

The manuscript presents a new set of relative pollen productivity estimates (RPPs) for a selected number of taxa across continental Spain using a REVEALS-based optimisation framework combined with modern pollen and vegetation datasets. The study addresses an important gap in Mediterranean palaeoecology, where quantitative vegetation reconstruction remains limited by the lack of regional RPP datasets. The manuscript compiles a substantial amount of data, including more than 1100 modern pollen samples, multiple vegetation datasets, validation coretops, and comparisons with previously published European RPP studies. I particularly appreciate the effort to discuss the methodological challenges associated with Mediterranean ecosystems and the attempt to validate the obtained RPPs. The study is potentially valuable for future palaeoecological reconstructions in Iberia and southern Europe.

However, several important methodological and interpretative issues should be addressed before publication. In its current form, some conclusions appear overstated, and several aspects of the optimisation and validation framework require clearer justification and more critical discussion.

- *We are grateful for the thoughtful comments by referee two that have therefore notably improved our manuscript. We are, besides, honoured by the recognition made on our efforts to produce sound research. We are grateful to the referee for emphasising the need for RPP datasets in the Mediterranean region, as their scarcity constrains the direct quantification of vegetation cover over the last millennia. We have tried to assertively respond to the comments made by the referee regarding their queries about our work; we understand that the concerns raised were legitimate, as they address key aspects relating to pollen-based quantitative reconstructions. Nevertheless, we provide evidence and references that respond to all of the reviewer's concerns, and we trust that these will clarify and strengthen their evaluation of this work. Throughout this response document, we refer to the changes of lines from the manuscript with marked changes.*

1. One of my main concerns relates to the comparison with other European RPP studies based on Gaussian Plume Models (GPM), while the present study relies on a Lagrangian Stochastic Model (LSM). The manuscript should discuss more critically how directly comparable recalculated GPM-based RPPs and LSM-derived RPPs actually are. Even after harmonisation, substantial methodological differences remain between studies. One of the key questions is therefore how these new RPP estimates can be meaningfully compared with previously published "traditional" RPP studies. Much more detail is required in the Methods section to explain how GPM-based RPPs were transformed or harmonised for comparison with LSM-derived values. At present, the manuscript refers to Abraham and Fortova (in prep.) for key methodological details. Since this work is not yet published, it is difficult to assess the robustness of the approach

presented here. Much more methodological detail should therefore be included directly in the manuscript itself.

- *We thank the reviewer for this important comment regarding the comparison between RPP estimates derived from Gaussian Plume Models (GPM) and those obtained using the Lagrangian Stochastic Model (LSM). We agree that the original version did not provide sufficient methodological detail, and we have therefore substantially revised the manuscript to clarify this aspect. In particular, we have expanded the Methods section to better explain how previously published GPM-based RPPs were treated and how comparisons with our LSM-derived estimates were approached.*

*We changed: "than the Gaussian Plume model (GPM) (Jackson and Lyford, 1999), which fails to predict the magnitude of long-distance dispersal (Kuparinen, 2006; Mariani et al., 2016; Theuerkauf et al., 2016)."*

*to: "Although Gaussian Plume models (GPM) (Jackson and Lyford, 1999), are the most used dispersal models, we considered GPMs not suitable for this study, since they are based on observations of the dispersion of larger objects than pollen, which can lead to have an incomplete picture of the full, long-distance, dispersal pattern, subestimating dispersal of heavy pollen grain taxa like Larix and Abies fails to predict the magnitude of long-distance dispersal (Abraham et al., 2014; Kuparinen, 2006; Mariani et al., 2016; Theuerkauf et al., 2013, 2016; Theuerkauf and Couwenberg, 2020). The weighting factor decreases their distance-weighted plant abundance, and therefore the pollen signal is counterbalanced with high pollen productivity. Since large basins strengthen overestimation of Abies RPP with GPM model (Abraham et al., 2014), studies with different basin sizes lead to different RPP for Abies." Lines 383-392*

*Rather than relying on Abraham and Fořtová (in prep.), we now include the key methodological elements directly in the manuscript to ensure transparency and allow a full assessment of the robustness of our approach.*

*At the same time, we would like to emphasise that our objective is not to directly equate GPM- and LSM-derived RPPs, as we acknowledge that inherent differences between these modelling frameworks limit strict comparability, even after harmonisation. Instead, our aim is to provide a critical evaluation of how these differences influence RPP estimates and to place our results within the broader context of existing studies.*

*To make this clearer, we have revised the discussion of dispersal models. Specifically, we replaced the previous statement with a more detailed explanation of the known limitations of GPM. The revised text highlights that GPM tends to underestimate the dispersal of taxa producing heavy pollen*

*grains (e.g., Larix and Abies), which can lead to inflated pollen productivity estimates. We also note that GPM-based results may vary depending on basin size and that removing the dispersal component can reduce inter-study variability (e.g., Theuerkauf, 2025). These points clarify why methodological differences are not trivial and why the use of LSM is justified in our study.*

*Accordingly, we have made the following specific changes:*

- *We expanded the description of model assumptions and limitations, with a clearer justification for the use of LSM (Lines 373-392).*
- *We removed reliance on unpublished work (Abraham and Fořtová, in prep.) by incorporating the necessary methodological details directly into the manuscript*
- *We clarified the treatment of specific taxa (e.g., Abies) and explicitly referenced corrected RPP values from published sources (Theuerkauf, 2025). We selected RPP-LSM value of Abies from Theuerkauf (2025) and removing our implementation of debiasing pollen dispersal from the workflow (Line 505).*

*We hope these revisions make it clear that we have carefully considered the reviewer's concerns, improved the transparency of our methodology, and clarified both the limitations of cross-model comparisons and the rationale for our modelling choices.*

2. The authors consider the existing commonly used methods as unsuitable for the study region. This clearly requires strong justification. In particular, the manuscript should better explain, why a more traditional RPP approach would not be preferable, how the proposed optimisation framework improves RPP estimation compared to standard methods for RPP calculation, and why an alternative framework is needed when traditional approaches have already been successfully applied in many regions worldwide.

- *We thank the reviewer for raising this important point and agree that a clearer justification of our methodological choices is needed. We have therefore revised the manuscript to better explain why we adopted this framework and how it relates to more traditional RPP approaches.*

*First, we would like to clarify that we do not consider commonly used approaches inherently unsuitable. Rather, we argue that their direct application in our study region is challenged by specific constraints, particularly the scarcity of regionally appropriate RPP datasets and the ecological characteristics of Mediterranean vegetation. These limitations motivate the use of an alternative framework that allows us to better account for these regional conditions.*

*Second, our approach does not constitute a completely novel methodology. Instead, it builds on well-established methods. The use of inverted REVEALS has already been demonstrated by Kuneš et al. (2019), and optimisation algorithms to estimate pollen-related parameters have been developed and applied in several previous studies (e.g., Theuerkauf et al., 2013; Theuerkauf and Couwenberg, 2017, 2018; Fang et al., 2019). Our contribution lies in adapting and combining these approaches within a consistent framework tailored to the specific context of our study.*

*In this context, the application of traditional RPP estimation methods would have been logistically unmanageable due to the large spatial extent of the study region. Implementing these approaches would require extensive vegetation surveys for each of the more than 1,100 modern pollen samples, as well as the calculation and processing of multiple vegetation rings, representing a substantial practical limitation.*

*Furthermore, the heterogeneity and scale of the study area introduce additional challenges. Traditional approaches, such as ERV, are known to be less well suited to landscapes characterised by large vegetation patches and strong ecological gradients (Theuerkauf and Couwenberg, 2022). In contrast, optimisation-based approaches offer greater flexibility, as they do not rely on the assumption of homogeneous regional pollen deposition, which may not be realistic in such settings.*

*We acknowledge that inverted REVEALS-based RPP estimates have not yet been systematically compared with those derived from traditional methods within the same region (with the exception of Kuneš et al., 2019). We agree that such comparative studies would be highly valuable and represent an important direction for future research.*

*Nevertheless, we support the reliability of our RPP estimates through an independent validation step. Although limited to tree taxa, this validation demonstrates that REVEALS-based vegetation reconstructions show a stronger relationship with observed regional vegetation patterns than raw pollen percentages. This result, presented in Figure 7, provides an empirical basis for the use of the REVEALS framework in our study.*

*We hope this revised explanation clarifies that our choice of method is not intended as a replacement for traditional approaches, but rather as a practical and context-appropriate solution given the scale, heterogeneity, and data limitations of the study area.*

*In any case, a revised explanation is now provided in lines 262, 278 and 308.*

3. Furthermore, the discussion concerning the Gaussian Plume Model (GPM) is currently not sufficiently convincing. The manuscript argues that GPM-based approaches are inappropriate while favouring the Lagrangian Stochastic Model (LSM). However, GPM remains the most widely used dispersal model in pollen modelling studies globally. At present, the manuscript dismisses GPM somewhat too easily, without sufficiently demonstrating why it should be rejected in this context. I strongly encourage the authors to calculate and compare two sets of RPPs: one based on LSM, and one based on GPM. Such a comparison would considerably strengthen the manuscript and would allow the authors to test their assumptions empirically rather than relying primarily on theoretical arguments. Currently, the manuscript presents several statements regarding the limitations of GPM without quantitative demonstration. A more scientifically robust approach would therefore be to compare the two frameworks directly and discuss their respective strengths and weaknesses based on empirical results rather than categorical statements.

- *We agree that the majority of published RPP studies have used GPMs describing dispersal patterns based on observations of particles in the atmosphere. Thanks to GPMs, studies from all over the world have been able to compute RPPs successfully and therefore advance quantitative pollen-based studies further. However, it is known that GPMs (like Sutton's equations or Prentice's model for unstable conditions), are based on observations of the dispersion of larger objects than pollen (balloons, smoke, etc). As a result, their application to pollen transport can provide an incomplete representation of the full dispersal process (Kuparinen, 2006; Theuerkauf, 2025). In particular, GPMs tend to underestimate long-distance transport and perform less well in complex environments, such as mountainous terrain and landscapes with heterogeneous canopy structure. These limitations are especially relevant in continental Spain, where such conditions are widespread, and therefore reduce the suitability of GPMs for accurately capturing pollen dispersal patterns in our study area.. Moreover, modelling deposition at ground level and within the canopy is complicated with GPMs, and that is one of the main reasons why some recent studies start to use Lagrangian Stochastic models, because they take into account air flow patterns below, in and above the canopy, based on physical laws and atmospheric measurements, capturing better the outcome of long-distance pollen dispersal (Kuparinen et al., 2007; Theuerkauf et al., 2013, 2016). Although GPM has been the main dispersal model used to compute RPPs, we believe there are enough references that support the use of LSM in pollen modelling, since it has been demonstrated a better performance using surface pollen and modern vegetation data (Theuerkauf et al., 2013, Mariani et al., 2016). As shown in previous studies (Abraham et al 2014, Theuerkauf and*

*Couwenberg 2020), GPM-RPPs even in GPM reconstruction can produce odd results with large sedimentation basins.*

*We consider that a detailed comparison between GPM-derived and LSM-derived RPPs would fall beyond the scope of this manuscript. Such an analysis would require a dedicated study specifically designed to evaluate the differences between dispersal models and their impact on RPP estimation. In our case, our methodological choice was guided by the need to account for dispersal processes that are particularly relevant for certain taxa (e.g., *Abies*), and we therefore focused on a single, internally consistent framework.*

4. Figure 6 is also not convincing. The relationships shown remain relatively weak, with substantial scatter and clear deviations from the 1:1 relationship for most taxa. Overall, these results appear mixed rather than strongly convincing. I would not consider this a particularly strong validation figure. The figure supports the idea that the approach may have some utility, but it does not convincingly demonstrate robust predictive performance across taxa.

*First, we would like to emphasise that achieving near 1:1 relationships across taxa would not necessarily be expected, nor desirable, in a study of this spatial scale. Our RPP estimates are derived at a large regional extent, where ecological variability and spatial heterogeneity are substantial. Perfect agreement would imply negligible variability in pollen productivity across different environments in Spain, which is not realistic.*

*Second, we note that the observed scatter is already present in the raw pollen-vegetation relationships. As shown in Figure 6, the empirical data themselves are inherently variable, and this variability inevitably propagates into any model-based reconstruction, including REVEALS-derived estimates.*

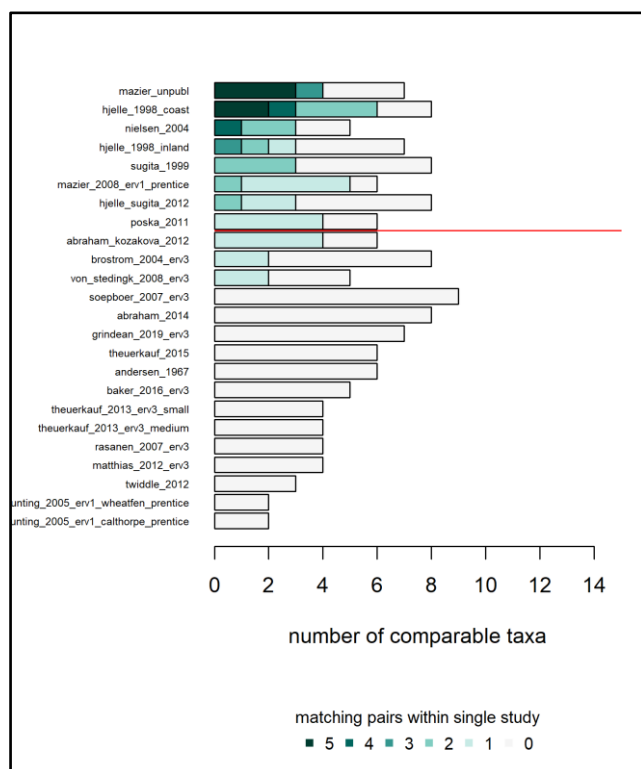
*We also recognise that the predictive performance illustrated in Figure 6 is mixed. Importantly, we do not present this figure as evidence of strong or definitive validation. Rather, its purpose is to provide a first-order evaluation showing that the approach captures general trends for arboreal taxa—something that is still lacking in many RPP studies, where independent validation is often absent.*

*Finally, we would like to stress that the main support for the usefulness of our RPP estimates lies in their relative improvement over raw pollen percentages. As shown in Figure 7, REVEALS-based estimates display stronger correlations with regional vegetation than uncorrected pollen data (with some expected exceptions, such as *Corylus*, *Betula*, and *Fagus*). While this improvement is moderate, it is consistent and sufficient to justify the application of the approach in this context.*

5. This is also the case for figure 8 that suggests that many of the obtained RPP values do not match particularly well with previously published studies. This makes it difficult to assess whether the proposed framework improves RPP estimation. Based on Figures 6 and 8, the overall results are not particularly convincing.

- *We appreciate the concern about the proposed framework in this manuscript. As we replied in the comment 2 above, our method choice is far from suggesting that we necessarily obtain better RPPs results, and rather fits better our original settings. We are comparing our dataset with almost all RPP values produced in Europe. Fig 8 shows that the closest values (or better pairs of values) are located in the geographically nearer studies to Spain.*

*To illustrate the comparison method used in this work, we applied the pipeline by selecting RPPs from Kunes et al (2019) (Figure "a") and Von Stedingk et al. (2008) (Figure "b") to be compared with other studies.*



*Figure a. Comparison of the RPPs from Kunes et al. (2019) with other studies in Europe.*

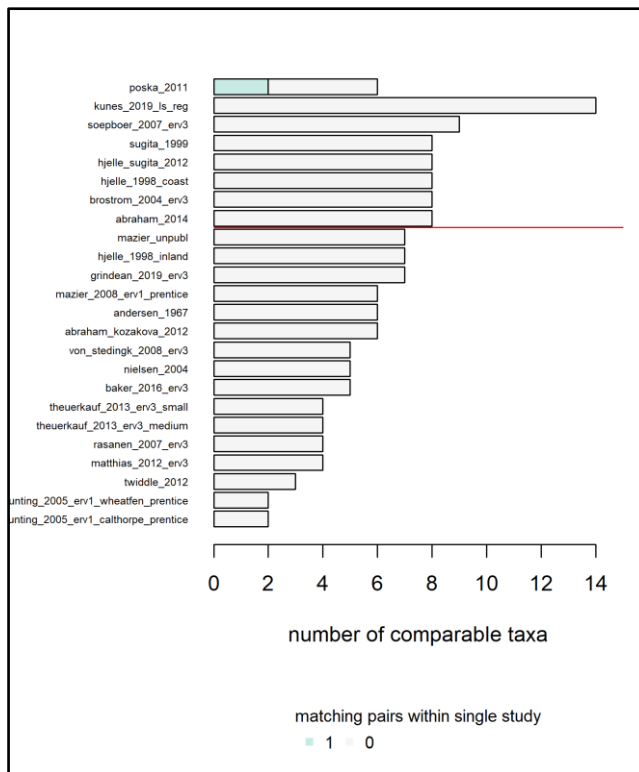


Figure b. Comparison of the RPPs from Von Stedingk et al. (2008) with other studies in Europe.

Both figures illustrate two key points. First, they show that the method applied here yields results that are broadly consistent with those reported in the literature, supporting its applicability in comparable studies. Second, they highlight that the degree of agreement varies among studies, reflecting differences in regions, datasets, and methodological choices.

Importantly, for the taxa selected for comparison, our estimates fall well within the range of published values and show good agreement with many studies conducted across Europe. This suggests that, despite methodological differences, our results are robust and comparable within the broader context of existing RPP research.

Figure 8 in the new version of the manuscript is now a map that compares the similarity of our RPPs with other studies in Europe. This new figure replaces the previous one, providing a more visual representation that helps to better understand the results of the comparison.

- The manuscript repeatedly emphasises validation as a major strength. However, only 8 arboreal taxa are effectively validated, despite presenting RPPs for 21 taxa. This creates confusion in several sections, including the Abstract and Discussion, where broader claims are made about “validation of the Iberian RPPs”. In reality, herbaceous and shrub taxa are not independently validated, and validation is restricted to selected

arboreal taxa. The manuscript should therefore clearly distinguish between validated taxa and taxa without independent validation.

- *We acknowledge the reviewer's concern and agree that the distinction between validated and non-validated taxa must be clearly communicated. However, we would like to emphasise that this limitation was explicitly stated in the original manuscript and has not been overlooked.*

*In particular, the Abstract already clearly specifies that validation was restricted to arboreal taxa (e.g., "To test the reliability of our RPPs, we validated 8 arboreal taxa..."), and the Discussion explicitly notes that shrub and herbaceous taxa could not be validated due to data limitations (i.e., the available vegetation dataset includes only arboreal taxa). We therefore did not intend to imply that all 21 taxa were independently validated.*

*We recognise that the wording in some sections may have been too general and could give the impression of broader validation. To address this, we have revised the manuscript to consistently and explicitly distinguish between (i) taxa for which independent validation is available and (ii) taxa for which such validation is currently not feasible.*

*Importantly, the absence of validation for shrub and herbaceous taxa is not due to a lack of consideration, but to fundamental limitations of the available data. While arboreal taxa are quantified in terms of absolute cover (allowing direct comparison with REVEALS estimates), shrub and herbaceous taxa are recorded using phytosociological (relevée) scales, which do not provide reliable information on actual area cover. As a result, any attempt to validate these taxa against REVEALS outputs would be methodologically inconsistent and likely produce misleading results.*

*For this reason, we deliberately restricted validation to tree taxa, where quantitative comparisons are robust and meaningful. We believe this represents a cautious and methodologically sound approach, rather than a limitation of the framework itself.*

7. Another important concern relates to the optimisation framework itself. The optimisation algorithm explicitly searches for RPP values that minimise the discrepancy between REVEALS-derived vegetation estimates and observed vegetation cover. Consequently, the later agreement between REVEALS outputs and vegetation data is at least partly expected from the optimisation procedure itself, rather than representing a fully independent validation outcome. This issue appears several times throughout the manuscript, especially where improved agreement between REVEALS estimates and vegetation cover is interpreted as evidence of methodological success. For example, the manuscript states

that the optimisation procedure identifies the RPPs that best reproduce vegetation composition, but later discusses this agreement as a result of the study rather than as a direct consequence of the optimisation target.

- *We thank the reviewer for this important observation. We agree that this is a general consideration inherent to inverse modelling approaches and therefore deserves clarification in the manuscript.*

*Our RPP estimates are derived from modern pollen and vegetation datasets, and as with any such approach, they are necessarily dependent on the quality and structure of the input data. This is not specific to our framework: all RPP estimates, including those obtained using classical ERV methods, rely on the same fundamental relationship between pollen and vegetation, and are therefore subject to similar constraints and assumptions.*

*To reduce potential circularity and to evaluate the robustness of the optimisation, we implemented a cross-validation strategy by excluding a subset of sites (51 coretops) during the estimation procedure and subsequently using them for independent evaluation. This step ensures that the agreement between REVEALS outputs and vegetation data is not solely a direct consequence of the optimisation fitting process.*

*We would also like to clarify that the agreement discussed in the manuscript is based on comparisons with independent pollen datasets that were not used to calibrate the RPPs. For this reason, we consider that the results do represent a meaningful, albeit not fully independent in the strictest sense, validation of the approach. We acknowledge this nuance and have revised the text to avoid overstating the degree of independence.*

*Finally, we would like to stress that our intention is not to claim that REVEALS-based RPPs derived through this framework are superior to those obtained using other approaches. Rather, our choice is motivated by data availability and spatial scale. While ERV-based methods may offer higher precision at local scales, they require detailed vegetation data that are not available for our study area. Both ERV and REVEALS ultimately rely on similar underlying assumptions, such as the representation of vegetation within defined spatial extents, even if they operate at different scales.*

8. Some conclusions also appear overstated. In particular, the discussion suggesting that Iberian landscapes may have been substantially more open than previously reconstructed should be moderated. The manuscript demonstrates that some taxa may be over- or underrepresented in pollen records due to differential productivity, but this alone does not directly demonstrate past landscape openness. Similarly, statements regarding future disturbance reconstructions and

ecosystem dynamics should be presented more cautiously, especially given that shrub and herb taxa remain largely unvalidated. The paper would be stronger if the discussion remained more tightly linked to the actual findings.

- *Thank you for the suggested comment. We have tried to be cautious within the section "Validation and potential implementation of the first Iberian pollen productivities". This is why we discuss the possibility, not the direct applicability, in Line 628 from the first version: "[...] implementing our RPPs to quantitatively reconstruct vegetation cover from fossil pollen records could be promising [...]". Likewise, we insisted on the possibility that future palaeo reconstructions with these RPPs could indicate that some taxa that have been traditionally over/under estimated may have changed. Anyhow we have reinforced the use of modal verbs (may, might, could) to existing descriptions. However, we are fully aware that these results alone do not demonstrate the existence of a more open landscape than previously assumed. Rather, we discuss this as a plausible interpretation supported by the current findings. The logical next step would allow these results to be applied to fossil records in order to provide more robust reconstructions of past vegetation cover.*

9. The study necessarily combines datasets with different spatial resolutions and taxonomic detail. While this is understandable given the complexity of Iberian landscapes, the implications of these mismatches are not discussed critically enough. In particular, the manuscript should discuss more explicitly RSAP-related issues, local versus regional vegetation representation, and how patchy Mediterranean vegetation may affect the optimisation procedure.

- *This is a very important question regarding our methodological approach. We agree that this is a key methodological issue, particularly in complex and heterogeneous systems such as Mediterranean landscapes, and we have now clarified this aspect in the revised manuscript.*

*With respect to the RSAP framework, we note that its interpretation differs fundamentally between ERV and inverted REVEALS-based approaches. In ERV models, RSAP is explicitly defined by comparing pollen data with vegetation mapped across increasing radii, allowing the identification of a threshold beyond which vegetation contributes as background signal. In contrast, the inverted REVEALS approach does not rely on such a breakpoint. Instead, it optimises regional relative pollen productivity estimates by integrating vegetation information across spatial scales, with all distances contributing continuously to the signal. For this reason, we consider that the classical RSAP concept is not directly applicable in this context.*

That said, we acknowledge the reviewer's concern regarding the representation of local versus regional vegetation and the potential influence of landscape heterogeneity on the optimisation procedure. To address this more explicitly, we have included additional analysis (Figure c) exploring vegetation structure at multiple spatial extents (15, 30, 45, and 100 km radii) around each core-top used for validation. This allows us to evaluate how vegetation patterns vary across scales and to assess the implicit source areas contributing to the pollen signal.

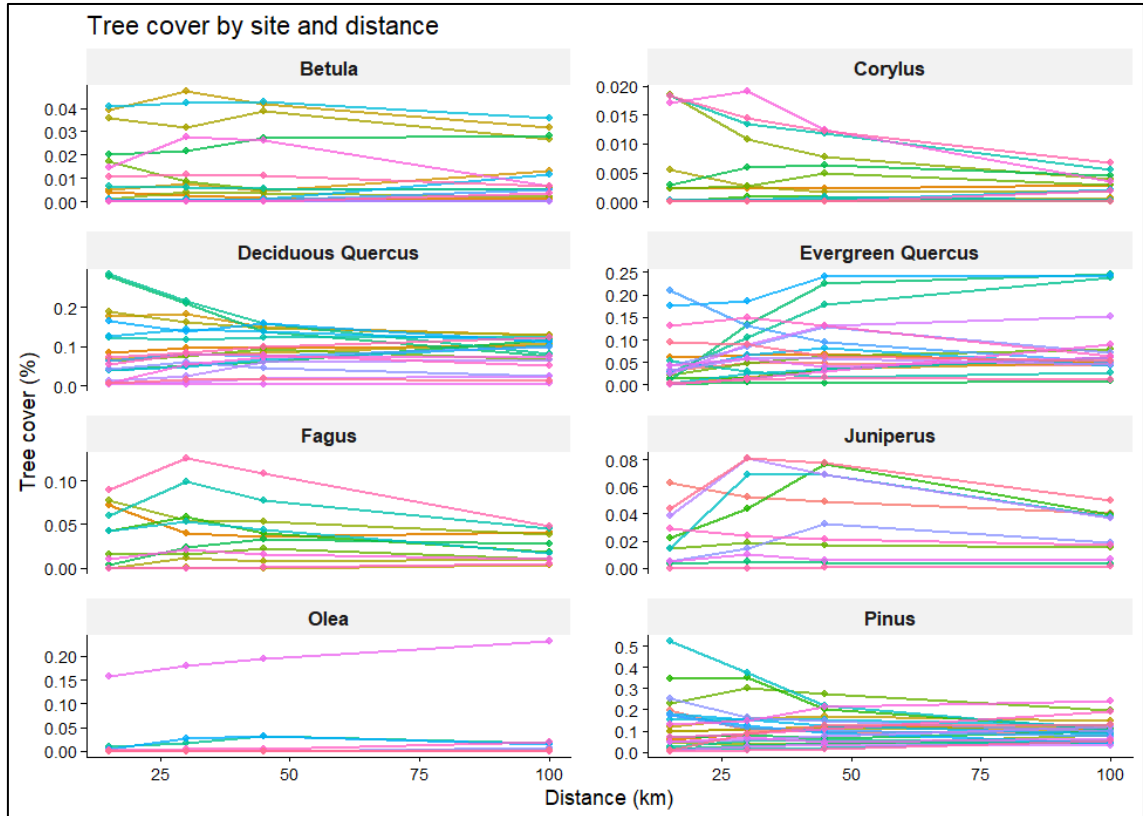


Figure c. Tree cover percentage across coretops and distances.

As expected, Mediterranean landscapes are characterised by patchy vegetation mosaics. However, our results indicate that increasing the radius does not substantially alter the overall proportion of tree cover, suggesting that, despite local heterogeneity, the assumption of regional representativeness required by the inverted REVEALS framework remains reasonable at the scales considered. We now discuss this point more explicitly in the manuscript, including the implications for the interpretation of vegetation signals and the potential limitations associated with spatial mismatches.

10. The rationale for excluding 51 modern coretops from open areas and using them as a validation dataset also requires better justification. Why were only open-area sites selected for validation? Would it not be preferable to include a wider range of vegetation settings in order to evaluate whether the framework performs consistently across different landscape types?

- *Thank you for raising that question up. We use surface top core samples from what we refer to in the manuscript as “open areas”; however, these do not correspond to monospecific plant communities but rather to patchy vegetation structures typical of Mediterranean mosaic landscapes. These sites were selected specifically to avoid locations in the immediate vicinity of forest understorey or other highly localised environments, thereby minimising very local pollen inputs and allowing a more integrated, wider pollen signal to be represented.*

*If modern samples are collected from beneath a closed-canopy forest, the pollen signal becomes biased towards higher proportions of the taxa forming the canopy, largely due to gravitational deposition. The optimal samples would seem to be those coming from forest gaps/hollows. This is what we tried to argue on section 2.2.2.: “From the 51 coretops validation dataset, we chose 26 samples by excluding salt lakes, where the surface samples are often subject to aeolian erosion, and samples under closed canopy or from high elevations where the pollen signal might be biased.”*

*Nonetheless, the coretops have been selected from a variety of landscapes, and in this new version we have included a cartographic atlas in the Supplementary section in which the 26 top core samples used for validation are shown overlaid by aerial imagery and forest cartographic layers. We hope that this is also useful for the potential readers of the manuscript and that this information will help to improve the reliability of our work.*

11. Finally, the manuscript relies heavily on statistical summaries, but the original REVEALS outputs and untransformed pollen relationships are not shown clearly. It would be useful to provide more transparent comparisons between raw pollen data, transformed REVEALS estimates, and observed vegetation cover.

- *Thank you for this helpful suggestion. We would like to clarify that the raw pollen data, observed vegetation abundances, as well as the derived RPPs and REVEALS estimates at different spatial scales have been made available since the initial submission (see the “Code and availability” section). However, we recognise that data availability alone may not provide sufficiently transparent visual comparisons for the reader.*

To address this point more explicitly, we have now included an additional figure in the Supplement (Figure S8), complementing former figure S7. This new figure provides direct comparison between REVEALS estimates and observed vegetation cover for each taxon, allowing a clearer evaluation of model performance. We have also revised the text to better guide the reader through these comparisons and to highlight how the transformed REVEALS outputs relate to both the original pollen data and the observed vegetation patterns.

#### Cited references:

Abraham, V., Oušková, V., and Kuneš, P.: Present-Day Vegetation Helps Quantifying Past Land Cover in Selected Regions of the Czech Republic, *PLoS ONE*, 9, e100117, <https://doi.org/10.1371/journal.pone.0100117>, 2014

Kuneš, P., Abraham, V., Werchan, B., Plesková, Z., Fajmon, K., Jamrichová, E., and Roleček, J.: Relative pollen productivity estimates for vegetation reconstruction in central-eastern Europe inferred at local and regional scales, *The Holocene*, 29, 1708–1719, <https://doi.org/10.1177/0959683619862026>, 2019.

Kuparinen, A.: Mechanistic models for wind dispersal, *Trends Plant Sci.*, 11, 296–301, <https://doi.org/10.1016/j.tplants.2006.04.006>, 2006.

Kuparinen, A., Markkanen, T., Riikonen, H., and Vesala, T.: Modeling air-mediated dispersal of spores, pollen and seeds in forested areas, *Ecol. Model.*, 208, 177–188, <https://doi.org/10.1016/j.ecolmodel.2007.05.023>, 2007.

Liu, Y., Ogle, K., Lichstein, J. W., and Jackson, S. T.: Estimation of pollen productivity and dispersal: How pollen assemblages in small lakes represent vegetation, *Ecol. Monogr.*, <https://doi.org/10.1002/ecm.1513>, 2022.

Theuerkauf, M., Kuparinen, A., and Joosten, H.: Pollen productivity estimates strongly depend on assumed pollen dispersal, *The Holocene*, 23, 14–24, <https://doi.org/10.1177/0959683612450194>, 2013.

Theuerkauf, M., Couwenberg, J., Kuparinen, A., and Liebscher, V.: A matter of dispersal: REVEALSinR introduces state-of-the-art dispersal models to quantitative vegetation reconstruction, *Veg. Hist. Archaeobotany*, 25, 541–553, <https://doi.org/10.1007/s00334-016-0572-0>, 2016.

*Theuerkauf, M. and Couwenberg, J.: Comment on: Pollen-based reconstruction of Holocene land-cover in mountain regions: Evaluation of the landscape reconstruction algorithm in the Vicdessos valley, northern Pyrenees, France, Quat. Sci. Rev., 244, 106463, <https://doi.org/10.1016/j.quascirev.2020.106463>, 2020.*