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Dataset of ENSO's Effects on the Annual Rainfall Erosivity in Shaoguan City of Guangdong Province (1951–2013)

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Abstract: The monthly rainfall erosivity of Shaoguan city from 1951 to 2013 was calculated using the rainfall erosivity model with the monthly rainfall data of the city. Sea Surface Temperature (SST) anomaly, Southern Oscillation Index, and Multivariate El Niño–Southern Oscillation Index were used as El Niño–Southern Oscillation (ENSO) indexes. The effect of ENSO on the monthly rainfall erosivity was analyzed, and the ENSO's effect on the annual rainfall erosivity of Shaoguan city from 1951 to 2013 was obtained. Results showed that the interannual and intraannual variations in rainfall erosivity in Shaoguan city were large, and the overall trend was fluctuating first and then increasing. Rainfall erosivity was significantly correlated with SST anomaly. The dataset includes: (1) rainfall erosivity and erosivity anomaly in Shaoguan city from 1951 to 2013; (2) monthly ENSO index and rainfall erosivity of Shaoguan city from 1951 to 2013. The dataset is archived in .xlsx format with the data size of 116.5 KB. The research results related to the dataset were published in *Scientia Geographica Sinica* (Vol. 36, No. 10, 2016).

Keywords: rainfall erosivity; ENSO; MEI; Shaoguan; 1951–2013; Scientia Geographica Sinica

1 Introduction

Rainfall is the direct cause and an important factor of soil erosion. The ability of rainfall to induce soil erosion is known as rainfall erosivity[1], which reflects the potential influence of rainfall on soil to some extent[2–3]. Rainfall erosivity (EI_{30}) is the product of total rainfall kinetic energy (E) and the maximum rainfall intensity for 30 min (I_{30}); EI_{30} is usually applied to the (revised) universal soil loss equation (USLE/RUSLE) in the calculation of rainfall erosivity, that is, the R value of rainfall erosivity[4–6]. Scholars have conducted many studies on rainfall erosivity and its application, and different rainfall erosivity formulas have been established in different regions of the world under different rainfall durations[7–12]. Changes in rainfall erosivity are closely related to climate change, and global climate change exerts extremely complex effects on rainfall erosivity[13]. However, few studies on the rain-

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[2] Chen, S. F. Impact of ENSO on rainfall erosivity in Shaoguan during 1951–2013 [DB/OL]. Global Change Research Data Publishing & Repository, 2018. DOI: 10.3974/geodb.2018.06.02.V1.

fall erosivity caused by global climate change are available, and datasets related to rainfall erosivity and global climate change are scarce.

El Niño–Southern Oscillation (ENSO) is an important influencing factor of global climate change. The eigenvalues of ENSO include Sea Surface Temperature (SST) anomaly in the central and eastern equatorial Pacific, Southern Oscillation Index (SOI), and Multivariate ENSO Index (MEI). Changing these characteristic values leads to corresponding changes in rainfall erosivity. ENSO and global precipitation differ. For example, precipitation increased in most parts of South America when an ENSO warm event occurred; winter precipitation in eastern Asia also showed an increasing trend, which resulted in less summer precipitation in eastern and southern Asia and less precipitation in Africa[14–16]. Although studies on the effect of ENSO on precipitation are available, works on the effect of ENSO on rainfall erosivity are limited[13,17]. On the basis of the rainfall data of Shaoguan city in Guangdong province from 1951 to 2013, this study analyzed the influence of each index value on the rainfall erosivity in the city through the index value of ENSO. The current dataset contained the ENSO eigenvalues of rainfall erosion force in Shaoguan city and its influence on the city and even the red soils with low hills in southern China. This dataset provides theoretical basis for the comprehensive control of soil erosion and references for the monitoring, assessment, and management of soil erosion in related areas.

2 Metadata of Dataset

The metadata of "Impact of ENSO on rainfall erosivity in Shaoguan during 1951–2013"[18] are shown in Table 1, including the dataset full and short names, authors, year of the dataset, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy.

Table 1 Metadata summary of "Impact of ENSO on rainfall erosivity in Shaoguan during 1951–2013"

Items	Description
Dataset full name	Impact of ENSO on rainfall erosivity in Shaoguan during 1951–2013
Dataset short name	ENSO_RainfallErosivityShaoguan_1951-2013
Authors	Chen, S. F. 0000-0002-1273-9668, College of Tourism and Geography, Shaoguan University, sgxycsf@163.com
Geographical region	Shaoguan city, Guangdong province (23°5′N–25°31′N, 112°50′E–114°45′E)
Year	1951–2013 Data format .xlsx
Data size	116.5 KB
Data files	The dataset includes (1) rainfall erosive force and anomaly in Shaoguan city of Guangdong province from 1951 to 2013, including annual rainfall erosive force, 5-year sliding average rainfall erosive force, rainfall erosivity distance, and 5-year sliding rainfall erosivity anomaly; (2) monthly ENSO index values from 1951 to 2013 and monthly rainfall erosivity data, including monthly rainfall erosivity over the years, Sea Surface Temperature anomaly in the central and eastern equatorial Pacific, Southern Oscillation Index, and Multivariate ENSO Index
Foundations	Guangdong province (GD18XGL55, 2015KQNCX148); Shaoguan city (G2017017, 2018sn055)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China

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Items	Description
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (data products), and publications (in this case, 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 percent 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[19]
Communication and searchable system	DOI, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS

3 Data Development Method

3.1 Date Sources

The monthly rainfall data of Shaoguan city from 1951 to 2013 were provided by the China Meteorological Sharing Service (http://data.cma.cn/). On the basis of the monthly rainfall data, the erosion of monthly rainfall was calculated to calculate the erosion of annual rainfall in Shaoguan city.

Published ENSO data were from the United States and Atmospheric Administration Climate Prediction Center (http://www.esrl.noaa.gov/), including monthly SST anomaly values, SOI, and MEI data (1951–2013).

3.2 Algorithm Principle

The rainfall erosivity model proposed by Zhou[8] was adopted to calculate rainfall erosivity using the monthly rainfall data of weather stations. The model formula is as follows:

$$R=\sum_{i=1}^{12}(-2.6398+0.3046P_i) \tag{1}$$

where P_i is the monthly rainfall (mm) and R is the annual rainfall erosion erosivity, MJ mm hm^{-2} h^{-1} a^{-1}.

Formula (1) was used to calculate the monthly rainfall erosivity in Shaoguan city, and the rainfall erosivity in a year could be obtained by accumulation.

An El Niño or a la Niña (anti-El Niño) event is considered when the SST anomaly in the eastern equatorial Pacific is higher 0.5 ℃ or lower than –0.5 ℃ and lasts for more than 6 months (one month less than 0.5 ℃ or –0.5 ℃ is allowed).

3.3 Technical Route

Shaoguan city in Guangdong province was used to analyze the effect of ENSO on rainfall erosivity. The technical route is shown in Figure 1. The change rules of SSTA, SOI, and MEI data of Shaoguan city in Guangdong province in the period of 1951–2013 were obtained by using the average monthly rainfall data of the city and the ENSO index. On this basis, SPSS 19.0 statistical software was used to analyze the rainfall erosivity, correlation among ENSO indices, influence of ENSO on rainfall erosion erosivity, and ENSO mechanism in Shaoguan city.

4 Results and Validation

4.1 Dataset Composition

(1) Data of rainfall erosivity and anomaly in Shaoguan city of Guangdong province from 1951 to 2013, including annual rainfall erosivity, 5-year sliding average rainfall erosivity, precipitation erosivity, and 5-year sliding rainfall erosivity anomaly;

(2) Monthly ENSO index values from 1951 to 2013 and monthly rainfall erosivity data, including monthly rainfall erosivity over the years, MEI, SOI, and ocean SST data.

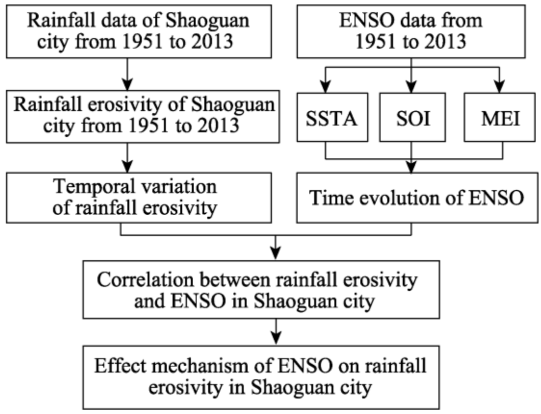

Figure 1 Technical route of the data development

4.2 Data Results

The average annual rainfall erosivity from 1951 to 2013 in Shaoguan city of Guangdong province was 476.53 MJ mm hm^{-2} h^{-1} a^{-1}. The maximum monthly rainfall erosivity over the years was 180.52 MJ mm hm^{-2} h^{-1} a^{-1}, while the minimum value was 0 MJ mm hm^{-2} h^{-1} a^{-1}. The maximum was 646.27 MJ mm hm^{-2} h^{-1} a^{-1} in 1994 and the minimum was 302.53 MJ mm hm^{-2} h^{-1} a^{-1} in 1963. The average monthly rainfall erosivity was 39.71 MJ mm hm^{-2} h^{-1} a^{-1}. The rainfall erosivity of May was the largest and reached as high as 78.64 MJ mm hm^{-2} h^{-1} a^{-1}, and the smallest was in December at only 14.03 MJ mm hm^{-2} h^{-1} a^{-1}[17]. According to the fitting curve of monthly rainfall erosivity (Figure 2), the rainfall erosivity was the largest from April to July, while the monthly rainfall erosivity was the lowest from November to February.

The rainfall erosivity distance showed a fluctuating trend. The 5-year sliding average of rainfall erosivity distance in Shaoguan city was calculated. From 1992 to 2013, the negative anomaly of rainfall erosivity reached the maximum, while the total rainfall erosivity from 1992 to 2013 was in the positive anomaly. The cumulative anomaly value fluctuated greatly, and the rainfall erosivity in this stage was highly abrupt. The rainfall erosivity showed a linear upward trend, which was a negative anomaly before the mid-1980s and a positive anomaly after the mid- 1980s[17–18].

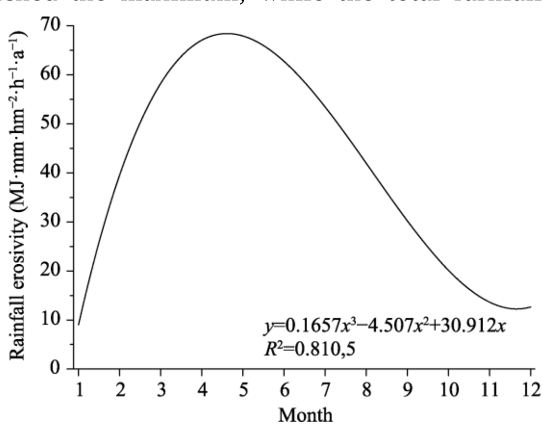

Figure 2 Variation curve of rainfall erosivity from 1951 to 2013 in Shaoguan city

As shown in Figure 3, 20 ENSO warm events (Figure 3A) and 13 ENSO cold events (Figure 3B) occurred from 1951 to 2013. During the ENSO cold and warm events, the average monthly rainfall erosivity was 35.44 MJ mm hm^{-2} h^{-1} a^{-1}. The average monthly rainfall erosive forces were 36.75 and 33.88 MJ mm hm^{-2} h^{-1} a^{-1} in the warm and cold event periods, respectively. Although the erosive force of rainfall in the warm event period was higher than that in the cold event period, the erosive force of rainfall in each cold event period fluctuated more than that in the warm event period. The rainfall erosivity of Shaoguan city was relatively large during the non-ENSO cold and warm events. Meanwhile, the rainfall erosivity was relatively small during ENSO cold and warm events, especially during ENSO cold events.

The rainfall erosivity of Shaoguan city was significantly correlated with the SST anomaly in the central and eastern equatorial Pacific (P<0.01). The rainfall erosivity was significantly correlated with the presence of SOI (P<0.05), and the rainfall erosivity gradually decreased with the increase in SOI. Rainfall erosivity increased with the increase of MEI (P<0.01), which indicated a very significant positive correlation between the two variables, and the correlation between rainfall erosivity and MEI was stronger than that between SST anomaly and SOI.

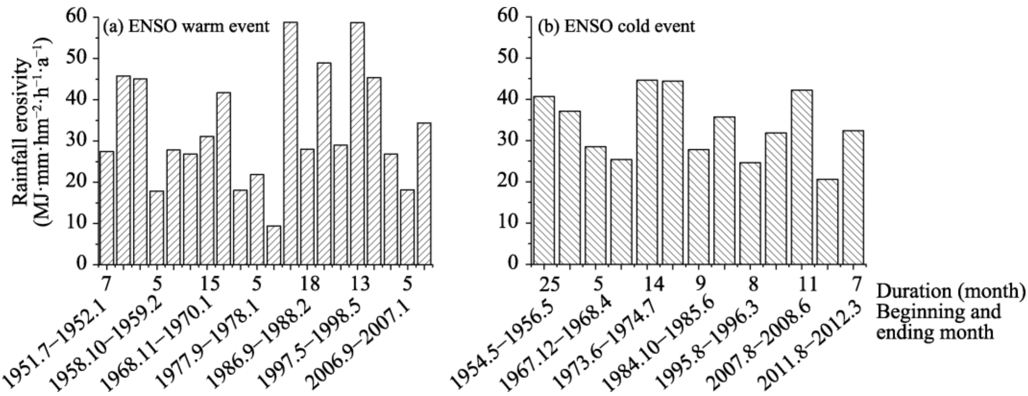

Figure 3 ENSO cold and warm events and rainfall erosivity from 1951 to 2013

Using the monthly rainfall erosivity formula of rainfall erosivity[8–9] from 1951 to 2013 is suitable for southern hilly areas with rich precipitation. However, the obtained daily and hourly rainfall erosivity values show no difference in rainfall intensity of rainfall erosivity, and extreme precipitation is affected by global climate change. Thus, future research should consider the relationships between ENSO and different rainfall erosion force formula to comprehensively reflect the effects of global climate change on rainfall erosivity.

5 Discussion and Conclusion

The current dataset was based on the monthly rainfall erosivity of Shaoguan city in the period of 1951−2013. The monthly rainfall erosivity formula was used to calculate the monthly rainfall erosivity, and the ENSO eigenvalue data were used to analyze the correlation between rainfall erosivity and ENSO. The dataset showed that the rainfall erosivity increased slightly in the period of 1951–2013, and the annual and monthly variations in rainfall erosivity were relatively large. The monthly rainfall erosivity of ENSO warm event was higher than that of ENSO cold event with a value of 33.88 MJ mm hm^{-2} h^{-1} a^{-1}. The rainfall erosion increased first and then decreased with the increase of SST anomaly. It decreased with the increase of SOI and increased with the increase of MEI.

The analysis of ENSO events in Shaoguan city provides data support for the ENSO influence on rainfall erosivity. Correlation analysis can be used to describe the influence mechanism. Rainfall erosion force, intensity, and duration have important influences on rainfall erosion erosivity. However, not all affecting factors of rainfall erosivity are considered. The future research will consider different rainfall intensities, durations, and erosion force changes in analyzing the ENSO influence. The current dataset provides basic data and methodological reference for calculating the monthly rainfall erosivity over long time scales in similar areas and its relationship with global climate change.

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