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Interactive comment on "Deep soil water ^{18}O and ^{2}H measurements preserve long term evaporation rates on China's Loess Plateau" *by* Wei Xiang et al.

Anonymous Referee #2

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Xiang and colleagues present a novel way to study long-term evaporation losses of infiltrated rainfall by using the isotopic fractionation signal of deep soil waters. The approach with a focus on deep soils is novel and they highlight the opportunity and benefit of such an approach with regard to rainfall partitioning. The manuscript is well structured and mostly well written, and the graphs are mostly informative. The topic is of interest for the HESS community and fits to the journal's scope.
The main issue of the presented study is the lack of information of the isotope ratios in the infiltrating rainfall at the individual sites. While it is unclear how the IAEA rainfall data were used in the study, the uncertainty introduced by not having site-specific rainfall isotope data are not assessed and thus not accounted for. If the actual rainfall isotope ratio differs from the IAEA data derived local meteoric water line, the lc-excess

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Discussion paper

for the soil water ends up being offset over the entire depth profile. In such case, one would assume negative lc-excess results from transport of partly evaporated shallow soil water into deeper depths. For example, if the intercept of the LMWL is overestimated, the lc-excess values of the soil water will be underestimated. If the slope of the LMWL will be underestimated, then lc-excess values of deeper soil water might be underestimated.

I now see that this aspect has been already addressed in the response to Reviewer 1. If II use some numbers provided in Fig. 2, assuming there is d2H = -68 permill and d18O = -9.2 permill in the subsurface (from reading the graph), the lc-excess could range between -4 and 9 permill depending on the assumption of slope being 6.11 or 7.56. Such uncertainty is not discussed yet in the manuscript.

Further, according to Figure 4, the lc-excess at several sites is within the interquartile range of the rainfall lc-excess. Is rainfall lc-excess related to rainfall intensity? More intense rainfall would probably reach deep soils more likely than less intense rainfall.

Any information about soil moisture is missing. Ratios between infiltrated non-fractionated rain water and fractionated soil water storage are discussed, but remain speculation when no mixing volumes are considered. For now, the authors cannot really provide a process description of how fractionated shallow soil water is transported - without or with only little mixing with rainfall water - to deep depths. Without a description of a hydrological process based on observed data leading to lc-excess < 0 in the subsurface, the interpretation remains speculation.

Specific comments:

25: “f” needs to be clearly defined. Currently not given.

39: typo: field

85: runoff, as surface OR subsurface runoff to streams (no rain reaches the stream) or do you mean “surface runoff”?

93: provide temperature, vacuum, and time applied.

110: It’s not clear which of the precipitation sampling stations has been used for constructing the LMWL of which soil sampling site. Please clarify. What are the time periods of the precipitation sampling? Did this overlap with the soil sampling? What was the sampling frequency of the precipitation sampling? Please provide the LMWL for each study site or was one LMWL used for all the sites?

139: What “annual values” are meant?

186: You miss showing the decrease in evaporation fractionation for your study sites. I suggest to replace the plot of d18O with a plot of lc-excess in Figure 2.

188: What does this mean? Thick soil depths prevent surface soil evaporation? Please rephrase to clarify.

190: In the review by Sprenger et al. (2016) that you refer to, they also presented modeling results assuming no preferential flow and even under such conditions, the evaporation fractionation signal was gone with depth because of the “subsequent mixing of the evaporated soil water with nonfractionated precipitation”.

199: This interpretation remains speculation since no information about fractionated soil water storage and mixing with non-fractionated rainfall are shown in the results.

224: Unclear how a ratio can have a residence time and how this residence was derived.

229: What do you mean of evaporation having long residence time? Do you mean the tome water resides in the soil until evaporated or transpired?

261: Extending the data set for northern sites, Sprenger et al. (2018, doi:10.1002/hyp.13135, 2018) found similar to your results that rainfall amount could explain most of the lc-excess dynamics, and not ET.

281: typo: 18O

285: You miss to discuss the uncertainty introduced due to lack of LMWL at the specific site.

473: Please add when was the “Deep profile” taken.

Figure 2: Consider replacing d18O in sub plot (b) with lc-excess, since you refer to evaporation fractionation. Having lc-excess plotted over depth would underline your discussion, while showing very similar d2H and d18O profiles does not provide that much information.

Figure 3: Since lc-excess is such an important measure in your study and you claim that the lc-excess changes over depth, it would be very valuable to see the lc-excess on a second axis in the plots shown in Figure 3.
Figure 4: How about sorting the boxplot by e.g., total rainfall? (Figure 5 shows that there is a relationship there)

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