

Reply to the review by Anonymous Referee #2 for the manuscript, “Deposition of Brown Carbon onto Snow: changes of snow optical and radiative properties” by N. D. Beres et al.

The authors thank the anonymous reviewer for their comments and recommendation for publication. Below, comments by the reviewer are in blue and the responses by the manuscript authors are in black.

The natural snow albedo is not 1.0 in the visible (see Fig.3). Therefore, it is clear that the snow samples were already polluted before introduction of BrC. I think, the better idea would be to use fresh or artificial (not polluted) snow samples.

The experiments in this study were conducted using a simple and portable deposition device (Beres and Moosmüller, 2018) which can mimic real-world aerosol dry deposition processes of varying mass concentrations onto real-world surfaces, such as snow. The goal of this study was a first investigation of how brown carbon (BrC) produced through the combustion of an important fuel source can change snow optical and radiative properties; future investigations using the deposition apparatus can benefit from varying the snow conditions (high versus low snow mass density, varying grain radii, etc.). However, for our study, to isolate the influence from BrC only, the presence and influence of light-absorbing impurities in the snowpack before the deposition experiment is negated by finding the difference in values of spectral albedo, TOC concentrations, and spectrophotometric absorption, as measured before and after the deposition of BrC. This way, the BrC influence – on the optical properties, primarily – is isolated and investigated. As noted in the manuscript, it will require further research to refine our methods and determine some additional BrC-related effects to snowpack chemistry and optics. Using an artificial snowpack – such as the methods described in Hadley and Kirchstetter (2012) – may reduce some uncertainty in these methods while increasing others because natural and artificial snow differ in morphology, etc., but the macroscopic BrC-related effects and key results presented in our manuscript will likely remain intact.

The snow samples used for analysis in this study were indeed already “polluted” (that is to say, not “pure” or free from *all* impurities) prior to the artificial deposition of BrC, and the authors were aware of this fact. Concentrations of BC measured in snow of the Sierra Nevada in the United States, for example, have values in the 10s or low-100s of ppb and dust concentrations may be greater (Hadley et al., 2010; Sterle, et al., 2013). It should be noted that “pure” snow spectral albedo equal to 1.0 in the visible is never found in a natural snowpack, and light-absorbing impurities will be found even in snow of the most pristine areas of the Earth’s cold regions, which will reduce the measured albedos or reflectance in the visible wavelength region (e.g. Warren and Wiscombe (1982), Warren et al. (2006), and Forrström et al. (2009)).

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