Near UV Aerosol Group Report

Omar Torres
NASA GSFC 614

GSFC Aerocenter Update
May 31, 2013
People

Research Group:
- Omar Torres (NASA – 614)
- Changwoo Ahn (SSAI)
- Hiren Jethva (GESTAR-USRA)
- Pawan Gupta (GESTAR-USRA)
- Santiago Gasso (GESTAR-Morgan State University)
- Peter Leonard (ADNET)

Collaborations:
- PK Bhartia
- Nick Krotkov
- Mian Chin
- Rich McPeters
- Peter Colarco, Valentina Aquila (JHU)
- E.S. Yang (SSAI)
- Sasha Marshak, Jay Herman (UMBC)
- Kelly Chance (SAO)
- Lorraine Remer (UMBC)
- Robert Loughman (HU)
Projects

OMI near UV aerosol algorithm and products
- Algorithm Upgrades (Ahn, Jethva, Gupta, Torres)
- Product Assessment (Ahn, Jethva, Gasso, Torres)
- OMI-MODIS Synergy (Gasso, Torres)
- Near UV High Spatial resolution (CAI, GLI) Analysis (Gasso, Torres)

Detecting Aerosol Above Clouds (Jethva, Ahn, Torres, Bhartia, Remer)
- OMI
- MODIS Application
- Inter-comparison to other techniques (POLDER, CALIOP)

Ground based observations of aerosols (Krotkov, Mok, Jethva, Loughman, Torres, Labow)
- Combined use of Cimel and UV and VIS MFRS sensors to measure aerosol absorption

Real and spurious effects of stratospheric aerosols on Satellite-measured total ozone (Aquila, Yang, Torres, Bhartia, McPeters, Colarco)

MEASURES Near UV Aerosol Project (Torres, Bhartia)
OMAERUV AOD Validation

Comparisons at 44 AERONET sites over for years (2005-2008)

Ahn et al., JGR 2013 (submitted); Torres et al., AMT 2013, (submitted)
Single Scattering Albedo Evaluation

Comparison to AERONET SSA (440 nm) retrievals

Most OMAERUV SSA retrievals agree with AERONET’s within 0.03 in South America, Northern India, NE China, Eastern Saharan Desert, and the Sahel region.

Larger differences are observed in Central Saharan, Southern Africa and Southeast Asia.

Jethva et al., JGR, 2013 submitted
OMI-MODIS AOD analysis
Identification of OMI algorithm and scene specific issues

(Santiago Gassó)

Cloud Contamination

Overestimation of AOD in partly cloud conditions

Algorithm Related issues

Underestimation of AOD in very dense dust storms (assumed size distribution, aerosol height)

About the graphs:
Collocated OMI+MODIS+Aeronet pixel (years 04-11)

Overlap: OMI AOD corrected by the MODIS AOD
Standard: OMAERUV AOD

Gasso and Torres (in preparation)
Aerosols Above Clouds: Sensor Inter-comparison

(Jethva, Torres, Waquet, Chand)
Combined use of CIMEL and Modified UV and VIS MFSR Measurements
(Krotkov, Torres, Mok, Labow, Jethva, Loughman)

**Direct Sun measurements: AOD**
**Sky-radiance measurements**

**Particle Size Distribution**
**Real Refractive Index**

**Inter-calibration:**
\[ \tau_{440}^{\text{Cimel}} = \tau_{440}^{\text{MFSR}} \]

- Replace three original UV filters with CIMEL’s 340, 380 and 440 nm filters.
- Add a 440 nm CIMEL filter to VIS MFSR sensor

Measure 1 min \( F_{\text{diff}} \) and \( F_{\text{tot}} \) (3% error)

Calculate \( F_{\text{dir}} \)
Derive \( \tau_{\text{MFSR}}^{\text{uv-vis}} \)

**Mie plus RT Calculations**

\[ K_{\text{uv-vis}}, \text{SSA}_{\text{uv-vis}}, \text{that explains measured} \]
\[ F_{\text{diff}}/F_{\text{tot}} \text{ ratios} \]
CIMEL and Modified UV and VIS MFSR observations: Results

Plan to return to Bolivia in 2013 using three-instrument suite
Future Perspective:

DSCOVR At Lagrange-1

Deep Space Climate Observatory

Earth Seen from L-1 on 12/25/2015 with Lunar Shadow in Northern Hemisphere

At L1, the neutral gravity point between the Sun and the Earth, DSCOVR will remain near the same position relative to the Earth and Sun.
### Channels and Applications

<table>
<thead>
<tr>
<th>Channel (nm)</th>
<th>FWHM (nm)</th>
<th>Purpose</th>
<th>Spatial Resolution (km)</th>
<th>SNR</th>
<th>Exp. Time (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>317.5 ± 0.1</td>
<td>1 ± 0.2</td>
<td>Ozone, SO₂, UV</td>
<td>10*</td>
<td>265</td>
<td>1.3</td>
</tr>
<tr>
<td>325 ± 0.1</td>
<td>1 ± 0.2</td>
<td>Ozone, UV</td>
<td>10</td>
<td>265</td>
<td>0.84</td>
</tr>
<tr>
<td>340 ± 0.3</td>
<td>3 ± 0.6</td>
<td>Ozone, Aerosols, UV, and Volcanic Ash</td>
<td>10</td>
<td>265</td>
<td>0.13</td>
</tr>
<tr>
<td>388 ± 0.3</td>
<td>3 ± 0.6</td>
<td>Aerosols, Clouds, UV and Volcanic Ash</td>
<td>10</td>
<td>266</td>
<td>0.087</td>
</tr>
<tr>
<td>443 ± 1</td>
<td>3 ± 0.6</td>
<td>Blue, Aerosols, Vegetation</td>
<td>10</td>
<td>265</td>
<td>0.052</td>
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<tr>
<td>551 ± 1</td>
<td>3 ± 0.6</td>
<td>Green, Aerosols, Vegetation</td>
<td>10</td>
<td>265</td>
<td>0.030</td>
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<td>680 ± 0.2</td>
<td>2 ± 0.4</td>
<td>Red, Aerosol, Veg., O₂ B-Band, Clouds</td>
<td>10</td>
<td>266</td>
<td>0.037</td>
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<tr>
<td>687.75 ± 0.2</td>
<td>0.8 ± 0.2</td>
<td>O₂ B-Band Cloud Height</td>
<td>10</td>
<td>266</td>
<td>0.060</td>
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<tr>
<td>764.0 ± 0.2</td>
<td>1 ± 0.2</td>
<td>A-Band Cloud Height</td>
<td>10</td>
<td>265</td>
<td>0.061</td>
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<tr>
<td>779.5 ± 0.3</td>
<td>2 ± 0.4</td>
<td>A-Band Reference, Vegetation</td>
<td>10</td>
<td>265</td>
<td>0.036</td>
</tr>
</tbody>
</table>

**Official launch date: November 2014**

**Science Team to be selected via ROSES call**
**Future Perspective (2):**

Tropospheric Emissions: Monitoring of Pollution (TEMPO)

*PI: Kelly Chance (Smithsonian Astrophysical Observatory)*

- First GEO NASA Science Mission
- Commercial Satellite Hosted Payload
- GEOCAPE Precursor
- To be launched in 2019

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### GEOGRAPHICAL COVERAGE

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### PLANED PRODUCTS

<table>
<thead>
<tr>
<th>Species</th>
<th>Band nm</th>
<th>SNR Reqs</th>
<th>SNR Predict</th>
<th>EOL Margin</th>
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<tbody>
<tr>
<td>SO₂</td>
<td>305-345</td>
<td>1297</td>
<td>1820</td>
<td>40%</td>
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<tr>
<td>H₂CO</td>
<td>327-354</td>
<td>487</td>
<td>2094</td>
<td>330%</td>
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<tr>
<td>NO₂</td>
<td>423-451</td>
<td>1233</td>
<td>1910</td>
<td>55%</td>
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<tr>
<td>C₂H₂O₂</td>
<td>433-457</td>
<td>1350</td>
<td>2331</td>
<td>73%</td>
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<tr>
<td>O₂ (UV)</td>
<td>303-345</td>
<td>1122</td>
<td>1635</td>
<td>46%</td>
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<tr>
<td>O₂ (Vis)</td>
<td>546-648</td>
<td>958</td>
<td>1254</td>
<td>31%</td>
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<tr>
<td>AOD</td>
<td>354, 388</td>
<td>1000</td>
<td>1596</td>
<td>60%</td>
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### KEY INSTRUMENT CHARACTERISTICS

<table>
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<th>Requirements</th>
<th>Comment</th>
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<tr>
<td>Field of Regard</td>
<td>GNA</td>
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<tr>
<td>Imaging Time</td>
<td>1 hr</td>
</tr>
<tr>
<td>Footprint N/S</td>
<td>2.0 km</td>
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<tr>
<td>Footprint E/W</td>
<td>4.5 km</td>
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<tr>
<td>Spectral Range</td>
<td>290-690 nm</td>
</tr>
<tr>
<td>Spectral Resolution</td>
<td>0.6 nm</td>
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<tr>
<td>Spectral Sampling</td>
<td>0.2 nm</td>
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Mexico City to Canada tar sands & Atlantic to Pacific

1250 scan positions with 2.8 sec integration

Native pixel achieved by 44 cm telescope effective focal length

1,024 spectral channels matched to 2k focal plane

Achieved by spectrometer design

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### SCIENCE TEAM

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>University/Institution</th>
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<tbody>
<tr>
<td>Kelly Chance</td>
<td>SAO</td>
<td>Xiong Liu (DPI)</td>
</tr>
<tr>
<td>James Carr</td>
<td>Carr Astro</td>
<td>Ronald Cohen</td>
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<tr>
<td>David Edwards</td>
<td>NCAR</td>
<td>Jack Fishman</td>
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<td>David Flittner</td>
<td>LaRC</td>
<td>Jay Herman</td>
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<tr>
<td>Daniel Jacob</td>
<td>Harvard</td>
<td>Scott Janz</td>
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<tr>
<td>Joanna Joiner</td>
<td>GSFC</td>
<td>Nickolay Krotkov</td>
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<tr>
<td>James Leitch</td>
<td>Ball</td>
<td>Randall Martin</td>
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<tr>
<td>Doreen Neil</td>
<td>LaRC</td>
<td>Michael Newchurch</td>
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<td>R. Bradley Pierce</td>
<td>NOAA</td>
<td>Robert Spurr</td>
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<tr>
<td>Raid Suleiman</td>
<td>SAO</td>
<td>James Szykman</td>
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<tr>
<td>Omar Torres</td>
<td>GSFC</td>
<td>Jun Wang</td>
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<tr>
<td></td>
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<td>U. Nebraska</td>
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