Reviewer #1 Comments

Novak and colleagues present research that corrects for biases in previously published alkenone sea surface temperature records at ODP882. These biases stem from differences between analytical techniques for quantifying alkenone concentrations (GC-FID vs GC-CI-MS). The GC-CI-MS method enables analysis of alkenone-poor sediments that were inaccessible with GC-FID. The authors demonstrate that the original GC-CI-MS ODP882 measurements overstated climate variability, though the overall patterns and trends remain unchanged.

While the manuscript is well-written and the research methodology is sound, the manuscript's critical weakness is the absence of a meaningful discussion section. The authors successfully identify and correct the proxy bias, and highlight that the ODP882 record is very important, but fail to explore what this corrected record reveals about our understanding of Pliocene climate and Northern Hemisphere glaciation—which should be a key contribution from this methodological innovation.

Dear Reviewer #1, thank you for taking the time to review our work. We are appreciative of your time and constructive comments, which will result in an improved revised manuscript. We completely understand the criticism that our work did not include a discussion of the implications of the overstated variability in sea surface temperatures at ODP Site 882 in the original GC-CI-MS record. We will include a comparison of the original vs. corrected ODP 882 sea surface temperature dataset to mid-Pliocene model output. We expect that the most important change to the ODP 882 data will be the substantially increased uncertainty in the sea surface temperature estimates than was previously recognized, which we will highlight in a new figure.

MAJOR ISSUE: MISSING DISCUSSION OF IMPLICATIONS

The research convincingly quantifies and corrects the ODP882 bias, but stops short of addressing why this matters for the current understanding of Pliocene temperatures and Northern Hemisphere glaciation. The authors need to address fundamental questions about their findings' significance:

How does this correction alter our understanding of Pliocene temperatures and the timing/intensity of Northern Hemisphere glaciation?

What are the implications for North Pacific temperature evolution during this critical climate transition?

How might this refined record affect estimates of Earth System Sensitivity (ESS), particularly given that ODP882 is frequently cited in multi-proxy compilations?

These questions are only meant to be illustrative and motivate deeper discussion as the current manuscript provides little context for understanding the broader implications of their correction. The paleoclimate community needs to understand not just that the record was biased, but what new insights emerge from the corrected data.

Thank you for prompting the requested additional discussion with specific questions. Given that revisiting estimates of Earth System Sensitivity would be a major undertaking requiring a separate manuscript (and development of a new skillset by the authors, which does not seem realistic on the timeframe of manuscript resubmission), we will focus the new discussion of the implications of the corrected dataset for our understanding of regional sea surface temperature patterns in the late Pliocene:

1). How does the proposed correction to the ODP Site 882 manuscript impact estimates of the latitudinal temperature gradient in the North Pacific during the late Pliocene? The mid-Piacenzian Warm Period will be a particular area of focus in this new section due to the widespread community focus on the mid-Piacenzian interval for data-model comparison. The new section will include a figure comparing the latitudinal temperature gradient as estimated from paleo sea surface temperature data with the original vs. corrected ODP 882 data to PlioMIP2 model output.

2). We will compare the Western vs. Eastern subpolar North Pacific sea surface temperature estimates to understand whether the correction to the ODP Site 882 record changes our understanding of longitudinal gradient in SSTs in the late Pliocene. This analysis has relevance for observations made using Data Assimilation methods by Tierney et al. (2025) in *AGU* Advances, although we would like to emphasize that the comparison we will undertake is with the proxy data only as we lack expertise in Data Assimilation.

Warm regards and on behalf of the coauthors,

Joseph Novak

SECTION 2.1

This section could use some more text, particularly since the methods of this manuscript are intertwined with the key message: that the ODP882 record is biased and this is how you quantified and corrected for that bias. In particular, a clearer explanation of how synthetic UK37 were generated is needed for the broad paleoclimate readership of Climate of the Past.

We will add further text to explain how synthetic $U^{K'}_{37}$ values were generated to produce the black lines in Figure 3. We would like to emphasize that these synthetic

values are for illustrative purposes only and are meant to give the reader an intuitive sense of how analysis by GC-CI-MS would result in different temperature estimates as compared to GC-FID, as this is a rather technical distinction that is not easily visualized from word on the page alone. The synthetic $U^{K'}_{37}$ values are not in any way used in the corrected ODP 882 record – the corrected values arise from a simple linear regression between GC-FID and GC-CI-MS $U^{K'}_{37}$ values in proximal samples from ODP 882.

FIGURE 4

A direct comparison between the original and corrected SST records at ODP882 is conspicuously absent. Figure 4 would be the logical place to show this comparison, allowing readers to visualize both the magnitude of the correction and its impact on key climate transitions.

We will add a direct comparison to this figure. Thank you for pointing this out – it completely slipped our minds that this is an important aspect of the data to display.

MINOR COMMENT

Without demonstrating the impact of the corrected record, the manuscript somewhat overstates its importance. For instance, the abstract begins by discussing Earth climate sensitivity but many studies of Earth System Sensitivity rely on multiple records, so the authors should either: (a) demonstrate how this correction specifically affects multi-proxy compilations, or (b) focus on what unique insights about regional climate dynamics this corrected record provides.

Thank you for pointing this out, as it is not our intention to present this work as particularly "high impact." In fact, we attempt to temper the reader's impression of the impact of this work by stating in the abstract that our findings do not invalidate the conclusions regarding Earth's climate history originally drawn from the GC-CI-MS data from ODP 882. Rather, we think that the information presented here is necessary to put out for the paleoclimate science community as we strive to improve the data that we use to assess the skill of climate models at simulating sea surface temperatures under boundary conditions different from historical period.

As noted in our previous response, we will add a new section and figures to the manuscript that assesses the extent to which the corrected record improves our understanding of regional climate dynamics.

RECOMMENDATION

This manuscript makes a valuable methodological contribution by identifying and correcting an important bias in a widely used proxy from an important site. However, it currently reads more as a technical note than a full research article. To maximize its impact, the authors must add a robust discussion section that explores what this corrected record teaches us about Pliocene climate that we didn't know before. I enjoyed reading this manuscript and hope the authors find my comments useful.

Thank you for taking the time to evaluate our work.

References Cited in Response

Tierney, J. E., King, J., Osman, M. B., Abell, J. T., Burls, N. J., Erfani, E., Cooper, V. T., & Feng, R. (2025). Pliocene Warmth and Patterns of Climate Change Inferred From Paleoclimate Data Assimilation. *AGU Advances*, *6*(1). https://doi.org/10.1029/2024AV001356