USArray TA Surface Pressure Observations within the Atmospheric Science Community

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Introduction

- Early 2012: MesoWest research group at Univ. of Utah contacted by IRIS about surface pressure data available from USArray TA
  - March 2012: automated procedures put in place to acquire real-time data from IRIS and store in MesoWest
  - Ingest code still running for TA, CEUSN, and Alaska stations

- Collaboration with Dr. Frank Vernon (co-PI) led to NSF proposal to further research 1 Hz sampled surface pressure observations with respect to atmospheric phenomena

What is MesoWest? (http://mesowest.utah.edu)

- Ongoing project with National Weather Service to collect and disseminate surface observations from various “mesonets”
  - Aviation, fire weather, road weather, public, research, etc.
  - 28,521 active stations reporting as of 1 June 2015
USArray TA and MesoWest (http://mesowest.utah.edu)

• 1 Hz surface pressure observations collected from IRIS
• 5 minute averages produced to satisfy real-time data needs
• Other atmospheric data also collected for TA-Inframet sites
USArray TA and MesoWest (http://mesowest.utah.edu)

- MesoWest data disseminated to NWS Western Region and NOAA Meteorological Automated Data Ingest System (MADIS), which sends to National Centers for Environmental Prediction (NCEP)

http://preview.weather.gov/edd

https://madis-data.ncep.noaa.gov/MadisSurface/
USArray TA Observations for Research Activities

• Additional processing collects 1 Hz surface pressure data on a daily basis and archives in compressed HDF5 format for quick access.

• Web tools also developed (http://meso1.chpc.utah.edu/usarray)

Pressure Perturbation Maps

1 Hz and Filtered Perturbation Time Series
Pressure Time Series Analyses

- Band-pass filters applied to extract perturbations of interest at several different scales of phenomena (Jacques et al. 2015)

1 Hz Actual Observations
- High/low pressure systems, blizzards

Synoptic (30 h – 5 days)
- Diurnal fluctuations, fronts, some convection

Sub-synoptic (4 – 30 h)
- Thunderstorm complexes, gravity waves

Mesoscale (10 min – 4 h)
Pressure Time Series Analyses

- Perturbation “climatologies” provide additional geographical and seasonal information on occurrences of high-impact phenomena

Mesoscale Perturbations (per season) > 3 hPa in Magnitude

Winter

Summer

Spring

Autumn
Pressure Time Series Analyses

- Web tools provide ability to examine individual events

**Synoptic Filtered Pressure Falls > 24 hPa/day from 1 Jan 2010 – 28 Feb 2014**

Clicking a station on the map will provide links to additional information on these perturbations.

*Signature statistics currently available for 1 Jan 2010 – 28 Feb 2014.*
Pressure Time Series Analyses

- Web tools provide ability to examine individual events

Synoptic Filtered Pressure Falls > 24 hPa/day from 1 Jan 2010 – 28 Feb 2014

M66A: Synoptic Event Table

<table>
<thead>
<tr>
<th>Begin Time (YYYY/MM/DD)</th>
<th>End Time (YYYY/MM/DD)</th>
<th>Duration (h)</th>
<th>Pressure Change (hPa)</th>
<th>Pressure Rate (hPa/day)</th>
<th>Graphical Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-11-20 17:16</td>
<td>2013-11-27 22:29</td>
<td>29.2</td>
<td>-32.84</td>
<td>-26.98</td>
<td>Click for Graph</td>
</tr>
<tr>
<td>2013-12-14 16:19</td>
<td>2013-12-15 18:28</td>
<td>24.1</td>
<td>-51.85</td>
<td>-31.85</td>
<td>Click for Graph</td>
</tr>
<tr>
<td>2014-02-04 21:04</td>
<td>2014-02-05 22:27</td>
<td>25.4</td>
<td>-26.59</td>
<td>-23.14</td>
<td>Click for Graph</td>
</tr>
<tr>
<td>2014-02-13 02:09</td>
<td>2014-02-14 07:09</td>
<td>29.0</td>
<td>-58.10</td>
<td>-31.61</td>
<td>Click for Graph</td>
</tr>
<tr>
<td>2014-02-15 08:33</td>
<td>2014-02-16 05:17</td>
<td>20.7</td>
<td>-21.18</td>
<td>-24.32</td>
<td>Click for Graph</td>
</tr>
</tbody>
</table>
Pressure Time Series Analyses

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Synoptic Filtered Pressure Falls > 24 hPa/day from 1 Jan 2010 – 28 Feb 2014

Spatial Perturbation Analyses

- Inclusion of USArray TA observations (high temporal resolution) with gridded model data (high spatial resolution) may improve evaluation of perturbations

- University of Utah Two-Dimensional Variational Analysis (UU2DVAR)
  - Start with gridded data that represents “background”
  - Collect observations independent of background
  - Assume background and observation error covariances
  - Use 2D variational approach to map observations onto background to produce an analysis grid

- Further information on UU2DVAR described by Tyndall and Horel (2013)
Spatial Perturbation Analyses

- Prior to analysis, hourly background grids interpolated every 5 min to better utilize temporal resolution of USArray TA

- Grids and observations converted to 1 hour pressure tendency (avoids any elevation conflicts between model terrain and station elevation)

- UU2DVAR analysis performed on 1 hour tendency data and final analysis grid converted to altimeter setting (sea-level pressure)

- Analysis grid time series are band-pass filtered (10 min – 8 h) to better identify perturbations produced by primarily mesoscale processes
Spatial Perturbation Analyses

0000 UTC 24 May 2011 Radar Reflectivity

0000 UTC 24 May 2011 Band-Pass Filtered Altimeter
Spatial Perturbation Identification

- Work underway to develop and test several algorithms to identify large perturbation features within the filtered analysis grids
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