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Spatial Pressure Perturbation Analyses Utilizing Earthscope's USArray Network

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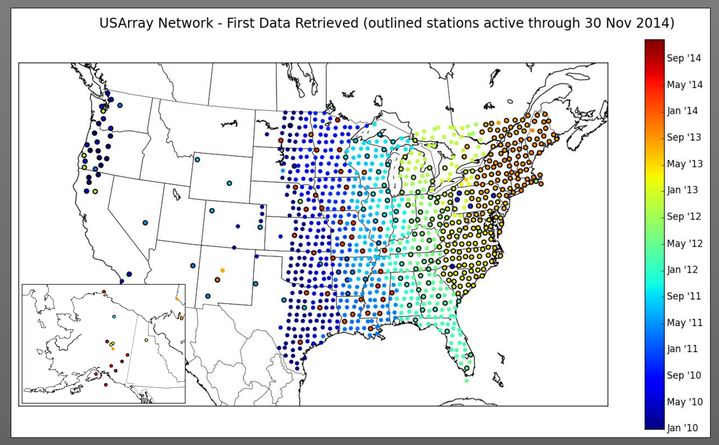
Project Overview and Objectives

- Assess high-temporal resolution surface pressure observations from the US Transportable Array (USArray) spatially with gridded background surface pressure fields
- Examine case events of high-impact phenomena that traversed active region of deployed USArray platforms
- USArray observations are accessible via numerous sources:
  - Project Website: http://meso1.chpc.utah.edu/usarray
  - MesoWest: http://mesowest.utah.edu
  - Five-minute observations distributed in real-time to NWS Western Region, MADIS, and other NOAA entities

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)
- 2014 main array location along eastern coast of US
- Subset of ~150 stations to remain in place over central and eastern US for next several years with more deployed in Alaska

Case Selection and Methodology

1) Cases selected using pressure signature catalogues via web tools (Jacques et al. 2015 – accepted by *Monthly Weather Review*)
2) NCEP Rapid Refresh (RAP) downscaled 2.5 km 1-h forecast surface pressure grids collected as background "first guess" fields
3) USArray surface observations retrieved from archived repositories
4) Grids and observations spline-interpolated at 5 minute intervals
5) Hourly pressure changes for grids and observations computed to eliminate potential elevation-based differences and influences
6) Gridded analyses of hourly pressure change computed using the University of Utah Two-Dimensional Variational Analysis (UU2DVAR – Tyndall and Horel 2013) at 5 minute intervals
7) Hourly pressure change added to previous background field and converted to sea-level using 2.5 km resolution terrain and standard altimeter conversion algorithm

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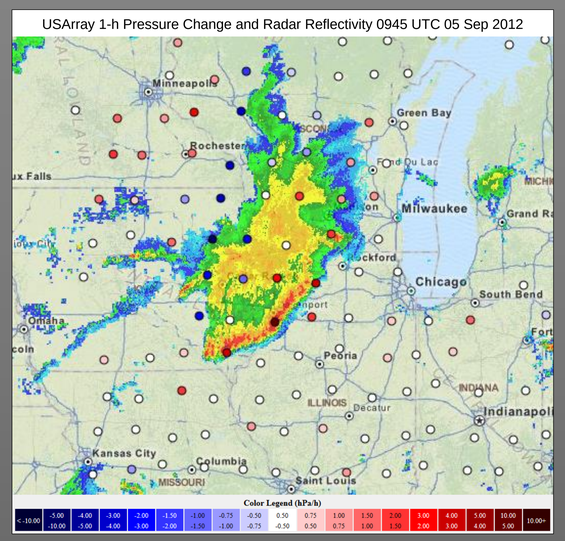
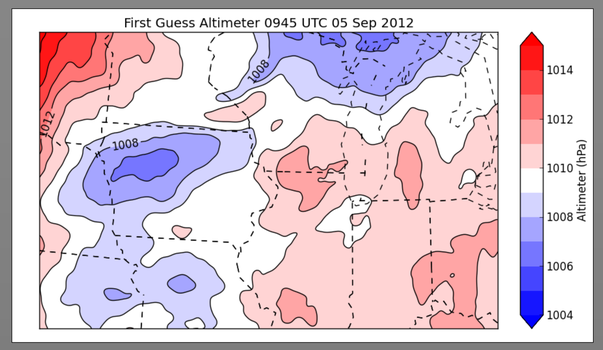
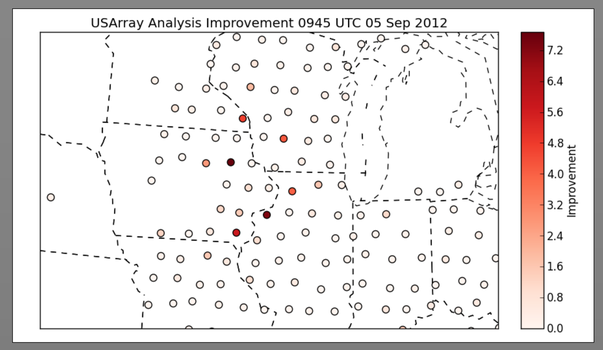
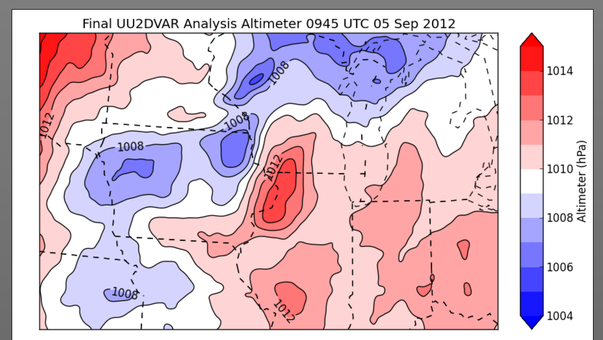
5 September 2012 Great Plains Mesoscale Convective System

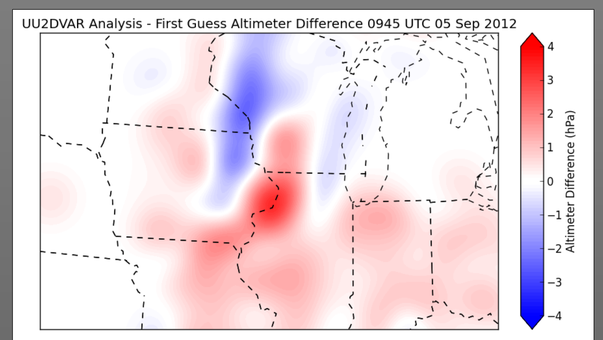
- Developed in northwestern Iowa and propagated southeast through Iowa and Illinois
- Several wind damage reports in Iowa/Illinois
- Prominent pressure rises and falls associated with mesohigh/wake-low couplet





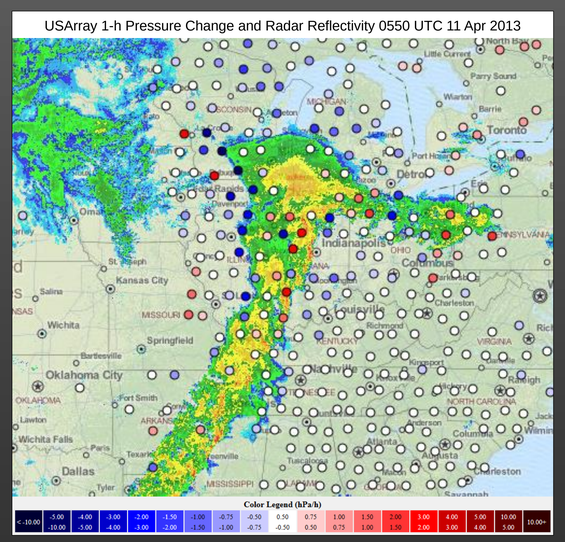


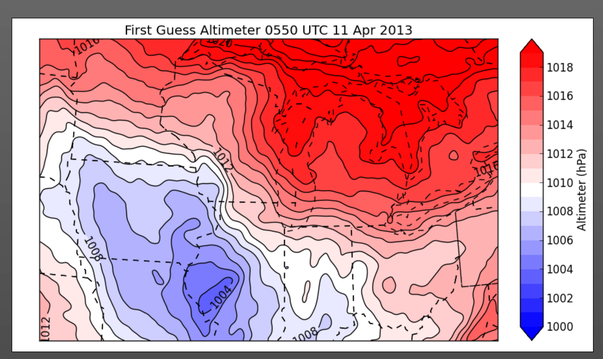


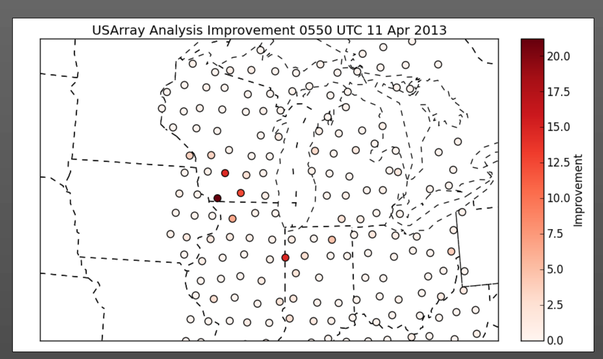


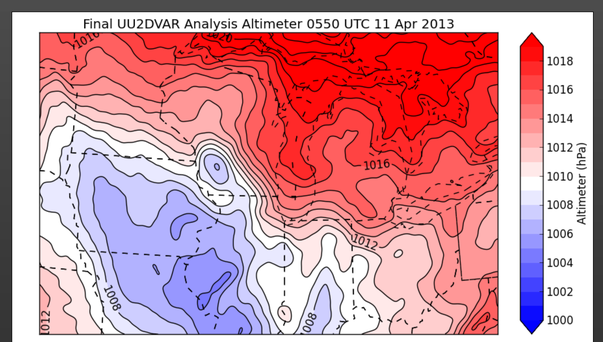
11 April 2013 Midwest Synoptic System and Inertia Gravity Wave

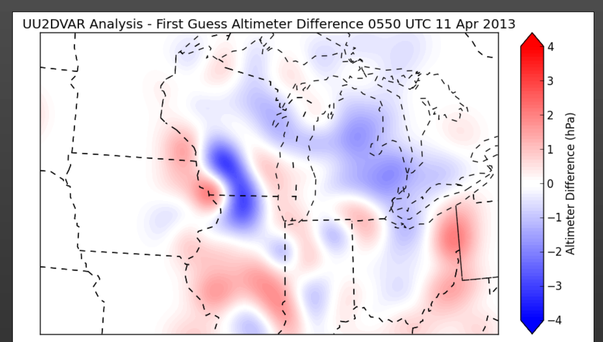
- Intensifying synoptic system over Great Plains
- Mesoscale solitary wave of depression propagated through Great Lakes region under primarily stable air mass north of warm front
- Large pressure falls with wave (> 8 hPa h^{-1})











Summary

- In both cases, background first guess field did not adequately assess pressure perturbations associated with mesoscale phenomena
- UU2DVAR analyses using the high-temporal resolution USArray data improved the detection of mesoscale features
- Stations along/near mesoscale phenomena had largest improvement on analyses
- Five-minute gridded pressure analyses may provide added potential for mesoscale feature tracking (not shown)

Future Work

- Use UU2DVAR to produce high-temporal resolution gridded pressure fields for additional mesoscale (and other) cases using USArray observations
- Assess objective feature identification and tracking abilities using gridded analyses at higher temporal resolutions (e.g., every 5 minutes)
- Explore potential methods to analyze gradients using resultant analyses
- Improve and enhance capabilities for web tools
- Continue to collect, analyze, and disseminate USArray observations in real-time