Utilizing Surface Pressure to Detect and Analyze Mesoscale Pressure Perturbations

Alexander A. Jacques (alexander.jacques@utah.edu), John D. Horel, and Erik T. Crosman
Department of Atmospheric Sciences, University of Utah

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-resolution spatial 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 >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)

TA Meteorological Data Resources

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<tr>
<td>MesoWest Maps/Graphs</td>
<td>Real-time</td>
<td><a href="http://meso1.chpc.utah.edu">http://meso1.chpc.utah.edu</a></td>
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<td>Integrated MET</td>
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<td><a href="http://dx.doi.org/10.5065/D6Q45TPR">http://dx.doi.org/10.5065/D6Q45TPR</a></td>
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Mesoscale Feature Detection

1) Surface pressure data collected and quality controlled:
   - TA observations (1 Hz temporal, ~70 km spatial resolution)
   - 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
4) Analysis grids temporally band-passed (10 min – 12 h) to isolate mesoscale pressure perturbations
5) Prominent perturbation features identified and tracked
   - Must last ≥1 h, ≥10000 km², ≥1 hPa magnitude
   - 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)

- 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 stinging (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

Incorporation of Additional Observation Resources

- Many publicly available 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

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

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References

