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Atmospheric Measurement Techniques Discussions

Interactive comment on "Accuracy Assessment of MODIS Land Aerosol Optical Thickness Algorithms using AERONET Measurements" *by* Hiren Jethva et al.

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Dear Reviewer,

Thanks for offering your valuable comments on our manuscript # amt-2019-77. We have tried our best to incorporate all your suggestions, which have greatly improved the scientific merit of the paper. In the revision, two important and major changes have been applied according to the suggestions made by Reviewer # 3. These changes include,

1) use of the latest AERONET version 3 dataset (instead of version 2 used in the

original paper) 2) replacement of MAIAC BRF dataset with the MODIS standard BRF product (MOD09) in performing error characterization vs. BRF shown in Figure 6.

With these two changes, the entire analysis presented in the paper was reperformed to derive results tabulated in Table 3, 4, and Figure 1 through 6. While using AERONET version 3 dataset provided increased matchups and marginal change in the resultant statistics of the comparison (R, RMSE, bias, slope, intercept), the overall interpretation and conclusion of the MODIS-AERONET comparison for all three algorithms, i.e., DT, DB, and MAIAC, presented in the original paper haven't altered.

Following is the one-to-one response to each comment/suggestion made on the submitted manuscript.

RC: Referee's comment AR: Author's response

RC: Throughout the paper: I suggest to replace GOES R/S with now standard GOES 16/17. AR: Suggestion considered in the revision.

RC: P. 3, Ln. 20: "The combination of sub-kilometer spatial resolution" It is 500m only in the Red band. Vis-NIR bands are at 1km, and 2.25um is at 2km resolution. AR: The sentence is revised as, "The combination of 500 m to 2 km spatial resolutions and multispectral observations in the visible to shortwave-IR make the ABI an optimum sensor for the derivation of an aerosol optical thickness (AOT) product. . ."

RC: Ln. 28: Replace "Spectrometer" with Spectroradiometer for both MODIS and MISR AR: Corrected.

RC: P.6, ln.20: Please, replace "061" with 6.0. Also, everywhere through the paper: MODIS DB and DT are Collection 6.1. MAIAC currently is Collection 6.0. AR: Corrected.

RC: Ln.11: "MAIAC considers two discrete aerosol models": This is correct for a given location. However, MAIAC has 7 different regional aerosol models for different regions of the world. Besides, the DT algorithm tries to mix the background model with the dust

model resulting in the fine mode fraction, whereas MAIAC uses either the background model or the dust model, if the dust has been detected.

Also, since the algorithm has rather significantly changed from 2011 to 2018 publications, I suggest that the initial reference adds the 2018 paper which really represents the MAIAC dataset used in this study.

AR: The suggested information on MAIAC's choice of aerosol model and a reference of Lyapustin et al. (2018) are clarified in the revised paper.

"MAIAC considers two discrete aerosol models, i.e., background and dust for a given location, similar to the ones adopted in MODIS dark target algorithm (Levy et al., 2007). However, MAIAC prescribes 7 different regional aerosol models for different regions of the world and uses either background model or dust model, if the dust aerosols are detected."

"The MAIAC aerosol dataset used in the present study is derived using the latest Collection 6.0 version of the algorithm documented in Lyapustin et al. (2018), for which the AOT accuracy can be evaluated as ïĆś(0.05+15%)*AOT or even better ïĆś(0.05+10%)*AOT as shown in a global validation analysis."

RC: P.6, ln26: "designed to do aerosol remote sensing". I suggest you remove this part as it doesn't sound right. It is ground-based sunphotometry, and "remote sensing" is usually associated with satellites. AR: Both AERONET and satellite do remote sensing of aerosols albeit the former does it from ground, whereas the latter from space. To avoid the possible confusion, the sentence is modified as,

"The Aerosol Robotic Network (AERONET) project is a ground-based federated network of globally distributed Cimel Sun photometers designed to measure aerosol optical and microphysical properties (Holben et al., 1998)."

RC: Ln.30: What is "radiative" properties? AR: We meant "radiative" as the properties of aerosols largely determining the aerosols forcing on climate. Fundamentally, the

measures of aerosol such as AOT, SSA, and asymmetry parameter are the driving intrinsic properties that play a key role in modulating aerosol forcing. The sentence is now simplified by removing "radiative properties".

"...and readily accessible public domain database of aerosol optical and microphysical properties."

RC: P.7, Ln.10: Given resolution of DB and DT is for the nadir only, it grows with the scan angle. "While AOT from all three aerosol products corresponds to an area intercepted in their respective spatial grid cells representing the atmospheric conditions over a small region, the direct measurements of the spectral AOT from AERONET sunphotometer are columnar point measurements." - It is not clear what you are saying, please re-write. AR: The sentence is revised as,

"While all three aerosol products report AOT at their respective nadir spatial resolutions, i.e., 10 km and 3 km for DT, 10 km for DB, and 1 km for MAIAC, representing the atmospheric conditions over the respective area intercepted at the ground,..."

RC: Table 1 (MAIAC): Replace collection with 6.0, and remove "at nadir". MAIAC gives 1km2 everywhere. AR: Corrected.

RC: Table 2: Add +- for the time interval. I don't understand the name "Spatial Grid km2" – is this the box size? The Figure 1 is very clear, but the name of the column, and also the description of the time-space collocation in the paper are very fuzzy. It will help if you improve the description. AR: +/- sign added to the time window column. "Spatial Grid km2" replaced with "Grid box size in km2". While we believe that the description of the collocation approach and spatiotemporal windows is adequate, we tried to improve the clarity by modifying the text in section 2.5

RC: Fig.5, Caption: remove "combinedly" AR: Figure 5 caption is revised as, "Scatterplots comparing MODIS-AERONET AOT matchups obtained over all sites located in eastern NA (top panel) and western NA (bottom panel)."

RC: P.9, Ln.21: “relatively better statistics”: This is a significantly better statistics. How do you define “relatively”? AR: We meant relatively w.r.t to the MODIS-AERONET statistical comparison obtained from other two aerosol algorithms.

RC: P.11, Ln.2: The use of “relatively highest” is confusing: it is either highest or not. Also, MAIAC slope 0.87 over Eastern USA seems to be closer to 1 than the slope of DT (1.17) – doesn’t it? AR: The sentence is revised as, “Given the simultaneous measurements of AOT and equal sampling among the three algorithms, MAIAC provides highest correlation (0.9 and 0.84) and lowest RMSE (0.053 and 0.052) over eastern and western NA sites, respectively”

RC: P. 11, Ln.22: The DB algorithm does not “assume” surface reflectance. The monthly surface reflectance database, binned over scattering angles, is derived from the previous years of measurements using the minimum reflectance method. In this sense, MAIAC approach is methodologically similar, though it derives SR spectral ratios via dynamical time series analysis from the latest measurements (on the fly). AR: The surface reflectance (SR) dataset used in the DB algorithm is created from the full time-series and revised during each reprocessing. The SR dataset is essentially based on minimum reflectivity approach and binned by scattering angle, season, and NDVI with no time dimension except for the seasonal split. Over vegetated surfaces, DB follows the spectral ratio approach similar to that of DT. The hybrid method scales SR by regional BRDF shape, based on atmospheric correction near AERONET sites. We have further clarified this in the DB data section.

RC: P. 12: Just to note that Superczinsky et al. 2017 (JGR) found similar dependence on SR in comparison of VIIRS (a version of DT approach) and MAIAC. AR: The findings of Superczynski et al. (2017) supporting our results are mentioned in the revision as,

“Superczynski et al. (2017) further supports our findings using the AOT validation results of the Suomi-NPP Visible Infrared Imaging Radiometer Suite (VIIRS) aerosol algorithm essentially basing on the DT approach, where VIIRS-derived AOTs are found

to be bias significantly higher w.r.t to AERONET measurements over North America at larger values of coincident MAIAC-retrieved surface reflectance.”

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