

Response to Reviewer #3

The reviewer's comments are in *italic* and our response in normal font.

1. *The authors investigate the connection between groundwater levels expressed through the standardized groundwater level index (SGI) and the standardized precipitation index (SPI) in Southern Germany and the Netherlands. The study aims to characterize the relationship on different accumulation time scales of both the SPI and the SGI as well as via evaluating the skill of the SPI in predicting groundwater droughts using hit rates and false alarm rates. The general message of the manuscript is that the SPI is a poor indicator for groundwater droughts in the given areas. The manuscript is well written, clearly structured and the figures are suitable. The science questions are clearly stated and I recommend publication in HESS after considering some recommendations listed below. I also appreciate the publication of mainly “negative” results which is unfortunately often avoided, although there may be potential to learn even more from negative results than from positive ones.*

We thank the reviewer for his/her encouraging words and helpful comments.

2. *P7407, L22-23: Aren't there other reasons than “non-linearity” of the transformation of a precipitation signal to a groundwater drought? What about the role of evapotranspiration as a key process in the terrestrial water cycle? Some comments and references on that issue should be added here.*

There are several reasons for that non-linear transformation of the precipitation signal to groundwater. Apart from the underlying (sub)-surface properties like terrain, soil, vegetation and geological properties, evapotranspiration plays a crucial role. We fully acknowledge this fact and for that reason we cited the study of Teuling et al., 2013 (in the same lines: P7407, L22-23) which looked into these issues. To come out more clearly, we will explicitly mention the possible contributing factors involved in the (non-linear) propagation of the precipitation signals to the groundwater drought.

3. *P7408, L12: years in the reference of Peters et al. should be 2003, 2005, 2006.*

Thank you. We will re-ordered this list in the revised manuscript.

4. *P7409, L15: The climate of Southern Germany is not ?continental?. It is not as close to the sea as the Netherlands and therefore less maritime, but the wording continental is not appropriate in this respect. Suggestion: ?...a region with hilly to mountainous terrain, less oceanic influence on climate and a wide range...?*

We will revise the manuscript as suggested.

5. *P7410, L19-21: These lines are not clear to me. What do you mean by filtering the precipitation time series? Are missing groundwater dates set missing in the precipitation time series? If yes, how does this affect the accumulation on different time periods? Please clarify.*

We recognize that we had not been clear on this point (as was also reflected in the Reviewer #2 comment). By filtering we mean, the months with missing groundwater values are also set to *missing* in the precipitation time series. We however applied the filtering after the accumulation of precipitation (for any selected time periods e.g., 3, 6, 12 months) had been performed. This way, we ensured that the consistency of longer time scale SPI estimates was maintained and not affected by the filtering procedure. We emphasize that the filtering step was necessary to ensure the comparability between the (accumulated) precipitation and groundwater time series so that both had the same sample size for the estimation of SPI and SGI. We will amend the text in the revised manuscript detailing out the filtering procedure to avoid any further misunderstanding.

6. *Section 4: I think the manuscript would benefit if there is a more in depth discussion on why the SPI is not a proper groundwater drought identifier. Particularly the role of the demand-side of the water balance seems a critical point, as well as the underlying geology. Please add some*

discussion and reference dealing with these issues. See for example: Natural Hazards and Earth System Sciences, 15, 1381-1397; Journal of Hydrology 477, 175-188, Water Resources Research 50, doi:10.1002/2013WR015051

Based on your and other two reviewers' suggestions, we will amend the text in the revised manuscript to reflect the possible role of geological properties (see Reviewer #1 response letter) and evapotranspiration (see Reviewer #2 response letter) in groundwater drought evolution. We will include the suggested references in our discussion wherever appropriate.

7. P7421, L12: *should be: "...on the basis of this data-based..."*

Thank you. We will revise the text based on your suggestion.