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Interactive comment on "Surface water and groundwater: Unifying conceptualization and quantification of the two "water worlds"" *by* Brian Berkowitz and Erwin Zehe

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We sincerely thank Matthias Sprenger (MS) for his thoughtful and constructive comments on our manuscript. We respond below to the individual points.

MS: I thank Brian Berkowitz and Erwin Zehe for outlining their views on heterogeneous flow and transport of water and solutes in the subsurface. Their manuscript offers several interesting aspects and I especially like the emphasis of connecting different communities. However, I would like to ask Berkowitz and Zehe to reconsider their use of "Two Water Worlds" throughout the manuscript. I highly recommend to not use this term for the following reason:

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RESPONSE: We are pleased MS finds that the manuscript offers interesting aspects and connects different communities. While we are fully cognizant that our use of the term "Two Water Worlds" is new and possibly somewhat unusual, we prefer to retain it. Throughout the manuscript, we emphasize the need for connection and cross-fertilization of concepts and methods between the surface water (catchment hydrology) and groundwater communities, which are currently split into two "water worlds". We state this clearly at the outset of the manuscript, and elsewhere. However, throughout the revised manuscript, we will ensure that we are clear on use of this term.

MS: 1. The term was introduced by McDonnell (2014) as "vegetation and streams returning different pools of water to the hydrosphere". The term is quite exclusively used in this very specific context – mostly in isotope hydrology (see list of citing literature here: https: ....). Contrary to your introduction, I am not aware that the groundwater community uses the term "Two Water Worlds". I do not see that groundwater hydrologists address the hypothesis posed by McDonnell nor do they use that term in a different way. (see: https: ...)

RESPONSE: While McDonnell use the term in a specific context, as noted by MS, there is no exclusivity or "monopoly" in the use of the term. Isotope hydrologists may indeed prefer this term to refer to vegetation and stream pools. In this respect, we note in the manuscript that it does not necessarily properly describe the actual physical situation and dynamics. Thus the term "Two Water Worlds" is a metaphor to better highlight the fact that plants may tap storage fractions in the subsurface which do not contribute to streamflow generation. We do not claim in the manuscript, and certainly do not mean to imply, that the groundwater community uses the term "Two Water Worlds" in the sense it has been introduced by McDonnell (2014). Rather, we introduce the term here to refer to the two worlds again in a metaphoric sense to better illustrate the largely disjunctive nature of the catchment hydrology/surface water and groundwater communities.

MS: 2. Based on the definition from McDonnell, the term "water world" is not correctly

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used in this manuscript, when the authors state for example in L43: ". . .two systems – surface water and groundwater – using the (often distinct) terminology of each of these "water world" research communities." The "Two Water Worlds" are not surface water vs. groundwater.
RESPONSE: As noted above, we introduce the term "Two Water Worlds" to emphasize the current separation between the two worlds – communities – of surface water and groundwater. With all due respect for his excellent research, McDonnell does not hold exclusivity over this term, which we in fact find to be somewhat misleading in terms of description of the true physical picture.

MS: 3. It is not correct that the term "Two Water Worlds" was used by Brooks et al. (2010) as you state in L576. Brooks et al. introduced "ecohydrological separation".
RESPONSE: We thank MS very much for pointing this out. We will correct the wording and citation to this term (McDonnell, 2014) in the revised manuscript.

MS: 4. Since it is stated in L579 that "We question the conceptualization of two (or more) separate, fully compartmentalized mobile and immobile regions of water and chemicals.", why would one continue using the term "Two Water World"? Why promoting an oversimplified expression about which you acknowledge in your response to Markus Hrachowitz (page C15) that a "distinct separation is indeed a highly idealized interpretation"?
RESPONSE: By questioning the conceptualization of two separate compartments, we explicitly do not recommend further use of the term "Two Water Worlds", after McDonnell (2014). Allow us to point out again that we use this metaphor in a totally different context, to emphasize the current separation between the two hydrology communities of surface water and groundwater.

MS: 5. The "Two" in "Two Water World" resulted from the two different methods to sample the isotopic composition (2H and 18O) of subsurface water (as done in the early work on "ecohydrological separation" by Brooks et al. (2010) and Goldsmith et al. (2012)): One is either limited to the more "mobile soil" water when using suction

lysimeters (often about 600 hPa) or one samples the entire pore water ("bulk soil water"; i.e., mobile and more tightly bound water) by using for example cryogenic extraction. I discussed these aspects in more detail in Sprenger et al. (2018) and Sprenger et al. (2019). Thus, the limitation to TWO separate subsurface pools is to a great extend a result of the methodological limitations, since we cannot simply sample stable isotopes along the water retention curve (but some attempts were done, see e.g. Figure 4 in Geris et al. (2015)).

RESPONSE: We sincerely thank MH for pointing this out, and we will happily clarify our text in the revised manuscript, adding these useful citations.

MS: I am concerned that the use of "Two Water Worlds" in this manuscript will cause confusion among the hydrological community and I hope that the points I raised here will encourage the authors to use a different terminology.

RESPONSE: While we are fully cognizant that our use of the term "Two Water Worlds" is new and possibly somewhat unusual, we prefer to retain it. Throughout the manuscript, we emphasize the need for connection and cross-fertilization of concepts and methods between the surface water (catchment hydrology) and groundwater communities, which are currently split into two "water worlds". We state this clearly at the outset of the manuscript, and elsewhere. We will ensure that we are clear on this point throughout the revised manuscript. We do not believe that use of the term will cause any real confusion. Rather, we are of the opinion that using the term helps to stress the current – but unfortunate and undesirable – lack of communication between the surface water and groundwater worlds.

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