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Interactive comment on "Mechanisms of consistently disconnected soil water pools over (pore)space and time" *by* Matthias Sprenger et al.

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Response: We thank Reviewer 2 for taking the time to critically evaluate our manuscript. We are glad to hear that Reviewer 2 agrees that our study is a "nice contribution". We respond to each comment below and discuss at length why we disagree largely with the comments provided on the lack of novelty.

Content: The paper examines isotopic differences in water pools across depth and time to quantify the extent of mixing. They find that tightly bound water, defined as water not sampled via suction lysimeters, differed consistently from more tightly bound water.

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Contextually, the paper is a comparison of two soil water extraction methodologies, it begs the question of whether the extraction technique equals the label applied here (and by many others!), i.e. if 'mobile' water and 'immobile' water (lysimeter and cryogenically sampled water, respectively) are truly so.

Response: Following Brooks et al. (2010) we refer to the differently sampled waters as "mobile" and "tightly bound" waters (Page 1 Line 15) and did not use the term "immobile" water in the paper. Indeed, we assume that the water extraction methods (suction lysimeters and cryogenic vacuum extraction) correspond to two actual different degrees of soil water mobility.

The authors transform the isotopic signatures using a mass-balance approach but this is ultimately based on differences between extraction techniques. Others have reported similar observations of the differences between soil water, and attributed it to the same process where small pores retain water. This derives similar conclusions from a larger dataset and expands on dynamics in time. However, it does seem to re-hash, in greater detail, the observations and conclusions drawn by Brooks 2010 and leaves the reader questioning the novelty of the results (indeed, many papers have noted consistent differences between cryogenically-extracted water and soil lysimeters).

Response: We are surprised to read that the novelty is questioned. To our knowledge there are no studies that provide in a similar way an explanation on the differences in the stable isotopic composition of waters in the unsaturated zone. We refer to several studies that show these differences in mobile and bulk waters, but we did not find in any of these studies an explanation laying out the processes that lead to the observations. Brooks et al. (2010) suggested the filling of smaller pores during low soil moisture conditions but they could not underline the hypothesis with sufficient data (3 soil sampling campaigns and NO rainfall data prior to soil sampling). As pointed out by Reviewer 2, our study presents results "in greater detail". We truly believe that this "greater detail"

allows us to go further in our observations and conclusions and therefore we think that our contribution do not deserve to be qualified as a "re-hash". We have seen numerous studies referring to "ecohydrological separation" and often limiting the analysis to comparisons of soil water and xylem water in dual isotope plots and then concluding that there is either an ecohydrological separation if they do not plot on top of each other, or there is (partially) no ecohydrological separation if they plot on top of each other. Therefore, we think that the fact that our study "expands on dynamics in time" (as acknowledged by Reviewer 2) is a truly new view on the issue.

Overall, the paper is a nice contribution to our understanding of partitioning of water in the subsurface. They refer to this as ecohydrologic separation but it seems more a function of meteorology and geology, with potential impacts on cycling of water and uptake by plants.
Response: We really only use the term "ecohydrological separation" once in our manuscript (Page 9 Line 30) when we discuss our findings in the context of the study by Brooks et al. (2010). We are glad that Reviewer 2 could follow our discussion that the observed separation stems from the interplay of the hydro-meteorological seasonality and the soil characteristics. This was one of our main messages and deriving this conclusion was only possible due to the long-term rainfall isotope and soil moisture observations.

Moreover, e.g. p9, line 5 (and elsewhere referred to) How many mm of water does this 'tightly bound', 'immobile' portion represent? What portion of the annual water budget at this field site is 'locked' away as suggested? Ultimately, how important is this water that doesn't mix? The various conclusions and potential impacts highlighted in the discussion section very much depend on an implicit assumption that this 'portion' is somehow significant.

Response: As indicated above, following Brooks et al. (2010) we are not using the term "immobile" water, but we highlight that this tightly bound water seems to play a minor role in the groundwater recharge and stream water contributions, as it does not mix well with the mobile water and has a lower hydraulic conductivity compared to the mobile water (compare thin blue and red lines in Figure S2).
According to the water retention curve (as shown with thick lines in Figure S2) the volumetric soil moisture of the more tightly bound water (h < -700 hPa) is 0.29 cm^3/cm^3. If we consider the studied upper 1 meter we would have about 290 mm stored in the soil matrix, which cannot be sampled with suction lysimeters. However, this water is not "locked away", as it would be partly available for evaporation and transpiration (permanent wilting point is often assumed to be about -15.000 hPa) and percolates according to subsurface pressure differences. 290 mm are about 1/3 of the annual rainfall. Why this water is relevant is discussed on Page 11 Line 31 and following. However, the actual volume does not seem to be most important here, but the strong "non-uniform" character of subsurface flow that can be recognized with our data set is the most relevant point.
We will add to the revised manuscript the 290 mm of water in tightly bound water. However, we will also rephrase the manuscript in a way to clarify that we cannot claim that the observed water pools do not mix at all, but mixing is very limited given the very distinct stable isotopic compositions between mobile and bulk soil waters.

Grammar: There were a fair number of mistakes in grammar and punctuation. Please revise professionally for verb tense agreement and use of imperfect tense, i.e. 'we got it or we took it' are informal and temporally less explicit than the perfect tenses.
Response: We will carefully revise the grammar in our manuscript. So far, we used a lot "We sampled…" or "We took…" as active voice is a more natural style. We will discuss with the Editor if that should be changed.

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