# MODIS Deep Blue: Validation of recent products and future plans

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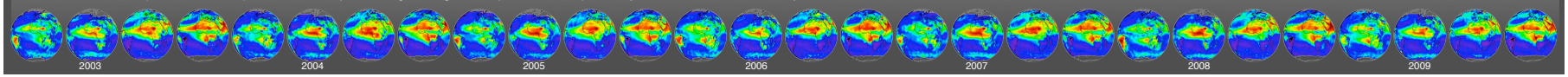
**VIEW OF AFRICA:** Seasonal (DJF, MAM, JJA, SON) AOT from MODIS-Aqua, combining Dark Target and Deep Blue retrievals. Sphere with year label is 'DJF' season, followed by 'MAM', etc.



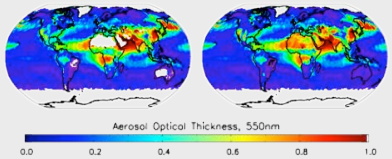

## Background

### About Deep Blue

Because of the difficulty in separating the signals of aerosols from those of highly reflective surfaces, aerosol retrievals over bright surfaces, such as deserts, have been limited. The MODIS Deep Blue aerosol retrieval algorithm uses the blue channels, where the surface contribution is relatively low, to retrieve aerosol properties over such regions (Hsu et al., 2004; 2006).

### The Deep Blue Advantage

Deep Blue fills in data gaps left by the Dark Target-Land aerosol retrieval, which does not operate over bright surfaces. Below are average aerosol optical thickness (AOT) maps for the summer (JJA) of 2008 from MYD04_L2 Aerosol Product without Deep Blue (left) and with Deep Blue (right). Note how important aerosol source regions, such as the Sahara Desert are filled in when Deep Blue is included.




### Data Availability

MODIS Deep Blue data is contained in the following MODIS Atmosphere products:

| | |
|---|---|
| Level 2 Aerosol Product | **MYD04_L2** |
| Level 2 Joint Atmosphere Product | **MYDATML2** |
| Level 3 Daily Product | **MYD08_D3** |
| Level 3 8-Day Product | **MYD08_E3** |
| Level 3 Monthly Product | **MYD08_M3** |

…and soon to be in Terra equivalents (MOD04_L2, etc., see right panel). Data can be downloaded from the LAADS website (http://ladsweb.nascom.nasa.gov).

### Collection 5.1

Major updates to the Deep Blue algorithm were included in the MODIS-Aqua reprocessing (Collection 5.1), which finished Spring 2009. Changes included:

- ✧ Refinement of QA/QC flags
- ✧ Improved cloud screening procedures
- ✧ Parameterization of BRDF effect on surface reflectances over desert

## Validation with AERONET over bright surfaces

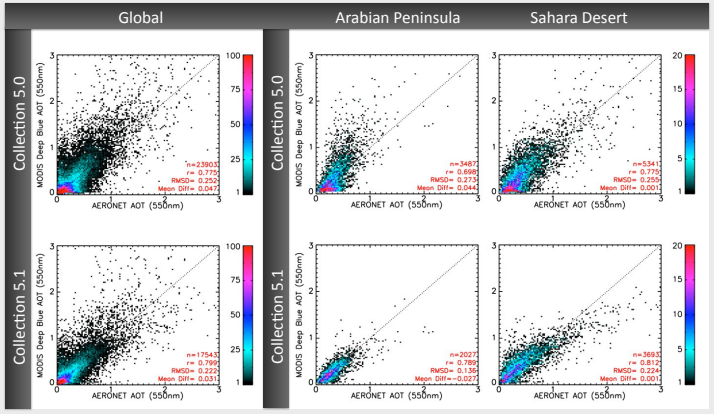
### Validation Methodology

MODIS-Aqua Deep Blue AOT retrievals are validated against the global AERONET sun-photometer network. The MODIS Atmosphere Parameters Subset Statistics (MAPSS) collocation tool (Ichoku et al., 2002) is used to create data pairs; collocated AERONET-MODIS pairs are composed of (1) the mean of all AERONET values +/- 30 minutes of MODIS overpass time and (2) the mean value of the 5x5-pixel MODIS box surrounding the AERONET site. AERONET data are constrained to Level 2.0 (Quality Assured). MODIS-Aqua Deep Blue data are constrained to QA=3.

### Density Plots

The map at right pinpoints AERONET sites around the globe where collocated Deep Blue retrievals exist. Thus far, site-specific validation efforts are concentrated in the Sahara Desert and the Arabian Peninsula, two important aerosol source regions. The entire MODIS-Aqua dataset is used, from July 2002 to December 2008.

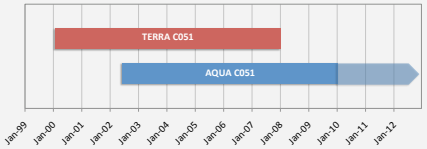
The improved agreement of Collection 5.1 versus Collection 5.0 is shown in the density plots below. Comparisons are separated by region, with global (left), Arabian Peninsula (middle) and Sahara Desert (right) results shown.




For all three regions, correlation coefficients (r) increase while root mean squared difference (RMSD) and mean difference values decrease from Collection 5.0 to Collection 5.1. Differences in the number of collocated pairs stem from the updated QA/QC in Collection 5.1.

## Coming soon: Terra Collection 5.1

The Collection 5.1 (C051) MODIS-Terra reprocessing is set to begin this month (see poster by M.-J. Jeong). Deep Blue datasets will be available in MODIS-Terra products from the start of the mission (Feb 2000) through Dec 2007. The timeline below illustrates Deep Blue C051 availability for both MODIS platforms.




NOTE: Files are posted to LAADS as soon as they become available. Make sure to select "51 - Collection 5.1".

## Plans for Collection 6

For the next major update, Collection 6, we plan to:

- ✧Extend coverage to vegetated regions
- ✧Improve surface reflectance database
  - Continue using minimum reflectivity technique
  - Use entire available time series for Terra and Aqua
- ✧Update phase function for dust models
- ✧Provide integer QA flag
  - Much easier to use than bit flags
  - Analogous to Dark Target team plan
- ✧Provide combined Dark Target/Deep Blue SDS
- ✧Provide 3km resolution products in addition to standard 10km
  - Analogous to Dark Target team plan

## Summary

The MODIS Deep Blue aerosol retrieval algorithm is an important addition to the MODIS Aerosol Product, as it fills in data gaps over bright surfaces, such as deserts. Recent updates to the algorithm, termed "Collection 5.1", yield improved AOT agreement compared to AERONET values as seen by global and local comparisons over six years of MODIS-Aqua data. The upcoming MODIS-Terra Deep Blue Collection 5.1 reprocessing will extend the Deep Blue record back to 2000 and allow for further validation and inter-comparision (e.g. with MISR) studies.



Hsu, N. C., S.-C. Tsay, M. D. King, and J. R. Herman (2004). Aerosol properties over bright-reflecting source regions. *IEEE T. Geosci. Remote, 42(3)*, 557–569.
Hsu, N. C., S.-C. Tsay, M. D. King, and J. R. Herman (2006). Deep blue retrievals of asian aerosol properties during ACE-Asia. *IEEE T. Geosci. Remote, 44(11)*, 3180–3195.
Ichoku, C., D. A. Chu, S. Mattoo, Y. J. Kaufman, L. A. Remer, D. Tanré, I. Slutsker, and B. N. Holben (2002), A spatio-temporal approach for global validation and analysis of MODIS aerosol products. *Geophys. Res. Lett.*, 29(12):10.1029/2001GL013206.