

Response to RC2

We thank the reviewer for their comments. We have provided responses to each comment below. Reviewer comments are in black and author comments are in gray.

Before I get to my review, I need to offer my sincerest apologies to the authors for taking so long to review this paper. A series of unfortunate errors on my part led to this paper falling through the cracks for a timely review. The underlying science of the manuscript didn't warrant such a slow response, and I owe the authors a significant apology for this error.

We appreciate the acknowledgement of the time delay.

The manuscript prepared by Palmer et al. is a literature review that incorporates data from 50-100 published studies of marine & terrestrial paleoclimate records from across the US West Coast and western US. The paper is arranged according to early, middle, and late Holocene time intervals, with subdivisions for each time period devoted to regional synthesis, terrestrial climate (including fire reconstructions), marine conditions (mostly SST & upwelling intensity), paleoecology (largely pollen-based as well as some limited consideration of marine diatom & foram fauna), human-environment interactions (e.g., archaeology), and/or specific climate events (e.g., Little Ice Age, 8.2 ka event, European colonization, etc.). Of particular significance is the inclusion of a series of maps that correspond to these different Holocene time intervals and climate interpretations of the underlying reviewed studies.

While the subject matter is of great interest to the field of paleoclimatology generally, and the US West Coast specifically, I take exception to this work on the basis of 4 reasons:

- Many of the subsections listed above are superficial treatments of the subject matter, particularly the archaeology subsections. In several cases, these subsections are based entirely on only 1-2 studies. Some of the human-environment interaction sections are so short, I wondered why the authors even considered writing them (e.g., Sect. 3.1.6, 3.2.5). Why the focus on the Channel Islands? There are thousands of archaeological sites in the western US, and if you really used only the search term "archaeology" as the basis for inclusion in your review, then there should be a LOT more information contained in your review! My suggestion is to either drop the archaeology sections since they are pretty tangential to the main climate thrust of the manuscript, or else improve the thoroughness of the archaeological review sections.

The reviewer brings up several important points. We address each here.

We will update the language in the methods section to indicate that the human-environment sections are not intended to be a comprehensive review, rather the goal of the paper was to conduct a comprehensive review of climate and to compare this to human history over time. In our revisions we will explicitly state that we intentionally choose to include human history as complementary to climate data, that data from human history are presented as snapshots falling within broader climate intervals that we examine, and that we utilize snapshots of human history to understand if human occupation/migration/behavior patterns aligned with climate interpretations (e.g., heightened conflict during drought periods). Further, human history, including Indigenous human history and colonization, is an important part of climate history. We will clarify the language around these sections and add additional studies and citations as suggested by RC2.

We focused on the Channel Islands because of the abundance of data available from these sites. The Channel Islands have excellent preservation: the longest and most continuous archaeological data come from here (addressed further below). We will add clarifying language around the Channel Islands and highlight that the focus on the Channel Islands is due to preservation alone, not its relative importance to climate history. The destruction of other archaeological archives throughout the West complicates reconstruction of human history over the entire area studied here.

- There is no consideration by the authors of the importance of age control regarding any of the records considered in this synthesis. I know this isn't the most fun subject to deal with, but you can't just ignore it. For example, several marine sediment records mentioned (e.g., Gardner et al., 1988; Barron and Bukry, 2007; Barron et al., 2017; McGann, 2015) either contain only 1 or 2 dates to pin down the entire Holocene, or are based on benthic forams that have huge reservoir corrections. I'd argue this fact may be a key reason to describe the lack of synchronicity in adjacent climate records that is mentioned in Line 856, or at least as important as the impacts of local vs regional "factors".

In this review, we maintain the original interpretations of the authors including both the age models and data interpretations. We attempt to include a diverse set of previously published studies and a variety of proxy types. As such, we maintain the original authors' interpretation of the proxy data as well as the original age model. Our work intentionally utilized the early, mid, and late Holocene as broad time bins to accommodate some age uncertainty. In our review, we will not recalibrate all age models, but throughout the text we will clarify the role of age uncertainty.

As the variability due to age control was highlighted by both RC1 and RC2 we will make two important changes. We will add statements throughout the paper highlighting the role of age uncertainty in interpretations. Additionally, we will add two columns to Appendix 1: type of chronology used and number of points in the age model. This will clarify the age model data for reviewers and readers.

Further, all interpretations from the second step of the review (coded results through time, Figures 2,3) are on millennial timescales, any exceptions to this will be noted in the updated manuscript. Importantly, the sections on the Medieval Climate Anomaly, Little Ice Age, and Era of Colonization are exceptions to our millennial-scale interpretations. We will clarify this in text.

- In the Methods section, you also highlight that you will "prioritize records with high temporal resolution, continuous records..." [Line 204] = you should state objectively what this high-resolution data threshold is. Also, archaeological midden piles are not continuous records, which again brings into question why the authors opted to discuss these papers in the context of this review.

As RC2 noted, there is variability in the development of age models. We will incorporate additional language about this variability in our revised manuscript and update the appendix (see above). To this specific point, for inclusion in step two of the review, studies must report reconstruction for at least "3000 years of the Holocene, and in which the authors must have identified and described a clear climatic pattern or patterns for an entire Holocene interval." [Line 180-183]. We will clarify in the text that the records we included are records of long temporal duration. We will change the language of this statement to state "prioritize continuous records."

Archeological midden sites provide snapshots of human history and due to the continuous deposition of material in midden sites, they can provide records through time, although these records are a collection of snapshots, rather than a continuous record. In addition to midden records, we also include pollen and fire records as they relate to human history in this area. See above for further explanation of inclusion of

archaeological data. We will add language to the paper to clarify the nature of midden (and other archeological data) as snapshots of human history, rather than a continuous record. In our revisions we will explicitly state that we intentionally choose to include human history as complementary to climate data, that data from human history are presented as snapshots falling within broader climate intervals that we examine, and that we utilize snapshots of human history to understand if human occupation/migration/behavior patterns aligned with climate interpretations (e.g., heightened conflict during drought periods).

- This manuscript requires significant restructuring. The research questions (hypotheses) are not introduced until Line 141, which is far too late in the introduction section. I read Sections 1.1 & 1.2 and got confused as to where this paper was going, as it rambled and lost focus until the hypotheses were introduced. Both of these sections can be culled by 50%. There is also no Discussion section that explicitly addresses the research questions using the results of the review, particularly Questions #2 and #3 (e.g., Lines 142-143).

The restructuring RC2 identifies is focused on the introduction and discussion. Regarding the introduction, we will improve the flow of the introduction by reducing the length of the section (per RC2), by incorporating line edits (provided by RC1), and making suggested changes to research questions (per RC1). The reviewer states that there is no discussion section that addresses the research questions 2 and 3. We chose to include a combined Results and Discussion section (as per the Climate of the Past protocol). In this section there are clearly labeled sections that discuss question 3 (ecological implications and human environment interactions). We will update the name of the Regional Synthesis sections to include language that indicates that these sections address the marine-terrestrial connections (question 2).

Minor issues

- There are many grammatical & style issues to address throughout the manuscript, particularly in the introductory paragraphs. Because I recommended you cull 50% of this section, I'm not going to go through that section in detail. However, the authors do need to pay attention to these issues in the rest of the manuscript. For instance, small typos such as in Line 198 [...(Figs.s 2,3)...] or Line 335 [add a comma after "of northern California"] require very detailed attention to catch, which the authors clearly need to do.

RC1 has kindly provided line edits that we will address. In addition to the line edits and restructuring of the introduction (see above), we will also take a close look at the grammar and style of the manuscript.

- The very first sentence of the manuscript's abstract begins with a prepositional phrase, which is considered bad form in scientific writing, so please re-write. The occasional prepositional phrase is okay, but generally you should avoid using them.

We will rewrite the first sentence of the abstract.

- The authors are inconsistent in their use of capitalization of directions to describe the western United States and the Northeast Pacific Ocean. There are specific rules for how to apply directional adjectives, check out <https://editorsmanual.com/articles/capitalizing-directions/> for examples.

We will update all capitalization.

- For the initial identification of potential studies using key words, which database(s) were used? Many bibliographical databases have known shortcomings (such as exclusion of key research papers that are older than a decade or two), so it is worth reporting this detail and defending its selection.

We will include further discussion of databases in the methodology section.

- Line 340: What is total carbon? Do you mean total ORGANIC carbon, or carbonate bound carbon? “Total carbon” is kind of a meaningless proxy, if that is indeed what you are reporting, so please clarify.

Total carbon was included by the original author. We will update the text to state “total carbon (organic carbon and carbonate bound carbon).”

- Fig 4b = Y-axis label is wrong, as there are 2 different proxies plotted (opal + sedimentary $d^{15}N$). Also, what is the color coding supposed to mean on all of these similar figures (e.g., Figs 4, 5)?

We will update the y-axis label on Figure 4b. We will clarify the use of colors in the figure caption.

- Appendix A = you have duplicated Columns 1 & 2, please clean it up.

We will update the titles of columns 1 and 2. These columns in fact are both needed as some papers include multiple sites that we include here.

In conclusion, I urge the authors to address these issues and re-submit the manuscript. I don't think any of these complaints are deadly to the manuscript, but some of them will require some time and careful effort to address. I hope the authors choose to pursue these modifications, as a Holocene-focused paleoclimatological synthesis of the US West Coast is of great interest to many scientists.

We appreciate this assessment and agree with the reviewer's assessment that this paper will be of value to the scientific community.