

Dear Professor Xavier Querol,

Thank you very much for handling our manuscript submitted to *Atmospheric Chemistry and Physics* (MS No.: egusphere-2023-479; Title: Summertime response of ozone and fine particulate matter to mixing layer meteorology over the North China Plain).

We deeply thank the reviewers for giving constructive comments and suggestions that are very helpful to improve our manuscript. We have polished this paper by native English speakers, and carefully revised the manuscript with details showed below. We hope the revised manuscript meet the publication standards. To proceed, we have uploaded three files, including 1) our point-to-point reply; 2) the revised manuscript with changes highlighted in yellow; 3) the revised manuscript without track-changes.

On behalf of all the co-authors, I would like to thank you and referees for all the invaluable comments. Please feel free to contact me if you need any further information.

Yours Sincerely,

Jian Gao

Professor

Chinese Research Academy of Environmental Sciences, Beijing 100012, China

E-mail address: gaojian@craes.org.cn

Phone: 18911819868

**Anonymous referee #1:**

**Comment 1:** The text and the explanation of results have significantly improved, and the results are very relevant and interesting. However, the English used in the latest revision is much neglected compared to the original text, which sometimes hinders its understanding. It is strongly recommended to review the English.

**Answer:** Thank you for your approval and your valuable comments. According to your suggestions, we have polished this paper by native English speakers, and carefully revised the manuscript with details showed below. We hope the revised manuscript meet the publication standards.

**Comment 2:** Line 23: “opposite change characteristics”  
Line 552: “opposite changes” is not understood.

**Answer:** “Opposite change characteristics” means the different effects of temperature on the change characteristics of  $\text{NO}_3^-$  and  $\text{SO}_4^{2-}$ .  $\text{SO}_4^{2-}$  concentration generally climbed up when temperature increased. Unlike  $\text{SO}_4^{2-}$ , which predominantly exists in the particle phase,  $\text{NO}_3^-$  could be either presented as nitric acid ( $\text{HNO}_3$ ) in the gas phase or as ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ) in the particle phase. Higher temperature could prompt the partitioning of nitrate to  $\text{HNO}_3$ , resulting in a significant decrease in  $\text{NO}_3^-$  concentrations. To make this easier to understand, “opposite” has been replaced by “different” in our revised manuscript. (Page 1, line 24; Page 27, line 544)

**Comment 3:** Line 27: “superposition-composite effects”

**Answer:** The daily changes in MLH can form the interactive superposition influence effects on  $\text{O}_3$  and  $\text{PM}_{2.5}$ . The superposition-composite effects has been reported before by Wang et al. (2022). It contains two meanings: the chemical interactions between  $\text{O}_3$  and  $\text{PM}_{2.5}$ , as well as the accumulation of composite pollutants ( $\text{O}_3$  and  $\text{PM}_{2.5}$ ) along with the evolution of MLH. The formation of  $\text{PM}_{2.5}$  and  $\text{O}_3$  superposition-composite pollution along with the evolution of MLH was due to two superposition mechanism. First, the decrease in  $\text{PM}_{2.5}$  during the daytime with the rise in MLH, can be partly offset by an increment in secondary pollutant formation derived from  $\text{O}_3$  growth. Then, with the decrease in MLH at night, the concentration of the original existing  $\text{PM}_{2.5}$  increased owing to unfavourable diffusion.

**Comment 4:** Line 83: “One speculative...” very long sentence

**Answer:** “One speculative reason for this phenomenon is that  $\text{PM}_{2.5}$  does not reduce actinic flux and  $\text{HO}_2$  radical significantly when the  $\text{PM}_{2.5}$  concentration was low.” → “One possible reason is that when the  $\text{PM}_{2.5}$  concentration is low,  $\text{PM}_{2.5}$  does not reduce actinic flux and  $\text{HO}_2$  radical significantly.” (Page 4, line 83–84)

**Comment 5:** Line 109: “Observation was made...” -> “Observations were made”

**Answer:** This has been corrected in the manuscript. (Page 5, line 108)

**Comment 6:** Line 138: “1 hour”, “1 h” or “hourly”

**Answer:** “1-h”→“1 hour”. (Page 6, line 136)

**Comment 7:** The first paragraph of section 2.2 is confusing and not understood. It is proposed to summarize the reason for choosing MLH without getting into terminological discussions about PBL. The sentence in line 156 can be reformulated as: "The way the boundary layer describes the influences of air pollution is easily duplicated and confused.

**Answer:** Thanks to your valuable comments. We have deleted the terminological discussions about PBL, and the content in the first paragraph of section 2.2 has been reorganized in our manuscript. (Page 7, line 150–153).

**Comment 8:** In line 188, it is mentioned that the concept of MLH is clarified, but it is not the purpose of this work.

**Answer:** The purpose of this work was to investigate the impact of MLH on the change characteristics of ozone and fine particulate matter. We have rephrased this sentence in our revised manuscript. (Page 8, line 183–185)

**Comment 9:** Line 194, Typo in MDA8.

**Answer:** “MAD8”→“MDA8”. (Page 9, line 189)

**Comment 10:** Line 200: “demonstrate?” Do the authors mean “show”?

**Answer:** “demonstrated”→“shown”. (Page 9, line 195)

**Comment 11:** At the end of line 206, it would be advisable to add a period or separate the sentence.

**Answer:**“The PM<sub>2.5</sub> concentration was much lower comparing with ozone, with the mean, maximum, and minimum of the regional daily mean PM<sub>2.5</sub> concentration as 25.62 μg m<sup>-3</sup>, 45.62 μg m<sup>-3</sup>, and 11.32 μg m<sup>-3</sup>, respectively, during the observation period.” → “The PM<sub>2.5</sub> concentration was much lower comparing with O<sub>3</sub> during the observation period. The mean, maximum, and minimum of the regional daily mean PM<sub>2.5</sub> concentration was 25.62, 45.62, and 11.32 μg m<sup>-3</sup>, respectively.” (Page 9, line 199–202)

**Comment 12:** In expressions like “when MLH higher,” a verb is missing. “When MLH was higher than...” This example is repeated in the manuscript.

**Answer:** We are sorry to make the mistakes, and the missing verbs have been added in our revised manuscript.

**Comment 13:** Line 222, It is obvious that comparing MDA8h with daily averaged PM<sub>2.5</sub> is not comparable.

**Answer:** According to your valuable suggestions, this sentence “we found that there is a lag time between the concentration peak of MDA8 O<sub>3</sub> and that of PM<sub>2.5</sub> along with the reduction of MLH” has been deleted in the revised manuscript.

**Comment 14:** Line 223, “turned to decline.”

**Answer:** “turned to decline”→“declined”. (Page 10, line 217)

**Comment 15:** Line 246, I recommend replacing “elsewhere” with “in other studies.”

**Answer:** “elsewhere”→“in other studies”. (Page 12, line 240)

**Comment 16:** Line 254, “higher” or “medium” boundary layer? The comparison with previous data is not very clear without numerical values.

**Answer:** The observations conducted by Reddy et al. (2012) showed that days of higher O<sub>3</sub> concentrations were associated with higher boundary layer height (2500 m) comparing with lower boundary layer height condition (1500 m) in April 1999, in India. Owing to the different observation seasons, the boundary layer height cannot be directly compared. This part has been deleted in our revised manuscript. (Page 12, line 244-247)

**Comment 17:** Line 261, “or not along” should be “along with.”

**Answer:** “or not along”→“along with”. (Page 12, line 253-254)

**Comment 18:** Line 273, Writing degrees like (45°-225°) appears as a range; it's better to remove the numerical value.

**Answer:** According to your comments, we have revised the expression of the degrees in the revised manuscript: “45-225°”→“45°-225°”, “45-90, 90-135, 135-180, and 180-225°” → “45°-90°, 90°-135°, 135°-180°, and 180°-225°”, “180-225°” → “180°-225°”. (Page 12-13, line 266-273)

**Comment 19:** Subjective terms like “two obvious peaks” and “obviously” should be

avoided.

**Answer:** Thanks to your valuable comments. Subjective terms like “obvious” and “obviously” have been deleted or replaced by “prominent” in our revised manuscript. (Page 17, line 354, 357; page 20, line 428; page 25, line 498; page 27, line 543)

**Comment 20:** Line 395, MLH, not BLH.

**Answer:** “BLH”→“MLH”. (Page 19, line 388)

**Comment 21:** Line 424, I'm not sure what the authors want to convey with the values of SOR and NOR mentioned there

**Answer:** The oxidation ratio for sulfate (SOR, the molar ratio of sulfate to the sum of sulfate and SO<sub>2</sub>) and nitrate (NOR, the molar ratio of nitrate to the sum of nitrate and NO<sub>2</sub>) means the secondary conversion capacity of gaseous precursors to secondary aerosols. The high levels of SOR and NOR on O<sub>3</sub>-PM<sub>2.5</sub>CPD indicates the strong secondary formation of SO<sub>4</sub><sup>2-</sup> and NO<sub>3</sub><sup>-</sup> by high oxidation capacity, leading to the combined increase of O<sub>3</sub> and PM<sub>2.5</sub>.

**Comment 22:** Line 560, A verb is missing.

**Answer:** The verb “of” has been added in the revised manuscript. (Page 27, line 552)

**Comment 23:** Line 561, “is” instead of “was.”

**Answer:** “was”→“is”. (Page 27, line 553)

**Comment 24:** Line 562, “are” instead of “is.”

**Answer:** “is”→“are”. (Page 27, line 554)

## Reference

Reddy, K. K., Naja, M., Ojha, N., Mahesh, P., and Lal, S.: Influences of the boundary layer evolution on surface ozone variations at a tropical rural site in India, *J. Earth Syst. Sci.*, 121, 911-922, 10.1007/s12040-012-0200-z, 2012.

Wang, J., Yang, Y., Jiang, X., Wang, D., Zhong, J., and Wang, Y.: Observational study of the PM<sub>2.5</sub> and O<sub>3</sub> superposition-composite pollution event during spring 2020 in Beijing associated with the water vapor conveyor belt in the northern hemisphere, *Atmos. Environ.*, 272, 10.1016/j.atmosenv.2022.118966, 2022.