

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

Anonymous Referee #1

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Review of the HESS discussion paper “Vulnerability of groundwater resources to interaction with river water in a boreal catchment” by A. Rautio, A.-L. Kivimäki, K. Korkka-Niemi, M. Nygård, V.-P. Salonen, K. Lahti, and H. Vahtera (HESS discussion paper, 12, 2435-2476, 2015). MS No.: hess-2014-556

General comments This paper describes a boreal catchment field study in southern Finland where the groundwater-river water (GW-RW) interaction has been investigated along two rivers and their tributaries. Data from AIR surveys and hydrogeochemical (stable isotopes, dissolved silica and EC) sampling campaigns are compiled into a conceptual framework to identify hydraulic connections between aquifers and rivers, and to verify the observed GW discharge into the rivers. Overall aim of the study is to obtain better understanding of GW-RW interaction along the river systems and

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the potential vulnerability of the water intake plants in the studied catchment. The paper is of my opinion of interest for the HESS readers. If the authors takes my comments/suggestions into consideration (all together moderate revision) I can fully support the publication of this nice work. Introduction I am missing a short review of potential thermal detection methods in the introduction that can be used on catchment scale (10th km-scale) and on study site scale (km-scale) (e.g. fiber-optic cables (DTS)) to identify the groundwater discharge zones to streams. Novelty of the work is not justified satisfactory. Make it more clear what is your contribution to the AIR survey literature that are not already published by e.g. Torgersen et al (2001); Conant and Mochnacz (2009) ?. I suppose it is the integrative approach of AIR survey and hydrogeochemical data that are new ? Specific objective (p. 2438, L25-26) must be formulated more precisely. E.g. is it an objective to examine DSi as a potential tracer to estimate GW to RW (p. 2444, L 10-11) ? Specific comments p. 2439, L 8. Add: 20 to 120 meters above sea level (m a.s.l.) p. 2439, L. 21. Cover-moraine sheets and end-moraine ridges need to be explained in Figure 1a. These two geomorphological elements are not shown on the legend of Fig 1a ? p. 2440, L. 2-5. Delineation of aquifers is not given in Fig 2b and not in Fig 1. p. 2440, L. 21-29. What is Tuusula artificial GW plant ? Is it the same as a water intake plant ? Artificial GW need to be defined. P. 2440, L. 25. Jäniksen linna aquifer is not shown in fig 3b. p. 2441, L. 10-14. What was the flying height?. You need to repeat essential details on specifications defined for the AIR work. I don't think it is enough just to refer to Korkka-Niemi et al (2012). p. 2442, l. 8. Explain why is most of the AIR surveys conducted in upstream direction ? P. 2442, L. 11. Add: meter above ground surface (m a.g.) P. 2442, end of L. 18. Text/words are missing ? P. 2442, L. 18-19. Need to explain what Tk and Tr is used for. p. 2443, L. 10-11. Two longitudinal profiles were collected. In what figure are they shown ? Unclear how they are measured ? p. 2448 L.1-2. The AIR method cannot at some places detect the temperature anomalies close to the river bed due thermal stratification. How deep in the water column can the AIR pictures normally detect an anomaly of discharging groundwater through the river bed if no thermal stratification exist ? p. 2448, L8-9.

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Sentence unclear. Change Fig 6 to Fig. 6b. p. 2448, L13. Surges of GW. What is that ? p. 2448, L16-18. What figure is the sentence referring to ? p. 2449 L7-14. Not sure how you have summarized this important EC information in figure 7. Explain more. p. 2450. L 1 The suggested ranked order is not logical based on the development in O18 and Deuterium (see suggestion to table 3). p. 2450 L15-16. Is the AIR data collected hand-held in 2010 and mounted in 2012 ? You need to give this information in section 3.1 p. 2451, L28 EC in river varies considerable in time and space. Do you have any explanation why ?

Figures In general I am not really happy with the layout of the figures. Be sure that the font of the text and size of symbols are readable. Especially Fig 5, 6 and 7 are difficult to read. The figures are too small to cover all the compiled informations. Fig1a. The legend is a mixture of lithological units and geomorphological units Fig 2b. Show the extension of the classified aquifers with a more pronounced signature. The dashed line used to outline the classified aquifers is difficult to see. I will suggest that you use oblique hatching as you use in Korkka-Niemi et al (2012, Figure 1). Explain “classified aquifer” – not explained in text. In the legend: IR flights 2011 and IR flights 2012 should be changed to AIR flights 2011 and AIR flights 2012 Fig 3. Indicate the area with the classified aquifers with another signature. It is impossible to see the position of the municipal intake plant and wells as they are grouped too close in Fig 3a and 3b. Fig 6c. Scale on Y-axis missing on all cross sections. The geographical orientation of each cross section is not specified in the inserted map above Fig 6d. B in B-BB is missing. J-JJ is missing. Fig 6d. what is the orientation of F-FF. Is the vertical T profiles measured in the middle of the river ? Dashed lines in the right side of the figure – what do they show ? How comes that it can be spring water. Where is the bottom of the river ? Fig 7c. Scale on the Y-axis

Tables Table1. River bed width: is it the width from side to side or is it the periphery of the river along the river bed ? River bed depth: what does the interval represent (max and min depth ?) Table 3. In accordance to the delta O18 and D values. Reverse order

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of: R Lepsämäenjoki and R Vantaa Reverse order of: R Palojoki and R Tuusulanjoki

Table 4 Reverse order of: R Vantaa and R Palojoki

References I would suggest that you in a parenthesis indicates the English translation of the purely Finnish-language reports

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