Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Mixing characteristics of refractory black carbon aerosols determined by a tandem CPMA-SP2 system at an urban site in Beijing" *by* Hang Liu et al.

Anonymous Referee #3

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General comments

This paper reports on SP2 measurements of BC in Beijing in the summer. This dataset adds to the growing inventory of SP2 measurements and has an advantage of incorporating tandem CPMA/DMA/SP2 measurements of ambient BC.

Before final publication, there are many improvements to the writing that need to happen.

First, a full and careful proofreading is necessary to catch all the grammar and word choice errors. I have listed a bunch, but am not confident I listed them all here. In fact, after awhile, I gave up listing them because this was taking too much time. Please

correct these errors before sending out for review again.

Second, there needs to be better quantification of the SP2 calibrations. To give this dataset importance in terms of the big picture, better uncertainties are necessary. The conclusions all sound reasonable as far as I can tell; but they need to be mathematically rigorous as well.

A final big comment, there are many places in the paper that need more detail and clarifications. See my many comments listed below. In general, a better description of the tandem experiments and of the models used to calculate absorption enhancements are necessary. Many other places need rewording for clarity.

Specific comments

Line 21 - Is "enhancing rate" standard terminology? I don't know what the units are (0.013 what per hour?).

Line 21 - Should the "x" be a subscript in "Ox"?

Line 65 - Is the "18.97%" number really accurate to two decimal places?

Line 95 - I don't understand the sentence beginning with "Anthropogenic".

Line 99 - A few more details would be nice on Fig 2a - what is the residence time in the diffusion dryer? Did you check if there were any particle losses in the dryer? When switching configurations, how long did you wait for the sampling to stabilize?

Line 104-105 - Should show error bars/scatter in the data on Fig S1. Also should *quantify* how constant the laser was during the study. Also, be careful of wording - two data points does not ensure that the laser was constant during the study, just that the beginning and end points were similar. Without more data, it even looks like intensity may have been drifting in one direction.

Line 115 - Is it useful? (Don't use "could be".)

Line 117 - Can you estimate uncertainty from your own calibration of the SP2? You should be able to, especially with a CPMA.

Line 121 - Is Fig S2 really necessary?

Line 123 - Is it really necessary to quote the CPMA force balance equation? What does your study do with this equation specifically?

Line 127 - Is the comment about superiority of the CPMA relative to the APM necessary? What value does this statement add to your study specifically?

Line 136 - More precisely, the *peak* LII signal is what is used, not the entire LII signal.

Line 137 - Why did you use a spline fit when earlier you state that there is a linear relationship between peak height and rBC mass?

Figure S3 - Should show error bars showing the scatter in the data and uncertainty in the particle mass from the CPMA. Also, if there is no calibration equation, how do you use these data?

Line 138 - What does "approximately" mean? You should quantify these fits. And be more clear - these are spline fits like in Fig S3? My same comments apply to Fig S4 as above for S3 (include error bars, etc.).

Figure S5 - Again, would be nice to see error bars showing scattering/uncertainty in the data.

Line 152 - Why multiply by 1.17 and not 1.15?

Line 159 - This whole section should probably be edited for clarity. Specifically here, I don't understand "dividing by laster intensity".

Line 161 - Again, clarity - reword "the data before a length"

Line 173 - How did you determine which was the most proper refractive index to use?

Supplemental - What is "RCT"?

Line 182 - To be clear, the M_{rBC} is what is measured by the SP2, correct? Section 2.3.3 needs some work for clarity.

Line 192 - Again, there is no quantification of how well the current study compares with previous studies. It looks like your data points are systematically higher than the polynomial fit by Gysel. You should quantify the relationship and tell the reader what it means for your study.

Line 195 - What is the purpose of Section 2.3.5? Need more details. Where exactly do the parameters going into the Mie model come from? The C_{abs} variables should be defined in Table S1.

Line 202 - What instruments measured the gaseous pollutants?

Line 207 - What measured total $PM_{2.5}$ mass? Was this measurement behind the cyclone? If so, was the cyclone's cut size at 2.5 microns, or something higher? These details might effect your measurement.

Line 210 - Should provide details on the MAAP in the method section.

Line 213 - What do you mean "may be affected by coating"? With the instrumentation you have, you should be able to unambiguously determine if the coatings are the reason for the discrepancy. That analysis could be an important part of this work.

Line 213 - Maybe start a new paragraph with the sentence beginning with "During"? This paragraph is a bit haphazard and should be rewritten probably.

Line 216 - You don't specifically reference the other parts of Fig 3 - you should.

Fig S9 - Need numbers of your scale bars.

Line 223 - Why is June 13 not shown in Fig S9?

Line 223 - To this point, I still don't understand what "the tandem CPMA-DMA-SP2 experiment" is. There are a lot more details and description needed in the Methods

section.

Line 276 - It actually looks like the increase was on June 12, not June 13.

Line 277 - Where does 63% come from?

Line 295 - Do you have any idea the magnitude/emission rate of fresh rBC in Beijing? If so, you could use that number for a closure study.

Line 305 - This sentence is worded as if the Li et al 2003 study took images of the rBC from this study, which is obviously not correct. Were any new microscopy images taken from the current study period?

Line 325 - What ambient measurements? From Peng et al 2016? These effective densities are nothing like what you report in the previous section.

Line 363 - Did you find the large uncertainty? Or did Liu et al 2017? Discuss more.

Line 366 - What is the "morphology dependent model"? I am very confused by the whole Section 4.2.2.

Line 380 - More efficient than what?

Technical corrections

It looks like all of your citation lists are not formatted properly; missing a space.

Line 44 - should be "into the atmosphere"

Line 45 - need a comma after condensation

Line 83-84 - reword: the data are not analyzed in the discussion section, they are presented

Line 86-87 - reword "incandescent signal emissions"

Line 87 - What is "this rule"?

Line 95 - Fig 1b, specifically

Line 104 - reword: the laser intensity is not constant by performing PSL calibrations

Line 148 - unified should be unity; low should be lower

Line 151 - without should be outside

Line 156 - is intracavity a noun?

Line 164-165 - reword "description ... described"

Line 170 - the densities are not defined in the text nor in Table S1

Line 174 - add "respectively" to the sentence

Line 179 - reword

Line 205 - reword

Line 207 - Don't use "this" as the subject of a sentence.

Line 209-210 - reword, I don't think this is actually a sentence

Line 232 - MED or MMD?

Line 242 - combination should be combined

Line 243 - reword

(I've stopped marking technical corrections, though many more exist.)