

Review of tc-2021-291

“Land-atmosphere interactions in sub-polar and alpine climates in the CORDEX FPS LUCAS models: II. The role of changing vegetation”
submitted to *The Cryosphere*

Synopsis:

This manuscript investigates the impact of land cover change on snow accumulation, ablation, and albedo. The authors use a nine-member regional climate model ensemble, with various combinations of atmospheric and land surface models. Using constant albedo differences between snow-covered and snow-free forest and grass, the authors calculate the snow albedo sensitivity index (SASI), using modeled snowpack variables as an indicator for snow-covered and snow-free conditions during the cold season (defined as January to June). The authors report that forested conditions reduce SASI, indicative of reduced climate forcing from snow albedo, with the greatest differences emerging during the ablation season.

Overall, I found this to be a clearly written and concise paper fit for publication in *The Cryosphere*. The figures are crisp, clean, and well organized.

Major Comments:

The authors used a constant $\Delta\alpha$ value of 0.5 for grass and 0.2 for forests (lines 138-140). Is there any reason the authors could not use the albedo values directly from the model output? I suspect albedo output was not available for all models? If this is the case, please indicate this in the text.

While I do not believe the results of the analysis would change (ie: SASI would still be reduced for forested conditions), use of model-derived $\Delta\alpha$ may shed additional light on why the models differ in their spatial and temporal evolution of the snowpack during the melt season. Use of modeled $\Delta\alpha$ may also illuminate differences in coniferous vs. deciduous forest effects on snow-vegetation albedo.

Minor comments:

Line 119: Could the authors please provide a source justifying the use of 312 kg/m^3 for an average snow density?

Line 171: Change km/m^3 to kg/m^3

Line 241: Considering adding a few references on the implications for “cold and snow refugia” management strategies.
<https://www.fs.usda.gov/ccrc/topics/climate-change-refugia>

Figure 3 & 4: Check units - SWE should be mm?