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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Climate change and stream temperature projections in the Columbia River Basin: biological implications of spatial variation in hydrologic drivers" *by* D. L. Ficklin et al.

Anonymous Referee #2

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This paper describes a coupled hydrologic and stream temperature model driven by historical and future climate for the Columbia River Basin. Stream temperatures are correlated with air temperatures and hydrologic pathways to determine drivers of stream temperature change with climate warming/climate change.

Overall, this paper is well written, of an appropriate length, and is well-presented. However, a few major shortcomings exist that should be addressed prior to publication:

1. The contribution of this paper is not adequately described. The authors imply that

they are the first to use a physically-explicit stream temperature model to assess atmospheric and climatic drivers of stream temperature change. However, this is not the case (see papers by Isaak and Null for other examples). The introduction acknowledges that deterministic numerical models and analytical approaches have been utilized, but then focuses on regression approaches. Better describing how this paper contributes to the existing literature would improve it immensely. Systematically describing hydroclimate effects on stream temperatures is a new and needed contribution, but this contribution is currently over-sold.

2. The stream temperature model is inadequately described. It is simply described as a model that 'reflects the combined influence of meteorological conditions and hydrological inputs on water temperature within a stream reach' (pg 5799, 1st paragraph) and model that 'includes the effects of hydrologic component inputs on stream temperature' (pg 5801, 1st full paragraph). Is it a physically-based, regression, or equilibrium temperature approach? There is a reference for Ficklin et al. 2012, but since the model is fundamental to this study, it must be described much more fully. The calibration optimization technique is described in more detail than the stream temperature model itself.

3. Similarly, what is the spatial resolution of the modeling? It may be at the ecological province scale and if so average size with ranges of ecological provinces should be provided; although pg 5799, 1st paragraph discusses water temperature within stream reaches.

4. Model fit is not great with $\sim$8 points with RMSE in the 13-20°C range from June – November (out of about 50 calibration/validation sites total). It is unclear if these locations are used when reporting results. If so, are results meaningful and representative of stream temperatures? Particularly, one of the main findings from this paper is that stream temperature increases the most during summer – but these outliers would considerably skew results. If not, how are locations with poor fit removed from results analysis?

Similarly, the text (pg 5803 ln 17-19) says the majority of simulated stream temperatures were in the 2-3C RMSE range, but figure 2 shows ∼7/50 sites in the 2-3C RMSE range, with the large majority > 3C. Text is misleading and oversells model fit. Finally, what parameters are adjusted with calibration? It is hard for the reader to make sense of calibration without know what parameters are changed.

5. The authors do a nice job of describing stream temperature changes by ecological province, but I would like to know what drove changes (e.g., runoff, snowmelt, air temperature...). Pg. 5804 ln 14-16, pg 5807 ln 7-10, and pg 5807 ln 14-17 are examples that could use explanation.

6. Pg 5811 1st full paragraph: The authors explain why snowmelt contributes water during summer. But why is snowmelt positively correlated with stream temperatures? This contradicts current understanding of thermal characteristics of rivers. It must be explained more thoroughly.

7. Some of the Pearson correlations are barely significant. Please discuss why you're confident that you're not overfitting hydrologic parameters.

Minor Revisions: Title – consider switching 'biological implications' to 'habitat implications' as this paper has no explicit biological criteria, but uses thermal habitat of fish species. Abstract ln 9-11: the temperature changes without an extent of time or description of climate change are not meaningful. Pg 5798: How big are ecological provinces? Give average and range. Pg 5801 last line: Justify why the model was calibrated using trimesters, but results presented using quarters. Section 3.3 – This may fit better with methods – as climate projections are not your results, but rather your input data. Pg. 5804, ln 20ish: Could you separate dry reaches from iced reaches? Where streams ice over, there is likely to be deep pool habitat for fish. But where streams dry, there will be mortality and barriers to migration – so these should be described and analyzed separately. Table 4: Are data for only the 2080 period? Clarify time period of data.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 5793, 2014.