Response to the Editor and Reviewers

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Title: Uneven Decline in the Hydrological Efficiency of China's Natural and Plantation Forests

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Cover letter

Dear Editor and Reviewers,

We sincerely thank the editor and the anonymous reviewers for their constructive comments and helpful suggestions on our manuscript. We have carefully revised the manuscript accordingly. The main revisions are summarized below:

- We added a new main-text decomposition analysis of the temporal change in total LAI–TF sensitivity (θtotal), explicitly separating the position/saturation effect from the shape/climate-related effect.
- We clarified the mechanistic interpretation of the decomposition by distinguishing movement along a fixed TF–LAI response curve from changes in the fitted response-curve shape itself.
- We replaced the former error-bar summaries of βSM and βVPD in Fig. 7g and Fig. 7i with boxplots showing the median, interquartile range, whiskers, and outliers. Because a new main-text figure was inserted, the revised panels are now Fig. 8g and Fig. 8i.
- We merged the former Sect. 2.2.1 into Sect. 2.2 so that the aridity-zone framework is introduced as part of the study-region description, and we corrected the formatting of the aridity-index equation.

Below, we provide a point-by-point response. Reviewer comments are shown in italics, followed by our responses and the corresponding revisions.

Sincerely,

Xiao Zhang, Xinxiao Yu, and Guodong Jia

Summary of revisions

Reviewer issue	Revision made	Where implemented
Partition θ trends into saturation and climate/shape components	Added a main-text decomposition of θ_{total} into position/saturation and shape/climate-related effects; promoted the counterfactual decomposition from the Supplement to the main Results.	Methods Sect. 2.3.2; Results Sect. 3.1; new main-text Fig. 4.
Clarify coordinate shift versus curve-shape change	Added explicit definitions and equations for $\Delta\theta_{position}$ and $\Delta\theta_{shape}$, separating LAI movement along a fixed TF–LAI curve from changes in the curve itself.	Methods Sect. 2.3.2; Results Sect. 3.1; Discussion Sects. 4.1–4.2.
Show β_{SM} and β_{VPD} distributions more clearly	Replaced error-bar summaries with boxplots showing medians, interquartile ranges, whiskers, and outliers.	Former Fig. 7g,i; revised Fig. 8g,i and caption; Results Sect. 3.2.3.
Move aridity-zone description	Merged former Sect. 2.2.1 into Sect. 2.2 and corrected the aridity-index equation formatting.	Methods Sect. 2.2.

Response to Anonymous Referee #1

Comment 1

Reviewer comment: *Although the partitioning method effectively distinguishes climate-driven effects from the saturation effect of TF, these specific components are not clearly presented in the Results section. Showing only the total θ trend may obscure the specific insights that the method is intended to reveal. I suggest that the authors include the partitioned trends of saturation and climate in the main analysis to provide a more robust and comprehensive interpretation, especially because θ trends associated with position (saturation effects) and shape (climate effects) differ substantially in natural forests.*

Response: We thank the reviewer for this important suggestion. We agree that presenting only θ_{total} in the main Results may obscure the mechanistic information provided by the decomposition framework. In the revised manuscript, we therefore added a new main-text decomposition analysis that separates the temporal change in θ_{total} into a position/saturation component and a shape/climate-related component. The position/saturation component represents changes caused by LAI moving along a fixed bounded TF–LAI response curve, whereas the shape/climate-related component represents temporal changes in the fitted TF–LAI relationship itself. This revision makes clear that the overall decline in θtotal is not a single-process signal. In particular, for natural forests, the negative position/saturation effect is partly offset by a contrasting shape-related change, demonstrating why the two components need to be interpreted separately. We have therefore moved the key counterfactual decomposition into the main Results and revised the text to discuss the mechanistic implications of the two components.

Revision made: We added a new paragraph in Sect. 3.1 after the original Fig. 3 description, inserted a new main-text decomposition figure (new Fig. 4), and revised the Discussion to explicitly interpret the saturation- and shape-related components.

Comment 2

Reviewer comment: *Although the authors partition the climate-driven component of the total trend, the mechanistic interpretation of these effects remains incomplete. To strengthen the attribution analysis, I suggest*

that the authors explicitly distinguish climate effects that manifest as coordinate shifts along the static response curve (position effects) from those that fundamentally alter biophysical sensitivity (shape effects).

Response: We appreciate this helpful clarification. We revised the terminology and equations to explicitly distinguish the two mechanisms. In the fixed-curve counterfactual analysis, the first-window regression coefficients are held constant while LAI is allowed to vary; this isolates the coordinate-shift, or position/saturation, effect. The residual between the observed θ trajectory and the fixed-curve prediction is then interpreted as the shape effect, which reflects changes in the fitted TF–LAI curve and therefore changes in the apparent biophysical sensitivity of TF to LAI under evolving hydroclimatic conditions. We also revised the wording to avoid implying that all fixed-LAI changes are caused exclusively by climate. Instead, we describe them as shape/climate-related changes and interpret them together with the hydroclimatic analyses.

Revision made: We expanded Sect. 2.3.2 with a counterfactual decomposition, added the relation $\Delta\theta_{total} = \Delta\theta_{position} + \Delta\theta_{shape}$, and revised the Results and Discussion to use the position/shape terminology consistently.

Comment 3

Reviewer comment: *Regarding Fig. 7g and 7i, I recommend replacing the current error bars with boxplots to better represent the distributions of β_{SM} and β_{VPD}. Given the large spatial heterogeneity among the study regions, and because the current error bars often lie above the zero line, boxplots would provide much-needed clarity on the median, interquartile range, and potential outliers of these sensitivities.*

Response: Thank you for this practical suggestion. We agree that boxplots provide a clearer representation of the pixel-level distributions of β_{SM} and β_{VPD} than mean ± error-bar summaries, especially given the strong spatial heterogeneity among climatic zones. We therefore replaced the former error-bar summaries in Fig. 7g and Fig. 7i with boxplots. Because a new main-text figure was inserted before this figure, the revised panels are now Fig. 8g and Fig. 8i. These panels show the median, interquartile range, whiskers, and outliers for β_{SM} and β_{VPD} in each climatic zone and forest type, with the zero line retained as a visual reference. The figure caption and Results text have been revised accordingly.

Revision made: The former Fig. 7g and Fig. 7i were redrawn as boxplots and renumbered as Fig. 8g and Fig. 8i. The revised caption now defines the boxplot elements, and Sect. 3.2.3 now refers to distributional patterns rather than only zonal means.

Comment 4

Reviewer comment: *Integrating the discussion of aridity zones in Sect. 2.2.1 into Sect. 2.2 would be more coherent, as it naturally forms part of the study-region description.*

Response: We agree. We merged the former Sect. 2.2.1 into Sect. 2.2 so that the climatic-zone classification is introduced together with the study-region description. This structural change improves the flow of the Methods section and avoids separating the geographic study area from the aridity-zone framework used to define the subsequent analyses. We also corrected the formatting of the aridity-index equation in this paragraph.

Revision made: The heading "2.2.1. Aridity index and analytical framework" was removed, and the aridity-index paragraph was incorporated into Sect. 2.2. The aridity index is now written as AI = PET / P, and subsequent section numbering was updated accordingly.

Response to Anonymous Referee #2

Reviewer comment: *No specific revision comments were provided in the report available to us.*

Response: We thank the reviewer for evaluating our manuscript. As no specific textual or analytical comments were provided, no direct revision was required in response to this report. Nevertheless, the revisions made in response to Referee #1 improved the clarity of the manuscript, especially regarding the decomposition of θ trends, the distinction between position/saturation and shape/climate-related effects, and the presentation of ridge-regression coefficients.