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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Specifying light absorbing properties of aerosol particles in fresh snow samples, collected at the Environmental Research Station Schneefernerhaus (UFS), Zugspitze" *by* Claudia Linke et al.

Anonymous Referee #2

Received and published: 8 February 2019

Referee Comments for: "Specifying light absorbing properties of aerosol particles in fresh snow samples, collected at the Environmental Research Station Schneefernerhaus (UFS), Zugspitze"

General Comments:

This manuscript presents a novel method for concurrently measuring the rBC mass-concentration and total aerosol absorption in snow. The authors find a discrepancy between the SP2-measured rBC concentration and a calculation of rBC concentration

that is based on total aerosol absorption and a fullerene-standard's MAC. The former being smaller than the latter, the authors conclude the likely presence of non-rBC absorbing aerosols in the snow. WIBS measurements indicate that the larger of these non-rBC aerosol are predominantly of biological origin. These results are both interesting and important, as the presence and properties of light-absorbing aerosols in snow and their impact on snow/ice melt is not presently well understood.

Overall, the methodology of the measurements seems sound, and the text contains all of the necessary information to understand the experiment. I have four main concerns, three of which are science-related, and one regarding the writing. These can be found in the 'Specific Comments' below. I believe that once these things are appropriately addressed, the manuscript deserves publication in ACP.

Specific Comments:

My first concern is that this study's calculated MAC for fullerene soot is quite high compared to other literature, which typically put it around 7 m2/g or so. The authors acknowledge this, but I don't feel they explore (at least in the text) the underlying cause sufficiently. As this is at least somewhat dependent on the size of the fullerene particles, I suggest that the fullerene standard's size distributions be added to Figure 8.

Second, the authors don't estimate the percentage of rBC in snow that is above the detection limit of the SP2. Again, the authors acknowledge the issue, beginning on line 278, by stating that the SP2 only detects rBC up to 500 nm VED, but then rather simply declare the mass beyond this as small. The size distribution in Figure 8 indicates that there is still non-negligible mass above 500nm, and exactly how much can easily be estimated using a lognormal fit to the distributions. I attempted to estimate this by extracting data from the plot (see my attached figure), doing my own fit, and calculating percentage of area under the curve that is above 500nm. . .I get about 10%. Furthermore, its highly doubtful that the SP2 is detecting with 100% efficiency below 60-70nm or so. This probably has a smaller effect on the total rBC mass, but including

that data in a lognormal fit could skew the fit result. If I do the same fit, but only use the size. distribution data between 70 – 500 nm, I come up with ∼13% of the mass above the detection limit. Of course, this is just an 'eyeball' estimate on my part, and may be off by a bit. I suggest the authors do a more careful check and add the details to the text.

Ideally, the gain on one of the SP2's incandescent channels should have been set so as to extend the detection limit. The fact that it wasn't does not necessarily damage the story the paper is telling, in my opinion. . .but nevertheless, more care should be given to estimating the effects of this. Ultimately, the SP2-determined rBC concentrations presented in the manuscript are more appropriately viewed as low-bounds until corrected for the undetected rBC mass. Note also that accounting for the undetected rBC would bring the SP2-determined concentration and the PAAS-3L calculated-concentration into better agreement.

Third, on Line 192: The concentration of the PSL standard is higher than I'm comfortable using for my own Marin-5+SP2 setup. . .I wonder if there was any evidence of multiple PSL particles existing within a single SP2 trigger? This could affect the efficiency calculation. It's easy enough to look through the raw SP2 data and confirm that this isn't a common occurrence for their data. I'm not claiming that I expect that there is a major issue, but simply that it should be looked for when using concentrations that high. Further, the authors do not include the size of the PSLs. . .this should be stated.

Finally, in general, the writing needs some 'smoothing', as certain word choices and sentence structures don't flow as well as they could. I would recommend a careful proofreading.

Technical Corrections:

General comment: I see no need to continually put 'fullerene' in parenthesis

Line 56: extend -> extent

Line 64: I don't like the phrasing "should be" in this circumstance. I'd suggest something like "The authors determined albedo values of only 0.5-0.7 for the ultraviolet and visible range, substantially lower than the 0.97-0.99 that is typical for clean snow [include a citation]"

Line 67: "Most Himalayan glaciers as glaciers. . ." - > Should this be "Most Himalayan glaciers and glaciers" ?

Line 74: smooth wording of sentence beginning "In the last decade. . ."

Line 96: analyses -> analyzes

Line 118: remove word 'used'

Line 207: the authors use the word 'daily' twice in quick succession. Again, smooth the writing here

Line 221: depending -> dependent

Line 225: the phrase "it turned out" is too colloquial for a scientific paper

Line 268: remove the word 'used'

Line 282: please add the word 'these' to specify that this statement isn't generally true (for instance, in the case of snow that has experienced freeze/thaw), i.e. "Thus, the majority of the rBC particles in these fresh snow samples have. . ."

Line 322: The use of the word "therefore" is not appropriate here. Recommend rewording.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1307, 2019.

NOTE: Black 'plus' symbols are just my best attempt to extract the Size distribution data from the authors plots might be off a bit, but doesn't affect my point.

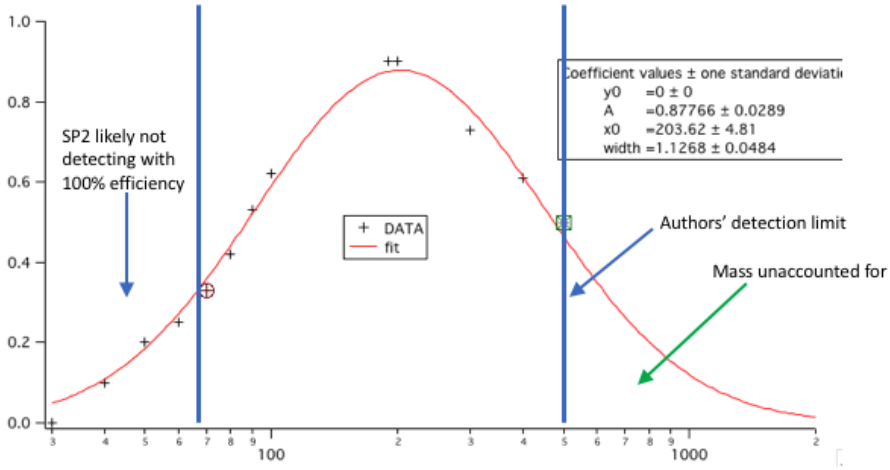

Fig. 1.