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Interactive comment on "Effects of snow grain shape on climate simulations: Sensitivity tests with the Norwegian Earth System Model" *by* Petri Räisänen et al.

Anonymous Referee #1

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Recommendation: Accept after minor revision. This is an interesting study which is suitable for publication in The Cryosphere. It is well-written.

lines 8-9. Say that the nonspherical grains are compared to spherical grains with the same specific surface area.

line 32. Cite also Dang et al. (2015).

line 47. If the snow grain contains concavities and hollows, then the projected area is not the appropriate measure, because internal surfaces also deflect photons. See Grenfell et al. (2005). Admittedly, although cavities are present in atmospheric ice crystals, they are uncommon in surface snow.

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Discussion paper

line 49, eq. 1. Point out that re is inversely proportional to specific surface area (SSA), a quantity that is commonly used in snow radiation work.

line 89. Change “retuning the snow grain size” to “increasing the snow grain size (of the nonspherical grains)”

line 96. “model model” is redundant.

line 183. “abundant snow cover . . . in parts of Tibet . . . “ What does NorESM predict for snow cover and snow depth in Tibet? In reality, Tibetan snow is patchy and thin, with average depth peaking in February at only 2 cm (Flanner and Zender 2005, Figure 3b).

line 185-186. “in the southern parts of northern Eurasia . . . the change in snow albedo is largely masked by forests.” This is also seen in a band of forest across North America at 50-60N between the Great Plains and the tundra.

line 209-210. Define “Q-flux”.

line 296. Change “Figs. 8 and Fig. 9” to “Figs. 8 and 9”.

line 303. Change “or” to “of”.

line 357. Change “NONSPH” TO “SPH”. This is important.

line 372-373. “2 W m-2 in eastern Greenland (mainly due to BC)”. This is probably excessive. The BC content at East Greenland AWS stations is only 2-4 ppb (Table 6 of Doherty et al. 2010).

line 441. Change “in lack of information” to “because of the lack of information”.

line 447. “indistinguishable” is misspelled.

line 516. Change “report” to “reports”.

line 603. Change “run” to “ran”.

Figure 3 caption line 3. Change “limit” to “threshold”. Also on captions to Figures 5 and 6.

Figure 7a. Give units on scale bar (probably micrometers).

Figure 7b. A ratio (rather than percent-difference) might be esier for the reader to interpret. Also in Figure 11a.

Figure 13 caption last line. These numbers will be easier to compare if they are given in the same units: “(24 ppb for hydrophilic BC and 8120 ppb for dust)”.

References

Dang, C., R.E. Brandt, and S.G. Warren, 2015: Parameterizations for narrowband and broadband albedo of pure snow, and snow containing mineral dust and black carbon. J. Geophys. Res., 120, doi:10.1002/2014JD022646.

Doherty, S.J., S.G. Warren, T.C. Grenfell, A.D. Clarke, and R.E. Brandt, 2010: Light-absorbing impurities in Arctic snow. Atmos. Chem. Phys., 10, 11647-11680.

Flanner, M.G., and C.S. Zender, 2005: Snowpack radiative heating: Influence on Tibetan Plateau climate. Geophys. Res. Lett., 32, L06501, doi:10.1029/2004GL022076.

Grenfell, T.C., S.P. Neshyba, and S.G. Warren, 2005: Representation of a nonspherical ice particle by a collection of independent spheres for scattering and absorption of radiation: 3. Hollow columns and plates. J. Geophys. Res. (Atmospheres), 110, D17203, doi:10.1029/2005JD005811.

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