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Comment on acp-2022-50

Anonymous Referee #2

Referee comment on "Observation-based analysis of ozone production sensitivity for two persistent ozone episodes in Guangdong, China" by Kaixiang Song et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-50-RC2>, 2022

Observation-based Analysis of Ozone Production Sensitivity for Two Persistent Ozone Episodes in Guangdong, China

In this paper by Song et al., the authors use 2 episodes in Guangdong, China and a large number of measurement sites in the vicinity to construct an observation-based method (OBM), utilizing the measurements of various pollutants from said sites alongside a box model based on the CB05 chemical mechanism, with the purpose of determining ozone production efficiency (OPE) from NO_x and VOCs. They conclude that the area is under a NO_x limited regime, indicating that limiting NO_x emissions is the optimal strategy to reduce ozone formation in the area, contrary to previous studies.

While the paper does have its strong points – the analysis is thorough, the English used is clear and appropriate – it is not without shortcomings, many of which reviewer #1 covered. The paper merits publication based on the rigor of its analysis, but not that of the conclusions. As such I recommend the paper for publication only after the following points have been addressed and the discussion strengthened.

Science comments

- As the authors mention two episodes are not enough. In addition, they are well into the ozone season in the fall, which could further bias the results. For example, biogenic emissions of VOCs are going to be significantly less than what they would be during the summertime, which could tip the balance of the OPE. A section should be added to

discuss the potential differences between summer and fall months. The box model the authors have developed can be used, driven with meteorological variables from the observation sites during different seasons (if available), to investigate

- Based on (1), the usage of CO to VOC ratios, while a valid strategy for anthropogenic emissions completely neglects possible biogenic impacts and thus is better suited towards the urban sites much more than the rural sites. In addition to the current analysis, it would be of value that the authors also conduct the same by splitting the sites in rural and urban which would be more representative
- I second reviewer's #1 comment about the NO_x quasi steady state. This would only apply from 13:00 to 16:00. Using the average OH value for the early day is not accurate
- The calculation of OPE assumes that the only real sink of NO_x is the ozone formative chemistry. However, NO_x is also lost to other processes and in an area like deposition and nitrate formation. The deposition is briefly mentioned towards the end, but some additional discussion and/or an estimate of the magnitude of the effect should be provided. Given the close proximity of ports in the area and therefore the likely high emissions of SO₂ and subsequent sulfate formation, the additional NO_x sinks could be of an important magnitude. I do realize that such an analysis would be out of the scope of the paper, and I do not require that authors conduct it, but some additional discussion on the matter is warranted, given the number of assumptions already used. On that note, particularities of Guangdong should be added to the introduction e.g., nearby ports, major highways, nearby agricultural activities etc.

Editorial comments

- The timeseries of meteorological parameters is more suited for the SI. Use the diurnal profiles instead in the manuscript, so the reader can directly go back and forth with the diurnal concentrations to clearly see the dilution effect due to the PBL
- While I do understand why Figure 8 was added, and it holds a lot of valuable information, it would be best to either omit it or add it to the SI. Figure 9 is more appropriate, and it would be even better if you turn it into 2D plots with variable marker sites
- The combined site isopleth could use some polishing; fill out the contours. Also, I very strongly recommend that you make isopleth for each of the observation site clusters from Figure 1. This also feeds into point 2 from the science comments above