Satellite Aerosol Validation

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Objectives

By the end of this presentation, you will learn to:

• Validate satellite-derived aerosol optical depth
• List the uncertainties in the MODIS aerosol product
• Access data and tools for validating satellite aerosol products
AERONET measurements of aerosol depth are considered **ground truth** and are used to validate satellite aerosol retrievals.

http://aeronet.gsfc.nasa.gov/
Spatial and Temporal Collocation

Satellite

Sun photometer data subset time interval: 1 hour (30 minutes before and after a satellite overpass)

Aerosol plume

Satellite data subset surface circle diameter: 50-55 km

Petrenko et al., 2012
MODIS Dark Target (DT) AOD Validation

**Land**

\[
EE\% = \pm (0.05 + 15\%)
\]

Source: Gupta et al., 2016

**Urban Surfaces**

Source: Gupta et al., 2016

NASA's Applied Remote Sensing Training Program
MODIS DT Aerosol Retrieval at 10 km in Asia

Source: P. Gupta
MODIS DT Aerosol Retrieval at 3 km in Asia

Source: P. Gupta
Dark Target

http://darktarget.gsfc.nasa.gov/

The effect of aerosols is one of the greatest sources of uncertainty in climate modeling. Aerosols vary in time and space and can lead to variations in cloud microphysics, which impact cloud radiative properties and climate. The Dark-Target (DT) aerosol retrieval algorithm is applied to multispectral satellite data, and derives aerosol properties including aerosol optical depth (AOD) over land and ocean, and spectral AOD and aerosol size parameters over ocean. Products of the DT retrieval are used to develop global and regional aerosol climatology, to study the interaction of aerosols with clouds, and for air quality assessments and forecasts.

There are two separate and distinct “Dark Target” (DT) algorithms. The first one is used for retrieving aerosol information over ocean (dark in visible and longer wavelengths) and the second one over vegetated/dark-soiled land (dark in the visible). In theory, these algorithms can be applied...
# MODIS Dark Target AOD Uncertainties

## MODIS 10 Km Product

<table>
<thead>
<tr>
<th></th>
<th>Collection 5</th>
<th>Collection 6 (Interim Values)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ocean</td>
<td>+/- (0.03 + 5% of $\tau$)</td>
<td>+/- (0.02 - 10% of $\tau$)</td>
</tr>
<tr>
<td></td>
<td>+/- (0.05 + 15% of $\tau$)</td>
<td>(+0.04 + 10% of $\tau$)</td>
</tr>
<tr>
<td>Land</td>
<td></td>
<td>+/- (0.05 + 15% of $\tau$)</td>
</tr>
<tr>
<td>Aqua</td>
<td>+/- (0.03 + 5% of $\tau$)</td>
<td>Data not yet available</td>
</tr>
<tr>
<td></td>
<td>+/- (0.05 + 15% of $\tau$)</td>
<td>Data not yet available</td>
</tr>
<tr>
<td>Terra</td>
<td>+/- (0.03 + 5% of $\tau$)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+/- (0.05 + 15% of $\tau$)</td>
<td></td>
</tr>
</tbody>
</table>

## MODIS 3 km Product Uncertainty Values for Collection 6 (Interim Values)

<table>
<thead>
<tr>
<th></th>
<th>Ocean</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aqua</td>
<td>+/- (0.04 + 5% of $\tau$)</td>
<td>+/- (0.05 + 20% of $\tau$)</td>
</tr>
<tr>
<td>Terra</td>
<td>Data not yet available</td>
<td>Data not yet available</td>
</tr>
</tbody>
</table>
Validation Maps

http://darktarget.gsfc.nasa.gov/
Scatter Plot

Bandung, Elev: 826 m

- **MODIS 0.55 μm AOD** vs. **AERONET 0.55 μm AOD**
  - Data points scattered along a trend line
  - Percent within EE = 60.66%
  - Percent above EE = 24.59%
  - Percent below EE = 14.75%
  - N = 61; R = 0.637
  - BIAS = -0.015
  - RMSE = 0.160
  - Y = 0.357X + 0.132

Source: [modis-atmos.gsfc.nasa.gov](http://modis-atmos.gsfc.nasa.gov/leigh/jpeg/modis_aeronet_plot_Bandung_DT_Land.png)
Deep Blue Product

http://deepblue.gsfc.nasa.gov
MAPSS

Multi-sensor Aerosol Products Sampling System

• Giovanni instances
• Used to evaluate the quality of satellite retrievals
• MAPSS allows you to compare AERONET data with coincident satellite data
• Quick and effective way to evaluate the quality of the satellite retrieval at particular locations for a range of dates or seasons
• Data from MODIS & MISR
  – Satellite-AERONET Inter-Comparison: http://giovanni.gsfc.nasa.gov/mapss/
MAPSS: Multi-sensor Aerosol Products Sampling System

This user interface is used to obtain selected parameter statistics from the MAPSS database for a chosen location and time period. Time Series Plot is available service. Plot output is rendered as a graph and also available in ASCII format.
MAPSS Statistical Explorer

http://giovanni.gsfc.nasa.gov/mapss_explorer/
MAPSS – Further Reading


Published Validation Results


