

The Cryosphere Discuss., referee comment RC3  
<https://doi.org/10.5194/tc-2021-85-RC3>, 2021  
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## Comment on tc-2021-85

Anonymous Referee #3

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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-RC3>, 2021

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## Review of tc-2021-85

## Submission to *The Cryosphere*

### Summary

The authors detail a SAR image sea ice-water classification technique for use during melting conditions in the Fram Strait region. The input data are dual-polarization (HH + HV) Sentinel-1 EW mode scenes which are widely available over marine regions and open access. Their method for pre-processing of the HV channel of the Sentinel-1 SAR data seems to work very well, enabling its inclusion in the classifier. A good classification accuracy of ~90% is achieved, and the results are used to examine sea ice concentration evolution in the summer months over the 2015-2020 period. Since C-band SAR images are commonly used for ice mapping and charting, the results are potentially extendable to other missions as well. The potential to use a SAR based sea ice concentration algorithm during the summer months, and in a marginal ice zone, when/where passive microwave data is less reliable, is also noteworthy.

- The paper is hard to follow, especially given that there is a lot of repetition in the text and figures, and some concepts and acronyms defined more than once. The input data to classification result is shown in Fig. 2 and Fig. 5; the SAR processing to remove noise is shown in Figs. 2, 3, and 4. Training sample selection is detailed in Sections 3.2. and 4.2. CRF and MSTA-CRF are defined on Page 3 then defined again on Page 6 (etc.). The selection of reference incidence of 23° doesn't need to be introduced on Page 8 then again on Page 13. The authors should describe their methodology in terms of input data, pre-processing, training, classification, and validation, and make it shorter in length. Everything on Page 17 and later could be included in Results and Discussion.

- It is unclear what input data is actually used. Fig. 1 shows some scene extents though it is difficult to tell whether they are arbitrarily chosen or what they are supposed to represent. Later in the paper there is mention of 488 images, or one image each day from June to September over the period of 2015-2018. Provide more detail on what Sentinel-1 data are used (without listing them).
  
- The images are described as pertaining to melting conditions. More justification for this should be provided since it is insufficient to assume that all images between June and September are in melting conditions at this latitude.
  
- If there is a Sentinel-1 image from each day in the Fram Strait, images that correspond more closely to the MET Norway ice charts should be used for selection of training data. Otherwise there is more chance for ice drift and changing ice/water conditions to introduce error into the training sample selection.
  
- Does the inclusion of GLCM features in the SVM classifier improve its performance when compared to using just HH + HV data? The inclusion of GLCM features is described but it is unclear why, and on what basis the GLCM parameters, the kernel size, quantization level, and displacement were chosen
  
- The main misclassification error, on a class-by-class basis, is given to be caused by the

presence of melting water on fast ice, leading to misclassification of ice as open water. However it is unclear how this was determined. If it is assumed, then the authors should provide some justification for it (e.g. article reference).

- Consistency in terminology is needed, e.g. "backscatter", "backscatters", "backscattering", and "backscatter coefficient"; "incidence angle" and "incident angle"; "RS-2" and "RS2" etc.

Specific comments:

(Page = P, Line = L)

P1L23: "backscatters" should be "backscatter"

P2L21: delete "value"

P2L23: should be "MAp-Guided"

P2L30: data "are" (plural)

P2L32: Backscatter is also affected by waves that form, e.g. by capillary action, not just waves propagating into the area.

P3L2: Delete "scatters of the"; also change "the mixture" to "a mixture" on the next line.

P3L7: "analysis" should be "classification"

P3L9: "Texture"

P3L14: Use of the term "usually" here creates ambiguity.

P3L26: It would be helpful to more clearly define superpixel and sub-superpixel at their first use.

P3L31: "A statistical distribution ...."

P3L34: Some spelling mistakes here.

P4L15-18: There is a lot of detail given about the classification method here. The focus should be on Fram Strait.

Fig. 1.: Make a better map with the image detail provided.

P5L6: "mode"

P5L15: Very Open Drift is defined as  $SIC < 1$  here, whereas in Table 2 it is shown as 1-4.

P7L12: "sub-swaths"

P7L18-19: Delete sentence that starts "Preprocessing methods ..."

P8L9-10: Delete the description "with SPAN being defined..." etc. since the equation is given. The equation doesn't need to be in Fig. 4.

P10L3: Delete "e.g." and correct "otherwise"

P10L32: "noise is based on..."

P12L8: Sentence beginning "It may have" is hard to understand. Perhaps break it up.

P13L28: The table isn't really necessary since the analysis and its outcome is described well above it.

P15L31: "and Weibull distributions are not ..."

P17L10: Delete "In the experiment"

P18L12: Provide some detail about the temporal offset between the classification result and the ice chart.

P20L13: "MSTA"

P21L4: "from the same orbits"

P22L3: delete "has"