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Interactive comment on "A sea ice concentration estimation algorithm utilizing radiometer and SAR data" *by* J. Karvonen

Anonymous Referee #1

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In this paper an algorithm is presented to combine segmented SAR imagery with polarization and gradient ratio data from AMSR-2 in order to map an ice concentration value to each SAR segment. Overall the paper is well-organized and well-written. However, there are a few issues that require attention before publication.

p. 2217 lines 11-21 - The authors state that the incidence angle correction does not work over water, but this does not affect the results as long as the open water and ice segments are separated. For the results presented here, they may have been separated, but how robust is this result? Could the authors state under what conditions this might be a problem. For example, what was the range of wind speeds for the image areas and times over which the algorithm was tested? In addition, how necessary the incidence angle correction? On p. 2222 lines the authors state that

'in the ice covered areas the SAR frame boundaries are not visible indicating that the incidence angle correction for sea ice has been successful' - but these image boundaries were not very visible over the ice in the original mosaics (or perhaps the authors could indicate which Figure they can see these boundaries in and link this with the incidence angle discussion). Due to the fact that water and ice have different dependencies on incidence angle, one might think retaining this dependence might help the classification.

p. 2217 lines 26-27 Were any atmospheric corrections applied to the brightness temperatures? All channels listed would have contamination due to atmospheric effects (e.g. water vapour, cloud water, and windspeed). For example, the overestimation by the algorithm seen in Figure 4(a) (blue area in the Gulf of Bothnia) could be due to weather effects - which might be why it shows up when the ice concentration is compared with the ice charts, but not when it is compared to other passive microwave products (ASI ice concentration - which is nearly, but not completely, weather independent).

p.2218 lines 16-22 Passive microwave brightness temperatures next to or near a land boundary will contain a signature from both the land and the water or ice (see for example *Improving passive microwave sea ice concentration algorithms for coastal areas: applications to the Baltic Sea* by Maab and Kaleschke, Tellus (2010), 62A, 393-410.) Unless the contribution from the land can be identified, the brightness temperatures located a specific distance from the land (e.g., the radius of the footprint for the given channel) are usually discarded. It's not clear from the method described on p.2218 if this is taken into account. Could this be contributing to the problem on p. 2226 lines 10-11 - 'in the case of a narrow ice zone near the coast the ice concentration is not estimated correctly'? Could the authors state in what way it is not estimated correctly (over estimated or under estimated)? A reference to one of the figures indicating where this problem is noted would be helpful to give the reader an

example.

p. 2218 line 25 Why was the mode the chosen metric instead of the mean? For example, if there were outliers in the passive microwave data, due to weather effects or variability in surface conditions, choosing the mode may reduce the impact of these outliers on the results.

p. 2221 line 5 and p. 2236 Figure 3 - Could the authors please indicate the resolution of the AMSR-2 bootstrap ice concentration, and the channels used. While the reader can look up the reference, a sentence would be helpful.

p. 2222 lines1-2 - The reference data were interpolated to the SAR mosaics (resolution 500m) in order to calculate the error statistics. However, this implies that the reference data can be represented at a resolution of 500m, for example a small-scale detail in the SAR mosaic that is not represented in the passive microwave data would show up as an error, but in fact may be correct. Have the authors checked the error statistics carrying out the interpolation the other way around? From this point of view the reference data is left at its original resolution, and the question then is how does the ice concentration from the proposed method compare to this estimate.

p.2224 lines 21 and 22 - The authors state that the set of 10 mosaics is not sufficient to capture the range of brightness temperatures, but seems to be sufficient when using polarization ratio and gradient ratios. Could the authors comment on how they know that their current set 'seems' to be sufficient (maybe they can link this part of the discussion back to that on pg. 2220).

p. 2236 Figure 3 - Zooming in on this figure indicates the ice concentration from the proposed method contains more fine scale detail of the ice edge than what is present in the AMSR-2 or ASI ice concentration. An additional figure zooming in on

part of Figure 3 would help emphasize this result, and would be complementary to the discussion on p. 2226.

p. 2216 line 10 - It would be helpful to add a sentence or two describing the nature of the ice cover on the Baltic Sea at this time of year. Is it completely ice covered? How thick is the ice? How deformed is the ice? Would wet snow or water be expected on the ice at this time of year (this is regarding the comment on p. 2226 l.15)?

p. 2214 lines 20-25 - An advantage of a passive microwave radiometer is that the low frequency channels are not affected by atmospheric conditions.The fact that AMSR-2 has daily coverage over most ice-covered areas is not an advantage of a radiometer, but of the orbit of the satellite carrying the radiometer.

Minor revisions

Acronyms should net be used in the abstract without explanation

p. 2238 In the figure there are 4 panels, but the caption only contains (a), (b) and (c).

p. 2216 Replace 'SAR segmentation' with 'SAR image segmentation'

p. 2218 line 25 upsampled MODIS polarization ratios? should this be up sampled AMSR2 polarization ratios?

p. 2215 line 19 - Leigh et al. 2014 used by HH and HV