

# ***Interactive comment on “A Late Quaternary climate record based on long chain diol proxies from the Chilean margin” by Marijke W. de Bar et al.***

## **Anonymous Referee #3**

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The authors of “A Late Quaternary climate record based on long chain diol proxies from the Chilean margin” analyzed a suite of organic biomarkers in a marine sediment core from the coast of Chile to a) assess glacial-interglacial dynamics in marine productivity (ie. upwelling) and associated climate change, and b) to establish the efficacy of long-chain diols in paleoenvironmental reconstruction, particularly with regards to the recently proposed Nutrient Diol Index (NDI) as a metric for marine productivity. They compared diol-based indices to independent records of SST (alkenones and GDGTs) and productivity (algal lipid fluxes, total organic carbon fluxes, etc.) and show that NDI is distinctly different than other upwelling proxies and so is not widely interpretable as an upwelling indicator, suggesting instead that the principal C28 1,14-diol producer,

*Proboscia alata*, occurs more commonly in non-upwelling settings. Furthermore, the Diol Index appears to reflect all *Proboscia* productivity, but still does not capture the upwelling signature expressed in other paleoproductivity proxies. The dataset seems robust and these topics are of broad interest to the paleoceanography and organic geochemistry communities. In general, I think the paper could be published after addressing issues regarding the clarity of the paleoclimate implications and the writing structure.

Please include the full name for each abbreviation the first time abbreviations are mentioned. Likewise, provide the diol-specific equations in the introduction because it would help the reader follow the introduction section easier without flipping through the paper to find the equations.

The goal stated in the first sentence of the abstract stands in contrast with the goal of the title.

Page 12-13: The relationship between temperature and productivity should be discussed more explicitly. I think this section relating the broader climate system and the productivity regime needs clarification. A plot showing the temperature and the nutrient/upwelling indicators together is warranted, given that the paper is drawing links between these two variables. Can either 'northward migration of the SWW' or 'southward migration of the subtropical high' or global cooling induce more upwelling and is there a way to distinguish between these factors in the paleoceanographic record?

Page 14: Many ideas are put forward about *P. alata* ecology, but I am left with an uncertain idea of what NDI (aka *P. alata* productivity) variations signify in a specific climatic or ecological sense. Is there a suggestion of why *P. alata* varies so dramatically during some periods, but not during MIS 1/2/3/4? I think the discussion on the modern observations of *P. alata* blooms and distributions are helpful, but should be related more explicitly to the paleoceanographic record if possible. Is the author's suggestion that reduced NDI around 100 ka is an indication that upwelling occurred continuously, rather

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than on a seasonal basis, thereby eliminating the "early- or post-upwelling nutrient conditions"?

There is an increase in TOC-MAR and importantly, 1,13- and 1,15-diols in MIS 4. Please comment on if this is an indication of specific upwelling or nutrient conditions that might promote the eustigmatophyte but not other algal groups.

P. 15 Starting line 31: Regional differences in the timing of deglacial warming might be expected, but this does not address the different timing among proxies at Site 1234. Please elaborate on the significance of the LDI versus UK37 difference during ~10 kyr around the LGM.

Some points need grammatical correction:

P1. L. 11: Change "proxies" to "indices" because the Diol Index is stated to be an indicator rather than a proxy in Line 12.

P1. L.12: "...the NDI as a quantitative proxy..."

P1. L. 15: Either specify the number of glacial/interglacial periods or just remove this clause.

P2. L. 16: Provide the equation for DI, or rephrase, because it is not simply the ratio, but rather the percentage.

P2. L 24: Remove "sea", or change to "marine"?

P2. L 24-25: If possible, specify if this the change in saturation is related to changing species or interspecies diol adjustments.

P2. L. 27: Remove "Preliminary"

P2. L28: "paleo-upwelling" could be used instead of past upwelling. Remove "as". Also, change "proxies" to "indicators" unless the reconstruction of upwelling rates is a quantitative transfer function.

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P3. L. 10: The Holocene is part of the Quaternary – no need to mention separately.

P3. L. 10: “large climate cycle” is kind of arbitrary

P3. L. 10: remove “bulk organic matter”

P3. L. 29: Can you include more specifics about the connection – namely, specify if stronger ACC and Westerlies result in warmer or cooler climate.

P. 3 L. 30-33. Does not follow from previous part of paragraph. I think it needs a segue from climate to upwelling/sedimentation dynamics, because this statement isn't about climate like the rest of paragraph. Also, please describe the subtropical high pressure system clearly because it is referred to later as a possible explanation.

P. 4 L. 2: There might be some variation in this, but I think a better spelling is Biobío

P. 4, L. 3: remove “both” and “large” to read “. . .which drain basins of 24,000 km<sup>2</sup>. . .”

P. 4 L. 13: Remove “providing the potential for high-resolution records” because it's not necessary and I don't think the author's did that kind of sampling.

P. 5 L. 5: If these benthic foraminifera data are already published, I don't think this paragraph is necessary, is it? Are any adjustments made to the McManus and Heusser paper? For brevity, this could be folded into the age model paragraph because it provides the basis for the correlations of the cores. This change is not critical for publishing the paper.

P. 6 L 9: Specify that the GDGT naming scheme in the following descriptions relates to the structures in Castañeda and Schouten, or some other appropriate reference.

P. 6 L. 28: Remove “in this case” and clarify that the BAYSPAR refers to the Tierney and Tingley citation.

P. 6 L. 31-32. Awkward phrasing because of passive voice.

P. 7. “Conductive”?

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P. 7, L. 7: “isomers can indicate these types of environments in the past...” should be rephrased because it is confusing as written.

P. 7 L. 8: Include a reference suggesting 0.3 is acceptable threshold for Methane Index.

P. 7 L 34: What was the injector configuration?

P. 8 L. 8: Helium does not need to be capitalized.

P. 8 L. 23: The first part of this sentence should be rephrased because it is confusing as written.

P. 8 L. 27: “..potentially riverine derived...” should be rephrased for grammar.

P. 8 L. 30: Given that you are testing the effectiveness of the NDI index, insert: “..The NDI index, a proposed proxy for PO43-...”

P. 10 L 34: Insert a comma after “In all sediments”

P. 10: It seems strange that crenarchaeol is the first biomarker presented when it has only been mentioned as a standard in the first part of the paper, and is never discussed or interpreted in any details. Could remove statement about crenarchaeol, else it should be discussed. Similarly, figures 4f and 4g and 4h come before 4a, 4b, etc. in the text. I recommend rearranging this so that diol results come first and things don't seem out of order, or just refer to them as figure 4.

P 10 L 4: The reported accumulation rate for crenarchaeol does not match what is shown in figure 4f.

P. 10 L. 16: Figure “4i”, not figure 4j. Also, the data are labeled pg g-1, but the text states  $\mu\text{g g}^{-1}$ . Likewise ng versus mg for the 1,14-diol accumulation rates.

P. 11 L 26-27: State on which proxies these estimates are based.

P. 11, L 28: The spline curves show a decrease of 4-6°C not 6-7°C. Smallest change is for iGDGTs.

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P. 12 L 27: "...since neither opal concentration nor opal or TOC-MAR increased simultaneously with TOC concentration" might help clarify this sentence.

P. 13, L 16: Intervals of enhanced upwelling are not explicitly labeled in Figs 3b and 3c.

P. 13, L 27. Rephrase "As for the diol index and the..." because this phrase has another common meaning than as it is used.

P. 14 L 10: "during/under" could just be "in"

Figure 4: How can there be sometimes more chaetoceros counts than total diatom counts?

Figure 5: What are the orange versus blue lines in the Site 1234 Benthic oxygen isotopes? It is not mentioned in the figure caption.

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