The Cryosphere Discussions

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# Reply on RC2

Wenkai Guo et al.

Author comment on "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 Wenkai Guo et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-119-AC2, 2021

The authors present results from a methodological investigation of the cross-platform transferability between training sets derived from two different C-band SAR platforms (namely Sentinel-1 and RadarSAT-2) for their joint use in providing improved spatio-temporal classifications of level and deformed ice. This is a very useful first look at this potential ! The authors have carefully and painstakenly considered and quantitified most of the relevant factors involved in level and rough ice signature differentiation using a combination of quantititative and qualitative analyses, including using expert knowledge from in-situ field personnel and data from the N-ICE 2015 experiment. The flowchart (Figure 1) is especially useful. I have one major concern and several minor editorial comments in my review. Overall, I recommend publication after minor revisions, including properly addressing my concern.

Major concern:

My major concern with this paper is with the treatment of the role of snow on sea ice and its potential influenece (both direct and indirect) on both surface and volume scattering at C-band for all FYI types. Most of co-authors are aware of the role of snow (ie. work of Barber, Yackel, Nandan, Geldsetzer, Mahmud, Gill and others, including Nghiem and Drinkwater) on C-band backscatter for ice types younger than one year which have snow temperatures warmer than ~ -5 C at image acquisition due to high dielectric basal layer snow brine volume effects (Barber et al., 1998 TGARS; Barber and Nghiem, 1999 JGR-Oceans). While the authors reference the SAR scattering season work of Barber et al., 2001 (originally Livingstone et al., 1987; 1991) and the polarimetric scattering characteristics from Gill et al., 2015, they have not provided convincing evidence of dry and cold snow conditions for some of the data used in their classifications (ie. an April 30, 2015 image north of Svalbard). N-ICE-2015 was characterized by frequent warm, southward originating storm events. Many of these warm storms would have warmed the snow and upper ice surface considerably, thereby altering the snow volume scattering properties on seasonal sea ice types.

I would ask the authors to present a time series of air temperature data from N-ICE (likely to be the most representative observation of air temperature for the region of image

acquisition) to confirm that the air-snow AND snow-ice interface temperatures were below -5 C for all images used in their classifications.

**Several datasets are used to derive time series of temperatures corresponding to the scenes used, shown in the attached figure (as a supplement). These include:**

- **(corresponding to the 2015 scenes) air and snow-ice interface temperatures derived from buoys and weather mast during the N-ICE2015 campaign (Granskog et al., 2015; Hudson et al., 2015);**
- **(corresponding to the 2015 & 2019 scenes) 2m air temperatures from NCEP-DOE 2 ° reanalysis data (Kanamistu et al., 2002) covering the portions (ice concentration > 87%) of SAR (RS2+S1) scenes used for classification in each day.**

**Several warm events can be seen from in-situ temperature time series, resulting in recorded air temperatures rising above -5°C. However, for the days corresponding to the SAR scenes (gray dashed lines), in-situ air temperature and snow-ice interface temperature are mostly lower than -5°C (only 1 snow-ice temperature record in SIMBA_2015d is higher - 2015-04-17: -4.625°C). Reanalysis data also shows air temperatures mostly lower than -5°C.**

**Additionally, personal communication with snow scientists who participated in the N-ICE2015 campaign, as well as published works on snow conditions in the campaign (mainly Merkouriadi et al., 2017; Gallet et al., 2017), reveal that despite observations of flooding and the formulation of slush and snow-ice at the base of the snowpack (e.g. Provost et al., 2017), no melting occurred in the snowpack from January to April, and melting began in early June.**

**Data references:**

**Kanamitsu, M., Ebisuzaki, W., Woollen, J., Yang, S.-K., *et al.* (2002) 'NCEP-DOE AMIP-II Reanalysis (R-2)'. Bulletin of the American Meteorological Society. Available at: http://www.cpc.ncep.noaa.gov/products/wesley/reanalysis2/kana/reanl2-1.htm.**

**Granskog, A., Haapala, J., Hudson, S. R., Kaleschke, L., *et al.* (2015) 'N-ICE2015 buoy data'. Norwegian Polar Institute. doi: 10.21334/npolar.2015.6ed9a8ca.**

**Hudson, S. R., Cohen, L. and Walden, V. (2015) 'N-ICE2015 surface meteorology [v2]'. Norwegian Polar Institute. doi: 10.21334/npolar.2015.056a61d1.**

**Paper references:**

**Provost, C., Sennéchael, N., Miguet, J., Itkin, P., *et al.* (2017) 'Observations of flooding and snow-ice formation in a thinner Arctic sea-ice regime during the N-**

**ICE2015 campaign: Influence of basal ice melt and storms', *Journal of Geophysical Research: Oceans*, 122(9), pp. 7115–7134. doi: https://doi.org/10.1002/2016JC012011.**

**Gallet, J. C., Merkouriadi, I., Liston, G. E., Polashenski, C., *et al.* (2017) 'Spring snow conditions on Arctic sea ice north of Svalbard, during the Norwegian Young Sea ICE (N-ICE2015) expedition', *Journal of Geophysical Research: Atmospheres*, 122(20), pp. 10,820-10,836. doi: 10.1002/2016JD026035.**

**Merkouriadi, I., Gallet, J. C., Graham, R. M., Liston, G. E., *et al.* (2017) 'Winter snow conditions on Arctic sea ice north of Svalbard during the Norwegian young sea ICE (N-ICE2015) expedition', *Journal of Geophysical Research: Atmospheres*, 122(20), pp. 10,837-10,854. doi: 10.1002/2017JD026753.**

Minor typographical and grammatical:

L16 - using the word 'thus' reads awkwardly. I suggest removing it.

**The introduction, including this sentence, has been re-worded for better clarity.**

**This sentence is now: 'SAR scenes are then classified based on the classifier re-trained for each dataset, and the classification scheme is altered to separate level and deformed ice to enable direct comparison with independently derived sea ice deformation maps.'**

L48 - I suggest adding the reference to Tschudi et al., 2020 TC for the NSIDC ice drift product ... like you did for the OSI-SAF latter on in that sentence.

**This has been added to the text.**

L106-108. The sentence beginning with ... " This study mainly examines ...' is redundant from previous mentioning. Please remove.

**This sentence has been revised to: 'SAR data used in this study are mainly wide-swath RS2 and S1 data, i.e. RS2 SCWA and S1 EW (hereafter referred to as S1) data.'**

L126. Remove 'covering' and replace with 'collected during'

**Edited as suggested.**

L138. Remove 'of' before lower

**Removed as suggested.**

L139. in the marginal ice zone

**This sentence indicates that the masking process primarily removes two targets: 1. large, contiguous open water; and 2. the marginal ice zone (with low ice concentrations). So we do not think 'in' should be placed here.**

Figure 4 caption: 'red' not 'read' ; Classification CA's ? ... how about just CA's ... otherwise it reads 'Classification classication acurracies'.

**Edited as suggested.**

Table 2: Mahmud values should be negative ... not positive. Also, Gill et al., 2015 time should be 2008 ... not 2018.

**Corrected.**

There are several typos in the reference list due to cutting and pasting ... causing characters to get formated incorrectly.

**The manuscript has been proofread again for typos and formatting mistakes.**

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2021-119/tc-2021-119-AC2-supplement.pdf