Comment on acp-2022-87

Anonymous Referee #1

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-RC1, 2022

The manuscript entitled "Secondary PM decreases significantly less than NO2 emission

reductions during COVID lockdown in Germany" by Vigneshkumar Balamurugan et al. explored the drivers of slight decrease of PM2.5 compared to NO2 emission during COVID-19 lockdown in Germany. The manuscript provides valuable information for understanding PM pollution under rigorous emission reduction measures and efficiently directing PM mitigation in the future. It is recommended that this manuscript be reconsidered for publication after major revisions.

General comments:

Line 54:" The composition of PM thus varies greatly depending on time and location; for

example, in urban areas nitrate and organic aerosol often dominate in winter time". More cases should be given to support this sentence.

Line 133:" The fractional change in meteorology accounted for pollutant concentration between 2020 and 2019, i.e., pollutant concentration changes between 2020 and 2019 due to emission changes only" This definition is misleading. According to your definition of ΔPM2.5(obs) and ΔPM2.5(GC), the ΔPM2.5(obs,emi) should be the change of PM2.5 caused only by emission. If so, relative descriptions in the whole paper should be revised correspondingly.

Line 170: We also compared the 2019 GC and 2019 observed in-situ PM2.5 concentrations and found that the GC and observed in-situ PM2.5 concentrations were in good agreement (R > 0.5 for all metropolitan areas, except Leipzig which has a R value of 0.39) (e.g.,Fig. 6 (c), for Cologne metropolitan area)." The performance of the model is the base of further analysis. Hence, more details of the statistical evaluation of the model performance for each site should be given. In addition, the agreement R is above 0.5 for most areas and is 0.39 for Leipzig. Personally, I think the R is not good enough.

Line 273:" The increase in OH radicals results from German metropolitan areas being in a NOX saturated regime". From BAU to lockdown period, the meteorological condition changed, which could lead to higher temperature and higher solar radiation, and this has the potential to increase OH concentration. Hence, the influence of meteorological between different period in 2020 should be considered.

Line 281:"However, higher night-time NO3 levels result in higher nighttime HNO3 production from N2O5 hydrolysis, resulting in slightly lower night-time lockdown PM nitrate compared to BAU" According to Figure 4, the change of nighttime HNO3 production from N2O5 hydrolysis is small compared to that during daytime. In addition, both of the production and sink of HNO3 should be considered to explain its influence on PM concentration.

Specific comments:

The use of "emission accounted", and "meteorology accounted" makes the discussion part puzzled. The authors are suggested to use more clear phases.

Figure 1: The part of "Ground-truth measurements" is misleading, it should contain the observations data from 2019 and 2020.