Response to SC2 by Cenlin He :

a) 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.

The authors are grateful to the referee for these suggestions on LAI-snow interactions, which enrich the discussion part of the manuscript.

b) 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 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 enhances 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.

Page 17 Line 20 has been modified accordingly: Finally, in the present study LAIs are assumed to be externally mixed to the ice matrix. Flanner et al. (2012) showed that internally mixed BC was up to 80\% more absorptive than externally mixed BC. Recently, Liou et al., 2014 and He et al., 2014 also pointed out that both impurity-snow internal mixing and snow nonsphericity play very important roles in snow albedo calculations. They showed that internal mixing can enhances BC-induced snow albedo reduction up to 50% compared with external mixing. This enhancement is stronger for nonspherical ice elements than ice spheres, although ice spheres still have a larger absolute albedo reduction than nonspherical ice elements under the same BC content in snow. Introducing an internally-mixed representation of LAIs in TARTES could in turn impact the results. However, a better knowledge of the partition between internally and externally mixed LAIs in seasonal snowpacks would be required to accurately characterize the impact of this variable.

c) 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 nearinfrared wavelengths, with even larger effects on dirty snow. Thus, it would be very helpful if the authors could include some discussions on this aspect.

The AART used in TARTES exploits the fact that, for large particles with respect to the wavelength and weakly-absorbing, the radiative transfer equation for dense media has the same form as the conventional (sparse medium) one, and that the free path length and absorption, which ultimately determines the macroscopic properties, are not affected by the concentration in the medium (e.g. Kokhanovsky 2004, chapter 4). This is an important result that support the validity of numerous works on albedo simulation with RT for snow (e.g. Warren and Wiscombe, 1980). It is true that scattering coefficient and phase function are affected by medium concentration; but both effects compensate each other owing to the similarity principle in the RT equation (C. Mitrescu, , G.L. Stephens, On similarity and scaling of the radiative transfer equation, Journal of Quantitative Spectroscopy and Radiative Transfer 86, 4, 387–394, 2004). This discussion is beyond the scope of the manuscript.

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