Interactive comment on "A low-cost method for monitoring snow characteristics at remote field sites" *by* Rosamond J. Tutton and Robert G. Way

Anonymous Referee #2

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Snow depth is a poorly observed variable: measurement networks are sparse (especially across the subarctic and Arctic) the measurements are prone to uncertainty, and often fail to capture the prevailing landscape-scale variability. Limited tools are available to address these weaknesses, so advancements in low-cost, easy to deploy instrumentation is of high interest to the snow community.

This manuscript provides an overview of a new low-cost approach to acquiring snow depth estimates using vertical profiles of light and temperature measurements. The paper is clearly written and provides a careful intercomparison of different processing techniques to derive snow depth from the profile measurements.

While I have only a small number of suggestions on the manuscript, my main concern, as outlined in my first comment below, is with the experiment design.

1. Because no independent time series of snow depth measurements were acquired coincident to the profile measurements, it is not possible to know what the 'true' snow depth was. This means the various approaches to estimating snow depth can be compared, but not assessed. Only in the case of Goose Bay can the SCLT-derived snow depth time series be shown alongside an independent measurement, and as rightly pointed out in the text, this comparison serves to highlight the differences between snow measurements made in open environments (airports) versus in the forest. Ideally, an SR-50 or another independent sensor would have operated alongside the SCLT profile, although I understand the cost of such a deployment could be prohibitive. To mitigate the lack of assessment and highlight the inter-comparison, it would be useful to see the multiple snow depth time series produced at each location from the various techniques on a single plot (individual panel for each site). This would illustrate the range/agreement in snow depth through time based on the analysis methodology, which can now only be inferred by flipping between figures, and looking at the correlation results in Figure S3. I suggest adding this new figure, and a brief discussion of it, to Section 5.

2. Line 262-268: consider moving Figure S3 out of the supplemental material to include it in this paragraph. I think these are worthwhile results to include in the manuscript.

3. This issue is acknowledged in the Discussion, but why not use consistent vertical spacing of 10 cm? In a relative sense, greater uncertainty with deeper snow is ok, but the current setup dictates that uncertainty will be greater when snow is deeper.

4. Line 122: can you provide a simple description of the PELT method? Not clear what is meant by 'asymptomatic penalty of 10%'.

5. Line 170: "all SCLT sites except for BaseSnow had a snowpack taller than the 170 uppermost data logger". Murphy's Law at work that there was an unusually deep snowpack during the season that you were evaluating this approach! Do you have a sense of how tall the profile needs to be? Is there any technical limitation to say, a 2 m

profile with sensors every 10 cm?

6. Cost effectiveness is a major driver of this work, but (unless I missed it) nowhere in the paper is the cost of the SCLT profiles stated. This information would be helpful! What is the cost sensitivity to the vertical resolution of the profile?

7. Sections 4.5 and 4.6 provide more detailed analysis of the light intensity methods. To improve the logical structure of the paper, I suggest shifting these up to follow Section 4.3, and shift down the temperature measurement approach reported in Section 4.4.

8. The reference list needs to be cleaned up. Some citations are missing (e.g. Archer, 1998) and details are missing from some references (journal titles, etc.). Review the sequence of figure numbers: figures jump from 10 to 13 to 15.

9. While the code and data availability are provided, what about schematics to the design of the probe? Will these be shared in some form so that others can follow your design if interested?

Editorial Line 30: change to 'snowfall is hard to catch, melts differentially once on the ground...'

Line 55: not clear what is meant by 'relatively unambitious method'...uncomplicated?

Line 60: suggest changing to 'broader snow science community'

Line 118: change to "We determined SCLT-derived snow surface heights using..."

Figure 4: minor point, but the y-axis range for BaseSnow is slightly different from the other sites.