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Atmospheric Measurement Techniques Discussions

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.

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The authors thank the reviewer for his/her comments helpful and useful for improving our manuscript. Replies to each comment are shown as the followings:

1.) The study size is very small. Snow samples collected from two locations only were analyzed. And, three replicates of each procedure were analyzed. The results for the two samples locations varied significantly. This would suggest that a more systematic study is clearly needed to quantify the loss as a function of melting temperature as well as snow conditions. The authors should state this.

(Ans.1)Following this comment, we have modified the manuscript to include this state-

ment in the conclusion section.

2.) The study is somewhat limited in that the samples are melted in "specific temperature" water baths. If the sample is large enough, it is possible that the actual temperature of the sample does not rise to the temperature of the bath. This is relevant to techniques which use larger sample volumes and filtering techniques (eg the University of Washington technique as well as the technique described in Schmitt et al: http://www.the-cryosphere.net/9/331/2015/tc-9-331-2015.html).

(Ans.2)It would take very long time to melt a large volume of snow sample, as used in the filtering techniques, especially at a low temperature as recommended in this study. This long melting time could affect the BC measurement result as shown in the melting time experiment. This is one of the reasons why the SP2 technique is more adequate for measuring BC in snow. We have modified the manuscript to show this. If a large volume sample would be melt at a high temperature, a considerable part of the sample would be heated near the container wall, the BC decrease could partly occur.

3.) The article could benefit from editing by an English language expert. There are numerous statements that are either grammatically incorrect or awkward and it is necessary to clear up those issues before publication.

(Ans.3)Following this comment, the revised manuscript has been edited by an English language expert.

4.) Did the authors quantify dust at all? The aged sample is likely to contain a lot more dust than the fresh snow sample.

(Ans.4)We did not measured dust in the snow samples in this study. This comment suggests us that dusts in snow may cause the BC decrease by adsorption on their surface. This is only speculation, and a systematic study is necessary to understand a role of dusts. We have modified the manuscript to show this.

Minor items: Thanking these reviewer's comments, we have modified the manuscript.

Page 1 line 18: Change “time conditions” to “amounts of time”. Line18: remove “its”. Then line 19 change “distribution” to “distributions” Line 20: change to “The experiments where the melting temperatures were varied. .” Page 2 line 1: change “or in a long time” to “or over a long time period” Note: After the abstract, I won’t address each grammar error individually. Line 11: it should also be noted in the publication that albedo changes can lead to significant changes in timing of snow melt therefore affecting water supply, therefore BC on snow isn’t solely a climate issue. Line 21: light “transmission”, not “transparency” Line 23: the second “technique” (not“one”) Page 3, line 5: There have been a few intercomparison studies between techniques (Schwarz et al, 2012). It might be of value to mention these studies and a brief summary of their uncertainties in order to further support the need for understanding all aspects of the techniques. Page4, line 10: instead of “it was”, “the snow samples were” Page 6 line 17: consider changing “presumably depends”to “could depend”. Page 7 line 30: use “after” rather than “since” Page 8 line 1: On successive days, were the samples stirred or shaken? (This is stated in the conclusions, but should be stated earlier) Page 3, Line 6-31: The authors comment several times about the melting of snow samples using a microwave oven. Clearly the process of melting is somewhat different using a microwave oven versus using a warm water bath. The study only involves using a warm water bath for melting. This should be stated.

(Ans.5)In this study, we used water bath in order to specify the melting temperature because it is difficult to control and specify the temperature when we use a microwave oven. Because melting using a microwave oven heats the snow sample at temperatures significantly higher than room temperature, it could influence the BC measurement. We have modified the manuscript to show them.

Page 5, lines 29-30: Can you speculate as to why the uncertainties in the Hakusan samples were so much larger than in the Shirouma samples?

(Ans.6)The higher uncertainties in the Hakusan sample would be mainly attributed to a larger inhomogeneity in the sample. The Hakusan sample was aged, and the

snow grain size was much larger than that of the Shirouma sample, indicating that the Hakusan snow had experienced the partial melting and re-freezing of snow. Redistribution of impurities in snow probably occurred during these processes to increase their inhomogeneity.

Line 25: Looking at the graph in Figure 5, it seems that the substantial loss begins around 150 nm rather than 300.

(Ans.7)As pointed out by the reviewer, the substantial loss exceeding 10% begins around 186 nm. However, the loss found between 186 and 324 nm is also significant, exceeding a random error range as shown in Figure 5 (Figure 4 in the revised manuscript). We have modified the manuscript to show them more clearly.

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