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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Sources and light absorption of water-soluble brown carbon aerosols in the outflow from northern China" *by* E. N. Kirillova et al.

Anonymous Referee #1

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A nice paper that presents interesting data on the levels of brown carbon measured in aerosols based on spectrophotometric measurements of filter extracts from a region with a range of aerosol sources. The topic is of interest and the paper appropriate for this journal. I suggest publication after some editing to improve clarity (ie, use of terminology) and a more complete analyses that makes use of more current published work. Issues are discussed in more detail below.

The WSOC is referred to sometimes as WS-BrC and at times just WSOC. It is not clear what the difference is. Consistent terminology would be helpful. Also, stating it as WS-BrC suggests that all the WSOC is light absorbing, which seems not true.

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Is the measured light absorption in the extracts correlated with WSOC concentration? I would think this is an analysis worthy of investigation and discussion.

Pg 19629 line 13, was the triplicate analysis just analytical or were three separate sections of the same filter analyzed?

Section 3.2 is confusing. Rewording, especially the last line, may help clarify things. For example, is the last line of this section stating that recorded WSOC concentrations, averaged over the study, or averaged just during the pollution event were both similar to measurements in Chinese cities?

Section 3.3 on AAE. Various AAE values are reported from other studies, all being filter-based and also all of similar values. However, recent measurements (Zhang, ES&T, 47, pp3685, 2013) show that online systems measure lower AAE values, possibly due to differences in the dilutions used in the extraction/analysis methods. How does this affect the results and subsequent radiative forcing calculations?

Page 19633 discussion of AAE. It is does not seem to be stated how good the fit was for the AAE linear regression. That is, does a power law explain the brnC absorption vs wavelength sufficiently well over the analyzed wavelength range?

Page 19633 line 23, what is recipient-intercepted? Also later in the text, the meaning of the term recipient is unclear.

Page 19634. Regarding the arguments relating to possible bleaching versus different MACs for different sources. It is known that different sources have different MACs, as pointed out in the paper, but concluding that the data suggest bleaching is less clear. For example, the MACs reported by Cheng, as noted in this paper, were 0.7 m2/g within Beijing in summer, somewhat lower than what was observed in the pollution event in air masses great distances from Beijing (the opposite should be observed if bleaching). Why would that be? Furthermore, lower MACs with aging may simply be due to formation of addition WSOC over time that is not brown and have nothing to

ACPD

13, C5459–C5462, 2013

do with bleaching. Mixing of air masses with WSOC of lower MACs with the Beijing plume would also lead to lower overall WSOC MAC and not be due to bleaching. The isotope data discussed later in the paper does, in a general sense, indicate that the WSOC is more chemically aged, which is expected, but again this does not prove bleaching. What seems to be needed is some analysis (eg, possibly a correlation) between the isotope data, which indicates aging, and MACs, for particles of roughly the same source and without significant SOA production or dilution during transit, which is just not possible. In summary, bleaching may be possible, but it is not at all clear from this data set.

Section 3.4, what is meant by biomass carbon? Is this biomass burning, solid particles of plant material, SOA from biogenic VOCs, or all of these? In this section it is also referred to as biomass/biogenic. Please use consistent terminology.

Pg 19635, line 8, typo in line; except for the dust episodes, when then biomass contribution was larger.

A number of points regarding the radiative forcing calculations. 1) The effects from water-soluble-brown carbon seem reasonable (although this depends on what BC MAC is used), but the water-soluble component of brown carbon is only a fraction of the total brown carbon. Other research shows that it can be roughly one-third the total BrnC. Including all brown carbon would likely make the prediction of brown carbon forcing relative to BC forcing unrealistically high. Any thoughts on why this would be? 2) The calculation uses the MAC, WSOC concentration and AAE for WS-BrC, which all introduces error. Why not just use the actual absorption data for the BrC calculation instead of going in circles, ie use data to estimate MAC and AAE, use MAC and AAE to go back and estimate light absorption? Then the error discussed in Supp. Material on line 103 regarding the applicability of the AAE over a wide wavelength range would not exist. 3) What is the justification to assume that the bulk light absorption data (ie, in a filter extract) can be directly applied to calculate light absorption by aerosol particles? Some studies have used small particles limits; more recent work has measured ambient BrnC

ACPD
13, C5459–C5462, 2013

size distributions.

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