

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	All analyses were performed using publicly available dataset, as described in the Methods section.
Data analysis	All analyses were performed using publicly available packages of python, as described in the Methods section.

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 dataset of global tree-restoration potential can be retrieved from <https://www.science.org/doi/10.1126/science.aax0848>. The ESA-CCI land cover dataset is available at <https://cds.climate.copernicus.eu/cdsapp#!dataset/satellite-land-cover?tab=form>. The aridity index database can be downloaded from https://figshare.com/articles/dataset/Global_Aridity_Index_and_Potential_Evapotranspiration_ET0_Climate_Database_v2/7504448/5. The world database on protected areas can be downloaded from <https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA>. The global population dataset is available at <https://>

landscan.ornl.gov/. The climate zones dataset can be obtained from <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DSDDQK>. The multi-model outputs (experiments names: piControl, deforest-glob) are available at <https://esgf-node.llnl.gov/projects/cmip6/>. The ERA5 reanalysis can be obtained at <https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5>. The current global wind installation locations are available at https://figshare.com/articles/dataset/Harmonised_global_datasets_of_wind_and_solar_farm_locations_and_power/11310269/2.

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	N/A
Reporting on race, ethnicity, or other socially relevant groupings	N/A
Population characteristics	N/A
Recruitment	N/A
Ethics oversight	N/A

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

Ecological, evolutionary & environmental sciences study design

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

Study description	Based on coupled land-atmosphere simulations with contrasting forest areas from eight Earth system models, we report a notable trade-off between wind energy and carbon sequestration across a range of potential forestation areas.
Research sample	This study employed coupled land-atmosphere simulations from eight Earth System Models (ESMs) participating in the Land Use Model Intercomparison Project (LUMIP, a contribution to CMIP6) to investigate changes in local surface wind speed in response to potential forest expansion. In addition, ten biomass density models were used to explore the carbon sequestration response to forest expansion.
Sampling strategy	All outputs from the ESMs and all biomass density models were used in this study.
Data collection	All analyses were made from publicly available data
Timing and spatial scale	The timing and spatial scale of different data have been described in Methods section.
Data exclusions	No data was excluded in this analysis.
Reproducibility	All analyses were performed using publicly available packages, as described in the Methods section.
Randomization	N/A
Blinding	Blinding was not applicable because data collection and analysis were based on model outputs without observer influence

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	Involvement 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	Involvement in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Plants

Seed stocks

N/A

Novel plant genotypes

N/A

Authentication

N/A