Measuring sea ice concentration in the Arctic Ocean using SMOS

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The use of L-band data for deriving SIC especially during summer, is indeed very welcome and relevant. During summer traditional sea ice concentration (SIC) algorithms using higher frequency channels (19-90GHz) have high uncertainties because the higher frequency brightness temperatures (Tb's) are affected by emissivity variability in the snow/sea ice surface fraction and because of higher levels of water vapor and cloud liquid water in the atmosphere than in winter. L-band Tb's are less sensitive to both noise sources (than 19-90GHz Tb's). In addition SMOS is measuring at several incidence angles at every point which can be exploited in the SIC retrieval (as it was done in this study).

So the idea is good, however, this MS is a collection of elements and sections which are not well integrated and focused towards the actual aim of retrieving SIC: for example, the sea ice forward model is used for selecting the parameters AD and PD to use for SIC retrieval and for estimating uncertainties, however, this may have been more convincing using measurements, or at least a combination of simulations and measurements. This could also give credibility to the model simulations.

Several assumptions needs supporting references or investigations (using data), for example, the postulate that Sic is a linear function of AD and PD and that the summer sea ice tie-point is derived from data which are at 100% SIC.

Specific comments:

P1, L19-20: SIC as an essential climate variable (ECV) has perhaps the longest continuous time-series of satellite measurements among all ECV's and its decline is measured in detail. I don't understand what is meant by lack of observations. You need to specify that.

What is meant by quasi-continuous? Please reformulate or delete the sentence.

P2, L22: It is important to state here that fig. 1 is for open water (it is not mentioned!). Fig. 1 could be relevant for discussion of the open water tie-point. Please include it in the discussion or delete it. The open water (L-band) emissivity is in addition to salinity also sensitive to SST and wind-speed.

P2,L25-26: Please mention the range of frequencies so that this is clear in the sentence.

Even though the MY and FY ice Tb's at L-band are overlapping there may be some differences in the mean value. This is a problem for the SIC retrieval since you may be introducing an ice type SIC bias. It needs to be shown, using measurements, how you handle this.

P2,L31: delete "quasi"

P2,L35: delete "theoretical"

P3,L20: Is the galactic reflection correction applied or not?

P3L23: It is unclear what is corrected at the bottom of the atmosphere (surface?) using what?

P3L26: What is the full range of incidence angles? Are they also extrapolated?

P3L30: Add "for comparison" at the end of the sentence.

P4L2: Add "dynamic" after "monthly".

P4L19: replace "observing" with "electromagnetic"

P4,eq.1: Eq. 1 is describing the self-emission of a homogeneous and isothermal material and there is no term for atmospheric reflection or emission/scattering. Perhaps less important terms at L-band but worth mentioning.

P4L23: Derbye, 1929, maybe there is a more sea ice relevant reference?

P4L23: Add: "…depend on the incidence angle and…"

P4L24: replace "complex value" with "complex number"

P5L18: "decrease" or "increase"? please give reference.

P8L18: reference for the physical parameters variability needs to be given. Only these three parameters contribute to the budget? Could perhaps also mention snow cover, sea ice type…

P9L29: SIC as a linear function of AD and PD. You need to show that this is true (using measurements), otherwise you will have to build in the non-linearities into the SIC model.

P11L3-4: why "less prone to errors"? and what is "natural way"?

P13L31: Sensitivity to physical temperature. This might be true for some algorithms but not all, please give a reference.

P14L1: "sensitive" -> "sensitivity"

P14L11: The advantage.. this sentence is nonsense. All tie-points are derived empirically and static tie-points are prone to errors due to sensor drift or seasonal variability, geophysical and climatic trends (in the noise).

P14L30: (less noisy) than what?

P15L1: what is meant by "good" correlation? Please quantify.

P15L13: The AD and PD ice- water contrast is not high for all incidence angles. The Tb contrast is high at all incidence angles. The dynamic range (between ice water) using Tb is much higher than AD and PD and therefor they could be less noisy. Please explain.