RC2: 'Comment on egusphere-2023-2623', Alistair W.R. Seddon, 08 Jan 2024
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The paper explores ideas related rate-of-change (RoC) analysis, using a published diatom and pollen dataset from the Italian Alps to move beyond RoC analysis of palaeoecological assemblages and towards ecological properties. They extend ideas of RoC analysis to look at the amount of change relative to baseline conditions. The main point is that whilst RoC analyses on assemblages can detect points of assemblage shifts, they can mask other important details (e.g. whether the changes are positive or negative in the context of management/conservation). In moving towards temporal analysis of ecological properties the authors are also making a small step towards acknowledging palaeoecology's potential contribution to assessing Essential Biodiversity Variables (EBVs).
I think the paper makes an important contribution since RoC curves (e.g. Mottl et al 2021) should always be assessed in the context of the ecological changes that are underlying them and this paper helps emphasise this point. The move towards highlighting the relevance of palaeoecology for IPBES and EBVs is also very welcome.
> Many thanks for the in-depth and positive appraisal of our manuscript.

One important caveat is that even some derived ecosystem properties (e.g. in this instance, tree cover inferred from arboreal pollen percentages) are also context dependent. Whilst increases in tree cover (i.e. 'positive' rates of change) might be viewed favourably in the context of the ecological restoration for this alpine ecosystem, in other locations (e.g. grasslands) increases in tree cover might not necessarily be representative of a positive change in terms of restoration (e.g. Veldmann et al. 2019, DOI: 10.1126/science.aay7976). Thus, some derived ecosystem properties are likely to be as context dependent as the pollen/diatom assemblages themselves. This is an important point to make if the approaches used on ecosystem properties are further generalized and I think this should be emphasized in the discussion.
> Thank you. Indeed, this is an important point that merits being mentioned. The caveat you highlight relates to the way changes of ecological properties are valued in the context of restoration. It seems therefore to be related to the long-term context relative to reference (or baseline) conditions. Thus, the caveat could build a transition between the paragraph delving on the limitations of our study due to the use of a limited set of ecological indicators, and the paragraph that addresses the baseline reference conditions.
We have taken your formulation as a basis to draft two sentences in the Discussion section. The sentences may read as follows:

> "Moreover, it should be noted that ecosystem properties are also context dependent. Whilst increases in tree cover might be viewed favourably in the context of the ecological restoration for this ecosystem, in other locations (e.g. grasslands) increases in tree cover might not necessarily be representative of a positive change in terms of restoration (Veldman et al., 2019)."

A second critique, particularly from the pollen data, is that there are obvious potential representation / preservation issues that are not taken into account when RoCs on pollen assemblages are analysed, which can be addressed by correction by pollen production values and through methods such as REVEALS modelling. If palaeoecology is going to move towards EBVs then I think here would be as good a place as any to at least reference this critique in reference to recently published RoC analysis and the analysis of the ecological properties derived in this specific study.

> Yes, this is indeed an important point, particularly for the pollen data. We agree, the revised manuscript should acknowledge that the tree cover estimates based on pollen percentages, e.g. the net gain of 50-60% between 1940-1950 and 2000 CE, may be higher as potential representation issues were not taken into account. We have therefore drafted a sentence that could fit in the discussion section:

> "While the higher net gain documented by the pollen does not take into account potential representation issues, which could be addressed by correction for the differences in pollen productivity and dispersal (Sugita, 1994; Seppä, 2013), it suggests the occurrence of a high spatial variability that could be further explored with a network of pollen records."

The methods are quite brief in the main text, but even if I understand the papers is limited on space, I think you should move the paragraph about which baseline periods were selected from the appendix to the main methods section.

> Right, many thanks for the comment, which meets a suggestion made by reviewer #1 who also highlighted the excessive brevity of the main Methods section. We shall move the paragraph about which baseline periods were selected from the Appendix to the main Methods section.

It was also not clear to me how the black lines are calculated in Figures 3e-f,

> Many thanks for highlighting this weak point of the manuscript. The black line in Figures 3c-f was supposed to show the rate of change per unit time for the ecological indicator. Indeed, it appears we did not explain the calculation in sufficient depth. Moreover, we noted that some errors moseyed into the R code that we used to perform the analyses.

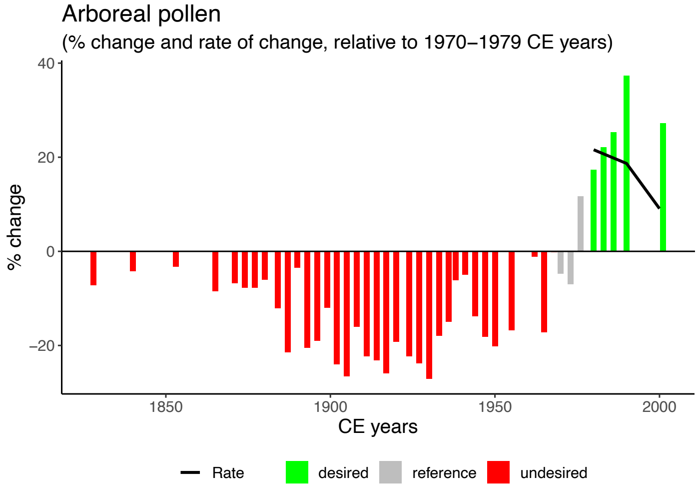
We thus shall add an explanation in section "A1.3 Trends of palaeoecological indicators" to clarify how the black line was calculated, and in addition made two corrections:

Firstly, we removed the black line for the period preceding the baseline interval (Figure 3e), as a rate of change that is calculated "backwards in time" may, indeed, be very awkward.

Secondly, we revised the formula to calculate the rate of change relative to the reference period. It now follows better the method used by Purvis et al. (2019) [see Supplementary material to Purvis et al. (2019) in SUP/GA/2.2 Chapter 2.2 Supplementary material (Nature) at https://www.ipbes.net/global-assessment].
Thus, the revised code first calculates the change between the mean reference value and the post-reference value, and thereafter divides that by the number of 'bins' between their dates to provide a per-unit-time rate of change. For instance, with bins equal to 10 years, the black line illustrates the per-decade rate of change.
As also stated by Purvis et al. (2019), it should be noted that this is just the average rate of net change over the time span being considered, whether or not the change was linear.
Please note that the code returns a plot with the black line and the grey vertical bars only in the case the user defined the reference period. Instead, if the user defined a reference value (or a

set of values), only the % change would be plotted (green and/or red vertical bars), as it would not be possible to calculate the time span separating the reference period from the target value. In addition, we revised the code to add the missing symbols in the legend of the Figure (the black line and the grey polygon).

See, for instance, the revised Figure 3e here below:



[and] The significance of using two different reference periods of the pollen data (e.g. Figures 3e and A2) is not really discussed in either the main text nor the appendix.
> Indeed, the choice of the reference period can strongly influence the outcomes of assessments on the status and trends. Specifically for the pollen data, we did choose two different reference periods (1970-1979 CE and 1940-1949 CE) as we aimed at comparing our results with documentary data (as was declared in the Appendix). However, it may be noteworthy to mention that the average per-decade rate of change in tree cover is about 9% both when setting the reference period at 1970-1979 (as of Purvis et al., 2019) as well as when setting the reference period at 1940-1950 (as of Fuchs et al., 2013). This evidence could support the notion of a net gain in tree cover documented based on land-cover datasets for Europe (Fuchs et al., 2013) for a longer time interval than the one considered in the IPBES assessment.

These revisions could help the reader.

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