

## Supplementary Material

## **1 SUPPLEMENTARY DATA**

A thermal index is used, the universal thermal climate index (UTCI), also known as ERA5-HEAT (Di Napoli et al., 2020), that is computed using the ERA5 reanalysis from the European Centre for Medium-Range Forecasts (ECMWF). UTCI describes how the human body experiences atmospheric conditions, specifically air temperature, humidity, ventilation and radiation. This dataset is a complete historical reconstruction for a set of indices representing human thermal stress and discomfort in outdoor conditions. It represents the current state-of-the-art for bioclimatology data record production.

The population and economy changes are also presented, which show that total population at 2090&2100 in Southern China will increase by about 30% from 1990&2000 basis, and GDP will increase by about 20 times. The Matthew Effect in population migration boosted by rapid urbanization is undoubtedly revealed, so the societal infrastructure is becoming more sensitive to weather and climate extremes, which would be exacerbated by climate change.

## 2 SUPPLEMENTARY TABLES AND FIGURES

The patterns of UTCI for 2000-01-01:12, 2000-07-01:12, 2020-01-01:12, 2020-07-01:12 are shown in Figure S1

- 2.1 Figures
- 2.2 Tables



**Figure S1.** Patterns of the universal thermal climate index (UTCI) from ERA5-HEAT dataset for 2000-01-01:12, 2000-07-01:12, 2020-07-01:12, and changes of January and July from year 2000 to 2020. To gain better visibility, figure a1 and b1 have a bias of 10 degree C larger than the real value.



**Figure S2.** Patterns of population density in 1990, 2000, 2090, 2100, and related 100-year changes, within Southern China Region, basing on the IIASA GGI A2r scenario data.



Figure S3. Same as Figure S2, but for GDP (measured at Market Exchange Rates, MER).

	Historical linear trends			RCP8.5 linear trends		
Model	T-35°C	T-38°C	T-40°C	T-35°C	T-38°C	T-40°C
	1 2223	0.0671	0.0080	0 8625	6 / 863	2 8826
bcc-csm1-1	-0.9017	-0.0878	-0.0069	12 3137	6 7759	2.8820
BNU-FSM	0.0212	0.0284	0.0124	14 0907	6 5896	1 5609
CanESM2	1 1513	0.0204	0.0124	8 6263	7 0518	2 9498
CCSM4	0.0136	0.0290	0.0050	2 9376	1 7716	0.6124
CESM1-BGC	-1 0058	0.0290	0.0010	5 3920	1 8925	0.6726
CNRM-CM5	-0.8785	-0.1030	-0.0122	6 2554	0.2965	-0.3632
CSIRO-Mk3-6-0	0.0048	0.0871	0.0107	8 7247	9 9938	6 6358
GFDL-CM3	-0 7317	-0.0559	-0.0016	11 7860	7 7705	2 5540
GFDL-ESM2G	1 4352	0 2338	0.0160	6 6 1 6 1	0.8406	-0 1773
GFDL-ESM2M	-0.3466	-0.0323	-0.0001	-0.1165	-3.9875	-2.7301
inmcm4	0.7767	0.1338	0.0132	4.8560	0.9068	0.3725
IPSL-CM5A-LR	1.6793	0.1866	0.0244	14.6913	6.3061	2.2793
IPSL-CM5A-MR	1.6549	0.4842	0.0903	14.0169	7.3246	3.5915
MIROC5	-1.0912	-0.1182	-0.0038	-0.2879	0.1047	0.0320
MIROC-ESM	-0.3755	-0.0200	0.0006	4.1146	2.7509	0.6576
MIROC-ESM-CHEM	0.3572	0.0694	0.0094	30.1405	25.6540	14.0311
MPI-ESM-LR	0.3515	0.0227	-0.0075	14.0858	6.3997	1.3858
MPI-ESM-MR	2.8386	0.2073	0.0178	12.4549	5.2116	1.2270
MRI-CGCM3	0.8595	0.1143	0.0215	5.2418	1.1361	0.2561
NorESM1-M	0.8091	0.0802	0.0012	12.7667	5.5299	1.7816
MME mean	0.3736	0.0678	0.0109	9.4557	5.0860	2.0451

**Table S1.** Names of all 21 models in NEX-GDDP dataset together with MME, and simulated linear trends of the EHTDs (unit: days  $(10 \text{ yr})^{-1}$ ) averaged over Southern China Region at three T-levels, for historical 1980–1999 and RCP8.5 2080–2099 periods.