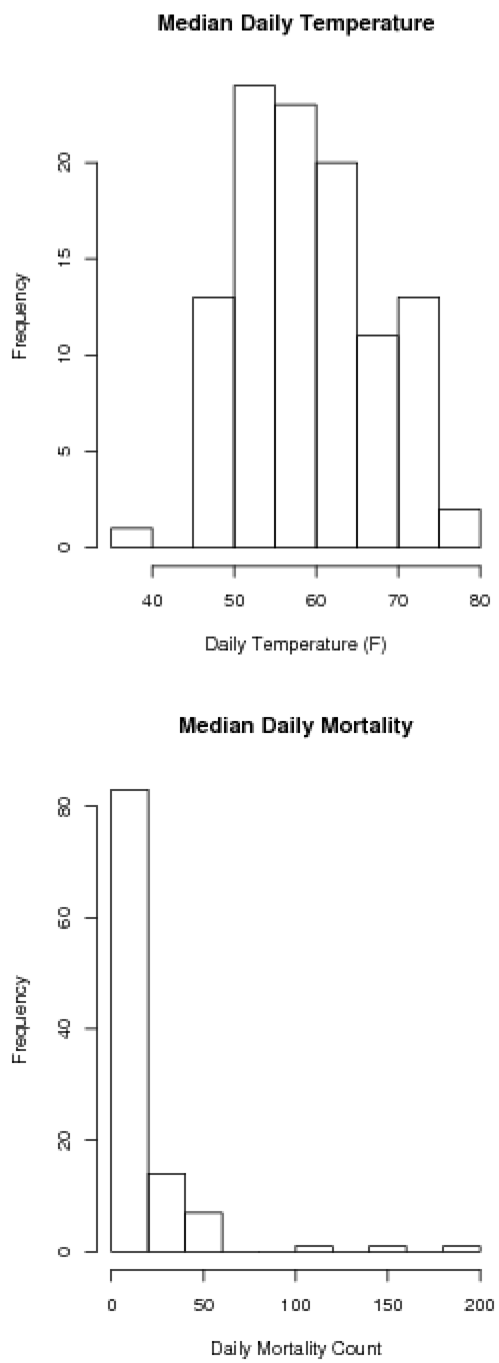
Online Supplement for: **Weather-Related Mortality: How Heat, Cold, and Heat Waves Affect Mortality in the United States,** GB Anderson and ML Bell, *Epidemiology*

List of Supplemental Figures

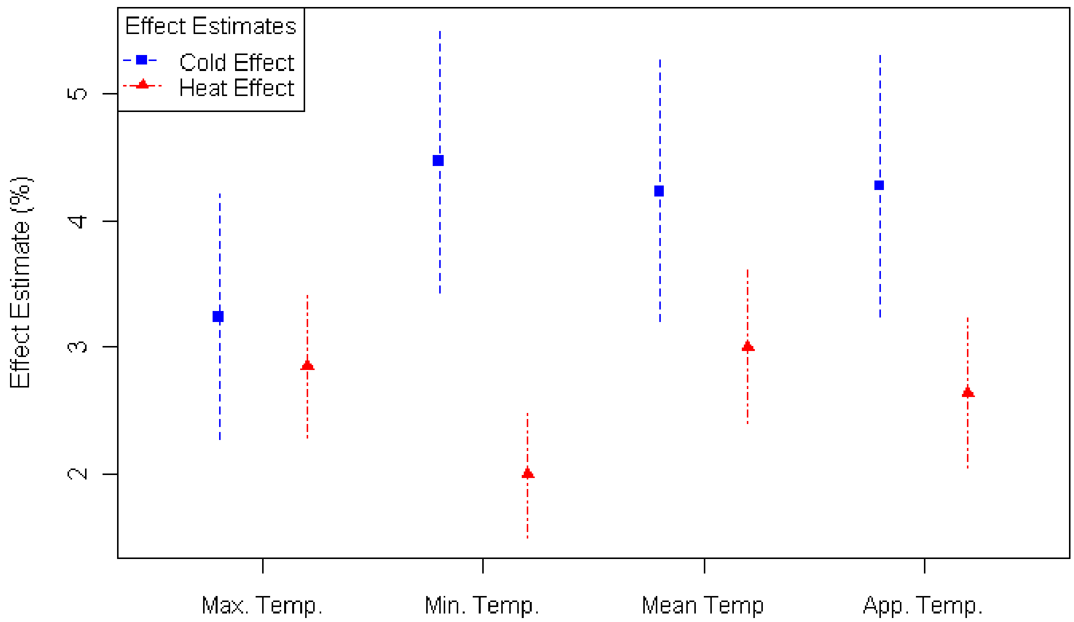
List of Supplemental Tables

eFigure 1. Distribution of community median values for daily mean temperature, daily mean dew point temperature, and daily mortality count.



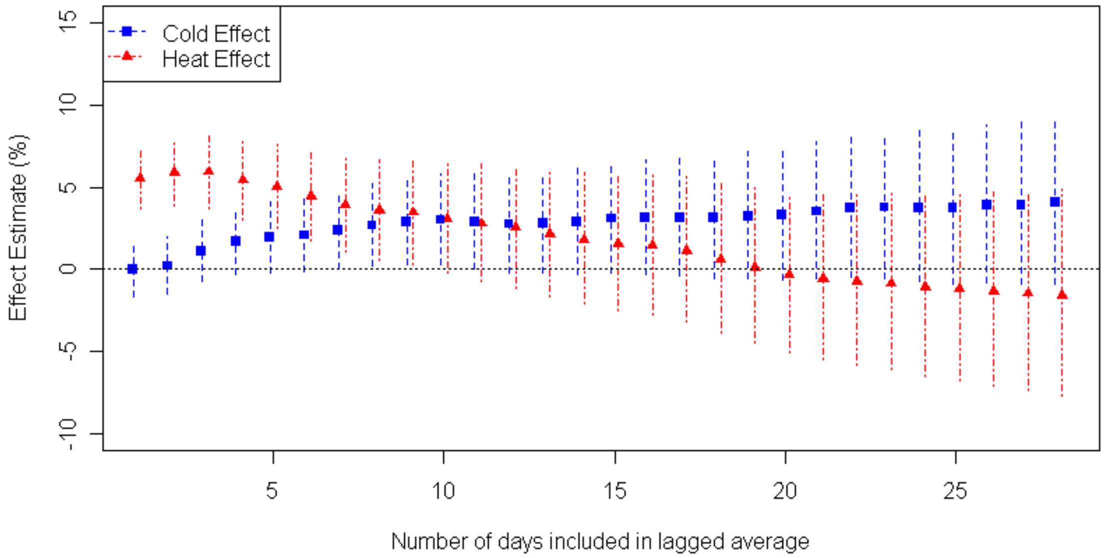
eFigure 2. National relative heat and cold effect estimates using various temperature metrics.

Note: The point reflects the percent increase in mortality risk for the relative heat effects (comparing risk at the 99th and 90th percentile) and cold effects (comparing risk at the 1st and 10th percentile) while the vertical line shows 95% posterior interval.

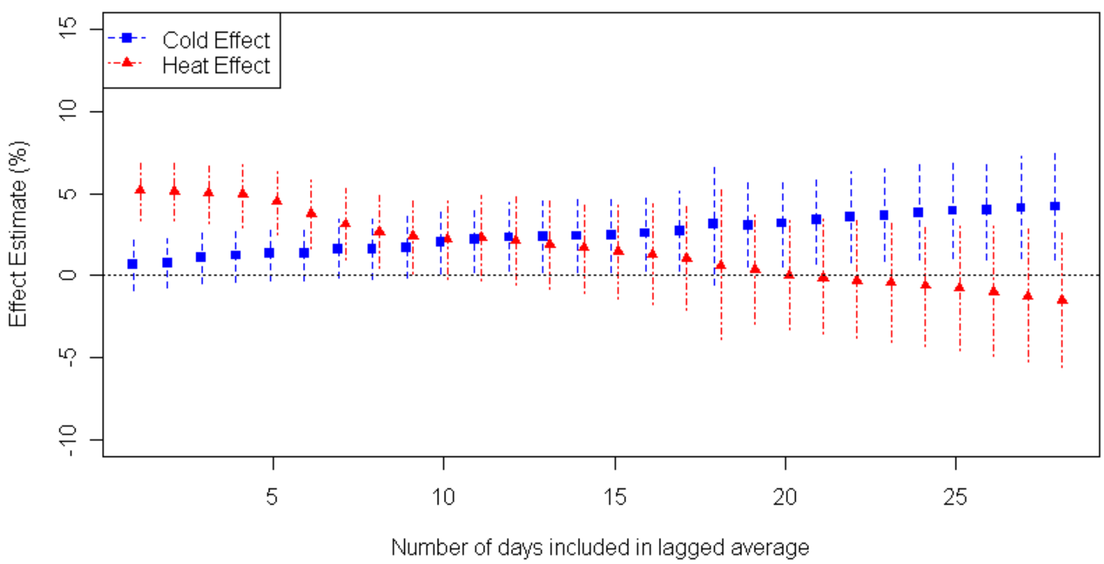


eFigure 3. The effects of lag structure on relative heat and cold effect estimates for various communities (a. New York City; b. Los Angeles; c. Chicago; and d. Dallas/ Ft. Worth).
Note: Points show central estimates while vertical lines show 95% confidence intervals.

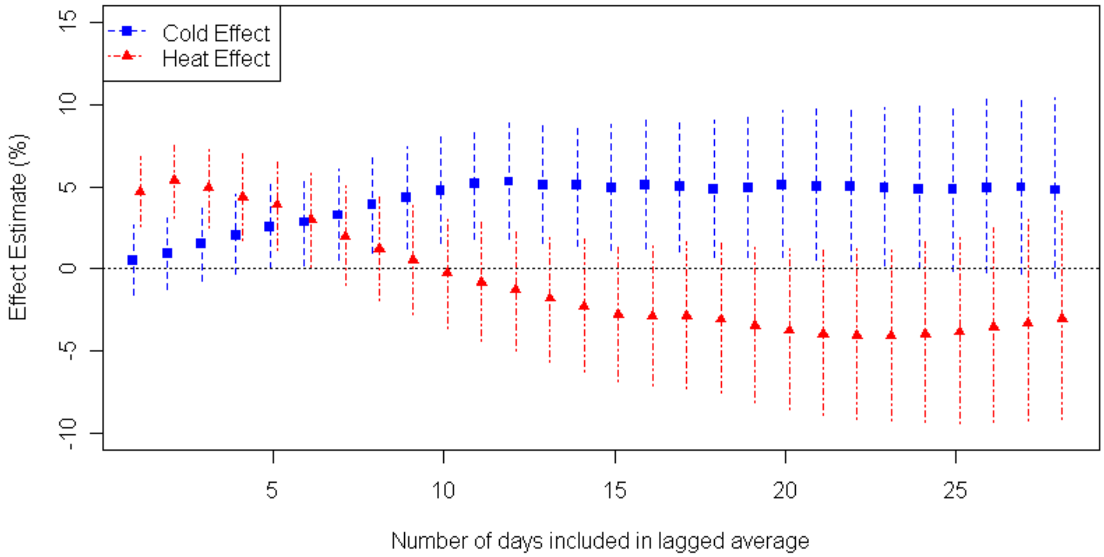
a. New York City



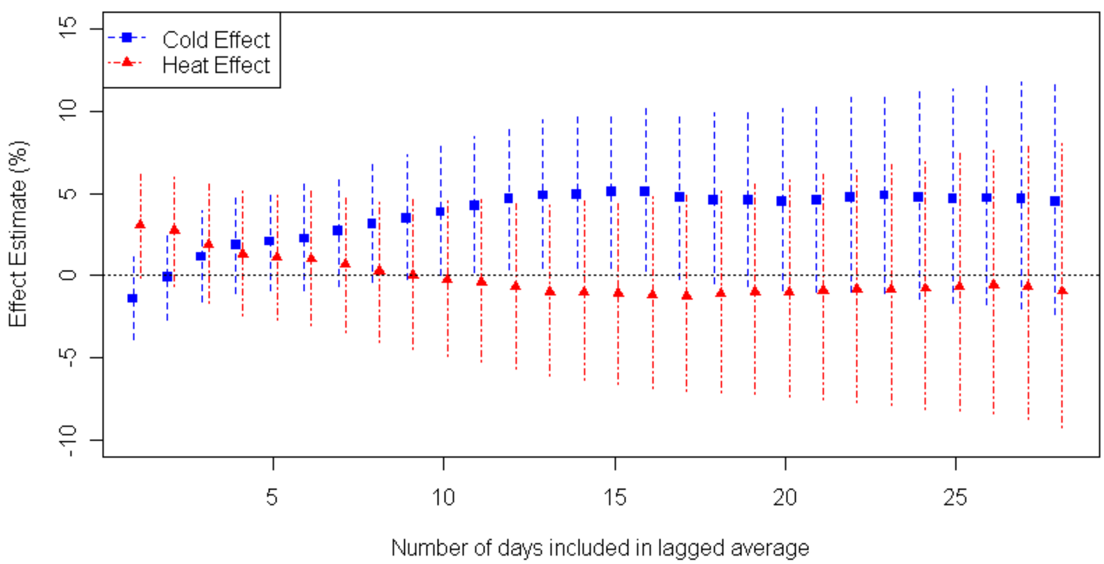
b. Los Angeles



c. Chicago

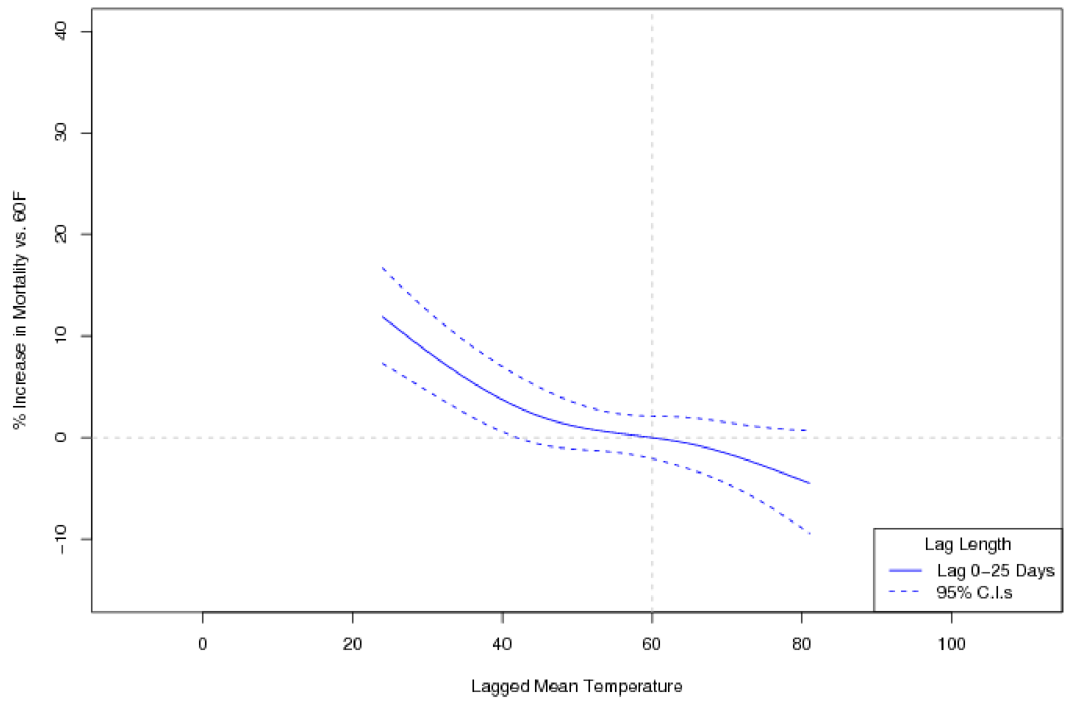


d. Dallas/Ft. Worth

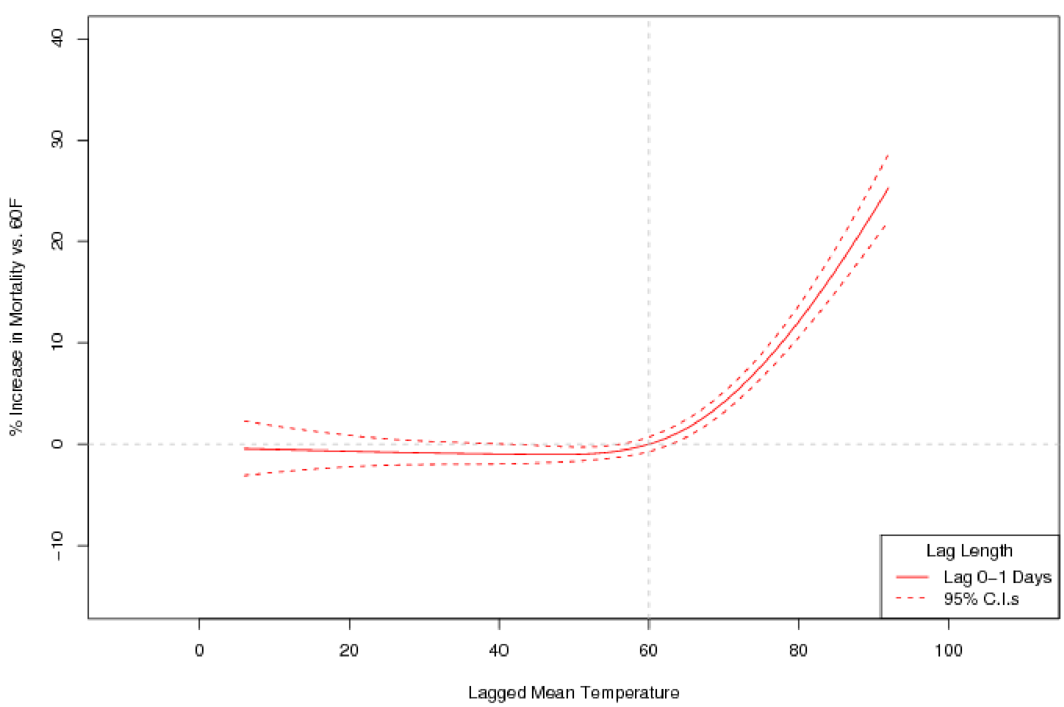


eFigure 4. Relationship between temperature and risk of mortality, comparing various temperature levels to a reference temperature of 60°F for New York City.

a. Lag 0-25 days

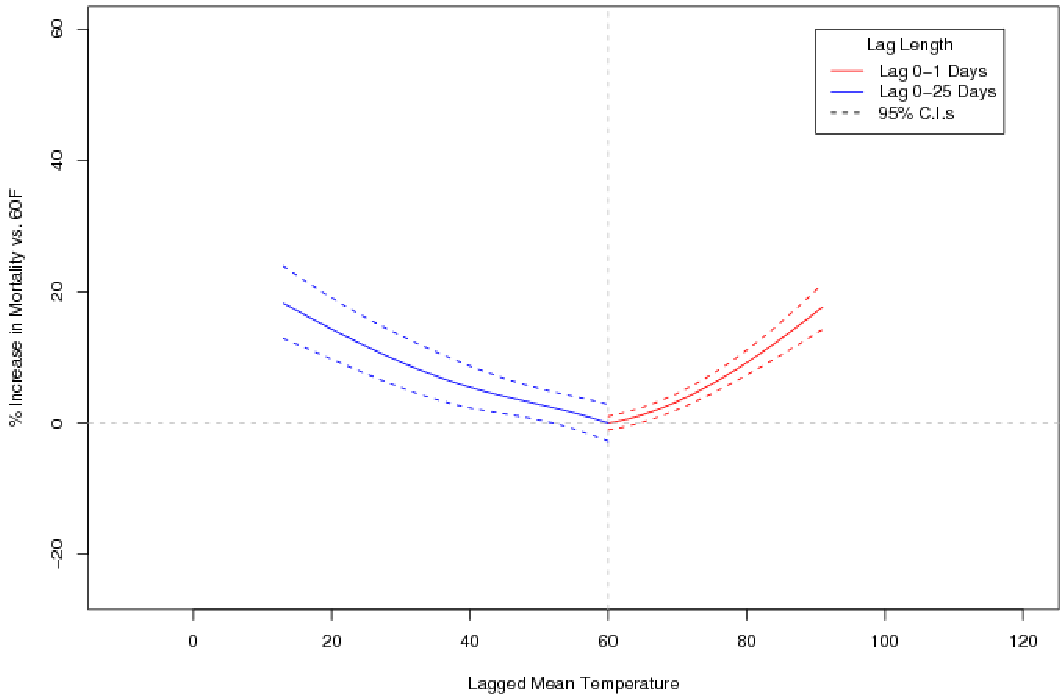


b. Lag 0-1 days

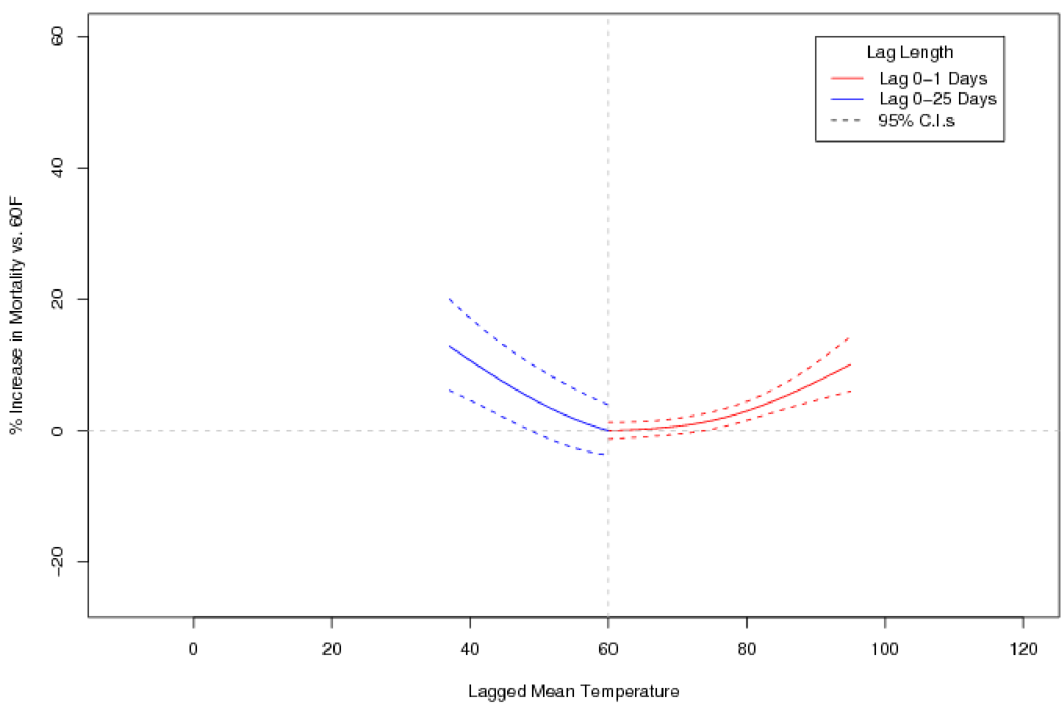


eFigure 5. Examples of temperature-mortality relationships in communities across the United States (a. Chicago; b. Dallas/Ft. Worth; c. Los Angeles; d. Minneapolis/St. Paul; e. Philadelphia; f. Phoenix; g. Seattle).

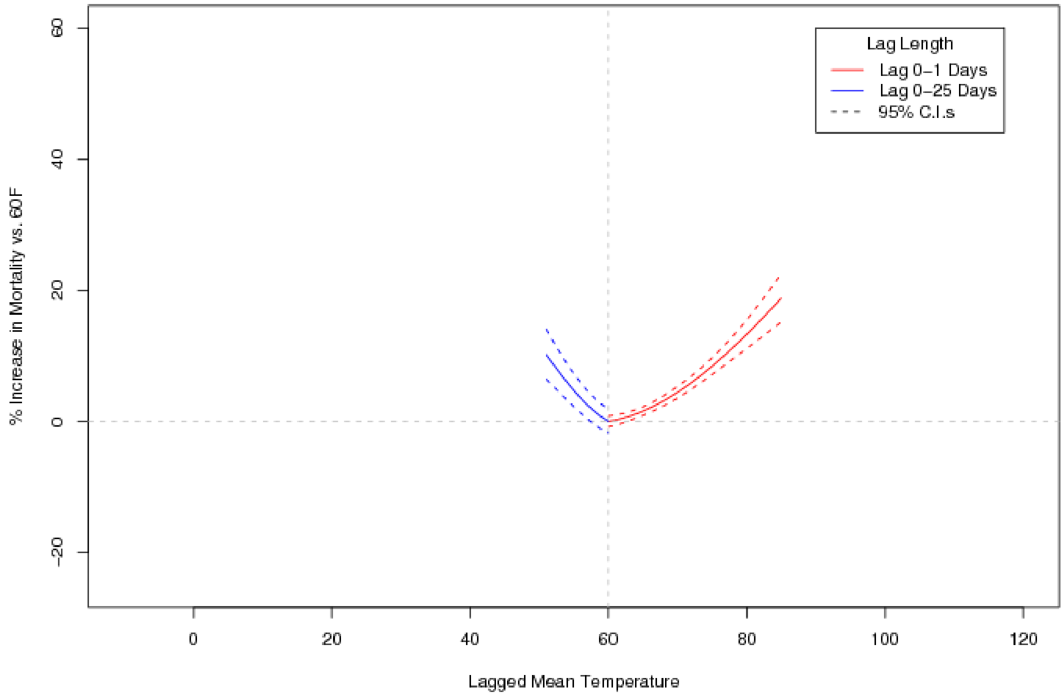
a. Chicago



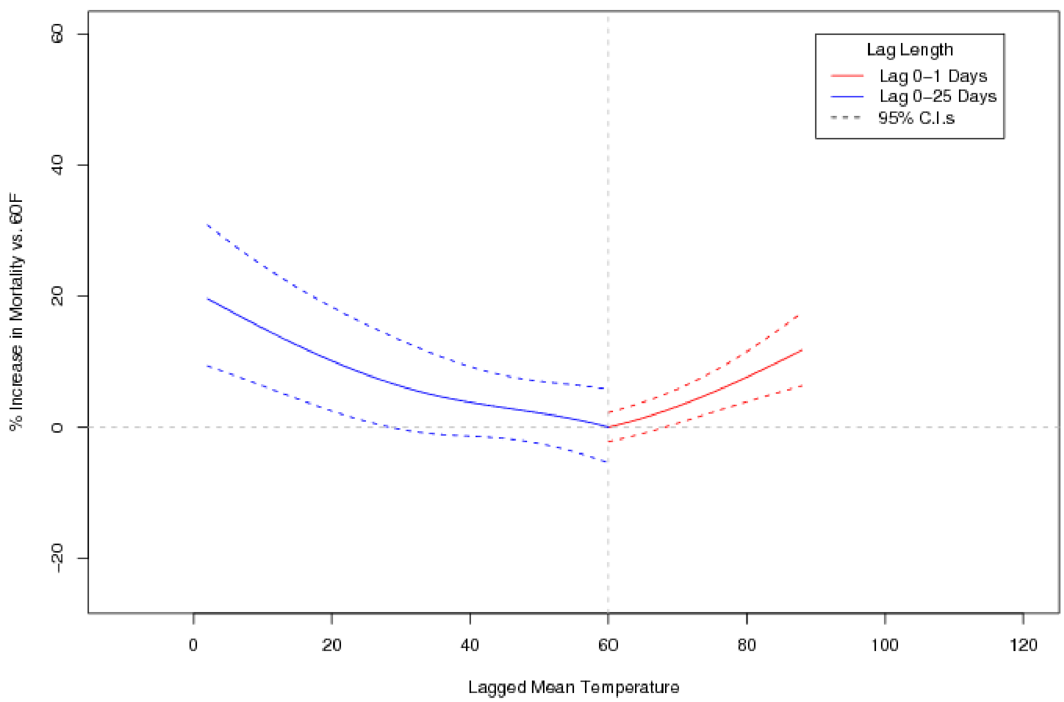
b. Dallas/Ft. Worth



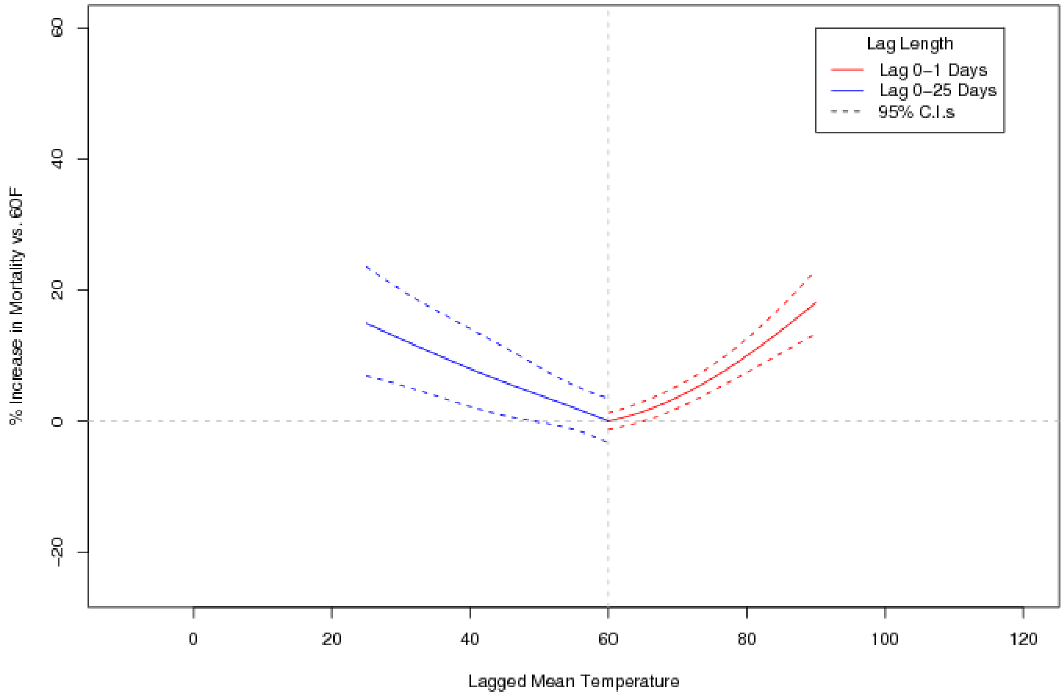
c. Los Angeles



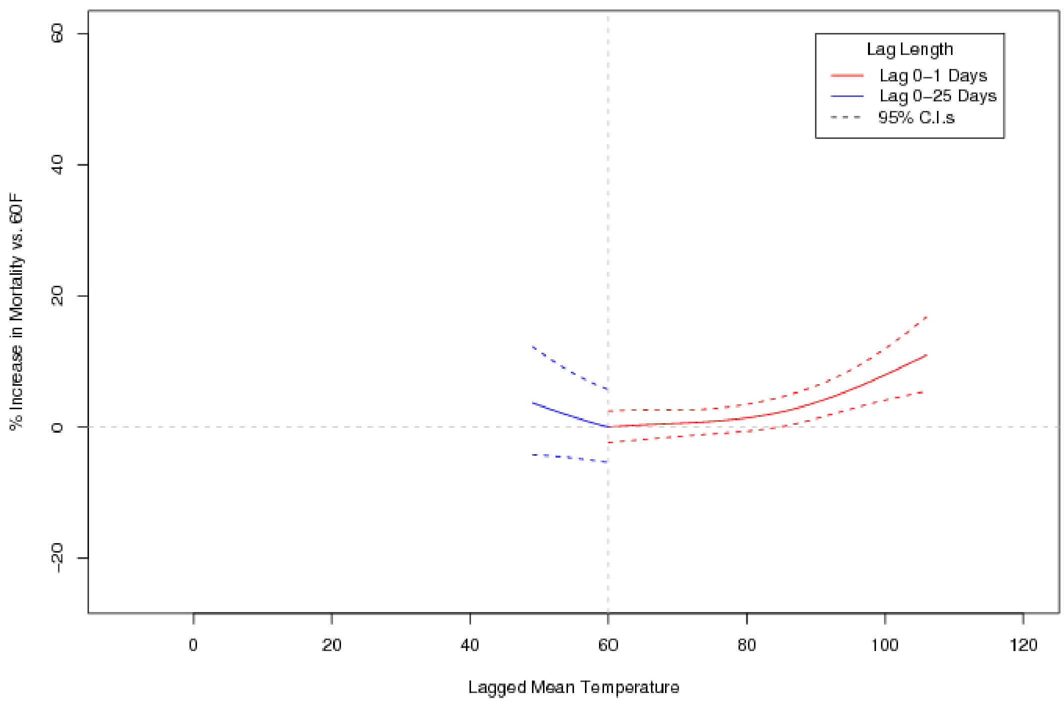
d. Minneapolis/St. Paul



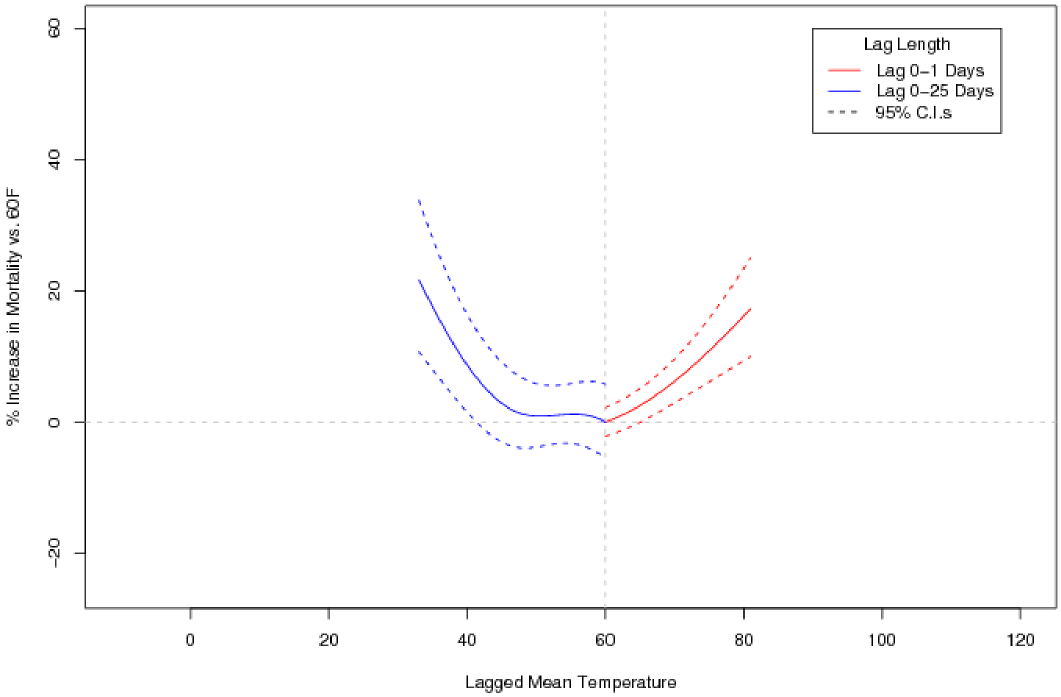
e. Philadelphia



f. Phoenix

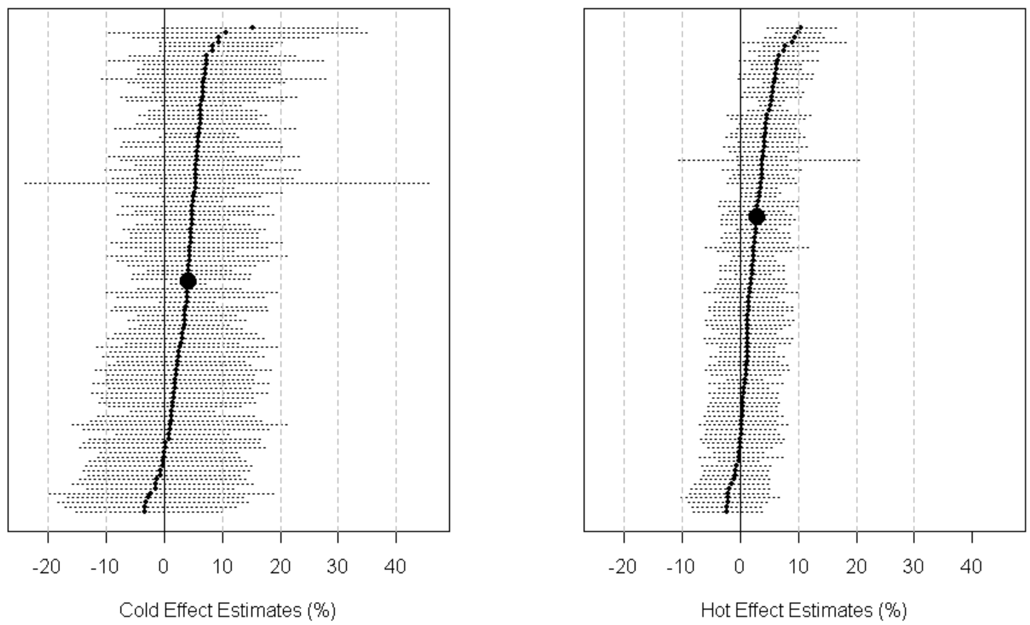


g. Seattle

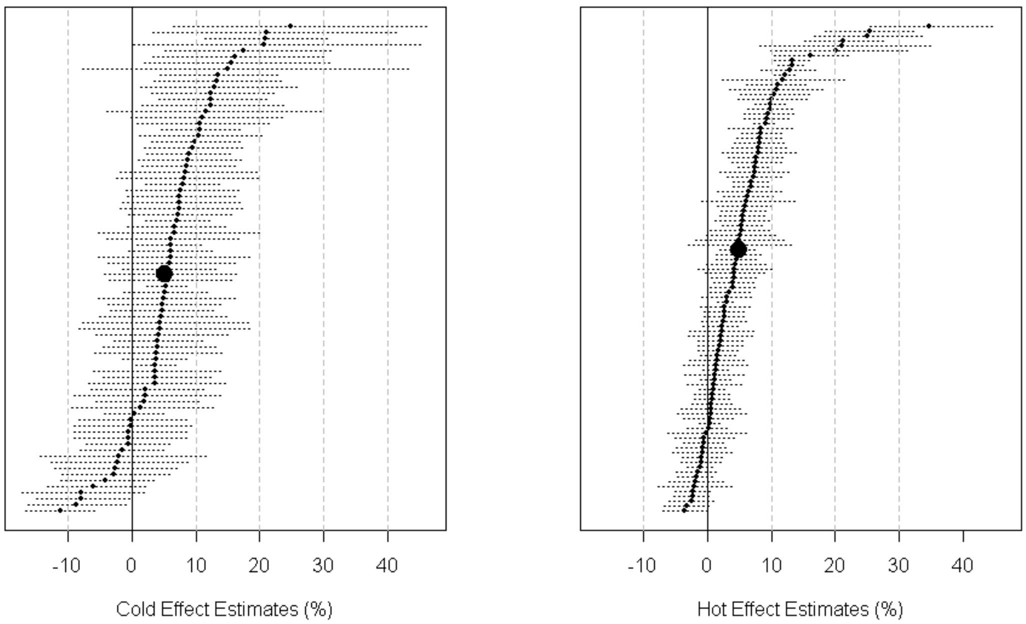

Lag Length
Lag 0−1 Days
Lag 0−25 Days
95% C.I.s
% Increase in Mortality vs. 60F
Lagged Mean Temperature
60
40
20
0
−20
0
20
40
60
80
100
120

eFigure 6. Community-specific increase in daily mortality risk for the relative cold effect (comparison of risk at 1st to 10th percentiles of $T_{lag0-25}$) and heat effect (comparison of risk at the 99th to 90th percentiles of T_{lag0-1}) (*n* = 107).

Note: Each point represents a community's central estimate, and the dashed lines represent the 95% interval. The large black dots represent the overall effect across the 107 communities. The scale of the graph is too large to show the 95% posterior interval for the overall estimates.

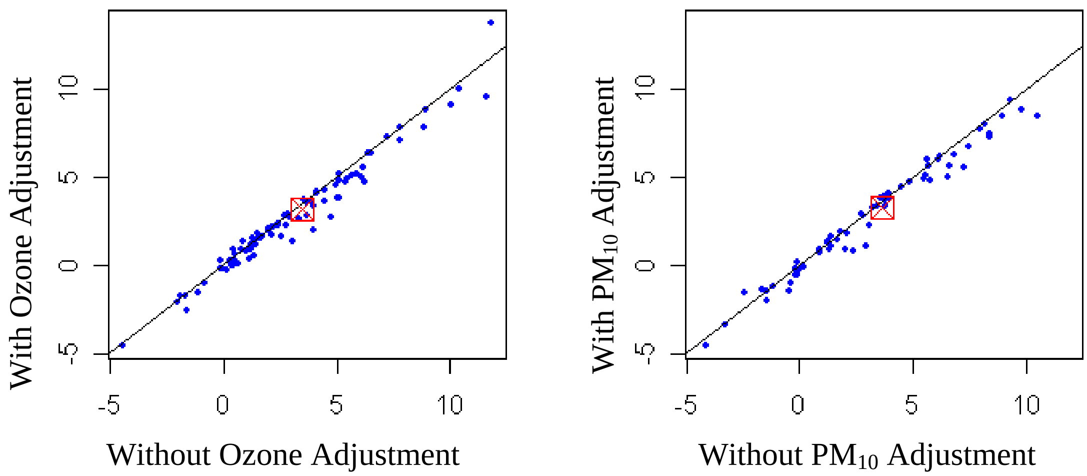


eFigure 7. Community-specific increase in daily mortality risk for the absolute cold effect (comparison of risk at 40 °F to 60 °F for $T_{lag0-25}$) (n = 81) and heat effect (comparison of risk at 80 °F to 60 °F for T_{lag0-1}) (n = 101).
Note: Each point represents a community's central estimate, and the dashed lines represent the 95% interval. The large black dots represent the overall effect across all communities. The scale of the graph is too large to show the 95% posterior interval for the overall estimates.



eFigure 8. Sensitivity analysis of relative heat effect estimates (comparison of risk at the 99th to 90th percentiles of T_{lag0-1}) to adjustment by air pollution.

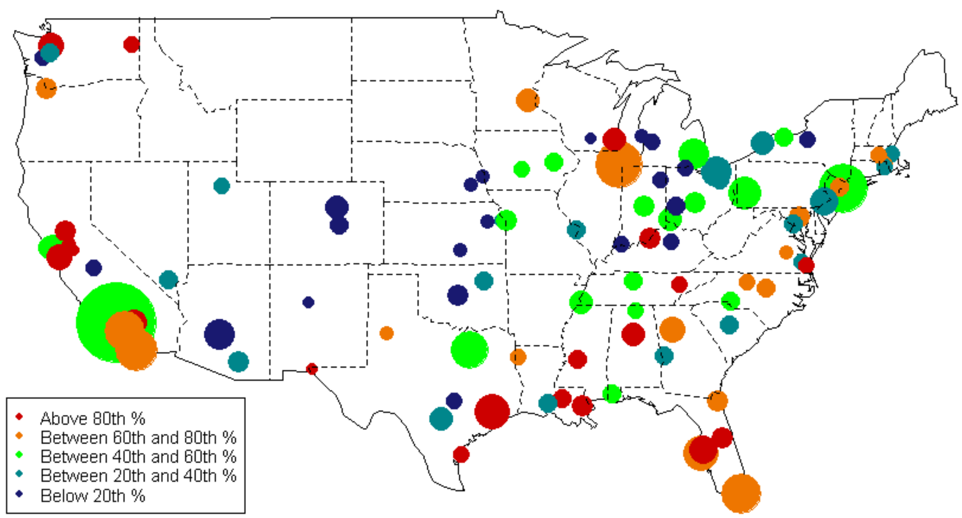
Note: Each point represents an individual community. The boxed X represents the overall effect across the communities (*n* = 87 for ozone analysis and 63 for PM_{10} analysis). If adding pollution to the model had no effect on results, points in this figure would fall on the diagonal reference line. Alternatively, if most of the temperature effect were actually caused by ozone or particulate matter pollution, points in this figure would be well below the reference line.



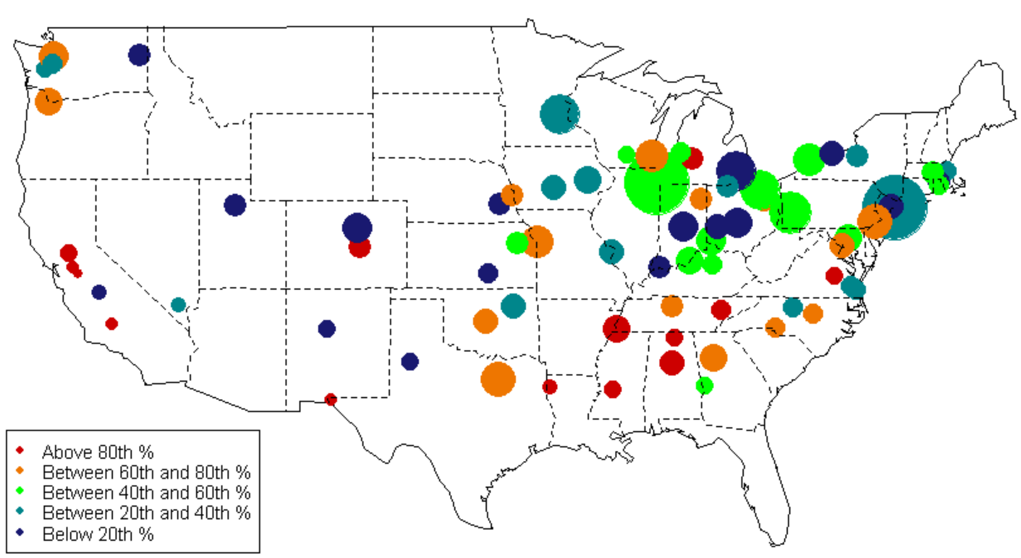
eFigure 9. Map of the relative cold effect (percent increase in mortality risk comparing 1st to 10th percentile of $T_{lag\ 0\text{-}25}$) (eFig. 9a), absolute cold effect (percent increase in mortality risk comparing 40 °F to 60 °F for $T_{lag0\text{-}25}$) (eFig. 9b), and the absolute heat effect (percent increase in mortality risk comparing 80 °F to 60 °F $T_{lag\ 0\text{-}1}$) (eFig. 9c).

Note: The color of each community corresponds to the level of the estimate; the size of the circle corresponds to the inverse of the variance of the estimate (i.e., larger circles are more certain). The two non-continental cities included in the dataset, Honolulu HI and Anchorage AK, are not included in this regional analysis.

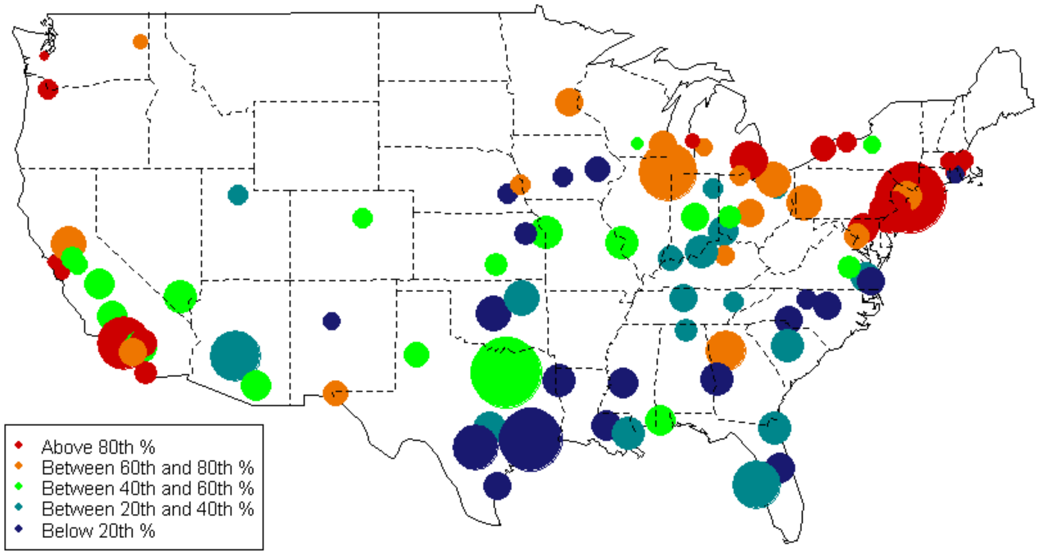
a. Relative cold effect



b. Absolute cold effect

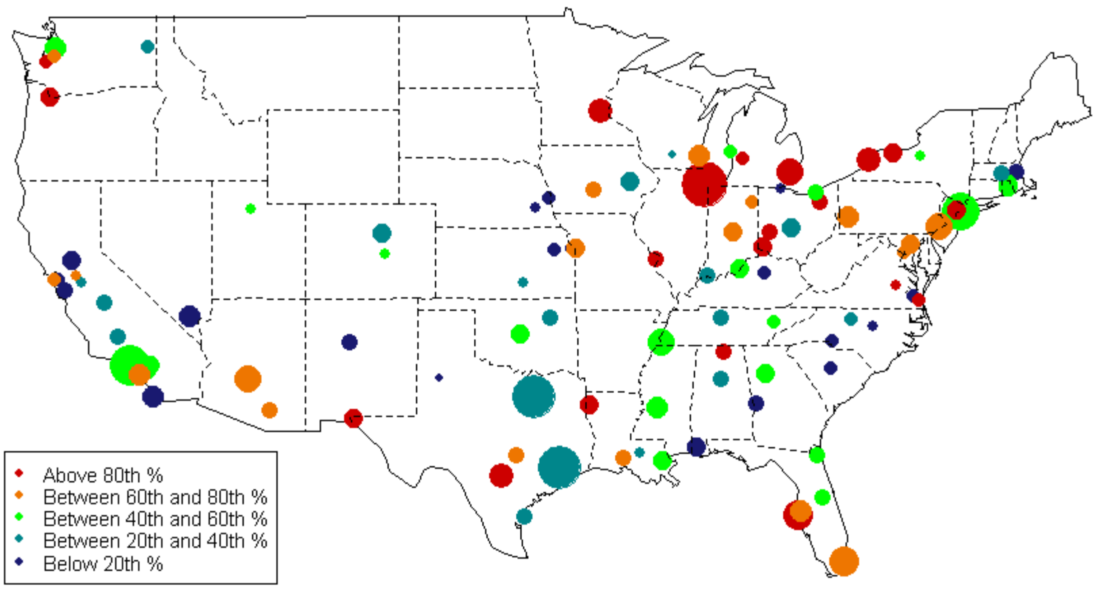


c. Absolute heat effect



eFigure 10. Map of community heat-wave effect estimates using the 2-day, ≥99.5th percentile heat-wave definition.

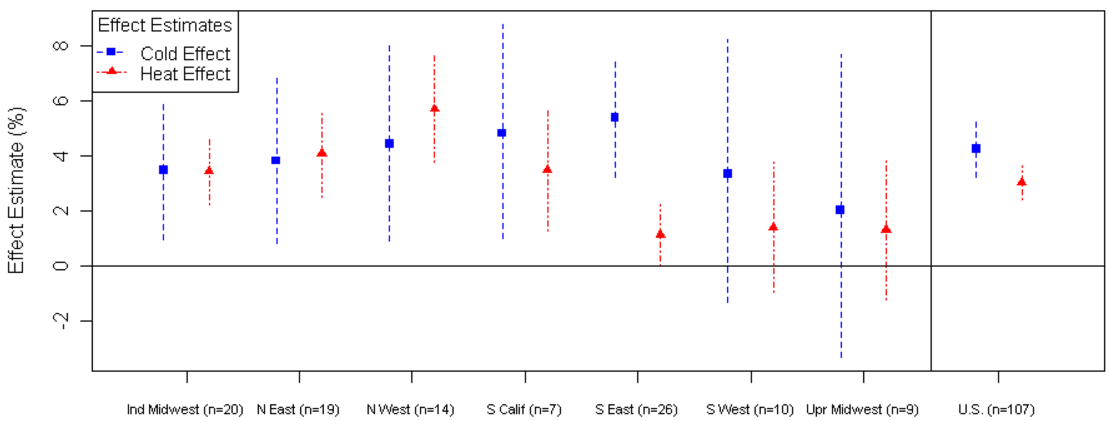
Note: The color of each community corresponds to the level of the estimate; the size of the circle corresponds to the inverse of the variance of the estimate (i.e., larger circles are more certain). The two non-continental cities included in the dataset, Honolulu HI and Anchorage AK, are not included in this regional analysis.



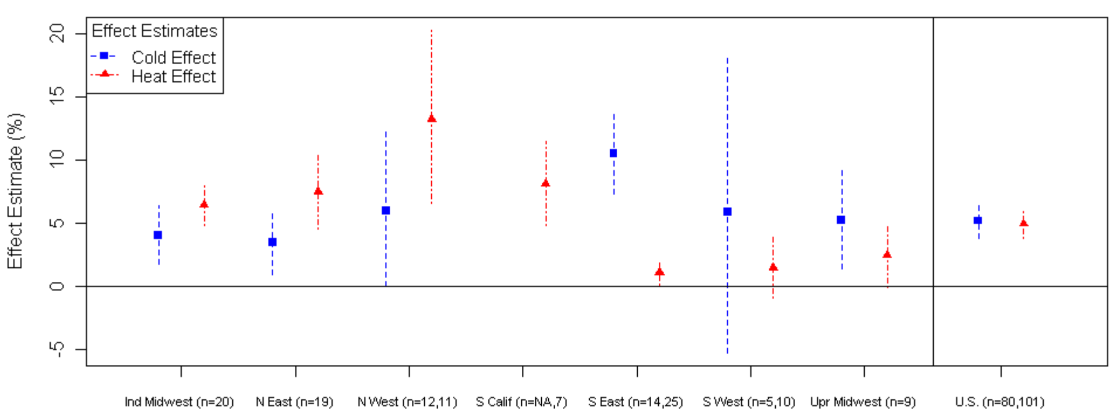
eFigure 11. Percent increase in mortality risk for the relative cold effect (comparison of the 1st to 10th percentile temperature) and heat effect (comparison of the 99th to the 90th percentile temperature) (eFig. 11a), the absolute cold effect (percent increase in mortality risk comparing 40 °F to 60 °F for $T_{lag0\text{-}25}$), heat effect (percent increase in mortality risk comparing 80 °F to 60 °F for $T_{lag0\text{-}1}$) (eFig. 11b) and heat-wave effect (eFig. 11c) by region.

Note: The point represents the central estimates; the vertical lines represent 95% posterior intervals. The numbers in parentheses provide the number of communities in each region's estimate. When two numbers are included, the first indicates the number of communities in the cold effect estimate and the second the number of communities in the heat effect estimate. The two non-continental cities included in the dataset, Honolulu HI and Anchorage AK, are not included in a region. The heat-wave effect was estimated using the two-day, ≥99.8th percentile definition. For the Southern California region, only one community had a temperature range suitable to calculate the absolute cold effect, so no regional estimate is provided (eFig. 11b).

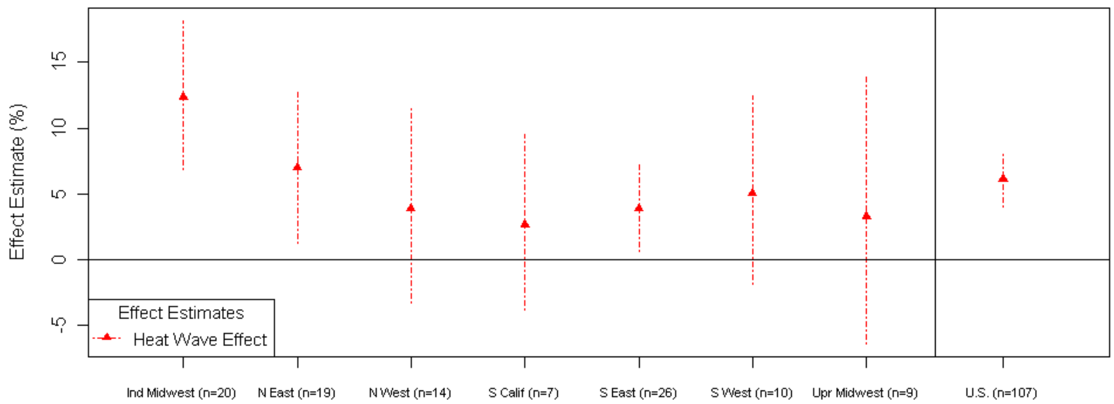
a. Relative cold and heat effect



b. Absolute cold and heat effect



c. Heat-wave effect



eTable 1. Summary statistics for weather variables and mortality rates, across 107 U.S. communities.
Note: These values reflect the median of the community-specific distributions for each variable.

		Minimum	25th	50th	75th	Maximum
Mean Temperature (^{o}F)	Yearly	3.8	45.0	58.5	71.8	90.0
	Summer	55.3	70.8	74.7	78.5	92.0
	Winter	3.8	30.3	36.5	42.3	64.7
Dew Point Temperature (^{o}F)	Yearly	-11.0	31.5	45.9	58.4	77.4
Mortality (deaths/day)	Total	2	9	11	14	27
	Cardiovascular	0	3	5	6	17
	Respiratory	0	0	1	2	7
	Non-cardiorespiratory	0	4	6	7	17

eTable 2. Correlation of temperature metrics across 107 U.S. communities.
Note: Values reflect the mean of community-specific communities (minimum to maximum for any single community).

	Maximum temperature	Mean temperature	Apparent temperature
Minimum temperature	0.89 (0.57 to 0.95)	0.96 (0.80 to 0.99)	0.96 (0.85 to 0.98)
Maximum temperature		0.97 (0.85 to 0.99)	0.95 (0.83 to 0.99)
Mean temperature			0.99 (0.95 to 0.997)

eTable 3. Sensitivity of relative heat and cold effects to changes in the degrees of freedom used to model temperature splines.

Degrees of freedom	Relative Heat Effect Estimate			Relative Cold Effect Estimate		
	Lower P.I.	Estimate	Upper P.I.	Lower P.I.	Estimate	Upper P.I.
4 d.f./year	2.44%	2.94%	3.45%	3.98%	4.80%	5.63%
7 d.f./year	2.42%	3.03%	3.64%	3.24%	4.28%	5.33%
14 d.f./year	2.86%	3.51%	4.16%	1.06%	2.80%	4.58%

eTable 4. Sensitivity of absolute heat and cold effects to inclusion of pollution variables in the temperature-mortality model.
Note: Results without pollution adjustment include only days and communities with pollution data available. Ozone is at lag 0 days; PM_{10} is at lag 1 day.

Pollutant Adjustment	*Heat Effect*			*Cold Effect Estimate*		
	Estimate	95% P.I.	Number of communities	Estimate	95% P.I.	Number of communities
without PM_{10}	4.55%	(3.06%, 6.07%)	57	6.18%	(3.31%, 9.13%)	48
with PM_{10}	3.81%	(2.33%, 5.30%)		6.25%	(3.36%, 9.22%)	
without O_3	5.38%	(4.09%, 6.68%)	86	5.22%	(3.11%, 7.37%)	54
with O_3	4.47%	(3.26%, 5.69%)		5.42%	(3.29%, 7.60%)	

eTable 5. Number of heat waves/year/community under different heat-wave definitions.
Note: Values reflect the average across all 107 communities, and the minimum and maximum for any single community.

	Duration:			
	2 days		*4 days*	
Intensity:	Average HWs/Community /Year	Range of HWs/Community /Year	Average HWs/Community /Year	Range of HWs/Community /Year
≥ 98th percentile	1.89	(1.29, 2.36)	0.57	(0.21, 1.07)
≥ 99th percentile	1.01	(0.64, 1.57)	0.25	(0.00, 0.57)
≥ 99.5th percentile	0.50	(0.29, 1.36)	0.09	(0.00, 0.29)

eTable 6. Increased risk of mortality for later days of a heat-wave event compared to non-heat-wave days, under different heat-wave definitions, using lag 0-2 days to control for temperature.

	Duration:					
	2 days			*4 days*		
Intensity:	Estimate	95% P.I.	No. communities	Estimate	95% P.I.	No. communities
≥ *98th percentile*	3.87 %	(2.77%, 4.99%)	107	3.99%	(2.04%, 5.98%)	107
≥ *99th percentile*	4.93 %	(3.31%, 6.59%)	107	6.50%	(2.71%, 10.43%)	105
≥ *99.5th percentile*	6.79 %	(4.72%, 8.90%)	107	10.49%	(5.91%, 15.27%)	81

eTable 7. Correlations among community variables (eTab. 7a.) and weather variables (eTab. 7b.) used in the second-stage analysis.

a. Correlations among community-specific variables

	Median Income	% Unemployed	% with H.S. degree	% Public Transportation	% African-American	% Urban	Population	AC
Median Income	1.00	-0.50	0.54	0.07	-0.42	0.04	0.20	-0.32
% Unemployed		1.00	-0.80	0.28	0.42	0.13	0.17	0.02
% Population with High School degree			1.00	-0.28	-0.44	-0.13	-0.19	-0.07
% Public Transportation				1.00	0.32	0.36	0.38	-0.24
% Black/African-American					1.00	0.24	0.00	0.36
% Urban						1.00	0.29	0.20
Population							1.00	-0.20
% Central AC (metropolitan survey)								1.00

b. Correlations among weather variables

	Mean Temperature	Summer Temperature	Winter Temperature	Dew Point Temperature	Summer Dew Point	Winter Dew Point
Median Income	-0.18	-0.43	-0.04	-0.15	-0.31	-0.03
% Unemployed	0.16	0.17	0.14	0.07	-0.04	0.13
% with H.S. degree	-0.35	-0.35	-0.30	-0.29	-0.22	-0.27
% Public Transportation	-0.12	-0.13	-0.09	-0.07	-0.01	-0.11
% Black/African-American	0.11	0.24	0.04	0.25	0.46	0.06
% Urban	0.14	0.12	0.13	0.05	-0.01	0.08
Population	0.11	-0.04	0.16	0.07	-0.06	0.12
% central AC (metropolitan survey)	0.59	0.79	0.36	0.50	0.61	0.33
Mean Yearly Temperature (^oF)	1.00	0.81	0.95	0.80	0.43	0.86
Mean Summer Temperature (^oF)		1.00	0.59	0.52	0.49	0.45
Mean Winter Temperature (^oF)			1.00	0.81	0.32	0.94
Mean Dew Point (^oF)				1.00	0.76	0.90
Mean Summer Dew Point (^oF)					1.00	0.42
Mean Winter Dew Point (^oF)						1.00

eTable 8. Increase in heat- and cold-related mortality effect estimates for those ≥65 years per interquartile (IQR) increase in community-specific weather variables.

Note: The values reflect the percent increase in each specific heat or cold effect estimate per an IQR increase in the specified long-term community-specific variable. [a] Significant at $p < 0.01$; [b] Significant at $p < 0.05$.

		Change in relative effect		*Change in absolute effect*		*Heat-wave*
	IQR (°F)	Heat effect	Cold effect	Heat effect	Cold effect	*effect*
Yearly temperature	12.9	-41.3% [a]	21.4%	-69.5% [a]	98.0% [a]	-37.0%
Summer temperature	9.2	-75.1% [a]		-112.6% [a]		-9.1%
Winter temperature	17.7		22.4%		96.7% [a]	
Dew point temperature	9.4	-23.4% [b]	21.5%	-41.6% [a]	91.6% [a]	-11.5%
Summer dew point temperature	8.4	-44.1% [a]		-37.3% [a]		14.1%
Winter dew point temperature	17.5		27.9%		113.0% [a]	

eTable 9. Increase in heat- and cold-related mortality effect estimates for those ≥65 years per interquartile (IQR) increase in community-specific socioeconomic, race, urbanicity, and air conditioning variables.

Note: The values reflect the percent increase in each specific heat or cold effect estimate per an IQR increase in the specified long-term community-specific variable. [a] Significant at $p < 0.01$; [b] Significant at $p < 0.05$; [c] Significant at $p < 0.10$.

		Change in relative effect		*Change in absolute effect*		*Heat-wave*
	IQR	Heat effect	Cold effect	Heat effect	Cold effect	*effect*
Median Income	$6,538.25	34.7% [a]	5.1%	56.6% [a]	2.5%	-38.6% [c]
% Unemployed	1.7%	26.3% [b]	8.7%	14.0%	8.9%	43.6% [c]
% with High School Degree	7.7%	-18.2%	-12.2%	-10.8%	-12.0%	-47.5% [b]
% Public Transportation	3.3%	10.3% [a]	1.2%	15.6% [a]	-0.8%	13.5% [b]
% Black/African-American	18.0%	-5.7%	12.3%	-15.6%	35.3% [b]	34.2%
% Urban	10.6%	18.4%	17.0%	15.6%	-0.1%	21.2%
Population	580,599	7.6% [a]	0.4%	13.5% [a]	0.3%	5.0%
% Central AC	47.1%	-94.9% [a]	-0.8%	-106.1% [a]	85.9% [a]	5.3%