

The Cryosphere Discuss., referee comment RC4  
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## Comment on tc-2021-78

Anonymous Referee #4

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Referee comment on "Sentinel-1 time series for mapping snow cover depletion and timing of snowmelt in Arctic periglacial environments: case study from Zackenberg and Kobbefjord, Greenland" by Sebastian Buchelt et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-78-RC4>, 2021

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This study focus on two years of Sentinel-1 data covering a small part of the Zackenberg valley in northeast Greenland to develop an algorithm for mapping snow evolution during the melting season. This time series is compared with snow cover fraction observations from time lapse imagery. The physical background on which the proposed approach is based is already described in the literature and this work can be view as an interesting extension and validation of the findings by Marin et al. 2020. However there are still some aspects that should be further improved/clarified for being of interest to the scientific community.

### General comments/concerns:

- The title and the definitions are misleading w.r.t. the content of the paper (at least to me in the present form). In this context, the gamma nought time series can be exploited to find a time series of maps indicating snow status related to the loss of snow mass i.e., depletion curve. This is a important variable that can be extracted only with SAR information (differently from the snow cover depletion curve). However the definitions should be better described for avoiding confusion (making use also of fig. 1).
- The use of only one track is limiting the understanding of the operational applicability of the proposed algorithm. Reconstructing the depletion curve with a sub-weekly sampling could be relevant in different contexts. This should be better analyzed and discussed.
- The thresholds adopted in the paper are derived from the dataset from which the reference information is available. The two considered years, which show different characteristics, already show a relative large variance in the results. Another independent test site(s) is necessary to fully understand the scope of applicability of the proposed algorithm. The use of fixed thresholds, even interesting to demonstrate the method, limit the generalization of the algorithm especially when more advanced methods are available.

## Specific comments:

Fig.1: A slight increase of LWC can produce a high decrease in the backscattering. So it's unreal that in the moistening phase, cycles of increase and decrease LWC are not influencing the recorded backscattering. Moreover, the decrease in SCF does not correspond to the runoff onset especially for deep snowpack. Interestingly this curve was introduced for high alpine snowpacks. Do you have SWE measurements showing that the runoff onset is correctly identified by your time series? This would be an interesting extension of the paper by Marin et. al.

Fig. 4 is rather difficult to be read. I suggest to divide it for section 3.1 and 3.2.

The works of Lievens et al. on snow depth retrieval, even if showing the characteristic melting curve, state an increase in the backscattering due to snow accumulation that seems not to be notice in your case given the comment of line 73. It would be interesting to know if you find the same behaviour in your experimental analysis and in case provide a comment on this aspect.

Line 140: Small et al. in their last paper (<https://ieeexplore.ieee.org/document/9352976>) comment that the implementation of their terrain flattening in SNAP is not correct. This should be better commented in the paper.

Line 305-310: do you have any measurements showing the increase in the superficial roughness?