

Deadline 31 Aug

Public justification (visible to the public if the article is accepted and published):
(The line numbers quoted below refer to the track changes version of the revised manuscript.)

We thank the editor for their constructive comments, which we addressed in blue below and incorporated into our manuscript. We would also like to thank the editorial team for their thoroughness. However, our paper has been under review with HESS for over a year (since May 2024), during which we have addressed three rounds of revisions. We would appreciate a resolution being reached soon.

I find that the authors did not adequately respond to a major concern of the 3rd reviewer, namely

“The major uncertainty around OFRs is how they are managed and how much water for irrigation is actually abstracted from them. [...] I find this aspect a little bit odd in the paper. The authors [...] never consider irrigation in the model configuration.” And again: “... the paper does not really advance this field significantly because the major source of uncertainty, i.e., irrigation abstraction and other management-related aspects of the reservoirs, are completely neglected”

The premise of the paper is that OFRs impact the hydrology (e.g. lines 51-52). But the main impact of OFRs on the hydrology is not the OFR itself but rather how the OFR is being managed, namely for using the stored water for irrigation. Without the use of the stored water in OFRs for irrigation, OFRs will have hardly a noticeable impact on the hydrology. But as this irrigation use of the stored water is ignored in the model used, the innovation of this paper is limited.

For example, there might be a correlation between the change in the number or size of OFRs in a certain area and a change in the irrigated area in that same area, and with it the change in water consumption by that change in irrigated area. There are currently many RS products that can reliably estimate such changes in water consumption patterns. Including this could possibly significantly improve our understanding of the impact of OFRs on the hydrology. I write this just to invite the authors to more adequately reflect on the 3rd reviewer’s concern.

Thank you for pointing this out. The reasons why we did not include irrigation from OFRs are the following: (1) Most irrigation withdrawals occur directly from the channel (e.g., USDA 2023), so the withdrawal term is excluded in Equation 3 (Please also see the answer to #3 below). (2) Given that OFRs are on-farm small water bodies, very few farmers keep track of the irrigation data at the individual OFR level, and water abstraction is not resolved by typical RS data products, and (3) Lastly, our method of comparing naturalized flows (i.e., baseline flows without

any OFRs or withdrawals) with observed inflows into OFRs, allows us to quantify how OFRs modify the natural flow regime, similar to other studies (Döll et al. 2009).

Döll, P., Fiedler, K., and Zhang, J.: Global-scale analysis of river flow alterations due to water withdrawals and reservoirs, *Hydrol. Earth Syst. Sci.*, 13, 2413–2432, <https://doi.org/10.5194/hess-13-2413-2009>, 2009.

USDA, 2023. Irrigation Organizations: Water Inflows and Outflows: https://ers.usda.gov/sites/default/files/_laserfiche/publications/107067/EB-36.pdf?v=48646

I have a few more detailed comments on the revised manuscript, as follows, which I would like the authors also to address:

1. In your rebuttal you promised the following, but I could not find this in the revised manuscript:

“We reviewed and cited the two studies in our manuscript. The new lines in the manuscript are copied below: “For example, previous studies have found that OFRs reduce annual and monthly runoffs in southeastern China (Yan et al. 2023) and Australia’s Murray-Darling Basin (Robertson et al. 2023).”

Added the text above and citations.

2. In lines 58-59 you write “... the spatial and temporal variability of OFRs ...” What do you mean by this? Kindly clarify.

We clarified by replacing it with “the spatial and temporal variability of surface water extent in OFRs.”

3. The paper frequently refers to inflows and outflows of OFRs (e.g. line 74, 568-569, 639, 692, 716, 719). But farmers also abstract water from OFRs through e.g. pumps and pipes, in order to irrigate their crops. This abstraction is also not covered in the OFR water balance given in the new equation 3 (line 294). Kindly explain why you omit this, in view important, feature of OFRs.

We thank the editor for this point. While farmers may abstract water from OFRs for irrigation through pumps or pipes, in our modeling framework, we assume that the main irrigation withdrawals in the study area are taken directly along the channels and streams, not from the small OFRs themselves. This assumption is supported by hydrological evidence that irrigation withdrawals predominantly occur at the channel level in many agricultural systems (e.g., Brochet et al., 2024). Hence, we did not include an explicit irrigation abstraction term in the OFR water balance (Equation 3). Inflows into OFRs already reflect upstream abstractions, and therefore, the observed inflow signal implicitly accounts for this impact.

We acknowledge this as a limitation of our approach: direct withdrawals from OFRs by individual farmers are not explicitly modeled, both due to the absence of reservoir-level

irrigation data and because OFRs are typically small water bodies, making it infeasible to quantify such abstractions reliably with existing datasets or remote sensing products. We have clarified this assumption and its implications in the revised text, by including the following:

“While farmers may occasionally withdraw water directly from OFRs, in our study region, most irrigation appropriations are taken from channels and streams. This is consistent with irrigation practices in Arkansas, where large-scale surface water projects withdraw directly from rivers and distribute water via canals and pipelines. Similarly, watershed-scale modeling that incorporates irrigation withdrawals into the river system yields better flow simulations, especially during low-flow periods (Brochet et al., 2024). Given this, and in the absence of high-resolution data on reservoir-specific withdrawals, our framework assumes that inflow to OFRs already reflects upstream irrigation abstractions. Thus, Equation 3 omits an explicit irrigation withdrawal term for OFRs, and our approach focuses on quantifying the hydrological signal alterations through natural versus reservoir-influenced flow comparisons”.

Brochet, M., Raimonet, M., Le Moine, N., Ducharne, A., Cheruy, F., Ottlé, C., Ducharne, F., and Gascoin, S.: Accounting for irrigation water withdrawals improves low-flow simulations of a regional watershed model, *Hydrol. Earth Syst. Sci.*, 28, 49–69, <https://doi.org/10.5194/hess-28-49-2024>, 2024.

4. In line 280-281 the paper now reads: “The total volume of water in the OFR fluctuates in response to changes in surface area ...” I think this is an incorrect statement. The volume of water in an OFR changes due to changes in inflows, outflows, or abstractions. Such changes of water volumes are associated with changes in the surface area of the OFR, but are not caused by it, as is suggested in this text.

We rephrased it to the following, as suggested: “The volume of water in an OFR, which changes due to changes in inflows, outflows, or abstractions, is associated with changes in the surface area of the OFR”.

5. Lines 311-314: I do not understand what the volume of water and the surface area at the emergency spillway or at the principal spillway mean. For readers that are unfamiliar with the specific design of an OFR, like myself, this needs an explanation.

We added the following explanation to the text: “Spillways release the water once it reaches a specific level. Most OFRs have uncontrolled spillways, implying that there are no gates to control the outflow. The outflow through the spillway depends on the level above the spillway crest. An emergency spillway, whose crest is typically at a higher elevation than the principal spillway, is an additional spillway designed to release excess water during heavy flooding. The surface area of the OFR represents the water spread area corresponding to a given level in the reservoir, which typically increases as the reservoir level rises.”

6. Line 352: “SWOT+” Is this correct?

Changed to SWAT+

7. Lines 557-560: Why does this sentence start with “Although”? In my understanding the sentence could more appropriately start with the word “As”.

Changed to start with “As” as suggested.

8. Line 641: “... may not lead to differences (e.g., > 10%) ...” I would add: “significant”, as follows: “... may not lead to significant differences (e.g., > 10%) ...”

Added as suggested.

9. At lines 184 and 735 you refer to Mollina-Navarro et al., but that should read Molina-Navarro et al.

Changed as suggested.