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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Mixing characteristics of refractory black carbon aerosols determined by a tandem CPMA-SP2 system at an urban site in Beijing" *by* Hang Liu et al.

Anonymous Referee #2

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The paper reports the microphysical properties and aging/ mixing state of rBC particles during summer time in Beijing. The research site is mostly influenced by traffic emissions from the surrounding highways and is well representative of the Beijing urban outflow. Ambient aerosol were measured using the single particle soot photometer (SP2) for ∼2 weeks (30 May to 13 June 2018). Complementary measurements of O3, NO2 and PM2.5 were performed, however, the measurement techniques were not specified in the methodology section, which I recommend to do so.

There were two case studies that the authors refers as 'clean' and 'polluted' for which the rBC properties were determined. Moreover, during these periods, a dedicated

experiment was performed by coupling a DMA or CPMA with the SP2 in order to determine the effective density, morphology and absorption enhancement of rBC particles due to coatings. The methods used in this study are valid, however, the measurement setup is questionable. For example, the authors do not mention whether the aerosol particles are dried before detection. The particle size depends on relative humidity (RH) that can strongly influence the results. Note that the RH is much higher in the "polluted" case. Moreover, I do not agree in using the terms "clean" and "polluted" applied for the two periods. The clean period is rather influenced by the fresh traffic emissions.

The description of the tandem experiment is not well described and difficult to understand. Since this is one of the highlights of the paper, it deserves a dedicated section on the methodology containing precise information of the measurement period, the atmospheric conditions during the experiment (what kind of air masses were sampled?) and the purposes of doing this. I suggest to have a dedicated section (after section 2.1) in the methodology for the case studies. A table containing the main results of this comparison can be also helpful.

Overall, I suggest improvements of the writing. In my opinion, the discussion of the results are not presented in a precise way and the figure notes are quite vague and lacking information. For all of them, I recommend to give more details, using the full name of the variables.

Specific comments:

L149: "In this study, the SP2's low detection bound was set to Dc = 70 nm". Please re-phrase.

L152: Why 1.17 factor was used?

L159: replace "owing".

L171: "The coating density was set to 1.5 g/cm3". Please re-phrase.

L209: remove “that”.

L211-212: Which MAC value did you assume for calculating the BC mass?

L212: “Overestimation” of? Incomplete sentence.

L218: Rephrase “during which time”.

L243 – 260: This whole paragraph discussing “after rain” case should be more concise. It is a bit confusing with presenting several dates. Try to group them.

L244: What was the decrease in MMD on June 4 in numbers? Is it consistent with the event on June 8?

L258: Are the southerly winds representative for the Beijing outflow? And the northerly winds?

L265: Investigation period.

L273: “Episode 1”, specify the time interval.

L274: “During episode 1, the Dp/Dc distribution exhibited a single peak at 1.05. However, during episode 2, two Dp/Dc distribution peaks were found”. What point do you want to make here?

L285-286: Tends vs. tended.

L304-305: There are more recent studies on the microscopy of BC.

L341: “The median MR values of the pollution day were all larger than those on the clean day for the four Mp points. This result demonstrated that rBC had more coating material during the pollution day than the clean day.” Couldn’t it be related to the higher RH?

L380: “indicating in-cloud nucleation scavenging may be a more efficient mechanism for rBC-containing particles”. Do you mean removal mechanisms?

Fig. 1: has four panels. It is helpful for the readers if there is a full description of the measurements (from the top to the bottom) and possibly how they were collected. Moreover, I recommend to indicate the two studied cases in the figure. The same applies for figures 5.

Fig. 2: Here you present the size distribution of rBC. You applied a lognormal distribution over all the range.

Fig. 5: Y axis in log scale and increased range. What are the units of dM/dlogDc? The values seems too high!

Fig.7: In the two upper panels, the integral of the area below the curve seems to be larger than 1, is it really the normalized dN/dlogDp? Moreover, the arrows indicating the clean and polluted periods are not precise.

Fig. 8: Where are the Ox measurements from?

Fig. 9: Relationship between effective density and mobility dimeter of?

Fig. 11: MR = mass ratio of non-refractory matter to rBC. Add the full name to the figure description.

Figure S1: Does the ‘after experiment’ calibration have only one data point? Try to use different markers so that both measurements are visible on the plot.

Fig. S7: This figure is important to understand the origin of air masses for the two study cases. However, there is no information of the age or the starting point of the back trajectories. Also please adjust the scale of the plot.

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