Analysis on long period noise in *InSight* data

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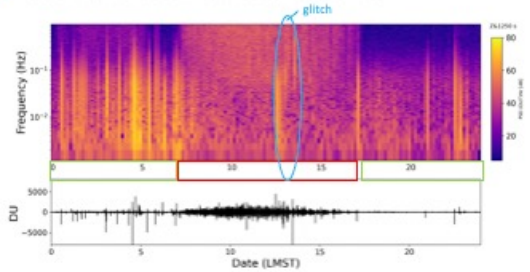
Mars daily seismic view

- Seismic noise on raw data for sol 200



Glitch are strong linearly polarized signals recorded in the data and mainly due to thermal cracking of some mechanical devices

remove glitches

Glitch modeled as the response signal of the seismometer to a Dirac impulse in acceleration and displacement respectively, *Scholz et al 2020*

- Seismic noise on deglitched data for sol 200

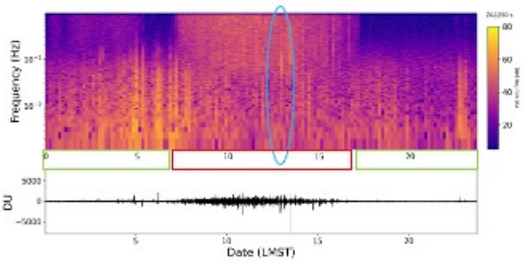


Figure 1 : Spectrogram in Z-direction (top) and corresponding traces in DU (bottom) for frequencies of 0.0016 up to 1 Hz. The 2 green squares are the main time-areas where we can find seismic events. The red square is more atmospherically turbulent.

Figure 2 : Spectrogram in Z-direction (top) and corresponding traces in DU (bottom) for frequencies of 0.0016 up to 1 Hz after the deglitching process.
We can see there are still some remaining glitches even after the deglitching step.

- Global seismic view of 1000 sols on Mars

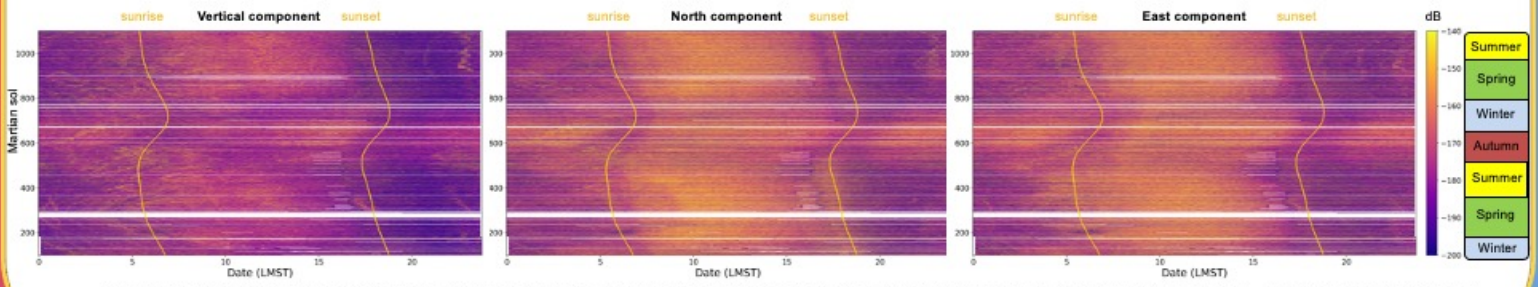
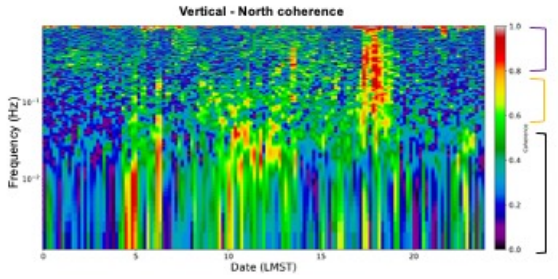


Figure 3 : Evolution of the PSD in acceleration unit for the 3 geophysical directions. A line in this figure give the spectrogram on this sol. The spectrogram bandpass filter is 0.0016 – 1 Hz and with an overlap of 50%. These figures show how the noise observed during day-time on the previous figures change according to the seasonal variation and the sunshining time. For example, the stormy period during the Winter is visible.

Global study of the coherence

- Coherence of a linear system is a number ≥ 0 that gives *the* **fractional** part of the output signal power produced by the input at that frequency



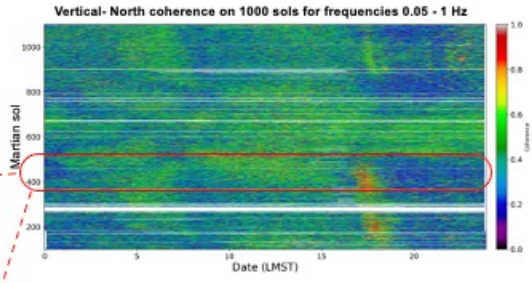
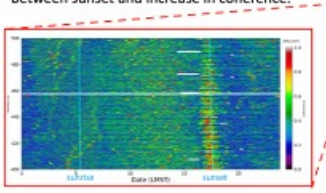
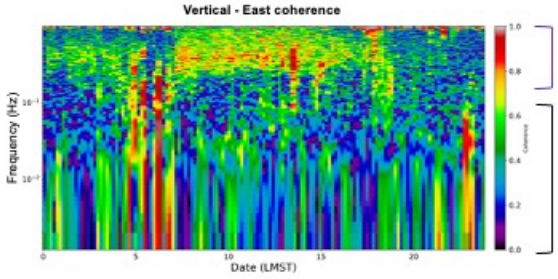


Figure 6 left : Coherence on Z-N direction for sol 200. We can see that the coherence change depending to the frequency band.
Figure 6 right : Evolution of the coherence depending on the period in a Martian year.

The zoom figure below show a correlation between sunset and increase in coherence.





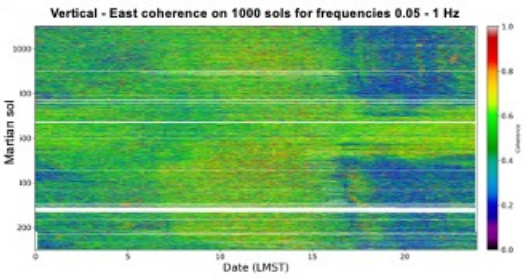
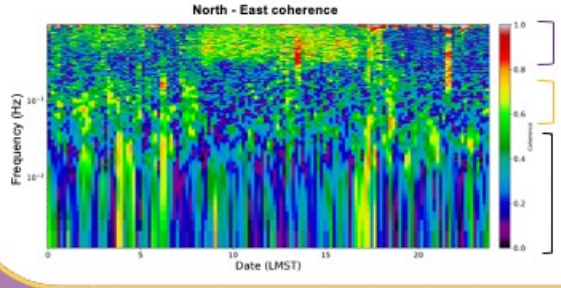
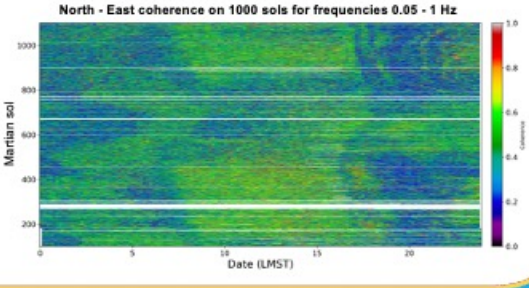


Figure 7 left : Evolution of the coherence between Z-E direction for sol 200. We can see mainly 2 different frequency areas. There is a more important coherence between 0.05 - 1 Hz during day time.
Figure 7 right : Evolution of the coherence depending on the period in a Martian year. The different frequency band are emphasized by the colored brackets.





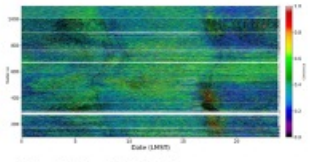


Figure 8 : In this Z-N coherogram, we see the origin of the high value of coherence observed : remaining glitches.
Indeed these value are located at the same place as the removed glitches (black dots).

In a nutshell

- We have a global view of approximately two Martian years of seismic data and the coherence between Z-N-E components for different frequency domains.
- In our computation on deglitched data we still have some glitches that distort the coherence computing approach. As a thermal feature, glitches can be linked with solar activity.
- To solve this problem we are going to increase the deglitching threshold parameter but the risk is to deteriorate our data. Next step is coherence between pressure and seismic data.