

Atmos. Chem. Phys. Discuss., referee comment RC2
<https://doi.org/10.5194/acp-2021-372-RC2>, 2021
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Comment on acp-2021-372

Anonymous Referee #1

Referee comment on "The role of emission reductions and the meteorological situation for air quality improvements during the COVID-19 lockdown period in central Europe" by Volker Matthias et al., Atmos. Chem. Phys. Discuss.,
<https://doi.org/10.5194/acp-2021-372-RC2>, 2021

Review of "The role of emission reductions and the meteorological situation for air quality improvements during the COVID-19 lockdown period in Central Europe" by Matthias et al.

This manuscript provides a comprehensive, methodological analysis of the individual and combined effects of COVID-related emission changes and meteorological variability on air quality over Central Europe during the core period of the COVID-19 lockdown in 2020. The study design is thoughtful and sound. The results provide a valuable contribution to the rapidly-growing set of studies investigating this topic, especially by highlighting the complex interactions between meteorology and emissions for key pollutants and cautioning against attributing observed concentration changes directly to changes in emissions without performing an in-depth analysis of potential confounding factors.

The manuscript is generally well written and organized. The introduction section could potentially be shortened by either eliminating or reducing the summary of results from previous studies. My only major comment is to consider adding analysis for modeled PM_{2.5} species to provide additional context on how changes in total PM_{2.5} are driven by how different processes (emission changes vs. meteorology) affect individual PM_{2.5} components (e.g. primary vs. secondary, inorganic vs. organic).

Specific comments:

Page 1, line 22: remove comma after "both"

Page 2, line 46: suggest moving "also" after "weather conditions"

Page 2, line 48: To my knowledge, Goldberg et al. (2020) is a notable exception to this statement and might be cited here: Goldberg, D. L., Anenberg, S. C., Griffin, D., McLinden, C. A., Lu, Z., & Streets, D. G. (2020). Disentangling the impact of the COVID-19 lockdowns on urban NO₂ from natural variability. *Geophysical Research Letters*, 47, e2020GL089269. <https://doi.org/10.1029/2020GL089269>

Page 2, lines 49 – 54: This section seems to summarize results obtained later in the paper without explicitly saying so, but without providing any separate reference, either. I suggest either providing a reference or removing it from this portion of the manuscript.

Page 4, line 126: were the COVID-19 lockdown effects considered in the IFS-CAMS fields used as boundary conditions? If not, does this introduce an additional level of uncertainty into the analysis, especially as it relates to the role of meteorology and longer-range air mass transport?

Page 5, lines 145-146: suggest moving "best" from the end of the sentence to before "reproduces"

Page 5, line 169: can you please provide a reference for the NMVOC split profiles used in this analysis?

Page 6, line 187: add comma after "time series data"

Page 6, lines 195 – 196: What was the rationale for not assuming any changes in shipping emissions between 2016 and 2020?

Page 7, lines 224 – 228: You may want to state upfront that this approach cannot distinguish between passenger cars and trucks which likely had very different activity changes resulting from the lockdown. This limitation is discussed in Section 6.2 but in my opinion should be mentioned here.

Page 7, line 237: most readers likely aren't familiar with the term RoRo for certain types

of ferries, please define or spell out.

Page 11, lines 286: suggest changing "... exceptional weather, what is assumed" to "exceptional weather that is assumed"

Page 11, line 301: change "supplemented" to "supplemental"

Page 12, line 327: remove comma after "meteorological fields"

Page 13, line 372: suggest moving "also" from before "advected pollutants" to after "meteorological conditions"

Page 13, line 373: add comma before "time series"

Page 14, line 386: add comma before "time series"

Page 20, lines 487 – 497 and Figure 12: recommend adding analysis and discussion for key PM2.5 species (sulfate, nitrate, ammonium, EC, OC) – see major comment above.

Page 22, line 511: suggest replacing "observed" with "simulated" to avoid confusion

Page 23, line 531: remove comma after "both"

Page 23, line 539: remove comma before "only"

Page 26, lines 604 – 605: Differences between observations and model simulations likely also are caused by other errors in the modeling system (uncertainties in simulated meteorological fields, chemistry, deposition, base emission inventory, etc.), not only uncertainties in representing the lockdown effects. Suggest reconsidering this statement.

Page 30, line 652: change "(Bauwens et al., 2020)" to "Bauwens et al., (2020)"

Page 30, line 661: remove comma after "selected"

Page 30, line 670: remove comma after "constellation"

Page 31, line 692: remove comma after "conditions"

Page 31, line 718: PM2.5 is both primary and secondary. My suggestion of adding analysis for PM2.5 components would potentially shed light on which portions of the PM2.5 changes are more sensitive to emissions changes vs. meteorology.

Page 33, line 769: remove comma before "only"