Comparative Analysis of Explosion Signals on Smartphones and Seismometers

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Poster #1

Introduction

Seismoacoustic signatures from a chemical explosion was recorded on two seismometers and eight smartphone accelerometers at Idaho National Laboratory (INL). The captured waveform's propagation and its time frequency representations are compared.

Mission Relevance

Employing smartphones as a ubiquitous sensor network for explosion detection adding to the arsenal of non-proliferation monitoring.

Methods

Smartphones (Samsung Galaxy S22) using the RedVox application were used to record an explosion with an effective yield of 300 kg.

The recorded vertical acceleration from the seismoacoustic signals captured on the smartphone accelerometers were compared to two nearby seismometers by looking at:

The propagation of the seismoacoustic signal

The time frequency representations with the continuous wavelet transform (CWT)

Results

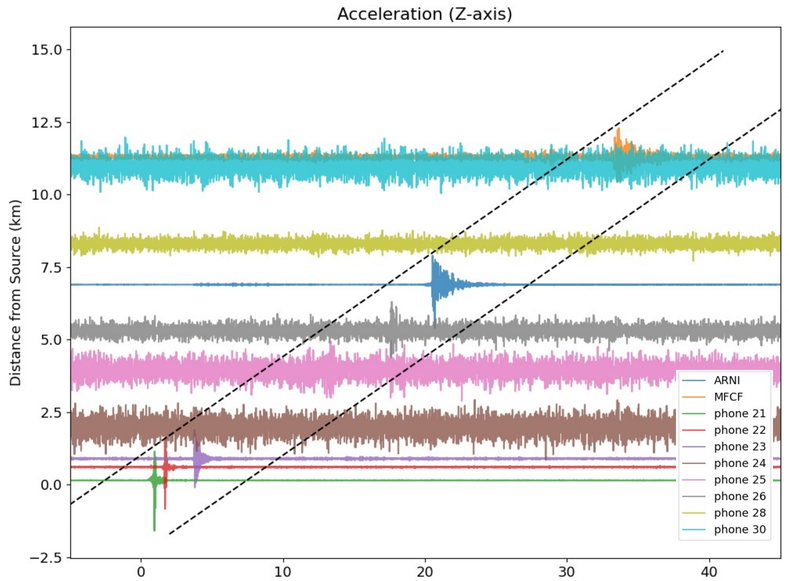


FIG. 1. The acceleration (z-axis) recorded by the sensors along with the section extracted for the CWT using the speed of sound.

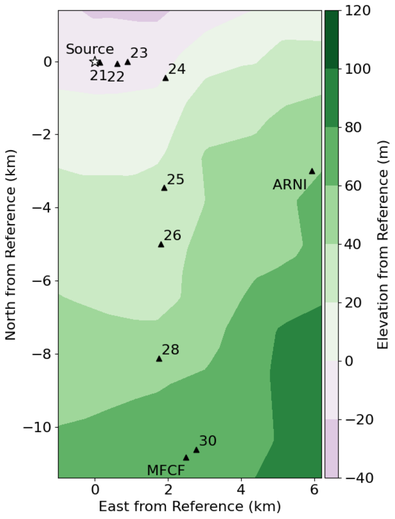


FIG. 2. The deployment map for the smartphones and seismometers with distance relative to the explosion.

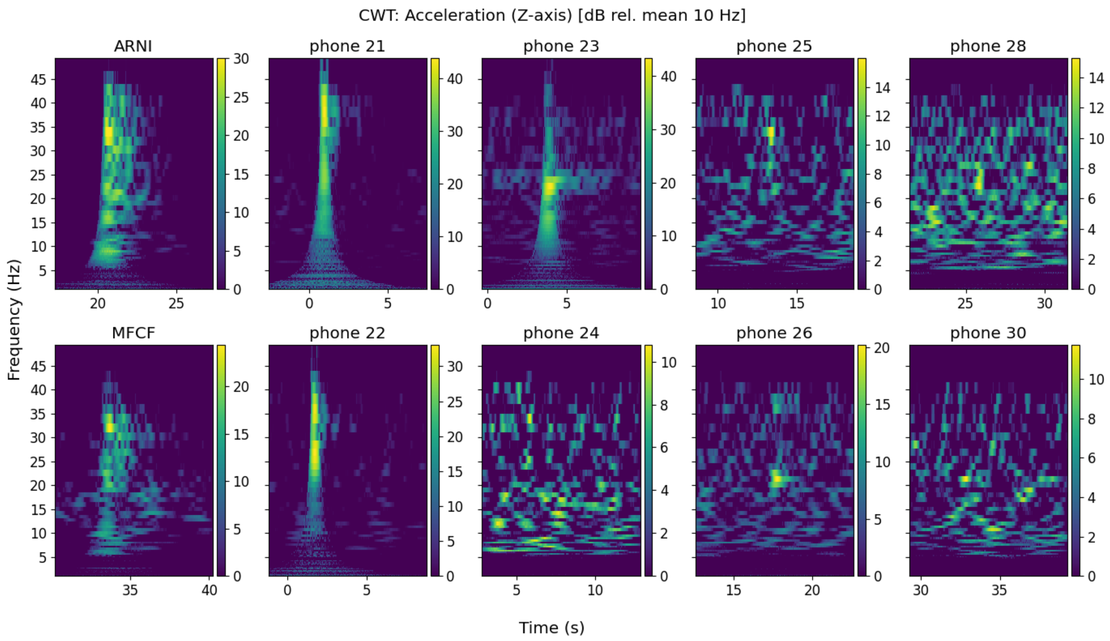


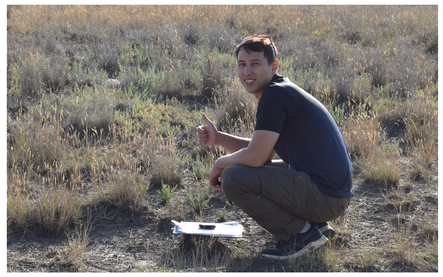
FIG. 3. The CWT of the extracted signal from the seismometers and smartphone accelerometers. The CWT for the seismometers have similar shape and frequency content for phones 21, 22, 23. Phones 25&26 seem to have a signal with similar frequency, however the closer phone 24 may not.

Goals and Objectives

Compare the explosion signals collected on smartphone accelerometers to seismometers for potential use in explosion detection.

Discussion

The smartphone accelerometers within 1 km (150 m/kg$^{1/3}$) recorded a clear explosion signal. The noisy signal or lack of signal in the farther smartphone accelerometers could be due to the sensitivity of the smartphone accelerometer or the deployment method / locations. Similar frequency content were found in the CWT for seismometers and smartphones. Future work will include co-locating smartphones with the seismometers and investigating the signals in the x/y axis.



Conclusion

The smartphone accelerometers were able to pick up a clear seismoacoustic explosion signal at within 1 km (150 m/kg$^{1/3}$) and a noisy signal up to 5.3 km (790 m/kg$^{1/3}$).

The similarities in the CWT could be used for explosion detection and/or analysis.

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