Satellite Aerosol Validation

Melanie Follette-Cook, and Pawan Gupta

Satellite Remote Sensing of Air Quality

September 19-21, 2017
University of California, Riverside
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

http://aeronet.gsfc.nasa.gov/

Serves as a validation tool for satellite air quality products
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

EE% = \pm (0.05 + 15\%)
MODIS DT Aerosol Retrieval at 10 km in U.S.

United States
MODIS DT Aerosol Retrieval at 3 km in U.S.

United States

Gupta et al., 2017, in-prep.
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 in 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><strong>Ocean</strong></td>
<td></td>
<td><strong>Ocean</strong></td>
</tr>
<tr>
<td><strong>Land</strong></td>
<td></td>
<td><strong>Land</strong></td>
</tr>
<tr>
<td><strong>Aqua</strong></td>
<td>+/- (0.03 + 5% of $\tau$)</td>
<td>(-0.02 - 10% of $\tau$)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(+0.04 + 10% of $\tau$)</td>
</tr>
<tr>
<td><strong>Terra</strong></td>
<td>+/- (0.03 + 5% of $\tau$)</td>
<td>Data not yet available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data not yet available</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><strong>Aqua</strong></td>
<td>+/- (0.04 + 5% of $\tau$)</td>
<td>+/- (0.05 + 20% of $\tau$)</td>
</tr>
<tr>
<td><strong>Terra</strong></td>
<td>Data not yet available</td>
<td>Data not yet available</td>
</tr>
</tbody>
</table>
Validation Maps

http://darktarget.gsfc.nasa.gov/
Deep Blue Product

http://deepblue.gsfc.nasa.gov

Welcome to the Deep Blue aerosol project webpage

Deep Blue uses measurements made by satellite instruments orbiting the Earth to determine the amount of aerosols in the atmosphere, and the properties of those aerosols. ‘Aerosols’ is a catch-all term covering particles suspended in the atmosphere, including but not limited to desert dust, smoke, volcanic ash, industrial smog, and sea spray. Improving our understanding of aerosols is important for reasons related to Earth’s climate, human health, and ecology, as well as many others.

This website is designed to act as a single portal to provide information to both new and experienced data users about our data sets, as well as give an overview of what we do and why we do it to non-specialists. Please use the links across the top of the page to navigate, and feel free to contact us with any questions.

Recent news relating to Deep Blue, such as new data versions or publications, are listed below. You can also subscribe to our RSS feed for updates.

MODIS Deep Blue Collection 6 data now available in NASA Worldview

MODIS Terra true color overlaid with Deep Blue aerosol optical depth, showing data from May 31 2016.

We are pleased to announce that select MODIS Collection 6 Atmospheres data products, including Deep Blue aerosol data, are now available on the NASA Worldview satellite imagery browsing tool. At present, data from 2007-2015 are currently available. Earlier years, as well as 2016 data (and near-real-time availability), are being added.

Key features of Worldview include:

Read more

Aerosols - above - clouds article featured as an EOS research spotlight

The American Geophysical Union (AGU) have selected our recent article about monitoring aerosols above clouds for a Research Spotlight. The
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 the available service. Plot output is rendered as a graph and is also available in ASCII format.

Data Selection

Select Station

Select Plot

Satellite Colocated with AERONET

- Time Series
- Scatter Plot

Select Measurements

Parameter

Layer

Measurement

Selected Measurements

MAPSS Time Series

Time Period: 2001-01-01 to 2004-01-01

Mean AOD at 440nm from AERONET_AOD_L2_2 at GSFC (tau)

Mean of AOD at 550nm - land and ocean from MOD04_L2_005 at GSFC
MAPSS Statistical Explorer

http://giovanni.gsfc.nasa.gov/mapss_explorer/

Published Validation Results


