Reply on RC2
Baptiste Dafflon et al.

Author comment on "A Distributed Temperature Profiling System for Vertically and Laterally Dense Acquisition of Soil and Snow Temperature" by Baptiste Dafflon et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-292-AC2, 2021

RC2: 'Comment on tc-2021-292', Michael Prior-Jones, 25 Oct 2021

My expertise is principally in electronic engineering, so I will make detailed comments on that aspect of the article, and will make only limited comment on the other aspects. This paper describes the development and field evaluation of a new temperature sensing instrument for measuring temperature profiles within snow or soil. The authors describe the development of the electronics, use thermal modelling to estimate the instrument’s performance, and develop a new approach to calibration which allows the digital temperature sensors used to perform at an accuracy in excess of their datasheet values. Finally they present results from field studies which demonstrate the potential value of this new instrument for studies of snow, ice and frozen soil. Broadly this looks like a solid piece of development work and contains a lot of useful insights as well as promising considerable advances in the field once the instruments are deployed in large numbers.

Dear Reviewer,

Thank you for your comments regarding the quality of the manuscript and study. We very much appreciate your review suggestions, which greatly helped us to improve this manuscript through revision.

Brief points of style and structure: in my view the introduction is rather longwinded and could be cut down to focus on the important points, which are that temperature profiling is an established technique for studies of both snow and soil, and that existing methods are cumbersome and expensive.

We cut down the introduction and improved it.

I note that one other reviewer has commented on the structure with regard to separating methods and results. My feeling is that an instrument-development paper is easier to read if you have the description of the engineering design rationale up front (as you have done) and then present the subsequent modelling, lab tests and field tests into separate chapters for each piece of work, each with its own methods, results and discussion. However, that’s not normally how a scientific paper is presented and so I leave that as a merely a suggestion to the authors and editor!
We agree with the reviewer. We kept the description of the instrument and related modeling and performance assessment upfront and we introduce the field studies later in the paper.

Lines 152-3: I’m presuming that the D-type flip-flops are arranged so that the whole length of the probe appears like a shift register, and then the logger clocks a single logic “1” down the chain to enable each IC in turn. I think this would benefit from further explanation or a diagram (perhaps as a Supplemental) as it’s not immediately obvious. It may also be worth pointing out that TWI and I²C are the same thing, as some people may have heard of one and not the other.

We have now provided more details in the text to make this clear.

Line 166: please give the part number for the RTC used.

Done.

Line 180: it would be helpful to give an indication of the amount of memory in bytes used to store each measurement. It’s possible to back-calculate this from your description of the Bluetooth data transfer speed, so why not state it explicitly? This will come in useful for anyone wanting to connect the instrument to a satellite modem for real-time reporting from a remote region.

We modified the manuscript to mention it explicitly.

Line 187: please give a manufacturer (and ideally a model number) for the CAB tube used.

We provided more details to ensure the reader can easily find/order such tubes, that are custom made by various companies. We do not want to include manufacturer names in the manuscript to not advantage one or another company. We can provide this information to the reader if contacted.

A more general point in this section: I’m not sure what the authors’ position on the intellectual property in the design is here, but if IP considerations allow, it would be wonderful if the whole design could be published open source (electronics schematics, PCBs layouts, firmware, etc) alongside this paper. If that’s not possible, maybe a complete bill of materials listing all the parts and their sources as a supplemental item? Neither of these are showstoppers for the paper but they would provide valuable information to anyone trying to replicate their work.

We agree with the reviewer that an open source release would be great. We are currently working on having all the information released. We added now a list of all the components (serial number and manufacturer) used to build the system in the data archive linked to the manuscript. The PCB layout and the logger firmware will be archived at a later time. The readers can contact the author to obtain more details.

Line 237: If I’ve understood this correctly, the calibration protocol is:

- Set the data loggers running
- Chill to -5C over 12-24 hours to ensure everything is fully frozen
- Transfer to a +3C incubator (or are you simply changing the setpoint on the -5C one?) and allow to warm up
- Wait until everything has come to equilibrium and then look at the results
- Look for the inflection in the time-temperature graphs, average it and then define that
as the offset from zero

Again, it would be good to have this clearly specified. It does become slightly clearer once you’ve seen the results section over the page.

We improved the description of the calibration protocol.

Figures 5 and 6: I found these both quite hard to read, especially on a printout. In particular, the thin green line used for soil temperature in figures 5b and 5c are almost invisible, especially for the dashed line.

We improved the figure.