Geophysical Research Abstracts
Vol. 15, EGU2013-760, 2013
EGU General Assembly 2013

Monitoring a CO_2-Storage site with Passive Image Interferometry

Martina Gassenmeier (1,2), Christoph Sens-Schönfelder (1), and Michael Korn (2)
(1) GFZ Potsdam (martina.gassenmeier@gfz-potsdam.de), (2) University Leipzig, Germany

In seismology, Passive Image Interferometry (PII), based on ambient seismic noise, can be used to detect small temporal changes in the propagation of the seismic wavefield. As these changes can be related to changes of elastic properties in the propagation medium, PII can be used to observe dynamic processes in the earth's crust. This technique was successfully applied, inter alia, to monitor seasonal variations in response to environmental changes or stress changes caused by earthquakes or material changes due to the eruption of volcanoes.
PII is based on the possibility of reconstructing the Green's function between a pair of receivers from continuous records of seismic noise. With two seismometers as receivers, the Green's Function describes the propagation of a seismic wave between the two receivers. It can be reconstructed by cross-correlating the ambient seismic noise, recorded at the receivers. A change in the medium between the seismometers directly affects the shape of the cross-correlation functions (CCFs), from which a change in the seismic velocities can be derived.
Our idea is to investigate the potential application of this technique to monitor the emplacement of CO_2 at the test site for CO_2 sequestration in Ketzin (Brandenburg, Germany). We calculated CCFs of the ambient noise field for a time period of about 4 years from the beginning of the injection. The analysis of the cross-correlations showed that they are asymmetric and dominated by a phase traveling with about 300 m/s, which is consistent with Rayleigh waves traveling in the shallow sediments. The noise direction was analysed with an optimal rotation algorithm over 1 month of data and showed a prominant direction incoming from north-east in a frequency range between 0.5 and 4 Hz. This direction matches with the location of a large windpark a few km away from the array. For lower frequencies, the noise is dominantly incident from north-west.
To analyse possible velocity changes for each day, we computed stretched versions of a reference CCF in different frequency bands and calculated correlation values between time windows in the coda part of the stretched traces and the reference trace.
Due to the almost continuous injection of CO_2 we expect a monotonic decrease of the seismic velocities.
So far, we can observe velocity variations with a period of approx. one year that indicates a seasonal influence, most probably due to environmental influences, which overlay the effect of the CO_2 injection.