Supplementary Material for Dahl et al., "Projections of the frequency of and human exposure to extreme and unprecedented heat index days in the contiguous United States during the 21st century"

Model Name	Model Agency and Country	Ensemble Used
bcc-csm1-1	Beijing Climate Center; China Meteorological Administration (China)	r1i1p1
bcc-csm1-1-m	Beijing Climate Center; China Meteorological Administration (China)	r1i1p1
BNU-ESM	College of Global Change and Earth System Science; Beijing Normal University (China)	r1i1p1
CanESM2	Canadian Centre for Climate Modeling and Analysis (Canada)	r1i1p1
CNRM-CM5	National Centre of Meteorological Research (France)	r1i1p1
CSIRO-Mk3-6-0	Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence (Australia)	r1i1p1
GFDL-ESM2M	NOAA Geophysical Fluid Dynamics Laboratory (United States)	r1i1p1
GFDL-ESM2G	NOAA Geophysical Fluid Dynamics Laboratory (United States)	r1i1p1
HadGEM2-ES	Met Office Hadley Center (United Kingdom)	r1i1p1
HadGEM2-CC	Met Office Hadley Center (United Kingdom)	r1i1p1
inmcm4	Institute for Numerical Mathematics (Russia)	r1i1p1
IPSL-CM5A-LR	Institut Pierre Simon Laplace (France)	r1i1p1
IPSL-CM5A-MR	Institut Pierre Simon Laplace (France)	r1i1p1
IPSL-CM5B-LR	Institut Pierre Simon Laplace (France)	r1i1p1
MIROC5	Atmosphere and Ocean Research Institute, The University of Tokyo; National Institute for Environmental Studies; Japan Agency for Marine-Earth Science and Technology (Japan)	r1i1p1
MIROC-ESM	Japan Agency for Marine-Earth Science and Technology; Atmosphere and Ocean Research Institute, The University of Tokyo; National Institute for Environmental Studies (Japan)	r1i1p1
MIROC-ESM-CHEM	Japan Agency for Marine-Earth Science and Technology; Atmosphere and Ocean Research Institute, The University of Tokyo; National Institute for Environmental Studies (Japan)	r1i1p1
MRI-CGCM3	Meteorological Research Institute (Japan)	r1i1p1

Table S1 CMIP5 models used for downscaled projections.

HI100+ Person-days per year

Period	RCP	SSP	Midwest	Northeast	N. Plains	Northwest	Southeast	S. Plains	Southwest	Total
Historical	-	BaseYr	11.4	4.9	0.5	0.0	42.5	32.4	15.1	106.7
Mid-century	RCP4.5	SSP2	85.9	51.9	3.7	1.1	247.2	129.5	57.8	577.2
Mid-century	RCP4.5	SSP3	70.6	43.4	3.0	0.9	204.3	108.4	49.0	479.7
Mid-century	RCP4.5	SSP5	102.4	60.9	4.5	1.3	293.7	152.5	67.3	682.7
Mid-century	RCP8.5	SSP2	121.7	83.2	5.9	2.2	319.5	151.0	74.0	757.5
Mid-century	RCP8.5	SSP3	100.2	69.5	4.8	1.8	264.0	126.3	62.7	629.3
Mid-century	RCP8.5	SSP5	145.1	97.7	7.1	2.6	379.6	177.9	86.2	896.3
Late-century	RCP4.5	SSP2	122.2	79.3	5.3	2.1	326.3	161.8	81.7	778.8
Late-century	RCP4.5	SSP3	74.5	49.6	3.2	1.3	200.2	102.9	52.7	484.4
Late-century	RCP4.5	SSP5	184.2	116.4	8.2	3.1	488.4	238.7	118.2	1,157.1
Late-century	RCP8.5	SSP2	251.5	200.4	15.9	9.5	532.7	236.9	153.4	1,400.3
Late-century	RCP8.5	SSP3	153.3	125.1	9.6	5.9	326.2	150.5	98.9	869.6
Late-century	RCP8.5	SSP5	378.5	294.7	24.3	14.0	798.7	349.6	222.1	2,082.1

HI105+ Person-days per year

Period	RCP	SSP	Midwest	Northeast	N. Plains	Northwest	Southeast	S. Plains	Southwest	Total
Historical	-	BaseYr	2.8	0.5	0.1	-	8.6	8.4	4.0	24.4
Mid-century	RCP4.5	SSP2	42.5	20.7	1.4	0.1	115.6	73.1	26.0	279.4
Mid-century	RCP4.5	SSP3	35.0	17.4	1.1	0.1	95.3	61.2	22.0	232.0
Mid-century	RCP4.5	SSP5	50.7	24.3	1.7	0.1	137.6	86.1	30.2	330.7
Mid-century	RCP8.5	SSP2	67.9	40.5	2.5	0.5	184.0	97.8	35.4	428.5
Mid-century	RCP8.5	SSP3	55.8	33.9	2.0	0.4	152.0	81.7	30.0	355.8
Mid-century	RCP8.5	SSP5	80.9	47.6	3.0	0.6	218.8	115.2	41.2	507.3
Late-century	RCP4.5	SSP2	66.3	36.4	2.2	0.3	173.2	100.1	38.7	417.2
Late-century	RCP4.5	SSP3	40.4	22.8	1.3	0.2	106.1	63.6	25.0	259.3
Late-century	RCP4.5	SSP5	100.0	53.3	3.4	0.5	259.8	147.7	55.9	620.5
Late-century	RCP8.5	SSP2	175.7	127.4	8.2	4.1	400.7	185.3	87.4	988.9
Late-century	RCP8.5	SSP3	107.1	79.6	4.9	2.5	245.5	117.4	56.3	613.4
Late-century	RCP8.5	SSP5	264.6	187.4	12.6	6.0	600.5	273.7	126.6	1,471.4

No analog HI Person-days per year

Period	RCP	SSP	Midwest	Northeast	N. Plains	Northwest	Southeast	S. Plains	Southwest	Total
Historical	-	BaseYr	-	-	-	-	-	-	0.1	0.1
Mid-century	RCP4.5	SSP2	1.6	0.0	0.0	-	1.8	2.3	2.7	8.3
Mid-century	RCP4.5	SSP3	1.3	0.0	0.0	-	1.4	1.9	2.3	6.9

Mid-century	RCP4.5	SSP5	1.9	0.0	0.0	-	2.1	2.7	3.1	9.9
Mid-century	RCP8.5	SSP2	3.5	0.2	0.1	-	6.2	5.3	5.2	20.6
Mid-century	RCP8.5	SSP3	2.9	0.2	0.1	-	5.0	4.4	4.4	17.0
Mid-century	RCP8.5	SSP5	4.2	0.3	0.2	-	7.4	6.3	6.1	24.4
Late-century	RCP4.5	SSP2	3.3	0.0	0.0	-	3.9	4.9	4.7	16.8
Late-century	RCP4.5	SSP3	2.0	0.0	0.0	-	2.3	3.0	3.0	10.4
Late-century	RCP4.5	SSP5	5.0	0.0	0.1	-	6.0	7.3	6.8	25.1
Late-century	RCP8.5	SSP2	30.2	12.4	1.1	0.2	53.4	31.2	16.6	145.0
Late-century	RCP8.5	SSP3	18.4	7.7	0.6	0.1	32.4	19.6	10.7	89.5
Late-century	RCP8.5	SSP5	45.6	18.2	1.6	0.3	80.7	46.2	24.0	216.7

Table S2 Multi-model mean person-days per year for each RCP and SSP scenario analyzed in this study. For a definition of the regional areas, refer to Figure 4.

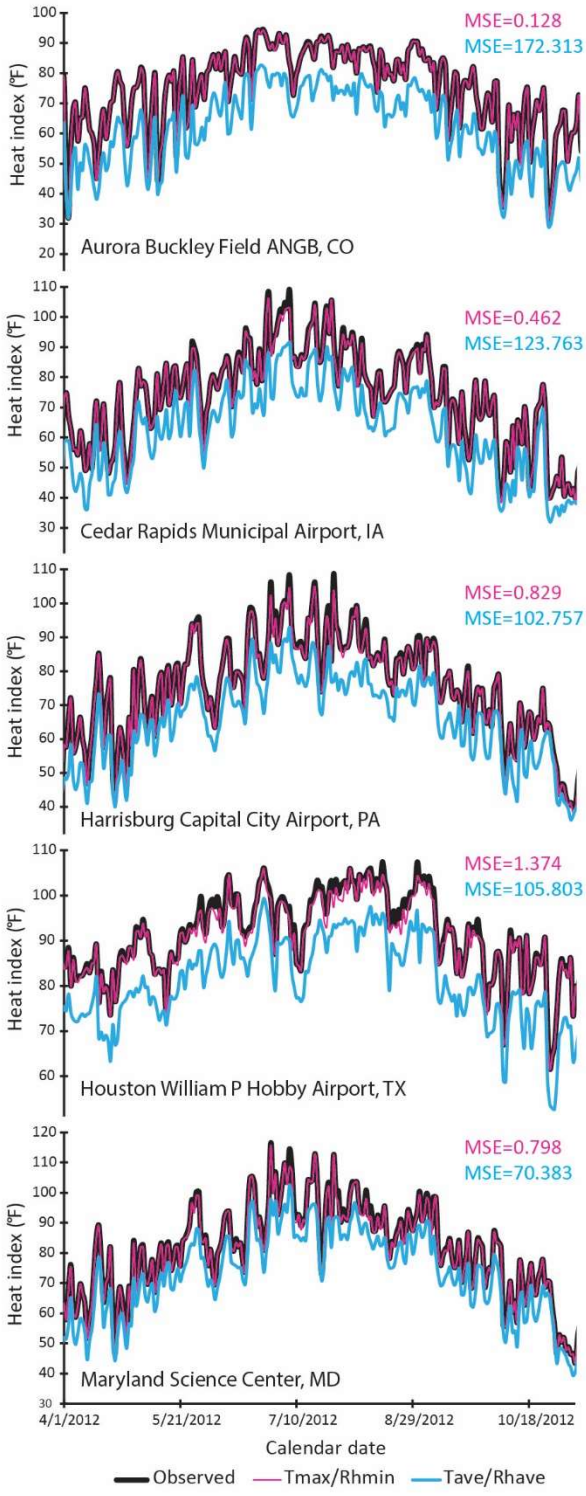

Figure S1 Daily maximum heat index values calculated using hourly observations (black) and different combinations of daily maximum/average temperature (T) and daily average/minimum relative humidity (RH) from weather station data. Data span the time period from April 1, 2012 through October 31, 2012 for five weather stations throughout the U.S.

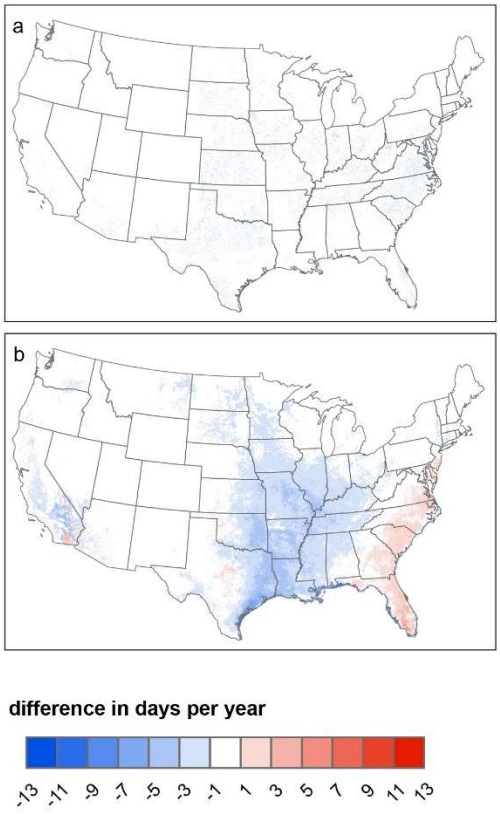

Figure S2 Multi-model mean differences in the number of HI100+ days per year for a) Historical model simulations for the late 20th century (1971-2000) minus historical model simulations for the full historical period (1950-2005); b) Historical model runs (1970-2000) minus METDATA gridded meteorological data (1979-2012).

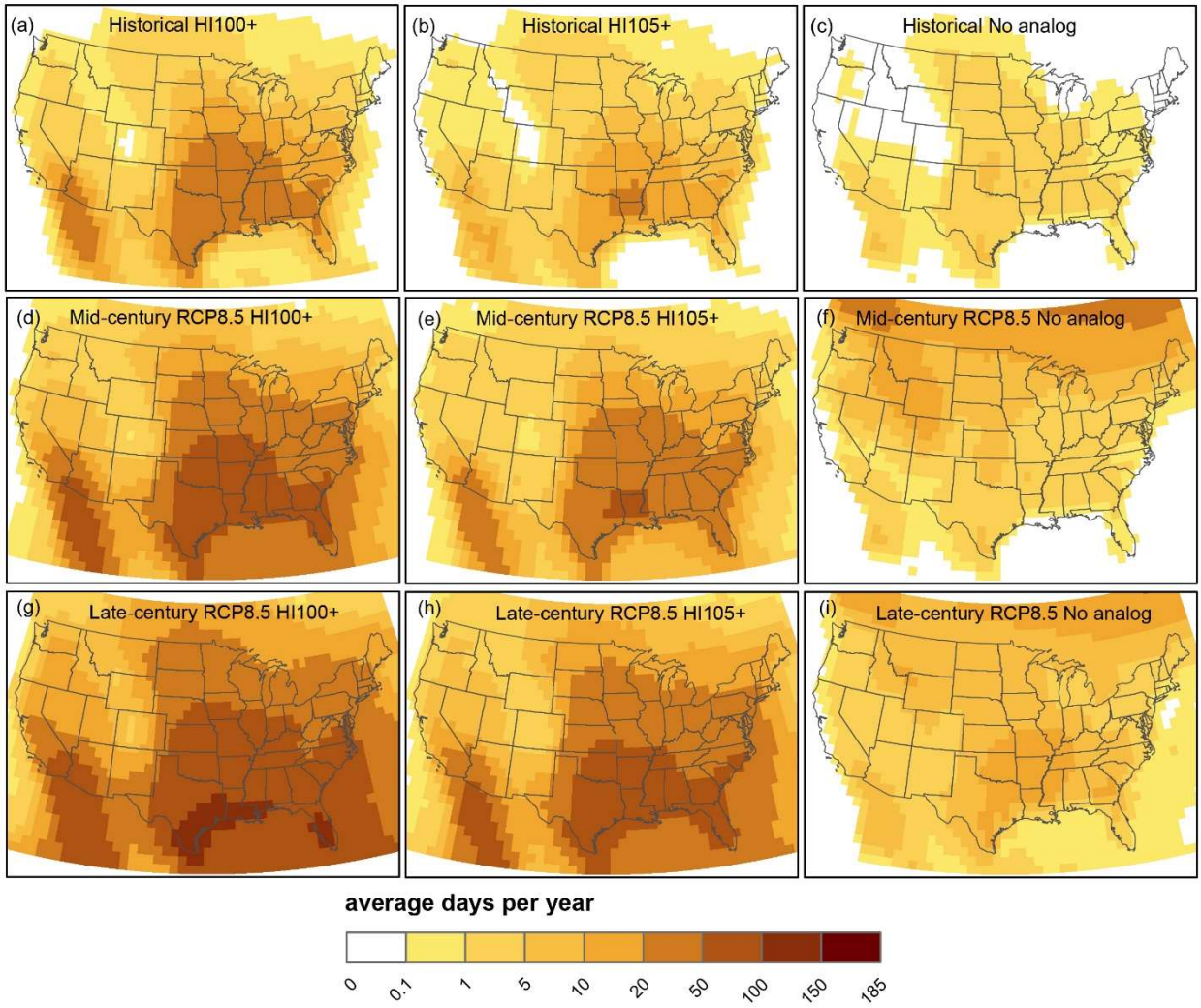

Figure S3 Number of days per year above different heat index thresholds as calculated using raw CMIP5 GCM data. a-c: Historical (1971-2000) period; d-f: Mid-century (2036-2065) period; g-i: Late-century (2077-2099) period.

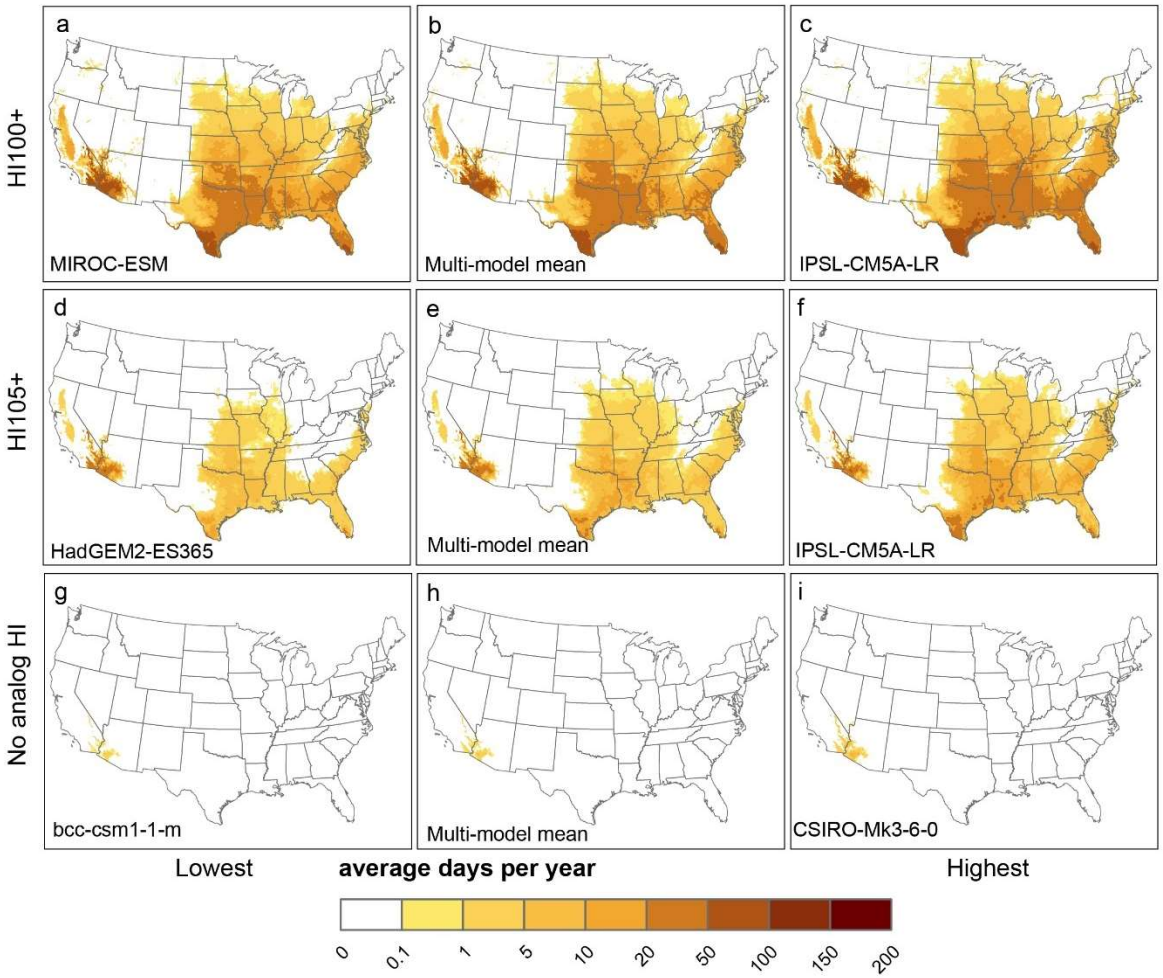

Figure S4 Lowest (left), multi-model mean (middle), and highest (right) model simulations of HI100+ (top), HI105+ (middle), and no analog HI (bottom) days for the historical period (1971-2000). Lowest and highest were determined by taking the average number of days above each threshold across the CONUS area. Models with the lowest CONUS-wide average number of days above each threshold are considered the "lowest" here.

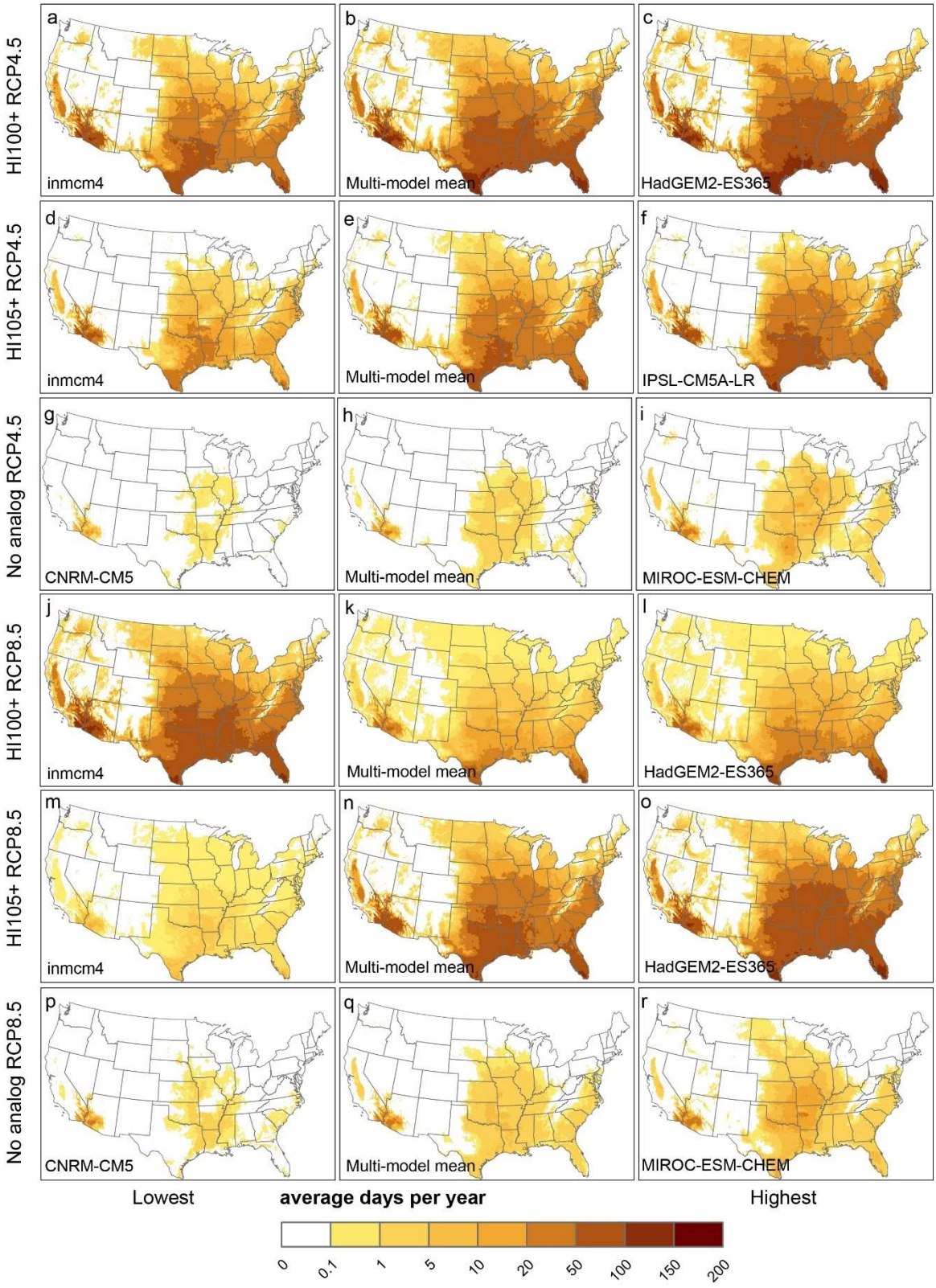

Figure S5 Lowest (left), multi-model mean (middle), and highest (right) model simulations of HI100+, HI105+, and no analog HI days for the mid-century period (2036-2065). a-i) for RCP4.5; j-r) for RCP8.5.

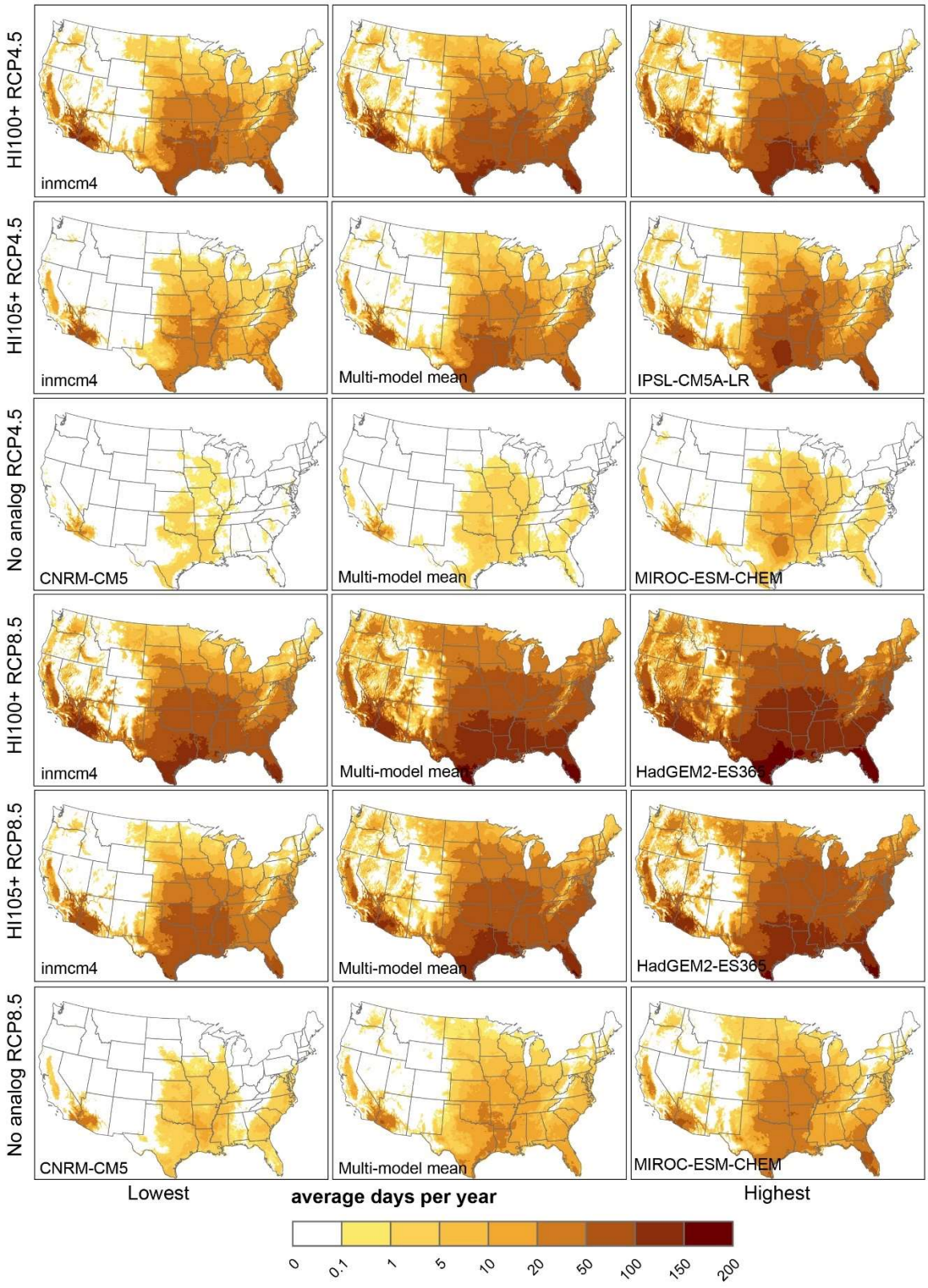

Figure S6 As for Figure S4, but for the late-century time period (2070-2099).

Heat index calculation (in °F, as per the U.S. National Weather Service):

For HI < 80°F, the NWS employs a simple formula:

$$HI = 0.5 * \{T + 61.0 + [(T - 68.0) * 1.2] + (.094Rh)\}$$

where T is temperature in degrees Fahrenheit and Rh is relative humidity (%).

When HI ≥ 80°F, the NWS employs the (Rothfusz 1990) regression:

$$HI = -42.379 + 2.04901523T + 10.14333127Rh - .22475541TRh - .00683783T^2 - .05481717Rh^2 + .00122874T^2Rh + .00085282TRh^2 - .00000199T^2Rh^2$$

For Rh ≤13% and between 80 °F < T < 112 °F, the HI is reduced with the Rothfusz equation:

$$[(13 - RH)/4] * \sqrt{\{[17 - ABS(T - 95.)]/17\}}$$

If Rh > 85% and 80 °F < T <87 °F, the HI is augmented with the Rothfusz (1990) equation:

$$[(Rh - 85)/10] * [(87 - T)/5]$$