

Aerosol Dark Target (10km & 3km)

Collection 6.1 Changes

Terra/Aqua MODIS

Version 2.0 (17 July 2017)

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Note that numbers 1.) through 5.), below, were implemented in both the 10km and 3km Aerosol Dark Target Products. Only number 6.) in the 3km section at bottom was unique to that product.

10 km Dark Target (MOD04_L2, MYD04_L2)

- 1.) A bug fix was implemented, which created problems running the code on Centos7. To fix this run-time issue, a few redundant subroutines were taken out.
- 2.) For Ocean only: Added reflectance, standard deviation, aerosol cloud fraction, and number of pixels for retrievals when optical depth is zero or very small. All earlier PGE04 Versions (Collections) reported only optical depth in these cases.
- 3.) For Ocean only: Modified the sediment mask to make it more robust.
- 4.) For Land only: Degraded the quality of retrievals to zero if there are more than 50% coastal pixels or 20% of water pixels in 10x10 km grid.
- 5.) For Land only: Modified algorithm for Aerosol retrieval over land surface when urban percentage is larger than 20% using a revised surface characterization (Gupta et al., 2016). MODIS land cover type data set is used to identify urban pixels. The revised surface ratios for urban regions were created using MYD09 spectral surface reflectance product.

3 km Dark Target (MOD04_3K, MYD04_3K)

- 1.) A bug fix was implemented which created problems to run code on Centos7. Few redundant subroutines were taken out.
- 2.) For Ocean only: Added reflectance, standard deviation, aerosol cloud fraction, and number of pixels for retrievals when optical depth is zero or very small. All earlier PGE04 Versions (Collections) reported only optical depth in these cases.
- 3.) For Ocean only: Modified the sediment mask to make it more robust.
- 4.) For Land only: Degraded the quality of retrievals to zero if there are more than 50% coastal pixels or 20% of water pixels in 10x10 km grid.
- 5.) For Land only: Modified algorithm for Aerosol retrieval over land surface when urban percentage is larger than 20% using a revised surface characterization (Gupta et al., 2016).

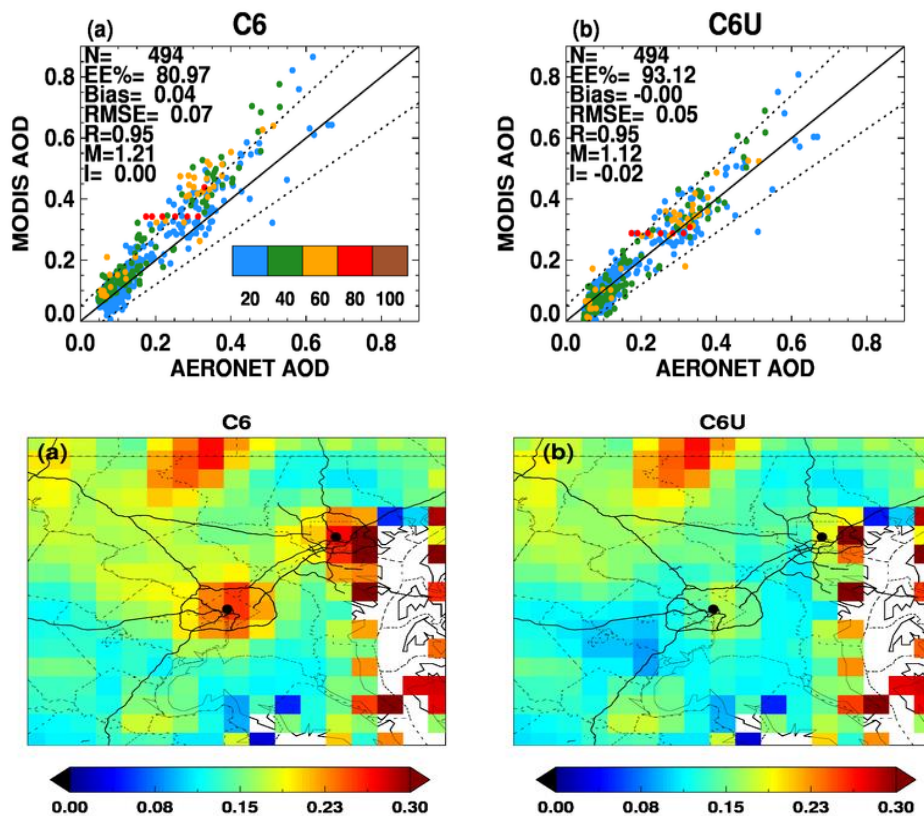
MODIS land cover type data set is used to identify urban pixels. The revised surface ratios for urban regions were created using MYD09 spectral surface reflectance product.

6.) Created a new SDS called BowTie_Flag. It is set to 0 when the bowtie effect is detected.

Revised Surface Scheme over Urban Area inside MODIS dark target land aerosol retrieval algorithm

Summary: In this study, we address the inaccuracies produced by the MODIS Dark Target (MDT) algorithm aerosol optical depth (AOD) retrievals over urban areas and suggest improvements by modifying the surface reflectance scheme in the algorithm. By integrating MODIS Land Surface Reflectance and Land Cover Type information into the aerosol surface parameterization scheme for urban areas, much of the issues associated with the standard algorithm have been mitigated for our test region, the continental United States

(CONUS). The new surface scheme takes into account the change in underlying surface type and is only applied for MODIS pixels with urban percentage (UP) larger than 20%. Over the urban areas where the new scheme has been applied (UP > 20%), the number of AOD retrievals falling



within expected error (EE %) has increased by 20 %, and the strong positive bias against ground-based sun photometry has been eliminated. However, we note that the new retrieval introduces a small negative bias for AOD values less than 0.1 due to the ultra-sensitivity of the AOD retrieval to the surface parameterization under low atmospheric aerosol loadings. We have applied and tested this approach over global regions and found that the new urban surface parameterization is able to correct AOD biases over urban areas. This can be further improved with more research and optimization of the newly developed

scheme for global region as well as for MODIS high-resolution (3km) aerosol product. Seasonal (March-April-May, 2011) maps of MODIS AOD at 0.55 μm as retrieved by C6 (a), C6U (b) (top panels). MODIS AODs with QAF=3 for three months have been averaged over 0.1x0.1 degree grids to generate these maps. C6U MDT retrieved AODs are lower over large cities as compared to C6 AODs, and the improvements are well correlated with UP.

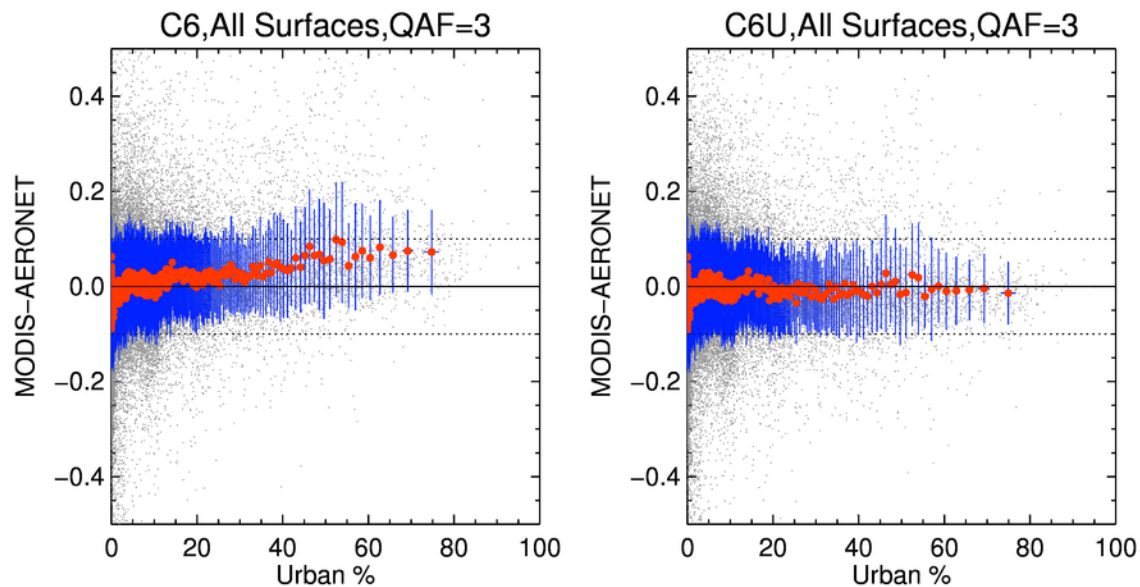


Figure 1. Figure 2. Binned bias in MODIS AODs compared to AERONET AODs as a function of UP using all collocated data sets with QAF = 3. This analysis used data from global (excluding CONUS region) AERONET network for the period of January 2003– June 2013. MODIS C6 retrievals are on the left and MODIS C6U retrievals are on the right. Each bin represents 100 points and the error bars are ± 1 standard deviation in both directions. There are a total of 50 948 MODIS–AERONET collocated points from 302 stations compared in this plot. C6 AODs show increased in bias over urbanized land surfaces whereas C6U is able to correct the bias over the region for QAF = 3 data points.

References

Gupta, P., Levy, R. C., Mattoo, S., Remer, L. A., and Munchak, L. A.: A surface reflectance scheme for retrieving aerosol optical depth over urban surfaces in MODIS Dark Target retrieval algorithm, *Atmos. Meas. Tech.*, 9, 3293-3308, <https://doi.org/10.5194/amt-9-3293-2016>, 2016. <http://www.atmos-meas-tech.net/9/3293/2016/amt-9-3293-2016.pdf>