

## ***Interactive comment on “Instantaneous sea ice drift speed from TanDEM-X interferometry” by Dyre Oliver Dammann et al.***

### **Anonymous Referee #1**

Received and published: 29 December 2018

### **General comments**

The paper presents nice experiments showing sea ice drift from InSAR using TanDEM-X data:

1. a comparison and validation using a ground based radar in Utqiagvik, Alaska
2. an investigation of fracture dynamics near Holm Land, Greenland
3. drift zones in Vilkitsky Strait, Russia

Though the method is not new, the authors provide a good discussion on interpretation, calibration and errors. They provide realistic arguments for the practical use

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of the method along with its limitations. The authors conclude that InSAR allows resolving meter scale, line-of-sight ice motion which is not resolvable using conventional methods. It is argued that even the relative speed provides insight into transient convergence and divergence of ice, and that this is relevant for ice management and tactical navigation.

Overall, I find the paper to be well structured, well written and of high quality. References are relevant and support the authors' claims. The paper seems like a good fit for this journal and I have only a few comments.

### **Specific comments**

- Title:

As noted by the editor, the drift is in the line-of-sight only which is not (explicitly) reflected in the title. The HF-radar is also not mentioned in the title, even though it is a significant part of the paper. I still like the title as it is and leave it to you if you want to take the above aspects into account.

- Page 2, line 22: "The technique further requires incorporation and manual interpretation of land areas in each scene"

Why manual? I would assume that this could be automatically estimated over land. If the absolute antenna behavior is known it should also be possible to correct the measurements even without land. There was a nice paper at EUSAR this year which mentions this: "... This will then allow proper correction also for scenes with insufficient land coverage." Reference: Hansen et al., EUSAR 2018 "A new look at Envisat ASAR range Doppler shift retrieval with the aim of reprocessing ten years of level-0 data".

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- Page 3, line 18-19: "to our knowledge has not been used to measure sea ice drift"

I was a little bit surprised by this as your paper already mentions Scheiber2011, who showed some results of TDX InSAR sea ice drift. I think it would be nice to include a reference here and comment on similarities/differences to what they did. As far as I remember they only showed the relative drift without any further calibration/validation, whereas you provide examples of absolute speeds and a more in-depth discussion.

- Page 4, line 1: "... a combination of existing and newly developed methods".

It would be nice to have the essence of the methods provided in the text also. Dense Lucas-Kanade optical flow or something more? Please add a sentence or two to make it more explicit.

### **Minor corrections / suggestions**

- Page 3, line 1: "in look direction" -> "in the look direction"

Please correct all occurrences (I might have missed some): Page 5 line 1, Page 5 line 2, Page 8 line 11, Page 8 line 20, Page 9 line 8.

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- Page 3, line 29: "...archived every 5 m and ..." -> "5 min." or "5 minutes".

- Page 4, line 21: "... sea ice grown in-situ ..."

The "grown in-situ" part sounds a bit strange to me and could be removed, but perhaps am just not familiar with the use of this phrase. What is it being contrasted with? Grown remotely?

- Page 5, line 3: "...which can be expressed" -> "...which can be expressed as"

- Page 5, line 5: "where theta is the incidence angle" -> "incident angle" or "angle of incidence"

Just a suggestion. Some people are picky about this.

- Page 9, line 20: "formation of ice arches"

The term "ice arch" could perhaps be more precisely specified in the text (I had not heard the term before). I guess it's clear from the context and the fact that your pointing to pont J in the image, but still.

- Page 11, line 11: "features larger multiyear floes" -> "features large multiyear floes"

Larger compared to what?

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- Page 16, Figure 1:

It would be nice to have the range in km of the ground-based radar in the caption for easy reference.

- Page 17, Figure 2:

The line of zero velocity is quite weak in the figure which made it disappear completely on my printout. Please try to make it more easily visible, perhaps by making the line thicker or more densely dashed. Was the line drawn manually, or automatically (e.g., from thresholding the velocity map (or similar)?

- Page 18, Figure 3:

I see the right circle in (a) and (b) mentioned in the caption for (d), but what about the left circle? Is it the same type? I could not find the reported  $R=0.85$  value in (d) discussed in the text. Please include a short comment in the text. It would also be nice to have the regression line in the plot along with the existing one-to-one line.

- Page 19, Figure 4:

Please specify in the captions what the white areas in the InSAR speed plot are. I didn't immediately see this commented in the text, sorry if I missed it.

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- Page 20, Figure 5:

Consider changing theta to another variable as theta is also used for the angle of incidence, but this is not very important (I guess it's clear enough from context).

- Page 21, Figure 6:

Please include a brief explanation of the regions marked by letters instead of referring to the text. It doesn't have to be long. For example: Different zones are indicated by letters (A-B) no drift in the look direction, (C-D) intermediate speeds, (F-H) channel of high speeds. As a reader I find it annoying to jump back and forth a lot between the text and the figure.

- Page 22, Table 1:

There is a lot of white space in the table. Perhaps it could be made a bit neater (e.g., consistent spacing around "/", expand Str. into Strait, add [deg] after theta), but this is a very minor issue. Is date/orbit/cycle enough to uniquely identify the frames you used for the experiment or would a timestamp or frame identifier be needed?

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2018-242>, 2018.

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