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Methodology of Dataset Development on Extreme Precipitation Indexes in Weihe River Basin (1961–2016)

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Abstract: Based on the daily precipitation data from 25 meteorological stations during 1961-2016, this paper formed the dataset of extreme precipitation indexes of Weihe River basin (1961–2016) through a series of processing methods such as unit conversion, outlier correction, meteorological data interpolation, error correction, and linear trend method. This dataset is composed of the following three parts: (1) Location data of the data collection point; (2) nine extreme precipitation-related indexes, including: total annual precipitation (PRCPTOT), continuous wetting index (CWD), precipitation intensity (SDII), the number of days with heavy precipitation (R10mm), the number of heavy rain days (R25mm), 1 day's maximum precipitation (Rx1day), 5 day's maximum precipitation (Rx5day), total heavy precipitation (R95PTOT), and total extreme precipitation (R99PTOT); (3) years with sudden changes in precipitation indexes. The data set is stored in .shp and .xlsx formats and consists of 8 data files. Its data volume is 55.5 KB which has been compressed into one data file of 39.0 KB. This dataset can provide data support for the study of extreme precipitation in the Weihe River basin, and the temporal and spatial differentiation rules of rainstorms and floods.

Keywords: Weihe River basin; extreme precipitation index; Mann-Kendall nonparametric test

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.2021.02.06.V1.

1 Introduction

The extreme climate indexes proposed by the World Meteorological Organization at the Climate Change Monitoring Conference have become a unified standard for climate change research. This set of extreme climate indexes contains a total of 27 core indexes, including 11 extreme precipitation indexes and 16 extreme temperature indexes, which were calculated from daily temperature data and daily precipitation data. In this paper, 9 precipitation-related

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extreme indexes were selected from them according to the temporal and spatial distribution characteristics of precipitation in the study area. Traditional methods such as linear regression algorithm[1,2], Mann-Kendall non-parametric test[3–7] and Morlet wavelet analysis method[8,9] are the mostly frequently used approaches in the research on extreme precipitation index, among which Mann-Kendall non-parametric test[6] can analyze the change trend and mutation point of meteorological data.

The Weihe River basin is located in a continental monsoon climate zone, which is also a transitional zone between arid and humid regions. As a result, it is uneven in the spatial distribution of precipitation, and is prone to heavy rain and flood disasters. The evolution rule of the spatial-temporal distribution characteristics of extreme precipitation in the Weihe River basin not only helps to improve basin's ability to respond to extreme climate events and disasters, but also provides basic research on the occurrence of extreme climate events in the surrounding area.

2 Metadata of the Dataset

The metadata of the Extreme precipitation dataset of Weihe River basin (1961–2016) is summarized in Table 1. It includes the dataset full name, short name, authors, year of the dataset, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the Extreme precipitation dataset of Weihe River basin (1961–2016)

Item	Description
Dataset full name	Extreme precipitation dataset of Weihe River basin (1961–2016)
Dataset short name	ExtremePrecipitationWeiheBasin_1961-2016
Authors	Zhou, Q. AAB-7588-2021, College of Geography and Environment, Baoji University of Arts and Sciences, cbozhou@163.com, Zhang, H. N., College of Geography and Environment, Baoji University of Arts and Sciences, 765049056@qq.com Ren, Y. X., College of Urban and Environment Sciences, Northwest University, 282180595@qq.com
Geographical region	Weihe River basin
Data format	.xlsx Year 1961–2016
Data volume	55.5 KB (after compression)
Data files	(1) Location data of the data collection point; (2) nine extreme precipitation-related indexes, including: total annual precipitation (PRCPTOT), continuous wetting index (CWD), precipitation intensity (SDII), the number of days with heavy precipitation (R10mm), the number of heavy rain days (R25mm), 1 day's maximum precipitation (Rx1day), 5 day's maximum precipitation (Rx5day), total heavy precipitation (R95PTOT), and total extreme precipitation (R99PTOT); (3) years with sudden changes in precipitation indexes
Foudations	National Natural Science Foundation of China (411771215); Shaanxi Province (2020SF-385)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11, 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[11]
Communication and searchable system	DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS, Crossref

3 Data Processing

3.1 Data Source and Preprocessing

First, the daily meteorological data from 25 meteorological stations in the Weihe River basin with complete climate elements, uniform spatial distribution and relatively complete time series were selected for pre-processing and quality inspection. Specifically, unit conversion and outlier correction were performed on the daily meteorological data. The missing data within three days were replaced by the mean precipitation of the two days before and after, and the missing data in 3 or more days were replaced by 99.99 as specified in the program[12]. The daily weather data period is 1961–2016. Then, based on the R ClimDex software, the extreme precipitation index of each meteorological station was calculated and a time series was established[13]. By calculating the weighted average of the extreme precipitation indexes of various meteorological stations in different regions, the 1961–2016 extreme precipitation index sequences for the upper, middle and lower reaches of the Weihe River basin and the whole basin were obtained. These sequences contain a total of 36 sets of data. The division of meteorological stations in the basin is shown in Table 2 and Figure 1.

Table 2 Distribution of meteorological stations in different regions of Weihe River basin

Basin	Meteorological station
Upper reaches	Qin'an, Qingshui, Tianshui, Weiyuan, Wushan, Zhangjiachuan
Middle reaches	Baoji, Fufeng, Huxian, Meixian, Qishan, Qianyang, Wugong, Xingping, Chang'an
Lower reaches	Dali, Fuping, Lantian, Lintong, Luochuan, Qianxian, Tongguan, Weinan, Changwu, Zhidan

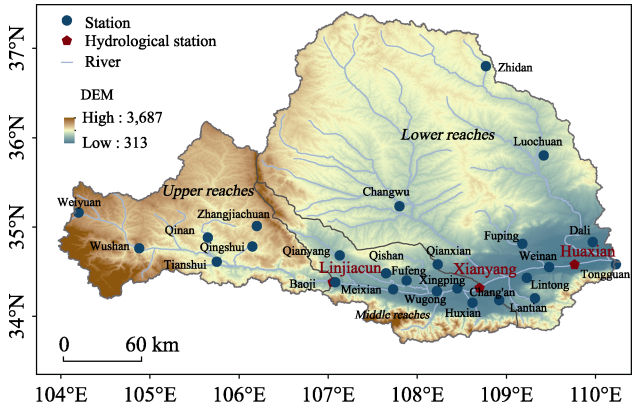

Figure 1 Distribution Map of water systems and meteorological stations in the Weihe River basin

3.2 Technical route

The linear trend method and Mann-Kendall non-parametric test were used to analyze the variation trend and abrupt changes of the nine extreme precipitation indices in the upper, middle, and lower reaches as well as the Weihe River basin, so as to study the spatial differences of each index among different regions. The technical route of dataset development was shown in Figure 2.

4 Data Results and Validation

4.1 Data Composition

The adopted dataset contains the following information: (1) Location data of the data collec-

tion point; (2) nine extreme precipitation-related indexes, including: total annual precipitation (PRCPTOT), continuous wetting index (CWD), precipitation intensity (SDII), the number of days with heavy precipitation (R10mm), the number of heavy rain days (R25mm), 1 day's maximum precipitation (Rx1day), 5 day's maximum precipitation (Rx5day), total heavy precipitation (R95PTOT), and total extreme precipitation (R99PTOT); (3) years with sudden changes in precipitation indexes.

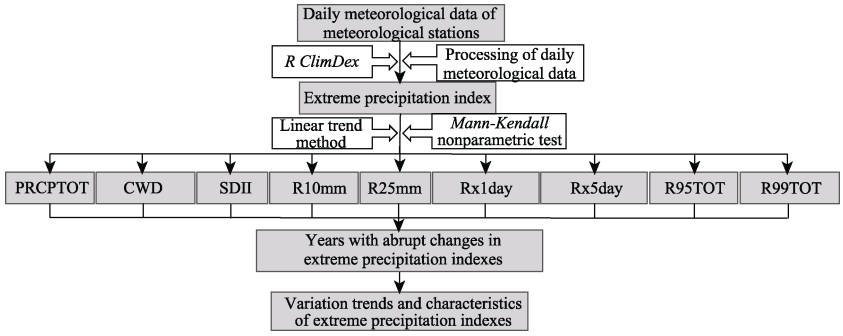

Figure 2 The technical route of dataset development

4.2 Data Results

Through processing and analyzing the extreme precipitation indexes in different regions of the Weihe River basin, it is found that there are spatial differences in extreme precipitation indexes in the upper, middle and lower reaches (Tables 3 and 4). The average value of total precipitation in the middle reaches of the Weihe River basin is 601.70 mm at its maximum, the upstream minimum average is 495.50 mm, and the average value of the whole basin is 560.15 mm. The years of extreme precipitation events in the Weihe River basin are concentrated in the 1990s and the early 21st century[14]. And the inter-annual differences in precipitation are large, with the most obvious changes in the middle reaches.

Table 3 Examples of total annual precipitation data of the Weihe River basin (1961–2016) (mm)

Year	Upper reaches	Middle reaches	Lower reaches	Weihe River basin
1961	690.80	643.10	663.78	662.82
1962	522.17	592.02	521.98	547.24
…	…	…	…	…
2015	403.02	583.46	575.85	537.11
2016	389.75	517.70	505.68	482.18

Table 4 Years with abrupt changes in the extreme precipitation indexes of the Weihe River basin (excerpt)

Index	Upper reaches	Middle reaches	Lower reaches	Weihe River basin
Total annual precipitation	1969, 1985	2010	1985	1985
Continuous wetting index	1976	1969	1974	1976
…	…	…	…	…
Total extreme precipitation	1982, 2005	1998	1999	1998

4.3 Data Validation

The data error results from the lack of daily meteorological data from meteorological stations, but the data quality of this dataset has been tested to minimize the data errors.

5 Discussion and Conclusion

The overall extreme precipitation index (1961–2016) of the entire Weihe River basin cannot clearly reflect the spatial difference of extreme precipitation conditions in the upper, middle and lower reaches. The data of the nine extreme precipitation indexes and mutation years of the upper, middle and lower reaches of the Weihe River basin and the whole basin were calculated. This data set provides data support for the analysis of the differences in characteristics of extreme precipitation in different regions of the Weihe River basin, and for the research on the occurrence of extreme climate events in the basin. Furthermore, research on the trend analysis and future prediction of extreme precipitation in the basin can be carried out based on this dataset.

Author Contributions

Zhou, Q. was responsible for the overall design for the development of the data set; Zhang, H. N. collected and processed extreme precipitation data; Ren, Y. X. designed the algorithm; Zhang, H. N. wrote the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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