Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2018-441-RC4, 2018

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

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 #4

Received and published: 2 November 2018

General Comments:

The article compares temperature data from DTS and thermal imagery within a stream reach where one-dimensional temperature modelling was conducted. The study takes place in the Walker Basin, NV, where stream temperatures can exceed thermal tolerance for native, threatened trout. This study provides a unique combination of methods and is useful in understanding the pros and cons of each. The study is relevant for work that seeks to restore habitat for fish in streams where temperatures rise above the thermal tolerance of threatened cold-water species.

Printer-friendly version

Discussion paper

There are a few places where the manuscript could be improved. The authors generally summarize the differences between the methods, but they could take it to the next level with doing a more quantitative analysis comparing the different methods. At the end, there is not a strong conclusion, or list of pros and cons, comparing DTS vs TIR methods for validating or contributing to stream modelling efforts. What would the authors decide to use - DTS or TIR - based on the results of this paper?

Second this paper has the data to conduct analyses that look at the availability of different water temperatures that are relevant for trout. For example, the authors focus on 28C as a thermal cut off for LCT, but these fish may become thermally stressed at much lower temperatures (e.g., 21 or 22C). Additionally, very cold temperatures in the summer may not be ideal for growth. The authors could consider adding an analysis that describes the area of stream that is available to LCT below different cut offs, e.g., below 18C, below 21C, below 25C, and below 28C, and the distance between those areas. The DTS and TIR methods identify river features that the one dimensional model doesn't, but how important/large/cold is the water provided by these features? The authors could also compare how the different methods perform in quantifying the amount and connectivity of thermal refugia.

One way that could improve the flow of the results section would be to put the comparison of all three methods up front, and then describe the results of how temperatures differ in the basin second. These are currently split into different sections, with the temperatures differences in the basin described following each method. Additionally, the description of the DTS channels can be a bit confusing because there are river channels and DTS channels – is there another descriptor that could be used in place? The focus on the Wabuska diversion can also be confusing, because it was flowing during the time window of one method and not flowing for the time window of the other method.

Finally, the introduction and discussion could use more context for why micro thermal regufia is important for cold water fish and trout. The author should look for more recent

Printer-friendly version

Discussion paper

citations of Sutton et al. 2007, Brewitt and Danner 2014, etc.

Specific Comments:

Pg 2 Line 5. It could be useful to explain here explicitly what you mean by one dimension. (Obvious to stream temp. modelers but less intuitive to managers). Do you mean longitudinal interpolations along the stream?

Pg 2 Line 13-15. Similar comment as above – what does 2, vs 3 dimensions mean for streams? Length, width, depth, and in that order?

Pg 2 Lines 23-25. Switch the order of these sentences. Describe how TIR has been used to locate various stream features, but then the downside is that it is a single snapshot in time.

Pg 3 Lines 2-5: This sentence is key in setting up what your study contributes to the ones that you cite, but it isn't clear. These methods have been used to calibrate reach scale models but hasn't been used to quantify temperature ranges within model reaches? The difference in the wording is very slight, and needs to be clarified.

Pg 3 Lines 9 – 10 Objective #3 is has circular wording, it's not clear what the objective is. Is the goal to dentify features with greater temperature ranges because they have variable temperatures? Maybe the objective is just to identify those features?

Pg 3, Lines 11-18 I suggest reducing this description of the Walker Basin to 1 sentence, maybe 2 sentences here. You get into more detailed description in the next section. For example, environmental water purchases seem relatively uncommon, and you do them more justice in the next section.

Pg 4 Second paragraph – It would be nice to include some description about how narrow the range of LCT is. It makes your study more special.

Pg 4 Line 8 – Are all these study sites in CA? For a European journal, the places should be better located.

Pg 4 Line 14 - This sentence is a little unclear as to what it means in context of the previous sentence. Because the lake is inhabitable, it means the lake and stream systems are disconnected?

Pg 4 Line 17 – Restore to tolerable salinity ranges? Restore is a broad word. The discussion of salinity is really interesting, but perhaps not relevant to your stream temperature focus.

Pg 4 Line 22 – Can you be more specific about what a 'dry year' means in this basin? I.e., received <25% of historical rainfall, or stream base flows were at XX% of the average flows for that time of year? (Especially since you do have USGS gauge data)

Pg 4 Line 26 – Comparing measured and modeled data? (rather than between)

Pg 6 Line 31 – the East Walker has more flow than the mainstem – presumably because of diversions? Remind the reader of that again

Pg 9 Line 30 – was the Elmore et al. 2015 study also conducted in the Walker R basin? This point may be better situated in the discussion

Pg 9 – Fig 2 caption – A reminder of what is the Wabuska Drain (not-flowing, but standing water from an ag ditch) would help the reader in the caption

Pg 10 – Fig 3 – The sub-panels in Fig 3 should be labelled. In looking at the figure, it's not clear why these two features are called out. It looks like there is more variation between river left and river right than anything else. Fig 3 b could probably be moved to supplemental.

Pg 10 – Why do Fig 3 and Fig 4 visualize different times, 5:30 pm vs 3:15 pm?

Pg 10 Lines 19-31 – How different would this look if the Wabuska drain was flowing? Is it more often flowing or not flowing in the summer months?

Pg 10 – Fig 4 – It would be nice to add a line or circle indicating where the beaver dam is on that reach of stream. Fig 4 b could also be moved to supplemental. However it

might be worth exploring why there is day-to-day variation in the temperature ranges – could plot the data against air temperature range for the day?

Pg 11 Lines 10 – 11 Have LCT been observed using the Wabuska drain when it is flowing, or when stream temps aren't so high at the mouth?

Pg 11 Lines 31-32 Are there studies that show that LCT cannot move through warm temperatures? Maybe save the temperature implications for fish for the discussion, when you can do a more thorough review of studies on LCT (and related salmonids) and their thermal tolerance. They may be able to move through a small area of warm temperatures. What may be more important is the extent of cold water refuges, which could be quantified with the given data.

Pg 11 – Lines 33-34 – Make it clear that the cool water from Wabuska was observed with the other method/time window when stream temps were monitored.

Pg 12 – Fig 5 – Similarly to the other figures, the sub-panels b,c,d could be moved to supplemental since they are redundant with the main figure. Alternatively, they may be a better way to present the data in the main figure, so you could consider dropping panel a.

Pg 13 – Lines 16-19 – Model estimated within 1C – that's pretty good! But under estimating by 2.5C is less desirable – could be a point to discuss.

Pg 14 – Lines 13-15, Maybe it didn't exceed 28C, but trout can be thermally stressed at much lower temperatures.

Pg 14 Line 23 – Is this study from the Walker R Basin, or generally citing groundwater depletion from drought?

Pg 14 Line 30 – How migratory are LCT? Would they historically migrate between lakes and streams, and was that during the summer? If not, then you could shift your focus to movement and opportunities for longitudinal connectivity rather than migration.

Pg 15 Lines 9-10 Describing that there is a range in temperatures doesn't necessarily mean that there is thermal refugia. How cold is the water around these features? If it has high variability but it still warm, then it may not provide refuge for LCT.

Pg 15 Lines 27-29 This would be a good place to give a nod to the work that has evaluated how fish use thermal refugia (do a forward search on Sutton et al 2007).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-441, 2018.

Printer-friendly version

Discussion paper