

## Referee comment on

### “Long-term real-time measurements of aerosol particle composition in Beijing, China: seasonal variations, meteorological effects, and source analysis”

by Sun et al., *Atmos. Chem. Phys. Discuss.*, **15**, 14549–14591, 2015

#### Anonymous referee #2

This manuscript reports results obtained with an Aerodyne Aerosol Chemical Speciation Monitor (ACSM) during a long-term measurement period (1 year) at Beijing, China. The authors describe the seasonal variations of non-refractory submicron particles (NR-PM<sub>1</sub>). Then, they discuss the properties of NR-PM<sub>1</sub> as a function of the meteorological conditions and the air mass origin.

This manuscript is very interesting and of prime importance, and is completely within the scope of Atmospheric Chemistry and Physics. Therefore, I highly recommend its publication after the authors address the following comments.

#### Specific comments:

- 1) Page 14555, lines 5-20: when I read the calibration procedure of the ACSM in this paragraph and in the two first papers published by the group on this study (Sun et al., 2012; Sun et al., 2013), it seems that the RIE sulfate has not been calibrated with (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>. This is important, because the RIE sulfate may vary a lot (up to a factor of 3) between different instruments. Therefore, if the default value has been used, there can be an important uncertainty on the accuracy of the sulfate concentrations. The authors can try to use the parameterization presented in Budisulistiorini et al. (2014) to estimate the RIE sulfate, and see if there is a high deviation from the default value. If it is the case, it can have an incidence on the NO<sub>3</sub><sup>-</sup>/SO<sub>4</sub><sup>2-</sup> ratio discussed later by the authors (page 14559, lines 14-26).
- 2) Page 14561, lines 14-18: the authors mention that in winter, the sulfate concentration increased because of a significant increase of precursor SO<sub>2</sub>, which can be oxidized to form sulfate via either gas-phase oxidation or aqueous-phase processing. However, the RH was very low in winter (< 40%), compared to the other seasons, so maybe the aqueous-phase processing had a very limited influence on the sulfate formation in winter.
- 3) Page 14562, lines 8-19: there are a few discrepancies between the information given in this paragraph and PMF results presented in the two previous publications of the authors on this study. For instance, the authors mention that the noon peak of organics was primarily caused by cooking emissions, while the evening peak was driven by different primary emissions (cooking, traffic, and coal combustion emissions) among the different seasons. However, according to Sun et al. (2012), only OOA and HOA factors were identified in summer, no cooking or coal combustion related emissions. It is only in winter that the authors identified cooking and coal combustion organic aerosols (Sun et al., 2013). Obviously, the HOA factor identified in summer was a mixture of HOA and COA (Sun et al., 2012), but if the noon peaks, which were more significant in summer than in the other seasons, were mainly driven by cooking activities, a COA factor would certainly be easily identified in summer.

Moreover, I am not sure to understand why cooking activities are reduced in winter (also mentioned on page 14565, lines 8-9). Normally, cooking activities should be more or less the same during the different seasons.

- 4) Page 14563, lines 24-25: how did the authors determine that chloride was present under the form of ammonium chloride? In Sun et al. (2012), the authors mention that chloride measured by the ACSM is primarily ammonium chloride, since the ACSM does not detect sea salt. However, non refractory chlorides include also other compounds, such as HCl and organic chlorides. It should be very difficult to determine this point with the scatterplot of  $\text{NH}_4$  measured vs  $\text{NH}_4$  predicted, since the contribution of chloride to the total inorganic species is small compared to sulfate and nitrate.

#### Technical corrections:

- 5) Page 14571, line 7: “in the formation of ~~serve~~-severe PM pollution”.
- 6) Figure 12: the text “(c)  $\text{NO}_3^-$ ” seems to be opaque, since it hides the label of the x-axis just on the top of it. Please make it transparent, or move it a little bit to the bottom.

#### References:

Budisulistiorini, S. H., Canagaratna, M. R., Croteau, P. L., Baumann, K., Edgerton, E. S., Kollman, M. S., Ng, N. L., Verma, V., Shaw, S. L., Knipping, E. M., Worsnop, D. R., Jayne, J. T., Weber, R. J., and Surratt, J. D.: Intercomparison of an Aerosol Chemical Speciation Monitor (ACSM) with ambient fine aerosol measurements in downtown Atlanta, Georgia, *Atmos. Meas. Tech.*, 7, 1929-1941, 10.5194/amt-7-1929-2014, 2014.

Sun, Y., Wang, Z., Dong, H., Yang, T., Li, J., Pan, X., Chen, P., and Jayne, J. T.: Characterization of summer organic and inorganic aerosols in Beijing, China with an Aerosol Chemical Speciation Monitor, *Atmos. Environ.*, 51, 250-259, 10.1016/j.atmosenv.2012.01.013, 2012.

Sun, Y. L., Wang, Z. F., Fu, P. Q., Yang, T., Jiang, Q., Dong, H. B., Li, J., and Jia, J. J.: Aerosol composition, sources and processes during wintertime in Beijing, China, *Atmos. Chem. Phys.*, 13, 4577-4592, 10.5194/acp-13-4577-2013, 2013.