

Interactive comment on “Measurement report: Characterization of severe spring haze episodes and influences of long-range transport in the Seoul metropolitan area in March 2019” by Hwajin Kim et al.

Anonymous Referee #2

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General comments: This manuscript reports the measurements of characterization of severe haze episodes and the influences of long-range transport in the Seoul metropolitan area using a high-resolution aerosol mass spectrometer (HR-AMS) and PMF analysis. The authors identified seven organic aerosol (OA) factors, including a HOA, a COA, a SFOA, two LO-OOAs, and two MO-OOAs. Their results present that nitrate was the major component of PM₁ and the source of nitrate was originated from regional transport. The Pb was identified by the HR-AMS measurement and was associated with the long-range transport of polluted areas during haze events.

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This manuscript presents lots of scientific results and figures to support the findings of the regional transport-influenced. However, some parts of the AMS measurement results seem to be too detailed and not concisely presented. In general, this manuscript presents lots of scientific results and data analysis, and it's publishable on Atmospheric Chemistry and Physics with a major revision. Some concerns and comments are listed.

Specific comments:

1. The authors present 7-factor solution in this PMF analysis for this study. However, three primary organic aerosol (POA) related factors and four secondary organic aerosol (SOA) factors could lead to a confusion to readers. From the Figure 2(d-q) and Figure S6(d), the results show the R values in mass spectra for 11 pairs of factors are greater than 0.8. The 7-factor solution has 11 pairs of factors with similar mass spectra. Have you evaluated the combination of similar factors and conduct correlation analysis with tracers? The factor 3 and factor 4 share similar time series profiles. The 6-factor solution still has a similar time series of mass spectra of factor 2, factor 3, and factor 4. The solid-fuel OA(SFOA) is a new factor in this study but has similar mass spectra with previous BBOA. When you create a new factor, which is different from previous studies, you should provide strong evidence to support the naming of a new factor. The SFOA and LO-OOA1 are both burning influenced (from Line 338-339). If you combine both factors, will you see the correlations with biomass burning tracers? The two LO-OOA and two MO-OOA factors have similar mass spectra and time series profile, which could lead to an unclear result to most readers. In line 408-409, the authors also claimed that the MO-OOA1 has secondary features but was influenced by burning sources, which was lined to SFOA. In this study, you have three factors with burning influenced factors (SFOA, LO-OOA1, and MO-OOA1). Besides, from Table 1, the LO-OOA2 and MO-OOA2 have similar correlation results. Both of them are regional transport-influenced and correlate highly or moderately with nitrate, ammonium, CHN fragments, MSA fragments, and Pb. I suggest that the LO-OOA2 and MO-OOA2 factors can be combined and rename the factor as regional transport-influenced OOA

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or any specific name for this important source.

2. Line 338-339: “The SFOA and LO-OOA1 contribute 32.9 and 29.7%, respectively, to the $\text{C}_2\text{H}_4\text{O}_2 + (\text{m/z} = 60)$ and $\text{C}_3\text{H}_5\text{O}_2 + (\text{m/z} = 73)$ signals (Fig. S16).” However, Table 1 shows the r is -0.10 between LO-OOA1 and $\text{C}_3\text{H}_5\text{O}_2+$. Please explain it.

3. From Figure 6 during the EP3-S3, we can see the strong wind and higher fraction of MO-OOA1. What’s the reason for the high MO-OOA1? Is the burning source from local or remote region? In line 514, “the enhancement of the burning-related sources (SFOA and MO-OOA1) was observed”, which didn’t show the enhancement of SFOA from Figure 6.

4. Line 531-535: Do you have evidence of planetary boundary layer height diurnal pattern from modeling result or from previous studies to support your hypothesis?

5. Line 533: “...due to the evaporative of semivolatile species at high air temperature...”, this sentence is not explained clearly. Do you mean the HNO_3 loss leads to the nitrate decrease?

6. Most main figures have multiple figures, which did not present the most important result but showed many detailed figures in the main figures. I suggest that the main figure just shows the most important figure and move other detailed figures to supplemental figures. For example, in Figure 3(a) is the main figure, and the Figure 3(b-e) can be moved to supplemental material.

Technical corrections:

1. Figure 2(c) is semivolatile oxygenated OA(SV-OOA), which is not mentioned in the main text.

2. Figure 4 (b) : “PM1 gaseous species” should be “PM1 mass species” in the caption.

3. Figure S3 is blurry. Please replace the figure with a higher resolution figure.

4. Figure S3 on p.8 (line 127) should be Figure S4. This figure is not clear but it

- presents the m/z 103, 103.5 and 104, which is not mentioned in the main text.
5. Figure S5 is blurry. Please replace the figure with a higher resolution figure.
 6. Figure S8 is blurry. Please replace the figure with a higher resolution figure.
 7. Figure S10 is blurry. Please replace the figure with a higher resolution figure.
 8. Figure S17 is blurry. Please replace the figure with a higher resolution figure.
 9. Table S3 line 58 (Figs. Sx and x): Please label the Figure number.
 10. Table 1 : $\text{CH}_2\text{SO}_2 + (79)$ should be $\text{CH}_2\text{SO}_2 + (78)$.
 11. Table 2: "BBOA" should be "SFOA".
 12. Figure 6: "BBOA" should be "SFOA".
 13. The name of episodes should be consistent in the main text and figures. For example, the EP3_S1, and EP3_S2, EP3_S3 are labeled in Figure 6, but in Line 505 and 507 they are S3. Line 264 : Ep1, Ep2, and Ep3 should be EP1, EP2, and EP3.
 14. Line 193: HRMS should be HR-AMS.
 15. Line 508: RSOA is not defined.
 16. Line 539 : NOR is not defined.
 17. Line 553 : SOR is not defined.
 18. Line 969: the "PMA" analysis should be corrected as "PMF" analysis.
 19. Please use a consistent mass unit ($\mu\text{g m}^{-3}$ or $\mu\text{g/m}^3$) throughout the main text, figures, and tables.

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