**The Cryosphere
Discussions**

Interactive comment on "A sea ice thickness retrieval model for 1.4 GHz radiometry and application to airborne measurements over low salinity sea ice" *by* L. Kaleschke et al.

Anonymous Referee #2

Received and published: 10 March 2010

Review of paper by L. Kaleschke et al, A sea ice thickness retrieval model for 1.4 GHz radiometry and application to airborne measurements over low salinity sea ice, submitted to The Cryosphere.

This paper describes modifications made a sea ice thickness retrieval model to account for Baltic sea ice conditions and then compares the retrieval estimates results from an airborne 1.4 GHz passive microwave system to those from a helicopter EM system. The authors also make the case for a spaceborne retrieval using SMOS and Cryosat-2. This is an interesting and generally well-written paper describing an approach to obtain perhaps the single most important sea ice measurement from space, but there

will be significant limitations to this retrieval even in the best of conditions. The model and retrieval algorithm are well described. I recommend the paper be accepted after the following list of items is discussed. As an aside, it is pretty interesting to read the other reviewer's comments and the author's response.

Detailed comments. 1. Introduction. The author's specifically address the retrieval model in terms of the nadir return. What is the estimate of the SMOS 1000 km swath that may be considered to fall within the nadir return region and what is the change in resolution with respect to swath position and incidence angle?

2. Salinity topic. While salinity is a ratio, the general oceanographic convention is to reference ocean salinity in terms of practical salinity units (psu).

3. Section 2. It is fortuitous that the model can utilize the large brightness temperature contrast between thick ice and open water, which effectively minimizes other factors. In 1001 from line 17 to 1002 line 8, a good point was made about large thickness variations smoothing out the periodicity so that an incoherent solution can be used. Approximately what is a large thickness variation in terms of the model and how does this value-range of values compare with results shown later in Figure 6?

4. Yes it would be good to properly order figures.

5. 1004 – line 20 and Figure 1. The incoherent solution does appear to converge with open water, while text says it does not. The dashed curve does not converge – is this incoherent or coherent line? Regarding Figure 1, the authors should specify which is the incoherent curve in the caption or on figure, since text says it is for 0.1 d value. What is reason to include 20 cm line- is this an coherent or incoherent?? This all needs to be clarified.

6. 1006 – line 11 and Figure 3. Concentration is not shown in Figure 3 so should be removed from this sentence.

7. I think it would be interesting to include a simple plot of the 1.4 GHz brightness

temperature along with EM thickness plot.

8. Regarding the comparisons of the EM data and retrieval, discussed in 1007-lines 18-24 and shown in Figure 6. I also refer back to the EM accuracy over ridged ice discussed in 1004-lines 1-2. Perhaps Figure 6 could be enlarged so that one could see the variations abit more clearly. Also have they really considered ridged ice properly, including in their comparisons? Why are red lines shown that extend above 1.5 m in thickness and are such portions of ice included in those 4 red dots shown in Figure 7? The plot in Figure 6 shows around 0.5 deg latitude or about 30-35 km. Divided by 1200 m segments results in like 30 points, as shown in Figure 7. It would be interesting to include the value for each 1200 m segment on Figure 6 and then discuss the impact of thickness variations (as discussed in item 3 above) on retrieval, if any. The idea behind these questions is that in terms of SMOS and its coarse resolution, the retrieval of thickness will be also be highly averaged. How will SMOS account for the actual thickness variations in terms of retrieved number? Some notion of this can be made based on EM data and retrieval. Also, it would be useful to hear what the authors think might be the reason behind the actually fairly significant differences between the averaged EM and retrieval derivations (0.8 m vs 0.65 m), including in terms of thickness variations.

9. Figure 8 accounts pretty well for the limitations based on concentration errors etc, as raised by reviewer 1.

10. References. Specific information should be included for how to access the grey literature references, such as ESA and internal reports, via web or address.

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