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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Air-borne in-situ measurements of aerosol size distributions and BC across the IGP during SWAAMI" *by* Mukunda Madhab Gogoi et al.

Anonymous Referee #1

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Review on 'Air-borne in-situ measurements of aerosol size 1 distributions and 2 BC across the IGP during SWAAMI' by Mukunda Madhab Gogoi1 et al., (ACP-2020-144).

This paper presents altitude profiles of aerosol size distribution and Black carbon obtained through in situ on-board research aircraft as a part of South-West Asian Aerosol Monsoon Interaction (SWAAMI) experiment conducted jointly under Indo-UK project over three distinct locations (Jodhpur, Varanasi, and Bhubaneswar) just prior to the onset of Indian Summer Monsoon. Simultaneous measurements from Cloud Aerosol Transportation System (CATS) on-board International Space Station and OMI measurements are also used as supporting information.

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Discussion paper

Major results include an increase in coarse mode concentration and coarse mode mass-fraction with increase in altitude across the entire IGP, especially above the well-mixed region. Further authors found increase with altitude in both the mode radii and geometric mean radii of the size distributions. Near the surface the features were specific to the different sub-regions ie., highest coarse mode mass fraction in the western IGP and highest accumulation fraction in the Central IGP with the eastern IGP coming in-between. The elevated coarse mode fraction is attributed to mineral dust load arising from local production as well as due to advection from the west which is further verified using CATS measurements. Existence of a well-mixed BC variation up to the ceiling altitude (3.5 km) is reiterated in this manuscript and match well with those obtained using previous aircraft and balloon platforms.

Results presented in the manuscript are in general unique and apt for the prestigious journal like ACP. Manuscript is written preciously and concise except at few places. The results presents also add new understanding on the size distribution of aerosol concentration in both altitudinal and longitudinally which are very important in understanding their role on precipitation processes besides radiative forcing estimates. Though major part of manuscript is written well, at some places revision is required. Manuscript may be acceptable after satisfactory revising the following.

Major comments/suggestions:

It is not clear from where and how rainfall and relative humidity measurements presented in Figure 2e are obtained. Further they are not discussed at all in the rest of the manuscript. Same for the profiles of temperature presented in figure 2f.

I suggest providing profiles of temperature and relative humidity (if obtained from aircraft) as a separate figure in Supplementary material and add related discussion the manuscript. This information may be useful while dealing with hygroscopic nature of aerosol.

It is not clear what is the source of the data (TPP) presented in Figure 12a. Further (b)

and (c) are inter-changed. Note that SO2 is presented in (c) and NO2 in (b).

Measurements of Black Carbon with Aethalometer: Though authors made correction to the data obtained from Aethalometer, it is not clear how they have taken care of it in the un-pressurized air craft?

It will be good to show heating rates due to BC profiles at these three different regions.

Some discussion is needed on how the results presented in the manuscript are linked with the main objective of the SWAAMI experiment.

Minor issues:

Results presented in Page 4 at lines 90-94 and 111-121 are mostly repeating. Both can be clubbed and rewrite to the point.

Figure 11 caption does not match with the information presented in the figure. I am unable to see (b) Daily profiles of MBC during each of the flight sorties on different days.

Figure 14. Figure caption need to be changed as per the information presented in the Figure (It should be 18 and 20 May but not 19 and 20 May).

I do not see any logic for presented vertical velocities for 2012, 2013 and 2016.

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