Reviewer #1

Comment [1-1]: General comments: In this manuscript, the authors gave a very details analysis mostly based on 3 year ozone and other gas pollutants observations on a 488m high Canton Tower with 4 levels. The data collected were precious, and the topic is of great interesting to recognize ozone vertical exchanges within boundary layer (BL) and related to ozone diurnal variation. The analysis is mostly sound, but some details need clarify.

Response [1-1]: We thank the reviewer for the positive and valuable comments. All of them have been implemented in the revised manuscript. Please see our itemized responses below.

Comment [1-2]: Specific comments: Refer to the discussion in 341-344, the study address the cases that rule out wind speeds above 2 m/s at four vertical layers, and say "exclude the possible influence of horizontal transport". My concern is that in a consecutive event (NOE), some periods could be in smaller wind speed, sometimes in bigger. While, I do not think that means horizontal transport is not important in a NOE. My interesting is what about the influence of horizontal transport, because horizontal transport from rural sites may also induce high surface ozone and the emission from high stacks could also contribute to high CO and NO_2 in RL. I suggest a detailed analysis of some typical cases, also at least compared the model results of ΔVDIF and ΔADV in different levels.

Response [1-2]: Thank you for your suggestions. We agree that horizontal transport from rural sites have the potential to elevate surface ozone in nighttime. We have added the statement in Section 3.3 "Ozone concentrations are higher in nighttime RL than at the surface, while NO_2 and CO concentrations are much higher at the surface as they are primarily released from anthropogenic emissions at near surface while there is almost no direct source at higher altitudes near the Canton Tower. As such, the increase in NO_2 and CO at 488 m during the NOE events, even though with very small magnitude, is most likely from the vertical mixing with surface layer air mass or from horizontal transport of polluted air parcels". We have also followed your suggestion to conduct two cases study to illustrate the contribution of horizontal transport on NOE event in Section 3.3. Please kindly refer to Response [3-6] for more details on the case studies.

Comment [1-3]: This study identify a strong ozone residual capacity, defined as the ratio of the ozone concentration averaged over nighttime to that in the afternoon (14:00-17:00 LT). As the ratio in mathematics, I suggest to replace the definition of "ozone residual capacity" to "ozone residual ratio".

Response [1-3]: We agree. We have replaced the definition of "ozone residual capacity" to "ozone residual ratio" in both Figure 5 and relevant contexts.

Comment [1-4]: It's not exact to say "weakens the titration effect by diluting NO_x concentrations." during NOE. It could be better to say "offset the surface ozone

decrease by NO diluting".

Response [1-4]: Thank you for pointing it out. We have revised the text for clarification: "The enhanced vertical mixing leads to NOE event by introducing ozone-rich and NO_x-poor air in the RL to enter the nighttime stable boundary layer."

Comment [1-5]: The explanation in line 270-279 were not sufficient. Except the "ozone-rich air at higher altitudes to mix with air in the lower boundary layer.", the higher ozone produced by photochemistry near surface should also convectively transport to upper BL or low free troposphere.

Response [1-5]: Thank you for correction. We have added the following text in paragraph 3 of Section 3.2 as follows for justification: "allowing ozone-rich air from higher altitudes and ozone chemically produced near surface to mix with air in the lower boundary layer."

Comment [1-6]: In fig. 12, what's the result if you statics the relation of surface ozone before noon (for example 9:00-11:00) and before the sunrise (for example 5:00-6:00)?

Response [1-6]: We further analyze the relationship between surface ozone before noon (averaged over 9:00-11:00) and before sunrise (averaged over 5:00-6:00), as depicted in Figure R1. We also find a comparable dependency of the two variables, consistent with Figure 12.

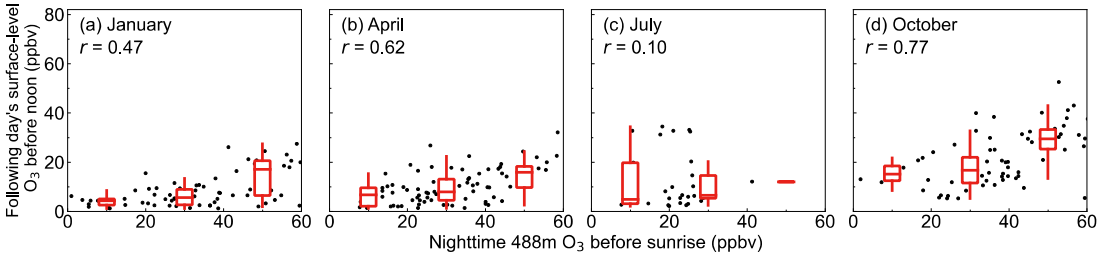

Figure R1. Relationship between nighttime 488 m ozone before sunrise (averaged over 5:00-6:00) and the following day's surface-level ozone before noon (averaged over 9:00-11:00).

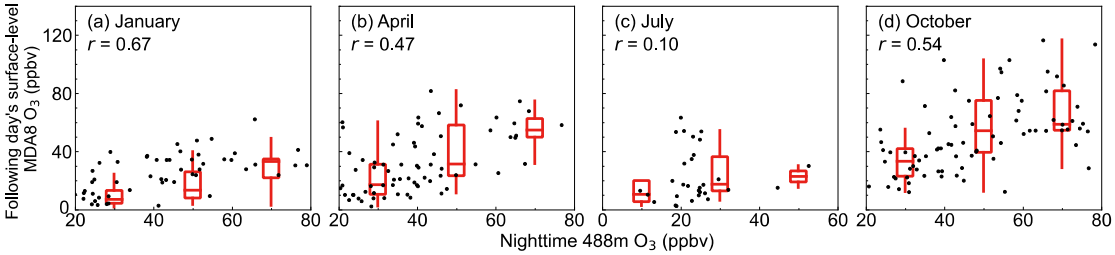

Figure 12. Relationship between nighttime 488 m ozone and the following day's surface-level MDA8 ozone.

Comment [1-7]: In introduction, in line 58-61, I suggest move and combined these sentences that introduce your study to line around 95. Also, please polish the context

and concisely present the analysis.

Response [1-7]: Thank you for pointing it out. In order to avoid redundancy in introduction in line 58-61, we have revised as: "Here we combine observations and model simulation to analyze nighttime ozone in the lower boundary layer in Guangzhou, the core megacity in South China". We prefer to have a short sentence to outline the major content of our study in the early part of the introduction.

We have polished the context in multiple places in the manuscript following your suggestion.