A New High Resolution Aerosol Dataset from Algorithm MAIAC

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MAIAC = Time Series + Spatial Analysis

MODIS, TOA RGB
NBRF
AOT
BRF
**MAIAC: Standard and New Features**

- Anisotropic surface model;
- Retrieval of Spectral Regression Coefficient;
- Detection and accommodation of seasonal and rapid surface change;
- Storing “static” (surface) information;
- Products: WV, CM, AOT, AE (over dark surfaces) and aerosol type (background/smoke/dust – in progress) @1km resolution and surface suite (spectral BRDF model, BRF (SR), albedo).

**New Features**

- Removed blockiness (25km) of AOT and SR images;
- Will provide uncertainty of AOT;
- Aerosol type classification (background/smoke/dust);
- Improvements in cloud detection.
Old: Multi-day minimization over 25x25km² blocks

New: Minimum Reflectance Method:
- We can express measured B3 radiance as a function of 2.1μm BRDF:
  \[ L_{B3} \cong D + L_s(b\rho_{B7}^B) \]
- Compute \( b \) for the background aerosol (AOT~0.05);
- Blue band is “dark”, aerosols increase SRC (\( b \));
- Select SRC as min over \( \Delta T \);
- Run 2 lines of SRC update: each line initializes over 2 months, and SRC is updated monthly
Example, incl. coastal and inland water
Aerosol Type Discrimination (Smoke/Dust)


Phys. principles (~OMI) – **enhanced shortwave absorption** (Red → Blue → DB)

\[
\delta_\lambda = R^M_\lambda - R^T_\lambda (\tau^a_{0.47} = 0.05) \quad \text{- proxy of aerosol reflectance}
\]

1) \(n_i\) increases \(R\rightarrow DB\); 2) Multiple scattering, and absorption, increase \(R\rightarrow DB\), for absorbing aerosols.

<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>
Idaho/Wyoming – Yosemite Fires (08-2013)
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Idaho/Wyoming – Yosemite Fires (08-2013)
MAIAC did not show decreased performance over urban surfaces over B-W area.
San Joaquin Valley 2012-2013

DOY: 329, 331, 2012

Yosemite Fires, Aug. 2013

248

250

251

252
San Joaquin Valley 2012-2013

Arvin
Clovis
Corcoran
Drummond
Garland
Hanford
Porterville
Shafter
Fresno
UCSB (Huron)
El Segundo
Table Mountain
C5 Trends: Aerosol and Clouds


Levy et al. (2010), Global evaluation of the Collection 5 MODIS dark-target aerosol products over land, ACP.

Koukouli et al. (2010), Signs of a negative trend in the MODIS aerosol optical depth over the Southern Balkans, Atm. Environ.
C6+: MODIS de-trending and X-calibration

- MODIS C6 L1 removed major calibration trends of Terra;
- Remained: Terra polarization sensitivity (PC); Applied PC algorithm developed by GSFC OBPG => found residual trends of T&A;
- Used CEOS desert cal. sites => TOA reflectances ($R_n$) for fixed geometry ($VZA=0^\circ$, $SZA=45^\circ$);
C6+: MODIS de-trending and X-calibration

- Use of $R_n$ allows us to X-calibrate Terra vs Aqua!
- Based on C6+, MAIAC processes Terra & Aqua jointly.

<table>
<thead>
<tr>
<th>Bands</th>
<th>$\Delta_T$</th>
<th>$\sigma$</th>
<th>$\Delta_A$</th>
<th>$\sigma$</th>
</tr>
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<tbody>
<tr>
<td>B1</td>
<td>0.0048</td>
<td>0.0020</td>
<td>-0.0046</td>
<td>0.0022</td>
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<tr>
<td>B2</td>
<td>0.0035</td>
<td>0.0019</td>
<td>-0.0062</td>
<td>0.0027</td>
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<tr>
<td>B3</td>
<td>-0.0082</td>
<td>0.0015</td>
<td>-0.0048</td>
<td>0.0016</td>
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<tr>
<td>B4</td>
<td>0.0049</td>
<td>0.0022</td>
<td>-0.0021</td>
<td>0.0023</td>
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<tr>
<td>B8</td>
<td>0.0094</td>
<td>0.0015</td>
<td>-0.0015</td>
<td>0.0013</td>
</tr>
</tbody>
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