

## ***Interactive comment on “The microwave emissivity variability of snow covered first-year sea ice from late winter to early summer: a model study” by S. Willmes et al.***

### **Anonymous Referee #3**

Received and published: 26 January 2014

An excellent paper on a very important subject. I suggest a number of smaller improvements/clarifications below, but in general the paper is publishable.

P5711L13-14: It is not quite clear what these percentages are of. In relation to ice concentration the relevant reference value could be the emissivity range between ice and water (and some considerations on measurement accuracy). It is not clear why the values given in the abstract differs from those stated in the discussion section P5722L27?

P5713L17: Variations in SIC retrievals are not only affected but rather dominated by anomalous snow emissivities.

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P5713L18: Properties influence -> properties may influence

P5716L10-14: I assume that the "setting" of the snow/ice temperature and the 1:3 relationship between the temperature gradients are only initial conditions and that SNTHERM will subsequently model these as the snow properties and environmental conditions evolve?? Please explain that thesis section is just for initialization. Since the numbers given cannot be assumed to be in thermodynamic equilibrium, did you consider a spin-up period from which data are not used in the subsequent analysis of emissivities?

P5717L4: Equation numbers are wrong. Should be eq2 and eq3, not 1 & 2.

P5718L3-5: The early effect of melt will increase emissivity (as is also evident from fig 3), so it is hardly the 'beginning effect' of surface melt that moves the signatures towards the OW tie-point in 37V vs 19V space. On the contrary it is more likely the very coldest period in Winter that stretches the cloud of points towards the OW point. It would require melt pond formation to get a similar effect in June, but I understand that melt pond formation is not included in the thermodynamic model and therefore cannot be the explanation. A comparison between fig 2 and fig 3 does not help understand where the few very low e19V values occur from (TB19V<200K). Please substantiate or change explanation.

P5719L28 & Table 1: It is surprising that in Table 1 the reference values are almost ALWAYS the largest ones, since variables are changed up and down and thus some of them should be able to generate higher emissivities. I suggest something is inconsistent in the computations here. Please explain or fix. P5720L21: Penetration into the ice -> Penetration into the snow (or snow/ice)? Please be specific.

P5721L8: The values for trends seem very high (and not small as stated) or are the units wrong. emissivity changes of even 0.01 per decade is huge and 0.08 per decade would be devastating for SIC retrievals. Please expand discussion and again reference to the emissivity difference between ice and water.

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P5721L17: determined -> assessed

P5722L9-11: How would you suggest doing this? Easy to say that we need this, but.....

P5722L26-18: See comment to Abstract and provide consistent numbers or explain in more detail why they differ.

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Interactive comment on The Cryosphere Discuss., 7, 5711, 2013.

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