Review of

"Sources and atmospheric processing of winterime aerosols in Seoul, Korea: Insights from real-time measurements using a high-resolution aerosol mass spectrometer"

By Kim et al.

General comments

The study reports real-time characterization and source apportionment of atmospheric PM_1 in Seoul, South Korea during winter 2015. Secondary species, i.e. sulfate, nitrate, ammonium, SV-OOA, and LV-OOA, is found to contribute significantly to the ambient PM_1. The PM composition is influenced by meteorological conditions, i.e. temperature and relative humidity. Wind speed and direction are particularly important in characterizing regional and local sources of OA. Locally produced OA, i.e. BBOA, COA, and HOA, contributes majorly to the total OA mass, suggesting the importance of air pollution control in Seoul during winter season.

This study is interesting and important as it is one of the first studies in the region to intensively characterize ambient PM in real-time. The results will be useful for developing or improving air pollution control and policy.

Overall the manuscript falls within the scope of Atmospheric Chemistry and Physics journal. The manuscript is well written and only some revisions are needed. Some statements in the manuscript need to be clarified and/or discussed further. After the following comments are addressed, I recommend the manuscript to be accepted for publication.

Specific comments

Experimental methods:

- PAHs measurements are not described in the methods section, yet the data shows up in discussion (e.g. Table 2). Information about PAH measurements should be added either in the methods, or in the SI and refer to it in the main text.
- For the backtrajectory analysis, what is the air mass estimated to arrive at the location?

Discussion:

- Pg 10 Ln 9: is the severe haze event related to the high loading periods (Fig. 2)?
- Pg 12 Ln 9-12: it could be helpful to add solar radiation data to Fig. 6 to give an idea of when photochemistry possibly occurs at the location. If solar radiation is not available, temperature could give some insights too.

- Pg 21 Ln 6-13: what does the lack of striking diurnal profile of LV-OOA suggest? I think the lack of diurnal variation is related to the regional source of LV-OOA, which has been observed in other areas, e.g. Budisulistiorini et al. (2015, ACP) in USA, Mohr et al. (2012, ACP) in Spain.
- Pg 23 Ln 4-7: it would be good to add short descriptions of what areas/regions are represented by each cluster. The readers may not be familiar with geography in the study location.

Figure 14:

- What does the percentage correspond to? If it is related to the average mass concentration of PM_1, the percentages for Cluster 1-3 are incorrect.
- The figure shows that air mass arrive at 191 m agl at the location, whereas on the figure title, it is 500 m (assuming also agl). Is this a typo or they are different terms? The two elevations are different, so please clarify and/or add description about the backtrajectory analysis.

<u>Technical comments</u>

Pg 3 Ln 28: add reference, such as Hennigan et al. (2009, ACP)

Pg 8 Ln 30: insert "respectively" after (SV-OOA).

Pg 10 Ln 7: define NIER

Pg 11 Ln 16: do you mean Fig. 4b?

Pg 12 Ln 4-6: insert "Fig. S10" in the sentence.

Pg 13 Ln 29: it's supposed to be Fig. S4b

Pg 19 Ln 5: *f44* of BBOA is higher than 0.01, I think it's around 0.05. Please check again.

Pg 19 Ln 26-27: BBOA enhances around 9:00 to be more exact.

Pg 20 Ln 21-23: I think NO_3 and SO_4 instead of NO_2 and SO_2, respectively are better tracers of oxidized species for comparison with SV-OOA and LV-OOA.

Pg 21 Ln 31: it should be "(Figs. 12a,b)"

Pg 22 Ln 19: space between O_3 and concentration.

Pg 22 Ln 21-22: what do you refer by "another possible reason", is it a reason of O_3 decreases? If it is so, the sentence needs to be clarified.

Pg 23 Ln 13: delete "compositions". The aerosol compositions are similar. The difference is only concentrations of species at each cluster.

Table 2:

- Correct m/z values for these compounds: $C_4H_9^+$ (57), $C_5H_{11}^+$ (71), $CH_2SO_2^+$ (78), $CH_3SO_2^+$ (79).
- Bold r-value for $C_2H_4O_2^+$ versus BBOA.

Table 3:

- Add "trace gas concentration" on the table caption.
- Subscript the trace gases: e.g. NO_2. Also check for this kind of typo elsewhere in the manuscript.

Figure 1c: it is not obvious where the city center is located. Add marker for the city center location.

Figure 2: personally, I think this figure is too crowded. The sub-figures are small and some have many lines (e.g. Fig. 2f, g). Although the lines are colored differently, they are still difficult to differentiate. On, Figure 2i particularly, the line representing average number concentration is almost similar to the gradient color of legend.

Figure 3: be consistent with species on the legend and the caption: e.g. NO_3 or NO_3^-. Also be consistent in the rest of manuscript.

Figure S4b: y-axis is supposed to be $dSO_4/dLogD_{va}$.

References

Budisulistiorini, S. H., Li, X., Bairai, S. T., Renfro, J., Liu, Y., Liu, Y. J., McKinney, K. A., Martin, S. T., McNeill, V. F., Pye, H. O. T., Nenes, A., Neff, M. E., Stone, E. A., Mueller, S., Knote, C., Shaw, S. L., Zhang, Z., Gold, A., and Surratt, J. D.: Examining the effects of anthropogenic emissions on isoprene-derived secondary organic aerosol formation during the 2013 Southern Oxidant and Aerosol Study (SOAS) at the Look Rock, Tennessee ground site, Atmos. Chem. Phys., 15, 8871-8888, doi:10.5194/acp-15-8871-2015, 2015.

Hennigan, C. J., Bergin, M. H., Russell, A. G., Nenes, A., and Weber, R. J.: Gas/particle partitioning of water-soluble organic aerosol in Atlanta, Atmos. Chem. Phys., 9, 3613–3628, doi:10.5194/acp-9-3613-2009, 2009.

Mohr, C., DeCarlo, P. F., Heringa, M. F., Chirico, R., Slowik, J. G., Richter, R., Reche, C., Alastuey, A., Querol, X., Seco, R., Peñuelas, J., Jiménez, J. L., Crippa, M., Zimmermann, R., Baltensperger, U., and Prévôt, A. S. H.: Identification and quantification of organic aerosol from cooking and other sources in Barcelona using aerosol mass spectrometer data, Atmos. Chem. Phys., 12, 1649-1665, doi:10.5194/acp-12-1649-2012, 2012.