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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An investigation on hygroscopic properties of 15 black carbon (BC) from different carbon sources: Roles of organic and inorganic components" *by* Minli Wang et al.

Anonymous Referee #2

Received and published: 5 May 2020

General comments

This paper reports on the hygroscopic properties of 15 different types of black carbon (BC) aerosol particles. Both equilibrium and kinetics of water uptake were measured with various methods. The results indicate a fairly wide variation of hygroscopicity amongst the BC types. These variations correlate with the types of dissolved minerals, organic carbon, and soluble ions present with the black carbon.

Overall the paper is fairly well-written, with some suggested corrections listed below. A few concerns listed below should be addressed prior to publication.

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Specific comments

Throughout the paper, be more specific and clear when referring to "black carbon". For example, in the title of the paper, I think you mean to say something like "15 black carbon types". Adding the word "types" at other points in the manuscript are necessary as well (e.g. line 420). You should also clearly define "soot". Why is it not diesel BC or herbal/woody soot?

Along the lines of the previous comment, I don't think that Line 61 is a completely accurate definition of BC. You reference Bond et al., 2013 in Line 43, so I would assume you would follow their definition. Bond et al., 2013 defines BC as being refractory, insoluble, and consisting of an aggregate of small carbon spherules (among other attributes). Thus, does "BC" really encompass the salts and minerals you mention? (In my opinion, no.)

Again, going back to my first comment, be more clear and specific in your language. You are measuring the hygroscopicity of BC-containing particles from these various sources and your results show how hygroscopicity changes with different impurities in the BC.

Some more details on the 3 soot types should be provided. How long was the household soot on the walls of the oven before collection? How much did this soot have contact with air? In other words, what was the likelihood that other gases not related to the actual combustion were adsorbed to this soot? Please also describe the differences in diesel soot - what do you expect the differences to be simply resulting from collection on a filter versus the walls of the tailpipe? Does the diesel engine have a particulate filter installed? I presume that "# 5" and "# 0" refer to different types of diesel fuel? Please explain.

Line 180 - Please comment on how drying the samples would effect interpretation of your results for ambient BC aerosol.

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Line 183 - How do you know?

Line 227-228 - I do not understand this sentence.

Figure 1 - What are the error bars/uncertainty on each datapoint? You talk about the hysteresis in the plots so it is important to establish that the adsorption and desorption curves are statistically different from each other. Also, the way these are plotted, some of the hysteresis is hard to see anyways. On Line 374, not all BC/soot curves are obviously hysteretic, so please specify here.

Line 327 - The results at 84% humidity are not shown anywhere in the paper or supplemental. Please add.

Line 330 - Is the weak correlation simply due to lower signals?

Line 334 - The OC constituents in which BC type? Can you point to specifics in Table 1 at this point in the paper as well?

Figure 2 - Rather than look at each constituent individually, what about a multi-factor approach, similar to Positive Matrix Factorization (PMF)? If it is always true, for example, that several of your compositional properties are always correlated, then separating them as you do in Figure 2 does not actually reveal any new information. You have plenty of data in this study to feed into a multi-factor analysis, and I think you may learn quite a bit from that type of analysis.

Line 369-373 - This seems like a reasonable hypothesis, but the way this section is worded makes it sound like you came up with the hypothesis to fit the results rather than vice-versa. You could cite some literature here to strengthen your arguments and show how your data supports this claim.

Figure 3 - Please use the same x-axis limits on parts a, b, and c.

Line 429-430 - Please explain the physical meaning behind a second-order model fitting the data better than a first-order model. Why is this important?

Line 458 - Figure 5 shows that EC is also positively correlated, not just total porosity (spelling error there too).

Line 496-500 - Why aren't there active sites at high humidity conditions?

Technical corrections

Line 25 - I don't understand the use of "BC pool" here.

Line 42 - Is recalcitrant the right word to use here?

There are several uses of "this" as the subject/noun in your sentences. Please be more clear in your writing.

There are a few other typos, missing "-s" or "the", missing spaces in captions, etc., throughout the paper. Give it another careful proofread before publication. Be consistent on whether using past or present tense.

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