

## ***Interactive comment on “Aerosol Characteristics in the Three Poles of the Earth Observed by CALIPSO” by Yikun Yang et al.***

### **Anonymous Referee #2**

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General comments: The manuscript entitled “Aerosol Characteristics in the Three Poles of the Earth Observed by CALIPSO” focuses on aerosol characteristics of the Arctic, Antarctic, and Tibetan Plateau by using CALIPSO L3 data and HYSPLIT model. The results show that the AODs over three regions have obvious spatial and temporal feature. Different type of aerosol has remarkable spatial and seasonal. Overall, this manuscript is clear and well written. Some concerns are needed to address.

1. Page 1, Line 18-19, the sentence should be “The annual average AODs over the Arctic, Antarctic, and TP are 0.046. . . . .”, or “The annual mean values of AOD over the Arctic, Antarctic, and TP are 0.046. . . . .”. 2. What is the basis of selecting the simulation points of backward trajectory? I recommend authors to add a simulation point over the eastern TP? 3. Page 7, Line 178, the authors described “decrease with the

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increase of latitude in any season”, however, Figure 2e shows some areas with high AODs at high latitudes of Antarctic in spring. 4. Page 7, Line 190, “high aerosol concentrations in the Arctic and Antarctic mainly occur in winter and spring”, The aerosol concentration of Arctic should be higher in late fall to early spring, not just winter and spring (Figure 3). 5. Page 7, Line 174, “the AOD averaged between Jun 2006 and Dec 2019”; Page 7, Line 187, “the monthly variations of multi-year (June 2016 - December 2019) average AODs”; Page 8, Lines 207-208, “the monthly AODs along with their standard deviations from June 2007 to December 2019”. Why not use the AOD data for same period? 6. Page 8, Lines 219-221, “First, there are anthropogenic emission sources over the TP region. Second, the TP is located in Central Asia surrounded by highly polluted areas, which is easily affected by external aerosol transport”. The corresponding evidence or reference is needed. 7. Page 8, Lines 219-221, “the wind speed in winter half-year in the Arctic region is higher than that in summer half-year”. However, in Lines 199-200, “On the other hand, stable atmospheric status with less precipitation occurs in the Arctic winter”. What is the real situation? It needs a verified evidence from satellite or reanalysis data. 8. Page 11, Line 287, “due to the northerly jet over the TP carrying dust aerosols to the internal TP”. Generally, there is westerly jet over TP. Please explain the existence of “the northerly jet over the TP. 9. Page 11, Lines 287-288, “In autumn and winter, the emission of anthropogenic aerosol increases”. Lines 290-291, “the increase of biomass combustion”. Some evidences or references are needed. 10. Page 11, Lines 309-310, “while in the near-ground area (altitude < 2 km), dust and polluted dust have a larger extinction coefficient”. However, there is a high value of the dust extinction coefficient above 9 km in Arctic in winter (Figure 6j), what is the possible reason? 11. Page 12, Lines 316-318, “the extinction coefficient of dust and elevated smoke increases significantly above 5 km, and the polluted dust aerosols have large extinction coefficients under 5 km”. Why do the dust and polluted dust occur at different altitudes? 12. Page 12, Lines 320-321, “From the perspective of seasonal variation, the vertical distribution of dust-related aerosol extinction coefficient is larger in spring (c) and summer (f) than in autumn (i) and winter

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(l)". However, as shown in Figure 6i, the polluted dust extinction coefficient at 3 km is significantly higher in autumn than in spring and summer. 13. Page 12, Lines 331-333, "Different from the above aerosol types, the highest OF of elevated smoke occurs at a height of about 2.5 km, and occurs at 8 km and 4 km, respectively in the Arctic and Antarctic regions." The meaning is unclear. 14. Page 11, Line 292, Page 12, Line 325, has the effect of topography in each region been considered when analyzing the vertical distribution of various aerosols? For example, the average altitude of TP is 4 km, while in Antarctic is 2.3 km. 15. Page 13, Line 347, "(10 × 2 × 12 × 13)". What do they represent respectively? 16. Page 14, Lines 371-377, from Figure 5c, it can be found that there are more dust aerosols over north and northeast TP, however, the backward trajectory does not catch the contribution of the dust from Qaidam Basin.

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