Mapping and living in marine habitats

*sonars, seismics and ambient sounds*

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**Active Sonar Mapping**

**High frequencies (> kHz)**
- Smaller wavelengths
- Higher transmission losses
  - *But higher resolutions*
- Seabeds extremely complex
  - Surface and volume 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

**Historical Data**

- **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
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
Habitats Around Renewable Energy Devices

Adaptive processing
Target tracking

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

7 times/second × 2+ weeks
Impacts of Renewable Energy Devices

**Acoustic Emissions**

*First proof* 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**

*First really long term measurements:* several years in Falmouth Bay, UK

Marine Renewables, weather, 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*

Seismic airgun testing is used to locate oil and gas deposits deep below the ocean floor.

*A vessel tows a seismic airgun, which shoots extremely loud blasts of compressed air through the ocean and miles under the seafloor, every ten seconds, 24 hours a day, for days to weeks on end.*

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

*see Banda et al. (tomorrow)*
Our Working Group was created in late 2017 and addresses several themes in the Arctic.
Arctic Acoustic Environments

POLAR NOISE 2015 – 2017 – …

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

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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.

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
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

Analyses increasingly standardised and comparable

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

Calibrated, repeatable measurements are the best way to provide necessary and actionable evidence