**Below is a description of all data used in this study and the corresponding sources:**

**Tree fossil data**

We compiled tree fossil data used in this study from two main sources: the Paleobiology Database (PBDB; <https://paleobiodb.org/>) and literature searches.

Use data link to obtain PBDB data: http://paleobiodb.org/data1.2/occs/list.csv?datainfo&rowcount&cc=EUR&pgm=gplates,scotese,seton&show=full,genus,env (accessed 26/06/2025)

See literature\_records\_28\_01\_25.xlsx for all literature as well as manually sourced PBDB records with citations (corresponding to literature\_references.docx).

See also dataset\_final\_28\_06\_25.xlsx for final fossil dataset used in all analyses.

**Tree species and genus checklists**

A global tree species checklist was obtained from Botanic Gardens Conservation International (BGCI) GlobalTreeSearch database (<https://www.bgci.org/>). See <https://tools.bgci.org/global_tree_search.php> for download link.

BGCI. 2025. GlobalTreeSearch online database. Botanic Gardens Conservation International. Richmond, UK. Available at https://tools.bgci.org/global\_tree\_search.php. Accessed on (24/10/2024).

**Climate data – CHELSA v2.1**

All current and future climate data used in this study was obtained from Climatologies at high resolution for the earth’s land surface areas (https://chelsa-climate.org/).

Karger, D.N., Conrad, O., Böhner, J., Kawohl, T., Kreft, H., Soria-Auza, R.W., Zimmermann, N.E., Linder, P., Kessler, M. (2017): Climatologies at high resolution for the Earth land surface areas. *Scientific Data*. 4 170122. <https://doi.org/10.1038/sdata.2017.122>

Karger, D.N., Conrad, O., Böhner, J., Kawohl, T., Kreft, H., Soria-Auza, R.W., Zimmermann,N.E., Linder, H.P. & Kessler, M. (2021) Climatologies at high resolution for the earth’sland surface areas. *EnviDat*. https://doi.org/ 10.16904/envidat.228.v2.1

**Species occurrence data - Global Biodiversity Information Facility (GBIF)**

All species occurrence data used in this study was obtained from GBIF (<https://www.gbif.org/>) using the rgbif R package (Chamberlain et al., 2022). See GBIF\_references.xlsx for DOIs corresponding to all data queries used in this study.

Chamberlain, S., Oldoni, D., & Waller, J. (2022). rgbif: interface to the global biodiversity information facility API.

**Taxonomic standardization – World Checklist of Vascular Plants (WCVP)**

Standardization was performed using the U.Taxonstand R package (XXX) with a provided .Rdata file for WCVP. See <https://github.com/nameMatch/Database/tree/main/Plants_WCVP> for download.

Govaerts R (ed.), (2024). WCVP: World Checklist of Vascular Plants. Facilitated by the Royal Botanic Gardens, Kew. [WWW document] URL http://sftp.kew.org/pub/data-repositories/WCVP/ [accessed 21 May 2024].

Zhang, Jian, and Hong Qian, (2023). "U. Taxonstand: An R package for standardizing scientific names of plants and animals." *Plant Diversity 45.1*, 1-5.

**Tree genus phylogenies**

Phylogenies were generated for each genus using the V.Phylomaker2 R package (Jin & Qian, 2022). The GBOTB.extended.WCVP.tre mega tree was used (see <https://github.com/megatrees/plant_20221214/blob/main/GBOTB.extended.WCVP.tre> for download) as well as plant\_genus\_list.csv (<https://github.com/megatrees/plant_20221214/blob/main/plant_genus_list.csv>).

Jin, Y. & Qian, H. (2022) V.PhyloMaker2: An updated and enlarged R package that can generate very large phylogenies for vascular plants. *Plant Diversity, 44*, 335-339.

Smith, S.A., Brown, J.W., (2018). Constructing a broadly inclusive seed plant phylogeny. *Am. J. Bot.* *105*, 302-314.

Zanne, A.E., Tank, D.C., Cornwell, W.K., et al., (2014). Three keys to the radiation of angiosperms into freezing environments. *Nature* 506, 89-92.

**Western and Central Europe geographic extent – World Administrative Boundaries**

A .shp file of the World Administrative Boundaries was obtained from the following link: <https://public.opendatasoft.com/explore/dataset/world-administrative-boundaries/export/>

**Stratigraphy**

The stratigraphy and time bins used in this study were defined by the International Commission on Stratigraphy (for all epochs-level time bins). For the five Pleistocene time bins, we used the nomenclature from Lang (1994).

Cohen, K. M., Finney, S. C., Gibbard, P. L., & Fan, J. X. (2013). The ICS international chronostratigraphic chart. *Episodes Journal of International Geoscience*, *36*(3), 199-204.

Lang, G. (1994). *Quartäre Vegetationsgeschichte Europas-Methoden und Ergebnisse*.