Review of Thermal conductivity of snow on Arctic Sea ice

This manuscript describes the variation of the thermal conductivity of snow, its density and how it varies according to the type of ice it falls on based on the MOSAIC campaign. Snow on sea ice is still one of the more uncertain topics in the Arctic environment and with its large impact on the development of sea ice studies that improves the understanding of this are welcome. The MOSAIC campaign includes a large and valuable dataset, which has the potential of improving the understanding of the Arctic environment. That being said snow is difficult and the findings are accompanied with large uncertainties, which should be discussed more. In addition, some of the definitions are a bit loose. This is especially the case in the introduction. At last it would generalize the conclusions if additional data set were used or if parts of the dataset were used for calibration of the polynomial and other parts of the data set were used for validation.

I find that the manuscript needs some revisions and it should be read through and updated where language seems a bit rough as this makes it difficult to follow. This blurs the conclusion.

Major

Leads are normally openings of the sea ice due to dynamics. What the authors mean is likely refrozen leads where new, thin ice is formed and snow has just started to accumulate. This needs to be specified more clearly.

An increase in density until March can be seen, however the uncertainties are large enough. Is it statically significant?

Sometimes it seems as if snow and ice are mixed up. This is a bit confusing.

General

Figure text should be the same same font all the way

Figures with multiple sub figures would benefit from nation such as figure XXa, XXb….

Minor

line 6. This is related to the definition of leads. I don't see that leads are in the ice age category, thus the parenthesis is a bit misleading. I would rephrase this.

Line 7 I would change dynamics to seasonal variation or something like that. I don't think that dynamics is the right word.

Line 10: I would not call the thermal resistance constant when uncertainties for first and second year ice is that high.

Line 12: I think that the uncertainties should be mentioned here as well as it seems, as there are snow on sea ice. The uncertainties are large and the thermal resistance of snow on ridges can be the same as the two other categories.

Line 13: I would skip the last sentence that starts with: “The implications of our findings….” It does not really fit into an abstract.

Line 27-32 This describes heat transfer through snow, however ice Is mentioned. I am not sure that it is intended.

Line 35 remove “the”. FEM is a general model not one specific.

Line 38 a model do not measure it calculates.

Line 41: I think that short fall should be shortcoming.

Line 44 please rephrase without parenthesis

Line 46. Rephrase as “on a snow”

Line 47 remove “,” and replace with and

Line 52 A faster method? Faster in what way?

Line 65 I would rephrase line 65 to we can draw new conclusions about the…

Line 68: Where does the +- 0.01 originate from. I assume that this is a constant.

Line 72 coordinates are listed as N/S. North and South. One of them should be E/W

Line 83. I did not think that the instruments are the focus of this study. It should be the snow properties.

Line 96 replace “to” with “in order to”

Line 96 replace “,” with and

Line 110: it is not clear what kair and kice are used for.

Line 114 to 120: This section is unclear. There are more x values than a, b, c. A table might help.

Line 125: Ag? Is it assumed that the reader reads Löwe (2013) as well?

Line 129. Is SMP and SMP force the same?

Line 132: Not sure what the sentence that starts and end in this line refer to.

Line 145: What is the current literature?

Line 168 It is not clear what the first sentence mean. Is it only high density variability or also KFEM and Ak?

Line 170 to 171. The reference to KFEM seems to be inserted into a discussion on density. I think that this should be reorganized.

Line 180: cover all. I would rephrase to a wide range.

Line 185. I assume equation 4. The parenthesis before Adapting due not have a start

Line 195: Is the seasonal variability significant compared to the uncertainty and variability of the measurements?

Line 208 Results in table 1 is mentioned but not really used.

Line 234 rephrase to avoid parenthesis

Line 255 and ridges? This should be rephrased to its own sentence.

Line 263: Any considerations on how the change of thermal conductivity would change the result of the models?

Line 338: This article that the conductivity of snow is 0.32 in sea ice modelling. Is this Crocus and SNOWPACK? I don't think that any of these models are normally included in sea ice modeling.

Figure 1

Remove " We could simulate…using the FEM method

Is the snow depth of each sample known?

Figure 7. Is there a dependency on the snow depth?