

## ***Interactive comment on “Residence times and mixing of water in river banks: implications for recharge and groundwater – surface water exchange” by N. P. Unland et al.***

**Anonymous Referee #1**

Received and published: 17 March 2014

General comments:

The paper contains a considerable amount field data ranging from field parameters such as EC to major ions and age tracers. Presentation and interpretation of the data is driven from a geochemical, somewhat stationary point of view. I think the variability between the sampling periods have not been explored sufficiently. For example, water table variations and variations of EC are hardly used for interpretation.

Try to go beyond the standard geochemistry textbook data analysis. I suggest to look at your data from a more explorative view rather than squeezing the data into a fixed

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framework of interpretations e.g. Mixing analysis in Figure 11

Bank storage is a dynamic issue. So how variable is geochemistry between the sites over time? This could be quantified based on coefficients of variation (to get rid of the different mean values). Which parameters (or ratios of parameters) are most variable. Is there any chemical variability correlated to hydrologic dynamics?

The main conclusion is that gaining conditions may hamper bank filtration, which is indeed an interesting finding. Support it with more data (EC, Ratios...). Too much text is dedicated to explain the geochemistry, which does not really lead to the dynamics of bank storage and gw- sw interaction.

In conclusion. The underlying data of this study is really nice. I encourage the authors to make use of the data and let the data tell the story rather than forcing the data into predefined set of interpretations. However the manuscript needs thorough revisions.

Specific comments

p. 1653 l. 5: To some extent understanding a concept also means to have some quantitative understanding. Maybe reformulate. p. 1653 l. 15: The concentration of what? What does this imply?

p. 1654 l. 1-6: The step from the conceptual understanding of bank storage to the limited number of field studies in Australia is quite big and not needed and somewhat implies a limited scope of your work. Later you bring it back to the general picture (p. 1655 l.4). I suggest to remove this local aspect at this prominent place in the introduction.

Section 1.1. This section contains a lot of information on regional geology (p. 1655 l. 14-26). Is this really relevant for understanding the hydrologic conditions at the sites? In contrast I miss some hydrogeologic information of the well transects. Please add information how the screened sections of the wells are related to the local stratigraphy. In relation to this: Figure 1 please add some stratigraphic information to Fig. 1 a) b) c).

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This would be the base for your interpretation in Figure 12.

p. 1656 l. 5: I suggest to use  $\text{m}^3/\text{s}$  for stream discharge.

p. 1657 l. 7: To my knowledge the Hvorslev method requires some prior information on anisotropy. Please provide the value applied.

Section 3.1. It would be helpful to provide also hydraulic head differences between the river and the gw, rather than absolute levels alone. Also any indication of variability would be good (tie together the Information provided in Figure 3 and add the information from the other sampling campaigns)

Section 4.1. I find the interpretation of the data speculative and not very elucidating for the "source of water" question. I think it is not the key point of the paper to explain all the processes that control bank water chemistry. Despite this, the section is difficult to read. I suggest to present the interpretation site by site and join it at the end, or alternatively go separately through the parameters and compare them for each site. Now it is a mix of both.

p. 1664 l.16-19. How realistic is this model assumption? I thought the site is gaining thus GW is discharging to the stream and not "lost" to deeper groundwater. Upwelling of deeper groundwater is one of your key interpretation of the old ages close to the river.

p. 1664 l.5-6. What are the reason for selecting this model and not another one.

p. 1668 l. 12: Why have the activities only been analyzed ones?

p. 1668 l. 17: Does the river flood over the banks during this event?

Figure 3: It would be more telling if the topography of the section would be included. You may use the drawings of Figure 1 a) b) c) as a basis. Also why don't you show the results of all sampling campaigns?

Figure 4: It seems that there is a yellow river signature in the GW bubble. Obviously

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there is considerable variability e.g. between Feb (yellow) and March (red). Particularly the Feb data suggest a slope different than LMWL and GMWL.

Figure 6,7,8 Why do Figures 6,7,8 not show the same parameters (c is always different). It would help to follow the interpretation if all figure would show the same set of parameters. Why not adding d and e and show everything.

Figure 11. I honestly have problems with the interpretation here. The mixing lines seem arbitrary and hardly represented in the data.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 1651, 2014.

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