Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-785-RC3, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Vertical profiles of light absorption and scattering associated with black-carbon particle fractions in the springtime Arctic above 79° N" *by* W. Richard Leaitch et al.

Anonymous Referee #3

Received and published: 26 November 2019

The paper is dealing with the very important topic of the vertical distribution of black carbon and vertical profiles of optical properties. Such measurements are still rare and urgently needed to answer the important questions connected to Arctic warming. The paper is based on a valuable data set which was analyzed in detail and complemented by model results. However, I miss some interpretation and real conclusions. The plots are mainly described by the authors but interpretation is sparse. The structure of individual sections could be a bit clearer, e. g. by introducing subsections. Thus, some more work needs to be done before presenting this valuable dataset to the scientific community. Overall, motivation and conclusions are not clear to me.
The paper needs to be checked also for consistency, different symbol or better different

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Discussion paper

indices are used for the same variable if I understood correctly.

Comments in detail:
Introduction:

Various literature is given, missing articles are already mentioned by other reviews, thus I don't want to repeat this now. But I miss a clear motivation for doing this study. What is the open question after all these publications and experiments in the past? This has to be given in the introduction to arouse the interest of the reader.

Methods:
Obviously, there was no dryer used in the aerosol line? Was there any measurement of rH in the inlet line? Even small changes at low rH may cause changes in particle absorption, in particular in clean environments (Düsing et al., 2019).
Line 140 ff. What was the filter medium used in the absorption photometers? How was the correction done? This is a very sensitive part of the data analysis in the Arctic.
Line 170 ff. Why was the volume compared? The surface area is more relevant for optical properties.
Line 193 ff. Was there any correction for losses in the sampling line or inlet? It is just mentioned that coarse particles are collected less effectively, but this should be taken into account for the analysis.
Please check the symbols: the scattering coefficient is named with the index scat or sp or are these different parameters.
Mie model: Do I understand correctly that no measurements of aerosol number size distribution are used? Why?

Results:

Figure 1: I see only one star, figure caption says “stars show the center. . .”
Figure 3: Figure caption contains < 2 μm, while axis and text say > 2 μm. I assume the latter one is correct. Are the zero-like number concentrations at the ground stations realistic or could this be also a result of inlet losses?
Line 275: is σ_{spt} the same as σ_{sp} ?
Line 284 ff. Why is the MAC observed here so different from any other Arctic studies? This should be critically discussed.
Figure 8 and 9: Model results: why do the model results show these structures? This is not really clear from the plot and text. Please explain!
Most of the figures are just described, I miss some more interpretation. Although the fact that the model does not generally underestimate BC, it is mainly in higher altitudes. This is an important fact and shows that the transport of anthropogenic pollution is by far not well understood and not covered by the models. This should be clearly stated and as a result more measurement for similar regions are needed to close this gap.

Literature:
Düsing, S., B. Wehner, T. Müller, A. Stöcker and A. Wiedensohler (2019). "The effect of rapid relative humidity changes on fast filter-based aerosol-particle light-absorption measurements: Uncertainties and correction schemes." Atmospheric Measurement Techniques 12(11): 5879-5895.

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