Reply to Referee 2

We thank the reviewer for his positive comments and for giving us the opportunity to improve our paper. Our responses are embedded in blue italics.

General comments: The research results presented in the manuscript represent significant contribution to the state of knowledge of seasonal variation of snow thermal conductivity in an Arctic environment and snow thermal conductivity variations in shrub covered areas; understanding of both processes is currently lacking with a definite dearth of observations available. The manuscript describes the methods used well; in particular, the discussion of the limitations of the transient needle probe method and the analysis of the data is well thought out and presented.

Technical comments (many of these are very minor):

Page 1634, Line 2: The temperature gradient isn't impacted by thermal conductivity, but thermal flux is.
Well, in fact if the thermal conductivity is high, the temperature gradient is reduced. One way to consider this is through our eq. 1. For a constant steady state flux through the snowpack, if keff is high in a layer, then the thermal gradient is autiomatically reduced in that layer. So we believe that the temperature gradient is impacted by the thermal conductivity in a vertically heterogeneous snowpack.

Page 1637: It might be good to introduce the average annual snow depths and/or general snow characteristics in this section. It is hard to envision how much the shrubs are being buried without this information. Also, begs the question of why the probes are put lower in the snowpack or why they were installed at these heights.

There is no long record of climatological data at Umiujaq. Snow depth records started in 2012. We will specify that our intended focus was on the impact of shrubs on snow properties. Before that, occasional measurements were made during visits by scientists. (Ménard et al., 1998) state "Snow depths varied from 0.08 m in lichenic areas to over 1.5 m in forested areas." This just serves to illustrate the huge spatial variability of snow depth, but does not answer the reviewer's question. All the data available are in our Figures 4 and 5.
Regarding the selected probe heights, we will specify that our focus was on the effect of shrubs. Furthermore, lower snow layers are subjected to more intense metamorphism and more changes are expected in these layers.

Page 1638, Line 12: "avoid that it perturbs the measurement" is awkward, would suggest, "to avoid the measurements of keff being influenced by convection."
Thank you. Following Richard Essery, we will write "and avoid resulting perturbations in the measurement of keff."

Page 1638, Line 14: suggest deleting the word "one" after "horizontal"
Thank you, but we do not feel comfortable with this suggested change.

Page 1639, Line 8: “resulting in general in parts” doesn’t make sense, suggest just, "resulting in parts of the plots..." or somehow quantify or clarify what is meant by the phrase "in general" Does this mean often or usually??
Thank you. We will remove “in general”.

Page 1639, Line 16: “which performed hourly measurements” isn’t right, but maybe make a new sentence, "Measurements were recorded hourly."
Thank you, we will follow this suggestion.

Page 1639, Line 22: “in a white...tubing” should be "in white...tubing" without the "a"
Thank you.

Page 1640, Line 27 should be "which gives a" instead of "which give a"
Thank you.

Page 1641, Line 20 "we concluded to the absence of convection" should be, "we concluded there was an absence of convection" or "we concluded there was no convection"
Thank you.

Page 1642, Line 11: "finally we applied a last check to ensure results quality" should be "finally we applied a last check to ensure the quality of the results."
Thank you. We changed to “measurement quality” following Richard Essery’s suggestion.

Page 1645, Line 21: There is no figure 8, although it is referenced, maybe this is figure 6 or 7 instead?
Yes, we will change to Figure 6.

Page 1647, Line 10: This paragraph doesn’t make sense. How can many values of alpha be 1, but then most range between 0.75 and 1.45? Maybe Maybe this can be clarified. 0.75 and 1.45 don’t seem to be that close to 1.
Good point. We will mention that “Over half of the values of alpha are close to 1 (between 0.8 and 1.2)” and that “over 90% of alpha values range between 0.7 to 1.45”. This can be deduced from Figure 8 of Riche and Schneebeli (2013).

Reference

Ménard , É., Allard, M., and Michaud, Y.: Field data of ground surface temperatures in various biophysical micro-environments near Umiujaq, eastern shore of Hudson Bay, Canada. Proceedings of the seventh International Permafrost Conference, Yellowknife, Canada, 1998, 723-730.