Atmos. Meas. Tech. Discuss., 5, C1718–C1721, 2012
www.atmos-meas-tech-discuss.net/5/C1718/2012/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Assessing recent measurement techniques for quantifying black carbon concentration in snow" *by* J. P. Schwarz et al.

Anonymous Referee #2

Received and published: 3 August 2012

Review of "Assessing recent measurement technique for quantifying black carbon concentration in snow" by Schwarz et al., submitted to Atmos. Meas. Tech. Discuss.

General comments:

This paper presents evaluations of the two recent methods for the measurement of BC concentration in snow. One utilizes the Single Particle Soot Photometer (SP2) and the other does the Integrating Sphere/Integrating Sandwich Spectrophotometer (ISSW). For the SP2 method, authors found that the efficiencies of the nebulizers used in this study and previous studies are strongly dependent on the size of the particles

in liquid samples. Authors also indicated that BC particles in snow tend to be larger than typically observed in the atmosphere, which brings about larger uncertainty of the SP2 calibration (and possibly for ISSW). These findings are very important considering recent increasing usage of the SP2 for measurement of BC in water samples.

However, discussion on the estimate of the measurement uncertainty is not clear as detailed below. They should be fully explained before this paper is considered for publication.

Major comments:

1. The descriptions of the critical parameters of the nebulizer are unclear, especially for the paragraph on page 3777, Line 7-18.

a) Here only a relative efficiency is shown (Figure 1). The procedure to derive absolute efficiency should be provided, including mathematical formulations. The use of stopping distance and effective density should be related to the efficiency in a more understandable way.

b) The efficiency for BC should be shown in the same way as for Figure 1. After all, what matters is the efficiency of BC.

Page 3778 L5-26. The authors assume that the nebulizer efficiency depends on particle stopping distance, and convert the PSL-based efficiency into the efficiency for BC. In that case, the figure of relative transmission efficiency for BC as a function of BC diameter (VED) should be shown, corresponding to Fig. 1 (the efficiency for PSL as a function of PSL diameter). How different are the size-dependent efficiencies between for PSL diameter and for BC diameter? Moreover, the authors adopted the effective density of BC of 0.8 g cm-3 by averaging six BC materials in Moteki and Kondo (2010), but the value of fullerene soot (the same laboratory standard of this manuscript) in Moteki and Kondo (2010) is 0.5 g cm-3 and that of ambient BC in Tokyo is 0.3 g cm-3. The uncertainty of the assumed effective density of BC would lead to the uncertainties of the estimated size-dependant nebulizer efficiency for BC and determined mass concentrations of BC in snow. These uncertainties derived from the assumption of the effective density of BC should be explained.

Page 3777 L7-11, in relation to a) and b). If the size-dependence of the nebulizer efficiency is due to the aerodynamic properties of the PSLs with the different diameters after the droplets evaporation in the nebulizer, the description "this efficiency was of order 1 ug-liquid cm-3 for 505nm PSLs" (L11) is somewhat confusing because "how much liquid the nebulizer aerosolized into a given volume of air" (in L9) may not depend on the size of the PSLs. Possible reasons for the size-dependence of the nebulizer efficiency should be mentioned clearly, and the efficiency of extracting PSL particles from liquid to air (i.e. to the SP2) should be quantified or explained in an appropriate way (e.g. the number fraction of the extracted particles to the total nebulizer-induced particles).

2. Biases to the ISSW measurements are discussed, including non-BC light absorbing and purely scattering particulate in water. In this paper, the shift in the BC size in snow is discussed. However, the effect of this shift on ISSW measurement is not discussed. It should be estimated.

3. This paper is aimed to assess the two measurement techniques. However, no inter-comparisons using the snow samples collected by the field campaigns are shown. This inter-comparison provides overall uncertainties of the two techniques and therefore should be included.

4. Page 3785 L9-18. The authors reports that the most contaminated dust in samples is equivalent to 15 ng-BC/g-H2O. What is the approximate BC-equivalent size of these dust particles? Is it possible that some large BC particles which the authors observed in Fig. 2 are artifacts due to the contaminated dust?

Page P3785 L9-18. The offset due to the contaminated dust (15 ng-BC/g-H2O) looks "small" (in L9 and P3787 L18) when considering the higher BC concentration (up to

about 1200 ng/gr) seen in Fig. 3. However, BC concentrations in many snow samples in previous studies are lower than 100 ng/g, and much lower than this for some arctic or mountain site snow samples. The lower the BC concentration in snow is, the larger the uncertainties due to dust will be. The offset indicates that previous studies using a SP2 for measurement of BC in snow and ice may overestimate BC concentration for highly dust-contaminated samples. I would suggest mentioning these points.

In relation to this point, the comparison shown in Figure 3 is made for the BC size ranges far exceeding the concentrations encountered in natural environment. The figure and discussion should focus on the BC range below 200 ng/g.

Minor Comments:

P3773 L4-5. Some papers are not included in the reference list.

P3776 L9-10. What is the volume flow rate of the peristaltic pump? How much total sample volume is required for the analysis of typical snow?

P3778 L11. Moteki and Kondo (2011) should be Moteki and Kondo (2010)

#P3779 L26. sonewhat should be somewhat

#P3783 L19-24. The range of BC concentrations for laboratory experiments also should be mentioned here.

#P3789 L21-26 The order of the references is incorrect.

Figure 3. The unit of the X-axis should be ng g-1, to be consistent with the text.

Interactive comment on Atmos. Meas. Tech. Discuss., 5, 3771, 2012.