

---

Real-time monitoring of noise and acoustic events: listening, identifying and understanding



Real-time monitoring of noise and  
acoustic events: listening to the deep,  
identifying and understanding

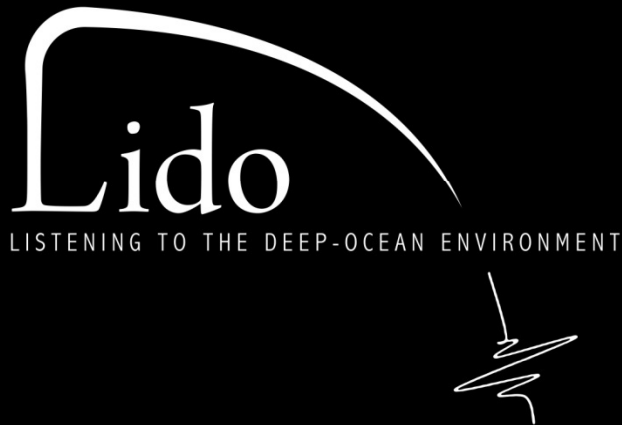
---

Michel André

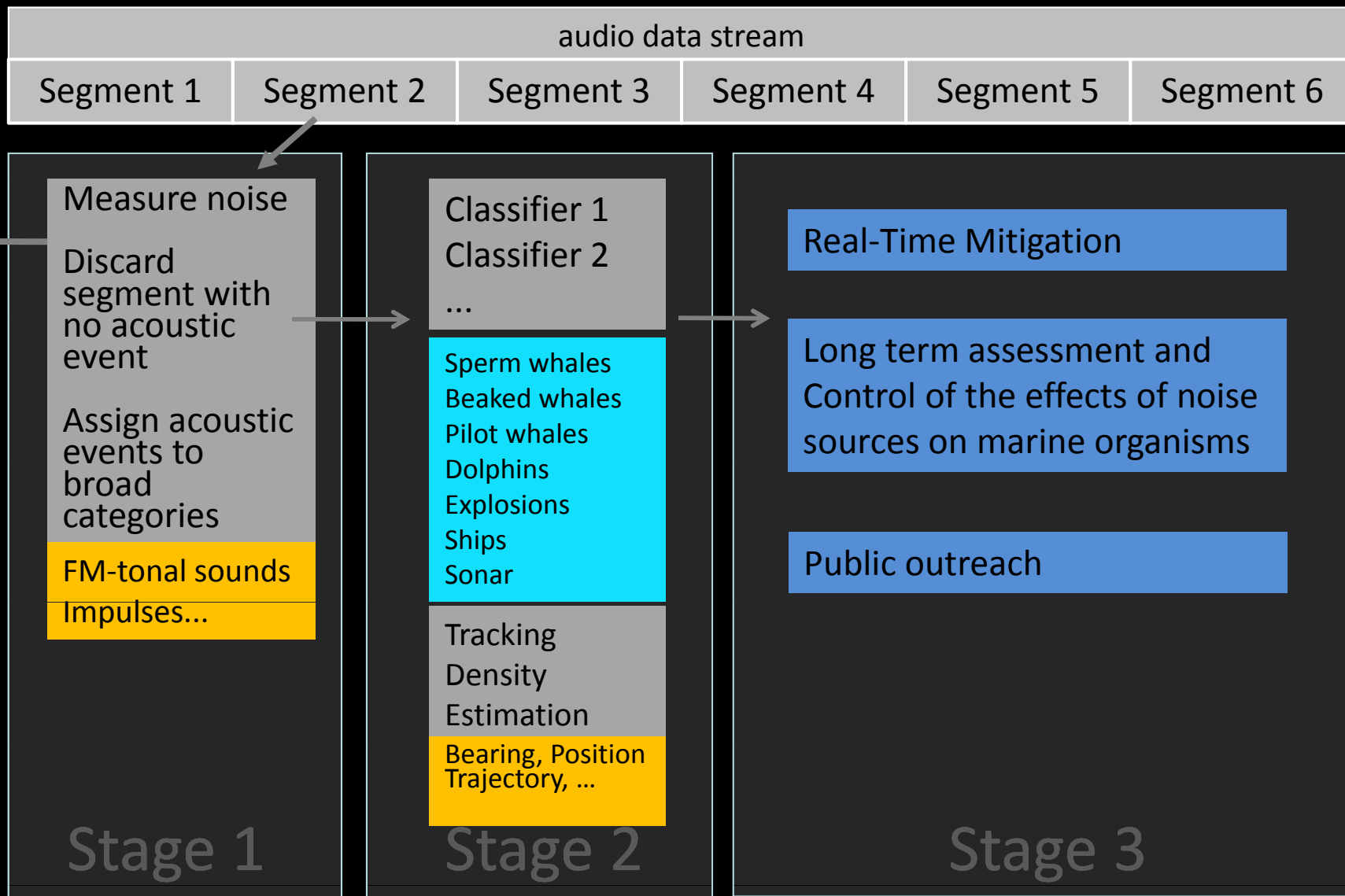
Laboratory of Applied Bioacoustics (LAB)  
Technical University of Catalonia (UPC, BARCELONA Tech)  
<http://www.lab.upc.es>

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

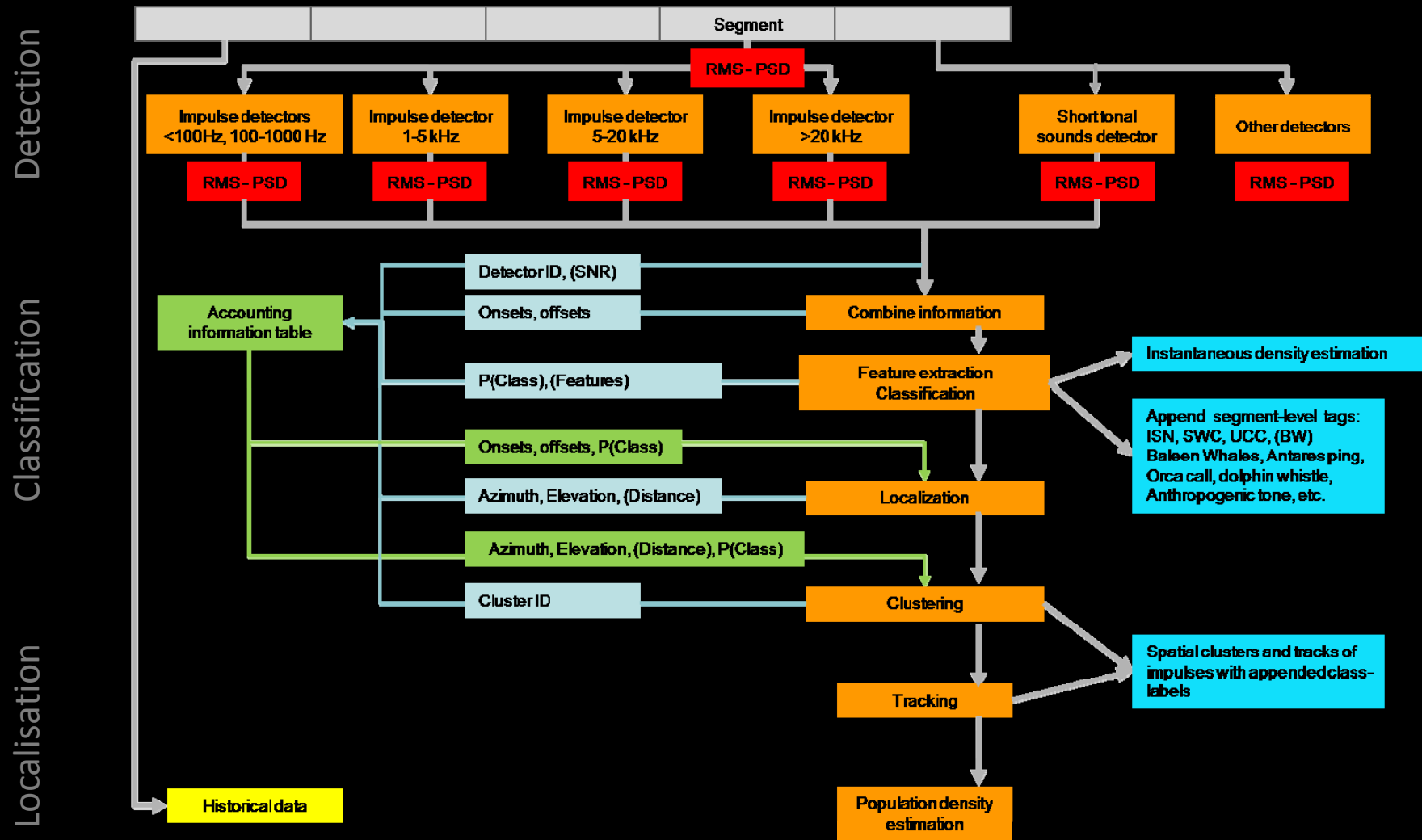
## LIDO live data flow



Country/Location	Platform	Data stream
FRANCE	ANTARES	36 x 250 kHz
NEPTUNE CANADA	Folger Passage	1 x 96 kHz
NEPTUNE CANADA	Barkley Canyon	1 x 96 kHz
NEPTUNE CANADA	Barkley Slope	1 x 96 kHz
SPAIN (MED SEA)	OBSEA	1 x 96 kHz
JAPAN (JAMSTEC)	Hatsushima	1 x 100 Hz
JAPAN (JAMSTEC)	Kushiro	3 x 100 Hz
ITALY (ESONET)	NEMO TSS/TSN	2x 4 x 96 kHz
SPAIN (ATLANTIC)	BIMEP	1 x 96 kHz
CTBTO ?	11 HA	11 x 200 Hz



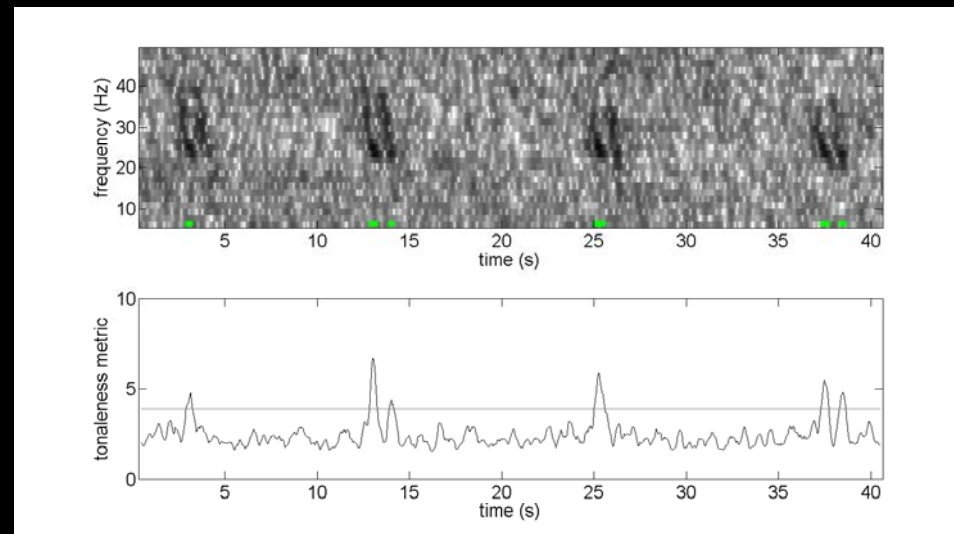
# Real-time monitoring of noise and acoustic events: listening, identifying and understanding



Real-time monitoring of noise and acoustic events: listening, identifying and understanding

## DETECTION & CLASSIFICATION

Fin whales, 29<sup>th</sup> April 2010, 02am, off Kushiro, JAPAN, JAMSTEC observatory  
(Feed Forward Neural Network)

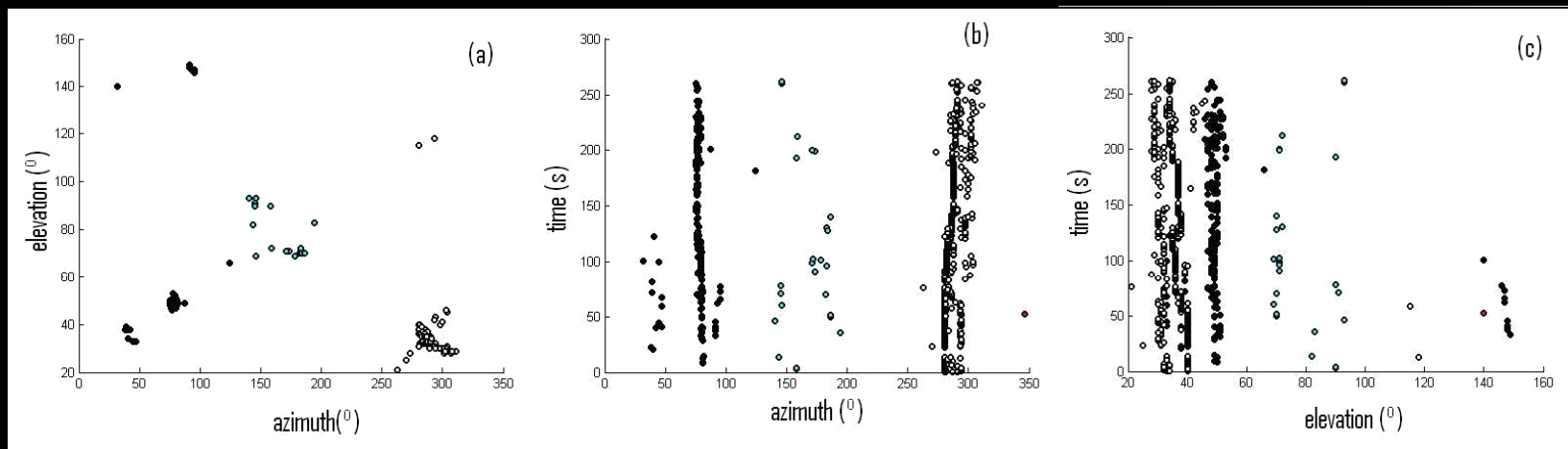


Zaugg, S., van der Schaar, M., Houégnigan, L., Gervaise, C., André, M. Real-time acoustic classification of sperm whale clicks and shipping impulses from deep-sea observatories. *Applied Acoustics*, issue doi:10.1016/j.apacoust.2010.05.005, 2010

# Real-time monitoring of noise and acoustic events in cetacean acoustic niches

## LOCALIZATION

Sperm whale tracking, 09<sup>th</sup> August 2005, 09pm, East-Sicily, NEMO observatory  
(Hybrid spatial spectral estimation: space-time methods and TDOA-based methods)

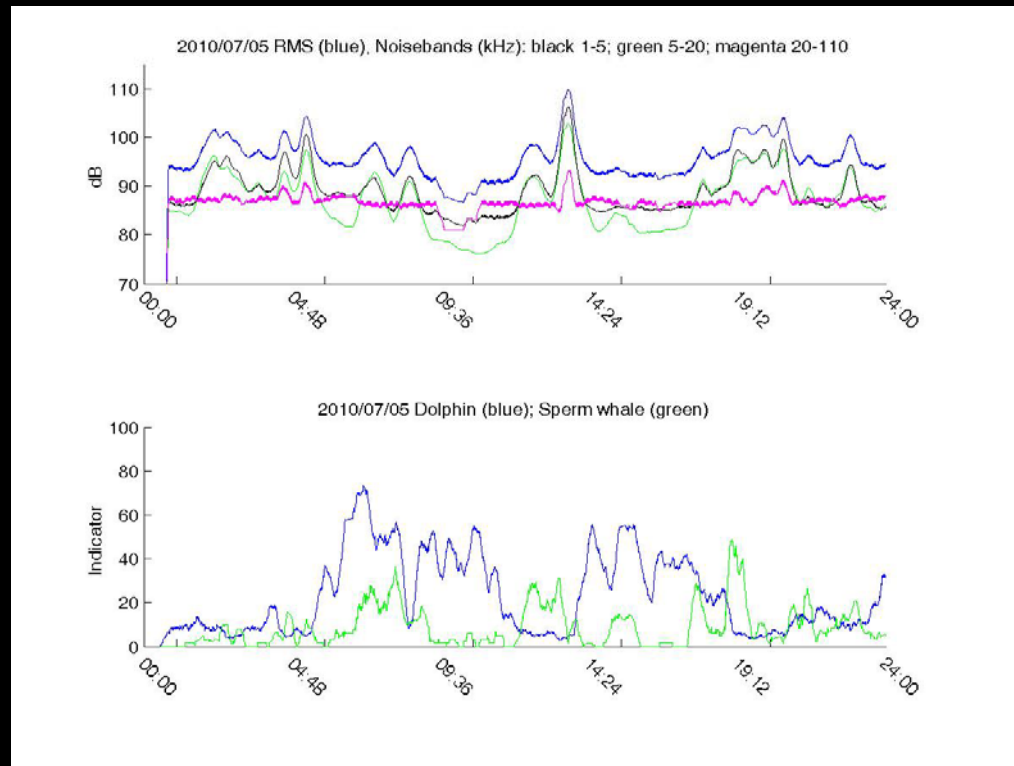


Houégnigan, S. Zaugg, M. van der Schaar, M. André. Space-time and hybrid algorithms for the passive acoustic 3D localisation of sperm whales and vessels. *Applied Acoustics* (2010), doi:10.1016/j.apacoust.2010.05.017

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

## INTERACTION WITH NOISE

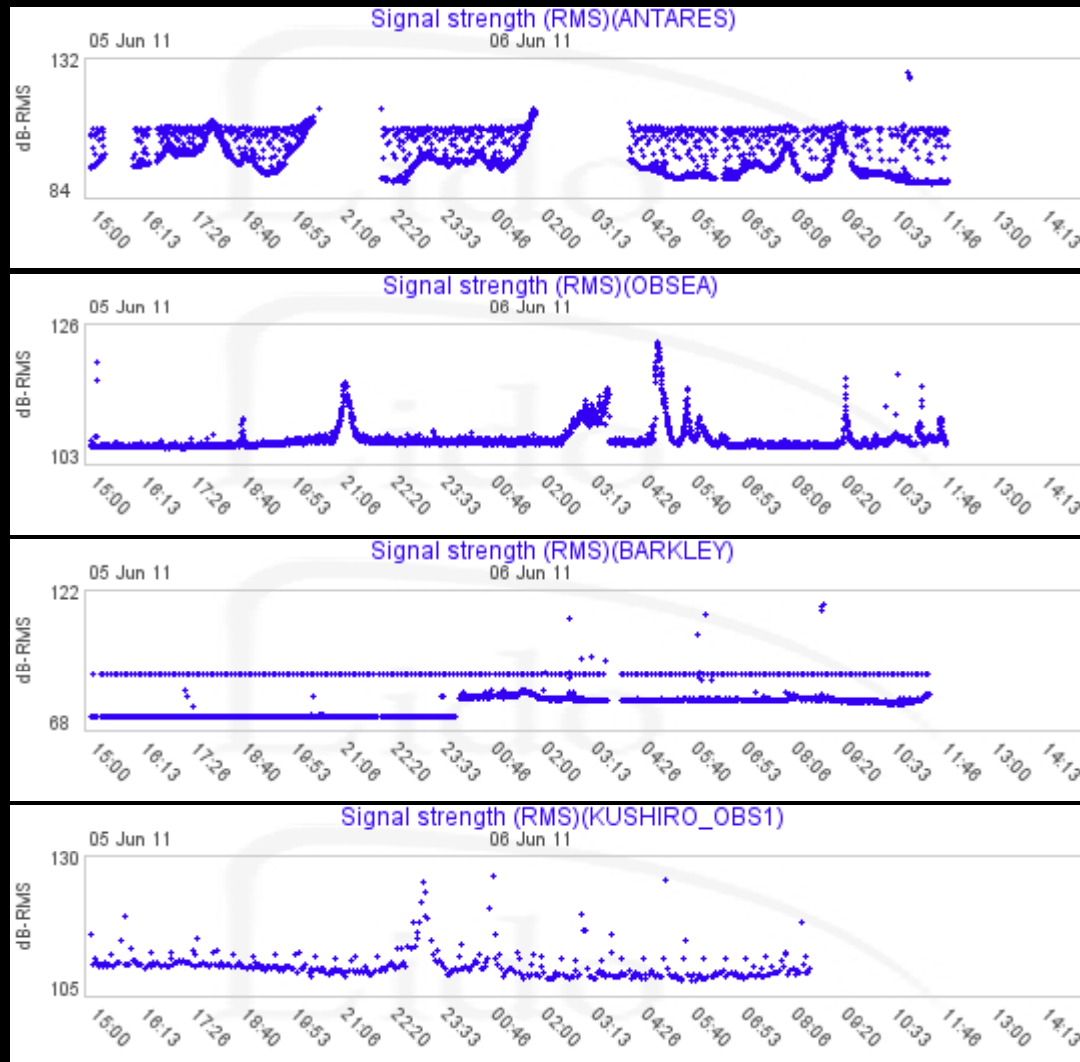
Sperm Whales at ANTARES (Ligurian Sea), July 2010



André, M., van der Schaar, M., Zaugg, S., Houégnigan, L., Sánchez, A., Mas, A. Listening to the Deep: real-time monitoring of noise pollution and cetacean acoustic signals. *Marine Pollution Bulletin* (accepted).

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

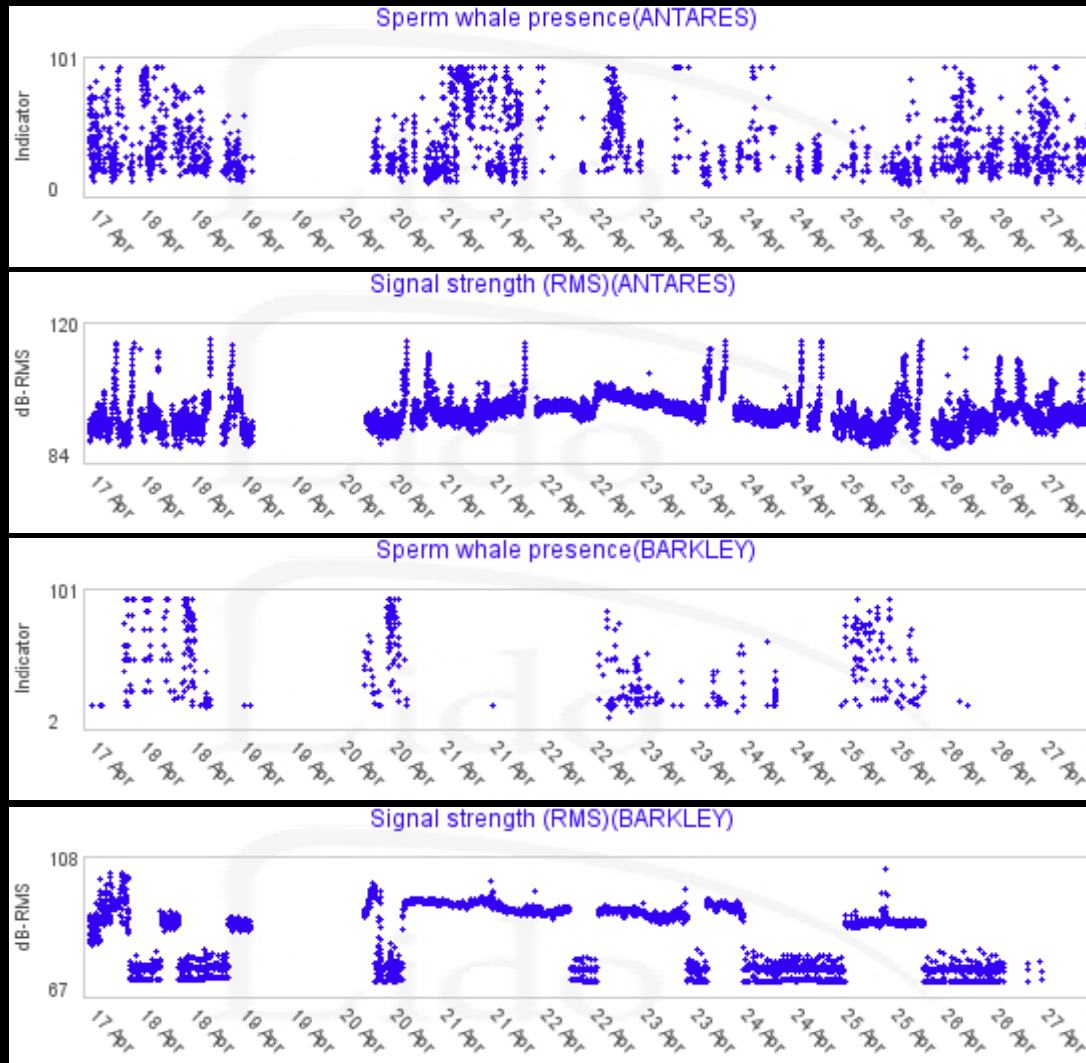
GLOBAL NOISE  
MEASUREMENTS  
(10 segment average)



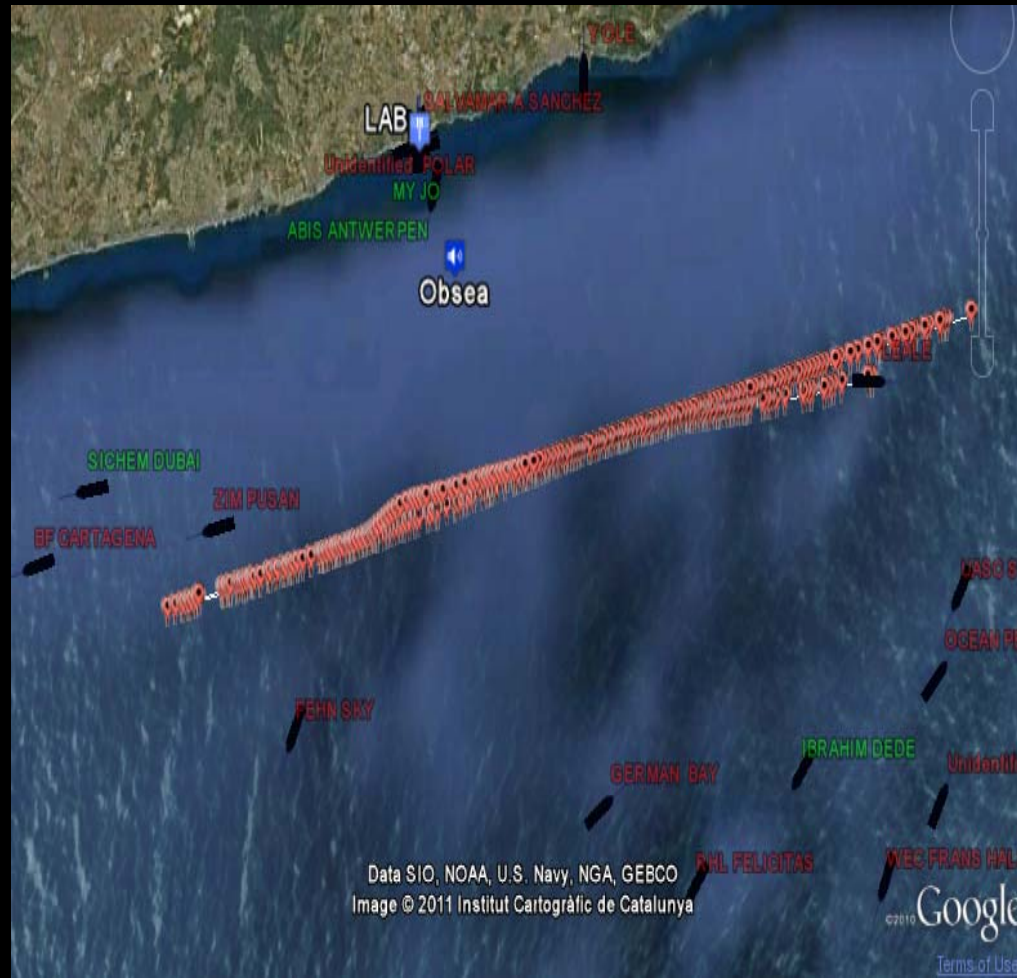


# Real-time monitoring of noise and acoustic events: listening, identifying and understanding

## GLOBAL CETACEAN DISTRIBUTION (50 segment average)



# Real-time monitoring of noise and acoustic events: listening, identifying and understanding



## LEALE

**MMSI:** 247238700

**Latest information received on:** 5th June 09:31:32 AM

**Speed:** 12.600 knots

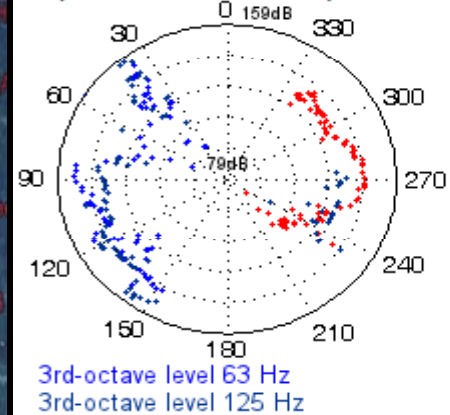
**Longitude:** 1.98573

**Latitude:** 41.14863

**Status:** Under way using engine

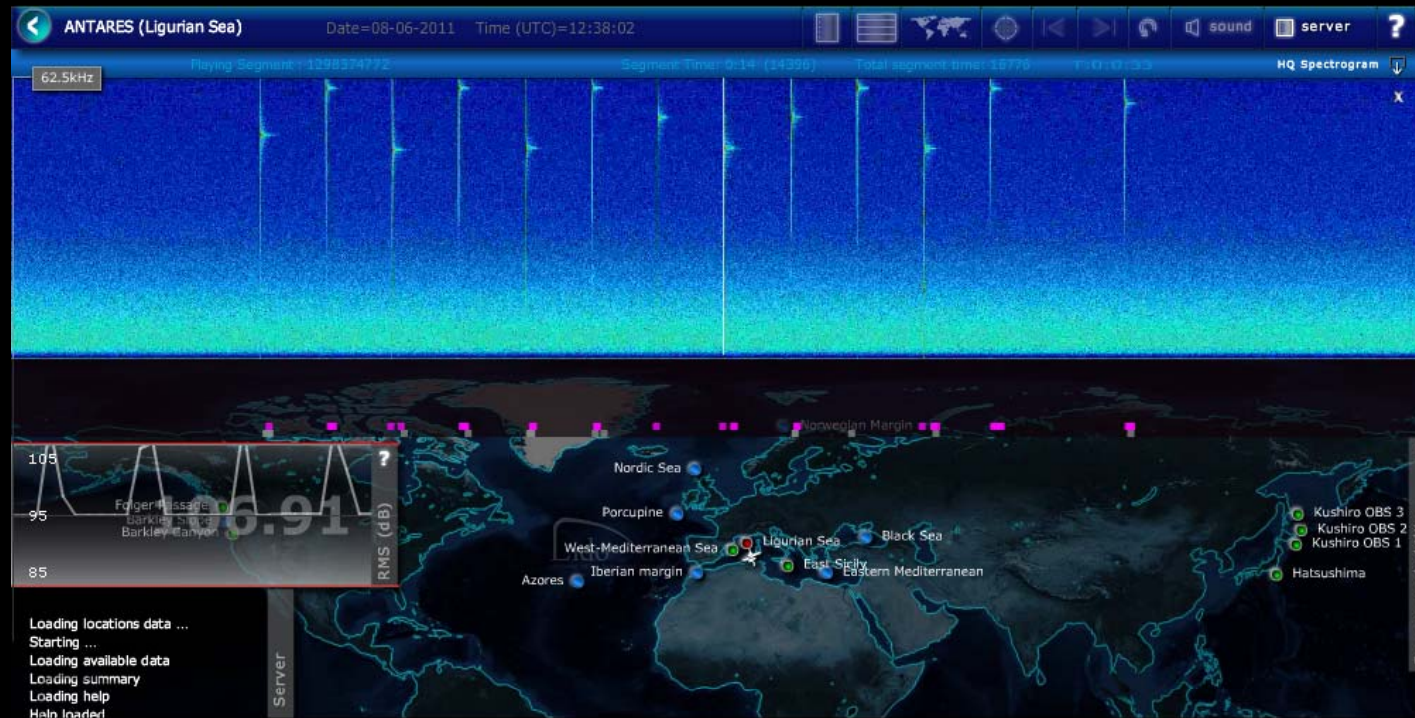
**Shiptype:** Tanker

Ship acoustic directivity\*:



Real-time monitoring of noise and acoustic events: listening, identifying and understanding

<http://listentothedeep.com>



LABORATORI D'APLICACIONS BIOACÚSTIQUES  
Universitat Politècnica de Catalunya



Laboratori d'Aplicacions Bioacústiques



Universitat Politècnica de Catalunya

# Real-time monitoring of noise and acoustic events: listening, identifying and understanding

Deep-sea or shallow water cabled observatories



Towed arrays



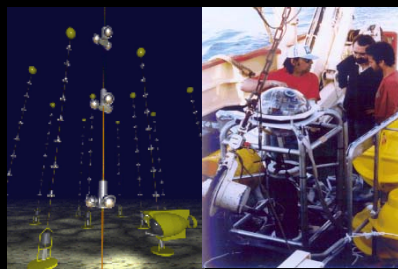
Radio-linked, expandable or moored stand-alone buoys



Underwater vehicles, e.g. gliders



Underwater neutrino telescopes



Past and Existing recordings



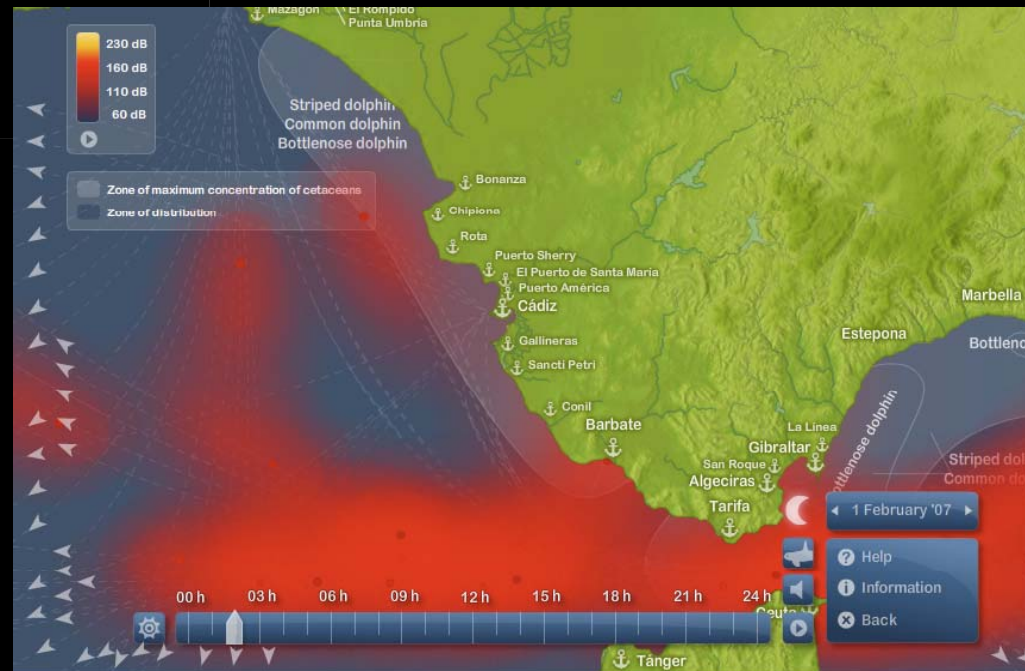


# Lido

LISTENING TO THE DEEP-OCEAN ENVIRONMENT



Monitoring  
existing noise  
sources



<http://www.sonsdemar.eu>



Laboratori d'Aplicacions Bioacústiques



Universitat Politècnica de Catalunya

---

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

CONCLUSIONS & PERSPECTIVES

The system is designed to be modular and dynamic (allows the choice of detectors/classifiers) depending on the objectives and geographical areas

The system successfully allows:

- the real-time detection and classification of acoustic events
- the real-time and long-term monitoring of noise
- immediate mitigation actions
- the online display of the audio stream and the statistical analysis

The modular system can be implemented on:

- cabled observatories,
- autonomous radio-linked buoys, moored antennas
- autonomous vehicles (e.g. gliders),
- towed arrays
- existing data sets,
- etc.

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

The system can be applied (industry):

- during offshore operations, seismic surveys (expandable buoys), windmills/wave energy (autonomous buoys during construction, cabled observatory during operation), shipping lines, coastal operations (e.g. harbour construction), etc.

The system can be applied (science):

- in existing and future acoustic observatories
- during CEE and tagging to understand the acoustic ecology of the individual,
- existing recordings

The system will be implemented (Fall) with:

- an alert procedure that will allow to automatically target acoustic events of interest and receive it live (e.g. mitigation or research)
- automatic display of AIS data and correlation with noise measurements to determine the acoustic signature of ships cruising over the observatories

---

Real-time monitoring of noise and acoustic events: listening, identifying and understanding

CONCLUSIONS & PERSPECTIVES

The data from the existing observatories are available to the scientific community

The system can be operated by a non-expert

The analysis is performed automatically and doesn't require post-processing

The system is immediately available to be applied to any Acoustics Observatory