



## Comment on acp-2020-1317

Anonymous Referee #2

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Referee comment on "On the Contribution of Fast and Slow Responses to Precipitation Changes Caused by Aerosol Perturbations" by Shipeng Zhang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2020-1317-RC2>, 2021

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The global aerosol-climate model ECHAM6-HAM is used to investigate the response of precipitation to perturbations of black carbon and sulfate based on examining changes in atmospheric energy budget on global and regional scales. Precipitation responses are divided into the fast response due to black carbon and the slow response due to sulfate. Overall, the manuscript is well written and good analyses have been provided. However, there is an important concern regarding the approach of the study, which includes application of a general circulation model (GCM) for unraveling precipitation responses on regional scales to aerosol perturbations. Further comments are listed below.

Although the manuscript is generally well written, some minor syntax errors need to be fixed. In addition, long sentences should be avoided. For example, in line 60-62.

Lines 31-38. The uncertainty of aerosol indirect effects or, maybe more precisely, different or even opposite conclusions, which have been obtained for the indirect effects of aerosols in different studies, are related to different environmental conditions, including relative humidity, vertical wind shear and cloud types. This needs to be clarified in this paragraph and the works of Khain et al. (2008), Khain (2009) and Alizadeh-Choobari (2018) can be cited.

Line 76. The recent related work of Keshtgar et al. (2020) can be also cited here.

Line 105-108. Here the lack of regional studies is emphasized to convince conduction of the study. However, a GCM) with a relatively low resolution (1.9 degree) is applied in this study, which is not appropriate to demonstrate precipitation responses on regional scales. Considering the fact that precipitation highly varies on regional scales, the authors should explain how application of a GCM can be helpful to unravel responses of precipitation on regional scales to aerosol perturbations.

Line 153. It should be explained why BC and Sulfur dioxide have been increased differently, and how it can impact the obtained results.

### References

Alizadeh-Choobari O (2018) Impact of aerosol number concentration on precipitation

under different precipitation rates. *Meteorological Applications* 25, 596-605

Khain, AP (2009) Notes on state-of-the-art investigations of aerosol effects on precipitation: a critical review. *Environmental Research Letters*, 4, 015004.

Khain, AP et al. (2008) Factors determining the impact of aerosols on surface precipitation from clouds: an attempt at classification. *Journal of the Atmospheric Sciences*, 65, 1721–1748.

Keshtgar et al. (2020) Seasonal and interannual variations of the intertropical convergence zone over the Indian Ocean based on an energetic perspective. *Climate Dynamics* 54, 3627-3639