

Interactive comment on “The comparison of MODIS-Aqua (C5) and CALIOP (V2 V3) aerosol optical depth” by J. Redemann et al.

Anonymous Referee #1

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The paper is analyzing CALIOP version 2 and version 3 aerosol dataset and shows comparisons with MODIS aerosol optical depth retrieval using different quality flags to filter the data.

General comments: The paper address the important problem of understanding the discrepancies between different aerosol optical depth retrievals from space.

I believe the paper has a lot of potential but is too technical in its present state and the results are presented in such a way that it raises more questions than it solves. I suggest the paper to be accepted after the authors have significantly expanded the discussion part.

I am providing some guidance in the specific comments but in general, you simply need

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to answer more often "Why do the data behave this way ?" and "What does that mean in term of aerosol properties". Also, I would suggest to derive the best filter based only on CALIOP quality flags that provides the best agreement with MODIS data, this way your research could be directly used by CALIOP data users.

What I mean by "too technical" is that right now, the reader has to go back and forth between your paper and CALIPSO documentation. This could be avoided if you added a few more sentences of explanations. I believe this would greatly benefit the clarity of your paper.

Specific comments: 1) About " cloud fractions less than 1% " which is referred several times for example: p. 22988 L17-19 "A restriction to scenes with cloud fractions less than 1% (as defined in the MODIS aerosol retrievals) generally results in improved correlation ($R^2 > 0.5$), except for the month of July when correlations remain relatively lower." p. 22998 L5-6 "MODIS cloud fractions (as determined by the aerosol algorithm) to be below 1% (comparison # 4 in Table 1);" p. 22999 L12-14 "As an additional restriction to even more cloud-free conditions, Fig. 2c and f show the comparisons between MODIS and CALIOP for cloud fractions of less than 1% as defined by the MODIS aerosol product (Cloud Fraction Ocean)."

Why is a low cloud fraction helping ? Is it because MODIS retrievals are more reliable and a better reference in that case or that cloud creates problem in the CALIOP retrieval ?

2) p. 22989 L15-16 "with particular strengths over oceans where surface conditions are fairly well known."

Please change this sentence. The "surface conditions" are not well known but the dark surface approximation applies relatively well. The recent study of "Kleidman et al. 2011 IEEE TGRS" clearly shows an error in MODIS retrieval introduced by the assumption on wind speed (which influence the "surface conditions") but the error stays relatively low.

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3) p. 22991 L20-21 "However, their comparisons were screened very differently from our data set, making a quantitative comparison of results difficult."

It is a problem and before being published, you should devote some time (and a few more sentences in your paper) to understand and explain how another study using the same data is reaching different conclusions. The source of discrepancy may have important repercussions on your work so the differences should not be discarded with just one sentence.

4) p. 22994 L5-6 "refinements to the layer detection algorithm including the elimination of a bug in the cloud clearing code"

Please clarify how the new layer detection algorithm is different. "A bug has been fixed" is not enough.

5) p. 22988 L20-21 "Regional assessments show hot spots in disagreement between the two sensors in Asian outflow during April and off the coast of South Africa in July."

Where is that disagreement coming from ? Assumptions in MODIS retrieval, lidar ratio selection, something else ?

6) p. 22992 L25 "30m and 333m at"

This is true below around 8km. Although it should be ok for most aerosol studies, I suggest you add something like "A resolution going up to".

7) p. 22993 L12-15 "It should be noted that the CALIOP instrument was not primarily designed to provide AOD, but instead vertical profiles of aerosol backscatter, depolarization and extinction. As such, the derivation of AOD from integration of extinction profiles is subject to several limitations and uncertainties."

This sentence suggests the problem is coming from the integration of the extinction profile and that the extinction is working perfectly well but not the AOD. Although you explain it with more details later, this sentence is misleading and should be rewritten.

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8) p. 22997 L28 "CALIOP extinction retrievals to have quality flags of 0, 1 or 2"

What does that mean ? Please write a few words to describe what a quality flag of 0, 1 or 2 is and why it is better than a value of 3 and higher.

9) "CALIOP extinction retrievals to have uncertainties less than 200% when extinction is below negative 0.2km^{-1} , or less than 500% when extinction is greater than 2.5km^{-1} and to eliminate profiles for which any extinction retrievals do not have 10 said extinction coefficients and uncertainty limits (as described in comparison # 5 in Table 1);"

How is the uncertainty calculated ? How does that translate in term of aerosol properties ? Are high optical depth less likely to be present so dust and biomass burning plumes less likely to be included in the statistic ? It is important you try to explain the meaning of those uncertainties in term of aerosol properties.

10) "CALIOP relative AOD uncertainty calculated from the extinction uncertainties to be below 100% (comparison # 6 in Table 1)."

Same comment than 9)

11) "larger uncertainties in MODIS over-land AOD retrievals"

There may be more uncertainties in CALIOP as the surface reflectance is usually higher over land than over the ocean and the background noise will be higher. Please consider if it is important enough to be noted and add a few sentences of discussion if it is.

12) "CALIOP extinction retrievals to fall within the "valid range" (identified in the CALIPSO data products catalog as 0 to 1.25km^{-1}) (comparisons # 2–4 in Table1);"

What is a "valid range". How is that defined and calculated ? Are there specific kind of aerosols not within this range ?

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