Evaluating controls of acoustic noise propagation across the continental margin [MG2.1PhD2]

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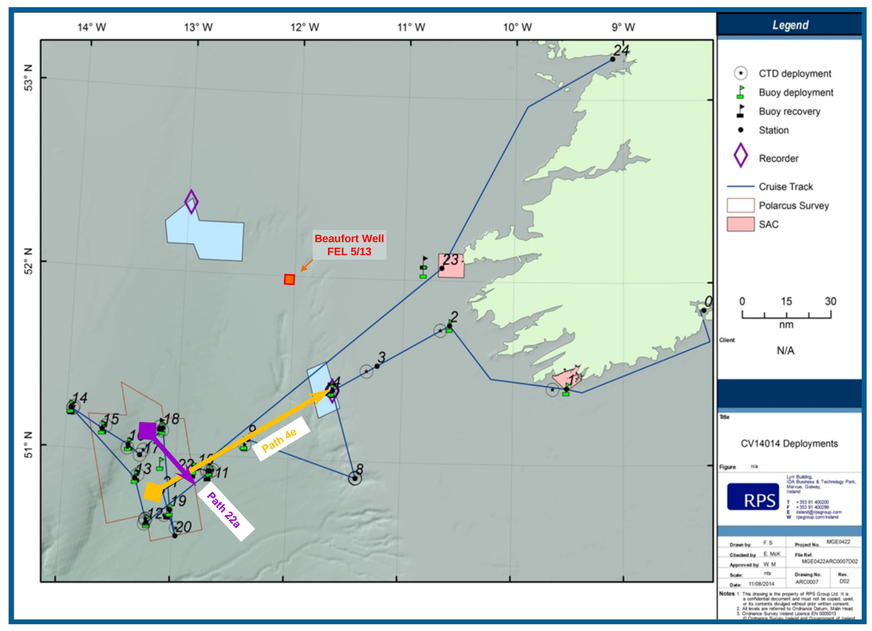
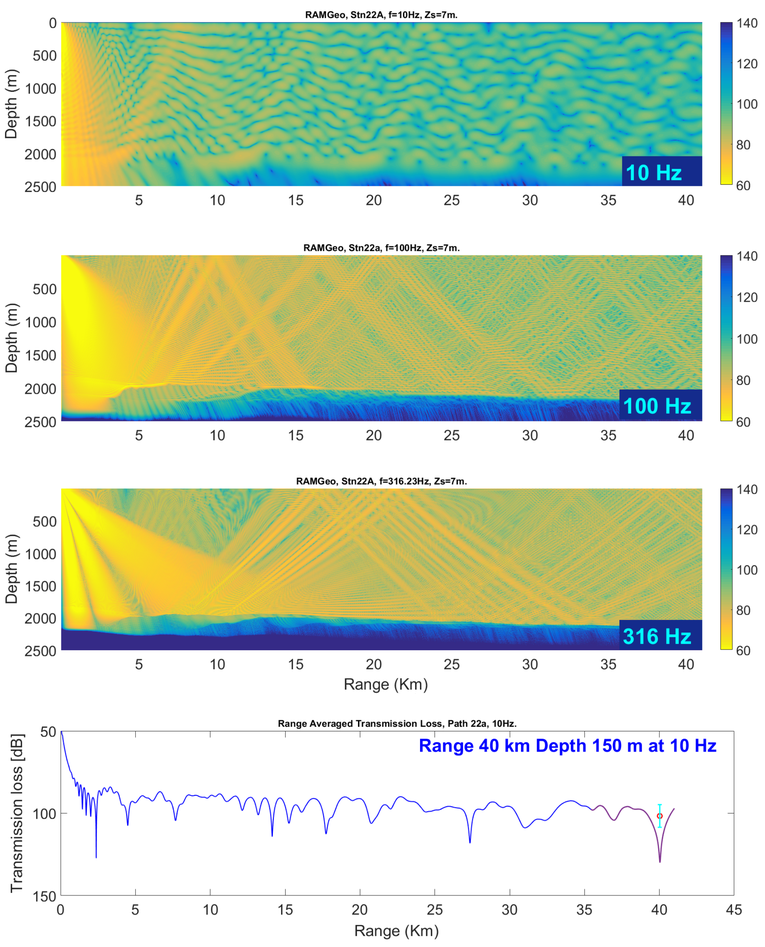
Background and location

Background noise in the ocean comes from an amalgamation of various sound sources, both natural and anthropogenic. On top of this noise there occurs louder events that can be pulsed, for example, whale song and seismic surveys, or can be more continuous, such as a passing ship. These loud sounds, especially in the deep ocean, can carry over large distances and be potentially harmful to the environment. Anthropogenic noise is classed as a pollutant and under the Marine Strategy Framework Directive (MSFD) should be quantified and monitored in Irish waters. The Porcupine Basin and adjacent shelf edge provide an ideal setting to study and model the character of underwater sound across the continental margin, due to the presence of offshore hydrocarbon exploration activities and many species of Cetacean.

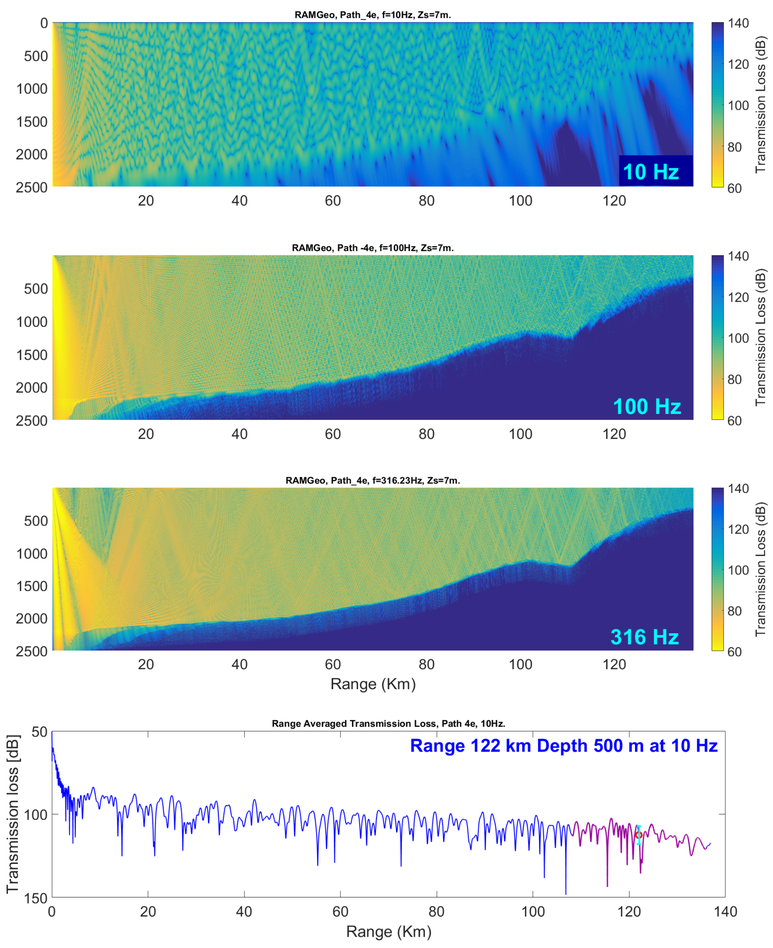
Across: Map of Polarcus MC's 2014 Seismic survey polygon (under PPL 2/14). Acoustic wave paths from source to example stations, in purple (Station 22a) and orange (Station 4e). Woodside's Beaufort exploration well (provisional location marked as a red square), has potential to provide this project with sound source data.



(A) Station 22a



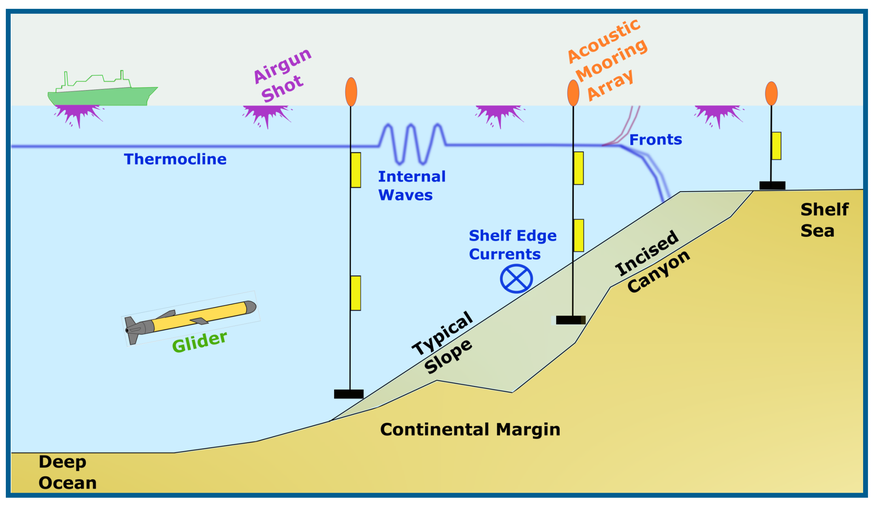
(B) Station 4e



Above: Top Down: AcTUP acoustic model outputs using RAMGeo (parabolic equation) **[3]**, showing sound Transmission Loss (TL) across two sound pathways. Path 22a, in purple, previously modelled by Crawford (2017) **[1]**. Bottom plots show a range averaging technique to find modelled TL at hydrophone deployment depths (Crawford: 150m; Woodside: 500m).

Observations and Models

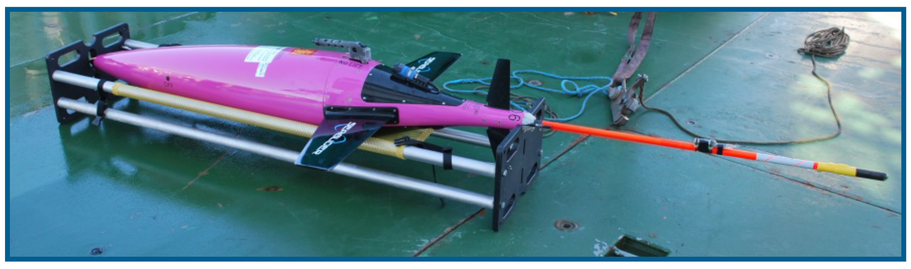
- ***Acoustic observation:*** Carried out using hydrophones placed at various depths, on moored deployments or drifter buoys.
- ***Previous Models:*** As part of a PIP funded project (IS13/07), Crawford, (2017) **[1]** developed a sound propagation model of seismic survey noise around the Porcupine Basin. This PhD project follows, in part, from that work
- ***Validation:*** Using real data from acoustic observation is the best way to match or tune up a model. Benchmarking against other known reference models also helps verify a model fit
- ***Initial Model:*** Has been built during this project from source to a location on the eastern flank of the Porcupine Basin using parameters defined by Crawford, et al. (2017) **[2]**, ***See left***. The model is chosen because receiver location (4e) coincides with a Woodside acoustic hydrophone survey in place at that time. It also coincides with a glider deployment by the University of East Anglia (UEA) which gave detailed hydrographic data and therefor in-situ sound velocity profiles
- ***Hydrographic Models:*** Again once validated, will be of use to more accurately inform acoustic models through sound speed profiling. By collating the two model types, acoustic hotspots may be identified along the continental margin



Above: Schematic of proposed 2018 survey. A moored hydrophone array located across both typical slope and submarine canyon. Controlled noise sources plus received sound levels will quantify propagation over contrasting margin settings and help refine model parameters. ***Right***: Sea Gliders can repeatedly dive to 1000m and resurface, gathering hydrographic and acoustic data for months on end. This data can identify processes, such as internal waves.

Project Elements:

- Proposed survey (R.V. Celtic Voyager, 2018) to deploy short-term acoustic monitoring mooring arrays across the Porcupine Basin margin and introduce a controlled airgun sound source, ***figure left***
- The Marine Institute's glider will be used for surveying hydrography and derived sound speed profiles, while on survey, ***image below***
- Long-term arrays may also be deployed near upcoming hydrocarbon seismic surveys or drill sites
- Collaborators Woodside are sharing their 2016 acoustic data, gathered within the porcupine basin. This will be modelled if possible and at the very least, will provide a secondary/backup dataset.



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References:

[1] Crawford, (2017). MSc Thesis, NUI Galway, pp. 98.

[2] Crawford, et al., (2017). Proc. Mtgs. Acoust. 27.

[3] Duncan, A. J. & Maggi, A. L. (2006). Proc First Aus. Acoust. Soc., 471-477.

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