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Atmospheric Measurement Techniques Discussions

Interactive comment on "Fiber optic distributed temperature sensing for the determination of air temperature" *by* S. A. P. de Jong et al.

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Short summary

The present manuscript describes an experimental assessment of the accuracy of fiber optic temperature measurements corrected for the radiation error. The authors give a broad introduction to the state of applications of distributed temperature sensing via fiber optics and shortly introduce the radiation correction applied. The experimental setup is carefully described and the results of the co-exposure of a set of fiber optics and a weather station are given in adequate detail. A short discussion rounds up the text.

General comments

I like the basic idea of the paper very much, because the studies using DTS, I have read so far, did not question the measured values as such, at least not very detailed. This problem is addresses by the present manuscript. With its results, however, I see several major problems that might be an obstacle in transferring them to other measurements:

a) The temperature reference measurement is crucial for the whole study but there is a number of open questions on the quality of these measurements. Foremost there is nothing stated on the radiation shielding, ventilation, and position (relative to the fibers), height above ground, calibration of the sensor, sampling frequency (only on the averaging interval of 5min), variance of the values averaged in each interval etc. b) There was no wind speed measurement at the site. The wind data used were taken 6km away. If I look at satellite images covering both positions, it looks like the measurements were on some sort of campus with buildings, whereas the wind data are from a nearby airport. I do not remember reading of any correction applied to account for a the different height of the wind measurements compared to height of the fibers nor for the different roughness lengths of both sites. Furthermore, the averaging of five minutes appear too short under these circumstances (at 5 m/s wind, 5min=3000s correspond to a spatial range of 15km, which is only above the largest size of turbulent eddies that could exist between the two positions), which gives room for unnecessary large random error of the wind speed and in consequence the radiation error. c) Although the DTS temperature values were averaged over a number of a number of individual measurements, it is not attempted to estimate the random error of an individual measurement, which would be probably the most valuable outcome.

Detailed comments ————

6288,7: "[the results...] were very good." is a too general statement. It would, however, be possible to state that they were very good, compared to something (the expected error of ... K, to a previous result of <citation>, the ... sensor, or similar).

6288,10: "close" is, likewise, an unjustified classification that might be totally different from a different point of view. Instead, it should be stated that for example, the difference was smaller than the standard deviation of the averaged values, the accuracy of the reference device , or something similar.

6288,10/11: The difference between "horizontal cables" and "vertical profiling" is not clear. To my knowledge, a recent study (Thomas et al ?) used a harp-like stack of horizontal fiber segments for vertical profiling.

6288,20: If 0.01K is the best available accuracy, what would be a typical value?

6289,19: A Stevenson screen is just one type of shielding. It should be noted that artificial ventilation is indispensable for high-quality measurements (for example see WMO CIMO guide).

6289,19: Who is Gaylon Campbell?

6290,5: the equation should be checked against the formatting guidelines of AMT. Crosses are usually reserved for cross products and sometimes the (decimal) exponent and should be removed here.

6290,17: 51°59'45.44"N, 42°2'39.56" is in Russia between Moscow an Saratov. It appears you mean 51°59'45.4"N 4°22'39.6"E

6290,12: There is no clear link or deviation from (1) to (2). The usual formula for the radiation error is T_indicated = T_air + Q / alpha_L, where Q is the net radiation at the temperature sensor surface and alpha_L the ventilation coefficient. The latter depends on the form of the sensor and ventilation speed. Could you derive (2) from such a more general expression?

6290,25: What does "fused together" mean?

6291,1:"measured" -> "operated" ?

6291,1st para: the water temperature was measured how? What was the accuracy of

this measurement? Was the water temperature constant? What was the stdv of the water temperature?

6291,9/10: How many values were averaged in total? You should use the stdv of the measurements to estimate the random error of the individual DTS measurements.

6291,14: If the reference exhibits a radiative error, it is trivial that the values are close to another sensor that has a similar radiative error. Was the Temp/RF sensor shielded from solar radiation and artificially ventilated? Or was ist alt least shaded by a naturally ventilated shield (e.g. HOBO RS3)? If not artificially ventilated: Did you estimate and correct its radiative error? The quality of the reference has to be thoroughly checked and its accuracy should be well defined.

6291,16-19: The wind is typically measured at 10m above ground at airports. The DTS fibers were at 1m above ground. Furthermore, the roughness lengths z_0 at both sites seem to be different. The CORINE-database says "airport" => 0.05m and TUD campus = "Discontinuous urban fabric" => 0.6m (see e.g. http://www.eea.europa.eu/data-and-maps/explore-interactive-maps/corine-landcover-2006)

6292,1st para: Does the difference T_air-T_fibre scale with the net radiation (or the incoming solar radiation, provided that the cloud fraction did not change much)? Compare my remark on (2).

6291,18: Even 0.61K difference is not really a close match between two thermometers. The statement should be replaced by a conclusions which is quantitatively backed by the results (see remarks on the abstract).

6291,21-: I cannot agree with the conclusion that the accuracy is "reasonably good" for vertical profiling. A random error of 0.61K corresponds to an error of 0.9K for a temperature difference or - if I assume a vertical distance of adjacent measurements of 2m (fiber section length) - an error of 0.42K/m for the vertical gradient. For 10m it would be 0.08K, which is still much larger than the adiabatic lapse rate. Hence, such

vertical profiles would be not very helpful. If, however, most of the RSME would stem from systematic (but not resolved in this study) errors and the random error of the DTS is much smaller (see my comment on the averaging) this statement might be supported by the measurements. But this has yet to be proven.

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