

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 #1

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General Comments

This paper is generally well written and the findings are interesting. The modelling approach is useful and results are timely given that the Columbia River is an important international basin. Some of the key findings of the paper seem to contradict our current understanding of process drivers of stream temperature. Therefore, more clarification is needed on how the model was applied (e.g. calibration parameters) so that the results can be interpreted by the reader. Although this is a discussion paper it

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would also be useful to include a better model description for those readers who do not have access to the Finklin et. al. (2012) paper.

Specific Comments

The introduction is well written; however, more context in terms of impacts of stream temperature change on aquatic organisms would be useful.

Section 2.2 - page 5799: The stream temperature model should be presented better here. A simple description that includes specific stream temperature equations, spatial and temporal scales of modelling, and better descriptions of important variables would be useful, particularly since some of the results seem counter-intuitive. This would help the reader understand what the model is not representing.

Section 2.5 - page 5801: What are the calibration parameters? It is not possible to determine what the model is doing without presenting these parameters. Also, please present the final set of calibration parameters. In addition, the manuscript does not present any uncertainty analysis. Uncertainty analysis can be conducted using the optimization algorithm and should be included in this manuscript.

Section 3.2 - page 5803: The high RMSE during summer months suggests that the model is not properly accounting for some factor (likely groundwater contribution, the effect of hyporheic exchange flow, shading, and/or bed heat flux). Therefore, results during the summer are also likely not representative. Please describe how model results are useful within the context of these very large errors.

Section 3.4 - page 5804: Lines 16 and 17 suggest that many of the projections fall within the range of modelling error. How is one to know if the projections are a function of expected changes or simply a modelling artifact? Further description of model parameters may help clarify this issue.

Section 3.4 - page 5804: Lines 17 to 20 indicate that a large number of sites were removed. This fundamentally changes the outcome of the manuscript and deserves

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much more attention. What might be expected if streams are dry during the winter? This argues that the trends presented may not be realistic. This may also present a substantial limitation in the modelling technique. Therefore, it would be useful to discuss these findings in terms of expected changes in stream temperature even though the model may not represent the important processes during this period.

Section 3.6.1 - page 5806: The findings in lines 20 to 23 differ substantially from our current understanding of stream temperature drivers in mountain streams. A better description of the causal relationship between groundwater and stream temperature is required given that groundwater has been shown by many previous studies to play a large role in governing thermal regimes. Why would groundwater not be correlated with stream temperature during the periods (summer, winter) where it plays the largest role?

Discussion - line 29 on page 5810: This finding does not make physical sense. Many studies have shown stream temperature to be inversely correlated with streamflow due to a streams' increased ability to store heat with higher volume. Please explain this finding and describe the physical mechanisms.

Discussion - lines 20 to 23 on page 5811: This sentence is not clear. If groundwater is a major proportion of the flow then shouldn't changes in groundwater result in changes in stream temperature? The subsequent sentence suggests there were no changes in the winter; however, many of the sites were removed from the analysis due to substantial changes. How can this finding be supported? Please clarify.

A figure with projected trends shown on a map similar to Figure 1 (with ecological provinces) would be useful.

Technical Corrections

Abstract - line 2: Should read "air" temperature, not just temperature.

Introduction - page 5797, line 26: "7" should be spelled out (this applies throughout the

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manuscript).

Please ensure to differentiate between air temperature and water temperature (e.g. page 5808).

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

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