Correction of the manuscript entitled
"Vegetation and climate changes at the Early-Late Pliocene Transition around the Mediterranean Basin: A case from the Burdur Basin in Southwestern Anatolia"
By Mary Robles et al.
January 2025

We thank the reviewers for their attentive reading and their accurate comments. As detailed in the point-by-point reply below, we have carefully addressed every point raised, added substantial new data and analyses and thoroughly revised the manuscript.

Responses to the comments of Reviewer 1

General comments:

Dear Authors,

Thank you for the opportunity to review your study on the Early–Late Pliocene transition. The topic you address is highly valuable and of great interest in the field.

However, at this stage, the study relies solely on a single high-resolution pollen record obtained from Lake Burdur, which limits the comprehensive examination of large-scale climatic and environmental changes. Evaluating the data within a broader context, incorporating multidisciplinary biostratigraphic information available in the literature, would significantly strengthen the study.

Although the magnetostratigraphic analyses provide important contributions, certain chronological uncertainties and wide sampling intervals complicate the precise identification of stratigraphically critical transitions and short-term environmental changes. This situation particularly limits the scope and reliability of interpretations regarding the Early–Late Pliocene transition.

Therefore, explicitly acknowledging some limitations in terms of scope and data completeness, and where possible, supporting the data with other regional studies would allow for more robust interpretations. With these adjustments, the study could offer a stronger contribution to the fields of paleoecology and paleoclimatology.
The manuscript in its current form is not considered suitable for publication; however, it may provide significant contributions with future revisions
The priority issues and other minor issues related to your manuscript are listed below.

Response: We thank Reviewer 1 for his feedback. We appreciate the recognition of the interest and value of our study, and we acknowledge the concerns raised regarding the limitations of our dataset and interpretations. We have carefully revised the manuscript to improve clarity, acknowledge methodological limitations, and better contextualize our findings. Please find below our detailed responses to each point.

Line 100-105: Based on the following explanation, the newly added explanation was deemed insufficient." The statement added by the authors — "Pliocene. Additional pollen records from Anatolia exist, but many are limited by the low sample resolution and insufficient chronological control…" — refers to the literature suggested by the reviewer, yet evaluates these studies within a general framework of insufficiency. However, each of the mentioned studies is based on distinct methodological approaches. These include complementary multidisciplinary biostratigraphic data such as mammalian fossils, pollen records (palynoflora), ostracods, charophytes, gastropods, and regional stratigraphic correlations. Especially in a region like Anatolia, where data from this period are limited, it is important that such studies are considered through a holistic and contextual perspective.

From this point of view, characterizing the literature in question with a generalizing statement such as "low sample resolution and insufficient chronological control" both disregards the variety of data involved in these studies and reflects a reductive approach to the existing body of work.

Moreover, the fact that the Ericek record, which the authors use for comparison in their own study, is based on mammalian fossil dating and a very limited number of pollen samples points to a methodological inconsistency. In this context, the criticism directed at other studies regarding sampling frequency or age control appears inconsistent with the nature of the data used in the authors' own work.

• Ericek 7 sample and low palynofloral diversity (MN15; Early-Late Pliocene translition; Jiménez-Moreno et al., 2015). Artemisia is absent
• Bıçakçı 7 sample and low palynofloral diversity (MN 17; Early Pleistosen=Late Gelasian in age; Jiménez-Moreno et al., 2015). Artemisia is abundant

In conclusion, describing these studies — which involve multiproxy biostratigraphic assessments based on mammalian fossils, palynoflora, ostracods, charophytes, gastropods, and regional stratigraphic correlations — merely in terms of limited temporal resolution and uncertain chronological control is neither meaningful nor appropriate. Therefore, it would be more suitable to revise the related statement in a more balanced, contextualized, and constructive manner."

Response: We sincerely thank the reviewer for this important and constructive comment. We fully understand the concerns raised regarding our previous wording and the methodological richness of the cited studies.

In our study, we focus exclusively on pollen data to describe vegetation changes, which means that the comparative framework we use is based solely on the palynological content and its resolution. Of course, we do not question the overall quality or the multiproxy value of these studies, which provide significant insights into the Pliocene stratigraphy of Anatolia.

However, since our objective is to document and compare vegetation and climate changes specifically across the Early to Late Pliocene transition, the limited temporal resolution and the imprecise chronological attribution (i.e., to the Pliocene in general, without further subdivision) of some of these records make it challenging to integrate them meaningfully into our discussion. In several cases, the pollen data consist of only a few samples, making it difficult to assess potential changes in vegetation over time or to situate them accurately within the Early or Late Pliocene intervals.

We also recognize the reviewer's remark on the apparent inconsistency in our inclusion of the Ericek site. We clarify that we used this record specifically because it was already chronologically interpreted by the authors (Jiménez-Moreno et al., 2015) as corresponding to the Early–Late Pliocene transition, thus allowing us to use it in the same comparative framework. Furthermore, we have integrated additional records from Anatolia in the discussion.

In order to better reflect the diversity of available data and improve the contextualization of regional records, we have added a more balanced and expanded discussion in section 5.2 "Vegetation changes around the Mediterranean Basin" of the manuscript. These additions include the following paragraphs:

"Elsewhere in Anatolia, the Çankırı-Çorum sequence from the central region indicates similarly open vegetation dominated by Poaceae, Amaranthaceae and Urticaceae; however, the sequence is poorly dated and may represent a period earlier than 4 Ma (Kayseri-Özer et al., 2017). Another sequence from Southwestern Anatolia (Şarkikaraağaç) is characterized by a dominance of Pinaceae and Amaranthaceae (Tuncer et al., 2023). The precise Pliocene age of this record, however, remains uncertain, and it is based on a limited number of samples (n = 7). Nevertheless, the presence of Cathaya may suggest an attribution to the Early Pliocene."

"In contrast, the Karahallı site (Southwestern Anatolia) records the presence of Pinaceae, Cathaya, Cupressaceae, and Asteraceae dated to the Early–Late Pliocene transition and possibly reflecting regional diversity (Tagliasacchi et al., 2024b). Yet this sequence is restricted to six samples, exhibiting limited taxonomic diversity, and seems dominated by pollen taxa most resistant to taphonomic processes. Another sequence from central Anatolia (Akçaköy) also indicates a dominance of Pinaceae and Asteraceae (Yavuk Işik et al., 2011), but its precise Pliocene age remains uncertain, and it is based on only five samples."

Line 105: Artemisia is absent in Ericek locality sample of the Early-Late Pliocene translition.

Response: We thank the reviewer for this comment. The sentence has been revised as follows: "Despite these limitations, available evidence suggests that prior to 3.6–3.4 Ma, mesothermic forests developed along the Black Sea coast (Popescu et al., 2010), while steppe vegetation prevailed across the Anatolian Plateau (Jiménez-Moreno et al., 2015)."

Age:
Magnetostratigraphic analyses are among the internationally recognized methods for chronological reconstruction and are of particular value in the context of this study. In this regard, the identification of normal and reversed polarity zones using ChRM inclination data from the Burdur drilling core, and the comparative interpretation of these zones with the Global Polarity Time Scale (GPTS), represent a methodologically sound approach. Furthermore, the comparison with stratigraphic data obtained from a site located approximately 20 km to the north, and the correlation of normal/reversed polarity zones that correspond to similar chrons, is meaningful in terms of regional correlation.

Nevertheless, there are certain limitations to consider. Firstly, the exclusion of short-duration normal polarity intervals identified below 60 meters—on the grounds of "isolated samples" or "possible core reorientation"—weakens the detail and resolution of the magnetostratigraphic correlation. Additionally, no direct radiometric dating or biostratigraphic data are presented in the study (or if such data exist, they are not explicitly stated); the chronological interpretations rely solely on the correlation of magnetic polarity zones with the GPTS. This inherently limits the reliability of the proposed chronological framework. In particular, interpretations related to the normal polarity zone identified in the upper part of the core (0–60 m) remain rather limited, and the stratigraphic age of this interval has not been clearly established.

Overall, while the magnetostratigraphic data presented in the study offer valuable contributions in supporting the chronological framework, they are not considered sufficient on their own for robust age determination. In order to enhance the scientific reliability and interpretive strength of the data, it is recommended that short-duration normal intervals not be entirely disregarded, that the interpretations of the upper section be further elaborated, and that, where possible, the chronological framework be supported with independent radiometric or biostratigraphic data.

Moreover, due to the relatively deep nature of the drilling and the use of wide sampling intervals for pollen analyses (averaging 5 meters), the precise lithostratigraphic level at which the transition to the Late Pliocene occurs cannot be clearly established. Consequently, distinguishing and interpreting the paleoenvironmental changes marking the transition from the Early to the Late Pliocene within the core log becomes challenging in stratigraphic terms.

Response: We acknowledge the reviewer's concern regarding the exclusion of short-duration normal polarity intervals below 60 meters. However, we have chosen not to interpret these as reliable polarity chrons based on methodological considerations. Specifically, we have not attempted to identify short normal chrons within this interval, as the presence of four isolated normal samples ($I > 30°$) could result from sporadic orientation errors (e.g., upside-down readings) or issues related to demagnetization. It is standard practice in magnetostratigraphy not to interpret isolated opposite polarity samples as a reliable magnetic field record.

To address the reviewer's suggestion, the following clarifications were added to the manuscript in the revised version:
In the Result 4.1 "Age-depth model", we now specify "intermediate inclinations (absolute values <30°)" and we added "It is standard practice in magnetostratigraphy not to interpret isolated opposite polarity samples as reliable magnetic field records."
In Figure 3, the caption was updated to: "Absolute values of inclination above or below 30° are shown as black and gray symbols, respectively."
In the discussion 5.1 "Age-depth model", we included the full reasoning behind the magnetostratigraphic choice, including the alternative (lower sedimentation rate) scenario and why it was rejected : "This magnetostratigraphic solution, although not unique in the absence of independent chronological constraints within the core, is consistent with the regional biostratigraphic constraints of the Burdur sedimentary sequence (mammalian zones reported in 3.2 and paleomagnetic study of Özkaptan et al., 2018)." and "A lower sedimentation rate for the reversed chron below 60 m depth could be obtained by assuming that the short normal chron below 4.19 Ma was missed, thereby placing the base of the studied section above 4.5 Ma. This adjustment would yield a sedimentation rate of ~31cm/ka rather than 51 cm/ka. However, this assumption does not improve the fit with the mammal zonation (Fig.2), and remains poorly unconstrained."

Line 240: Pollen and Non-Pollen Palynomorph (NPP) analyses
The current sampling strategy is generally adequate and meaningful for reconstructing long-term and large-scale paleo-vegetational and climatic patterns in the Burdur Lake basin. However, in order to better capture short-term environmental fluctuations and to more accurately interpret temporal transition phases (e.g., from the Early to Late Pliocene), it is necessary to increase sampling resolution, particularly in stratigraphically critical transition zones or climatically sensitive intervals. Therefore, this limitation should be clearly stated in the manuscript when presenting the interpretations. Moreover, it should be determined that the precise stratigraphic level of this transition could not be defined with confidence based on the available data.

Response: We agree with the reviewer that higher-resolution sampling is essential to precisely characterize short-term environmental changes and stratigraphic transitions. However, we would like to emphasize that our study focuses on long-term vegetation and climate changes and try to understand the difference between the Early and Late Pliocene around the Mediterranean basin. While the sampling resolution (~1 sample every 5 meters, ~50 samples total) may not capture short orbital-scale fluctuations (~20 kyr), it remains significantly higher than that of most existing palynological records from Anatolia for the same time interval, which typically include fewer than 10 samples and are often constrained by limited chronological control.

Discussion
5.1 Age-depth model
The presented study establishes a consistent and reasonable age model for the analyzed sequence; the placement within the Pliocene is reliably supported by the magnetostratigraphic tie point defined at 3.596 million years (corresponding to approximately 60 m depth). Strengths of the age model include the assignment of the entire core to the Pliocene, consistency with regional sedimentation rates, and the careful rejection of alternative correlations that would imply unrealistically high accumulation rates. In addition, the climatic and vegetational reconstructions provided throughout the core further support the chronological framework and contribute meaningfully to the environmental interpretation.
However, despite these positive aspects, it does not appear possible to precisely identify the Early–Late Pliocene transition stratigraphically based on the current data. This is primarily due to: (1) the tie point at 3.596 Ma carries a depth uncertainty of ±10 m, which corresponds to an age uncertainty of approximately 44,000 years based on the minimum sedimentation rate; (2) the average sampling resolution of ~1 meter yields a temporal resolution of approximately 2,000–4,000 years between samples, which is insufficient to capture short-term environmental changes or cyclic fluctuations on the order of ~20,000 years; and (3) the stratigraphic interval corresponding to the transition in question remains uncertain due to limitations in sampling resolution and age control.

Therefore, although the climatic and vegetational interpretations presented in the manuscript are insightful and scientifically valuable, it would be appropriate to clearly defined the limitations of these interpretations specifically in relation to the Early–Late Pliocene transition. It should be emphasized that the temporal resolution provided by the age model may not be sufficient to precisely constrain this transition. Consequently, some of the palynological interpretations face challenges in being accurately aligned with precise chronological boundaries.

Response: We thank the reviewer for this comment. We agree that the current dataset does not allow for a precise identification of the stratigraphic boundary marking the Early–Late Pliocene transition.

However, we would like to emphasize that the objective of this study is not to characterize short-term climatic events or to precisely pinpoint the boundary, but rather to document longer-term climatic and vegetation trends across the broader Early to Late Pliocene interval. In this framework, the existing resolution is among the highest available for Pliocene pollen records in Anatolia, with nearly 50 samples analyzed, compared to fewer than 15 in most regional studies. This provides a robust basis for interpreting long-term palaeoenvironmental evolution before and after the ~3.6 Ma transition.

Regarding the magnetostratigraphic solution, although non-unique in the absence of other independent chronological constraints within the core, it fits with the regional biostratigraphic constraints on Burdur sedimentary sequence (mammalian zones reported in § 3.2 and paleomagnetic study of Ozkaptan et al., 2018). A solution leading to a lower sedimentation rate for the below 60 m depth reversed chron, would be to assume that we missed the short normal chron below 4.19 Ma, thus putting the base of the studied section above 4.5 Ma (see Fig.3). The corresponding sedimentation rate would be over 31 instead of 51 cm/kyr. However, such an assumption does not improve the fit with mammal zoning (Fig.2), and appears to be unconstrained.

To address the reviewer's suggestion, the following clarifications were added to the manuscript in the revised version:
In the discussion 5.1 "Age-depth model", we included the full reasoning behind the magnetostratigraphic choice, including the alternative (lower sedimentation rate) scenario and why it was rejected : "This magnetostratigraphic solution, although not unique in the absence of independent chronological constraints within the core, is consistent with the regional biostratigraphic constraints of the Burdur sedimentary sequence (mammalian zones reported in 3.2 and paleomagnetic study of Özkaptan et al., 2018)." and "A lower sedimentation rate for the reversed chron below 60 m depth could be obtained by assuming that the short normal chron below 4.19 Ma was missed, thereby placing the base of the studied section above 4.5 Ma. This adjustment would yield a sedimentation rate of ~31cm/ka rather than 51 cm/ka. However, this assumption does not improve the fit with the mammal zonation (Fig.2), and remains poorly unconstrained."

Vegetation changes around the Mediterranean Basin
As noted in the Introduction, other pollen records from Anatolia were not included in our study. The main reason mentioned for authors for their exclusion is that the age data in the cited studies are primarily based on mammal, ostracod, charophyte, palynological gastropod, and regional stratigraphic correlations, which limit their chronological precision. Additionally, the Ericek study sould be also excluded due to its reliance on biostratigraphy for age control and the limited number of samples it contains. Consequently, this study is considered a local investigation restricted to the Burdur area rather than a dataset applicable on a regional scale. Although comparisons with Western Mediterranean data were made to partially extend the manuscript's relevance to a broader (global) scale, the local nature of the Eastern Mediterranean data prevented meaningful regional comparison.

Response:
We thank the reviewer for this valuable comment. In fact, we have already included one of the references suggested by the reviewer (Çankırı-Çorum sequence), as it presents a sufficient number of pollen samples and focuses specifically on the Early Pliocene, rather than covering the entire Pliocene period without chronological subdivision as in many other studies.

Moreover, the Ericek sequence is chronologically constrained by the authors themselves (Jiménez-Moreno et al., 2015), which allows us to position it following their interpretation. We have also chosen to include mediterrnean sequences with a sampling resolution high enough to support meaningful paleoenvironmental interpretations and for which a distinction between the Early and Late Pliocene has been made, criteria that unfortunately are not met by the majority of palynological records from Anatolia.

However, in order to better reflect the diversity of available data and improve the contextualization of regional records, we have added a more balanced and expanded discussion in section 5.2 "Vegetation changes around the Mediterranean Basin" of the manuscript. These additions include the following paragraphs:

"Elsewhere in Anatolia, the Çankırı-Çorum sequence from the central region indicates similarly open vegetation dominated by Poaceae, Amaranthaceae and Urticaceae; however, the sequence is poorly dated and may represent a period earlier than 4 Ma (Kayseri-Özer et al., 2017). Another sequence from Southwestern Anatolia (Şarkikaraağaç) is characterized by a dominance of Pinaceae and Amaranthaceae (Tuncer et al., 2023). The precise Pliocene age of this record, however, remains uncertain, and it is based on a limited number of samples (n = 7). Nevertheless, the presence of Cathaya may suggest an attribution to the Early Pliocene."
"In contrast, the Karahallı site (Southwestern Anatolia) records the presence of Pinaceae, Cathaya, Cupressaceae, and Asteraceae dated to the Early–Late Pliocene transition and possibly reflecting regional diversity (Tagliasacchi et al., 2024b). Yet this sequence is restricted to six samples, exhibiting limited taxonomic diversity, and seems dominated by pollen taxa most resistant to taphonomic processes. Another sequence from central Anatolia (Akçaköy) also indicates a dominance of Pinaceae and Asteraceae (Yavuk Işik et al., 2011), but its precise Pliocene age remains uncertain, and it is based on only five samples."

Conclusion:
The article aims to evaluate climatic and environmental changes related to the Early–Late Pliocene transition in the Eastern Mediterranean region. However, the primary basis of the study is a high-resolution pollen sequence obtained solely from Lake Burdur. Since other comparable datasets from the Eastern Mediterranean are either unavailable or considered chronologically insufficient by the authors, making regional-scale generalizations based on this single record is methodologically limited.

Although the Lake Burdur record offers a valuable and detailed paleoenvironmental archive, its capacity to represent the climatic variability across the Eastern Mediterranean basin is limited due to its nature as a single-site dataset. Considering the microclimatic differences, topographic diversity, and marine influences present in the Mediterranean basin, regional-scale inferences are expected to rely on multiple data sources. Even though comparisons have been made with other datasets from the Western Mediterranean, generalizations for the Eastern Mediterranean based on a single location should be approached with caution.

Therefore, it should be clearly stated in the manuscript that the interpretations are developed based on a local record, and any regional or basin-scale generalizations should be presented with a cautious and qualified tone. In addition, a methodological note should be included in the text highlighting that the representativeness of the Burdur record at the regional level is limited.

Response: We agree with the reviewer that interpretations based on a single site must be made with caution, especially when considering regional-scale variability. While the pollen data from the Burdur record capture local, extra-local, regional, and even long-distance vegetation signals (Jacobson and Bradshaw, 1981), we fully acknowledge that this record cannot represent the entire Eastern Mediterranean. Accordingly, we have revised the conclusion to explicitly state the limitations of our dataset with regard to regional-scale generalizations and clarified that our interpretations are based on a single high-resolution record from Southwestern Anatolia. We have also added a methodological note

to highlight that additional high-resolution records are necessary to improve regional reconstructions for the Eastern Mediterranean.

Minor remarks:
Figures
1. Figure 1 should be revized: All rock units mentioned in the text (such as the Beydağları Autochthon) should be clearly indicated on the map presented in the study. This is important not only for visually supporting the descriptions, but also for enabling the reader to accurately and comprehensively follow the regional geological context.
Response: Figure 1 has been revised and reduced to focus on the study area. In the revised figure the Beydağları autochthon is now out of the map margin, and it is excluded from the text accordingly.

2. Therefore, it is recommended that the map be revised accordingly. In addition, the resolution of some figures is currently quite low, which affects their clarity. It is recommended that the image quality be improved to ensure better readability and visual presentation.
Response: We are aware that the current resolution of some figures appears low due to Word formatting. However, all figures will be submitted in high-resolution (SVG format) during the final production stage, ensuring that they appear clearly in the published version.

Responses to the comments of Reviewer 2

Minor remarks:
Table 1 still has a track-change edit to be validated.
Response: Thank you for pointing this out. The tracked change in Table 1 has now been accepted and the table has been finalized in the clean version of the manuscript.

Acknowledgements: you may want to thanks the editor and 2 anonymous reviewers for their reading and comments.
Response: Thank you for the suggestion. We have now added a sentence in the Acknowledgements section to thank the editor and the two anonymous reviewers for their helpful comments and suggestions, which improved the quality of the manuscript.