The paper by Paţilea et al. deals with retrieving thin sea ice thickness (SIT) from L-band radiometry using brightness temperatures (TB) from two different satellite missions: SMOS and SMAP. The study mainly deals with three things: 1) An existing SIT retrieval is applied to a newer data version of SMOS. 2) A slightly different approach to fit TBs in the SMOS retrieval is applied (using a TB fit to a specific incidence angle, e.g. 45°, instead of using the average TB from measurements between 40 and 50°). 3) SMAP TBs are "converted" to be used in the SIT retrieval, which was originally set up for SMOS, and combined SMOS and SMAP SIT maps are produced.
The produced maps are compared with each other but not compared with independent SIT data.

Unfortunately, the used methods are not described precisely enough (see, for example, comments 6), 10), 11), 12) below). Furthermore, the Level 1B SMAP data is claimed to be "top of the atmosphere" TBs, i.e. atmospheric effects are not taken into account. However, according to the Algorithm Theoretical Basis Document (ATBD): "SMAP Calibrated, Time-Ordered Brightness Temperatures L1B_TB Data Product" [1] and De Lannoy et al. (2015) [2], for example, SMAP Level 1B TB data are "corrected for atmospheric effects". As far as I know, this is also one of the reasons why SMOS (Level 1C) TBs (which are not corrected for atmospheric effects) and SMAP (Level 1B) TBs differ. Thus, it is not clear how the authors dealt with this. In general, I think the differences between SMOS and SMAP should be discussed and presented in more detail.

Another issue is that there is a study by Huntemann et al. (2016) [3] that deals with using SMOS and SMAP for ice thickness retrieval and shows a resulting map (it is mainly with the same authors). The paper ([3]) gives the difference between SMAP and SMOS retrieved SIT for Oct to Dec 2015 and contains a SMAP SIT map and the SIT difference between SMAP and SMOS for 7 Oct 2015, while the paper presented here compares the combined SMOS and SMAP SIT with SMOS SIT and shows a combined SMOS and SMAP SIT map and how it differs from SMOS SIT for 11 Oct 2015 (Fig. 5). As these two studies seem to deal with very similar things, I think it is very important to clearly state the difference and the "added value" of the study presented here. My main concern is that there is already a paper ([3]) that shows how SIT retrieved from SMAP compares with SIT retrieved from SMOS (for the TB polarization difference and intensity approach) for Oct to Dec 2015. The new thing in the study presented here seems to be that SMOS and SMAP SIT are not compared but instead averaged to form combined SIT maps, and these have been compared to SMOS-only maps for Oct to Dec 2015 (I think this is the period, see comment 19)). However, as it is not clear how the SMAP SIT or the combined SMOS and SMAP SIT compare with independent SIT data, just combining the two data sets, as done here, does not necessarily bring new information.

The manuscript contains several spelling errors that could have been avoided by simply using a spell checker (thus I will not point them out). Furthermore, the style of writing could be improved and the usage of commas should be revised. Not all statements are supported by references (or a reference is given that I cannot find/access), see specific comments below.

Specific comments:

1) Introduction:
- I think the introduction should be improved in that the work presented here is put more into a scientific context. Is this the first time SMOS and SMAP are merged? What are the "challenges"? Why not elaborate more on the differences between SMOS and SMAP? This is not mentioned at all in the introduction (only shortly in the abstract but that should be independent). In general, I think that the introduction (especially starting from p. 1, l. 22) may be hard to understand for those who are not very familiar with the SMOS SIT retrieval and the SMAP mission.

- No references given for statements made in the first lines of the introduction (p. 1, l. 10-13) and for "*The atmosphere has little influence on the radiation at L-band as both absorption and scattering are small.*" (p. 1, l. 16-17).

2) Several sentences start with "*It*" or "*This*", which can make reading hard because it is not always clear what "it" or "this" refers to (especially if referring to something mentioned in the last sentence or even earlier...).
Example 1 (four sentences in a row): "*and it will be used... This is combined ... It is used for... This is also...*" (p. 1, l. 24 - p. 2, l. 1)
Example 2: "*It adds better ... At the same time it ...*" (p. 2, l. 17-18)

3) p. 2, l. 9-15, including eq. (1): Maybe this section is not needed because this is not the focus of the study and seems to be the same approach as in Huntemann et al., 2014?

4) Statements on p. 2, l. 17 ("*It adds better RFI flagging...*") and l. 20-21 ("*The new data version also reduces...* ") are not supported by references. Is "SMOS Calibration team and Expert Support Laboratory Level 1, 2015" the reference for these? I cannot find or access this. Please provide a web link or other hints how to find this. Also the "Indra Sistemas S.A.: SMOS Level 1 and Auxiliary Data Products Specifications, Product Document, Madrid, 2015" reference may contain more information to make it more easy to find. References for statements in p. 2, l. 29 - p. 3, l. 3?

5) p. 2, l. 18-19: "*... it introduces a warm bias in the brightness temperatures of aproximately 1.4 K relative to the previous version 5.05 over ocean...*" -> Is 1.4 K warmer brightness temperatures over the ocean more/less realistic? Or just a trade off to get the SMOS brightness temperatures over land (and Antarctica) closer to modeled and measured values? But for this study this is not important anyways because no changes were observed for the high latitudes? This is somewhat confusing...

6) p. 2, l. 29 - p. 3, l. 5 two RFI filters are described. However, it is not mentioned which RFI filter approach is used in the study presented here. Later (p. 4, l. 28-30) you describe a third RFI filter method. Were different RFI filters used for different parts of this study?

7) p. 3, l. 12-14: "*retrieval based on a fitting function ... through the full incidence angle range. This will provide more stable brightness temperatures and is necessary for a consistently combined SMOS and SMAP ice thickness retrieval.*" -> What is the "*full incidence angle range*"? Why is this "more stable"? More stable than method by Huntemann et al., 2014? Is that a result of the work presented here? Or has that been shown somewhere else (where?)? Please clarify. Why is fitting through the full incidence angle range "*necessary for a consistently combined SMOS and SMAP*" retrieval if SMAP measures only at one incidence angle?

8) p. 4, l. 6: "*From a total of 5.1 million data points,...*" -> Where does this number come from? All Arctic data points from a certain time period?

9) p. 4, l. 19-22: Maybe a reference to a paper that describes the SMOS snapshot geometry would be useful here.

10) Where do the equations in eq. (3) come from? How is C "*determined by averaging the sum of the polarizations for each observation*" (p. 4, l. 33-34)? After all fit parameters a_h, a_v, b_h, b_v, d_v have been determined first (are they determined for each observation? for each incidence angle range? as generally valid values?) ?

11) p. 5, l. 9-10: "*only grid cells with the incidence angle range of observations that covers the wanted angle, e.g. 45°, are used for the retrieval*" -> What is the exact criterion here? (e.g. "only

grid cells that contain at least *N* observations with incidence angles θ±Δθ around the considered incidence angle θ")

12) p. 5, l. 27-30:
-"*On the other hand for many ocean areas which formerly were excluded by the RFI filtering (grey in Fig. 4 left) now data is available, e.g. around Iceland, Eastern Greenland and Vladivostok.*" -> I don't know which TB measurements are used for the "fitted 45° brightness temperature" method... The text says that you need "*at least one observation under 40°*" and that you use "*only grid cells with the incidence angle range of observations that covers ... 45°*" (see also comment above). If the latter means, for example, that you use incidence angles between 40 and 50° PLUS at least one measurement with incidence angle <40° (which adds at least one more possibility to encounter an RFI-contaminated observation), how can this method be less influenced by RFI than the algorithm that uses the daily mean from measurements between 40 and 50°? Is it because of different RFI filters? (see also comment 6)) Is there a minimum number of measurements that has to be available in order to perform the SIT retrieval?
-"*At the same time in the area of the Hudson Bay there is a 30% decrease in the area covered due to the high uncertainty of the fit.*" -> How does the "*high uncertainty of the fit*" influence the number of grid cells the retrieval is performed on? Is there a criterion for cases in which the retrieval is terminated / not performed? Is that given anywhere in the manuscript?
- Is the same number of SMOS measurements used for both retrieval approaches here? SMOS data can be quite "scattered", the number of data points used/averaged in the retrieval can have an impact on the results...

13) In the manuscript text, Fig. 4 is mentioned before Fig. 3.

14) p. 6, l. 1: "*estimated retrieval error of 30% of SIT.*" -> Where does this number come from?

15) p. 6, l. 5: "*within the error margin of the retrieval*" -> Which error margin? From where? (the 30% given in l. 1?)

16) Do the RMSD and bias given on p. 6, l. 2-5 refer to the comparison of the two retrieval approaches for just the one day (29 Oct 2010) shown in Fig. 3 and 4? I wouldn't consider this representative...

17) p. 6, l. 16-17: You mention that Lannoy et al. (2015) take into account atmospheric contributions for SMOS "*to convert between SMOS and SMAP TBs*". You didn't, did you? (earlier (p. 2, l. 26) you claimed that SMAP TBs are "*top of atmosphere*"). Please write clearly what YOU have done to bring SMOS and SMAP TBs together and how and why your approach differs from other approaches etc.

18) p. 7, l. 1-2: "*For 11 October 2015 (not shown) the differences ... between SMOS fitted TBs retrieval and SMAP retrieval are small.*" Why do you pick one day to state this, and then not even show it? What about the other days? What is "SMOS fitted TBs retrieval" here? The one fitted to 40° incidence angle?

19) p. 7, l. 13-14: "*The RMSD between the original 40◦ to 50◦ incidence angle daily mean retrieval from Sect. 3.1 and the new mixed sensor one is 2.14 cm for the three months period investigated, while the bias is -0.63 cm...*"
-What is the "*three months period investigated*" here? The same as was used for calibration earlier (Oct to Dec 2015)?
-It would be interesting to know the difference between SIT from SMOS fitted to 40° and SMOS+SMAP; otherwise we cannot distinguish whether the difference comes mainly from the

different approaches for the SMOS retrieval (fitted to 40° or mean between 40 and 50°) or the different sensors (SMOS or SMOS+SMAP). Indeed, the values from the comparison in 3.3 are very similar (bias 0.69cm and RMSD 2.2cm), although a) I am not sure in which direction the negative sign in "-0.63 cm" points here, and b) the results in 3.3 seemed to be for a comparison of one day only.

20) In the conclusions, there seems to be a "new" result: "*Using SMAP data and the SMOS data fitted to the same incidence angle to calibrate the SMAP TBs to those of SMOS has improved the TB RMSD between the two datasets for both polarizations with 2.7 K and 2.81 K for TBh and TBv, respectively.*" (p.7, l. 22-24) -> This was not mentioned before. Do you mean improved to or by 2.7K? The sentence is hard to understand, also because the reference to the "improvement" comes only in the next sentence. It says "*This is an improvement from previous attempts (Huntemann et al., 2016) where the the RMSD for both polarizations was over 4 K showing that using fixed incidence angles for SMOS data increases the accuracy.*" The phrasing could be clearer (who concludes this?). And I don't agree... 1) This shows only that SMOS and SMAP TBs as compared here and in Huntemann et al. 2016 agree better if a fixed incidence angle is used. And as I don't know how you dealt with the atmospheric corrections for SMOS, I cannot say whether it is a good thing that the SMOS TBs you used here (not corrected for atmosphere? corrected differently than SMAP?) and the SMAP TBs (atmosphere corrected) are closer to each other or not... 2) Averaging SMOS TBs differently does not "*increase the accuracy*" of SMOS data, but these SMOS data might be more suitable for comparison with SMAP.

21) What about ice concentration? Has big impact on L-band TBs but is not mentioned at all.

22) The numbers given in Tab. 2 for the "*original 5.05 data version*" (SMOS) do not correspond to the numbers given in the literature for this SIT retrieval with SMOS (Huntemann et al., 2014 & Huntemann et al., 2016). (a and b interchanged for I_abc; different a, c, d for Q_abc).

23) Fig. 1 in the current print version is quite small, especially the label font size.

Further comments:

p. 1, l. 4-5: "... *SMAP observes at a fixed 40◦ incidence angle which makes thin sea ice thickness retrieval more stable as incidence angle effects do not have to be taken into account.*" -> Why would this be "*more stable*"? Isn't it mainly a restriction to not have any measurements at incidence angles other than 40°? For example, wouldn't a retrieval using only SMOS measurements at 40° be as stable?

p. 1, l. 20: Very abrupt and sudden transition from describing SMOS to introducing SMAP.

p. 1, l. 22-23: "... *by calibrating the SMAP brightness temperatures (TBs) to those of SMOS*" -> Why do SMAP measurements have to be calibrated to SMOS measurements? Here you could mention whether/how they differ. I guess this has also to do with SMOS brightness temperatures having been compared (or "validated") with other sources (in Huntemann et al., 2014, for example).

p. 2, l. 12: "*the the*"

p. 2, l. 16: "... *version 6.20 has been available since 5 May 2015 operationally...*" -> version 6.20 has been operationally available since 5 May 2015

p. 2, l. 24: "*a equator*" -> an equator

p. 2, l. 24: "*...data is used, which contain...*" -> "...data is used, which containS..." or "...data ARE used, which contain..." (but then "data" has to be used as a plural word throughout the paper)

p. 2, l. 27: "*36x47 km*" -> 36 km x 47 km

p. 3, l. 20: "*retrieval curve*" singular vs. two equations

p. 4, l. 7: "i*t increases*" -> they increase?

p. 4, l.10: "*This allows to estimate*" -> I think this is grammatically incorrect (while "This allows us to estimate..." should be ok I guess)

p. 4, l. 13-14: Remove "*given above*"?

p. 4, l. 29: "*observation*" -> observations

p. 7, l. 17-18: I recommend to combine these two lines to one because they are very repetitive.

p. 7, l. 19: "*rage"* -> range

p. 7, l. 25: "*the the"*

References:

[1] Algorithm Theoretical Basis Document (ATBD): "SMAP Calibrated, Time-Ordered Brightness Temperatures L1B_TB Data Product", J. Piepmeier, P. Mohammed, G. De Amici, E. Kim, J. Peng, and C. Ruf (2014), e.g. Tab. 1, p. 11, file accessed at https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwiF2sqb3MDYAhVBa1AKHbJKAfIQFgg2MAI&url=https%3A%2F%2Fsmap.jpl.nasa.gov%2Fsystem%2Finternal_resources%2Fdetails%2Foriginal%2F278_L1B_TB_RevA_web.pdf&usg=AOvVaw34MP0zjMXDqHm83OB1qAog

[2] De Lannoy, G. J., Reichle, R. H., Peng, J., Kerr, Y., Castro, R., Kim, E. J., & Liu, Q. (2015). Converting between SMOS and SMAP level-1 brightness temperature observations over nonfrozen land. *IEEE Geoscience and Remote Sensing Letters*, *12*(9), 1908-1912.

[3] Huntemann, M., Patilea, C., and Heygster, G. (2016): Thickness of thin sea ice retrieved from SMOS and SMAP, in: Proceedings of 2016 IEEE International Geoscience and Remote Sensing Symposium (IGARSS), pp. 5248–5251.