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Atmospheric Measurement Techniques 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.

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This paper identifies the frequencies in which the CALIPSO L2 algorithms fail to detect tenuous aerosol layers (AOT < 0.05) and reports retrieval fill values (RFV) for extinction for the entire column. It also compares these profiles to collocated MODIS and AERONET data to determine AOT is being undetermined/underestimated by CALIPSO. Finally, a method to remedy these RFV profiles is presented. As noted in the conclusion, the main impact of the results shown in the paper, from a data product and lidar algorithm standpoint, is that the CALIPSO L2 aerosol products (AOT, extinc-



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tion) are underestimated. The method presented for correcting these RFVs is a novel concept and valid method. The paper is well written, clear, and gives proper credit to related work. It deserves to be published with a few minor revisions.

I have 2 main comments that I believe would strengthen the paper:

1) The “scientific” impact of the work presented in the paper is not well stated. The impacts on lidar data products and processing algorithms are well stated and important, but not everyone that reads the paper will be a “lidar expert”. High aerosol loading critically impacts the Earth’s radiation budget and air quality, but what is the influence of aerosols at AOTs less than 0.05? To put it bluntly, why should a non-lidar expert care about AOTs of less than 0.05? I think the answer is that, from a climate perspective, they are so frequent that they become important if we ever want to decrease the uncertainties in aerosol radiative effects. I suggest adding a figure that shows the MODIS detection frequencies of AOTs < 0.05 in cloud-free retrievals relative to all cloud-free retrievals (for a few months or even a year of data if possible). Then add a few sentences discussing the figure and point to the potential cumulative impact of these low aerosol loading profiles on global aerosol models (Koffi et al. 2012; http://onlinelibrary.wiley.com/doi/10.1029/2011JD016858/full) and the global/regional radiation budget (Use something like Figure 4 from Yang et al. 2009 to determine radiative impact; http://onlinelibrary.wiley.com/doi/10.1029/2009GL039801/full).

2) The section discussing the anticipation of CALIPSO V4 data products is lacking some important details. The study uses V3 CALIPSO data and V6 MODIS data, but new releases have been made (CALIPSO) or will be made shortly (MODIS). Section 3.7 shows that the frequency of RFV profiles doesn’t change dramatically with CALIPSO V4 data products, and points out the important improvements to the L1 calibration and impacts. However, do any of the improvements to L2 retrievals impact your study? Surely changes in cloud-aerosol discrimination or surface detection can also impact aerosol detection and likely play a role in some of the differences in all-RFV frequencies observed. Please add a few sentences in section 3.7 on this impact. Also,





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there is no discussion about how MODIS V6.1 may change the statistics of MODIS AOT for CALIPSO RFV profiles. Since that data hasn't been released yet, you can't do a re-analysis yet, but please add a few sentences on this topic. I'm not too familiar with what changes will be made for MODIS, so it is possible that none of the changes will impact your results. If that is the case, please let the reader know because that strengthens your paper.

Minor comments/suggestions:

Line 112: The phrase "believed likeliest" is awkward to read. I suggest rewording it.

Line 445: The fixed lidar ratio of 29 sr is appropriate, but I would include the standard deviation computed in Kim et al. 2017 along with a few words about the fact that the value was derived from constrained lidar ratios over ocean and represents background aerosols within the entire tropospheric column. Otherwise, the reader has to look up the paper to find out that information. (Note: for the future, it would be interesting to see the values of 532 nm lidar ratios that are measured by the LaRC HSRL during NAAMES).

Table 2: I suggest adding columns for the standard deviation of the MODIS and AERONET distributions.

Tables 3: I suggest highlighting rows 2 and 3 because it is a key result of your work. I also suggest adding columns for the standard deviation of the MODIS and CALIPSO AOT distributions.

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