Review of: 'Occurrence of seeding multi-layer clouds in the Arctic from ground-based observations' by Achtert et al.

General comments

In this work, the authors make use of radio soundings and cloud radar measurements from 3 ship campaigns and 2 ground stations. Based on these, they first identify and then classify arctic clouds following a complex, layered classification scheme. They separate between single or multiple layer clouds and focus on their occurrence and the presence of ice crystal seeding in cold MLCs. For these cases they consider the ice crystal size and habit as well as the depth of the subsaturated layer between the cloud layers.

The manuscript is overall very well written. The topic and open question are introduced in an easily understandable manner. The methodology and especially the cloud classification scheme is presented in detail. The results are shown with straight forward plots and explained well. I find the immediate discussion of some results in section 3 very useful.

The topics discussed in this paper, the methodology and findings are in the scope of the journal and the interest of its readers and the scientific community and I would propose this work for publishing after minor revisions and technical corrections.

Specific comments & questions

- Figure 3: From the description of the method in the text I understood that all soundings are verified with a radar measurement, but it is not obvious in the graph. If that is the case -although it might escape the scope of this paper-, it would be interesting to know how many SLC and warm MLC were reclassified as no cloud by the radar measurements or to rephrase this, how often there are ice supersaturated regions without clouds. This would then open many other questions, as for example where, when and why these ISS regions form and what are the dynamics within them.
- Figure 7: As the authors already acknowledge in the text (lines 265 – 266) the latitudinal analysis includes the seasonal bias. Is there an estimate of how strong that is? Maybe with a multiple regression analysis this could be estimated. If it is significant, weighting or performing the latitudinal analysis for each season and averaging could remove the bias. Something similar could also be considered in terms of normalizing the amount of measurements, to support seasonal comparisons.
- Lines 429 – 431: It would we good if the authors could once again mention here, that the latitudinal analysis is also affected by the seasons.
- Lines 436 – 438: Obviously during drifting campaigns measurements are performed only over sea ice, sea ice cover could also play a role in the latitudinal and seasonal variability or even point to a long-term trend.

Suggestions for technical corrections

- Figure 1: The black stars are a bit tough to spot. You could consider filling them.
- Line 156: 30 min
- Figure 4 3rd panel: Legend not legible
- Line 214: Figure~~s~~ 6
- Figure 6: 'cloud classification of Figure 3.'
- Line 243: I think seasonal variation would better describe what is presented than annual.

- Line 279: Instead of ‘orientation’ maybe ‘clarification’ would be a better word? I immediately though of ice crystal orientation.
- Figure 8: he descriptions ‘seeding’ and ‘non-seeding’ could be added to the plot for a faster/ easier understanding of the context.
- Line 324: there seems to be one extra word