The authors thank the referee for the constructive helpful comments. Below, the original comments are italicized and black, while our response is bolded and blue. We have revised the manuscript accordingly.

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. 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.

Thank you for the suggestions. We have added one section (section 3.4) to compare CALIPSO and MODIS AOD with AERONET observations. Please see the details in this added section.

Second, the present analysis uses dataset at much coarser resolution than the respective prodcuts 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.

We have added one paragraph (section 3.3) to address the sampling issue. We examined the sampling days in the CALIPSO monthly mean 2º×5º resolution data (Fig.10), and found that there are generally 5-8 days in a month (Sahara, July 2007) that has CALIPSO observations, which are then used to obtain the monthly average. To reduce the uncertainty caused by this sampling issue, we used level-3 daily MODIS AOD 1º×1º to re-compute MODIS monthly average, in which only those days having CALIPSO observations are taken into account for the monthly mean. This approach allows us to obtain the monthly average AOD for both CALIPSO and MODIS corresponding to the same observational days. As shown in Fig.10, the modified MODIS monthly mean AOD, has a slight difference compared to the original one, but is still higher than CALIPSO AOD, which is consistent with our findings. To further investigate this issue, we applied this approach to all 4 regions as well as a complete year in 2007. The results shown in Fig. 11 compare the AODs

from CALIPSO, MODIS, and modified MODIS over 4 regions. It can be seen that the sampling issue, while causing slightly different AODs, does not affect the findings of this manuscript.

Specific comments to authors: Abstract, page 8344, line 4: remove line "but further research is needed to evaluate CALIPSO products".

We have removed the line.

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 analysis on CALIOP/MODIS Vs. AERONET AOD comparison.

We have compared AOD from both CALIPSO and MODIS with AERONET observations, and modified the text in the abstract accordingly.

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.

The text has been modified as suggested.

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..."

The text has been modified as suggested.

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.

The text has been modified as suggested.

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

Yes, we re-gridded MODIS AOD from 1°×1° to 2°×5° to match with CALIPSO/CALIOP.

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

The text has been modified as suggested.

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.

The reference has been included.

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?

In terms of global multi-year annually averaged values, AODs from Terra and Aqua are very close. But CALIOP AODs at daytime are generally much lower than at nighttime, as shown in Table 1. As previous studies pointed out, the lidar observations at nighttime have higher accuracy than that at daytime because sunlight complicates the aerosol retrievals (Yu et al., 2010).

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

The figures and associated text have been modified as suggested.

Figure 3. binning AODs would make plot readable and also convey the message that CALIOP<MODIS. Keep current plot but superimposed with binned AODs.

We are not sure what the referee means here. The inserted plots have shown the frequency of binning AODs from both CALIPSO and MODIS.

Figure 4. see above comments.

Same as above.

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.

We have added one paragraph (section 3.4) to compare CALIPSO and MODIS AOD with AERONET observations. As discussed in the text, over South Africa the AOD from CALIPSO appears to be closer to AERONET measurements than

MODIS, which is particularly apparent in the biomass burning seasons. Comparisons over South America show that MODIS seems to have better agreement with AERONET than CALIPSO. Over major dust regions, AERONET measurements are very limited. We didn't find any site which has more than 8 months continuous data available (our criterion to select data) over Northwest China, but found one site over the Sahara region (Tamanrasset INM). Comparisons based on this limited observations could not give evidence on which product is closer to the AERONET observations.

CALIOP behaves differently over biomass burning regions, where it retrieves higher-than-MODIS AODs over South Africa and lower-than-MODIS over South America. This could be due to the different burning type in the two regions. In South Africa, the burning is more of the flaming type, while in South America it is more of the smoldering type. As discussed in the manuscript, despite both South Africa and South America being dominated by the intense biomass burning activities during the dry season, total AODs could be different due to different species over the regions.

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.

CALIOP feature mask products categorize aerosols as several types, such as clean marine, dust, polluted continental, clean continental, polluted dust and smoke, so it only tells us which aerosol type it might be in each grid cell. In fact, in most cases aerosols occur as a mixture or combination of a few different species, e.g. even over major dust regions, there normally are other aerosol species. Therefore, CALIOP feature mask data will not help much in this study.

Similarly, AERONET-measured Angstrom exponent can provide us the information on particle size, but will not differentiate the aerosol species, e.g. over South Africa and South America, both of which are dominated by biomass burning activities. Aerosol particle size might be similar but could cause different AOD due to different aerosol species.

We think the current plot clearly demonstrates the variation of ΔAOD and its relationship with AOD from different aerosol species. An additional scatter plot is not necessary.