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Interactive comment on "Apparatus for Dry Deposition of Aerosols on Snow" *by* Nicholas D. Beres and Hans Moosmüller

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SUMMARY

The aim of the present manuscript is to describe a portable apparatus for the generation and deposition on snow of solid aerosol. The presentation of the method and results is logic, well organized and easy to read. Nevertheless, the apparatus is still under development and potentially affected by some biases. Moreover, the scarce amount of data limits the judgment of the apparatus performances: absolute concentration of deposited aerosol, temperature enhancement of air and snow in the deposition chamber. The discussion on the change of snow optical properties is very basic and based on the simple inverse proportionality between impurities presence and snow reflectance. Without knowing the amount of deposited aerosol, the overall meaning of such results is very limited. However the topic is of interest for the "snow community" and matches

the scientific domain of AMT, the lack of investigation of the above-mentioned issues makes me judge the submission of the manuscript as premature. I thus do not recommend the publication of the present work in its current status, and I encourage the authors to perform additional measurements and resubmit their results. The comments listed below might help the authors to improve their work.

MAJOR COMMENTS

1)Amount of deposited material As an apparatus for deposition, the range of aerosol in snow concentration that can be achieved should be known, this was unfortunately not quantified. Up to the reviewer, this lack affects the entire manuscript, limiting the assessment of deposition homogeneity and the understanding of radiative snow properties. First, the visual assessment of deposition is not exactly robust. From Figure 4 it is evident that there is a remarkable pattern of impurities dispersion, within the same experiment and among the different aerosol types. Second, in order to study radiative impact or potential migration of BC/BrC/dust, the operator should know the initial concentration of impurities. Here, without such information is extremely hard to contextualize the results shown in Figure 5, 6 and 7. The authors are encouraged to collect the snow and quantify the presence of particles across the deposition areas by nebulizing the snow with a pneumatic nebulizer (Lim et al., 2014) and by measuring the absorption coefficient (Ajtai et al., 2010) or refractory black carbon concentration (Katich et al., 2017). Preferably, the concentration of BC or absorption should be quantified before and after deposition.

2)Vertical penetration

While the vertical distribution of the impurities affects the overall light absorption through the snowpack (Tuzet et al., 2017), melting might change the vertical distribution of BC particles (Doherty et al., 2013). It is thus of extreme importance to know the exact location of the impurities layer. In the here presented setup, the particles are transported from the generator to the deposition chamber by an air stream. The authors should verify if the air flow pushes the particles within the snowpack and to which depth the penetration occurs.

3)Temperature artifacts in the deposition chamber

The authors mentioned that the temperature in the chamber might increase during the deposition process and might modify the size and optical properties of the snow grains. However, this potential bias was not quantified. I suggest the authors repeating the deposition experiments without aerosol generation and simultaneously monitoring the air and snow temperature inside and outside the deposition chamber. Ideally, the assessment should be conducted under different environmental conditions: cloudy-sunny, cold-warm temperature. This method will provide an indication of the temperature increase inside the chamber. The subsequent and potential change in the properties of the snow such as liquid water content, density, specific surface area, and reflectance should be quantified. Beside the warming caused by the "greenhouse" effect of the chamber, I imagine that the exhaust of the combustion might contribute to the temperature enhancement. Although the long coil line (Figure 3) and the cold ambient temperatures might mitigate the heat transport, the potential warming effect should be assessed.

4)Combustion chamber

The in-situ generation of combustion generated particles is definitely interesting but of complex deployment, especially in extreme cold conditions (here tested at air temperature above 5°C), and might contaminate the surrounding snow (Figure 5 shows that deposition is not limited to the area below the deposition chamber). Moreover, the variety of fuels, the combustion efficiency (function of relative humidity, temperature, and altitude) limits the reproducibility of the experiments. The suspension of dry black carbon powder, similar to dust, might reduce the risk of contamination, increase the reproducibility of the experiments and reduce the weight of the entire apparatus. Did the author consider this option?

SPECIFIC COMMENTS

P3L22: the airflow exiting the combustion chamber is of approximately 5 L, where does the air exit the combustion chamber? At the bottom through the snow? Wouldn't this contaminate the surrounding snow? Did the authors ever consider the installation of an exhaust line with a total filter?

P3L30: do the authors know how much dust is actually transported to the deposition chamber?

P3L41: would a fan (moved by the airflow or a portable battery) enhance the dispersion of the particles?

F1-2: the schematics are basic, technical details should be added: airflow intake and output, size of combustion and deposition chambers, interested snow area.

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