

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☐ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ | The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ | A description of all covariates tested |
| ☐ | ☒ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ | A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ | For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☐ | ☒ | Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection Data collection was not performed using any custom code. The literature was managed with the reference management software EndNote 21.

Data analysis All statistical analyses were performed in R version 4.4.1.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

The raw data for this meta-analysis have been deposited as supplementary data files.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	Since this study focused on plants and did not involve human subjects, distinctions between biological sex and gender were not applicable.
Reporting on race, ethnicity, or other socially relevant groupings	The program does not apply to this study.
Population characteristics	The program does not apply to this study.
Recruitment	The program does not apply to this study.
Ethics oversight	The program does not apply to this study.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☐ Life sciences ☐ Behavioural & social sciences ☒ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	we conducted a global meta-analysis and two-level subgroup analyses of 256 studies, encompassing 1,604 observations, to comparatively evaluate the impact of anthropogenic global change factors (GCFs) on plant β -diversity in environments with and without human influences. Additionally, we explored the influence of ecological and methodological factors on the effect size of GCFs on plant β -diversity using random forest models and meta-regression.
Research sample	1604 test results from 256 studies
Sampling strategy	Not applicable
Data collection	We conducted a literature search in Web of Science, Google Scholar, and the China Knowledge Resource Integrated (CNKI) between 29 March and 31 November 2023. The search strategies for each database were as follows: Web of Science: We used the following search query in the Topic field (TS=): TS= (beta diversity OR β diversity) AND (biotic homogen* OR biotic differentiat* OR biotic heterogen* OR biological homogen* OR biological differentiat* OR biological heterogen*). Google Scholar: The same keyword combination was entered directly into the general search bar: (beta diversity OR β diversity) AND (biotic homogen* OR biotic differentiat* OR biotic heterogen* OR biological homogen* OR biological differentiat* OR biological heterogen*). CNKI: We searched in the Topic field using the Chinese equivalents of the above terms, including the phrases corresponding to beta diversity OR β diversity OR biotic homogenization OR biotic heterogenization. Across the three databases, our search initially retrieved 35,206 records after deduplication within each database (see Supplementary Figure 1). Since some studies appeared in multiple databases, we subsequently merged the datasets and conducted cross-database deduplication to eliminate overlapping records. In addition, we manually reviewed the reference lists of key review papers and relevant studies that cited them^[16, 17, 19, 35-37], which yielded 229 additional studies. After combining the database records with these citation-tracked studies, we performed a final round of deduplication across all sources. This process resulted in a total of 14,977 unique studies for screening. Only published, peer-reviewed articles were retained for the final analysis.
Timing and spatial scale	global and regional scale, 0.5~250 years
Data exclusions	Unsuitable publications were excluded based on the following criteria: (1) review papers and studies lacking quantitative analysis, (2) articles predicting changes related to homogenization or differentiation in plant communities based on changes in plant α -diversity but not directly analyzing the impact of GCFs on plant β -diversity, (3) articles lacking statistical comparisons between the effects of GCFs and control groups, (4) articles focusing on intraspecific variation caused by GCFs, and (5) articles comparing old and new methods for monitoring plant species diversity at multiple scales with respect to plant β -diversity. (6) To reduce the potential biases in the results, we excluded the observations with sample sizes smaller than 3. Any uncertainties or disagreements were resolved through discussion with a third reviewer.
Reproducibility	Not applicable
Randomization	training and test data set were computationally defined without any external parameters.

Blinding

Not applicable

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☐	☒ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Dual use research of concern

Policy information about [dual use research of concern](#)

Hazards

Could the accidental, deliberate or reckless misuse of agents or technologies generated in the work, or the application of information presented in the manuscript, pose a threat to:

No	Yes
☒	☐ Public health
☒	☐ National security
☒	☐ Crops and/or livestock
☒	☐ Ecosystems
☒	☐ Any other significant area

Experiments of concern

Does the work involve any of these experiments of concern:

No	Yes
☒	☐ Demonstrate how to render a vaccine ineffective
☒	☐ Confer resistance to therapeutically useful antibiotics or antiviral agents
☒	☐ Enhance the virulence of a pathogen or render a nonpathogen virulent
☒	☐ Increase transmissibility of a pathogen
☒	☐ Alter the host range of a pathogen
☒	☐ Enable evasion of diagnostic/detection modalities
☒	☐ Enable the weaponization of a biological agent or toxin
☒	☐ Any other potentially harmful combination of experiments and agents

Plants

Seed stocks	Not applicable
Novel plant genotypes	Not applicable
Authentication	Not applicable