Final Editors comments:

Dear authors,

thankyou for your hard work and revisions which have improved what was already a very nice study.

I am happy to accept it for publication with a very minor revision based on the comments I have screenshot aand inserted below. As you noted in point 9 this is an empirical study and the idea is not to develop the theory so much, however in your explanations for point 10 and point 13 I think you make some very interesting and valid points that would be of interest to the general reader, even if they are hard to back up with concrete evidence and for which there would in any case be little space in this paper. I would therefore like to see these elaborated if at all possible in the discussion section. I do not think it will mean adding more than 2-3 sentences as these are speculative points and possibilities for future investigation.

9. Section 2.4.1: I would suggest to move the section on page 13 (L338-350) to somewhere around section 2.4.1 within the methods, since this provides the theoretical support for your classification method. Moreover, it is not well placed in the summary and future work section, since it provides new theoretical information (not a summary).

Agreed. The authors changed the section to **4. Discussion and Future Work** – rather than a summary. As this is mostly an empirical study, the theoretical description was included at the end as a path to our next paper which explores both annual and perennial firn aquifer signatures using field data and electromagnetic modeling.

10. L228-239: Which regions typically correspond to $\zeta > -0.008$ and why?

The authors originally assumed this lower threshold corresponded to shallow firn aquifers in the peripheral areas. However, these signatures are typically radiometrically warm and a shallow heavily water saturated perennial firn aquifer would be radiometrically cold. A better explanation might be that these signatures are mixed emission firn aquifer-ice signatures, where the ice is the peripherally warm emitter. Another explanation is that there is a heavily saturated layer with an overlying layer with lower volumetric fractions of meltwater throughout the winter (the warm emitter). It's difficult to know – and there are many signatures with similarly complicated explanations, which is why a detailed explanation was left out and saved for future work.

13. The paper often refers to 'perennial' firn aquifers. How can you be sure that the firn aquifers in some places are not completely refrozen late in the frozen season, based on your detection method?

I honestly don't believe there is any way to be sure. If the signature continually decreased over the entire freezing season, then that might be considered a 'for sure' perennial firn aquifer case. But that only happens sometimes, and would need a more sophisticated time series analysis to identify exact dates. However, a perennial firn aquifer can also reach a stable depth at a given point in the freezing season. In this case, the signature becomes stable. However, an aquifer that completely refreezes also becomes stable. This may be able to be somewhat sorted out with brightness temperature values, however, these vary in both space and time. Although the authors have done extensive analysis on this topic, we still don't have a good grasp on the behavior of these signatures. They are extremely complicated. And left to future work.