nature research

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Last updated by author(s): Sep 15, 2021

Reporting Summary

Nature Research 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 Research 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	Based on analysis of existing data
Data analysis	All data were analyzed using Google Earth Engine and exported for statistical analysis in ArcGIS for Desktop (v10.8.1).

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 Research 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 list of figures that have associated raw data
- A description of any restrictions on data availability

All data are currently available on Conservation International's servers and as assets in Google Earth Engine. The data and code is published on Zenodo under Conservation International's account under a Creative Commons Attribution Non Commercial 4.0 International license.
As noted in the manuscript, two input datasets are under restricted access and can be obtained only upon request by the data managers directly.

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 study is based on a global analysis of the best available carbon datasets and an analysis derived from the Cook-Patton et al (2020) study to derive sequestration rates for ecosystems. The resulting output defines global datasets of vulnerable and irrecoverable carbon in biomass and soil carbon.
Research sample	The sample size used to determine sequestration rates was derived from the Cook-Patton et al (2020) study gathering samples from over 13,000 measurements and 256 studies. The final layer is based on global remote sensing data and has global coverage except for the areas described below in data exclusions.
Sampling strategy	We filtered the sequestration database to determine the measurements with stand age and above ground carbon to derive sequestration rates for each of our defined ecosystems. The sample sizes and statistics are reported in Table S7 of the supplement.
Data collection	The study is based on an analysis of existing data from Spawn 2020 (GlobBiomass: biomass carbon), ISRIC 2020 (SoilGrids: soil carbon), and sequestration database (Cook-Patton et al 2020).
Timing and spatial scale	The study produces several global datasets at 300m resolution for 2010. The sequestration rates were estimated using a range of field measurements taken from 1-100 years stand age.
Data exclusions	The irrecoverable carbon map was created using global remote sensing products. We initially included all biomass and soil carbon. In keeping with our definition of irrecoverable carbon as carbon within natural, manageable areas, we excluded urban areas, crops, tree plantations, and cryosols (permafrost). These exclusions are detailed in the Methodology.
Reproducibility	This study is replicable using the openly available datasets and public code used for this analysis.
Randomization	Not relevant for this study
Blinding	Not relevant for 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