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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Source apportionment of $PM_{2.5}$ in Seoul, Korea" *by* J.-B. Heo et al.

Anonymous Referee #1

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This manuscript describes the application of receptor modeling (PMF) to PM2.5 compositional data collected in Seoul over three years; nine sources (or factors) were thereby resolved. The manuscript describes an interesting dataset and its topic is within the scope of ACP. It is however not possible to fully evaluate this manuscript and, therefore, can not be recommended for publication in its present form: there are some open issues and questions that need to be addressed. The following comments are provided in part to guide the revision of the manuscript, and in part out of interest in the authors reply.

o General remarks:

1) More PMF diagnostics need to be provided. This comprises the report of Q-values as a function of the number of factors, as well as a discussion of the model errors, e{i,j}, as a function of time and species. This will make the choice of the number of factors

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more reproducible. In addition, please provide the factor profiles and time series from the 8- and 10-factor PMF (supporting material).

2) As far as I am aware, no novel concepts are included in the present analysis and hence even more emphasis should be put on the interpretations of the statistical results provided by this (standard) analysis. The identification and interpretation of factors as sources lacks support. The estimated factors and the corresponding time series need to be validated by ancillary data (by collocated trace gas measurements CO, NOx etc.), numerical comparisons with literature source profiles, results of PMF-independent modeling approaches etc.

3) Many of resolved sources reported here have a non-constant emission profile over time. It is not very plausible that this PMF assumption (constant emission profiles) is fully valid for a three-year period, e.g. for biomass burning. How stable is the PMF solution with respect to PMFs on yearly data subsets (as an example)?

4) Throughout the manuscript the terms "factors", "sources" and "components" should not be confused, e.g. "secondary nitrate" is not a physical emission source.

5) Based on the distribution of OC to the different factors representing primary as well as secondary components, it would be interesting give estimates for the amount of secondary OC (SOC) and primary OC (POC) and compare them to results from other approaches.

o Specific comments:

p. 20429, lines 18-19: The reference list here should be extended. The reviewer remains in doubt, if the authors are aware of work carried out by other groups (e.g. PMF applications in the AMS community by Ulbrich et al., 2008, and Lanz et al., 2007). Furthermore, PMF developments should be concisely re- and overviewed in the context of other receptor models (e.g. COPREM by Wahlin, 2002, and the most recent developments by Lingwall et al., 2008).

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p. 20430, line 5: However, chemical profiles are needed to verify the factor analytical results.

p. 20435: What was assumed for the height (of the polluted planetary boundary layer) of the geophysical grid cell?

p. 20437, line 6: How were these standard deviations calculated precisely? In the corresponding Fig. 3, please plot these std dev. with a color and both, the upper and low confidence limit.

p. 20437, line 13: add OH/radiation

p. 20437, line 13: nighttime chemistry via NO3(g)

p. 20438, line 18-22: the same applies for diesel emissions. The "diesel emission"-factor however does not show such a behavior.

Supplementary material, Fig. S1 and Fig. S4: Please indicate the average absolute mass concentration for both plots. "Residue" shown in Fig. S4 is 14.4%. After the PMF analysis and reconstruction of the data, the "Residue" diminished to only 3.1%. Please explain and/or rewrite the Figure captions and re-label. Was the PM2.5 residue (probably water and mineral dust) also included as a species in the data matrix (x{i,j})? Does the particle mass shown in Fig. 2 include the residue? It further might be confusing that there is more calculated "Secondary nitrate" (20%) (Fig. S1) than measured nitrate (Fig. S4). I suggest to re-label the factors.

o Linguistic/technical corrections:

p. 20437, line 14: "Secondary nitrate vary seasonally, ... " change to "Secondary nitrate concentrations vary seasonally ..."

p. 20437, line 17: add reference.

p. 20437, line 17-18 "huge amounts", rewrite.

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p. 20437, line 20: "slightly higher", rewrite

p. 20437, line 27-29: "Two types of motor vehicles ... were separated at the sampling site", rewrite

p. 20434, line 6: possibly "wind directions"

p. 20447: "Malinowsk" or "Malinowski"

p. 20455, Fig. 5: the lower confidence level is not plotted.

References

Lingwall, J. W., Christensen, W. F., and Reese, S. C.: Dirichlet based Bayesian multivariate receptor modeling, Environmetrics, 19, 618-629, 2008.

Ulbrich, I. M., Canagaratna, M. R., Zhang, Q., Worsnop, D. R., and Jimenez, J. L.: Interpretation of organic components from positive matrix factorization of aerosol mass spectrometric data, Atmos. Chem. Phys. Discuss., 8, 6729-6791, 2008.

Lanz, V. A., Alfarra, M. R., Baltensperger, U., Buchmann, B., Hueglin, C., and Prévôt, A. S. H.: Source apportionment of submicron organic aerosols at an urban site by factor analytical modelling of aerosol mass spectra, Atmos. Chem. Phys., 7, 1503-1522, 2007.

Wahlin, P.: COPREM - A multivariate receptor model with a physical approach, Atmos. Environ., 37, 4861-4667, 2003.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 20427, 2008.