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 software was used for data collection.
Data analysis	Land deformation was processed using GAMMA Remote Sensing software v1.6 (https://gamma-rs.ch/gamma-software) and WABInSAR algorithm version 5.6, which can be obtained here: https://www.eoivt.com/software. The copula analysis was carried out using Multivariate Copula Analysis Toolbox (MvCAT) version 02.01, which can be obtained here: https://www.mathworks.com/matlabcentral/fileexchange/69217-multivariate-copula-analysis-toolbox-mvcat.

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 vertical land motion (VLM) rate, angular distortion, and risk datasets for the 28 US cities are available through the Virginia Tech repository at https://

doi.org/10.7294/27606942. The Sentinel-1 data used in this study are publicly available from the Alaska Satellite Facility (ASF) and can be accessed at https://asf.alaska.edu/. The population dataset is available from the US census bureau (https://www.census.gov/). The groundwater data can be obtained from the US Geological Survey (USGS) (https://waterdata.usgs.gov/nwis/gw).

Human research participants

Policy information about studies involving human research participants and Sex and Gender in Research.

Reporting on sex and gender	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	We processed synthetic aperture radar (SAR) datasets for 28 most populated cities in the US to measure the rate of VLM across the urban landscape. We investigated the role of groundwater withdrawal on land subsidence in these cities. We used the derived VLM information to understand the risk to infrastructure.
Research sample	We studied 28 US metropoplises: New York, NY; Los Angeles, CA; Houston, TX; Philadelphia, PA; San Diego, CA; Jacksonville, FL; San Francisco, CA; Seattle, WA; Washington, DC; Boston, MA; and Portland, OR; San Antonio, TX; Austin, TX; Columbus, OH; Indianapolis, IN; Nashville, TN; El Paso, TX; Detroit, MI; and Memphis, TN, Chicago, IL; Phoenix, AZ; Dallas, TX; San Jose, CA; Fort Worth, TX; Charlotte, NC; Denver, CO; Oklahoma City, OK; and Las Vegas, NV.
Sampling strategy	We selected the cities based on the 28 most populated US cities in 2020.
Data collection	SAR dataset was obtained from the Alaska Satellite Facility here: https://asf.alaska.edu/. The groundwater data was obtained from the The groundwater data can be obtained from the US Geological Survey (USGS) (https://waterdata.usgs.gov/nwis/gw).
Timing and spatial scale	The spatial resolution is 28m, while the temporal resolution is from 2015 to 2021. Although some cities may have a different temporal resolution due to the lack of SAR images for certain periods.
Data exclusions	No data was excluded from the study.
Reproducibility	All dataset can be reproduced by following the methods section described in the manuscript.
Randomization	No experiments were conducted and the analyses did not involve radomization.
Blinding	No experiments were conducted in 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
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

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