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Interactive comment on "Empirical sea ice thickness retrieval during the freeze up period from SMOS high incident angle observations" *by* M. Huntemann et al.

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In this paper the authors propose and attempt to validate an algorithm to derive thin ice thickness from brightness temperature data from ESA's SMOS mission. General comments: The subject is highly relevant and the paper contains sufficient evidence for the method to be applied in a wider context and data made available to a wider user community. The paper would generally benefit from a thorough revision of the english language.

Specific comments

P4380L1: needed for climate modeling... -> important for sea-ice modeling...

P4380L19: to few -> to a few

P4380L22: mission is observing -> mission has been observing

P4380L23: At this frequency -> At this microwave frequency

P4380L24: Please provide reference or evidence for 50cm penetration depth

P4380L24: I suppose you mean less saline ice, not water?

P4381L6-9: There is a huge difference between TB for open water and ice also at higher frequencies (C- and Ku band), but no apparent stronger sea ice thickness signal there. TBH18 for water is around 100K and TBH18 for ice is in the order of 240K. This cannot be the main argument for looking for ice thickness info in the SMOS data.

P4381L10: for nadir observations up to 40 -> for observations up to 40

P4381L20: takes radiances -> observes or measures radiances

P4382L2: errors of a few -> errors of no more that a few

P4382L3: SMOS footprint with its size at nadir about -> SMOS footprint size at nadir is about

P4382L4: Since most of the remaining paper is about the incidence angle range 40-50 degrees, it would be more relevant to know the foorprint size at 45 degrees than at 65!

P4382L10: each second -> every other

P4382L21: sorted out -> discarded

P4382L22: I would think that even a TB of 280K would be unrealistically large during freezing in the Arctic, so why exactly 300K? TB of ice will be <273K and TB of water will be even muck lower. TB of land areas would also be <280K during frezeup?

P4383L7-10: This is not clear, and perhaps not necessary. Either remove or explain properly. Perhaps just replace by a reference.

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P4383L22: ground truth -> a reference for comparison (model data cannot be ground truth!)

P4384: For all the model systems please provide some model version number or similar, since all these models evolve with time.

P4384L15-18: As an example it is not clear if you are using data from ERA40 or ERA-Interim. ERA Interim resolution is approx 75 Km though, so perhaps it is ERA40? Please specify.

P4384L23: In general CFDD models use 0 degrees as reference. Please check if your reference (which I do not have access to) states that it should be -1.8 or if that is just something you assumed?

P4384L25: Because of the region -> Because of the limited region

P4385L1-2: Please provide a reference for sea ice drift being small in these regions

P4385L5: What do you mean by 'too large errors'? This is a vague statement.

P4385L6: Ice thicknesses will be correlated over large distances since air temperature has large correlation lengths! Perhaps what you mean is that the ice thicknesses are computed from independent model grid cells (which is also not true since data assimilation procedures imposes correlations across large model domains). If you use model data (ECMWF) with a grid spacing of 1.5 degrees your points are closer than that. This statement needs reformulation.

P4385L16: CMDD ice decay models also exist which you might have applied.

P4385L23: I only see a correlation up to about 20 cm and the correlation seems to be also with ASI suggesting that it is an ice concentration effect rather than an ice thickness effect. I suggest using a scatter plot instead of a time series for this argument.

P4386L1: If possible provide a reference for underestimation of thin ice in most SIC algorithms

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P4386L4: Please check with wind data instead of speculating.

P4386L6: Heygster et al, 2012 is an ATBD. If this has more results than this paper, I suggets to summarize the results from the ATBD instead of just showing examples.

P4386L13-15: Scatter plots of data (I and Q vs x) please. 'in an appropriate way' is hardly convincing when the reader cannot see!

P4386L23-28: This argumentation is not stringent. Please rewrite. In fact fig 5 show that SIT varies with both I and Q throughout the thickness range (which I guess is the whole point of the algorithm). I suggest to rephrase to something like "At SIT>50cm the retrievals become very sensitive to noise in I and Q"

P4386L27: incident ->incidence

P4387L15: the NCEP CFDD -> the training NCEP CFDD

P4387L16: error -> uncertainty

P4387L18-19: it is not clear how the restriction (cut off) of SIT>50 can lead to larger deviations. This should lead to smaller deviations since you have removed half of the variance?

P4387L19: "margins" is not the right word here

P4387L21: errors -> uncertainties

P4388L4-5: MODIS data have to be -> MODIS data were

P4388L6: resolution -> resolution before the analysis

P4388L6-8: You argue elsewhere in the paper that comparing data from two days is a reasonable consistency check, so perhaps rephrase here to "Another smaller discrepancy" or something like that.

P4388L14-15: screened out in the SMOS retrieval because of potential land influence -> screened out because of potential land influence in the SMOS data.

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P4388L23-24: Again if you have more data analyzed in the ATBD, please synthesize instead of just showing an example. Comment relevant to figures 4 and 6.

P4388L26: errors of mostly 40-50% -> uncertainties up to 40-50%. (Mostly 40-50 means 40-50 most of the time which I presume is not what you want to say).

P4389L7: I thought the EM-bird was a more or less off the shelf instrument. http://www.geomatrix.co.uk/em31-mk2.php or older versions

P4389L9: How can you use the conductivity of water to get a height difference?? Please reformulate.

P4389L11: Please provide a reference for 10cm (perhaps Haas et al, 2009?)

P4389L15: "we expect the EM-bird to deliver valuable validation data" is vague.

P4389L20: SMOS resolution is not 12.5 km, so what is the point.

P4389L20: If you think averaging over a day is an issue (as stated earlier but later downplayed in the section on consistency) you should explain why you do not use swath data (which are available) or have a closer look at deltaSIT(FDD)/deltaT where deltaT is 1 day (what are typical changes of thickness during a day). This could provide some quantification of this uncertainty which would be helpful in the interpretation.

P4389L27-28: The EM-bird measurements should provide data to allow a better assessment of lead frequency/fraction along track.

P4389L28: Please provide numbers for SMOS footprint size at 40-50 degrees incidence angle.

P4390L5-10: A median value is not an average! Why not use simple average? Is +/- 25 km appropriate for the SMOS SIT footprint? It seems this is done on a 12.5km SMOS grid, so the SMOS SIT values are highly correlated. I am not sure the correlation is very meaningful in this case.

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P4390L19-20: variations in SIT in order of +/- 10 cm occur quite seldom -> deviations in SIT in order of +/- 10 cm are rare

P4390L24: perpedicular -> perpendicular

P4390L28: You could help the reader by noting that this location is in the Laptev Sea

P4391L1: concluding, this is a realistic -> In conclusion, the SMOS data generally provides a realistic

P4391L5: of -> from

P4391L5-6: Kara and Barents sea -> Kara and Barents seas

P4391L14: retrieval data bases -> validation data sets

P4390L21: growth speed -> growth rate

P4391L22: Even though EMbird may be the most reliable method for measuring SIT at a location, the EM dataset suffers from lack of spatial coverage, even within the SMOS footprint, so I would not call it the most reliable validation data.

P4392L12-13: SUggest to reformulate to: We thus expect the strongest influence on the retrieval from temperature and snow cover and we suggest that these influences should be investigated further.

P4395L21: Please provide page numbers for book reference (not number of pages in book, but which page you are referring to).

P4399: Please provide color legend for figure.

P4400: A km scale would be useful

P4401: The colours are hard to distinguish. It would be interesting to have included also 2m air temperature (that drives the FDD) and wind speed. This could enlighten the discussion about possible reasons for the SIT reduction in certain periods.

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P4403: Since you have much more data in the ATBD, you should synthesize that instead of just showing an example on 1 day.

P4404: You should include whiskers indicating 1 standard deviation of the variablity in the EM-bird measurements. Each datapoint could have a horisontal line showing +/- 1 standard deviation, or even going all the way from min to max.

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