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Interactive comment on "Inter-comparison of snow depth retrievals over Arctic sea ice from radar data acquired by Operation IceBridge" *by* Ron Kwok et al.

Anonymous Referee #1

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General comments:

In the study "Inter-comparison of snow depth retrievals over Arctic sea ice from radar data acquired by Operation IceBridge", snow depth retrievals from five different algorithms are compared with each other, with in-situ snow depth measurements from two field surveys, a modified Warren climatology, and snow depths derived from ERA-Interim products. Most of the retrievals seem to reproduce the expected spatial snow depth patterns, certainly the gradient between first-year and multiyear ice. Nevertheless, differences between the products exist and biases can be significant. The authors state that the aim of this study is not to select the best algorithm, but to give an

informative overview of existing retrieval algorithms, also serving to develop the next-generation retrieval algorithm.

The manuscript fills an important gap in providing a comparative overview of the different Operation IceBridge snow depth retrievals that have been presented over the past years. The scientific analysis seems to be rigorous and the manuscript is well structured. Therefore, I do not really have any major objections. But I think the paper can be improved in terms of figure quality, and also some clarifications and more details are needed in some parts of the manuscript (see specific comments). For example, it is not always clear over which period the different retrievals exist. Sometimes, one retrieval is missing in the comparisons and figures. I guess this is because an algorithm was not applied during the time when the in-situ measurements took place? I would suggest to include an additional figure or table, showing the intervals of the 5 retrievals and the overlap with the in-situ measurements. Moreover, some figures lack a complete description, which sometimes makes it time-consuming to understand their content (see specific comments). I also wonder if the authors can provide some concluding remarks regarding the characteristics of the individual products in the conclusion section. To be more specific, GSFC-NK seems to reject much more echoes than other algorithms. Moreover some retrievals rather seem to over- or underestimate snow depths depending on how the interfaces are picked. Although I acknowledge that the aim of the paper is not to select the best algorithm, I think a statement about the characteristics of the different retrievals should be added in the conclusion.

Specific Comments:

P5L7: How does the automated snow depth probe work? Is there any reference to the instrument? I also couldn't find much information in Strum et al. (2006).

P7: What about the method and analysis in Holt et al. (2015)? Why is it not considered here? At least, I believe, results should be discussed and mentioned briefly in the introduction and/or discussion section.

P10L27: Why were the wavelet retrievals not available for the assessment? This question/comment aims to the one in the general comments. I think it would be useful to clarify the availability of the different retrievals, may be by including another figure or table.

P15L7: “work was not to the select. . .”: delete “the”

P17L28: “Large interannual variability of retrievals from a given algorithm suggests issues in algorithmic robustness in adapting to changes in radar data quality.” Could these signals not be (partly) real? Why should the interannual variability suggested by W99 be the reference?

Figure 2: a) Why is NSIDC missing here?

Figure 4: It would be helpful to add a legend in the figure explaining red and black dots rather than only mentioning it in the caption. And, there is a typo in the last sentence of the caption: “. . .are showN. . .”.

Figure 5: I guess the error bars represent the standard deviation at certain cm bins? It is not really stated, neither in the caption. This should be added.

Figure 6: Why are there gaps in the histogram in d)?

Figure 9: a) Some points are beyond the axis, which looks a bit odd. Moreover, the number in the first column in the insets is not explained. I guess it is the number of measurements?

Figure 11: Why is the wavelet retrieval missing here (counts also for Figures 7, 8, 9 and 12)? b) I do not really understand the maps. Are the shown tracks the outbound and return tracks, but shifted to make differences visible? I would suggest to show just one map with the location of the tracks without color scale, and then ad xy along track plots with snow depths along outbound and return tracks.

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