

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## **Comment on acp-2021-351**

Anonymous Referee #1

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Referee comment on "Physical and chemical properties of black carbon and organic matter from different combustion and photochemical sources using aerodynamic aerosol classification" by Dawei Hu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-351-RC1>, 2021

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### **Review of the manuscript titled: "Physical and chemical properties of black carbon and organic matter from different sources using aerodynamic aerosol classification" by Dawei Hu et al.**

The paper describes laboratory measurements of the physical properties of black carbon particles emitted from different sources. The paper is overall well written (with some relatively minor issues as discussed later), and the approach seems quite comprehensive and, for the most part, sound. The results provided by this study are important for the community and I would like to see them published. The paper requires some significant but relatively straightforward revisions, after which, the paper can be most probably published.

#### **General comments**

- A good part of the introduction focuses on optical properties and refractive indices, but then at the end of it, the authors mention that the optical properties are not the subject of the current paper. I would suggest refocusing the introduction on the topic of the paper.
- The excessive use of emphatic words in the abstract/introductions such as "pioneering", "authoritative", "novel", etc. detracts from the undoubted value of the work. I would suggest removing these terms that are just irritating and add nothing to the paper.
- How do multiple charges affect the mass measurements provided by the CPMA and how is that accounted for?
- Results are reported without uncertainties, making comparisons, and the understanding of the significance of the results difficult. Please estimate potential uncertainty bounds (both statical as well as biases) for all the quantities reported or calculated including chemical, morphological, or other physical quantities such as densities, fit slopes, shape factors, etc.

- Some grammatical and tens consistency checks would be advisable (limited examples in the specific comments next).
- References are somewhat scarce and myopic, neglecting some important related work especially on the AAC/CPMA/DMA use, BC morphology, and SP2 signal interpretation. I did not provide too many specific examples below just because there is a lot of work out there that seems very relevant to this study.

## Specific comments

Line 44: "This implies" or "This suggests", how certain are the authors about the following statement?

Line 51: Please provide uncertainty bounds for these values, otherwise it is hard to understand if the later statement (on line 55) on the difference from the 0.75 value might be justified; in other words, is the difference significant?

Line 75: The statement that the absorption coefficient for BC is wavelength-independent is incorrect, the typical dependence, as extensively reported in the literature, is often expressed as a power law with an exponent of about -1 (which is still a strong wavelength dependence, although weaker than that of brown carbon). What is often assumed (but probably also not always true) is that the imaginary part of the index of refraction is wavelength-independent (or at least not very strongly dependent). BrC also has an absorption that is wavelength dependent just with an exponent that is significantly larger, in absolute value, than that of BC.

Line 95: This is an interesting approach but it is hardly pioneering, I would call this incremental in a very positive sense (see, for example, the work by the Olfert's group, or others). I suggest removing this exaggerated adjective and point to existing literature. Same in line 99.

Line 97: How do the authors determine themselves that the method is "authoritative"? That, if true, should be a judgment left to the community.

Line 111: In what way does the SP2 provide information about the morphology? The information is likely limited and subject to large uncertainties. Several papers have been published on the topic, some in contrast with others.

Line 116: Consider rewording "which makes the complexity of the calibration methods" to "which makes the calibration methods complex" or "challenging"

Line 118: Change "corrected" to "correcting"

Line 135 "to to" -> "to"

Line 146: The AAC select aerosol by aerodynamic size; so, aerosol particles passing through it are indeed monodisperse in terms of aerodynamic size, but that does not mean that the output distribution is monodisperse in every size measure; for example, particles of the same mass (and therefore mass-equivalent diameter) could have very different aerodynamic size depending on their morphology. So, the term monodisperse here is ambiguous. And it all depends on the property one wants to measure (for example, absorption mostly depends on mass).

Line 200: How well does an optical size measurement calibrated with PSLs perform on fractal-like black carbon particles? Is the size an optical equivalent to a spherical PSL particle? That should be mentioned as the meaning of "size" for a fractal-like particle is always quite ambiguous (see the previous comment as well).

Line 217: Change verb in the sentence "The instrument operation and data analysis of HR-AMS has been..." to "The instrument operation and data analysis of HR-AMS have been..." for number consistency.

Section 2.1.5: The CPMA, using an electric field, also suffers from the issue of multiple charges as in the case of the DMA, this should be mentioned. Also, what charge neutralizer was used for the CPMA should be mentioned for consistency with the following description of the SMPS.

Line 259: It would be good to provide a reason behind the choice of the denuder temperature set point.

Line 285: Suggest changing "can be" to "to be"

Line 285-286: Do the authors have a more quantitative measure of the aerosol loss rate?

Line 329: How many iterations does the process typically take?

Line 366: Something awkward about this sentence. Maybe "igniting" should be "ignited" or "ignites"?

Line 387: Remove "in" or "during"

Line 476: Just a comment: interestingly, these results seem similar to what was reported by Bhandari, et al. Scientific Reports 9(1): 11824 (2019)

Line 482: I am confused by the potential explanation (2), and maybe I missed something, but I thought at least in some of the experiments that the particles were minimally coated, so how would the size be dominated by organic coatings, also in those cases?

Line 490: This is a very small diameter. How large were the monomers in these BC particles, and how many monomers typically in an aggregate? Were these particles made of only a very few monomers?

Line 501: Maybe replace "improve" with "improving"?

Figure 6: Especially for Aquadag (but it might be slightly visible also in some of the other BC types), there seems to be a slight negative curvature in the graphs (especially visible in the center and right graphs). What is the reason for such a change in slope? One could study these changes of the slope by graphing residuals plots. I believe Aquadag comes already compacted; is it possible that the compacted morphology "shields" the aggregate lowering the incandescence signal at higher masses with respect to what might be expected for not compacted BC particles of the same mass, resulting in the negative curvature?

Lines 510 to 526: These are very interesting results, but uncertainty bounds should be reported to understand how significant these differences are. How the uncertainties (both statistical and systematic) are estimated, should also be carefully described.

Lines 516-521: This means that some organics still coat the BC particles, even if in a small amount, correct? Is it possible that some of this organic would char and generate an incandescence signal like that of BC? See, for example, Sedlacek, et al. Atmos. Chem. Phys. 18: 11289-11301 (2018).

Section 3.2: As mentioned in the general comments, here (as in other places in the paper) a comparison is difficult without having a good estimate of how certain these reported values might be.

Lines 644-645: What does it mean that "the peaks are most dominated in the smouldering phase"? Do they mean "are most dominant in the smouldering phase" or something else? Also, check tense consistency with just a couple of lines earlier

Line 653: "in" in front or "contrast".

Lines 669 – 671: "clear difference... was" or "clear differences ... were" but not "clear difference... were"