Comments

General

With this work the authors achieved insight in several aspects of modelling and observing arctic sea ice with 1.4 GHz brightness temperature data from SMOS for November 2012 and March 2013. The key to the results is the coupling of a full set of models, consisting of meteorological forcing, sea-ice physics, microwave emission and comparison with observations. In spite of some inconsistencies, especially during the sea-ice growth phase, the results are encouraging. I am glad for these results. Congratulation! Exploration on what these results mean with respect to sea-ice research would be helpful. Unfortunately the text is often unclear, sometimes misleading or erroneous, the main reason why it took me a long time for writing this response. The authors should try to find a more appropriate title and better names for each section. Furthermore they should reduce the hand-waving explanations in words, and instead use the logic of mathematical formulations. Furthermore, there is a need for improving the language.

Special - suggestions for improvements

1) Throughout the paper change from plural to singular (as already done in Table 2) for:
- "sea-ice thicknesses" because there is only one thickness parameter for sea ice.
- "snow thicknesses", even better, use "snow depth".
- "sea-ice concentrations", unless you distinguish between different types of sea ice (e.g. first year, multi year).

2) Section 2 "Data and Methods". This section is poor:
- formally (longest part of Section 2 without any subsection, followed by short Subsections 2.1 and 2.2, and by a related Section 3),
- logically (models are not well presented, some parameters not defined, equations are missing, Figure 1 confusing, Table 1 inconsistent with text for brine volume fraction),
- with respect to the motivation for this paper (e.g. the multilayer model description starts with "The incoherent model used in Maaß et al. (2013) is based on", without any indication why this text is found here, and the same holds for the single-layer model). Start e.g. with "For our analysis we selected ... It is useful because ..."
- and details:

p. 1, line 22: The statement "Microwave radiation is especially useful to derive thin sea ice thicknesses as it is able to penetrate snow and sea ice for more than half a meter". This statement is incorrect because it is far too general. Microwave (1 to 300 GHz) penetration into sea ice is certainly much less than half a meter in most types of sea ice and it is marginal even at the lowest frequency.

p.3, line 6: ORAP5 seems to play an important role. A description would help, a proper reference is a 'must'.

p. 3, lines 14 - 15: What do you mean with "salinity ration"? (misprint?)

p. 5, lines 3-4: Improve this part, but do not try to correct the galactic radiation nor let the atmosphere deviate. What do you mean?: "To account for corrections of the galactic background radiation and atmospheric deviations a simplified atmospheric model (Peng et al., 2013) is taken forced by..." And why do you use a simplified model? What kind of simplification? Use mathematics to show exactly what you did. Readers might want to check.

p. 5, line 17: What do you mean with "temperature insulation"? Do you mean "thermal insulation"?

p. 5, line 23 once more: "The incoherent model used in Maaß et al. (2013) is based on radiative transfer equations and describes the emitted radiation from a stratified bare soil". Please be more specific, e.g. by writing "... describes the upwelling brightness temperature at h and v polarisation from

bare soil represented by plane-parallel layers with or without surface roughness".

p. 5, line 27: The snow density selected seems to me rather high for the usually shallow snow layers found on sea ice. Why do you consider a fixed value?

p. 5, line 32 to p. 6, line 3: Modification of the model. Either describe exactly what you did or delete this part. Note that there is a risk of introducing errors.

3) Improve the description of all methods by using appropriate figures for explaining the geometry, angles, etc. as well as mathematical formulas at least for the relevant expressions to enable definitions of the coefficients mentioned (p. 3).

4) p. 7, lines 3-5: Improve physics and timing in "In the melting season, when melt ponds form on sea ice and temperatures begin to rise". Note that temperature rise is much earlier than formation of melt ponds. Explain what you mean and improve the sentence that follows: " SMOS brightness temperatures over sea ice are impossible to connect to a specific sea ice property (Kaleschke et al., 2010)". The logic to the next sentence and its meaning are not clear: "Thus, November and March are the first and the last month, respectively, with full monthly data coverage from SMOS and therefore chosen."

5) p. 7, line 15 - : Improve " chosen as values higher than that are not expected to be seen". Also improve the following sentence: " The brightness temperature product consists of vertical and horizontal polarization, which are averaged up to 40 incidence ...". I do not understand. And what do you mean with the sentence that follows? " These brightness temperatures are said to represent L-Band measurements at nadir as brightness temperature changes that are connected to the varying incidence angles are expected to cancel out each other when both polarisations are considered."

6) p. 7 "Sea water correction" What do you mean? Please do not try to correct the water! Please first explain the purpose of this section, and then improve it, especially explain what Figure 2 is supposed to show. Its legend cannot be used to understand what the data clouds mean, nor is the caption of any help. Furthermore the quality of these data is not convincing due to the poor correlation shown. And there must be a reason for the Tb correction. Try to find the error.

7) p. 8 "Brightness temperature comparison". Give a motivation to the reader for not skipping this section. If it is a 'result' section, then please call it accordingly.

8) p. 10, line 1, also discussion p. 17-18: Explain what the "Kolmogorov-Smirnov-Test " is supposed to check and present the results properly. This is relevant because you use this information for the decision to drop one of the models used. Can you support this decision by physical arguments?

9) p. 13, Figure 5: Nice representation. However the concentration of data points near the two main spots causes problems in the interpretation. It appears that the assessment of thin ice and medium ice concentration is difficult. Think about how to improve the situation, e.g. by omitting some of the data.

10) p. 13, lines 16-17: "we observe an underestimation of sea ice concentration" underestimation by what, i.e. which model?

11) p. 15, Figure 8: Exchange the two legends in order to be close to the respective y axis, and clarify 'growth model' with respect to caption (Lebedev ?). What is the role "Lebedev" is playing here (missing in Sect 2).