

Atmos. Chem. Phys. Discuss., referee comment RC1  
<https://doi.org/10.5194/acp-2021-906-RC1>, 2022  
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## Comment on acp-2021-906

Anonymous Referee #1

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Referee comment on "The pathway of impacts of aerosol direct effects on secondary inorganic aerosol formation" by Jiandong Wang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-906-RC1>, 2022

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Wang et al. "The pathway of aerosol direct effects impact on secondary inorganic aerosol formation"

This short and concise study investigates the different pathways of aerosol direct effects impact on secondary inorganic aerosol formation between winter and summer. The results show that solar radiation is the restricting factor in winter, and the formation of sulfate is sensitive to the perturbation of solar radiation. While in summer, availability of gaseous precursors primarily dictates the levels of secondary aerosol concentrations. The findings are valuable and interesting to the science community. Thus, I would like to recommend its acceptance for publication after necessary minor revisions.

### General comments

There are some writing issues with several figured out in the following comments.

Line 37-40, aerosol effects on regional weather is not due to their spatio-temporal distribution, but due to the radiative effect or impact on cloud properties. In addition, three studies about the aerosol impacts on regional weather are suggested here, Sun and Zhao (2021, doi: 10.5194/acp-21-16555-2021) for aerosol impacts on precipitation time, Zhao et al. (2018, 2020, doi: 10.1093/nsr/nwz184, doi: 10.1029/2018GL079427) for aerosol impacts on weather over Tibetan Plateau and western pacific.

Line 40, What do the authors mean "aerosol direct effect on air pollutants"? The authors might provide a definition for the aerosol direct effects (ADE).

Line 43-44, this is true, which could further reduce the planetary boundary layer height and near surface wind speed, resulting in further heavier aerosol pollution, as indicated by Yang et al. (2016, doi:10.1002/2015JD024645).

Line 44-45, regarding the aerosol solar radiative cooling effect, a few references might be helpful, such as Yang et al. (2016,2018, doi:10.1002/2016JD024938, doi:10.1016/j.atmosres.2018.04.029). In addition, it might be not necessary to indicate the values here since they should vary with time and location.

Line 52, it might be useful to define "secondary aerosol" first. Also, personally, I would more prefer using "secondary formed aerosol".

Line 55, "illustrate" should be "illustrated"?

Line 57, "show" should be "showed"?

Line 59, "has" -> "have"

Line 69-74, this should be the air quality status of the past, not current. However, as indicated by Fan et al. (2020, doi: 10.1016/j.atmosenv.2019.117066) and Zhang et al. (2020, doi: 10.1007/s13143-019-00125-w), the air quality in China has improved significantly owing to the strict control acts in China. This fact should be acknowledged.

Line 81, it should be "in Xing et al. (2017)"

Line 87-88, I believe the "other physical processes" should be more than what described here. The authors might slightly modify the description.

Line 99, what are the vertical resolutions for the two model simulations within boundary layer height?

Line 101-103, How reliable are the observation data from this platform? Are there any scientific studies based on the dataset that can serve as supporting references?

Line 110, "was" -> "were"

Line 114-121, a brief description about the PA technology and IPRs is necessary for readers to understand.

Line 124-125, I wonder if these are monthly average values including days with clouds? Or simply, are these values monthly averages for clear skies? How did the authors exclude the clouds?

Line 127-129, Similarly, are the results for all skies or clear skies only?

Line 168, "raises"?

Line 176, the authors can simply describe "effective optical depths" as "optical paths" without further definition or explanation.

Line 177-178, It is not robust to say "this impact will be more significant at high tau" since it actually depends: when tau is not too high, the diffuse increase with tau; however, when tau is large enough, the diffuse radiation will decrease with tau.

Line 179-180, This increase to 2.5 is not a common phenomenon that can be observed frequently, thus I would suggest changing "reaches to 2.5" to "reached 2.5".

Line 189, "affect" -> "affects"

Line 198-199, I would suggest changing "The height of strongest effect is" to "The height with the strongest effect is"

Line 199, "amplify" -> "amplifies"

Line 204, "reduce" -> "reduces"

Line 210, local time or UTC time?

Line 218, "studies"?

Line 225, delete one "shown in" from the twos.