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Late summer sea ice segmentation with multi-polarisation SAR features

in C and X-band

Authors: AS. Fors et al.

General:

The authors study the classification of late summer sea ice types based on C- and X-band multi-polarisation SAR data. This task is probably the most challenging in the SAR based sea ice analysis. The paper is a case study consisting of totally five SAR scenes. The results presented show a promising progress in the classification problem. The performed analysis is sound but the text slips occasionally to a report like listing (Results Section). The current paper is a continuation to the work by Moen et al. (2013) . To fully appreciate the paper the reader should be familiar with this work. This is a slight restriction for the paper but hard to avoid.

I had the possibility to read the excellent comments written by the referee 1.

I agree with them, especially the points numbered 1-5. Here I add just some things which were not touched in those comments.

Specific comments and technical corrections:

P4541L22-25: A slightly contrasting claims in two subsequent sentences. First, "... C- and X-band .. largely equivalent", then "X-band ... add information when used .. with C-band".

C: It seems that this issue is still open. Reformulate the sentences.

P4543L10: Individual

P4544 L8: opportunity

P4545L12: The footprint of the EM-bird has a diameter of about 50 m.

C: General question (not related only to the EM measurements):

Please add in the text your opinion about the scales in which SAR image is geophysically reasonable to analyze. For which purposes, except for scientific research, sea ice type classifications in resolutions from 10 m to 100 m are needed? (Leads, heat budget, ...).

P4549L7: dual-polarimetric

P4549L10: 'G'

C: Did you mean B or where is G defined?

P4550L5: 'supervised classifier'

C: An essential part of the supervised classification is the selection of the training areas.

Here this question is ignored. How were the classwise training areas selected, how large were they? Were they selected just from one SAR scene (a good choice) or from several scenes?

In the latter case the temporal evolution of the features has been implicitly included.

Hence, the classification results are not as representative as in the former case.

P4550L14-16: A 7×7 pixels neighbourhood,  $L = 49$ , is used in the classification and a stepping window with steps of 5×5 pixels was employed to reduce neighbourhood overlap.

C: Do you have used the same resolution for RS-2 and TSX imagery? If not, then why not?

The variation of ice surface roughness and other ice features on sea ice layer remain the same independent of the resolution of the sensor. So it would be logical to analyze them in the same resolution, especially if one wishes to compare two different frequencies.

P4552L1 'segmentation uses ..'

C: Do you utilize here a six-dimensional pdf or 6 independent one-dimensional pdfs? If the former option, how do form a 6-D nonparametric density function? Clarify text.

P4551L7-9: A stepping window with steps of 5×5 pixels was used to reduce neighbourhood overlap, and an additional sub stepping window of 10× 10 pixels was used during the algorithm for computation efficiency.

C: This sentence is an unnecessary computational detail. Remove.

P4551L10-11: The algorithm was set to segment the scenes into six different classes, to allow for detection of the major sea ice types visually expected to be present in the scenes.

C: Write out the selected ice classes. Assign also to each color in Figs. 8 and 10 the corresponding ice class, like in Fig. 4 in Moen et al. ( 2013). It is difficult for the reader to assess the images when the color label explanations are imbedded in the text.

P4552L8: 'received'

P4554L1: Differences in ... resolution could also cause the lower accuracies in the X-band scenes.

C: Do you mean that a finer resolution is a disadvantage? You can always decrease the resolution. Please clarify.

P4556L1-15 and P4557L1-12: You can remove the references to the colors when you have added the color labels in Figs. 8 and 10 (see an earlier comment). This also improves the clarity of the text.

P4556-4557: I would prefer using the class labels in Section 3.2. instead of the ROI abbreviation. Then it would be easier for the reader to follow the text.

P4558L12-20: '...The meteorological conditions could explain the poor segmentation of T1....'

C: It is worth noting that R2 was acquired just 24 hours later than T1. Around R/V Lance the air temperatures remained during this period close to zero degree Celsius. However, the results for R2 were good unlike for T1. In this case C-band SAR scene was more informative than X-band scene although the weather conditions were likely very similar for T1 and R2. Add a sentence or two about this in the text.

P4560L11-13: In the other scene the segmentation performed poorly, probably due to air temperatures above freezing point and hence difficult conditions for sea ice characterization by SAR.

C: The classification results were poor for X-band SAR (T1) but not for C-band SAR (R2). Reformulate text.

P4569. Table 4 text: The best result for each ROI and the best overall accuracy for each scene are highlighted in bold.

C: Where is the best overall accuracy? I can not see that in Table 4.

