Review of "Estimating the sea ice floe size distribution using satellite altimetry: Theory, climatology, and model comparison", by Horvat et al.

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The paper sets out a framework for estimating geophysical parameters relevant to the sea ice floe size distribution based on floe chord lengths measured by the CryoSat-2 radar altimeter. The paper exploits the fact that it is possible to distinguish between returns originating from leads and returns originating from floes, to estimate chord lengths as the distance over which consecutive CS2 waveforms are identified as floes uninterrupted by leads. These chord lengths are then related to the floe size distribution by statistical considerations. I was asked by the editor to assess the remote sensing aspect of this paper; I have not attempted to assess the theoretical developments because this is outside of my area of expertise, and I leave this to other reviewers. Based on the remote sensing aspect only, I would recommend publication after the authors address the following points.

P1 L8: "radio" should be "radar"

I would like to see a little more discussion on the limitations of the technique imposed by the sampling of the radar and its high sensitivity to areas of open water. Any amount of bright open water (lead) in the pulse limited footprint (300m along-track x 1.6km across-track) is likely to be identified as a lead or ambiguous. Also, bright open in the larger beam limited footprint (up to ~20km across-track) can potentially lead to an 'ambiguous' return (although this depends on the specific waveform processing). I think this could affect your processing in a few ways:

1. Your assumption that theta is uniformly sampled: The fact that the altimeter footprint isn't symmetric means that for large theta the footprint is almost tangent to the floe perimeter when they intersect, whereas for small theta the footprint is almost perpendicular to the floe perimeter where they intercept. This means that chords with small theta are more susceptible to 'snagging' or contamination by leads, particularly at the beginning and end of the chord closer to the floe edge. This means that the length of chords with small theta could be underestimated.
2. Your taking Dmin as ~300m (P8 L11): I think the minimum chord length (if you are taking a minimum of two consecutive floe measurements to represent the smallest possible chord) is closer to 600m. This is because for a waveform to be classified as a floe you really expect (at least) the pulse limited footprint to contain entirely sea ice and no open water – any amount of open water will dominate the sea ice return. The other side of this is then that you can only assign a range to Dmin (from around 600m up to maybe 1200m if the leads either side are at the forward and backward limit of the along track footprints) and within this range it is ambiguous.

Figure 3 and P9 L3-10: You claim that the largest representative radii lie along the Canadian Archipelago, but the maps show that the largest radii actually surround the 'pole hole'. It seems like there is a geophysical signal, with larger radii in the MYI zone, which I would expect, but then superimposed on that is a signal that seems to increase with latitude such that the largest floe sizes are close to the pole hole. I was wondering if you have an explanation for the large floe radii surrounding the pole hole, because this isn't something I would intuitively expect? The spatial sampling increases as you move north due to the convergence of orbits, could this skew the mean floe radius large?

Incidentally I couldn't find Figure S1?