

Comment on hess-2022-166

Anonymous Referee #2

Referee comment on "Does non-stationarity induced by multiyear drought invalidate the paired-catchment method?" by Yunfan Zhang et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-166-RC2>, 2022

General comments

- In general it's clear that the authors improved the original manuscript (<https://doi.org/10.5194/hess-2021-5>). They did improved the flow of the storyline and the analysis of the control catchment. The manuscript has appropriate objectives and gives insight in the change in hydrological processes caused by the combination of land use and climate changes.
- Although the assumptions and following conclusions are constructively fine and according to the applied methods, the arguments (especially in the abstract and conclusion) are not very clear. Although some comparative values per method are presented, for a reader it is not clear where the conclusions are based on.

Specific comments

- The abstract ends with "paired-catchment method is proven to be still the moist reliable method even the control catchment experienced climate-induced shift in rainfall-runoff relationship", but within the abstract no information on the control catchments are presented. I would suggest to give actual numbers so that the reader is able to draw this conclusion himself.
- In my opinion it's a missed opportunity that the majority of input by the previous reviewers and especially the replies by the authors are not processed within this manuscript.
 - e. reply to reviewer 1 (<https://doi.org/10.5194/hess-2021-5-AC1>): "During 1988 the uppermost 50 ha of Red Hill was planted to p. radiata, with the remaining 145 ha planted to p. radiata in April 1989. During 2003 the plantations in Red Hill catchment were thinned to remove pulpwood and to promote the growth of sawlogs in the remaining stands. During the prolonged drought period, no trees died in the treated catchment. The change of annual PET can be seen in Figure 8 (b) (Page 42). PET

showed an insignificant ($p\text{-value} > 0.1$) increasing trend of 3.5 mm year⁻¹. PET initially decreased before 1996 and then increased after 1996. The mean annual PET during the period of 1990-1996, 1997-2009, 2010-2015 and 1997-2015 are 1168 mm, 1262 mm, 1186 mm and 1238 mm, respectively. Compared with the period of 1990-1996 and 2010-2015, the mean annual PET during the period of 1997-2009 (the prolonged drought occurred) increased by 94 mm and 76 mm, respectively. Compared with the period of 1990-1996, the mean annual PET during the period of 1997-2015 increased by 70 mm. It is consistent with the cognition that afforestation and drought can make PET increase.”

- e. reviewer 2 (<https://doi.org/10.5194/hess-2021-5-AC2>), which you may use in the introduction and/or discussion: “Considering the influence of prolonged drought on the rainfall-runoff relationship in the treated catchment, the result of the paired catchment method is closest to the real runoff change caused by vegetation change. Because the control catchment indirectly eliminates the influence of prolonged drought and climate variability on the treated catchment under the assumption that the response of the two catchments to prolonged drought is similar. Interannual changes in watershed storage occur primarily in soil water and shallow groundwater, pools that are often hydrologically active at time scales shorter than 1 year (Sayama et al., 2011). Rice and Emanuel (2019) indicates that downâ€regulation of transpiration and inhibition of hydrologic connectivity by forest vegetation represent two important negative feedback processes that can avert large losses in soil water or plantâ€accessible groundwater during dry periods. In doing so, this feedback mechanism has the potential to reinforce steadyâ€state (or nearâ€steadyâ€state) conditions in dry conditions. So, the sensitivityâ€based method may be less affected by the prolonged drought because it is used in the forest and the time scale of PET and P data used in this method is annual scale. Runoff changes calculated by the sensitivityâ€based method are induced by climate variability.”
- For some statements I suggest to add some additional more recent papers.
 - e. at line 33.
 - e. at lines 52-53 “in many catchments around the world” two papers are cited one from 1980 and one from 2005, may be implying that these methods are not used that often anymore?
- Lines 79-93: The data and location description are very brief. I suggest to give some more extended information. i.e. “It can be seen that Kileys Run experienced a multiyear drought that lasted ... with the period of the Millennium Drought”, explain why? What is lowest amount of rainfall measured?
- Lines 346-357, the paragraph about “Multiyear drought induced changes in the rainfall-runoff relationship” is short and doesn’t discuss the subject. I suggest to compare your results with other locations where multiyear drought led to changes in the rainfall-runoff relationship.
- In this paragraph you do mention a change in physical processes (runoff, soil moisture and evapotranspiration?), but not really compared with studies elsewhere. Do you have any specific evidence available about changes processes?
- In addition to that, add some references about global and local knowledge about land use changes and their effects, such as the infiltration trade-off hypothesis (i.e. Bruijnzeel, 1989) and regional water availability caused by tree restoration such as (i.e. Hoek van Dijke, et al. 2022).
- Lines 412-426, I suggest to re-introduce abbreviations.
- Lines 417-418, conclusion. Add numbers so the reader is able to “agree” with your conclusion.
- Idem line 420.

Technical corrections

- Line 82, what about Red Hill?
- Line 87, it would be nice to apply your analysis with data up to 2020?
- Line 87, which method did you used to measure the runoff? Of where did you collected the data?
- Lines 88-89, add more information/background. You use daily rainfall and runoff, but monthly PET?
- Line 90, "figure 2 shows the rainfall anomaly that was calculated by the method proposed by", I suggest to describe the method (define anomaly). Which in this case is the annual percentage of rainfall being larger or less than the average rainfall.
- Line 91-92, I suggest add to add the reference again.
- Figures 3 – 5, and 7: used colours (combination of red and green) are not very suitable for colour blind readers (HESS - Submission (hydrology-and-earth-system-sciences.net))
- Lines 363-365, add reference?
- Line 372, add reference?
- Figure 4, perhaps add cumulative rainfall and the separated periods.