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Discussions

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

Anonymous Referee #1

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This study presents a combination of groundwater interpolation with digital filter and chemical baseflow separation. Over all the manuscript is well written and well structured. The concise style with which the study is presented can be applauded. That said there are some concerns to be addressed. The more general comments follow here with minor/editorial comments later on.

General Comments

The bore density in the catchment (98 bores per 311 km2) seems remarkably high and is primarily due to the catchment having been investigated for water supply and damming purposes. This is not typical for most catchments. I wonder how the findings would fair if a lower density of groundwater measures were available. Say 50% of

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the current density? There is, of course, a break point when the geostatistics cannot really be applied anymore. Still, I wonder how much value there is in the groundwater observations when fewer observations in space are available. This could easily be checked by some random removal of data from the entire set and then kriging the remainder. What error is introduced? Cycling through realizations of the random removal in a Monte Carlo sense and systematically considering 10%, 20%, etc. removal would really give insights to stability and robustness of the approach. It would also shine light on true added value of considering groundwater maps. This would also help the study find resonance with those working in not-so-heavily instrumented sites (which would likely be prevalent in most parts of the world).

The mass balance separations (Table 1) are very useful. I think these would be more useful if some level of uncertainty was included in the analysis. There must be some way to show uncertainty bounds in these estimates? Either by considering spatial variations across the various end members and/or temporal variations in the stream samples themselves. This will help demonstrate how robust the estimations are that separate between the two "unknown" flows in the system. Can you make statements about differences between these two flows given the uncertainty in the separation estimates?

It is confusing when considering the saturated volume estimates from the groundwater maps (around P12421L5). Was the specific yield taken as 0.3 and held constant spatially over the entire region? That is a fairly strong assumption given the inherent heterogeneity in soils (and subsequently specific yield) one would expect both across the catchment and into the ground. I would have anticipated a much more thorough consideration of the specific yield variability especially since this estimate is a cornerstone of the study. Looking at the title of the study, I would have expected spatial explicit estimates of water volumes coming from the groundwater maps. Instead all the variability in the water table maps is filtered through a constant specific yield. A better job representing the 3D variability of specific yield and its subsequent impact on

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variability in potential groundwater contribution is required. Further, the uncertainty in specific yield should be considered since they are typically difficult values to estimate. Regardless, this lack of accounting for soil variability in the estimations is worrisome since the differencing of the groundwater maps is the more novel aspect of the study. If some variability in specific yield is not considered, then it would be recommended to remove these estimates (at which point the study gets a bit thin).

Finally, there is a lack of quantification with regards to relating the groundwater volume estimates to the hydrograph separations. The manuscript presents results as time series comparison (Figure 10 for example). Would it be more informative to relate the various techniques to each other? How similar are the various flow estimate techniques and over what periods are they more alike and more different? Currently, there is too much qualitative analysis regarding the timing of peaks in one dataset compared to another. These qualitative statements should be firmed up with some quantification and statistics. This will really drive home the utility of the groundwater maps for constraining estimates.

Minor/Editorial Comments

P12406L2: All “ff” where formatted strangely in my version...

P12408L20: How does this compare to recent work by Brutsaert (2008)?

Brutsaert, W. (2008), Long-term groundwater storage trends estimated from streamflow records: Climatic perspective, Water Resour. Res., 44, W02409, doi:10.1029/2007WR006518

P12410L21: Well, I am guessing you mean any given date within the period of observation?

P12413L14: How is having a water table 1m below the surface “nominally saturated”? I appreciate the effort to consider variations in this arbitrary part of the work, but what realism is retained with these values? 25cm is already quite far away from the soil

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surface for saturation.

P12413L22: Would be good to see the equations used here to help make sense of all the parameters mentioned in this section.

P12415L7: Should the ions have charges?

Figure 2: It might be the printout I am working from, but I cannot see multiple baseflow separations in this figure. It would be simple to have three panels and show each separation separately.

Figure 4: Strange symbol in the word “Concentration”.

Figure 10: I cannot follow this figure. It has too many small dots and not sure what I am supposed to be comparing. Would it make more sense to plot the various parameters against each other rather than against time?

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