

Interactive comment on “Aging and hygroscopicity variation of black carbon particles in Beijing measured by a quasi-atmospheric aerosol evolution study (QUALITY) chamber” by Jianfei Peng et al.

Anonymous Referee #1

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In the manuscript the authors measured several physicochemical properties, including size, density, chemical composition, hygroscopicity, and Cloud Condensation Nuclei (CCN) activity of coated Black Carbon (BC) particles as a function of aging (coating with condensable species from photo-oxidation of VOCs) in a quasi-atmospheric aerosol evolution study (QUALITY) chamber using a suite of instruments, such as differential mobility analyzer, aerosol particle mass analyzer, High Resolution – Time of Flight – Aerosol Mass Spectrometer (HR-ToF-AMS), Humidified Tandem Differential Mobility Analyzer (HTDMA), and a CCN Counter (CCNC). Their results show that under ambient condition in Beijing, the BC undergoes rapid growth to 77 ± 33 nm coating

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thickness with an average growth rate of 26 ± 11 nm h⁻¹. The O/C ratio of the SOA coating is 0.5, lower than ambient level, indicating the lack of aqueous phase oxidation inside QUALITY chamber. The hygroscopic parameter (κ) is about $0.035 \sim 0.040$ as measured by HTDMA and CCNC, suggesting that the initial photochemical aging of BC particles does not appreciably alter the particle hygroscopicity in Beijing. This study and the data provided are quite extensive. The most valuable addition of this manuscript is the “close to ambient (Beijing)” aging condition in the QUALITY chamber. The author showed in Figure 3 that the O₃, NO_x, CO, and SO₂ concentrations inside and outside of the chamber is close. However, the VOCs plot inside and outside of the chamber is missing. The authors also mentioned they applied heater, drier, alumina spherules coated with potassium permanganate (KMnO₄), and activated charcoal to remove the VOCs, H₂S, SO₂, NO_x, and O₃. It would be nice if the authors could also show the VOCs are efficiently removed down to sub-ppb level while injecting the BC particles into the chamber. Did the authors use proton-transfer-reaction mass spectrometer (PTR-MS) to monitor the VOCs inside and outside the chamber? Since the coating is caused by condensable species from photo-oxidation of VOCs and “close to ambient” condition is an important part of the manuscript, I would suggest the authors add the VOC plot. Besides my major point above, I also have several minor comments. 1) On page 1 in abstract (line 18), “wall loss of primary gaseous pollutants was negligible, . . .”, please add “was negligible compared with the replenish rate by gas exchange”. Because other readers who don’t have gas exchange might also think it is negligible in their chamber, which will cause confusion. 2) On page 3 (line 100), is “polytetrafluoroethylene” PTFE? PFA should be “Perfluoroalkoxy alkane”. 3) On page 6 (line 207), “The transmission . . . were measured using a Fourier Transform Infrared Spectroscopy (FTIR) system”. However, in the following context, the authors are discussing about the UV-Vis spectrum of the Teflon film and acrylic shell. Did I miss something? Or does the authors actually mean “UV-Vis” system? 4) On page 12 (line 444), Fig. 11a and Fig. 11b should be Figure 10a and Figure 10b. Please correct that. 5) On page 13 (line 473, and equation 3), if some of SOA components are not

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very soluble in water, the updated formula in reference (Petters and Kreidenweis 2008) (formula 10) should be used. Otherwise, based on the κ of 0.04, the average molecular weight of the coating material is about 450 g mol⁻¹. 6) This is not a comment but a discussion. In the end of "Section 4", the authors discussed about the relationship between κ and O/C ratio. In the reference (Jimenez et al. 2009), Figure 3 shows at around O/C = 0.5, the κ is about 0.12 for ambient (including Mexico city, Jungfraujoch, Hyytiälä SV-OOA, Hyytiälä LV-OOA) and α -pinene SOA, but about 0.16 for Trimethylbenzene (TMB) SOA. All the cases have larger κ values than reported here (0.04). However in another reference (Massoli et al. 2010), Figure 2 shows the α -pinene and m-xylene SOAs have κ value about 0.14 at O/C=0.5, but TMB SOA has κ value of only 0.04, consistent with the value (0.04) reported here. If we believe the latter reference is correct, does that mean the VOC source in Beijing is more TMB like? O/C could not be used as the only parameter for predicting κ as discussed. This could also suggest the VOC source in Beijing is different from other places, such as Mexico City.

Overall, I think it is a good manuscript. I support the publication of the manuscript after my major comment and five minor comments are addressed. Reference

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Please also note the supplement to this comment:

<http://www.atmos-chem-phys-discuss.net/acp-2017-370/acp-2017-370-RC1-supplement.pdf>

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2017-370, 2017.

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