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Atmos. Chem. Phys. Discuss., referee comment RC2
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Comment on acp-2021-740

Anonymous Referee #3

Referee comment on "Zonal variations in the vertical distribution of atmospheric aerosols over the Indian region and the consequent radiative effects" by Nair K. Kala et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-740-RC2, 2022

Zonal variations of the vertical distribution of atmospheric aerosols over the Indian region and the consequent radiative effects Kala et al.,

A compilation of vertical profile and horizontal data for atmospheric aerosol properties (SSA, extinction coefficients and depolarization ratios). This group has produced several papers that have similar flavor to this one, primarily taking data and doing radiative forcing calculations using SBDAT. The 'novelty' here may be the use of CALIPSO data to build vertical profiles that seem to have been rescaled using surface observations from the various field studies conducted around India, including the ICARB. I don't have any big issues with the paper, except that it doesn't offer anything new in terms of analysis/modeling. The two major concerns would be

- There is not much ground validation for the data in terms of comparisons with some ground based or aircraft data collection performed by the team
- The 'correction' of the ASSA over the ocean using for profiles uses a the OSSA extended over the ocean and obtain a regression factor that was applied to ASSA. This seems arbitrary in some sense. Why not use a physics informed method that uses the differences in temperature profiles, water vapor profiles or PBL heights between the coastal and overland regions to inform the corrections?

Beyond these two, the manuscript badly needs a comparative evaluation with some model simulations. It is hard to get a sense to understand how this will feedback into improving models (regional and global). There are several runs performed as part of the CMIP6 with GCMs of various resolution and model output from the (AerChemMIP) for example. These should be accessible; how does this dataset compare with these simulations. There is a lot of qualitative description of mixing and gradients that are driven by dynamics. Using a model result to put these in context would be essential and making all the discussion more

concrete. Without an accompanying model evaluation, the added value of this product to literature is questionable.

Some Specific Comments:

Line 45: Feng et al., 2016 did a detailed evaluation of the radiative forcing due to differences in land and ocean vertical profiles using MPLNet, CALIPSO and WRF-CHEM (doi:10.5194/acp-16-247-2016) and seems highly relevant to work discussed here. How do the calculations on radiative forcing performed here differ or similar to that discussed in that publication?

Line 204: What dynamics are of importance here? Synoptic, mesoscale or boundary layer?Table 4: How do these heating rates compare to those being calculated by GCMs and models from AEROChemMIP?