

Atmos. Chem. Phys. Discuss., referee comment RC1
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Comment on acp-2021-402

Anonymous Referee #1

Referee comment on "Effect of rainfall-induced diabatic heating over southern China on the formation of wintertime haze on the North China Plain" by Xiadong An et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-402-RC1>, 2021

Review of Effect of rainfall-induced diabatic heating over southern China on the formation of wintertime haze on the North China Plain (acp-2021-402):

An and the co-authors found when extreme rain fell over southern China, the probability of a haze event over the NCP during our research period of 1985–2015 was 59.09%. Further analysis revealed that the secondary circulation, associated with rainfall over southern China, in conjunction with Rossby wave trains along the waveguides may apt to the haze pollution over the NCP. This is important for understanding of haze pollutions over China. Although this manuscript fit into the scope of ACP, there are still several concerns must be addressed before publication.

Major comments:

- The major concern is the small samples and half (13) and half (9) category. I suggest the authors to carefully illustrate the necessity of research and the robust of your revealed relationship. 50.9% is not a high probability.
- Possibly, to discuss the differences between SR-NH and SR–noNH is a helpful way. That is, to answer why there is no haze pollution in North China form the perspective of physical mechanisms.
- It is difficult to say the anomalous large-scale atmospheric circulations over North China were simulated by the extreme rainfall. Possibly, it is a dipole pattern of

atmospheric anomalies, which simultaneously influenced the haze in North China and rainfall in South China. The diabatic heating might be an attendant phenomenon. Thus, more robust evidences are required to make your arguments stand.

- Related to the above comment, I suggest the authors the re-plot the schematic diagram or provided more evidence to enhance the story line.
- Figure 9, 11 and related texts: I did not find anticyclonic responses over North China.
- Why show visibility in Figure 2, but $PM_{2.5}$ concentrations in Figure 15? Can you kindly show me both of the anomalies visibility and $PM_{2.5}$ concentrations in the reply letter (relative to climatology), associated with SR-NH, SR-noNH and the left samples?

Specific comments:

- Abstract: Some abbreviations, that occurred only once (or less than 3 times), are not necessary in abstract. Too much abbreviations are not easy to read. Possibly, the authors could also check the main texts throughout.
- Line 26: The 'diabatic heating' was defined as Q much later (Line 107).
- Line 30: The range of NCP should be added in the text, and the others are similar.
- Line 46-47: "Overall, the role of meteorology in the generation of haze is crucial but uncertain, and may be closely related to the regulation of the large-scale circulation". This sentence must be rephrased, because the meanings are confused.
- Line 51: The abbreviation of SSTAs may be not necessary.
- Line 83: $PM_{2.5}$ here has a format error.
- Line 83-85: Because the climate scientist must carefully choose the data series, can you show the readers about the quality assessment of Yang's $PM_{2.5}$ datasets for the period 1980–2019? In my opinion, excellent agreement with ground measurements during 2013–2019 did not illustrate good performance for the period 1980–2019.
- Line 162: Add the full name of 'EU' if it is the first time it appears.
- Line 251: "the appearance of haze over the NCP" may only be some of haze event, which related to the rainfall over southern China.
- Figure 1: the color of the circular arrow was confusing.
- Figure 6: $\omega > 0$ ($Pa\ s^{-1}$, shading) means descending motion, why is it an ascending motion here? Is it multiplied by -1 ?
- Figure 7: The positive velocity potential may represent divergence.
- Figure 10: "As Fig. 5," may be "Fig. 6"?
- How did you composite the maps associated with 13 SR-NH events. I did not find it in any of the Figure captions.