

We thank you and the other reviewer for your insightful review and very constructive comments, which helped improve our paper greatly. We really appreciate your review very much! We also thank other three colleagues who also made very useful comments. We have revised our paper based on the comments from you, the other reviewer and other three colleagues. We also have reworded/rephrased some sentences which we believe can improve the paper. Our responses are listed in below after each reviewers' comment.

## Anonymous Referee #2

Satellite remote sensing of above-cloud aerosol is an emerging capability, which is expected to contribute significantly to the understanding of aerosol long-range transport and climate effects. This paper evaluates CALIOP standard above-cloud aerosol retrieval in nighttime by applying multiple retrieval techniques (e.g., depolarization-based retrieval, full column retrieval), which has allowed for the characterization of data accuracy and identification of error sources. It is a suitable topic for ACP readers. Results from this study provide essential information for CALIOP data users. I recommend the paper be published after address following issues.

1. The paper would benefit from a better organization. There are some redundant texts in sections 2 and 3. Please reorganize and avoid the redundancy. Also the first two paragraphs of section 4 (just prior to 4.1) seemingly belong to section 3 (methodology).

Response: Thanks for the comment. WE have reorganized the sections 3 and 4.

2. Please improve quality of figures. For example, a. Figure 1: you can add "dust" and "smoke" to the red boxes. Also it is necessary to add unit for wind speed in figure caption. b. Figure 3: better color scales can be designed to show the spatial distribution more clearly. c. Figure 5: modify the figure caption to clarify (c). It is not easy for readers to distinguish dark green from light green. d. Figure 6: for this dust region, you are including smoke aerosol near the equator and trying to explain this in the text. This is causing some confusion. I would suggest filtering out the smoke. e. Figures 8 & 9: please add color bars. In both figures, there are significant data points with  $AOD < 0$ . Can you explain why? It is also interesting to plot PDR vs AOD. f. Figures 10, 11, & 12: it would be informative if correlation coefficients are noted in the figure and discussed in the text. g. Figure 13: upper x-axis label " $S_a/S_a=40$ " is a bit confusing. Looks that " $S_a/40$ " is adequate.

Response: Made changes accordingly.

3. Page 23585, line 23-26: recent capabilities as demonstrated for passive sensors such as OMI (Torres et al., JAS, 2012), MODIS (Jethva et al., IEEE TGRS, 2013), and POLDER (Waquet et al., AMT, 2013) should be mentioned/commented and cited. Yu and Zhang (2013, Atmos. Environ.) summarized these capabilities.

Response: Thank you for pointing this out. We noticed the advent of innovative new retrieval techniques. We revised the manuscript by adding "(The advent of innovative new retrieval techniques suggests that this situation is now changing for the better; e.g., see Waquet et al., 2009; Torres et al., 2012; Yu et al., 2012; Jethva et al., 2013; and Waquet et al., 2013; and an intensive overview by Yu and Zhang, 2014)." This way makes the introduction more concise and clear while the readers who want to learn more about the progress of the passive sensor retrieval can read the many papers we cite in the revised manuscript.

4. Page 23589, line 7: avoid using "semi-direct radiative effect". Not all readers are familiar with this terminology. "Sakaeda et al. (2011)" is not listed in the references.

Response: Deleted "direct and semi-direct" before "radiative effect".

5. Page 23599, line 9-11: how did you determine final lidar ratio?

Response: We do not determine the lidar ratio in the FC retrieval. The FC retrieval is performed for a diagnosis purpose. The lidar ratio is retrieved in the OWC constrained retrieval.

6. Page 23601, line 12: change “2x3 maps” to “2x3 resolution maps”.

Response: Done

7. Page 23604, last line: “Shuster” should be “Schuster”.

Response: Thank you for catching this!

8. Page 23608: It was speculated that “marine” aerosol classification above clouds arose from a “coding error”. This doesn’t seem to be an issue in the dust region. Why?

Response: The depolarization measurement helps greatly to classify dust especially when the dust layer is single layered and not mixed with other type aerosols. This is the case of the dust above cloud considered in this paper. During daytime, however, because of the large background noise, the depolarization measurement can be noisier and more dust can be misclassified as other type of aerosol.

9. Page 23610, line 12: add”/” between two “tau”.

Response: Done.

10. Page 23611, last line: it is necessary to specify that this study looked into nighttime data only.

Response: Done.

11. Page 23613, 2nd paragraph: some conclusions about smoke are mixed with that for dust. It is better to move smoke-related conclusions to next paragraph.

Response: Good suggestion. We deleted one sentence in the first paragraph, “This AOD underestimate increases to 38.6% in the smoke transport region (0.191 for L2 vs. 0.311 for OWC).”, and added one sentence in the second paragraph, “The AOD underestimate is 38.6% in the smoke transport region (0.191 for L2 vs. 0.311 for OWC), larger than that in the dust transport region.”