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Pressure Variations from Earthscope's USArray Network near the Appalachians

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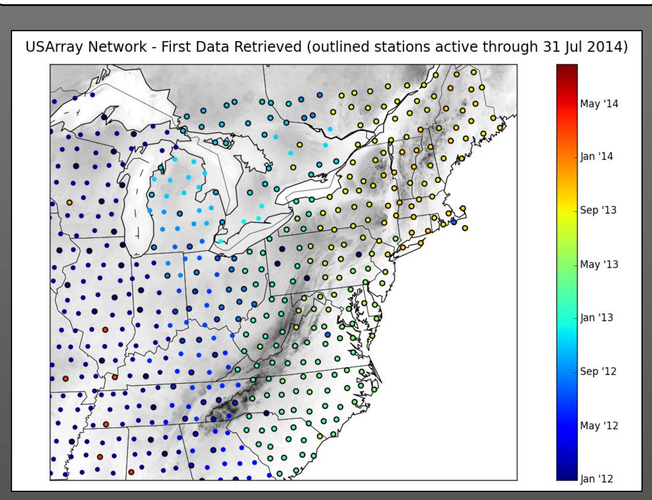
Project Objectives

- Catalog and analyze signatures/behavior produced by pressure variations at reporting sites, including near the Appalachians
- Provide access and products to visualize observations:
  - Project Website: http://meso1.chpc.utah.edu/usarray
  - MesoWest: http://mesowest.utah.edu
  - MesoWest data distributed to NWS Western Region, MADIS, and other NOAA entities

What is the USArray?

- EarthScope-sponsored network of 400+ seismic stations
- Stations equipped with pressure sensors starting in 2010, providing data at a reporting frequency of 1 Hz
- Platform spacing based on a ~70 km quasi-grid
- Stations report for 1-2 yr, then redeployed east of main array
- Stations starting to be deployed in Alaska for a few years
- Additional stations also being left in place across portions of the CONUS for additional data collection



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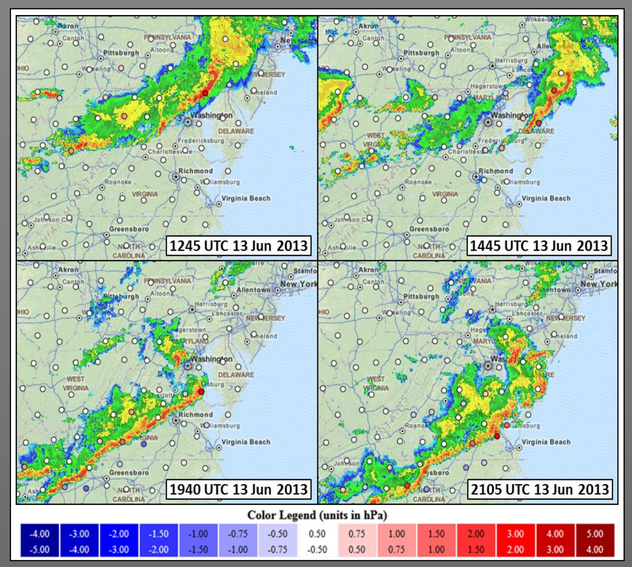
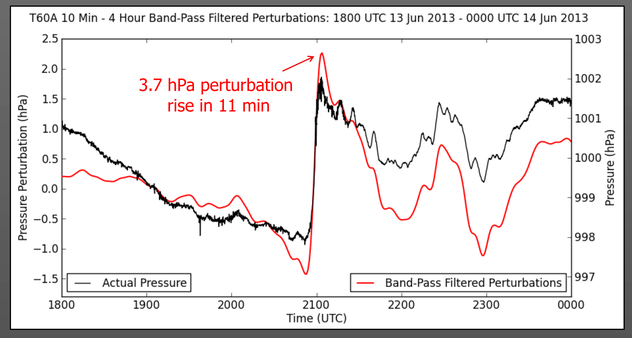
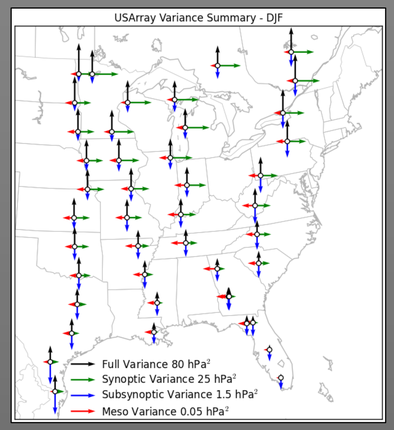
- Two separate convective systems impacted Mid-Atlantic region from New Jersey through the Carolinas
- Secondary line developed near Appalachians before propagating east and producing excessive wind damage

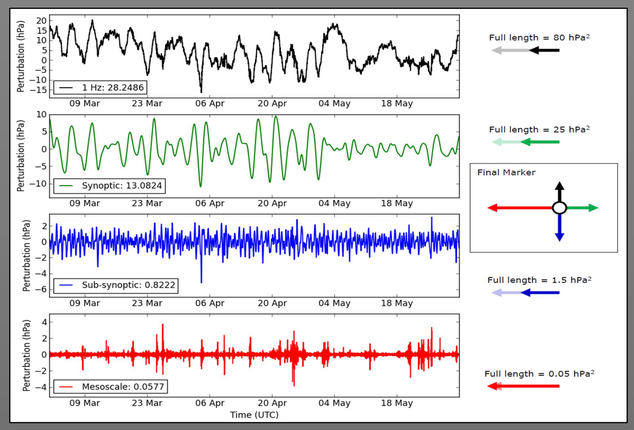


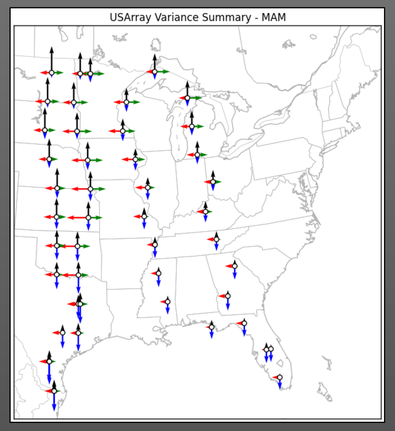


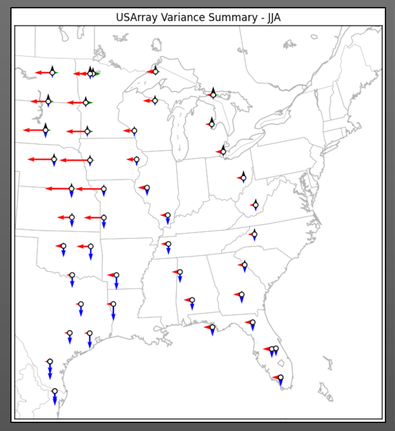
Temporal Filtering and Clustering

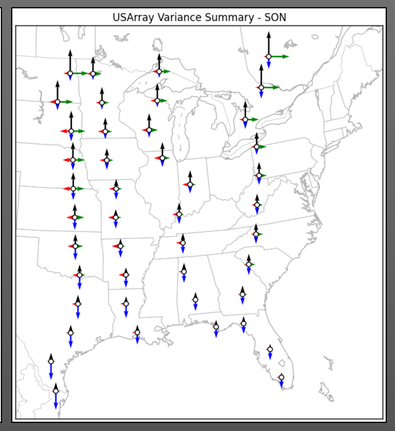
1) Perturbation time series generated by applying digital band-pass filters corresponding to **meso** (10 min – 4 h), **sub-synoptic** (4 – 30 h), and **synoptic** (30 h – 5 days) scales
2) Pressure signatures determined through consecutive maxima/minima pairings within filter time window
3) Variances calculated for seasonal perturbation time series and arranged into markers (as seen below)
4) Stations clustered into latitude-based bins for each season using longitudinal proximity to other active stations









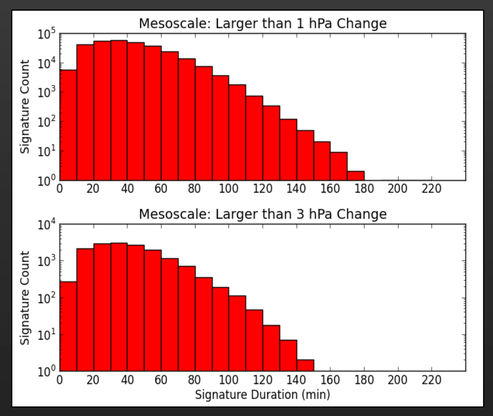


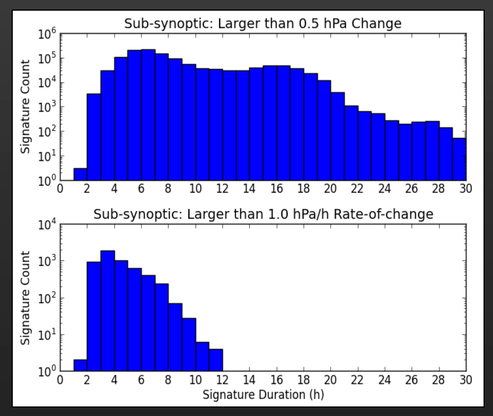
Quality Control and Signatures

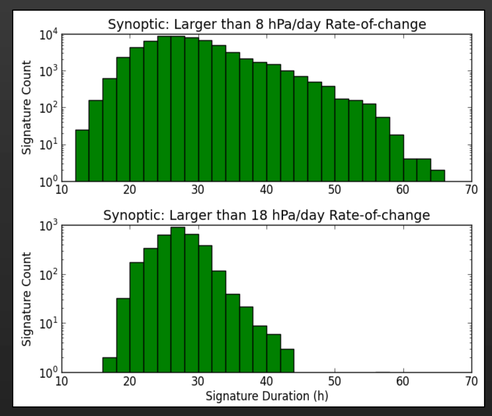
- Objective and subjective QC procedures identified missing and spurious data periods (e.g., discrete pressure fluctuations)

Statistics for 1 Jan 2010 – 28 Feb 2014	
Total Stations	**997**
Total 1 Hz Observations	**48,358,325,315**
Median Station Active Period	**615.5 days**
Percentage of Obs Retained	**97.61%**

Pressure Signatures for 1 Jan 2010 – 28 Feb 2014	
Mesoscale ≥ 1 hPa change	**301,294**
Mesoscale ≥ 3 hPa change	**15,703**
Sub-synoptic ≥ 0.5 hPa change	**1,187,795**
Sub-synoptic ≥ 1 hPa h^{-1} rate-of-change	**5,262**
Synoptic ≥ 8 hPa day^{-1} rate-of-change	**62,482**
Synoptic ≥ 18 hPa day^{-1} rate-of-change	**3,269**







Summary and Future Work

- Variations in signature frequency and variance for all band-pass filters indicative of seasonal shifts in meteorological phenomena (e.g., synoptic storm tracks, convective seasons, etc.)
- Temporal variations indicative of some interannual variation (e.g., more active 2010-2011 convective seasons as opposed to 2012-2013)
- All 1.5 million+ analyzed signatures can be examined individually through the project website

- Continue archival and dissemination of USArray pressure observations to MesoWest/MADIS
- Analyze pressure signatures and seasonal variation for the remainder of 2014 and beyond
- Assess perturbation pressure observations against gridded perturbation analyses for high-impact events (wind ramps, convection, gravity waves, etc.)
- Examine perturbation pressure gradients in the context of wind ramp events

Acknowledgements and References

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Additional results/information on this project can be accessed through a manuscript to be submitted for publication at http://meso1.chpc.utah.edu/usarray/references.html.