Reviewer #1: This manuscript presents a significant and timely contribution to our understanding of ozone pollution dynamics in the GBA under tropical cyclone influence. The study provides a comprehensive three-dimensional characterization of O3 transport mechanisms during TC events, thereby moving beyond previous work that has primarily focused on general TC-O3 relationships. The combination of high-temporal-resolution wind profile measurements with hourly meteorological and air quality observations, supplemented by model simulations, represents a methodologically robust approach that enables detailed process-level understanding. The manuscript offers valuable quantitative insights into distance-dependent transport mechanisms. Notably, the finding that TC activity accounts for 39.9% of O3 pollution episodes underscores the practical importance of this work for pollution forecasting and mitigation strategies in the GBA and other TC-affected bay regions globally. Despite these considerable strengths, several aspects of the manuscript would benefit from further clarification and refinement to strengthen its scientific contribution and accessibility to the broader readership. Therefore recommend this manuscript for publication after minor revisions addressing the following points.

Response: We thank you for your thoughtful review and constructive feedback. We have carefully addressed all your concerns and revised the manuscript accordingly. Our detailed responses to each comment are provided below. point-by-point responses given below.

Specific comments:

(1) Formatting issues with superscript units. Multiple instances of incorrect superscript

formatting for units such as "μg m -3" and "m s -1" are found throughout the manuscript.

Please check and correct all unit expressions consistently throughout the text.

Response: Thank you for your suggestion. We have carefully reviewed and revised all instances of the aforementioned issues in the manuscript, and have also checked that all formatting is appropriate.

(2) Lines 290-295: There appears to be a date inconsistency in this section. Please clarify whether the events occurred in July or August.

Response: Thank you for your suggestion. The dates throughout the manuscript have been checked and unified.

(3) Line 295: The model results do not adequately address whether the elevated ozone concentrations at the HD site on the 23rd-24th were primarily due to local photochemical production or regional transport. Please provide additional analysis.

Response: Thank you for your question. Firstly, the spatial wind field distribution in Figure 6 shows that wind speeds around the HD station are relatively low, indicating limited conditions for regional transport. Secondly, the backward trajectories in Figure 8 suggest minimal near-surface regional transport at the HD station, with noticeable regional transport occurring mainly at higher altitudes. Finally, we applied non-negative matrix factorization (NMF) for source apportionment, which identified two primary factors (local production and regional transport).

The diurnal variation patterns in the above results allow us to identify Factor 1 as local production and Factor 2 as regional transport. Our analysis shows that local production contributes 71.2% of the ozone at the HD station, significantly higher than the contribution from regional transport. Based on these findings, we conclude that ozone at the Huadu station during this period originated primarily from local sources. The relevant section of the manuscript has been revised accordingly (Lines 416 - 431):

we applied non-negative matrix factorization (NMF) for source apportionment, which identified two primary factors (local production and regional transport). The diurnal variation patterns in Figure 7(a) allow us to identify Factor 1 as local production and Factor 2 as regional transport, as local emissions typically peak in the afternoon, whereas regional transport often shows higher contributions during the early morning (Zong et al., 2023). Figure 7(b) shows that local production contributes 71.2% of the ozone at the HD station, significantly higher than the contribution from regional transport. This finding aligns with the spatial distribution shown in Figure 6 and is further supported by the backward trajectory analysis presented in Figure 8.

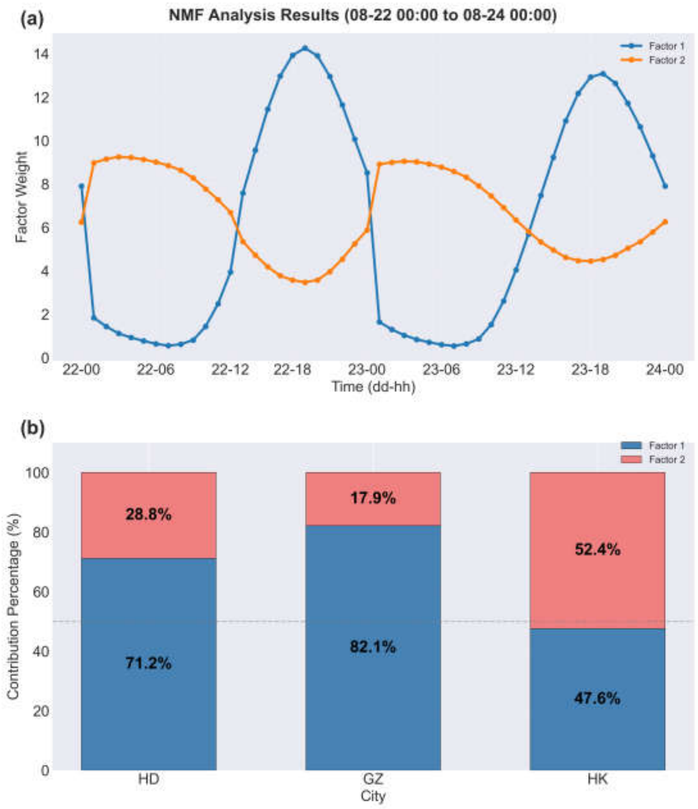

Figure 7. (a) Two factor time series (August 22-24). (b) Proportion of local generation and regional transmission in HD, GZ and HK

In summary, the high O_3 concentrations observed at the HD station from 22 to 23 July were primarily attributed to local photochemical production, as weak winds limited regional transport. On 24 July, O_3 levels at the HD station decreased significantly due to wind changes that enhanced transport, moving O_3 to downstream regions. As a result, elevated O_3 concentrations were observed at the GZ and HK stations, especially at the HK stations where the winds converged.

(4) Line 341: There is an inconsistency in the surface wind direction for the HK on August 24th. Line 281 and Figure 5c both indicate southwesterly winds, while Line 341 describes northwesterly winds. Please verify the actual wind direction from the observational data and correct this discrepancy.

Response: Thank you for pointing this out. We have revised the text to indicate that the wind direction in Hong Kong on the 24th was from the southwest.

(5) Line371-374: How does the RI value at the GZ site indicate the occurrence of convergence? Does " which led to reduced wind speeds within the boundary layer" refer to horizontal or vertical wind speed? Please specify. And The explanation in lines 371-374 transitions abruptly from wind speed changes to terrain and urbanization effects. Please provide more detailed explaining.

Response: Thank you for your question. We sincerely apologize for this error and have re-conducted the analysis with greater precision. We have thoroughly revised the relevant section, as the original wording inappropriately conflated the analysis of vertical wind speed with the discussion of RI and presented unclear reasoning.

In Guangzhou, the significant difference in vertical wind speed inside and outside the boundary layer indicates that O_3 is transported into the boundary layer via downdrafts. Subsequently, weaker vertical wind speeds within the boundary layer lead to the accumulation of ozone near the surface. This phenomenon may be related to the topography and urbanization level of Guangzhou, both of which contribute to reduced vertical wind speed within the boundary layer, thereby limiting vertical mixing and dispersion of ozone.

Thus, the term "wind speed" here specifically refers to vertical wind speed. For the revision of the original text, the following changes have been made (Lines 537 - 544):

On 24-25 August, differences in RI in GZ indicated that the concentration of O3 within the boundary layer was significantly influenced by local convergence effects, resulting in the accumulation of O_3 near the surface. This phenomenon may be attributed to the topography and level of urbanization in GZ, which led to reduced wind speeds within the boundary layer, thus limiting the vertical mixing of O_3. These combined topographic and urban effects weakened the ventilation capacity of the boundary layer, thus promoting the retention and accumulation of pollutants near the surface.

(6) Line 376: Based on Figure 10, O_3 appears to be more uniformly mixed within the boundary layer at the GZ site, which seems inconsistent with the text description.

Response: Thank you for your comment. We agree that the wording and analysis in this section were inadequate and have revised the relevant analysis in the manuscript (Lines 542 - 548):

These combined topographic and urban effects weakened the ventilation capacity of the boundary layer, thus promoting the retention and accumulation of pollutants near the surface. However, Hong Kong exhibited smaller wind speeds along with nearly identical vertical wind speeds inside and outside the boundary layer, suggesting a more uniform dynamic structure that facilitated stronger vertical mixing of O_3. In this case, O_3 transported horizontally from the upstream could be effectively carried to the surface.

(7) Line 385-392: The relationship between O_3 and VWS requires more detailed explanation. Specifically, the authors should clarify: (1) how VWS magnitude corresponds to O_3 levels (i.e., whether larger/smaller VWS values correspond to higher or lower O_3 concentrations), and (2) how changes in VWS affect o O_3 concentrations. Currently, this section provides minimal explanation of these mechanisms . And "But the HK station had a higher boundary layer height that could accommodate more O_3." this statement appears contradictory: if the boundary layer can accommodate more O_3, one might reasonably infer that O_3 concentrations would be lower. However, the HK actually exhibits higher O_3 concentrations. The authors should provide more comprehensive explanations to reconcile this apparent inconsistency and ensure logical coherence in their interpretation.

Response: Thank you for your suggestion. Based on previous research, vertical wind shear (VWS) facilitates the downward transport of ozone from upper levels to the near surface. The deeper boundary layer in Hong Kong is more conducive to capturing ozone transported from inland regions, which is then brought downward by

VWS, leading to an increase in ozone concentrations within the boundary layer. The text has been revised to clarify this mechanism (Lines 562 - 579):

On the other hand, **VWS can improve the vertical mixing of O_3 in the boundary layer by transporting ozone from altitude to the surface, thus modifying its vertical structure (Zhang et al.,2020).** As shown in Figure 13, on 22 August (15:00, about 1600-1800 km away from the GBA), the VWS centers were visible around 1.5 km and 2.5 km, with a maximum of 70 m •s-1 at the GZ station. On 23 August (15:00, about 1000-1300 km from the GBA), the HD station had a more consistent wind direction in the upper part of the boundary layer (Figure 89a) and the VWS was relatively small (Figure 123a). However, the wind direction was more complex at the GZ and HK stations in the upper part of the boundary layer (Figure 89b-c), leading to an increase in VWS with values around 7 m • s-1 within the boundary layer (Figure 123b-c). On 24 August (15:00, about 600-800 km away from the GBA), obvious VWS appeared within the boundary layer at all three stations. VWS centers were most pronounced around 1 km at the HD and GZ stations. **The higher height of the boundary layer at the Hong Kong station facilitated the entrainment of ozone transported from the inland above the boundary layer (Li et al.,2025), which was then brought to the near-surface by vertical wind shear.**