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The Cryosphere Discussions

Interactive comment on "Thermal conductivity of anisotropic snow measured by three independent methods" *by* F. Riche and M. Schneebeli

Anonymous Referee #2

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I find the manuscript: Thermal conductivity of anisotropic snow measured by three independent methods by F. Riche and M. Schneebeli interesting and important. The thermal conductivity through snow is central to many scientific problems and has received significant attention over the years.

I recognize that the authors have a long career in working with snow, however, I would have benefitted from an approach with more intermittent steps. I would have built an artificial anisotropic material whose thermal properties are known exactly. Then one could use the different probes, and simulations to convince the reader that the methods actually return the known properties. Although phase change and mass flux would still be left out. However, after that exercise I would have been more convinced that the measured snow properties are real.

I think this a worthy contribution highlighting a question that is seldom asked or tackled.

List of detailed comments:

Page 1840, rows 3-5 It is unclear what the “parameterization” refers to and what is the “bias”. The abstract should be understandable without reading the paper itself.

P1840 r6 I believe the authors mean “the anisotropy of the thermal conductivity” or thermal properties.

R7 Unclear what is the “bias”

R24 Heat budget of what?

P1841 r25 Contact of what?

P1842 r25 The comment on latent heat came unexpectedly. So, now there are two error sources: the anisotropy and the latent heat. It seems that it would be tough to separate those effects. I think it would be worth to elaborate here a little on the latent heat.

P1843 r1-3 I think you need to convince the reader that the convection is not important in your case. As you are trying to determine the magnitude of the anisotropy on thermal conductivity. The determination could be off if the convection played some role in your measurements.

R5 Why is the thermal conductivity of porous media often anisotropic? For example beach sand probably has no anisotropy in thermal properties, other than moisture content.

R22-23 It is unclear what the “parameterizations” refers to.

p1844 r1 Usually there is no heat flux in the absence of temperature gradient.

P1846 r10 What is a micro-CT analysis?

R18-19 It is unclear how snow thermal conductivity could be 0 Wm-1 K-1. I do not think

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6, C2224–C2226, 2012

there is any material with zero thermal conductivity.

R23-24 It is an interesting question, what is the reference thermal conductivity of, for example, granular sea salt. It seems to me that someone must have done something similar to what is done in this paper. Therefore you may be trying to calibrate your probes and methods with values obtained by same probes and methods.

P1847 r14-18 What was the ambient temperature of the snow block? It has been shown that the needle probe can melt the ice and skew the measurement (Putkonen. 2003. Determination of Frozen Soil Thermal Properties by Heated Needle Probe. Permafrost and Periglac. Process. 14: 343–347).

p1848 r1 Unusual way to give a volume, although strictly speaking probably correct. It should be either 45 cm x 45 cm x 45 cm or 91125 cm3.

P1849 It would be nice to have pictures and schematic diagrams of the system.

P1850 r16 Direct numerical simulation of heat flow through porous material containing ice/water is a difficult task. I wonder if the authors have considered many inherent difficulties discussed in this paper: Hallet, B; Rasmussen, L A. 1993. Calculation of the thermal conductivity of unsaturated frozen soil near the melting point. International Conference on Permafrost, Proceedings 6, . 1: 226-231.

Interactive comment on The Cryosphere Discuss., 6, 1839, 2012.