

General comments:

The paper presents carbonate clumped isotope records of modern and Last Glacial Maximum (LGM) land snails from the island of Lanzarote, as well as LGM climate records simulated by various climate models. They found that temperatures reconstructed from LGM fossil snail carbonate clumped isotopes ($\Delta 47\text{-T}(\text{°C})$) were $-8.4 \pm 2.9 \text{ °C}$ lower than modern values ($\Delta 47\text{-T}(\text{°C})$), and this cooling magnitude was greater than those simulated by all climate models included in this study. It is widely recognized that reconstructing precipitation $\delta^{18}\text{O}$ using the evaporative snail body water flux model requires multiple variables. In this study, the authors constrained temperature using shell carbonate clumped isotopes and fixed relative humidity at approximately 90% based on the physiological traits of land snails in the study area and previous studies, thus reconstructing LGM precipitation $\delta^{18}\text{O}$ ($\delta^{18}\text{O}_{\text{precipitation}}$). Moreover, previous studies suggested that paleosol layers on Lanzarote indicate a more humid condition during the LGM. Based on previous work, the authors proposed that the high humidity derived from the Evaporative Snail Body Water Flux Model represents microenvironmental humidity. They further linked marine water to $\delta^{18}\text{O}_{\text{precipitation}}$ and $\delta^{18}\text{O}_{\text{shell}}$. After ice-volume correction, $\delta^{18}\text{O}_{\text{shell}}$ together with $\delta^{13}\text{C}_{\text{shell}}$ confirms a more arid climate in the study area during the LGM.

Currently, terrestrial paleoclimate records are mainly concentrated in mid- and high-latitude regions. On Lanzarote, it is difficult to find geological archives other than land snails that can be used to accurately reconstruct regional temperatures using carbonate clumped isotopes. Therefore, this study provides a new perspective for paleoclimate reconstruction in the low-latitude eastern Canary Islands during the LGM. In addition, the authors' approach of constraining the humidity parameter in the evaporative snail body water flux model based on snail physiological characteristics, as well as their strategy for validating the reliability of the humidity parameter, is also excellent.

However, there are also some problems that should be solved in this paper. The study repeatedly mentions that land snails on Lanzarote ingest dew water, which originates from the condensation of marine vapor. Nevertheless, this study did not consider the dew water isotope effect and directly equated the snail-imbibed water $\delta^{18}\text{O}$ output by the flux model with precipitation $\delta^{18}\text{O}$. Meanwhile, given the high sensitivity of relative humidity in this model, the validation of constraining relative humidity at 90% may also be challenged.

Specific comments:

Line 28-29: “Proxy data indicate that LGM mean annual air temperatures $\sim 8.4 \text{ °C} \pm 2.8 \text{ °C}$ cooler than...”

This sentence is missing the predicate **were**.

Line 51-53: “on the island of Lanzarote to assess both the modern climate and the Last Glacial Maximum ($\sim 23\text{-}24 \text{ ka}$).”

The LGM is defined as $\sim 21 \text{ ka}$ in Line 21, but your LGM samples are dated to $\sim 23\text{-}24 \text{ ka}$. It is recommended that you revise the term to early Last Glacial Maximum (early LGM).

Line 174: *Bao et al., 2023*

The bibliography does not contain this reference.

Line 227 -228: “... do not exhibit any season-dependent change in behavior.”

It is a little bit arbitrary to state that there are no seasonally related behavioral changes here. This contradicts lines 370-372, where the lower temperatures reconstructed from clumped isotopes are attributed to the cold preference of snails.

Line290: " $R_{sbw} = \alpha_{w-v}(\alpha k (1 - h_{surf}) R_{surf} + h_{surf} R_{vap})$ "

The original formulas in Balakrishnan & Yapp (2004) and the Craig-Gordon model of lake evaporation include the ratio of water outflow flux (other than evaporation) to water inflow flux. You have set this ratio to 0 by default here. It is suggested that you explain why you assume nearly all snail body water is lost via evaporation.

Line 437-438: "*Therefore, it is possible that a rainout effect during the wintertime leads to more depleted values relative to the present.*"

The explanation that the Hadley Centre model simulates more negative winter $\delta^{18}\text{O}_{\text{precipitation}}$ due to a rainout effect caused by approximately half an inch more winter precipitation during the LGM than in the pre-industrial period is somewhat unconvincing. First, you do not specify the actual difference in $\delta^{18}\text{O}_{\text{precipitation}}$ between the LGM and the present. Second, it remains unclear whether this half-inch precipitation difference falls within the model simulation error, making it difficult to assess the magnitude of the rainout effect exerted by such a small precipitation anomaly on the $\delta^{18}\text{O}_{\text{precipitation}}$.

Line484-487: "*so the Balakrishnan & Yapp model produces results consistent with lower relative humidity at these warmer temperatures,*"

It is mentioned that the LGM temperature reconstructed from snail carbonate clumped isotopes is warmer than winter temperatures. Please clarify which climate model was used to simulate these winter temperatures and provide the specific temperature values. In addition, do you think this argument is reasonable?

Line459 -462: "*The reconstructed $\delta^{18}\text{O}_{\text{precipitation}}$ values for both modern and LGM datasets are indistinguishable from one another (-4.6 ‰, 95% C.I. = 0.6 for the modern, and -4.7 ‰, 95% C.I. = 0.6 for the LGM once corrected), suggesting that while temperatures were cooler at this site during the LGM relative to the present, the cumulative $\delta^{18}\text{O}_{\text{precipitation}}$ signal remained the same.*"

You reconstructed $\delta^{18}\text{O}_{\text{precipitation}}$ using the Balakrishnan & Yapp (2004) snail flux-balance model. However, you implied in Lines 523-524 and Lines 207-208 that snails may ingest dew as a water source. Jiawei Da (2025, CG; [Isotopic evidence for dew uptake by land snails from Bayesian modeling of body water \$\delta\text{D}\$ and \$\delta^{18}\text{O}\$](#)) demonstrated that a high proportion of dew intake by land snails can lead to overestimated relative humidity from the flux-balance model output. I suggest you add a sensitivity analysis to evaluate how dew proportion affects the retrieved humidity and $\delta^{18}\text{O}$ of snail-ingested water.

Line488-490: "*The LGM land snail samples are also unlikely to be indicative of full summertime growth because the calculated relative humidity is greater than 100% -- not physically impossible, but likely an implausible circumstance given the proximity to a major dust source that could trigger condensation.*"

Since there is nearly no summer precipitation, using summer precipitation isotopes to simulate

relative humidity becomes meaningless. In Lines 494-496, it has already been stated that isotopic data from modern snail shells better match the late spring to early autumn period. It is therefore suggested that the simulation should instead use precipitation isotope data for this time window directly.

Line547-548: *“...the reconstructed $\delta^{18}O$ precipitation values show a possibility of aridity driving enrichment of heavy isotopes.”*

You attribute the heavier $\delta^{18}O_{\text{shell}}$ values after ice-volume correction to evaporation. According to my understanding, “heavier” here means that $\delta^{18}O_{\text{shell}}$ is heavier than the $\delta^{18}O_{\text{shell}}$ derived from theoretical fractionation based on LGM $\delta^{18}O_{\text{precipitation}}$. You also mentioned in lines 528–530 that the LGM precipitation baseline is -3.5‰ and the seawater baseline is 1.08‰ . Therefore, is it possible that a higher proportion of dew consumed by land snails caused $\delta^{18}O_{\text{shell}}$ to be heavier than theoretical expectation? Please evaluate the impact of this scenario on your aridity assessment.