

Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-69

Anonymous Referee #2

Referee comment on "Seasonal distribution and drivers of surface fine particulate matter and organic aerosol over the Indo-Gangetic Plain" by Caterina Mogno et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-69-RC2>, 2021

The authors use the WRF-Chem model to study the influences on fine particulate matter and organic aerosol (OA) over the Indo-Gangetic Plain (IGP). This paper presents a well constructed and informative sensitivity study to establish the extent to which PM_{2.5} concentrations are dependent on the strength of various emission sources, in different seasons. The paper is well written and certainly within the scope of ACP – I would recommend publication once the following minor issues are addressed.

General comments:

The distinction between anthropogenic and pyrogenic is a tricky one in reality so it would be useful to describe explicitly what is included in each category here. Is pyrogenic everything in the FINN inventory? For example, where do emissions from solid fuel combustion or agricultural burning fall? It's difficult (or impossible) to disentangle these two sources completely but it will be helpful for those doing further work in this area if you can clarify exactly which emissions are where.

In general, the model performs quite poorly at simulating atmospheric composition during the monsoon season which may be related to issues with the precipitation or circulation patterns, rather than emission sources. I appreciate that these are beyond the scope of this study to explore but some further discussion of the performance of the model in this regard, or reference to studies that have looked at this, would be helpful to the reader.

Could you review the color scales for the figures? On several of them (e.g., Figure 2 and Figure A1 (f)) it's quite difficult to discern the variation that is referred to in the text because of the choice of values.

Minor / specific comments:

Page 1, line 23: could you rephrase this description of the sources of pollution to clarify how they are distributed? If the pollution is concentrated over the cities, then you could say that it *is* distributed proportionally, according to population?

Page 2, line 37: there is a spare "(June to September)" here

Page 6, line 138: sorry if I've missed this point elsewhere, but it would be useful to state somewhere in the Methods how the land cover is described / defined in WRF-Chem as this will have an important impact on the biogenic emissions being generated by MEGAN

Page 7, line 162: check this reference?

Page 8, line 203-204: could you include a map (in the Appendix?) to show the location of the stations used in the evaluation (those from OpenAQ and the literature values), this would help the reader to understand how they are distributed across the IGP region and the extent to which they can be used to constrain the model's performance in each region

Page 8, line 206: correct "components"

Page 8, line 220: somewhere in this section it's worth being clear about the fact that the model has been run for 2017/2018 and many of the observations that are available do not necessarily cover the same time period

Page 9, line 224: you say that the poor model skill may be attributed to difficulties in retrieving AOD during the monsoon season, but the model also performs poorly at simulating PM2.5 concentrations during the monsoon season (according to Table A3). Could you edit this section to reflect the fact that, whilst there may be difficulties in retrieving AOD during the monsoon, the model may also not simulate AOD accurately during this period?

Page 11, line 270: correct "out" to "our"

Page 12, line 308: "The sensitivity of PM2.5 is highest for biogenic emissions" this isn't necessarily clear from Figure 4 due to the different color scales used to show the different sources, can you add some quantification to this?

Page 12, line 311: add here that this is the simulated / modelled composition (since you do also have observations in the study)