nature portfolio

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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 *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒ 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 *Give P values as exact values whenever suitable.*
☒	☐ 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	All data were collated from the study websites, the Oak Ridge National Lab's FACE study website and publications. The references about data are listed in the Supplementary Tables 1-2. All the data were put together by Excel spreadsheets.
Data analysis	The Excel Data Analysis, SigmaPlot 11, SPSS v.28.0 and the plug-in macros MetaReg.sps were used for data analyses. there are computer coded generated for this study.

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

Data collated and used for analyses, figures and tables of this study are available for access (https://doi.org/10.2737/RDS-2021-0093). The processed data underlying Figures 1-3 and Extended Data Figures 1-4 are available in the Source Data files. Full description of the original datasets is provided in Supplementary Tables 1-4.

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

Ecological, evolutionary & environmental sciences study design

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

Study description	This is a synthesis study that uses the data collated from 14 CO2 enrichment experiments. The designs of experiments including equipments, sample plots, replicates, sampling methods, data processing are described in the Supplementary Tables 1-4. The study applied general statistical methods, Z-score analysis, and fixed effect IPD meta-regression for analyzing the data and deriving response patterns between CO2 enhancement in aboveground net primary production and annual precipitation.
Research sample	The data were based on measurements of annual aboveground net primary production (ANPP) from control plots with ambient CO2 and plots with higher CO2 treatments in the study sites.
Sampling strategy	Woody and grassland ecosystems have different strategies for sampling. In general, woody ecosystems used tree stem and height measurements, litter baskets and biomass conversion methods to estimate ANPP, while grassland ecosystems applied harvest methods to estimate ANPP.
Data collection	The scientists in the experimental sites collected raw data and processed them and presented in websites or publications. Yude Pan collated data from different sources including some contributions from co-authors (who are scientists of the experiments).
Timing and spatial scale	The experiments were run in different years, ranging as early as 1989 to the latest 2016. All experiments were at ecosystem scales, and the sites are located in temperate and subtropical zones between latitudes of 48oN and 43oS in the northern or southern hemisphere.
Data exclusions	We selected the study sites running experiments more than 4 years and having more than 4 years' data of ANPP or enhancement ratios of ANPP because we exploring response patterns of ANPP enhancement in this study.
Reproducibility	The manipulative experiments were diverse and expensive, most of the experiments have been ended years ago. In general, these experiments are not the type that could have reproducibility.
Randomization	The experimental designs (see Supplementary Tables 3-4) considered randomness in selecting plot locations and sampling methods. However, this study only used data from these experiments, was not directly involved with the issue of randomization.
Blinding	Blinding is not relevant to this study.

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
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

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