

Interactive comment on “Novel aerosol extinction coefficients and lidar ratios over the ocean from CALIPSO-CloudSat: Evaluation and global statistics” by David Painemal et al.

Anonymous Referee #2

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The authors describe a method for deriving aerosol lidar ratios over the oceans from combining CALIPSO and CloudSat data and present their findings for a year of data. The paper is of interest to the readership of AMT and well within the scope of the journal. I recommend publication only after major revision according to the points listed below.

Major issues

- The description of the methodologies used in this study could be improved so that it will be easier for the reader to follow.

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- It would be good to have separate subsection for the different methods (1L and 2L).
- A flowchart of the procedure would also be helpful.
- Also, some details should be added in the description of the methodology. For instance:
 - Have any CAD scores been used to select the CALIOP data used for comparison? Or have you used any other quality-assurance criteria for filtering CALIOP data (apart from the requirement for cloud-free conditions)?
 - Have you checked if GEOS-5 MBL heights agree with the layer in which the CALIPSO vertical feature mask shows marine aerosols?
 - Why are CALIOP and HSRL observations averaged over 0.5 degree in latitude?
 - Why is the upper boundary in Eq. (4) fixed at 6 km height? Have you checked that aerosol layers always extend to this height?
 - Why do you use five month in Section 5.1 and 12 months in Section 5.2?
 - Will there be a difference if cloud screening is performed before averaging the data?
- I find it really hard to assess the quality of the findings without any information on the number of matches for the data presented in Figures 4 to 13. For all I know, results could be based on 10 or 100000 data points per grid cell. Please add some maps that show the number of matches.
- I am surprised that the maps in Figures 7 and 8 show no clearer structure according to known aerosol transport pathways. For instance, I would expect a clear increase in LR (at least for the 2L method) for the transport of Saharan dust from Africa to South America during summer (particularly as this is visible in the

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AOD plots in Figure 9). It rather seems that patches of increased LR occur in regions of persistent low-level cloud decks to the west of the continents. Information on the number of data points per grid cell is needed to assess the quality of the results.

- The difference between AOD from MODIS and SODA is quite large over some regions. This is discussed much too late in the text. It should also be explored what this means for the LR retrieval.
- The choice of reference literature is rather one-sided. The discussion mostly refers to Burton et al. (2012, 2013) and the authors seem to neglect a host of publications on the lidar ratio of different aerosol types and aerosol mixtures. In general, the discussion of the findings needs improvements in light of my earlier comments.

Minor issues

- Please make certain that acronyms are properly introduced when first mentioned
- Please connect statements such as “good agreement” to something more quantitative
- P3L6: omit one coefficient
- P3L6: Have you been varying the background values as well? What values have been used?
- P4L25: A systematic error of 0.059 for daytime AOD over the ocean seems very high to me, i.e. within the range of total AOD for clean marine conditions. Has this large systematic error in any way been considered in this study?
- P4L31: uncertainty calibrations = calibration uncertainties?

- P6L1: Should it not be $\sigma_a(z)$ here? σ_m is known once you know β_m as $LR_m = 8\pi/3$.
- P6L5: What's the effect of the SODA bias mentioned earlier to the LR retrieval?
- P9L22/23: Omit the description of line colours. This belongs into the figure caption.
- P12L26: Is the reference to Figure 9 correct?
- P13L4: Should be Figure 7a?
- Figure 1: Please note the meaning of the coloured circles in Figure 1a.
- Figures 5 and 6 could be moved to the supplement.
- Figure 14: What do the grey regions refer to?

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