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# ANALYSIS OF AMBIENT SEISMIC NOISE AT SVALBARD

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The analysis of Green's function estimates constructed from the ambient wave field (e.g., Weaver and Lobkis, 2001) has become a standard tool in seismology for velocity change monitoring (Campillo et al., 2011). Techniques targeting the multiple scattered coda wave field of inter-station noise correlation functions provide thus the opportunity to measure velocity changes over times and distances that are governed by the properties of the coherent parts of the ambient wave field.

In the present study, we analyze the ambient seismic wave field recorded at two different sites in Svalbard (Norway), namely the CO2Lab and the SPITS array. The objective is to characterize the frequency dependent properties of the ambient wave field and to estimate the resolution power of passive methods for future monitoring of subsurface velocity variations induced by anthropogenic and natural processes.

The CO2Lab is close to the town of Longyearbyen and was built in 2007 for research on Carbon Capture and Storage in Norway (Braathen et al., 2012). The site consists of 8 wells, with the deepest well reaching about 1000 m depth. The seismic network is composed of 18 3-C geophones (3 shallow boreholes from 7 to 12 m depth, 2 strings of 5 and 8 geophones down to 300 and 540 m depth, respectively). The SPITS array was installed by NORSAR in 1992 and is composed of 9 broadband stations. The data are continuously processed to provide earthquakes bulletins to national and international data centres (http://www.norsardata.no/NDC/stations/SPI/).

The computation of cross-correlation functions (CCFs) includes signal pre-processing performed on segments of data (e.g. 30 min) consisting mainly of removing the mean and trend of the signal, spectral whitening in a given frequency band and time normalisation (e.g., 1-bit normalisation) (see e.g., Bensen et al., 2007 for detailed description of the processing).

An example of CCFs obtained between two stations of the SPITS array with a distance of about 1 km is given in Figure 1 (left). In this case, our strategy includes spectral whitening and amplitude clipping at three times the standard deviation of the amplitude distribution in a 4-hour yet sub-daily time window, and we remove windows containing suspiciously large amplitudes indicative of earthquakes (Whisper project http://whisper.obs.ujf-grenoble.fr/; Poli et al., 2012; Boué et al., 2013; Hillers et al., 2014). Daily CCFs computed from the 1st to the 15th of January 2014 are presented in the lower part of the figure and the upper part is the stack of all CCFs. The CCFs are asymmetric, in particular during the second half of the monitored period, which indicates changes in the distribution of the sources of the noise (Stehly et al., 2006).

An example is also given for CCFs computed with CO2Lab data (Figure 1, right). The geophones belong to the same string deployed in one of the well (DH4_1 at 190 m depth and DH4_8

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at 540 m depth). Coherent energy is observed between 2 and 8 Hz which could be associated with a deep source mechanism.

Further analyses covering longer periods of time will be performed, targeting microseism noise excitation for example (SPITS data). From both datasets, we will investigate potential velocity changes from the comparison of daily CCFs with a reference cross-correlation function (e.g., Brenguier et al., 2008).

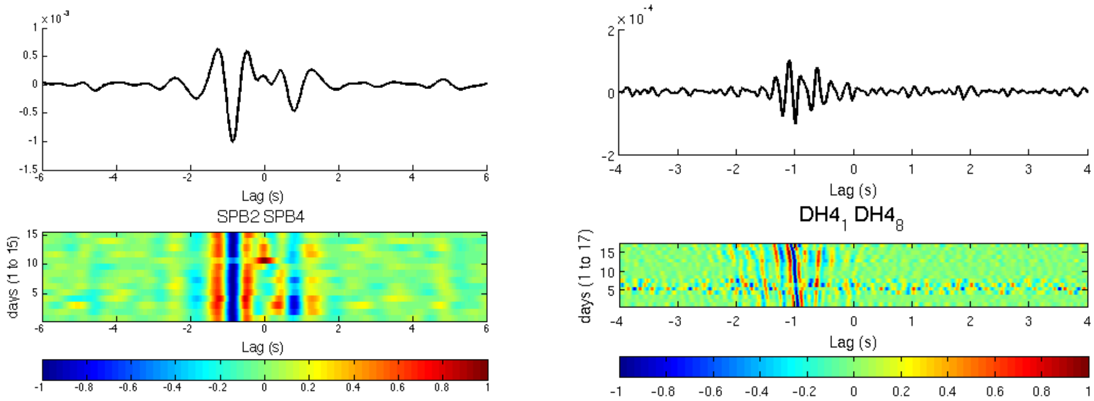


Figure 1. Example of cross-correlations function obtained for two stations of the SPITS array (left, 0.05-1 Hz frequency band) and of the CO2Lab network (right, 2-8 Hz frequency band).Top: stack of 15 (17) daily CCFs computed at SPITS (CO2Lab). Bottom: Daily CCFs from 1st to 15th (17th) of January 2014 computed at SPITS (CO2Lab).

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