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The Cryosphere Discussions

Interactive comment on "Melt in Antarctica derived from SMOS observations at L band" *by* Marion Leduc-Leballeur et al.

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We appreciated very much your comments and efforts in reviewing this paper. The manuscript has been revised, according to comments and suggestions provided. We answered your comments (introduced by '»') in the following.

»The authors have performed a study to detect the melt occurrence in Antarctica using SMOS observations. Authors have compared the SMOS detection results to those obtained using 19.7 GHz passive observations. This study provides very good results –showing the usefulness of SMOS observations for melt occurrence detection. Theoretical analysis explains well the differences between the L-band and 19.7 GHz observations and provided very nice basis on understanding the importance on having ob-

servations at both frequencies to better monitor the melt occurrences. The manuscript is well written and structured, it is easy to read and understand. The aim of the study is clearly explained, and conclusions are well provided. Scientifically, the paper is solid, it provides interesting and important new information on how to better detect and monitor the ice melt on Antarctica. I recommend this paper to be published and have only some minor comments to be considered before publishing.

»The comments are listed below.

1) Line 46: I assume the authors are using CATDS data from 50 to 55 degrees.

Yes. We now specified in the text: "TB at vertical (V) and horizontal (H) polarizations for the 50-55° average range of incidence angle are used here.".

2) Lines 120-121: The selected temperature profile is a little strange: From surface to 10 m: 273 K, then constant 263K to 500m depth. Are the authors really using this, or should it be from surface to 10 m dropping from 273K to 263 K?

There is a mistake in the text for the temperature profile description. In fact, the used profile is: from the surface to 5 m is 273 K, then constant 263 K to 500 m. We choose to fix the temperature at 273 K within the first 5 m in order to limit the temperature variations effect and highlight the LWC effect.

3) Figure 5: Based on the model results, the selected density profile has a large impact. Tb as a function of the liquid water content is totally different if a smooth density profile is applied. Daily winter SMOS observations are compatible with the third density profile (20 kg/m3). How much the density profile varies in real life, may there be an additional source of uncertainty for the SMOS based estimations?

It is really difficult to have a reliable estimation of the density variability range, due to the lake of in situ measurement and the large penetration depth of SMOS. For example, at Dome C, we estimated the density variability about 25-30Âăkg/m3 close to the surface (Leduc-Leballeur et al., 2015). However, the snowpack structure in Dome C area is

typical of the dry snow region, which is completely different of the wet snow area. Here, thanks to the simulations with 3 values of density variability and the comparison with the SMOS observations during winter, we can suggest that a variability lower than 10 kg/m3 is not very probable and 20 kg/m3 was selected (Figure 5). However, the standard deviation of the SMOS histogram (206.9$\pm$8.9 K) also suggests a variability which could be in part linked to a change in the density variability of the profile. So, as you highlight, the lake of knowledge of the density variability can adding uncertainty to simulate the SMOS observations.

4) Line 138: Odd sentence, maybe “have been selected” should not be there.

Thank to have notice that. We removed “have been selected”.

5) Line 162: Maybe, to clarify the readers, the authors could use: “The wet layer thickness” instead of “The layer thickness”

We added “wet” to clarify the sentence.

6) Line 174: The sentence is a bit confusing starting from words “or if the event was produce a lot...” To clarify, we corrected this sentence part as:

“if water has percolated over a sufficient thickness to be detected by SMOS.”.

7) Figure 6: The caption text is not as informative as it could be. “as a function of the wet snow depth” => how about: “as a function of the wet snow layer depth”. By adding word layer, it is easier to understand that the simulation is done using constant layer thickness but in different depths. Also, consider adding the layer thicknesses here.

We changed the caption text for Figure 6 as: “DMRT-ML brightness temperature at H polarization (K) for 55deg of incidence angle as a function of the wet snow layer depth within the snowpack for a wet layer thickness of 1 m at 1.4 GHz (green) and 0.1 m at 19 GHz (blue). ”

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