Comment on amt-2021-378
Anonymous Referee #3

Referee comment on "Assessment of tropospheric CALIPSO Version 4.2 aerosol types over the ocean using independent CALIPSO-SODA lidar ratios" by Zhujun Li et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-378-RC3, 2021

The authors assess the CALIPSO Version 4.2 aerosol typing and assigned lidar ratios over ocean. To do that, they use (i) the aerosol optical depth (AOD) retrievals from the Synergized Optical Depth of Aerosols (SODA) algorithm and (ii) retrieved columnar lidar ratio estimated by combining SODA AOD and CALIPSO attenuated backscatter (CALIPSO-SODA). This paper is of good quality, well written and structured. It will be worthy of publication once the issues below are addressed.

Major comments

We recommend that the authors:

. first compare CALIOP-SODA and CALIOP V4 AOD as well as lidar ratios for all CALIOP V4 aerosol types before they classify their analysis by CALIOP V4 aerosol types. As they know, CALIOP V4 is likely to miss tenuous aerosols or misclassify aerosols. Starting by classifying CALIOP-SODA lidar ratios per (likely misclassified) CALIOP V4 aerosol type is confusing and slightly circular.

. clarify why CALIOP does not consider the possibility of polluted dust within the PBL

. clarify their filtering method and technique as a bullet list or a table (includes 1L vs 2L techniques, cloud masking, altitude selection etc)

. clearly suggest which CALIOP product is accurate, which one is not. And proposes fixes to the algorithm or additional filters to be applied by the users moving forward

Detailed comments:

. line 14 – "This implies that the CALIPSO classification scheme generally categorizes aerosols correctly" is too strong of a statement. Please consider watering it down.
abstract – the authors point out issues with CALIOP V4 polluted continental/ smoke, dust, dusty marine and clean marine aerosol types. They should suggest some future fixes and possible filtering

Figure 1 – can you briefly specify how reliable is GEOS-5 ML?

line 226 – I don’t understand the sentence. Please rephrase.

line 240 or eq. (1) – explain i=1 to N

Figure 5 & 6 – consider saying “density plot” instead of histograms

Figure 7 – add (a), (b) and (c) on graphs

These Figures and Tables are redundant, consider consolidating/ simplifying – Fig 9 and Table 4 as well as Fig. 7-8 and Table 3

Line 275 to 277 – aerosol variability depends on the environment. Please refer to e.g., Shinozuka and Redemann (2011).

Line 305 – there is a repeat in the sentence. Please rephrase

Line 303 to 307 – can we make sure to say that the lidar ratio for a specific aerosol type should be independent of the AOD? The fact that it varies with AOD points to some issues in the CALIOP algorithm and I suggest describing them.

Line 432 – assumed by the CALIPSO

first bullet in the conclusion – consider explaining the reasons and implications

Line 443 – within ±10sr of those

Line 460 – is a repeat of the sentence above