Answers to anonymous referee #1

We would like to thank the reviewer for his/her time and effort reviewing our study. We have found the comments to be constructive and helpful.

In this reply, the comments from the reviewer are in black, and our answers are in red. The new text and lines of the revised document where the adjusted text can be found are also in red. In the revised document, all new text is marked in blue, and deleted text is crossed out in red.

Major comments:

1. Abstract: This work mainly investigated the dust aerosol impact on precipitation vertical structures using multi-source data, and gave statistical results. Nevertheless, I did not see the specific study area and time period.
   A: We have added the specific study area and time period to the abstract.

   "Abstract. The potential impacts of dust aerosol and atmospheric convective available potential energy (CAPE) on the vertical development of precipitating clouds in southeastern China (110° E-125° E; 20° N-30° N) in June, July, and August during 2000 to 2013 were studied using multiple-source observations."

2. The titile of Section 2 of "Study area and data" needs to be rephrased, since most of the paragraphs focus on the methodology. As such, this section can be restructured. For instance, I do not understand what is the logic and purpose of the references such as "Teller and Levin (2006)" and Yin and Chen (2007), both of which are simply listed as seprated arguments and not tightly linked to the data or methodologies used in this study. In my opinion, these descriptions are more like related to the research status and can be moved to the introdution part.
   A: We agree with this comment. Since the two references are not tightly linked to our study, we decided to delete them in the revision. And we changed the title of Section 2 to be "Data and Method".

3. The English writing of this manuscript needs thorough improvement, and a complete polishing from the abstract to conclusion part is necessary with the help of a native English speaker or a more experienced researcher.
   A: We agree with the reviewer, and we will have a native English speaker to polish the revised manuscript.

4. L204-206: In the presence of dust episode occurring in eastern China, a combination of high wind shear, low cape was observed, the author argued that "Such condition doesn't favor the vertical development of convection." Are there any literatures supporting this argument? In my view of point, the precipitation accompanied with dust episode is largely under the influence of large-scale circulation. This synoptic forcing favors the lifting of air mass and convection initiation. Besides, not every

precipitation event was characterized by high CAPE, low wind shear.

A: We agree with the reviewer that precipitation in dusty days in southern China is largely influenced by large-scale circulation. And this synoptic forcing favors the lifting of air mass and convection initiation comparing to that in non-raining days.

The description "high wind shear and low CAPE, such condition doesn't favor the vertical development of convection" is an inaccurate expression on our part. What we want to express is that the background field of precipitation in dusty days has a lower CAPE and stronger wind shear compared to the pristine days. Low CAPE (Rosenfeld et a1., 2008) and strong wind shear (Fan et al., 2009, 2013) were found to be detrimental to the development of convection in other study areas.

Indeed, only from long-term statistics, pristine precipitation events are featured by relatively high CAPE and low wind shear conditions. There are considerable variations on the relationship between PTT and CAPE as shown in Section 3.

We clarified all above concerns in the revision as:

"In both dusty and pristine precipitation days, the synoptic forcing conditions favor the lifting of air mass and convection initiation comparing to that in non-precipitating days. Statistically, pristine precipitation events are featured by relatively higher CAPE and lower wind shear conditions, which may enhance the vertical development of the precipitating clouds."

Minor comments:

1. "eastern China" in the title of this manuscript can be revised to "southeastern China"
   A: Yes, and we have changed it in the manuscript.

2. L14: "the study area" is suggested to be replaced with a specified area (e.g., southeast China?)
   A:Yes, and we have changed it in the manuscript.

3. L15: "contained"-> "containing"
   A: Yes, and we have changed it in the manuscript.

4. L34: ", they can" -> ", which can"
   A: Yes, and we have changed it in the manuscript.

5. L35: "to directly affect" -> "thereby directly affecting"
   A: Yes, and we have changed it in the manuscript.

6. L38: "warmer temperature" is not appropriate and can be revised to "higher temperature"

A: Yes, and we have changed it in the manuscript.

7. L39: “server” -> “serve”
   A: Yes, and we have changed it in the manuscript.

8. L40: “moderate” can be revised to “mediate” or “modulate”
   A: Yes, and we have changed it in the manuscript.

9. L46: “Studies” -> “Previous studies”
   A: Yes, and we have changed it in the manuscript.

10. L78:“significantly was” -> “was significantly”
    A: Yes, and we have changed it in the manuscript.

11. L79: “. Such as” -> “, including”
    A: Yes, and we have changed it in the manuscript.

12. L83: I would suggest adding more recent references on the dependence of aerosol effect on precipitation on “the altitudes of the aerosol layer”, and the authors can refer to Lee et al. ACPD 2022 (https://doi.org/10.5194/acp-2022-385) and the references therein.
    A: Thanks, and we have added the reference to the manuscript.

    “Aerosol-cloud-precipitation interactions (ACIs) also largely depend on meteorology conditions including wind shear (Fan et al., 2009, 2013), atmospheric stability (Huang et al., 2014), relative humidity (Li et al., 2019b), and the altitudes of the aerosol layer (Yin et al., 2012, Lee et al., 2022).”

13. L104: “In some studies,” in which studies? The authors can add references here to support this statement.
    A: Since this statement is not tightly related to this study, we decided to remove it from the manuscript.

14. L132: grammar errors in “, they are treated”.
    A: Yes, and we have changed it in the manuscript

15. L137: The acronym for “precipitation top temperature” has been given in introduction part and in this place and the following section, it is supposed to appear as “PTT”.
    A: Yes, and we have changed it in the manuscript.

16. L173: the references to ERA-5 reanalysis are lacking.
    A: We have added the references in the manuscript. And we have clarified this point as:

"The atmospheric thermodynamic conditions under pristine or dusty environments were derived from hourly ERA5 reanalysis data at horizontal resolution of 0.25°×0.25° (Hersbach et al., 2020)."

17. L178: "during recent two decades" -> "during recent decades"
    A: Yes, and we have changed it in the manuscript.

18. L179-180: it is a too long sentence in "by anthropogenic emission related fine mode aerosols with small fraction of coarse mode aerosol", and full of redundant words. I would suggest rewriting
    A: Yes, and we have changed it in the manuscript. We have clarified this point in the revision as:

    "In summer, the area generally was dominated by anthropogenic emissions of fine mode aerosols."

19. L181: "in which" or "when" can be added before "heavy dust aerosol"
    A: Yes, and we have changed it in the manuscript.

20. L182: "are" -> "were", and "that" is missing before "were defined"
    A: Yes, and we have changed it in the manuscript.

21. L183: "excessed" -> "exceeded"
    A: Yes, and we have changed it in the manuscript.

22. L188-190: I would suggest clarifying whether the selected date of 12 June 2006 was also a rainy day in the southeast China.
    A: Yes, it is a raining day and this is clarified in the revision as:

    "For example, on 12 June 2006 a typical dusty precipitation day, about half of the study area was covered by heavy dust (Fig. 2) with satellite observed CMAOD up to 1."

23. L199: "CAPE" is not an atmospheric dynamic variable
    A: We clarified the associated statement as:

    "Finally, as an overall measure of regional mean atmospheric insatiability, regional CAPE was 600 J kg^{-1} in dust conditions and 743 J kg^{-1} in pristine conditions."

24. L200: please clarify what is "strong coupling" between dusty condition and meteorology condition? It seems to me this term is contradictory with the following weak correlation observed between dust AOD and meteorology.
    A: Yes, the statement is not precise enough, so we refined it as:

"In summary, in southeastern China, heavy dusty condition is generally accompanied by certain synoptic pattern dominated by strong north wind."

25. L225: "start"-> "starting"
    A: Yes, and we have changed it in the manuscript.

26. L288 and L321: the full name for precipitation top height was actually given in L66, and thus should be avoided here.
    A: Yes, and we have changed it in the manuscript.

27. L362: Except for the "atmospheric thermodynamical effects", the atmospheric dynamic impact can not be ignored.
    A: We have changed it in the manuscript, and now it was clarified as:

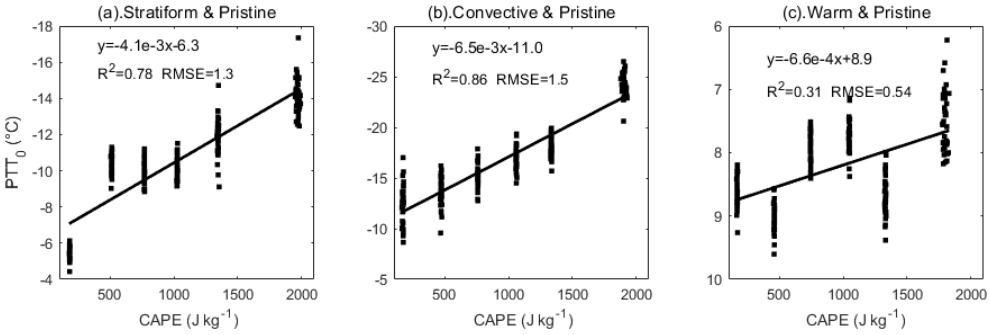
    "The physical characteristics of cloud or precipitation in real observations are affected by both aerosol indirect effects (if any), atmospheric thermodynamical and dynamic effects."

28. Figure 3: I would suggest adding the time period for which the meteorological fields are derived. Also the data sources are suggested to be added in this figure caption.
    A: Thanks for this valuable suggestion. We modified the caption of Figure 3 as:

    "Figure 3: The fields of wind and temperature at 500 hPa (upper row), U wind shear (middle row), CAPE (bottom row) averaged from selected 46 dusty days (left column) and 92 pristine days (middle column) in JJA during 2000-2013 based on ERA5 reanalysis data at horizontal resolution of 0.25°×0.25°, and the associated differences between them (dusty minus pristine, right column)."

29. Figure 11: it would be beneficial to give more descriptions in the figure caption on "70%" at the top of each panel in this figure. What does it mean, or how is it defined.
    A: To avoid confusion, we have deleted the "70%" from the Figure, and we have modified the Figure caption as:

    "Figure 11: The variation of PTT_0 with CAPE under pristine condition for (a) deep stratiform precipitation; (b) deep convective precipitation and (c) warm rains. The results are derived from randomly selected 70% precipitation samples from total."



References

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