Atmos. Chem. Phys. Discuss., 13, C5781–C5785, 2013
www.atmos-chem-phys-discuss.net/13/C5781/2013/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the attribution of black and brown carbon light absorption using the Ångström exponent" *by* D. A. Lack and J. M. Langridge

Anonymous Referee #1

Received and published: 12 August 2013

1 Overview

This paper describes the procedure to attribute absorption to "black carbon" and "brown carbon," with a view to determining uncertainties in that process. The topic is timely because many investigators are attempting this kind of separation. Authors have produced quality measurement work and analysis elsewhere. I was interested in their perspective about this topic.

This paper contains some promising direction of investigations and it supports the findings with an interesting data set. However I was disappointed in the presentation. I

would recommend publication only after a major overhaul of the presentation with significant improvement to the analysis.

2 Main criticism

The title of the paper is "On the attribution of black and brown carbon light absorption..." That leads the reader to believe that the paper will contain information about the separation between BC and BrC absorption, given a total measured absorption. The paper begins with this promise (first full paragraph p15495), giving the following causes of absorption: BC; coating of BC; BrC; dust. The paper really does not treat dust, and that is acceptable to limit the scope. But after this promise the paper seems to lose its way, and does not return to the central question: How much of absorption is BC, how much coating, and how much BrC? By page 15501 we read, "Given that the primary interest is in determining the MAE of BrC..." which does not agree with my understanding of the goal.

A useful contribution would be providing an understanding of the magnitude of the attribution uncertainty. There now exist several theoretical and experimental studies regarding the absorption Angstrom exponent. The knowledge obtained from these studies appears not to be employed here. For example two theoretical studies are described with range of a_{Abs} of 1-1.7. What conditions caused the range? Can the value be constrained, especially for the experimental data reported in this paper? If the attribution can be improved with some additional measurements, what should they be? Instead the reader gets the impression that these values of a_{Abs} are equally possible. Some guidance should be given based on the authors' expertise. Value of a_{Abs}=0.55 from one study is also treated as equally possible under all conditions. Is it plausible?

The analysis that leads to Fig 3 and Fig 4 could be more straightforward. What is the calculation in Fig 3b? How is the "internal mixing lensing effect" removed? I realize

this is described in another paper but it is not possible to interpret this presentation without understanding it. Is the internal mixing lensing effect included in Fig 3a? The reasoning in the discussion of this figure is roundabout. Just say which values have greater physical evidence to support them and which theoretical models they agree with best. Perhaps a scatterplot would be better for comparing paired values and could replace Figs 3 and 4. Also, isn't there an estimate of MAE for BC– used in the calculation of observed values? How does this compare with inferred MAE for BC?

In sum: authors have access to a lot of information that is not being exploited here, which could provide recommendations for how to separate black and brown carbon absorption using Angstrom exponent, or whether one should do it at all.

3 Other comments

Intro to section 2: Authors imply that any two wavelengths will suffice for this method. Certainly one must make some choice of a wavelength where only BC absorbs.

Page 15496. Line 19. "Additional absorption... was added... also assuming a_{Abs}=1". Doesn't this contradict authors' earlier statements that coating could change a_{Abs}– perhaps they should use Mie theory to predict this? Then "additional absorption due to BrC was represented..." It seems that authors are describing the construction of an absorption spectrum– NOT illustrating absorption decomposition. Later they go to the decomposition, but this is less clearly explained.

Page 15496. Line 22. "Other more complex multi-wavelength methods..." Please describe some of them briefly. A reader might wonder if the method described here (whose uncertainties are pointed out) is sufficient, and might benefit from learning about the other tricks.

Page 15499. Line 10. "to achieve an uncertainty..." Most analyses are not trying to

achieve large values of uncertainty. Why not say what the uncertainty is for different relative values of BrC. This could be a useful figure.

Page 15500. Line 4. "The actual MAE..." A calculation is not an actual MAE, but an inferred or calculated one. Are particles assumed to be spherical? How does that assumption affect the calculations?

Page 15501. Line 16. "...is likely an indication of a fundamental methodological problem with the a_{ABS} approach." Overstated. It probably just means that a_{Abs} isn't that high (>1).

4 Writing

The language is imprecise throughout, and unfriendly to a reader. An example of unfriendliness is the last paragraph beginning on p15495, and last paragraph in Section 3. Reading is difficult because of all the parenthetical statements. Examples of imprecision are use of "lower wavelength" (p 15496 line 12)– "shorter wavelength" is OK but lower could mean lower energy which is the opposite. Another one is calling Figure 1 a "schematic". Figure 1 is an illustration, not a schematic. Schematic diagrams show physical or calculation flows. Please have one or more colleagues proof this paper.

5 Terminology

The terminology for exponent is multiplying. Here a small "a" is used sometimes and "å" other times. Kirchstetter (2004) used α which doesn't explicitly identify absorption, and so is confusing because there is also wavelength dependence of scattering. Moosmuller (2011) used AAC. Bond (2001) used $å_{ap}$ presumably standing for Ångstrom and absorption. Bergstrom (2007) used AAE. I wish the community would get some con-

sistency but at very least, authors should not introduce yet another term, when there is other literature predating; or they should state a reason for their choice.

Another issue is the MAE. Authors use this term to refer to brown carbon without any subscript. But MAE or MAC is used a lot to refer to BC.

Other awkward uses are BC_{Int} (why not use at least BC_{Ext} and BC_{Int}), and the sudden appearance of m(NR-PM).

The last paragraph on p15501 (continuing to next page) is really difficult to read because of all the new definitions of MAE.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 15493, 2013.