

Interactive comment on “Influence of the melting temperature on the measurement of the mass concentration and size distribution of black carbon in snow” by T. Kinase et al.

Anonymous Referee #1

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General comments:

The paper reports results from a study of the effects of melt temperature and the amount of time over which a snow sample is melted on the mass and size distribution of BC in one set of new-snow samples and one set of aged-snow samples. The study is conducted using SP2 measurements of BC mass size distributions.

The scope of the study is somewhat limited. However, given the growing use of the SP2 to measure BC in snow samples, and the challenges of doing so – e.g. as noted by Schwarz et al. (2012) and Lim et al (2014), both referenced in the manuscript – I believe it should be published, and AMT is certainly the appropriate journal.

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The paper is understandable as-written but would benefit from editing by a native English speaker. The Conclusion section in particular is in need of editing for clarity/flow.

Specific comments:

1.) Section 1, pg 3 paragraph starting on line 6 notes that previous studies have melted snow samples by heating in a microwave and by heating in a warm-water bath. The stated goal of the study is to test whether these approaches affect the size distribution and mass of BC in the melted snow sample. However, the study only tests for the effect of using different temperature water baths. There are no measurements of snow samples melted in a microwave oven. Tests would need to be done to see whether it matters, for example, if the snow is microwaved just long enough to melt the snow or long enough to actually warm the snow meltwater much above freezing. As no such studies are done, the authors should be clear that the results presented only apply to samples heated in a warm bath. This point should be made in the conclusions.

2.) pg. 4, lines 26-27: “Inhomogeneity in each snow sample was estimated with the standard deviation of measurement results for these three bottled samples melted at a same temperature.” Then again on pg 7, lines 7-8, it is noted that three samples are used to determine error bars. An n of 3 is not sufficient to calculate a standard deviation. An alternative possibility: Instead of showing error bars in the figures using standard deviations for 3 samples that the relevant figures simply show all three values as, e.g., dots. Similarly, on pg 6, line 23 and in Figure 5, it is not clear if the error bars are again standard deviations of n=3 tests. If so, again, I think these should not be presented as standard deviations but instead show all three data points, as well as the mean. If it's not from n=3 tests, what is it?

3.) pg. 5, lines 15-17: snow melt-water samples were aerosolized with “a concentric pneumatic nebulizer (Marin-5, Cetac Technologies Inc., Omaha, Nebraska, USA), with a peristaltic pump (REGRO Analog, ISMATEC SA., Feldeggstrasse, Glattbrugg, Switzerland)”. Schwarz et al. (2012) and Lim et al. (2014) have demonstrated variable

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efficiencies for getting BC into the SP2 from liquid samples using different nebulizers. Was the efficiency of the system used here tested/quantified? If there is poor efficiency at larger sizes this could affect the conclusions about the change in total BC mass with heating temperature/rate. This is an important point that must be addressed, or at least acknowledged as a source of uncertainty in the study.

4.) Figure 1 & Table 1: I don't think Figure 1 is really needed. In the context of this study what is important is that the samples were of new and aged snow. No statement is made about how the geographic location of the samples might affect the study, so I would delete this map and just give the lat/lon of the sample locations for the interested reader. This is currently done in Table 1. The information contained in Table 1 is mostly also in the text. I think this information should be provided either in a table or in the text, but not both, given the brevity of this study/paper. My suggestion would be to delete both Figure 1 and Table 1, and simply include the relevant information in the text.

5.) It is not at all clear what the SO₄, NO₃ and other chemical analyses add to this study. They do not provide any information regarding whether or why the BC concentrations and size distributions are affected by the heating temperature or melt time. All reference to these analyses should be removed from the paper.

Technical corrections:

6.) Section 1: References to Bond et al. (2012) need to be corrected to Bond et al. (2013). This correction also needs to be made in the References list.

7.) pg. 2, lines 15-16: Bond et al. (2013) also provided a central estimate of 0.04 W/m², not just a min/max.

8.) pg. 4-5, Section 2.2: Multiple references to "grass bottles" need to be corrected to "glass bottles"

9.) pg 6, lines 14-16: "Figure 4 shows the size distributions of the 30 BC mass ratio of the 70 °C melting sample to the 5 °C melting sample, indicating that the ratio system-

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atically decreases with the decrease of the BC particle diameter.” Suggest rewording to: “Figure 4 shows the ratio of BC mass in the samples heated to 70degC to those heated to 5degC, as a function of BC size. This shows that the ratio is lower for smaller particle sizes”.

10.) pg. 6, lines 18-20: “...considering that the Hakusan sample was more aged and that it contained more pollutants such as SO₄²⁻ and NO₃⁻ in comparison with the Shirouma sample.” The Hakusan sample didn’t only have higher SO₄ and NO₃ concentrations – it also has more than double the BC concentrations, as shown in Figure 3. Why not just state this directly?

11.) pg. 8, lines 25-27: “These results indicate that the decrease by the heating to high temperature can occur not only during the snow melting but also during the storage in the liquid phase.” This statement needs to be modified: the decrease in mass was not for samples that were simply stored in liquid form, but that were heated to 70deg C (which is very warm, and so not a temperature samples would encounter simply by being stored at e.g. room temperature).

12.) pg. 8, lines 28-30: “In the melting time experiment, the Hakusan and Shirouma snow samples in the 30 cm³ bottles were melted for about 2 hours, and those in the 500 cm³ bottles were melted for more than 6 hours.” This wording, and the discussion that follows, implies that this study was about the bottle size, not the amount of time it takes to melt smaller vs. larger snow samples. This sentence should be reworded, e.g. to: “The effect of melting time was also tested using the Hakusan and Shirouma snow samples. Sub-samples of each of approximately 30 cm³ took about 2 hours to melt at 1deg C, whereas samples of approximately 500 cm³ took about 6 hours to melt.”

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