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# 2011 Mesoscale Convective Systems Identified from Surface Pressure Array

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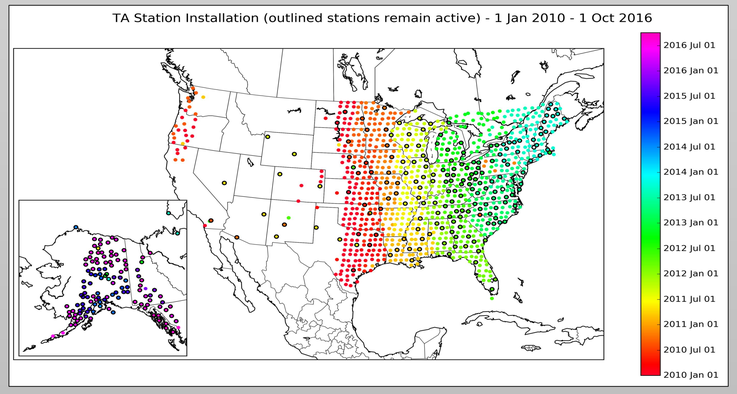
## Project Overview and Objectives

- Time series analyses of 1 Hz surface pressure from USArray Transportable Array (TA) indicated prominent mesoscale activity over central US 1 Mar – 31 Aug 2011 (Jacques et al. 2015)
- Time series analyses only assessed at individual stations
  - Mesoscale pressure perturbations treated independently
  - Spatial extent/properties of perturbations not assessed
- Objective: assess and detect prominent mesoscale pressure features spatially using 5-min perturbation analysis grids
  - Assess feature occurrence frequencies and characteristics
  - Assess general patterns (e.g. feature speeds/directions)

## USArray Surface Pressure Network



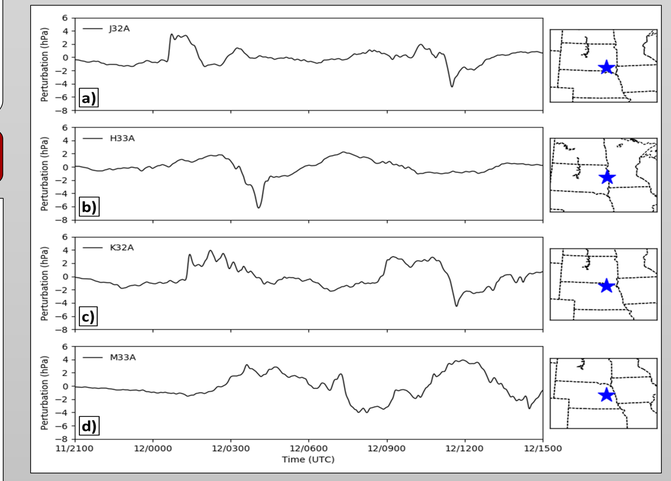

- EarthScope-sponsored network of 400+ seismic stations
- Platform spacing based on a ~70 km quasi-grid
- Equipment deployed for 1-2 yr, then redeployed east of array
- Pressure sensors added in 2010 (1 and 40 Hz sampling)
- Majority of platforms now in Alaska for final phase of project
- 1 Mar – 31 Aug 2011: array placed across central US (red markers)

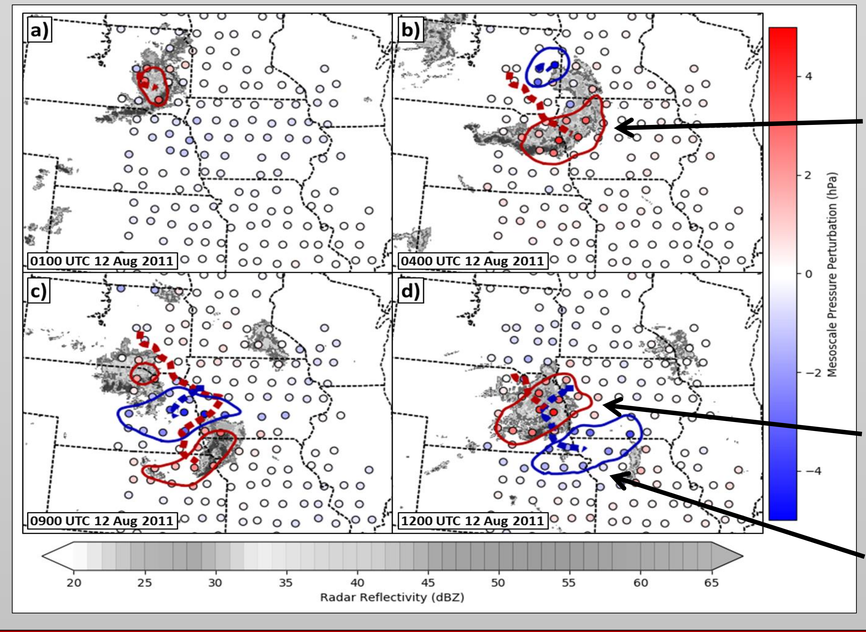
## Feature Analysis Methodology

1) Surface pressure data collected and quality controlled:
   a) TA observations (1 Hz temporal, ~70 km spatial resolution)
   b) RTMA surface pressure grids (1 h temporal, 5 km spatial)
2) Grids (obs) interpolated (subsampled) to 5 min temporal resolution
3) Final analysis grids = blend of interpolated RTMA + TA obs
   a) Blended using 2D variational approach (UU2DVAR)
   b) TA observations capture sub-hourly perturbations RTMA lacks
   c) RTMA spatial resolution better than TA alone
4) Analysis grids temporally band-passed (10 min – 12 h) to isolate mesoscale pressure perturbations
5) Prominent perturbation features identified and tracked
   a) Must last ≥1 h, ≥10000 km$^2$, ≥1 hPa magnitude
   b) Speed/direction assessed via modified MODE-TD method
6) Aggregated statistics for all features assessed 1 Mar – 31 Aug 2011

## Case Example: 11-12 Aug 2011 Great Plains Mesoscale Convective Systems (MCSs)

- Two distinct MCSs formed and moved through TA domain
- Each had distinct mesohigh and/or wake low regions which were detected and tracked for several hours
- *Storm Data* wind damage reports for both complexes



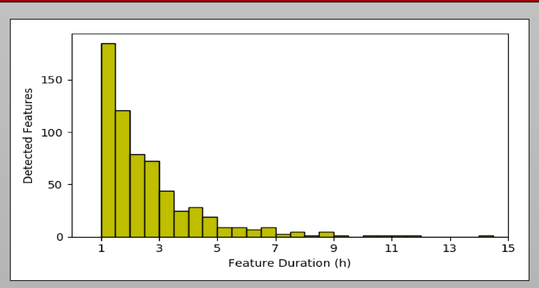



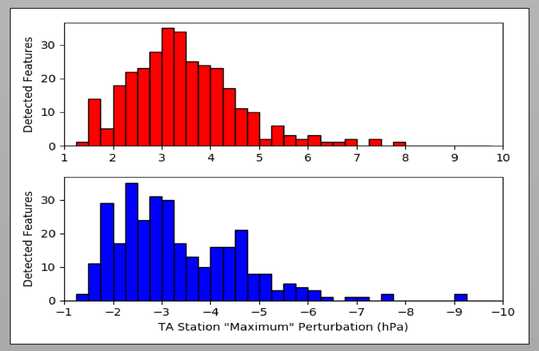

**Mesohigh #1**
**Lifetime: 10.1 h**
**Max Magnitude: 4.9 hPa**
**Median Speed: 22.4 m s$^{-1}$**

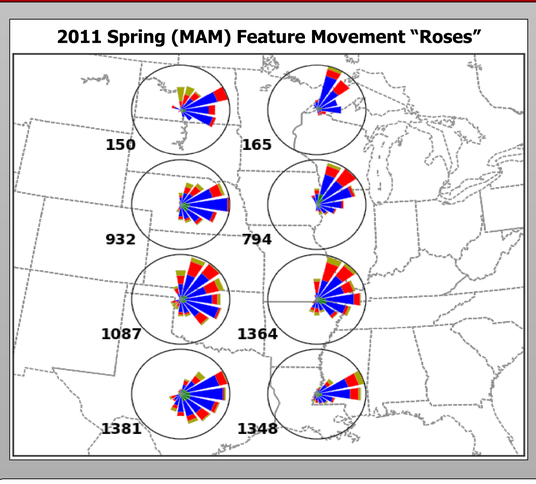
**Mesohigh #2**
**Lifetime: 7.6 h**
**Max Magnitude: 4.5 hPa**
**Median Speed: 20.8 m s$^{-1}$**

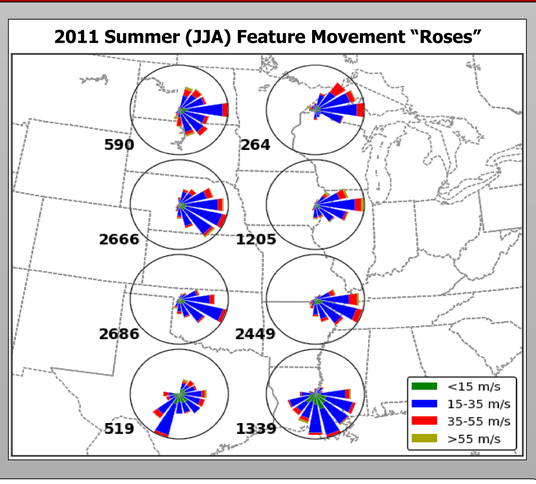
**Negative Feature #1**
**Lifetime: 9.0 h**
**Max Magnitude: 5.8 hPa**
**Median Speed: 22.1 m s$^{-1}$**

## Assessed Mesoscale Pressure Perturbation Characteristics




- 73% of detected perturbation features lasted for less than 3 h
- Majority of perturbations assessed had maximum perturbation magnitude of 2-4 hPa (positive and negative)
- 76% of detected features moved at a median speed of 15-35 m s$^{-1}$
- Feature movement "roses" provide additional context regarding feature speeds/directions
  - 2011 Spring: many features had northeast direction component with slightly faster speed
  - 2011 Summer: majority of features had east-southeast component with slower speed

## Acknowledgements and Resources

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## Summary and Future Work

- Assessed characteristics of prominent mesoscale pressure perturbation features from spring-summer 2011 consistent with past climatological and case-study literature assessing mesoscale perturbation feature properties
- Results provide support for possible automated gravity wave detection
  - Attempted before but halted due to real time data/computer resource issues
  - Observational resources: 5-min ASOS, additional mesonets, etc.
  - Numerical grid resources: HRRR analyses, 2.5 km RTMA, etc.

## References

Jacques A. A., J. D. Horel, E. T. Crosman, and F. L. Vernon, 2015: Central and eastern United States surface pressure variations derived from the USArray network. *Mon. Wea. Rev.*, **143**, 1472-1493, doi:10.1175/MWR-D-14-00274.1

Jacques A. A., J. D. Horel, E. T. Crosman, F. L. Vernon, and J. Tytell, 2016: The Earthscope US Transportable Array 1 Hz surface pressure dataset. *Geoscience Data J.*, **3**, 29-36, doi:10.1002/gdj3.37