

Review

Introducing relative pollen productivity estimates for Iberian taxa: 1 methodological insights and implications for landscape modelling in the 2 Western Mediterranean

Jungkeit-Milla et al.

This paper represents a methodological step towards quantitatively reconstructing past vegetation in the Iberian Peninsula based on pollen records. For the first time, relative pollen productivity (RPP) estimates are presented for 21 taxa. Modern pollen samples and vegetation data were used, drawing on several existing databases. Candidate RPPs were applied to compute REVEALS estimates of vegetation cover, which were then compared with observed vegetation. A loss function was used to identify the best-fitting RPPs by calculating the distance between modelled and observed vegetation. RPPs of eight arboreal taxa were validated in 26 present-day core tops across Iberia and compared with findings from other European studies.

The results show that *Pinus* and both evergreen and deciduous *Quercus* are high pollen producers, while temperate forest species (*Betula*, *Corylus* and *Fagus*) and herbaceous species produce medium to low amounts of pollen. Further research is needed, as previous reconstructions may have overestimated the presence of pine and oak, suggesting a more mosaic-like pattern of woodland and open landscapes.

General comments

I have read this manuscript as a non-specialist in quantitative reconstruction of past vegetation (e.g. REVEALS), but as a palaeoecologist with a broad interest in palaeoenvironment. I have tried to understand the main reasoning behind the methods applied to reconstruct past vegetation cover in Iberia and to quantify the relationships between fossil pollen assemblages and the vegetation that produced them.

The manuscript represents a substantial contribution to scientific progress within the scope of Biogeosciences. The approach and methods are valid (as far as I can judge) and the results are discussed in a proper and balanced way. I particularly appreciate the sub-chapter “Approach limitations” at the end of the Discussion section, as it critically evaluates both the methodology and the results.

The conclusions are substantial and clearly address the research objectives outlined in the introduction.

The manuscript is well structured and well written. It is rather long, but I believe all information is necessary. Figures/tables are appropriate and necessary.

Regarding the supplementary material, I have the impression that references in the main text to supplementary figures, tables and text are not made in a consistent or straightforward way. I think a considerable number of references are missing. The question is if all supplementary material is necessary.

Below, I provide some suggestions for the authors.

Comments and suggestions

Key words

RPPs and PPEs. Are these both important/necessary? See also my comment for Lines 95-99.

Vegetation cover instead of land cover?

Palaeoecology. Delete? This paper is not really about palaeoecology.

Maybe add palynology or pollen analysis to the key words.

Add Iberia?

Introduction

Line 56-57: *Likewise, land cover reconstructions are crucial elements for answering various ecological questions and changes in land use.* Rephrase: Land cover reconstructions are crucial for changes in land use? ...are crucial to reconstruct changes in land use? Something is wrong with this sentence.

Line 63 - *...traditional view of densely forested wilderness...* add some references here?!

Line 62-70: I am not sure if this discussion is relevant for the present study. Further in the text little is mentioned about this long-standing debate. Or it could be better linked to the study area. In conclusions the following is stated: *Finally, these findings suggest that previous reconstructions of past vegetation dynamics in the Iberian Peninsula may have overestimated the presence of pines and oaks, and therefore fossil records from the Southwestern Mediterranean may require reinterpretation... could indicate a more mosaic-like pattern of broadleaf woodlands, conifers, temperate forests and open ecosystems, aligning with most recent findings.* However, no information on previous pollen-vegetation reconstructions in Iberia is mentioned in the text.

Line 82: change proxies into proxy records.

Lines 95-99: PPE and RPP are these the same? If not explain more clearly. I think it is better to use only RPPs as it is less confusing. In most of the text RPPs is used.

Line 102: RPP is already introduced in line 96. So move “(hereafter referred to as RPPs)” to line 96.

Lines 102 – 103. Both pollen productivity estimates (PPEs) as relative pollen productivity (RPPs) are mentioned here while in most of the text RPPs is used. It is confusing to me so leave PPEs out, if it is not necessary.

Caption Fig. 1: “green diamonds” instead of “green squares”?

Lines 148-157: in the description of the climate, the authors refer to several regions (landscapes) such as plateau regions, mountainous areas, coastal etc. For a reader not familiar with Spanish geography it might be useful to add a map where these regions are located, to make the connection with Fig. 2. Also show the delimitation of the Mediterranean bioclimatic region and Eurosiberian region.

Line 183: also, here a map would be useful! Add all geographical names used in the text on the map!

Caption Fig. 2: change squares to diamonds?

Line 202: add bioclimatic in the sub-title as in a).

Line 247: (Theuerkauf and Couwenberg, 2022) change to Theuerkauf and Couwenberg (2022)?

Line 283: change “*Our methodological approach*” into Methodological approach...

Line 284: “relative to Poaceae”. Why Poaceae? Please explain.

Line 347: dispersion should be dispersal?

Lines 345-353: It is not entirely clear to me how pollen dispersal is integrated in the methodological framework. Please elaborate.

Line 355: “*In short, we have developed a framework that could be applied in other regions, in which we use the inverted (Theuerkauf, 2025) or reverse REVEALS approach...*”. Is the methodology used here is new or taken from Theuerkauf, 2025). Please make this obvious. Also use or “inverted” or “reverse” REVEALS, not both as this is confusing.

Line 379-380: How were the grids defined? Do they cover more than one vegetation type? And is that a challenge?

Line 388: “pollen productivity estimates” is used here. Do you mean PPEs or RPPs. Please be consistent.

Line 390: This is the first time "pollen fall speed" is mentioned. Where is this fitting in the previous part of the methods, the methodological approach used? Is it important for pollen dispersal? Please clarify.

Line 428: LSM, please write in full. The abbreviation occurs only twice in the text.

Line 435-437: Why using abbreviations here. These are not occurring anymore later in the text.

Line 449: what is meant by “numerical pipeline”?

Lines 466-467: “Poaceae was used as the reference taxon and assigned a RPP value of 1”. Shouldn’t this be mentioned earlier? Poaceae is mentioned in lines 283 – 284 but very briefly.

Fig. 5. In the table in the figure itself it says PPE instead of RPPs.

Fig. 5: are *Artemisia* and Brassicaceae shrubs? I would classify them as herbs. Maybe it is useful to have some more information on the definition of the groups in figure 5.

Fig. 7: add more information in the caption on what the figure shows. Why using two colours and what do they show?

Discussion

Line 588: here the authors refer to “heterogeneous environments”. I think it would be good to introduce this earlier. I also made a comment on the 125 x 125 km grids (Lines 379-380) where this heterogenous environments might play a role?

Line 589: “disaggregated by taxa” - this is also not specifically mentioned in the methods, I think.

Line 599: please clarify better. “*Nevertheless, our hypothesis is that some herb and shrub taxa would be overrepresented if we apply REVEALS, as in Li et al. (2023) or in Marquer et al. (2020), since in Iberia these are low pollen producers, as it happens with other trees as Betula, Corylus and Fagus.*” These are what? The herb and shrub taxa?

...as it happens with other trees as as *Betula, Corylus* and *Fagus*. Do you mean rather “as is the case” instead of as it happens?

Lines 606-607: refer to a specific figure/chapter in supplementary material.

Line 630: write SE in full (standard error).

Line 642: how can these wood and macrofossil data overestimate the presence of pine? Please clarify?

Line 780: name the temperate taxa please.

Technical corrections

Line 173: delete point after Arnold?!

Line 189: sparse scrub and grasses, also line 222. What is meant by scrub? Scrub only occurs in the text in the chapter 2.1 Study area. Elsewhere in the text shrubs is used. Please clarify. Scrub is also not mentioned in Fig. 2, shrublands are.

Line 276: delete hyphen

Line 673: as well as

Line 720: two main factors