**Response to Anonymous Referee #2**

We thank the referee for the useful comments, suggestions, and corrections. Addressing the questions posed by the referee have helped us to improve the clarity of the manuscript. Referee comments and original text are shown in black font below. Responses to referee comments and modified text are shown in red font. Page and line numbers below refer to the original manuscript.

The paper by Tackett et al. is very well written and provides the necessary information and guidance to construct the CALIPSO level 3 data product and, furthermore, to understand the ramifications of the quality screening procedure. The methodology employed for averaging extinction coefficient profiles and calculating the AOD as well as the filtering steps is clearly documented and accompanied by clear paradigms. The discussion on the impact of the quality screening criteria altogether and separately, both globally and regionally, demonstrates the choice of the relevant filtering steps. The paper reads very well and is appropriate for AMT. Minor revisions are given for consideration:

**Specific comments**

Pg3Ln28–34 & P4Ln1-6 & Fig.1: The choice of integrated aerosol information for constructing level 3 profiles sounds wrong to start with. The authors can keep the relevant discussion if they think it adds to the clarity of the document.

Our team has worked with several data users to help them understand the importance of using the level 2 profile product rather than level 2 layer product to generate profile information. We sense that this is a point of confusion with using CALIOP products to generate level 3-style averages. We believe this paper is an appropriate opportunity to clarify how to properly use the profile data and to demonstrate the ill effects that would arise by using the layer data. We attempted to keep the discussion on this topic brief.

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Pg6Ln19: Why not the other aerosol subtypes, in particular polluted continental?

In order to manage the file size of the level 3 product, we chose to include a subset of aerosol subtypes. CALIOP excels at dust detection so dust and polluted dust were prime candidates. Since polluted dust is intended to be a mixture of smoke and dust, it made sense to include it (and CALIOP does well at detecting elevated smoke). We chose to stick with those three subtypes to keep the file size from becoming too large. If we receive requests from the science community desiring polluted continental, we may consider including it in a future version of the level 3 product.

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Pg11Ln10: Could the differences between the version 3 level 3 quality screening strategy and the one reported in Winker et al. (2013) be described?

Yes, the following text in red was added to the introduction of Section 5.

> *These filters are designed to counteract four main issues: noise misclassified as aerosol, clouds misclassified as aerosol, extinction retrieval errors, and an instrument artifact that intermittently produces large negative signals near the surface. All of these filters, except the last, are identical to*

*filters A1 – A5 described in Appendix A of Winker et al. (2013) for the beta level 3 product. The near-surface negative signal anomaly filter (Sect. 5.4) replaces filter A6 of Winker et al. (2013).*

The following text in red was also added to the end of Sect. 4.2 (Pg8Ln11 in the original manuscript):

*To avoid a low bias in near-surface mean aerosol extinction, the level 3 algorithm ignores all clear-air samples below the lowest aerosol layer in each column having a base below 250 m….[Note that the beta version of the level 3 product used 2.46 km rather than 250 m as the threshold (Winker et al., 2013)].*

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Pg19Ln3: A couple of lines could be spent to explain better how you arrived at the value of 4 km. What about higher latitudes?

The following sentences in red were added to the manuscript to provide a rationale for the 4 km threshold.

*The 4 km altitude threshold limits the magnitude of error that would be made by rejecting legitimate aerosol in the lower troposphere where aerosol and clouds are more likely to coexist. For example, 95 % of all aerosol layers detected in 2010 are below 4 km (global). Meanwhile, 11 % of all ice clouds are also detected below this altitude. Ice clouds below 4 km are even more frequent at high latitudes: comprising ~22 % of all ice clouds at latitudes higher than 50° N/S in 2010. The global 4 km threshold thereby protects the majority of legitimate aerosols from being incorrectly rejected, albeit with the possibility of some remaining cirrus fringes at high latitudes.*

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Pg26 Fig.18: To my opinion, the area 160◦–180◦ W and 20◦–30◦ N should be boxed in as the effect of the filter is also evident.

This comment refers to Fig. 19. The additional boxes have been added.

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Pg27 Fig.20: Will the "misclassified cirrus fringe filter" have the same impact for different height thresholds, smaller or greater to 4 km?

The fringe filter would remain the most aggressive filter at the highest altitudes, say above 6 km (Fig 20(d)) if the altitude threshold was adjusted up or down by a kilometer. The frequency of sample rejection (Fig. 20(c)) would look the same, but with a cutoff altitude corresponding to the new altitude threshold. The impact on global mean AOD and the mean extinction profiles would be small because any additional sample rejected or accepted due to the threshold moving up or down by a kilometer or so would mostly have small extinction values (Fig 20(a)). I modified the 4 – 5 km value in following line to "~6 km" to better state where the cirrus fringe filter is the most aggressive (Pg27 Ln. 8):

*Above ~6 km, the cirrus fringe filter is by far the most aggressive at changing $\bar{\sigma}$. A similar conclusion is expected for small (~ 1 km) perturbations of the 4 km altitude threshold for this filter.*

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**Technical corrections**

Pg1Ln22: Add “the” before “version”.

Done

Pg2Ln29: Replace “335” with “333”.

Done

Pg3Ln24: Replace “a level 2” with “an”.

Done

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Pg10Ln1 & Ln5: The triple bar could be avoided

I prefer to keep the triple bar to emphasize that the extinction value of 0 /km is assigned rather than retrieved or measured. To explain the meaning of the notation, the following in red was added to Pg7Ln10:

> *Level 2 atmospheric samples classified as “clear-air” (i.e., no feature is detected) are assumed in the level 3 algorithm to have aerosol extinction equal to 0 km$^{-1}$, denoted by $\sigma_{clear}$ (specifically, extinction $\sigma$ for clear-air samples are assigned $\sigma \equiv \sigma_{clear}$ ; the triple bar denotes the assignment).*

I also replaced “setting” with “assigning” on Pg10Ln1 & Ln5 to be consistent with the language above (i.e., inferring to the reader that the triple bar denotes an assignment).

> *Therefore, ~~setting~~assigning $\sigma_{aer} \equiv 0$ km$^{-1}$ for other species is equivalent to assuming that only one aerosol type is present in the detected layer…~~Setting~~Assigning $\sigma_{aer} \equiv 0$ km$^{-1}$ for other species avoids these biases and maintains consistency with the CALIPSO aerosol typing paradigm.*

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Pg10Ln8: Remove “Aerosol optical depth” and the parenthesis.

Done

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Pg10Ln8: Replace “passive satellites” with “spaceborne passive sensors”.

Done

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Pg11Ln13–15: You can insert the subsection number to these main issues. For example, it can be “noise misclassified as aerosol (Sect. 5.1), clouds misclassified as aerosol (Sect. 5.2)”.

Done. That is a superb idea.

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Pg18Ln18: Fix the citation as "(Vernier et al., 2011, 2015)".

Done

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Pg19Ln3: Remove "the" before "having" and "is" before "less".

Done

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Pg21Ln26 & Ln28: The triple bars could be avoided.

I prefer to keep the triple bars to emphasize that these are the default lidar ratio values assigned by the lidar ratio selection algorithm. Granted, the assigned values are meant to represent the actual lidar ratios observed in nature, but there is some natural variability in lidar ratios. I want to be clear that the errors discussed in this paragraph are due to differences in the assigned values. To explain the notation, the following text in red was added:

> *In this region, dust ($S_p \equiv 40$ sr) commonly mixes with marine aerosol ($S_p \equiv 20$ sr) and this mixture is misclassified as polluted dust by the version 3 aerosol typing algorithm (the triple bars denote that these are default assigned values).*

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Pg21Ln31: Remove ", however".

"However" has been moved to earlier in the sentence so it reads more smoothly:

> *Rejections over the Antarctic, however, are more often caused by special error states listed in Table 1 rather than the need to adjust $S_p$.*

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Pg23Ln4: I think something is missing after "likely" or consider removing "because overlying layers are more likely".

The sentence has been rephrased to:

> *Aerosol layers near the surface therefore tend to have larger $\Delta\sigma$ compared to those at higher altitudes because there are more likely to be overlying layers.*

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Pg23 Fig.16: Add the units for Δσ in the caption.

Done

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Pg23Ln19: Give the acronym for ITCZ.

Replaced “ITCZ: with “intertropical convergence zone”.

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Pg25 Fig.18a: Add the colorbar.

Done

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Pg26 Fig.18b: What LL3 stands for?

This comment refers to Fig. 19b which has “LL3” in the title. “LL3” stands for “lidar level 3”, referring to the product. However, to improve clarity, I removed “LL3” and replaced the title of this panel to “AOD ratio (filter/no filter)”.

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Pg29Ln4: Add “shown in” before “Fig.S7”.

Done

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Pg31Ln9: Replace “on” with “for” after “guidance”.

Done. A similar statement on Pg2Ln16 was also changed to use “for”.

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Pg31Ln15: Add “of” after “levels”.

Done

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Pg31Ln18: Add “the” after “and”.

Done