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.

○ A statement of 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.

Software and code

Policy information about availability of computer code

Data collection

No code was used to collect data

Data analysis

Data were analyzed using R version 4.0.2 using EpiEstim package version 2.2. Code is available at https://github.com/rebaker64/winteroutbreaks.

For manuscripts utilizing custom algorithms, software that was used to analyze data must be made available in source code form, either on GitHub (github.com) or through a similar hosting service.

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

Coronavirus case data, for estimating R (effective), were downloaded from the https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv (US county level data) and https://github.com/ndph/covid19 (country level data). Specific humidity come from https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5.
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/sr-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 analyzed publicly available data using a mathematic model. |
|--------------------|---------------------------------------------------------------|
| Research sample    | We used publicly available data.                              |
| Sampling strategy  | No data was collected.                                        |
| Data collection    | No data was collected.                                        |
| Timing and spatial scale | No data was collected.                                    |
| Data exclusions    | No data was collected.                                        |
| Reproducibility    | No data was collected.                                        |
| Randomization      | No data was collected.                                        |
| Blinding           | No data was collected.                                        |

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 | Methods |
|---------------------------------|---------|
| n/a                             | n/a     |
| ☒ Antibodies                    | ☒ Chip-seq |
| ☒ Eukaryotic cell lines         | ☒ Flow cytometry |
| ☒ Palaeontology and archaeology | ☒ MRI-based neuroimaging |
| ☒ Animals and other organisms   |         |
| ☒ Human research participants   |         |
| ☒ Clinical data                 |         |
| ☒ Dual-use research of concern  |         |