**Hydrology and
Earth System
Sciences
Discussions**

Interactive
Comment

Interactive comment on "Investigating patterns
and controls of groundwater up-welling in a
lowland river by combining fibre-optic distributed
temperature sensing with observations of vertical
head gradients" *by* S. Krause et al.

Anonymous Referee #3

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Overall comment:

Manuscript hess-2011-393 by Krause et al. presents an interesting empirical study of groundwater-stream water exchange dynamics in a lowland stream environment. In particular, the novelty of this investigation is the authors' use of two independent methods of observing water flux patterns across the stream bed. These methods consist of the well-established vertical head gradient technique, and the increasingly well-established fiber-optic DTS technique for temperature measurement. The authors make a compelling point that these methods can complement each other and create

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Interactive Discussion

Discussion Paper

a more complete picture of groundwater-stream water exchange dynamics in streams, especially low-land streams during baseflow conditions. For this reason, I find the study compelling, novel, and appropriate for publication in HESS-D.

The manuscript itself can be significantly improved before publication. I find the core of the science in the study to be rigorous and interesting, but the presentation of the study does not clearly convey the novelty and context of this study in light of other literature. Overall, I suggest that the discussion and conclusion be significantly restructured with this in mind. Correcting these manuscript structural problems will likely amount to moderate revisions, but will greatly improve the clarity of the paper and the likelihood that this paper will have a large impact in the hydrology community. Below I provide suggestions to the authors which I hope will help strengthen this manuscript.

General comments:

-Manuscript structure should be improved. The major structural problem lies in the discussion and conclusion section content. The minor structural problem lies in the sentence structure used throughout the paper. The major structural problem should be addressed before publication, while the more minor issues with sentence composition should be noted by the authors so that they can strive to improve composition in the future. Suggestions for improving these structural aspects are provided detailed comments below. Of note, the introduction, methods, and results do not suffer from any major structural problems – they are good, just occasional sentences that should be revised. These good sections amplify the structural problems in the discussion, namely the lack of discussion showing how this study is novel and related to theory and previous work.

-The mathematical formulae, notation, and discussion need to be improved, especially section 3.2. The authors must take care to layout these equations properly, and then be consistent with notation throughout the entire manuscript. I do not doubt that the authors made the correct calculations in their analysis, but Section 3.2 does not clearly

convey what they calculated. There are certain notation used that is not defined, and the expressions do not seem to be in proper form given what the authors calculated (e.g., standard deviation). The notation in Section 3.2 is incomplete, and the notation that they do present in the equations is then presented differently in the results and discussion sections.

-Dates of VHG measurements do not appear to significantly overlap in time (or hydro-logic conditions) with the FO-DTS measurements. How to you address the possible uncertainty of comparing two different measurements collected at two different periods in the surface and groundwater conditions? The discharge was ~1.5 to 3 times larger and variable during most of the DTS measurements compared to the more stable base-flow conditions under which the VHG measurements were collected. This variability in catchment conditions and in stream head is causing changes in the gw-sw exchange dynamics, and yet this is not addressed in the paper.

-Figures are good. Many are very nice, but many of them have a lot of very small graphics which may make them less effective. I think there are some simple modifica-tions which will enhance these compelling figures. I provide these suggestions in the detailed figure comments below.

-There are inconsistencies in the dates of the study which arise in the text, tables, and figures. See detailed comments for cases.

Detailed Comments:

Introduction:

Need to clearly define in the introduction what you mean by "streambed structure." Discuss surface features, subsurface features, porous media properties (K values and heterogeneity).

P341 L26 – P342 L3: Runon sentence, break into 2 statements.

P341 L28: add "changes"…"measurable changes in temperatures…"

P342 L14-16: This sentence is unclear; reword.

Materials and Methods:

P344 L2: replace "section" with "of the study reach"

P344 L4: replace "exemplary" with "example"

P344 L5: replace "for" with "of"

P344 L5-L11: runon sentence; reword in separate sentence statements.

P344 L9: (and global comment): remove use of "/" as a character between words. It has an ambiguous meaning, and your study should be reducing ambiguity. Use explicit words in its place here and in all uses of it throughout the text. For example, in this sentences replace "existence/absence" with "presence or absences of"

P344 L19: (and global comment for text, tables, figures): Period of study varies within 2009 according to dates here in text, in table 1, and in the figures. Take care to make sure all dates are consistent. These small inconsistencies cast doubts in the reader's interpretation of the study.

P346 L8: write out the word "approximately"

P346 L15 & 20: Briefly explain what "double-ended mode" means and make sure to use it consistently – with our without the hyphenation.

P347 Line8-9: Are you stating that you assumed that the piezometer terminated in a low conductivity zone of the streambed if you were unable to draw a pore water sample from it? Be clear in stating the assumption as this seems to come up later on in the results and discussion.

P.347-348 Section 2.3 Data Analysis: This entire section needs to be redone with care, especially in the mathematical equations and notation. There are inconsistencies and ambiguities all throughout this section, which cast major doubt on the interpretation of

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Interactive Discussion

Discussion Paper

data throughout the rest of the paper. I assume that the calculations were done properly, but taken at face value, this section does not clearly show what was done. Each equation should have proper notation, notation definition, and parameter indexing.

P347 L11: replace "indicating" with "indicate". Change runon sentence by placing a period "." after "surface water", should read "...and surface water. The VHGs were determined from..."

P348 L4-5: do not use a), b), etc for a listing of 2 items. This is done here and a few more times in the manuscript. This is not needed for a list of two statements. Just use delete use of a) and b) in this case.

Results:

P350 L2-5: There is no data, even anecdotal to support your assumption that the bed was entirely immobile while your FO cable was buried? Did not someone do visual inspections to make sure it was not exposed during the course of the data acquisition period? Beds, especially lowland streams have constantly moving bed material (e.g., ripple and dune formations and migration will cause multi-centimeter variations in burial depth alone).

P349 L25: Again remove use of "/"

P350 L7: replace "at" with "on"

P350 L16: VHG keeps getting redefined. Is this proper format?

P351 L190-21: remove "(a)" "(b)" not necessary. Remove uses of "/" in these sentences too. Reword sentences to make statements more clear.

P352 L6 (and throughout results discussion): Why are you using STDEV here? This is not consistent with Section 3.2. I know what you mean, but be consistent with definitions and notations throughout the manuscript.

Discussion:

***The discussion needs to be restructured. It needs to focus on what new contributions this study makes in light of existing literature and theory. Start off by stating what makes this study novel and then put your work in the context of other literature. It has virtually no connection to the literature which was nicely introduce in the beginning of the paper. This is a major issue that needs to be fixed in the discussion. Also, do not bury the novel concepts (i.e., your framework in Section 4.3) way below a significant amount of rehashing results in Sections 4.1 and 4.2. Together, these issues are likely to decreases the clarity and impact of the paper for most readers. I suggest the following potential fix for the authors to consider:

The key point is really that of a new methodological framework to describe certain gw-sw systems. Right? And you state that point, roughly on P355 L7-16. . .after two sections of ambiguous discussion. So lead with that idea and how it naturally leads you to your framework discussion in Section 4.3. Then develop your general framework as you do in Section 4.3.1. And illustrate it as you have in Section 4.3.2., but with addition information from cases in the literature and your specific examples from Section 4.1 and 4.2 that show own VHG or DTS on their own lead to ambiguity, but how your data and methods get rid of some of the ambiguity under certain conditions.

This suggested restructuring will greatly reduce the length of the discussion, put the most important contributions up front for the reader, and then expand on the concepts through your data and other existing literature.

Also for section 4.3.1. I recommend you putting your different cases in a table or bulleted format, because it is hard for the reader to keep referring back to them while reading the rest of the discussion. Basically you are stating:

Case1: increase SD, increase VHG – increase flux

Case2: decrease SD, decrease VHG – decrease flux

Case3: decrease SD, increase VHG – K limited

Case4: increase SD, decrease VHG – dh/dl limited (head limited)

P359 L3: The title of this section has "Uncertainty" in it by uncertainty is not discussed here or anywhere else in the manuscript, which raises a concern. Only limitations in applying this approach to other systems are discussed here. So a proper discussion of uncertainty is needed. I am not asking for quantitative uncertainty analyses to be added, but to at least discuss how the disparate timing and hydrologic conditions in the measurements of VHG vs DTS may impact the interpretation of the data and findings. You specifically, state summer baseflow conditions in this section, and yet elsewhere and in the data we see that the flow conditions were clearly not just baseflow – they varied almost 3-fold during the observation period and predominantly when you were measuring DTS temperature and not when you were measuring VHG.

P359 L16-17: delete "(a)" and "(b)", and ")" after "gradients."

P359 L26: delete and replace usage of "/"

Conclusions:

Unfortunately, the sentence structure used throughout most of the conclusion really limits the comprehension of the main points. Much care is needed to restructure the sentences throughout the paper, but especially in this section. More effort needs to be paced on removing all of the qualifying prepositional phrases from the beginning of the sentence. The most effective short sentences typically have a simple structure: 1. Noun, 2. Action verb, 3. Modifying statement adding information about the noun and action. In many cases in this paper, and especially in this section (e.g., P360 L17-28), there are one or two prepositional phrases before we get to the noun and verb. This makes the reader struggle to know what the point of all the upfront details are because they have not context as to why it is important. Specific sentences that need to be addressed structurally are pointed out below. Hopefully, simply rearranging the components of the sentences and cutting out some of the redundancy in this section will help make the conclusions more effective and clear.

P360 L4-5: What is this about "proportionally smaller groundwater contributions to the overall discharge? This is the first time this comes up, and makes me wonder why this was not addressed elsewhere? Is it really relevant? If so, it needs to be discussed, not presented as a conclusion.

P360 L7-12: Condense and reword this sentence per above recommendation.

P360 L17-28: These 3 sentences need to be restructured and honed.

P360 L28- P361 L3: I am not sure I understand this sentence or the point. How does this comment connect to anywhere else in the manuscript?

Tables:

Table 1: First of all, great idea to put this information all in one place. Very effective. Second, this is another place where the dates show inconsistencies within the other parts of the manuscript. Specifically, the early part of the season May or June seem to have date inconsistencies here and elsewhere.

Table 2: Just so you know it becomes very hard to read the numbers under the color once you look at or print this table in grayscale. Maybe you can highlight these rows in different ways?

Figures:

All figures are very good, just minor recommendations on how to possibly improve them and deal with the issue of very small figures and numbers.

Figure 1: text in labels is just about as small as you can go, and if it gets compressed down in publishing then they may become unreadable. Might consider making label text larger.

Figure 2 caption: replace "exemplary" with "example". Nice figure, but again very small text verging on unreadable.

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Interactive Discussion

Discussion Paper

Figure 3: again, nice figure but text is too small, and you cannot tell for certain by looking at the piezometer diagram that they are multiple nested piezometers. The image is just too small. This is how you make apparent identification of low K zones in your stream bed so it might be worth enlarging this figure and text font size. Plate C is clear to read so maybe target that format.

Figure 4: Recommend showing in box shading or with vertical lines when you did your VHG and FO-DTS sampling. This will clearly show when and over what hydrologic conditions you got your data.

Figure 5: try to make label text larger.

Figure 6: Suggest removing the northing and easting labels because they take up a lot of plot space and add nothing to the figure. . .in fact they are distracting. They are not necessary because you have a scale bar and we already know where in the world we are from Figure 1. Getting rid of the N and E labels will free up space for you to enlarge the other text in the figure and make it more clear.

Figure 6 caption: just another date example that seems inconsistent "25 May?"

Figure 7: these are cool, but are too small to really read. One suggestion is to get rid of the N and E text that takes up so much space and adds nothing. This will allow you to expand the actual images by at least 20% without having to increase the overall size of the figure. You will need to add North arrow and a scale bar after removing the N and E values.

Figure 8: y-axis labels are very small and make sure they are consistent with your text notation after you make the above section 3.2. corrections.

Figure 9: again x and y-axis are verging on unreadable, be consistent with new notation once selected. For C, D, E, F plates, again get rid of N and E which are unreadable and add nothing, then put in a scale bar.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 337, 2012.