Dear editor,

Thank you for your kind considerations on our manuscript entitled "Aerosol-meteorology feedback diminishes the trans-boundary transport of black carbon into the Tibetan Plateau" (egusphere-2023-252). We appreciate that you gave us a chance to improve our manuscript to a level suitable for publication in ACP. We also want to express our deep thanks to the reviewers of the positive comments. Those comments are all valuable and very helpful for revising and improving our paper. We have studied comments carefully and have made corrections, which we hope meet with approval. The main corrections in the paper and the responds to the reviewer's comments are as following:

Answers to reviewers:

Reviewer #2:

The interaction between aerosols and meteorology, and its impact on the cross-boundary transport flux of BC (black carbon) over the Tibetan Plateau (TP), has received limited attention in previous research. This paper presents a comprehensive investigation of the aerosol-meteorology feedback and its influence on BC transport flux during a period of heavy aerosol pollution. The study utilizes WRF-Chem simulation to thoroughly analyze the phenomenon. Additionally, the paper elucidates the meteorological factors that contribute to the occurrence of severe aerosol pollution events over the TP. The concept introduced in this article is characterized by its novelty, and the study's findings hold significant implications for the preservation of the TP's ecological environment. Hence, I recommend that this manuscript be revised and considered for publication in ACP. Please find below some specific comments for further improvement:

Firstly, we appreciate that you gave us a chance of revision to improve our manuscript to a level suitable for publication in Atmospheric Chemistry and physics. The comments are replied as follows:

1. The authors validated the model performance on BC and AOD by comparing the simulation and observation. Although the comparison results are basically satisfactory, the data used to validate the model performance is still simple and I suggest inter-model comparison should be considered, which might be more convincing.

Response: Thank you very much for your valuable advice. The reviewer made a very good point here. According to the reviewer's suggestion, we not only validated the model performance on temporal variation in AOD at different stations by comparing the simulated AOD with the ground-based and satellite-based observational AOD (Figure S4), but also verified the model performance on the spatial distribution of AOD over the study area by comparing the simulated AOD with the satellite-based and reanalyzed AOD (Figure S5). However, for BC, the comparison between reanalysis and simulation was only conducted because we have very limited in-situ observed BC (the observed BC is only available at the QOMS station). According to the reviewer's suggestion, we further validated the model performance by conducting the inter-comparison among in-situ observation, simulation, and MERRA-2 reanalysis, as shown

in Figure A1. The results show that the temporal variation in simulation is very close to that of simulation. Moreover, the correlation coefficient between the simulation and observation is 0.867, passing the 99% confidence level. Therefore, the model configuration used in this study presented a reasonable performance on BC. For the spatial distribution of BC over the study area, we compared the simulation with reanalysis from MERRA-2 and simulation from CAM_Chem. The results show that the spatial pattern of the WRF-Chem simulated BC is similar to that of the reanalyzed BC (Figure S6); however, the spatial pattern of BC from CAM_Chem is not reasonable (Figure A2).

Additionally, in terms of the BC transport flux, as the spatial pattern of BC from CAM_Chem is not reasonable, we can't further verify the transboundary transport flux of BC with CAM_Chem data. Also, the BC from MERRA-2 has no vertical information, resulting in the inability to provide vertical profile of BC transport flux. Therefore, the transport flux of BC was not verified by inter-model comparison.

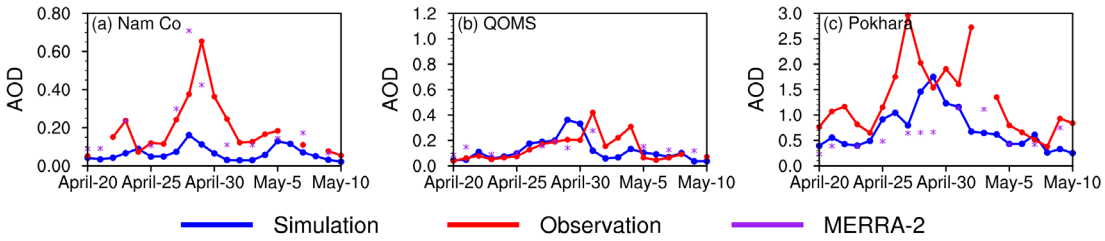

Figure S4. Inter-comparison of temporal variations in simulated AOD and ground-based as well as satellite-based AOD at (a) Nam Co, (b) QOMS, and (c) Pokhara stations for the period from April 20 to May 10, 2016.

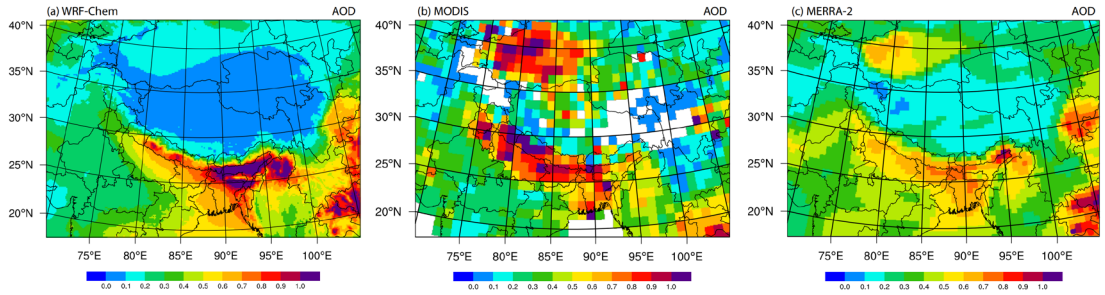

Figure S5. Inter-comparison of spatial distribution of simulated mean daily AOD and satellite-based as well as reanalyzed mean daily AOD from April 20 to May 10, 2016, over the study area.

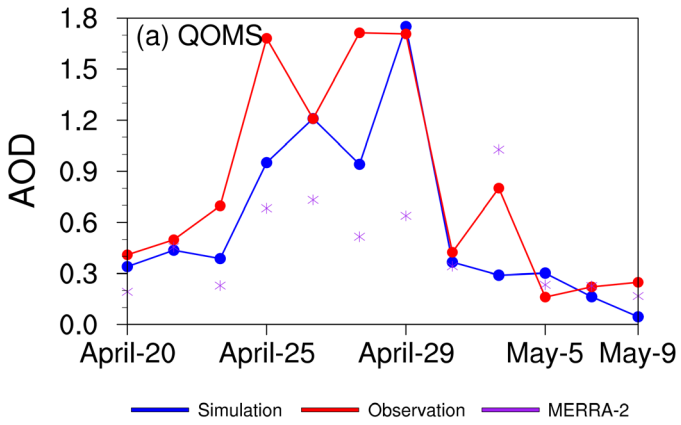

Figure A1. Inter-comparison of temporal variations in simulated BC and in-situ observed BC as well as reanalyzed BC at QOMS station for the period from April 20 to May 10, 2016.

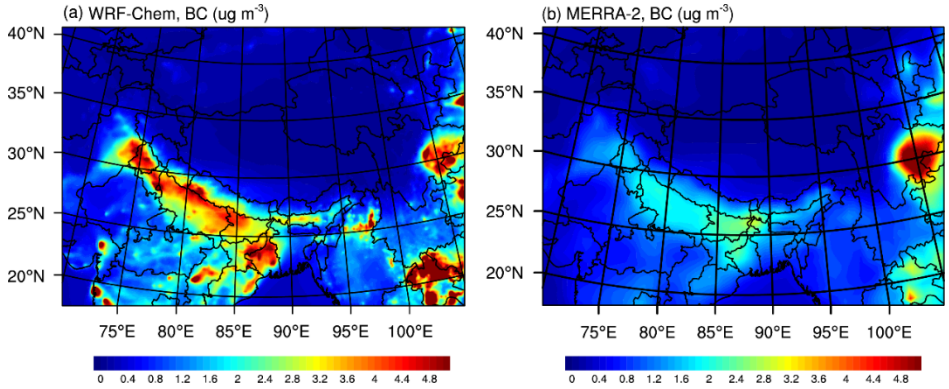

Figure S6. Spatial distributions of simulated and reanalyzed daily mean BC concentrations over the domain averaged for the period from April 20 to May 10, 2016.

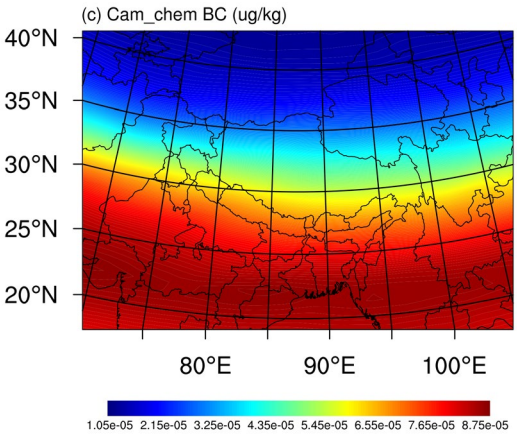

Figure A2. Spatial distribution of daily mean BC from CAM_Chem data averaged for the period from April 20 to May 10, 2016.

2. When analyzing the meteorological causes of the heavy aerosol pollution event, isotherms in the weather maps in Figure 3 are not included in the analysis, and isotherms

lead to blurring of potential heights and wind fields in weather maps, so I suggest removing them.

Response: Thank you very much for your kind remind. According to the reviewer's suggestion, we have removed the isotherms in the weather maps in Figure 3 and the replotted Figure 3 is shown as follows:

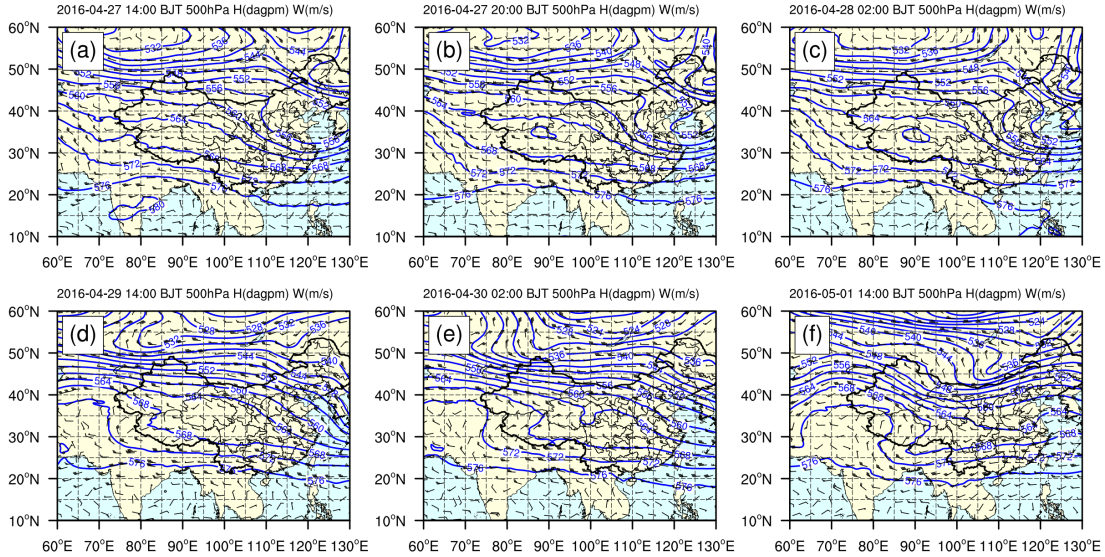

Figure 3 Weather maps at 500 hPa over the study area during the severe aerosol pollution event based on ERA-Interim reanalysis dataset. The blue lines are isopleths of geopotential height (unit: dagpm). Wind speed (unit: m/s) and direction are denoted by wind barb.

3. As the author stated in the title as well as in Figure.12, the aerosol-meteorology feedback decreased the cross-boundary transport flux of BC towards the TP. In fact, this conclusion is the result of pure model simulation because of the harsh environment, limited access for fieldwork, and the sparsity of fixed instrumental stations over the TP. So is there similar study in other places and What effect does the aerosol-meteorology feedback have on the transport flux of aerosols?

Response: Thank you very much for your good suggestion. This suggestion is somewhat similar to that made by the first reviewer. By reviewing extensive literature, it was found that there are similar studies in other places. For example, using ground-based multi-axis differential optical absorption spectroscopy (MAX-DOAS) at the Nancheng site in suburban Beijing on the southwest transport pathway of the Beijing-Tianjin-Hebei (BTH) region, Hu et at. (2022) estimated the vertical profiles of transport fluxes in the southwest-northeast direction. The results showed that the maximum net transport fluxes per unit cross-sectional area, calculated as pollutant concentration multiply by wind speed, of aerosol extinction coefficient (AEC), NO_2, SO_2 and HCHO were 0.98 $km^{-1}m\ s^{-1}$, 24, 14 and 8.0 $\mu g\ m^{-2}\ s^{-1}$ from southwest to northeast, which occurred in the 200–300 m, 100–200 m, 500–600 m and 500–600 m layers, respectively, due to much higher pollutant concentrations during southwest transport than during northeast transport in these layers. The average net column transport fluxes were 1200 $km^{-1}\ m^2\ s^{-1}$, 38, 26 and 15 $mg\ m^{-1}\ s^{-1}$ from southwest to northeast for AEC, NO_2, SO_2

and HCHO, respectively, in which the fluxes in the surface layer (0–100 m) accounted for only 2.3%–4.2%.

However, in terms of the influence of aerosol-meteorology feedback on transport flux of aerosols, it is found that no matter in regions with abundant observational data or in regions with sparse observational data, the influence of aerosol-meteorology feedback on the transport flux of aerosols was evaluated by means of model simulation, because sensitivity tests are involved in such studies. For instance, Huang et al. (2020) reported that long-range transport and aerosol–meteorology feedback may interact rather than act as two isolated processes as traditionally thought by investigating typical regional haze events in northern and eastern China. This interaction can then amplify transboundary air pollution transport over a distance of 1,000 km and boost long-lasting secondary haze from the North China Plain to the Yangtze River delta. The results show an amplified transboundary transport of haze by aerosol–meteorology interaction in China and suggest the importance of coordinated cross-regional emission reduction with a focus on radiatively active species like black carbon.

4. Line 949, Line 1090, Line 1176, Line 1213–1214, and Line 1227: ATMOSPHERIC CHEMISTRY AND PHYSICS --> Atmos. Chem. Phys.

Response: Thank you for your suggestion. We are very sorry for our carelessness, and "ATMOSPHERIC CHEMISTRY AND PHYSICS" has been revised as "Atmos. Chem. Phys".

5. Line 1128: JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES --> Journal of Geophysical Research: Atmospheres

Response: Thank you for your suggestion. We have revised "JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES" as "Journal of Geophysical Research: Atmospheres".

6. Line 1034–1035: NATURE CLIMATE CHANGE -->Nature Climate Change

Response: Thank you for your suggestion. We have revised "NATURE CLIMATE CHANGE" as "Nature Climate Change".

7. Line 1220: SCIENTIFIC REPORT--> Scientific Report

Response: Thank you for your advice. We have revised "SCIENTIFIC REPORT" as "Scientific Report".

8. Line 1221–1224: The corresponding article is quoted incorrectly and lacks the journal name.

Response: Thank you for your suggestion. The journal name has been added and the correct citation is 'Zheng, B., Zhang, Q., Zhang, Y., He, K. B., Wang, K., Zheng, G. J., Duan, F. K., Ma, Y. L., and Kimoto, T.: Heterogeneous chemistry: a mechanism missing in current models to explain secondary inorganic aerosol formation during the January 2013 haze episode in North China, Atmos. Chem. Phys., 15 (4), 2031-2049, https://doi.org/10.5194/acp-15-2031-2015, 2015.'.

Once again, special thanks to you for your good comments.

Best Regards.

Yuling Hu and Shichang Kang on behalf of all co-authors.

Hu, Q., Liu, C., Li, Q., Liu, T., Ji, X., Zhu, Y., Xing, C., Liu, H., Tan, W., and Gao, M.: Vertical profiles of the transport fluxes of aerosol and its precursors between Beijing and its southwest cities, *Environ. Pollut.*, *312*, 119988, https://doi.org/https://doi.org/10.1016/j.envpol.2022.119988, 2022.