

Towards an improved representation of carbonaceous aerosols over the Indian monsoon region in a region climate model RegCM4.6

Ghosh et al.,

General comments:

A set of sensitivity studies from a changes to emissions and the ageing factor (conversion rate of hydrophobic to hydrophilic) were presented using RegCM4.6 for BC and organic carbon aerosols over India. This was shown to produce better results and reduce the bias often by factors of two or more over much of India. Most of the discussion and improvements in model performance are presented in terms of default simulations and the so-called dynamic regional, that includes adjustments to both the emissions and ageing. It is thus hard to understand if most of the improvements are due to emissions or due to changes in the ageing. As the authors are aware there are numerous papers on sensitivity of the aerosol burden over India to emissions and that is not worth another paper as it adds no new information beyond what we already know. The ageing changes should change the ratio of dry deposition/wet deposition in the model and later the lifetime of the aerosols in the model. There are no figures in the paper that show the deposition fluxes and their changes and I am left to wonder if that was even significant in the results? As the primary idea seems to be that this will change the lifetime of BC and OC in the model, why are there no calculations of lifetime of particles regionally, seasonally and annually?

Are there any changes because of the lifetime changes in particle fluxes over to Indian Ocean that varies by season?

The model setup also leaves much to be desired. There are only 17 levels in the models, not sure how many of them are in the boundary layer? How well does the model simulate convection and mixing over the Ganges valley and central plains where the transport to above PBL could be a major factor in increasing the long-range transport of aerosols and hence their lifetimes? How well does the model simulate column water depths and hence removal rates through wet deposition in the model?

The radiative forcing calculations are for direct radiative forcing one assumes as there is no discussion of aerosol-cloud interactions in the model. If that is the case, did you separate the clear days from cloudy days to perform these forcing calculations are these are seasonal averages for days with and without clouds? How well does the model represent RH in the vertical column (Feng et al., RAWEX-GVAX special issue, Current Science, 2016). How much effect does the change in aerosol burden in the column have on the atmospheric profiles and how much of this contributes to changes in optical properties and hence forcing?

Overall, I find the manuscript poorly constructed and doesn't add any new insights to what is already known and needs a rethinking from the authors on both the analysis and experimental design.

I should also point out that the figures are poorly constructed with figure titles that are not very descriptive, figure 2 for instance the title has misspelled 'South' as 'Sout'.