

## ***Interactive comment on “Comparing C- and L-band SAR images for sea ice motion estimation” by J. Lehtiranta et al.***

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We thank referee #1 for their comments and suggestions!

The major criticism was about the “Validation of motion estimates” section, which compared the operational algorithm by Karvonen to the results of our study. We agree with the suggestion (3), that our tracking algorithm should really be compared to manually generated drift data. We agree that such a comparison would be more revealing. This will be done for the revised manuscript.

R1 (1): Why was it necessary to implement another algorithm instead of using the existing operational one?

The maximal cross-correlation algorithm was used in this study for several reasons.

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First, the operational algorithm has been tuned for C-band radar images and built to work in conjunction with open-water detection and ice type classification algorithms written for C-band images. Second, there was a desire to write a GPGPU program code, which speeds up the calculation and enables quick testing, many re-runs with a large set of images, and the development of computationally intensive algorithms. The author also wished to avoid problems, such as correlation wrap-around, that are specific to methods operating in the frequency domain. It was also feared that phase correlation, used in the operational algorithm, might be problematic for correlating images acquired using different frequency bands.

R1 (2): Why do the results of the two algorithms shown in Fig. 14 differ so much?

The results of the two algorithms, illustrated in fig. 14, differ so much for several reasons. First, the operational phase-correlation algorithm was run without the customary open-water information that was not available. The phase-correlation algorithm produces spurious results for open-water areas, roughly, south of  $63^{\circ}40'$  N and west of  $22^{\circ}$  E. In the ice-covered area the phase-correlation algorithm also fails to find motion in certain locations, and produces southward movement mainly in the central area of the moving ice pack and on its southern edge. The reason for this is not known.

Minor comments:

Abstract: By “seasonal sea ice inner structure” we mean volume scattering that happens below the ice surface. Due to the longer wavelength and bigger penetration depth, L-band SAR images contain significant information of the inner structure of sea ice. We will clarify this text in the revised manuscript.

Introduction: By “empirical data” we mean “observations”. The word has been changed. The references we list for optical flow all do motion estimation for SAR images by some method of correlation for pixel blocks, except for Liu et al., 1997, which applies wavelet analysis to track edges of ice floes. The term “optical flow” encompasses several different approaches, and we are still unsure which of the references

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should be excluded.

Section 2.3 Performance: you would be right that the tracking algorithm by Karvonen provided better results than the model simulation. Comparing these kinds of motion data would be more meaningful for the evaluation of a model simulation. The peak-to-background ratio, along with most ideas mentioned in the first paragraph (lines 14 - 23), was not used in this work. We will consider removing those references from the revised manuscript. The ice drift fields are compared to the observed winds by comparing the drift directions by eye - a very rudimentary sanity check. The “two-highest-peaks ratio” and “median-row difference” are the two main measures considered in addition to correlation peak magnitude. For the two measures, a threshold roughly corresponding with correctness was determined empirically, and the percentages of motion vectors fulfilling this threshold are reported in Table 2. The vector median filtering is edge-preserving (Astola et al., 1990), so it should preserve discontinuities as long as the vector field is dense in comparison to the scale of local discontinuities. You’re right that “displacement” and “motion” are used interchangeably in the discussion paper and that it is confusing. We agree that section 2.3 needs a rewrite.

Page 2728, lines 14-16: The registration error did vary spatially, and an interpolation between land points was done. This will be clarified in the revised manuscript.

Section 3: We will add pointers in the images you mention. Thank you for the reference to Dierking and Dall, we will consider modifying the section accordingly.

Page 2732 line 14: We originally printed these as left and right column, which would underline the fact that the corresponding rows of upper and lower parts of Table 2 are comparable. We will rethink this table once more.

The other issues regarding unreferenced important articles, wording and clarifications will be addressed in the revised manuscript.

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Interactive comment on The Cryosphere Discuss., 8, 2721, 2014.

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