

Geosci. Model Dev. Discuss., referee comment RC2  
<https://doi.org/10.5194/gmd-2021-330-RC2>, 2022  
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## Comment on gmd-2021-330

Anonymous Referee #2

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Referee comment on "Towards an improved representation of carbonaceous aerosols over the Indian monsoon region in a regional climate model RegCM" by Sudipta Ghosh et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-330-RC2>, 2022

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Comments on "Towards an improved representation of carbonaceous aerosols over the Indian monsoon region in a regional climate model RegCM4.6" by Ghosh et al.

The study focuses on examining the changes in the carbonaceous aerosols and their impact on the radiation budget over South Asia. The sensitivity of carbonaceous aerosol burden simulated in RegCM4.6 to dynamical aging scheme and new emission provided by new inventory has been estimated.

- After reading a manuscript, it is unclear whether the authors are arguing that replacing the emission inventory or dynamical aging scheme or combined effect causes a better representation of carbonaceous aerosols in the RegCM4.6. It will be more appropriate to present or at least discuss (a) how the use of new inventory to represent carbonaceous aerosols improved the simulations? (b) How did implementing the dynamical aging scheme improve aerosols' representation with default emission inventory and (c) the combined effect? It is recommended that authors design the experiments to address the concerns above.
- From Figures 2 and 3, it is evident that both default and changed models underestimate the surface BC compared to in-situ observations even though the augmented model has better skill than the default one. It is not clear that the better representation of the surface of aerosols (Figure 1) causes more concentration of BC due to convection (vertical mass flux) or lateral advection at higher levels from sources at higher elevations in the IGB region (Fig 4) and why there are no appreciable changes seen over PI region. The in-depth analysis is required to quantify the changes in the vertical of the results in terms of changes in the vertical mass fluxes and vertical velocity vs. mass advection simulated in the model to quantify the impact of on

distribution of aerosols.

- The result in Lines 371-3, "Due to the model improvements (forcing estimates 371 with the default model are shown in Figure S8), the TOA forcing changes by -72.75%, and the 372 surface dimming increases by 39.73% over the IGP and by -23.94% and 34.35%, respectively," should be cross-checked with the amount of clouding simulated model and reflections from clouds at TOA due to them vs. the effect of surface dimming as mentioned in the manuscript to be sure. Alternatively, these differences in the simulations can be attributed to the amount of cloudiness simulated (secondary effects) by default and the augmented model. The manuscript will be more readable if the same terminology is used in the revision to specify model setup (augmented model or customized setup).
- Line 402-403 "Our work demonstrates that even the improvement of some aspects of the aerosol representation can lead to substantial enhancements in the model performance." The sentence requires to be rewritten with more quantification and elaboration.
- More justification is needed to conclude that " a dynamic aging scheme and a regional emission inventory substantially improve the model performance over the Indian sub-continent." and "The BC and OC surface concentration and column burden increase due to the model improvements, more so as a combined effect of the two factors than because of the individual ones."

The manuscript is poorly written and needs to be organized better. In addition, the typographical and grammatical errors need to be corrected by the authors in the revised submission. Therefore I feel the manuscript should be considered after major revision.