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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Altitude profiles of CCN characteristics across the Indo-Gangetic Plain prior to the onset of the Indian summer monsoon" *by* Venugopalan Nair Jayachandran et al.

Anonymous Referee #1

Received and published: 26 August 2019

General comments:

The submitted manuscript reports and discusses the detailed airborne measurements of cloud condensation nuclei (CCN) and aerosol scattering/absorbing properties conducted during 2016 pre-monsoon over the Indo-Gangetic Plain (IGP) region covering urban-industrial, semi-arid, and coaster areas. The analysis of the airborne datasets finds the highest CCN concentration over the central IGP accompanied by least CCN activation efficiency possibly linked to higher amounts of with high black carbon (BC). Similar measurements over western semi-arid IGP show high CCN efficiency indicating the hygroscopic nature of mineral dust particles. The vertical structure of CCN

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reflects the role of marine airmass in increasing CCN efficiency. Finally, the study reveals an empirical relationship between CCN and aerosol scattering properties that can potentially predict the CCN from aerosol optical properties.

The paper brings out important detailed information on CCN and aerosol properties over the monsoon region of northern India where the complex aerosol properties might have substantial impacts on clouds, thereby precipitation, through aerosol-cloud interactions. Overall, the paper is well-written, however, requires proofreading from an expert to improve the language and presentation further. The topic addressed in the article fits into the scope of ACP. The conclusions drawn based on dataset, methodology, and research analysis are reasonable and mostly clear to the reader.

Attached are several comments I have derived while reviewing the manuscript, which authors need to clarify during the revision process. The paper can be published after these corrections, and also those from other reviewers, are reflected in the revised manuscript.

Abstract Line 6-10: Too long statement. Break it into two. Line 15: ". . .followed by that in the west" Line 17: ". . .at all altitudes" Line 20: "The Great Indian Desert", also known as "The Thar Desert" Line 23-24: Due to washout of aerosols?

Page 4, line 5-10: Authors may cite following references related to the seasonality of aerosols (Jethva et al., 2005) and trends (Dey and Girolamo, 2011) over IGP.

Jethva, H., Satheesh, S. K., and Srinivasan, J. (2005), Seasonal variability of aerosols over the IndoâĂŘGangetic basin, J. Geophys. Res., 110, D21204, doi:10.1029/2005JD005938.

Dey, S., and Di Girolamo, L. (2011), A decade of change in aerosol properties over the Indian subcontinent, Geophys. Res. Lett., 38, L14811, doi:10.1029/2011GL048153.

Page 4, line 16: ". . .one of the best natural laboratories for investigating the complex nature of aerosols on clouds and precipitation."

Page 5, line 5-7: The paragraph seems to be ending abruptly. Here, the author should mention concisely about the overall goals of the airborne experiments and objectives of the paper. Also, a brief writeup about how the analysis was conducted and what they were looking for would help the reader to familiarize with the overall content of the paper.

Page 5, line 12: “before the onset of ISM over central and northern India”

Page 5, line 13-14: “also shown in Figure 2”

Page 5, line 20: “. . .at the southern peninsular coast of Kerala state”

Page 7, line 5: “All aircraft sorties. . .”

Page 7, line 12-13: “Due to the unpressurized. . .”

Page 7, line 5-10: Wouldn’t be good if another sub-plot of the ratio of CCN-to-CN is added here?

Page 13, line 13: “there seem to be a notable difference in the hygroscopicity of aerosols. . .”. Author needs to be specific here though the hygroscopicity of aerosols is associated with aerosol type.

Page 15, Figure 4: The CN-CCN relationship over all three stations looks near-linear for the CCN range up to 3000-5000 cm-3, after which it becomes non-linear irrespective of the difference in aerosol type. Interesting.

Page 16, Figure 5: If possible, please reverse the colors in the scale, i.e., blue for lowest altitude, red for the highest.

Page 17, line 5: . . .represented by BBR, blue lines in Figure 6 (?). Also, is the flattening of CCN curve with SS for BBR an indication of aerosol type/size. Due to its proximity to the coast, BBR is likely influenced by coarse sea-salt particles against finer size aerosols over interior IGP.

Throughout the discussion in this section, the author should cite corresponding aerosol studies supporting the link between aerosol type/size and CCN spectra.

Table 2. A concurrent geographical plot showing k values with colored circles as a symbol would be more effective and easier for a reader to grasp the reported values.

Page 28, line 15: slopes for BBR and VNS are comparable.

Page 28, Figure 11: Maintain the same X-axis range for all three sub-plots.

Page 28, line 17-18: While this assumption generally holds, it would be interesting to plot CCN as a function of extinction aerosol index. Since the aircraft measurements delivered both scattering and absorption coefficients, it would be straightforward to create a similar plot using extinction AI.

Page 29, line 23-24: The relationship between CCN and aerosol properties further implied the use of satellite-retrieved AOD products in the region, which are now matured and fairly accurate, and model-generated aerosol profile aided by ground (MPLNET at Kanpur)/space lidar (CALIOP), in predicting CCN. This should be mentioned here and also in the conclusion.

Also, did author check the relationship between CCN efficiency and aerosol scattering/extinction properties, if any? It is worth to perform such analysis.

Page 30, line 5: ". . .towards characterizing/understanding the ACI. . ."

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