Dear Prof. Yongping Wei,

Thank you for sending these further constructive reviews of our work. We hereby summarise how the manuscript has been revised according to reviewer's comments. We are grateful to the reviewers for their helpful comments that have further improved the paper.

We addressed the technical corrections raised by reviewer 1.

We expanded the discussion on the unique value of isotopic information compared to ET data for model calibration according to reviewer 2's comments. Specifically, we clarified that while ET observations can constrain the magnitude and temporal variability of evapotranspiration, they provide limited information on the underlying water sources contributing to ET. In contrast, isotopes offer valuable insights into ET source partitioning, which cannot be readily inferred from ET data alone (line 590-602).

Best wishes,

Hanwu Zheng (on behalf of all co-authors)

Author response to Referee #1 comments:

We thank reviewer 1 for the detailed additional review of our work. We hereby provide our point by point responses how the comments by referee #1 were addressed in the revised manuscript.

Best,
Hanwu Zheng

Anonymous Referee #1
The revised manuscript on tracer-aided modeling in catchments with substantial anthropogenic influences is a solid contribution to science within the scope of HESS with a sound methodology and well-described results. I would recommend the paper for publication, and have only a few suggestions for corrections:

Reply: *We thank reviewer 1 for this positive assessment of the improvements and importance of our work.*

Figure 1: The legend color scale for sub-figure a) is unlabeled, I think it might be elevation, and probably m.a.s.l., but this should be explicit.

Reply: *We corrected this accordingly.*

Figure 3: The labels sometimes overlap the plot and points in the time series plot, and for a1 to d1 the simulated maximum is cut off. Readability would be improved with some rescaling.

Reply: *We corrected this accordingly.*

Figure 7 would benefit from some minor visual revisions, points and bars are overlying labels, and the stars/points are all squished up the top covering each other such that it's hard to see anything other than the frequent separation of the forest model/observation. Also, the description has 'balanced solutions' but the figure has 'compromised solutions', which is inconsistent.

Reply: *We corrected this accordingly.*

Line 531 Sentence is currently too vague, should be expanded or combined with previous sentence

Reply: *Rephrased.*

Line 533, 'Previous' incorrectly capitalized

Reply: *Corrected.*

Line 543, just a suggestion, but 'normally' should probably be 'has been shown to', as one study is unlikely to be enough to establish a norm

Reply: *We corrected this accordingly.*

Author response to Referee #2 comments:

We thank reviewer 2 for their further review of our work. We hereby provide our point by point responses how the comments by referee #2 were addressed in the revised manuscript.

Best,
Hanwu Zheng

Anonymous Referee #2

I have reviewed the revised manuscript and the authors' detailed response. I appreciate the substantial efforts made in this revision. The manuscript has significantly improved in terms of methodological rigor and clarity.

Reply: *We thank reviewer 2 for the detailed and careful review of our work and this positive assessment of the importance of our work.*

The authors' explanation regarding the attribution of trade-offs to human management, supported by the inter-catchment comparison within the same region, is reasonable. However, I have one remaining question about the unique value of isotopes vs. ET data that I believe would significantly strengthen the discussion if addressed.

I appreciate the authors' response regarding the comparison between using ET data and isotopes, and the inclusion of ET products for validation. However, upon reading the response, I feel that my original comment regarding this comparison might not have been phrased clearly enough, as the authors' reply emphasizes that isotopes also constrain ET. I would like to clarify my intended point to help fully articulate the unique contribution of the isotopic dataset in this specific study.

While I understand that isotopes can indeed help constrain ET partitioning (as noted in the reply), I am wondering about the fundamental difference in the type of information provided by these two data sources. My assumption is that using Discharge + ET data (even acknowledging the advantage of high temporal resolution provided by remote sensing) for calibration would primarily constrain the flux magnitudes (i.e., the volume of water leaving as evaporation vs. streamflow), ensuring a closed water balance.

My question to the authors is: Could the authors clarify if isotopes provide unique information that ET data cannot offer?

Reply: *Thank you for the comments and clarification. In addition to ET partitioning, isotopes are capable of helping identify the water sources contributing to ET (from e.g., channel water, canopy interception, shallow or deep subsurface), which has been shown by many other studies. This source-level information represents a key advantage of isotopic data that cannot be provided by ET observations alone. We extended our discussion accordingly (line 590-602).*

I note that in the Discussion, the authors rightly state that "Subsurface processes in the deeper layer (e.g., discharge from groundwater...) are inherently challenging to constrain using near-surface observations (e.g., ET, soil moisture)". This aligns with my concern that ET data (as a near-surface flux magnitude) might not provide sufficient constraints on transport mechanisms (such as residence times/velocities) and source tracking (e.g., distinguishing between recent precipitation, soil water, and groundwater).

I suspect that isotopes might possess a unique capability here to constrain the age and origin of water, and thus shed light on these deeper subsurface processes which are otherwise challenging to constrain.

• Could the authors expand on this distinction in the Discussion?

• Is there a specific result in the current study (for example, the groundwater contribution patterns shown in Figure 6) that likely could not have been correctly identified if the model were calibrated only with Discharge + ET data?

If this distinction is valid, explicitly discussing it (perhaps with a concrete example from the results) would significantly strengthen the argument for using isotopes in such manageable catchments, highlighting that they prevent the model from getting the "right fluxes" (which ET data could also

ensure) for the "wrong reasons" (internal mixing processes). Conversely, if the authors find that this distinction is not clearly evident in their results, discussing the potential reasons or limitations would also be valuable.

Reply: *Thank you for the comments. We extended our discussion to highlight the unique contribution of isotopes in resolving ET water sources. The contrasting water balance components between isotope-aided calibrations and discharge-only based calibrations revealed in the present study provide supporting evidence for this argument. The explicit discussion was shown in line 590-602.*