

***Interactive comment on* “Quantifying the Direct Radiative Effect of Absorbing Aerosols for Numerical Weather Prediction: A case study” by Mayra I. Oyola et al.**

Anonymous Referee #1

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This study attempts to verify the simulated aerosol vertical profiles and the corresponding radiative responses, by using the combination of NAAPS and NAVGEM models, against the observations from the measurements of the high spectral resolution lidar (HSRL) and aircraft during the SEAR4RS field campaign. The sensitivity of aerosol radiative effects to the surface reflectance is specifically evaluated. The results in general is scientifically self-explanatory, and the scientific information in the manuscript are clearly delivered. My major concern is about the lack of sufficient discussions related to the different aerosol initializations. Below I list some issues which need to be addressed before the paper for publication.

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Specific comments:

1. Although the authors conducted simulations with three different aerosol setups, including the OPS case, a case with 2D/3D data assimilation, and a “free” running case, there is very limited discussion about the sensitivity of aerosol vertical distribution and its radiative effect to the different aerosol setups. It is worthy performing such discussions since the differences in aerosol radiative forcing/heating rate could be notable. For example, as mentioned in lines 297-298, the net surface SW irradiances from different NAAPS versions are distinct from each other. In addition, the authors may pay attention to radiative forcing efficiency (=radiative forcing per unit AOD) under different aerosol initializations because of using different NAAPS version.

2. In light of the distinct discrepancy in aerosol vertical distribution between the HSRL and the simulations, it is expected that the associated aerosol radiative implications are greatly different between them. I suggest the authors might take a look at the radiative forcing efficiency, an index that eliminates the effect of different AOD levels. By doing such comparison between the HSRL and the simulations, the readership may get more sense about the model performance on the aerosol radiative effect.

3. Does the measured irradiance from the airborne broadband radiometers (the black dots in Figs. 3-6) match the modelling results when doing comparison between them? Put another way, what are the time scale and spatial scale of the measurements, and is it same as or close to the modeling results?

4. Throughout the whole paper the authors emphasize that the study focuses on a smoke event, but, according to Fig. 1, the realistic loadings of the smoke and urban originated aerosols are comparable at least in terms of AOD magnitude. The authors should state more carefully regarding the aerosol speciation. For example, the authors may want to rephrase the statements in lines 83-86 by taking off “smoke” related expressions.

Technical corrections:

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1. Line 51: the first author name in the citation should be Mulcahy not Mulchany.
2. Line 297: miss the right parenthesis.

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