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Development of the Grid Dataset of High-Temperature Days and Types in Southern China (1983–2017)

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Abstract: In the context of global warming, high-temperature events have shown a clear increasing trend, and most parts of China are deeply affected by high temperatures (HTs). The high-temperature day (HTD) data can reflect the characteristics of HT changes, it is one of the most important data types used in HT research. A dataset of HTDs in China and midsummer high-temperature types (HTTs) in Southern China (SC) was developed based on daily maximum temperature data recorded from 2,374 meteorological stations during June to September and midsummer HT data collected from 750 stations in SC during 1983–2017. The dataset includes (1) 0.5° raster data of the annual number of HTDs in China; (2) 0.5° raster data of the average annual HTDs in China; (3) 0.5° raster data of the trend of HTDs in China; (4) 0.5° raster data of the spatial pattern of HTTs in SC in midsummer; (5) statistical data of the interannual variations in HTDs from June to September in SC; and (6) statistical data of the interannual variations in HTTs in SC in midsummer. This dataset is archived in .nc and .txt formats and is composed of 6 data files, with a data size of 2.43 MB (compressed into one file, 554 KB).

Keywords: Chinese high temperature; clustering analysis; raster data; 1983–2017

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2021.01.06.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2021.01.06.V1.

1 Introduction

In the context of global warming and climate change, extreme high-temperature events (EHTEs) have shown a clear increasing trend. Due to their huge impacts on human health, the aggravation of energy consumption, and the destruction of the environment, EHTEs have

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attracted much attention in recent years[1–4]. Based on the June–September daily maximum temperature data of 2,374 surface meteorological stations in China from 1983 to 2017, the absolute threshold of the daily maximum temperature exceeding 35°C is used to define the high-temperature days (HTDs). This study calculated the number of HTDs in China and the corresponding annual average and trend to improve the understanding of the frequency and the spatial pattern of trend associated with high temperatures in China.

Southern China (SC) is region of densely populated, economically prosperous, and highly susceptible to EHTEs[5]. At the same time, its vast area and complex climatic conditions have influenced the diversity of EHTEs and the diversification of weather and climate influencing factors. In general research, it is easy to obscure the characteristics of different EHTEs[6,7]. Clustering analyses can effectively solve the above-described problems, extract the characteristics of different high-temperature (HT) categories, and provide a theoretical basis for analyzing the causes of HTs to improve HT forecasting[8]. This dataset provides the spatial patterns of classified EH in SC and the statistical data of various types of interannual variations, to reflect the characteristics of HT diversity in SC well.

2 Metadata of the Dataset

The metadata of the Grid dataset of high temperature days and types in China (1983–2017)[9] is summarized in Table 1. It includes the dataset full name, short name, authors, year of the dataset, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the Grid dataset of high temperature days and types in China (1983–2017)[9]

Items	Description
Dataset full name	Grid dataset of high temperature days and types in China (1983–2017)
Dataset short name	HDs_1983-2017
Authors	Jia, Z. K., College of Atmospheric Science, Lanzhou University, China jiazk17@lzu.edu.cn Zheng, Z. H., College of Atmospheric Science, Lanzhou University,, China zhengzh@cma.gov.cn Feng, G. L., Laboratory for Climate Studies, National Climate Center, China Meteorological Administration, fenggl@cma.gov.cn
Year	1983–2017 Spatial resolution 0.5°
Data format	.nc, .txt Data size 554 KB
Data files	Composed of 4 .nc files and 2 .txt files
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[10]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

3 Data Development Method

The basic data used in this research were the homogenized daily maximum temperature data of 2,374 surface meteorological stations in China released by the National Meteorological Information Center of the China Meteorological Administration. NCL (NCAR command language) was used to detect and process the missing values of the data. Finally, station data covering the 35 years from 1983 to 2017 were selected for this research. The absolute value definition method with the maximum temperature exceeding 35 °C was used to define the HTDs of each station, and the number of HTDs from June to September at all stations were then summed to obtain the annual HTD dataset in China. Next, the arithmetic average method and linear tendency estimation method were used to obtain the annual average and trend. The inverse distance weight interpolation method of NCL was used to interpolate the above-described data to generate 0.5°×0.5° raster data.

In SC (east of 108°E and south of 33°N), more than 1/3 of the total stations that recorded daily maximum temperatures over 35 °C were defined as regional HTDs, and the interannual variation data of the HTDs in SC were obtained. The progressive clustering method was used to classify the EH in SC. By considering the anomalous temperature data of each EHD as a vector and assuming, there are N vectors in total. In the first step, the two vectors with the smallest Euclidean distance were combined to the first category, the average value was taken as the center of the category, and N–1 vectors were obtained; in the second step, the above operation was repeated to obtain N–2 vectors; finally, the HT was divided into one category in step n–1. The results obtained based on some comprehensive analysis could be conducive to the next analysis by dividing HT into three types[11]. The three types of HT differ greatly in their center positions, relative strengths and ranges. Thus, the raster data of three types of high-temperature patterns and the corresponding annual frequency data were obtained.

4 Data Results and Validation

4.1 Data Composition

The dataset developed in this study consists of the following data: (1) raster data of annual high-temperature days in China from 1983 to 2017; (2) raster data of average annual high-temperature days in China; (3) raster data of the trend of high-temperature days in China; (4) raster data of the spatial patterns of high-temperature anomaly classifications in Southern China in midsummer; (5) statistical data of interannual variations in high-temperature days from June to September in Southern China from 1983 to 2017; (6) statistical data of interannual variations in high-temperature days of various types in Southern China in midsummer.

A total of 4 raster datasets were interpolated from station data to 0.5°×0.5° raster data, and the storage format was .nc; 2 interannual variation datasets were obtained, and the storage format of these datasets was .txt.

4.2 Data Results

To facilitate the introduction of the climate state and trends in HTDs in China, the annual average and trend of HTDs were visualized. According to the mean value, eastern Xinjiang and southeastern China represent the areas with frequent HTDs, with the average number of HTDs exceeding 20 d in a year. The average annual HTDs in North China were close to 10 d, while HTDs rarely occurred in the remaining regions[12]. The trend distribution was similar to the mean value, with a strong increasing trend in Xinjiang and SC, where high temperatures occurred frequently, and a trend greater than 5 d/10a in the central region, while a decreasing trend did not appear anywhere in China. From the perspective of the average values and trends, EHTEs will continue to be the main meteorological and climatic disaster in China in the future (Detailed results can be found in the references [12]).

It can be seen from Figure 1 that regional HTDs in SC had an obvious increasing trend and were mainly concentrated in the midsummer period (July and August). July was the month with the highest frequency of HTs, followed by August, and the number of HTDs in some years exceeded the number of days in July. Although there were few high-temperature days in June or September, there was an obvious change over the study period. There was only one HTD in the first decade, but there were two HTDs per year on average in the last decade; this change was strongly correlated with global temperature changes and the increasing frequency of extreme events[12].

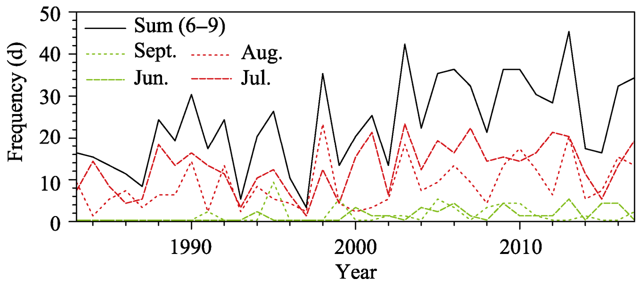

Figure 1 Interannual variations in regional high-temperature days from June to September in Southern China

Based on clustering analysis, the HTs in midsummer in SC were divided into three types: Jianghuai type (JHT), South China type (SCT) and Central China type (CCT)[12]. The central area of JHT is the Jianghuai region, which has the strongest relative intensity and the widest range among the three types. Figure 2 shows that the JHT high temperatures are also the highest-frequency category, accounting for more than 56% of the HTs in midsummer, and the growth trend is obvious. In 2013, the highest occurrence of JHT high temperatures was observed, which coincided with the continuous EHTE in the middle and lower reaches of the Yangtze River in 2013[7,13]; SCT high temperatures were located in South China, and negative temperature anomalies were observed in the northern region of the Yangtze River, with the lowest occurrence frequency. The year 2003 represented a typical year, in line with

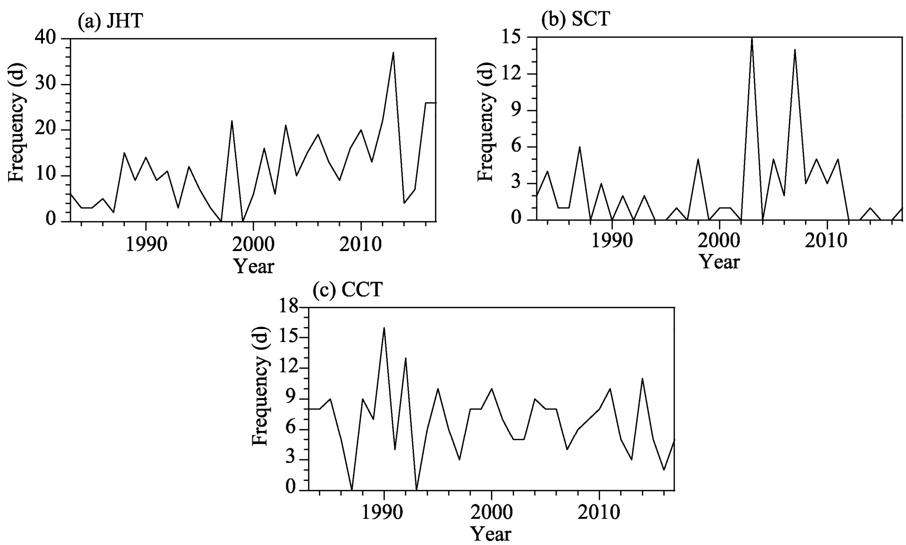

Figure 2 Interannual variation in high-temperature days for JHT, SCT, and CCT

the characteristics of long-duration high temperatures in SC in 2003[7,14]. The center of CCT is in Hunan and Hubei provinces, where the relative intensity of HTs is the weakest and the frequency of occurrence is higher. The circulation characteristics and external forcing factors of the three high-temperature types are also significantly different [12].

5 Conclusion

In this study, the daily maximum temperature data of meteorological surface stations in China were used to obtain data of annual HTDs in China using the absolute threshold definition, and normalized raster data were obtained by the inverse distance weighted interpolation method. It is very important to study the spatial distribution and trend change of HTs in China. The increasing trend of HTs indicates that EHTEs will be an important extreme weather and climate event affecting China in the future. Determining how to prevent and reduce HT damage has become an important field of meteorological research. The progressive cluster analysis method was used to classify and analyze the HTs in SC, and three types of HTs with different characteristics were obtained along with their interannual variations to provide a way of thinking for further analyses of HT characteristics. Analyses of the causes of circulation and the external forcing factors of HT diversity will be beneficial for improving high-temperature forecasts.

Author Contributions

Zheng, Z. H. and Feng, G. L. provided the overall idea of the dataset development and the revision of the data in the paper; Jia, Z. K. completed the processing of the dataset and wrote the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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