

General comments:

The authors have made some sincere efforts to address the questions and comments I raised. I feel the manuscript is improved considerably. In particular, the comparison of ACA frequency between MODIS--OMI and CALIOP Based retrievals is now solid and pretty comprehensive. However, I still feel the authors haven't adequately addressed what are the reasons for the differences between the two techniques. There are still quite a few speculations in this part without solid proofs, which can be further improved. Overall, I think the revised manuscript is worthy of publication, although a few technique points (in particular the one about MODIS Cloud fraction) should be clarified before acceptance.

We thank the reviewer/editor his/her comments.

Detailed comments:

- 1) *One of the major conclusions from the manuscript is that the “cloudy--sky ACA Frequency differences between the OMI--MODIS-- and CALIOP--based methods are mostly due to differences in cloud detection capability between MODIS and CALIOP as well as QA flags”. But it is made largely based on statistical results. It would be much more convincing if some level--2 images from CALIOP and/or MODIS can be shown to support the argument. For instance, it is speculated that the misidentification of heavy dust as cloud by MODIS could be an important reason for the abnormal high ACA frequency over North Africa. The argument would be more convincing if the authors can identify and show one or two cases from level--2 data, i.e., CALIOP vertical feature mask image side by side with MODIS observations. In general, I think it is a good idea to add some level--2 cases (could be supplementary materials) to support the argument regarding the “cloud detection capability between MODIS and CALIOP”.*

Response: This is a nice suggestion. We have included a case study, as suggested, in the revised version of the paper.

- 2) *Line 76: CALIOP is no longer the “lone” space--borne lidar. The Cloud--Aerosol Transport System has been in operation since early 2015. See <http://cats.gsfc.nasa.gov/>*

Response: Agreed. We have revised the sentence and removed the word “lone”.

- 3) *Line 167: it is very important to note that in MODIS operational product the fraction of successful retrieval (i.e., cloudy pixel with valid >0 COD) is significantly smaller than the total cloud fraction. This is because in collection 5 product pixels with broken clouds and highly heterogeneous pixels are excluded all together from optical thickness retrieval (a process called “clear--sky restoral”). In the latest collection 6 product, the clear--sky restoral process is removed. However, there are still a significant fraction of cloudy pixels that have failed cloud property retrievals (i.e., cloudy but no COD retrieval). A recent paper by [Cho et al., 2015] did a comprehensive analysis of such pixels. It may help the authors better understand this issue. Please clarify which version of MODIS*

cloud product is used in the paper and whether the cloud fraction means real cloud fraction or successful retrieval.

Response: Thanks for the suggestion. We have indicated in the paper that the MODIS Collection 5.1 products were used.

The 5-km resolution “Cloud Fraction” from the MODIS DYD06 data are used in this study. The 5-km resolution cloud fraction data is derived from the MODIS Cloud Mask (MYD035 product). The MODIS cloud mask is derived independent of the success of COD and LWP retrievals, thus the cloud fraction used in our study is a “real cloud fraction”. We have inserted this description into the text.

- 4) *Figure 2A: please also use different line styles in addition to color to distinguish lines for the sake of color blind readers.*

Response: We have changed Figure 2a to reflect the requested changes.

- 5) *The MODIS cloud fractions in Figure 7F and L seem too low to me. See my comments above about successful retrieval vs. total cloud fraction. Please also see Figure 2 in [King et al.,2013]. You need to clarify what is the definition of MODIS cloud fraction in the paper (i.e., Table 1)*

Response: This is a good question as well as suggestion. We have added the following explanation in the text:

“Readers should be aware that the spatial distribution of MODIS cloud fraction, as shown in Figs. 8f and l, differ from the spatial distribution of cloud fraction obtained from the standard MODIS cloud products (e.g. King et al., 2013) for a few reasons. First, Figs. 8f and l are constructed using the MODIS cloud fraction values from a collocated OMI, CALIOP and MODIS dataset, and thus, only near-nadir MODIS cloud mask data are used. Also, cloud fraction values (at a 5 km resolution) from the MODIS MYD06 product are used. To be consistent with the OMI-MODIS analysis, only the 5-km granules that are 100% cloudy (or 25 1-km MODIS pixels within a 5-km granule are all cloudy) are counted as cloudy granules. Thus, broken and/or non-contiguous clouds may be excluded in the cloud fraction calculation.”

- 6) *[Toth et al.2013] is missing from the reference list*

Response: We have added the reference to the list.

- 7) *Previous studies, e.g., [Holz et al., 2008], found pretty good agreement between MODIS and CALIOP cloud fraction retrievals, certainly not so large as shown in Figure 7. Please comment.*

Again, the following discussions have been added to clear the issue.

“Readers should be aware that the spatial distribution of MODIS cloud fraction, as shown in Figs. 8f and l, differ from the spatial distribution of cloud fraction obtained from the standard MODIS cloud products (e.g. King et al., 2013) for a few reasons. First, Figs. 8f and 8l are constructed using the MODIS cloud fraction values from a collocated OMI, CALIOP and MODIS dataset, and thus, only near-nadir MODIS cloud mask data are used. Also, cloud fraction values (at a 5 km resolution) from the MODIS MYD06 product are used. To be consistent with the OMI-MODIS analysis, only the 5-km granules that are 100% cloudy (or 25 1-km MODIS pixels within a 5-km granule are all cloudy) are counted as cloudy granules. Thus, broken and/or non-contiguous clouds may be excluded in the cloud fraction calculation.”