

## ***Interactive comment on “CALIPSO climatological products: evaluation and suggestions from EARLINET” by N. Papagiannopoulos et al.***

**Anonymous Referee #2**

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### **General Comments**

Altogether, the Papagiannopoulos et al. manuscript is very well written and provides useful comparisons between the CALIPSO level 3 aerosol product methodology and ground based observations provided by EARLINET. The methodology employed by the authors is clearly documented and related work is adequately cited. The results give important context for interpretation of CALIOP level 3 data products in the regions examined. This paper is appropriate for publication in ACP. Most of my specific comments are only to encourage more clarity in the descriptions of CALIOP level 3 aerosol product algorithms. The final comment aims to add context to the numbers currently reported. None of my comments should change the author's primary conclusions. With that, I recommend the manuscript be published provided the authors please address

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my comments.

### **Specific Comments**

1. (Page 31199, lines 1-2) “The...CL3 product, available since December 2011, is the most recent data set produced...” Actually, the most recent version of the CL3 product is Version 3, released in September 2015. The December 2011 product was Version 1 Beta. Technically, Version 3 was released after this paper was submitted to ACP, but it may be worthwhile to change the wording to reflect that the product has been available since 2011 and delete the “most recent version” language.
2. (Page 31203, lines 19-20) “The main outputs are the aerosol extinction coefficient at 532 nm and its vertical integral (AOD).” The column AOD mean output in version 1 of the CL3 product is not the vertical integral of the mean aerosol extinction coefficient profile. It is the average of the vertically integrated level 2 aerosol extinction profiles. In other words, the procedure is integrate then average, not average then integrate. This statement implies the latter. Maybe a better choice of words would be “...and mean column aerosol optical depth (AOD).”
3. (Page 31205, lines 21-22) Quality assurance step 2 is not unique to Campbell et al. 2012). The CALIOP level 3 algorithm also requires that the Atmospheric Volume Description bits 1-3 equal 3 to include the aerosol extinction coefficient in averaging.
4. (Page 31206, lines 3-4) “...a value of 0.0/km is assigned...where the screening criteria are invoked or no retrieval was made above 2.5 km.” When screening criteria are invoked, the corresponding level 2 aerosol extinction coefficients are ignored, not assigned a value of 0.0/km. The statement “...or no retrieval was made above 2.5 km” is confusing and does not accurately depict what happens with the CALIOP level 3 algorithms. This statement refers to the quality filtering strategy designed to avoid low biases in mean aerosol extinction when aerosol layers are not detected entirely to the surface in level 2. When the lowest aerosol layer base is below 2.5 km but is not in contact with the surface, the “clear-air” below these aerosol layers are ignored

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in the average. Please add more details to this statement to clarify what is happening. The CALIPSO data user's guide webpage for level 3 aerosol has the details under the "Undetected Surface Attached Aerosol Low Bias Filter" heading in the quality filters section. Note that the lower limit changed from 2.5 km to 250 meters between Version 1 and Version 3 of the level 3 aerosol product.

5. (Page 31206, lines 5-6) "...the portion of the extinction profile below the range bin that meets those conditions is excluded." This statement suggests that extinction is always excluded below 2.5 km. Please reword and clarify.

6. To be clarify the three points above, here is a summary of how the CALIOP level 3 algorithms decide which level 2 range bins to exclude and which to assign 0.0/km. Please comment on any discrepancies between these conventions and the conventions used in CL3\*. a. Aerosol samples not passing quality filters are excluded. Note that if the extinction uncertainty is deemed bad, then all samples in the level 2 profile below the first bad sample are excluded. b. "Clear-air" samples (as identified by the Atmospheric Volume Description) are assigned a value of 0.0/km except in the case that the base of the lowest aerosol layer in the column is below 2.5 km. In that case, "clear-air" below the layer is excluded" c. Cloudy samples (as identified by the Atmospheric Volume Description) are excluded. But this does not matter since the analysis here evaluates only cloud-free columns.

7. The relative differences in mean extinction and backscatter profiles shown in Figure 11 and discussed on page 31215 need to be treated carefully at high altitudes. Closer to the surface where scattering is strong (let's say below 4 km based on Figure 3), errors in lidar ratio could be ascribed to the relative differences shown in Figure 11. However at higher altitudes, detection of weak layers should be the limiting factor for CALIOP mean level 3 extinction. At very high altitudes, the large relative difference shown in Figure 11 arise from taking the ratio of very small numbers. I get the feeling that the average relative differences based of Figure 11 which are quoted in lines 12-13 of page 31215 include these high altitude differences. Should they? Perhaps a better

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way to quantify the relative difference between the two mean profiles be to calculate the relative difference below the altitude with which contains say, 90 percent of the total AOD. That way the relative difference would be with respect to the altitude regime containing most of the aerosol. There are other ways to do this of course. Perhaps just showing the numerical difference between the mean extinction profiles along with the relative difference will be enough for readers to understand where scattering is strong and where it is weak. Or perhaps just calculating the relative difference below 5 km will suffice. In short, when summarizing those relative differences into a single number, it is important to add context to that number. Please consider revising how the averaged relative differences are computed for lines 12-13 on page 31215. Ultimately, this should bolster the argument made on that page (the better agreement of backscatter is due to higher influence in lidar ratio assumption).

#### **Technical Corrections**

1. (Page 31207, line 7). Either delete "of the" or make "subtype" plural.

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