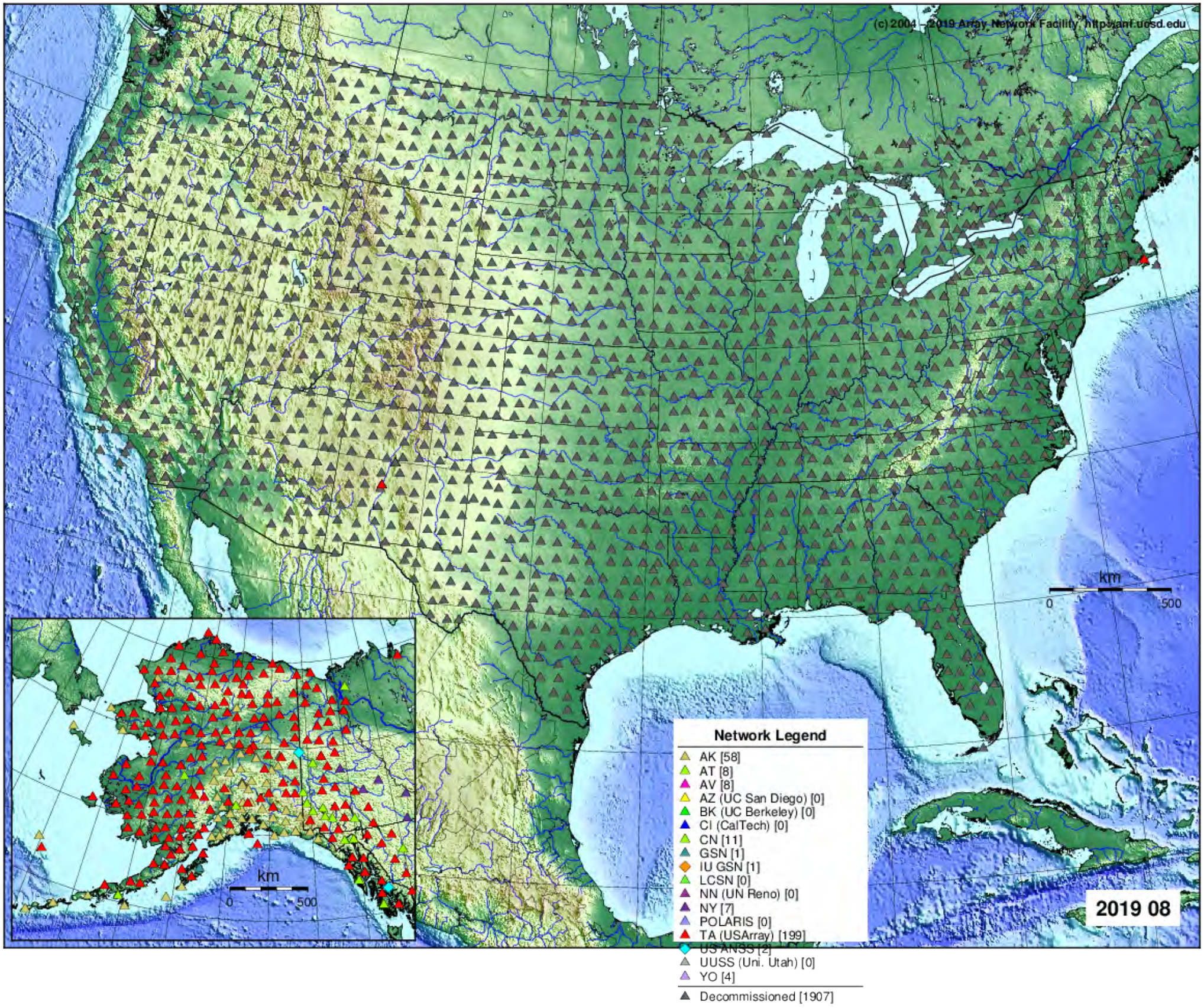
Antelope USARRAY Accomplishments And Future Directions

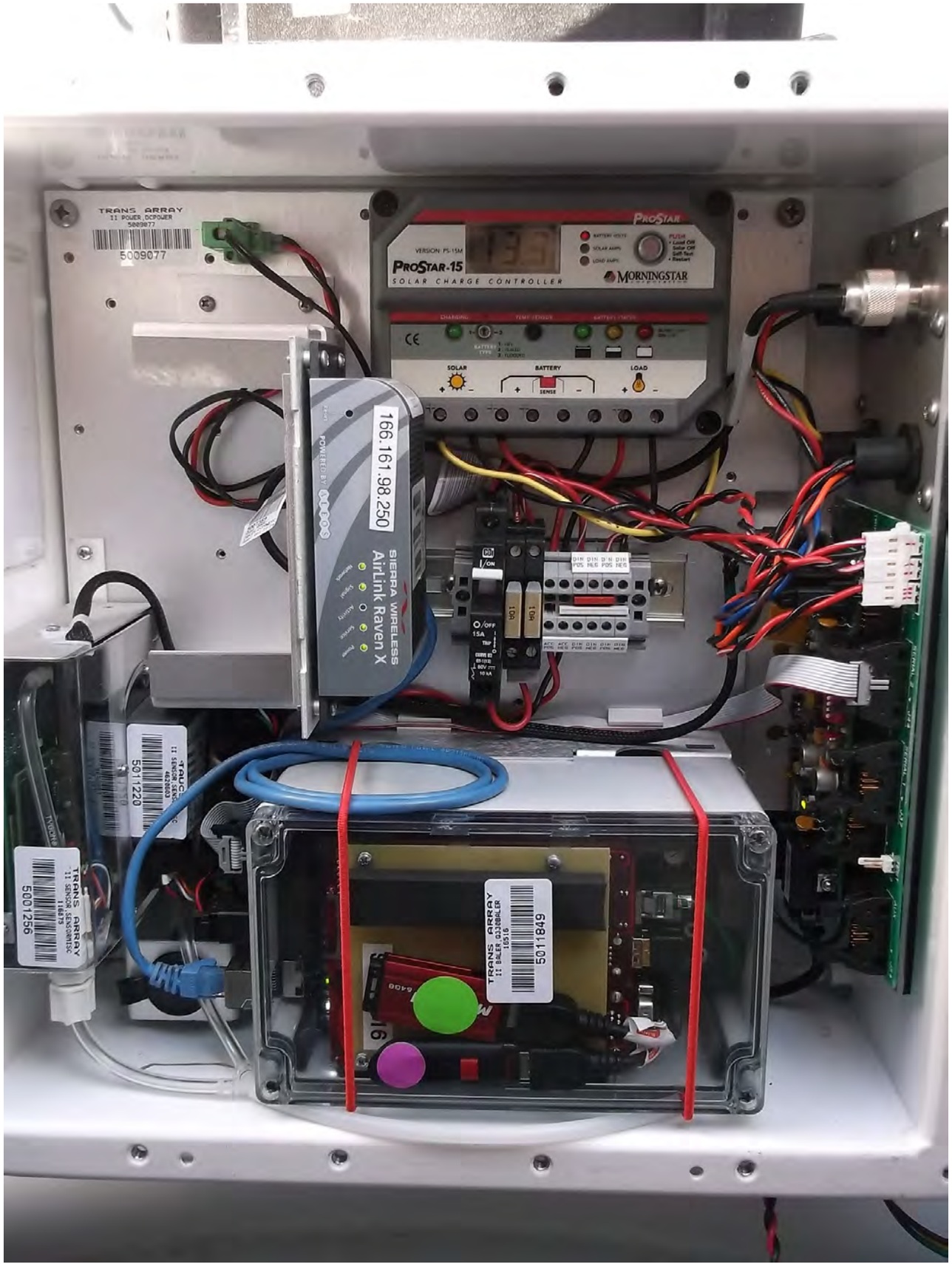
Frank Vernon Calgary AUG 17 September 2019

USArray Cumulative Station Coverage

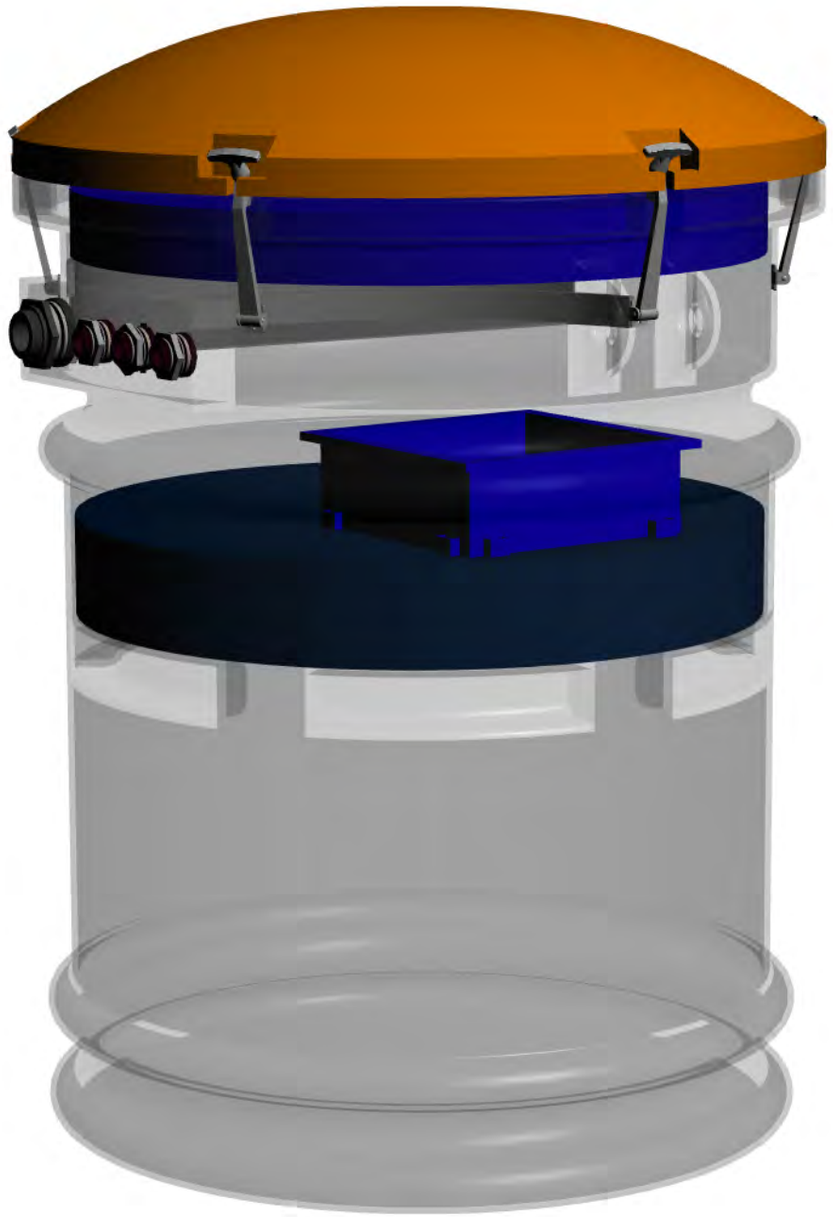


USArray Q330 Datalogger

USArray VIE and other electronics

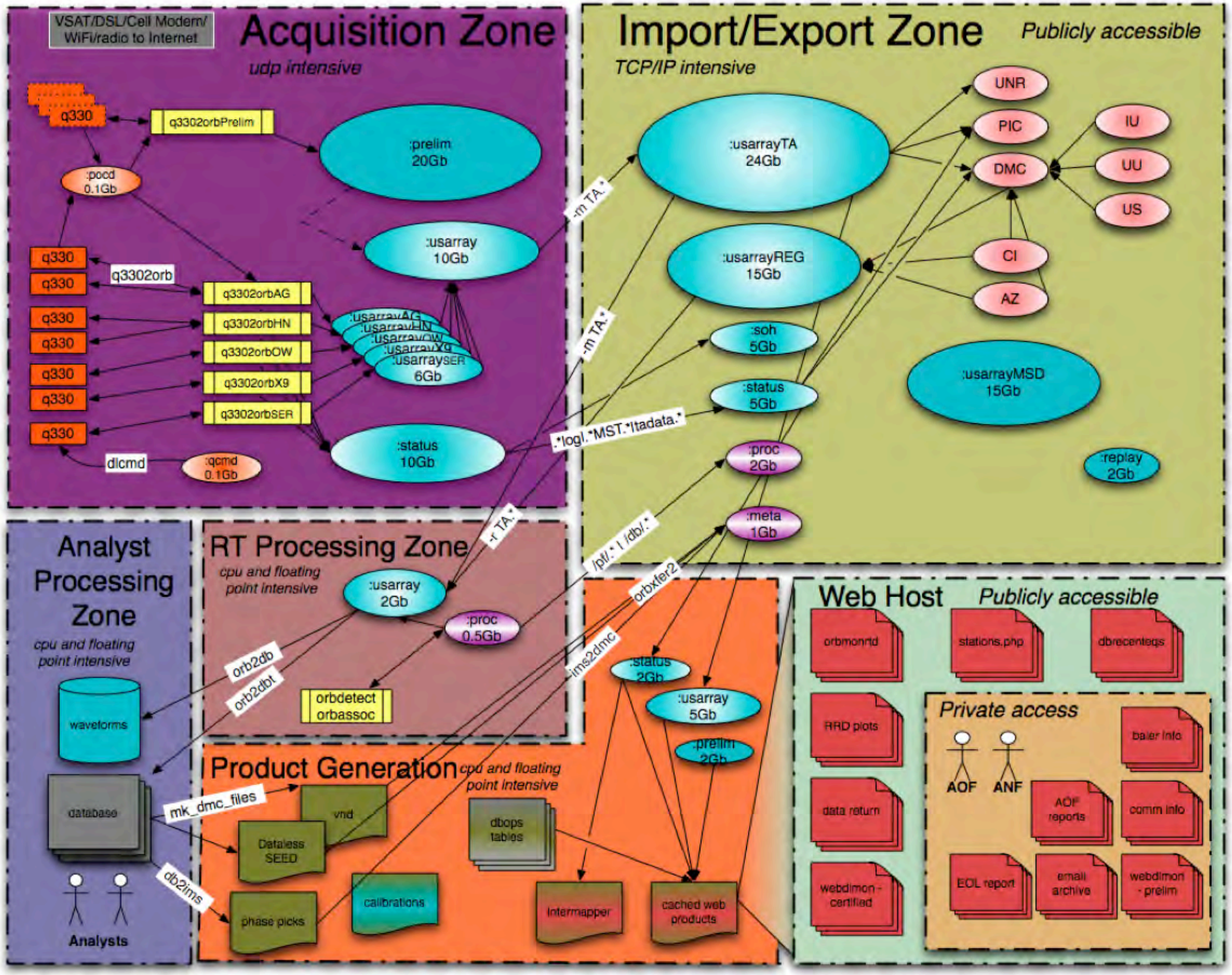


USArray Vaults - Rev 2

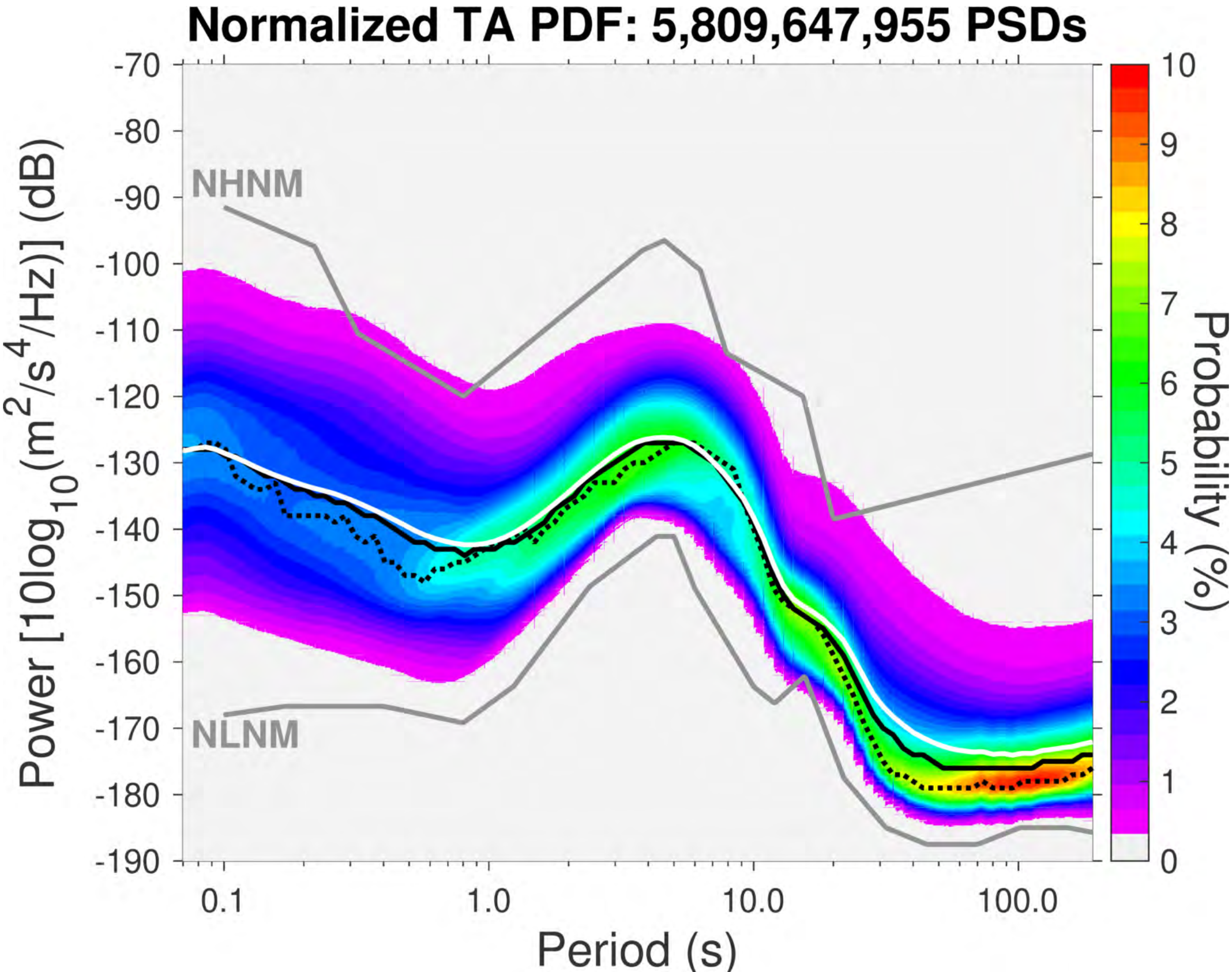


USArray Seismic Station - W52A

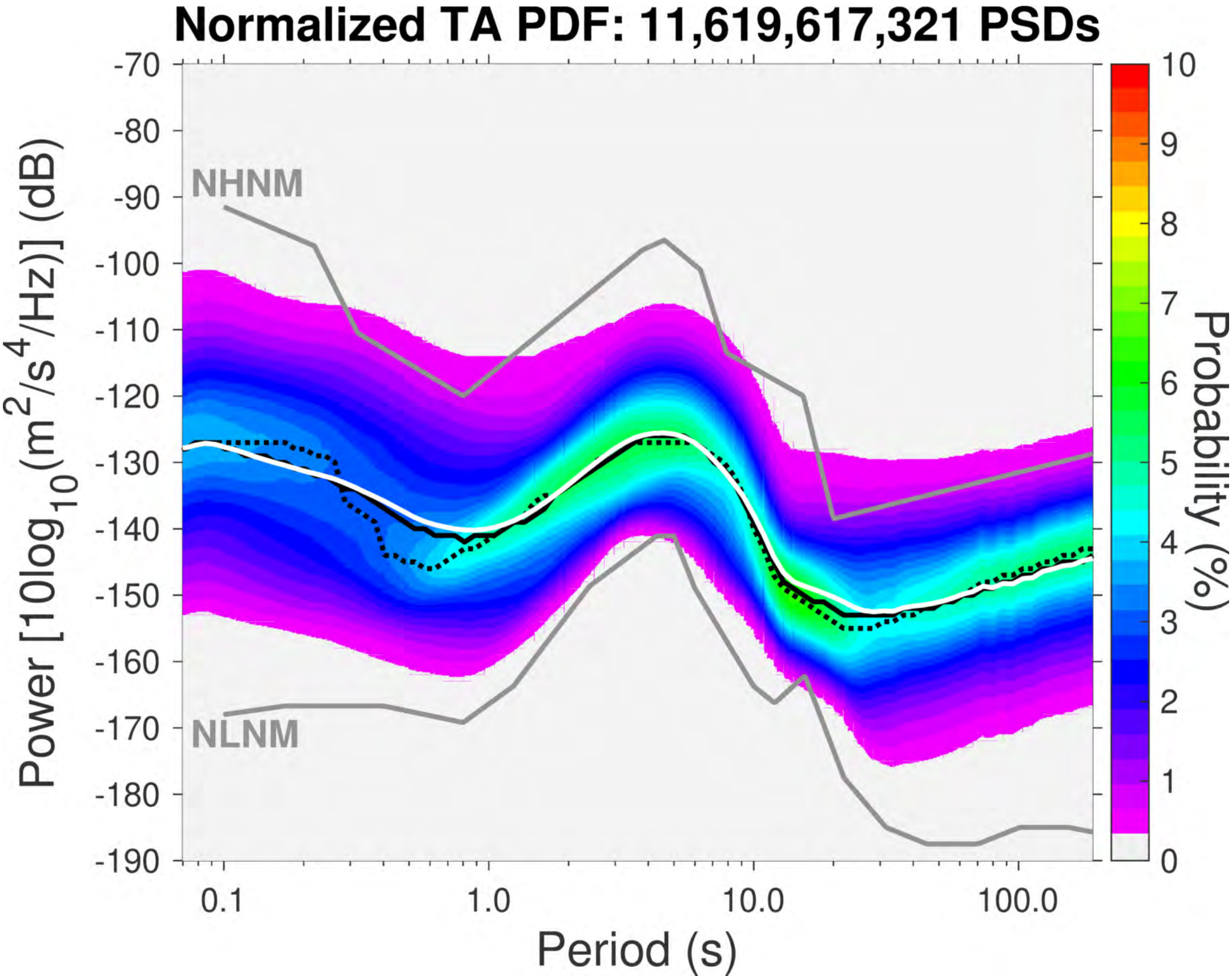
USArray Antelope Configuration



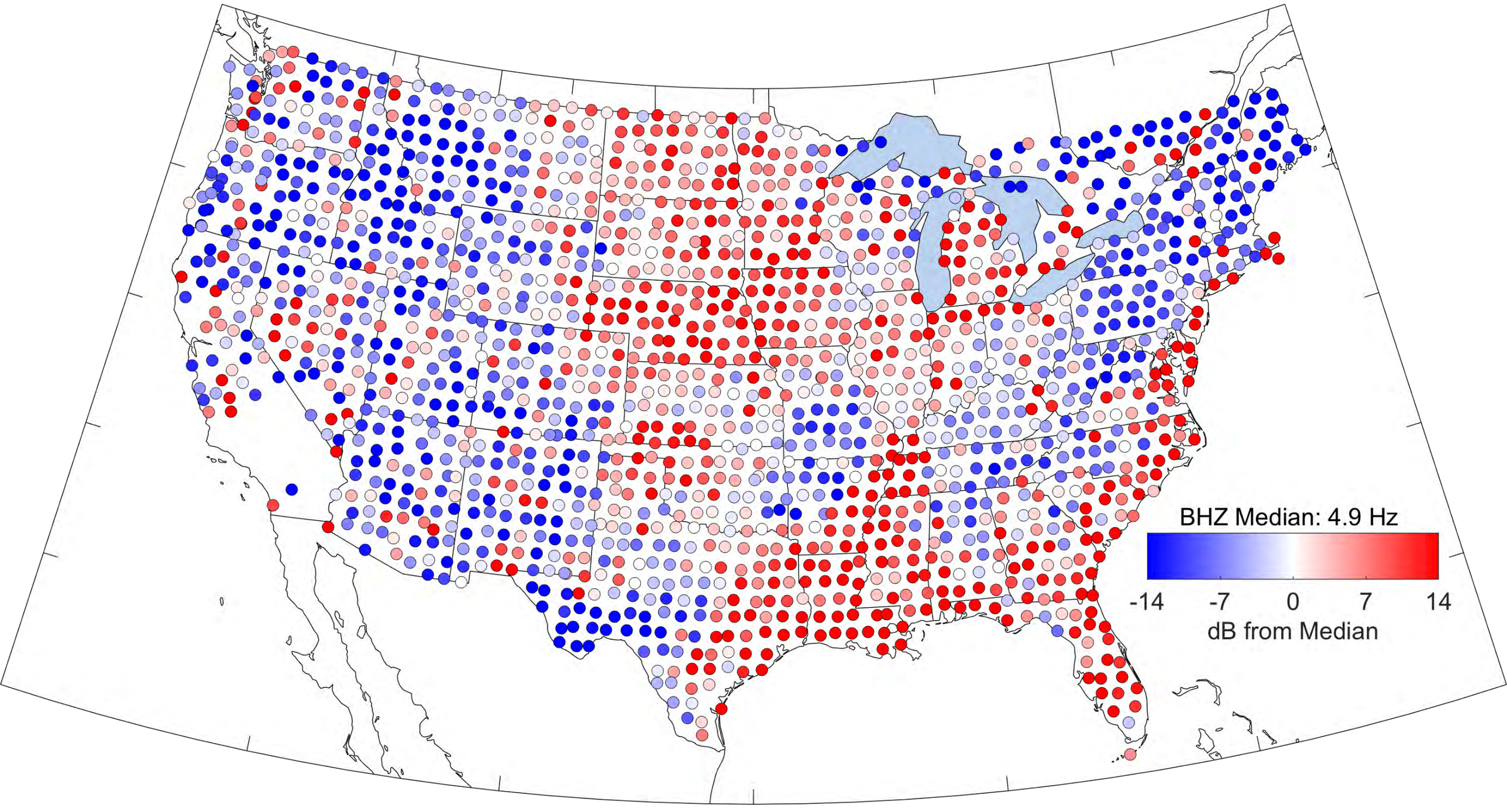
USArray Vertical PDF



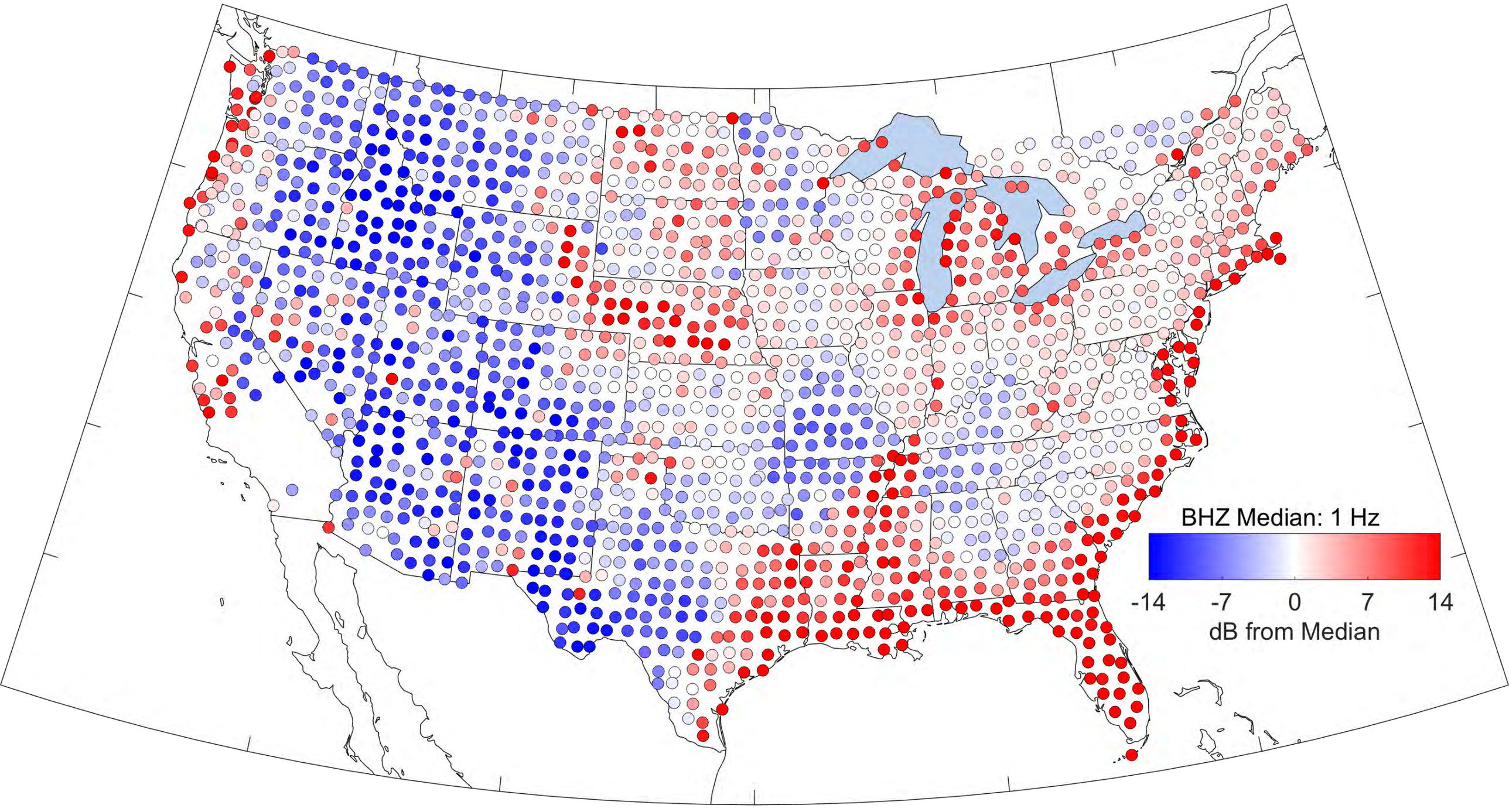
USArray Horizontal PDF



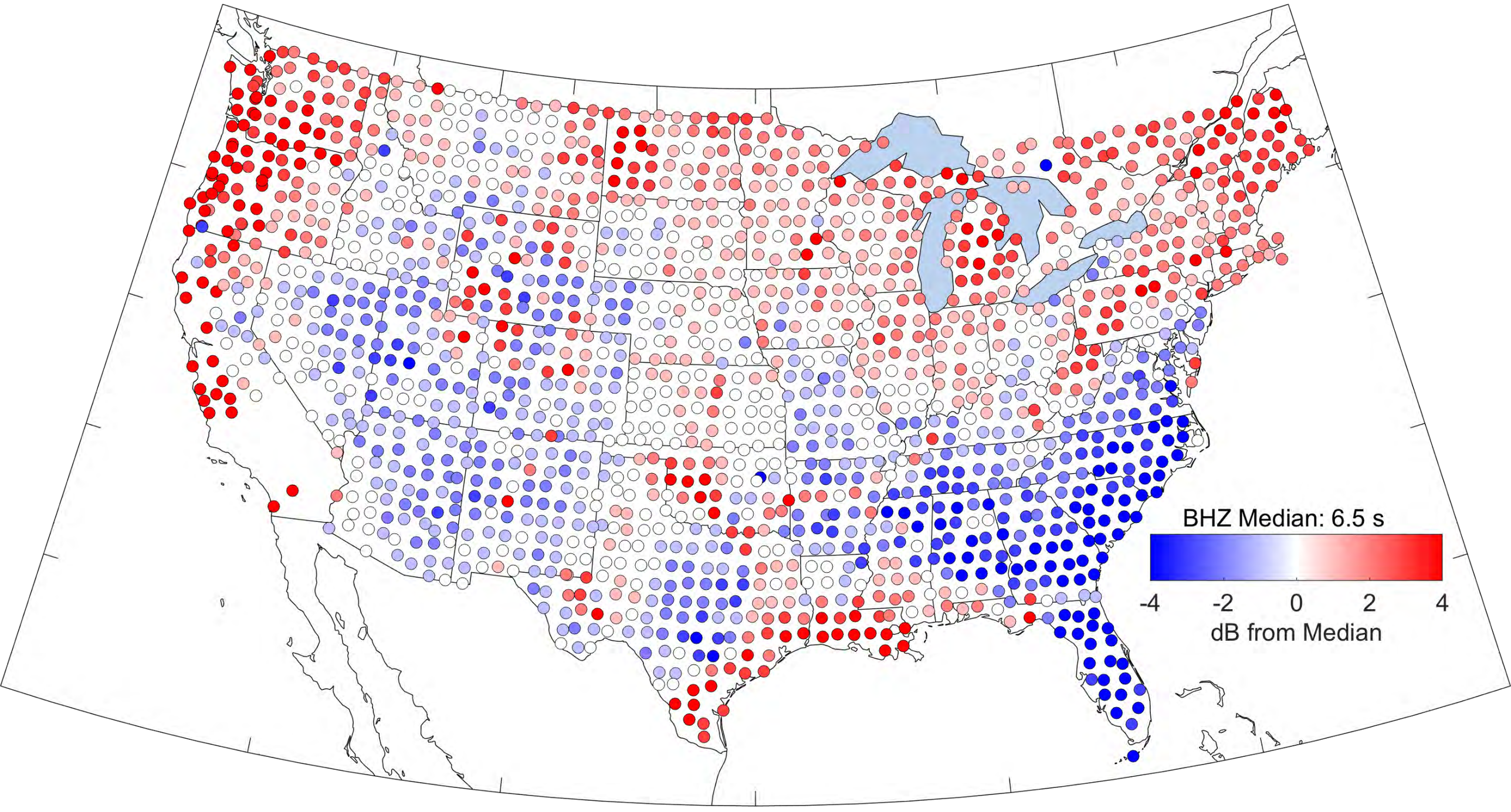
USArray 5 Hz Median Spatial Distribution



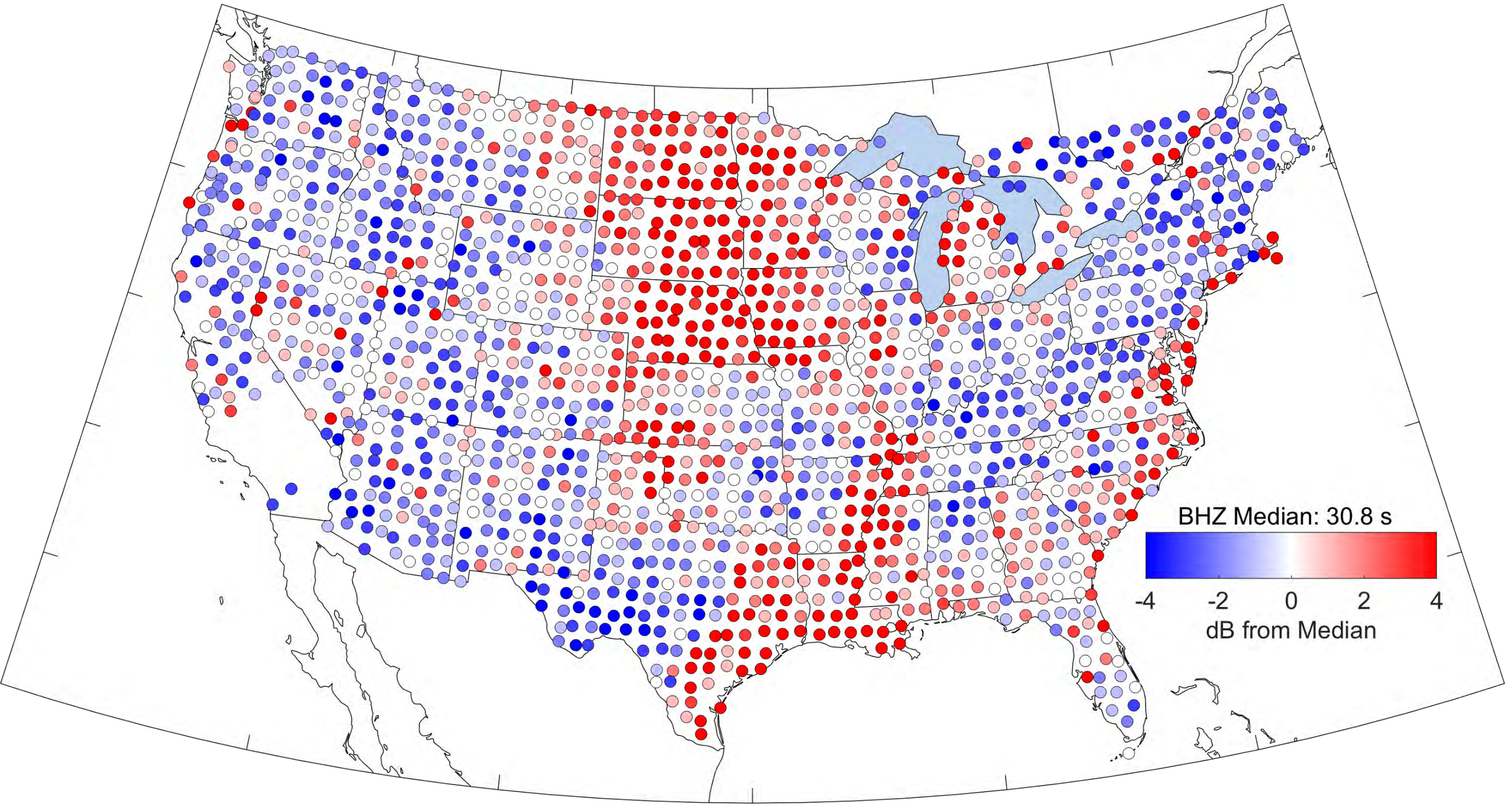
USArray 1 Hz Median Spatial Distribution



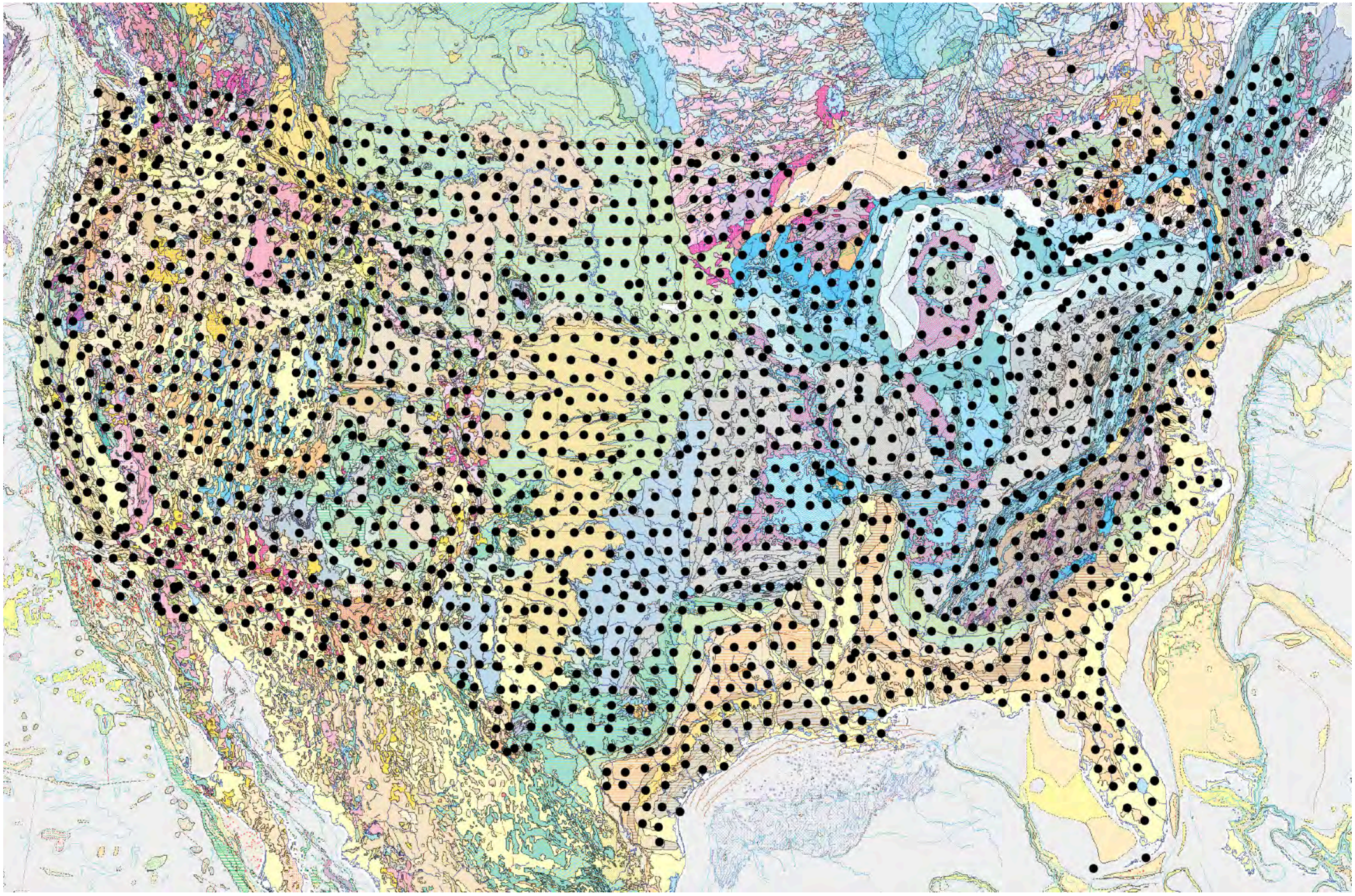
USArray 6.5 Sec Median Spatial Distribution



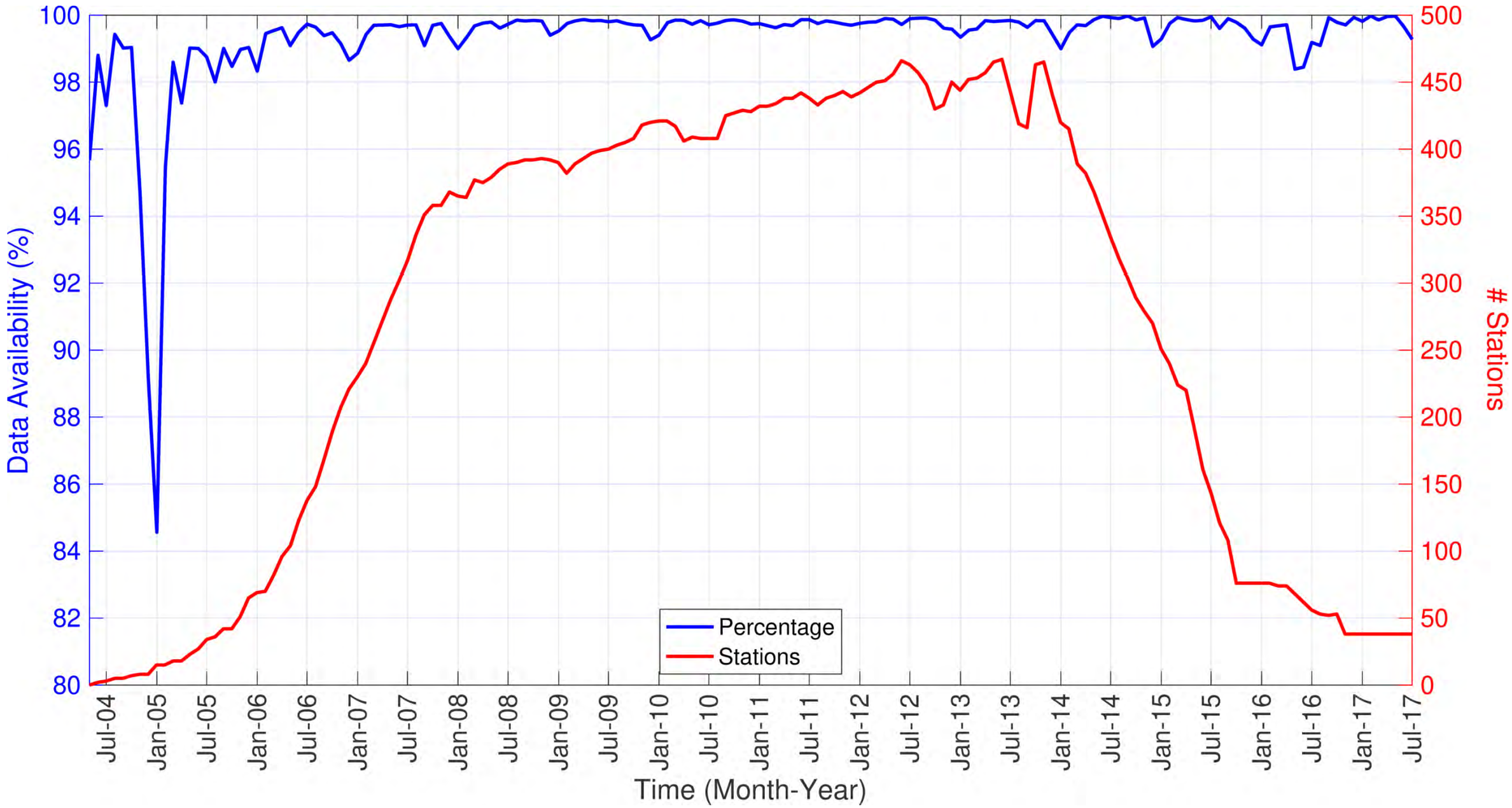
USArray 30 Sec Median Spatial Distribution



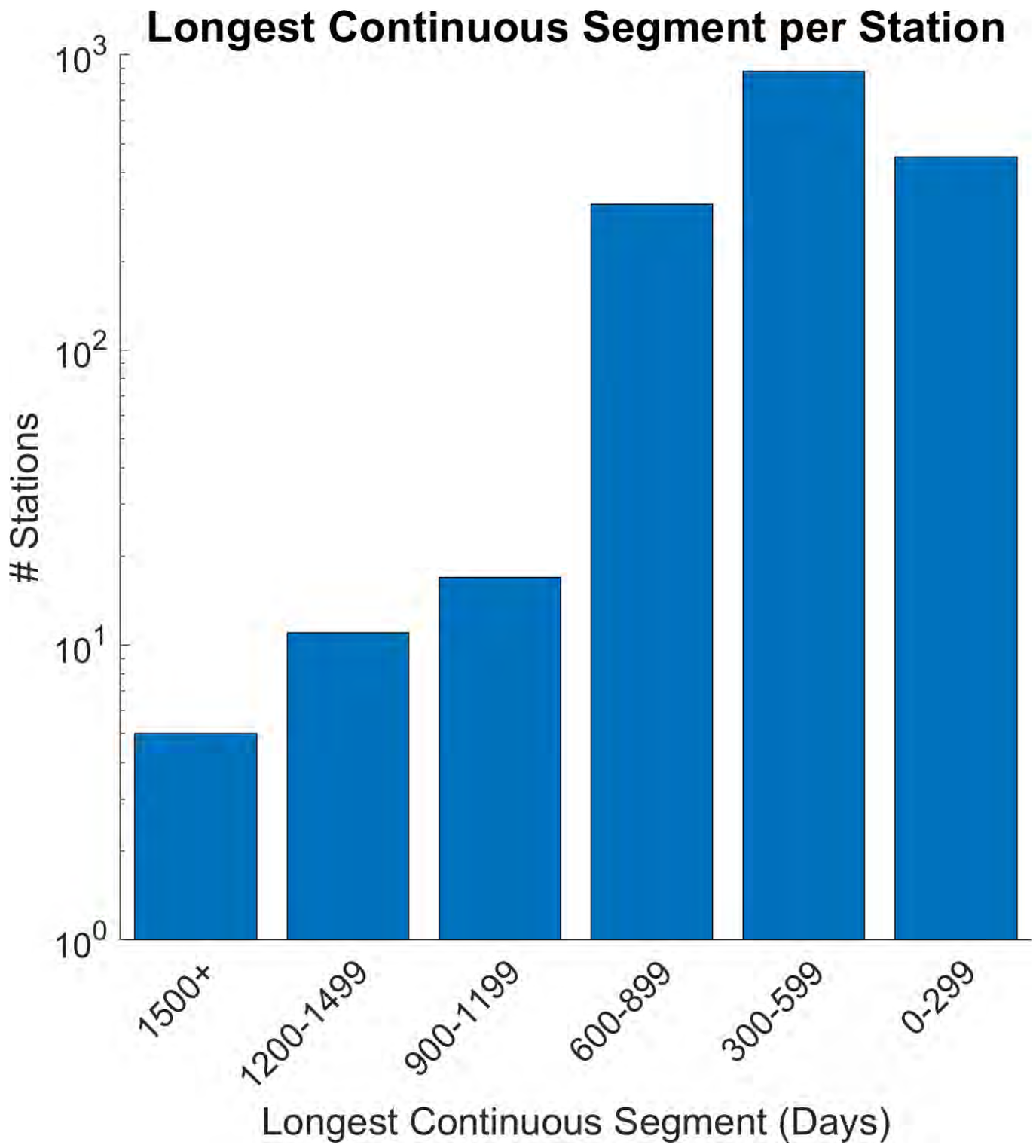
USArray Geology



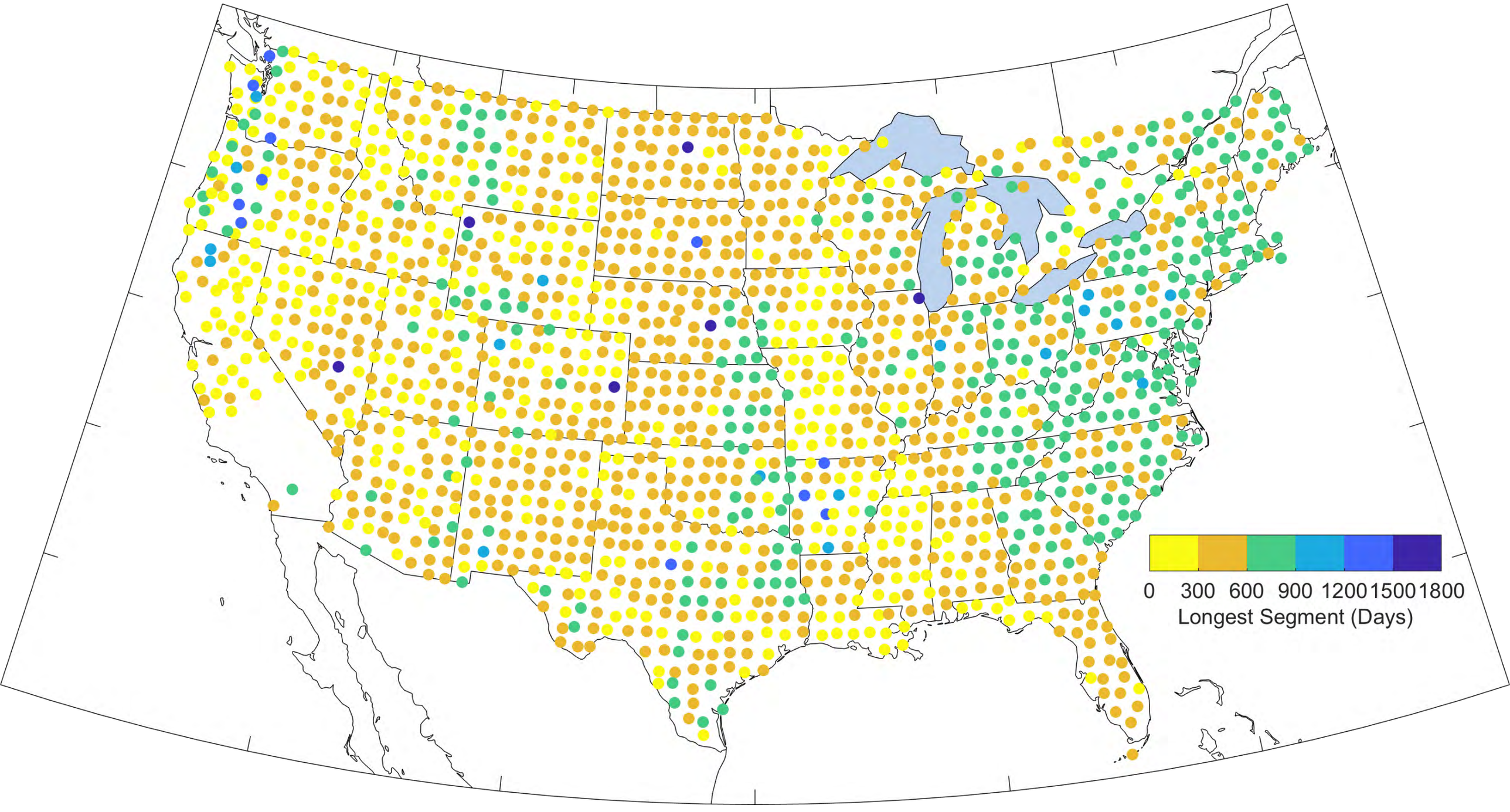
USArray Data Return



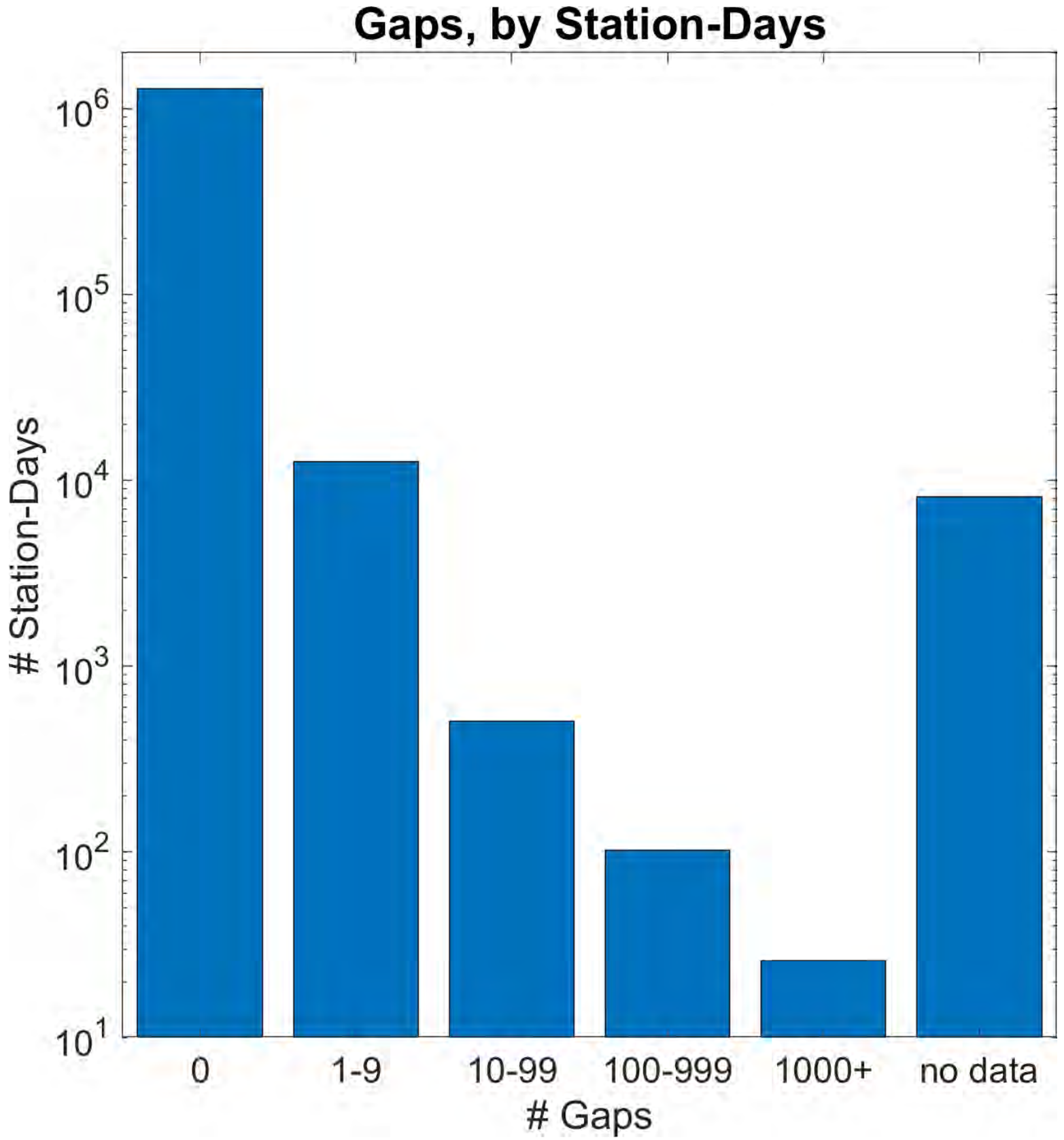
USArray Contiguous Time Series



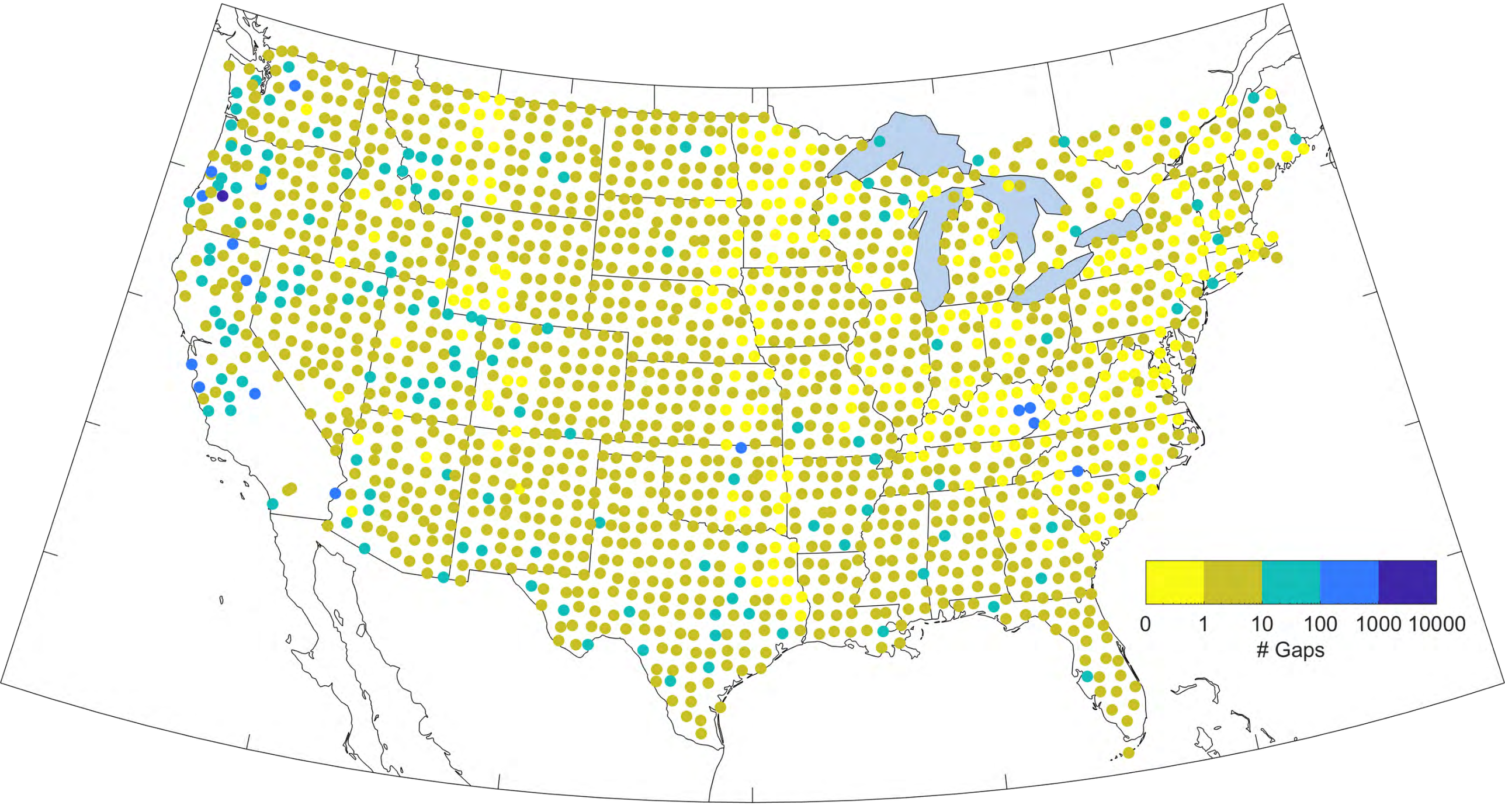
USArray Contiguous Time Series



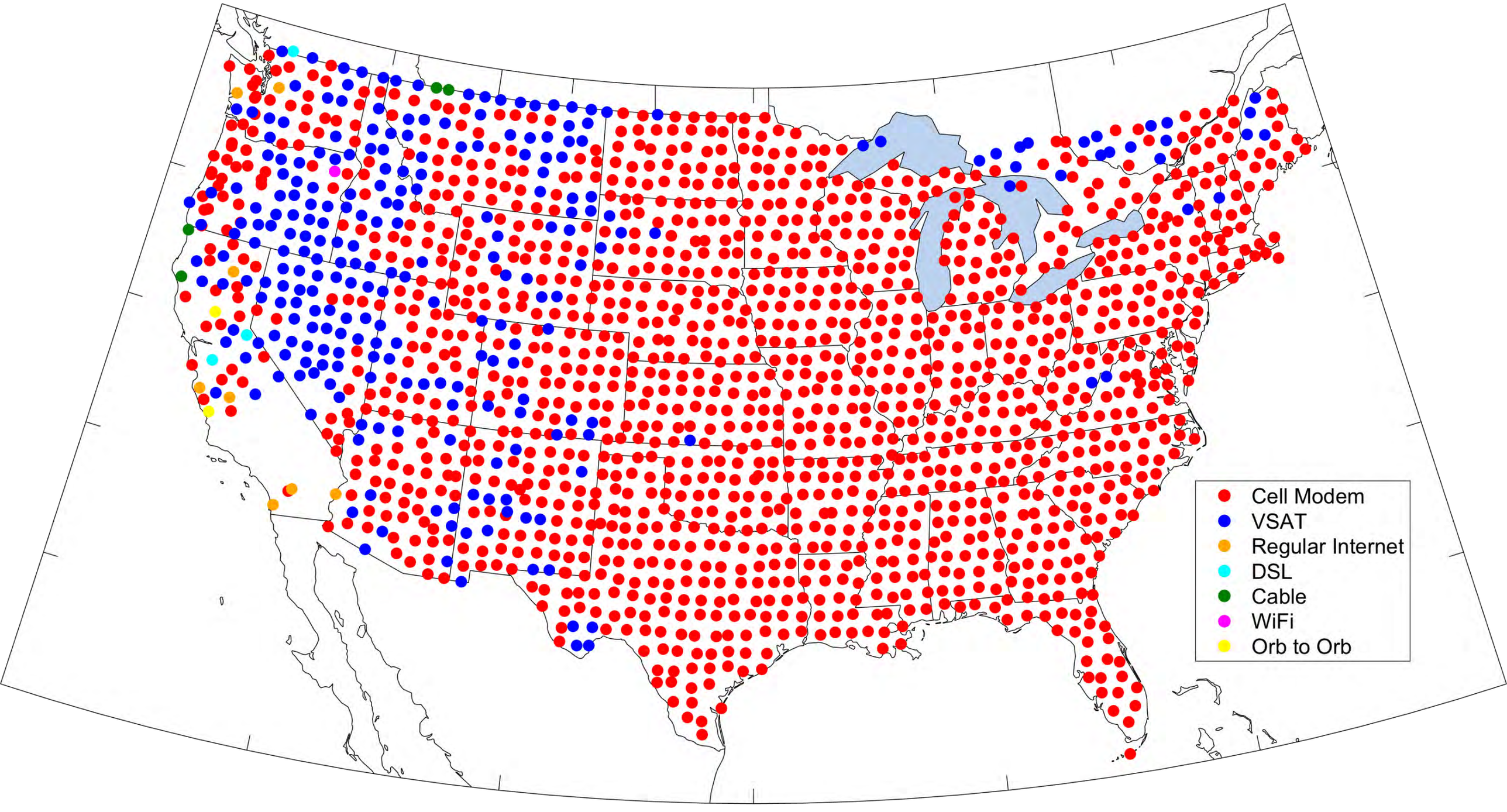
USArray Gap Count



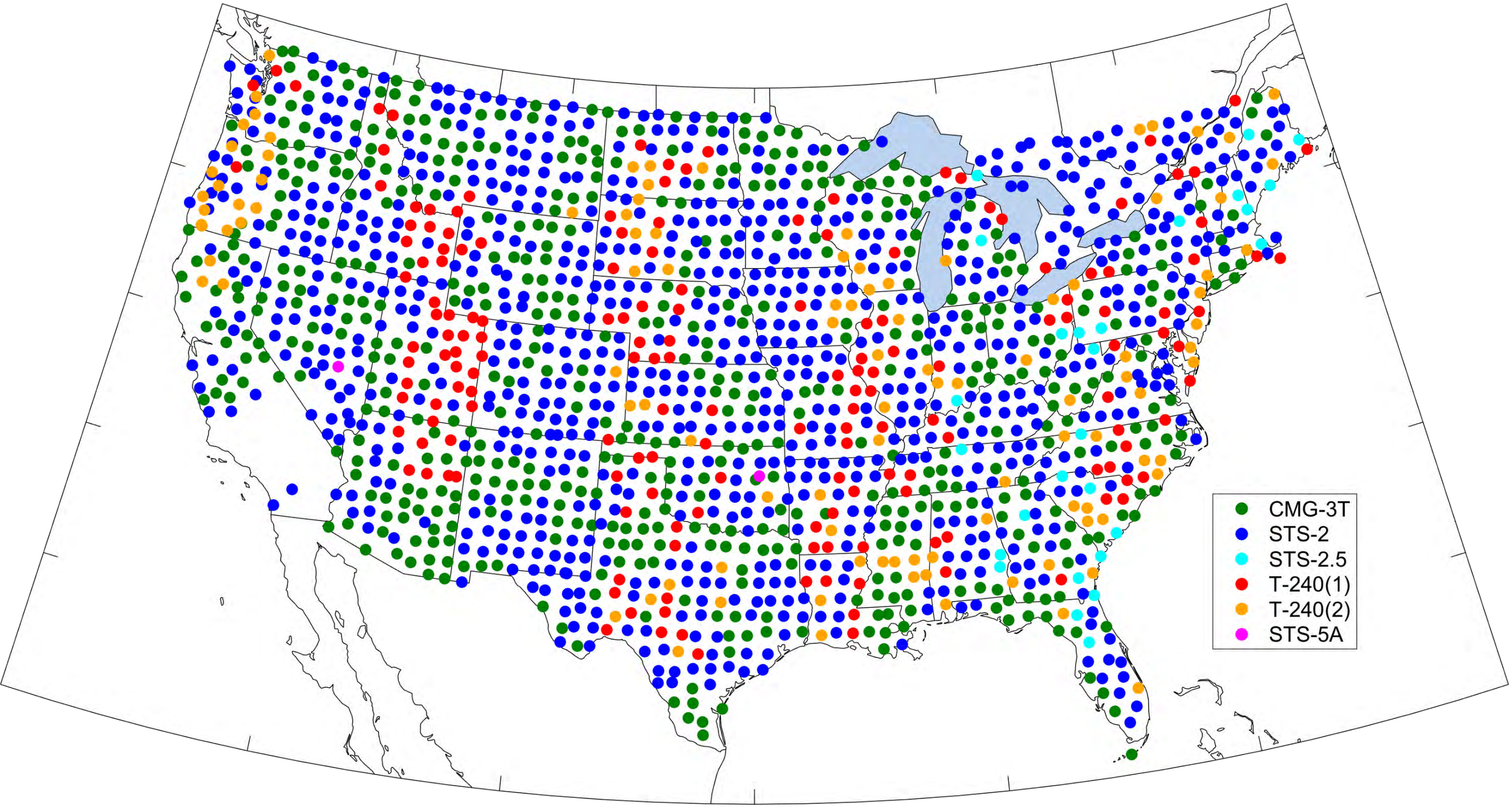
USArray Gaps



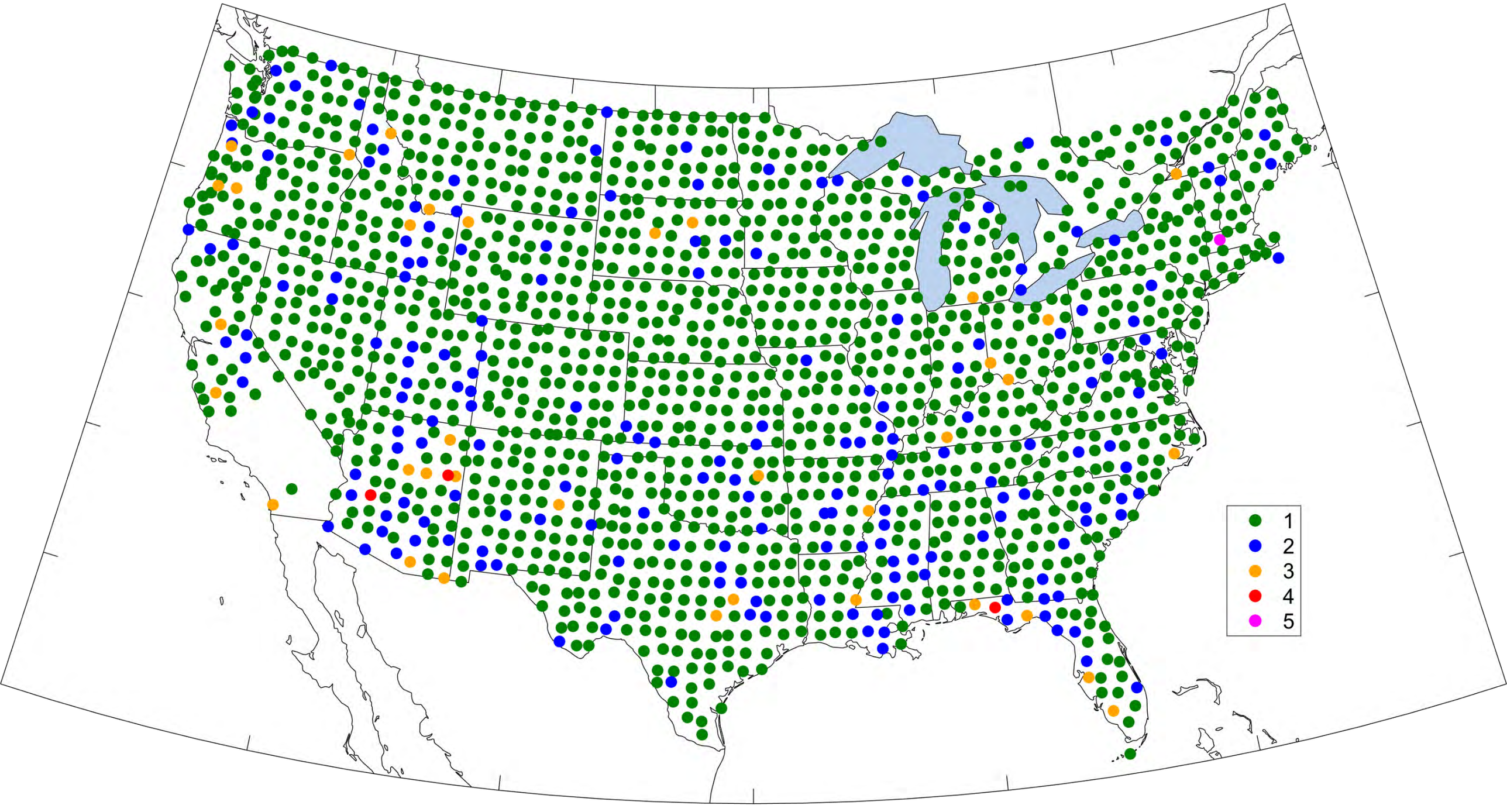
USArray Communications



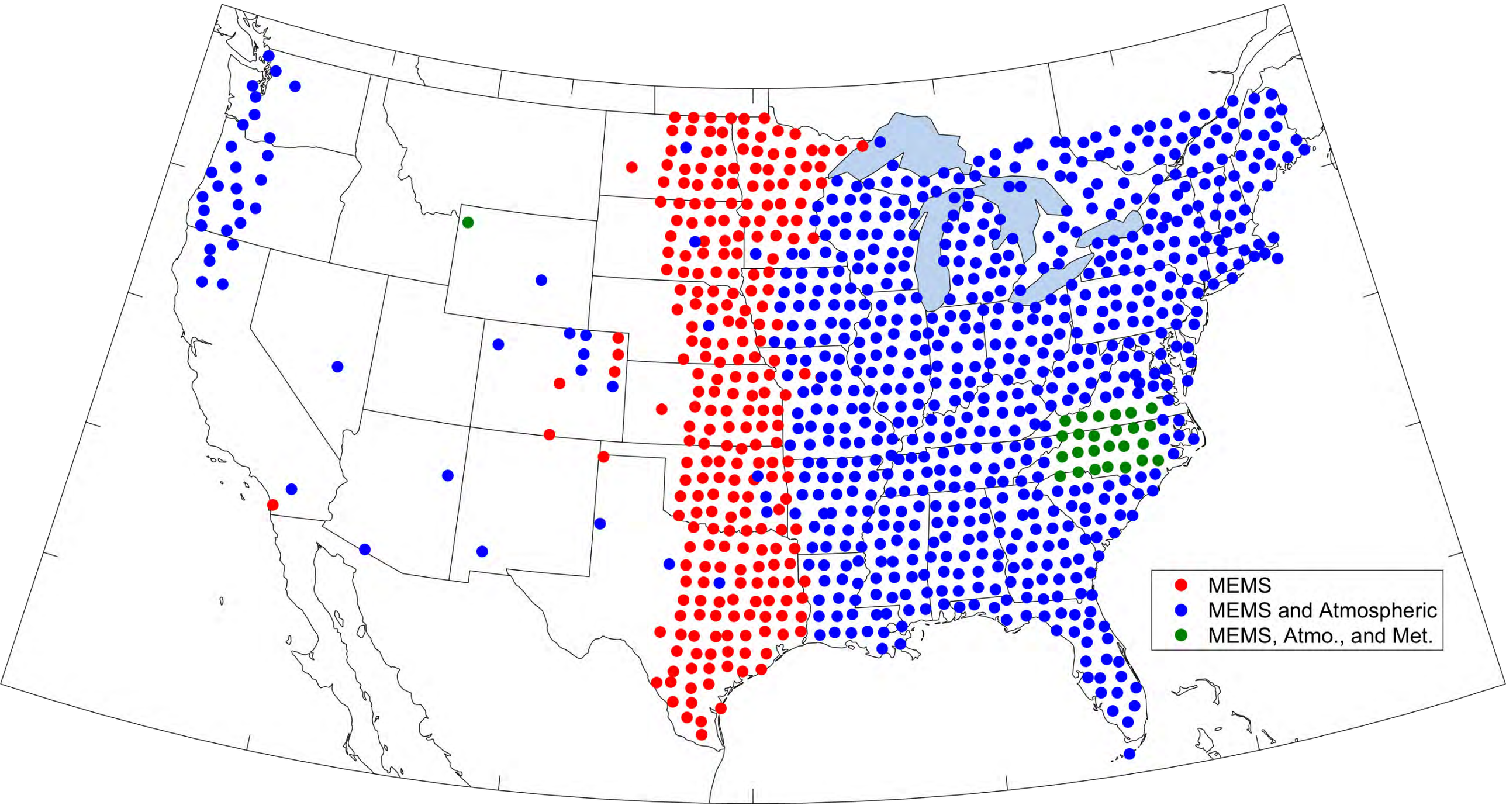
USArray Seismometers



USArray Seismometers Per Station



USArray Pressure Sensors

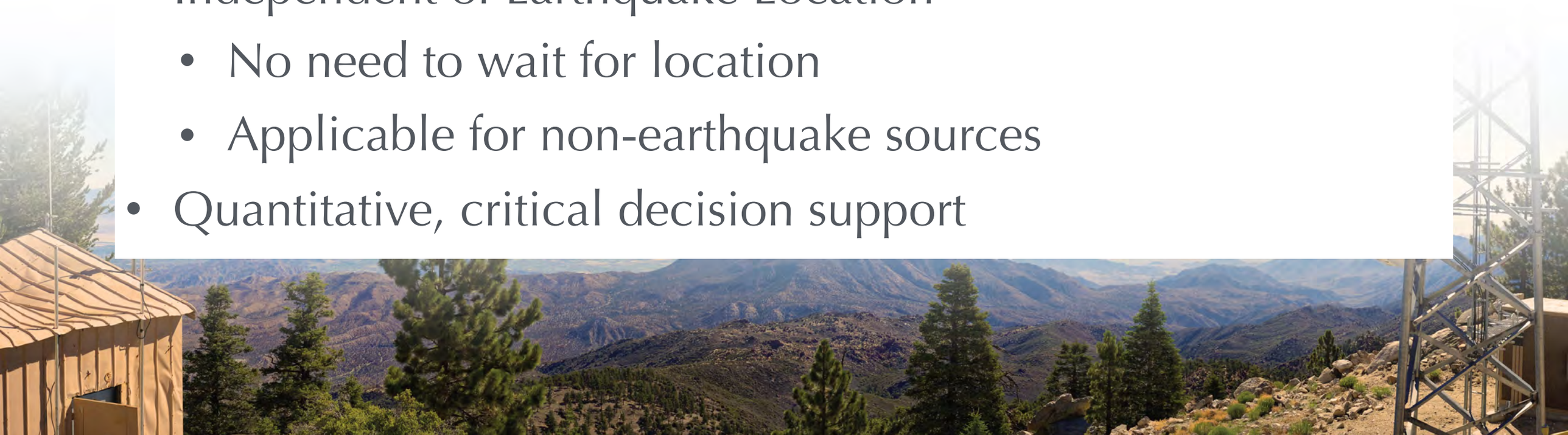


Bighorn Opportunities

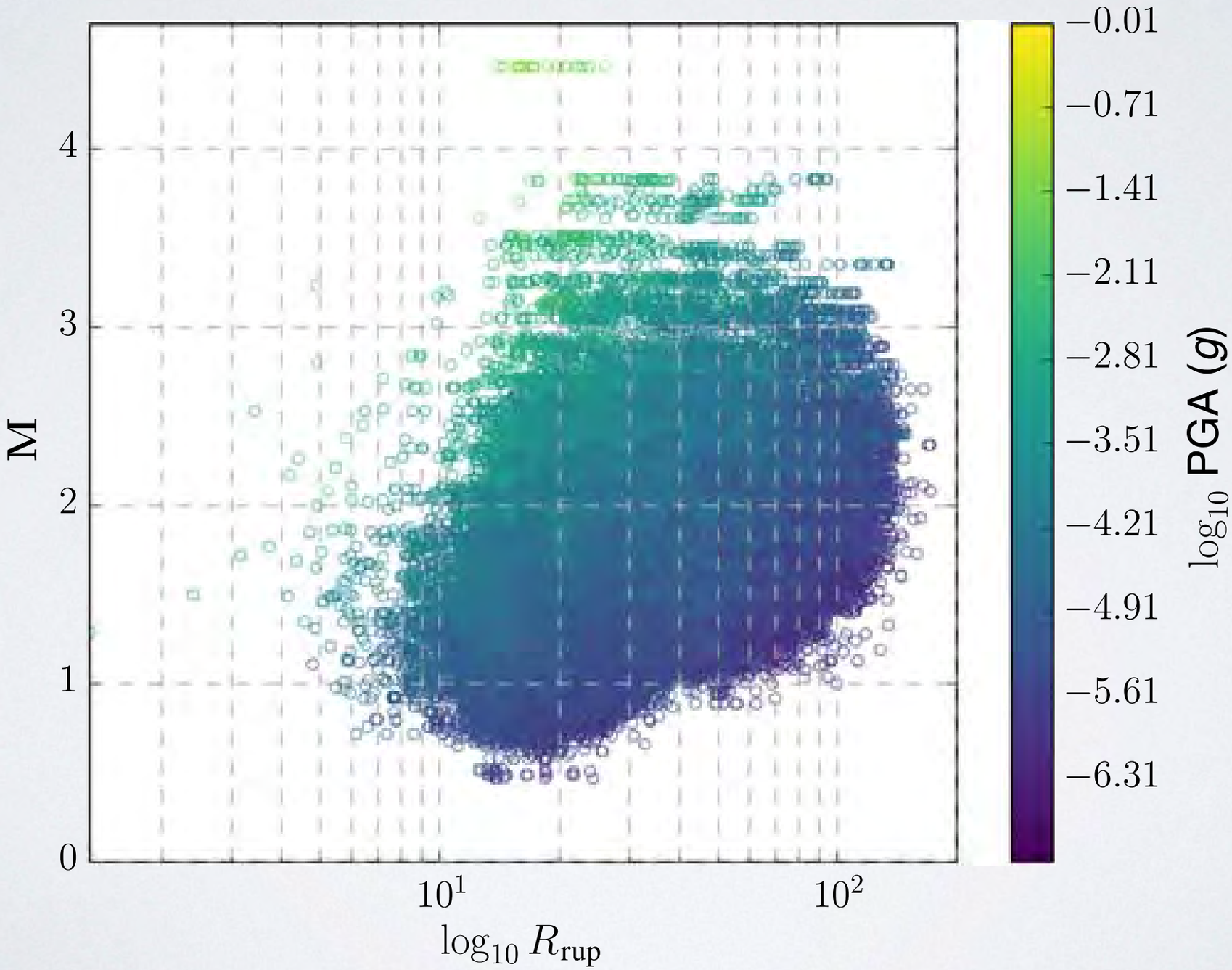
Bighorn

Main Features

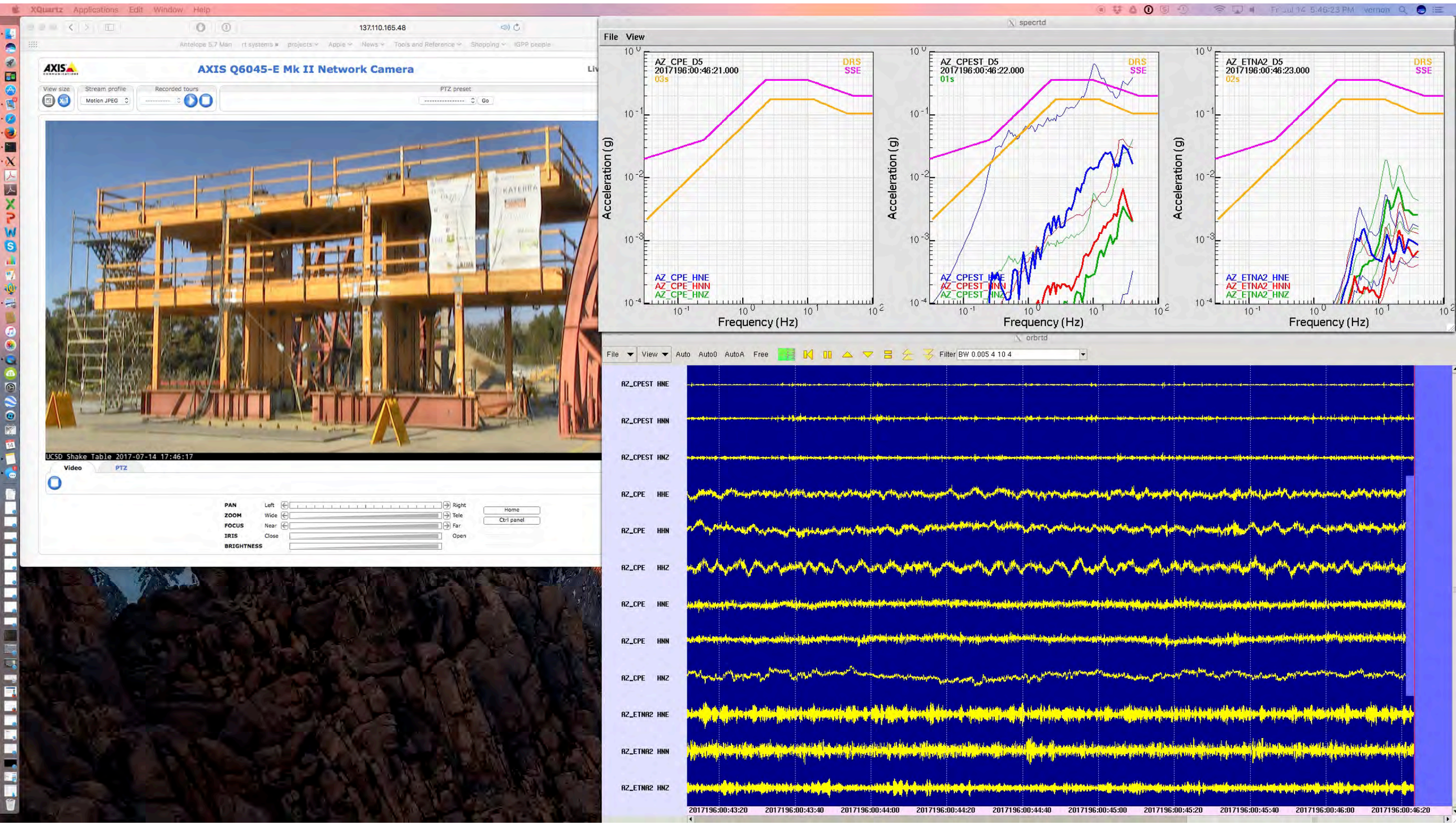
- Now-casting of wavefield spectral content
- Real-time, continuous response spectra exceedence
- Immediate results tailored for response criteria
- Automatic alarms against engineered criteria (Structural Health Monitoring)
- Independent of Earthquake Location
  - No need to wait for location
  - Applicable for non-earthquake sources
- Quantitative, critical decision support



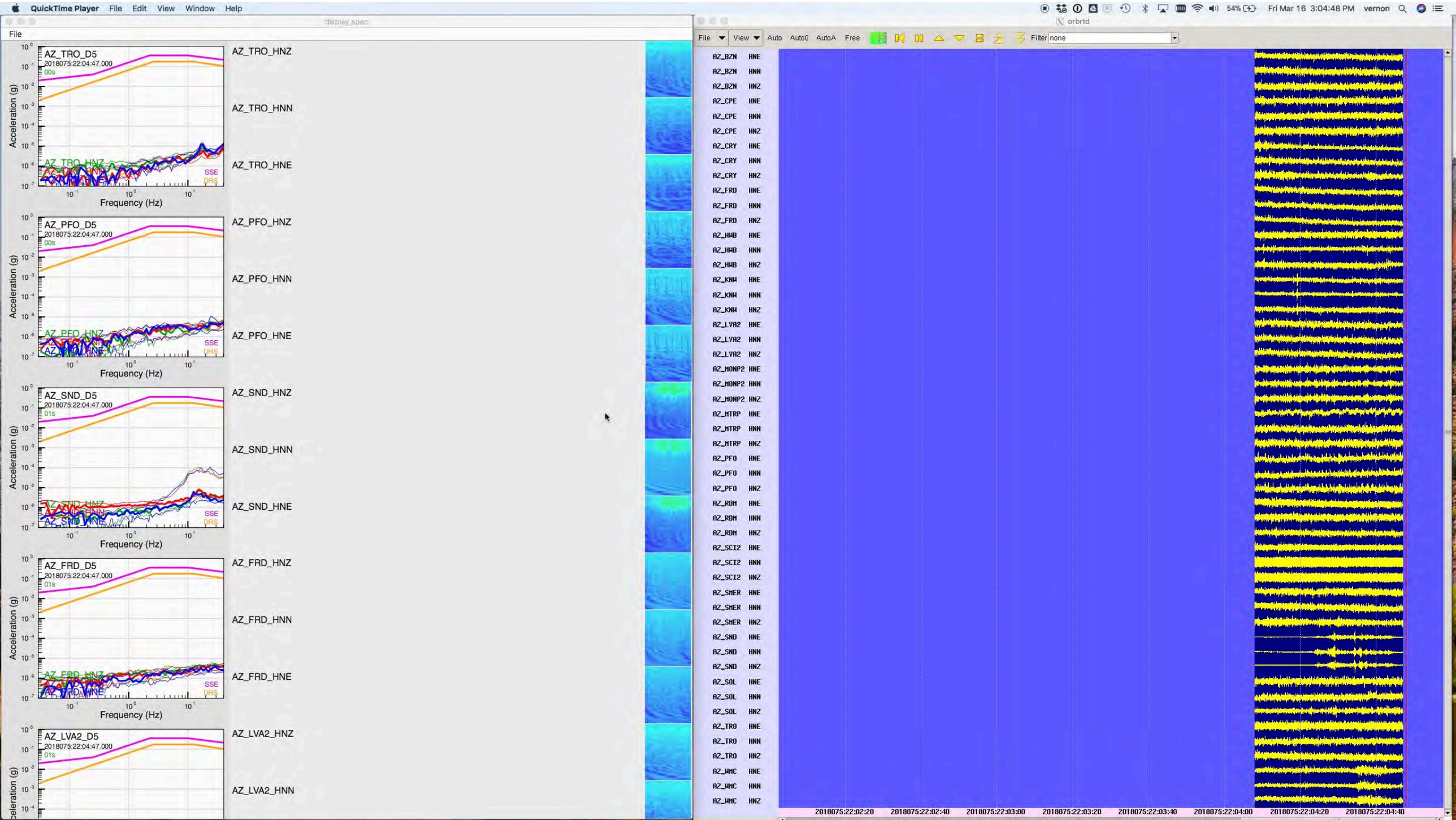
Southern California PGA



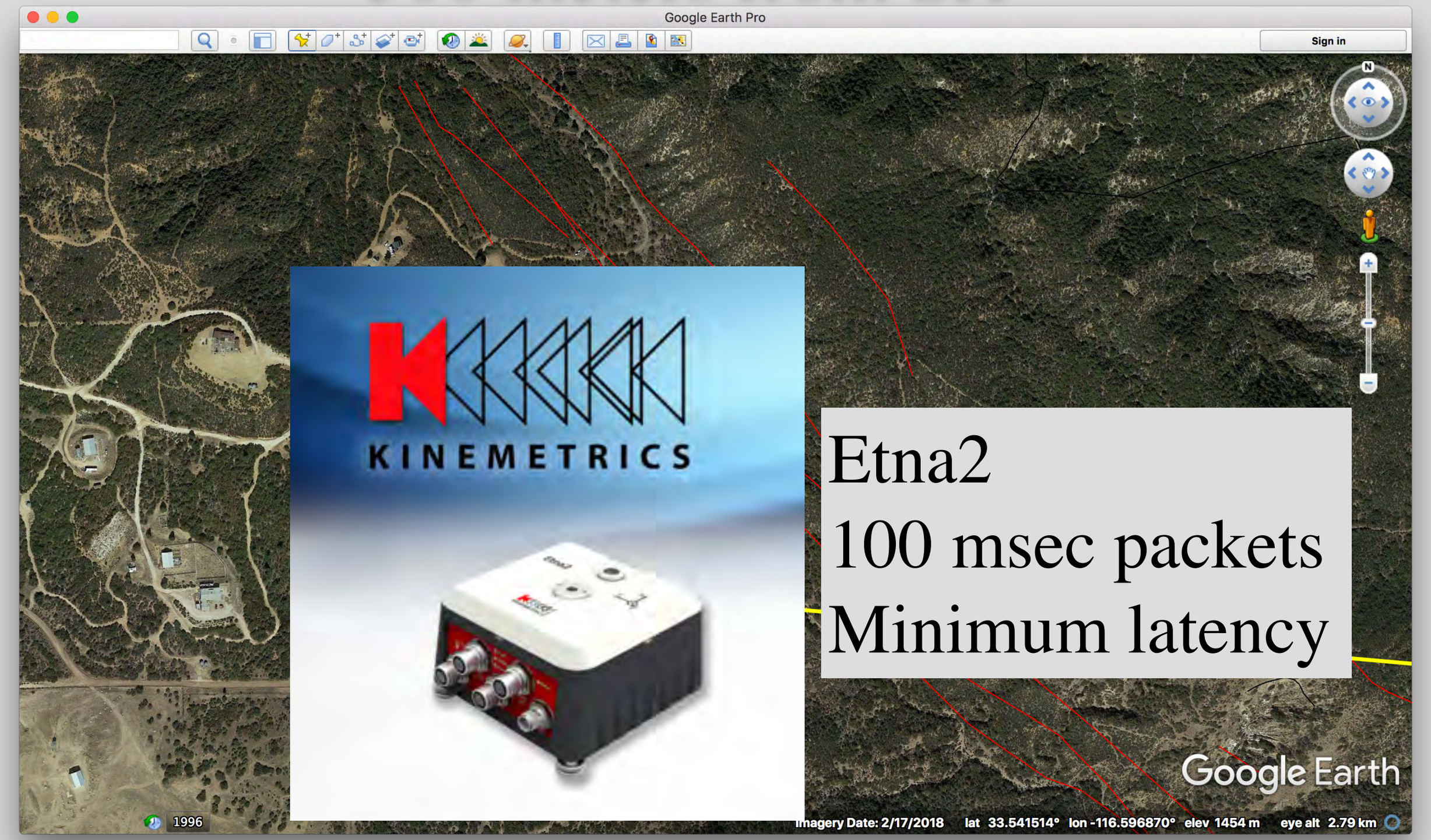
Northridge - Max Credible Eq * 1.2



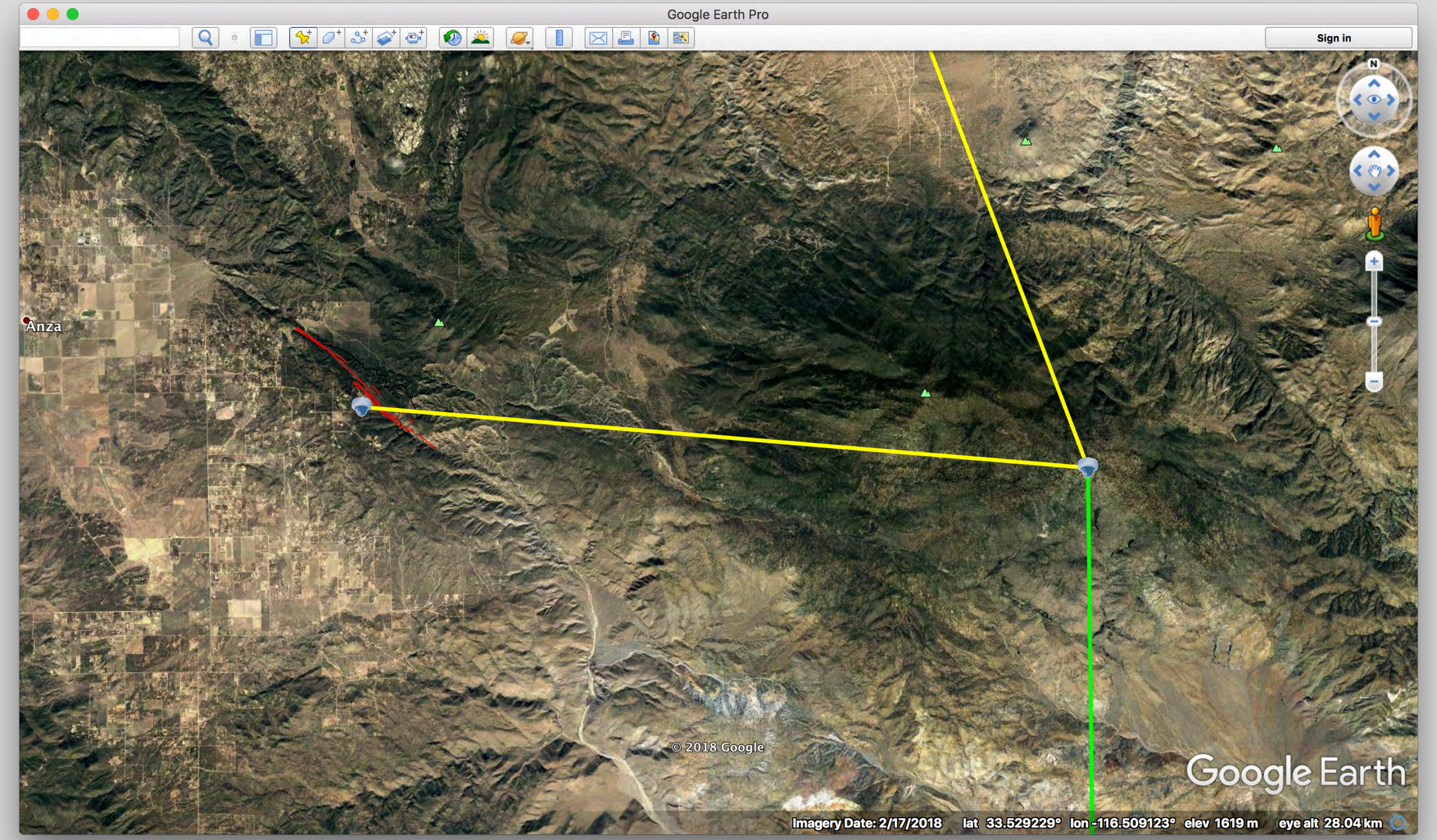
Examples from two M~5 events



Sagebrush Flats – Etna 2
300 meters from SJF

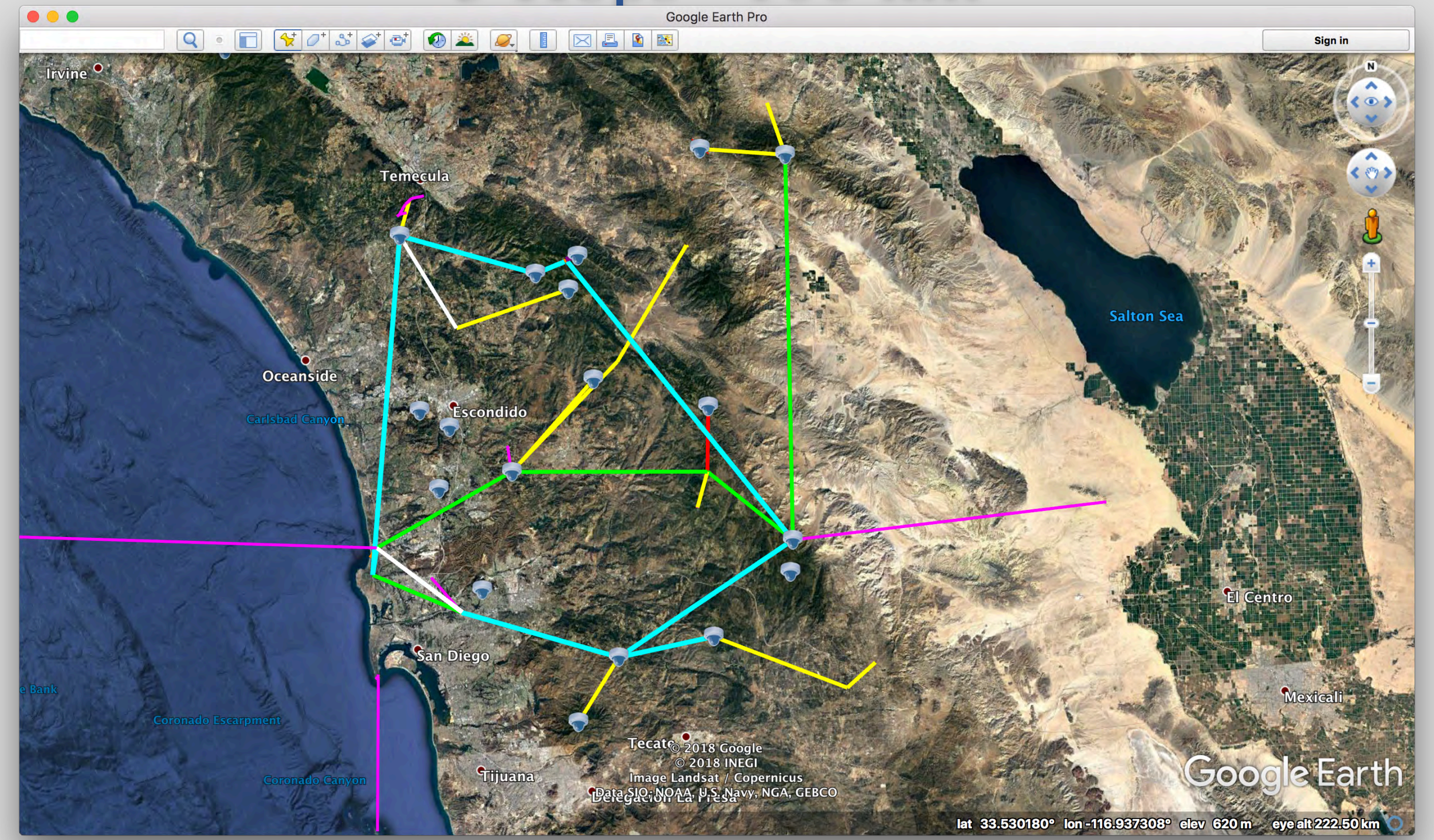


Sagebrush Flats to Toro Peak
15.5 km link



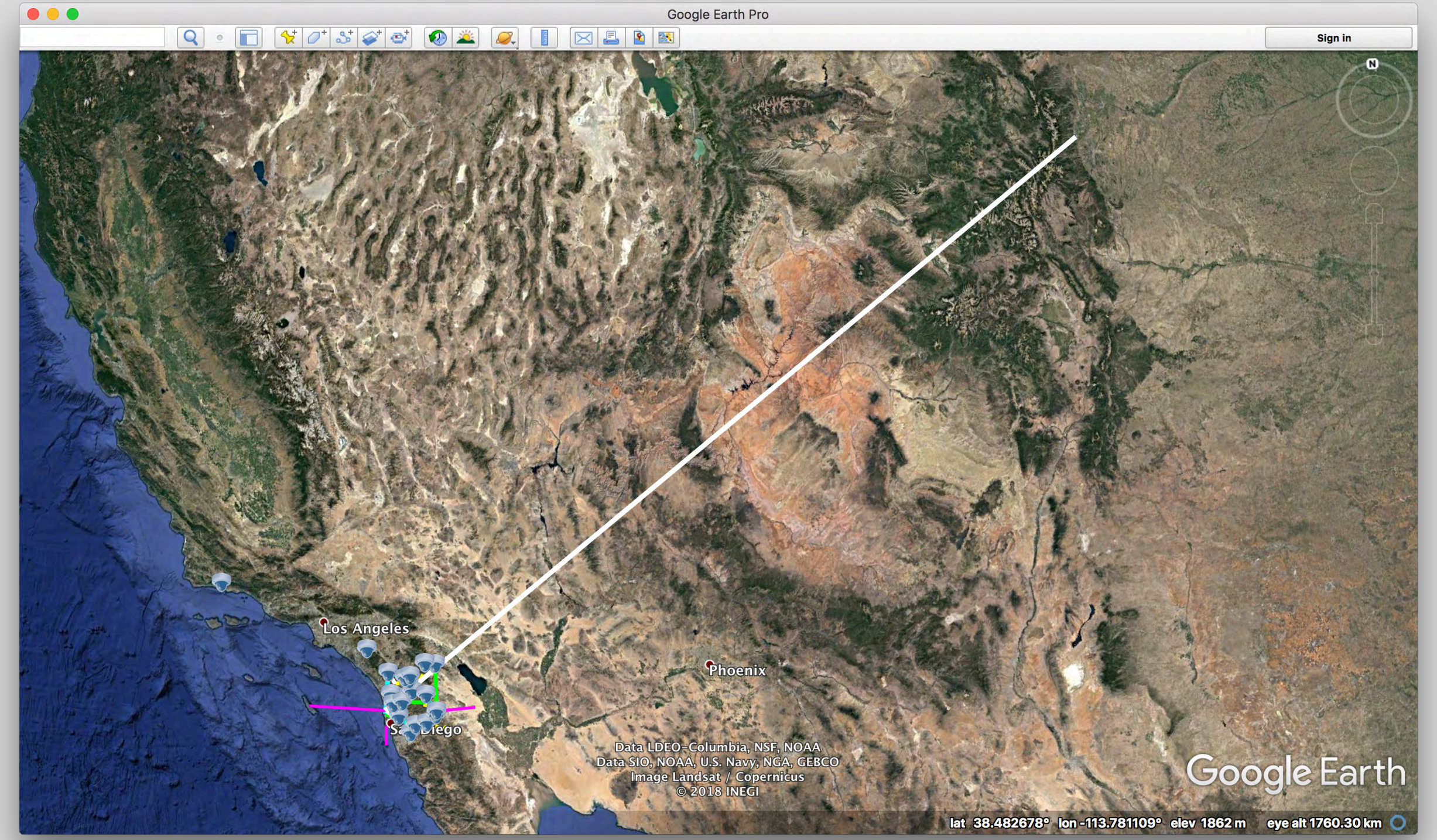
Sagebrush Flats – UCSD

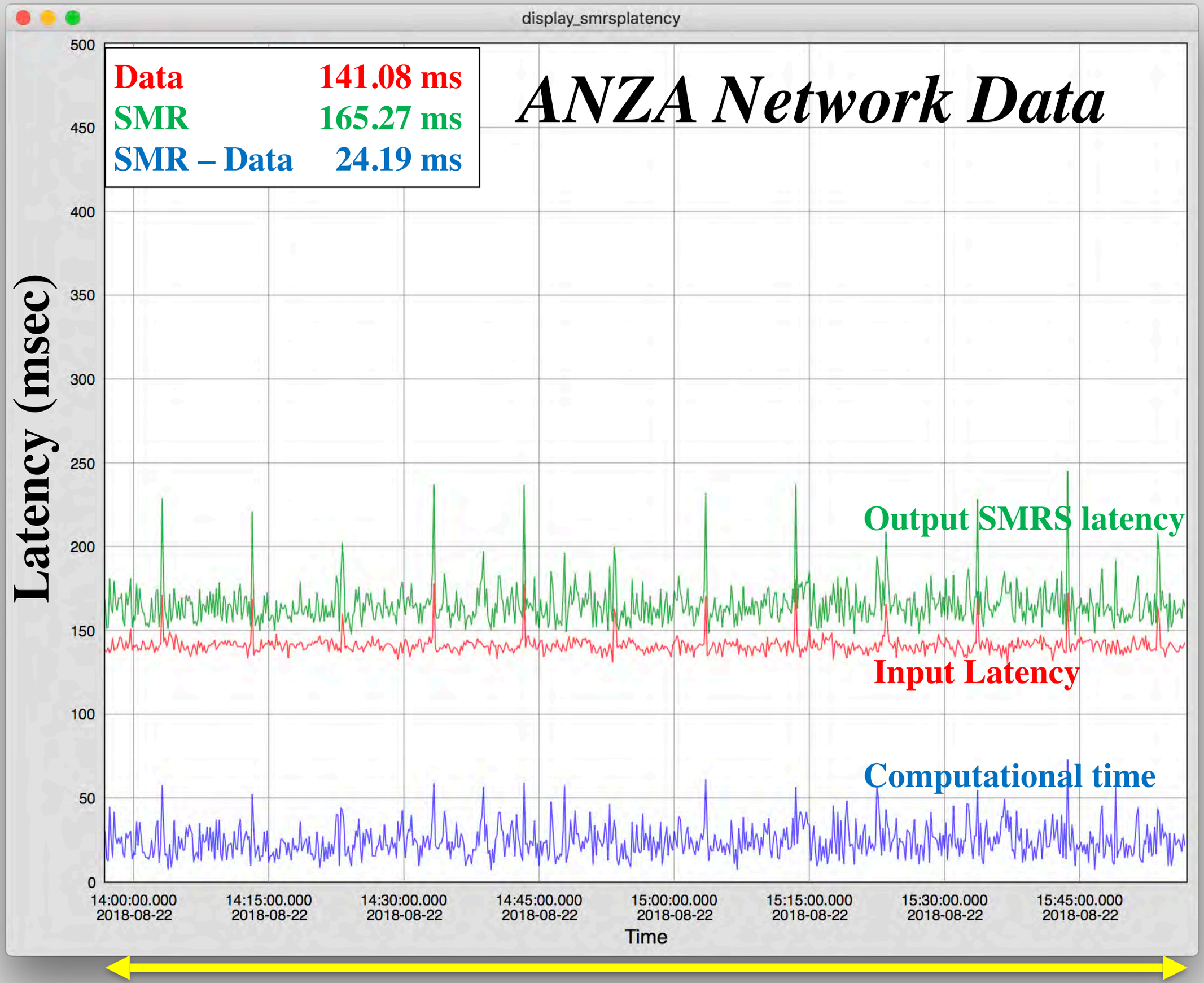
5 Hops 100 km



Sagebrush Flats – Boulder

Public Domain Internet 1300 km

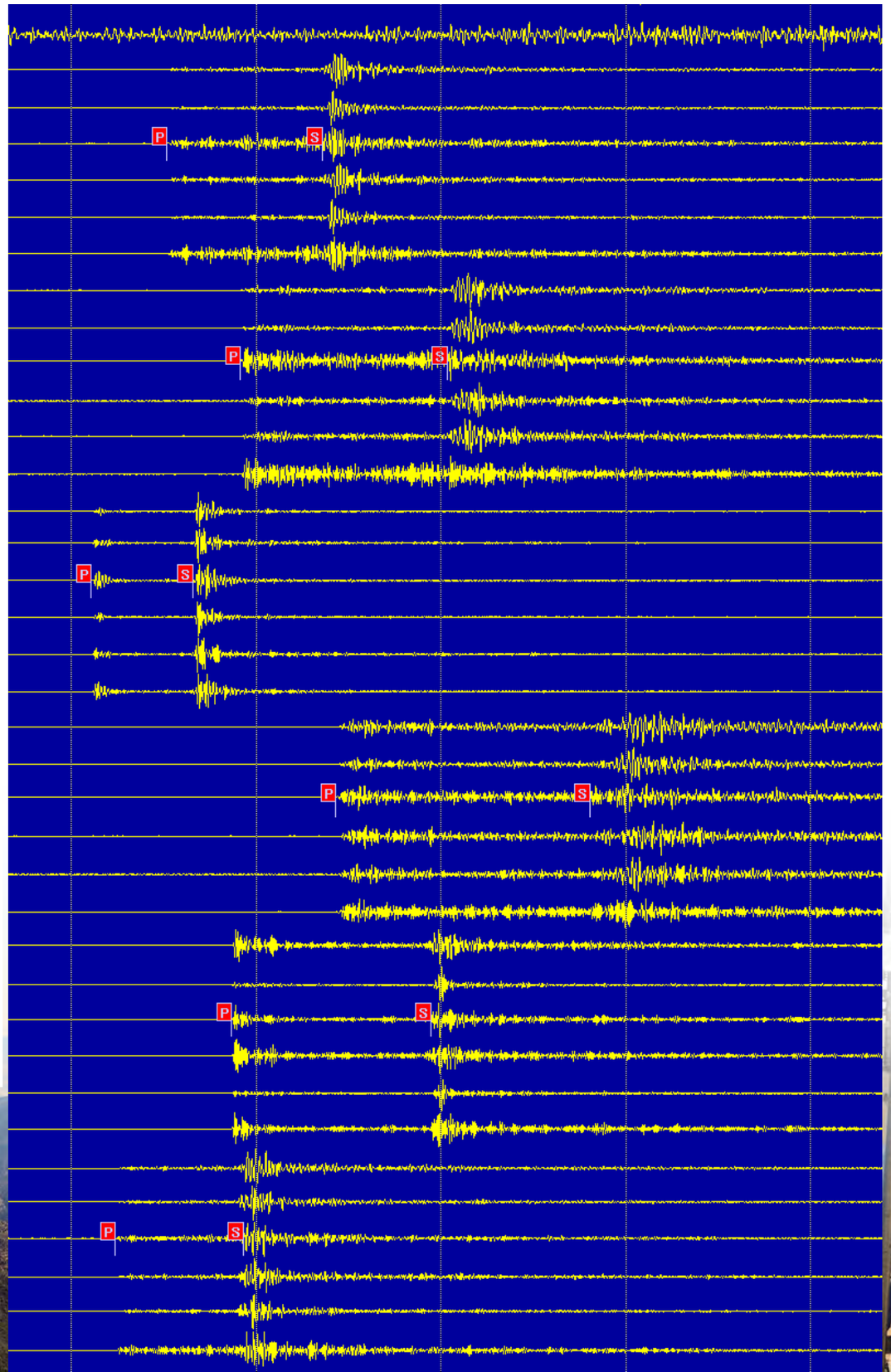



display_smrsplatency
ANZA Network Data
Data 141.08 ms
SMR 165.27 ms
SMR – Data 24.19 ms
Output SMRS latency
Input Latency
Computational time
Latency (msec)
500
450
400
350
300
250
200
150
100
50
0
14:00:00.000 2018-08-22
14:15:00.000 2018-08-22
14:30:00.000 2018-08-22
14:45:00.000 2018-08-22
15:00:00.000 2018-08-22
15:15:00.000 2018-08-22
15:30:00.000 2018-08-22
15:45:00.000 2018-08-22
Time

2 hours

Machine Learning

- 3 trained convolutional neural networks
  - Phase detection, precise phase timing, and first motion
- Analysts quality phase picks
- ~30 sec per daily station record
- Record phase timing, first motion, phase displacement amplitude, and SNR
- Currently feeds into Antelope workflow; adaptable to generic output
- Performance can improve with new learning model design



Future Directions?

- Ground Motion Prediction
  - Data
  - Equations
- Realtime Structural Response
  - Spectra
  - PGA, PGV, other parameters
- Earthquake Early Warning
- Machine Learning