nature portfolio

Peer Review File

Late Pleistocene-to-Holocene Ecological Change and Hunter-Gatherer Adaptations in Lesotho, Southern Africa

Web links to the author's journal account have been redacted from the decision letters as indicated to maintain confidentiality

7th Dec 22

Dear Dr Patalano,

Your manuscript titled "New Proxy Record of Late Pleistocene-to-Holocene Ecological Change and Afromontane Human Adaptations in Lesotho, Southern Africa" has now been seen by 2 reviewers, and I include their comments at the end of this message. They find your work of interest, but some important points are raised. We are interested in the possibility of publishing your study in Communications Earth & Environment, but would like to consider your responses to these concerns and assess a revised manuscript before we make a final decision on publication.

We therefore invite you to revise and resubmit your manuscript, along with a point-by-point response that takes into account the points raised. Please highlight all changes in the manuscript text file.

We are committed to providing a fair and constructive peer-review process. Please don't hesitate to contact us if you wish to discuss the revision in more detail.

Please use the following link to submit your revised manuscript, point-by-point response to the referees' comments (which should be in a separate document to any cover letter) and the completed checklist:
[link redacted]
** This url links to your confidential home page and associated information about manuscripts you may have submitted or be reviewing for us. If you wish to forward this email to co-authors, please delete the link to your homepage first **

We hope to receive your revised paper within six weeks; please let us know if you aren't able to submit it within this time so that we can discuss how best to proceed. If we don't hear from you, and the revision process takes significantly longer, we may close your file. In this event, we will still be happy to reconsider your paper at a later date, as long as nothing similar has been accepted for publication at Communications Earth & Environment or published elsewhere in the meantime.

We understand that due to the current global situation, the time required for revision may be longer than usual. We would appreciate it if you could keep us informed about an estimated timescale for resubmission, to facilitate our planning. Of course, if you are unable to estimate, we are happy to accommodate necessary extensions nevertheless.

Please do not hesitate to contact me if you have any questions or would like to discuss these revisions further. We look forward to seeing the revised manuscript and thank you for the opportunity to review your work.

Best regards,

Alienor Lavergne, PhD
Associate Editor

Communications Earth & Environment

EDITORIAL POLICIES AND FORMATTING

We ask that you ensure your manuscript complies with our editorial policies. Please ensure that the following formatting requirements are met, and any checklist relevant to your research is completed and uploaded as a Related Manuscript file type with the revised article.

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Furthermore, please align your manuscript with our format requirements, which are summarized on the following checklist:
Communications Earth & Environment formatting checklist

and also in our style and formatting guide Communications Earth & Environment formatting guide .

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In particular, the Data availability statement should include:
- Unique identifiers (such as DOIs and hyperlinks for datasets in public repositories)
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Please refer to our data policies at http://www.nature.com/authors/policies/availability.html.

REVIEWER COMMENTS:

Reviewer #1 (Remarks to the Author):

1. This paper is well written but a complex topic. I don't know if it is possible to discuss this topic any clearer, but I encourage the authors to look for ways to make it more readable. But in any case, I think this is original and important work that should be published. I should state that I am not an expert on plant waxes so my comments are focused on the archaeology. The results seem to be valid, the data and methods are reliable, and the comparison to other paleoenvironmental/climatic records complete. I would suggest that the authors use nonparametric rather than parametric statistical methods because it is not clearly stated that these samples are normally distributed. I also think more attention should be given to the Bayesian chronological model and an additional figure showing the calibrated adjustments with the appropriate explanations be added to the Supplemental Information. I also think that a stratigraphic profile should be added that shows the position of the various wax samples and radiocarbon samples. Finally, the paper needs a discussion on taphonomy of the plant waxes that includes transportation processes of plant materials into the shelter deposits, how human selection may have influenced the samples, and why the human selection process is immaterial to the climatic interpretations.

Reviewer #2 (Remarks to the Author):

This paper presents new plant leaf wax biomarker data derived from sediments from the archaeological rock shelter site of Ha Makotoko in western Lesotho (southern Africa).

The compound-specific stable carbon and the hydrogen isotope records are able to characterize vegetation composition changes and changes in precipitation from MIS 3 into the Holocene. From the data, a clear distinction can be made between the late Holocene and the period from MIS 3 – the early Holocene. From the new data new insights and more detail is provided in terms of palaeoclimates over this period. The authors assert that the stability of the climate within the Pleistocene – with uniform rainfall amounts together with perennial

freshwater reserves and reliable food resources - were the incentives for persistent habitation within this inland mountain region.

My one major comment to the authors is that I do not agree with the assertions relating to "on-site" being more useful/applicable than "off-site". I agree in terms of applications to elucidating evidence of hominin habitation and how they may have used resources and modified landscapes etc. But in terms of reconstructing palaeoenvironments and palaeoclimates, I think that natural archives are far superior to "on-site" archaeological sediments. The fact that sediments within an archaeological context such as a rockshelter comprises of occupational sequences surely means that the sediments are modified/disturbed/altered. There are also clear sedimentation accumulation hiatuses meaning that records derived from these sources are discontinuous. Natural palaeo-archives, which within the context of southern Africa normally take the form of sediment cores from wetlands and rock hyrax middens, have the potential to be highly spatially and temporally resolved. They are also, in many cases, well-dated and therefore have robust chronologies and the potential for high-resolution palaeoclimate data.

Is there potential for natural archives to be analyzed from nearby Ha Makotoko rockshelter? This would be a useful means to calibrate the rockshelter biomarker data and strengthen the claims that anthropogenic modifications did not alter the biomarker data.

Specific Comments:
The title could be improved, the "New Proxy Record" part sounds rather vague (and not fully accurate given that I'd say its multi-proxy derived from one overriding method which is not "new"). Could possibly just delete that phrase.

Line 45: "Meanwhile" seems like the wrong word here

Lines 79 – 81: "However, these environmental records are often located far from archaeological sites and cannot reveal the ecological subtleties that on-site and catchment scale (i.e., proximal) records provide"
What do you mean by ecological subtleties? (and these I am assuming do not equate to palaeoclimate subtleties, which is the objective here)

Line 325 - 327: "Our δ13C and δD data document this directly as the increase in C4 plants in the Holocene is positively correlated with higher temperatures and warm-season precipitation"
Reference / reference to a Figure missing here

Lines 330 – 336: A bit of a disconnect between these two sentences.

The sediments themselves:
I would have liked to have more details about the site, the sample collection procedure and the nature of the sediments that were analyzed within the SI material –most of this information is presented in the earlier paper relating to the bulk isotope data but this is not very clear.

The chronology:
Why IntCal and not SHCal?
No age-depth model figure presented (but referred to it in Line 500)

Interpretation of the results:
I commend the authors in terms of the thorough, yet concise, explanations relating to the interpretation of the biomarker data, and I fully agree with these interpretations if/when applying to sediments/soils not part of an archaeological sequence.
Out of interest was any work done on identifying and characterizing polycyclic aromatic hydrocarbons (PAHs)? Is there evidence of burning within the sediments and what would the effect of burning be on the n-alkane data?
Is there evidence of bedding material in the shelter and if so, would this affect the biomarker signals? For example, if grasses were used and incorporated into the sediments would this not bias/alter the signal?

The unpublished phytolith data: unable to examine this or verify the claims made using this data without it being published or presented here.

Figure 1:
Reference / source for the vegetation data missing.

Figure 4:
Is the hiatus between ~30 – 11 ka in the data presented as plots A an B explained in the paper / SI?
There seems to be a slight difference between these plots and the data in the Dataset 1 spreadsheet: there is data from mean age of 23.5 ka, unless mean ages where not used for this figure?
I suggest including the age uncertainty envelopes for plots A and B.

Supplementary Information
Plant Wax Isotope Ratios: any significant contributions of CAM plants in the area that need to be taken into account?

Table S1
Include the units for the depth and thickness columns and include a last column with the median/mean calibrated age.
Also again, why IntCal20 and not SHCal20?

Point-by-Point Response to Reviewers

Patalano et al., Late Pleistocene-to-Holocene Ecological Change and Afromontane Human Adaptations in Lesotho, Southern Africa

We wish to thank the reviewers for their helpful, thorough, and constructive comments. We acknowledge and accept most of the suggestions made by both Reviewers and have provided our responses and documented our changes accordingly. We are fortunate for the time and effort they have put into improving and strengthening the manuscript. To highlight our reply to each recommendation, we provide a detailed list responding to comments made by the reviewers below. We feel that our detailed response to the Reviewer's comments demonstrates the added value of our approach and illustrates the advantage of using these organic materials as proxies for regional environment and climate changes in Lesotho upland environments.

Reviewer 1:

I would suggest that the authors use nonparametric rather than parametric statistical methods because it is not clearly stated that these samples are normally distributed.

We would like to thank the Reviewer for this suggestion. We have now included additional nonparametric statistical tests, specifically Mann-Whitney *U* and Kruskal-Wallis tests to test for differences in $\delta^{13}C$ and δD values between the C_{29}, C_{31}, and C_{33} *n*-alkanes. We also performed Spearman's rank tests to correlate the molecular characterizations of $ACL_{25\text{-}35}$, $CPI_{25\text{-}35}$, $\delta^{13}C$, and δD of the individual C_{29}-C_{33} *n*-alkanes. All tests were run using PAST 4.03 and three new tables were created to display the statistical results.

I also think more attention should be given to the Bayesian chronological model and an additional figure showing the calibrated adjustments with the appropriate explanations be added to the Supplemental Information.

Thank you for this suggestion. We agree that the Bayesian chronological model is another further important output of this research and have now tried to highlight its significance a little more and make it more prominent in terms of the Results and Discussion. We also have updated the text in the Methods and Supplementary Information.

I also think that a stratigraphic profile should be added that shows the position of the various wax samples and radiocarbon samples.

We have included a new stratigraphic profile (Fig. S5) of the main excavation area from Ha Makotoko. Samples analyzed in this study came from an adjacent geoarchaeological column that had direct stratigraphic relationships to those in the open excavation area. This, and a secondary column, were positioned at different areas of the site, specifically near the main excavation areas to capture any functional changes in the internal spaces of the site. Samples were taken as loose sediment from contexts that had direct stratigraphic relationships to those in the main archaeological trench.

Finally, the paper needs a discussion on taphonomy of the plant waxes that includes transportation processes of plant materials into the shelter deposits, how human selection may have influenced the samples, and why the human selection process is immaterial to the climatic interpretations.

We thank the Reviewer for this very important point. We have added a new paragraph to the *Effectiveness of Biomarkers in Archaeological Contexts* section within the Discussion. We feel that the new paragraph stresses the limitations of using plant wax biomarkers in rockshelters but also highlights that the environmental evidence from the *n*-alkanes is still representative of region changes in plant ecology and hydrology.

"*As Ha Makotoko was exposed to the prevailing winds of the Phuthiatsana Gorge, aeolian plant waxes are likely to be the dominant source of rockshelter sedimentary n-alkanes. In terrestrial sediments, wind and dust act to ablate leaf waxes, a portion of which accumulate in the air as micrometre-sized particles*[80-82]*. These molecules then serve as proxy measures of the vegetation that synthesized them. We cannot rule out, however, that humans selected from specific plants surrounding the site and brought them into Ha Makotoko, or that there was a change in collecting strategies in the late Holocene compared to older layers, which could have contributed to the observed change toward increasing* C_4 *input and increased precipitation. Nevertheless, climate, specifically temperature, appears to be the predominant control on vegetation distribution in Lesotho and would have influenced the availability of plants to select from or those being ablated and transported by wind (SI: Plant Type Distribution and Ecology). When other records from southern Africa suggest Holocene increases in temperature and precipitation (see Fig. 4 and sections below), isotope analyses and phytoliths suggest more abundant* C_4 *plants. This is something we also observe in our own data and, as a result, we are confident that it indicates changes in the local landscape, whether in addition to or over selection strategy changes.*"

<u>Reviewer 2</u>

My one major comment to the authors is that I do not agree with the assertions relating to "on-site" being more useful/applicable than "off-site".

We thank the Reviewer for this fully valid and important point. We had not meant to suggest that 'off-site' data is not useful or applicable, but rather instead sought to emphasize the importance of both scales of analysis working in tandem. We have now amended this section to show that both types of records are essential, especially when they can be used in comparison, and have changed the text so that it does not read as if on-site record are more useful/applicable.

"*Long-term proxy records from southern Africa show the potential impacts of changing plant landscape composition and hydroclimate on human populations over the Quaternary*[32-42]*. Because these environmental records are often located far from archaeological sites, however, it is important to compare these data to on-site and catchment scale (i.e., proximal) records to develop highly spatially- and temporally-resolved palaeoclimate and palaeoenvironmental information relevant to human evolution*[43-46]*. As a result, if we are to understand human adaptations to ecological variability associated with Late Quaternary climatic fluctuations in the interior of southern Africa, it is essential to examine records from archaeological sediments that can*

elucidate local responses of specific ecological communities and biomes to climatic change at sites where rich cultural assemblages have been recovered."

There are also clear sedimentation accumulation hiatuses meaning that records derived from these sources are discontinuous.

We have included a new section in the Methods to highlight the uncertainties associated with this hiatus.

"*There is a large sedimentation accumulation hiatus at Ha Makotoko between MIS 3 and the Holocene. Although we cannot say for certain, it is possible that changes in wind patterns either prevented rockshelter sediment accumulation or, alternatively, removed whatever had accumulated naturally. Additionally, a lack of human activity in the rockshelter may have prevented sediment buildup or worsened wind erosion of sediments. The overall occupation record of the region suggests that there may have been very few people in the area between ~30 and 13 ka, except for very brief and highly episodic visits*[122]*. That is, the generally colder conditions of the LGM may have instigated shifts in settlement patterns away from (certain) rockshelters, such as Ha Makotoko. Nevertheless, from the age-depth model perspective (see below), halted or eroded accumulation of sediments are equal, meaning that from the perspective of tie-points, there does not appear to be any compelling evidence of reversals or serious mixing of sediment throughout the sequence. The sedimentary structure and contexts of the geoarchaeological column and excavation trench suggests it is unlikely that the rockshelter sediments were severely turbated."*

Is there potential for natural archives to be analyzed from nearby Ha Makotoko rockshelter? This would be a useful means to calibrate the rockshelter biomarker data and strengthen the claims that anthropogenic modifications did not alter the biomarker data.

In 2010, coauthors Mike Morley and Adrian Parker conducted geoarchaeological and palaeoenvironmental research in the Phutiatsana Gorge. We are also conducting a project looking at modern data and elevation and the impact of temperature (associated with altitude) on plant type distribution. We currently have multiple transects that span 1600 – 3200 m.a.s.l and $\delta^{13}C$ data from plant wax biomarkers. That particular paper is forthcoming.

The perceived power of isotope analyses in Lesotho is currently based on bulk $\delta^{13}C$ measured on grasses from four altitudinal transects between 1,600 and 2,600 m a.s.l. in 1994/5, and assumptions coming from fluctuations seen in palaeoenvironmental records of soil organic matter and mammalian tooth enamel. This principle has been well-established and utilized in a number of studies in Lesotho, as well as in other high-altitude areas in Africa.

We thank and agree with Reviewer 2's suggestion to shorten the title.

The title is now "Late Pleistocene-to-Holocene Ecological Change and Afromontane Human Adaptations in Lesotho, Southern Africa."

Line 45: "Meanwhile" seems like the wrong word here

"Meanwhile" has been deleted.

Lines 79 – 81: "However, these environmental records are often located far from archaeological sites and cannot reveal the ecological subtleties that on-site and catchment scale (i.e., proximal) records provide"

See above. We have now changed this text accordingly.

Line 325 - 327: "Our $\delta^{13}C$ and δD data document this directly as the increase in C_4 plants in the Holocene is positively correlated with higher temperatures and warm-season precipitation." Reference / reference to a Figure missing here.

We have now referenced Figure 4.

Lines 330 – 336: A bit of a disconnect between these two sentences.

We have amended the second sentence to highlight that ACL is also indicative of warm temperatures or increases in C_4 plants, which hopefully connects better to the previous sentence in which we outline that C_4 abundance increased even though precipitation was higher, which would be more beneficial to C_3 plants if temperatures had not also increased.

"*The higher $ACL_{25\text{-}35}$ values in the late Holocene samples also help explain elevated growing season temperatures as a mechanism for ecosystem change because ACL correlates with higher growing season temperatures[85-89] and has been shown to be higher for C_4 grasses[83]*."

I would have liked to have more details about the site, the sample collection procedure and the nature of the sediments that were analyzed within the SI material – most of this information is presented in the earlier paper relating to the bulk isotope data but this is not very clear.

We have now addressed this and added more details in relation to the site, sample collection, and the nature of the sediments in the Methods:

*"**Site Overview and Sampling.** Ha Makotoko rockshelter (29°19'26"S, 27°48'13"E) was found on the south side of the Phuthiatsana River before being drowned by the Metolong Dam reservoir in 2014. It had a northwesterly aspect (300˚) and received direct sunshine for much of the year, thus being on the slope face where the transition to C_3-dominated vegetation only occurs around 2,700 m.a.s.l. The rockshelter had a ~60 m wide dripline, a maximum depth of 22 m, and a total area of approximately 820 m^2. Ha Makotoko was the largest rockshelter along the Phuthiatsana.*

Sediment samples (n=21) were taken from a geoarchaeological column adjacent to the primary excavation trench (Fig. S5) during the 2009/2010 excavations[17,53]. This, and a secondary column, were positioned at different areas of the site, specifically near the main excavation areas for the 1989 and 2009/2010 field seasons, to capture any functional changes in the internal spaces of the site. Samples were generally selected from the 2009/2010 column to facilitate complementary micromorphological, particle size (125 ml), phytolith (125 ml), and stable carbon

isotope analyses (125 ml), including plant wax biomarkers. These were taken as loose sediment from contexts that had direct stratigraphic relationships to those in the main archaeological trench. Any sample that had visibly high concentrations of charcoal were avoided to prevent the analysis of n-alkanes degraded by intensive burning or heating."

The chronology: Why IntCal and not SHCal? No age-depth model figure presented (but referred to it in Line 500)

This was an oversight and we greatly appreciate the reviewer catching it. The code and model have now been updated with SHCal. No major changes occurred in the modelled ages. We have also added the missing plot to the SI.

Out of interest was any work done on identifying and characterizing polycyclic aromatic hydrocarbons (PAHs)? Is there evidence of burning within the sediments and what would the effect of burning be on the n-alkane data?

We have not yet studied the sediments for PAHs, but are developing the protocol for doing so in our lab. We know other studies have done exactly this and showed that burning played a major role in the concentration of sedimentary biomarkers from Diepkloof so it is definitely something that we must consider in future studies. In our study, any sample that had visibly high concentrations of charcoal were avoided to prevent the analysis of *n*-alkanes degraded by intensive burning or heating.

Is there evidence of bedding material in the shelter and if so, would this affect the biomarker signals? For example, if grasses were used and incorporated into the sediments would this not bias/alter the signal?

Although we do not have direct evidence of this, we must assume that human selection may have been responsible, at least in part, for the accumulation of biomarkers in the site. We have added a new paragraph to the *Effectiveness of Biomarkers in Archaeological Contexts* section within the Discussion detailing this (see above). This is also addressed in Roberts et al. (2013) (reference 14 in the main manuscript) regarding bedding being brought into Ha Makotoko and Ntloana Tšoana, and in Parker et al. (2011) (reference 18 in the main manuscript) regarding the Likoaeng archaeological site in the Senqu Valley. Bedding being brought into the sites would reflect the broader local vegetation, and should therefore at least parallel environmental shifts. The new paragraph now states:

We cannot rule out, however, that humans selected from specific plants surrounding the site and brought them into Ha Makotoko, or that there was a change in collecting strategies in the late Holocene compared to older layers, which could have contributed to the observed change toward increasing C_4 input and increased precipitation. Nevertheless, climate, specifically temperature, appears to be the predominant control on vegetation distribution in Lesotho and would have influenced the availability of plants to select from or those being ablated and transported by wind (SI: Plant Type Distribution and Ecology). When other records from southern Africa suggest Holocene increases in temperature and precipitation (see Fig. 4 and sections below), isotope analyses and phytoliths suggest more abundant C_4 plants. This is something we also observe in

our own data and, as a result, we are confident that it indicates changes in the local landscape, whether in addition to or over selection strategy changes.

The unpublished phytolith data: unable to examine this or verify the claims made using this data without it being published or presented here.

Unfortunately, this data is being used to prepare a separate manuscript so we could not provide the full data here. We do however, reference to other publications that did study phytoliths from Lesotho for the same timeframe:

Parker, A. G., Lee-Thorp, J. & Mitchell, P. J. Late Holocene Neoglacial conditions from the Lesotho highlands, southern Africa: phytolith and stable carbon isotope evidence from the archaeological site of Likoaeng. *Proceedings of the Geologists' Association* **122**, 201-211, doi:https://doi.org/10.1016/j.pgeola.2010.09.005 (2011).

Stewart, B. A. *et al.* Afromontane foragers of the Late Pleistocene: Site formation, chronology and occupational pulsing at Melikane Rockshelter, Lesotho. *Quaternary International* **270**, 40-60 (2012).

We leave it up to the Editor as to whether it is more appropriate to remove it for now.

Figure 1: Reference / source for the vegetation data missing.

We have now updated the text accordingly:

Maps created using ArcGIS Pro desktop GIS software developed by Esri and bioregion information from reference 49.

Figure 4: Is the hiatus between ~30 – 11 ka in the data presented as plots A an B explained in the paper / SI? There seems to be a slight difference between these plots and the data in the Dataset 1 spreadsheet: there is data from mean age of 23.5 ka, unless mean ages where not used for this figure? I suggest including the age uncertainty envelopes for plots A and B.

This has been updated with the new age-depth model. Originally, we had used the upper 95% range limit for this sample (31580), but have now used the mean years before present value (26188) in Figure 4. This change does not impact our overall interpretations, but the sample's age range is factored into the issues with our sediment accumulation hiatus (from Methods: Site Overview and Sampling):

"*There is a large sedimentation accumulation hiatus at Ha Makotoko between MIS 3 and the Holocene. Although we cannot say for certain, it is possible that changes in wind patterns either prevented rockshelter sediment accumulation or, alternatively, removed whatever had accumulated naturally. Additionally, a lack of human activity in the rockshelter may have prevented sediment buildup or worsened wind erosion of sediments. The overall occupation record of the region suggests that there may have been very few people in the area between ~30 and 13 ka, except for very brief and highly episodic visits*[122]*. That is, the generally colder conditions of*

the LGM may have instigated shifts in settlement patterns away from (certain) rockshelters, such as Ha Makotoko. Nevertheless, from the age-depth model perspective (see below), halted or eroded accumulation of sediments are equal, meaning that from the perspective of tie-points, there does not appear to be any compelling evidence of reversals or serious mixing of sediment throughout the sequence. The sedimentary structure and contexts of the geoarchaeological column and excavation trench suggests it is unlikely that the rockshelter sediments were severely turbated."

We have also updated figures 3 and 4 to highlight this hiatus.

Supplementary Information: Plant Wax Isotope Ratios: any significant contributions of CAM plants in the area that need to be taken into account?

This is difficult to determine solely with isotopes as CAM plants often have overlapping values with both C_3 and C_4, specifically facultative CAM-C_3 species. Generally, from an ecological sense, the Maloti-Drakensberg can be separated into Montane, Subalpine, and Alpine vegetation altitudinal zones, with transitions between zones occurring lower or higher on a slope according to aspect. *Themeda triandra* (C_4 grass) tends to be more important at the lower and middle elevations while *Festuca caprina* (C_3 grass) dominates at higher altitudes, although there is considerable altitudinal overlap between these species. The medium-tall grass *Merxmuellera macowanii* occurs along water courses and drainage lines, like in the Phuthiatsana Gorge, but herb species in the Asteraceae family increase alpha diversity considerably.

There are, however, a number of plant families that contain species which exhibit crassulacean acid metabolism (CAM) photosynthesis, in addition to combined C_3-CAM and C_4-CAM photosynthesis. Not all are necessarily known, but are assumed based on other species in the same families which are found outside of Lesotho. Whilst some are classified as constitutive CAM plants, some of these species might also show some degree of plasticity in CAM expression in response to environmental conditions. For example, those in the Aizoaceae family, unlike many other succulents, do not rely solely on CAM photosynthesis, but instead, switch back and forth between C_3 and CAM, presumably to improve plant water-use efficiency. A number of succulents in the Asphodelaceae family, like *Aloe* species, use CAM photosynthesis but generally do not make up large portions of the vegetation in this part of Lesotho. With regard to $\delta^{13}C$, some CAM and most facultative CAM species (Boom et al., 2014) have overlapping values with C_3 plants in their C_{29}-C_{33} *n*-alkanes, which therefore causes issues with understanding ecosystem scale C_3-C_4 proportions.

Nevertheless, seeing as Ha Makotoko is located in the Mesic Highveld Grassland bioregion, which is dominated by grasses, who do not think our precipitation and temperature change interpretations are misguided and that the overall contribution of CAM plants is minimal. Indeed, CAM plants are most densely concentrated in highly arid regions. This is also confirmed by phytolith work in the region (Parker et al., 2011; Stewart et al., 2016), with the phytolith assemblage being dominated by the presence of C_3 Pooid forms, but also includes a notable presence of Panicoids (bilobate, polylobate forms) and some Chloridoids (saddles). This information is now outlined in the SI.

6th Mar 23

Dear Dr Patalano,

Your manuscript titled "Late Pleistocene-to-Holocene Ecological Change and Afromontane Human Adaptations in Lesotho, Southern Africa" has now been seen by our reviewers, whose comments appear below. In light of their advice I am delighted to say that we are happy, in principle, to publish a suitably revised version in Communications Earth & Environment under the open access CC BY license (Creative Commons Attribution v4.0 International License).

We therefore invite you to revise your paper one last time to address the remaining concerns of our reviewers. At the same time we ask that you edit your manuscript to comply with our format requirements and to maximise the accessibility and therefore the impact of your work.

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Best regards,

Alienor Lavergne, PhD
Associate Editor
Communications Earth & Environment

REVIEWERS' COMMENTS:

Reviewer #1 (Remarks to the Author):

The authors have adequately addressed my previous concerns. I have no further comments and recommend the paper for publication.

Reviewer #2 (Remarks to the Author):

I am satisfied with the authors' responses to my comments and questions.

My only final - and minor - comment is that I think the title could still be improved upon, the phrase "Afromontane Human Adaptations" sounds awkward to me.