Howard University – Beltsville Site Report

5th GRUAN Implementation-Coordination Meeting
De Bilt, Netherlands
23 February - 1 March 2013

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Contributions:
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Acknowledgment:
NASA, NOAA, NOAA/NCDC; NOAA Center for Atmospheric Studies
Summary of activities

**Beltsville Sounding Data, 2012 Statistics.**
- RS92 soundings: RS92 ➔ *>1/week continues*
- Ozone soundings: EN-SCI ➔ ~ 1/month
- RSLAUNCH - *In progress* (plan to put all retroactively)

**Soon to start:**
- CFH: Periodic launches continue
- NOAA/NASA funding will allow for 1/month with lidar support.
  - Nighttime (~ Whiteman and Venable)

**NWS/Sterling-Beltsville Collaboration**
- More focused on ceilometer network expansion
- New DIAL water vapor testing.

**NOAA/STAR Collaborations**
- Soundings are targeted for NPP nighttime overpass.
- Supported by Lidar/MWR etc (SASBE??)

**Other:** Involved in GATANDOR, Trend analysis, others tasks, WCRP etc.
Examples of *student* projects that could benefit GRUAN
Update-1: Raman Lidar Calibration+

Motivation: *(Student project)*

- As GRUAN moves forward with Raman lidar mixing ratio profile product, documenting the state of optics, calibration, etc becomes paramount.
- How can measurements of lidar (Raman) water vapor (GRUAN priority-2 product?) from different instruments be compared?
- GCOS112: A roving Raman lidar as a calibrator *(Cost, feasibility)*

→ *Lamp Mapping Technique* – Use of a Scanning Standard Lamp Technique for Direct determination of Water Vapor Mixing Ratio Calibration Factor and more!
A standard lamp is scanned across the aperture of the Lidar telescope. Signals received in $\text{wv}$ and $N_2$ channels contain information for system diagnostics and calibration.

### System Diagnostics

- **Vignetting**
- **Aligned**

### Glue Coefficients: $PC = m \cdot AD$

<table>
<thead>
<tr>
<th>Ch</th>
<th>LMT ($10^{10}$ Hz/V)</th>
<th>Traditional ($10^{10}$ Hz/V)</th>
<th>Diff (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N_2$</td>
<td>9.59±0.30</td>
<td>9.51±0.03</td>
<td>0.84</td>
</tr>
<tr>
<td>$\text{wv}$</td>
<td>10.6±0.2</td>
<td>10.5±0.01</td>
<td>0.95</td>
</tr>
</tbody>
</table>

### WV Mixing Ratio Calibration, radiosonde (RS) and LMT

$$\left| \frac{C_{LMT} - C_{RS}}{C_{RS}} \right| \leq 5\%$$

### Channel Overlap Function-
radial distribution of LMT data

- **MapH2O Scale Fac 0.628**

### Technology is Transferable
Current data:  
*A lot of redundancy*

IPW: GPS/NOAA  
MWR: 2 & 39(2) Channel  
Sonde: RS92  
Raman: HURL/ALVICE  
Ozone: 1/month

**Plan:**
- CFH/lidar  
- Extend to UT/LS  
- Test “SASBE”
**Methods of using redundancy (Student project)**
- Overlapping coverage leads to instrument error characterization
- Data gaps filled
- Check calibration degradation
- Physics of retrieval: (e.g. MWR are very good in IPW but not so in profiling)

<table>
<thead>
<tr>
<th>Instrument</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>Freq.</th>
<th>WVMR Units</th>
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<tbody>
<tr>
<td>Vaisala RS-92</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>varying</td>
<td>g/kg</td>
</tr>
<tr>
<td>MP-3051A</td>
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<td>NA*</td>
</tr>
<tr>
<td>MP-3089A</td>
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<td>x</td>
<td></td>
<td></td>
<td>2 min</td>
<td>NA*</td>
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<tr>
<td>2-Channel MWR</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>2 min</td>
<td>NA*</td>
</tr>
<tr>
<td>NOAA—GPS</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>30 min</td>
<td>NA*</td>
</tr>
<tr>
<td>HURL</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>1 min</td>
<td>g/kg</td>
</tr>
<tr>
<td>NCAR DIAL</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>20 min</td>
<td>g/cm³</td>
</tr>
</tbody>
</table>
Update-3: Redundancy

- Example: 1-5 August 2006 data
  - Issues with lidar calibration constant
  - Redundancy - we will use GPS to correct the lidar
  - We are looking at several IOP data like this to do the data check
Update-3: Redundancy

Preliminary evaluation of IPW instruments!
Wind – A forgotten priority-1 GRUAN variable? *(Student project)*
Analysis of multi-year wind trend data started.
Preliminary results include the following.
Summary:
- we are launching 1xwk; + remote sensing+
- data will be in GRUAN data stream soon
- most of the work is being done by students.
- work that would could benefit GRUAN
- coordinated flight with NPP
- NIST tracable Raman Lidar Calibration tech.
- Contributing to other tasks.
UPDATE: Wind comparisons continues
Sterling/NWS Vs Beltsville

**IPW Comparisons**

- LWX1 (Sterling) Vs DCHU (Beltsville)
- GPS-Sonde variations at Sterling is comparable to the GPS-GPS variations for Beltsville-Sterling.
- GPS IPW may be used to scale mixing ratio profile variations.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>LWX/DCHU</th>
<th>RRS/LWX</th>
<th>CFH/DCHU</th>
<th>RS92Corr/DCHU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg.</td>
<td>0.953</td>
<td>0.994</td>
<td>1.023</td>
<td>0.979</td>
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<tr>
<td>Std. Dev.</td>
<td>0.094</td>
<td>0.132</td>
<td>0.085</td>
<td>0.099</td>
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<tr>
<td>Pts.</td>
<td>5179</td>
<td>3030</td>
<td>18</td>
<td>119</td>
</tr>
</tbody>
</table>