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Decrease in High-Frequency Background Seismic Noise after the COVID-19 Lockdown at a Suburban Site Outside Washington DC

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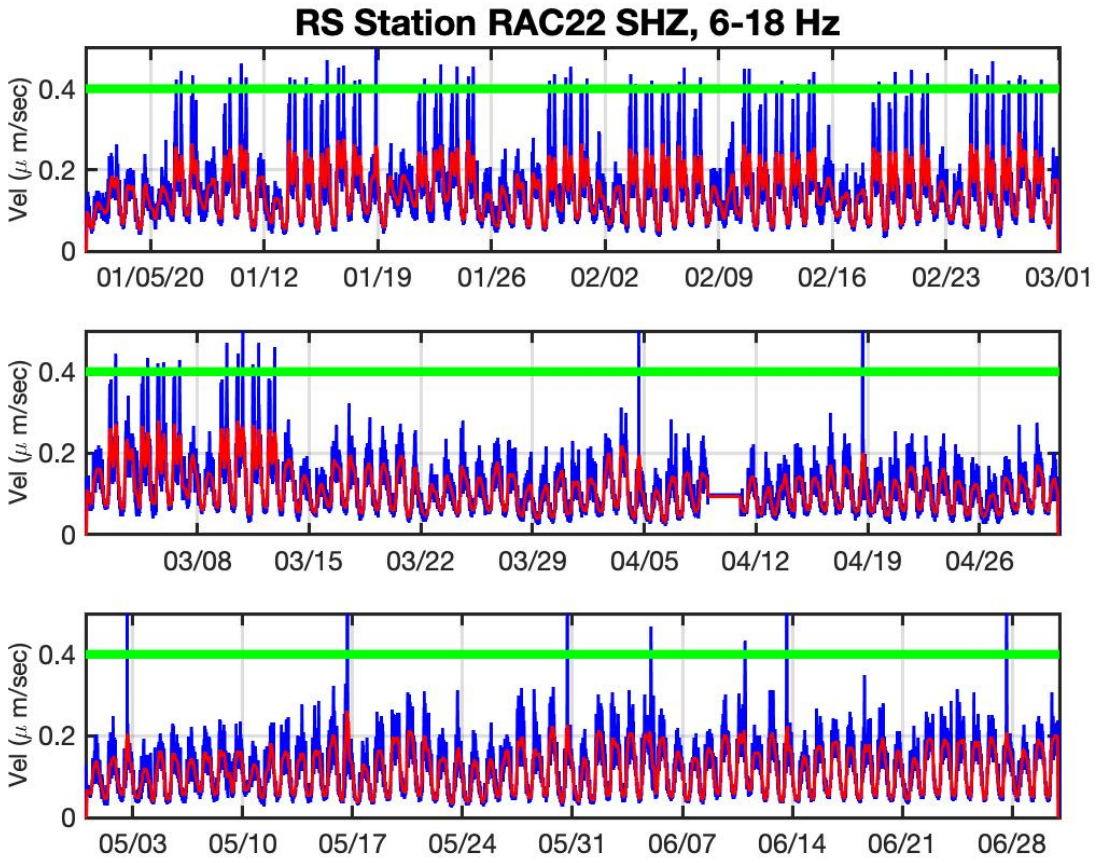
Abstract Text:

The global slowdown in human activity brought on by the COVID-19 virus in early 2020 has resulted in a measurable decrease in high-frequency background seismic noise at many sites around the world (Lecocq et al., 2020). We measure and interpret this decrease in at a Raspberry Shake station (RAC22) outside Washington DC. We processed the vertical channel data starting January 1, 2020 by bandpass filtering in the primary noise band of 6-18 Hz, and computing the signal envelopes using Gaussian smoothing windows of widths 15 minutes and 4 hours. The resulting envelopes show the diurnal cycles of human activity, the decrease in levels on weekends and holidays, and the overall decrease after the March 15 lockdown. We compare these measurements with non-seismic measurements of human activity and use a model of traffic noise from nearby roads to identify the likely noise source.

RAC22 is located ~26 km west of Washington DC. The site is 1.7 km north of a major highway, RT 66. Pre-shutdown weekday signal velocity peaks were ~0.4 μmeters/s with additional peaks of 0.5 μmeters/s during the morning and evening rush hours. After the March 15 shutdown, weekday peaks decreased to ~0.2 μmeters/s with no apparent rush hour peaks, a decrease of ~50%. Nighttime lows before and after the shutdown are both ~0.05 μmeters/s. Acoustic measurements at RAC22 show a post lockdown decrease in ambient noise from ~38 to 26 dB.

Correlation of the noise data with human activity requires activity metrics. One such metric is the Citymapper Mobility Index (based on the number of requested map tracks per day per city), an indicator of traffic activity. For the DC area, this index shows a decrease of ~90% after March 15, larger than the decrease in noise. Another measure of human activity is the Apple Mobility Index which shows a 50% decrease in traffic after March 15 but a recovery to the baseline after early June. This metric does not correlate well with the seismic data. Using a statistical traffic model based on average vehicle size, speed, the number of road lanes, digitized tracks for four roads, and a simple propagation model (1/sqrt(R), vel 2.5 km/s, Q = 20), we conclude that RT 66 is the primary source of the ambient noise at RAC22. Back propagating 0.4 μmeters/s level to the highway, we estimate a source level of 2 mmeters/s, typical for mid to large size trucks.



Plain-Language Summary:
Decreases in human activity resulted in a decrease of 50% in background seismic noise at a station west of Washington DC.

Session Selection:
S025. Social Seismology - The effect of COVID-19 lockdown measures on global seismic noise