Review of

Extreme melting at Greenland's largest floating ice tongue

by Zeising et al., submitted to *The Cryosphere*

The manuscript presents an analysis of a combination of measurements for detecting the local balance conditions in the grounding line region of Nioghalvfjerdsfjorden Glacier (79NG) in NE-Greenland. For this purpose the authors use pRES and ApRES and ultra-wide-band airborne radar measurements, complemented by surface elevation models, derived from TanDEM-X imagery. The geometry data are also compared to earlier seismic investigations form 1998, in order to analyse the long-term changes of the grounding zone of 79NG. They find extremely high melt rates on a local scale, but still considerable strong subglacial melting across the entire grounding zone.

The manuscript is clear and well written and presents a detailed analysis of data quality and comparison of data from different sources. Data and results are very well presented. In general, the results are based on a rigorous processing and analysis approach and provide new insight into the recent and medium term evolution of the grounding zone of 79NG. The manuscript will add important new knowledge to the scientific efforts of understanding the complex interaction of ice, ocean and climate in NE Greenland.

Apart from some minor issues, which I list further down, there is only one major question concerning the localised detection of incised channels into the underside of the glacier. The strong increase of the channel height is documented by UWB radar data between 2018 and 2021 and on a longer time scale by pronounced and locally concentrated surface lowering from SAR imagery. It was stated the measurements of Mayer et al. (2000) show no indication of subgacial channels close to the grounding line in 1998. However, the seismic measurements were performed with a 24 channel instrument, covering horizontal distances of 240 m. The single measurements were up to 2 kilometres apart and the final figure in Mayer et al. (2000) only shows an interpolated cross profile of the single shots. Therefore, it cannot be concluded that there was an absence of subglacial channels in 1998. There exists an unpublished data set of airborne radar data also from 1998 (named the "Niels Reeh data set" in e.g. Seroussi et al., 2011) which shows a much more detailed ice bottom topography in the grounding line region of 79NG. The figure shows a cross profile in the vicinity of the BB' profile, with large subglacial undulations across the entire glacier, where the deepest reaches more than 200 m.

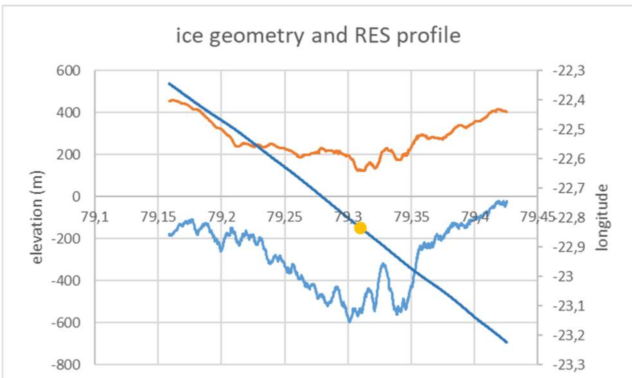

Fig.: RES cross profile in the grounding line region of 79NG from 1998. The dark blue line shows the profile location in Lat/Lon. The orange and bright blue lines show the ice geometry, while the yellow dot indicates the location of the subglacial channel identified in the recent manuscript.

Therefore, I highly recommend to consult to airborne RES data from 1998, in order to reach to sensible conclusions with regard to the temporal evolution of localised melt features.

Minor comments:

L. 51: I might be useful to already mention the data source of the DEMs here (e.g. from InSAR processing)

L 52: GROCE needs a reference.

L. 53: either “an UWB radar”, or the “UWB radar” and adding some information.

L. 68: the spatial adjustment requires some error estimate.

L. 80: I do not understand this sentence. What do you presume in the hardware?

L. 85: The processing steps change the ground resolution, which should be discussed here.

L. 90: Accuracy of the laser measurements?

L. 105: The off-nadir reflections depend on the location of the instrument. This could be demonstrated in more detail here.

L. 135: This is unclear to me. Does that apply generally to single-repeat pRES measurements, or is this a special case?

L. 167: You state that you are able to estimate the ΔR^n, why are you underestimating the melt rate then?

L. 180: citation format needs change

L. 188: The inaccuracy of signal propagation speed does not depend on the melt rate. I you would like to state that the uncertainties in the propagation speed result in similar inaccuracies as about 1% of the melt rate do, this should be reformulated.

L. 195/196: To which width does the region of surface lowering reduce in which distance?

L. 201: In which distance free floating occurs and what are the criteria for “free flotation”?

L. 222: The Lagrangian perspective also tells only one side of the story. Only the combination completes the information.

L. 222: I would be good state again that the profiles are taken from Fig. 1

L. 260: The 42% thinning are restricted to a narrow region, compared to the 79NG total extent. This should be mentioned here.

L. 270/271: This is true for significant changes in general, but applies also for warmer termperatures and therefore enhanced melt rates.

L. 281: As long as the pinning points exist at the front, seasonal changes cannot be expected.

L. 307/308: The low melt rates upstream of the grounding line and outside the large channels depend on what? Is there a patchy grounding line, or do you expect a distributed drainage system, if you refer to low water columns?

Seroussi, H., Morlighem, M., Rignot, E., Larour, E., Aubry, D., Ben Dhia, H., & Kristensen, S. S. (2011). Ice flux divergence anomalies on 79north Glacier, Greenland. Geophysical Research Letters, 38(9).