Atmos. Meas. Tech. Discuss., 7, C3634–C3638, 2014
www.atmos-meas-tech-discuss.net/7/C3634/2014/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessment of the sensitivity of core/shell parameters derived using the single-particle soot photometer to density and refractive index" *by* J. W. Taylor et al.

Anonymous Referee #3

Received and published: 8 November 2014

General comments:

In this paper the authors discuss the effects of assumptions of density and refractive index in the determination of thickness of rBC combining SP2 and SP-AMs data of incandescence and scattering, and applying a core/shell model and Mie model. These analyses are interesting and important in rBC retrievals. However, some aspects of the analysis and discussion are not fully explained or clear to me, and in my opinion they require a significant revision and some addition of information.

The conclusion that a given set of density and refractive index is the most appropriated

is based only in the fitting data of the least coated particles. It would be interesting to add a discussion about the sensitivity to density and refractive index in the case of the most coated particles. A diagram showing the products obtained and the stages of this analysis, including the experimental phase and modeling, would benefit this work and help the understanding of the applied method. The authors should also avoid the excessive use of parenthesis along the text.

Specific comments:

Page 5492, Line 2: "The optical properties and cloud condensation nuclei (CCN) activity of soot depend on the amounts (both relative and absolute) of BC and nonrefractory material in the particles." , you also wrote on Page 5494, Line 48, that "SP2 quantifies refractory black carbon (rBC) mass...". It might be good to briefly mention what is refractory black carbon and how it is relate to the total black carbon content in soot. Also, you should make clear in the text what are the assumptions in the distribution of refractory black carbon inside the particles for the shell/core model, and for each one of the techniques you used: SP2, SP-AMS, and thermal denuder. For instance, when you say that SP2 measures only refractory BC, are you assuming that rBC is present in the shell, core, or both?

Page 5492, Line 17: "This demonstrates that using this technique the SP2 can accurately determine the mixing state (externally or internally mixed) of ambient soot ", Your previous sentence cannot demonstrate what you are claiming. Discuss why or how this is demonstrated?

Page 5496: Line 18: "From 18 May 2010, the SP2, PASS and SP-AMS sampled through a line, alternating every 10 min between an ambient inlet and a line drawn through a thermodenuder" . What is the importance of this date in the whole campaign? Were all data presented in this study taken under the same condition or not? Clarify it.

Page 5497, Line 26: "During CalNex, the tungsten vaporizer was removed and only

BC-containing particles were vaporized". It is not clear why the tungsten vaporizer was removed and neither why you say that "only BC-containing particles were vaporized". What is the temperature that the particles reach in this case? Why do you consider that the part analyzed is only BC-containing?

Page 5498, Line 29: "For the purposes of estimating the shell refractive index (ns), the reported mass fractions are used." What are the "mass fractions" you refer to? Where did you report them?

Page 5501, Line1: "the data presented here were taken after 26 May 2010, when the SP2's detectors were re-aligned." Do you have data from the period where the SPS's detector was not aligned? What is the relevance of this sentence in the context?

Page 5501, Line 23: "this regime is appropriated for externally-mixed BC (i.e. with a single refractive index)". Add at least one more sentence about the meaning of externally-mixed BC and why it is appropriated in this case.

Page 5503, Line 3: "The refractive index of the coating was calculated using the chemical composition of the coating material measured by the SP-AMS." In the section 2.4 (Page 5497, Line 25) the authors also state " SP-AMS [. . .] selectively vaporize BC–containing particles and measure the composition of core and coating". Did you measure composition of core and coating separately? How were these measurements done? What were the results obtained in each case?

Page 5503, Line 10: "By examining the size dependence of these factors, a range of core diameters for which the scattering data was considered reliable was identified." What criteria were used in this identification?

Page 5503, Line 3: ". . .and allowed to vary during the course of the campaign". What was allowed to vary? How?

Page 5503, Line 4: "A number of look up tables were generated for a range of different core and coating refractive indices, and thermally denuded data was used to constrain

the most appropriate core density and refractive index, such that the measured scattering matched the modelled scattering if the cores were assumed to be uncoated". This description is not sufficient for the understanding of your procedure. You might want to say (as a minimum) why and how the data of denuded particles were used to constrain the core density and refractive index. It is not clear how "the measured scattering matched the modelled scattering if the cores were assumed to be uncoated."

Page 5504, Line 26: "In this analysis we avoid this issue by choosing the core diameter range in which particle coatings are considered such that these particles only make up a small fraction of particles, and do not affect derived coating properties. " Even though you say that this will be better explained in the next section, some more elaboration is needed in this paragraph.

Page 5507, Line: 11: Please justify why you chose 80nm as minimum as well.

Page 5509, Line 21: What was assumed for the imaginary part of the refractive index? Why? How important is the refractive index of the coating in your analysis?

Page 5511, Line 12: "For the purposes of this work it is most important to work out the overall uncertainty, not diagnose different sources of it." I disagree with this point of view. Diagnoses of different sources of uncertainty are essential to identify possible systematic errors.

Fig 3: The plot is missing the blue continuous line and it has two blue dashed lines.

Fig 4: Why don't you apply the sensitivity study for a case of most coated particles?

Technical corrections:

Page 5493, Line 17: Consider replacing ", but" by " . In opposition, ...results:"

Page 5495, Line 22: Consider replacing ". . .emissions, and biomass" by " . . .emissions. Biomass burning",

Page 5496, Line 10: Consider writing the meaning of "a.g.l." (above ground level?).

Page 5498, Line 5: Define “m/z” channels.

Page 5498, Line 27: Explain secondary and primary coatings

Page 5500, Line 5: “the variable collection efficiency of the SP-AMS complicated factors”. Please be more specific about what do you mean.

Page 5500, Line 11: define “PANs”.

Page 5501, Line 15: define “SOA”.

Page 5501, Line 24: “. . .this regime is appropriate for externally-mixed BC (i.e. with a single refractive index) < 10-20m3 in volume (equivalent to 267 nm diameter).” The text above is confusing. The authors might consider removing the excess of parentheses and rewrite the information clearer.

Page 5502, Line 16: Specify what “this” refers to.

Page 5510, Line 3: Please remove the “.” after “refractive index”.

Page 5511, Line 21: Explain where the range was discussed.

Page 5509, Line 17: separately.

Fig. 4: Consider changing the legend entry “Recommended by review paper”. You can add the references from where you took the values instead.

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 5491, 2014.