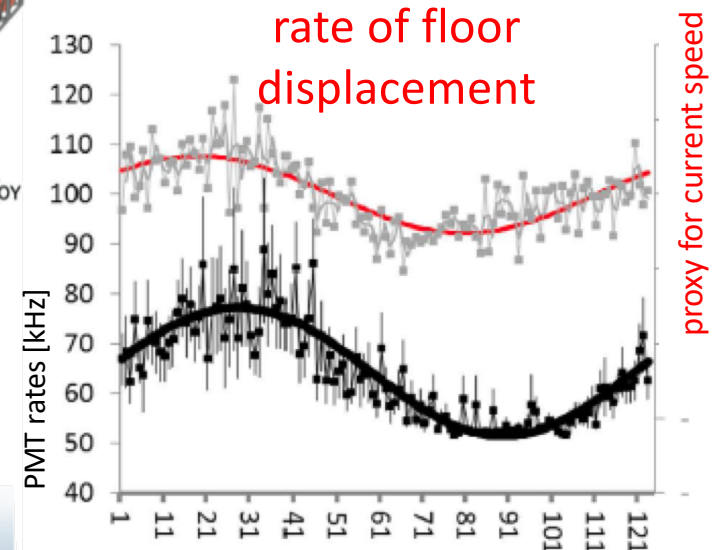
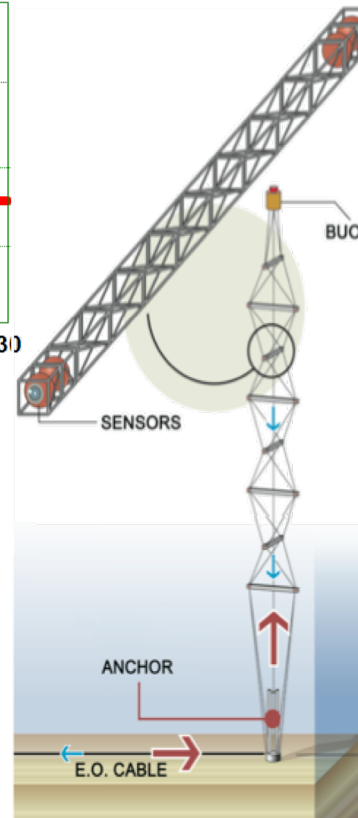


Bioluminescent bacteria concentration and optical background rate (measured with 8' PMTs, 0.5 s.p.e)



Bioluminescent Bacteria concentration

KM3NeT prototype NEMO mini Tower: 32 Oms (10'' PMTs)

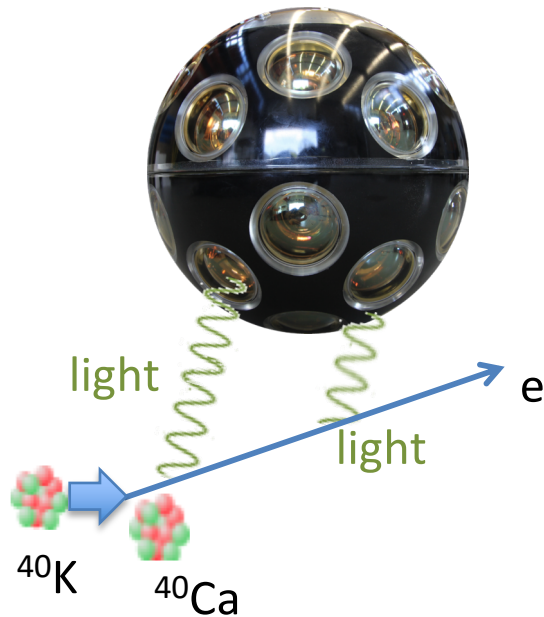


1 day, tidal frequency 20.5 h

SCIENTIFIC REPORTS
NATURE, March 23, 2017

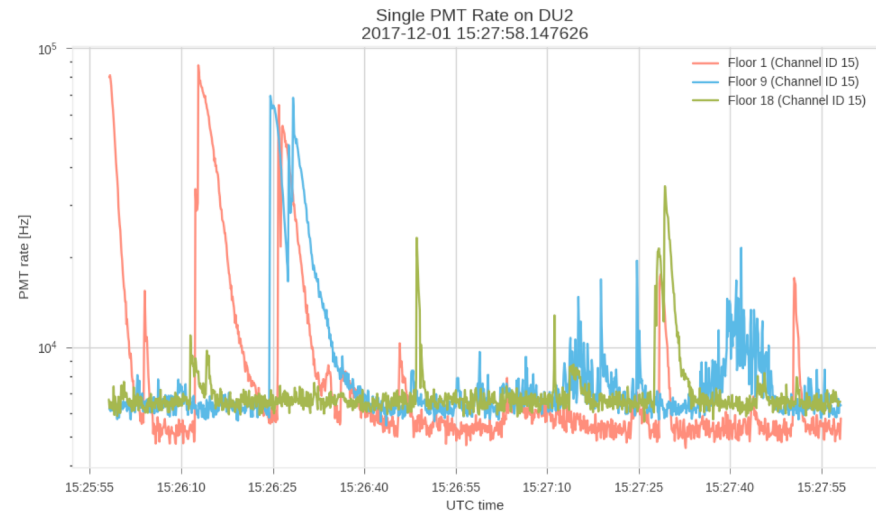
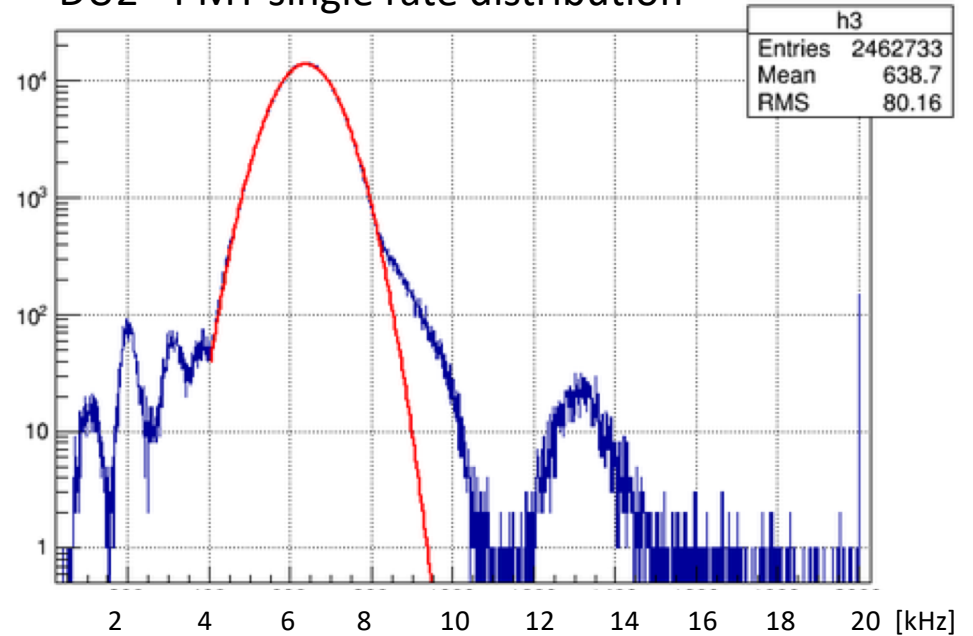
Data collected since 2000 with different instrument

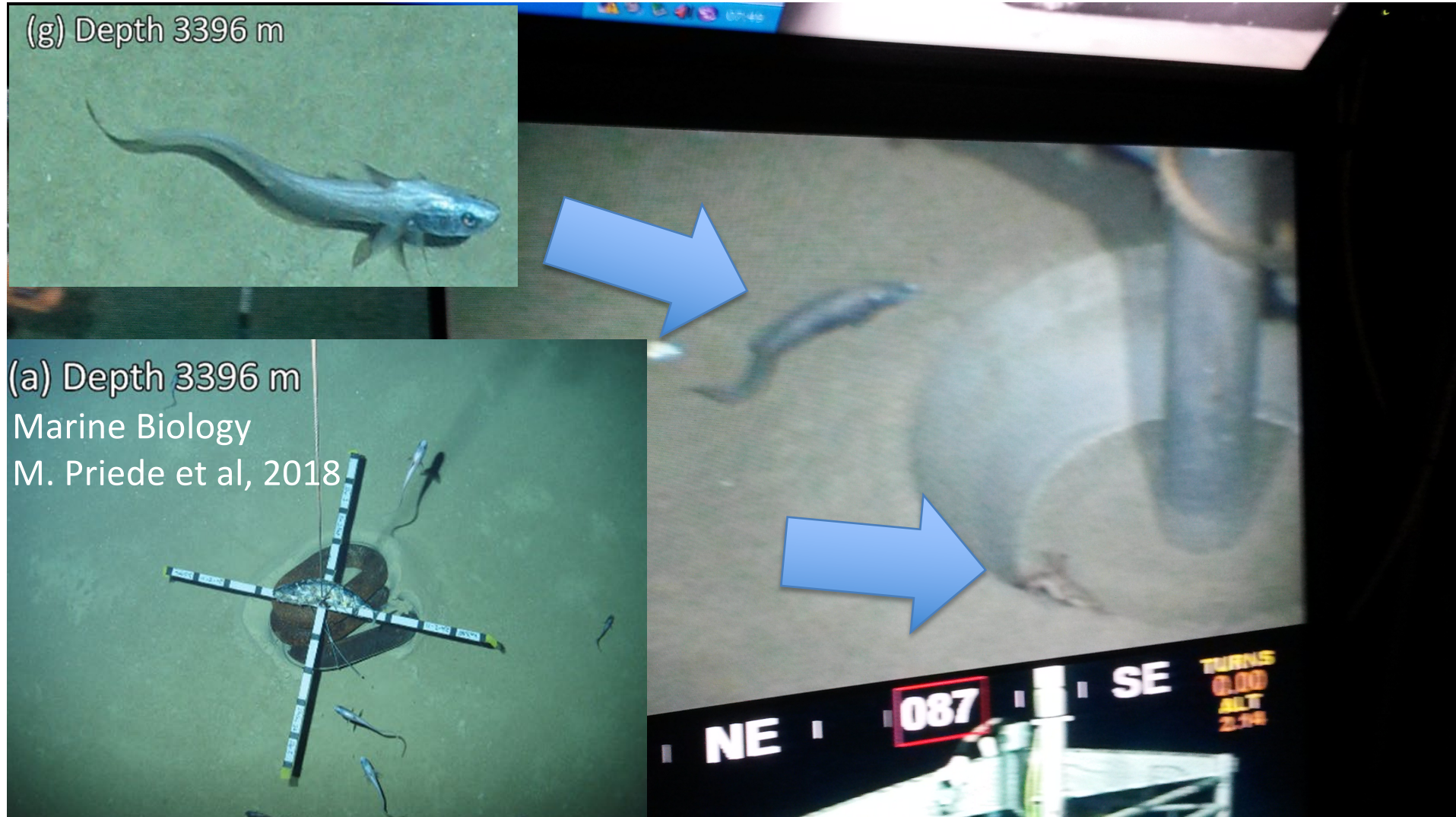
KM3NeT DUs (since 2015): multi PMT DOM

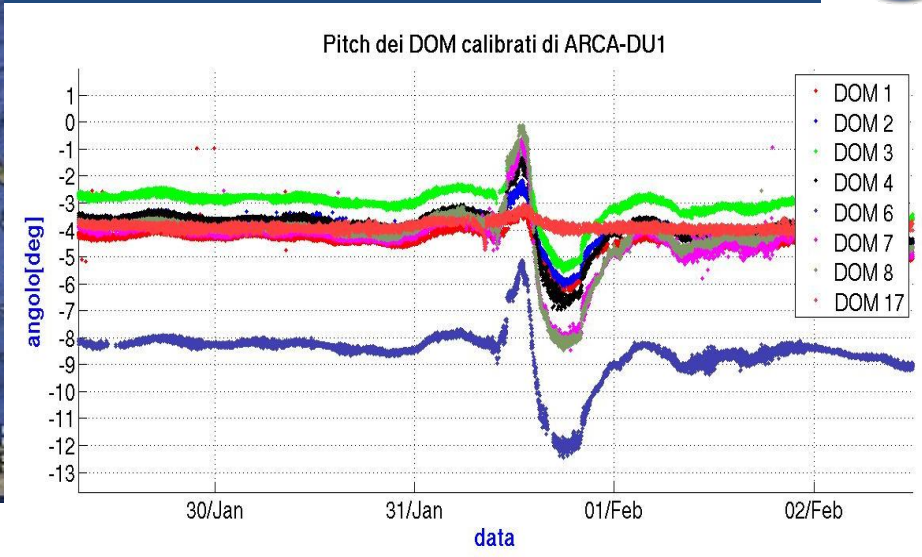


150 Cherenkov photons/decay
stable ^{40}K concentration

DU2 - PMT single rate distribution



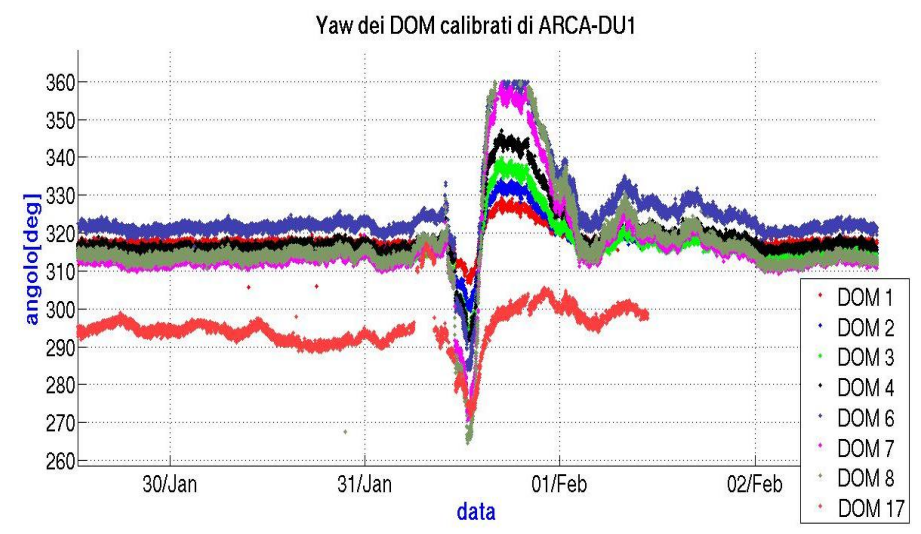




The DU starts to move (rotate, and tilt) and continue for about 10 hours.

The higher the DOM, the larger the swing.

Just connected to sea-floor displacement (string mechanics) or also a submarine wave?



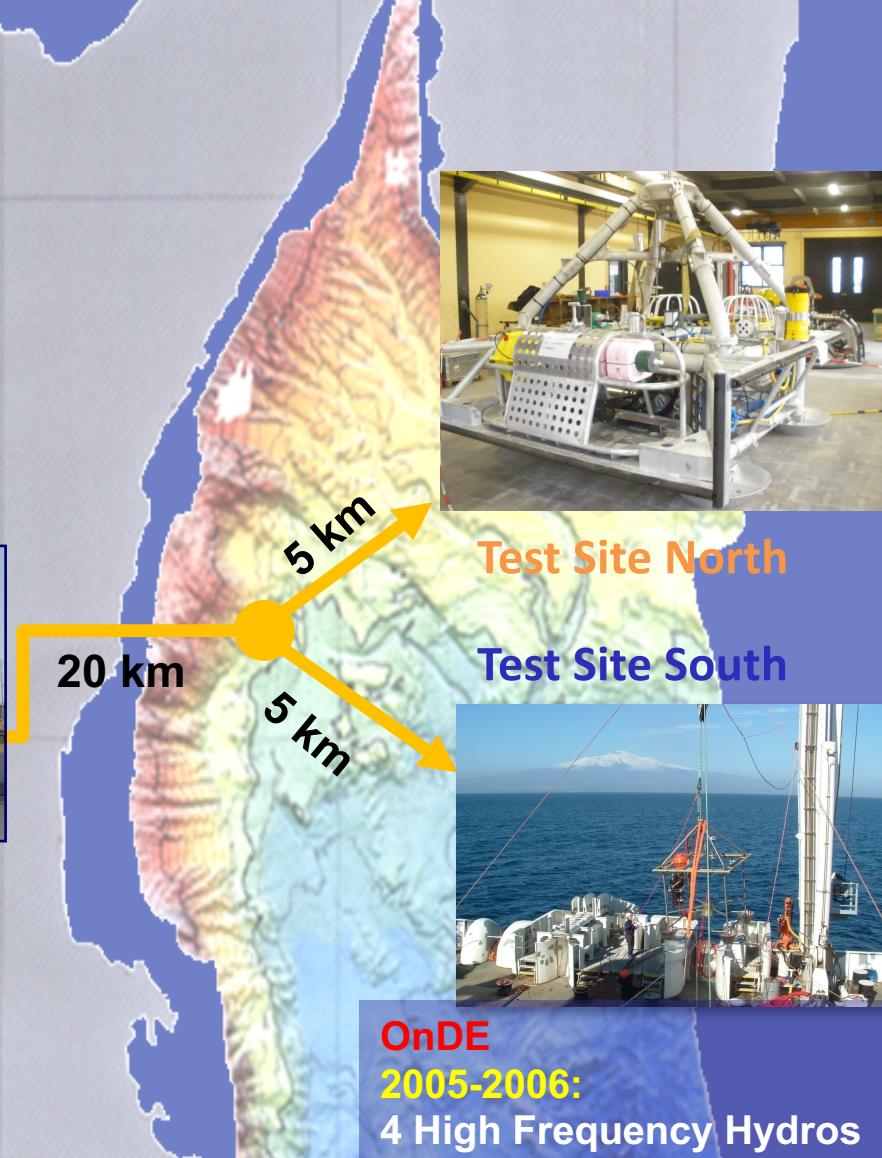


LNS-INFN Catania

1 Gbps fiber link



LNS Test Site Laboratory at the port of Catania



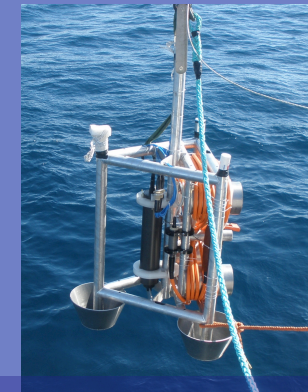
Test Site North

Test Site South



**OnDE
2005-2006:
4 High Frequency Hydros**

**NEMO-SN1
2005-2008:
Geophysics sensors
2012-2013:
Multidisciplinary node
2 CTDs, CM, seismic hydrophones, LF hydrophones, 4 HF hydrophones, magnetometers
2018 –
New deployment**



**OnDE 2-SMO
2013-today
4 High Frequency Hydros**

2018: CREEP (UCL) long term creeping of rocks at high pressure and a real time camera (CSIC)

Tetrahedral antenna (1m size):

4 Reson TC4042 hydrophones (special production for 2500 m depth).

Low cost professional audio electronics (96 kHz, 24 bit sampling, $\Delta\Sigma$)

Hydrophones synchronised and phased.

On-line monitoring and recording on shore. Recording 5' every hour

Data taking from Jan. 2005 to Nov. 2006 (when NEMO Phase 1 was deployed).

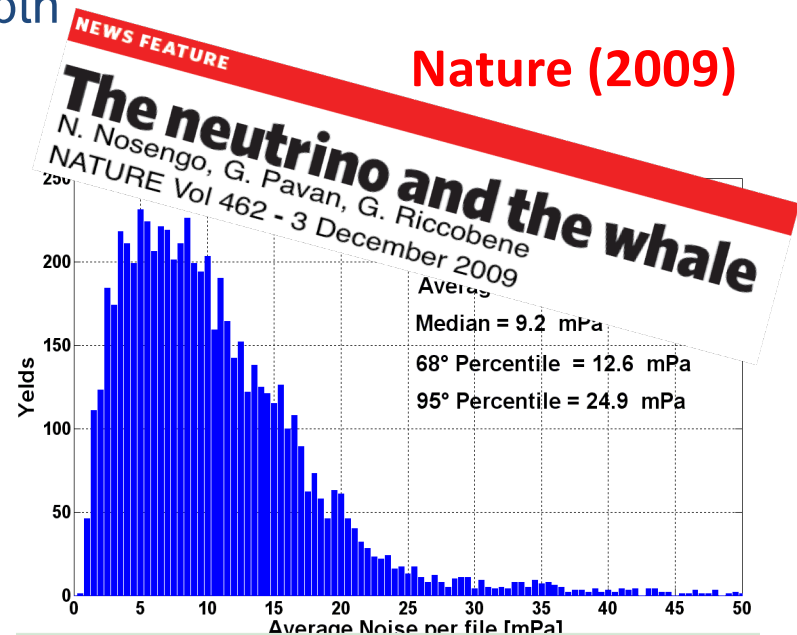
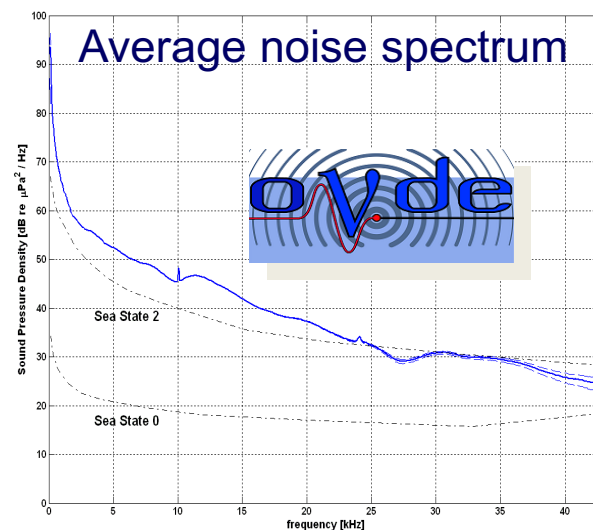
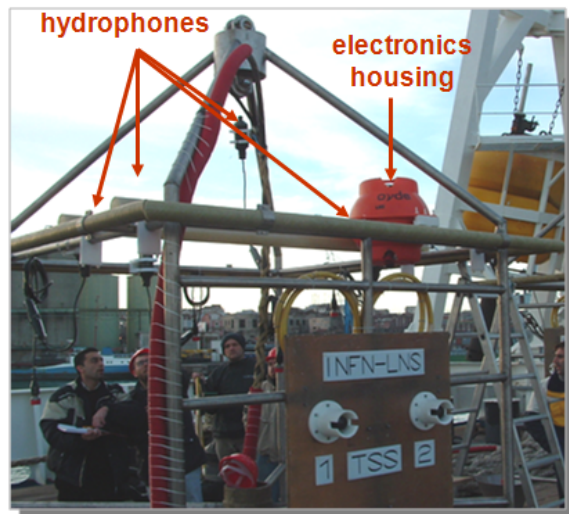
Sea Noise measurement and modelling (presently under study)

Bioacoustics: study of sperm whales population in the East Med Sea

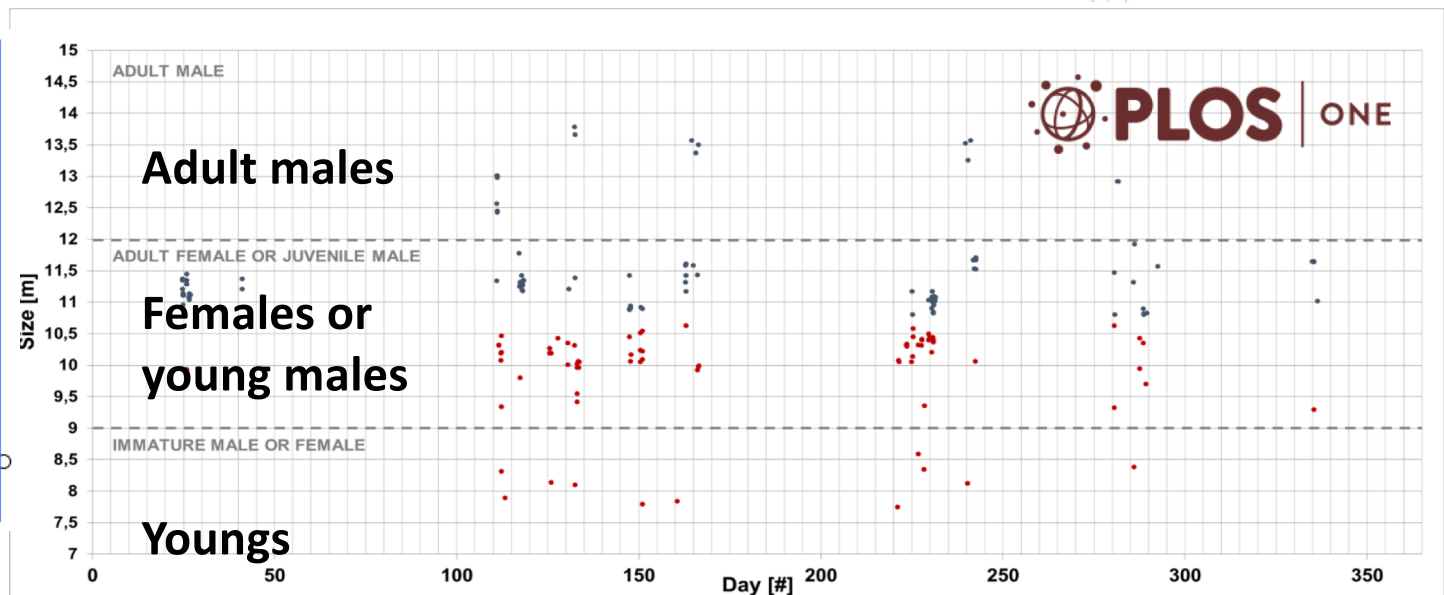
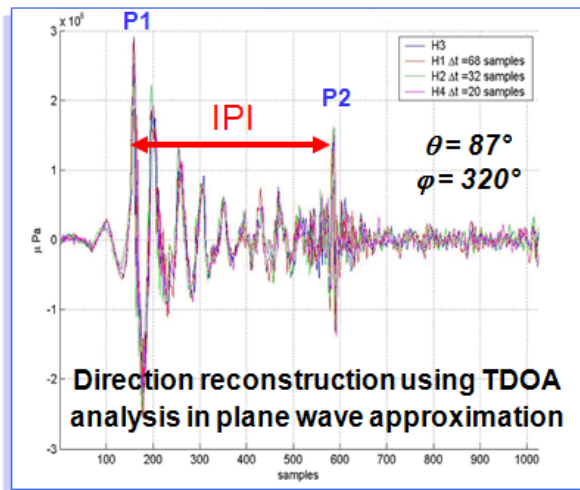
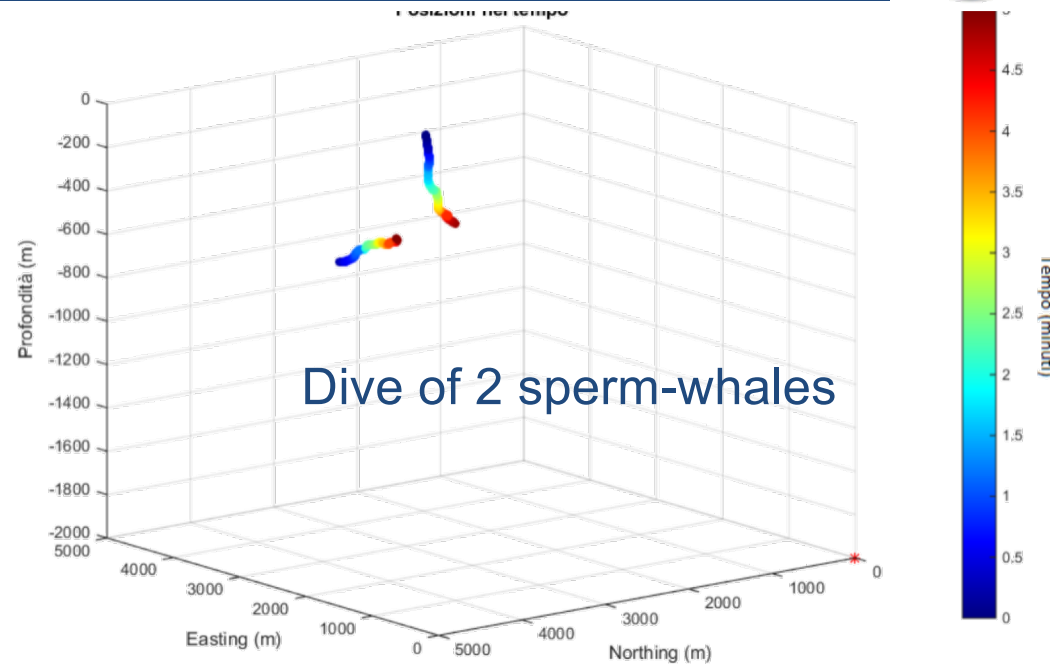
2005-2006: First experiment to perform long-term measurement and monitoring of the acoustic background @ 2000 m depth



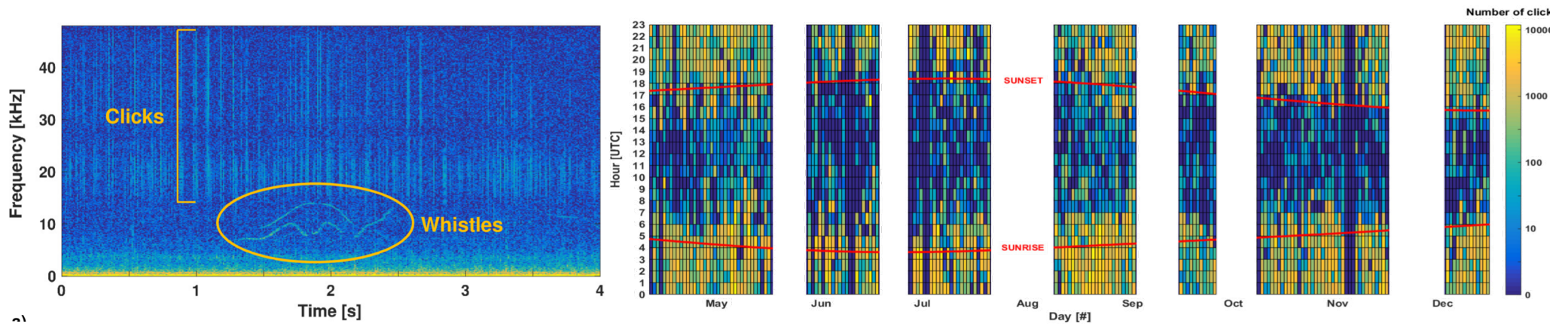
CIBRA



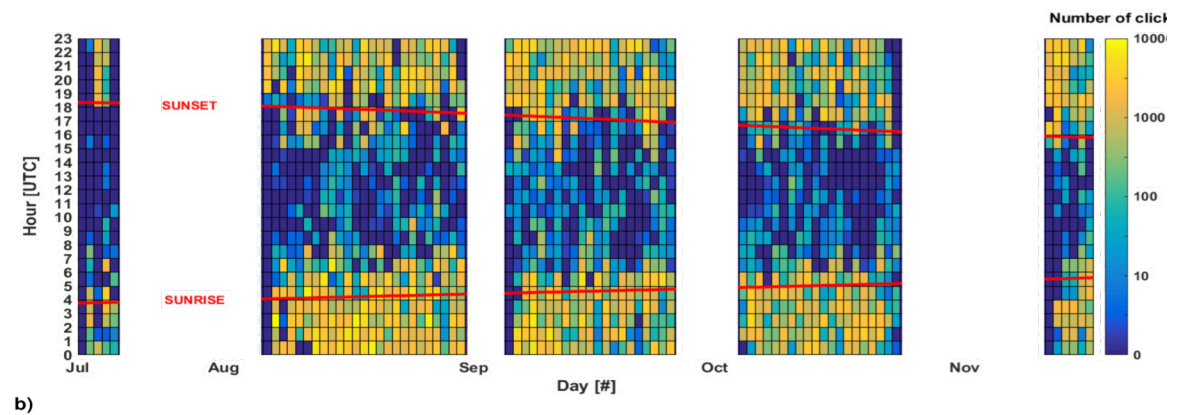
On-line monitoring of acoustic signals with OnDE allowed identification of sperm whales, determination of the population, size and tracking



Automatic identification of dolphins' echolocation clicks (hunting) day/nigh cycle assessed with 2 years of data

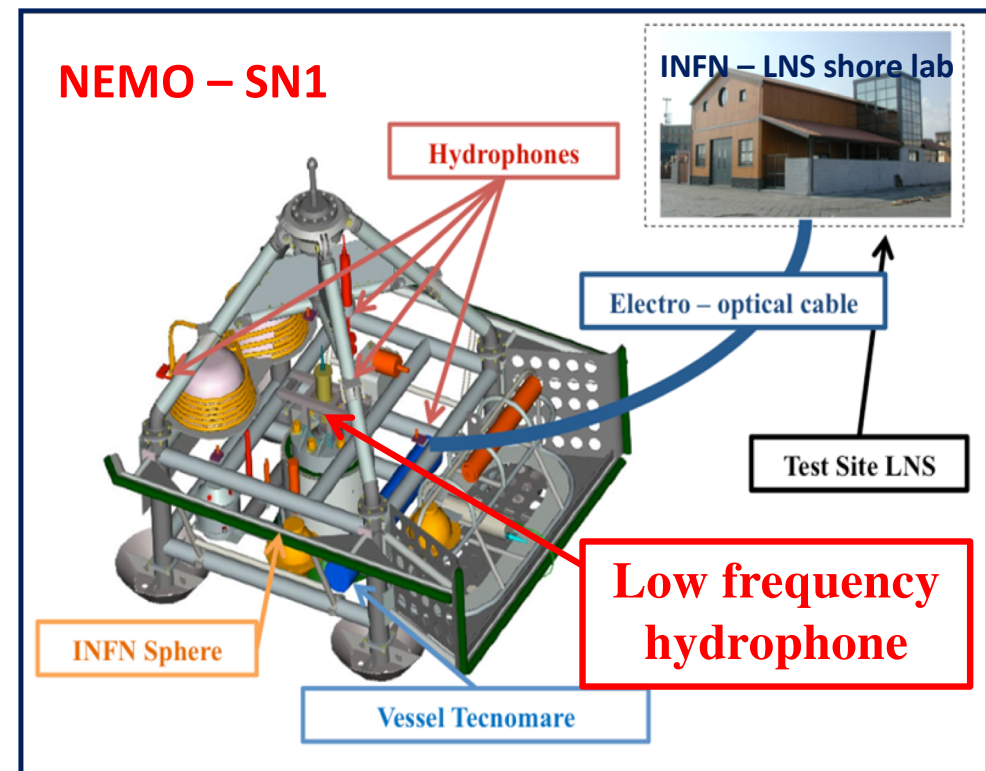


SCIENTIFIC REPORTS



First Cabled node of EMSO

- Monitoring of volcanic and seismic activity in Sicily: thanks to reduced noise SN1 has improved sensitivity with respect to inland observatories.
- Prototype of a Tsunami early warning system



Real-time data acquisition

Sensor

Three-component broad-band seismometer

Hydrophone (geophysics)

Gravity meter

Scalar magnetometer

Three-axes single-point current meter

CTD

Sampling rate

100 Hz

100 Hz

1 Hz

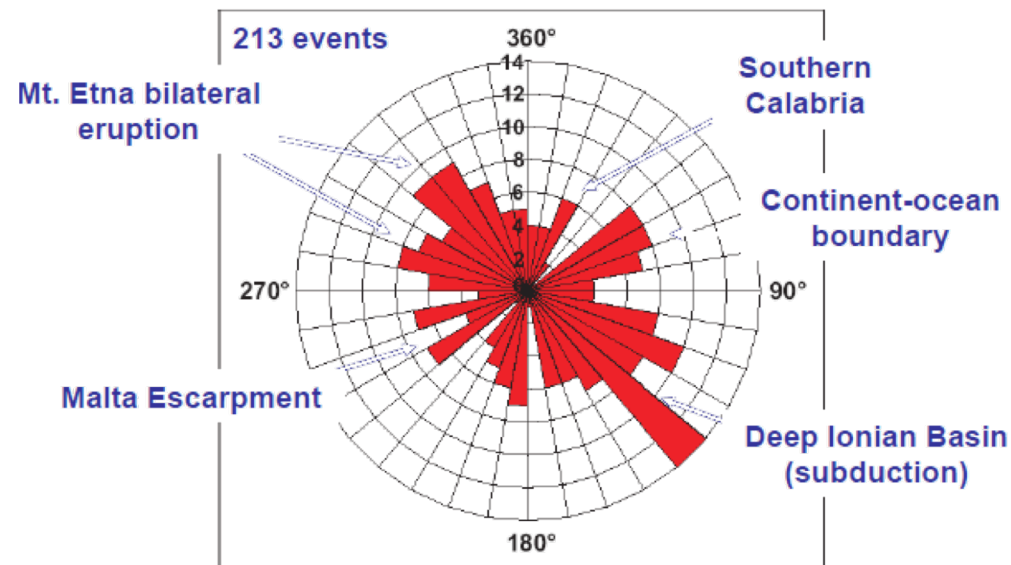
1 sample / 10 min

2 Hz

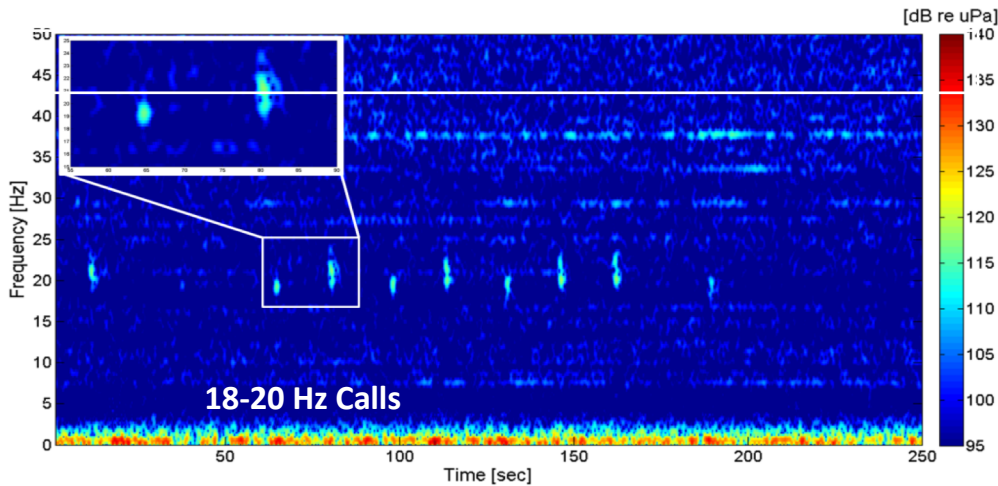
1 sample / 12 min



Seismic activity map reconstructed by NEMO-SN1



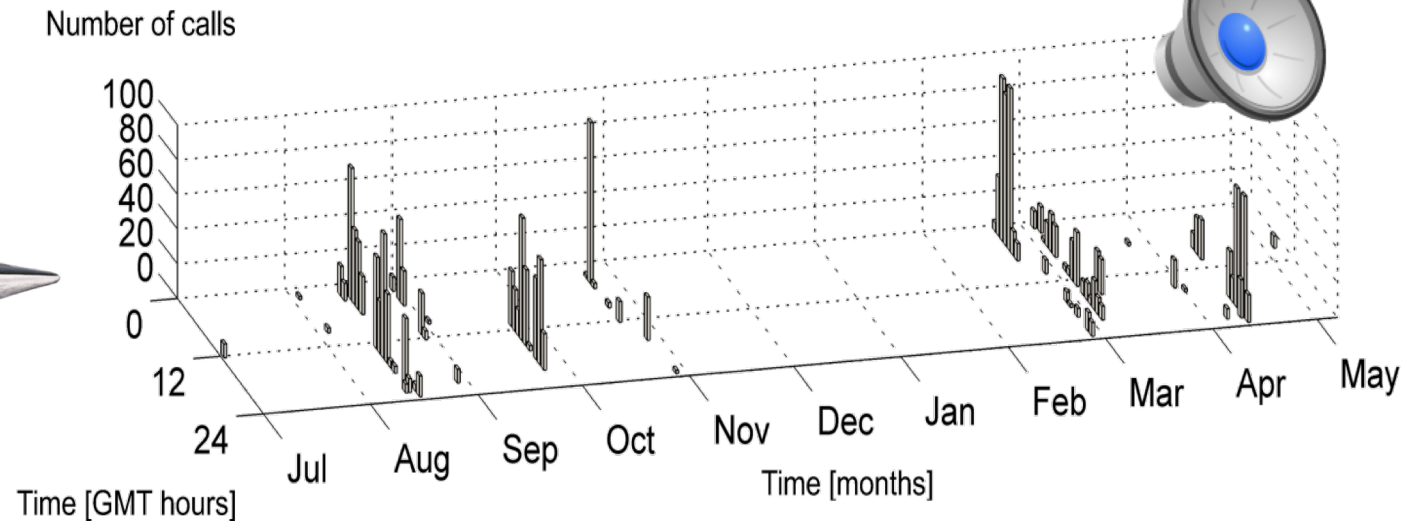
Low frequency hydrophone on SN1
 bio-acoustics (mysticetes)
 acoustic noise monitoring (Marine Strategy Directive)



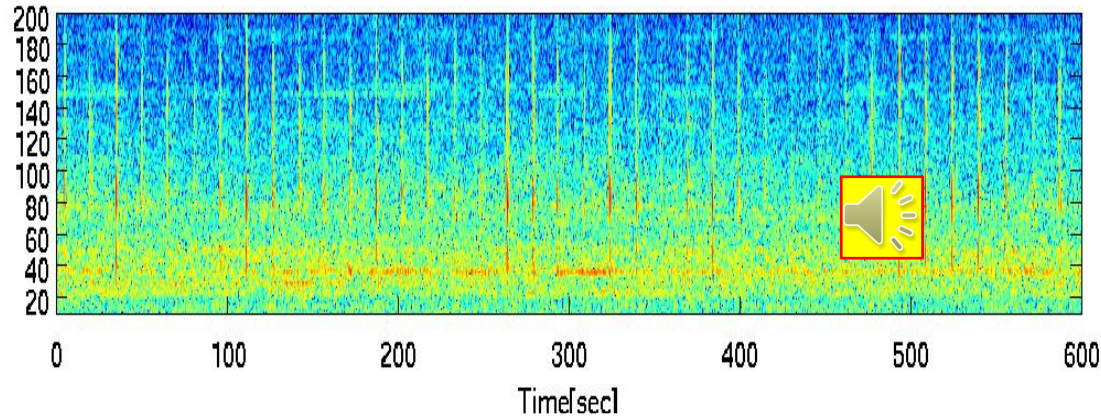
Identification and monitoring
 First data on effect of anthropogenic noise



Target Species IUCN



Real-time identification of “airguns” (compressed-air cannons) used for geophysics studies



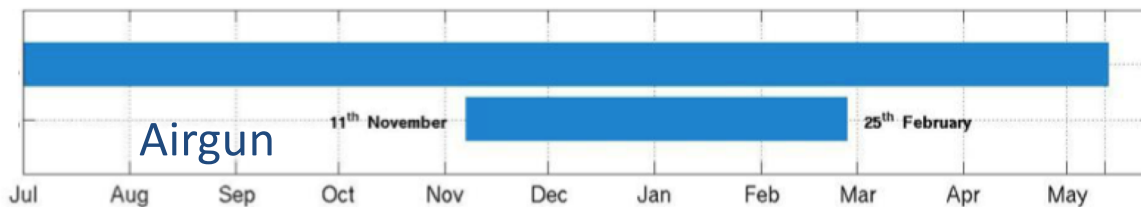
Noise level increase: 10 dB
Identified source, offshore Greece

Need of transnational policies !



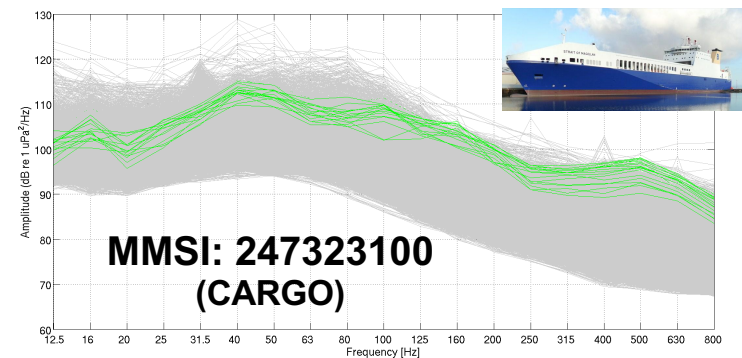
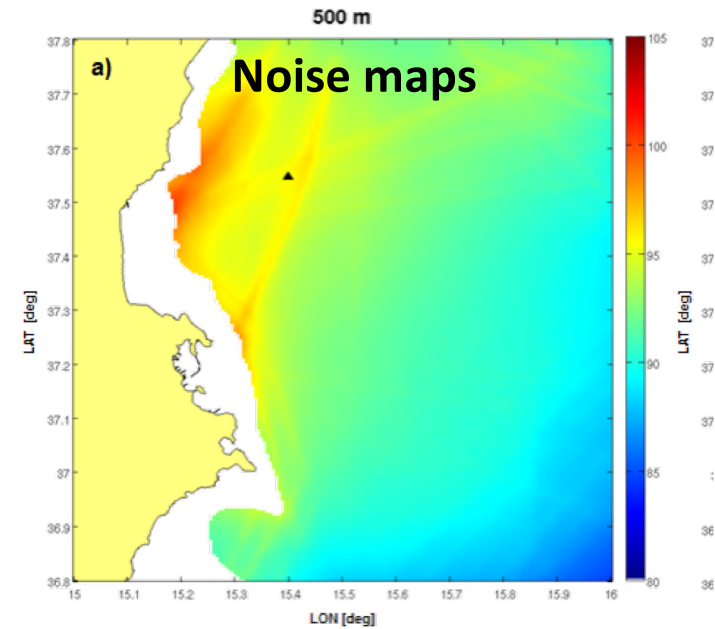
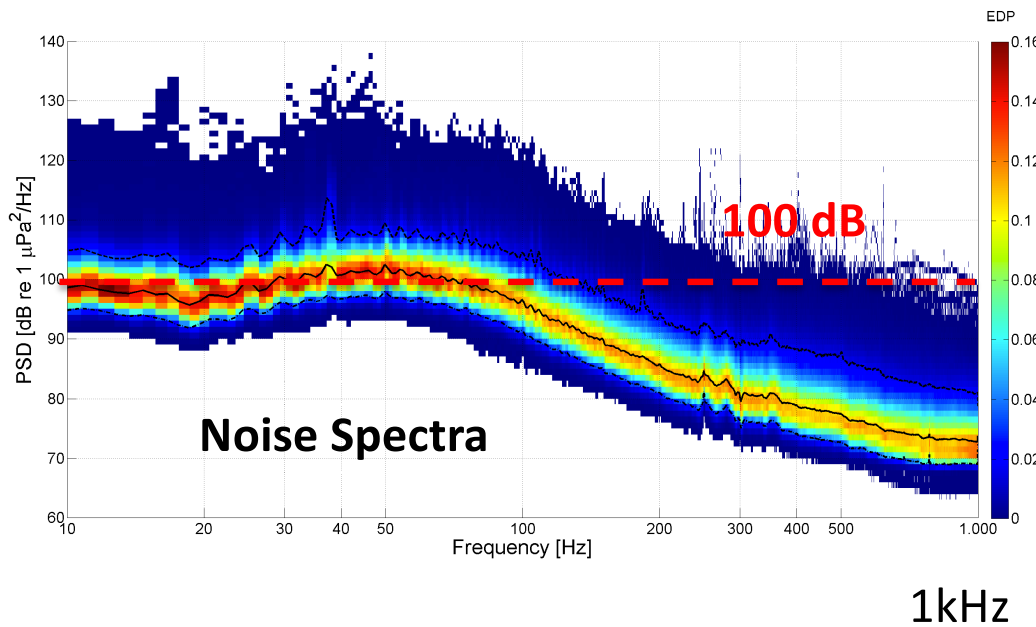
Italian Ministry for the environment

Anticoincidence between airgun shoots and fin whale presence



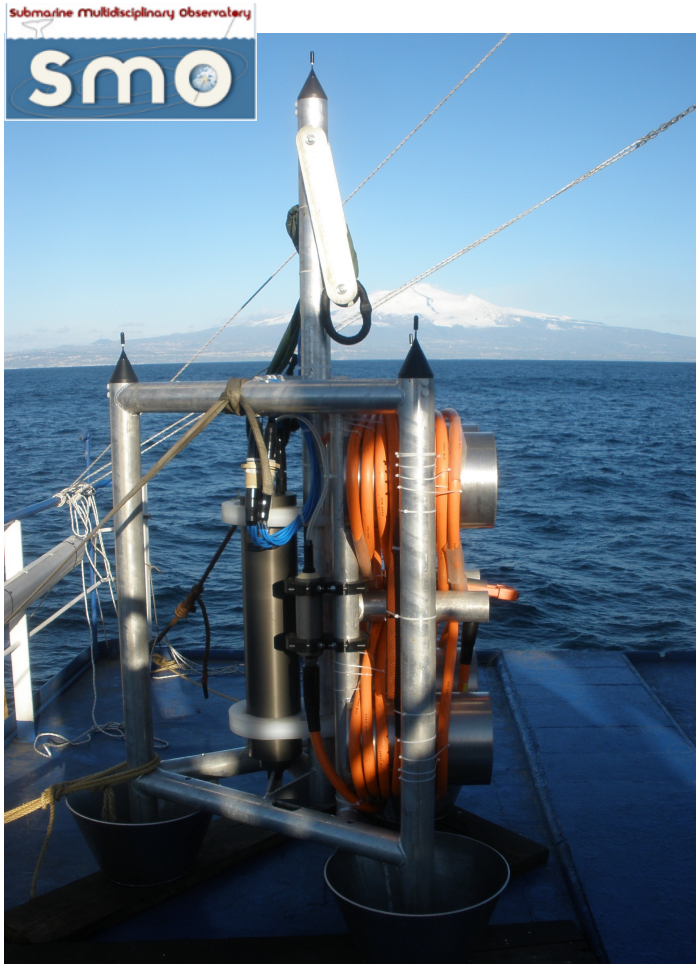
Real-time monitoring of man-made acoustic pollution in the Central Mediterranean Sea

Ship identification with AIS and acoustic sign signature

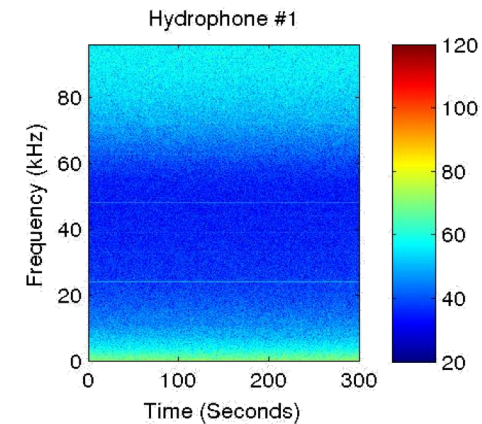
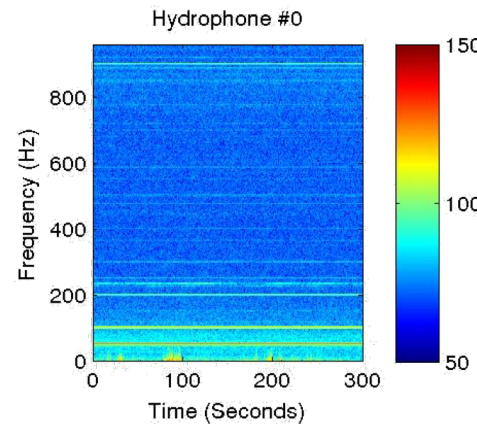
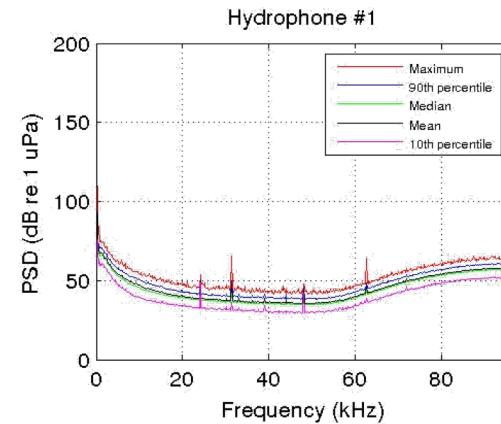
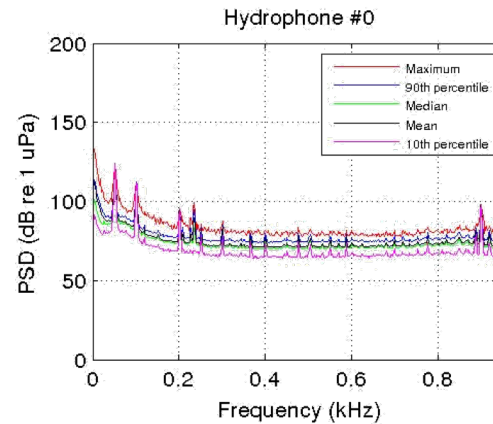


Real time data acquisition and analysis (24h/7d)

Improved sensitivity and sampling rate, GPS synchronisation



Data available for the implementation of the Marine Strategy Directive in Italy



Thanks for your attention