Investigating Ocean Generated Microseisms Offshore Ireland

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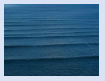
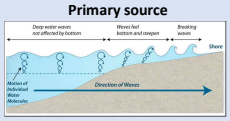
Overview

In contrast to earthquakes, microseisms represent continuous background low frequency seismic signals generated by ocean wave pressure fluctuations on the sea floor. With the presence of the stormy NE Atlantic, Ireland is ideally located to investigate further our understanding of ocean generated microseisms.

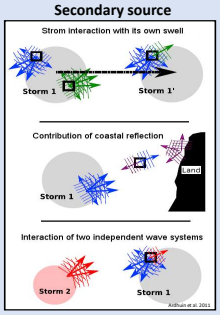


Primary source



Primary microseisms will occur in shallow water as a result of the interaction of ocean waves with the sea floor (max depth = half a wave length).

Secondary source



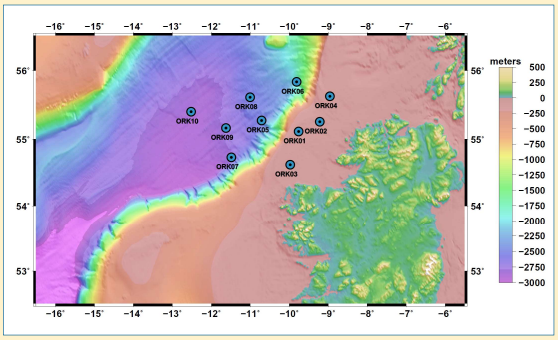
Secondary microseisms result from the interaction of two opposite wave fields of similar periods leading to pressure fluctuations at the sea floor of half the period of the swell.

Synthetic and the recently acquired OBS seismic data can be compared to help better understand microseism source locations as well as the effect of the water column and sediments thicknesses on signal propagation. 2D numerical simulations have been carried out to study the coupling of seismic and acoustic signals at the sea bed and its evolution in both the deep water and shelf areas.

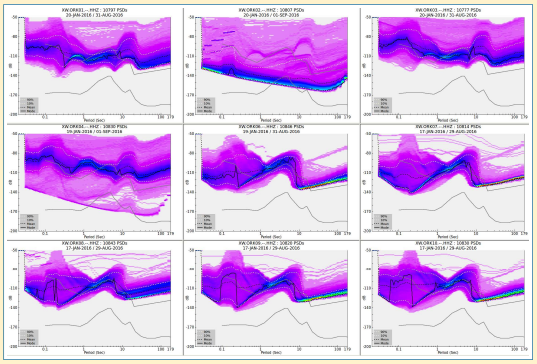
Understanding ocean generated seismic ambient noise sources and propagation is very important as 'noise correlation' techniques can be used for broad (regional) scale seismic passive imagery and time-lapse monitoring (e.g. in reservoirs). Microseisms can also be used for ocean storm tracking and for determining areas of maximum cyclical pressure fluctuations on the sea floor.

OBS Deployment Offshore Donegal

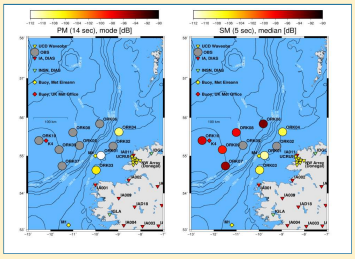
In January 2016, 10 broadband Ocean Bottom Seismometers (OBSs) stations, including acoustic sensors (hydrophone), were deployed across the shelf offshore Donegal and out into the Rockall Trough.
The instruments were recovered in August 2016 providing 8 months of seismic and acoustic data from both shallow and deep water regions.



First look at the OBS data



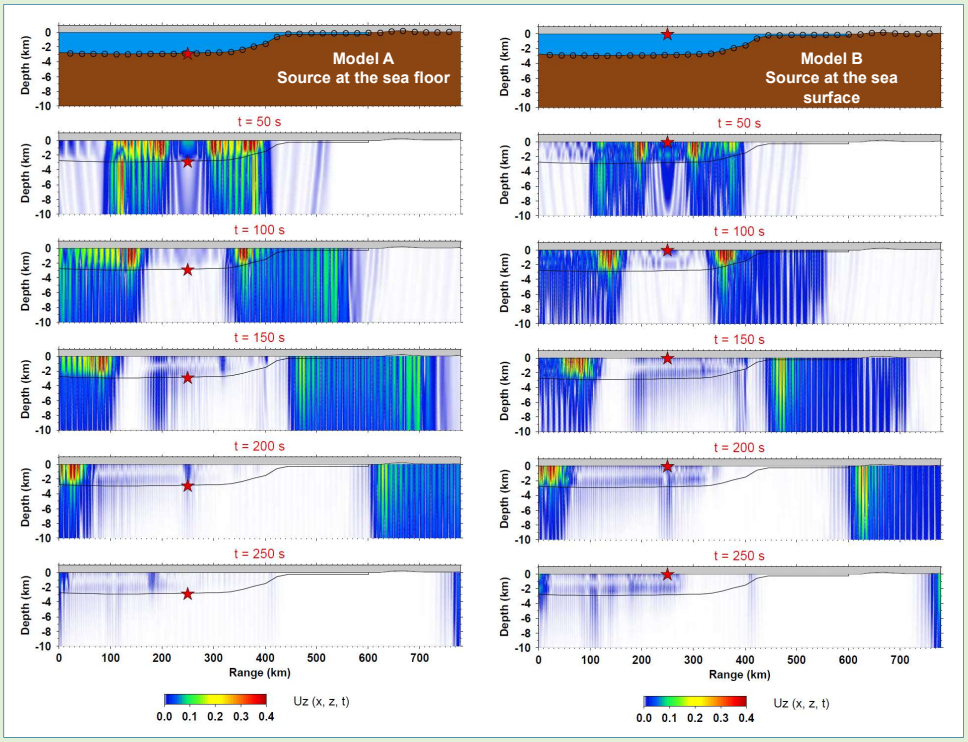
Monthly Stacked Power Spectral Density plots from each OBS

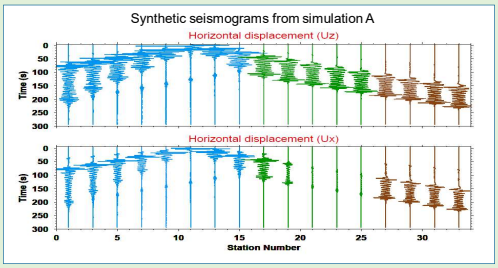


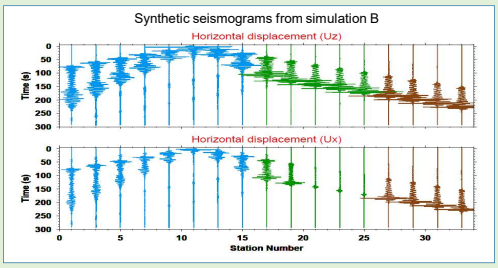
Deep vs Shallow water effects on the recorded primary (PM) and secondary (SM) microseisms

Ocean generated ambient noise behaves differently in deep and shallow water. Where and how is it generated and how does the signal propagate to the land?

2D Numerical Simulation of Secondary Microseisms







Blue = station in deep water/ Green = station on continental edge and shelf / Brown = Station on land

Conclusion

- **Microseisms are very spatially variable on the sea floor. That variability holds information about (i) variations in the generation source process (which holds meteorological information) and (ii) variations in geological structure.**
- **Synthetic simulations highlight that the source location in modelisation of microseisms is a key issue.**

This publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under Grant Number 13/RC/2092 and co-funded under the European Regional Development Fund and by PIPCO RSG and its member companies.

Ireland's European Structural and Investment Funds Programmes 2014-2020
Co-funded by the Irish Government and the European Union
European Union
European Regional Development Fund
Science Foundation Ireland sfi For what's next

This research survey is supported by the Marine Institute, and is funded under the Marine Research Sub-Programme 2014-2020 by the Irish Government

We thank the "German Instrument Pool for Amphibian Seismology (DEPAS)", hosted by the Alfred Wegener Institute Bremerhaven, for providing the ocean-bottom seismometers.

A big thank you to the crew of the Celtic Voyager for their significant help during the stations deployment and recovery.

Thank you also to everyone involved in planning and taking part in the survey and particularly to Henning Kirk, Aline Ploetz and Jürgen Gossler for their technical support during the OBS survey.