We would like to express our sincere gratitude to the reviewer for your positive feedback and valuable suggestions. In light of these recommendations, we have carefully revised the manuscript point by point and addressed other areas requiring improvement. The specific revisions are outlined below.

1. L26–L30 (Abstract) / L546–L549 (Conclusion): The text states “the opposite was true during the dry season”, but the numbers in parentheses still indicate water age for deep-rooted trees > shallow-rooted trees (e.g., 139.6 d vs 128.5 d), i.e., not a reversal. Please verify and make the statement consistent throughout the manuscript: if the intended meaning is that deep-rooted trees still have older water age in the dry season, revise/remove “opposite”; if a reversal is truly intended, the numbers, statistical tests, and discussion logic must be updated accordingly.

Reply: We would like to express our sincere gratitude to the reviewers for their thorough review and valuable suggestions. Due to an oversight on our part, there is no seasonal reversal in the transpiration water age of plants with different root depths in the manuscript. We have also removed the word ‘opposite’; we sincerely apologise for any confusion this may have caused.

2. L228–L229 (Section 2.3) / L L248 (Section 2.4): The reported analytical precision for δ18O and the “error threshold” used for setting β to zero are inconsistent, which may affect β classification. Section 2.3 reports δ18O precision of ±1‰, while Section 2.4 uses “δ18O error ±0.3‰” as the β=0 threshold. Please check whether these values are misreported or swapped (e.g., δ2H vs δ18O).

Reply: Thank you for your feedback. The error was caused by a lack of thorough checking, and we have now corrected it.

Namely: the formula, δ (‰) represents the ratios of $^{2}H/^{1}H$ and $^{18}O/^{16}O$, and R is the ratio of the sample to the standard seawater, respectively. The analytical precisions of the instrument are ±0.1‰ for $\delta^{2}H$ and ±0.2‰ for $\delta^{18}O$.

It is worth noting that when the soil water content θ is considerably high and shows little variation between two sampling events, and the difference between $\delta_{x,i}$ and $\delta_{x,i-1}$ is minimal over a short period (less than the analytical error of $\delta^{18}O$, ±0.2‰), β is defined as 0.

3. L232–L265 (Section 2.4, Eq. 2–4) / L398–L403 (Discussion) / L556–L562 (Appendix A, Fig. A1): MixSIAR and the PIB (β) framework do not report the same type of "ratio". β is closer to the fraction by which recent precipitation updates the plant-available storage in the root zone, whereas MixSIAR outputs the proportional contributions of different water pools to plant uptake; these are not equivalent. Please clarify β's physical meaning, end-member choices, units/truncation rules, and explain why "precipitation-dominated updating (recharge)" and "fissure-water-dominated uptake (source)" can both hold in karst systems. Also provide minimal MixSIAR methodological details (source grouping and temporal aggregation, priors, MCMC settings, convergence diagnostics, and credible intervals), and state whether the MixSIAR input time window is consistent with the β water-age segmentation used in the PIB framework.

Reply: Thank you for your suggestion. We will address this in the following ways:

The meaning of β: β (root-zone water replenishment ratio) represents the proportion of recent precipitation that replenishes the plant-available water storage in the root zone between two consecutive sampling events. It reflects the dynamics of hydrological connectivity between the root-zone storage system and atmospheric precipitation (Luo et al., 2019; 2022). When $\beta > 0$, it indicates that precipitation has effectively entered the root-zone storage system and been taken up by plants; when $\beta = 0$, it indicates that precipitation has failed to replenish root-zone storage (or the replenishment is negligible). β is a process-based indicator, with its magnitude indicating the rate at which root-zone water is replaced by "new water."

Meaning of the formula: $\delta_{x,i}$ and $\delta_{x,i-1}$ represent the $\delta^{18}O$ values of plant stem water at two consecutive sampling times, respectively, while $\delta\sum_{\rho}$ represents the precipitation-weighted $\delta^{18}O$ value of rainfall during the interval between the two sampling events (a single rainfall event may consist of several smaller events, requiring weighted averaging based on rainfall amounts to calculate the $\delta^{18}O/\delta^{2}H$ value for each event). Under the following conditions, β is defined as 0: when $\delta_{x,i} < \delta_{x,i-1}$ and $\delta\sum_{p} > \delta_{x,i-1}$; or when $\delta_{x,i} > \delta_{x,i-1}$ and $\delta\sum_{p} < \delta_{x,i-1}$. It is worth noting that when the soil water content θ is considerably high and shows little variation between two sampling events, and the difference between $\delta_{x,i}$ and $\delta_{x,i-1}$ is minimal over a short period (less than the analytical error of $\delta^{18}O$, ±0.2‰), β is also defined as 0. We have already described the meaning of this formula and the selection of end-members in detail in the methodology.

The physical meaning of MixSIAR: MixSIAR (Stock et al., 2018) outputs the proportional contributions of various potential water sources (end-members) to plant transpiration. It is a source apportionment metric that answers the question "where does the water actually taken up by plants come from?" Unlike β, MixSIAR does not directly address temporal dynamics but is based on a steady-state assumption, considering the isotopic signal of plant xylem water as a mixture of the isotopic signals from different water sources. However, we believe that the two can be integrated for the following reasons: β represents the replenishment of plant-available root-zone water storage by recent precipitation, derived directly from the relationship between plant xylem water and precipitation, while the source apportionment in the Bayesian model also uses plant xylem water. When the Bayesian model quantifies rock fissure water as the main water source for plants, it indicates that the plant root zone is primarily distributed within rock fissures. The input time for our MixSIAR is consistent with the β used in the PIB framework.

To validate the applicability of the PIB method at the temporal scale of this study, we previously conducted a deuterated water (D_2O) tracer experiment in the study area. The results showed that approximately one week after irrigating with deuterated water, the xylem water isotopes of the target plants exhibited a significant enrichment signal, indicating that plant roots respond relatively quickly to water replenishment, and the impact of precipitation events can be reflected in the isotopic composition of xylem water within a weekly scale. The sampling interval in this study was more than two weeks, fully covering the response window of plants to precipitation events; therefore, the current sampling frequency can effectively capture the dynamics of root-zone water replenishment without missing critical replenishment signals.

After precipitation events, the isotopic signal of plant xylem water gradually approached the mixed characteristics of fissure-filled soil water and rock fissure water (Liu et al., 2025). This transition process reveals that although precipitation is the initial driver of root-zone water renewal, plants continuously utilize water stored in fissures between precipitation events. In karst regions, due to shallow soils with poor water retention capacity, we do not deny the role of shallow soil; we will discuss the role and influence of soil in the discussion section. Therefore, it is this hydrological pathway—precipitation recharging fissures and fissures sustaining transpiration—that enables plant transpiration water age to reflect the mean residence time of root-zone water storage. In other words, the transpiration water age estimated under the current PIB framework represents more of an integrated temporal response of fissure water storage.

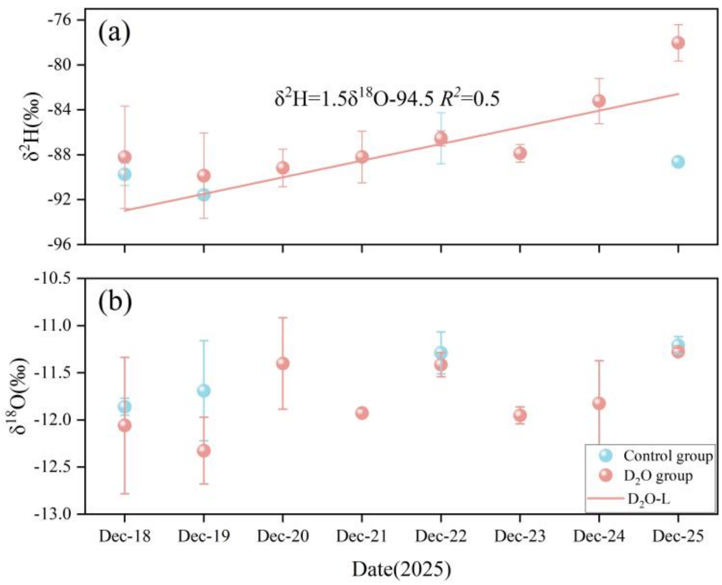

Figure S1. Xylem sampling over a consecutive week following the tracer experiment, along with the isotopic characteristics of the xylem.

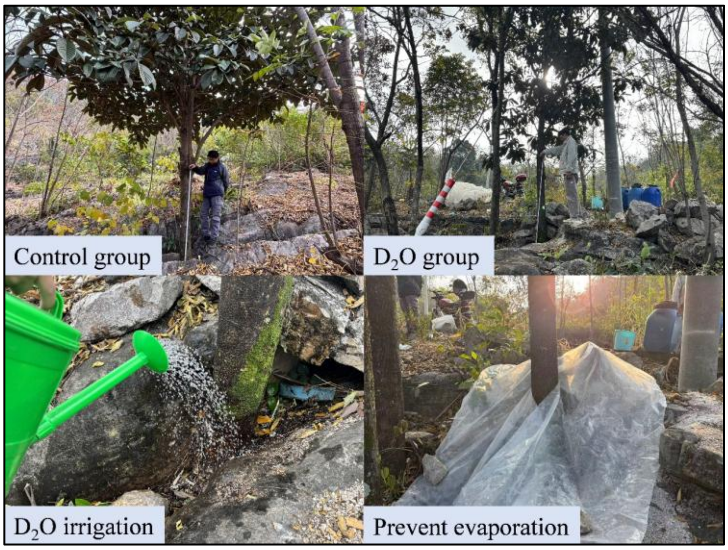

Figure S2. Procedure of the tracer experiment. To track the dynamics of plant water uptake from fissure water, two plants with similar growth status were selected in a fissure habitat. One plant was irrigated with deuterated water (D_2O) as the treatment group, while the other was not irrigated and served as the control. Prior to irrigation, the soil surface around the root zone of the treated plant was covered with polyethylene film to prevent D_2O evaporation and potential dilution by subsequent precipitation (no precipitation occurred during the sampling period). After irrigation, xylem samples were simultaneously collected from both plants at predetermined time intervals for isotopic analysis. Leaf stomatal conductance was measured using a portable leaf porometer (AP4, UK) to monitor plant physiological responses to water availability.

Reference: Liu, X., Chen, X., Zhang, Z., Liu, W., Gao, F., Cheng, Q., Peng, T.: The role of rock fractures as a water source for trees growing in karst, Water Resour. Res, 61(11), e2024WR039588, 2025.

4. L279–L286: Incorrect figure citations make it difficult for readers to trace the results. Section 3.1 cites relative humidity and soil moisture as Fig. 2b/2c, but Fig. 4(b) corresponds to ET and relative humidity, and Fig. 4(c) corresponds to soil moisture. Please check and correct the panel citations in Fig. 2 vs Fig. 4.

Reply: Thank you for pointing this out; it was an oversight on our part, and we have now made the necessary changes.

Namely: Relative humidity decreased with increasing air temperature, averaging 75.9% in the rainy season and 71.5% in the dry season (Fig. 4b). Regional evapotranspiration was significantly higher in the rainy season (monthly mean of 130.0 mm) than in the dry season (monthly mean of 28.6 mm). Soil moisture varied with depth and season (Fig. 4c), with the mean soil water content in the rainy season (29.6%) being higher than that in the dry season (24.7%).

5. L323–L324 (Section 3.3): The text mentions "walnut, willow and loquat", but "willow" is not among the study species, suggesting a typo.

Reply: Thank you very much for pointing this out. This was due to a lack of thorough proofreading on our part, and we sincerely apologise for any inconvenience this may have caused you.

Namely: Based on the piecewise isotope balance method, this study revealed the dynamics of root-zone water replenishment rate (β) for plants with different rooting depths under the influence of cumulative precipitation (Fig. 6). Throughout the observation period, the root-zone water replenishment rate fluctuated with precipitation variability. During the rainy season (May to October), characterized by abundant precipitation, plant root-zone replenishment rates were generally high, reaching 100% on multiple occasions (e.g., September 16, 2024; September 21, 2025). However, even in the rainy season, replenishment rates could sharply drop to 0% following intense precipitation events (e.g., October 23, 2024; October 13, 2025), primarily due to short-duration heavy rainfall exceeding soil infiltration capacity, with water rapidly bypassing the root zone along preferential flow paths and failing to be effectively utilized by plants. In the dry season (November to April), precipitation decreased sharply, and plant root-zone replenishment rates remained generally low, ranging mostly between 0% and 30%. Notably, at the end of the dry season (e.g., April 1, 2025), some plants exhibited replenishment rates of 0%. From the perspective of rooting depth differentiation, deep-rooted plants (*Ailanthus altissima*, *Juglans regia*) and shallow-rooted plants (*Zanthoxylum bungeanum*, *Eriobotrya japonica*) showed obvious seasonal differentiation patterns in replenishment rates. During the rainy season, the replenishment rate of shallow-rooted plants (38.8%) was generally higher than that of deep-rooted plants (35.4%); conversely, in the dry season, the root-zone replenishment rate of deep-rooted plants (27%) was higher than that of shallow-rooted plants (16.5%). Additionally, multiple periods during the observation interval showed replenishment rates of 0% for all plants (e.g., October 23, 2024; October 13, 2025), which corresponded to either intense precipitation events or high evapotranspiration periods in the dry season. Meanwhile, no instances of extremely high soil water content were observed where xylem isotope values showed insignificant changes between two sampling periods. In summary, the root-zone water replenishment rate exhibited significant seasonal fluctuations, closely related to precipitation patterns, with deep-rooted and shallow-rooted plants demonstrating differentiated response patterns.

6. L427–L439 (Fig. 9 caption): The caption mixes terminology such as "electrical conductivity profiles" and "low resistivity anomaly", and directly interprets colors as "higher/lower water content" or "reservoirs". Please unify the terminology (choose either resistivity or conductivity), add units and a color bar, and provide the basis and uncertainty for inferring water content "reservoirs" from electrical properties (or explicitly state that the figure is only a qualitative/relative indicator rather than quantitative water content).

Reply: Thank you very much for this professional and detailed comment. We fully agree that the presentation of Electrical Resistivity Tomography (ERT) data must maintain unified terminology, specify units, and provide a clear explanation of the boundaries between electrical properties and hydrological implications—whether it is quantitative inversion or qualitative indication—must be clearly communicated to readers in the figure caption. Meanwhile, for greater clarity, we have re-quantified and redrawn the figure.

Namely:

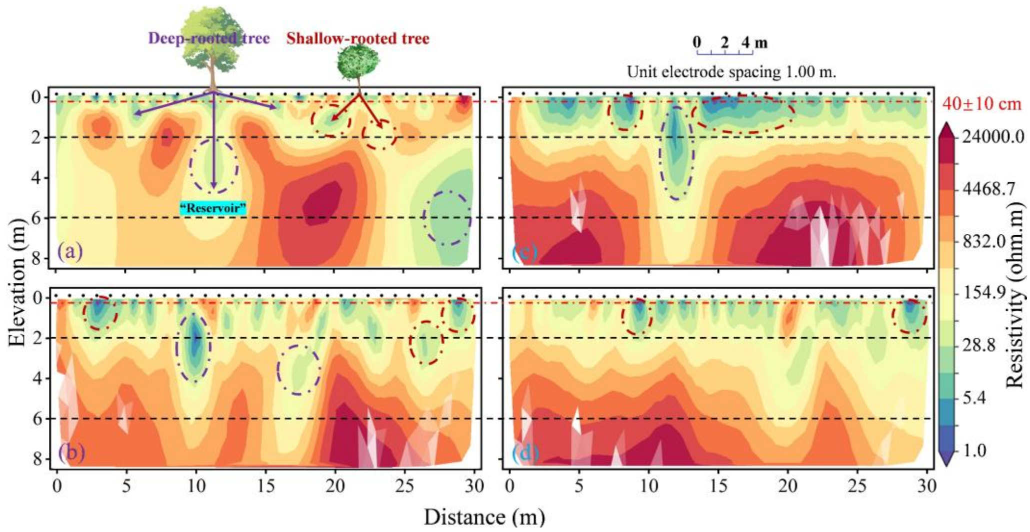

Figure 9. Subsurface resistivity profiles obtained from Electrical Resistivity Tomography (ERT) inversion within plant root zones. ERT surveys were conducted in two plots, yielding four profiles. Each profile consisted of 32 electrodes with a spacing of 1 m, achieving an exploration depth of approximately 8 m (black dashed lines indicate different subsurface depth intervals). Panels (a) and (b) show resistivity inversion results from one plot, while panels (c) and (d) correspond to the other plot. Note: Colors represent resistivity values (unit: Ω·m) on a logarithmic scale, ranging from low resistivity (dark blue) to high resistivity (red). The red dashed line indicates the average soil depth in the study area (approximately 40 cm), and the black dashed lines serve as reference lines for exploration depth. The purple elliptical dashed lines delineate low-resistivity anomalies beneath deep-rooted plants (inferred as deep water storage zones), while the dark red elliptical dashed lines indicate water storage zones beneath shallow-rooted plants.

7. L524 (Section 4.3): Citation format needs standardization. "Roberts and Hanan et al., 2025" (L523) should be revised to "Roberts and Hanan, 2025" (or "Roberts et al., 2025", depending on the actual author list).

Reply: Thank you for bringing this to our attention; we have now made the necessary changes. We will also be reviewing the entire text to ensure that such formatting errors do not occur again. Namely: Roberts and Hanan, 2025.