# ACOUSTIC SENSORS: MAPPING AND MONITORING THE ENVIRONMENT


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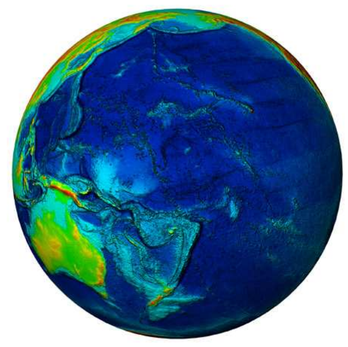
## BACKGROUND



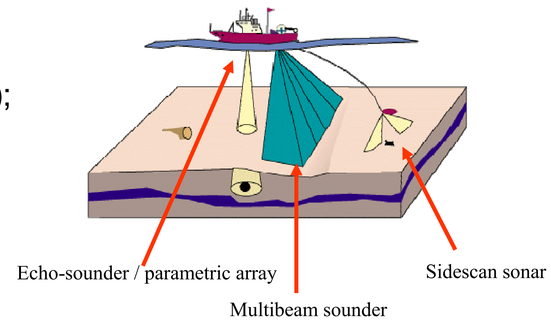
The world is a large place, and most of our planet is covered with water and inaccessible to direct observations.

Acoustic sensors are the only tool filling this gap: by sending directed beams of sound, we can image the water column, any objects in it, the seabed, any objects on it, and the immediate sub-surface, at all points in the world.

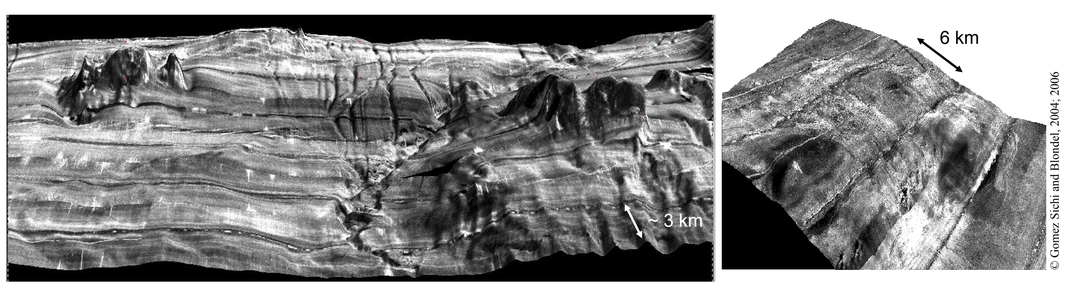
Our research is divided into three main thrusts:

- ✓ **understanding** the physics of acoustic scattering (theoretical and experimental acoustics);
- ✓ **developing** new instruments and processing techniques (e.g. for seabed classification);
- ✓ **applying** these results to topical problems (e.g. marine habitat mapping, effects of climate change, tsunami risks);

To do that, we use our large water tanks, local open-water sites and regularly go to sea on international expeditions.

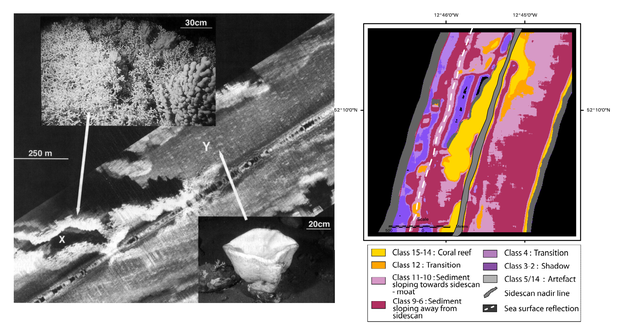



## CURRENT APPLICATIONS



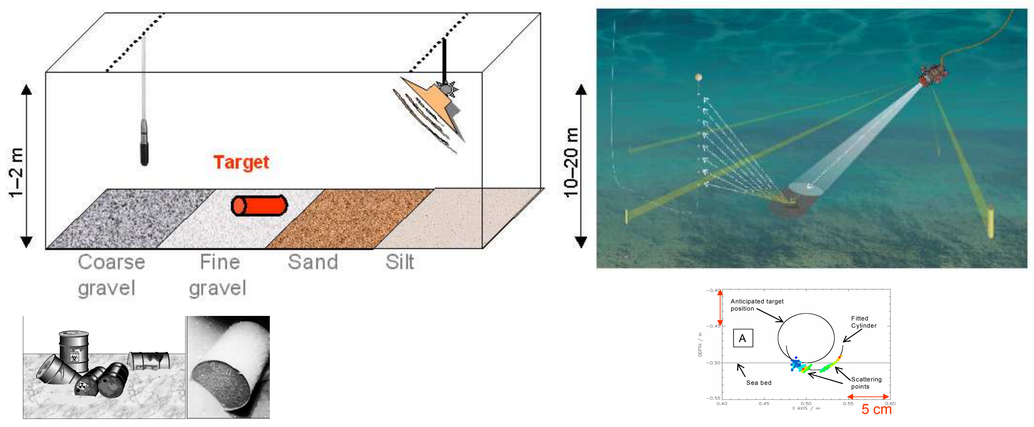

### *Mapping tsunami risks in Europe (HITS project, EC Marie-Curie)*

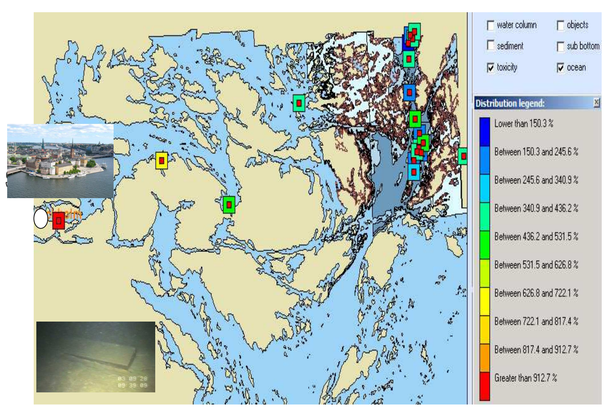
Sensor merging shows the 3-D structure of risk areas (left: south of Almeria, right: offshore Lisbon) and sub-seabed imaging shows past evolution and potential risks.
Seafloor characterisation challenges visual interpretations and identifies the most important areas.

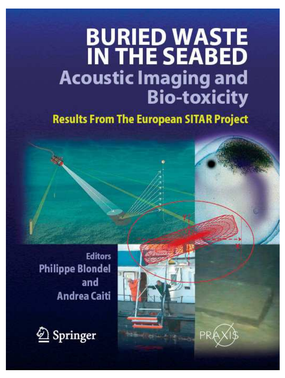



### *Marine Habitats: mapping and monitoring*

Fragile ecosystems (here: cold-water coral reefs off Norway) can be monitored using acoustic classification systems, and protected by fishing/mining restrictions.



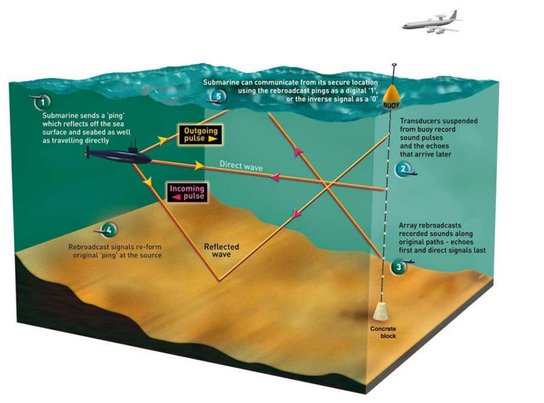



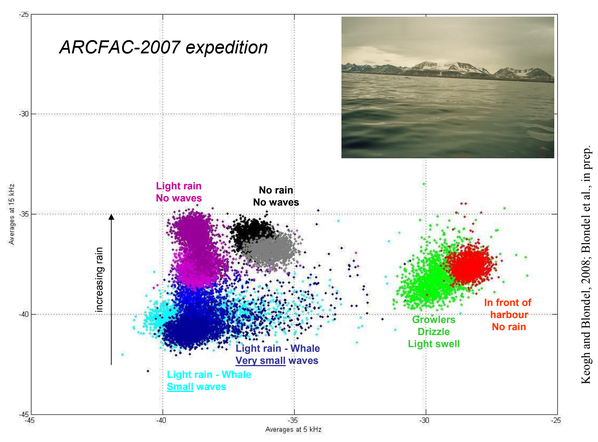

### *Bistatic sonars (DERA/QinetiQ + NATO projects)*

Scaled tank experiments have been used to design new, bistatic sonars and prepare for sea trials, reducing R&D time and deployment effort.
These new sonars have been used in several sea trials to detect and identify buried waste in the seabed and other objects. This a recognised EC Marketable Technology.
The results can be combined with those from other sensors (e.g. submarine videos) and fed into Decision-Support Systems for non-specialists (right: toxic dumpsite in Stockholm Archipelago)

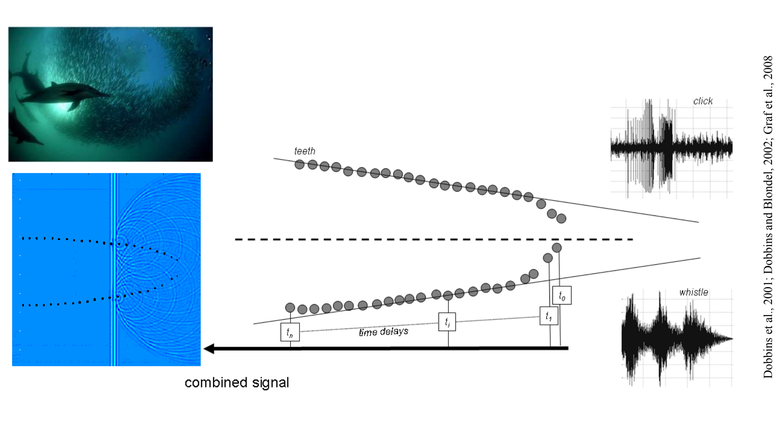
### *Imaging buried waste in the seabed (EC-SITAR project)*




Adamson et al., 2004; Adamson, 2008




Keogh and Blondel, 2008; Blondel et al., in prep.




Dobbins et al., 2001; Dobbins and Blondel, 2002; Graf et al., 2008

### *Time-reversal (CASE QinetiQ)*

Initiated by V.F. Humphrey at Bath. We showed with tank experiments and open water trials how this can be used for water column imaging.

### *Passive ocean monitoring (EC-ARCFAC + EPSRC)*

Ocean sounds can be used to monitor weather evolution in remote areas (here in Svalbard). Validated with tank experiments, our approach gives a better view on small-scale processes and climate change.

### *Biosonars and marine mammals (UoB)*

There is still much to learn about marine mammals and their acoustic abilities. Our research into sound reception by dolphins aims at validating concepts useful for biosonars

## SENSING CHALLENGES

***3-D imaging***

Sonar imaging of complex structures like algae or coral reefs. How can we merge measurements to calculate biomass or assess health?

***Sensor development***

Bringing bistatic sonars to a wider user community: cheaper, more versatile, easier to deploy and interpret. More varied applications.

***Climate change and the ocean***

Improving reliability/repeatability of all types of sonar surveys.

Accessing remote and key regions, at all depths, in all weathers.

## Bridging the Gaps

The Bath Interactive Ideas Factory: your opportunity to start a new collaboration across disciplines.


The Ideas Factory has been funded by the Engineering and Physical Sciences Research Council through the initiative **'Bridging the Gaps between Mathematics, Computer Science and Engineering'.** The aim of this project is to foster interdisciplinary collaboration and communication.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