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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Contrasts between chemical and physical estimates of baseflow help discern multiple sources of water contributing to rivers" *by* I. Cartwright et al.

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The manuscript "Contrasts between chemical and physical estimates of baseflow help discern multiple sources of water contributing to rivers" by Cartwright et al. highlights some very interesting aspects for identifying the sources of baseflow. The paper is well written and structured and it will make a very interesting contribution to literature. I have only a couple of general comments that I would like to encourage the authors to address in order to strengthen the relevance of their results.

(1) Although I guess it is justifiable, I think it is nevertheless a rather strong assumption

that EC acts conservatively. I would thus firstly invite the authors to add one or more additional references, supporting this assumption. Secondly, and this is the only real concern I have about this paper, it would be good if the authors explored and discussed the effects of relaxing this assumption with respect to at least two processes: the temporal scale and magnitude of dissolution of ions stored in the soil and the temporal scale and magnitude of evapoconcentration. If I understand correctly, neither of them are considered at the moment. This closely links to the fact that the authors did not make any attempt in consequently quantifying the uncertainty in their results, which in simply end-member mixing analysis can be considerable (please include e.g. Rice and Hornberger, 1998; Hrachowitz et al., 2011). It would thus be fantastic if the authors could include a simple sensitivity analysis, by just varying the degrees to which these effects occur, i.e. for how long it takes the water in the system to take on the chemical composition of groundwater (this can be a simple linear relationship), so that they can report some sort of uncertainty ranges in their results, which will potentially effect the interpretation of the findings (e.g. page 5956, lines 13-20). The same is true for the digital filters: instead of using just one parameter value for each filter, use a set of different values and report the range of baseflow estimates in the results. This will significantly increase the relevance of the results.

(2) To bring the work a bit more in the context of previous work I would encourage the authors to discuss their results with a bit more depth, also including more references. For example, a) the notion that soil moisture/shallow groundwater is often geochemically distinct to water stored in deeper groundwater (i.e. addressing the assumption of a conservative behaviour, but also the mixing mechanisms in the soil), e.g. Stewart et al. (2010); Rouxel et al. (2011); Hrachowitz et al. (2013), or b) how does the observed hysteresis and its interpretation relate to earlier work, e.g. Aubert et al. (2012); Murphy et al. (2012); Hrachowitz et al. (2013).

(3) A clearer definition between the terms "groundwater" and "base flow" should be given early in the paper and for clarity and consistency it would be good if the authors

then sticked with this distinction for the rest of the paper. To me the two terms seem to be currently used in a confusing way – sometimes interchangeably, sometimes describing different mechanisms.

(4) I would like to encourage the authors to provide units of flow in mm/yr throughout the manuscript for convenience for the reader (it is just easier to read).

(5) The focus on bank storage might be a bit narrow, as water stored in other components of the system (e.g. unsaturated zone; cf. Hrachowitz et al., 2013) might be equally important. Therefore, perhaps use a more general expression.

(6) In the data sources section (1.2) it is stated that river and groundwater EC were monitored, but no details are given for the groundwater monitoring set-up. Only later in the manuscript it becomes clear that the groundwater EC used here was not actually measured in boreholes. Please clarify this upfront.

(7) Please make it clearer earlier in section 2 that salinity in the soils/groundwater mainly originates from evapoconcentration.

(8) on page 5951, from line 7, for clarity please make it explicit that you are referring to stream water EC.

(9) page 5953, line 2: should read "...Barwon River using the following..."

(10) p.5957, line 22ff.: this description seems to fit better into the methods section.

References: Aubert, A.H., Gascuel-Odoux, C., and Merot, P., Annual hysteresis of water quality: a method to analyse the effect of intra- and interannual climatic conditions, Journal of Hydrology, 478, 29-39, 2012.

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