

Review - egusphere-2025-1397

June 2025

1 General Remakes

The manuscript introduces a reproducible method of developing a coiled-DTS array capable of observing air temperature at the millimeter scale. The authors go through various constraints necessary for a good design and present a material capable of fulfilling these design requirements. A parametric method for developing the DTS coil is developed, from which one can estimate the vertical resolution the array is capable of. The design's vertical accuracy was then verified in lab experiments followed by a field deployment for assessing temperature accuracy and the effect of artifacts. Some exemplary profiles of air temperature were presented. Radiative artifacts were evaluated against a standard reference probe. Extensive documentation for the code and assembly of the DTS coil are provided.

Generally, I think this is a fantastic concept and the manuscript is worthwhile of publication. However, there are a number of items to address first. The writing can be unfortunately repetitive and a general edit is necessary to create a more fluid text. I noted some of these instances. The introduction could do with a bit of reorganizing so that a non-DTS expert can more easily understand the justification of the problem. There are some issues with the description of the lab experiments (e.g., potentially flipped axes, saying experiments will be discussed later and not discussing them). The biggest need is creating a more robust statistical comparison against the reference probes, otherwise the statements being made are too ambitious given the limited results shown. The documentation is extensive and commendable. One thing to potentially add is a piece of code that converts the DTS from LAF to height. I look forward to seeing the revisions as I believe this work is important and provides a powerful method.

2 Major Comments

Introduction:

- The paragraph starting on line 57 introduces concepts that a non-DTS expert would need earlier to understand the discussion of previous work.

I recommend moving this concept to be much earlier, especially since this paragraph in essence introduces the entire problem and makes the literature review clearer.

- I also recommend expanding the studies that used coiled DTS setups in your review of previous work to better incorporate studies not originating from the same institution (e.g., more directly include Sigmund et al and Zeller et al).
- Line 82-84: I was left confused because the cited studies did study the specified media but the sentence suggests these media have not been studied.

Design

- Line 134: Citing a thesis, while accepted, should be done only when strictly necessary. I am certain you did great work in it, but I do not want to read a thesis to understand your manuscript. If the design considerations were not relevant enough to include in the manuscript then I suggest not mentioning them at all. If they are important, they should be discussed, even if briefly, in the text. I do not want to diminish the work you did, but I also do not want to read another document.
- Material selection: It seems like there is a trade off between the materials depicted in gold and blue in Figure 3. The materials in blue minimize thermal conductivity while those in gold have the potential to further minimize heat capacity at the expense of larger thermal conductivity. Could you comment on the reason to minimize one over the other, e.g., how was the "pareto front" chosen?
- The parametric design lists coil radius as one of the critical parameters. But, this parameter is also limited by the minimum bend allowed by the fiber. I think including a short warning of that limitation would be beneficial.

Experimental validation and discussion

- Naively, based on the affiliation of the authors of the study, I would assume you are using the 'dtsclibatron' python package. If so, please include a citation for the paper describing the method as well as a citation for the code. Upon further reading I see that I am correct in which case the information needs to be consolidated.
- The lab experiment for assessing the vertical accuracy has the water level decreasing with time in sub panel (c) while the water level appears to be increasing in time in sub-panel (b). Could you please clarify what the axes mean? Additionally, how was the true water level assessed?
- End of section 3.1: A lab experiment for assessing the effect of rain was performed and a later analysis of the experiment was promised in Section 3.3, but no such analysis was presented.

- Section 3.2.1: For describing the field setup it is also necessary to include the separation distance between the observations. How consistent is the grass height between the reference temperature probe and the DTS coil? Please address.
- DTS uncertainty versus resolution: On line 109 the instrument time and temperature resolutions are specified, but it is known this is different than the instrument accuracy. Later this is recognized through the calibration bath validation, with an instrument uncertainty of 0.13 C. I think the introduction would benefit from highlighting the literature assessing the actual uncertainties and resolvable scales in addition to the manufacturer supplied resolutions.
- 3.2.2 and Figure 5: I am left puzzling if the DTS device is measuring artifacts from the grass contacting the DTS. Could you comment on this either here or in the manuscript?
- 3.2.2: Time-averaging to 30 minutes is a substantial amount of time aggregation. In night time conditions the temperature structures will almost certainly include processes at minute time scales, as seen in Figure 7b. Further, this is a total of 180 observations (correct?), which seems like an unnecessary number of observations needed in order to "reduce noise". I recommend carefully evaluating if this level of temporal aggregation is necessary.
- 3.2.2: I am quite certain I read much of this material in the introduction.
- Figure 8 and 9: Given the logarithmic shape and the fine scale features, I recommend moving these plots to an $\ln(z)$ spacing. Further, the variability of the observations should be indicated (I anticipate the variability will be large which is part of the reason I think a 30 minute average is inappropriate).
- 3.2.2: I strongly disagree that extrapolating an observation to a distance 100% outside the fitted region counts as a validation, as suggested in the Figure caption and in this section. If you want to make this statement, I strongly argue for the inclusion of a more robust statistical fit, including uncertainty as well as a statistical test comparing the extrapolated value to the reference observation. In fact, I think I would like to see a statistical comparison generally. The 'statsmodel' in python is a useful package for performing such statistical inferences and tests. I also think a general illustration of the error distribution is necessary.
- The paragraph starting on line 311 needs to be re-written. It is currently too informal for a publication. Further, many of the assessments come off as overly confident given the sparsity of information presented.
- Section 3.3: There is no mention of wind-mitigated radiation artifacts. Including an analysis on the basis of wind and net radiation simultaneously

would benefit the statements being made regarding the accuracy of the system. It also seems like the Sigmund et al., 2017 manuscript could also be cited in this section. Finally, it is stated that radiative effects can be compensated for, but this was not performed here, which seems a bit odd.

Conclusions

- Line 405-406: It is stated that this resolution and accuracy have never been achieved before, but this was not discussed directly in the text and seems hard to verify in any case. Specifically, part of the motivation for the study was that it is hard to verify what the resolution and accuracy was for other studies. I recommend amending this statement to be consistent with the motivation.

3 Minor Comments

- The abstract reads a bit disjointed and could benefit from making the sentences flow better into each other.
- Line 10: "different, identical" I think this sentence needs to be clarified.
- Line 34: Zeller et al do use a coiled DTS setup, but they do not specify this is to observe the insulating plant canopies as implied.
- Line 52-53: Vertical accuracy is unclear here. I think re-organizing the introduction as suggested could help make the intent clear.
- Line 118: I do not believe that you need to make the parenthetical statement.
- Line 164-166: I naively would assume that reducing the specific heat would reduce the lag between a temperature change and the change in the signal observed by DTS.
- Line 181: The sentence starting here needs revision.
- Section 3.2.1: Many sentences begin with "This site" or similar. Please re-write to be less repetitive.
- Line 264-266: The sentences are disjointed and incomplete.
- Line 319: "the" is an odd choice for a word to bold.
- Line 341: "In the worst case" and "sub-optimal conditions" convey the same concept.
- Line 417: I am confident I read this statement previously in the manuscript.