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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.

Anonymous Referee #2

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The manuscript is a nice piece of work using innovative combination of up-to-date methodologies to shed light on the properties of rBC in ambient air. In this respect, the study is novel in the field and brings up some interesting results that can be useful for both the modelling and experimental communities.

However, I feel myself a bit uncomfortable with the approach the authors have taken in the followings:

1) While the authors are fully aware that rBC particles in ambient air range in their effective densities from as low as 0.3 g/cm3 (see Page 8 Line 230 and references therein), they arbitrarily set the lowest limit of detection to 0.8 g/cm3, thus giving up a

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sizable fraction of rBC particles in ambient air. This makes their conclusions truncated that need to be supplemented with extrapolation and to some extent speculations. Why did they do this? One might presume that by setting the mobility diameter to 240 nm they perhaps thought that native (freshly emitted) rBC particles having very low effective densities are not relevant in this range?

2) In spite of the fact that several important physical parameters used in this study are derived by subtraction and division of measured quantities that were obtained by fundamentally different techniques (e.g. equations 4 and 5), the authors pay little if any attention to (propagated) uncertainties that can be huge in these cases.

Detailed comments:

Page 2 Line 37 'glacier reduction' is an imprecise term. Reduction in what? length? volume? albedo? and how? Sea ice and snow albedo is also reduced and melt is affected directly (e.g. by albedo reduction) and indirectly (e.g. by affecting radiative balance over reflective surfaces by absorbing reflected radiation)

Page 2 Line 38 Second most important warming agent. There is no consensus yet whether methane or rBC comes second. Reference outdated, please update references and modify the statement accordingly

Page 2 Line 40 'Visibility degradation' is not a major effect of rBC, it is mostly due to scattering aerosols. It is not the human respiratory system that is directly 'harmed', but soot has many adverse health effects (including cardiovascular illnesses, cancer, and even brain damage)

Page 2 Line 44 'other complicated processes': heterogeneous chemistry, including cloud processing is of utmost importance in affecting the mixing state of submicron particles, it should be mentioned separately

Page 2 Line 54 'minimize the estimate'? minimize the error in the estimation. . .

Page 2 Line 82 'substantial presence' please rephrase

Page 4 Line 103 ‘principal’?

Page 4 Line 105 ‘emits incandescence’ please rephrase

Page 5 Line 148-149 flaws in logics: here morphology and properties of BC is preset for the calculations, while the major objective of the study is to determine both

Page 6 Line 165: uncertainty should be reported here since the two parameters are determined by two principally different methods having their own inherent uncertainties

Page 6 Line 171-172 ‘microgram/cm3’ ?

Page 6 Line 175 ‘density’ use plural

Page 7 Line 195 this statement is definitely not true. Bulk non-rBC particles should differ from the coatings of rBC due to differences in chemistry of their formations.

Page 8 Line 243-249 The whole statement is highly speculative (see my comment immediately above)

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