The authors developed a good algorithm to retrieve the coarse-mode dust AOD and particle size using thermal infrared measurements from MODIS and vertical distribution from CALIOP. The retrieval results were validated using ground-based and aircraft measurements to evaluate the algorithm reliability, and were applied in the first climatology study about dust particle size global distribution. I think this new product can provide important data source for global model simulations and radiative impact estimations of dust, so it deserves to be published and can receive more attentions from the research community in the future. The manuscript is well organized and presented, and most figures show good quality. I only have minor comments to make the descriptions clearer before it can be published.

1. Line 24-25: The full name of PSD should be put in the place where it shows up in the first time. When PSD was mentioned, I think it's better to mention the distribution function assumption, such as lognormal distribution.

2. Line 28: Suggest to be "the two DAOD retrievals" to avoid misunderstanding.

3. Line 85: This sentence could become shorter to remove repeated information.

4. Line 100-101: "atmospheric window channels that are ..." $--$ > "atmospheric window channels with little gas absorption."

5. Section 3.1.2: 1) Several RI database were mentioned here. I think some missing information about the similar or different wavelength dependence of RI in three thermal infrared bands from these database is important.
   2) When creating the LUT for spheroidal dust using T-matrix method, how to choose the aspect ratio values? Since this parameter is not retrieved, is a fixed value or an assumed distribution used in the radiative transfer simulation?

6. Figure 2: Small comments about the figure quality: 1) For a), the text for small D_{eff} is too dense and cannot be recognized clearly. 2) For b and c, could you change the colors of the lines with different D_{eff}? It is a little hard to follow the change of D_{eff} between these lines. Maybe think about using some colormaps. 3) For b and c, why do you use the 11μm as a reference wavelength for beta ratio? It seems in the main text, you mainly discuss the BTD_{8-12} and BTD_{11-12} and it is a little hard to find the beta ratio between 8 and 12 μm.

7. Since all the case studies and climatology analysis shown in this manuscript are only over ocean, I suggest to emphasize this "ocean" application in the title. As the authors mentioned, this algorithm can be easily used over land by replacing surface data using land surface, but the retrieval accuracy and uncertainties over land may differ from over ocean and need more studies.

8. One limit of this algorithm is that the D_{eff} is assumed the same at different altitudes. Could the particle size information from CALIOP aerosol extinction profiles at two

wavelengths (532 nm and 1064 nm) help provide the vertical distribution of particle size? Is it possible to add this information in the algorithm? Some discussions and potential studies about this can be mentioned in the last section.