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Discussions

Interactive comment on "Quantifying Small-scale Temperature Variability using Distributed Temperature Sensing and Thermal Infrared Imaging to Inform River Restoration" *by* Jessica R. Dzara et al.

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In this manuscript, high spatial resolution temperature observations are used to investigate small scale spatial variability in stream temperatures. These are placed on top of simulated stream temperatures with grid cells of 300m, leading to the conclusion that at moments when the simulated temperature exceeds the critical temperature (for LTC) of 28 C, there are always pockets of water that are cool enough to serve as refuges.

Although these findings are potential useful, this manuscripts reads a bit as an engi-

neering report with the focus on 'improving' an existing 1D 300m-resolution temperature model. There is little in-depth science involved: the results section is mainly a summing up of observations at the 300 m scale, while more quantitative assessment of the uncertainties/sensitivities of the used approach is missing.

Because I still think the available data is sufficient to improve the manuscript significantly, I am advising major revisions.

What in my opinion is needed is a more in-depth analysis about spatial variability over a whole range of scales. For example: one can compare the left and right bank DTS measurements for each cross section as the smallest scale ($\sim$1m). Subsequently, the temperature range for progressively larger scales can be obtained. Finally, the implication for the model scale (300m) can be used as a practical case study. Similar things can be done for the TIR observations. Although it was not clear to me if the 10 points which were used to obtain the summary points were measured in 1 cross section or if they were measured over 300m, with a spatial resolution of 0.6 m, there seems to be enough data to do the same analysis for the TIR data.

Line by line comments:

P2,L29: Westhoff et al. (2007) did their research in the Maisbich river in Luxembourg.

P3, L3: Neilson et al. (2010) did indeed not use these measurements, but they did model the temperature of transient storage zones.

P3,L10: isn't spatial variability not the same as temperature range?

P3, L23: please also indicate stream width and depth estimates.

P4, L31: change to: the majority of the reflected energy has it original wavelength.

P6, L25: Are these 10 locations spread over 300 m, or 10 locations covering one cross-section? And why are only values in the centre of the channel taken? Pools etc, are generally located on the sides of the channel. The spatial variability will probably be larger when these values on the side of the channel will be taken into account as well.

Section 3.4: Here, many statistical parameters are explained. As a reader I found it difficult to remember what the meaning is of each statistic. Furthermore, the symbols defined here hardly ever comes back in the results section. My suggestion here is to only define a few of them, and in the results section clearly state if a spatial or temporal range is discussed.

P7, L16: use subscripts for TSavg: now it reads as T*S*a*v*g (the same for all other equations). Instead of 'avg' one can also use a bar on top of T

P8, L1: what does "top of hour" mean?

P8, L10: If I understood it correctly, these summary points were the mean, min and max. So why are there "on average" 3 summary points? This implies that at some location you have less and at others you have more summary points.

P8, L15: L is river length, isn't it?

P8, L28: What do you mean with "extrapolate model outputs"?

P8, L31: the key features are the same as the river features discussed in the previous lines, aren't they?

P11, L15: I guess you mean that the backwater location is subject to a higher thermal mass (or lower heat capacity)?

P11, L33: with a single snapshot in time one cannot conclude that the stream is cooling. One can only see that it is cooler downstream, but this can also be caused by warm water that only travels slowly downstream.

Section 5: Discussion: I miss a discussion on the difference between TIR and DTS measured ranges: which one has the largest range and highest temperature, and why? Although both methods measured at different periods in time, it must be possible to say something about it.

P14, L4-5: Why is the change in temperature over time minimized on warm days? I would presume that on such days the rate of change is at its maximum, since also the daily amplitude is the largest on these days

P14, L8-9: Can you quantify the effect of stratification?

P15, L6: The definition of temperature range is defined as Tmax-Tmin, so it can never be a negative value.

Section 5.4: this belongs in the conclusion (or summary) section.

Figures, general comment: add the caption of the figures also right below the figures: I know this will happen once the manuscript is published, but as a reviewer, I found it annoying that these captions were only listed in the text.

Fig. 3b: reduce the scale on the vertical axis to max 2 C?

Fig.5: In my opinion, there is little added value to the panels b-d. I also wouldn't call them "summaries" anyway: it is just a different way of plotting the same results.

Fig.7: What was the time for the simulated temperature? I am also wondering how variable the range over time is. This is especially interesting since the TIR data is from a completely different year than the DTS measurements. The legend of panel b can also be improved: What is the dark blue line, how are the average temperatures obtained?

References:

Westhoff, M. C., Savenije, H. H. G., Luxemburg, W. M. J. ., Stelling, G. S., van de Giesen, N. C., Selker, J. S., Pfister, L. and Uhlenbrook, S.: A distributed stream temperature model using high resolution temperature observations, Hydrol. Earth Syst. Sci., 11(4), 1469–1480, doi:10.5194/hess-11-1469-2007, 2007.

Neilson, B. T., S. C. Chapra, D. K. Stevens, and C. Bandaragoda (2010), TwoâĂŘ-zone transient storage modeling using temperature and solute data with multiobjective calibration: 1. Temperature, Water Resour. Res., 46, W12520, doi:10.1029/2009WR008756.

With kind regards,

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