

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-85

Anonymous Referee #2

Referee comment on "Sea ice and water classification on dual-polarized Sentinel-1 imagery during melting seasons" by Yu Zhang et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-85-RC2>, 2021

This manuscript introduces a new method for the ice mapping based on dual-polarized Sentinel-1 SAR data during summer season. The proposed method was developed from a conditional random field based on mixed statistical distribution. The results indicate the potential to derive reliable ice extent operationally. Unfortunately the author's use of English is very poor, and the meaning was ambiguous and confusing in most cases. Missing methodological details, incorrect use of models, and the large number of typo and formatting errors do not make an impression of a self-contained manuscript. The authors should not submit a manuscript which is not ready for submission. I would recommend a rejection of this paper, but I think that the author could have a chance of publishing the results of their study if they prepare the manuscript better next time.

General Comments:

1. The description of the methodology is so poorly structured, which makes the logic of the research very confusing and hard to follow. One example is that the description of data preprocessing and training samples selection should not be introduced in the section of methodology. I am pretty sure a lot of efforts are still needed for improving the general structure of the paper.
2. The training samples was selected from the MET Norway ice chart. The MET ice chart is a weekly product and it inevitably has a time lag with SAR data. The change of sea ice is fast in melting period. How do you make sure the samples you choose are correct?
3. In the step of incidence angle correction, the authors used an incorrect sea ice scattering model. In equation (1), the backscattering of sea ice is described as the function of nadir backscattering and $\cos^n(\theta_i)$. When the radar echo is incident

vertically, the scattering mechanism of sea ice is specular scattering which is completely different from the scattering mechanism of SAR. Therefore, the used approach is illogical and unphysical.

4. The mean-shift method is critical to the proposed classification method. But the principle of mean-shift algorithm and the parameter setting for unsupervised segmentation should be introduced.

5. What I am most dissatisfied with is the use of distribution models. The distribution model of Gamma, Weibull and Alpha-stable is based on the statistical characteristics of pixels. However, the distribution model was for "sub-superpixel" (patches derived from unsupervised segmentation method) not for pixels. I don't think these distribution models could be adaptable to image patches.

6. There are many SAR sea ice classification methods, taking these methods as baselines and comparing them with your method is necessary for validating the effect of your method. Moreover, the authors claimed that the advantage of proposed method is to identify sea ice in melting season. So you should give more examples to prove that the developed method can solve the problem of sea ice classification in summer.

7. According to the results of Table 4, the classification accuracy depends on used reference incidence angle. In equation (2), $\cos^n(\theta_{ref})$ is a constant value. I don't understand why the variation of constant value has an impact on classification accuracy.

8. How to determine the parameters used in the proposed method (e.g. n and weight coefficients) is not clarified. Many details are not clear and need further explanation.

9. As the stated by the author, the accuracy of classification was validated by all the training data (see Page 10 Line 6). This is obviously incorrect. I am very confused about the sentence "If the overall accuracy (OA) is lower than 99%, we add 100 patches (50 for ice and 50 for water) from the rest of the training dataset to train the revised model,". I'm not sure of your reasons for doing this?

Minor Comments:

Page 2, line 5: "search-and rescue" --> "search-and-rescue".

Page 2, line 6: "ERS-1/-2, RADARSAT-1/-2, Sentinel-1A/-1B" --> "ERS-1/2,

RADARSAT-1/2, Sentinel-1A/B”.

Page 2, line 14: “introduced” --> “have”.

Page 2, line 15: “channel” --> “polarization”. Please replace “channel” with “polarization” in the full text.

Page 2, line 18: “for improved” --> “for improving”.

Page 2, line 27: here Radarsat-2 is “RS-2”, but its abbreviation is “RS2” in line 6.

Page 2, line 28: “-3” --> “Sentinel-3”.

Page 2, line 29: “with low resolution passive microwave form low resolution microwave from AMSR2” reformulate this sentence.

Page 2, line 32: “As the backscattering is usually affected by ocean waves propagating into the ice area,” for thin sea ice, the backscattering coefficient could be affected by wave. But for thick sea ice, the effect of waves on backscattering is very low.

Page 3, line 7: “SVM realize” --> “realizes”.

Page 3, line 7: “by training the kernel with the transformation into high dimensional space,” reformulate this sentence.

Page 3, line 9: “Textual feature based neural network methods also shows” --> “show”.

Page 3, line 10: “Murashkin et al. (2018) use” --> “used”.

Page 3, line 11: “th MIZ” --> “the MIZ”.

I stop here with my comments and I think I almost had comments in every single sentence. There are a lot of grammatical issues but also, more seriously, inaccurate statements.