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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison of AOD between CALIPSO and MODIS: significant differences over major dust and biomass burning regions" *by* X. Ma et al.

Anonymous Referee #1

Received and published: 24 December 2012

Comments to the Editor:

In this paper, author compares the aerosol optical depth (AOD) retrieved by two sensors namely, CALIPSO/CALIOP and Terra-Aqua/MODIS, over major dust and biomass burning regions of the world. Author uses level-3 gridded dataset available from both sensors to perform the analysis. They find that though the spatial patterns in AOT appear similar CALIOP tends to retrieve much lower AOD over the Sahara and northwest China; both are source regions of dust outbreaks. On the other hand, CALIOP is found to be higher-than-MODIS in the retrieved AOD over southern African region

where seasonal biomass burning takes place. However, during burning season over South America, CALIOP tends to be lower-than-MODIS which apparently linked to the aerosol load/AOD. Finally, author attributes the discrepancies observed between two sensors to the algorithmic issues such as lidar ratio in CALIOP inversion and aerosol model and surface reflectance in MODIS algorithm.

Though author calls for further research to narrow down the exact source of bias, he/she doesn't show in this paper which sensor is closer to the ground-truth. My main suggestion to author is that he/she should compare both satellite retrievals with AERONET-measured direct AOD values in order to establish the validity of the two products.

Second, the present analysis uses dataset at much coarser resolution than the respective products native higher resolutions. In such analysis, author should discuss about the statistics about the retrievals collected in each grid box which is missing altogether in the paper. This is essential to make a reasonable comparison between two sensors whose temporal/spatial coverage is very different.

This paper also lacks in adequate discussion on the assumptions made in the two algorithms which are critical for ensuring the predicted accuracy. At least a brief discussion on this is required.

I have attached my specific comments and suggestions to authors. I would prefer to reconsider this paper once the satisfactory response received from author and appropriate changes/modification made to the present manuscript.

Thank you,

Wishes,

Dr. Hiren Jethva USRA/NASA GSFC Greenbelt, MD, USA

General comments to authors: In this paper, author compares the aerosol optical depth (AOD) retrieved by two sensors namely, CALIPSO/CALIOP and Terra-Aqua/MODIS,

over major dust and biomass burning regions of the world. Author uses level-3 gridded dataset availale from both sensors to perform the analysis. They find that though the spatial patterns in AOT appear similar CALIOP tends to retrieve much lower AOD over the Sahara and northwest China; both are source regions of dust outbreaks. On the other hand, CALIOP is found to be higher-than-MODIS in the retrieved AOD over southern African region where seasonal biomass burning takes place. However, during burning season over South America, CALIOP tends to be lower-than-MODIS which apparently linked to the aerosol load/AOD. Finally, author attributes the discrepancies observed between two sensors to the algorithmic issues such as lidar ratio in CALIOP inversion and aerosol model and surface reflectance in MODIS algorithm.

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Specific comments to authors: Abstract, page 8344, line 4: remove line " but further research is needed to evaluate CALIPSO products" Abstract, page 8344, line 25: Author can make such statement only when both satellite retrievals (CALIOP and MODIS) are significantly depart from the ground-truth such as AERONET-measured AODs for

which author needs to present an anlysis on CALIOP/MODIS Vs. AERONET AOD comparison.

Introduction, page 8345, line 11: Add OMI and SeaWiFs in the list. Introduction, page 8345, line 13: Recently, Bond et al. (after 2009) have analyzed the impact of vertical profile of BC on the radiative forcing.

Section 2.1 CALIPSO, page 8346, line 23: "CALIPSO/CALIOP was launched on 28 April 2006 as a part of NASA's A-train constellation..."

Section 2.2 MODIS, page 8347, line 14: "MODIS measures TOA radiances" Section 2.2 MODIS, page 8347, line 20: Difference in retrieved AOD by Terra and Aqua MODIS can also be attributed to different aerosol mass and sensor calibration. Section 2.2 MODIS, page 8347, line 22: citations provided here are old and applicable to the MODIS Collection 004 products. Use Levy et al. (2007) – JGR which launched Collection 005 products.

Section 3, page 8348, line 2: Do author average MODIS AOD retrievals in 2 by 5 deg box to match with CALIOP?

Section 3.1, page 8349, lie 6-9: the dection limit issue can also be a problem for MODIS.

Seciton 3.2.2, page 8351, line 21: Add Torres et al. (2009 or 2010) here which addresses the inter-annual variability over S. America.

Table 1: it is interesting to see how close are Terra and Aqua despite some calibration issues realized in Terra during later years. Do you think that the noise in CALIOP measurements in daytime reduces AODs?

Figure 1. author should compare CALIOP daytime retrievals with Aqua/MODIS since both fly on A-train constellation with few mintues time difference.

Figure 3. binning AODs would make plot readable and also convey the message that

CALIOP<MODIS. Keep current plot but superimposed with binned AODs.

Figure 4. see above comments.

Figure 5. Here, I have few thing to say. First, why don't author compare CALIOP and MODIS with AERONET over these regions? For this purpose, author may select a representative AERONET site located in these regions and compare both satellite retrievals against ground-truth AERONET. Second, over both desert regions, the message is clear that CALIOP is significantly lower than MODIS. However, CALIOP behaves differently over biomass burning regions where it retrieves higher-than-MODIS AODs over S. Africa and lower-than-MODIS over S. America. This is surprising to me because both are dominated by the intense biomass burning activities during dry season and therefore I expected CALIOP to deliver similar AOD retrievals compared to MODIS. Can author make any point here. Also, it appears that the tendency of CALIOP to be higher-than-MODIS over S. America is dependent on the aerosol load/AOD.

Figure 6. CALIOP also derives feature mask which will be helpful in associating the difference with particular aerosol type. Author should use AERONET-measured Angstrom Exponent for a representative site or a few sites located in the respective regions to infer the dominant particle size which can be associated with the aerosol type.

Figure 9. Difference between CALIOP and MODIS apparently link to aerosol load/AOD over S. America. Here, an additional scatter plot of diff. vs. AOT would convey this message.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 8343, 2012.