Review of "***Thermal infrared dust optical depth and coarse-mode effective diameter retrieved from collocated MODIS and CALIOP observations***" by Zheng et al.

General Comments:

This study developed a novel algorithm to retrieve dust optical depth at 10 μm ($DAOD_{10\mu m}$) and coarse-mode dust effective diameter (D_{eff}) from the collocated MODIS thermal infrared (TIR) products and CALIOP dust vertical profiles over the ocean. The $DAOD_{10\mu m}$ retrievals are validated against $DAOD_{10.6\mu m}$ from the combined IIR and CALIOP observations and compared with LMD and ULB IASI DAOD products and have shown improved performance than $DAOD_{10.6\mu m}$ and high correlations with IASI retrievals. The derived D_{eff} is evaluated by comparing with in-situ measurements from AER-D, SAMUM-2 and SALTRACE field campaigns. Finally, the climatological (2013–2017) distribution of D_{eff} is examined for major dust transport pathways over the North Atlantic, Indian Ocean and North Pacific. The paper is quite well written and very comprehensive, with a clear motivation and thorough background review, detailed methodology and solid analysis, along with discussions of uncertainties. The derived MODIS-CALIOP $DAOD_{10\mu m}$ adds to the existing TIR DAOD products, and the distribution of D_{eff} over the global ocean provides insights into transport patterns of coarse mode dust. I have some minor suggestions for the authors to consider.

Specific Comments:

1. The evaluations of D_{eff} are mainly through case studies during three field campaigns over the Atlantic basin. While the limitation of not including evaluations for the Pacific Ocean is briefly mentioned in Section 6 (line 830), it probably would be more informative to explain why the validation focuses over the North Atlantic earlier in the data and method section or the beginning of section 4.

2. While validating $DAOD_{10\mu m}$ against a previously well-validated $DAOD_{10.6\mu m}$ product (Zheng et al. 2022) is probably sufficient, it is not clear why a direct comparison with AERONET station data as by Song et al. (2021) and Zheng et al. (2022) is not performed. Is this due to smaller sample sizes in a shorter time period (5 years)? Would be good to add some explanation.

3. It would be nice to show a spatial distribution of derived $DAOD_{10\mu m}$ as well, e.g., similar to that of D_{eff} in Fig. 11.

4. Are $DAOD_{10\mu m}$ and D_{eff} retrieved for both daytime and nighttime overpasses? Are there any noticeable differences in data quality between daytime and nighttime products?

5. Since both polluted dust and dusty marine aerosols from CALIOP are used (Table 1), will this contribute to the uncertainties of D_{eff} estimation?

6. Line 195, the retrieval focuses over 2013–2017, then why are AMSR-E products "(ceased operation in December 2011)" needed?

7. Line 434, “dust plume is concentrated around 3 km to 4 km (see Figure 3a). Therefore, the HYSPLIT back trajectories are initiated at 3 km and 4 km.” However, in Fig. 4, back trajectories are initiated around 2.5 ~ 3 km, if I understand correctly.

8. Line 565, “vertical dust distribution observed by MODIS-CALIOP”, are any vertical profiles retrieved as well?

9. Line 645 and Fig. 10 caption (line 650), “seasonal mean”, of which season? Do you refer to all the seasons of a year?

10. Fig. 10, consider adding information of RMSE.

Technical Corrections:

Line 24-25, PSD definition should be moved to line 24.

Line 403, can you please add a reference for AERONET?

Fig. 7, why is there a clear boundary between data below and above 8 km in CALIOP total attenuated backscatter plots?

Line 662, add “with IASI-ULB” after “(including NP)”.

Fig. 13, why do histogram plots show $DAOD_{10\mu m}$ >0.1 while seasonal mean showing $DAOD_{10\mu m}$ >0.005. Would it be better if both figures use the same criterion to display $DAOD_{10\mu m}$?

Fig. 14, figure caption indicates “$DAOD_{10\mu m}$ >0.1 ” but plot titles show “$DAOD_{10\mu m}$ >0.05” and “$DAOD_{10\mu m}$ >0.005”.