Long-term ambient noise monitoring off eastern Scotland, and an exploration of tidal influence on MSFD reporting

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Background

Underwater soundscape: natural, biological and anthropogenic sounds

EU Marine Strategy Framework Directive (MSFD)

- Descriptor 11.2.1. Ambient (continuous) noise
- Threshold levels have not been set yet
Aims

Assess the spatio-temporal variability in ambient noise
  • Averaged RMS levels & percentile statistics (for the 1/3 octave band centred at 63 Hz)

Investigation into tidal influence on MSFD reporting
  • Average RMS levels
  • Exceedance of hypothetical GES threshold
Methodology: Data collection

Deployments: **10 coastal sites**

Acoustic broadband recorders: **SM2M/SM3M**
- 96 kHz sampling rate
- 10/10 and 10/20 min on/off duty cycle

5 years of data: **2013 - 2017**

Increased monitoring effort over the years
Methodology: Data analyses

Ambient noise analysis: Modified version of PAMGuide

Tidal influence:
- Tidal **velocity data** obtained from Scottish Shelf Model
- Top 3 tidally-affected sites (Kernell’s rank correlation coefficient)
- Exclusion of periods with highest velocity (‘tidal-corrected dataset’)

RMS levels compared against GES thresholds
Results

Effort: 0 – 5191 hrs / site / year
→ Total 112,071 hrs

Annual RMS levels: 86.8 - 111.0 dB re 1 μPa
Results

Per year:
• Higher noise levels at Cruden Bay
• Lower RMS levels at Stonehaven and/or Fraserburgh (& Cromarty)

Per month:
• Winter levels appear lower (but limited data: 2017 only, and unequal effort)
Results

Per site:
- No general pattern
Results

Tidal corrections:
• Substantial exclusion of data
• Varying consequences on RMS levels

<table>
<thead>
<tr>
<th>Location</th>
<th>Tidal correction – Data excluded</th>
<th>Change in RMS measurements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stonehaven</td>
<td>61.0 – 91.8 %</td>
<td>-3.9 to -11.1 dB</td>
</tr>
<tr>
<td>Fraserburgh</td>
<td>28.2 – 86.3 %</td>
<td>-6.3 to +2.0 dB</td>
</tr>
<tr>
<td>Cruden Bay</td>
<td>51.7 – 85.6 %</td>
<td>-2.1 to 0 dB</td>
</tr>
</tbody>
</table>
Results

Stonehaven - 63 Hz

Cruden Bay - 63 Hz
Summary

Annual RMS levels: 86.8 - 111.0 dB re 1 μPa

Consistent noisier and quieter sites identified

Tidal correction (i.e. data sub-setting) possible due to vast amount of annual data

Applied to sites influence by tide → meaningful data for MFSD ambient noise monitoring
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