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	No specialized software were used by the authors for data collection.
Data analysis	Code for the analysis is available at http://doi.org/10.6084/m9.figshare.25687113. To identify energetically extreme wildfire events, we calculated the daily energy released by wildfires using an equal area, equal shape global lattice with a 0.2° resolution, equating to cell sizes of approximately 22 × 22 km (~495km2). For each cell, we summed the FRP (ΣFRP) of hotspots for each of the 7,639 days between 1 Jan 2003 and 30 Nov 2023. This process yielded 30.7-million daily ΣFRP "events" from 88.4-million satellite observations. After calculating ΣFRP events, we then selected the most energetically extreme events for subsequent analysis, defined here as events with ΣFRP ≥ 99.99th percentile (N = 2,913 events). To evaluate temporal trends in the frequency and magnitude of extreme events, we fitted separate statistical models that investigate (i) the frequency of extreme events globally, (ii) the frequency of extreme events among biomes, and (iii) the magnitude of extreme events globally. In all models, we interpreted p-values as continuous rather than categorical measures of the strength of evidence. First, we fitted a generalised additive model (GAM) of the annual count of extreme events in response to a smooth (i.e., non-linear) effect of year (continuous variable; 2003-2023). GAMs allow fitting of non-linear effects if supported by the data. We fitted the model using automatic term selection ("select = TRUE") available in the "mgcv" package, which imposes an additional penalty on smooth terms such that they are penalised out of the model if there is little evidence for an effect. We fitted the model using the negative binomial distribution to account for overdispersion. We followed the same process to model the trend for day ΣFRP and night ΣFRP separately.

Second, we fitted separate generalised linear models (GLM) for each of the 6 biomes with the largest number of events (providing a reasonable sample to interrogate for trends). We fitted these models with the annual count of extreme events modelled in response to a fixed effect of year, using the negative binomial distribution to account for overdispersion.

Third, to investigate trends in the magnitude of the most extreme events, we selected the 20 most extreme events from each year, from which we calculated the annual average of extreme ΣFRP. We then modelled the annual average of extreme ΣFRP in response to a non-linear effect of "year" using a GAM with Gaussian distribution.

All analyses were conducted using R version 4.3.0. GAMs and GLMs were fit using the "mgcv" package (version 1.8-42).

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

MODIS active fire records used in the analysis were downloaded from the University of Maryland ftp server (sftp://fuoco.geog.umd.edu) and archived at https://figshare.com/s/1de93c198fa2e15150da. Biomes of the world were downloaded from https://ecoregions.appspot.com/

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	The study analysed the intensity of the most extreme wildfires on Earth over 21 years.
Research sample	We analysed a global, systematic sample of active wildfires observed by NASA's MODIS satellites. Our primary analysis used data from the Terra and Aqua satellites between Jan 2003 and Nov 2023.
Sampling strategy	We used all data available from the MODIS Terra and Aqua satellites between Jan 2003 and Nov 2023 (but see "Data exclusions").
Data collection	The Moderate Resolution Imaging Spectroradiometer (MODIS) sensors on NASA's Terra and Aqua satellites identify active wildfires based on thermal anomalies. The MCD14ML product provides point locations of predicted wildfires at a resolution of 1 km. These locations represent the centre of a 1 km pixel that was identified by the fire and thermal anomalies algorithm as containing at least one fire somewhere within the pixel, thus detecting fires significantly smaller than a pixel. Each fire observation is accompanied by a measure of fire radiative power (FRP), measuring the radiative energy (megawatts) emitted by a fire.

Timing and spatial scale	Each of the MODIS satellites (Aqua and Terra) pass overhead approximately twice per day. We analysed the full dataset from the Terra satellite from the start of Jan 2003 to the end of Oct 2023.
Data exclusions	In the main analysis, we did not analyse data prior to the year 2003 because the 2003 was the first year both the Terra and Aqua satellites were both operational for full years. We excluded locations labelled as likely resulting from non-fire sources, such as volcanoes, other static sources, or offshore (e.g., industrial). For additional robustness, we further filtered out "low confidence" fires (i.e., confidence < 30). We also excluded hotspots that were likely duplicated as a result of overlapping swaths of successive satellite overpasses. Polar orbiting satellites are biased at high latitudes because there is some overlap in the swaths of adjacent satellite overpasses, leading to the possibility that the same pixel is double counted in subsequent orbits. We attempted to correct this problem by identifying and omitting likely duplicate hotspots. For the Terra and Aqua satellites, there should each be a maximum of one hotspot for each day and each night in each pixel. Thus, to identify likely duplicates, we identified pixels with multiple observations in a given day or night at a resolution of 500 m. Such cases with multiple hotspots indicate a likely duplicate, in which cases we retained one hotspot at random, leaving a combined maximum of four hotspots per 24-h period in each location. Of a total dataset of 88.4 million hotspots, this cleaning process removed 176,181 (0.19%) likely duplicates.
Reproducibility	The analysis is fully reproducible. Data are from a standardized, permanent, public source. The computer code and data used for analysis have been archived at a permanent repository.
Randomization	N/A
Blinding	N/A

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

Plants

Seed stocks	N/A
Novel plant genotypes	N/A
Authentication	N/A