

Atmos. Chem. Phys. Discuss., referee comment RC2  
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## Comment on acp-2021-834

Anonymous Referee #2

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Referee comment on "Insights into the significant increase in ozone during COVID-19 in a typical urban city of China" by Kun Zhang et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-834-RC2>, 2021

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This study targets an important question, what causes the ozone increase during lockdown despite substantial decrease in anthropogenic emissions? By applying some statistical approaches, the authors decouple the effects of changing meteorology and emission on ozone formation, and reported that changes in emissions causes a 5 ppb increase in ozone during the lockdown, where changes in meteorology conditions only increase ozone by 0.5 ppb. Further, it is shown that the ozone formation shifts from a VOC-limited regime before lockdown to the conjunction of NO<sub>x</sub>- and VOC-limited regime, which increase ozone formation. Overall, the scope of this study fits the journal. I recommend publication after major revisions.

### Major Comments

- Several statistical methods are applied in the study, but it is not clearly stated why they are selected? For example, why Sen's slope is used rather than a simple linear regression? There is a myriad of machine learning algorithms, so that the rationale behind each selection should be discussed. For example, Sen's slope is a robust slope and less susceptible to outliers. Further, current description of deweathered model lacks details. What does the model do? If I understand correctly, it takes several parameters as inputs and use random forest to predict O<sub>3</sub> concentration, right?
- The interpretation of O<sub>3,met</sub> and O<sub>3,emission</sub> is confusing, partly because of lack of details in describing the stats methods. To the reader, the difference between observed O<sub>3</sub> and weather-normalized O<sub>3</sub> represents the influence of changing emission, as weather-normalized O<sub>3</sub> takes into account the variation in O<sub>3</sub>. The difference in observed O<sub>3</sub> between different years does not represent the influence of emission,

because the meteorology between different years is different. Such interpretation will fundamentally change the conclusion on this manuscript as well as the conclusions from the box model. Please clarify.

- The discussions on ozone formation potential (OFP) can be reconstructed in a more meaningful way. Mainly, it should be clearly stated that OFP does not indicate O<sub>3</sub> concentration. With this premise, there is no need to discuss “consistency” or “inconsistency” between the two (Line 282). In other words, OFP is not helpful to answer the O<sub>3</sub> question in the manuscript.
- The reliability of the box model results is compromised by the fact that the modeled O<sub>3</sub> during full lockdown (29 ppb) is lower than that during partial lockdown (32ppb), which contrasts the observation.

#### Minor Comments

- Line 167 is a confusing sentence.
- Line 257. “Vary”, not “varies”.
- Line 281. It is “full-lockdown”, not “partial-lockdown”.
- Line 299. What does “AOC” represent?