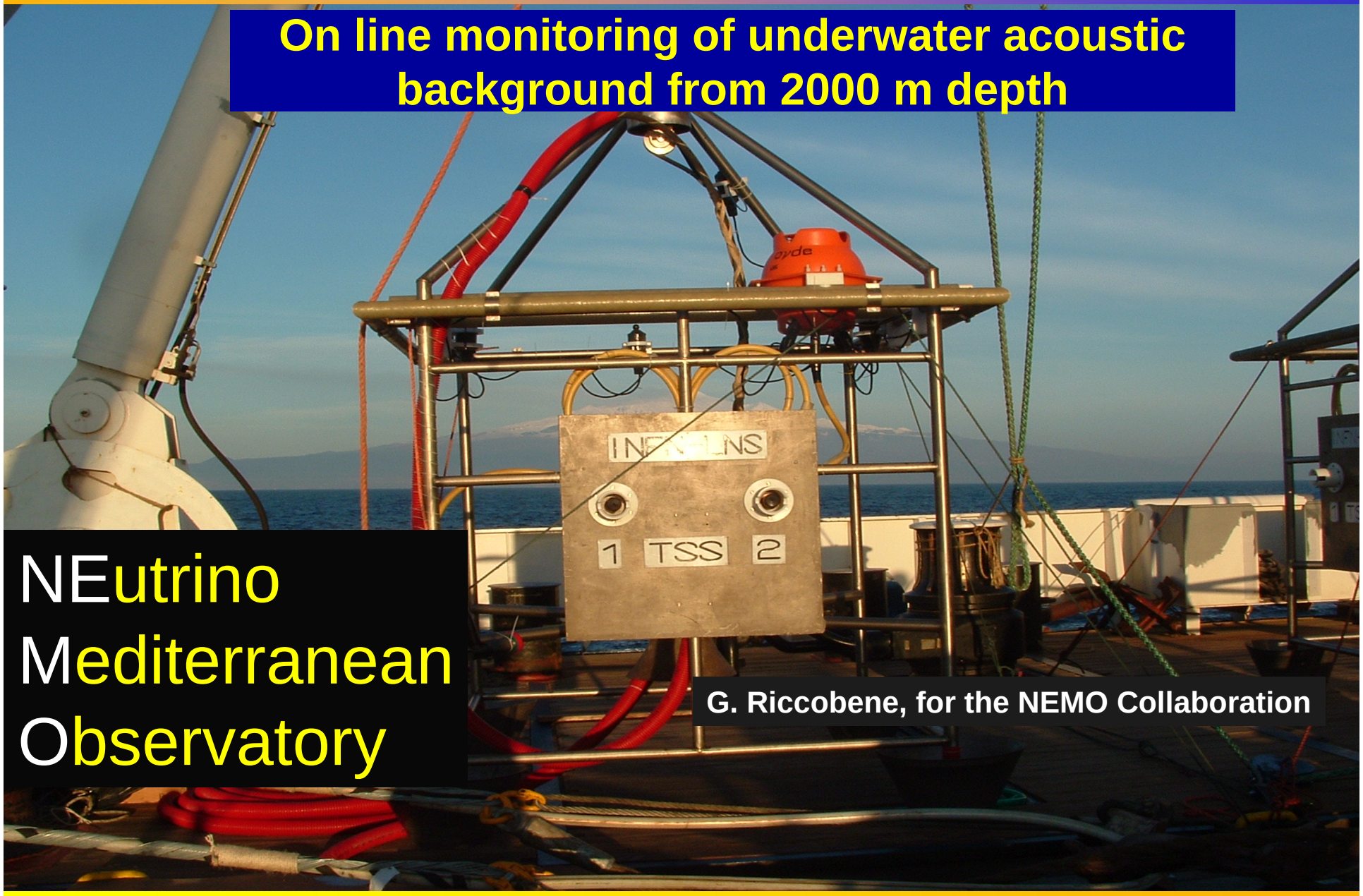
On line monitoring of underwater acoustic background from 2000 m depth



NEutrino Mediterranean Observatory

G. Riccobene, for the NEMO Collaboration

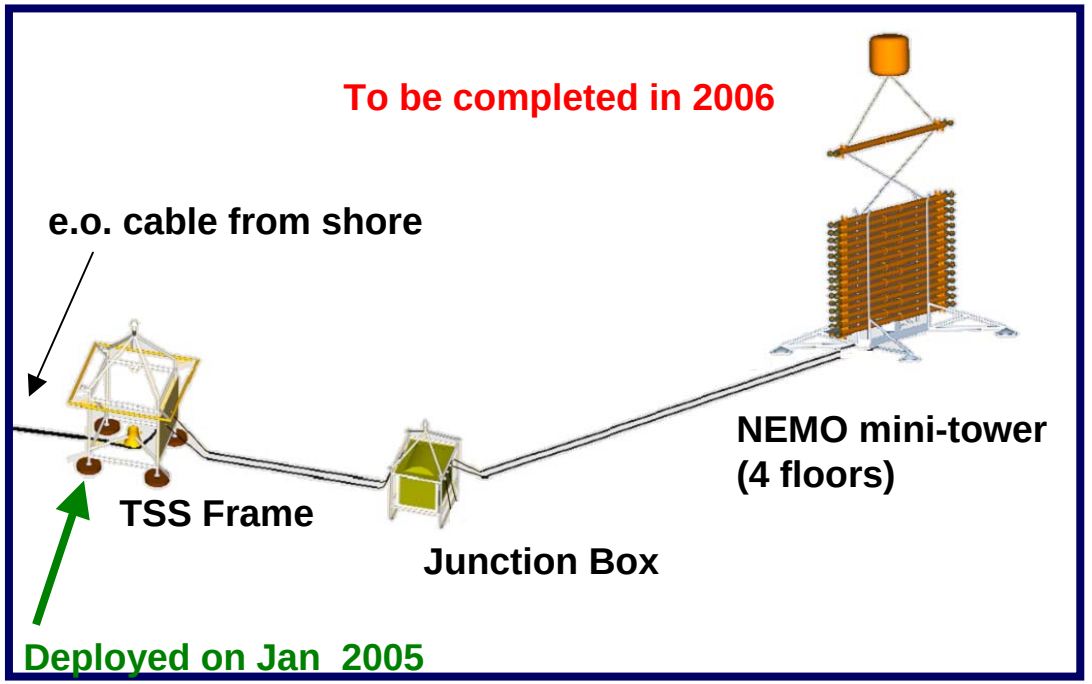
The NEMO test site in Catania

The NEMO Collaboration aims at installing a km^3 Telescope in the Mediterranean Sea (see M.Circella for the NEMO Collaboration)

The Collaboration is undergoing the Phase 1 of the project, installing a fully equipped Deep-Sea facility to test prototypes and develop new technologies for the detector.

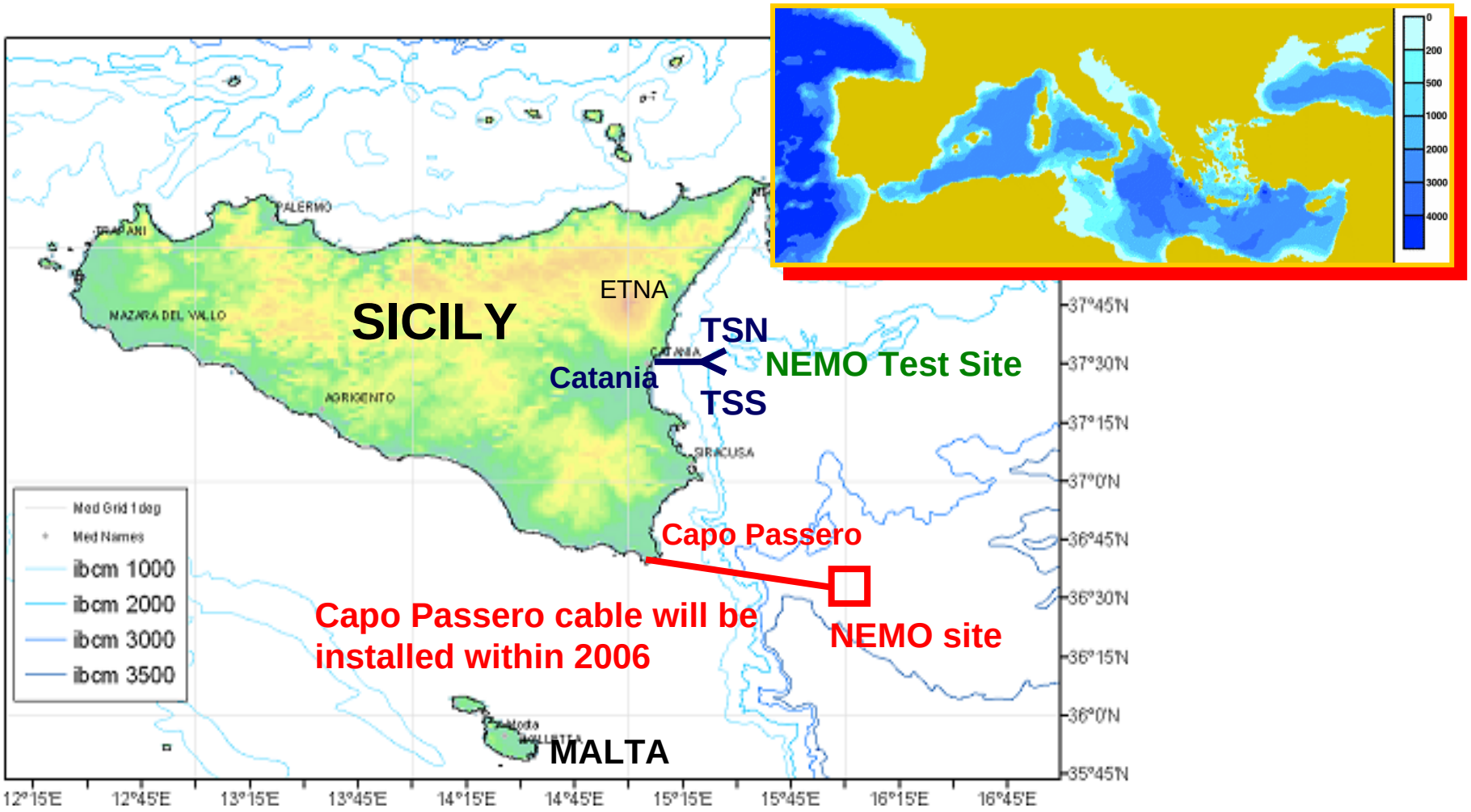
Shore laboratory port of Catania

Underwater test site: 25 km E offshore Catania at 2000 m depth



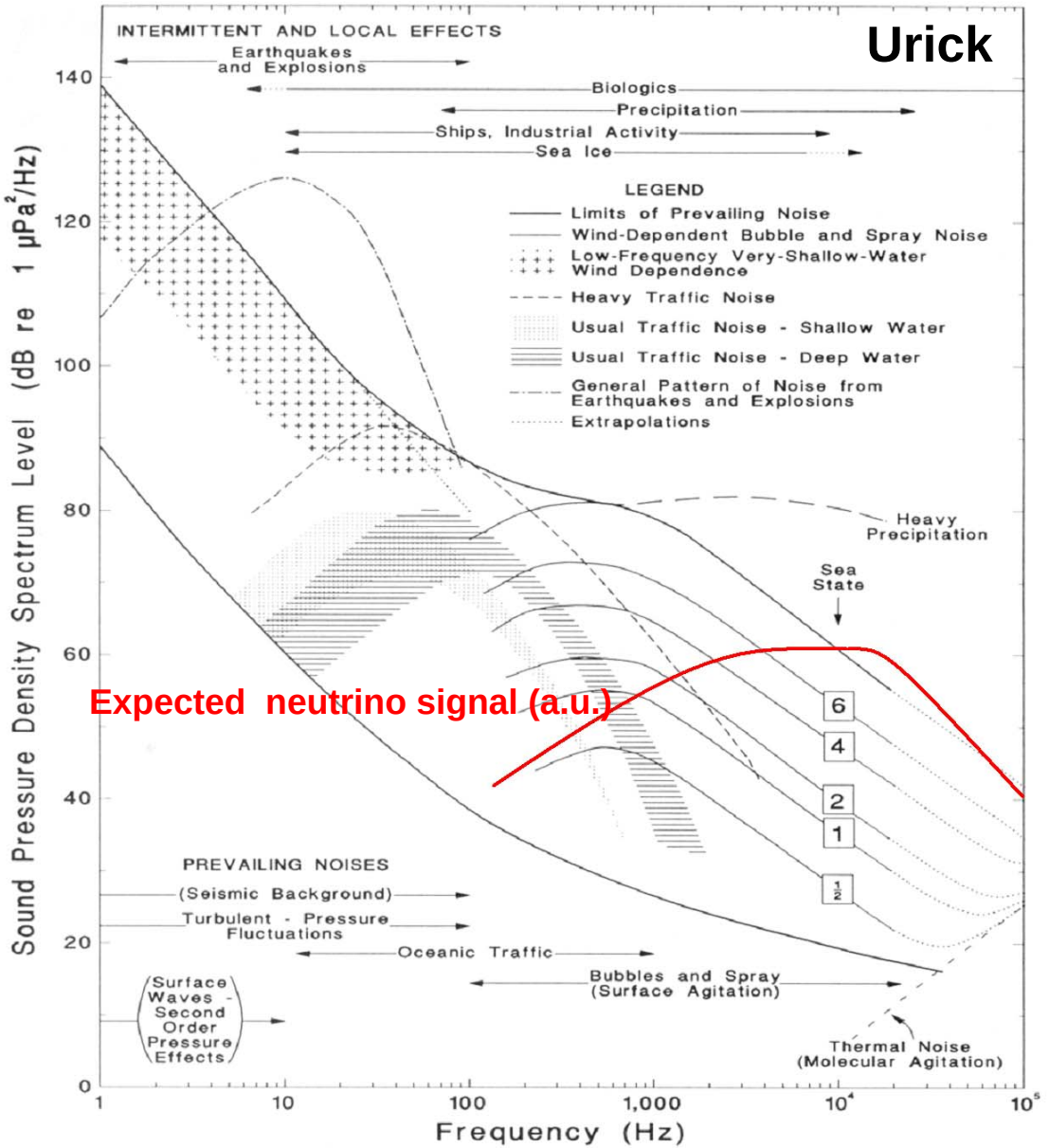
The NEMO Test Site in Catania

An electro-optical cable (10 fibres, 4 conductors) connects the shore laboratory, in the Port of Catania, with the underwater test site



Capo Passero is the candidate site for the km³ detector (see T. Chiarusi for the NEMO Collaboration)

Acoustic neutrino detection: a long step to go



The NEMO Collaboration started preliminary studies on the acoustic detection technique, firstly suggested by Askarian in 1950's.

Knowledge of the ocean noise at large depth is needed to develop acoustic detection systems.
(and it is extremely interesting for multidisciplinary sciences !)

There is a lack of long term measurements at large depth.

NEMO deployed a Deep-Sea station for acoustic noise monitoring using the Test Site infrastructures.

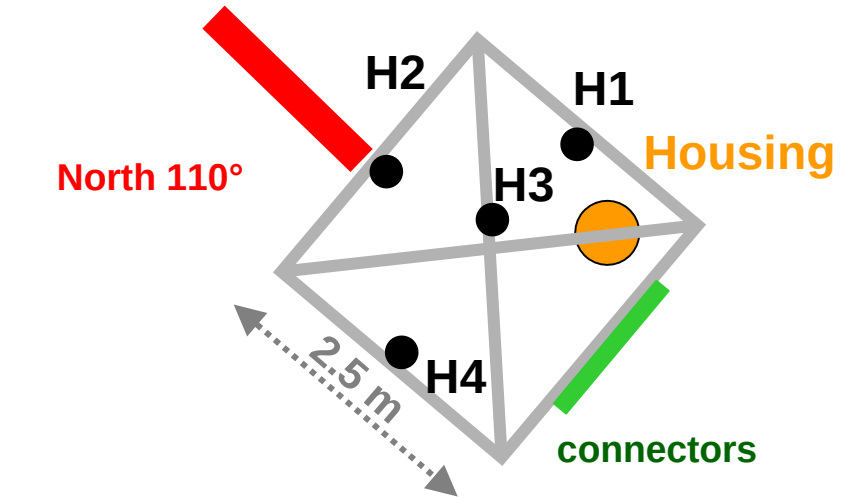
OnDE: Ocean Noise Detection Experiment

Installed on NEMO TSS (Test Site South) frame.

Equipped with 4 hydrophones, acoustic signal digitization (24bit /96 kHz) at 2000m depth.

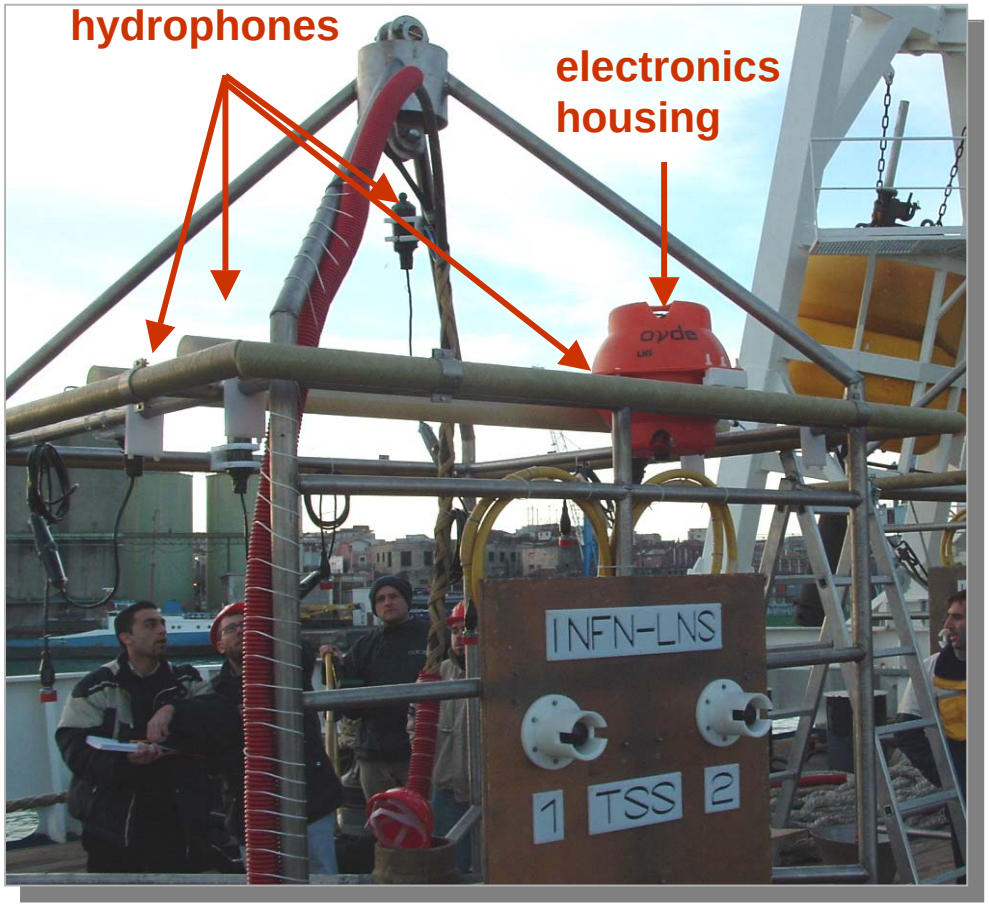
On shore : Continuous on-line data monitoring, data recording (5' each hour).

In operation since 2:30 am Jan 23, 2005.

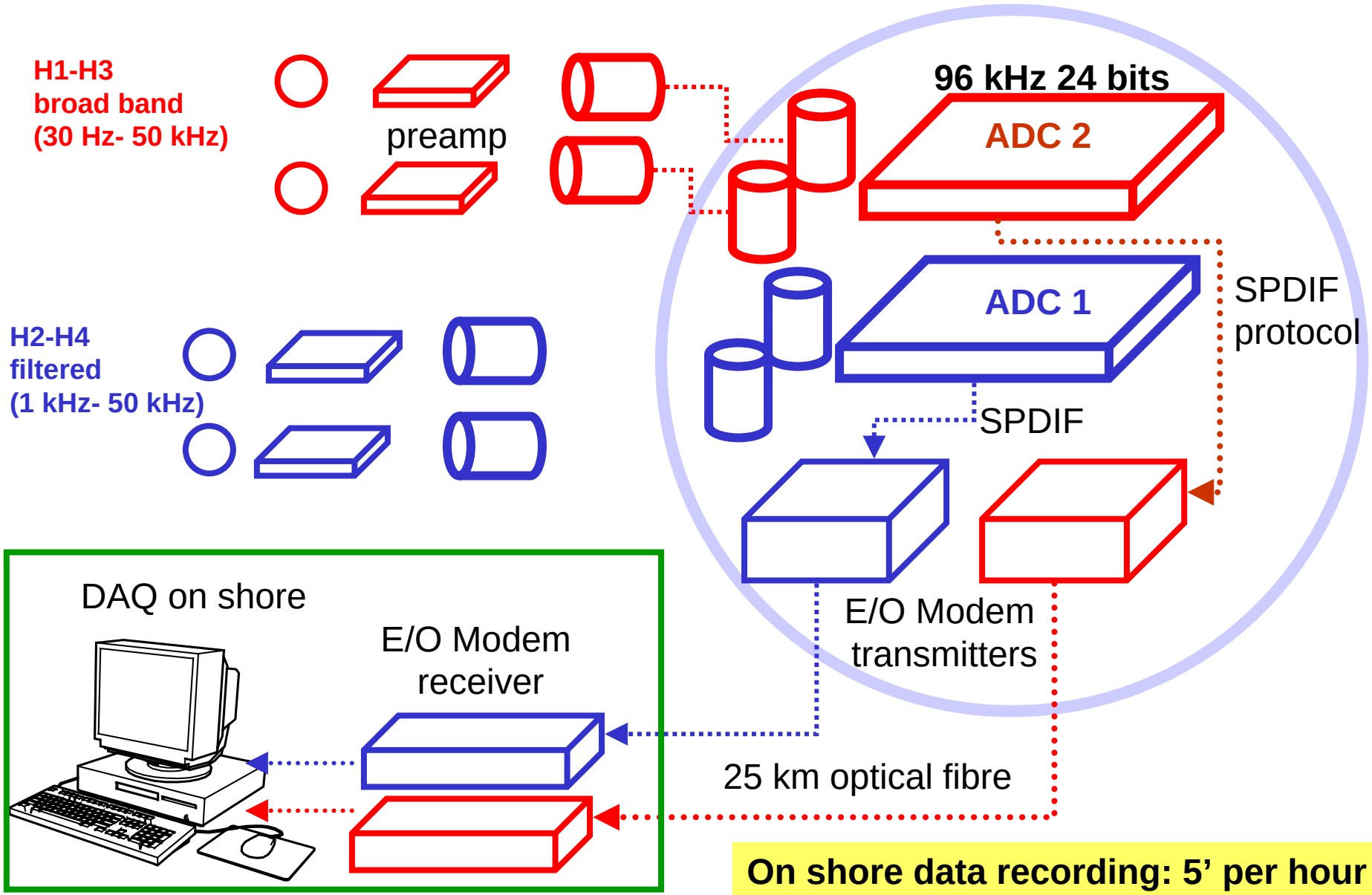


Height from seabed :

H1, H2, H4: ~ 2.6 m H3: ~ 3.2 m



DAQ Layout

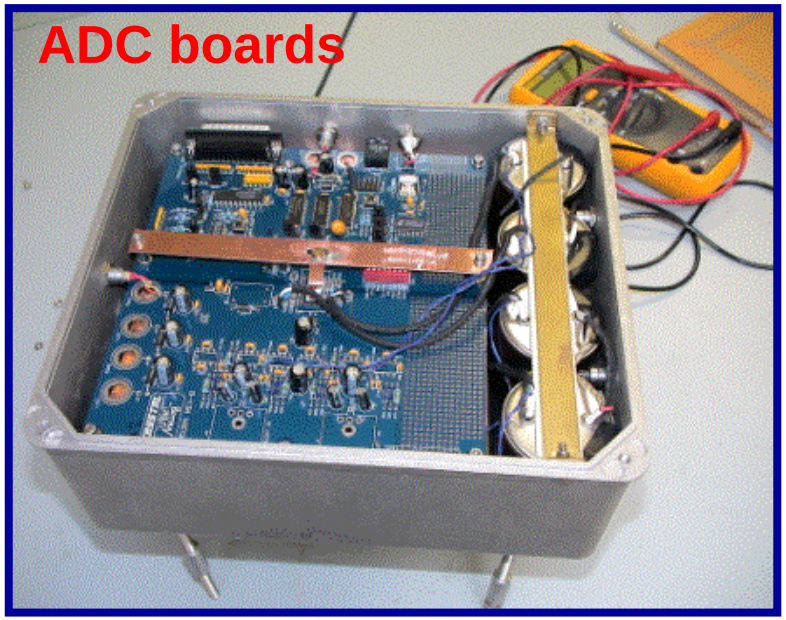


On shore data recording: 5' per hour

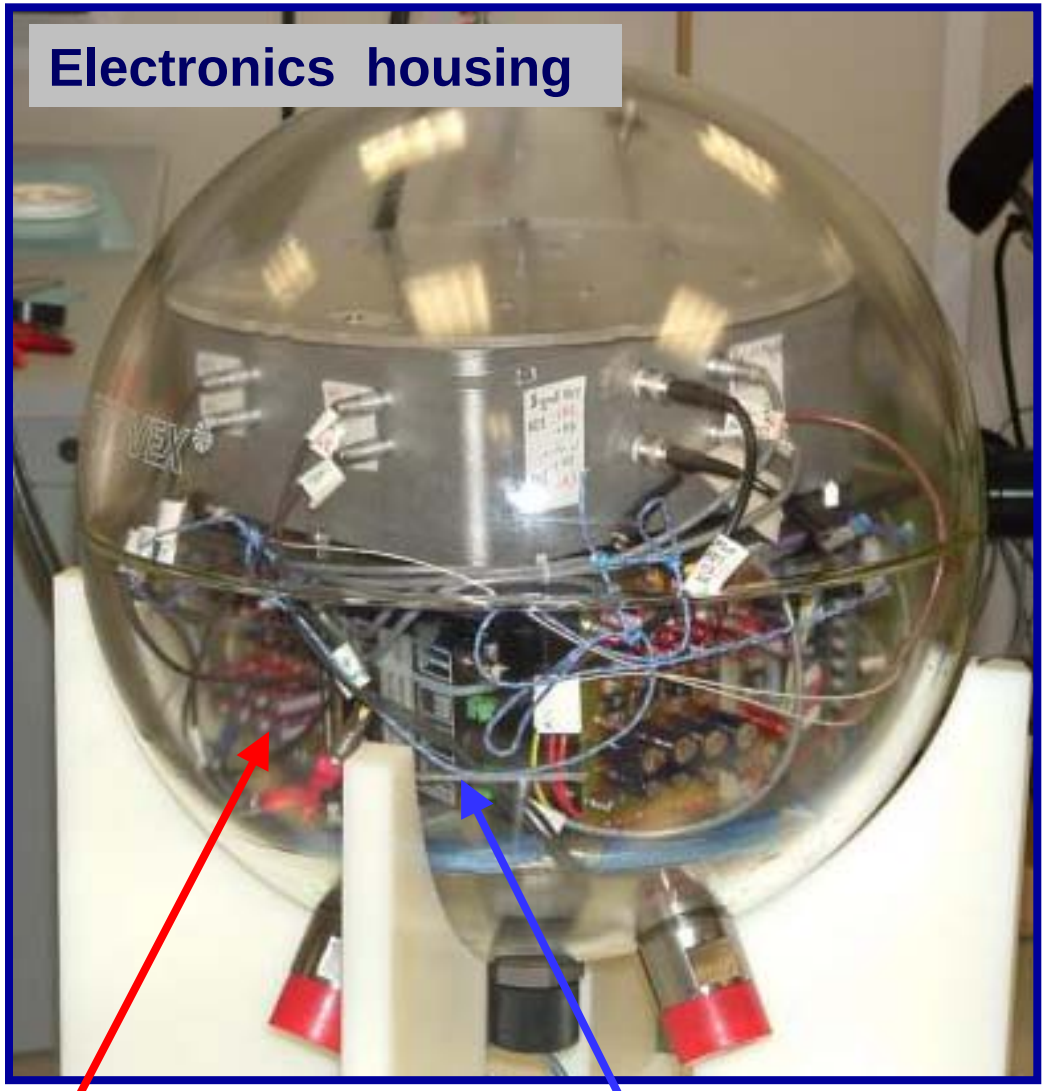
Experimental Apparatus

Hydrophone housing

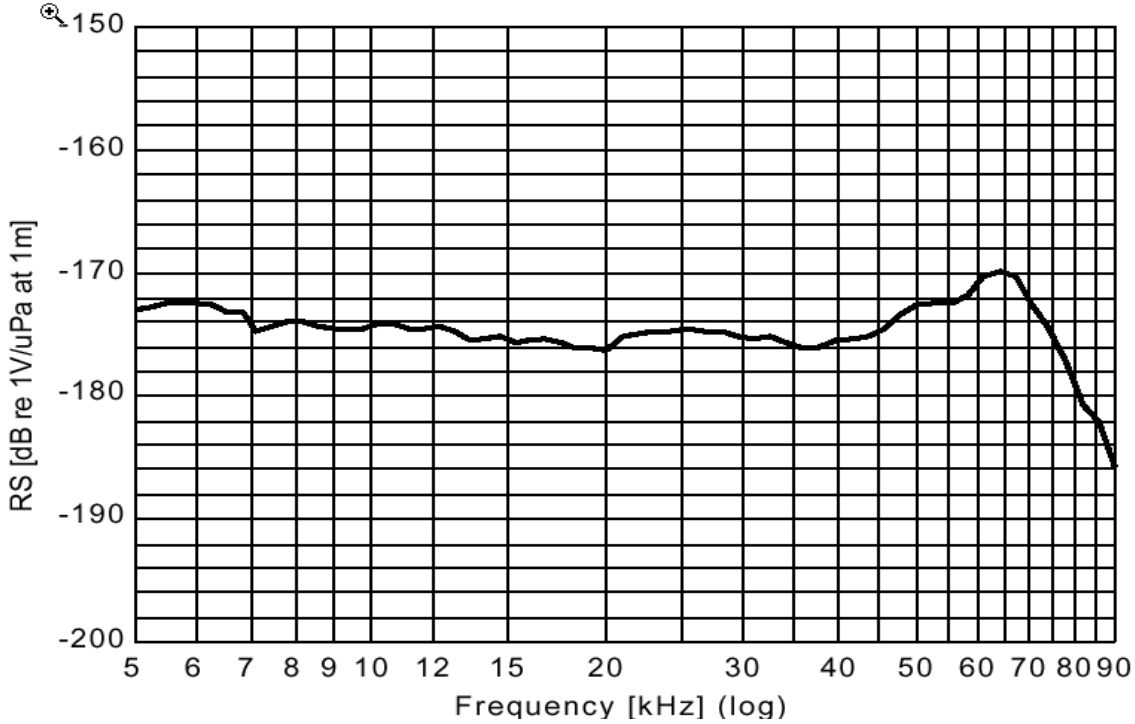
ADC boards



Electronics housing

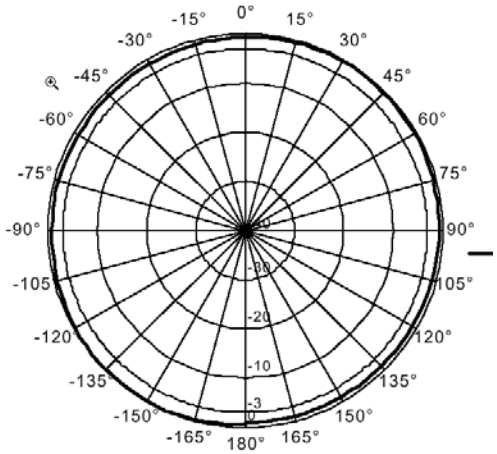


The Reson Hydrophone TC 4042-C



Special production for NEMO
operating depth 2500 m

Usable Frequency range:	1 Hz - 80 kHz
Linear Frequency range:	1 Hz to 50 kHz
Receiving sensitivity nominal:	194dB ±3 re 1V/uPa
Horizontal Directivity Pattern:	Omnidirectional ±2dB at 40 kHz
Vertical Directivity Pattern:	270° ±3 dB at 40 kHz
Operating depth:	1500 m
Survival depth:	2000 m
Metal body:	Aluminum (Seabronze for NEMO)

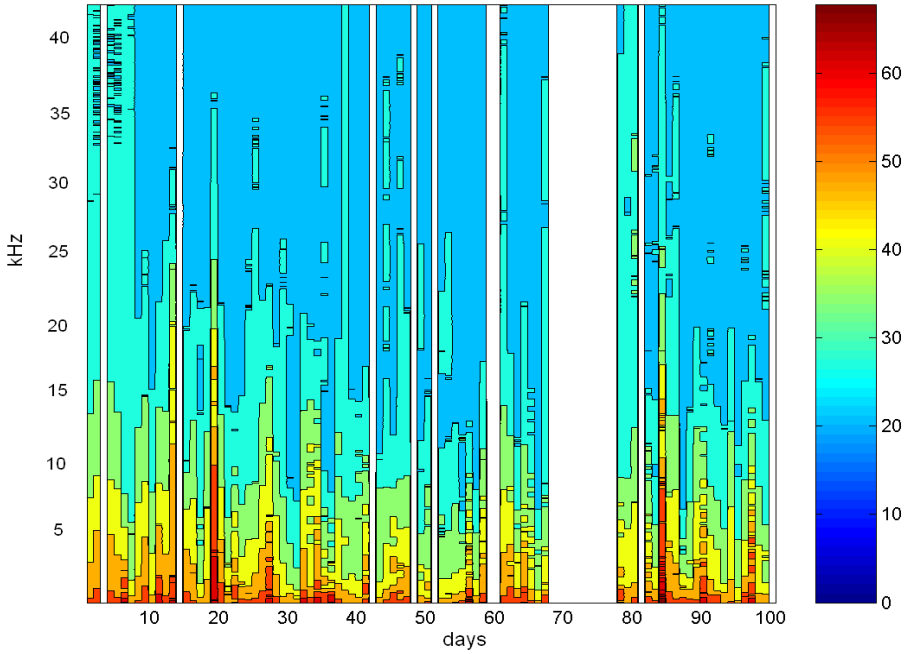


OnDE deployment

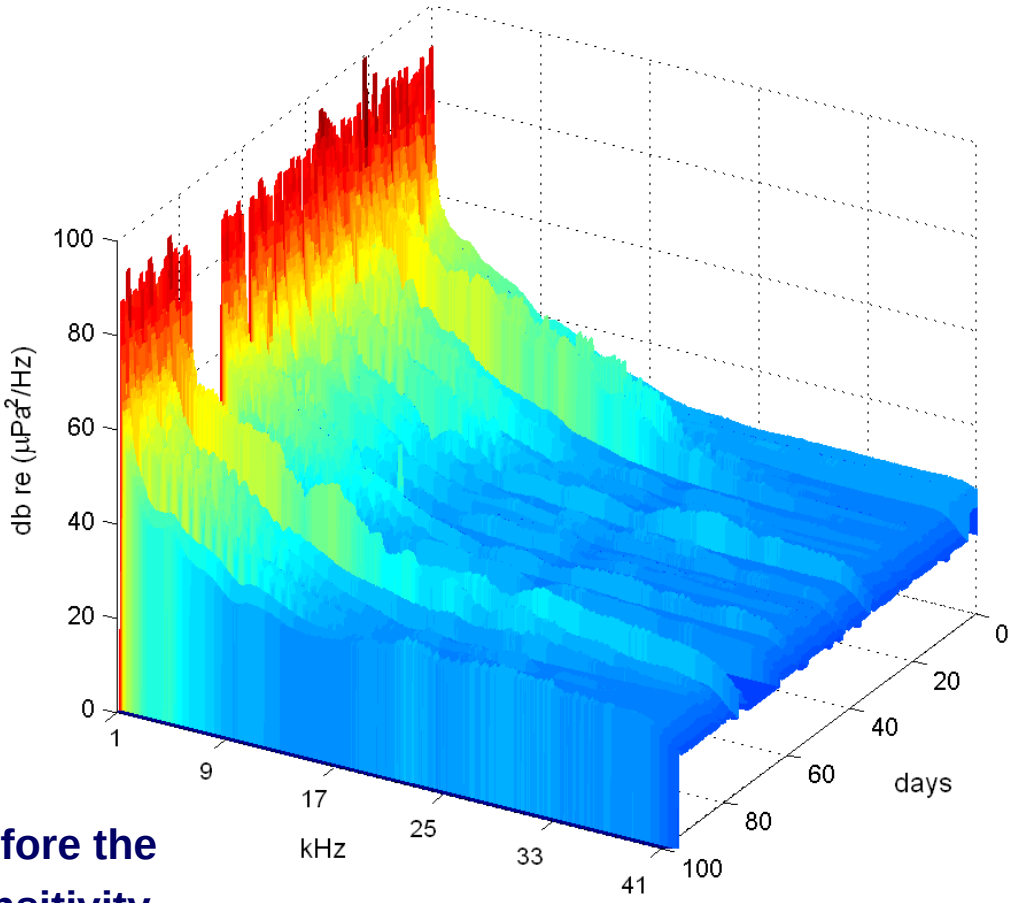
22 January 2005

Preliminary results: noise Power Spectral Density

Detector Sensitivity ~ -175 dB re 1V/μPa (Hydrophone H1:-195 dB, preamp + 20dB)

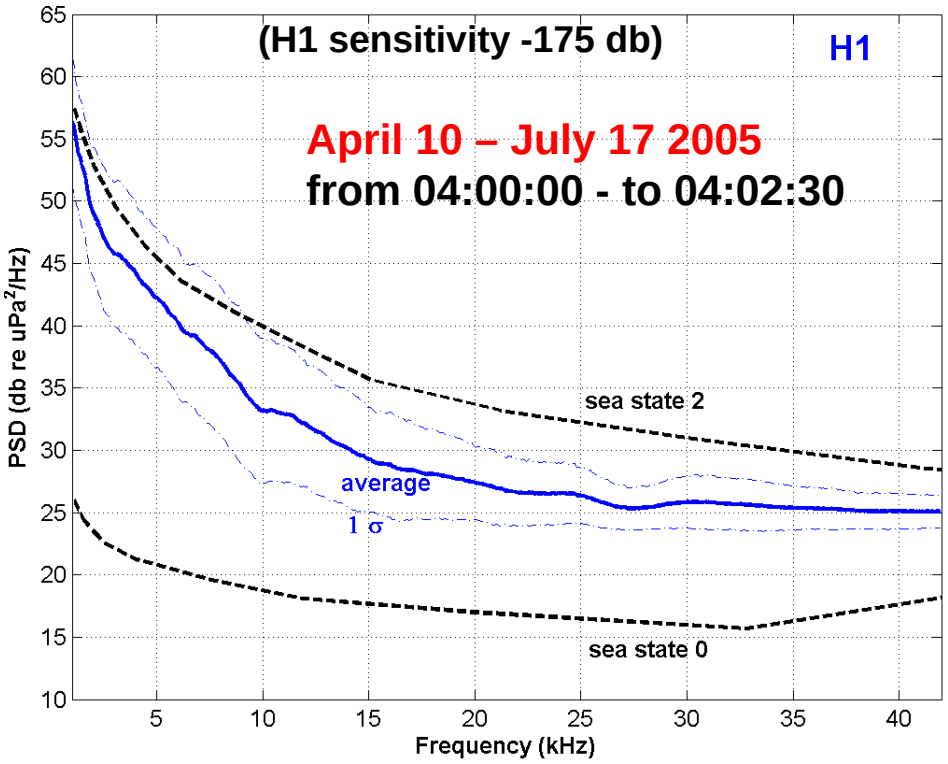


Hydrophone H1 data
April 10 – July 17 2005
from 04:00:00 - to 04:02:30



Calibrations of H1 and H3 were checked before the deployment, results agree with nominal sensitivity

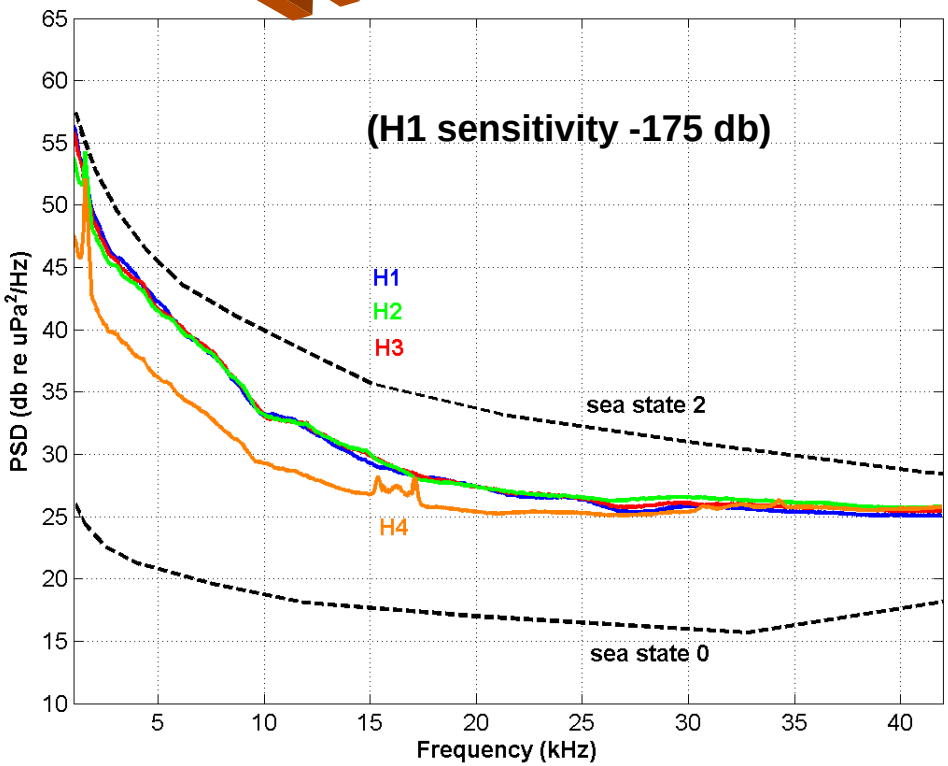
Average Noise Power Spectral Density



Fluctuations of noise level are strong below 20 kHz.

At higher frequency PSD = 25±2 μPa²/Hz

Preliminary



All Hydrophones (except H4) measure the same noise level at all frequencies.

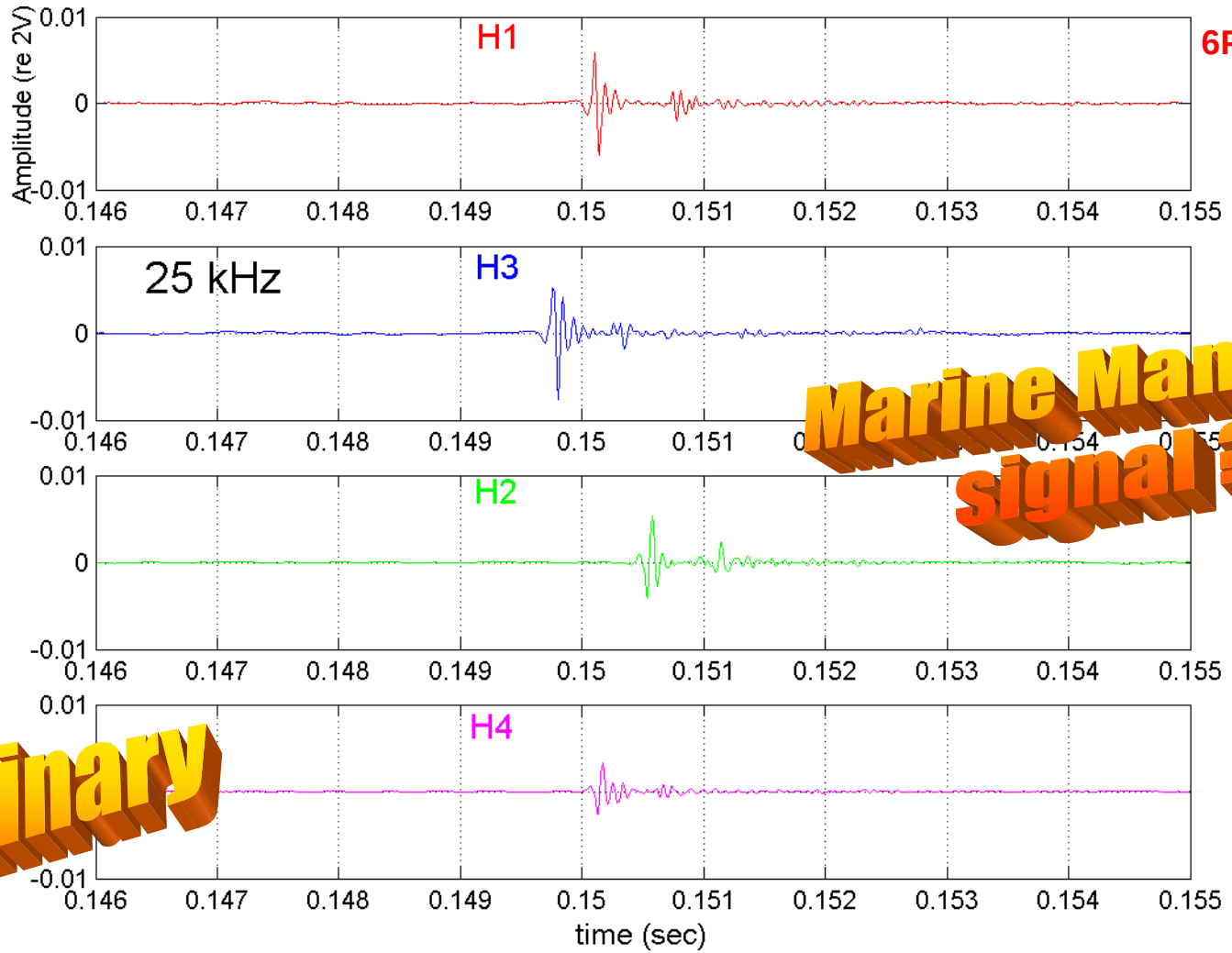
Calibration of H2 and H4 could not be checked before the deployment

Preliminary results: search for correlated signals

Event recorded on May 1 at 19:00

2V~ 1.2 kPa

6Pa (Signal Peak)

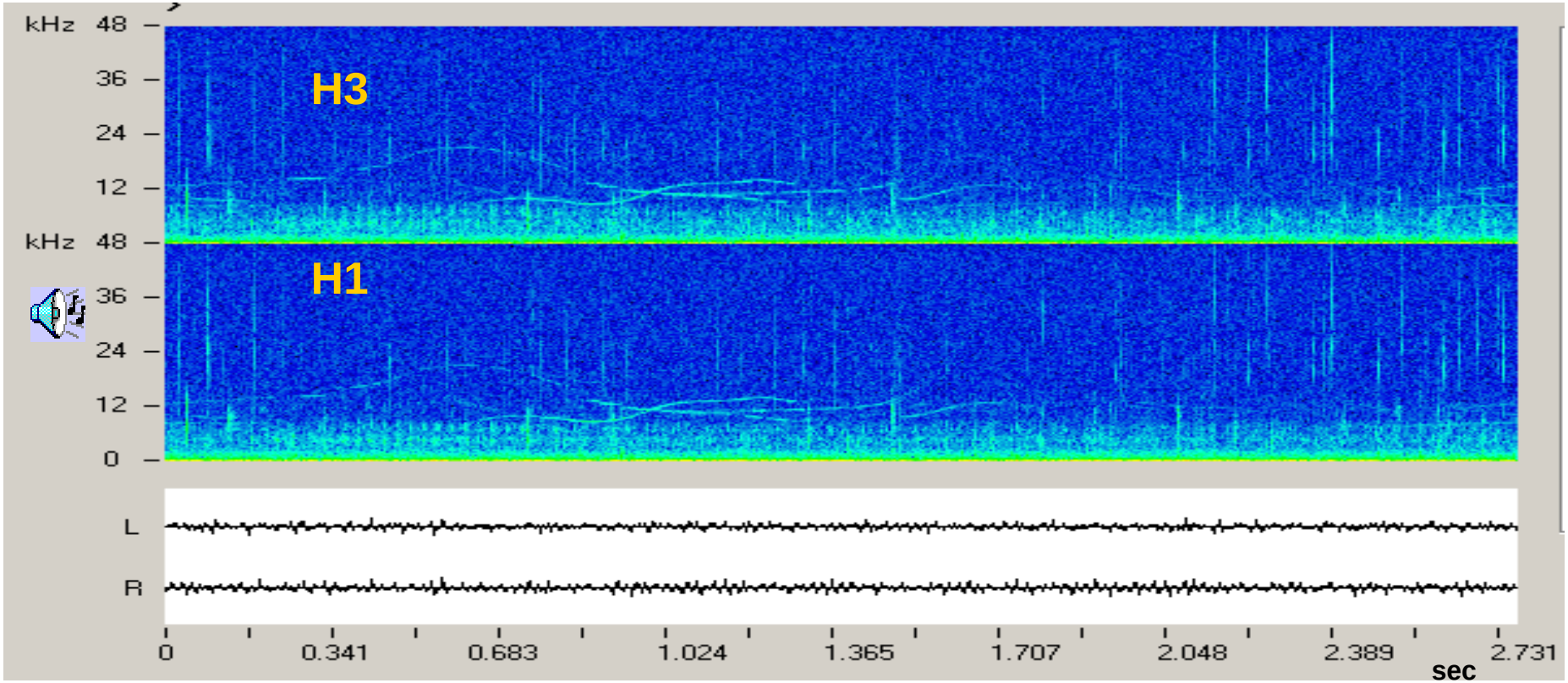


Marine Mammal signal?

Preliminary

The exact position of the four hydrophones is known, this information will be used to locate the source position (direction)

Search for Cetaceans in the Gulf of Catania



The detection of such sounds indicates presence of marine mammals more frequent than previously believed.

Long term observation and signal tracking will allow the determination of their presence and seasonal routes.

By analyzing sperm whale "click" details it is possible to assess the size and the sex of the animals.

INFN and CIBRA

Outlook

Status:

- The first step of "NEMO Phase 1" construction was successful
- A continuous stream of acoustic data from 2000m depth is monitored on shore since Jan 23. Data recording is performed for 5' each hour.
- Data analysis is in progress. Preliminary results indicate:
  - Acoustic noise is less than "*Sea State 2*" and variable at $f < 20$ kHz
  - Average PSD of acoustic noise at $f > 20$ kHz is ~25 $\mu Pa^2/Hz$

Goals:

- Improve knowledge of short and long term variations of underwater acoustic noise
- Develop acoustic neutrino detection technique and noise rejection algorithms using signal shape and hydrophones correlation

Interdisciplinary activities:

- Biological researches on marine mammals resident in the Gulf of Catania or passing through in their seasonal movements