Analysis of MAIAC Dust Aerosol Retrievals from MODIS over North Africa

A. Lyapustin,[a] Y. Wang,[b] C. Hsu[a], O. Torres[a], G. Leptoukh[c], O. Kalashnikova[d], S. Korkin[e]

Abstract. An initial comparison of aerosol optical thickness over North Africa for year 2007 was performed between the Deep Blue and Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithms complimeted with MISR and OMI data. The new MAIAC algorithm has a better sensitivity to the small dust storms than the DB algorithm, but it also has biases in the brightest desert regions indicating the need for improvement. The quarterly averaged AOT values in the Bodele depression and western downwind transport region show a good agreement among MAIAC, MISR and OMI data, while the DB algorithm shows a somewhat different seasonality.

1. Introduction

MODIS is a wide field-of-view sensor providing daily global observations of the Earth. Currently, global MODIS aerosol retrievals over land are performed with the main Dark Target algorithm [1] complimented with the Deep Blue (DB) algorithm [2] over bright deserts. The Dark Target algorithm relies on surface parameterization which relates reflectance in MODIS visible bands with the 2.1 μm region, whereas the Deep Blue algorithm uses an ancillary angular distribution model of surface reflectance developed from the time series of clear-sky MODIS observations. Recently, a new Multi-Angle Implementation of Atmospheric Correction (MAIAC) algorithm has been developed for MODIS [3]. MAIAC uses a time series and an image based processing to perform simultaneous retrievals of aerosol properties and surface bidirectional reflectance. It is a generic algorithm which uses the same principles over both dark vegetative and bright surfaces, and performs retrievals at 1 km resolution.

Retrieving aerosol over bright desert regions is difficult, and the associated accuracy is not yet well understood. This work provides an initial comparison between the DB and MAIAC aerosol products over selected bright AERONET [4] sites as well as over the North Africa for year 2007. This analysis is complimented with aerosol data from OMI [5] and MISR [6].

2. Aerosol Data Comparison

Figure 1 shows a comparison between MAIAC and AERONET AOT at 0.47 μm for the

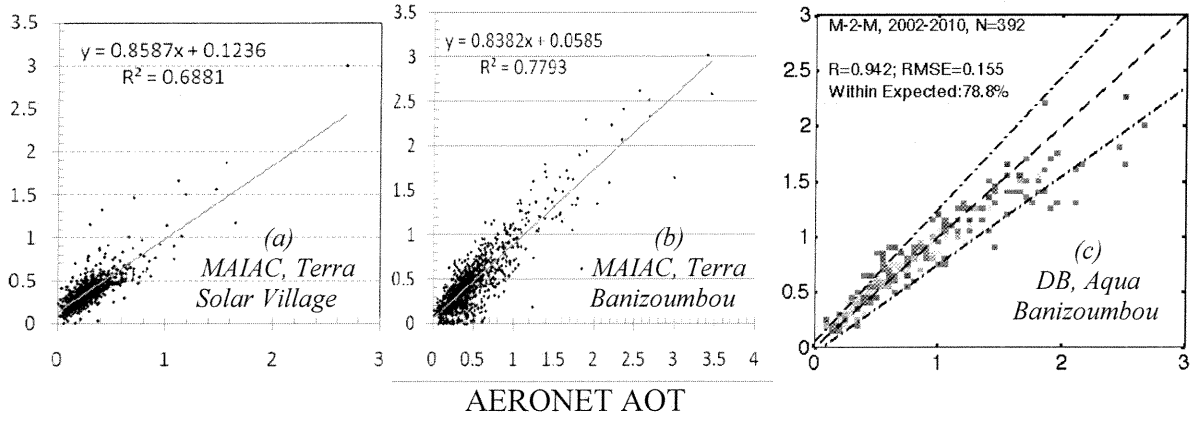

Figure 1. MODIS Terra MAIAC AOT (0.47 μm) vs AERONET AOT for the Solar Village, Saudi Arabia (a) and Banizoumbou, Niger (b) sites, and MODIS Aqua Deep Blue AOT vs AERONET at Banizoumbou (c).

bright Solar Village (Saudi Arabia) site (a). Scatterplots (b-c) give the same comparison for MAIAC and DB algorithms for Banizoumbou site, Niger, showing a generally similar performance except DB algorithm producing lower values at AOT≥1.2. For the purpose of this work, we processed 1 year (2007) of MODIS data for the North Africa with MAIAC algorithm.

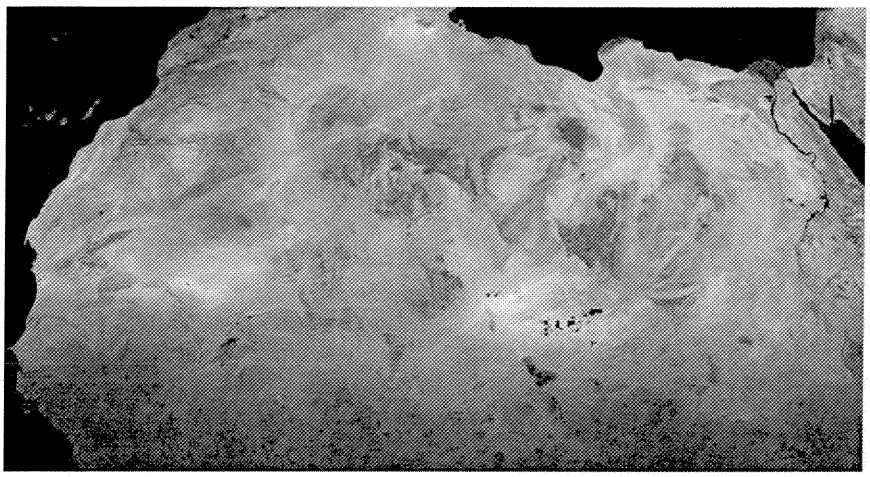

Figure 2. MAIAC RGB normalized bidirectional reflectance (NBRF) of the study area for the nadir view geometry and SZA=45°.

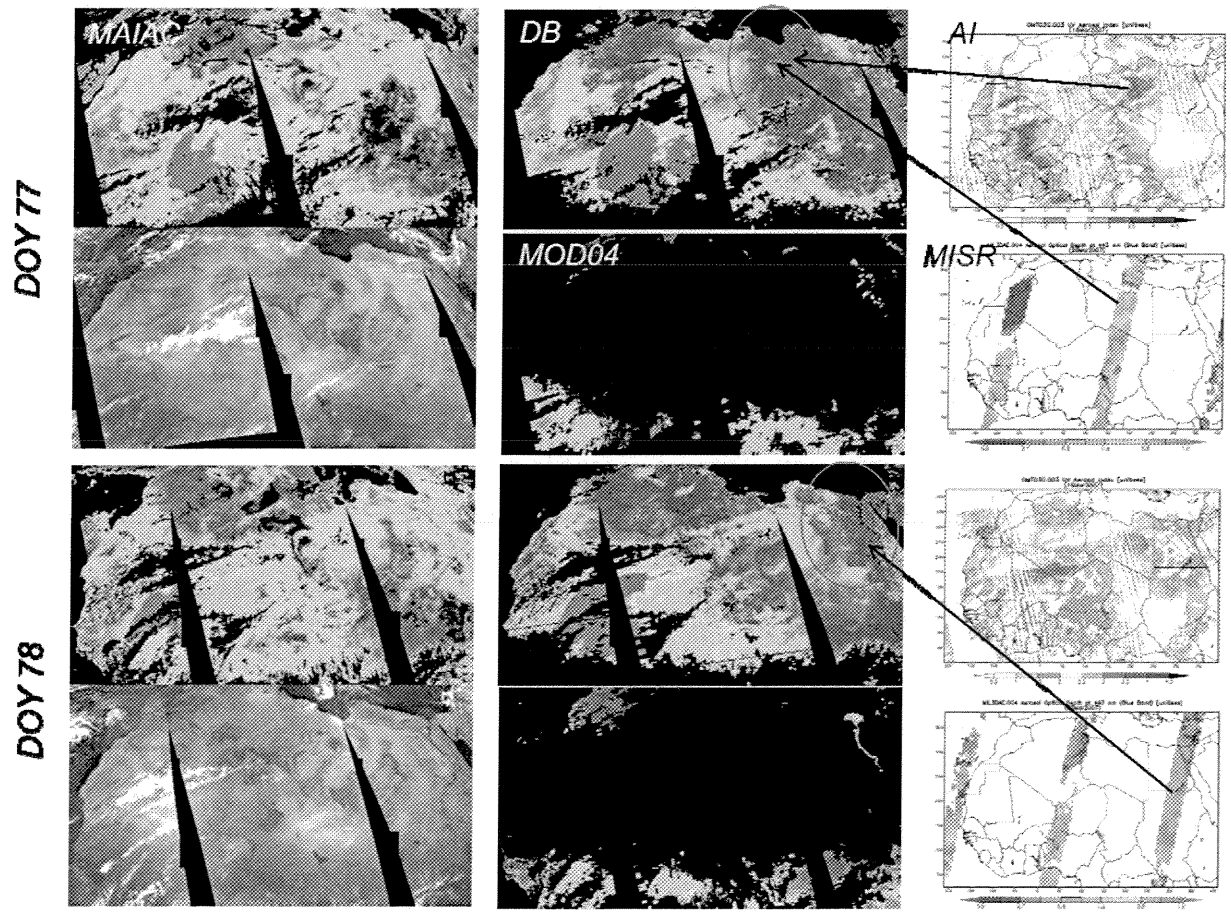

Figure 3. An example of MODIS MAIAC, DB and Dark Target (MOD04) AOT, MISR AOT and OMI Aerosol Index (AI) for days 77-78 of 2007.

Figure 2 shows an RGB image of the surface bidirectional reflectance from MAIAC for the study area. In the context of MAIAC processing, this image can be considered as a static well-characterized background which is required for the cloud masking and aerosol retrievals. An example of comparison among MODIS MAIAC, DB, Dark Target (MOD04), and MISR AOT as well as OMI Aerosol Index (AI) is shown in Figure 3 for two days (77-78) of 2007. This figure shows that 1) MAIAC and DB algorithm AOT is similar in the source and downwind transport regions, and 2) MAIAC is more sensitive detecting more dust aerosol events, which can be confirmed by the OMI and MISR data (see marked regions).

The next Figure 4 shows a seasonally averaged AOT from DB, MAIAC and MISR as well as OMI AI. This Figure shows that current version of MAIAC algorithm has surface-induced AOT biases in the north-eastern and western regions indicated by the oval shapes. On the other hand, the seasonal AOT pattern in the Bodele depression and western downwind regions agrees well among MODIS MAIAC, OMI and MISR data, and has less agreement with DB data. In particular, MAIAC, OMI and MISR show higher AOT in the second and third quarters of the year whereas DB algorithm shows strongest activity in the first three months and a substantial reduction of activity in the third quarter.

This initial analysis shows a good potential of MODIS MAIAC algorithm for dust aerosol retrievals over Saharan region, as well as a need for further development in the areas of maximal surface brightness producing AOT bias.

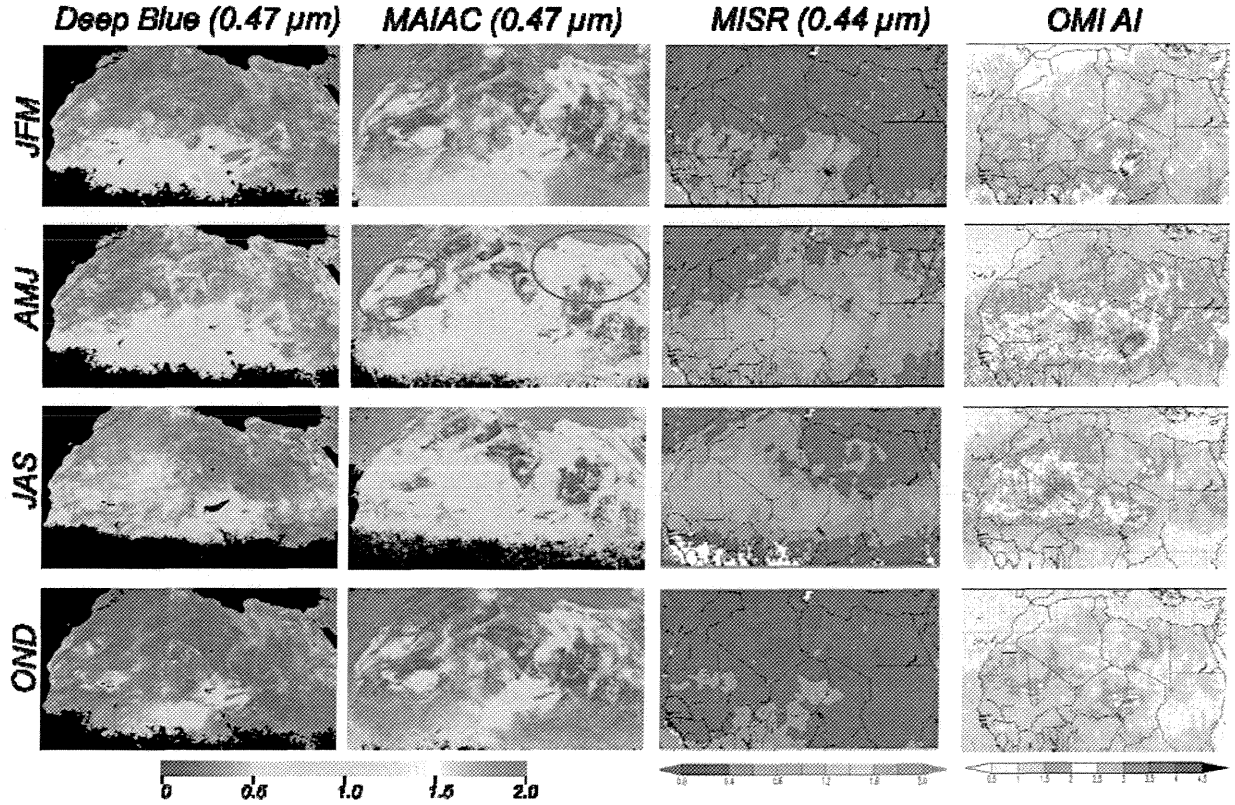

Figure 4. Quarterly Averaged AOT from Deep Blue, MAIAC and MISR algorithms and OMI AI for 2007. The ovals show the regions of biased MAIAC retrievals.

Acknowledgements

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[a]Laboratory for Atmospheres, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA
[b]University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore, MD, USA
[c]NASA Goddard Space Flight Center, code 610.2, Greenbelt, Maryland, USA
[d]NASA Jet Propulsion Laboratory, Pasadena, CA, USA
[e]Universities Space Research Association, 10211 Wincopin Circle, Columbia, MD, USA.

E-mail: Alexei.I.Lyapustin@nasa.gov