

Interactive comment on “Seasonal evolution of the effective thermal conductivity of the snow and the soil in high Arctic herb tundra at Bylot Island, Canada” by F. Domine et al.

Anonymous Referee #1

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Seasonal evolution of the effective thermal conductivity of the snow and the soil in high Arctic herb tundra at Bylot Island, Canada

F. Domine, M. Barrere and D. Sarrazin

General comments:

The paper analyzes measurements of thermal conductivity of snow and soil in the Arctic, specifically at Bylot Island, Canada. Measurements occurred through 3 field seasons, and values compared to other studies, and to modeled values from the French snow model Crocus. Results are very interesting since it is suggested that a bi-modal distribution can be used to characterize the soil thermal conductivity. Simulated values

C1

from Crocus are contrary to measurements, the authors explain this by the absence of upward vapor flux from temperature gradient in the model.

Overall, the analysis and measurements are thorough and are quite relevant for the improvement of snow modeling in the Arctic, which remains poor. This paper provides insights on improvements needed for a better assessment of climate variability in the Arctic. I recommend this paper for publication in The Cryosphere, after minor revisions detailed below.

Specific comments:

Section 2.1: The authors describe the vertical locations of NPs and thermistors. One was moved following observations of depth hoar height. Furthermore, the chosen height for the other NPs and thermistors seem to be motivated by stratigraphy, which makes sense. However, such detail is not mention. It would be nice if the authors explain the reasoning behind the 2-12-22cm heights for NPs, and the 2-7-17-37 for thermistors? Also, why are thermistors at different height than NPs? They seem aligned with the initial positions of the NPs (7-17-27), why were they not lowered to match the NPs?

I will leave to the discretion of the author to include a map of Bylot to Figure-1.

Line 142: I would clarify why depth hoar are more conductive in the vertical direction (i.e. owing to the higher thermal conductivity of ice relative to air, and an elongated grain)... And why is it more conductive horizontally in wind slab?

Section 2.3: Although the modeling is described in details elsewhere, I would put a little more details here, otherwise the section can be removed and stated elsewhere since it is only 2-3 sentences long. The authors could simply add the data that was missing, the reasoning using ERA, and how Crocus computed thermal conductivity. The conclusions are significant with regards to Crocus, and more context need to be provided here for the reader's understanding.

C2

Figure-2 has very poor resolution and consequently very hard to read.

Section 3.1: I assume SSA are from DUFISSS? This should be mentioned in the paper. . . Figure-6: dates are in French

Section 4.3.: A figure on Crocus output, visualized profile with marks on the melt event would greatly help the understanding of this section. The authors could display Crocus thermal conductivity and snow temperature (or temperature gradient). The problem of density profiles and simulated grains would be more obvious. . .

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