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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Understanding runoff processes in a semi-arid environment through isotope and hydrochemical hydrograph separations" *by* V. V. Camacho et al.

Anonymous Referee #2

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Review of HESS 2014-549: Understanding Runoff Processes in a Semi-Arid Environment through Isotope and Hydrochemical Hydrograph Separations by V.V. Camacho et al.

I carefully read the manuscript (MS). In their MS the authors aim to study runoff generation processes in the Kaap basin South Africa which they refer to as semi-arid. Moreover, they aim at general statements on the validity of tracer-based hydrograph separation methods in semi-arid environments.

I fully support the comments of referee#1, who concluded that the collected data is not

enough to back up the conclusion drawn on complex runoff generation processes as presented by a conceptual model. But I have two additional major concerns why I think that this paper is not publishable in HESS. Those are detailed down below. However, after a general re-writing the data presented here could be used for another paper with another focus: e.g. a regional study on runoff generation processes. Its main finding might be useful for the region: "API dictates the event-water percentage during runoff events and hence one might hypothesize that the importance of quick, surface runoff processes is more important during wet conditions." In general, however, this is known for many humid areas (and Kaap during summer is humid, see below), why I propose to approach another journal with a more regional focus. I detail all my concerns down below in hope that they will be useful for the authors.

1.) The Kaap basin is not "semi-arid"

There are two main ways to hydrologically define prevailing climate, e.g. by indices or by hydrological characteristics.

Indices:

According to Köppen-Geiger, Kaap lies in Cwb, which is generally temperate, only dry during the winter, if at all. Your study was undertaken during the wet summer. But hydrologically an even more relevant indicator is the division of annual precipitation (P) by potential evapotranspiration (PET). According to UNESCO the threshold for semi-arid is 0.5, for sub-humid is 0.65. Everything higher is truly humid. Using your data (p980) I arrive at 0.73, this assuming that your Class-A-data is corrected. If pan correction is necessary, P/PET will even be higher.

Hydrological characteristics:

Although the minimum daily flow is 0, there is still a monthly average of 0.8 m3s-1 after the dry season (p980). This indicates that periods of zero streamflow are very short and that your channels are not ephemeral which they should be, if you are in

a really dry region. Another indication for a humid system is the fact that you have a gaining river system (p 987). This means there are constant flow paths through the subsurface, and constant baseflow (see above). Then a relevance of groundwater is logic also during runoff events, because piston-flow mechanisms may activate existing subsurface flow paths. This is in accordance with your tracer results that show the dominance of pre-event water during runoff events. You state yourself that this well-known for "semi-humid" regions (p977. This means that these results confirm existing knowledge from humid systems but do not contribute to process knowledge for semi-arid environments, which you aim at.

2.) Mix-up of concepts for hydrograph separation

Tracer-based hydrograph separation is your promoted method for the study of runoff generation processes. There is, however, no clear separation of different concepts. Tracers can be used to separate event from pre-event waters (mainly isotopes) or to distinguish runoff source areas (mainly hydrochemical tracers). However, they should not be used to separate direct runoff ("quick-flow") from base flow. While the latter mainly stems from groundwater and contains pre-event waters, direct runoff must not be used as a synonym for event water or surface runoff components, like you do in p988 (l20-21) and in the discussion section. Just in humid systems (as in the Kaap during the wet summer, see above) most of the runoff response (i.e. quick flow or "direct runoff") is made of pre-event components. You mix these concepts also for existing studies you cite: I just checked one (Hrachrowitz et al. 2011): They did not find "direct runoff contributions of 9%" in Tanzania as claimed (p 992) but rather showed the dominance of pre-event water during runoff events.

Other concerns (chronological order):

P977 ll18-22: You summarize characteristics of dry areas. These are true but additionally to the fact that they are not relevant for your system (see above), I do not agree that all of them per se pose a particular challenge to runoff generation studies, just the op-

posite may be true, e.g.: if you have sparse vegetation, interception is less important; if groundwater is truly deep, surface –groundwater interaction is only in one direction; and if surface runoff is lacking, is there any runoff process to be studied?

P977-978: Kendall and McDonnel 1998 is a brilliant textbook on isotopes in hydrology but no adequate reference for processes in arid and semi-arid hydrology.

P978: The sparse nature of vegetation does not add to the complexity of evaporation, rather does vegetation variability.

P978: Among others, transmission losses are not relevant for your basin which you identified as gaining stream (see above). Hence the Kaap should not be compared to Saudi Arabia as well.

P981: How can a method for crop evaporation be used for your land use types, what are the uncertainties?

P983/984: You used different sampling strategies (volume-based and temporal) for rainwater to obtain you event component. What is the exact difference and how different are your signatures? You only use SD for your error, the total difference would be more appropriate.

P984: What are "In situ groundwater consultants"?

P990 (l8-9): Why does high potassium indicate vegetation influence?

P990: You hypothesize a "shallow groundwater component" only by considering high potassium and "slightly less depleted" isotopes. There is no proof that this component really exists. Hence the results of the three-component separation are rather speculative, which is also true for the conceptual model of runoff generation.

P990: Why did you use +- 10% as errors of the groundwater end-members, why not +-20%, why not +- 30%? Your "shallow" groundwater component is rather virtual, see above.

Figure 10/ Table6: I agree with referee#1 that these are highly speculative and not backed up by the data presented.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 975, 2015.