

I applaud the authors for producing a comprehensive data set of indices biomarkers related to ocean temperature from modern sediments. Their focus on potential differences in the interpretations of the proxies as a result of seasonal differences in ecology is reasonable. The issue is whether the data set has the ability to resolve the question posed. A major obstacle is that all temperature calibrations are empirical. This means that anomalies in inferred temperature must be made PRESUPPOSING that the calibration to temperature is accurate, and then finding the best fit of the proxy to local (seasonal) temperature. I don't have a smart way out of this dilemma, but it poses a significant signal:noise issue: at what point does a proxy deviation from an expected relationship become large enough to be meaningful? A big caveat for this study region is recognized in lines 203-204: "Note that spring, autumn and annual temperatures are very close to each other. " This problem severely limits the seasonal interpretations proposed here.

I was a bit surprised that the authors did not consult satellite estimates of seasonal chlorophyll patterns. This might have buttressed some of the claims made for e.g. the late spring importance of riverine runoff on production.

In the end, I was left unconvinced that the data sets had the resolving power to support the proposed seasonal biases in biomarker production. Some examples: a spring bias for alkenones claimed, but then later (page 25,) that "alkenone production is biased to warm season". In this regard, using a definition of May to June as "spring" is hard to follow- there can't be much discriminatory power in using SST by this definition. Furthermore, as the authors acknowledge, the difference between spring and mean annual SST is minute.

Likewise, the difficulty in interpreting the meaning of the TEX86 values becomes apparent (p. 28-29) and it's hard to support a seasonal mechanism.

For the RI-OH calibration, residuals range from 1.5 to 1.9 oC for the 4 seasons- simply picking the season of lowest residual does not make a compelling statistical argument.

Abstract:

The spring bloom is more typically triggered by winter mixing followed by increasing sunlight and stratification, not riverine input of nutrients. Is there evidence to support the importance of riverine input to these sites?

The claim that eustigmatophytes would be "insensitive to nutrient inputs" is hard to believe since these are photoautotrophs.

Controls on GDGT production left very vague: "relatively high nutrients levels, low light and high concentrations of SPM". Of these, nutrients in the usual sense does not apply to non-photosynthesizing archea (some of which are believed to be ammonium oxidizers as mentioned in the Introduction, others chemautotrophs) nor do light conditions seem relevant.

Lines 68,69: "Recently, the LDI proxy was found to be limited by the input of 1,13 and 1,15-diols from fresh-water eustigmatophyte algae, especially in the coastal seas" The meaning of "limited" is not clear. Presumably the sense is that the LDI proxy departs from an expected calibration because of the input of the 1,13 and 1,15 diols?

Section 2

Since inferences of seasonal production rely on the deviation of the measured indices relative to temperature from reference calibrations, and those deviations may only be a few degrees,

the quality of the analyses becomes very important. The quality of the analytical determinations may be critical, especially in the case of shallow water sediments, which typically contain a wide variety of organic compounds, many of which may interfere analytically with the compounds of interest. Insights (and examples?) of the degree to which lipid extraction and separation removed interferences would be very helpful. In this regard, the method used for alkenone determination employs a rather fast temperature ramp and would not be ideal to resolve co-eluting compounds, unless the fraction analyzed is very pure. The uncertainty reported for alkenone UK'37 determination comes from a reference standard- it would be very valuable to know the reproducibility of the SCS sediments, with full replication of extraction, separation, and GC analysis. The same caveat applies to analytical uncertainties in the GDGT and RI-OH method.

I am not an expert in the LDI analysis. However, the sentence beginning at line 138 concerning the use of a Pearson correlation coefficient is very unclear (what is being correlated to what, and why is this a measure of uncertainty?)

Climatological temperatures:

Typically, coastal SST shows a lot of heterogeneity. Is the resolution of the WOA gridded data set sufficient to define the climatology at the resolution of the core sampling?

Section 3

Given that deviations relative to expected values are key, much attention needs to be devoted to the uncertainties inherent in estimating deviations/residuals. Although the authors have responded about their non-use of the Bayspline, their use of the Conte 2006 calibration would not be the choice of most in the alkenone field (the standard reference would be to Muller et al.,). To side-step a debate on which calibration is "best", a more rigorous effort is needed. The authors do not report the mean and standard deviation of their UK'37 values. This would let the reader assess better whether the data support any attribution to a season of production. My guess is that the alkenone data agree to within error to spring, autumn, or annual production. Similarly, reporting the mean and standard deviation of LDI estimates (screened to remove terrestrial inputs) would be very useful.

Given the low apparent temperature derived from the coastal sites using the TEX86 values, how do the authors assess the importance of contamination from terrestrial inputs as opposed to a marine production signal?

The discussion of the relation of TEX86 together with the Ring Index is confusing for a non-specialist. The claim at first appears to be that the TEX index should not be used to estimate temperature, but then the claim is contradicted. I appreciate that resolving proxy uncertainties isn't easy, but this section isn't very satisfying.