

## ***Interactive comment on* “Brief communication: An alternative method for estimating the scavenging efficiency of black carbon by meltwater over sea ice” by Tingfeng Dou et al.**

**Tingfeng Dou et al.**

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- Response to reviewer1’s comments: We thank the reviewer for a helpful review. The reviewer’s comments have guided further improvements in the logic and statement, making this work more rigorous. A detailed response follows below.

This study presents a new and efficient technique to determine the meltwater scavenging efficiency of black carbon in snow overlying sea-ice. Simply, the concentrations of BC within a melt-refreeze layer and within the overlying snow are compared, and the assumption is adopted that BC and ice have been conserved within these two layers during the melt event. Conservation within about 7

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General issues: - It is a bit frustrating to have to refer to supplementary figures and tables for a 'Brief Communication'. This may indicate that the material should instead be presented in a standard paper rather than a brief communication. Alternatively, could the supplemental figures (especially S2, which I think is important for conceptual understanding of the technique) be worked into the main body of the paper?

- Response: Thank you for your suggestion. The supplemental figures and tables have been merged into the main body in the revised MS. A 'brief communication' has also been changed to a standard paper since the revised MS beyond the volume required by a "brief communication".

- The abstract (and manuscript, generally) should acknowledge more clearly that the technique requires the presence of a 'melt-refreeze ice layer', or some term that is similarly precise. Although the abstract refers to sampling of an "ice layer within the snowpack", it is not clear until later what the nature of this ice layer is, and confusion arises especially because the previous sentence refers to sea ice. Furthermore, a re-freeze layer will not always exist, for example when persistently warm conditions cause complete meltout of thin snow layers, and this limitation could perhaps be acknowledged more clearly.

- Response: We have clarified the melt-refreeze ice layer that formed by refreezing of the snow meltwater within the snow cover in the revised abstract and MS. A discussion of the limitation in this technique is included in the section of "Results and discussion", please see details in L187-206 in the revised MS.

- The applied technique also assumes that the refreezing process does not preferentially exclude BC, i.e., that the BC concentration in the ice layer will be identical to that in the melt water. Please comment on this assumption, how it could affect the utility of the technique, and any observational evidence you have that can shed light on this matter.

- Response: In theory, melt-water can release some BC impurities during freezing,

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resulting in less BC mass concentration in the melt-refreeze ice layer than in the melt-water. However, we have no observational information about this process, so we cannot give a quantitative discussion about it in this study. We make a discussion about this uncertainty in the section of “Results and discussion”, please see details in L200-203 in the revised MS.

- Abstract, line 20: "It is concluded that MSC exhibited a regional difference in the western Arctic during the sampling period" - These differences are not very large, however (i.e., they are all substantially less than 100

- Response: Thank you for your suggestion. We downplayed the regional differences in the revised abstract and MS, and some statements that emphasized the significance of regional differences were removed. The observed differences in MSC may be due to the different particle sizes and hydrophilicity of BC particles in different regions. We add a discussion about this point in the revised MS (See L177-179).

- The grammar and writing in general should be proofed by a native English speaker prior to publication.

- Response: The grammar and writing have been proofed.

Please also note the supplement to this comment:

<https://www.the-cryosphere-discuss.net/tc-2019-147/tc-2019-147-AC1-supplement.pdf>

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-147>, 2019.

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