The Cryosphere Discussions

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Comment on tc-2021-292

Anonymous Referee #1

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-RC1, 2021

The manuscript "A Distributed Temperature Profiling System for Vertically and Laterally Dense Acquisition of Soil and Snow Temperature" by Dafflon et al. is a technical description of high-density temperature measurement (Distributed Temperature Profiling; DTP) system of ground surface and subsurface. The newly developed DTP system has an unprecedented measurement capacity with low cost, high resolutions, easy data retrieval, and flexibility in the sensor configuration. The authors also perform numerical experiments to assess potential errors in practical scenarios of sensor installations. Finally, they demonstrated the performance of the new DTP system in two field case studies.

I agree that there will be numerous applications using this densely obtained temperature, which will certainly lead to new understandings in various areas of environmental studies. This DTP system will be breakthrough instrumentation in environmental monitoring when it becomes readily available for the public. The overall quality of the study is excellent, but there is a space to improve the presentation of the contents.

I have minor comments to improve readability and attention from the research communities.

The manuscript structure is not consistent with the chaptering.

This paper would not fall into a traditional structure because it contains a section of numerical simulation and two field case studies. Although Sections 3.2, 3.3, and 3.4 are in the Results chapter, they have their introduction and methods before the result descriptions. If authors want to follow the conventional chaptering, they should be consistent. Or, they could re-organize the chapters and sections separately for each different component.

1 Introduction explains various aspects of the importance and applications of DTP. However, I think this Introduction could be more concise in explaining former application in the dense measurement of temperature, and technical challenges in the previous studies that could be overcome in this study should be more focused on. Although the authors summarized shortcomings of an earlier prototype of the DTP system (Leger et al.,

2019), the readers would like to know a summary of individual limitations and shortcomings of the previous attempts of DTP referred to in Introduction.

The sentence of the research objective starting from L113 is tediously long, and I could not understand it smoothly. And this doesn't seem to match the content of this paper. “to improve our predictive understanding of …” is also the objective of this study? I think this is suspended from the previous phrase “to design and develop,” but this sentence is confusing.

L146: “digital temperature sensors” It would be helpful to explain in more concrete wordings (e.g., semiconductor-based IC?) for readers who are only familiar with thermistors, RTDs, and thermocouples. Every sensor output could be digital. Provide a long-term trending of the sensor quality.

L172-3: This is beneficial information. Could you also provide the battery life with Bluetooth connectivity (always on / occasional on) if possible?

L260: soil and temperature à soil temperature?

L264: frost-affected à frost-susceptible

L337: I was confused with “measured” and “true” temperatures. What were compared? The analytical solution with simulated temperature by your numerical model? Or “true” measured temperature in the field??? Hypothetically measured temperature?

Figure 3: Please use the same term in (b) graph and caption. Phase shift vs. time delay in amplitude.; Please consistent use of a or alpha for diffusivity in Table 1 and Figure 3.

Section 3.3: This section describes the overall performance of the temperature and snow depth measurements, but snow depth estimation could be more focused. This study used a different algorithm using temperature gradient from previous studies with standard deviation differences. Why did you choose the new algorithm, and what was the performance compared to the previous algorithm? Figure 5b could be more explained to describe the result of snow thickness calculation and its reliability.

Figure 5: Unit for Soil moisture missing; The abbreviations for the title of color bars on the right of the figure should be explained in the capture. The color pallet, especially for Gv (b), should not be cropped because the readers like to see how prominent the boundary of the Gv between in air and in the snow was.

Section 3.4 also has the same structure and nature in describing the other case study.

What material was used for the DTP tubes in the two case studies, plastic or metal?

Figure 6: Is the snow depth derived from the DTP system or from ultrasonic? Are there data gaps in +5cm temperature? If so, please describe the gaps too.

4 Discussion: this chapter is mostly a summary of the previous chapters. Potential usages of dense temperature measurements enabled by the DTP system are repeatedly described here after the descriptions in 1 Introduction. They could be merged, at least for some portions.

Instead, the discussion of the system’s advantages and limitations, which is currently performed only in the last several sentences. They could be sufficient, but if possible, please add discussion on pitfalls/difficulties in detecting temperature boundaries to decide freeze-thaw or snow-air interfaces.