Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-41-RC1, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Variability in the mass absorption cross-section of black carbon (BC) aerosols is driven by BC internal mixing state at a central European background site (Melpitz, Germany) in winter" *by* Jinfeng Yuan et al.

Anonymous Referee #1

Received and published: 3 March 2020

General comments:

This study presents the mass absorption cross-section of BC and the related parameters based on observation at background site. They showed that clear correlation between coating thickness and mass absorption cross-section of BC. One of the relations between lensing effect and mass ratio of BC was well corresponding with simply relation based on recent simulation study which considered some morphological factors. These main results based on observation measurements are of interest and useful to the community. I found that the measurements were conducted and analyzed

Printer-friendly version

Discussion paper

well carefully. However, some evaluations for factors which concluded as “minor role” seemed to be biased and insufficiently. I felt that measurements and discussions was partly different from that expected in abstract and introduction. I recommend publication of their study after the following expressions are improved.

Specific comments:

1) “Mixing morphology” in abstract and introduction: “Morphology” sets reader expectation for shape factor, such as aggregation or chain, core-shell or non-spherical, attached or coating, and etc. However, this study did not investigate morphology itself (e.g. microscopic observation) and parameters well-relevant with shape (e.g. particle density and light polarization). In discussion, I found that authors used ratio of inorganic to organic in place of morphology, based on previous knowledge. However, as authors mentioned in discussion, ACSM data contains none of single particle information relating external and internal mixed. Also, organic species in a particle and the phase (liquid or solid) of the particle in the atmosphere relates to formation of the morphology. Therefore, it would be impossible in their measurements to infer and evaluate morphology. I recommend to replace the word into direct expression of measurements such as “ratio of inorganic to organic (in balk particles)” simply. For whole manuscript, some “morphology” relating with mixing states should be revised. “mixing morphology” were used in introduction relating a hypothesis by Cappa et al. (2019), but I could not find the word the literature. The word is not general and gives confusion.

2) Introduction explained that maximal MAC depends on particle morphology and size. Although increase of coating thickness of BC can enhance the lensing effect, the lensing effect of atmospheric aerosols would be less than that expected by spherical core-shell shaped particles. In addition, coating thickness and morphology (morphology of individual particles and distribution of different morphological variation of particles) can alter in combination by aging process. These are not independent parameter. Inhibition of lensing effect by morphology and size can affect to not only correlation but also slope of relation between MAC and coating thickness. Therefore, the minor or major

Printer-friendly version

Discussion paper

roles should not be defined by only correlation. The observation period was short. It is unclear that morphological factors in the period changed such to have given variation of the EMAC.

3) All parameters for aerosols seemed to be measured after passing drier in the study. This point should be noted in abstract, discussion and conclusion. For example, hygroscopicity of BC-containing particle depends on coating composition. If the coating thickness strongly affect the lensing effect, the deliquescence relative humidity and growth factor depending on the composition can influence on the lensing effect.

4) I could not understand what specific cause and process was expected to different BC source as factor affecting to MACBC. Coating thickness usually increases with aging process. If MACBC is different according to BC source, the difference will be clearer freshly BC before aging. The coating thickness as shown in Fig. S7 was not bi-modal distribution which often found in urban sites, suggesting the BC observed in the site was almost well-aged. It is not surprising that effect by property of BC core in source decrease with increase coating thickness. I think that discussion of BC source should be mentioned with property of the observation site and the aging level of BC.

5) How was relation of MACBC after denuded BC coating to AAE and diameter of rBC? As commented above, I thought that it would be difficult to evaluate these relations after aging proceed.

Technical comment and minor issues:

Abstract:ãĂĂ As commented in specific comments, abstract should be improved for reader to understand contents which were directly used in measurement and evaluation. The conclusion should be limited adequately for atmospheric condition, considering the method and the property of observation site.

P2L54 “The maximal MAC enhancement factor that can be reached for a particle depends on particle morphology and size, with greater values for smaller particles.” Which

Printer-friendly version

Discussion paper

are these “particle” meaning “BC core/BC particle” or “BC-containing particle”? The sentence sound not right if they are BC-containing particle because particle morphology and size can alter by aging process.

Figure S1: What does mean the “all particles”? I wondered about their inconsistence with sum of BC-free particle and BC-containing particle.

P9L1 “choosing it in this manner ensures bias-free measurements of the coating thickness of uncoated bare BC particles.” I could not understand this sentence until section 2.4.3. (I confused why “uncoated bare BC” have coating?). Also, in this paragraph, “bare BC”, “BC core”, and ”uncoated BC” was used, but their difference was unclear.

P11L309 “Since the MAAP is more robust as an absolute reference,. . .” I cannot agree with this sentence. MAAP measure absorption of cumulative particles on filter. Therefore, the absorption might include more inaccurate lensing effect comparing to that by photo-acoustic spectroscopy.

Table S1, ∼P12L330 Please specify instrument information of SO2, NOx and aerosol concentration, and species measured by ACSM, in Table S1 or section 2.2.

P15L394 Probably, “Fig. 05b” is “Fig. S5b”.

P20LL498 “It is seen that the denuded-MACBC values all fall in the range from 5.6 to 6.0 m2 g-1. . .” However, some yellow dots seem to be >7 m2 g-1, which were probably in gray period of Figure 5. Does the MACBC of denuded BC depend on coating of denuded BC coating?

P20LL461 Although authors inferred short residence time as a cause of incomplete remove coating. However, some residuals such as incomplete charring of organic compounds can also remain after passing denuder at 350âŮęC. The absorption of such charring organics would be slight at 870 nm. However, I think that lensing effect by residuals can appear as some bias of MACBC of denuded BC coating when such residuals presence on BC core.

Printer-friendly version

Discussion paper

P26L616 Sorry If I miss the point. Is upper limit of EMAC are MACBC,ambient/5.8? Which is upper limit of EMAC, MACBC,ambient/5.0 (constant) or MACBC,ambient/MACBC,denuded (time variable)? I recommend to show equations.

P28L668 Which instruments measured the Mtotal and MBC? What particle dose "total" contain? BC-containing particles or whole partilces?

Figure 8 Please remove "BC mixing state" of x-label because of above confusion.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-41, 2020.