The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-292

Michael Prior-Jones (Referee)

Referee 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-RC2, 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.

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 and snow and soil, and that existing methods are cumbersome and expensive.

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!

Specific comments:

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 I^2C are the same thing, as some people may have heard of one and not the other.

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

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.

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

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.

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.

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.