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Atmospheric Measurement Techniques Discussions

Interactive comment on "The CALIPSO Version 4 Automated Aerosol Classification and Lidar Ratio Selection Algorithm" *by* Man-Hae Kim et al.

Anonymous Referee #4

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Review of "The CALIPSO Version 4 Automated Aerosol Classification and Lidar Ratio Selection Algorithm" by Kim et al.

This manuscript details and evaluates changes to the new version 4 CALIOP aerosol classification algorithm. Major highlights, the inclusion of a "dusty marine" type and improvements to smoke classification in the troposphere, and a new stratospheric aerosol subtyping algorithm. Changes in the algorithm lead to improved extinction retrievals when compared to AERONET and MODIS over the ocean. The manuscript is well written and thoroughly details modifications to the algorithm. Therefore, I recommend that this manuscript be accepted following minor revision.

Major Comments:

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1. For evaluating CALIOP extinction using MODIS, why not include MODIS deep blue AOD, which provides AOD over land, including bright surfaces? In particular, this might help to validate the impacts of improved surface detection in Figure 15e.

Minor Comments:

Page 2, Line 2: “Aerosol subtyping...” This sentence doesn’t make sense to me.

Page 2, Lines 12 – 16: These findings (dust in marine boundary layer and smoke layers classified as marine) were also reported in Nowottnick et al., 2015. Consider adding a reference to this paper.

Page 5, Line 11: Is Rmas is defined as the ratio of the total attenuated backscatter to the molecular backscatter or the ratio of total attenuated backscatter to molecular attenuated backscatter? Some clarification would be useful to the reader. Also, is the molecular depolarization ratio assumed to be the same as in Omar et al., 2009? If so, please refer to that or provide to the reader.

Page 5, Lines 21-22: “First, . . .” This sentence is confusing, please consider revising.

Page 6, Lines 9 – 12. In both V3 and V4 versions, why is polluted dust reduced over land compared to night? I’m assuming it’s due to better signal-to-noise at night, but an explanation might be useful.

Page 6, Line 12: “AODdifferences”. Missing a space.

Page 7, Line 9: I agree that a simple assumption of the PBL height is sufficient, but some justification for the threshold value (2.5 km) from literature or a figure that shows 2.5 km is a good global approximation should be included here.

Page 7, Lines 9-15: If I’m understanding the new modification to the algorithm correctly, polluted continental cannot be classified if the top of a layer is greater than 2.5 km. How does this impact the identification of long-range sulfate transport (ex. Asian pollution reaching North America)? This limitation might be noted here.

Page 8, Line 14: What is the integrated color ratio threshold for cloud vs. aerosol discrimination? The same as in Omar et al., 2009? Please include this in the discussion.

Page 9, Line 6: Consider explicitly stating the CALIPSO data and what version were used to make Figure 5.

Page 11, Lines 13-14. Is the tropopause altitude coming from GEOS output?

Page 11, Line 20. “aa”, replace with “a”.

Page 11, Lines 20-22. Does this misclassification have a significant impact on the extinction product?

Page 12, Line 4. “..”, replace with “."

Page 14, Line 7. “releasesreleases”, replace with “releases”.

Page 16, Lines 6-9. Nice results using SCARF in the vertical. Is applying SCARF horizontally possible?

Page 19, Lines 23-24. Could you provide an example of detection of a tenuous layer?

Page 20, Line 4. “demonstratesan”, replace with “demonstrates”

Page 22, Lines 19-20. There also is regions where polluted continental is the dominant aerosol type over southern Africa. So, the catch-all “PC/smoke” type works well in the region.

Page 23, Lines 11-12. Why does the overestimation of the estimated particulate depolarization ratio primarily affect dust/polluted dust over land?

Page 24, Line 18. “Whilewhile”, replace with “While”.

Page 24, Line 19. Consider omitting “correctly”, since the occurrence of “dusty marine” cannot be independently validated.

Page 24, Line 24-25. What are there less nighttime stratospheric aerosol features than

during the day in V4?

Page 25, Line 8. “V3 or V4”. Should this be “V3 and V4”?

Page 25, Line 22. What is “AVD”?

Page 28 – Why does the daytime AOD decrease from V3 to V4 over parts of the ocean, while the nighttime does not?

Page 30, Line 18. What is “STS”?

Page 32, Lines 21-23. “Resolution. . .CALIOP and MODIS over land are excluded from further consideration in our analyses.” However, MODIS over land is compared to CALIOP in Table 8 and CALIOP AODs are biased higher in V4. Consider adding a sentence to explain this result. Also, see Major Comment #1 regarding the possible inclusion of MODIS deep blue in this evaluation.

Page 33, Line 8. Consider omitting “(perfect agreement. . ..).”

Figure 16: What is causing the AOD hotspots in V4 over Alaska and central North America? The lidar ratios from V3 to V4 for elevated smoke are similar and improvements to the surface detection in this region show a decrease in AOD (Figure 15e).

Figures & Tables:

Figure 1: Caption – Consider forward referencing the justification for using 2.5 km as a threshold in the manuscript (page 6 in section 2.1.1 and section 2.1.3).

Table 1: Last line – “Canadians”, replace with “Canadian”.

Figure 7: Since depolarization and color ratio are inputs to the new stratospheric typing algorithm, consider adding those quantities to the figure.

Table 4: Consider adding “Tropo.” to the “Aerosol” header in the 5th column.

Figure 15: Is it possible to adjust the color bar to resolve differences in V3 and V4 AOD more clearly (use a finer delta AOD)?

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