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The Cryosphere Discussions

Interactive comment on "Microwave snow emission modeling uncertainties in boreal and subarctic environments" *by* A. Roy et al.

Anonymous Referee #1

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This paper concerns the modeling of microwave radiation from snow with DMRT-ML, to quantify the simulation sensitivity to parameter uncertainty. This is the most complete study to date due to the consideration of the forest contribution as well as density, grain size, ice lens and soil roughness variability or uncertainty, with the latter effects providing no surprises based on other similar studies. In addition, to my knowledge, this is the first study to look at the effects of the bridging assumption between low and high density snow in the context of real data. The nominal simulations are considered to include a given grain scale factor, the density bridging assumption and appropriate treatment of ice lenses, before looking at other effects, which is a logical approach to take.

Specific comments:

- This study looks at 3 different sites within the Canadian sub-Arctic, which gives a range of snowpack properties, but makes the paper somewhat hard to read. Due to the wide range of measurement locations, a figure with the sites indicated on a vegetation map would be useful.

- In the James Bay measurements, the mean snow density from January to February decreased, and with minimal increase in grain size. Is this expected for this site? Is this due to the influence of recent precipitation, or spatial variability in the measurement locations? Also, how is the mean grain radius calculated?

- Constant soil parameters from a different study were used here (section 2.2.3). The authors must comment on the applicability of these parameters to the sites chosen for this study. The experiment presented in section 3.2.1 considers the effect of the roughness of the soil, but not the permittivity, which governs the Fresnel reflectivity and is a more fundamental parameter. The authors note this limitation later in the section, but I do not agree with their statement (pg 5732, line 15) that this does not affect their main goal. It may do, as the variability in the permittivity may cause greater snow TB variability than is possible to simulate with adjustment of the roughness alone. The authors should justify why a particular constant value of permittivity derived elsewhere is an appropriate assumption here or base the sensitivity on permittivity rather than roughness variability.

- Pg 5730 line 9-11. This is really hard to see in the figure. There are multiple outliers that easily cover this range in the simulations, so this sentence should be more precise.

- Figure 6, right doesn't add much to the message of the paper and diverts attention as there are many figures in this paper. As it has already been summarised in a single sentence I would recommend removing the figure.

- Section 3.2.4. How was the density of ice lenses measured in the field and what was the result (alternatively this comment may belong in the next section if 'was attempted' should be replaced with 'was not attempted').

Technical comments:

pg 5724 line 6. Make clear that the SSA is per unit mass rather than per unit volume.

pg 5724 line 15 and onwards. JB may be a better, easier to read acronym than BJ.

pg 5726 line 22. As a scaling factor of 3.3 has been applied following previous work, presumably non-sticky grains are assumed in the DMRT-ML simulations. This should be stated.

pg 5727 line 21. In setting ice lens thickness to 1cm, how are the thicknesses of the adjoining layers adjusted, or is the overall depth of the profile in the simulations allowed to differ from the measured depth?

pg 5728 line 11. This should be > 350, not < 350.

pg 5729 line 20. The bridging implementation was tested for simulations based on snowpit data rather than tested on snowpits themselves.

pg 5734 line 12. gains -> grains

lg 5736 line 11. weaker -> less

Interactive comment on The Cryosphere Discuss., 9, 5719, 2015.