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Reporting Summary

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Statistical parameters

When statistical analyses are reported, confirm that the following items are present in the relevant location (e.g. 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
☒	☐	An indication 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 statistics 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
☐	☒	Clearly defined error bars *State explicitly what error bars represent (e.g. SD, SE, CI)*

Our web collection on statistics for biologists may be useful.

Software and code

Policy information about availability of computer code

Data collection	Version 3.6.1 of the WRF-ARW regional climate model was applied to generate all results. WRF is freely available here: http://www2.mmm.ucar.edu/wrf/users/download/get_source.html Modest modifications to WRF were made to incorporate subgrid features. A separate model code, previously published (Krayenhoff et al., 2014, Boundary-Layer Meteorol, 151, 139-178), was used to determine shading of urban surfaces by street trees. All code is available upon reasonable request from the corresponding authors.
Data analysis	Analysis was performed using custom scripts coded in Matlab version 2017a and in Python.

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/reviewers upon request. 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

Regional climate simulation output analyzed during the current study is accessible at erams.com/public_data/climate/#asu_wrf. Erams is an online services platform for geospatial analysis.

Field-specific reporting

Please select 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/authors/policies/ReportingSummary-flat.pdf

Ecological, evolutionary & environmental sciences study design

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

Study description	Multiple 10-year regional climate simulations for a model domain that includes the contiguous U.S. (CONUS) are performed, for contemporary and projected future climates. Two global climate models (GCMs) are downscaled, and two Representative Concentration Pathways (RCPs) are evaluated. Different projections of future urban land cover, as well as potential adaptation implementations, are assessed. Interaction between drivers of urban heat are assessed by subtracting the sum of simulated 10-year average effects of two individual drivers with corresponding effects of their interactive combination.
Research sample	We perform 13 ten-year regional climate simulations for CONUS. Two simulations are performed for contemporary climate (2000-2009), and 11 are performed for end of century climate (2090-2099). For the end of century period, we dynamically downscale two GCMs and assess two RCPs. Dynamical downscaling one of these GCMs, we further assess four heat adaptation strategies individually, using separate simulations, and one combined adaptation implementation applied to two RCP scenarios (i.e., two additional simulations).
Sampling strategy	The choice of ten year simulations represents a balance between available computational resources, in particular with respect to data storage, and the number of sensitivity simulations performed and associated spatio-temporal sampling. Longer simulations would have precluded assessment of diurnal and/or adaptation effects. Ten year simulations eliminate most impacts of inter-annual variability. During analysis, regional 'sample' sizes were determined by spatial frequency of existing and projected urban development in each region; i.e., we included all urban data points in our analysis. The region with the least contemporary and projected urban development nevertheless had projected expansion of urban area in n = 58 grid squares, and existing urban development in n = 102 grid cells. For urban densification, the least spatially common effect according to projections, regional 'sample' size exceeds 21 grid cells for all regions except the North Central region.
Data collection	Scott Krayenhoff performed the WRF simulations at the Arizona State University supercomputer facility using standard procedures. Ashley Broadbent modified the land use required for these simulations using Geographic Information Systems techniques, and Mohamed Moustaoui prepared the GFDL global climate model output for ingestion in WRF. All other input data was obtained from the National Center for Atmospheric Research, the Environmental Protection Agency, or from the literature.
Timing and spatial scale	All simulations begin one month prior to their respective 10-year periods, i.e., 0000 UTC Dec. 1, 1999 for the 2000-2009 period (inclusive); 0000 UTC Dec. 1, 2089 for the 2090-2099 period (inclusive). Data was output every three hours for every grid cell in the domain for the duration of each simulation. All output data points represent an average for a 20 km by 20 km area.
Data exclusions	We principally analyzed the summer (June-July-August) months from our continuous 10-year simulations. We therefore primarily exclude autumn, winter, and spring months from the current analysis, with the except of assessment of extreme heat days in the final subsection of the Results section (i.e., some extreme heat days fall in May and September, for example). Our objectives pertain principally to assessment of summertime heat.
Reproducibility	Ten-year simulations provide sufficient averaging such that replicates will yield very similar results in terms of 10-year averages, in part because application of identical initial and boundary conditions and spectral nudging would constrain the otherwise chaotic nature of the simulation.
Randomization	Data was grouped by geographic region and/or time of day, and all data for each particular (combination of) grouping(s) was analyzed. Hence, no randomization is required.
Blinding	We understand blinding to be designed to control for human biases and perceptions and their conscious or unconscious influences. Our experiments involved very clear changes to model code and/or inputs, which are extensively documented in the Methods and Supplementary Materials. Therefore, unconscious and unreported human influence on the results is minimal.

Did the study involve field work? ☐ Yes ☒ No

Reporting for specific materials, systems and methods

Materials & experimental systems

n/a	Involved in the study
☒	☐ Unique biological materials
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology
☒	☐ Animals and other organisms
☒	☐ Human research participants

Methods

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