Bathymetry and Sediments effects on Ocean Wave generated Acoustic/Seismic Noise Offshore Ireland

Florian Le Pape[1], Chris Bean[1], David Craig[1], Philippe Jousset[2], Sarah Donne[1] and Martin Möllhoff[1]

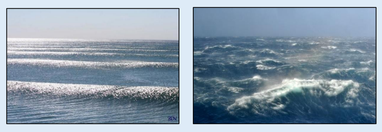
[1]Dublin Institute for Advanced Studies (DIAS), Dublin, Ireland
[2]Helmholtz Center GFZ Potsdam, Germany

Summary

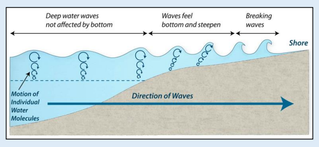
- ✓ Stronger secondary microseisms (SM) are observed in the deep water offshore Ireland. Both sediments, quite thick in the middle of the Rockall Trough, and the continental shelf have a significant role in secondary microseisms generation and propagation.
- ✓ The cross-correlation of the OBS data highlight the strong coupling of acoustic and seismic data at the seafloor showing seasonal variations in the waveforms with different apparent velocities that likely reveal a change in the ocean noise source location.
- ✓ The 3D simulations are a very useful tool to generate synthetic acoustic and seismic data at a regional scale offshore Ireland. The first results are very interesting and quite consistent with observations.
- ✓ Compared to previous studies that used 2D simulations, the use of 3D enables to highlight the significant impact of lateral heterogeneities in the bathymetry as well as subsurface geology and how it affects the generation and propagation of the secondary microseism signal.

Background

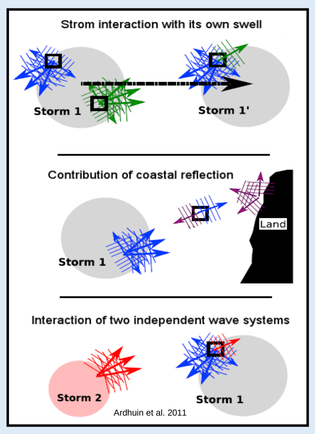
Ocean wave pressure fluctuations (acoustic) on the sea floor which generate low frequency seismic waves



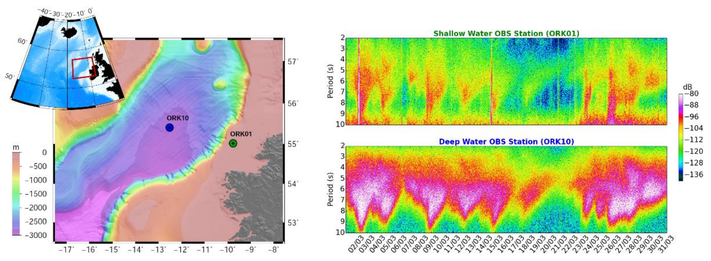
Primary Microseisms (**PM**)
- Recorded signal = same period as ocean waves
- Max depth = half a wave length



Secondary Microseisms (**SM**)
- Recorded signal = 1/2 period of ocean waves
- Water depth independent

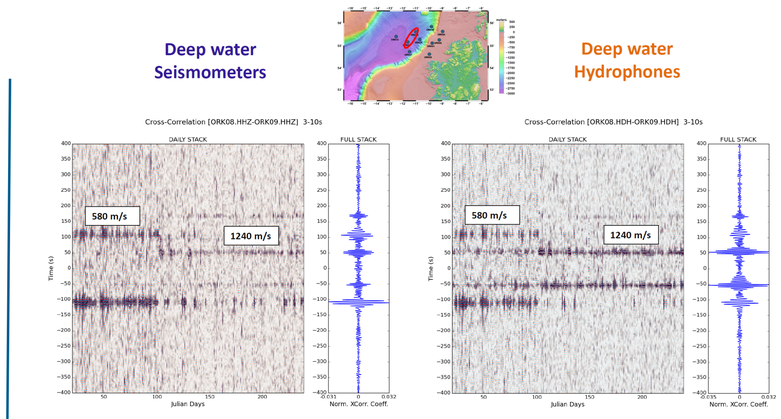


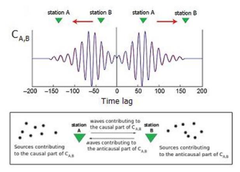
Observed Ocean Wave induced Noise



Map of the survey area – Deep (station ORK10) vs shallow (station ORK01) water spectrograms of the vertical component of the recorded seismograms for the month of March 2016

There is a very clear correlation on the main secondary microseism events recorded in both the Rockall Trough and continental shelf. However, the OBS data from the Rockall Trough reveal stronger signal. In order to understand better those observations, we look at 3D simulations for the area of interest to study the effects of the bathymetry and sediments.





Seasonal changes in both acoustic and seismic wavefield likely related to changes in the source location. The observed acoustic and seismic wavefields share a common signal component characteristic of the coupling of both signals at the sea-floor

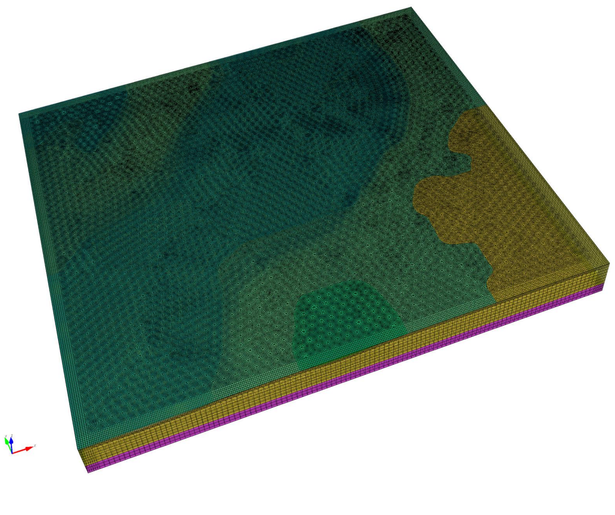
Noise cross-correlation between two stations gives information on the medium between the stations.

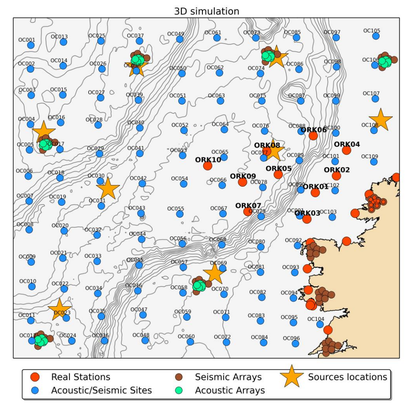
3D Simulations

In the 3D model, three different mediums are included: water (acoustic), sediments (elastic) and crust (elastic). In addition to the bathymetry, the significant thickness of the low-velocity sediments of the Rockall Trough need be to taken into account for the study of seismic wave propagation in the region of interest.

876,285 mesh elements
vertical sources = Ricker wavelet 0.15Hz

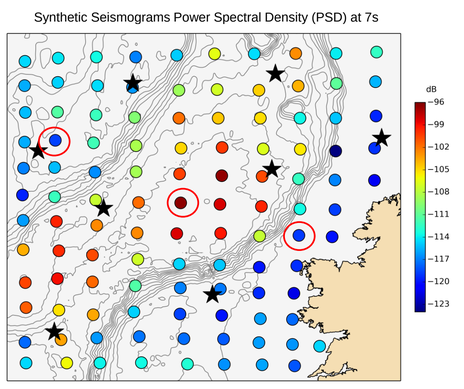
SPECFEM3D
The code simulates acoustic (fluid), elastic (solid), coupled acoustic/elastic, poroelastic or seismic wave propagation.

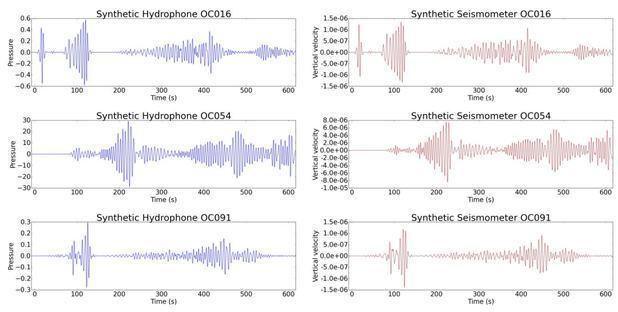


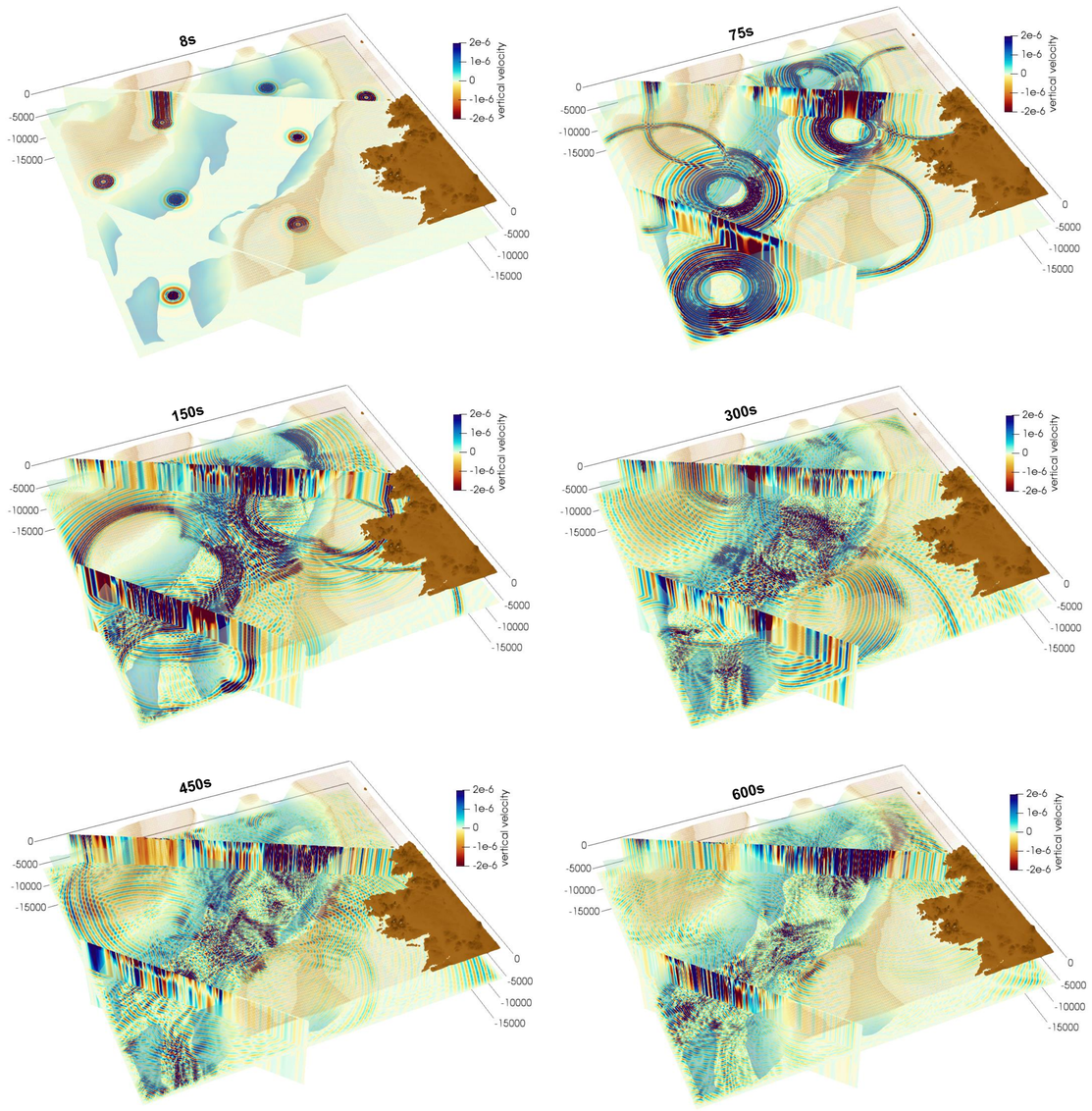


Synthetic stations locations implemented in the simulations as well as sources locations associated with the multi-source simulation.

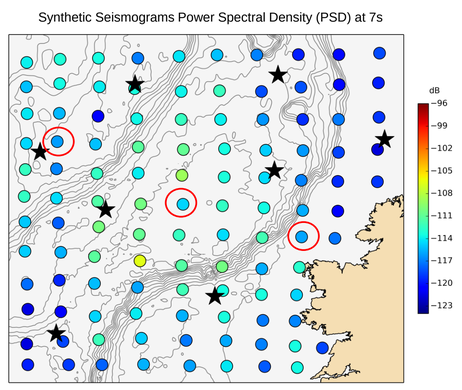
Water + Sediments + Crust

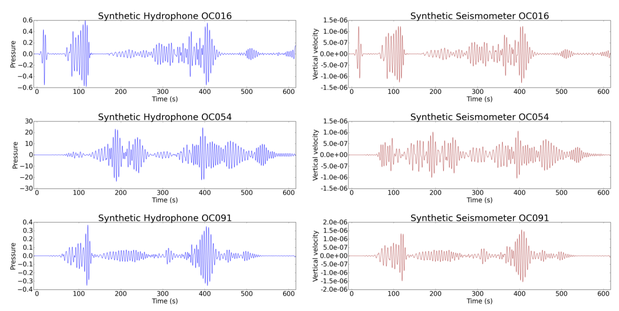


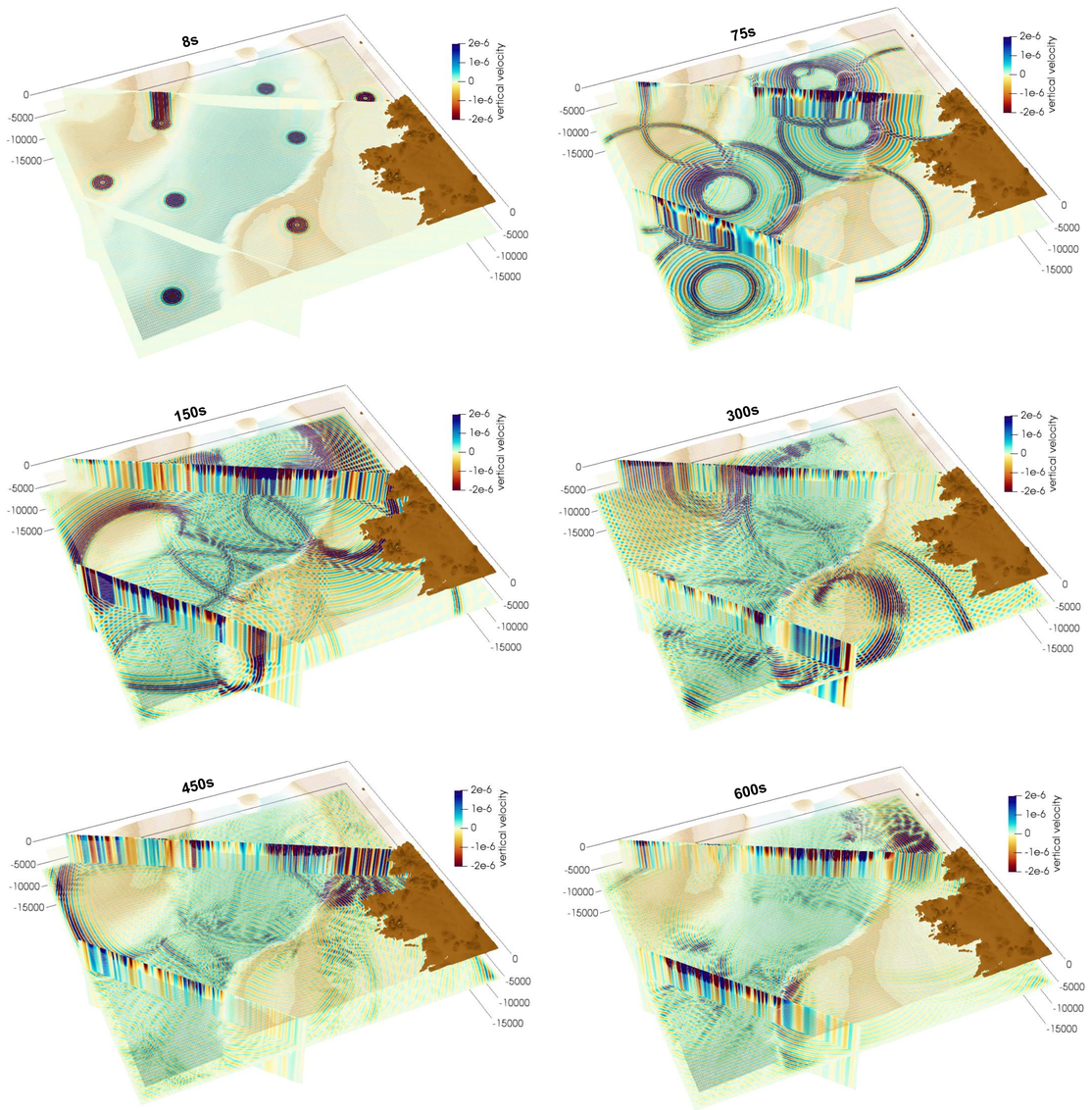




Water + Crust







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European Union
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Science Foundation Ireland sfi For what's next

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PIP Petroleum Infrastructure Programme