Geophysical Research Abstracts
Vol. 15, EGU2013-4100, 2013
EGU General Assembly 2013

Preliminary investigation on apparent seismic velocity variations caused by microseism noise source variability

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Currently there is strong interest in monitoring temporal changes in seismic wave velocity in various geological settings. These settings can range from volcano monitoring to reservoir monitoring amongst others. Green's functions are often used to monitor temporal variations in seismic velocity as their arrival times contain information about velocity changes. The velocities can be measured through the cross correlation of Green's functions for a given pair of stations. Correlation of ambient noise is typically used for Green's function retrieval. The great advantage of using noise is that noise is continuous in time and there are no natural explosive or repeatable sources required. However temporal and spatial variations of non-uniformly distributed noise sources may lead to apparent changes in Green's functions which are related to the source not the path. This could lead to a misinterpretation of temporal changes in wave velocity.

Ireland is a good location in which to study these effects, as it is tectonically very quiet and is relatively close to large noise sources in the North Atlantic. The spatial and temporal distribution of noise sources are being tracked using seismic arrays deployed in Ireland under a sister project (called WaveObs). Concurrently, in this project, we are searching for temporal variations in wave velocity using noise correlation and comparing them to the temporal and spatial distribution of the noise sources as determined under the WaveObs project.

The aims of this project are to find out how the waveform and the arrival time of the Green's functions correlate with spatial and temporal variability of the noise sources and what minimum trace length of noise is required for the Green's functions to converge. The expected outcome of the project is therefore an assessment of the degree to which velocity variations are caused by changes in the sources. Hence, these lemiting conditions can be considered when this method is used in a different setting where we expect velocities to change rapidly e.g. on a volcano or in a reservoir.