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.

Anonymous Referee #3

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Hydrology and Earth System Sciences manuscript HESS-2018-441 describes the result of a study to quantify small-scale temperature variability in the Walker River, Nevada, using a combined approach leveraging DTS, thermal infrared (TIR) remote sensing and one-dimensional river temperature modelling. DTS and TIR data were incorporated with coarser temperature model predictions to identify potential thermal refugia habitat that may otherwise be missed from lower-resolution temperature model outputs. While the general idea of combining TIR, DTS and model predictions is laudable (and there is definitely a need for this type of research), I felt that the manuscript

was generally too descriptive, with a lack of formal hypothesis testing or deeper analysis. Furthermore, the method by which the TIR/DTS data was combined with the temperature model predictions (through simple addition of temperature ranges to the temperature model-derived thermal long profiles) was rather simplistic and does not appear to offer a substantial benefit over the use of the DTS/TIR data alone. Despite these issues, I support the general concept of the manuscript and believe that the idea of combining DTS, TIR and model predictions has merit, but I feel that significant revisions (including a much more in-depth treatment/analysis of the data beyond the scope of what would normally be considered 'major revisions') is needed prior to publication.

—General comments—

-In section 3.4 (and table 1), it is quite difficult to remember/follow the names of the different variables. Is there any way of streamlining/simplifying this?

-It's probably not necessary to give all of the detail about the DTS system (ie. 2 channels, cable stress, etc) in the methods and results sections. Consider removing all superfluous information to streamline the manuscript.

-It would be nice to see some of the TIR imagery to allow for comparison with the DTS data; given the large time difference between the TIR and DTS data, the information in table 3 is of limited use.

-Use of the word 'RMS' (ie. the name of the model) is confusing in places when you are also talking about RMSE. Consider putting 'RMS' in italics or similar to avoid confusion.

-There is very little information about the RMS model in terms of inputs, implementation, etc. I appreciate that this information is already given in the other references provided, but it would nonetheless be useful for see it outlined in this MS (maybe a short paragraph explaining model function, input data, etc).

-It's not immediately clear in the manuscript how you 'apply' the DTS/TIR temperature data to the model. From my reading, you simply add/subtract the temperature range

to the model outputs. Is this correct? If so, I would have thought that this process (ie. calculating temperature variability from DTS and TIR and simply adding/subtracting to/from the model outputs) is accompanied by a range of issues given that the DTS data is essentially a measure of spatio-temporal temperature range, whereas the TIR data only gives spatial variability. Also, given that the TIR data and DTS data were acquired at different times, it does not seem appropriate to overlay these data onto the RMS model output for the same point in time (eg. fig 7).

-What is the reason for the large temperature discrepancy between the two river banks? This kind of information is quite interesting and could benefit from a thorough treatment in the manuscript.

-Section 3.4 of the methodology is difficult to follow. Given that this section contains the majority of the analyses covered in the results and discussion sections, it would be beneficial to restructure this section to make the subsequent results and discussion easier to follow.

—Introduction—

P2 L1: Would be good to have 1-2 sentences of more general information on the importance of river temperature in the context of climate change.

P2 L24: It would be a good idea here to qualify the point about TIR only providing a single snapshot in time by saying something along the lines of 'unless acquired multiple occasions'.

—Methods—

P4 L22-28: These lines are potentially redundant and could be moved or redistributed elsewhere in the methods section.

P4 L30-31 and P5 L1-5: I'm not sure that a description of how DTS works is necessary; consider removing this paragraph (or at least, shortening it to one sentence)

P5 L6-13: Consider adding a figure to illustrate the deployment of the DTS. I appreciate that this is partially covered in fig 1 (large scale) and fig 3/4, but it would be nice to see a full resolution map showing the DTS installation.

P5 L18-22: Is this information necessary? Consider removing.

P5 L28: This sentence formulation is slightly difficult to follow. Do you mean to say that the calibration process consisted of using a linear transform to correct the DTS based on the difference between the DTS and thermocouple temperatures in the ice bath?

P6 L18-32: There isn't any mention here of the winter TIR data collection flights which you subsequently refer to later on in the manuscript. The manuscript only appears to have dates and hydrometeorology information for the summer flights. I appreciate that the winter data is only used for locating seeps, but it would be good to talk about the winter flights here first.

P6 L32: Although I managed to find the Watershed Sciences documents online, they were quite difficult to track down. It would therefore be good to give some further brief details of the flights, for example RMSE or R2 of TIR data vs. logger values, etc.

P7 L7: Sentence ('each reach [...] throughout the reach') is a little clunky – consider rewriting.

P8 L28: This sentence ('To extrapolate model outputs...') is difficult to follow; it is difficult to understand exactly what you are doing here. Can you think of a different way to explain this step in the methodology?

P8 L32 and P9 L1: What do you mean by 'were developed in 2012'? Do you mean that diversions/return flows were implemented in 2012 in the model, or in reality? Or just that they were mapped/identified?

P8 L2-4: If you wanted to exhaustively identify all seeps, I wonder if a better practise would have been to combine data from the winter and summer survey flights? Also, please give some detail about how the seeps were identified. Was it from manual photo

interpretation? Were aerial photos acquired simultaneously to aid the interpretation process?

—Results—

P9 L26-30: These sentences would be better suited to the discussion section.

P10 L8-9: I'm assuming that the 'shaded backwater eddy' and 'pools with overhanging shrubs' are the inset panels in fig 3(a)? If so, please label these panels in the figure, as it is not clear what they are.

P10 L20: I'm not sure what you mean here when you say that the daily max/minimum temperature changed little when analysed with the Walker River. Do you mean to say that a lack of large-scale temperature variability in the study reach masks considerable localised variability in areas like the Wabuska drain?

P10 L25-30: Some of this material might be better suited to the discussion section.

P11 L32-33 and P12 L1-5: This would also be more suitable to the discussion.

—Discussion— P13 L23-31 and P14 L1-9: I'm not really sure what information this 'limitations' section adds to the manuscript. There are clearly limitations when conducting an approach such as this combining TIR, DTS and modelling. However, this section reads more like a list of problems associated with TIR and DTS data collection (which have already been well established in the literature) rather than a critical appraisal of the inherent difficulties of combining and comparing these types of data with 1D temperature models, which would be much more interesting (and potentially useful for the reader).

—Figures—

Figure 7(b). As discussed above, it is not clear how you combine the RMS stream temperature data with DTS data from June 2015 and TIR data from July 2012. Surely this mixing up of different dates and times means that the temperature ranges from the

DTS cannot be comparable to those from the TIR? Also, to what does the 'average temperature' refer? Is it from the DTS data (temporal) or is it average temperature (spatial) calculated as the mean of all pixels covering the refugia/beaver dam, etc?

Interactive comment