



Seismo-Acoustic Studies Along the US "Northeast Corridor" With Raspberry Shakes & Booms: Utilizing Low-Cost Sensors for Citizen Seismology and Basic Research

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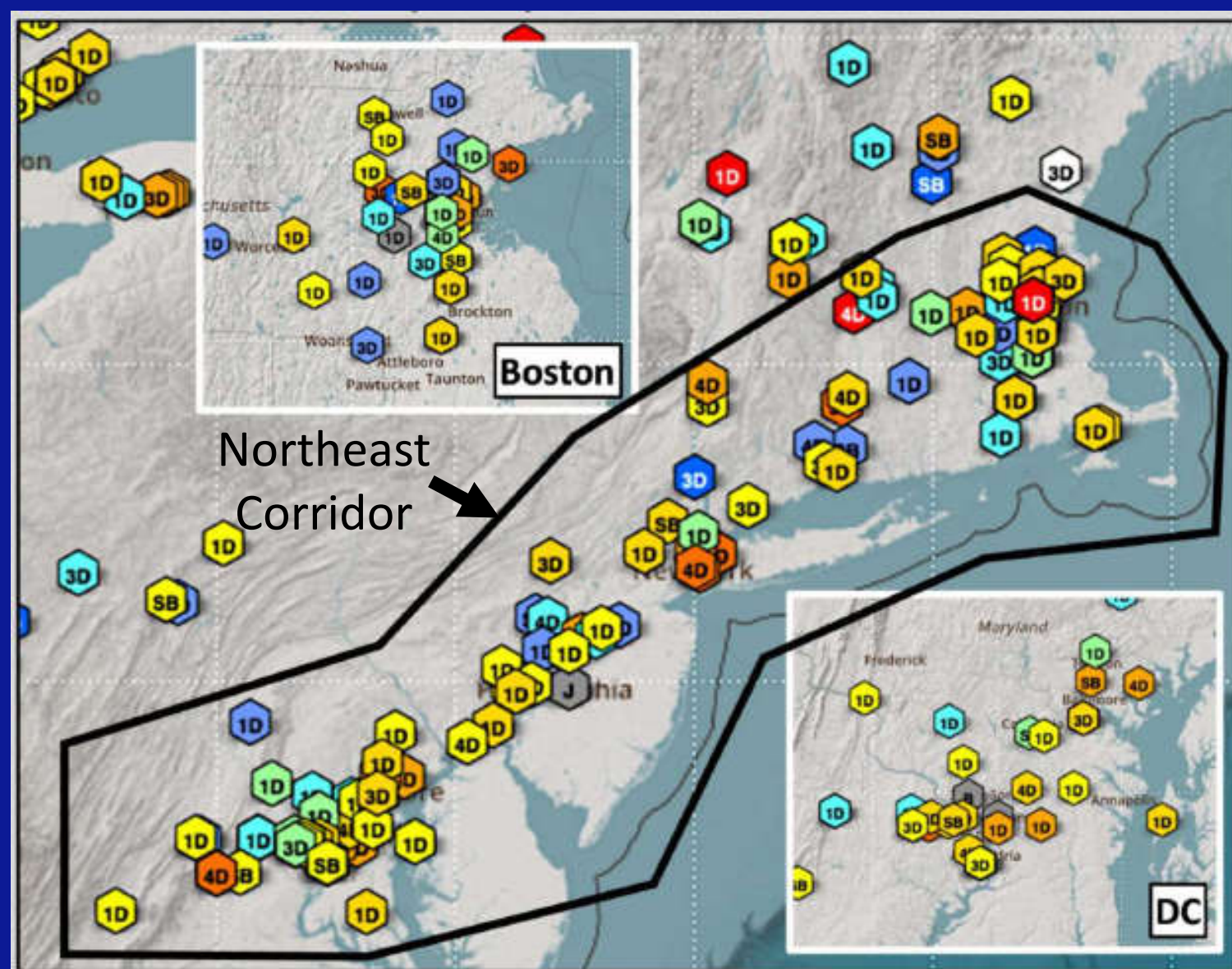
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Abstract

Two to three decades ago, seismological research in the northeastern US was hampered by sparse networks and limited financial resources. Equipment was costly, deployment was expensive and data communication was complicated. At the time it was difficult to argue for spending limited resources on this area of infrequent but sometimes high impact earthquakes. But starting around 2016, the availability of low cost, high quality citizen seismographs, notably Raspberry Shakes and Booms (RS&Bs), flipped the deployment equation and now anyone with an interest in seismology and a modest budget can have their own seismic station with data sent to a public server for anyone to analyze within 30 minutes of real time.

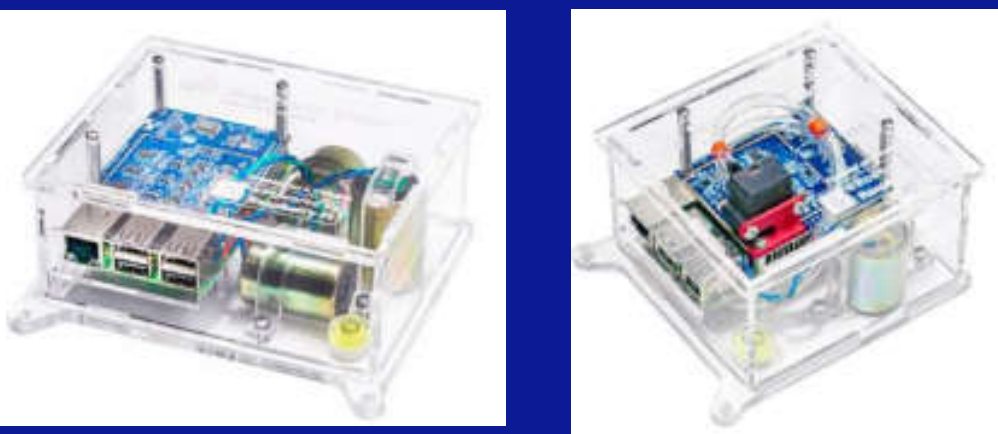
By 2023 there were over 200 RS&B stations across the "Northeast Corridor", from Washington DC to Boston, one of the most densely populated regions of the US. Although most of these stations are located in homes, schools and public buildings, the presence of local noise sources has not hampered their utility. We find that most suburban "cultural noise" is in the frequency band 8-18 Hz at levels of less than 1.5 micro m/s during the day and less than 0.1 micro m/s during the night. This leaves plenty of bandwidth for the analysis of local and regional earthquakes. The low frequency sensor rolloff means that with some filtering, many teleseisms, are recorded. With close sensor spacing, we can apply coherent processing techniques, such as frequency-wavenumber and ambient noise correlation. Since many stations have three component Shakes, we can also, for example, apply HSV techniques to map the depths to bedrock. Thus, RS&Bs are not only good for citizen science, they are also useful for basic scientific research. Here we present examples of basic research in seismo-acoustics that are possible based on RS&B instruments at sites within the Northeast Corridor.

"Northeast Corridor"



Shake

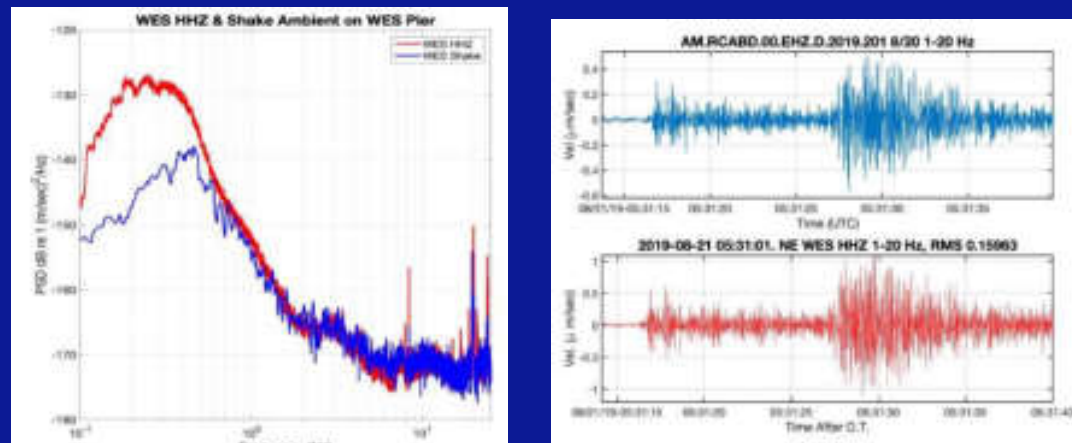
Boom



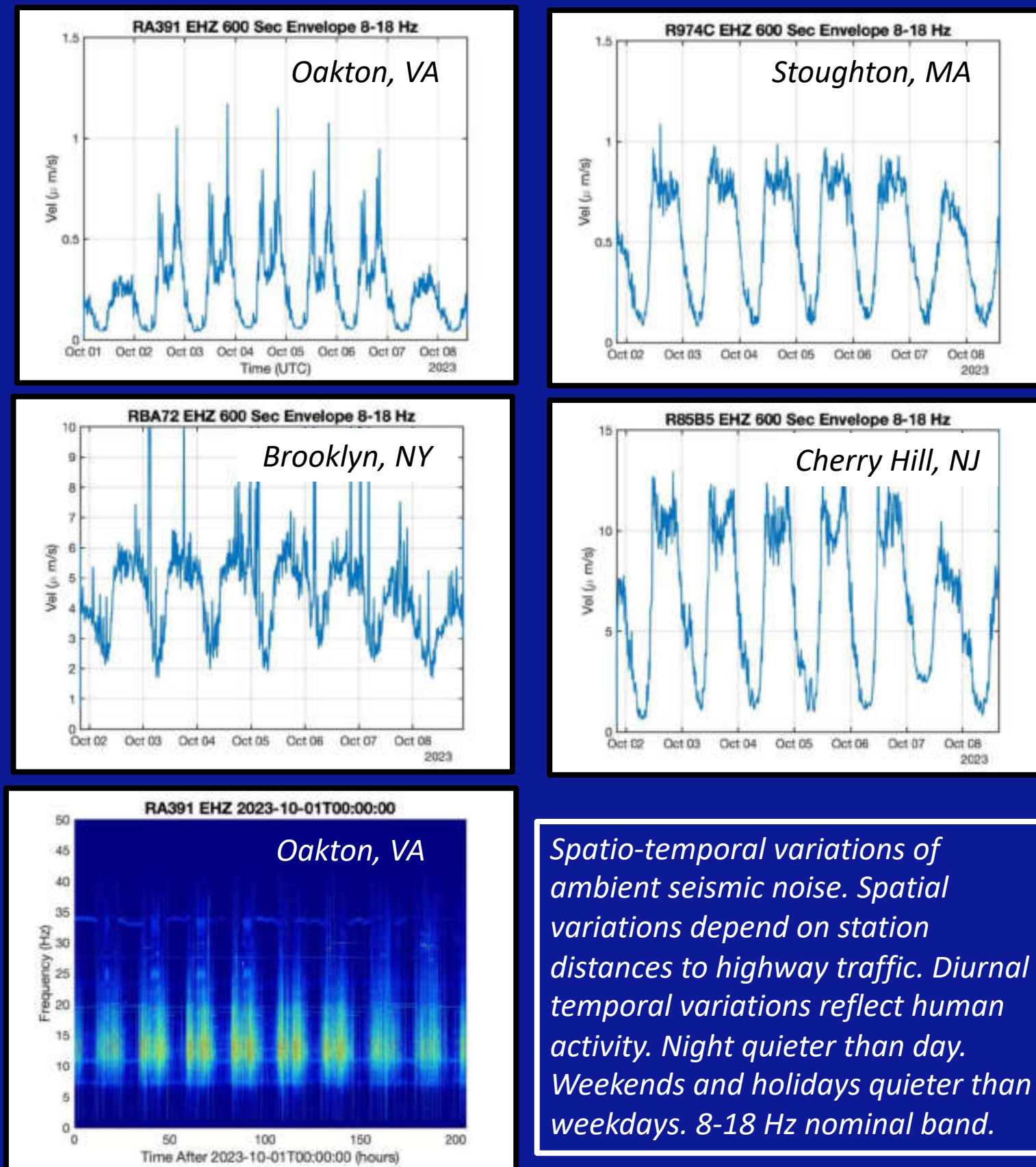
Indoor & outdoor versions available. Data continuously uploaded to server. Openly available.

Shake

Trillium

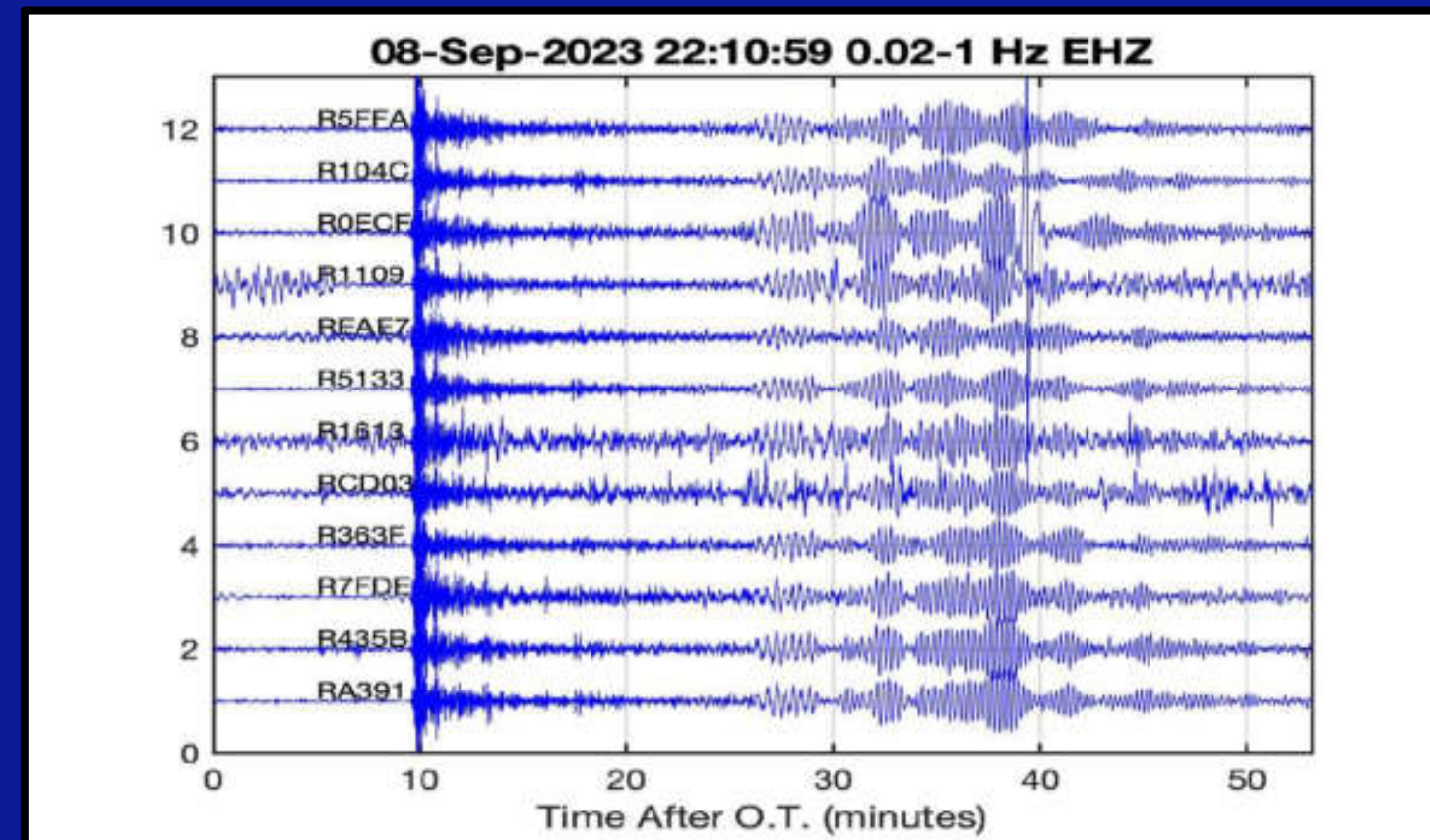


Suburban Ambient Seismic Noise

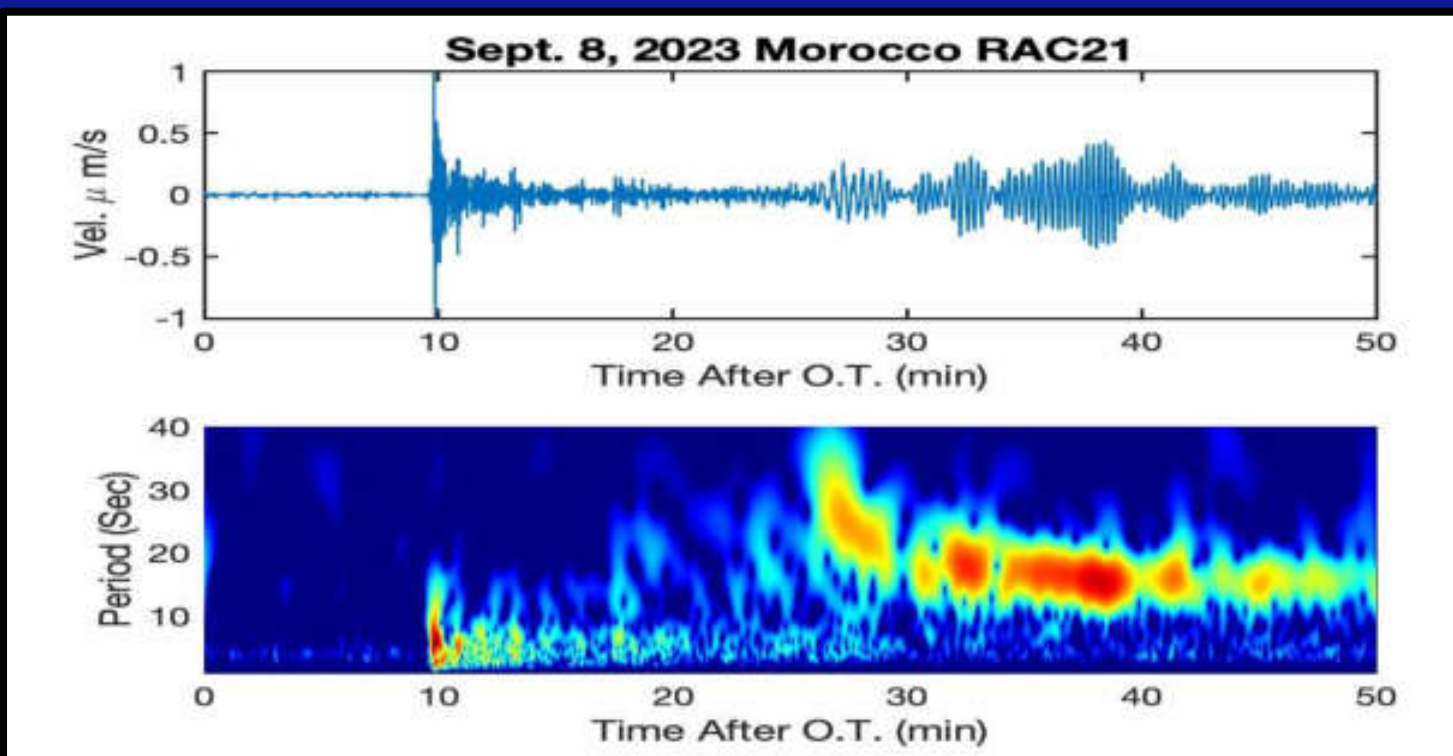


Spatio-temporal variations of ambient seismic noise. Spatial variations depend on station distances to highway traffic. Diurnal temporal variations reflect human activity. Night quieter than day. Weekends and holidays quieter than weekdays. 8-18 Hz nominal band.

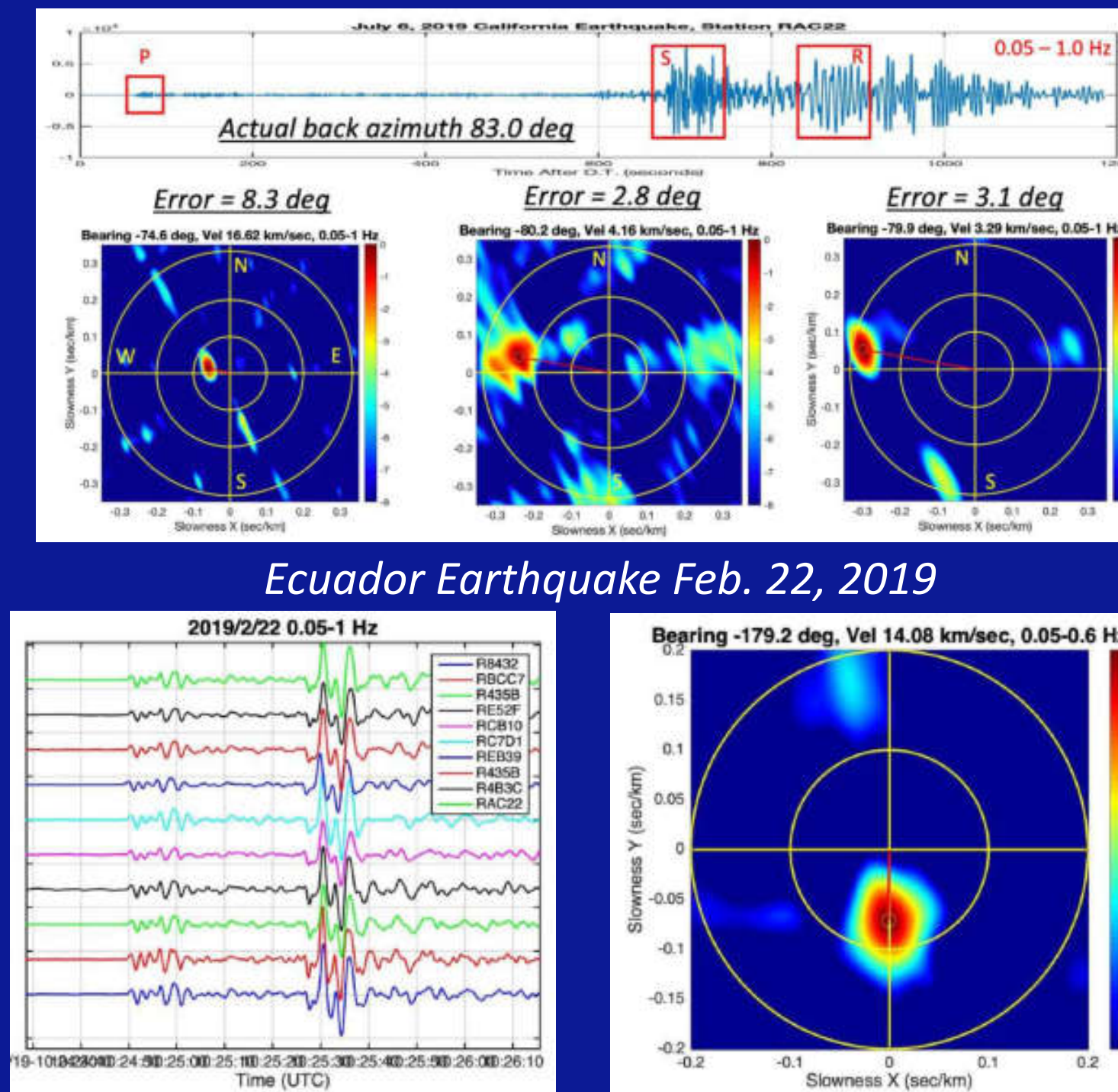
September 8, 2023, Morocco, Mag 6.8



Long Period Surface Wave Dispersion

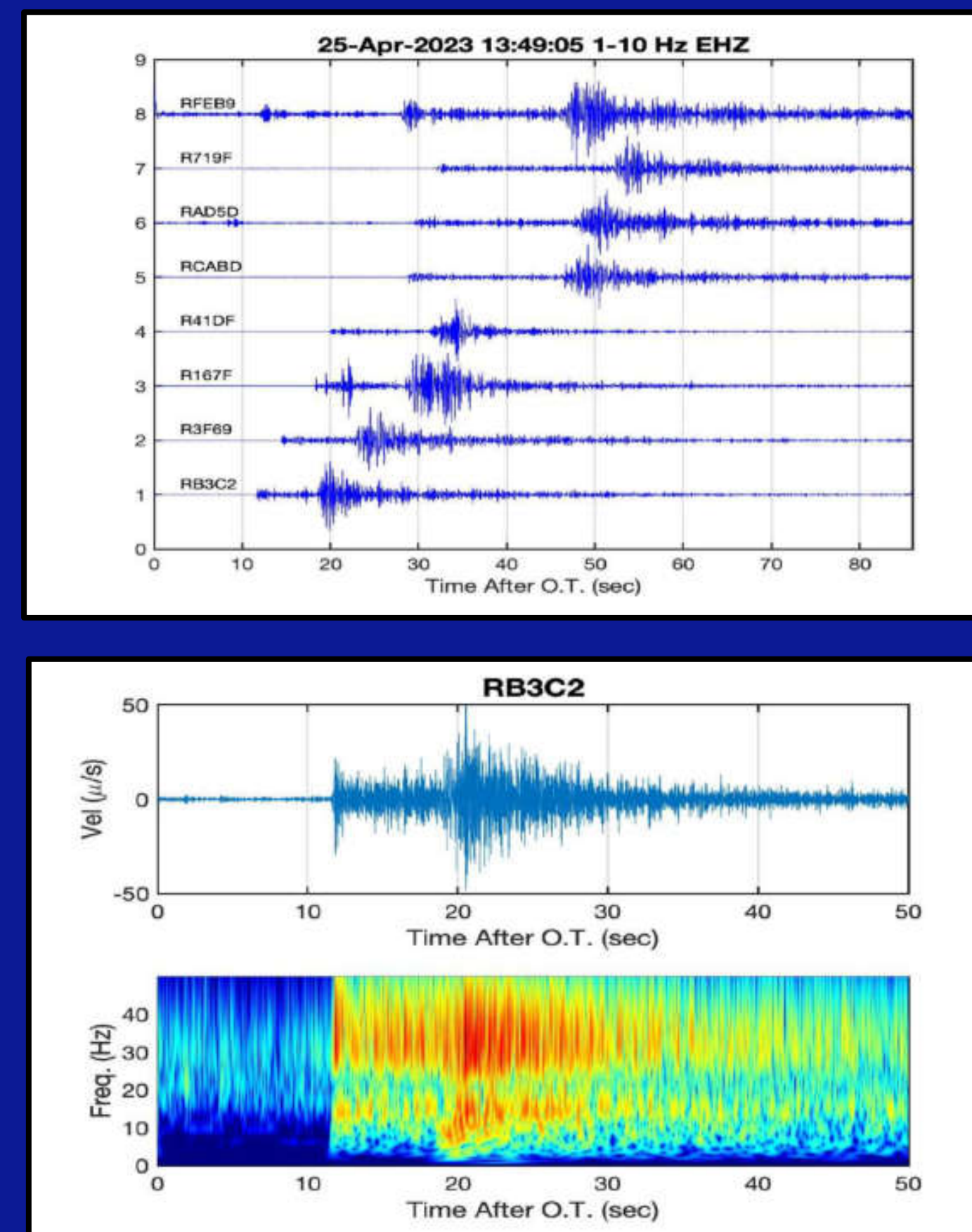


Coherent Processing California Earthquake

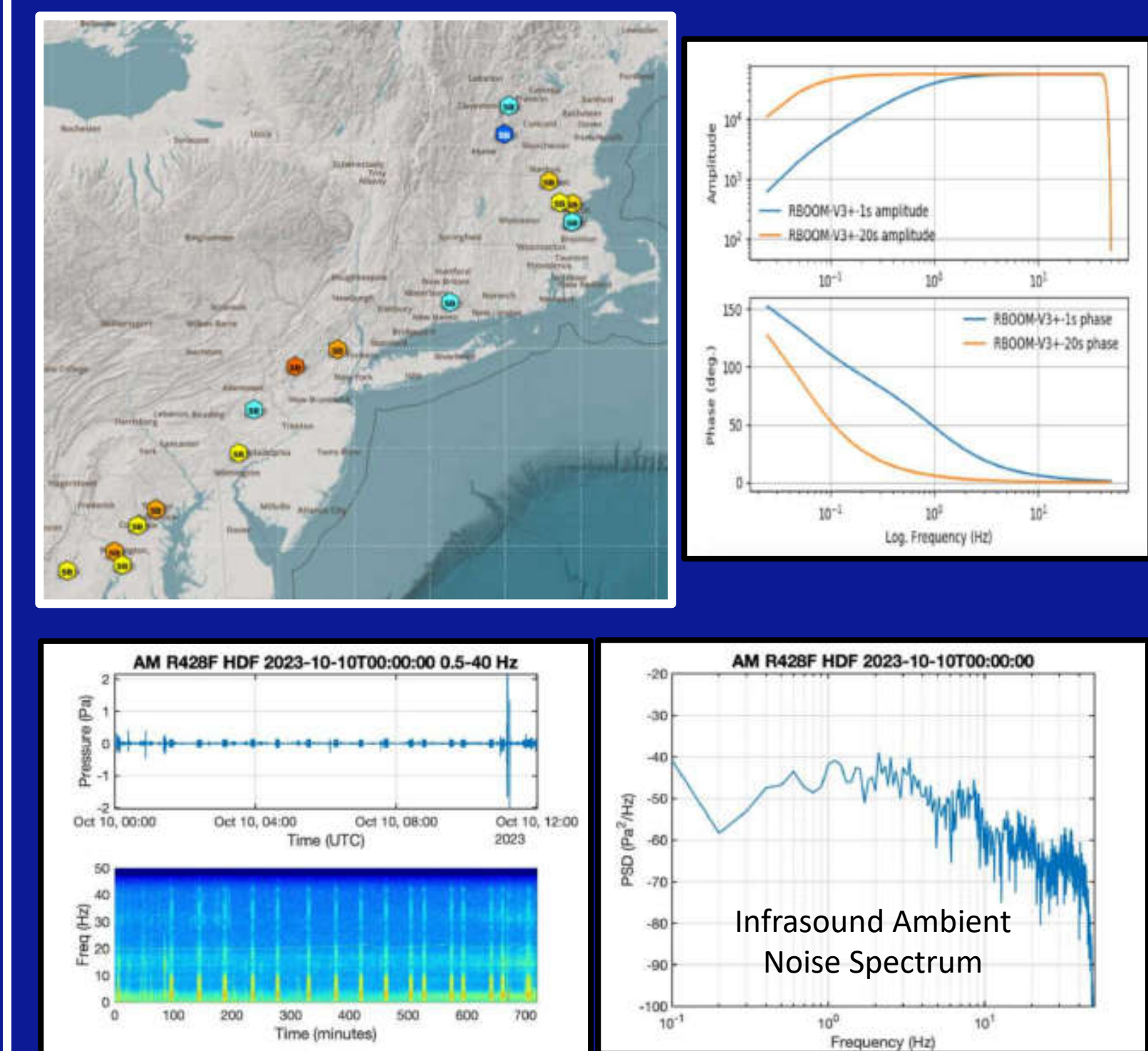


Local Earthquake

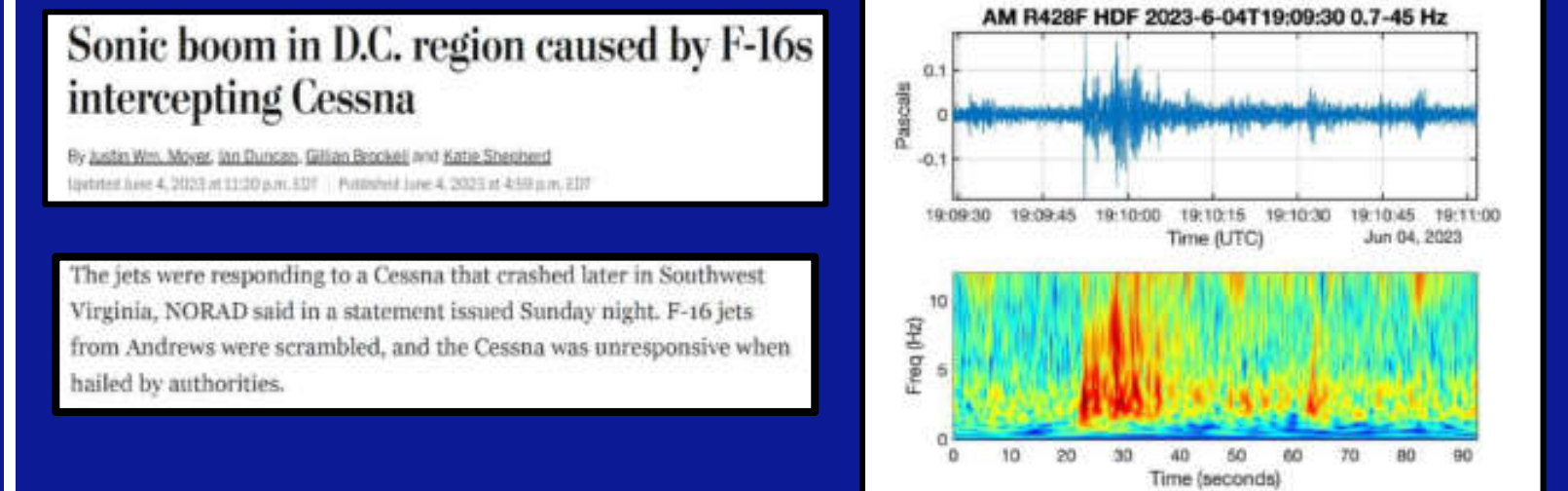
April 25, 2023, Central New Hampshire, Mag 2.9



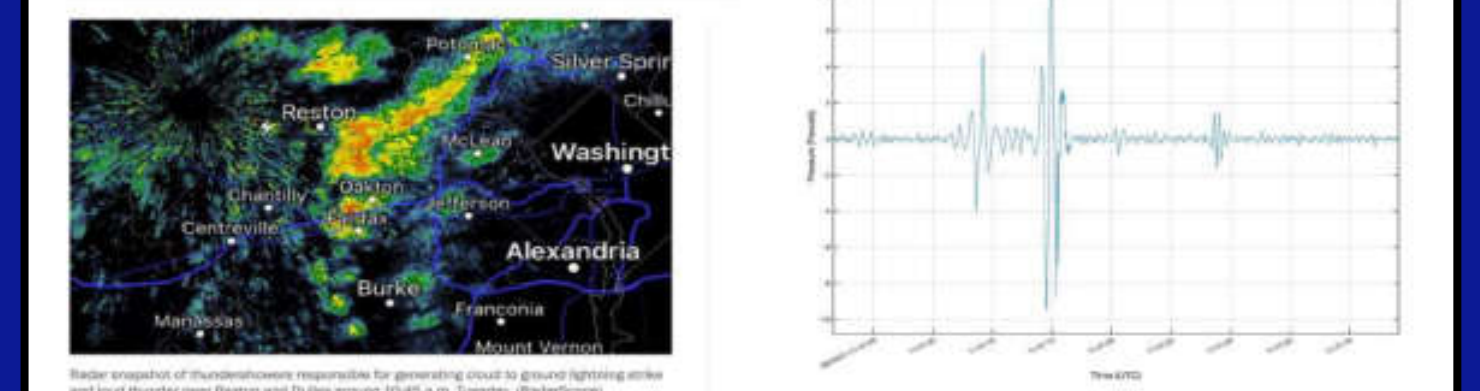
Boom Infrasound



Other Infrasound Signals



Enormous boom heard over D.C. area was almost certainly from lightning in Northern Virginia



Thunder

Helicopters

