

Response to Reviewer and Associate Editor Comments

Manuscript ID: egosphere-2026-241

Title: Saturation effect of background temperature and aridity on vegetation phenological sensitivity to urban warming

Dear Dr. Vicca,

We sincerely thank you for forwarding the reviewer's comments and for your careful editorial handling. We also appreciate the anonymous reviewer for the constructive suggestions. We apologize that our previous response document failed to fully address the reviewer's detailed suggestions. In this revised response, we provide a point-by-point reply to each of the reviewer's comments. We have thoroughly revised the whole manuscript and prepared this point-by-point response to resolve all concerns raised by both the reviewer and yourself. All revisions are tracked in the submitted revised manuscript, with exact page and line numbers provided for each modification.

1. **Q:** Line 50: This statement appears to be a general conclusion about urban warming effects on vegetation phenology. Please provide appropriate references to support this statement.

R: We appreciate this valuable comment. Following the reviewer's suggestion, we have provided appropriate references to support the general conclusion regarding urban warming effects on vegetation phenology. Specifically, we added Li et al. (2017) and Zhou et al. (2016) to support the statement that urban warming advances SOS and delays EOS. Additionally, we supplemented Buyantuyev and Wu (2012) and Crawford et al. (2025) to reinforce the argument that these phenological responses must be evaluated through a dual lens of heat and water availability.

Location of changes: Section 1 Introduction, Page 2, Lines 41 - 45.

2. **Q:** Formula formatting problems: Several equations are displayed incorrectly in the manuscript. For example, Equation (1) appears as garbled characters in both the ATC and revised versions, and Equation (3) is also not displayed properly in the revised manuscript draft. Please carefully check the equation formatting, symbols, and compatibility of mathematical expressions in the final version.

R: We appreciate this comment. We have thoroughly revised the formatting of all equations in the manuscript. To avoid display-compatibility issues during journal processing, all equations together with their corresponding numbers have been reorganised within three-column borderless tables, which ensures all mathematical expressions render correctly without garbled characters.

Location of changes: Section 2.3 Pre-season temperature and background climates, Page 9, Lines 221 - 222; section 2.4 Urbanization effect on phenology, Page 11, Lines 262 - 263.

3. **Q:** The section “Phenology response to aridity” remains relatively difficult to follow. The authors discuss AI together with multiple response metrics (e.g., R_{t-SOS} ,

R_{t-EOS} , ΔSOS , and ΔEOS), which makes the logical relationship among these variables unclear. Please consider restructuring this section to clearly distinguish (1) the effect of aridity on phenological temperature sensitivity and (2) the effect of aridity on urban-rural phenological differences.

R: We appreciate this constructive comment. To clarify the logical relationship among different response variables, we have re-organised the paragraph structure within Section 3.4. Results are separated into distinct paragraphs: the first two paragraphs describe the effects of aridity on phenological temperature sensitivity (R_{t-SOS} , R_{t-EOS}), while the subsequent paragraph focuses on aridity impacts on urban-rural phenological differences (ΔSOS , ΔEOS). Brief interpretive sentences have been added to explicitly explain the ecological meaning of key relationships.

Location of changes: Section 3.4 Phenological responses to aridity, Page 20, Lines 459 - 496.

4. **Q:** In addition, the derivation of critical AI thresholds (e.g., $AI = 1.7$ and $AI = 2.0$) is unclear. Please clarify whether these thresholds were identified through statistical breakpoint analysis, model fitting, or empirical classification.

R: We thank the reviewer for this helpful comment. We apologize for the lack of clarity. The AI thresholds were identified through model fitting rather than segmented breakpoint analysis: for each response variable, we fitted a linear regression against the aridity index (AI), and the threshold was determined as the zero-crossing of the fitted regression line (i.e., the AI value at which the response variable equals zero). Specifically, $AI = 1.7$ corresponds to the zero-crossing of R_{t-SOS} (Fig. 8a), $AI = 1.4$ to that of R_{t-EOS} (Fig. 8c), and $AI = 2.0$ to that of ΔEOS (Fig. 8d). The zero value serves as the ecologically meaningful boundary: it is the point at which the response variable changes sign (for R_{t-SOS} and R_{t-EOS} , the sign determines whether warming advances or delays phenology; for ΔEOS , it determines whether urban EOS is earlier or later than rural EOS). Thus, the zero-crossings separate contrasting response regimes rather than representing arbitrary cutoffs.

Location of changes: Section 3.4 Phenological responses to aridity, Page 20, Lines 459 - 463.

5. **Q:** The manuscript contains multiple threshold values derived from different analyses (e.g., temperature thresholds, LST thresholds, and AI thresholds). Although the authors have clarified their meanings to some extent, it would be helpful to provide a concise summary table or clearer descriptions indicating the corresponding response variable and analytical method used to derive each threshold.

R: We thank the reviewer for this constructive suggestion. To keep the manuscript concise, we have chosen the alternative of providing clearer descriptions in the text rather than adding a separate summary table. Each threshold is now explicitly linked to its corresponding response variable and the analytical method used to derive it: the LST thresholds are described separately for phenological date stabilization ($LST = 12\text{ }^{\circ}\text{C}$ for SOS and $18.5\text{ }^{\circ}\text{C}$ for EOS), urban-rural disparity reversal ($LST = 18\text{ }^{\circ}\text{C}$ for ΔSOS and $18.5\text{ }^{\circ}\text{C}$ for ΔEOS), and phenological sensitivity

saturation ($LST = 12.5\text{ }^{\circ}\text{C}$ for SOS and $4\text{ }^{\circ}\text{C}$ for EOS) in Section 3.3; the AI thresholds ($AI = 1.7, 1.4,$ and 2.0) are described as the zero-crossings of the linear regressions of $Rt\text{-}SOS$, $Rt\text{-}EOS$, and ΔEOS on AI , respectively, in Section 3.4 (Fig. 8). We hope these clarifications address the reviewer's concern. If a summary table is preferred, we would be glad to add one.

6. Q: The manuscript has been substantially improved; however, some grammatical errors and awkward expressions remain throughout the text. A careful language revision is recommended before final publication.

R: We thank the reviewer for this suggestion. In the revised manuscript, we have conducted a careful language revision throughout the text. Grammatical errors and non-standard expressions have been corrected, and the readability of several passages has been improved.