

Summary statement:

The authors effectively utilize a variety of paleoenvironmental indicators to reconstruct hydrological conditions over the past 2500 years in mid-to-low elevations of the Atacama Desert of northern Chile. Importantly, they draw from both paleoecological indicators as well as archaeological data to identify changes in surface hydrology in a hyper-arid desert setting. Based on 26 radiometric dates of macrobotanical remains from archaeological and natural depositional contexts, they identify three phases of increased surface hydrology over the past 2500. The general correspondence of these changes with other records of the western Andes suggests regional scale pluvial processes are involved in these hydrological conditions.

I believe the significance of this work is the integration of multiple lines of evidence for paleoenvironmental reconstruction at local and regional scales. Human activity is often thought to only passively respond to climatic shifts and changes in environmental parameters. The work of Gayo et al. recognizes the importance of (1) integrating both human and non-human data sets for paleoenvironmental reconstruction, but also (2) the role of humans in modifying local and regional environmental parameters (in this case, distribution of surface water and consequently vegetation). The authors also present a thoughtful discussion surrounding the evidence for natural (non-human) factors in promoting changes in vegetation and hydrology (changes in SST, highland precipitation, aquifer recharge) vs. cultural (human) factors (irrigation management of field systems and secondary vegetation growth). My comments on specific questions asked of the Climate of the Past review process are offered below.

**1. Does the paper address relevant scientific questions within the scope of CP?**

Climate and environmental change in the Atacama has been a growing focus of archaeological and paleoenvironmental inquiry over the past few decades, the significance of which is growing given current processes of global change and transformation of our planet's desert environments. In this context, and given the mission statement of Climate of the Past, the research presented in this paper is both appropriate and timely.

**2. Does the paper present novel concepts, ideas, tools, or data?**

The authors' coupling of both human and non-human records (e.g., archaeological, relic trees, rodent burrows) to reconstruct paleoenvironmental conditions is a novel approach to paleoenvironmental research. Recognizing that past human activity both reflects and impacts environmental change is an important element of current lines of environmental research. This work re-enforces the importance of combining multiple lines of evidence in a multi-scalar reconstruction of past climates and environments.

**3. Are substantial conclusions reached?**

The authors draw significant conclusions regarding paleoenvironmental reconstruction, specifically the use of ecological and archaeological data to interpret changes in surface hydrology, and they offer well-supported insight into the broad-scale mechanisms of climate and environmental change that may have catalyzed such conditions. The authors are also quick to offer alternative explanations or point out areas where additional research is need to either further support or reject their conclusions.

**4. Are the scientific methods and assumptions valid and clearly outlined?**

The methodological approach and assumptions are clearly outlined in the manuscript and are valid measurements for reconstructing paleoclimate/environment.

**5. Are the results sufficient to support the interpretations and conclusions?**

The results are generally sufficient to support the interpretations. Importantly, the authors present the shortcomings of their data, or alternate interpretations, as well.

**6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?**

Yes, I believe so.

**7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?**

All appropriate work appears to be referenced. The authors' original contribution is clear.

**8. Does the title clearly reflect the contents of the paper?**

The title is appropriate for this manuscript

**9. Does the abstract provide a concise and complete summary?**

The abstract is clear and appropriate for the work presented.

**10. Is the overall presentation well structured and clear?**

This manuscript is well written and well organized, with appropriate use of subheadings. The argument is well presented and includes relevant background information to contextualize the original research and data presented in the manuscript.

**11. Is the language fluent and precise?**

Language is precise and appropriate for this outlet. My only editorial comment refers to 3177, line 26-27: "over the last 14.6 million of years" should be "over the last 14.6 million years"

**12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?**

Symbols, abbreviations, and units appear to be correctly used.

**13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?**

Table 1 Radiocarbon – probability curves would be a helpful visual to accompany provenience and raw data. Alternatively, you might reference Figure 5 within the Table 1 caption to point out the dates in graphical format.

Table 2 plant macrofossil – middle of Table 2: why are there six locations with no data (i.e., QM-3, -14, -16, -18, -22A, -22C)?

Figure 1. excellent as is

Figure 2. good

Figure 3. good

Figure 4. I like the idea of including each of the images, but at the current scale, they are much too small to be effective. Groups of 2, 3, or 4 would be helpful. Of course, this would require several more figures, but the information would be much more effective and appropriate. As it stands, the figure would be very ineffective in print copies of the manuscript. Readers can zoom with respect to on-line viewing, but is a bit of an inconvenience.

Figure 5. Image should be a bit larger; difficult to read (particularly in print, but see comment on figure 4.).

Figure 5B. Is it possible to color coordinate lithic concentrations high/low with the red line to which it is linked?

Figure 5C. Should 'dashed horizontal line' be written as 'solid horizontal line'? There is no dashed line present.

**14. Are the number and quality of references appropriate?**

References seem appropriate to me.

**15. Is the amount and quality of supplementary material appropriate?**

If 'supplemental material' implies the number of figures and tables, then yes, it is appropriate. However, as mentioned above, Figure 4 should probably be broken into several figures to make the images more effective.

In summary, the authors present original and significant scientific research related to paleoenvironmental reconstruction and mechanisms of environmental change in the hyper-arid region of the northern Atacama desert. Their work is interdisciplinary, broad reaching, and well-organized, and it will be widely read by social and environmental scientists alike. It holds relevance to both our understanding of past cultural and environmental change and contemporary peoples in desert settings. I strongly support its publication in *Climate of the Past*.