Support Information: Tables

Table S1: Abbreviations used in this study.

Abbreviation	Complete term
ANOVA	Analysis of variance
AMHP2012	Administrative measures on heatstroke prevention, issued in 2012
isiBC	Bias-corrected Dataset provided by ISI-MIP
reBC	Bias-corrected Dataset with a simple method in this study
noBC	Raw GCM outputs without bias correction
CMIP5	Coupled Model Intercomparison Project Phase 5
E	Ratio of formal employment to total population
E1	Employment structure scenario with a conservative formal employment rate
E2	Employment structure scenario with an increased formal employment rate
EP	Ratio of employed to total population
FE	Ratio of formal to total employment
HRSS	Department of Human Resources and Social Security
HTD	High-temperature day
HTS	High temperature subsidies
HTS_{CHN}	Total Chinese HTS
HTS_{PE}	National mean HTS per employee
IPCC	Intergovernmental Panel on Climate Change
ISI-MIP	Inter-Sectoral Impact Model Intercomparison Project
NBMS	National Bureau of Statistics of China
popH	Population scenario with high growth rate
popM	Population scenario with medium growth rate
popL	Population scenario with low growth rate
RCP	Representative Concentration Pathway
SD	Standard Deviation
SSPs	Shared Socioeconomic Pathways
T_{max}	Daily maximum temperature

UNPD	United Nations Population Division
WFD	WATCH Forcing Data
YEY	Yuan per employee per year

Table S2: Summary of the HTS standards issued by local Human Resources and Social Security (HRSS) departments in 27 provinces/municipalities in China. The type of HTS is referred to as "M" when subsidies are paid as a fixed monthly sum during summer regardless of the weather conditions, while it is referred to as "D" when paid at a daily rate depending on the frequency of HTDs. NA indicates the standard HTS is not issued in the province. The unit of payment is in yuan/month and yuan/day for types "M" and "D" respectively. The sources are documents issued by the HRSS departments and other related departments in each province/municipality, and accessed via the web links in the last column.

Province	Unit Payment	Type	Period	Issued Year	Web link****
Beijing*	120, 180	M	6-8	2014	1
Shandong*	80,100,120	M	6-9	2006	2
Jiangsu	200	M	6-9	2011	3
Shanghai	200	M	6-9	2011	4
Zhejiang*	145,180,225	M	6-9	2014	5
Fujian	200	M	5-9	2013	6
Liaoning	200	M	7-9	2014	7
Shanxi	240	M	6-8	2013	8
Jiangxi*	160,240	M	6-9	2012	9
Hunan	150	M	7-9	2005	10
Guangdong	150	M	6-10	2011	11
Guangxi*	100,200	M	6-10	2011	12
Gansu*	35,40,45	M	7-9	1997	13
Inner Mongolia	180	M	1-3	2013	14
Tianjing**	Base+Special	M/D	6-9	2013	15
Anhui	10	D	No limit	2011	16
Jilin	10	D	No limit	2011	17
Shaan'xi*	6, 10	D	6-9	2013	18
Henan	10	D	No limit	2008	19
Hubei	12	D	6-9	2013	20
Hainan	10	D	4-10	2013	21
Guizhou	8	D	6-9	2013	22

Yunnan	10	D	No limit	2013	23
Sichuan*	8, 12	D	No limit	2012	24
Chongqing***	5,10,15	D	No limit	2013	25
Xijiang*	10, 20	D	No limit	2012	26
Ningxia*	8, 12	D	6-9	2014	27
Hebei	NA				
Heilongjiang	NA				
Qinghai	NA				
Xizang	NA				

* The unit HTS payment depends on the labor load regardless of the category of HTDs.
** The base HTS is paid in summer regardless of the weather conditions and was respectively 414 and 512 yuan per employee per year (YEY) in 2013 and 2014; the special HTS payment varies with the average wage of the previous year, and amounted to 21 and 24 yuan/day in 2013 and 2014.
*** Unit HTS payment depends on the HTDs class.
****Web links:

1 Beijing HRSS et al. (2014) Notice on heatstroke prevention during summer in 2014. Available at http://www.bjsafety.gov.cn/announcement/saqjdj/2c9831e846679cf1014669f4d6b7002e.html. [Accessed May 30, 2014]

2 Shandong HRSS et al. (2006) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://wenku.baidu.com/view/f454c5858762caaedd33d4e5.html. [Accessed June 30, 2006]

3. Jiangsu HRSS et al. (2011) Notice on heatstroke prevention during summer. Available at http://jshrss.gov.cn/zcfg/ldzjfg/201106/t20110629_85419.html. [Accessed June 27, 2011]

4. Shanghai HRSS et al. (2011) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.12333sh.gov.cn/2009wza/zcfg/06/201107/t20110704_1131435.shtml. [Accessed June 1, 2011]

5 Zhejiang HRSS et al. (2014) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.zjhz.lss.gov.cn/html/zcfg/zcfgk/in/zcfg5525354.html. [Accessed June 1, 2014]

6 Fujian HRSS et al. (2013) Notice on adjusting of the standard of high temperature subsidy during summer. Available at http://www.fjnplss.gov.cn/Info/View.Asp?id=682. [Accessed July 10, 2013]

7 Liaoning HRSS et al. (2014) Notice on heatstroke prevention during summer. Available at http://www.lnsafety.gov.cn/pc/show.asp?id=130. [Accessed July 2, 2014]

8 Shanxi HRSS et al. (2013) Notice on adjusting of the standard of high temperature subsidy during summer. Available at http://knews.shaanxi.gov.cn/0/105/8356.htm. [Accessed May 23, 2011]

9 Jiangxi HRSS et al. (2012) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://hrss.jiangxi.gov.cn/view.aspx?TaskNo=003003001004013&ID=108591. [Accessed August 13, 2012]

10 Hunan HRSS et al. (2005) Urgent notice on heatstroke prevention during summer. Available at http://wenku.baidu.com/view/f773d328ed630b1c59eeb59b.html. [Accessed July 7, 2005]

11 Guangdong HRSS et al. (2011) Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://www.gdhrss.gov.cn/publicfiles/business/htmlfiles/gdhrss/s51/201206/35873.html. [Accessed May 24, 2011]

12 Guangxi HRSS et al. (2011) Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://www.gx.lss.gov.cn/127/2012_10_24/127_19268_1351061136890.html. [Accessed August 17, 2011]

13 Gansu finance department et al. (1997) Notice on the measures for heatstroke prevention. Available at http://www.51fa.org/fagui/2013/74710.html. [Accessed July 24, 1997]

14 Inner Mongolia HRSS (2013) Notice on forwarding the national administration for heatstroke prevention measures. Available at http://www.nm12333.cn/ecdomain/framework/nmrsw/index.jsp. [Accessed October 21, 2013]

15. Tianjin HRSS et al. (2013) Notice on the trial implementation of high temperature subsidy in enterprises. Available at http://www.labourhr.com/news_detail.asp?bid=5&sortid=19&id. [Accessed June 1, 2013]

16. Anhui HRSS et al. (2011) Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://www.ah.hrss.gov.cn/Root/web/templet/siteColumnContent.jsp?siteColumnContentId=57842. [Accessed July 4, 2011]

17 Jilin HRSS et al. (2011) Notice on adjusting the standard of Hardship Subsidy for special posts. Available at http://hrss.jl.gov.cn/zcwj/201109/t20110929_1079282.html. [Accessed July 20, 2011]

18 Shaan'xi HRSS et al. (2011) Notice on adjusting of the standard of high temperature subsidy during summer. Available at http://www.shaanxihrss.gov.cn/Html/2011-5-26/105726.Html. [Accessed May 26, 2011]

19 Henan HRSS et al. (2008) Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://wenku.baidu.com/view/534d0268b84ae45c3b358c67.html. [Accessed May 12, 2008]

20 Hubei HRSS et al. (2013) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.hb.hrss.gov.cn/hbwzweb/html/zcfg/zcfgk/61631.shtml. [Accessed September 9, 2013]

21 Hainan HRSS et al. (2013) Notice on the implementation of high temperature subsidy during summer. Available at http://hi.lss.gov.cn/3342344.html. [Accessed February 2, 2013]

22 Guizhou HRSS et al. (2013) Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://gz.hrss.gov.cn/gzdt/ywdt/ldgx/8058.shtml. [Accessed June 1， 2013]

23 Yunnan HRSS et al.（2013） Notice on the announcement of the standard of high temperature subsidy during summer. Available at http://www.ynhrss.gov.cn/NewsView.aspx?NewsID=5893&ClassID=571. [Accessed May 23, 2013]

24 Sichuan HRSS et al. (2012) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.scbz.hrss.gov.cn/index.php/cms/item-view-id-4098.shtml. [Accessed June 26, 2012]

25 Chongqing Municipal People's Government (2013) Chongqing municipal administration for heatstroke prevention measures. Available at http://www.cq.gov.cn/publicinfo/web/views/Show!detail.action?sid=1108725. [Accessed June 27, 2013]

26 Ningxia HRSS et al. (2014) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.nxhrss.gov.cn/zcfg/2127.htm. [Accessed May 15, 2014]

27 Xinjiang HRSS et al. (2012) Notice on adjusting the standard of high temperature subsidy during summer. Available at http://www.xjrs.gov.cn/fwdh/ldgx/gzfp/201205/t6734.html. [Accessed May 17, 2012]

Table S3 Global climate models included in this study.

Institute/group	Model Version	Atmospheric Resolution (Lon. x Lat.)
IPSL, Paris, France	ISPL-CM5A-LR	3.75° x 1.875°
MIROC, JAMSTEC-AORI-NIES, Japan	MIROC-ESM-CHEM	2.8° x 2.8°
MOHC, Exeter, UK	HadGEM2-ES	1.875° x 1.25°
NCC, Oslo, Norway	NorESM1-M	2.5° x 1.875°
NOAA-GFDL, Princeton, USA	GFDL-ESM2M	2.5° x 2.0°

Table S4: Statistics of total Chinese HTS, in billions of yuan/year, over the 1979-2005 period, as derived from reference data and three ensembles of GCM simulations with different post-processing methods. The corresponding range of HTS is in brackets. The HTS cost at different classes ("Moderate", "Strong" and "Extreme") and the total are listed. The last column is calculated as the sum of absolute bias over all the grids for the ensemble mean of five GCMs and for each GCM.

Data set	Moderate	Strong	Extreme	Total HTS	Bias of Total HTS	Absolute Bias of Total HTS
Reference	23.4	14.0	1.20	38.6		
isiBC	26.9 (18.4, 33.5)	19.3 (8.66, 29.1)	5.4 (1.2, 11.8)	51.5 (29.3, 70.0)	13.0 (-9.60, 31.4)	18.7 (13.4, 32.7)

reBC	23.0 (21.9, 23,5)	13.0 (12.9, 13.40)	1.3 (0.6, 1.8)	37.3 (36.0, 37.9)	-1.3 (-2.6, -0.7)	1.7 (1.6, 3.1)
noBC	14.6 (0.7, 47.3)	16.5 (0.3, 55.4)	7.8 (0.0, 24.4)	38.9 (1.0, 127.2)	0.3 (-37.6, 88.6)	28.6 (32.5, 104.7)

Supporting Information: Data

Supporting Information Data S1: Observation-based meteorological data

The WFDEI climate reanalysis dataset (1) is used as a reference to investigate the present-day variability of extreme events. WFDEI is tailored for land surface model forcing, and consists of eight meteorological variables including T_{max} for the global land surface at 0.5°x0.5° resolution for the 1979-2010 period. It was produced using the WATCH Forcing Data (WFD, Data S2) methodology (1) applied to ERA-Interim data (1). An earlier version was used as a baseline for bias correction in the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) (2, 3). The resulting bias-corrected dataset, widely used in climate change impact studies, is also used here to derive the HTS (see below). In addition, meteorological data from 823 stations (4) is used to estimate the HTS cost in 2013 and 2014. The station information and the datasets in the summer of 2013 and 2014 are provided as stationsName.dat, tmax2013jja.txt and tmax2014jja.txt, respectively (https://files.lsce.ipsl.fr/public.php?service=files&t=e75c9b38909287779a43804ea89219e3).

Supporting Information Data S2: Climate model outputs and bias correction

We use daily T_{max} values in historical simulations and their future projections under RCP2.6, RCP4.5 and RCP8.5 scenarios from five CMIP5 (5) global climate models (Table S3) to derive HTDs and HTS. The choice of models was based on the availability of bias-corrected simulations performed within ISI-MIP (2). To compare raw and bias-corrected simulations for the calculation of the number of HTDs and the HTS, three datasets are built as following:

- *"isiBC" dataset*: Downscaled and bias-corrected daily T_{max} values are provided by the ISI-MIP project (3) at 0.5°x 0.5° resolution. The ISI-MIP bias correction method (2) preserves the long-term absolute trend of the simulated temperature data. It modifies the daily variability of the GCM simulated data around their monthly means so as to match the observed daily variability, using the WFD (6) from 1960 to 1999 as a reference. Long-term differences between simulated and observed monthly mean data period are first adjusted over the reference period. To correct the variability of the daily average temperature values, the residual distribution of the GCM is adjusted to that of the WFD using a parametric quartile mapping. Daily maximum temperature correction is derived from the correction of the daily average temperature using the mean distance between daily maximum and daily average temperatures.
- *"reBC" dataset:* We propose another method to correct the biases of the modeled T_{max} from the five GCMs in CMIP5. Following Zhao et al. (7), we modify the thresholds defining the categories of HTDs in each land grid and for each GCM, so that, over the present-day period, the modeled number of HTDs according to the new thresholds exactly matches the observed frequency of HTDs in each category. Thus, the biases for the estimated number of HTDs in the present day are "perfectly" corrected. The set of modified thresholds is then used to project future frequencies of HTDs. The resulting HTDs and derived HTS estimations are referred to as "*reBC*". We note that the "perfect" correction in the present day does not guarantee an accurate projection in the future. The systematic evaluation of this bias-correction method is beyond the scope of this study.
- *"noBC" dataset:* Raw T_{max} values from the five GCMs are bi-linearly interpolated onto a common 0.5°· 0.5° grid. We then calculate the frequency of HTDs and the associated HTS

cost at each grid.

Given these three different post-processing techniques, we build an ensemble of 5 x 3 simulations for historical and future periods. The ensemble mean/standard-deviation (SD) of them is referred to as "grand ensemble mean/SD". We also calculate the ensemble mean/SD across the five members of each dataset.

Supporting Information Data S3: Population data

Population data in 1970 and 1980 are extracted from the HYDE gridded dataset (8). Original data available at the 5' · 5' resolution are projected onto the 0.5° · 0.5° grid of the reference climate data. The population data in 1990, 1995, 2000 and 2005 are extracted from the Gridded Population of the World version 3 (GPW v3) (9) and aggregated onto the 0.5° · 0.5° common grid from its original 2.5' · 2.5' resolution. The population at each grid-point in the other years of the 1979-2005 period is linearly interpolated between the above years. The Chinese population is unevenly distributed (Fig. S1): along the densely populated East coast, there are more than 400 inhabitants/km^2, while the sparsely populated plateaus in the West count less than 10 inhabitants/km^2. A majority of the population (ca 95%) lives in North and East-Southeast parts of the country (east of 105°E, south of 40°N).

To derive the Chinese population from 2006 to 2099, we use three growth rates: high, medium and low growth rates at the country level based on the dataset published by the United Nations Population Division (UNPD; http://www.un.org/en/development/desa/population/). These data at a five-year time step are linearly interpolated to obtain annual values, and are then used to scale up the gridded population data in 2005 (9) to match the UNPD country totals (thus neglecting changes in the population distribution within China). The three growth rates define three population scenarios, respectively called *popH*, *popM*, and *popL*.

In validating the HTS_{CHN} in 2013 and 2014, we use the latest population data in each province, as obtained from the online database of the National Bureau of Statistics of China (NBSC; www.stats.gov.cn).

Supporting Information: Methods

Supplementary Method S1: Validation of the estimated HTS_{PE} in 2013 and 2014

We choose the two years for validation because 50% of provinces have renewed their HTS standards since 2013 (Table S2), thus the present practiced standards represent the most recent cost of climate-based hot weather costs. Making use of the meteorological station data in 2013 and 2014 (4) and the latest population statistics in each province from NBSC, we compare the HTS_{PE} based on two standards: the "national" uniform standards (See Method section) and the "provincial" HTS standards (Table S2). Statistics on the gross annual salary of Chinese employees and the Chinese GDP are also available from the NBSC (www.stats.gov.cn).

First, we linearly interpolate the frequency of HTDs in 823 meteorological stations onto 0.5°· 0.5° grid-cells. Because the stations densely cover the high-populated Eastern China, the conversion from station data to gridded data remains accurate in terms of the population impacted by hot weather. Then the following calculations are made in each grid-cell.

The estimation of HTS_{PE} is performed with a "national" standard following Eq. (1). The results are 510 and 230 yuan per employee per year (YEY) in 2013 and 2014, respectively (Fig. S4), corresponding to roughly 1% and 0.41% of the mean Chinese gross annual salary. Assuming the formal employees-to-total population ratio is close to 0.28 (See Method), the estimations of HTS_{CHN} are roughly 195 and 88 billion yuan in 2013 and 2014, i.e. 0.33% and 0.14% of Chinese GDP.

The estimation of HTS_{PE} according to "provincial" standards can also follow Eq. (1) except over the grids where HTS is paid as a province-dependent fixed sum regardless of the number of HTDs. When there are two or three payment standards related to work intensity (indicated as "*" in Table S2), then the mean or median unit value is used for the calculation. This leads to HTS_{PE} estimates of 384 and 347 YEY in 2013 and 2014, respectively (Fig. S4), corresponding to 0.75% and 0.62% of the mean Chinese gross annual salary. The estimates of HTS_{CHN} then amount to 0.25% and 0.21% of the GDP in 2013 and 2014, respectively.

Figure S4 shows that HTS_{PE} based on a "national" standard displays larger inter-annual variability than if based on "provincial" standards, but the two-year mean of HTS_{PE} based on both standards are very close to each other. Therefore, the "national" standard can be seen as the synthesis of the "provincial" standards and reflects the climate variability. Thus the "national" standard is used throughout our study without specification.

Supplementary Method S2: Variance decomposition

The uncertainty of the estimated HTS for a certain period is due to different effects: radiative forcing scenarios, changes in population, changes in employment-structure, dispersion between GCMs, and post-processing (bias-correction). Therefore, we use an analysis of variance (ANOVA) to decompose the pooled variance. Since the classical application of the method tends to underestimate the variance in small sample sizes (10), we followed the method proposed by Bosshard et al. (10) to subsample the HTS derived from five GCMs (GCM), three scenarios of climate change (RCP), three scenarios in population growth rate (POP), two employment-rate scenarios (E) and three post-process treatments (PP). In each subsampling iteration, we select two out of five GCMs, two out of three RCPs, two out of three POPs, both Es and two out of three PPs; as a result, we build 270 ($C_5^2C_3^2C_3^2C_2^2C_3^2 = 270$) possible combinations and define our combination matrix (2 x 2 x 2 x 2 x2) for the variance decomposition.

Taking the ith matrix as an example, $Y_i^{m,n,p,q,k}$ is the projected change in HTS based on the mth GCM, the nth RCP, pth POP, qth E and kth PP, $Y_i^{o,o,o,o,o}$, $Y_i^{m,o,o,o,o}$, $Y_i^{o,n,o,o,o}$, $Y_i^{o,o,p,o,o}$, $Y_i^{o,o,o,q,o}$ and $Y_i^{o,o,o,o,k}$ are the ith pooled ensemble mean, mean across the GCMs, mean across the RCPs, mean across the POPs, mean across the Es and mean across the PPs, respectively. The ANOVA model can be written as:

$$SST_i = \sum_{m=1}^{M} \sum_{n}^{N} \sum_{p}^{P} \sum_{q}^{Q} \sum_{k}^{K} (Y_i^{m,n,p,q,k} - Y_i^{o,o,o,o,o,o})^2 \quad \text{(S1)}$$

$$SSA_i = N.P.Q.K \sum_{m=1}^{M} \left(Y_i^{m,o,o,o,o} - Y_i^{o,o,o,o,o,o}\right)^2 \quad \text{(S2)}$$

$$SSB_i = M.P.Q.K \sum_{n=1}^{N} \left(Y_i^{o,n,o,o,o} - Y_i^{o,o,o,o,o,o}\right)^2 \quad \text{(S3)}$$

$$SSC_i = M.N.Q.K \sum_{p=1}^{P} \left(Y_i^{o,o,p,o,o} - Y_i^{o,o,o,o,o,o}\right)^2 \quad \text{(S4)}$$

$$SSD_i = M.N.P.K \sum_{n=1}^{N} \left(Y_i^{o,o,o,q,o} - Y_i^{o,o,o,o,o,o}\right)^2 \quad \text{(S5)}$$

$$SSE_i = M.N.P.Q \sum_{m=1}^{M} \left(Y_i^{o,o,o,o,k} - Y_i^{o,o,o,o,o,o}\right)^2 \quad \text{(S6)}$$

$$SSI_i = SST_i - SSA_i - SSB_i - SSC_i - SSD_i - SSE_i \quad \text{(S7)}$$

where SSTi, SSAi, $SSBi$, SSCi, $SSDi$, $SSDi$ and $SSEi$ are the total, GCM-attributed, RCP-attributed, POP-attributed, E-attributed, PP-attributed variances, and the interaction among them, respectively.

Then for each effect, the variance fraction is derived as follows:

$$\eta_{GCM}^2 = \frac{1}{I} \sum_{i=1}^{I} \frac{SSA_i}{SST_i} \quad \text{(S8)}$$

$$\eta_{RCP}^2 = \frac{1}{I} \sum_{i=1}^{I} \frac{SSB_i}{SST_i} \quad \text{(S9)}$$

$$\eta_{POP}^2 = \frac{1}{I} \sum_{i=1}^{I} \frac{SSC_i}{SST_i} \quad \text{(S10)}$$

$$\eta_{E}^2 = \frac{1}{I} \sum_{i=1}^{I} \frac{SSD_i}{SST_i} \quad \text{(S11)}$$

$$\eta_{PP}^2 = \frac{1}{I} \sum_{i=1}^{I} \frac{SSE_i}{SST_i} \quad \text{(S12)}$$

$$\eta^2_{Interactions} = \frac{1}{I}\sum_{i=1}^{I}\frac{SSI_i}{SST_i} \quad \text{(S13)}$$

Values of 0 and 1 for the variance fraction η^2 correspond to a contribution of an effect to the total pooled variance of 0% and 100%, respectively. If one effect, for instance post-processing, is not considered in the pooled variance, then the above process is simplified to have four effects, i.e., the variance contribution of PP is taken out from the pooled total variance, η^2_{PP} is 0.

Supplementary Method S3: HTS_{CHN} estimation from province/municipality data

In this study, we assume the ratio of formal employee to total population (*E*) to be evenly distributed across China, due to the lack of relevant data. Although some employment-related data are available at provincial/municipal level on the Thematic Database for Human-earth System website (http://www.data.ac.cn/zrzy/g22.asp), this information is not complete. For instance, the "Unit employment", corresponding to main portion of formal urban employees, is only provided from 1991 to 1998; the "Township and Village Enterprises", which is the main part of formal rural employment, has no data after 1995. Over the five years (1991-1995) when both urban and rural employment data are available, 11 out of 31 provinces/municipalities show no data or incomplete data. Assuming the missing province-level employment data equal the national mean values, we could estimate the HTS_{CHN} as the sum of HTS costs in each province/municipality over 1991-1995. The resulting five-year mean HTS_{CHN} is 39.4 billion Yuan, about 5 % higher than the corresponding five-year mean HTS_{CHN} (37.3 billion Yuan) under the assumption of even E distribution.

Supplementary Method S4: Evolution of the ratio of HTS_{CHN} to China's GDP

The Chinese GDP and its growth rate over the historical period (1979-2012) are available from NBSC (www.stats.gov.cn). The projected Chinese GDP per capita is available as part of the Shared Socioeconomic Pathways (SSP) projections (11) from the SSP database (https://secure.iiasa.ac.at/webapps/ene/SspDb/dsd?Action=htmlpage&page=welcome).

The Chinese nominal GDP has increased from 407 billion yuan in 1979 to 54312 billion yuan in 2012 (Fig S5a). For pluriannual analyses, the nominal GDP needs to be corrected from inflation, to define the real GDP. The correction relies on the GDP deflator index (12):

$$DEFLATOR_i = \frac{NOMGDP_i}{REALGDP_i} * 100 \quad \text{(S14)}$$

where $DELATOR_i$, $NOMGDP_i$ and $REALGDP_i$ are the i^th year's GDP deflator index, nominal GDP and real GDP, respectively.

The GDP deflator index can be derived as:

$$DEFLATOR_i = (1 + \frac{GROWTH_i}{100}) * 100 \quad \text{(S15)}$$

where $GROWTH_i$ is the i^th year's GDP growth rate based on preceding year's prices.

It follows that:

$$DEFLATOR_{i+1} = (1 + \frac{GROWTH_{i+1}}{100}) * DEFLATOR_i \quad \text{(S16)}$$

As the AHPM2012 was issued in 2012, we take 2012 as the base year to derive each year's GDP deflator index knowing the series of GDP growth rates (Fig S5b). The real GDP can then be derived annually from Eq. (S14) (Fig S5a).

To keep consistency with our population scenarios, we estimate the future Chinese GDP based on the medium population growth scenario (*popM*), combined to the projected GDP per capita in the SSP projections, which used 2005 as base year (11). We used 2012 as base year to convert the projected GDP per capita in US dollar to Chinese Yuan, thus the forms of projection do not change but the absolute values are modified to meet the 2012 GDP statistics. GDP per capita shows a large spread across the five SSPs (Fig. S5c). The resulting Chinese GDP (Fig. S5d) is projected to reach a maximum around 2050, then to decrease because of decreasing population and the stable/downward trend of GDP per capita (Fig. S5c). In this study, we take the central SSH2-based GDP as a reference to estimate the evolution of HTS_{CHN} relative to the Chinese GDP (Fig 5).

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Support Information：Figure

Supplementary : Figure legends

Figure S1: Population density in mainland China averaged over the 1979-2005 period. The black dashed line indicates the “Hu Line”.

Figure S2: Ensemble mean biases for the frequency of annual HTDs and annual HTS cost over the 1979-2005 period. **a**, Biases for the frequency of HTDs based on the raw outputs of the GCMs (noBC); **b**, Biases for the frequency of HTDs based on the ISI-MIP bias-correction dataset (isiBC); **c**, Biases for the HTS cost derived from the noBC dataset; **d**, Biases for the HTS cost derived from the isiBC dataset. Black dots indicate robust biases (if the bias produced by at least four out of the five models have the same sign as the ensemble mean does).

Figure S3: Evolution of the frequency of HTDs and related labor cost (HTS_{PE} in yuan per employee per year), based on the WFDEI reference data over the 1979-2005 period (OBS) and on the grand ensemble of simulations over 2020-2039 (2030s) and 2080-2099 (2090s). **a**, Multi-year mean annual frequency of HTDs. **b**, Multi-year mean HTS_{PE}. Grand ensemble refers here to the ensemble of 5 x 3 simulations, covering five GCMs and three bias-correction methods (isiBC, reBC and noBC).

Figure S4: Box-and-whisker plot of the derived HTS_{PE} in 2013 and 2014 according to uniform “national” and “provincial” HTS standards. The red, blue and orange box-and-whisker plots indicate the distributions of the annual HTS cost in 14 provinces with fixed-sum HTS payments during summer, in 13 provinces which pay HTS on HT days only, and in the total 27 provinces, respectively. In each box-and-whisker plot, the central bar represents the median value, while the bottom and top of the box indicate the 25% and 75% quartiles. The extremes of the plot correspond to the minimum and maximum values. The population-weighted HTS costs according to uniform “national” and “provincial” HTS standards are superimposed as black circles and orange triangles in the orange box-and-whisker plots.

Figure S5: Evolution of Chinese GDP over 1979-2012 and over 2010-2099 with projections under the five SSPs. **a**, Historical evolution of nominal and real GDP. **b**, GDP growth rate (in %) and 2012-based GDP deflator index over 1979-2012. **c**, Projected GDP per capita over 2010-2099 for the five SSPs. **d**, Projected GDP over 2010-2099 based on **c**, and population scenario *popM*.

Supplementary Figures:

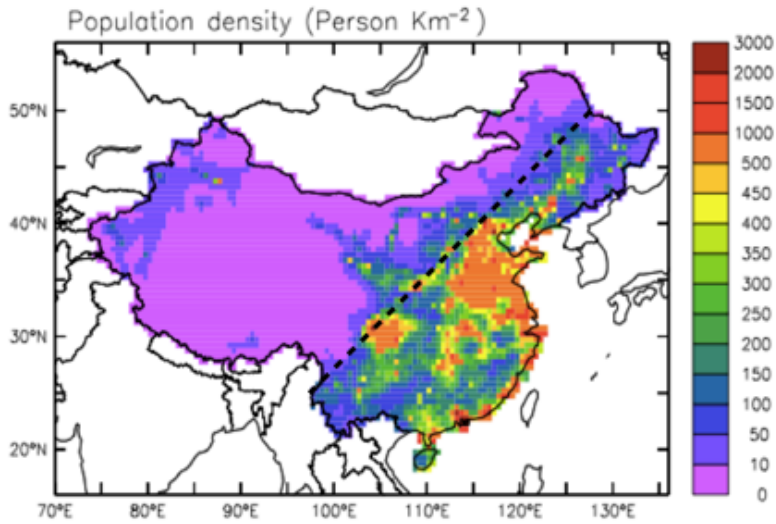


Figure S1:

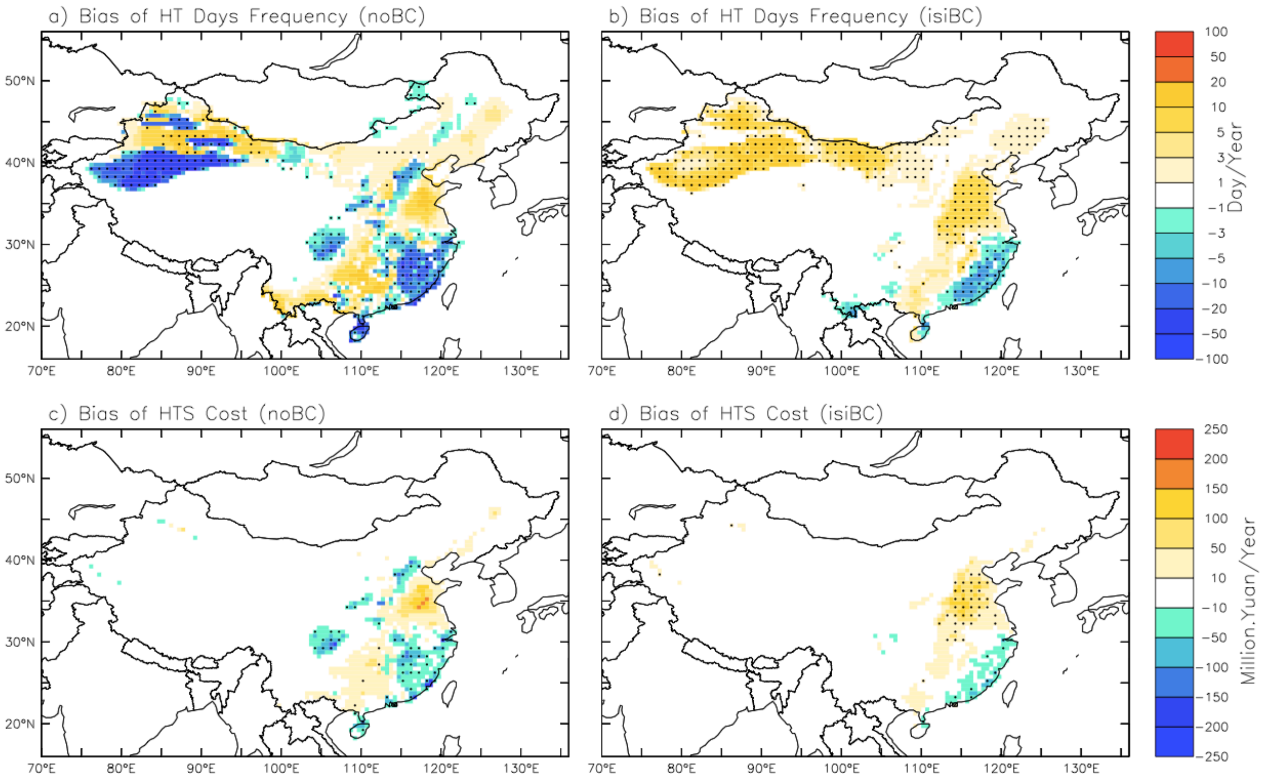

a) Bias of HT Days Frequency (noBC)
b) Bias of HT Days Frequency (isiBC)
c) Bias of HTS Cost (noBC)
d) Bias of HTS Cost (isiBC)
50°N
40°N
30°N
20°N
70°E
80°E
90°E
100°E
110°E
120°E
130°E
Day/Year
100
50
20
10
5
3
1
−1
−3
−5
−10
−20
−50
−100
Million.Yuan/Year
250
200
150
100
50
10
−10
−50
−100
−150
−200
−250

Figure S2

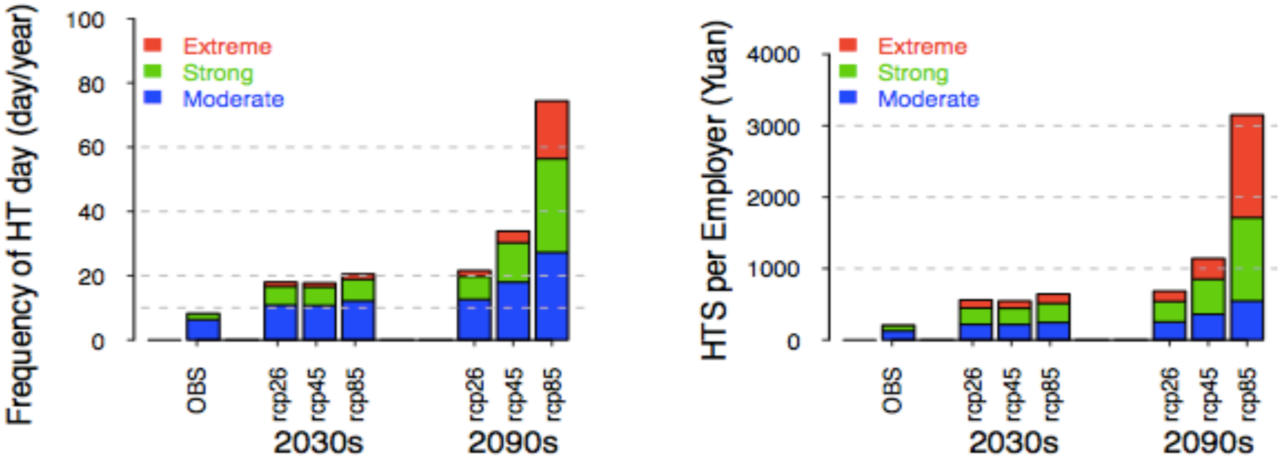

Frequency of HT day (day/year)
100
80
60
40
20
0
Extreme
Strong
Moderate
OBS
rcp26
rcp45
rcp85
2030s
rcp26
rcp45
rcp85
2090s
HTS per Employer (Yuan)
4000
3000
2000
1000
0
Extreme
Strong
Moderate
OBS
rcp26
rcp45
rcp85
2030s
rcp26
rcp45
rcp85
2090s

Figure S3

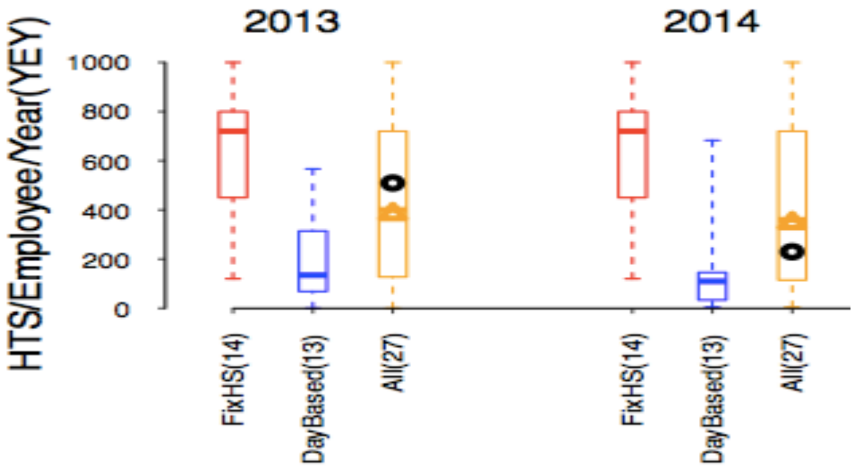
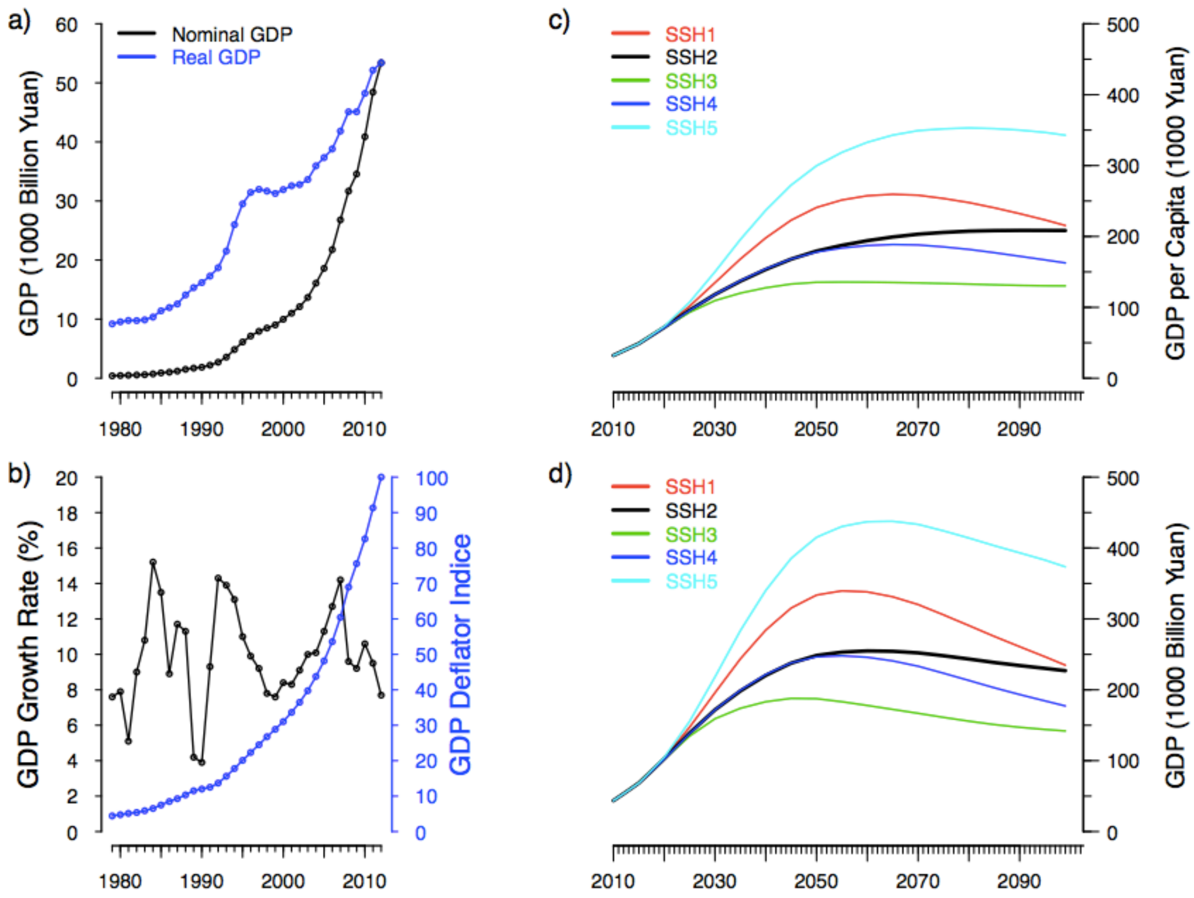

2013
2014
HTS/Employee/Year(YEY)
1000
800
600
400
200
0
FixHS(14)
DayBased(13)
All(27)
FixHS(14)
DayBased(13)
All(27)

Figure S4



a)
Nominal GDP
Real GDP
GDP (1000 Billion Yuan)
0
10
20
30
40
50
60
1980
1990
2000
2010
b)
GDP Growth Rate (%)
GDP Deflator Indice
0
2
4
6
8
10
12
14
16
18
20
0
10
20
30
40
50
60
70
80
90
100
c)
SSH1
SSH2
SSH3
SSH4
SSH5
GDP per Capita (1000 Yuan)
0
100
200
300
400
500
2010
2030
2050
2070
2090
d)
SSH1
SSH2
SSH3
SSH4
SSH5
GDP (1000 Billion Yuan)
0
100
200
300
400
500
2010
2030
2050
2070
2090

Figure S5