Response: Impacts of tropical cyclone-heatwave compound events on surface ozone in eastern China: Comparison between the Yangtze River and Pearl River Deltas

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Dear Editor,

We would like to submit our revised manuscript entitled "**Impacts of tropical cyclone-heatwave compound events on surface ozone in eastern China: Comparison between the Yangtze River and Pearl River Deltas**" to ***Atmospheric Chemistry and Physics.***

On behalf of my co-authors, we thank you for handling the peer review of our manuscript. We appreciate your time and efforts for the careful reviews and constructive comments that have helped improve the quality and readability of the manuscript. We have carefully revised our manuscript to address the comments accordingly. Below are the point-to-point responses to the review comments.

Kind regards,

Key:

Black: Editor's comments

Blue: Author's responses

#Editor:

Major comments:

L234-236: There are high winds and high rainfall, so what are the chances of "heat waves" in these conditions. This has to be discussed, and past studies should be mentioned.

Reply: Thanks for your question. In this work and our previous study (Wang et al., 2023), we have emphasized that extremely high temperatures typically occur preceding the landfalls of tropical cyclones, driven by the descending motions and intensified solar radiation. However, the high temperatures rapidly decline once the tropical cyclones make landfall, primarily due to the accompanying strong winds and precipitation (Gori et al., 2022; Zhang et al., 2024). We have accordingly added the discussions in the updated manuscript (**Line 456-461**).

References:

Zhang, M., Yang, Y., Zhan, C., Zong, L., Gul, C., & Wang, M.: Tropical cyclone-related heatwave episodes in the Greater Bay Area, China: Synoptic patterns and urban-rural disparities. Weather and Climate Extremes, 44, 100656. https://doi.org/10.1016/j.wace.2024.100656, 2024.

L271-272: So ozone decreases during TC? Is it because of chemistry? Or transport? How do you differentiate the contribution of transport and chemistry during this period? Note that, during TCs, there will be high winds. You have used the model simulations, but the model simulates cyclone condition well? Please discuss this.

Reply: Thanks for your constructive and helpful comments and suggestions.

As we have stressed in this study and previous works (eg., Zhan et al., 2020), throughout the lifetime of a tropical cyclone, its position exerts different influences on ozone concentration. For example, in the Yangtze River Delta region, surface ozone concentrations are abnormally elevated when tropical cyclones are away from the land.

However, when the typical cyclones make landfalls, there is a sharp decline in ozone concentrations (as shown in Fig. 5). We have accordingly added the discussions in the updated manuscript (**Line 461-464**).

Furthermore, GEOS-Chem simulations are utilized to evaluate the anomalies in physical and chemical processes associated with tropospheric ozone during both TC-HDs and AHDs. This approach allows us to distinguish the contributions of transport and chemical processes, as illustrated in Figures 10 and 11, with detailed explanations provided in **Section 5.2.** Moreover, the GEOS-Chem model's ability to capture TC activities is not a concern, as it is driven by MERRA2 reanalysis data. Consequently, the meteorological outputs from GEOS-Chem directly reflect the reanalysis data, ensuring accurate representation.

Zhan, C., Xie, M., Huang, C., Liu, J., Wang, T., Xu, M., Ma, C., Yu, J., Jiao, Y., Li, M., Li, S., Zhuang, B., Zhao, M., & Nie, D.: Ozone affected by a succession of four landfall typhoons in the Yangtze River Delta, China: Major processes and health impacts, Atmospheric Chem. Phys., 20(22), 13781–13799, https://doi.org/10.5194/acp-20-13781-2020, 2020.

L113-115: Please introduce some of these studies here, and discuss the results in the Discussion Section.

Reply: Thanks for pointing this out. We have introduced studies in **Lines 89 to 108** in the introduction part, for example, “High ozone concentration events are typically associated with high temperatures, which lead to increased emissions of BVOCs and enhance the chemical formation of ozone (Lu et al., 2019; P. Wang et al., 2022). P. Wang et al. (2022) indicate that ozone pollution levels are significantly higher during extreme heat events compared to other days in the North China Plain.” in **Lines 90-94** and “Shu et al (2016) investigated the impacts of Typhoon Utor on an ozone pollution episode over the Yangtze River Delta (YRD) of China from August 7 to 12, 2013. They found that the peripheral circulations of the approaching typhoon intensified downward airflow, leading to a short-term local weather pattern of high temperatures, low humidity, intense solar radiation, and light winds, which exacerbated ozone pollution. Following the passage of TCs, the lower tropospheric transport of ozone-rich air and

strong photochemical reactions also contribute to amplifying ozone pollution (Zhan et al., 2020). For ozone pollution in Pearl River Delta (PRD), influenced by the strong downdrafts related to the periphery of TCs, the PRD region typically is dominated by high pressure, low humidity, and strong solar radiation, leading to the accumulation of ozone (Wei et al., 2016; Ouyang et al., 2022)" in **Lines 97-106.**

Moreover, we have added more related discussion in the Discussion Section (**Lines 429-436**): "High ozone levels are generally linked to high air temperatures, which increase BVOC emissions and enhance ozone formation (e.g., Lu et al., 2019; P. Wang et al., 2022). TC activities can modify surface ozone concentrations by affecting the transport and accumulation processes, exacerbating pollution in the YRD and PRD (e.g., Shu et al., 2016; Zhan et al., 2020). The SECC region experiences both frequent TCs and heatwave events under global warming (W. Wang et al., 2016; Xiao et al., 2011) which has proven to have an intrinsic concurrent relationship (Matthews et al., 2019; P. Wang et al., 2023). However, the impacts of the compound extremes of hot extremes and TCs on ozone pollution over SECC have received limited attention.".

L268: How different is your work from the study of Shu et al. (2016)?

Reply: Thanks for pointing this out. As we have discussed in the manuscript, Shu et al (2016) use a case study to investigate the impacts of Typhoon Utor on an ozone pollution episode over the Yangtze River Delta (YRD) region in China from 7 to 12 August 2013 whereas our work systematically examines the effects compound hazards of tropical cyclones and hot days on the near-surface ozone concentrations over SECC throughout the summertime of 2014-2019. We have accordingly added more classifications (**Lines 97-101**).

Technical corrections:

1. L43, 55, 58, Please correct citation format.

Reply: Thanks. Modified.

2. L258: delete "deliberately"

Reply: Thanks. Deleted.

3. L275: What are the "others" here?

Reply: "Other" refers to the tropical cyclones excluding those that move northeastward to the YRD, as shown in Figure 5b. We have corrected this sentence in the updated manuscript: "Particularly, TCs heading northeast to YRD favor the increases in ozone concentrations in the PRD whereas the other TC tracks tend to cause a reduction in surface ozone concentrations following landfalls (Fig. 5b)."

4. L315: Why there is high ozone?

Reply: As shown in Fig. 4b, surface ozone concentrations are higher in the majority of the SECC region but fall in the northern part of SECC during TC-HDs. Here, we are talking about the unfavorable meteorological conditions for ozone pollution over the northern part of SECC.

5. L433: What are "clean" sea winds?

Reply: Thanks for pointing this out. The term "clean" refers to the clean marine air transport inland by the sea breezes. We have reworded the sentence that "…it is influenced by strong sea breezes, which aid in ozone elimination."