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Utilizing Surface Pressure to Detect and Analyze Mesoscale Pressure Perturbations

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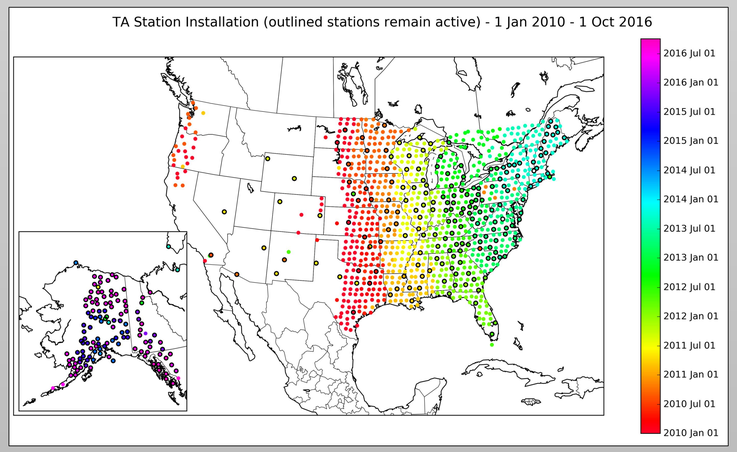
Project Overview and Objectives

- Primary Objective: spatially assess and detect prominent mesoscale pressure perturbations using 5-min perturbation analysis grids
- Analysis grids produced by combining high-temporal resolution observations from USArray Transportable Array (TA) with high-spatial resolution grids from Real-Time Mesoscale Analysis
- Period of Study: 1 Mar – 31 Aug 2011
  - TA located over central Great Plains during period of interest
  - Jacques et al. (2015, MWR) assessed prominent mesoscale activity during period via time-series analyses of 1 Hz TA observations
- Project demonstrates feasibility for incorporating more observation resources

USArray Transportable Array (TA)



- Component of extensive EarthScope field campaign: 400+ seismic stations
- Platform installation strategy based on a ~70 km quasi-grid across CONUS
- Each platform deployed for 1-2 yr, then retrieved and redeployed further east
- 2010: atmospheric pressure sensors installed (1 and 40 Hz sampling)
- Majority of platforms now being installed in Alaska (some with WXT520 all-in-one met sensors – real-time data available via MesoWest and MADIS)

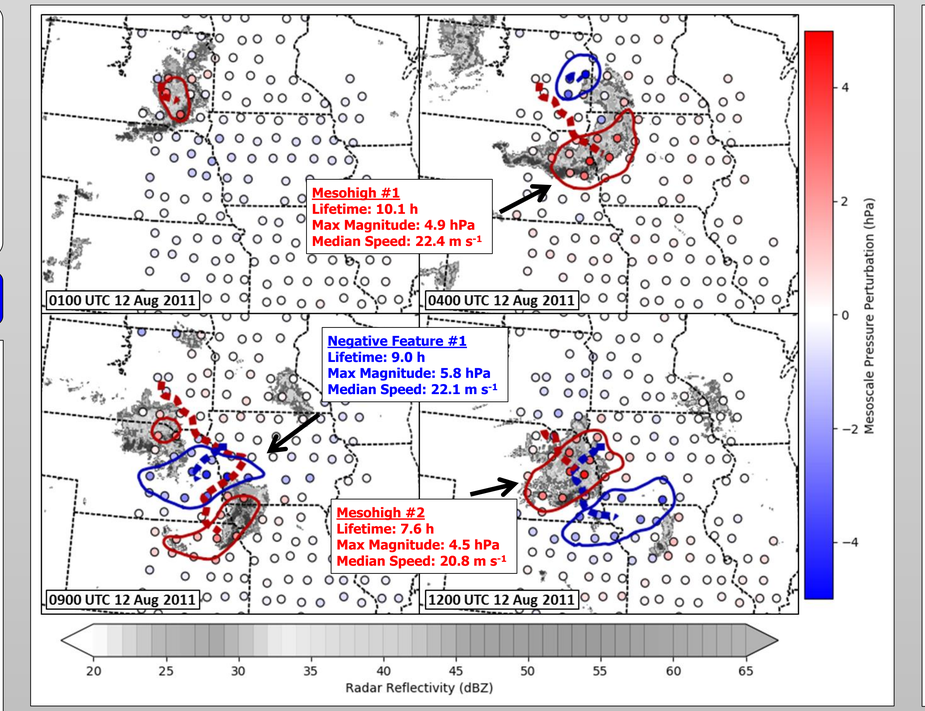
TA Meteorological Data Resources

Resource	Type	Access
MesoWest Maps/Graphs	Real-time Pressure/MET Data	http://mesowest.utah.edu
SynopticLabs API	Real-time Pressure/MET Data	https://synopticlabs.org/api
NOAA MADIS System	Real-time Pressure/MET Data	https://madis.noaa.gov/
Research Archive Visuals	Real-time/Archived Pressure	http://meso1.chpc.utah.edu/usarray/
NCAR RDA Archive	Archived 1 Hz Pressure Data	http://dx.doi.org/10.5065/D6028PRS

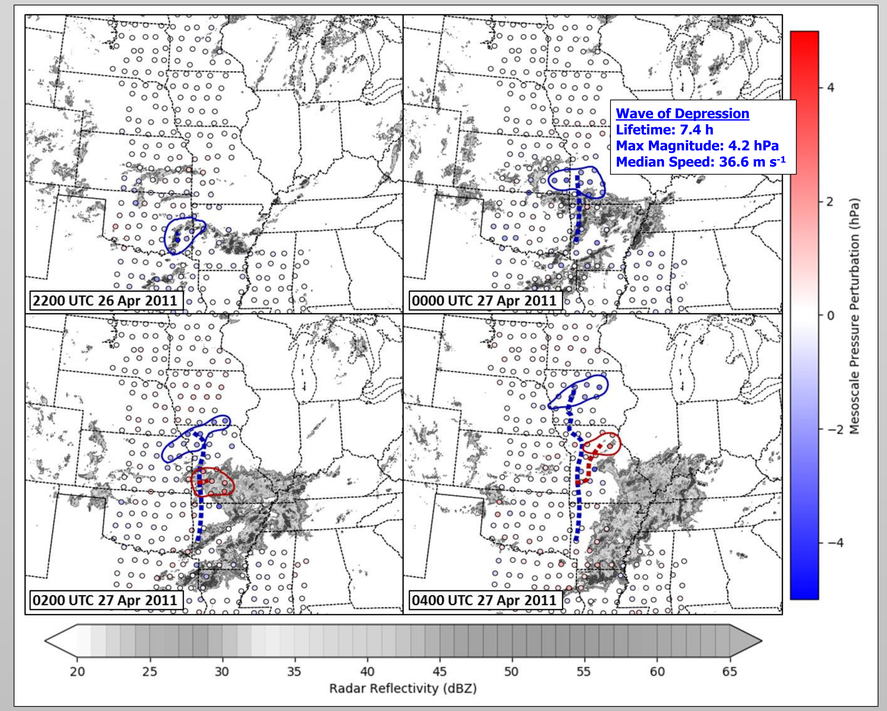
Mesoscale Feature Detection

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

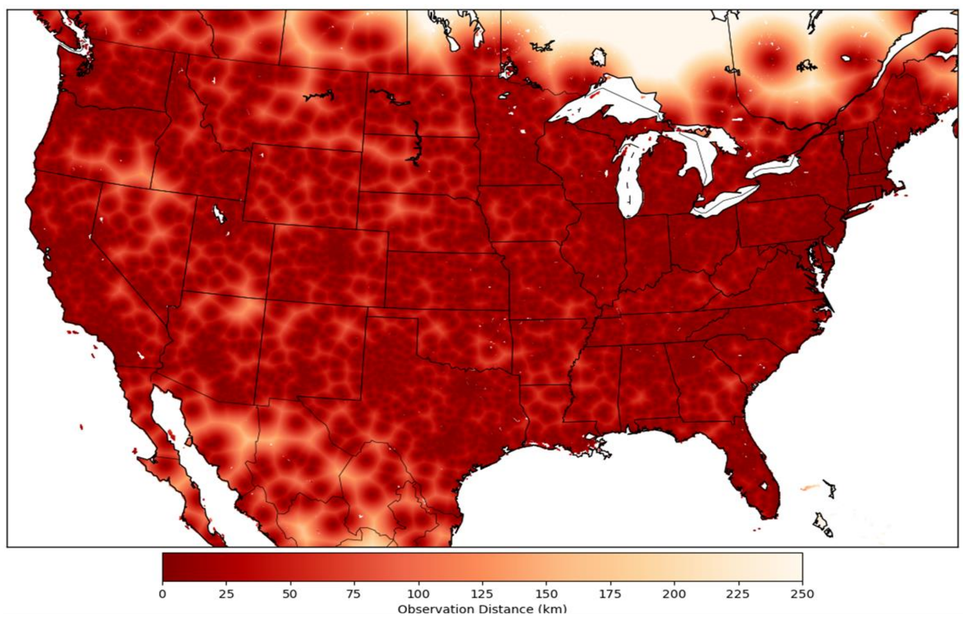
Multiple MCS Case (11-12 Aug 2011)



Gravity Wave Case (26-27 Apr 2011)



Incorporation of Additional Observation Resources



- Median distance to nearest real-time pressure observation (reporting frequency 15 min): 29.5 km
- The above only considers publicly available data (no inclusion of private or NOAA-only weather stations)
- Incorporation from diverse resources more feasible compared to other state variable measurements
  - Fewer installation concerns such as siting (pressure not impacted unlike temperature and wind)
  - Many resources transmit data at intervals ≥ 15 min
  - Data disseminated to prominent resources (e.g. MesoWest, MADIS) with minimal latency

Summary and Conclusions

- Case studies demonstrate ability to effectively combine observations and grids to adequately detect prominent mesoscale pressure perturbations
- Many publicly-available surface pressure data resources now available in real-time from MesoWest and MADIS, with expansive coverage across CONUS
- Clear potential to utilize for operational detection of pressure perturbations

References

Presentation 11B.1: 4:00pm Today (Room: Tahoma 3)
Detection of Mesoscale Pressure Perturbations with Five Min. Gridded Analyses
Alexander A. Jacques, J. D. Horel, and E. T. Crosman

Jacques, A. A., J. D. Horel, E. T. Crosman, and F. L. Vernon, 2017: Tracking Mesoscale Pressure Perturbations Using the USArray Transportable Array. *Monthly Weather Review*, submitted.

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

Acknowledgements and Resources

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