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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Vulnerability of groundwater resources to interaction with river water in a boreal catchment" *by* A. Rautio et al.

Anonymous Referee #2

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The authors present a field study using multiple techniques to characterize interaction between groundwater and river water in a boreal catchment. Study uses temperature as a tracer for groundwater inflow to streams aby measuring temperature with airborne techniques and in situ in streams. Also environmental tracers of dissolved silica and stable isotopes are applied. The study provides a well-planned and reported field study showing successful application of the above mentioned techniques.

I like the use of multiple methods in studying the GW-SW interaction at the site. In general the manuscript is well written and pleasant to read. Methods carefully presented. My main concerns are related to the novelty of the work and justification of the management viewpoint in the case study. Below I provide general and specific comments to bring forward issues that in my opinion hamper the quality of the manuscript. I also

include an annotated PDF file in my review for technical comments, mostly.

general comments:

Intro is not well in line with the actual study. Authors address flooding and water quality, which are not central to the methods or outcomes of the study. I would like to see more text related to methods in the intro.

Authors stress the possible contamination of GW with RW in the discussion section (P2456). Their data shows clearly GW discharge to streams, but they do not provide any evidence of flow in the opposite direction. Fact that there is interaction, doesn't tell us that there is a clear risk of contamination due to flow direction reversal at a given site. Contamination by bank infiltration is of course a well-known risk in general, but in my opinion the authors do not have convincing enough data to highlight this issue so much in the manuscript. Perhaps some simple estimates of the hydraulic heads in between the river (low flow and flood) and the location of water abstraction could be used to justify risk of contamination. In this regard on P2438 L12-14 authors address the first main aim well with this study, but in my opinion fail to prove much insight to the latter.

This is a nice case study with multiple methods used, but unfortunately I do not much novelty in any of them individually. I see, that authors could focus their discussion on what benefits do use of multiple methods bring to understanding of GW-RW interactions, instead of trying to force a management angle to the paper. Perhaps the authors could further expand their toolbox of methods by including streamflow measurements, referred to in the discussion, to this manuscript? And discuss more thoroughly the weaknesses and strengths of the methods based on their data.

specific comments: Flow of intro, the first chapter is not related to the second one. You could use text currently on P2438 L4-L9 onwards to create link from GW-SW interaction to study catchment.

P2438 L8 – It would be interesting if you could set you results of GW-RW interaction in this context. Do your field studies give any insight on the effect of GW on water quality and quantity?

P2444 L16 number of samples per site is not very clear, perhaps create a table for this?

P2444 L23 – How were the spring identified, and were they considered to represent GW quality?

3.3 Statistics – You state that ". . .in order to assess the GW component. Please clarify what are you assessing exactly? Does the population taken within GW area differ from outside samples? Do you differentiate up- or downstream form GW area, for the "no GW effect group"? I would expect the GW signal to be seen also downstream

Section 4.1 until P2446 L12 in description of methods, in my opinion

P2447 L11-16 – This paragraph is difficult to understand. I read figures in a way that point 0 is the river outlet, so the river flows from 20km (left) to 0 km (right). This doesn't agree with you wording telling that artificial GW cools the river water. Instead we see a sudden warming. Please clarify what you mean by distance upstream and to which direction does the river flow?

P2448-2449 – interpretation of figs. 6 and 7 is quite confusing. In many occasions I'm not sure to which of the subplots the authors are referring to. Perhaps consider dividing the data into more plots, instead of trying to fit in too many subplots. Or at least please refer to the letter of subplot more actively.

P2451 L22-26 - Can we see this stratification in your plots? And furthermore, is the location lacking AIR observed GW discharge? It would be interesting, if you can explicitly demonstrate with your dataset that stratification is hiding GW discharge.

P2453 L8-L10 – To me this is not very obvious in the data. I would interpret stratification also downstream the pool in cross-sections OO' and PP'

section 5.3 – much of this regarding chemical tracers and M-W U test should be moved to results section, as they are central evidence of GW-SW interaction in the streams.

P2458 – L4 – "This research provided new insights for water management." I don't agree with this statement, what are the new insights here.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/12/C788/2015/hessd-12-C788-2015-supplement.pdf

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 2435, 2015.