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The Cryosphere Discussions

Interactive comment on "Differential InSAR for tide modelling in Antarctic ice-shelf grounding zones" *by* Christian T. Wild et al.

Anonymous Referee #1

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In this manuscript, the authors use differential SAR interferometry (DInSAR) to refine tide models on 2 test sites. By adjusting the DInSAR, they improve traditional tide models against the GPS data and can retrieve interesting information about the ice rheology. In my opinion, the methodology for both, remote sensing and model is solid, the results are interesting and the paper is well-written. I would recommend publication after correction of the minor comments below:

Minor comments:

In my opinion, the InSAR part should have a stronger description, not necessarily the technique that is already dealt with in Rack et al. 2017, but more regarding the number of acquisitions and how they were combined in time to form DInSAR. For example, Table 1 with the acquisition dates is not mentioned in the main text. Indeed, I am confused

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with the number of SAR acquisitions and the number of DInSAR that were formed. Did you form 45 DInSAR observations from 12 SAR acquisitions? If so, this would indicate that you did not use consecutive acquisitions only, but tried every available combination. If it is the case, what is the advantage in using the additional combinations, that are not independent (from the consecutive pairs)?

Figure 5 shows reconstructed vertical displacement maps that look like interferograms, but they correspond to the tide displacement at the time of the acquisitions, not what we are observing through double differential interferometry. I believe that, at least, one illustration with direct comparison between DInSAR and reconstructed differential displacement would be useful for the reader. I also wonder why grounded portions of the glacier are moving in with tide, especially the speed slope on the top left corner. I would assume that the grounded portion should not move up and down with the tides.

3.3.2 Ice heterogeneity

As mentioned previously, as the grounded portion are vertically moving in your reconstruction, it translated in large standard deviations in Figure 8 on the top left corner where the steep slopes are found. I also notice large misfits (saturated in red) in the bottom left that are not mentioned in the text. Is the misfit due the absence of ice thickness measurements in this corner? Some comments would be welcome.

3.3.3 Detection of errors in phase unwrapping.

It is an interesting way of catching unwrapping issues. Would it make sense to include a new misfit map after the phase jumps are corrected?

3.4 Finite-element modelling of viscoelasticity

You mention that a Young's modulus of E=10GPa and an ice viscosity of 10 TPa s fits best your measurements. It would be nice to include uncertainties to appreciate how well these parameters are constrained.

4.3 Large-scale ice anisotropy

Results show that the shear margin of Darwin glacier are softer than surrounding ice (viscosity reduced by five-fold). The authors hypothesize that the change is due to ice anisotropy (from preferred crystallographic orientation). Some other hypothesizes have been proposed such as heating due to the important shear. It would be a nice if the authors could expand on this. Conclusions would remain unchanged but the origin of the softening would be different.

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