Major Comments

In this manuscript, the authors use the GEOS-Chem model to look at the impacts of aerosols on surface ozone levels in India in two years, one with low and one with high PM10. They find that ozone decreases by ~30 μg m^{-3} in the year with high aerosol pollution during the winter and post-monsoon. During the monsoon, the decrease in aerosol causes an increase in ozone of 10-20 μg m^{-3}. PM can be mitigated by reducing anthropogenic NO_x. This paper could be appropriate for publication in ACP with major revisions.

My main comments/concerns are as follows:

1. The authors go into too much detail that is not relevant to their specific study that makes the paper difficult to read. The authors should focus their discussion on the points they are trying to make. For example, they can shorten in particular Section 3 and just focus on when ozone and aerosols are high and impacts might be large. There is no need to get into a large overview of all aspects of India. Section 4.1 is not really needed until you discuss results. Use the information in Section 4.1 as needed to explain large impacts in Section 4.2.
2. There seems to be more data available in India than is used in this work. According to this paper, there are 123 sites with PM2.5 from www.openaq.org. https://pubs.acs.org/doi/epdf/10.1021/acsearthspacechem.2c00150?ref=article_openPDF.
3. This study would be more powerful if it better addressed trends. How much can reduced aerosols explain increased ozone or help improve model ability to capture trends? Overall, the paper needs at a minimum to show that the model can capture the relative difference in observed ozone and PM10 between 2018 and 2022.
4. The authors should be careful about directly relating changes in PM10 to changes in ozone. How much for example do differences in temperature and biogenic VOCs impact the ozone difference? Or meteorological factors such as windspeed and transport alter concentrations as well as PM10 levels? The authors should better describe their model setup, and it may be more appropriate to remove the effect of meteorology and focus on emissions by running 2018 and 2022 with the same meteorology.
5. Previous work has found that γHO2 of 0.2 might be too high in East Asia https://doi.org/10.5194/acp-23-2465-2023 and references within. How much would a value of 0.1 impact your results? Please include a discussion of the uncertainties surrounding this uptake coefficient. Also see this recent paper on the large variability in γHO2 depending on atmospheric conditions. https://pubs.rsc.org/en/content/articlehtml/2024/ea/d4ea00025k

Specific Comments

Page 2, line 38:

The authors state: “In the NO_x-limited regime, the concentration of NO_x is low compared to VOCs, implying that increasing VOC levels can promote further ozone generation due to inadequate NO_x to completely react with VOCs.” This in incorrect. In the NOx-limited regime, the concentration of NOx is low relative to VOCs, meaning that ozone production is limited by the availability of NOx and increasing VOC levels has little effect. Similarly, the authors state “In a VOC-limited regime, the availability of VOCs is restricted, and further VOC emissions will exert a negligible impact on ozone formation until NO_x concentrations are high.” This is also incorrect. If ozone chemistry is VOC-limited, adding VOCs will increase ozone production.

Page 2 line 45 – The authors should cite https://www.nature.com/articles/s41561-022-00972-9 and https://www.pnas.org/doi/abs/10.1073/pnas.1812168116 where appropriate in this manuscript.

Page 2, line 49 – There must be a typo in 2017–18. since 2019.

Page 2, line 51 – How many exceedances were there in 2018?

Page 3, line 78 – What about the impact of aerosols on modifying PBL dynamics? I believe there is a large body of work also on this topic (e.g., https://academic.oup.com/nsr/article/4/6/810/4191281).

Page 3, line 94 – Cite https://www.nature.com/articles/s41561-022-00972-9 again here.

Page 4, line 124 – It is good practice to give the model version number and DOI here.

Page 4, line 125 – FlexChem is an option. Do you actually use it? If not don't cite it.

Page 4, line 130 - Cite the associated papers, although these advancements don't seem relevant to this work. Generally, just cite the relevant updates that impact your work.

Page 4, paragraph starting on line 138 – It is not necessary to cite GEOS-Chem papers from other regions. Just focus on India, and if necessary other parts of Asia. Other papers to include on India: https://pubs.acs.org/doi/full/10.1021/acsearthspacechem.2c00150. It is most important to show that your model setup has good performance against observations.

Page 5, paragraph starting on line 163 – Please provide information on what emissions you have chosen for India, and what scheme you are using to calculate aerosol (simple, complex, etc.). Also please provide information on the observations. Only PM10 is available? How did you calculate PM10 from GEOS-Chem individual species? It looks like there is ozone in the supplement as well? What is the instrument used, and the temporal resolution?

Figure S1 – Typically people show observations in black, and the model in red.

Page 6, line 180 – If the model is biased that high, there is likely something wrong with emissions. If you are not going to be able to investigate that, then it would be important to show that the model can capture the 2018 vs. 2022 difference to provide support for the relative impacts on ozone from aerosol differences.

Figure 2 – Could you put the observations as colored circles on top of the model? This would help with the previous comment. It is also important if you are going to discuss drivers of the pollution hotspots to show confidence in the model distribution.

Page 9, line 300 – Be careful of stating too much causation here. In winter there is also low sunlight, and cooler temperatures that promote nitrate formation.

Page 10, line 305 – BC scavenging of ozone is not in models, how important is it?

Page 10, line 307 – This is not an inverse relationship then if both PM and ozone accumulate near the surface. Also, you haven't mentioned the impact on the PBL height from aerosols (e.g., https://academic.oup.com/nsr/article/4/6/810/4191281). Also, if the PBL is suppressed, you might get ozone titration from high NO_x emissions.

Page 11, line 343 – Does the model have different emissions in 2022 or 2018, or are the same emissions (e.g. for biomass combustion) used for both years?

Page 15, line 407 – This is opposite the conclusion of Ivatt et al., 2022, who found that Delhi is VOC-limited. Looking at your map, it looks like Delhi could be either a purple color or red color depending on the season, which would be VOC-limited or aerosol-inhibited.

Page 15, line 408 – The authors state that "The dominance of peroxyl-radical self-reactions in urban areas such as Delhi, Bhiwadi, Vadodara, Jamshedpur and Nagpur indicates that NOx emissions in these cities limit ozone formation, promoting pathways where peroxy radicals neutralize ozone. This is typical of regions where high NOx levels suppress the production of ozone by inhibiting HOx chemistry (Romer et al., 2018)." This is incorrect! High-NOx regions suppress ozone because the dominant loss is NO2 + OH, but this means that these cities are VOC limited.

On Figure 7 – It looks like Delhi is in the VOC-limited or aerosol-limited regime, depending on season. This contradicts the statement on Line 406 that Delhi (and other urban areas) are NOx-limited.

Page 17, line 442 – Again there is a need to be careful here as it is unlikely that 100% of the ozone difference is due to the reduction in aerosols. One possible way to remove the impact of meteorology would be to use the same year of meteorology but with different emissions, assuming that different emissions are used in these two years.

Page 17, line 454 – Can you give more specific reasons for why the monsoon season would be more susceptible to aerosol uptake than winter or post-monsoon?

Paragraph starting on Page 18, line 480 – How much does reduced NO_x also reduce aerosol? What is the composition of aerosol? Is there a lot of ammonium nitrate?