

The Cryosphere Discuss., author comment AC1  
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## Reply on RC1

Wenkai Guo et al.

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Author comment on "Cross-platform classification of level and deformed sea ice considering per-class incident angle dependency of backscatter intensity" by Wenkai Guo et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-119-AC1>, 2021

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Cross-platform application of a sea ice classification method considering incident angle dependency of backscatter intensity and its use in separating level and deformed ice by Guo and others

General Comments:

This study has two inter-related objectives. The first investigates the utility of cross-platform (i.e. difference satellite sensors) transferability of training sites between S1 and RADARSAT-2 using the GIA classifier. The second is to evaluate if separation from level and deformed ice is possible with HH and HV channels of C-band SAR imagery. I liked both of the objectives of this study, but I was particularly intrigued with the idea of objective 1 and think it could find utility for the operational ice services whereby a database of training data could be created, utilized and refined. Overall, the results are clear and show cross-platform re-training at C-band is possible with the exception of leads. My only major concern is I felt that the parcel tracking did not really add much to the analysis. It is mostly qualitatively and subjective in my opinion the authors can make their case without it. ` 1

In terms of minor criticisms, I felt the introduction was thorough but too verbose. Even the authors felt the need to summarize their own introduction. Perhaps some of the information could be moved to the data and methods or elsewhere to tighten it up. With respect to parcel tracking, should the authors decide to keep this component, some additional details on the uncertainty are required. Further, a more quantitative comparison would be better as up until that point in the paper there is a nice balance between qualitative (visual) and quantitative results.

**The introduction is edited to be more concise, and parts of it have been moved to Methods & Materials.**

**The over-arching goal of this paper and the lead author's project is to use ice type classification to detect ice deformation. Therefore, we intend to keep the comparison between classification and deformation. Additional statistics of the correspondence between deformation and classification (percentage of each class in the deformation parcels) have been derived and added to the text. Although the spatial resolution of deformation parcels is very coarse (600m x 600m), the statistics do show that more 'deformed ice' is under areas of 'mainly**

**convergence' than under areas of 'mainly divergence.'**

**Qualitative comparison between classification and deformation has been revised too. To better compare with ice divergence, the 'leads' and 'others' class (in the 3-class scheme) are combined, and smaller groups of pixels are removed. This filtered product is then used to compare with deformation parcels. This more clearly and analytically demonstrates the ability of the classification to derive areas of ice divergence.**

Specific Comments:

Line 41

Perhaps mention this will continue with the recent launch of the RADARSAT Constellation Mission (RCM)

**Yes this is a good point. Added to the text.**

Line 56

Perhaps better to rephrase and state that the scattering coefficient is controlled by incidence angle, surface roughness and the dielectric constant

**This paragraph serves to argue that deformation is potentially derivable through SAR classification, due to SAR signal's primary dependency on surface roughness.**

**For this, in the preceding sentence (lines 53-55), radar parameters (including IA) have been removed from the discussion. Then, the focus is on how radar scattering from the ice surface affects backscatter signals. Lines 56-57 goes on to show that surface scattering is the main scattering mechanism, and is controlled by roughness/dielectric properties. The IA issue is fully introduced later, and could be confusing to show up in this sentence.**

Line 64

Suggest over-reaching or ultimate instead of terminal

**Changed to 'ultimate goal.'**

Line 68

are instead of is

**The 'is' corresponds to 'cross-platform application' in line 66, and is therefore singular.**

Line 95

Remove also or additionally in this sentence

**'Also' is removed.**

Line 119-121

Why talk about data you are not able to use? Remove.

**The information was included to deal with potential questioning of the lack of in-situ data used for ground truthing in this study. Removed as suggested.**

Line 124

As defined by Barber et al. (2001) based on the time series evolution of the backscatter coefficient at C-band.

**Added to text.**

Line 136

Is the ice concentration from OSI-SAF?

**It is from NSIDC. A reference was missing here and is now added.**

Line 173

Remove for this purpose

**Removed.**

Line 224

I would suggest groups instead of labels. i.e. MYI and DFYI are grouped together.

**Edited as suggested.**

Line 235

Maybe I missed it but about what leads that are wind-roughened? How are they dealt with?

**More explanation is added (now Line 235-239) – as separating open water in different wind states is not in the scope of this study, large water bodies have been filtered out, and the remaining within leads are well within pack ice and less affected by wind. Visual examination shows that within the selected scenes, open water in all major leads is calm.**

Line 239

are used

**Edited.**

Line 280

affected

**Edited.**

Line 304

Would it not be initiative to correlate the original GIA to the retrained data? This would add robustness to the results.

**The authors are not sure what this suggestion points towards specifically, and it would be great if the reviewer can further clarify. We guess it probably means the following (no materials have been added to the manuscript yet):**

- **This means comparing pixels in each class derived in reference and in classification with different training. This is then equivalent to per-class classification accuracies, before vs after re-training. These values (F1 scores) for leads are shown in Figure 7 (now Figure 8 after revision). The values for all classes can be added as a new table, showing re-training yields results more similar to reference data.**
- **This means making correlation analyses between the IA slopes of classes from the polygons, the original GIA, and the re-trained GIA. This can be done and added to the text (more correlation is found b/w polygons & re-trained, than b/w polygons & original).**

Line 331

So, I guess this impacts lead orientation in the imagery? If the leads are in the near-range and oriented vertically in the imagery then they would be identified correctly by S1? Does a caveat like this need to be added in the text?

**This point is certainly valid, given the change of classification quality in the range direction. It has been added to the text (now Line 335).**

351

You could add they are only applicable in the near range of IA's. Classification of leads is challenging with S1.

**Edited according to this and other comments.**

Line 364

Remove also or additionally in this sentence

**'Also' is removed.**

450

I think the results are compelling except for leads.

**This section is reworded to reflect the proportion of the transfer-learning that 'worked'.**

Figure 3

Useful to put the training sites on both images. In fact, is there a need to show all these examples? I suggest just showing one and zoom in so readers can see the details. I do not think the photos of NICE add anything to this Figure. I realize they are referenced latter in the text for a different situation. In this case, it might be better to create a new Figure with the photos for the young ice and LFYI situation.

**The example scenes and areas are picked for maximum representativeness in**

**one figure, i.e. each class is represented, and so are both S1 and RS2 SCWA, both S2 and S8, and both 2015 and 2019. But now zoomed-in subsets of all classes are also shown to give more spatial details. Polygons are added to the optical scenes too, but their positions are manually adjusted to account for time differences from the SAR scenes.**

**Bottom panel is now a separate figure.**

Figure 4.

The caption is missing accuracy. i.e. Classification accuracy (CA)

**Yes a typo. CA has been defined in the preceding paragraph, so should be used directly here.**

Figure 5

I like this Figure, but it would be better with some text on the panels to help the reader similar to Figure 6. The Figure caption is also very confusing. I think some refinement is needed because this is a key Figure. I also think you do not need to show all 5 panels. Perhaps just 1 S1, 1 RS2, and RS2 FQ.

**Edited as suggested.**