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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effective densities of soot particles and their relationships with the mixing state at an urban site of the Beijing mega-city in the winter of 2018" *by* Hang Liu et al.

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Liu et al. use a tandem DMA-CPMA-(CPC/SP2) system to measure the effective densities of refractory black carbon (rBC) particles in the atmosphere of Beijing. The setup of DMA-CPMA-SP2 is very novel. However, this paper has obvious weakness in the data interpretation, which is sometimes rather imprecise.

I use several examples to illustrate my main concerns of the paper. 1. Comment on the representative of rBC particles in this study This paper only focuses on the rBC particles with effective density from 0.8 to 1.8 g cm-3. Actually, lots of rBC particles emitted from emission sources show a much lower effective density. Unfortunately,

they are not included in this study.

2. Comment on the calculation and definition of effective density This paper presents two methods of effective densities calculation, but I do not quite understand them. Previous studies (Qiao et al., 2018; Momenimovahed and Olfert, 2015) generally used a log-normal or Gaussian function to fit the eff distribution. The eff of the bulk aerosols was determined to be the peak location of the fit function. In this paper, however, the first calculation method (Lines 125-130) is, "Particles with known effective densities preselected by the DMA-CPMA system were injected into the SP2 to obtain information on the corresponding BC. In practice, the mobility diameter selected by the DMA was set at a constant value of 240 nm. The setpoints of the CPMA were 5.79, 7.24, 8.69, 10.13, 11.58, and 13.03 fg, which corresponded to a eff of 0.8,1.0, 1.2, 1.4, 1.6, and 1.8 g/cm3, respectively." This calculation is totally different from the calculation in the previous studies. Is no a log-normal or Gaussian function fitted? It is imprecise in theory and in practice. What is the strategy about the selection of CPMA data?

The second calculation method defines a new effective density which names the bulk aerosol density, as stated in Lines 137. In my opinion, it should be the bulk aerosol effective density. Additionally, the authors simply use the PSL to demonstrate this method, which lacks the experiments about rBC.

3. Comment on the setup of DMA-CPMA-SP2 This study uses a novel setup to characterize the effective density of rBC particles in the atmosphere, but this setup does not be verified by rBC particles produced in laboratory. I strongly suggest that it should be assessed before applying it to the field observation.

4. Comment on the determination of the shape factor In 2.3.3, author uses the equation (3) to determine the dynamic shape factor. In the equation, Dmev is the mass equivalent diameter. The authors do not explain how the value of this mass equivalent diameter is obtained. According to the instruments used in this paper, it seems impossible to obtain Dmev. I am confused that this paper has calculated dynamic shape

factor by the value of Dmev.

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