Comment on hess-2022-291

Anonymous Referee #2

Referee comment on "Estimating karst groundwater recharge from soil moisture observations – A new method tested at the Swabian Alb, Southwest Germany" by Romane Berthelin et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-291-RC2, 2022

This paper tries to link precipitation- soil moisture- recharge relationship in catchment area scale of karst aquifer environment Good results and discussions are valid and clearly described. The contents of the paper are good and with valuable information to share with related field. Just some minor points suggest to check before the publishing:

Reply: We thank the reviewer for her/his constructive comments that will contribute to improving the manuscript. According to her/his comments, we will perform and clarify the following points.

1. There are limited information about the data distribution. For example, 15 sites of soil moisture measurement and discharge hydrograph. It's quite importance to evaluate characteristic from time series of different observation. I like to suggest to authors to add some typical hydrograph or data plots in suitable time windows.

Reply: A figure with the time series of the different data used will be added to the manuscript in section 2.3.

2. Some challenges rises after author use three spatially-combined-averaged soil moisture time series: grassland (G), woodland (W) and all area (C). It's needs to have some assumption and simplify the sites specific and spatially heterogeneity. Specially the karst surface - groundwater system will be spatially continuity such as G-W-G or W-G-W... from upstream to downstream. Such assumption as the paper describe could be only on infiltration processes and assume homogeneous after that.

Reply: The idea to use spatially combined-average time series is used to average out site-specific patterns that are likely not representative of the average catchment behaviour. We wanted to avoid basing the analysis on a single time series that might be an outlier in terms of catchment-average behaviour.

We chose to average the observations in the grassland and woodland categories, assuming that these different vegetation types would have diverse influences on infiltration processes. Here, the tree and plant species are the same for the different observation points in the grassland and woodland. Furthermore, figure 5 of the paper showed that the standard deviation values of the soil moisture measurements over the catchment decreased when recharge was observed. The heterogeneities of measurements over the catchment are thus reduced when recharge is occurring.

Concerning the percolation processes, we assumed that the water infiltrated to the unsaturated zone is recharged according to the assumptions from Hartmann et al., 2021; Hartmann et al., 2012; Worthington et al., 2016.

We will add some text to make clear and describe the assumption of homogeneity in the system. We will also add some text to make clear that we assume that rainwater infiltrates into the soil and then vertically percolates down into the epikarst and karstic system, with one or two citations to justify this assumption. Under this assumption, a flow path from grassland to woodland to grassland or vice versa (G-W-G or W-G-W) is not a dominant flow path.

3. Precipitation- soil moisture- recharge relationship as Fig.2, the paper chose "temporal delays" with a simple temporal buffer. Actually, the time lag or responses lag could be evaluating from cross check between two time-series. Such quantitative linkages also needed to support the following analysis and discussion.

Reply: Indeed, we applied a cross-correlation analysis between the precipitation, soil moisture and discharge time series to estimate the temporal delays. The method applied was adapted from Delbart et al. 2014, who used the sliding-windows cross-correlation method. This information is given in section 2.1.2 of the paper. We will add some text about the approach to clarify this point.

4. I am concerning the precipitation- soil moisture- recharge relationship analysis is event base, and the referred hydraulic parameters also random walks or with discrete distribution. For the calculation in catchment scale or annual flow in close years, such representative hydraulic parameters should be stable. It's better to check the timevariation of the related parameter between different events.

Reply: We will check the variability of ks throughout different periods.