

## ***Interactive comment on “Brief Communication: Light-absorbing impurities can reduce the density of melting snow” by O. Meinander et al.***

### **Anonymous Referee #2**

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This study presents measurements indicating a correlation between snow BC content and snow density. The findings are based on a small number of measurements, preventing any robust conclusions. Because this connection has not been previously drawn, however, the study seems of sufficient novelty, interest and importance for publication, despite the preliminary nature of the conclusions. Importantly, the authors also propose three physical mechanisms that could potentially explain the relationship.

Comments:

Abstract: The authors should mention that no relationship was found between density and BC content in natural non-melting snow (without the artificial addition of impurities).

It would be helpful to indicate more clearly throughout the paper, and especially in

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Figure 2, which samples were subject to artificial addition of impurities, and of those, which samples were subject to volcanic sand versus chimney soot.

In Figure 2 and elsewhere in the paper, it is unclear whether the samples were taken from different snowpack locations (potentially all in the same general vicinity) or different times from the same snowpack. Please clarify.

p.261,26: The meaning of the superscripts are unclear.

p.262,14: "One density measurement for each location was made." - This implies that density at each location was only sampled one time. Was this also true of the BC measurements? (i.e., are any of the data points shown in Figure 2 taken from the same snow column, but at different times?)

p.262,18 and p.264,21: "consequent" -> "subsequent"

Equation 1: Please report 95% confidence intervals of the slope of this equation. This calculation could be done exclusively using the midpoint values shown in Figure 2b.

p.264,5: "previous FMI Sodankyla snow density data" - Was this snow subject to artificial addition of impurities? If not, what are the implications for extending these data to high-BC-content snow?

p.264,9: The use of "natural snow" here and elsewhere is a bit confusing because some of this snow was presumably subject to the artificial addition of impurities. I suggest that the authors try to clarify these descriptions. (This is related to the point above about the need to clearly distinguish between unperturbed and artificially contaminated snow).

p.265,2: "evaporation" -> "sublimation"

p.265: Process #3: Earlier in the paper, snow grain size measurements are reported. Is there any relationship between BC content and snow grain size? Please comment here on this.

Table 1: It would be helpful to remind readers here about which campaigns included

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the artificial introduction of impurities to the snow.

Fig 2a: Is the "reference spot" indicated with only one point on this plot? What distinguishes the reference spot from the other "natural snow" points shown in this figure?

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Interactive comment on The Cryosphere Discuss., 8, 259, 2014.