

Interactive comment on “A multi-layer physically-based snowpack model simulating direct and indirect radiative impacts of light-absorbing impurities in snow” by Francois Tuzet et al.

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The authors developed a sophisticated snowpack model to quantify radiative effects of LAIs in snow, which could potentially improve our understanding on aerosol contamination in snow. I have a few suggestions regarding two key factors in impurity-snow interactions, which may improve the discussions in the manuscript.

1. The authors assumed external mixing between LAIs and nonspherical snow grains using AART theory. However, recent studies (Liou et al., 2014; He et al., 2014) pointed

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Discussion paper



out that both impurity-snow internal mixing and snow nonsphericity play very important roles in snow albedo calculations. They showed that impurity-snow internal mixing can significantly enhance BC-induced snow albedo reduction compared with external mixing, but the enhancement is stronger for nonspherical snow grains than snow spheres, although spherical grains still have a larger absolute albedo reduction than nonspherical grains under the same BC content in snow. Thus, it is important to account for the combined effects of both key factors. I would recommend the authors to include these recent studies and add some discussions on this aspect.

2. Another important factor the authors did not mention is the underlying assumption of independent scattering among snow grains. However, snow is a close-packed medium in reality. He et al. (2017) recently found that snow close packing can reduce the albedo of pure snow by ~ 0.01 at visible wavelengths and by up to ~ 0.05 at near-infrared wavelengths, with even larger effects on dirty snow. Thus, it would be very helpful if the authors could include some discussions on this aspect.

References:

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