CLARREO IR Radiance Benchmark Product Analyses

Robert Knuteson, Jacola Roman, Steve Dutcher, Henry Revercomb, Dave Tobin, Bill Smith

University of Wisconsin-Madison, Space Science and Engineering Center

CLARREO SDT Meeting
NASA LaRC
17-19 May 2011
1. Refine Mission requirements using Observations

2. Refine Measurement requirements using Observations

3. Focus on Water Vapor Variability and Trends
UW Developed CLARREO Proxy Dataset derived from AIRS observations (Nadir only, up to 100 km FOV diameter, continuous sampling)
CLARREO IR Proxy Dataset derived from AIRS observations
(1 degree gridded monthly product)
CLARREO IR Proxy Dataset

AIRS Global Five Year Mean (2003-2007)

- window -

AIRS Monthly Deviation from Mean (+/- 4K color scale)

Month starting Jan. 2003

SSEC
Regional Monthly Variability (15°×15°)
CLARREO Proxy Dataset derived from AIRS observations was used to characterize natural variability from 3.5 to 15 microns.
### AIRS-Proxy Inter-annual Variability Summary

<table>
<thead>
<tr>
<th>Latitude Zone</th>
<th>Stratospheric Chs 4.3μm Std Dev. (K)</th>
<th>AIRS LW Window 11μm Std Dev (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>0.1</td>
<td>0.05</td>
</tr>
<tr>
<td>Arctic</td>
<td>&gt; 1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>NH Mid-Lat</td>
<td>0.25</td>
<td>0.15</td>
</tr>
<tr>
<td>Tropical</td>
<td>0.1</td>
<td>0.11</td>
</tr>
<tr>
<td>SH Mid-Lat</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Antarctic</td>
<td>0.2</td>
<td>0.2</td>
</tr>
</tbody>
</table>

* Std Deviation after detrending
Used to evaluate the sensitivity of variability to CLARREO FOV diameter.
Define Measurement requirements (FOV dependence)

Northern Hemisphere
5 deg lat zones

Orbit-Orbit variability is larger than Along-track Variability

This explains why there is only weak sensitivity to FOV size.
Roman, Jacola A.; Knuteson, R.; Revercomb, H. and Tobin, D.


Undergraduate research project to look at regional differences in climate model predictions and methods to validate those models.
Focus on Regional Water Vapor

Total Column Water Vapor

Winter

Summer

Zonal

Great Plains

Zonal DJF

GP DJF

Zonal JJA

GP JJA

PWV (mm)

Latitude

Latitude

Latitude

Latitude

CCSM3
CGCM3
GISS
PCM1
Only the GISS model captures Summer time moisture flux from Gulf of Mexico
Focus on Water Vapor Validation

Ground-based networks of GPS receivers measure Total Column WV
Focus on Water Vapor Validation

Winter

Summer

Latitude

Longitude

DJF Region Longitude Boundary

DJF Region Latitude Boundary

PWV (mm)

Latitude

Longitude

Latitudes and Longitudes

Radiative Forcing

Comparison of Models

Seasonal Variations

GPS
Focus on Water Vapor Validation

Water Vapor Vertical Profile Validation

Using Radiosonde data from the DOE ARM SGP site

Winter

Summer

DJF 5 Year Mixing Ratio Mean

JJA 5 Year Mixing Ratio Mean

Height

Mixing Ratio

Height

Mixing Ratio

CCSM3
CGCM3
GISS
PCM1
Sonde
Focus on Water Vapor

Slide 17

CCSM3 has reduced seasonal amplitude for entire 100 year time period 2000-2100.

CCSM3 PWV Trend: 0.050 ± 0.008 mm/yr
Focus on Water Vapor

GISS AR4 SRES A2 Scenario

GISS PWV Trend: 0.054 ± 0.009 mm/yr

CCSM3 and GISS 100 yr PWV trends (in mm/yr) are identical while Seasonal Amplitudes are very different!
Focus on Water Vapor

GP_OK_KS

Oklahoma/Kansas Region

PWV Trend (mm/yr)

2000 - 2009

Null Trend in 10 year record: 2000-2009

PWV Trend (%/yr)

% / yr Trend
We propose to make use of the operational high spectral resolution cross-track sounders (NPP CrIS and METOP IASI) to further refine the measurement requirements for a future CLARREO mission.

We will make use of CLARREO IR proxy datasets to determine variability on regional scales and develop methods to interrogate climate models using observations.