AMPS and Henry AWS Preliminary Analysis 2009 to 2015

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Overview

- Understand how Antarctic Mesoscale Prediction System (AMPS) is performing specifically in the South Pole region
- Using Weather Research and Forecasting (WRF) era AMPS analysis and University of Wisconsin-Madison Henry Automatic Weather Station (AWS) data
- Temperature, Pressure, and Wind 2009-2015
Motivation

- January of 2015 visit to Henry AWS
- March of 2015 visit with Kevin and Jordan at NCAR to talk about AMPS
- Fall of 2015 course in Climatological Analysis

Henry AWS on January 15th, 2016 with Carol (right)
Data and Methods

- Time period 2009 to 2015
- AMPS 00Z 24 hour forecasts for 6 to 27 hours
  - 2 meter Temperature
  - Surface Pressure
  - 10 meter U and V wind components
- Henry AWS data
  - Station Temperature
  - Station Pressure
  - Station Resultant Wind Speed
## AMPS Versions and Distances from Henry AWS

Assuming Henry AWS at -89.001/-0.391

<table>
<thead>
<tr>
<th>AMPS Version</th>
<th>AMPS Coordinate</th>
<th>Distance from AMPS to Henry AWS</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1 D4, 5-km, 169x169 2008/11/01-2012/12/31</td>
<td>-88.9940/0.1759</td>
<td>1.350 km</td>
</tr>
<tr>
<td>V2 D4, 3-km, 255x255 2013/01/01-2013/01/31</td>
<td>-88.9942/0.0212</td>
<td>1.102 km</td>
</tr>
<tr>
<td>V3 D4, 3-km, 255x255 2013/02/01-2013/04/08</td>
<td>-88.9938/0.0621</td>
<td>1.191 km</td>
</tr>
<tr>
<td>V4 D3, 3-km, 537x826 2013/04/09-2015/12/31</td>
<td>-88.9949/0.0949</td>
<td>1.163 km</td>
</tr>
</tbody>
</table>

*NO interpolation was done in between the AMPS grid point and the AWS coordinate*
Analysis Information

- All (+) values correspond to a positive bias in AMPS
- All (-) values correspond to a negative bias in AMPS
- Thus all calculations are AMPS - Henry AWS
- Seasons are defined as follows
  - Summer: December and January (calculated for the January year)
  - Autumn: February and March
  - Winter1: April, May, and June
  - Winter2: July, August, and September
  - Spring: October and November
Temperature

- Average Annual differences in temperature range between -0.3 to +1.1 °C except 2015 at -1.4 °C

- **Summer** experiences the largest differences and most often a **cold bias** in AMPS

- **Spring** experiences the smallest differences and most often a **warm bias** in AMPS

- 2015 is anomalous
**Summer Temp Cold Bias**

**Temperature Summer Henry AWS and AMPS 2014**

3 Hourly Observations

**Temperature Summer 2014**

\[ y = 1.0876x + 4.4614 \]

**Spring Temp No Bias**

**Temperature Spring Henry AWS and AMPS 2013**

3 Hourly Observations

**Temperature Spring 2013**

\[ y = 0.99029x + 0.37582 \]
Pressure

- Average Annual differences in pressure range between +4.7 to +5.6 hPa
- **Winter** experiences the largest differences and with all average annual difference > +5 hPa
- **Summer** experiences the smallest differences and will all average annual difference +4 to +5 hPa
- 99.9% of the pressure values have higher values in AMPS than Henry AWS
*Note slope close to 1 and large y-intercepts
Wind Speed

- Average Annual differences in wind speed range between 0.6 to 1.2 m/s except 2015 which is +3.3 m/s

- **Autumn** experiences the largest differences with all average annual differences > +1 m/s

- **Summer** experiences the smallest differences with all average annual difference < +1 m/s except 2015

- 2015 is anomalous
Autumn Higher WS Bias

Summer Lower WS Bias

*Note slope is much further from 1 since the bias in AMPS increase as Henry AWS WS approaches 0
## 2015 Difference [AMPS-Henry AWS]

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</thead>
<tbody>
<tr>
<td>Temperature (°C)</td>
<td>1.06</td>
<td>0.52</td>
<td>-0.27</td>
<td>-0.87</td>
<td>-0.65</td>
<td>-0.31</td>
<td>-1.40</td>
</tr>
<tr>
<td>Pressure (hPA)</td>
<td>5.27</td>
<td>5.21</td>
<td>4.92</td>
<td>5.07</td>
<td>4.93</td>
<td>4.80</td>
<td>5.56</td>
</tr>
<tr>
<td>Wind Speed (m/s)</td>
<td>1.16</td>
<td>0.72</td>
<td>0.68</td>
<td>0.58</td>
<td>0.95</td>
<td>0.92</td>
<td>3.31</td>
</tr>
</tbody>
</table>
2015 Speculation

- GFS or NCEP not utilizing the Henry AWS data
- Differences in sensors between the AWS2B and the AWSCR1000 swap out that happen in Jan. 2015
  - Motivation for side by side instrumentation
- Issue with post engineering when returning equipment from the 2014-2015 field season
  - Difficulty in finding past errors
Conclusions

- AMPS average annual bias in temperature has been -0.3 to +1.1 °C throughout 2009 to 2014
- AMPS average annual bias in pressure has been +4.7 to +5.6 hPa where the bias is positive 99.9%
- AMPS average annual bias in wind speed has been 0.6 to 1.2 m/s
- 2015 is anomalous in temperature and especially wind speed
THANK YOU

- The authors appreciate the support of the University of Wisconsin-Madison Automatic Weather Station Program for the data set, data display, and information, NSF grant number ANT-1245663.

- Questions?