Supplemental Material

Projected Temperature-Related Deaths in Ten Large U.S. Metropolitan Areas Under Different Climate Change Scenarios

Kate R. Weinberger, Leah Haykin, Melissa N. Eliot, Joel D. Schwartz, Antonio Gasparrini, Gregory A. Wellenius

Contents:

Figure S1: Exposure-response curves characterizing the relationship between mean daily temperature and mortality (1985-2006) in the major city within each metropolitan area.

Table S1: List of counties included in the definition of each metropolitan area and associated city proper.

Table S2: CMIP5 modeling centers or groups and model names.

Table S3: Mean (range) change in ambient temperature projected by the CMIP5 model ensemble, 2045-2055 (referred to as "2050") and 2085-2095 (referred to as "2090") versus 1992-2002, under two representative concentration pathways (RCP), and projected change in population size under the ICLUS B2 scenario.

Table S4: Number of deaths (95% eCI) attributable to heat and cold in 1997, 2050, and 2090 under two representative concentration pathways (RCP) in 10 metropolitan areas, assuming the population size of each metropolitan area remains constant at 1997 levels.

Table S5: Number of deaths (95% eCI) attributable to heat and cold in 2050 and 2090 under two representative concentration pathways (RCP) in 10 metropolitan areas, accounting for projected population growth.

Figure S1: Exposure-response curves characterizing the relationship between mean daily temperature and mortality (1985-2006) in the major city within each metropolitan area. The histogram under each curve depicts the distribution of observed mean daily temperature during this time period.

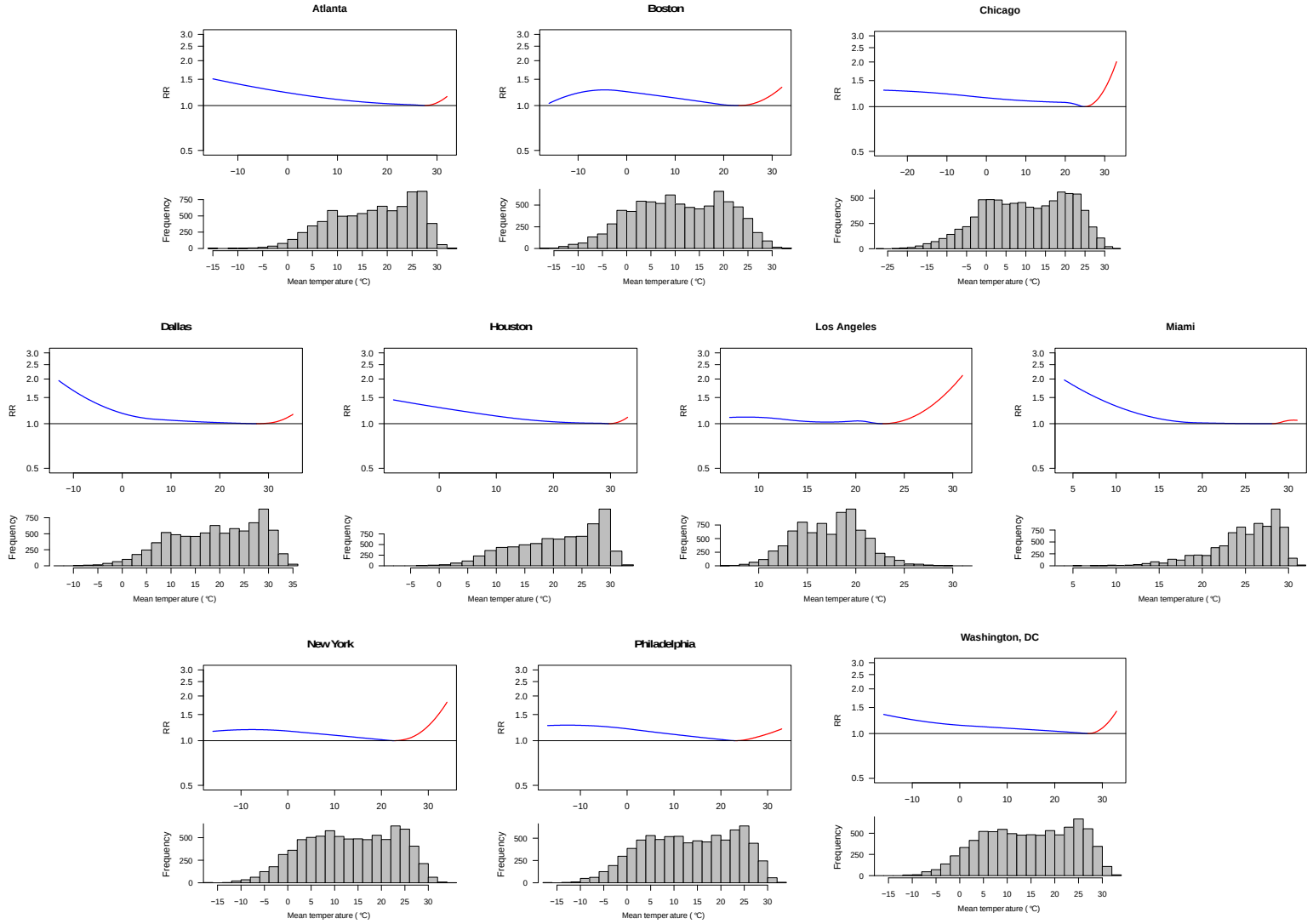

Table S1: List of counties included in the definition of each metropolitan area and associated city proper.

Metropolitan Area Name	**Counties, Metropolitan Area**	**Counties, City Proper**
Atlanta	Barrow (GA) Bartow (GA) Butts (GA) Carroll (GA) Cherokee (GA) Clayton (GA) Cobb (GA) Coweta (GA) Dawson (GA) DeKalb (GA) Douglas (GA) Fayette (GA) Forsyth (GA) Fulton (GA) Gwinnett (GA) Haralson (GA) Heard (GA) Henry (GA) Jasper (GA) Lamar (GA) Meriwether (GA) Morgan (GA) Newton (GA) Paulding (GA) Pickens (GA) Pike (GA) Rockdale (GA) Spalding (GA) Walton (GA)	Clayton (GA) Cobb (GA) DeKalb (GA) Fulton (GA) Gwinnett (GA)
Boston	Essex (MA) Middlesex (MA) Norfolk (MA) Plymouth (MA) Suffolk (MA) Rockingham (NH) Strafford (NH)	Middlesex (MA) Norfolk (MA Suffolk (MA)
Chicago	Cook (IL) DuPage (IL) Grundy (IL) Kendall (IL) McHenry (IL) Will (IL) DeKalb (IL)	Cook (IL) DuPage (IL) Lake (IL)

	Kane (IL) Lake (IL) Jasper (IN) Lake (IN) Newton (IN) Porter (IN) Kenosha (WI)	
Dallas	Collin (TX) Dallas (TX) Ellis (TX) Hunt (TX) Kaufman (TX) Rockwall (TX)	Dallas (TX)
Houston	Austin (TX) Brazoria (TX) Chambers (TX) Fort Bend (TX) Galveston (TX) Harris (TX) Liberty (TX) Montgomery (TX) Waller (TX)	Harris (TX)
Los Angeles	Orange (CA) Los Angeles (CA)	Los Angeles (CA)
Miami	Miami-Dade (FL)	Miami-Dade (FL)
New York	Dutchess (NY) Putnam (NY) Nassau (NY) Suffolk (NY) Bronx (NY) Kings (NY) New York (NY) Queens (NY) Richmond (NY) Westchester (NY)	Bronx (NY) Kings (NY) New York (NY) Queens (NY) Richmond (NY)
Philadelphia	Bucks (PA) Montgomery (PA) Philadelphia (PA) Burlington (NJ) Camden (NJ) Gloucester (NJ)	Bucks (PA) Delaware (PA) Montgomery (PA) Philadelphia (PA)
Washington, D.C.	Frederick (MD) Montgomery (MD)	District of Columbia

	District of Columbia Calvert (MD) Charles (MD) Prince George's (MD) Arlington (VA) Clarke (VA) Culpeper (VA) Fairfax (VA) Fauquier (VA) Loudoun (VA) Prince William (VA) Rappahannock (VA) Spotsylvania (VA) Stafford (VA) Warren (VA) Alexandria City (VA) Fairfax City (VA) Falls Church City (VA) Fredericksburg City (VA) Manassas City (VA) Manassas Park City (VA) Jefferson (WV)	

Table S2: CMIP5 modeling centers or groups and model names

Modeling Center (or Group)	**Institute ID**	**Model Name**
Commonwealth Scientific and Industrial Research Organization (CSIRO) and Bureau of Meteorology (BOM), Australia	CSIRO-BOM	ACCESS1.0
Beijing Climate Center, China Meteorological Administration	BCC	BCC-CSM1.1
Canadian Centre for Climate Modelling and Analysis	CCCMA	CanESM2.1 CanESM2.2 CanESM2.3 CanESM2.4 CanESM2.5
National Center for Atmospheric Research	NCAR	CCSM4.1 CCSM4.2
Community Earth System Model Contributors	NSF-DOE-NCAR	CESM1(BGC)
Centre National de Recherches Météorologiques / Centre Européen de Recherche et Formation Avancée en Calcul Scientifique	CNRM-CERFACS	CNRM-CM5
Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence	CSIRO-QCCCE	CSIRO-Mk3.6.0.1 CSIRO-Mk3.6.0.2 CSIRO-Mk3.6.0.3 CSIRO-Mk3.6.0.4 CSIRO-Mk3.6.0.5 CSIRO-Mk3.6.0.6 CSIRO-Mk3.6.0.7 CSIRO-Mk3.6.0.8 CSIRO-Mk3.6.0.9 CSIRO-Mk3.6.0.10
NOAA Geophysical Fluid Dynamics Laboratory	NOAA GFDL	GFDL-ESM2G GFDL-ESM2M GFDL-HIRAM-C360[a]
Institute for Numerical Mathematics	INM	INM-CM4
Institut Pierre-Simon Laplace	IPSL	IPSL-CM5A-LR1 IPSL-CM5A-MR1 IPSL-CM5A-LR2 IPSL-CM5A-LR3 IPSL-CM5A-LR4
Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	MIROC	MIROC-ESM MIROC-ESM-CHEM1
Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	MIROC	MIROC5.1 MIROC5.2 MIROC5.3
Max-Planck-Institut für Meteorologie (Max Planck Institute for Meteorology)	MPI-M	MPI-ESM-LR.1 MPI-ESM-LR.2 MPI-ESM-LR.3

		MPI-ESM-MR-1 MPI-ESM-MR-2[b] MPI-ESM-MR-3[b]
Meteorological Research Institute	MRI	MRI-CGCM3
Norwegian Climate Centre	NCC	NorESM1-M

[a] RCP 8.5 only
[b] RCP 4.5 only

Table S3: Mean (range) change in ambient temperature projected by the CMIP5 model ensemble, 2045-2055 (referred to as "2050") and 2085-2095 (referred to as "2090") versus 1992-2002, under two representative concentration pathways (RCP), and projected change in population size under the ICLUS B2 scenario.

Metropolitan Area	RCP	Mean (range) projected change in temperature [°C]		Projected change in population size [n]	
		2050	2090	2050	2090
Atlanta	4.5	1.8 (0.5, 2.5)	2.3 (1.2, 3.3)	5,031,162	8,523,834
	8.5	2.3 (1.2, 3.4)	4.7 (2.9, 6.3)		
Boston	4.5	2.0 (0.8, 3.0)	2.6 (1.2, 3.7)	752,682	1,148,279
	8.5	2.6 (1.3, 4.0)	5.1 (3.0, 7.0)		
Chicago	4.5	2.3 (0.9, 3.7)	3.0 (1.1, 4.7)	3,478,696	5,686,433
	8.5	2.9 (1.4, 4.6)	5.8 (2.5, 8.0)		
Dallas	4.5	2.0 (0.9, 2.9)	2.5 (1.2, 3.8)	3,185,239	5,404,898
	8.5	2.5 (1.3, 3.5)	5.1 (3.4, 6.5)		
Houston	4.5	1.6 (0.7, 2.5)	2.2 (1.0, 3.3)	3,163,759	4,908,397
	8.5	2.1 (0.8, 3.0)	4.5 (3.0, 5.8)		
Los Angeles	4.5	1.4 (0.4, 2.1)	2.0 (1.0, 3.0)	6,417,290	11,023,052
	8.5	1.9 (1.0, 2.6)	4.3 (2.6, 6.1)		
Miami	4.5	1.0 (0.4, 1.5)	1.4 (0.6, 2.1)	3,457,213	6,763,449
	8.5	1.4 (0.6, 2.0)	3.4 (1.9, 4.7)		
New York	4.5	2.0 (0.8, 3.1)	2.7 (1.1, 3.8)	9,194,748	16,646,324
	8.5	2.6 (1.5, 4.1)	5.3 (3.1, 7.2)		
Philadelphia	4.5	2.0 (0.8, 3.0)	2.7 (1.1, 3.8)	888,157	1,548,654
	8.5	2.6 (1.3, 4.0)	5.2 (3.0, 7.0)		
Washington, DC	4.5	2.0 (0.6, 2.8)	2.6 (1.1, 3.6)	5,857,223	7,683,628
	8.5	2.5 (1.2, 3.8)	5.1 (2.9, 6.9)		

Table S4: Number of deaths (95% eCI) attributable to heat and cold in 1997, 2050, and 2090 under two representative concentration pathways (RCP) in 10 metropolitan areas, assuming the population size of each metropolitan area remains constant at 1997 levels.

Metropolitan Area	RCP	Number of heat-related deaths			Number of cold-related deaths		
		1997	2050	2090	1997	2050	2090
Atlanta	4.5	11	100	155	1538	1292	1224
		(-17, 55)	(-111, 341)	(-189, 574)	(176, 2735)	(97, 2356)	(90, 2271)
	8.5	10	157	607	1543	1232	977
		(-16, 56)	(-176, 554)	(-741, 1920)	(191, 2731)	(85, 2264)	(-21, 1880)
Boston	4.5	69	235	317	3592	3196	3058
		(-88, 235)	(-164, 683)	(-215, 942)	(1168, 5812)	(969, 5244)	(895, 5064)
	8.5	68	312	848	3595	3065	2548
		(-90, 224)	(-212, 923)	(-738, 2443)	(1179, 5809)	(914, 5098)	(615, 4394)
Chicago	4.5	346	1447	1950	5856	5077	4884
		(128, 715)	(596, 2663)	(73, 3554)	(2329, 9179)	(1896, 8143)	(1790, 7895)
	8.5	345	1944	5107	5858	4925	4188
		(132, 688)	(802, 3193)	(2080, 8328)	(2316, 9204)	(1821, 7886)	(1403, 6847)
Dallas	4.5	47	154	203	615	476	439
		(-130, 220)	(-165, 467)	(-175, 616)	(-247, 1412)	(-290, 1202)	(-293, 1144)
	8.5	47	209	517	616	449	322
		(-128, 220)	(-171, 598)	(-480, 1402)	(-244, 1420)	(-285, 1141)	(-293, 909)
Houston	4.5	3	67	125	1252	1007	937
		(-13, 26)	(-158, 345)	(-355, 745)	(-81, 2535)	(-145, 2128)	(-174, 2032)
	8.5	3	132	639	1259	954	696
		(-11, 26)	(-322, 714)	(-1455, 2514)	(-78, 2555)	(-160, 2027)	(-245, 1611)
Los Angeles	4.5	662	2476	3509	2804	2240	2040
		(282, 1083)	(1177, 3895)	(1588, 5635)	(388, 5214)	(179, 4300)	(132, 4020)
	8.5	654	3504	9535	2808	2096	1443
		(283, 1068)	(1664, 5597)	(4720, 14347)	(395, 5192)	(153, 4057)	(55, 3003)
Miami	4.5	42	168	202	171	134	120
		(-71, 168)	(-359, 639)	(-893, 1094)	(-800, 1113)	(-694, 927)	(-653, 863)
	8.5	42	199	330	179	127	75
		(-69, 162)	(-787, 1048)	(-3202, 2733)	(-802, 1125)	(-662, 888)	(-515, 645)
New York	4.5	916	2342	2993	6205	5384	5125

		(176, 1704)	(991, 3811)	(1198, 4815)	(2383, 9759)	(1874, 8687)	(1747, 8340)
	8.5	902	2899	6471	6210	5184	4238
		(175, 1710)	(1365, 4679)	(3138, 9637)	(2366, 9779)	(1809, 8405)	(1270, 7074)
Philadelphia	4.5	208	495	608	3002	2587	2459
		(-43, 483)	(60, 962)	(113, 1173)	(1698, 4213)	(1400, 3718)	(1308, 3590)
	8.5	209	605	1169	3010	2484	1998
		(-43, 481)	(116, 1113)	(157, 2275)	(1694, 4242)	(1318, 3594)	(989, 3013)
Washington, DC	4.5	20	156	249	1839	1595	1527
		(-7, 79)	(-5, 405)	(-5, 653)	(-262, 3668)	(-285, 3247)	(-287, 3135)
	8.5	19	240	1014	1844	1543	1283
		(-8, 73)	(0, 587)	(-35, 2246)	(-235, 3686)	(-297, 3162)	(-316, 2705)
Combined	4.5	2362	7721	10426	26751	22920	21752
		(1392, 3370)	(5356, 10261)	(7098, 14100)	(19612, 33810)	(16531, 29260)	(15630, 27945)
	8.5	2336	10304	26050	26797	21976	17711
		(1367, 3337)	(7063, 13523)	(17673, 33961)	(19699, 33859)	(15773, 28219)	(12411, 23102)

Table S5: Number of deaths (95% eCI) attributable to heat and cold in 2050 and 2090 under two representative concentration pathways (RCP) in 10 metropolitan areas, accounting for projected population growth.

Metropolitan Area	RCP	Number of heat-related deaths		Number of cold-related deaths	
		2050	2090	2050	2090
Atlanta	4.5	217 (-243, 744)	461 (-560, 1705)	2819 (211, 5141)	3637 (267, 6746)
	8.5	342 (-385, 1209)	1804 (-2201, 5704)	2690 (186, 4940)	2903 (-61, 5586)
Boston	4.5	276 (-192, 801)	401 (-272, 1192)	3749 (1137, 6153)	3869 (1133, 6408)
	8.5	366 (-249, 1083)	1073 (-934, 3092)	3596 (1072, 5981)	3224 (779, 5561)
Chicago	4.5	1942 (800, 3575)	3040 (1139, 5541)	6816 (2546, 10931)	7615 (2790, 12309)
	8.5	2610 (1077, 4286)	7962 (3242, 12984)	6612 (2445, 10587)	6529 (2187, 10676)
Dallas	4.5	312 (-333, 945)	554 (-480, 1686)	965 (-586, 2434)	1202 (-802, 3129)
	8.5	424 (-347, 1210)	1414 (-1313, 3836)	910 (-577, 2311)	880 (-801, 2486)
Houston	4.5	114 (-269, 587)	261 (-742, 1556)	1713(-247, 3620)	1957 (-363, 4242)
	8.5	224 (-548, 1214)	1335 (-3038, 5249)	1623 (-272, 3447)	1453 (-511, 3363)
Los Angeles	4.5	3814 (1813, 5999)	6770 (3064, 10872)	3450 (276, 6624)	3935 (255, 7755)
	8.5	5397 (2563, 8621)	18394 (9106, 27679)	3229 (235, 6249)	2785 (106, 5794)
Miami	4.5	437 (-933, 1661)	836 (-3692, 4522)	349 (-1807, 2412)	498 (-2700, 3569)
	8.5	519 (-2049, 2727)	1362 (-13235, 11295)	329 (-1723, 2310)	312 (-2130, 2668)
New York	4.5	4171 (1765, 6786)	7227 (2892, 11627)	9587 (3337, 15469)	12377 (4219, 20140)
	8.5	5163 (2430, 8332)	15626 (7578, 23272)	9232 (3222, 14967)	10234 (3066, 17083)
Philadelphia	4.5	598 (73, 1161)	829 (154, 1599)	3122 (1690, 4488)	3351 (1783, 4891)
	8.5	730 (140, 1344)	1592 (214, 3099)	2999 (1591, 4338)	2722 (1347, 4105)
Washington, DC	4.5	303 (-11, 786)	561 (-11, 1472)	3100(-554, 6310)	3441 (-648, 7065)
	8.5	466 (0, 1141)	2286 (-78, 5061)	2998 (-577, 6146)	2892 (-711, 609
Combined	4.5	12309 (8384, 16414)	21142 (13609, 29139)	35491 (25175, 46210)	41671 (28971, 54891)
	8.5	16398 (10964, 21794)	52339 (32187, 70736)	34037 (23908, 44180)	33785 (22864, 44868)