

Responses to reviewers' comments

We appreciate the positive comments of both reviewers on the revised version of our manuscript. We describe the final changes made below, along with our point-by-point response to the reviewers' comments. For clarity, the comments of the reviewers are shown *in italics*, while our response with an indication of the lines and references in the revised MS track-change is presented in normal font.

Author response Referee #1

I highly appreciate the authors' diligence in responding to reviews. This is an interesting data set and study that will be of interest to the scientific community and the revisions have made this a much better paper. I have a few suggestions for minor changes but think this paper is ready for publication after these few changes for grammar and clarity.

REPLY: First, we would like to express our gratitude to Referee#1 for his/her favorable appraisal and insightful remarks on our revised manuscript.

Referee#1's comments are as follows:

-Line 42: I think this should be "island's" not "islands" - as Madagascar is one island.

Reply : We have corrected this as suggested. (Abstract. L46)

-L132 should be "...ranging from 11...to 28..." or "ranging between...to..."

Reply: We have corrected this accordingly. (2.1 Study Area. L126)

-L138" this paragraph is much improved but I wonder if the connection between this historical intensification in grazing and the increase in C4 grasses can be more explicitly stated. If not, perhaps you can present this as a hypothesis that you will support in this study?

Reply: The relationship between the historical intensification of grazing and the increase of C4 grasses has not been directly explored. There is recent work from our group looking into changes in lava erosion rates (Brosens et al. 2022), and work based on pollen and charcoal records in sediment cores of Lake Alaotra that shows a vegetation transition in the catchment (Broothaers et al. in revision). However, neither of these allows us to conclude whether grazing followed an opening in the landscape, or was partially responsible for this shift. As we do not have a clear hypothesis to favor one scenario over another, we prefer to keep this open.

-L139 “the period considered” seems unfinished (considered for what?) or do you just mean “in this period”?

Reply: Indeed, we are referring to the period when lavaka erosion rates increased dramatically. Therefore, we modified the text as suggested. (2.1 Study area. L134)

-L155 “If almost part of...” should be something like “While most of..”I think you can more clearly explain that the C4 grasses are indicative of cattle grazing while C3 grasses and forest vegetation suggest less anthropogenic influence.

Reply: Thank you for your comments. We have corrected the text as suggested. Indeed, the abundance of C4 grasses could be indicative of the importance of cattle grazing, yet any opening of the landscape would likely result in a dominance of C4 rather than C3 grasses given the temperature & precipitation regime in the region (Zhang et al., 2014). Moreover, in our introduction section, we mentioned that the C4 grasses might be an ancient origin and endemic in Madagascar, thus, in this section (description of the study area) we could not yet assume that the C4 grasses are linked to cattle grazing. (2.1 Study area.L155)

-L164 “and bamboos” does not flow with the rest of the sentence. Can this be deleted? I am not sure what it means – the forest shade clade C3 grasses are one type and the bamboos are another?

Reply: We removed “and bamboos” as suggested. (2.1 Study area. L164)

-L248 it is not entirely clear that the soil samples for 14C analysis were acidified in tin cups because the 14C analysis follows the description of the 13C equations and C3/C4 partitioning. This could be clarified here (e.g. with “on bulk soils loaded into tins and acidified to remove carbonates”. Or the description of the analyses for 14C could immediately follow the 13C with the reporting and calculation information provided after.

Reply : This information was indeed missing in the methods section. The text has been clarified as follows: “Additional ¹⁴C measurements were made at 20–25 cm, 50–55 cm and 100–110 cm depth for GLP-T, GLP-V, F2-T and F2-V (see details on Supplementary Material). These measurements were performed on bulk soil samples which were acidified to remove carbonates”. (2.3.1 OC content, δ¹³C and ¹⁴C measurements. L248-250).

-L516 change “via the erosion of recent C4 inputs from the upper slopes which are deposited at the valley positions.” To “via erosion of recent C4 inputs from the upper slopes and subsequent deposition in the valley”. As is there are 2 grammatical issues – “erosion...are” and “which” should be followed by a comma, but I do not think you want to separate your thought this way.

Reply: Thank you for this correction, the sentence has been modified accordingly. (4.1. Difference in carbon sources between grassland and forest soils. L527-528).

-L529 is this an increase in erosion rates from the top to the valley or an increase in deposition rates? It seems counter intuitive that erosion rates (soil mass loss) would be higher lower – if this is true can you remind the reader about the shape of your slopes?

Reply: We do indeed mean erosion rates. While this might seem counter-intuitive, this is related to the convex shape of the slopes, and we have added this aspect to clarify:

“This is confirmed by soil erosion rates derived from in situ ¹⁰Be analysis of the topsoil samples (5–15 cm) which indicates that on a convex hillslope, both under grassland and forest, erosion rates increase from the top towards the valley position, where the erosion rates are consistently higher under grassland when compared to forest (L. Brosens et al., unpublished data).” (4.1. Difference in carbon sources between grassland and forest soils. L541).

-L535 “admixture of young eroded C” – if this is an admixture, what is it mixed with? Do you mean “component” or “addition” rather than mixture?

Reply: We mean that more significant young eroded C has been added/deposited, hence the sentence has been corrected accordingly. (4.1. Difference in carbon sources between grassland and forest soils. L571)

-L541 need to specify “grassland soil profiles”

Reply: Thank you for this remarks, this has been clarified. (4.1. Difference in carbon sources between grassland and forest soils. L577-578).

-L613 I would use “decades” because often it is expected for this to take multiple decades, not just one and decades is used more commonly than decennia.

Reply: Thank you for this remark. It has been updated. (4.2. Difference in carbon sources between grassland and forest soils. L635).

-L620 I like this new paragraph and it flows well from the preceding paragraph. However, it seems out of place. Perhaps it would be better to move the discussion about erosion in the first section (around L528) here? This paragraph is largely about 13C.

Reply: Thank you for your comment. This paragraph has been moved to the recommended line and section. (4.1. Difference in carbon sources between grassland and forest soils. L544-566)

Author response Referee #2

The authors have made the requested corrections and clarifications. For me the paper is ready for publication after a few technical corrections.

REPLY: We appreciate and thank referee#2 for his/her favorable evaluation and suggestions.

The comments of Referee#2 are as follows:

Lines 488-490: "The total SOC stocks in the grasslands are substantially lower than in the forest, and despite the absence of substantial new inputs from C3 vegetation, the bulk of the SOC stocks remains largely dominated (70%) by (old) C3-vegetation". No problem with this sentence, however the first part "The total SOC stocks in the grasslands are substantially lower than in the forest," says the same as lines 485-486. It would be good to rephrase.

Reply: Thank you for these remarks. Since the sentence "The total SOC stocks in the grasslands are substantially lower than in the forest" has already been stated, we have removed it from the following phrases to avoid this repetition. (Conclusions. L660)

Line 501: SOC pool, not C-SOC pool

Reply: Thank you for this remark. It has been rectified. (Conclusions. L672)

References

- Brosens, L., Broothaerts, N., Campforts, B., Jacobs, L., Razanamahandry, V. F., Van Moerbeke, Q., Bouillon, S., Razafimbelo, T., Rafolisy, T. and Govers, G.: Under pressure: Rapid lavaka erosion and floodplain sedimentation in central Madagascar, *Sci. Total Environ.*, 806, 150483, doi:10.1016/j.scitotenv.2021.150483, 2022.
- Zhang, Q., Ding, Y., Ma, W., Kang, S., Li, X., Niu, J., Hou, X., Li, X. and Sarula: Grazing primarily drives the relative abundance change of C4 plants in the typical steppe grasslands across households at a regional scale, *Rangel. J.*, 36(6), 565, doi:10.1071/RJ13050, 2014.