Earthquake Early Warning Model using Signal Analysis and Data Classification

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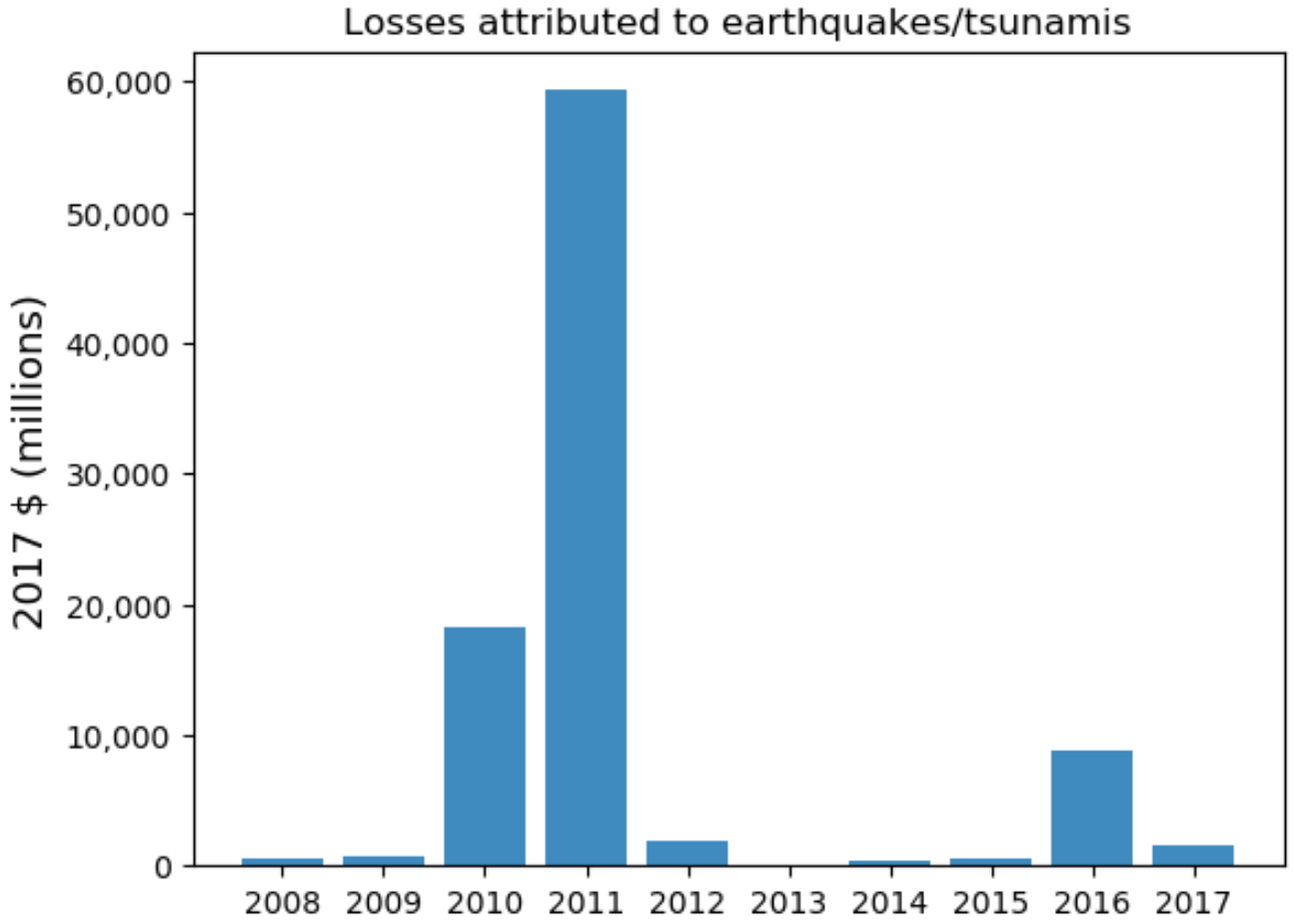
Motivation: Earthquake Early Warning System

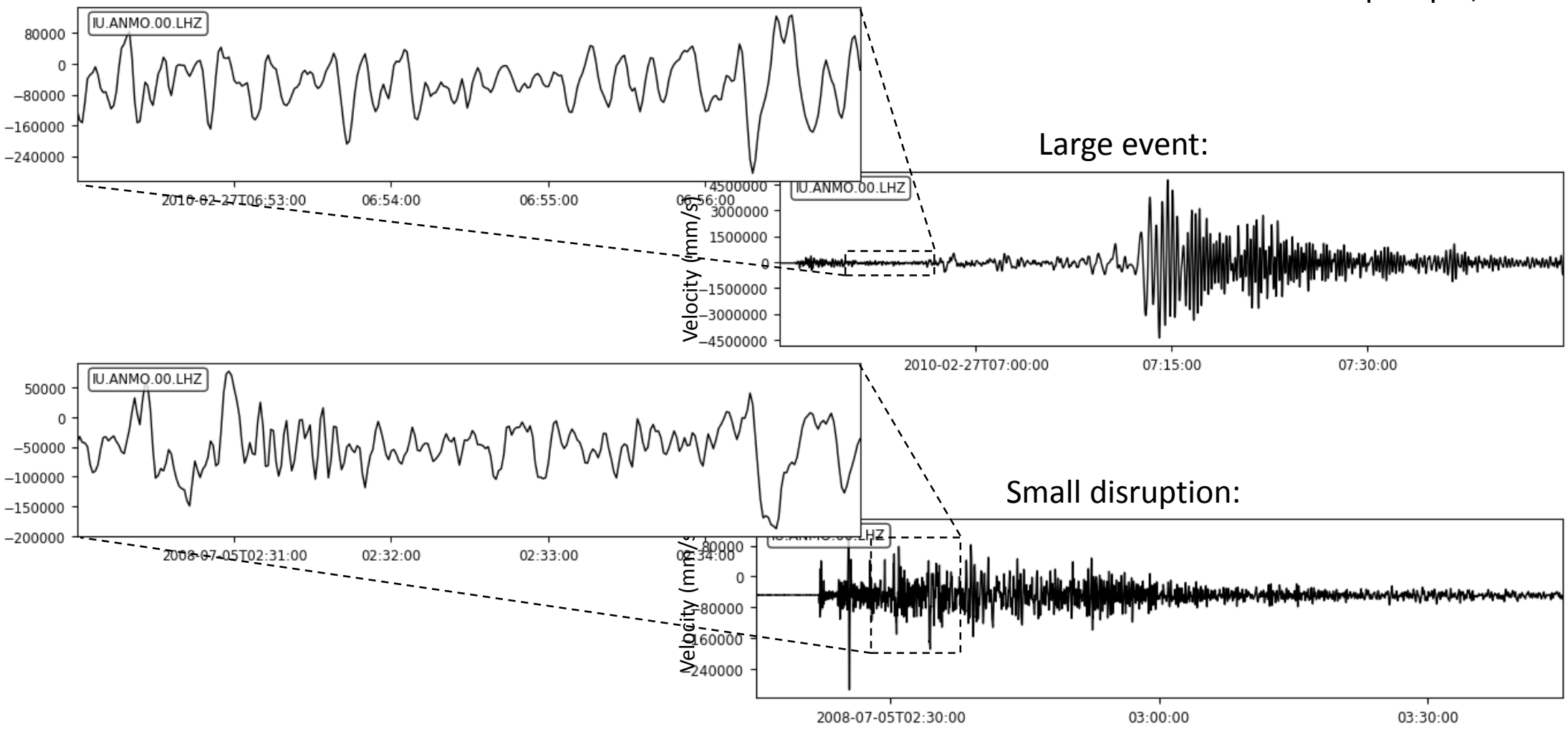
- In the Bay Region, there is a 72% probability of at least one >6.7 magnitude earthquake occurring between 2014-2043 (USGS).
- Early warning systems aim to provide ~10s of seconds of warning to limit damage incurred.



Data from Swiss Re Institute

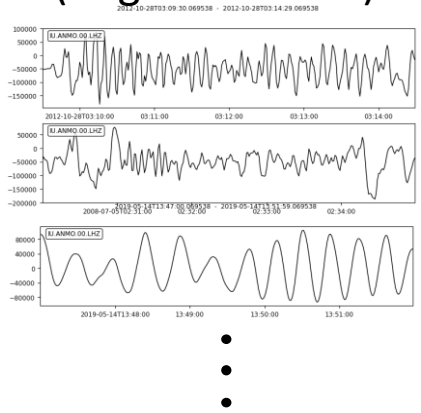
Seismic Waveforms

Data source: Global Seismic Network, Station IU ANMO
Albuquerque, New Mexico, USA

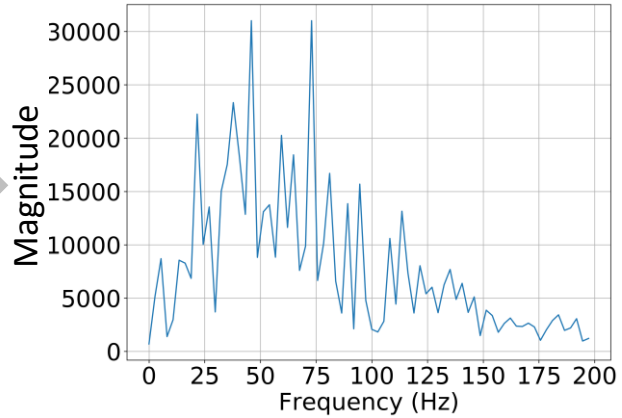


Data Mining Procedure

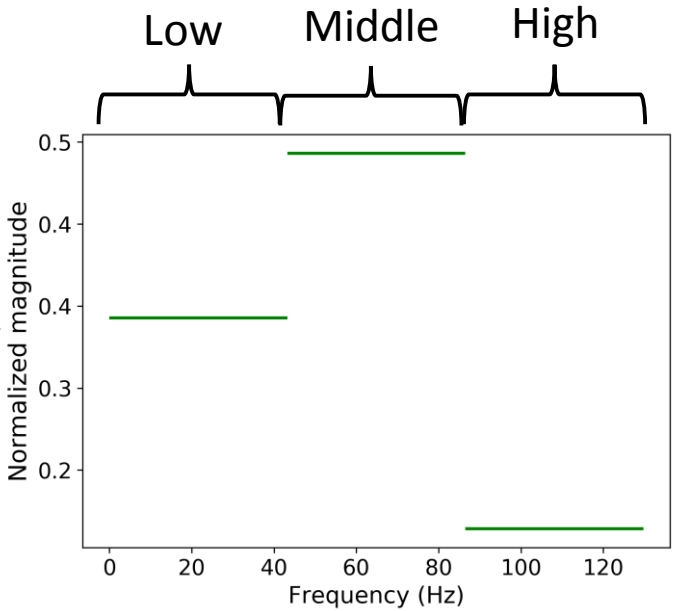
Array of waveforms (large and small):



Perform FFT on each waveform

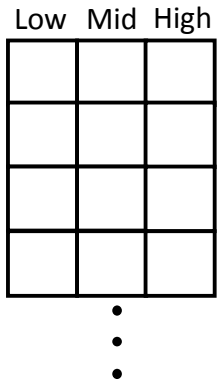


Bin FFTs into 3 frequency domains

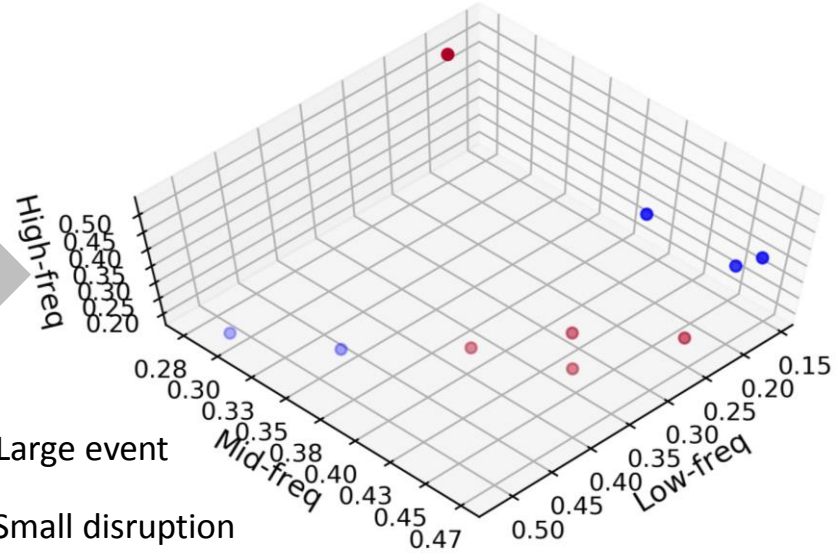


Create array of normalized fft

Array of binned frequencies



In 3D space

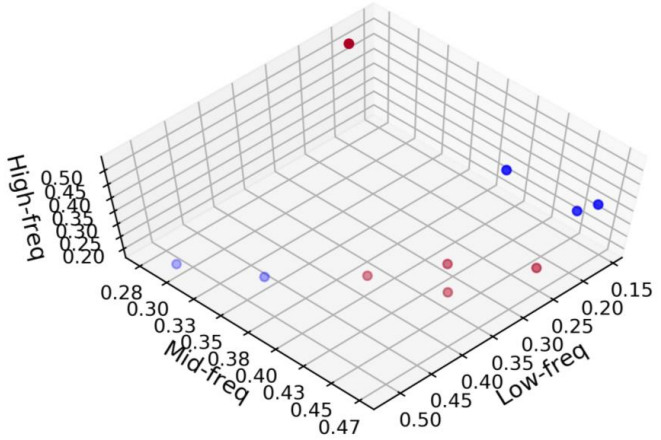


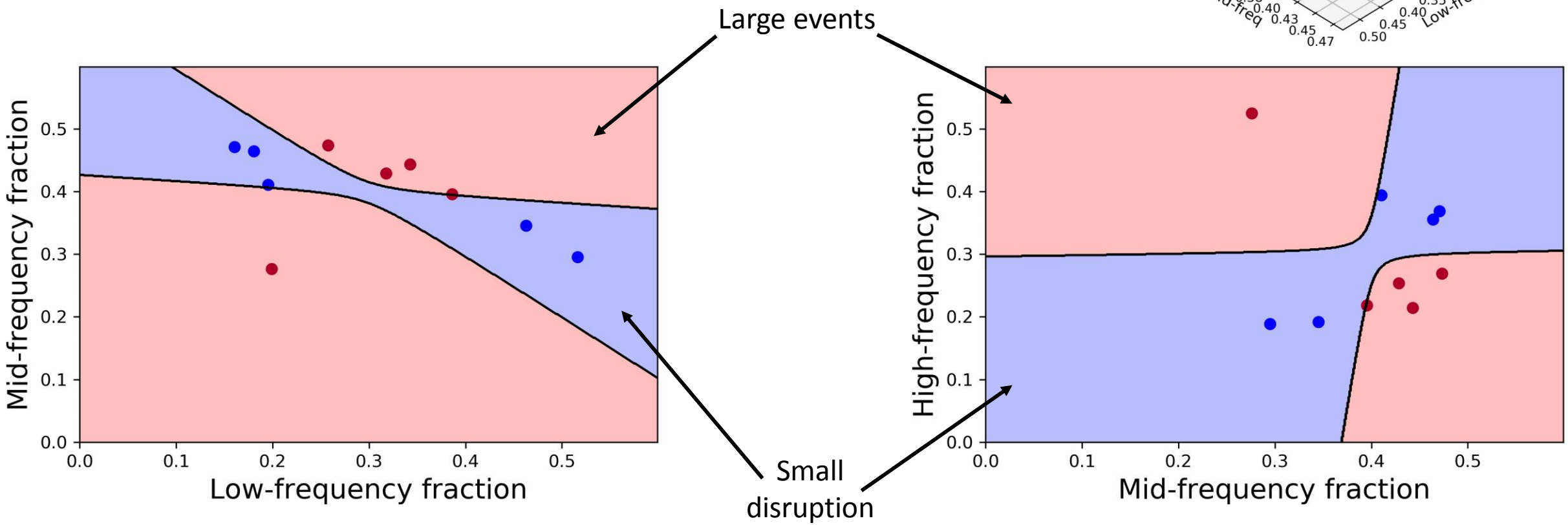
Large event

Small disruption

Classify using quadratic discriminant analysis

QDA Classification (2D)





Model has the potential to provide ~10-20 minute early warning before peak intensity of an earthquake.

Possible Future Directions

- More training data
  - Automate waveform collection for 150 GSN stations for 10 years: ~5 TB of data
  - For 150 GSN Stations w/10^4 waveforms per station: ~50 GB
- Upscale the model
  - More frequency bins w/running average
- Test data using historical seismic records