

Reply to Referee #2

Dear Referee,

We sincerely appreciate your time and thoughtful review of our manuscript. Your insightful comments and careful revision have improved the quality of our work and helped us present our results accurately. Below, we provide a point-by-point response (in blue) to your main comments (in black) and outline how we address each suggestion in the revised manuscript.

Sincerely,

Nariman Mahmoodi, Ulrich Struck, Michael Schneider, and Christoph Merz

1. The authors combine a hydrological modeling approach and an isotopic modeling approach to understanding lake water balance issues within a lake in Germany that has been declining in lake water levels. While I think the approach is interesting and has potential, I have serious concerns about the isotopic modeling as presented. While the isotopic theory they present is mostly correct, and they are using the Hydrocalculator developed by Skrzypek et al 2015, the parameters they present in Table 2 as input to the Hydrocalculator are so far out of line, I'm surprised they actually got any numbers out that make any sense at all. I fear they may have calculated some critical values using ‰ values, when they should have been using absolute values (not multiplied by 1000). The literature can be confusing on this point, but using the wrong value would lead to the negative and completely out of bounds values they give for kinetic fractionation and other values. I give detailed comments on the pdf directly, but these errors on input for the hydrocalculator might explain why the authors had to "adjust" their isotopic estimates of evaporation before coming to something that might be reasonable. I am also unclear on many steps that they take in their methods. Until they revisit these data, I can't really evaluate the rest of the manuscript. The isotope data themselves look OK, and I am hoping they can redo the analysis without too much problem, once they find the error that led to those values in table 2.

We appreciate the reviewer's careful assessment of our work and the constructive feedback regarding the isotopic modeling approach. We acknowledge the concerns raised about the parameters presented in Table 2 and the potential errors in the input values used in the Hydrocalculator.

Upon reviewing our submission, we discovered that an incorrect version of Table 2 was inadvertently included in the manuscript during the final stage of preparation before submission. This mistake resulted from inadvertently carrying over the table from an earlier draft that contained outdated parameter

values. We deeply regret this oversight and understand that it significantly impacted the reviewer's ability to evaluate our isotopic modeling approach.

To address this issue, we replaced Table 2 with the correct version (presented below as Table 2) and an additional table (presented below as Table 1) containing the input values. We have also carefully rechecked our calculations to ensure that all output parameters, including fractionation factors, were applied correctly following the guidelines in Skrzypek et al. (2015). Additionally, we have revised the Methods section to clarify our step-by-step approach in the isotopic modeling, ensuring transparency and reproducibility.

The reviewer's comments have been invaluable in helping us identify and rectify this error. We hope that with these corrections, our analysis is now clear, and we look forward to any further suggestions.

In addition, to clarify the integration of the isotope analyses and hydrological models, we provide a more detailed explanation here:

To validate the accuracy of our hydrological model, we tested how well it could estimate lake evaporation. We compared its results with evaporation values derived from isotope analysis (HydroCalculator), an independent method. If both approaches produced similar results, it confirmed that the model accurately simulates water fluxes, including lake inflow and evaporation.

Since isotope data was unavailable for earlier years (2015–2021), but significant changes in lake levels were observed during this period, we extended our analysis to estimate evaporation for these years. However, the evaporation-to-inflow (E/I) ratio from recent years (2022–2023) could not be directly applied to earlier years due to variations in temperature and inflow, which influence isotopic signatures through dilution and enrichment.

To account for these variations, we incorporated annual temperature and inflow differences into our model. Specifically, we calculated temperature and inflow ratios by comparing each year (Y_x) to the reference period (2022–2023). These ratios were then used to adjust the E/I values for earlier years. For example, if a given year was warmer than 2023, it would have experienced higher evaporation and isotopic enrichment, requiring an increased E/I ratio. Similarly, if inflow was lower in a particular year, evaporation effects would be more pronounced, further influencing the E/I adjustment.

The adjusted E/I ratios were then applied to refine evaporation estimates for 2015–2021, which were subsequently compared to the evaporation rates simulated by the hydrological model. The strong agreement between these estimates enhances confidence in the model's ability to accurately simulate key water balance components over extended periods.

This approach allows us to reconstruct evaporation dynamics in years without direct isotope measurements, improving our understanding of historical lake and groundwater variations.

Table 1. Input Data for the Hydrocalculator Model

	$\delta^2\text{H}$	$\delta^{18}\text{O}$	Climate data
Pool start (lake winter sample)	-16.160	0.090	
Pool final (lake summer sample)	-10.660	1.370	
Precipitation	-65.715	-11.790	
Mean temperature ($^{\circ}\text{C}$)			20
Relative humidity (%)			60

Table 2. Variables used for the calculation of evaporative losses

Parameters	Description	δD	$\delta^{18}\text{O}$
ϵ_k	Kinetic isotope fractionation factor [‰] (h dependent)	5	5.68
ϵ^*	Equilibrium isotope fractionation factor [‰] (T dependent)	84.355	9.778
ϵ	Total isotope fractionation [‰]	82.793	15.363
Ck	Kinetic isotope fractionation constant [‰]	12.5	14.2
α^*	Equilibrium isotope fractionation factor [‰] (T dependent)	1.0844	1.0098
δ^*	Limiting isotope composition	-0.4727	4.358
m	Enrichment slope	1.277	1.441
δ_A	Ambient air moisture	-138	-21
E/I_{Y2022}	Evaporation over inflow ratio [%] of Groß Glienicke Lake in 2022	43.37	29.63
E/I_{Y2023}	Evaporation over inflow ratio [%] of Groß Glienicke Lake in 2023	42.28	29.07

How were the water samples collected? Was the water within the well pumped purged before sampling?

The following procedure was followed for water sampling:

Before sampling, the total water depth was measured to calculate the volume of stagnant water inside the piezometer. At least three well volumes of water were then pumped. Pumping continued until field parameters (temperature, electrical conductivity, and pH) stabilized, ensuring that the sample was representative of the aquifer rather than stagnant casing water. After sampling, the collected water was stored in a cooling box and transferred to the cooling room and laboratory. This procedure will be added to the manuscript.

2. Likely VSMOW, VSLAP and GISP were not analyzed in the same set as your samples. What standards, and how many were analyzed with your set, and did you have an independent standard (not used in the calibration regression) to calculate accuracy? Did you take field duplicates to calculate precision?

Laboratory analyses were performed by using VSMOW Gisp and VSLAP at the start of each sample run. For example, on a daily basis, we used the sample vials of the three standards to confirm the calibration which is performed once

a while (about every half a year) on fresh samples of the three calibration standards. Over the past 15 years, the internal calibration of the Picarro instrument has not changed significantly.

- Usually, the first couple of injections are deleted, unless all samples are very close in range as the injections have significant carryover from the previous sample. Was this evaluated?

No, the carry-over effect of the system is highly dependent on the isotopic difference between samples. In the case of a $\delta^{18}\text{O}$ difference of 1 ‰, no significant carry-over effect is observed. For differences greater than 5 ‰ in $\delta^{18}\text{O}$, the carry-over effect influences only the first two injections by approximately 0.5 ‰, depending on the isotope composition of the prior sample. The remaining four injections stay unaffected and show no trend.

What was an acceptable sigma between injections? If you actually did run VSMOW and GISP, this carryover effect can be huge.

Exactly, find here an uncorrected actual set of Standard Samples including six injections as a startup in a sample sequence. Since “Gisp” is sold out we got our own standard sample “TapwaterSTD”.

Table 2. Raw data for the first three standard samples, each measured six times in replicate (output of Picarro instrument). The “ignore” and “good” columns are generated as a helpful guide to indicate which injections are considered good or bad (to be ignored).

Line	Analysis	Raw $\delta^{18}\text{O}$ Measurements	$\delta^2\text{H}$ Mean	H_2O Mean	Ignore	Good
Slap	P-5274	-48,766	-350,391	16882	-1	0
Slap	P-5274	-53,131	-406,01	17327	-1	1
Slap	P-5274	-54,1	-420,473	17446	-1	1
Slap	P-5274	-54,805	-427,223	17542	0	1
Slap	P-5274	-54,775	-429,082	17608	0	1
Slap	P-5274	-54,657	-430,547	17722	0	1
TapwaterSTD	P-5275	-14,19	-136,45	17768	-1	1
TapwaterSTD	P-5275	-9,492	-84,021	17990	-1	1
TapwaterSTD	P-5275	-7,994	-68,112	17978	-1	1
TapwaterSTD	P-5275	-7,872	-63,604	17873	0	1
TapwaterSTD	P-5275	-7,871	-59,801	18042	0	1
TapwaterSTD	P-5275	-7,816	-60,205	17907	0	1
SMOW	P-5276	-0,847	-16,212	17949	-1	1
SMOW	P-5276	-0,564	-9,799	17958	-1	1
SMOW	P-5276	0,036	-5,905	17888	-1	1
SMOW	P-5276	0,182	-4,353	18000	0	1
SMOW	P-5276	-0,317	-5,749	17923	0	1
SMOW	P-5276	0,102	-5,666	17944	0	1

4. Minor comments on the manuscript:

To ensure clarity, all minor comments on typos and rephrasing will be addressed in the revised manuscript.