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Discussions

Interactive comment on "Minimum Aerosol Layer Detection Sensitivities and their Subsequent Impacts on Aerosol Optical Thickness Retrievals in CALIPSO Level 2 Data Products" *by* Travis D. Toth et al.

Anonymous Referee #1

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The CALIPSO aerosol optical depth (AOD) for a particular profile is the sum of the extinction of various features identified as aerosol layers within it. Optically thin or diffuse layers may be missed due to detection limitations, leading to an underestimate of the total aerosol loading. The data product contains retrieval fill values (RFVs) when no aerosol layer is detected. Whether these are counted as zeroes or not when creating aerosol climatologies affects the results. This study builds on previous work to quantify the occurrence of RFVs and estimate, via comparison to MODIS and AERONET, what the missing optical depth in (daytime over-water) CALIPSO data as a result of this is.

This work is within scope for AMT and since CALIPSO is one of only two spaceborne lidar providing aerosol data (the other being CATS, which likely has similar issues for the same reasons), so understanding and correcting for biases, which some users may be unaware of, is unimportant. The authors do a thorough job and have a fairly rigorous approach. I recommend publication following minor revisions. I would be happy to review the next version, although a re-review may not be necessary.

A general comment is that the authors have done this analysis with data versions which are all becoming out of date around now (and this is something they acknowledge). For example CALIOP version 4 products are partially or fully released already (and are examined briefly in the paper in section 3.7); MODIS Collection 6.1 and AERONET version 3 are both available within the coming weeks or months. I agree with the authors' statements that this paper is a quantification of the problem and not the final word on the issue, but as some aspects of the data relevant to the analysis change in the latest data versions (e.g. CALIOP version 4 has improved a few detection and calibration issues, AERONET version 3 does a better job of screening out cirrus and not screening out smoke), rerunning the analysis with the latest data versions before final publication then that would be good to keep everything up to date. This is particularly relevant because AERONET, CALIOP, and MODIS all have fairly infrequent update schedules so these new versions are likely to be the latest for several years. Otherwise in the coming few years it may not be clear to readers how quantitatively transferable the results of this analysis are to the data products available at that time.

A second general comment is that the map projection used in mapped figures (e.g. Figure 3, but all of the maps) is a strange one. It distorts to give a disproportionately high weight to high-latitude areas, which is not only a comparatively small fraction of the Earth but the portion with fewest interesting aerosol features. For example the data gap resulting from Antarctica covers about the same amount of page space as the whole African/Asian dust outflow region. I suggest a better map projection is used. Even the regular equal-angle projection would be better, if not an equal-area projection.

Otherwise the eye is naturally drawn away from these areas of most interest.

Line 186: For MODIS, I think it makes sense to use the data set Effective_Optical_Depth_Average_Ocean rather than Effective_Optical_Depth_Best_Ocean, as the 'average' solution is the one which is used to generate level 3 aerosol products (which are perhaps more heavily used than the level 2 products). There has not to my knowledge been much evaluation of the best vs. average MODIS ocean AODs, but Table 5 in Sayer et al (AMT 2012, doi:10.5194/acp-12-8889-2012), in comparison with limited ship-based data, suggests that the 'average' solution may have smaller bias and RMSE than the 'best' solution. That is relevant given the present study's attempt to use MODIS AODs to quantify the missing aerosol from CALIOP RFVs.

Line 196 (and also 425): It is true that AERONET data can suffer from cirrus contamination, but this is also true for the satellite products; perhaps an explicit mention of that is warranted. Related to my general comment, the AERONET team's presentations suggest this screening is better in AERONET version 3 than the version 2 the authors are using.

Line 201: I believe the AERONET team like people to cite Smirnov et al (RSE 2000, doi:10.1016/S0034-4257(00)00109-7) when discussing the AERONET cloud screening and quality assurance procedures.

Section 3.3: I wonder if this information about how collocation is achieved could be moved earlier in the manuscript. It is cumbersome to have results in Section 3.1 refer forward in the paper to a method in Section 3.3. Method description should come before results so the reader can understand what is done without having to flip forwards and then backwards again.

Line 379: I am not sure why Ichoku et al (2003), which is about MODIS aerosol retrievals in Africa, is being cited in the context of limited over-ocean sampling at high ocean latitudes due to sea ice? This reference should be updated to a more appropri-

ate reference, or removed (since almost all readers will know MODIS does not provide AOD retrievals over sea ice, and that sea ice is common near the poles).

Line 474: From the earlier discussion of MODIS, shouldn't this be 0.02-0.04, not 0.02-0.03? Given the MODIS ocean uncertainty estimate for near-zero AOD ranges from -0.02 to +0.04.

Lines 475-478: This sentence (known biases in V3 CALIOP calibration which have been addressed in V4) is another example why it would be better to update the study to use V4 CALIOP products instead. As the authors note V4 was released last year, and the authors include some CALIOP team members, so I don't understand why the study was performed and submitted using an outdated CALIOP data version.

Figure 6: It would be clearer to present this as one panel with three different colored lines (one per region). That would aid the reader in making the comparison between the different latitude ranges.

Table 3: The left column is quite awkward, especially as the descriptions require two additional subscripts in the caption to differentiate certain rows. Perhaps this can be redrawn as a set of check-boxes, i.e. check a box if non-all-RFVs are corrected, check another box if all-RFVs are set to zero, another box if all-RFVs are ignored, etc. That would more clearly and directly show the permutations. Also, the right column is somewhat redundant given it is just column 2 subtracted from column 3. Perhaps some additional statistics could be presented here.