

Preliminary model of transmission loss with slope using Acoustic Toolbox User-Interface and Post Processing (AcTUP)

S. Crawford¹, C. Brown¹, E. McKeown², F. Stapleton², M. Fabeta¹, M. White¹
¹Earth and Ocean Sciences, School of Natural Sciences, Ryan Institute, N.U.I., Galway, Ireland
²RPS Group, Galway, Ireland

Introduction

The Porcupine Bank (Fig.1) was one of the areas identified by the Department of Communications, Energy and Natural Resources as a hotspot for seismic activities to obtain 2D and 3D data (DECNR, 2007). The exploration licensing for 2015 alone is illustrated in Figure 1. Irish waters, however, are also some of the most important in Europe for a wide range of cetacean species, with a number of dolphin and baleen whale species recorded throughout the year in the IOSEA 2 study area (DCENR, 2007). McCauley *et al.* (2000) document the environmental implications of marine seismic surveys, highlighting alarmed and avoidance behaviour in several marine species as a common response to air gun signals. The acoustic monitoring and mapping of areas of interest has been targeted as a research priority Under the Marine Strategy Framework Directive (MSFD) by Task Group 11 (European Commission, 2010). Such research is essential for designing and implementing appropriate regulation.

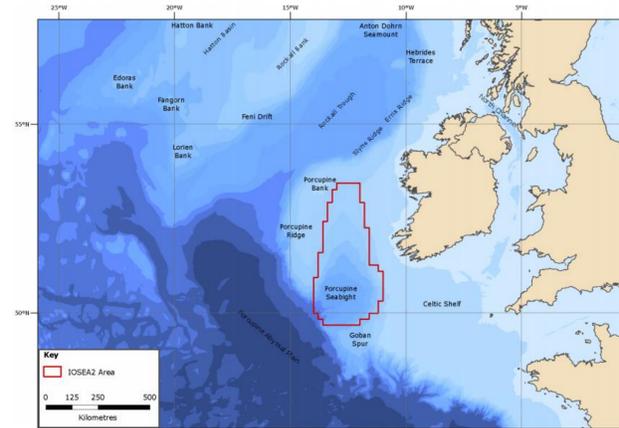


Figure 1: IOSEA 2 Study Area identified by the Department of Communications, Energy and Natural Resources (DECNR) (2007).

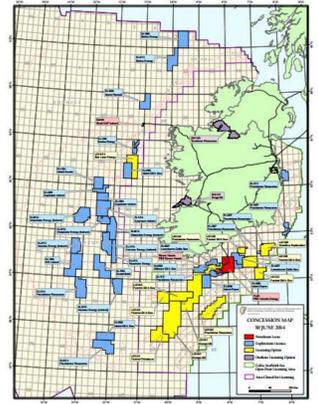


Figure 2: Concession Map June 2014 illustrating current licensing for exploration (DCENR, 2014).

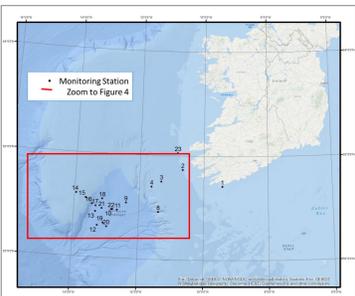


Figure 3: Map of the CE14014 cruise monitoring stations.

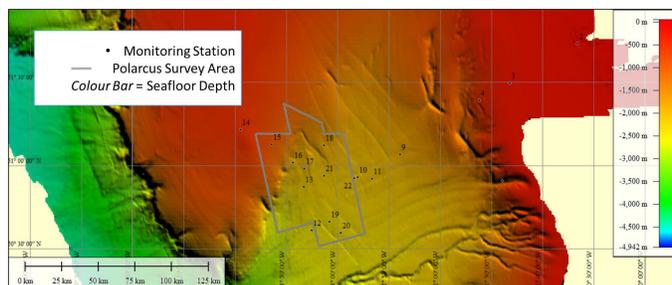


Figure 4: Close up of the CE14014 monitoring stations with Polarcus Survey area highlighted and INFOMAR bathymetry to illustrate sloped nature of seafloor in area.

CE14014: Acoustic and Hydrographic Data Collection

The overall aim of this project is to develop and validate a 2D model of acoustic noise propagation from seismic sources in Irish waters.

In order to provide both environmental data for the model and validation data for comparison, a research cruise on board the RV Celtic Voyager was undertaken in July 2014 in collaboration with Polarcus and their planned survey on the Porcupine Seabight and Bank.

Resulting Transmission Loss Plots

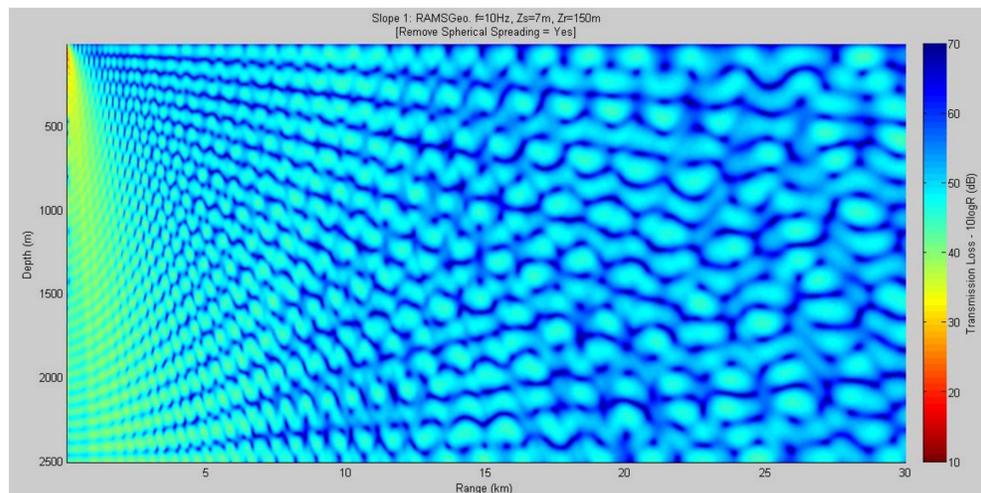


Figure 6: Slope A Transmission loss (10logR dB) versus range (km) and depth (m) with cylindrical spreading removed.

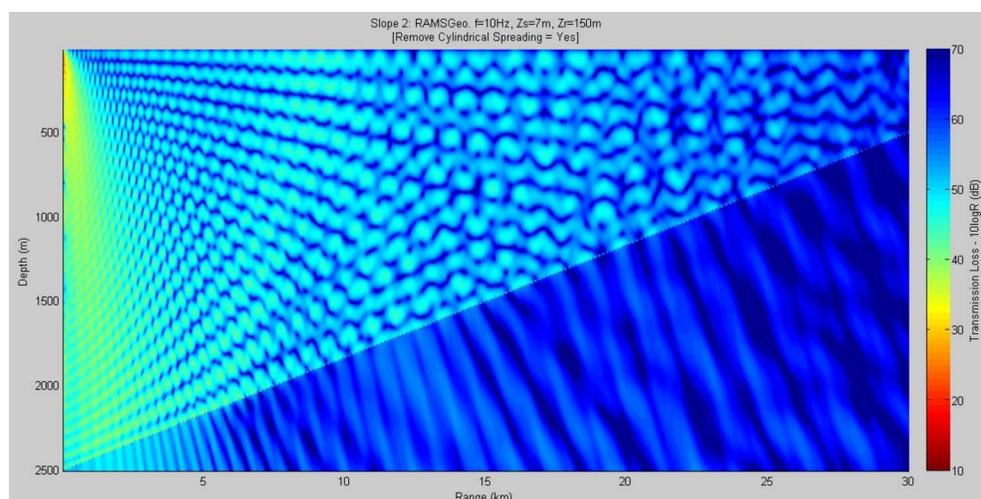


Figure 7: Slope B Transmission loss (10logR dB) versus range (km) and depth (m) with cylindrical spreading removed. Darker transmission loss (TL) boundary is the seabed but pattern of TL should be ignored below boundary as no seabed values were specified for the model run.

Modelling Using AcTUP v2.2/

- Using an underwater acoustic propagation modelling programme: Acoustic Toolbox User Interface and Post Processor (AcTUP V2.2) by Curtin University.
- An important feature of the 2D model being developed and validated is the inclusion of range-dependent bathymetric and seafloor data as well as hydrographic data.
- AcTUP V2.2/ RAMSGeo allows range-dependent parameters. (Duncan and Maggi, 2006).
- Two idealised slopes used to provide preliminary results of the model's transmission loss output with range-dependent depth (see Figure 6).



Figure 5: Idealised slopes A and B used to experiment the modelling outputs with contrasting slopes.

Conclusions

The capability of RAMSGeo to cope with one range-dependent parameter (bathymetry) was tested with preliminary, idealised bathymetry datasets to roughly gauge the range in transmission loss outputs.

- Variation in transmission loss magnitude and pattern across the 30km range with different slopes.
- Sound appears channelled from the source vertically downwards to the seabed with transmission loss increasing conically with depth.
- Patterns at the seabed interface and deeper should not be considered as no seabed values (such as attenuation) were specified.

Later stages of this project will involve:

- Further testing of the model's range-dependent capabilities with more realistic bathymetry files.
- The introduction of range-dependent water column data and sea-floor compositional attributes.
- Validation of the model's output with measured acoustic data.

Acknowledgements

We are grateful to RPS for the use of acoustic recorders, to the crew of the RV Celtic Voyager for assistance and support, to Polarcus for collaboration and sharing of data (such as real-time positional data) and to Curtin University for making accessible the AcTUP V2.2 software and user guide.

Sinéad Crawford's research is funded by the Petroleum Infrastructure Programme (PIP).

References:

- AcTUP V2.2 can be downloaded directly from the Centre for Marine Science and technology website: <https://cmst.curtin.edu.au/products/actoolbox.cfm>
- Duncan, A. J., & Maggi, A. L. (2005). AcTUP v2. 2/ Acoustic Toolbox User-Interface & Post-Processor—Installation & User Guide. Curtin University of Technology, Perth.
- Duncan, A. J. and Maggi, A. L., 2006 'A Consistent, User Friendly Interface for Running a Variety of Underwater Acoustic Propagation Codes' In Proceedings of ACOUSTICS 2006. Christchurch, New Zealand, 20-22 November, pp. 471-477.
- European Commission (2010) 'Task Group 11 Report: Underwater Noise and Other Forms of Energy'. Luxembourg: Office for Publications of the European Communities.
- Department of Communications, Energy and Natural Resources (2007) 'Second Strategic Environmental Assessment for Oil and Gas Activity in Ireland's Offshore Atlantic Waters: IOSEA2 Porcupine Basin'. [Online] Available from: <http://www.dcenr.gov.ie/Natural/Petroleum+Affairs+Division/Irish+Offshore+Strategic+Environmental+Assessment+%28IOSEA+2%29/> [Accessed 12/09/14]
- Department of Communications, Energy and Natural Resources (2014) '2015 Atlantic Margin Licensing Round: Concession Map June 2014'. [Online] Available from: http://www.dcenr.gov.ie/NR/rdonlyres/1CD8ACF1-5548-4D6D-8622-4D729789D5F3/0/Concession_Map_A3_30June2014.pdf [Accessed 12/09/14]
- McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K. (2000). 'Marine Seismic Surveys- A Study of Environmental Implications'. Australian Petroleum Production and Exploration Association Journal 2000, pp.692-708.

