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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Groundwater surface mapping informs sources of catchment baseflow" *by* J. F. Costelloe et al.

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This contribution is valuable as it presents a multi-technique approach to understanding groundwater-surface water interaction. Quantifying groundwater inflows to streams is critical for understanding and managing hydrological systems and contributions in this field are welcome. The methodology outlined here can be applied to other catchments and is relatively straightforward in its application. Overall, the paper is well considered and written, although there are a number of sections where more details are needed. It fits well within the subject matter of HESS and should be of interest to a broad readership.

I consider that it will be publishable following fairly minor revisions (mainly more expla-

nation of certain key points)

The main comment that I have is regarding the bores used for the water-table mapping. Being familiar with the area, there are numerous groundwater bores constructed for the reasons outlined in the paper. However there are two to three sets in the Gellibrand Valley. Many of the bores are shallow and probably located in the near-surface alluvial aquifers that interact directly with the rivers. However, there are numerous bores in the underlying confined Eastern View Formation. The head levels in these two aquifers can be very different (generally there are large upwards gradients between the Eastern View and the alluvials and many of the deeper bores). Given the large number of bores in the area it is difficult to see exactly which ones have been used for data analysis but presumably they are all in aquifers that can be reasonably expected to be hydraulically connected such that a potentiometric surface can be constructed. There needs to be more detail of which bores were used for this analysis.

Other Comments

Introduction

This is a nice general introduction to the field of groundwater-surface water as a whole that has relevance outside this specific study. Specific points

1.I'm not sure exactly what you mean by "unconfined" – I presume that you mean an aquifer that is intercepted by the stream rather than one which unconfined throughout the catchment.

2.Given that you use both tracers and physical parameters, it is worth mentioning that these techniques often yield disparate results as they classify water differently. Specifically, as transient stores of water (eg bank return flows) are likely to be chemically similar to the river, then a chemical mass balance will record them as event water while a digital filter will record them as part of the slow flow. The last paragraph on page 12407 views baseflow from the physical perspective, from a geochemical perspective

baseflow is all water that looks chemically different from rainfall.

Methodology

This is generally clearly explained; however seen the comment above regarding the choice of bores and the aquifers that they monitor. Also as discussed below, I think that your BFI value needs more justification.

Results

The BFI used in the Eckhardt filter seems anomalously low. As explained in section 3.1, values closer to 0.8 are expected for this type of catchment. Although you note this, do you have an explanation? Adopting a BFI which minimises overestimates of baseflow wrt total stream flow sounds logical, but are there other studies that you can point to which have done this to lend some support for this methodology. I guess the related question is what the results would be if a highr BFI were adopted?

I am not certain that the stable isotopes (section 3.3) add very much to this study. The values (Fig. 4) overlap and the differences between the sampling rounds are subtle. The interpretation on Page 12417 that the lower 18O values in winter possibly reflect differences in source or imply a short residence time may be correct although some of the difference could be related to evaporation in the warmer months increasing 18O (and this probably should be mentioned if the data are retained). Without the estimate of evaporation, it is difficult to use the stable isotopes for mass balance (especially given the large relative variability in the groundwater).

Section 3.4. I am not certain that that Fig. 6 shows the difference between March and September (page 12420, line 10); looking at the caption to Fig. 6, it seems to be just the September data (depth to water and the SD of the kriging)? This needs clarification.

Discussion

Section 4.1. The chemical mass balance would be improved by the discussion of un-

certainties as noted by one of the other reviewers. Possibly propagating the variability in the groundwater composition through the calculations would achieve this. Additionally, the impact of the assigned BFI could be considered (especially as it appears to be lower than expected).

Conclusions

Some perspective regarding the impact that bore numbers and bore density has on the results would be useful to researchers considering applying this to other catchments.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 12405, 2014.