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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Technical note: Analytical sensitivity analysis and uncertainty estimation of a two-component hydrograph separation method which uses conductivity as a tracer" *by* Weifei Yang et al.

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The authors present an interesting analysis of sensitivity of the two-component chemical mass balance method based on specific conductivity (SC). The paper is generally clear, although the final version should be read carefully for grammar and understanding.

My main concern is how the errors in the baseflow SC are dealt with. As noted by the authors, this has a major impact on the results of the chemical mass balance. Aside

from the question as to whether to use the 99th percentile or the maximum SC, there are several common ways of estimating the SC of baseflow in chemical mass balance studies, these include:

1) Measurement in near-river groundwater bores

2) Using a single value based on the highest SC of the river throughout the study period

3) For multi-year studies, assigning a constant value for each water year (generally based on the highest SC in low summer flows)

4) Assuming that the baseflow SC varies linearly between the SC of successive low flow periods (the paper of Miller et al., 2014 uses that strategy).

These strategies can produce very different estimates of baseflow from the same river SC data. This is especially true for catchments where the contrast between the SC of surface runoff and baseflow are large and where the maximum SC in the river varies between successive low flows.

In practice, it is very difficult to estimate the SC of baseflow due to

* Groundwater having spatially variable SC and the fluxes of groundwater from different areas of the catchment varying over time as water tables rise and fall

* Baseflow being comprised of different components (groundwater, interflow, bank return waters), all of which have different SC, that contribute to river flow in different proportions at different times.

An uncertainty of 5% (section 4.2) is probably over optimistic. In section 4.1, it would be better to calculate an uncertainty based on the last three strategies noted above (perhaps with or without the 99th percentile constraint as well). While there is no foolproof methodology for estimating the SC of baseflow, this would yield a better estimate of what the realistic uncertainties are.

Other minor comments

Equation (1). Suggest changing the nomenclature – Q is commonly used for streamflow in papers.

Somewhere in the introduction, you should outline the necessary conditions for chemical mass balance

a) Contributions from end-members other than baseflow and surface runoff are negligible

b) The SC of runoff and baseflow are constant (or vary in a known way) over the period of record

c) Instream processes (such as evaporation) do not change SC makedly

d) Baseflow and surface runoff have significantly different SC

Check consistency with spelling of Eckhardt throughout

Page 2 lines 12-15 is not very clearly written – try to rephrase it

Section 2.2. The errors in streamflow y are only briefly discussed. The value of 3% may be fine but this value looks to come from a thesis and it is not certain whether the gauges studied are relevant to this study. Presumably someone has addressed this for the USGS gauges? More justification of this value is needed.

Page 4, Lines 10-30. Do you need this amount of detail for these minor errors? Perhaps keep the text as is, but I do not think that the figures are strictly necessary.

Page 5, line 6. State the assumptions that the uncertainties are uncorrelated and have a Gaussian distribution.

Section 4. This application is appropriate but as noted above, the uncertainties in the SC of the baseflow (and possibly yk) are understated.

Conclusions. You should add a sentence or two stating what the main sources of error are and how practitioners can go about reducing those. For example, better rating

curves are probably more important than better loggers and more work on understanding the SC of baseflow (although it is not clear how you might do that) is more important than understanding the SC of surface runoff.

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