Review for manuscript: 'Development and comprehensive analysis of spatially resolved technological high resolution (0.1°×0.1°) Emission Inventory of Particulate Matter for India: A step Towards Air Quality Mitigation'

This publication deals with the development of a high resolution emission inventory for particulate matter (PM10 and PM2.5) over India for the year 2020. The work is very interesting since it deals with a highly polluted area in the world, thus having significant health related implications.

However, the manuscript requires major revisions in terms of clarity, methodological details and results presentation.

General comments:

-the methodology for emission estimation and the data sources used for each sector should be clarified. A Table could help in summarizing all the data sources.

-the methodology for producing spatially distributed emissions is not completely clear: do the authors apply a downscaling procedure of national emissions over the global gridmap at 10x10 km resolution? A Table could help to summarise approaches and data used for producing emission gridmaps.

-The authors should clarify the sector definition linking each sector to the corresponding IPCC categories (it can be done also in a supplementary table).

-the authors should explain why this work should be considered as a reference emission inventory for India or why it represents an improvement compared to existing inventories for India (e.g. REAS and others). Statistics used for estimating the emissions may not be complete and uncertain also in this work. Comments from the authors may provide indications on the limitations of this work.

-Why the authors provide estimates only on PM10 and PM2.5 and not on BC and OC?

-In order to run air quality models, all air pollutant emissions are needed over the domain of interest. How can regional air quality modellers use this work when only PM emissions are provided? Recommendations on which dataset could complement the current work for all other pollutants should be provided.

-the manuscript contains several English mistakes, typos, spaces missing between words etc. Accurate revision of the text is required before publication.

Detailed comments

-line 21: IPCC does not provide a methodology for estimating air pollutant (PM) emissions. Please clarify what is exactly meant here.

-the structure and story flow of the introduction is confusing and should be revised. It starts with a global picture, then it moves to India, then to South Asia...then it addresses again the health effects of PM and finally again back to India (although not explicitly mentioned).

-line 85: what is meant with ultra-precision?

-line 111: countries (e.g. in the world) or country (i.e. India)?

-lines 115-116: what type of sources are different from urban and rural sites? Is it mostly the relative share of the emissions being different between the 2 sites or are the sources different?

-line 125: remove major/minor.

-line 127 and 136 (and everywhere in the text when it appears): remove 'based' before EF

-line 136: what are secondary activity data? What is meant with secondary emissions?

-line 173: MT should be Mt and similarly everywhere in the text.

-line 220: replace decides with determines.

-line 303: do waste emissions belong to household or waste sector? Why are they included in households? Again linking to IPCC sectors would be useful.

-line 318: street vendor represents a specific activity for India and certain countries. However, it could be possibly related with emissions from combustion in commercial activities and services from sector 1A4 of IPCC. Is it correct?

-lines 342-344: not clear what was done to deal with missing/uncertain information.

-line 413 Kg should be kg. This correction should be applied everywhere in the text.

-line 428: it should read 'and therefore waste is burned..'

-line 447: this paragraph discusses construction activities. What is the data source of the statistics used in the emission computation?

-Figure 2 presents several features of the Indian territory with maps. I think not all of them are relevant or discussed in the current work. I suggest including in the main text only those maps relevant for the emission work (e.g. removing water bodies, since no shipping emissions are discussed, etc.). The authors could split the figure to have first the characterization of the Indian territory, then the degree of urbanization and hen a focus on point sources, linear sources etc.

-line 537: actually no methodology and scientific justifications are presented. The authors should add a section on how emissions where calculated, data sources used, EFs values, and clarify any assumption made for each sector.

-section 2.3: it is not clear how spatially distributed emissions were calculated. Are they the result of the downscaling of a national total through the use of spatial proxies?

-section 3.3: in order to facilitate the comparison among the different inventories, I suggest including a Table summarizing for each sector the emission values provided by each inventory. REAS is used in the HTAP_v3 emission mosaic (https://essd.copernicus.org/articles/15/2667/2023/) as reference inventory for India. Why your study differs so much from REAS? A more consistent discussion should be provided in this section, using IPCC sectors to aggregate the emissions from different inventories. What is the reference year for your comparison? 2020 for all inventories? Figure 6 is not always clear, for example in the top panel power plant emissions for the current work are not visible. I suggest improving the visualization of these results.

-section 3.4 line 689: it is not clear from where uncertainty values for AD and EF are taken. References for uncertainty estimates should be provided.

-line 721: what is the contribution of super-emitting vehicles to PM emissions in India? I think adding a section in the transport sector description regarding super-emitters would be valuable.

-the conclusion section lists several mitigation measures. What is the feasibility of each of them? For example, how fuel adulteration could be monitored (lines 738-739)? Point b) is not clear. I suggest expanding this section including more details for each mitigation option.

-line 732: What is the usage of improvised public transport system? Do you mean 'improved'?

-line 823 Crippa et al. 2019 refers to a paper on temporal profiles which are not discussed in the current work. If the authors are searching for a reference for the EDGAR inventory, they should mention the version used and include the corresponding citation (e.g. doi:10.1016/j.enpol.2022.113021, doi:10.5194/essd-10-1987-2018, https://edgar.jrc.ec.europa.eu/dataset_ap61).