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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Seasonal analysis of submicron aerosol in Old Delhi using high resolution aerosol mass spectrometry: Chemical characterisation, source apportionment and new marker identification" *by* James M. Cash et al.

Anonymous Referee #1

Received and published: 1 February 2021

The manuscript titled "Seasonal analysis of submicron aerosol in Old Delhi using high resolution aerosol mass spectrometry: Chemical characterisation, source apportionment and new marker identification" describes the measurements carried out in the year 2018, in Old Delhi, India, covering 3 seasons: pre-monsoon (∼1 month), monsoon (∼15 days) and post-monsoon (∼6 weeks). The study uses positive matrix factorization (PMF) to interpret the measurements and finds a 7 factors solution that separates cooking organic aerosols (COA), solid fuel OA (SFOA), hydrocarbon-like organic aerosols (HOA), nitrogen-rich HOA (NHOA), semi-volatile biomass burning OA (SVB-

BOA), semi-volatile OA (SVOOA), and low-volatile OA (LVOOA). The Authors find that the major contributor for the PM1 in the area is: 1) sulfate, LVOOA, and COA during the pre-monsoon period; 2) sulfate, SVOOA, LVOOA and HOA during the monsoon period; and 3)LVOOA, SVBBOA, SFOA, and HOA during the post-monsoon period. Traffic and funeral pyres, crop residue, and waste burning are fund to be major contributors. Another important finding is that the concentrations during the post-monsoon period are around 3-fold higher than in the pre-monsoon and monsoon period and that the chloride fraction has a 5-fold increase in the same period. The authors present a large amount of data both in the manuscript and in the supplemental information (SI). They present them clearly and use the SI effectively to show the reader the process that has led them to choose a particular PMF solution using multivariate fits to external tracers. The article presents data and findings that are of interest to the scientific community and in a location where air pollution is very high and affects a large number of people. The methods used are sound. The interpretation of the data and the conclusions are well rooted in the data with minimal speculation. The presentation of the data and the results are good, although it could use some more clarity especially in the figures as mentioned below in more detail. The location where the measurements were carried out presents a number of challenges such as high temperatures and high relative humidity that can be really tricky for instruments. I think the authors have generated a great dataset in those challenging conditions. The authors also did an excellent job at interpreting such a complex mixture of sources.

The manuscript is of high quality and within the scope of the journal. I recommend the publication after minor revisions.

Detailed comments:

1- The manuscript similarly to many manuscripts based on AMS data and PMF, makes extensive use of acronyms. These acronyms are probably very familiar to the authors and to experienced AMS users, however, they tend to be hard to follow for readers less involved with AMS and PMF analysis. I recommend making a list of acronyms to help

the reader follow the text.

2- Figure 1. I suggest adding the time series of the standard AMS species (NO3, SO4, NH4, Chl, and Org) and BC. This will give the reader a good bird's eye view of the dataset, maybe merging it with some version of Figure 5.

3- Figure 3. I suggest adding dark and light hours with a shaded area for the transition/changing light conditions over the measurement period to help the reader form a picture of the data presented.

4- A lot of figures have tiny labels that are really hard to read especially once the manuscript is printed. In Figure 4 the percentage numbers in each panel are very small I suggest using fewer vales and a larger font. Also, "mean" and "calm" (panels a-e), as well as the Wind Speed values in panel (f) are almost not readable in the printed version.

5- Figure 5. I suggest merging it with figure 1 as mentioned in comment 2

6- Figure 6. Dates are very small, please increase the font.

7- Figure 7 the y axis could be harmonized. It's ok to keep a different scale but I suggest keeping the same number of ticks.

8- Figure 10. the y axis labels for the O:C, H:C and N:C ratios panel are too small. Please reduce the number of ticks, decide how many to put there (3?) and maybe increase the font

9- Figure 11. "mean" and "calm" almost not readable

10- Figure 12. Panel (a) the numbers of ticks could be harmonized by making it the same (4?).

11- Figure 14. I recommend increasing the resolution for the top panel (VK diagrams) the dots are lost even in the electronic version if zoomed in.

12- In the abstract, I recommend adding a mention that sulfate is the largest mass fraction for the pre-monsoon and monsoon periods.

In the methods section

13- at lines 129-131 the Authors mention that they calibrated the AMS "throughout the campaign". I recommend adding a sentence explaining how many times and when (e.g., before, middle, and after?).

14- At lines130 to 135 the Authors mention that in their analysis they had to use different CEs to match the "PM2.5 filter measurements". I recommend expanding this sentence explaining which measurements they are referring to, carried out by which group, with which instrument, and at what time resolution.

15- At lines 146 -148 the sentence "Therefore, only peaks which significantly improved the open and closed signal residuals were fitted regardless of the residuals in the difference (diff = open – closed) signal." is unclear and leaves the reader wonder which peaks were not included. I understand that the fitting at higher m/z is tricky, but I am wondering if the authors can modify or expand on the sentence to clarify the process to the reader, maybe explaining which peaks were not fitted and why.

16- Lines 163-165: ". . . black carbon (BC) measurements which were taken using an Aethalometer AE-31 and corrected for by a Single Particle Soot Photometer (SP-2; Droplet Measurement Technology, Boulder, CO) (Reyes-Villegas et al., 2020).". This sentence is quite vague. I understand that there is a reference to look up, however, I recommend adding a short sentence giving a few more details, e.g., explaining briefly 1)how the Aethalometer data were corrected 2) if/when and for how long the SP2 was co-located with the Aethalometer. Results

17- Lines 235-238: here and in a few other parts, the authors cite "personal communication with Ben Langford". In all those cases I think that this information should be removed as it doesn't seem critical to the point of the sentences unless a paper has

been published in the meantime and can be properly referenced.

18- Line 458: “UnSubPAHs” acronym not defined Conclusions

19- Lines 894-895: “These high post-monsoon concentrations have been linked to an increase in burning emissions mainly from crop residue and solid fuel.” Are higher concentrations only due to an increase in burning emissions or the boundary layer height affect these concentrations as well? If that’s the case, I recommend adding it here. Supplementary Information

20- Figure S2 y-axis label too small

21- Page 12: “Error! Not a valid bookmark self-reference.” Should be “Table S2”

22- Figure S8: “Polar graphs showing the concentrations . . .” add units of concentrations.

23- Figure S9 “Mean” and “calm” not legible.

24- Figure S13: add that the points not labeled neither “Delhi” nor “Chack2018” come from Table S3.

25- Page 20: “The factor mass profiles and their diurnal cycles during each measurement period are summarized in Figure S14”. I think it should be “Figure S15”

26- Figure S15 and S16: y-axis labels are too small

Finally, reading the manuscript I have been wondering why the Authors decided not to run the PMF in bootstrap mode for the 7 solutions combined periods.

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