Update on Algorithm MAIAC

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May 20, 2015
MAIAC: Building a Complete Physical Model of Atmosphere-Surface (RT)

- Anisotropic surface;
- SRC Retrieval (global aerosol retrievals; low urban bias)
- Detection of seasonal and rapid change:
- Dynamic LWS classification;
- Adaptive and learning system:
  (store and dynamically update clear-sky TOA reflectance; spectral BRDF; spatial variability metrics; brightness temperature and contrasts @1km)
- Aerosol Type Discrimination;
- Synergy among WV, CM, aerosol and AC;
Current Status

- MAIAC is at MODAPS;
- MAIAC MODIS reprocessing expected to start this summer;
- MAIAC MODIS for North America, South America, Africa (±10°), and Europe for 2000-mid-2014 is available at NASA NCCS ftp:
  ftp://maiac@dataportal.nccs.nasa.gov/DataRelease/
  (if asked for password, press Enter);

- Continuous science development: CM, snow detection and characterization, aerosol typing; specific developments for tropics.
VIIRS AOT IP vs MODIS MAIAC (25km)
(S. Kondragunta, S. Superczynski (NOAA), study for NASA GeoCAPE project)
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AERONET Comparisons

VIIRS AOT IP vs MODIS MAIAC (25km)

(S. Kondragunta, S. Superczynski (NOAA), study for NASA GeoCAPE project)
Bias vs. Surface Reflectance

- MAIAC and VIIRS comparable at sfc. reflectances below 0.05

- Similar slope (opposite sign) from 0.05 - 0.1, then VIIRS bias increases dramatically.
**Aerosol Type Discrimination (Smoke/Dust)**


**Phys. principles (~OMI) – enhanced shortwave absorption** (Red $\rightarrow$ Blue $\rightarrow$ DB)

\[
R_{\lambda}^{Aer} = R_{\lambda}^{Meas} - R_{\lambda}^{Molec} - R_{\lambda}^{Surf}(\tau^a) \quad \text{- proxy of aerosol reflectance}
\]

1) \(n_i\) increases \(R \rightarrow DB\) for OC (smoke) and dust;

2) Multiple scattering, for absorbing aerosols.

<table>
<thead>
<tr>
<th>TOA</th>
<th>CM</th>
<th>AOT</th>
<th>(\delta_{0.412})</th>
<th>(\delta_{0.47})</th>
<th>(\delta_{0.66})</th>
<th>(\delta_{2.13})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>Smoke</td>
<td>Dust</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
\delta_{\lambda} = R_{\lambda}^{M} - R_{\lambda}^{T}(\tau_{0.47}^a = 0.05)
\]

<table>
<thead>
<tr>
<th>Model</th>
<th>Abs.</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Backgr.</td>
<td>No</td>
<td>Small</td>
</tr>
<tr>
<td>Smoke</td>
<td>Yes</td>
<td>Small</td>
</tr>
<tr>
<td>Dust</td>
<td>Yes</td>
<td>Large</td>
</tr>
</tbody>
</table>
Aerosol @1km: China

July 2013

November 2011

Beijing (AOT~2.5)

Detected “smoke”
(fine mode, absorbing)
Europe-North Africa: Aerosol Types
Recent Developments

Morton et al. (Nature, 2014): BRDF retrieval in Amazon doesn’t happen often

Equatorial Amazon, 150km: Rare 3-day period of low cloud cover (BRDF variation >> spatial variation)

Meso-scale (50km) RTLS retrieval

- Select high NDVI (>0.75) pixels;
- Get average $\rho_{0.66}$ for 20-50th percentile (N>20); filter residual clouds (~0.005) and shadows;
- If sufficient angular sampling during 10 days (Terra+Aqua), then RTLS inversion;
- Joint inversion of RGB and 2.1 $\mu$m channels for more robust retrieval;
- Get pixel’s BRDF by scaling using single good observation

BRDF shape update every 1-2 weeks to track geometry and phenology changes
Dry Season and Biomass Burning

Clearing of Amazon forests for agricultural development.

As timber dries, biomass burning begins.

**CM Legend**
- Clear Land
- Clear Water
- Detected Smoke
- Clouds
- Cloud Shadows
... Biomass Burning (2003)
Quality of Atmospheric Correction

CM Legend
- Clear Land
- Clear Water
- Detected Smoke
- Clouds
- Cloud Shadows

296 - 2003
Quality of Atmospheric Correction ...

TOA RGB

BRF RGB

Decreasing brightness – moving from backscattering towards forward scattering

1200 km
Aerosol Effect on NDVI

(from Hilker et al., 2012)

Smoke aerosol model (more absorption at 0.47 µm) gives larger AOT resulting in lower BRF$_{0.67}$. 

Northern area
(7°30' N, 70° W)

Southern area
(7°30' S, 70° W)