

Reviewer #2 Comments

Novak et al. present a method to correct systematic biases in UK'_{37} -based SST reconstructions from ODP Site 882. The original published SST estimates (Haug, 1995; Haug et al., 2005; Martínez-Garcia et al., 2010) were derived from alkenone measurements using GC-CI-MS, a method known to introduce non-linear, concentration-dependent biases. The original SST record shows systematic offsets relative to subsequent GC-FID-based records from overlapping samples at ODP Sites 882 and 883. The authors propose a linear correction approach based on the relationship between GC-CI-MS (Haug, 1995) and GC-FID (Studer et al., 2012) SST estimates where data overlap at ODP Site 882.

Dear Dr. Rattanasriampaipong,

Thank you for taking the time to evaluate our work. We are appreciative of your constructive comments and criticisms, which will result in an improved revised version of the manuscript. In particular, we will add a new section to the revised manuscript that explores the implications of our proposed correction to the ODP 882 alkenone sea surface temperature dataset for our understanding of regional sea surface temperature patterns in the Pliocene. Please find our responses to your specific comments below. Given the similarity of your comments to the criticisms raised by Reviewer #1, you may find our responses to those comments of interest as well.

Warm regards and on behalf of the coauthors,

Joseph Novak

Major comments:

- **Insufficient discussion of the implications and broader significance of the correction:** I echo the other reviewers' concern that the manuscript lacks adequate discussion of why this SST correction matters and how it changes our understanding of North Pacific climate evolution. The following additions would significantly strengthen the manuscript:

We agree and will take steps to add data-model comparison and a reassessment of regional sea surface temperature gradients in the revised manuscript.

- **Data-model comparison:** The authors mention that the original SST record is unsuitable for evaluating Earth System Models but provide no actual model-data comparison. Including this comparison (either with existing model

outputs or literature values) would demonstrate the practical impact of the correction and justify the effort.

We have requested access to PlioMIP2 model output for this purpose and will include this comparison in the updated manuscript. This section will focus on how the correction (and resulting increase in the quantified uncertainty) to the ODP 882 alkenone record might change late Pliocene data-model comparison assessments of the latitudinal temperature gradient in the North Pacific basin.

- **SST gradients and ocean circulation dynamics:** The corrected SST record will substantially alter the temporal evolution of meridional temperature gradients in the northwestern Pacific. Given ODP Site 882's position within the Kuroshio Extension region, the authors should discuss implications for our understanding of western boundary current dynamics and their role in North Pacific climate variability over the past 6 Ma.

We will include a new section that reassesses the longitudinal gradient in proxy sea surface temperature estimates in the subpolar North Pacific. We will also discuss the implications of the correction for the community's understanding of the sea surface temperature variability of the Kuroshio Extension region over the past 5.7 Ma. This new discussion will focus on the reduction of the magnitude of reconstructed sea surface temperature changes that result from the proposed correction.

- **Prevalence of GC-Cl-MS measurements:** The authors state that GC-Cl-MS is used when alkenone concentrations are very low but cite only a handful of studies employing this method. A more systematic assessment of how commonly GC-Cl-MS has been applied in the published literature would help readers evaluate the broader applicability of this correction approach. If this method has been widely used (particularly in low-productivity regions or deep-time studies), the implications extend well beyond ODP Site 882.

We conducted a literature review and will include in the introduction citations to published studies that used the GC-Cl-MS technique without explicitly stating that the analytical setup accounted for the concentration-dependent ionization efficiency issues that we suspect are the reason for the issues with the ODP 882 record that we report here. These studies primarily aimed to understand paleo sea surface temperature trends through time (Durham et al., 2001; Madureira et al., 1997; Martínez-Garcia et al., 2010; McClymont et al., 2008; McClymont & Rosell-Melé, 2005; Roberts et al., 2017; Sánchez-Montes et al., 2020; Weaver et al.,

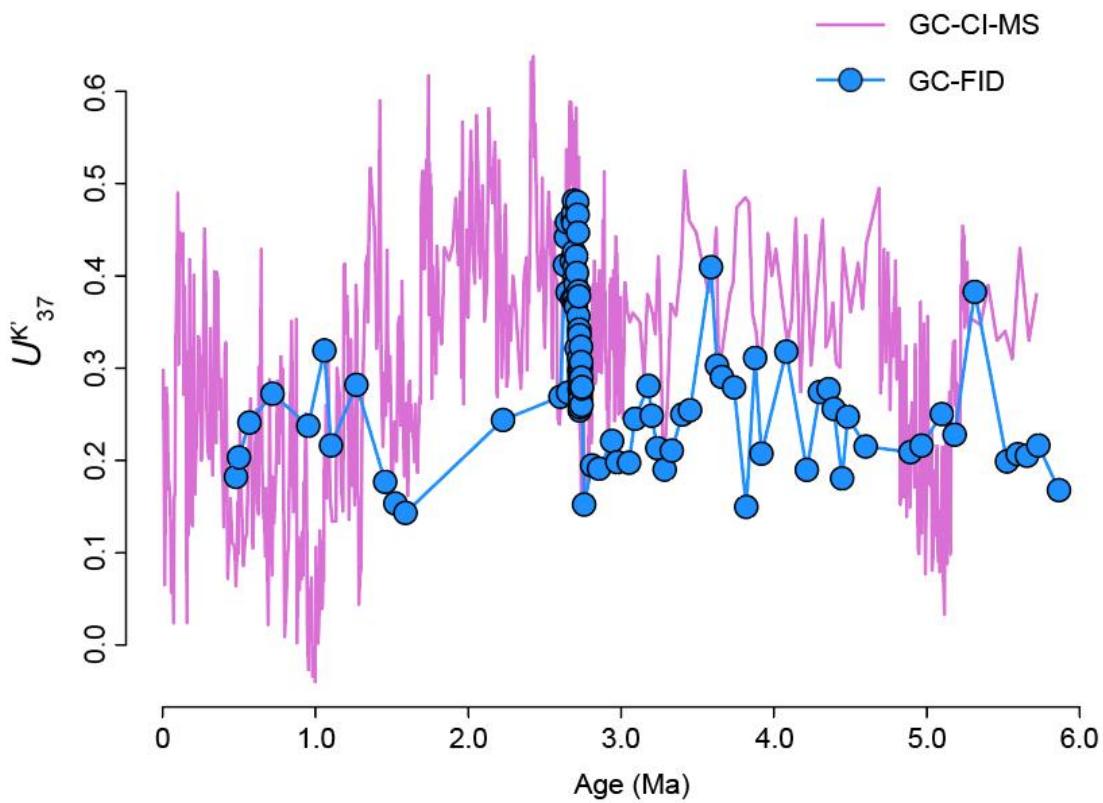
1999), but also includes a study of particulate organic matter in the modern ocean water column (Bendle & Rosell-Melé, 2004).

• **Uncertainties in extrapolating the correction beyond the calibration interval:**

The linear correction is derived from a relatively brief temporal interval where the Haug (1995) and Studer et al. (2012) datasets overlap. Applying this correction to the entire 6 Ma record likely introduces additional uncertainties that must be properly quantified and propagated. Specifically:

- The magnitude of the GC-CI-MS bias may vary systematically with alkenone concentration, sample matrix effects, or instrumental drift over time.
- The bias may differ between glacial and interglacial periods due to changes in alkenone preservation, sediment composition, or productivity regimes.
- The authors should provide uncertainty estimates for the corrected record and discuss how confidence in the correction degrades outside the calibration interval.

In the course of preparing our response to the reviewer comments, we came across an additional GC-FID alkenone dataset from ODP 882 (Yamamoto & Kobayashi, 2016) that expands the temporal range of the data available to attempt a correction of the Haug (1995) GC-CI-MS alkenone dataset through the entire 5.7 million year interval spanned by that record (see figure below). These new data allow us to identify more confidently: (1) the systematic differences between the GC-FID and GC-CI-MS data from Site 882 and (2) the substantial uncertainty inherent to correcting the GC-CI-MS dataset. The revised manuscript will feature an expanded discussion of these uncertainties.



U^K_{37} data from ODP Site 882 generated by GC-CI-MS (purple) and GC-FID (blue).

We will also more thoroughly explore the differences between the original and proposed correction to the ODP 882 record by systematically comparing the original vs. corrected glacial vs. interglacial SST values in the Pliocene and Pleistocene through a new figure presenting box-and-whisker plots for this purpose. Lastly, we will add published Early Pliocene data from ODP Sites 883/884 (Herbert et al., 2016) to expand the timescale of the independent validation of the corrected ODP 882 record shown in Figure 4 of the original manuscript submission.

General comments:

- Ensure consistency in citing Haug (1995) versus Haug et al. (1995) throughout the manuscript. For example, Figure 3a shows "Haug et al. (1995)..." which appears incorrect if the reference is to a single-author 1995 publication.

Thank you for pointing this out. Yes, the proper citation here is to Haug (1995). We will correct this issue.

Figure comments:

Figure 1 – Consider adding modern SST contours or climatology to emphasize that these sites are located in the subarctic North Pacific, where accurate SST reconstructions are critical for quantifying meridional temperature gradients and evaluating climate model performance in this sensitive region.

We will add modern SST contours to the figure.

Figure 2 – Please extend the x-axis to cover the entire range of the data

We will extend the x-axis.

Figure 4 – Include a comparison showing the original versus corrected SST estimates for the entire ODP 882 record, not just a subset. This would clearly demonstrate the magnitude of the correction during different climate states (e.g., glacial-interglacial extremes) and help readers assess whether the bias is constant or varies systematically with SST.

We will add the requested comparison of the original vs corrected SST estimates from ODP 882 to Figure 4.

Line-by-line comments:

L17-18: Should "Haug 1995" be cited here along with "Studer et al., 2012"?

Yes – we will cite the Haug (1995) paper here also, thank you for catching that.

L18: Either remove "long" or change it to "long-chain." "Long alkenone SST" sounds odd.

Here long is intended to describe the temporal length of the record. We will replace long with the age range covered by the record to be more exact.

L65: Please provide lat/lon and water depth coordinates of ODP sites 882 and 883.

We will do this in the revised manuscript.

References Cited in Response

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