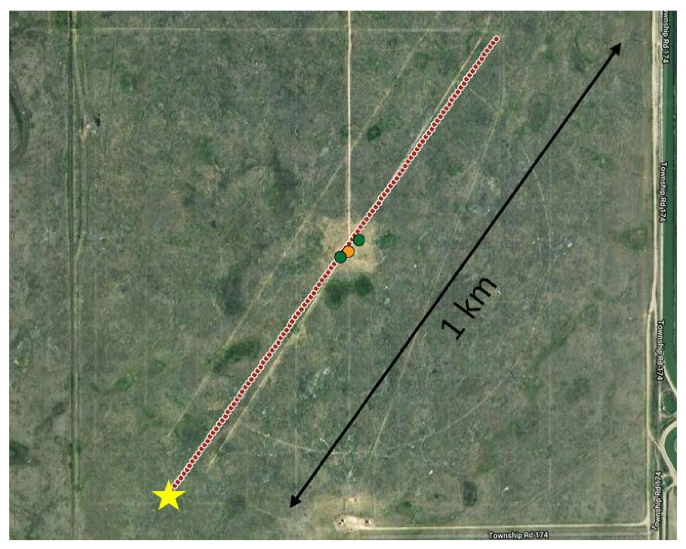
Ambient noise correlation study at the CaMI Field Research Station

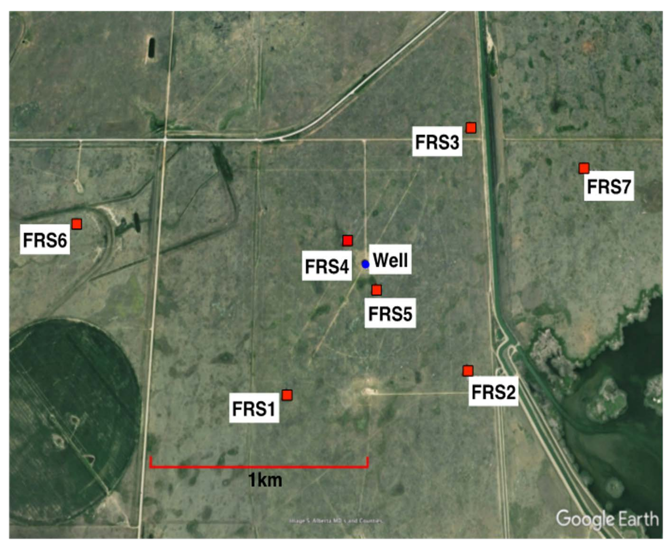
Marie Macquet and Don Lawton
marie.macquet@ucalgary.ca

Summary

We record passive continuous seismic data at the CaMI Field Research Station to study the feasibility of using ambient noise correlation method as a tool to monitor and verify the secure storage of injected CO2. In this paper, we focus on two aspects: (1) the near surface tomography, using 112 stations along the 1.1 km trench and (2) the long-term monitoring of the velocity changes using continuous recording since October 2015 on 7 broadband stations.



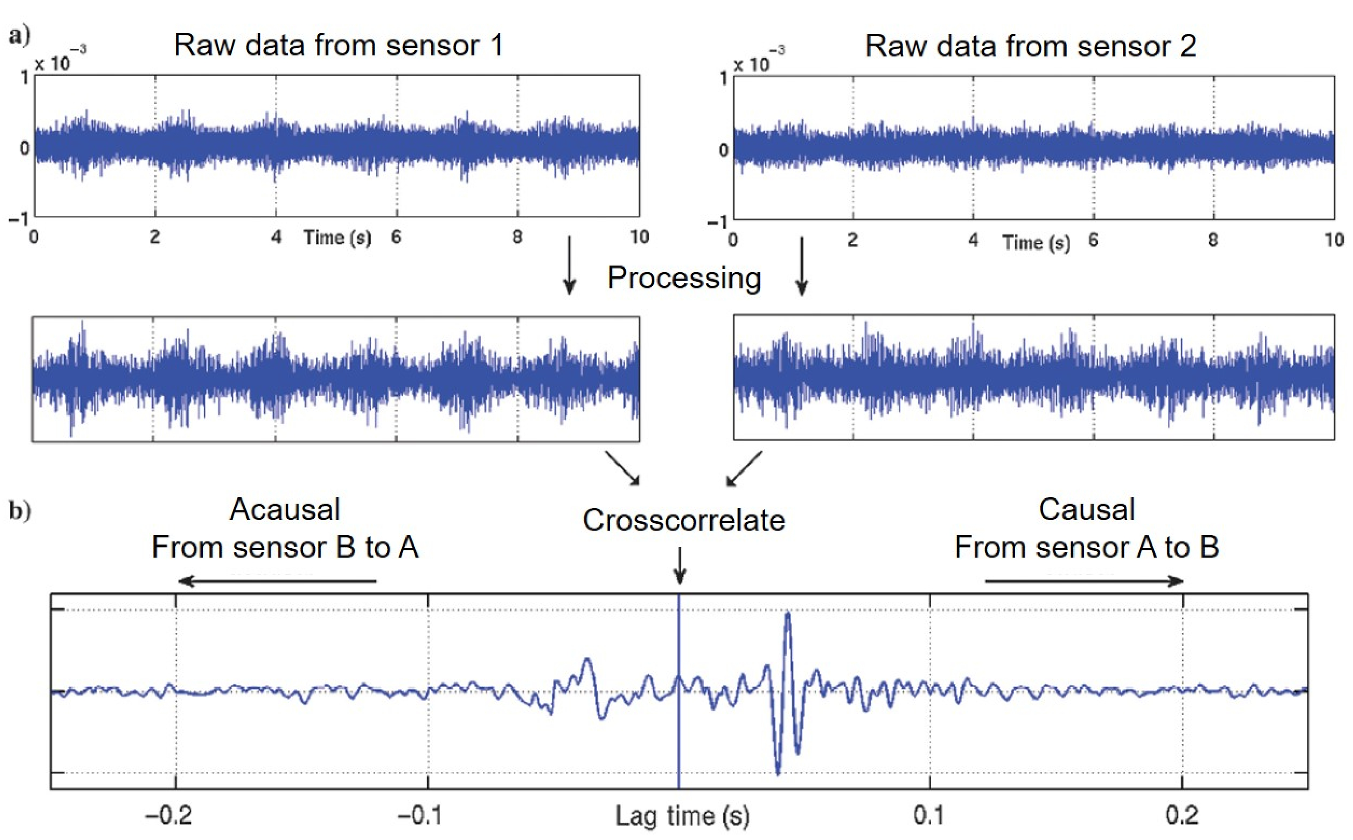
February 2018
112 geophones – 25 days



Since October 2015
7 broadband stations

Ambient noise correlation

Principle : reconstruct the Green's function by correlating the continuous ambient noise recorded between two captors.

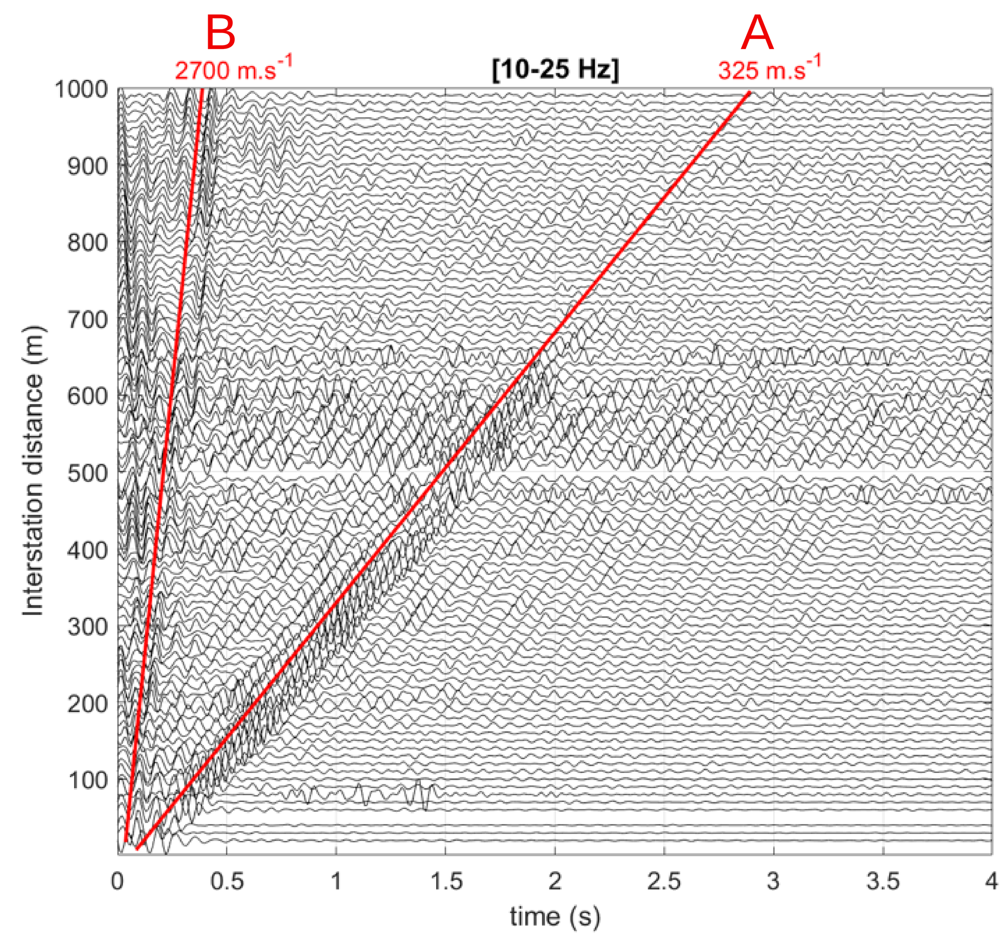


Applications:

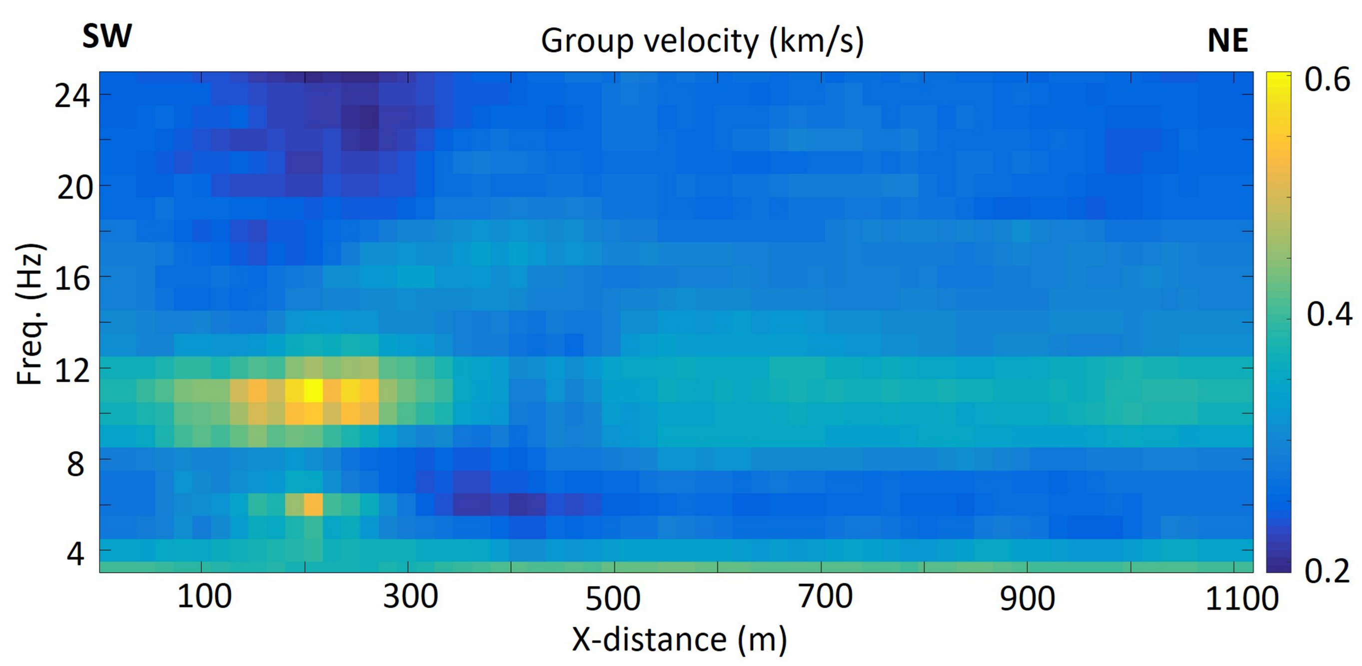
1. Surface waves are usually dominant; their dispersion curves can be inverted to obtain elastic models and obtain ***a tomography*** of the subsurface.

2. The ambient noise correlation can be used ***as tool for monitoring***: as the cross correlation approximates the Green's function between two stations, if the medium changes, the result of the correlation will change

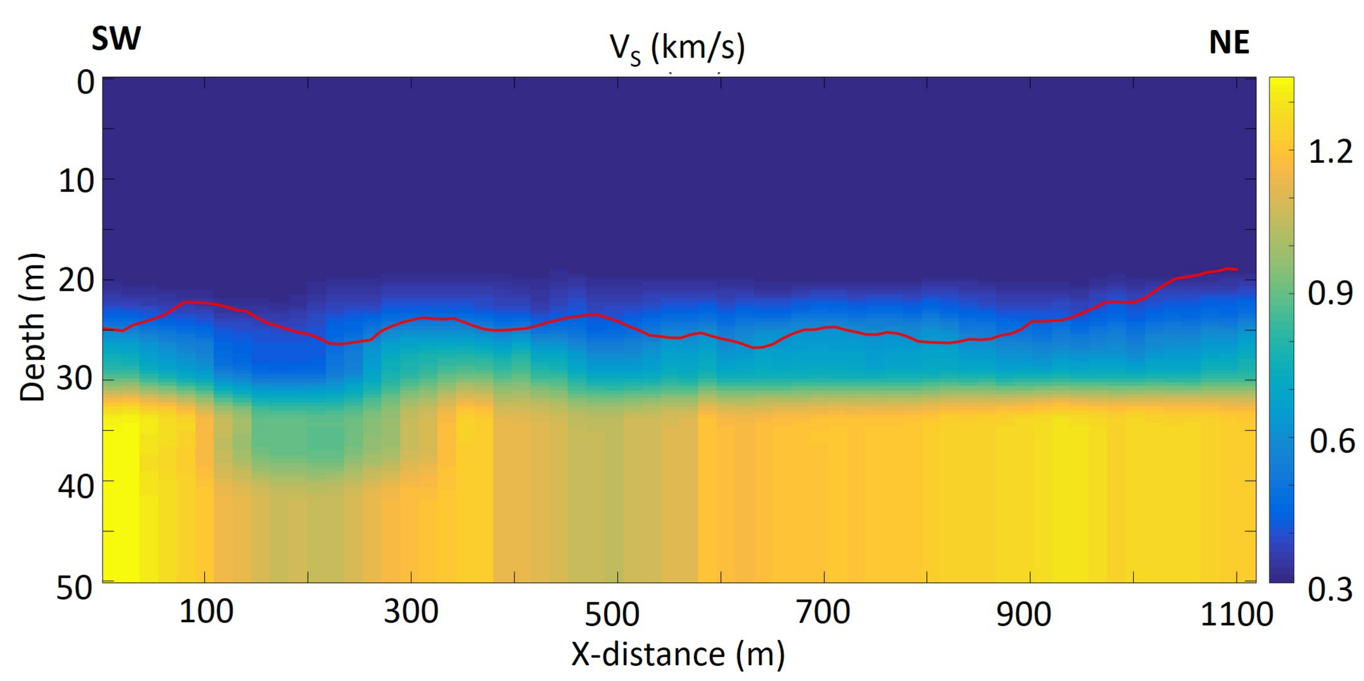
Near surface tomography



February 2018: Virtual shot gather (noise correlation between the SW station and all 112 stations of the 2D line). Both surface waves (A) and body waves (B) are visible.

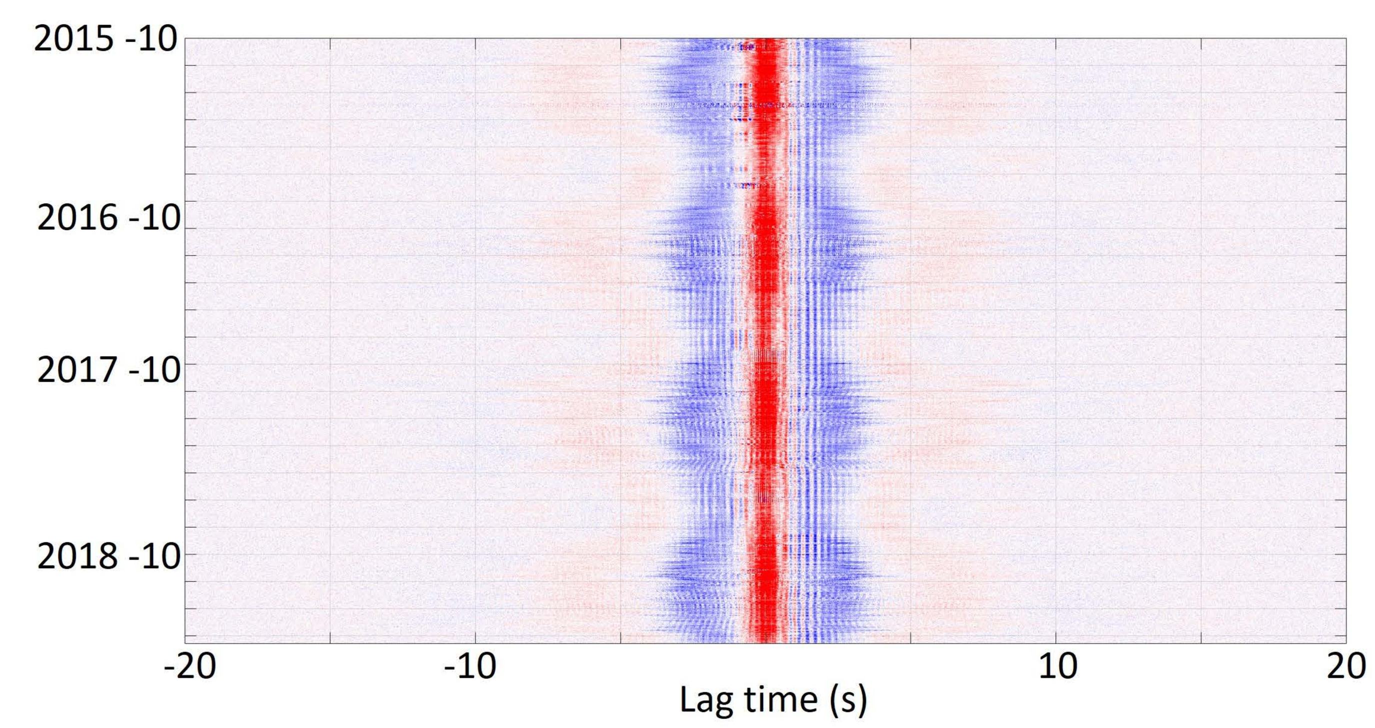


The group velocity dispersion curves between all pairs of stations (4098) are computed with frequency-time analysis, quality-checked and removed if necessary. They are then regionalized to obtain a 2D model (frequency-group velocity). At high frequencies (shallow depth), we observed lower velocities on the SW part. At low frequencies (deeper part), we observe higher velocities on the SW part. These observations are coherent with Isaac and Lawton (2019).

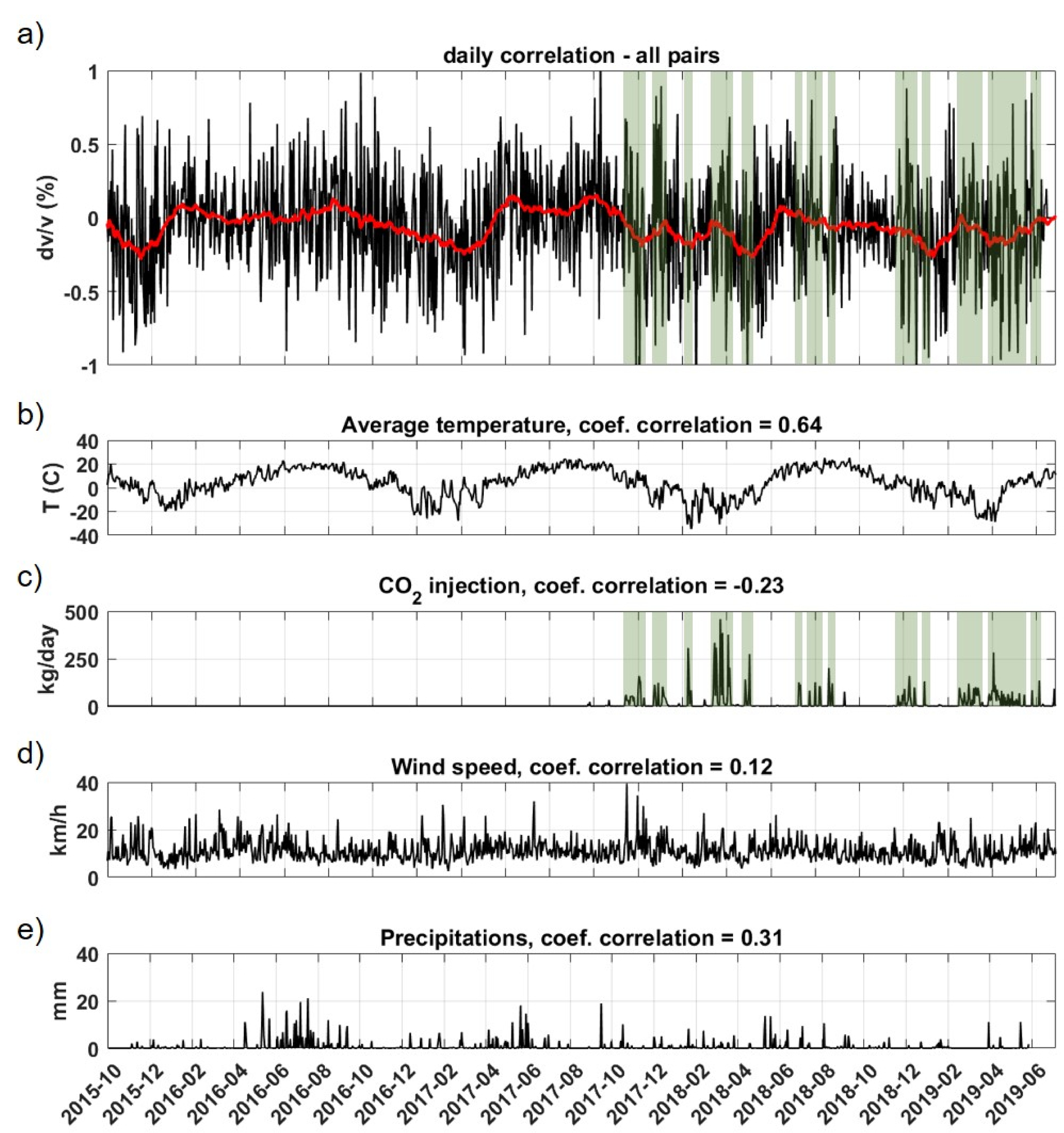


We invert local dispersion curves using Markov Chain Monte Carlo method to get a V_S model. Red line is the bedrock depth in Isaac and Lawton (2019).

Monitoring



4 years of daily correlation between two broadband stations (FRS4 and FRS5). We can clearly see the winter/summer pattern.



a) Velocity variation computed between the daily correlation and the reference correlation using Moving-Window Cross Spectrum analysis. Red is the smoothed curve.
b to e) Weather parameters and daily CO_2 injection.

We can clearly see a good correlation between the smoothed curve and the average temperature (a and b). The CO_2 injection periods are highlighted in green. They seem to correspond to periods of velocity variation decreasing (a and c).

NSERC CRSNG
UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
Department of Geoscience
CMC Containment & Monitoring Institute