

Interactive comment on “Characterization of spatial heterogeneity of groundwater-stream water interactions using multiple depth streambed temperature measurements at the reach scale” by C. Schmidt et al.

Anonymous Referee #3

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General Comments: This paper is an excellent application of existing techniques for using heat as a tracer of shallow ground water near a surface-water body. The authors have correctly pointed out the importance of quantitatively examining spatial and temporal exchanges between surface-water and nearby sediments. This is especially true in their case, where there is potential for rapid contaminant transport across the interface. The paper is generally well written, except where noted below, and the conclusions are appropriate and reasonably comprehensive. Specific issues are address below, per HESS request. 1) Does the paper address relevant scientific questions

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within the scope of HESS? HESS is not a journal I was familiar with before being asked to review this manuscript, so I think its best that others address this question.

2) Does the paper present novel concepts, ideas, tools, or data? The paper presents new data for an environment where the use of heat as a tracer has not been test.

3) Are substantial conclusions reached? Yes. 4) Are the scientific methods and assumptions valid and clearly outlined? The authors assume one-dimensional, vertical flow through the sediment, but discussion of hyporheic flow paths in the introduction and elsewhere, suggestions that the authors anticipate that non-vertical flow is important at their site. Also, the issue of heterogeneity is not explicitly addressed by a one-dimensional, analytical solution to the problem. This is why many researchers feel physically-based, simulation models (such as, Sutra, Tough2, or vs2di) more correctly represent the streambed hydraulic properties. 5) Are the results sufficient to support the interpretations and conclusions? Yes. 6) Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? No, the description of the field installation of equipment needs substantial improvement. For example, were 140 probes installed, or was one probe inserted in 140 separate locations? Lines 13 through 25 on page 1424 require substantial editing and elaboration. 7) Do the authors give proper credit to related work and clearly indicate their own new/original contribution? Yes. The use of heat as a tracer of stream exchanges with shallow ground water is a rapidly expanding field, so some of the very newest citations are not included. This is not surprising and quite acceptable. 8) Does the title clearly reflect the contents of the paper? Yes, but again the issues of heterogeneity is a concern. The authors examine spatial heterogeneity in the one-dimensional, vertical flux only. 9) Does the abstract provide a concise and complete summary? Yes. 10) Is the overall presentation well structured and clear? In general, the overall presentation is well structured and clear; however, there are a few exceptions. As indicated above description of data acquisition is poor and needs to be expanded. Also, there is no need to even include the concept of hyporheic exchanges when focusing on one-dimensional, vertical fluxes. 11) Is the language fluent

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and precise? Yes, except for the use of the word 'surrogate' in multiple locations in the text. The authors state that temperature can be used as a surrogate for head and hydraulic conductivity. More correctly, time-series measurements of streambed temperature at multiple locations coupled with an appropriate heat and water flux model provide estimates of water flux as an alternative to measurements of head and hydraulic conductivity. Also, in the introduction (page 1420, line 21) the use of the phrase 'different ways' is too vague. 12) Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? I reviewed the manuscript with the assumption that the math was correct. The units of liters per square meters per day is less common than meters per second, so the authors might consider adding the more common unit for flux density in parenthesis where appropriate. 13) Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Figure 4 is both detailed and important, and one would hope that it is presented in a much larger format in the final publication. It was impossible to see many important characteristics in this 'postage stamp' presentation of the condensation of the entire research effort. A 1:1 one-to-one plot of the slug-test derived hydraulic conductivities compared with the temperature based estimates would be a potentially nice graphic. 14) Are the number and quality of references appropriate? Yes. 15) Is the amount and quality of supplementary material appropriate? N/A

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