

Atmos. Meas. Tech. Discuss., referee comment RC1  
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## **Comment on amt-2020-500**

Nikolas Angelou (Referee)

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Referee comment on "Use of thermal signal for the investigation of near-surface turbulence" by Matthias Zeeman, Atmos. Meas. Tech. Discuss.,  
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### **General Comment**

The author presents a measurement technique which combines a thermal imaging instrument and distributed temperature sensing system in order to monitor spatial and temporal fluctuations of the temperature. Those measurements are supplemented by point observations of the temporal wind fluctuations, which are used in order to provide a more thorough insight of the local ambient conditions. The article is in general well written and the measuring techniques and the data analysis are presented in detail. However, I think that the results presented in the submitted manuscript are lacking an assessment of how accurate and precise the estimation of the measured temperature fluctuations are. This is discussed briefly in the text and a qualitative comparison could be performed visually from the results in Figure 3. However, it will contribute to the assessment of the measuring capability of this setup if a direct comparison with the reference sensors is performed. Moreover, I think that it is not explained clearly the reason for selecting the specific shape and size for the experimental setup. This information is going to be useful for understanding and interpreting the results of this study.

### **Specific Comments**

Line 1. Organized motions of what? Please specify.

Line 6. What is meant with the term "Variance Events"?

Line 9. I suggest replacing the "with the naked eye" with visually.

Line 13 – 14. The author states that “the available methods to determine energy and scalar fluxes from terrestrial land surface are relatively imprecise due to a multiscale of irregularities in the land surface and the turbulent transport mechanisms”. I think that this statement is not very clear. This imprecision originates from limitations in the precision of the measuring methodologies or does the imprecision refer to the need for spatially distributed measurements?

Line 24. An abbreviation should be added after the “roughness sublayer”. Later in the document (line 26) is referred to as RSL.

Line 45. What it is meant by the following statement: “the quantification of Tb outside a controlled laboratory environment is a challenge, in and of itself”?

Line 57. I recommend that this statement about the goal of this study is also mentioned in the abstract. It will give a clearer idea to a reader about the objective of this study.

Lines 58-61. I think that references to previous studies that have used the DTS and TIR measuring techniques should be mentioned. An example is:

Dzara, J. R., Neilson, B. T., & Null, S. E. (2019). Quantifying thermal refugia connectivity by combining temperature modeling, distributed temperature sensing, and thermal infrared imaging. *Hydrol. Earth Syst. Sci.*, 23(7), 2965–2982.  
<https://doi.org/10.5194/hess-23-2965-2019>

Please note that I am not neither the author or any of the co-authors of the aforementioned study.

Lines 65: What does ICOS stand for?

Lines 68 – 69: In these lines the author gives details about elements of the landscape surrounding the experimental area. It is not clear how this information is relevant to the study. I suggest that the author explain briefly the impact of the landscape to the experiment presented in the manuscript or remove that part.

Line 70: What are the ScaleX campaigns?

Line 74: Why is the period between 18 – 22 Jul 2016 considered as a reference period?

Line 75: What was the purpose of the UAV use? And how could they have an impact on this study?

Line 78: What does EC stand for?

Line 78: I think that it would be very helpful for a reader if the author specify that is the figure 1c and table 1.

Line: 82: What was the reasoning for the number of sonic anemometers used, the selection of the locations of the tripods and the heights of the sonic anemometers? Also, from the Figures 1 and 2 it is visible that the sonic anemometers were located between the supporting poles of the DTS mast. Could there be any interference to the sonic anemometers measurements acquired during the period selected in this study from wakes generated from the supporting poles?

Line 97: Where was the TIR system pointed to?

Line 101: What is meant that the location was determined in post-processing?

Line 116. The air temperature ( $T_a$ ) is mentioned here, but it is only discussed how it is measured in Appendix A3.3. I would suggest a brief statement about those measurements also in section 2.4.

Additionally, regarding Figure 3. What is the sampling frequency of the time series presented in Figure 3? How is the  $T_c$  estimated at the presented heights? Is it the average over all the four sides of the box? Which sonic anemometer's data is being used in the Figure 3 c?

Line 127. The author states that "some turbulence statistics were rarely acceptable ... "

What is it meant by the words "some" and "acceptable"?

Line 129-130. It is not clear how what are the assessment criteria used here to assess the quality of the flux computations.

Line 132. How were the temperature gradients calculated?

Line 136. Figures 3a-c allow a visual comparison of the time series. However, there is a lack of a statistical comparison of the different methods (e.g. correlation, mean absolute error). I suggest that the author elaborate more on this part.

Line 140. In Figures 4b-c time series of the normalized by the Obukhov length scale height and the friction velocity are presented. Measurements from which sonic anemometer were used for those calculations. Which criterion has by used to assess the atmospheric stability is stable or unstable?

Line 145. Is it the air temperature or the cable temperature presented in Figure 6?

Line 189. The DTS measurement set-up has a rectangular shape. What is meant here the mean wind was mostly aligned to the set-up?

Line 191: How does the animations reveal scale interactions? And why they are note easily identified in the statistical analysis?

Line 196: I do not understand what is meant with this statement. Can the author elaborate explain this a bit more?

Line 213. Why is there a sudden jump in the TKE in Figure 11 between 00:00 and 12:00 in 21 jul 2016?

Line 228. The author gives a very thorough list of the limitations of the current measurement technique. It would be very constructive if the author could provide a short recommendation regarding in which applications this setup should or shouldn't be used.

Line 235. Can the author elaborate more on why three-dimensional sonic anemometers at lower heights would be advantageous in this study?

Line 249. How is this precision calculated?

Line 250. What is the reference scale for the recommendation for the size spatial domain and what is meant with the "2.5 dimensional or better"?

Line 260. Does "turbulence" refer here to wind speed or temperature?

Line 261. Both here and in the abstract, it is mentioned the development of physics-aware machine learning techniques. The current topic is not discussed in the introduction, so it is difficult to understand what a physics-aware machine learning technique is, assess how this study contributes to their development and understand their potential value. I think that it would increase the comprehension of the manuscript if the author could briefly explain this.

Line 271. How accurate was the time keeping?

Line 285. How did the author recognize the period with winds from the north?

Lines 369 – 380. Why is this paragraph in the appendix? Isn't this part of the results? What is the physical meaning of the grouping of the clusters presented in Figure A7? Also, what is the impact of variations of atmospheric stability in the results presented in Figure A7?

Table 2. What is the reason for mentioning the different ways of parameterizing the atmospheric stability? How is this used in this study?

Figure 1. Units are missing from the x and y axis in all three plots, as well as from the color plot in figure 1a.

Figure 4. Over what time scales the friction velocity has been calculated?

Figures 3,4 5. I suggest changing the color scale in Figure 3a-c, Figure 4a, Figure 5 a-b, the colors are going to be very difficult distinguished from color blind people.

## Technical Corrections

Line 150: "or were more" should be changed to "or more were"

Line 177: The acronym TED is explained only in line 370. That explanation should be moved here.

Line 179: change "though-out" with "through-out"

Line 201: I suggest change the "it is assumable" with "it is assumed"

Line 242: "eight" -> "eighth"

Line 244: "nine" -> "ninth"

Line 332: "data are" -> "data is"

Line 425: There is one extra dot before "1"

Line 467: " 17, 0"-> "17: 1-17 180060"

Lines 503, 516, 521, Please check that all the details in the references Petrides 2011 Sayde 2015, Selker 2006 are written correctly.