

## ***Interactive comment on “Snow albedo sensitivity to macroscopic surface roughness using a new ray tracing model” by Fanny Larue et al.***

### **Anonymous Referee #2**

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**SUMMARY** Larue and colleagues present both in-situ observations and a Rough Surface Ray Tracer (RSRT) model to assess the impact quantify the impact of surface roughness on snow albedo. Their observations show that surface roughness features have a strong impact at albedo reductions. This impact is already apparent for low roughness values, but becomes more pronounced for higher roughness values, where the albedo reduction depends strongly on the roughness orientation relative to the sun. Besides the observations, Larue and colleagues also introduce for the first time a model that allows to account for surface roughness in snow albedo simulations. Simulations with the model show that albedo simulations are improved by a factor 2 compared to those assuming a smooth surface. The model gives moreover insight in the role of Specific Surface Area (SSA), slope, the solar zenith angle and the roughness orien-

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tation. Finally, the paper highlights the necessity to take into account the roughness effects to compute the surface energy budget.

**GENERAL COMMENTS** The paper of Larue and colleagues touches upon an important topic, is well written, extensively analyzed. As such it build further on earlier work of Warren, Cathles, Pfeffer, Lhermitte and many others, but with the clear novelty that it adds new well designed measurements and the RSRT model that allows to assess the effects in 3D (versus earlier 2D models). Based on these comments I think the paper is well suited and already well written and organised to merit publication in TC. Nevertheless, I have some minor comments that might be addressed in an eventual revised version of the paper.

**MINOR COMMENTS** L124 "by uniformly pressing a rectangular metal bar into the snow" : What would be the effect of compression and corresponding differences in density/SSA on the observed albedo values. Do you expect this to interfere with the observations? If so/not, why and what would be the effect?

Measured albedo values above 1: the paper shows several figures with spectral albedo values above 1 which is physically impossible. It would be good to explain where these values come from and what it means in terms of uncertainty (also for the rest of the observations and conclusions).

Figure 1: Based on this figure it seems that the sun is oriented North. I know that it is only an illustration and a minor detail, but it might be clearer if the sun is positioned south for norther hemisphere experiments.

Figure 5: Comparison between the simulated smooth and observed albedo values seems to show still some minor contamination by LAP's in shorter wavelengths. Perhaps worthwhile to mention that as well when discussing this graph?

L650 "large scale": it would be good if the authors could already add a discussion point of what the current results would mean for larger scale roughness features and/or how

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the conclusions from this paper can (or not) be extrapolated to larger scale roughness features.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-179>, 2019.

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