Mapping and living in marine habitats

sonars, seismics and ambient sounds

Philippe Blondel

CGeol FGS FIOA FHEA

Department of Physics, University of Bath
Bath, UK

Active Sonar Mapping

High frequencies (> kHz)

Smaller wavelengths

Higher transmission losses

But higher resolutions

Seabeds extremely complex

Surface <u>and volume</u> scattering

Need for calibration

dB not just “grey levels”

comparison of repeat surveys

Need for traceability

acquisition

processing chain

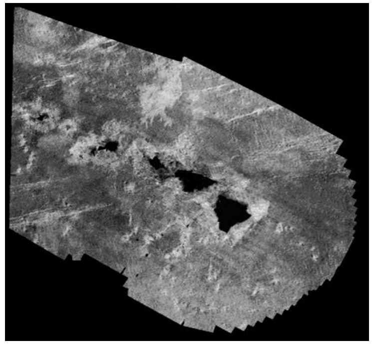
interpretation (e.g. EUNIS)

Need for long-term access

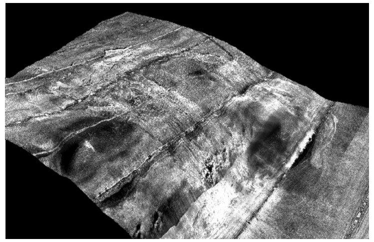
enhancing acquisition costs/benefits

assessing long-term changes

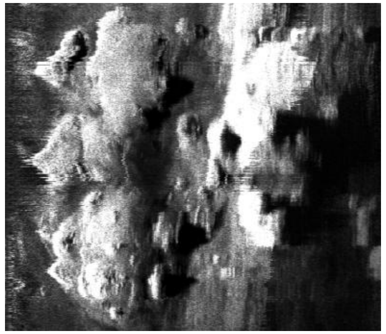
1980’s
6.5 kHz
60-m resolution



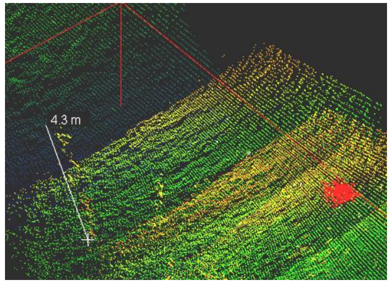
early 1990’s
30 kHz
6-m resolution

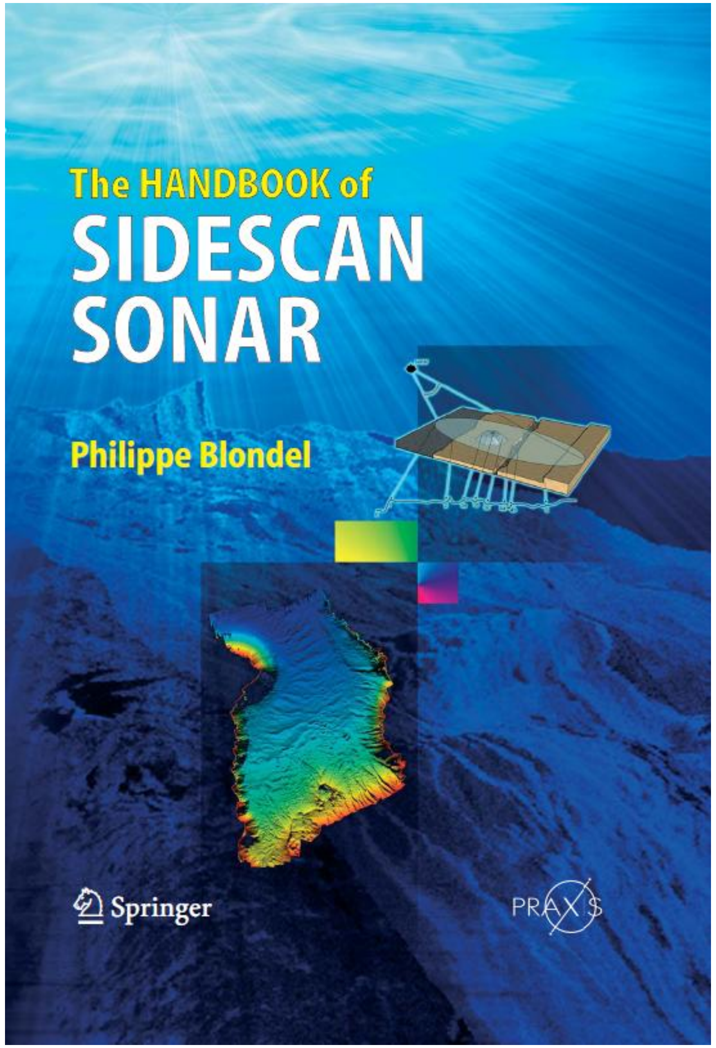


mid-1990’s
120 kHz
60-cm resolution



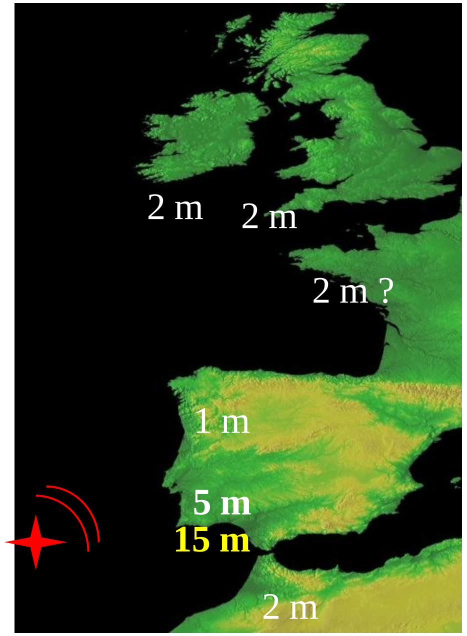
2000’s
260 kHz
< 6-cm resolution

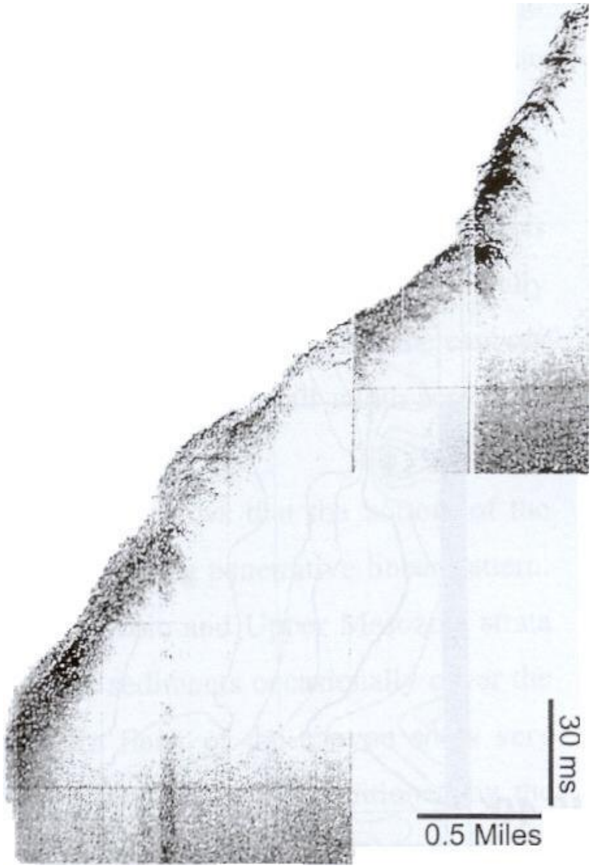


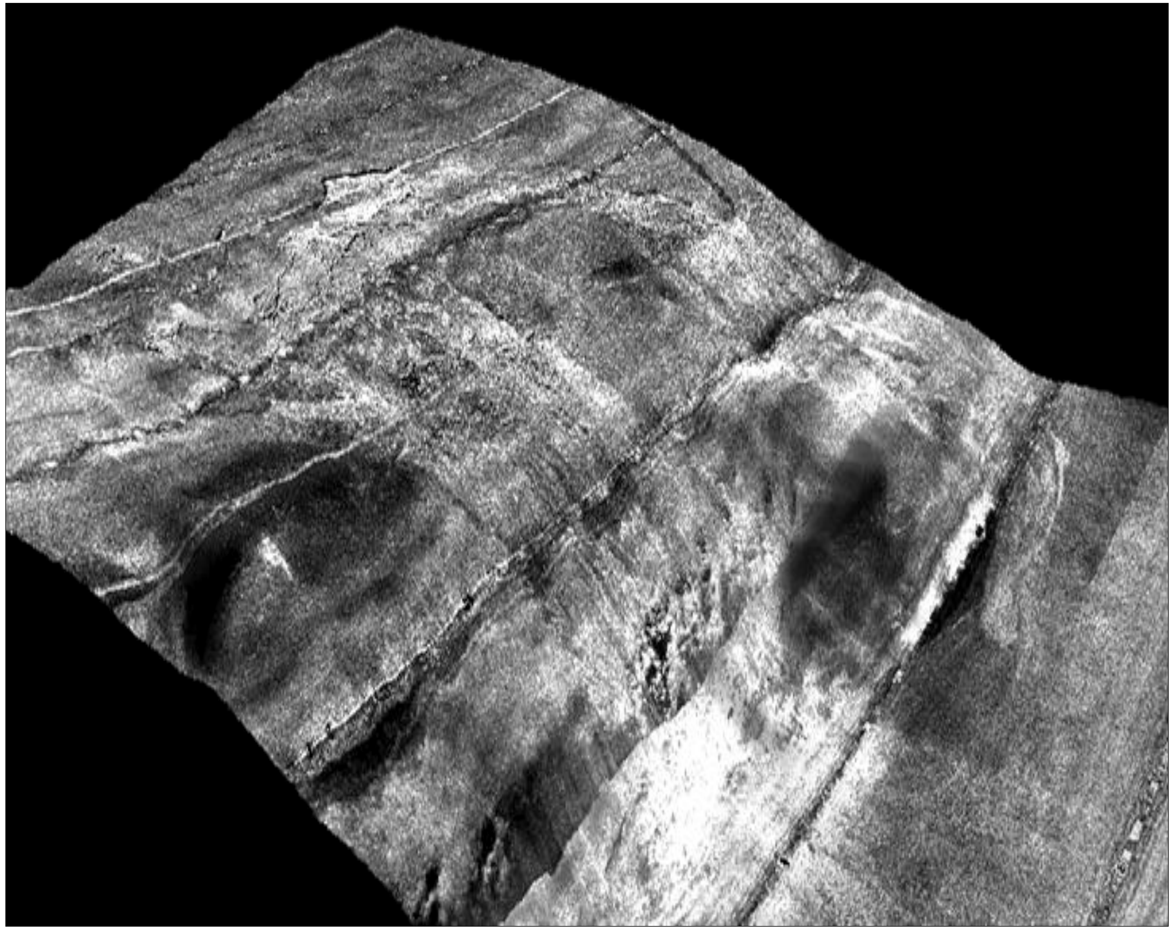


UNIVERSITY OF BATH

Geohazards



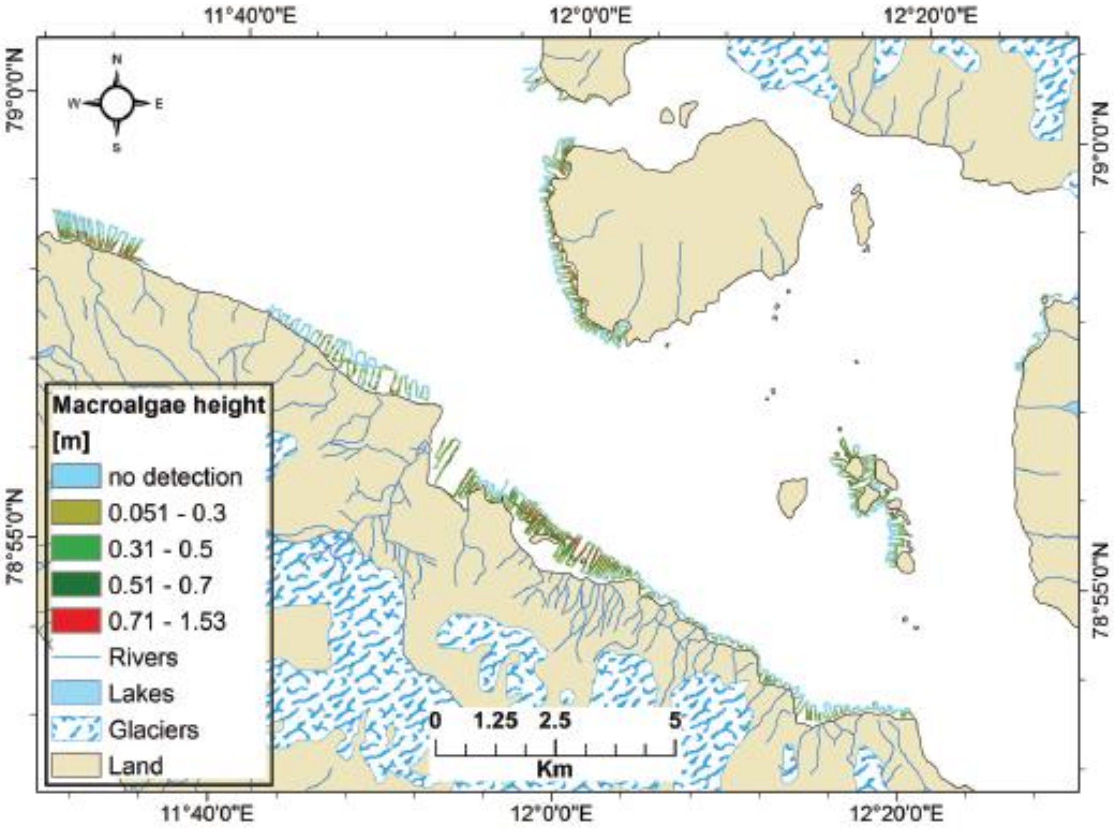




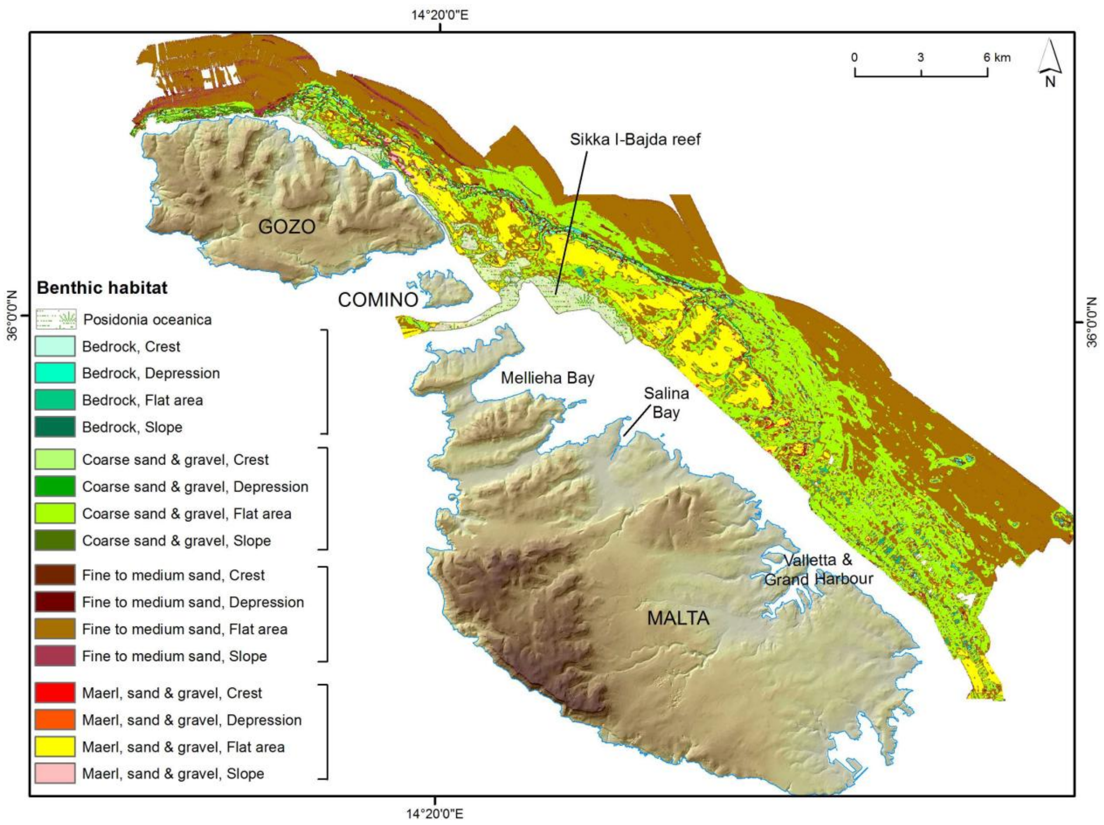
20 km x 13 km, very steep slopes (~ 1:20)

Source of the Lisbon tsunami (1755)

Marine Habitats



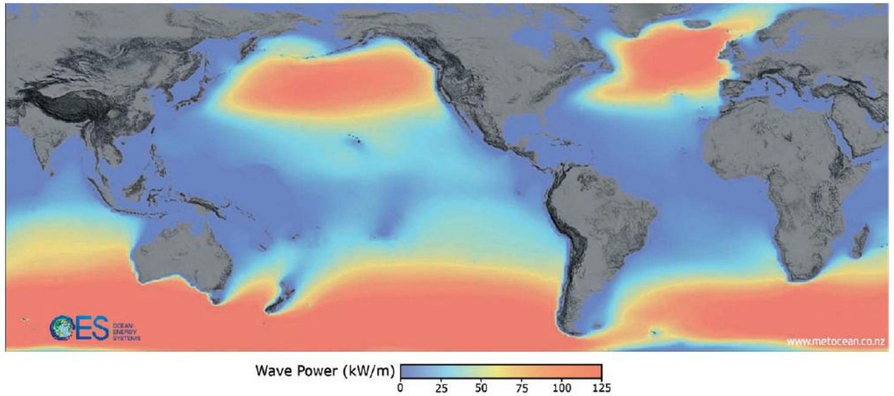
Faint targets in cluttered backgrounds
Algae and habitat mapping with new sonars
Biomass assessments – Climate-induced changes
Kruss et al., 2008, 2012, 2017



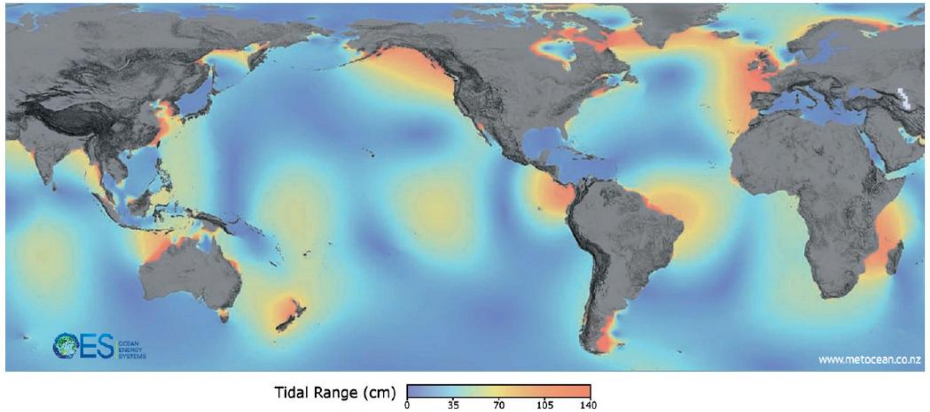
Large-scale mapping of complex terrains
Acoustics and geo-hazards around Malta
Palaeo-landscapes and responses to sea level changes
Micallef et al., 2012; Prampolini et al., 2016

UNIVERSITY OF BATH

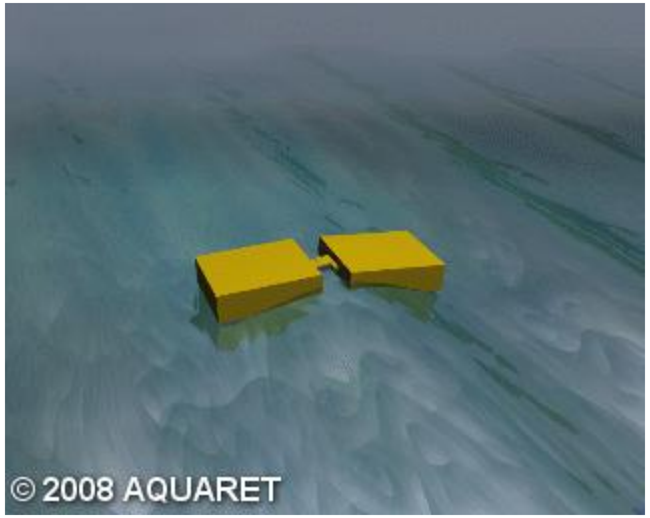
Marine Renewable Energies

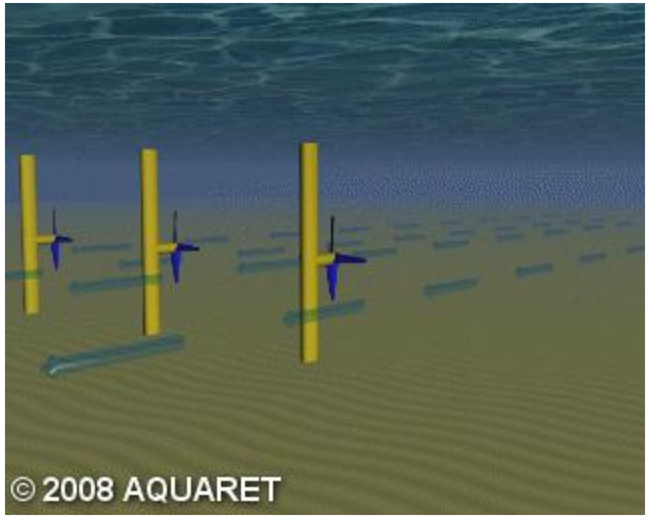


29,500 TWh/year

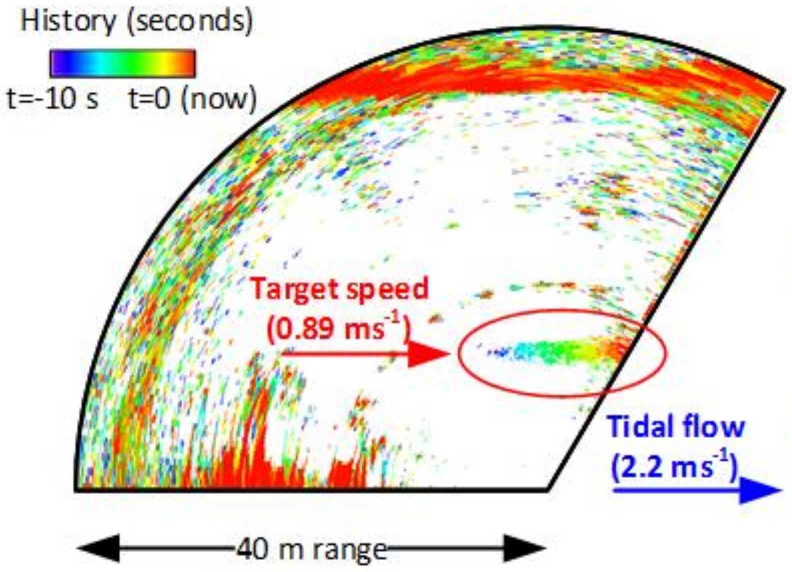


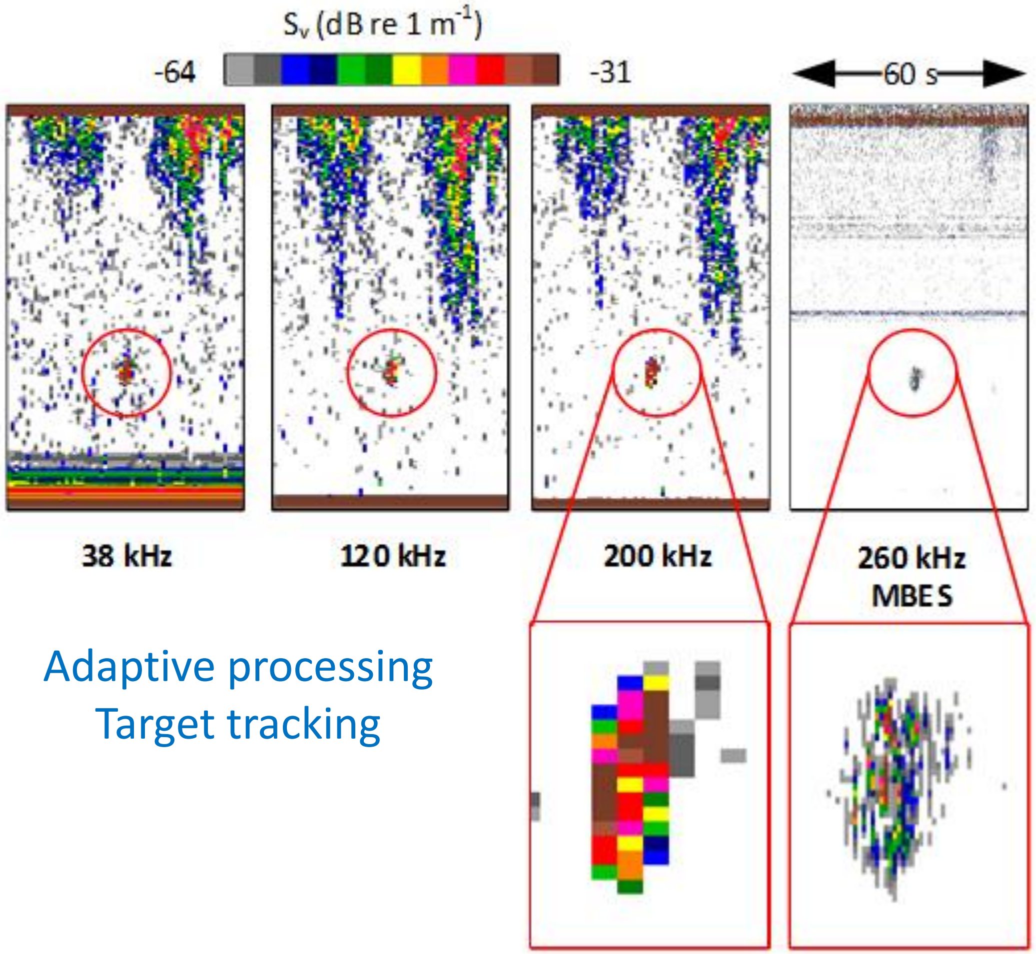
7,800 TWh/year

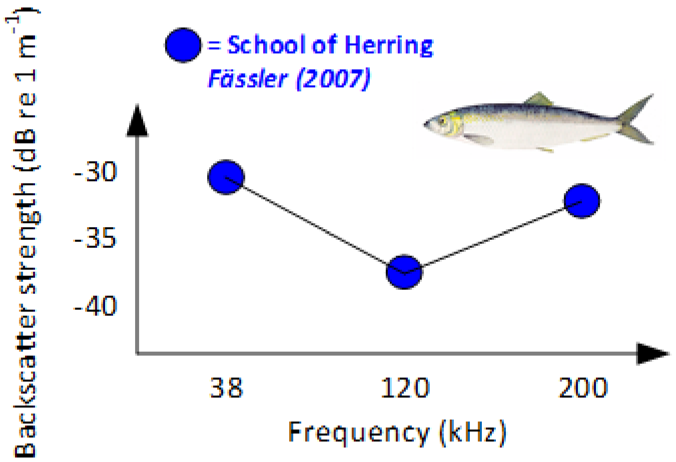




Habitats Around Renewable Energy Devices





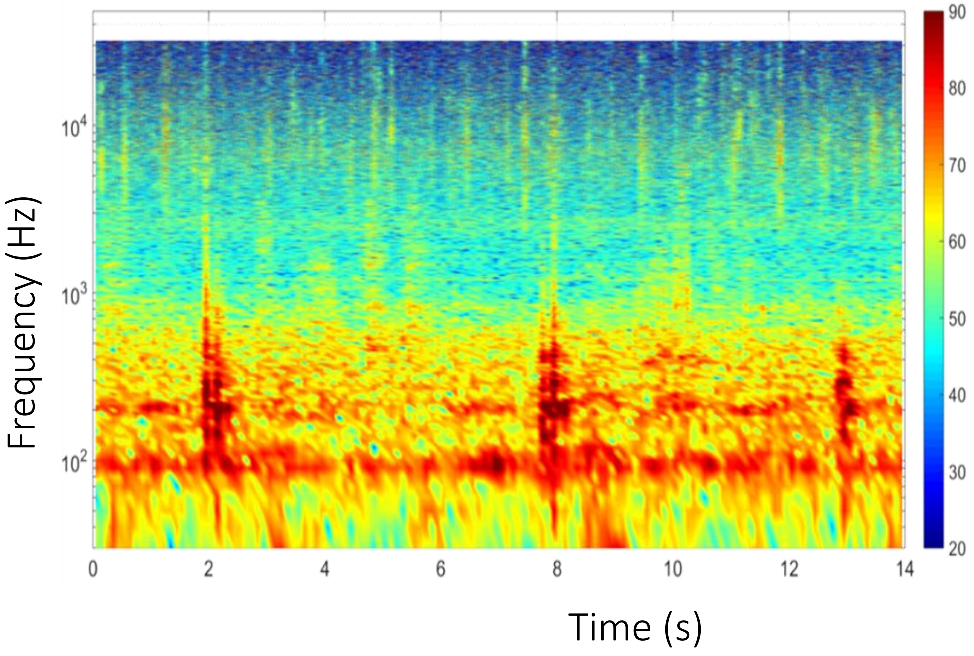


Adaptive processing
Target tracking

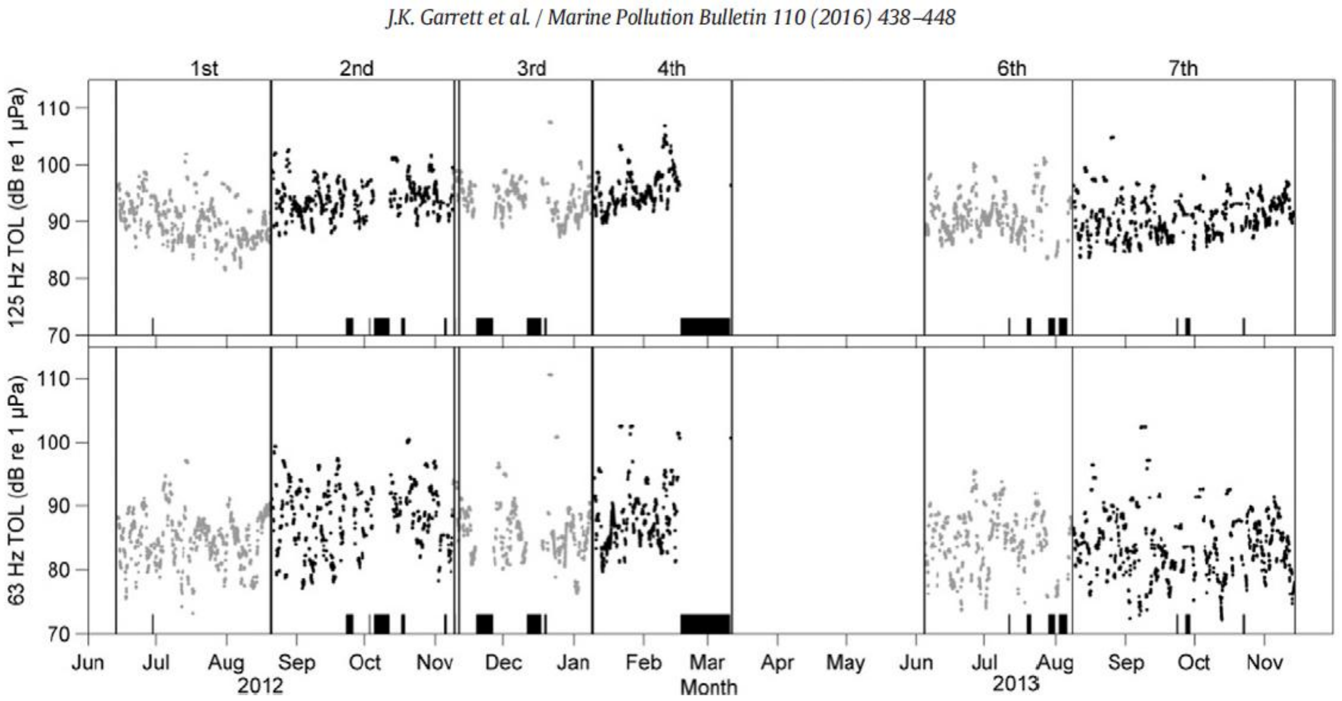
7 times/second × 2+ weeks

Blondel et al., 2012; Williamson et al., 2015, 2017

Impacts of Renewable Energy Devices



Walsh et al., 2015, 2016, 2017



Merchant et al., 2012; Garrett et al., 2016; Blondel et al., 2017

Acoustic Emissions

<u>First proof</u> that noise from Wave Energy Converters can be detected > 200 m away, in all sea conditions

Used for Condition-Based Monitoring

Long-term impacts – Comparison with backgrounds

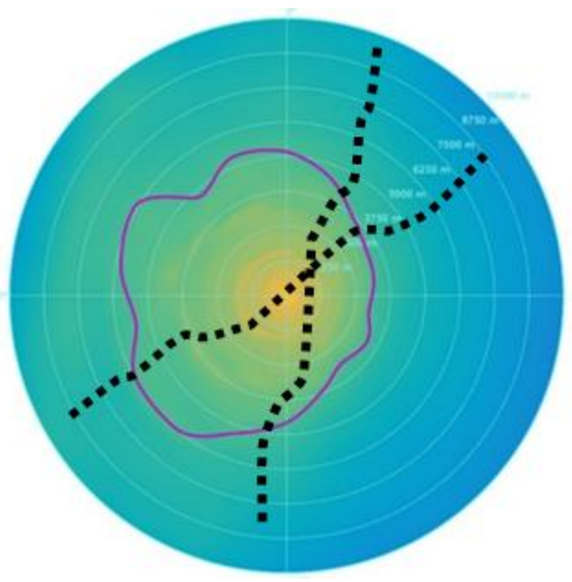
<u>First really long term measurements:</u> several years in Falmouth Bay, UK

Marine Renewables, weaher, shipping and marine life

Acoustic impacts (or not …)

Seismic Mitigation

Complex and variable environments



Blondel et al., 2016

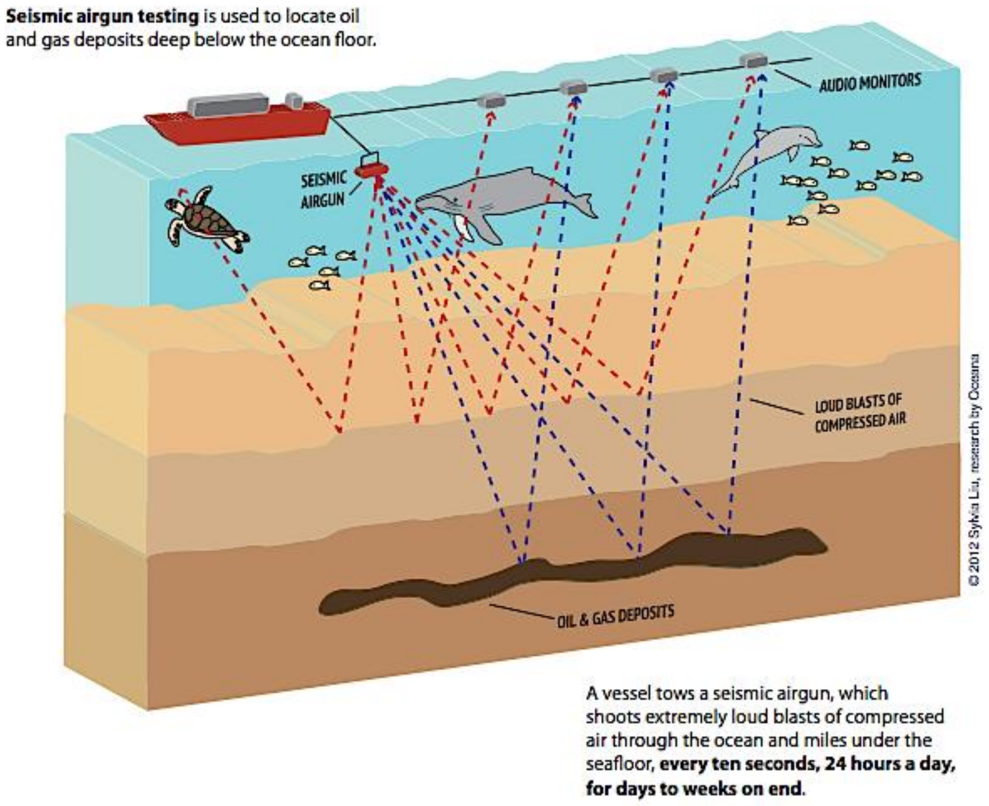
Can we know the exact shape of the mitigation range?

WHERE and **WHEN** it is best to measure?

HOW MANY measurements are enough?

Use of mathematical approaches (e.g. 4-D var)

Ideal testing ground for Artificial Intelligence



Can we use airguns as *sources of opportunity* to detect "hidden" animals?

see Banda et al. (tomorrow)

UNIVERSITY OF BATH

International Quiet Ocean Experiment

IQOE Working Group on Arctic Acoustic Environments

September 26, 2017

On 12 September 2017, IQOE announced the formation of the IQOE Working Group on Arctic Acoustic Environments. The group is co-chaired by Philippe Blondel (UK) and Hanne Sagen (Norway). The working group will coordinate national acoustic observations, research, and modelling in the Arctic Ocean and will compile of baseline acoustic data.

IQOE
International Quiet Ocean Experiment

HOME
FUNDAMENTAL QUESTIONS
THEMES
PRODUCTS
WORKSHOPS
WORKING GROUPS
ENDORSED PROJECTS
NATIONAL ACTIVITIES

ACOUSTIC OBSERVING SYSTEMS
ACOUSTIC DATA PORTAL
LITERATURE LIBRARY
MARINE ANIMAL SOUNDS
IQOE EMAIL LIST SIGN-UP

Our Working Group was created in late 2017

and addresses several themes in the Arctic

UNIVERSITY OF BATH

Arctic Acoustic Environments

POLAR NOISE 2015 – 2017 – …

Co-chairs: Hanne Sagen
Philippe Blondel

1. **What is "the vision"?**
   Scientific Arctic to useful Arctic

2. **Filling the gaps**
   Metrics and standards – Propagation models
   Pan Arctic Collaborations?
   Long term **Archiving**

3. **Measuring – Comparing**
   Do we have any priorities regarding where to collect data?
   (e.g. Greenland Ice sheets, protected areas (environment); along ship lanes)
   Integrative analysis

With thanks to:
Mike van der Schaar, Nathalie Roy, Bazile Kinda, Bruce Martin, Torill Hamre, Jennifer Miksis-Olds

From Science To Policy

AAE co-chairs participated to **Arctic Observing Summit** (Davos, Switzerland, June 2018)
Endorsement of AAE-IQOE goals and activities

Contributed to recommendations for 2nd Arctic Science Ministerial

*"We recommend exploring the possible call of a **forum of Arctic science funders** to discuss strategies for supporting the research that is necessary to achieve the goals agreed at this Ministerial meeting"*

*"There is a need to enhance reciprocal collaboration and coordination of efforts on Arctic observations of all types, spanning from **community-based observatories to high-tech autonomous systems**, and to **increase their spatial and temporal coverage**"*

UNIVERSITY OF BATH

Conclusions

Active and passive acoustics have matured – Used everywhere, with all marine stakeholders

Calibration

dB not just "levels" — comparison of repeat measurements

Traceability

acquisition and processing chain — interpretation (e.g. EUNIS)

Need for long-term access

enhancing acquisition costs/benefits — assessing long-term changes

New tools for processing large and complex datasets:

- machine learning
- parallel processing
- distributed and shared computing

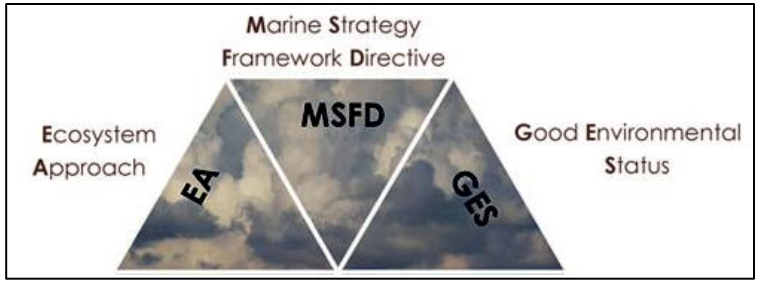

Methods in Ecology and Evolution

Methods in Ecology and Evolution 2015 — doi: 10.1111/2041-210X.12330

REVIEW

Measuring acoustic habitats

Nathan D. Merchant[1, 2, 3*], Kurt M. Fristrup[4], Mark P. Johnson[5], Peter L. Tyack[5], Matthew J. Witt[6], Philippe Blondel[3] and Susan E. Parks[2]



Analyses increasingly standardised and <u>comparable</u>

The oceans are changing (fast) and we need to protect what we discover

Calibrated, repeatable measurements are the best way to provide necessary and <u>actionable</u> evidence