

Interactive comment on “Spring melt pond fraction in the Canadian Arctic Archipelago predicted from RADARSAT-2” by Stephen Edward Lee Howell et al.

Anonymous Referee #1

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This manuscript uses RADARSAT-2 imagery to derive peak melt pond fraction values for sea ice in the Canadian Arctic Archipelago between 2009 and 2018. The basic method for deriving peak pond fraction was developed in an earlier publication, and this work applies that method to a larger dataset from a different satellite. The manuscript is well written and has only a few grammatical errors that are noted below. The results presented offer valuable insight into sea ice trends and variability in the CAA. However, there are a few issues with the validation of the RADARSAT-2 derived data that should be fixed or clarified prior to publication.

General Comments

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- You define fp as melt pond fraction. Throughout the paper you also use fp to refer to peak melt pond fraction calculated from RADARSAT-2. It would improve clarity to separate the notation for these two different parameters.
- There are two issues with the in-situ comparison:
 1. The spatial footprint of the LIDAR scans from Landy et al., (2014) are small in comparison to the 100m resolution of RADARSAT-2 data used. These in-situ datasets would only cover 1-2 pixels in the radar image. Does this area represent the whole region? Perovich (2002) determined the aggregate scale (area at which a sample can be considered representative of the larger region) at SHEBA to be multiple kilometers. If the aggregate scale is much lower in the CAA (more homogeneous ice cover) this should be discussed.
 2. Two in-situ samples are not enough to assess the accuracy of this method given the error presented in Figure 7. Here the prediction for 2011 is correct and the prediction for 2012 is not. On line 180 you state that the error is 0.1, but it looks more like 0.2 in the figure. Have you considered other in-situ datasets? For example, the three years of melt pond fraction timeseries observed on landfast ice near Utqiagvik, AK described in Polashenski et al., (2012)?
- Lines 183-194: What is the conclusion from the comparisons with MODIS? You note the reasons why RADARSAT-2 derived fp and MODIS fp could be misaligned (i.e. that the MODIS product is an 8-day average and peak ponding occurs on short timescales), and I am left with the impression that the MODIS data do not agree with your results. I would suggest expanding or clarifying the statistical analysis here. In Figure 8, both 2010 and 2011 make the RADARSAT-2 look

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statistically different than MODIS. The mean (blue line) of RADARSAT-2 is approximately equal to the max (top whisker) of MODIS.

Specific comments

104 – Maybe this is covered in the Scharien paper, but is there a hypothesis for why this correlation exists? Is this method essentially just relating surface roughness (via radar backscatter) to peak pond fraction?

107 – If fp is calculated directly from each radar pixel value (Eqn. 1), how does speckle filtering impact the fp results?

165 – If both sensors are the same frequency, why is there any difference here (Figure 6) (spatial resolution difference? Sensor measurement errors?)

180 – this looks like it is 0.2 lower (difference between dashed pink line and peak pink dot). Am I reading this plot incorrectly?

248 – “Slightly lower” is maybe an understatement? It is 20% lower. Either way, quantify the amount it is lower here.

251 – In 214-231 you posit that the predictive power of this method only holds for landfast ice (i.e. when ice breakup is due to thermodynamics and not due to ice motion), how would this method be applicable to pan-Arctic estimates?

Technical Corrections

59-61 – Run-on sentence.

97 – “during April in within the CAA”: Extra “in” here.

152 – This sentence is unclear.

154 – “in addition” and “also” are redundant here.

161 – 3.2 header has extra “and”. Also consider including oxford comma in this list for added clarity.

183 – Again a stylistic choice, but I find oxford commas to be helpful for clarity.

190 – “but” is an extra word here.

192 – Do you mean Figure 8 here? 215 – “The origin of the some of the ice” extra

words here.

239 – "Overall, within the . . . ": Revisit sentence structure here.

253 – "Was found to be excellent agreement": Missing "in" here.

249 – "maybe" should be "may be" in this context.

References

Landy, J., Ehn, J., Shields, M. and Barber, D.: Surface and melt pond evolution on landfast first-year sea ice in the Canadian Arctic Archipelago, *J. Geophys. Res. Ocean.*, 119(5), 3054–3075, doi:10.1002/2013JC009617, 2014.

Perovich, D. K.: Aerial observations of the evolution of ice surface conditions during summer, *J. Geophys. Res.*, 107(C10), 8048, doi:10.1029/2000JC000449, 2002.

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