

Interactive comment on “Study of a temperature gradient metamorphism of snow from 3-D images: time evolution of microstructures, physical properties and their associated anisotropy” by N. Calonne et al.

Anonymous Referee #1

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This is a very well-designed study. Three topics are addressed in this manuscript: (1) variations in physical parameters of snow (density, specific surface area, correlation length, mean and Gaussian curvature distribution, air and ice tortuosities, effective thermal conductivity, and intrinsic permeability) based on 3-D image measurement using an X-ray system, (2) development of physical parameter anisotropy under TG conditions, and (3) comparison of measured data with two analytical models based on snow density, and size and anisotropy. The study demonstrates the importance of anisotropy of the snow physical parameters in modeling snow under TG conditions. The three top-

C356

ics are well organized and their conclusion is reasonable. The manuscript is very well written, and I do not see any problems with the analysis or presentation. Moreover, the data are definitely useful in evaluation of snow metamorphism models. I believe the manuscript requires only minor editing before publication in The Cryosphere. I have provided specific editorial comments below, and my suggestions for improvement of the arguments are in the manuscript.

Specific comments:

2.5. Re-adjustment in density

The authors readjusted the values of effective thermal conductivity and permeability to eliminate the influence of spatial inhomogeneities of density, but they did not readjust the values of other physical parameters (e.g., correlation length, air and ice tortuosities, and specific surface area). As pointed out by the authors in 4.2 Link with the physical properties, effective thermal conductivity and permeability depend on these physical parameters. Thus, if effective thermal conductivity and permeability need to be readjusted against inhomogeneities of density, other physical parameters should also need readjustment. I believe the effect of readjustment is not strongly evident in their results: however, if there are specific reasons for not readjusting other physical parameters, they should be explained in the text.

P1418L2 & P1430L26

Although the room temperature during the experiments was -4 degree Celsius (269 K), the authors used the value of k_i and k_a with 271 K. I believe the difference between the values with 269 K and those with 271 K is small; however, if there are specific reasons for using the values with 271 K, please explain them in the text.

Suggestions for improvements:

P1415 L11. The equation (7) may have typing error: K should be G.

The legends in Fig. 5 are difficult to read because of the small size. Please make these

C357

legends bigger.

Interactive comment on The Cryosphere Discuss., 8, 1407, 2014.

C358