Dear Editors and Reviewers,

Thank you very much for your careful review and helpful comments on our manuscript egusphere-2024-2493. We appreciate very much your constructive comments and encouraging suggestions on our manuscript. We have accordingly made the careful revisions. The revised portions are highlighted in the revised manuscript. Please find our point to point responses to the reviewer's comments as follows:

Responses to the reviewer 2

The regional transport of air pollutants driven by atmospheric circulation is one of the important causes for air pollution in atmospheric environment change. However, the driving mechanisms of atmospheric circulation have been poorly understood in the variations of regional Pair pollutant transport. Therefore, it is interesting in this study on the quasi-weekly oscillation (QWO) of regional $PM_{2.5}$ transport over China regulated with the influence of synoptic-scale disturbance of the monsoon circulation. The paper is well organized and fit the scope of the ACP journal. There are some minor issues need to be improved before publication.

[1. The quasi-weekly oscillation (QWO) of the monsoon circulation is a driver for the regional transport of air pollutants. Please include a discussion regarding the quasi-weekly oscillation of the East Asian winter monsoon circulation system.]

Response 1: Many thanks for the encouraging comments and helpful suggestions on our manuscript. Following the reviewer's comments, we have accordingly revised the manuscript in lines 177-186.

Atmospheric motion encompasses a variety of temporal and spatial scales. The sequences of meteorological variables often contain complex periodic components and exhibit multi-time-scale variations, including daily, weekly, seasonal, and interannual variations. Numerous observations have found QWO with periods of less

than 10 days across various meteorological elements in the EAWM system (Compo et al., 1999; Murakami, 1979; Wu and Wang, 2002). Synoptic-scale atmospheric variations are closely related to atmospheric longwave adjustments, with QWO periods of 4-7 days observed in cold air activities of the EAWM (Bai et al., 2022; Wu and Wang, 2002). The synoptic-scale disturbance regulates the generation, transport, and removal of $PM_{2.5}$ in air pollution, which is a key mechanism behind the 4-7 day periodic changes in $PM_{2.5}$ in CEC during the periods of EAWM (Guo et al., 2014; Liu et al., 2018; Quan et al., 2014, 2020).

Refrences

Bai, Y., Zhao, T., Hu, W., Zhou, Y., Xiong, J., Wang, Y., Liu, L., Shen, L., Kong, S., Meng, K., and Zheng, H.: Meteorological mechanism of regional $PM_{2.5}$ transport building a receptor region for heavy air pollution over Central China. Sci. Total Environ., 808, 151951, https://doi.org/10.1016/j.scitotenv.2021.151951, 2022.

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[2. It would strengthen the manuscript to include a quantitative comparison of the changes in $PM_{2.5}$, specifying the extent of any reductions or increases. A clear data comparison can make the manuscript more rigorous.]

Response 2: Following the reviewer's comments, we have added the following content (lines 317-323) and Figure S2:

Under the context of QWO, the average $PM_{2.5}$ TFM in NCP decreases from approximately 400 μg m^{-2} s^{-1} in the 1st and 2nd phases to 200 and 100 μg m^{-2} s^{-1} in the 3rd and 4th phases, respectively (Fig. S2a). Correspondingly, the $PM_{2.5}$ concentration anomalies decline from around 100 μg m^{-3} to approximately –50 μg m^{-3} (Fig. S2c). In the downwind THB, the average $PM_{2.5}$ TFM increases from about 200 μg m^{-2} s^{-1} in the 1st phase to approximately 300 μg m^{-2} s^{-1} in the 2nd and 3rd phases (Fig. S2b), with $PM_{2.5}$ concentration anomalies also rising to around 50 μg m^{-3} (Fig. S2d).

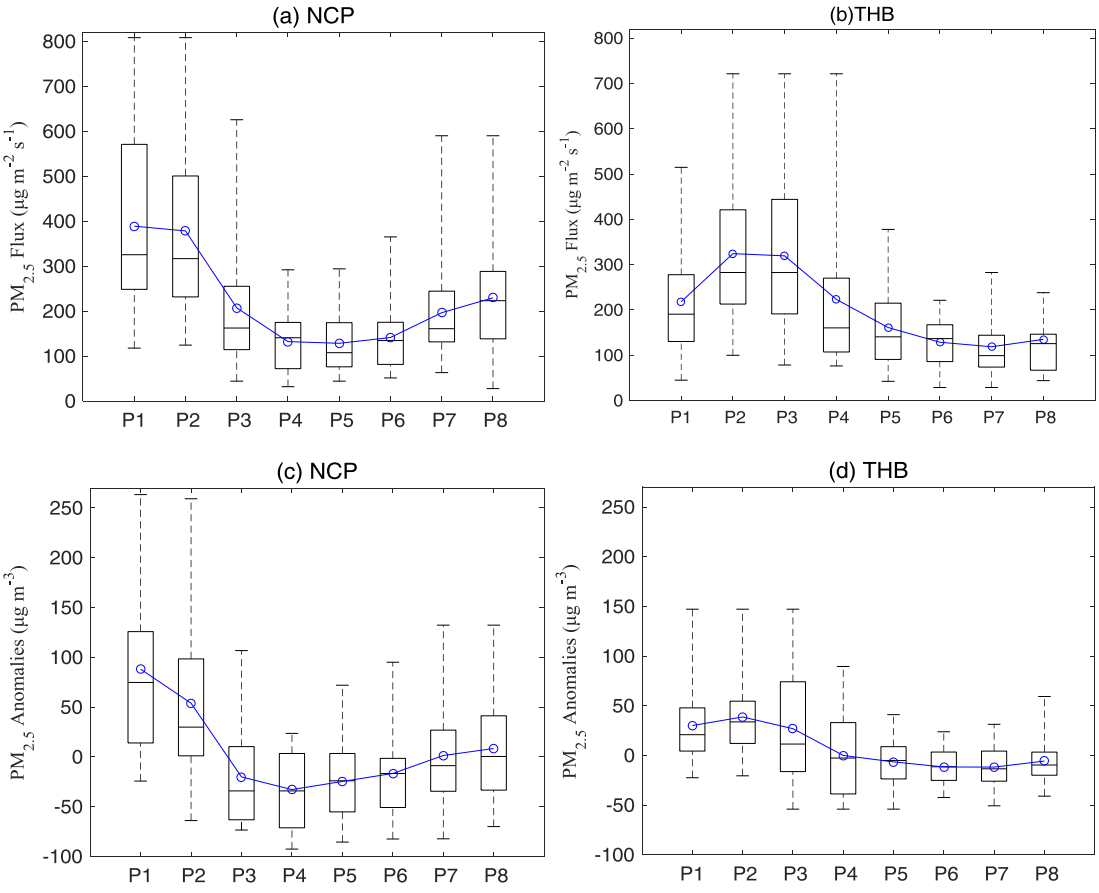

Figure S2. Box plots illustrating the 8 phases of QWO during 23 typical events of regional $PM_{2.5}$ transport from NCP to THB of (a,b) $PM_{2.5}$ TFM (μg m^{-2} s^{-1}) and (c,d) anomalies of $PM_{2.5}$ (unit: μg m^{-3}); each box plot displays the maximum, minimum, median, and upper and lower quartiles, with the circles indicating the mean.

[3. The manuscript provides a detailed analysis of regional $PM_{2.5}$ transport from the North China Plain to the Twain-Hu Basin; however, there is insufficient discussion regarding the impact of this transport on $PM_{2.5}$ over the Twain-Hu Basin. Please include a paragraph in the discussion that addresses potential impacts and offers a comparison with existing literature on this topic.]

Response 3: Following the reviewer's comments, we have accordingly revised the manuscript in lines 381-391.

Driven by prevailing winds of EAWM, the THB became the main receptor for regional transport of air pollutants over CEC (Bai et al., 2022; Shen et al., 2021). During 2015–2019, approximately 65.2% of the total $PM_{2.5}$ heavy pollution events in the THB were triggered by regional transport of air pollutants over CEC (Hu et al., 2022; Shen et al., 2021). Such $PM_{2.5}$ transport from upstream source regions in CEC contributes 51%-85.7% of the $PM_{2.5}$ pollution over the THB receptor region (Hu et al., 2021; Lu et al., 2017; Shen et al., 2022; Yu et al., 2020), revealing the dominance of regional transport of air pollutants from CEC to the THB with the meteorological drivers. Our research emphasizes the QWO of regional $PM_{2.5}$ transport over CEC with the driver of the synoptic-scale disturbances of EAWM circulation, confirming the source-receptor relationships with their 2-day lagging effects in the regional $PM_{2.5}$ transport between the upstream NCP source region and the THB receptor region.

References

Bai, Y., Zhao, T., Hu, W., Zhou, Y., Xiong, J., Wang, Y., Liu, L., Shen, L., Kong, S., Meng, K., and Zheng, H.: Meteorological mechanism of regional $PM_{2.5}$ transport building a receptor region for heavy air pollution over Central China. Sci. Total Environ., 808, 151951, https://doi.org/10.1016/j.scitotenv.2021.151951, 2022.

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Minor comments:

[4. Line 45: The citation "X. Huang et al., 2020" appears to be formatted incorrectly. A similar issue is observed in lines 88-91 with "Y. Yang et al., 2021" and "W. Yang et al., 2021." Please correct these references and conduct a thorough check of the entire manuscript to ensure the accuracy of the citation format.]

Response 4: Thanks the referee for pointing out the printing errors, which have been corrected in the revised manuscript.

[5. Line 93: The authors should provide a more detailed explanation of the term "susceptibility zone" to enhance comprehension of this concept.]

Response 5: Following the reviewer's comments, we have provided a more detailed explanation of the term "susceptibility zone" in lines 102-106.

The "harbor" effect on the eastern lee of the Tibetan Plateau's large topography on the westerlies is possibly an important factor influencing the regional distribution of $PM_{2.5}$ pollution in CEC with weak horizontal winds and sinking motion in the lower troposphere, which exacerbates the environmental impacts of local air pollutant emissions establishing a "susceptibility zone" in this region.

[6. Lines 289-290: The sentence "The source-receptor relationship between NCP and THB during the regional $PM_{2.5}$ transport over CEC is discussed in detail in the next section" does not significantly contribute to the manuscript. As it serves primarily as a transition to the next section, it could be removed for clarity.]

Response 6: Following the reviewer's comments, we have removed the sentence from the revised manuscript.

[7. Please improve English writing include grammar and expression in the manuscript.]

Response 7: With the help of English Language editing service, the English witting errors including incorrect grammar, confusing wording and inappropriate expression have been substantially revised to improve the readability of the manuscript.