Hydrology and Earth System Sciences Discussions

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Comment on hess-2021-568

Anonymous Referee #1

Referee comment on "Spatiotemporal responses in crop water footprint and benchmark under different irrigation techniques to climate change scenarios in China" by Zhiwei Yue et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-568-RC1, 2022

General comments

- One could divide WFP benchmarking techniques into two methods. Method 1 compares the WFP of different producers (or grid cells) within the same region, ranks them and sets a benchmark based on some percentile. Method 2 compares the WFP at each location under different management practices and sets a benchmark based on best practices (those resulting in the smallest WF). Method 2 is for example applied in the studies by Chukalla et al. (https://doi.org/10.5194/hess-21-3507-2017 and https://doi.org/10.5194/hess-19-4877-2015). The drawback of method 1 is that no matter what spatial scope one takes in grouping producers, within that scope there will still be variability from place to place (section 4.3.2.1 in https://doi.org/10.1016/B978-0-12-822112-9.00006-0). Rainfall, for example, shows strong spatial variability over short distances, such that a few producers in a larger area simply had more favourable local circumstances. Therefore, one can always question the comparability of producers that operate in different locations and the WFPs they achieve. Method 2 overcomes this drawback. In this manuscript method 1 is applied, although different irrigation practices are simulated. What are your reasons for determining the benchmarks based on method 2? Why don't you determine the benchmarks (also) based on method 1? You seem to have the data/simulations for that.
- AquaCrop provides crop parameters sets for maize and wheat which are to some degree calibrated for the conditions of recent history. How do you make sure the model produces reliable results for ET and Y under climate change scenarios?
- Micro-irrigation results in the smallest WFP and largest Y (Figure 3). Yet how feasible (and profitable) is micro irrigation in maize and wheat production in practice? Is it commonly applied for these crops in some parts of the world? Or is micro-irrigation mostly used for cash-crops only? Some elaboration on this in the manuscript is needed to justify the research setup and to put the results into perspective.
- What assumption do you take in terms of irrigation strategy/scheduling? This needs to be added to the methods. And how does this affect your results? This is important to

address in the discussion, preferably with some quantitative substantiation. The more irrigation events you have, the more effect you will see from moving to a more efficient irrigation application technology (from furrow to drip). So I suppose your outcomes in terms of WFP for different irrigation technologies are quite sensitive to the assumption for the irrigation trigger (x% of soil moisture depletion?) and amount (back to field capacity?).
- The most common abbreviation in water footprint assessment literature for water footprint is WF not WFP. I strongly suggest to stick to WF.

Specific comments

- The abstract should mention what method (model) has been used to estimate WFPs.
- "Wheat WFP will increase under RCP2.6 (by 12 % until the 2080s), while decrease by 12 % under RCP8.5 until the 2080s." Please add a brief explanation for this opposite trend under RCP8.5 in the abstract.
- Please add in the abstract what benchmarks have been determined. You mention that "Furthermore, the spatial distributions of WFP benchmarks will not change as dramatically as those of WFP" but the WFP benchmarks themselves have not been mentioned earlier in the abstract.
- "The present study demonstrated that … must be addressed and monitored". Stated too strongly. Did you really provide evidence that this ***must*** be done (in order to …)?
- A general overview of the methodological steps at the start of the section is missing. You now jump directly into "Determining the baseline year", but it is not yet clear that/why you need to determine that (and why you use the Aridity Index for that).
- Why do you take the maximum root depth (Zx) and Harvest Index (HI) from Allan et al. (1998)? These parameters are also available for maize and wheat in the default crop files that come with AquaCrop, like the rest of the parameters that you take from Raes et al. (2017).
- Refrain from mentioning that in your study the AquaCrop model was coupled with GCMs. You did not couple these models. You used GCM outputs as input for AquaCrop. That is something different than coupling models.
- In the before last sentence of the conclusion you suddenly introduce other agricultural management practices that water-saving irrigation technology to reduce agricultural water use, such as mulching. The way it is phrased suggest that this is a conclusion from this study, which is not the case. Thus, you may want to rephrase this. Also, it is advised to add in the Introduction a description on the alternative options to reduce agricultural water use, after which you decide to focus this study on exploring the effects of water-saving irrigation technology only.