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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The real part of the refractive indices and effective densities for chemically segregated ambient aerosols in Guangzhou by a single particle aerosol mass spectrometer" *by* G. Zhang et al.

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This manuscript describes the characterization of aerosols in Guangzhou, China with a single particle mass spectrometer. The analysis included using the collected mass spec data to determine the density and the real part of the refractive index. This manuscript is well-written, the topic is relevant for ACP, and provides important new results. The results are put into context with previous studies. I would recommend that the manuscript is accepted. I do have a couple minor points on the manuscript that I would recommend are addressed before the final submission.

In section 2.2, the discussion of the use of the "upper limit" is a little unclear as written. I would recommend either on page 3452 line 27 adding the exact "data" that are being referred to in the sentence ": : :we only used data that lie at the 90th percentiles." I believe this is referring to LSS. Alternatively, if the discussion of how the calculation was performed (page 34653 starting at line 6) was moved towards the beginning of the paragraph, might help to make the description of the upper limit more clear. Also, I would recommend in this section to include a line that says something about how in the figures that follow in the results section these points are referred to as "upper limit," as that term was not specifically used often in the methods section, and thus was a little confusing in the results section.

We would like to thank the reviewer for his/her useful comments and recommendations to improve the manuscript. We agree with the comments, and we have revised this paragraph as recommended to make the description of the upper limit more clear.

The paragraph has been revised to "The methodology is briefly summarized herein. Firstly, theoretical response is firstly compared with the response of scattered light measured by SPAMS from PSL particles with sizes ranging from 150 to 2000 nm. Then a calibration curve is constructed to transform the LSS (at the 90th percentiles, i.e., upper limit) measured by SPAMS to the PSCS, enabling a quantitative comparison between the measured and theoretical PSCS. Before performing scattering calculation, the detected particles were grouped into 17 particle types on the basis of chemical compositions. Finally, a series of n and eff were used as input in Mie theoretical calculation to find the best fit (i.e., a global minimum of the sum of squares due to error, SSE) between the measured and theoretical PSCS with least square method, thus enabling the estimation of n and eff. A detailed description of the methodology for the SPAMS and the results of the test on the known aerosol particles (i.e., NaNO3 and (NH4)2SO4) is available in our previous publication (Zhang et al., 2015a). During the sizing detection, the particles diverge from each other and thus a wide range of light scattering intensities from nearly zero to some upper limit are obtained for similar particles. This is due to the uneven distribution of laser beam energy, and also to the relative position of the laser beam and the pathway of particles. In order to avoid the effect of high intensity outliers in our study, we used only LSS that lie at the 90th percentiles of the collected data in 20 nm size bins, regarding the upper 10% as outliers. Satisfied results were obtained for calibration on PSL and test on NaNO3 and (NH4)2SO4). Other percentile data (such as values lie at 95th and 99th percentiles) was also tested, however, the PSL calibration cannot be improved, which is possibly attributed to much more outliers lying at the upper 10% percentile of the collected data. Therefore, we use 90th percentiles of LSS as their upper limit values in the following discussion." Please refer to Lines 113-134 in the revised manuscript.

Section 3.1.2, starting line 14 of page 34656, it is stated that EC that has been exposed to water can change its shape towards more spherical. In this study the particles were dried. Would it be expected that EC particles, if they started as spheres, would keep their shape after they are dried?

It is hardly to show the change of particle shape after they are dried in this study. With a Transmission Electron Microscopy, Pagels et al. (2009) illustrated that fresh soot is with a highly irregular structure, coated soot with a considerable compaction. They also showed that considerable compaction of the particles had occurred when they were heated or dried. Consistently, our study showed that there were still spherical particles when particles are dried as indicated in Figure 3. This literature has been cited here. Please refer to Lines 210-214.

Page 34650 line 7, should read ": : :various compounds: : :"

It has been corrected as suggested.

Page 34650 line 15 should read ": : :measurements into aerosol mass: : :"

It has been corrected as suggested.

Page 34650 line 20, should read "..which have served as important parameters: : :"

It has been corrected as suggested.

Page 34651 line 25, I would recommend "related" instead of "corresponded" in "the velocity is corresponded to: : :"

It has been corrected accordingly.

Page 34652 line 23, include cite of previous publication that explains methodology. The citation (Zhang et al., 2015) has been included in the revised manuscript, please refer to Line 124.

Zhang, G., Bi, X., Han, B., Qiu, N., Dai, S., Wang, X., Sheng, G., and Fu, J.: Measurement of aerosol effective density by single particle mass spectrometry, Science China Earth Sciences, 1-8, doi:10.1007/s11430-015-5146-y, 2015a.

Page 34686, line 6, should read ": : :there metal rich types are mainly: : :"

It has been corrected as suggested.

Figure 5, it is hard to distinguish between black and green line. Perhaps would lighter color for the green line work better? Or even just a different symbol (i.e. square, cross) would help.

The line color has been revised to light green and different symbols are used as suggested, please refer to Figure 5 in the revised manuscript.

Reference

Pagels J., Khalizov A.F., McMurry P.H., Zhang R.Y., 2009. Processing of Soot by Controlled Sulphuric Acid and Water CondensationMass and Mobility Relationship. Aerosol Science and Technology 43, 629-640.

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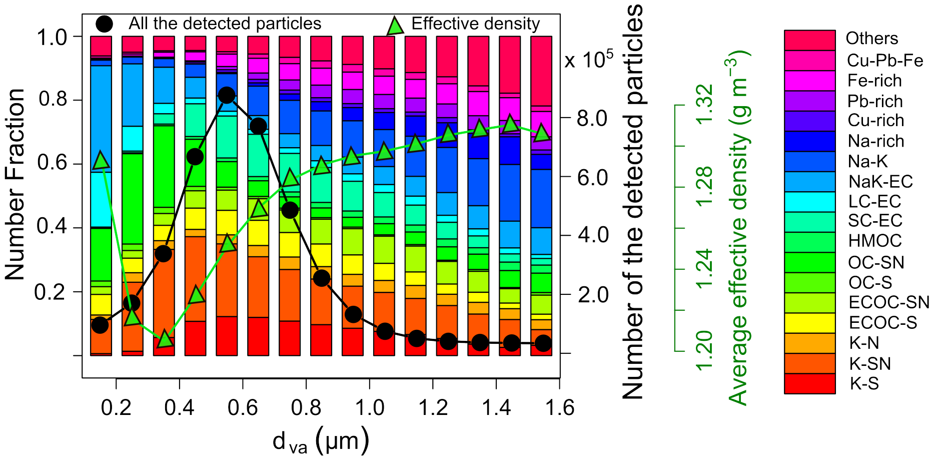
All the detected particles
Effective density
Number Fraction
1.0
0.8
0.6
0.4
0.2
x 10^5
8.0
6.0
4.0
2.0
Number of the detected particles
1.32
1.28
1.24
1.20
Average effective density (g m^-3)
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
d va (µm)
Others
Cu-Pb-Fe
Fe-rich
Pb-rich
Cu-rich
Na-rich
Na-K
NaK-EC
LC-EC
SC-EC
HMOC
OC-SN
OC-S
ECOC-SN
ECOC-S
K-N
K-SN
K-S

Fig. 1.