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Comment on acp-2022-87

Anonymous Referee #2

Referee comment on "Secondary $PM_{2.5}$ decreases significantly less than NO_2 emission reductions during COVID lockdown in Germany" by Vigneshkumar Balamurugan et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-87-RC2, 2022

Review of "Secondary PM decreases significantly less than NO2 emission reductions during COVID lockdown in Germany" by Balamurugan et al.

Built on their previous work, the authors investigated the role of anthropogenic emissions on PM2.5 changes during the COVID-19 lockdown in Germany. After subtracting the meteorological effects, they found that NOx emission decreased by about 20% but there were small changes in PM2.5 concentrations. By applying modeling analysis, they attributed the small decrease of PM2.5 to increased formation of sulfate and nighttime nitrate, offsetting the decreased formation of ammonium and daytime nitrate. In addition, the authors also discussed the role of NH3 emission in driving high PM2.5 episodes. Overall, the study provides some interesting results and adds insights in the formation of secondary aerosols. The methodology is reasonable and the manuscript is well-written. I think it fits well within the scope of ACP journal. I would suggest its acceptance after the following comments are well addressed.

Comments:

The study focused on $PM_{2.5}$ only, so I would suggest to replace "PM" by "$PM_{2.5}$" in the title.

It seems fine to fix anthropogenic emissions at 2014 in the simulations, but it will be better if the authors could add some discussion about the emission changes from 2014 to 2019.

I am still concerned about the assumption of unchanged VOC emissions in response to COVID-19 lockdown, although the authors tried to justify this treatment in their reduction scenarios. If NOx emissions from transportation sector were strongly affected during the lockdown, there is a reduction in VOC emissions as well. What are the sectors mainly

accounting for VOC emissions in Germany? More discussions are needed on this issue.

The explanation of ozone increases is not quite clear. It is possible that ozone formation efficiency was increased in response to NOx reduction under NOx-saturated regime. However, this reason might not work both for daytime ozone and nighttime ozone. In the cold season, ozone could be strongly titrated by NOx emissions which maybe directly increase ozone at night. I would like the authors add some analysis on the changes of Ox (NO2+O2) that can be used to isolate the effect from weakened titration.

I am wondering if there is ambient measurement for PM2.5 components. It deserves a comparison between simulated and observed PM2.5 species concentrations.