

Interactive comment on “Vertical profiles of sub-micron aerosol single scattering albedo over Indian region immediately before monsoon onset and during its development: Research from the SWAAMI field campaign” by Mohanan R. Manoj et al.

Anonymous Referee #2

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Review of "Vertical profiles of sub-micron aerosol single scattering albedo over Indian region immediately before monsoon onset and during its development: Research from the SWAAMI field campaign" by Mohanan. R. Manoj et al., (ACP-2019-657)

This paper presents some interesting results on vertical distribution of sub-micron size aerosol characteristics obtained from five different locations over India including Bay-of-Bengal and Arabian Sea. These are obtained from SWAAMI aircraft field campaign

C1

during June-July covering before, during and after the onset of Indian Summer Monsoon. This study claims in obtaining the high resolution vertical profiles of Single Scattering Albedo (SS) and extinction coefficients extending from near surface to about 6 km. Highlight of this study lies in showing an underestimation (over-estimation) of the heating rates over regions with low (high) SSA, when a single SSA value is used. This leads to emphasize the importance of height resolved information particularly in obtaining the heating rates. In addition, significant heating of the atmosphere by sub-micron aerosol absorption in the middle troposphere is reported when realistic profiles are used which is expected to have strong implications on clouds and climate, as authors rightly claimed.

In general, paper is concise and well written with some new information and apt for Atmospheric Chemistry and Physics Journal. However, few clarifications are required before accepting for its publication. Below are the some of the issues which authors need to take care. Authors are strongly encouraged to revise this manuscript.

Major Comments:

1. At several places (for example lines 16-20 in page 12), it is mentioned that the present results matches well with previous reported results (not all but at least few) where they have used single SSA values. Is it not contradicting in saying that height profile of SSA will give more information when compared to use of single value?
2. Page 12, Lines 18-20: 'Strong meridional and zonal gradients in aerosol induced heating rates over AS and BoB across the peninsular landmass (from <0.1 K day⁻¹ over the south - western Arabian Sea, increasing to 0.5 Kday⁻¹ over the north - eastern Bay of Bengal).'

It is mentioned that realistic observations are used in estimating the heating rates. However, it is not mentioned anywhere on what is the uncertainty in estimating the heating rates? Have you considered the uncertainty in several parameters that are used in estimating the heating rates?

C2

3. Page 6, Lines 22-25: It is mentioned that 'Extinction coefficient, decreases near exponentially with altitude over most of the mainland, while over the oceanic regions of the Arabian Sea and Bay of Bengal, an increase in extinction is indicated above 2 km, attributed to elevated layers of aerosols. These layers appear to be stronger over the Arabian Sea than over Bay of Bengal. In general, highest values are observed within 3 km from the surface where the aerosol abundance is more.'

This paragraph has several contradicting statements. Why elevated aerosols are not seen over mainland? In fact several earlier studies have reported elevated aerosol layers over mainland (Mishra et al., 2010; Ganguly et al., 2006; Niranjana et al., 2007; Sinha et al., 2013; Venkat Ratnam et al., 2018). Further, it is mentioned that highest values are observed within 3 km from the surface. Then question arises why they are not washed out after the onset of monsoon?

Minor comments:

1. Page 7, Lines 23-26. 'Examining our values with those reported earlier for this region, based on airborne measurements, Earlier observations over this region have reported a columnar (up to 3 km altitude) mean SSA of 0.86 at 520 nm over Lucknow during pre-monsoon period (Babu et al., 2016) which is just a shade higher than our value of 0.83 ± 0.08 (for the altitude range 0-3 km for the same season).'

Previously you have mentioned that SSA has been estimated for 550 nm (Equation 2). Are you comparing the values for same wavelengths?

2. Page 10, Lines 3-5 and also Page 12, Lines 8-9: 'At Lucknow, as stated earlier, significant washout leads to very low extinction above 3 km, while at the lower altitudes, the SSA has increased compared to the pre-monsoon with values remaining around 0.9 up to 2 km and decreasing above to be less than 0.8 at 3 km.'

Why washout should happen only above 3 km. Are you talking about rainout? In fact washout should happen throughout the altitude as mentioned in many recent papers

C3

(for example Venkat Ratnam et al., 2018).

3. There are few grammatical mistakes and typos and hope they are taken care in the editing. However, I suggest authors to go through the manuscript carefully again before submitting revised draft.

Additional references:

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Venkat Ratnam, M., P. Prasad, M. Roja Raman, V. Ravikiran, S. Vijaya Bhaskara Rao, B.V. Krishna Murthy, A. Jayaraman, Role of dynamics on the formation and maintenance of the elevated aerosol layer during monsoon season over south-east peninsular India, *Atmospheric Environment* 188 (2018) 43–49

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