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Hydrology and Earth System Sciences Discussions

Interactive comment on "Investigating the spatio-temporal variability in groundwater and surface water interactions: a multi-technical approach" *by* N. P. Unland et al.

Anonymous Referee #1

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This study uses a number of approaches to investigate groundwater and surface water interactions in two Australian rivers. This topic seems to be gaining momentum and the large dataset obtained by the authors is a valuable contribution to the field. Overall, I found the experimental approach appropriate and the conclusions sound. The finding of fast response of groundwater to recharge events is clearly a highlight.

Major comments: 1) When I read river tracing studies I wonder why tracers are needed if there are two reliable gauging stations. A recent paper by the same group (McCallum et al. already cited in the paper) makes a good case that chemical tracers may reduce

uncertainty. I thought this paper could build on McCallum's paper and go deeper into this problem. 2) The paper is longer than needed and can be easily shortened. Many passages read more as a technical report of local interest only. Better use of literature and shorter descriptions of data already presented in figures would improve readability. 3) Figure 13 is a great achievement but barely discussed in the paper. Better highlighting the differences obtained from radium and chloride may provide deeper insight into the effectiveness of the different tracers and how they may be combined to provide stronger conclusions. The authors make a case that the Cl groundwater endmember may prevent its application (see abstract, line 14). If this is correct, why the radon endmember seems to be working so well?

Minor comments: 1) Abstract: If the spatial variability limits the use of Cl, why Rn can be used? 2) Introduction: I missed reference to Burnett's paper on Rn in rivers (Burnett, W. C. et al. 2010. Journal of Hydrology, 380(3-4), 298-304.). 3) Page 3798, Line 9 and 10: The link between 226Ra and 222Rn is somewhat confusing. The authors are mixing aquifer minerals, radium in surface water and radon in groundwater. Revise the sentence. 4) To avoid confusion, I suggest the same symbols are used in all equations. "I" is used for groundwater inflow in equation 2, while Qf is used as groundwater discharge in equation 1. 5) Equation 2: What Cr stands for? 6) Page 3804: Wind speeds are often considered in gas exchange models. Please explain why they have been ignored or include them in the model. 7) Results: Several sections are longer than needed and hard to digest. Much of that information is already available from the figures. I suggest the authors to significantly shorten the text from results and rely more on calls to figures to describe their data. Those long descriptions give a data report flavour to the paper. Some of the text could be replaced with tables such as the description of groundwater radon concentrations. 8) Page 3810, Line 23: The results of sediment ingrowth experiments are not reported. I suggest a table with sediment and groundwater observations so that the reader can judge that statement. 9) Section 4.1 repeats too much of the information from the results. Much of that text could be shortened and even omitted. 10) Fig. 5 is potentially very interesting but hard to follow.

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Interactive Comment

Could that information be conveyed in a simpler way to highlight the locations where the different approaches agree or disagree providing stronger evidence for areas of enhance/decreased discharge. 11) Figs 10 and 13 are outstanding outcomes!

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 3795, 2013.