Temporal and spatial variations of rainfall erosivity of Lianshui basin in red soil region, South China

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Outline

- **Introduction**
- **Materials and methods**
- **Results and analysis**
- **Discussion and conclusion**

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1.Introduction

- Characteristics of the red soil region

- A significant decreasing trend was observed on annual sediment load ,while the runoff from Ganjiang river maintained steady.

- R-factor analysis will help to understand the process of soil erosion within the watershed.

- The distribution of rainfall and R within the year were analyzed based on the monthly rainfall data and the temporal and spatial trends of R value were studied

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2. Materials and methods

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2.1Study area: Lianshui basin
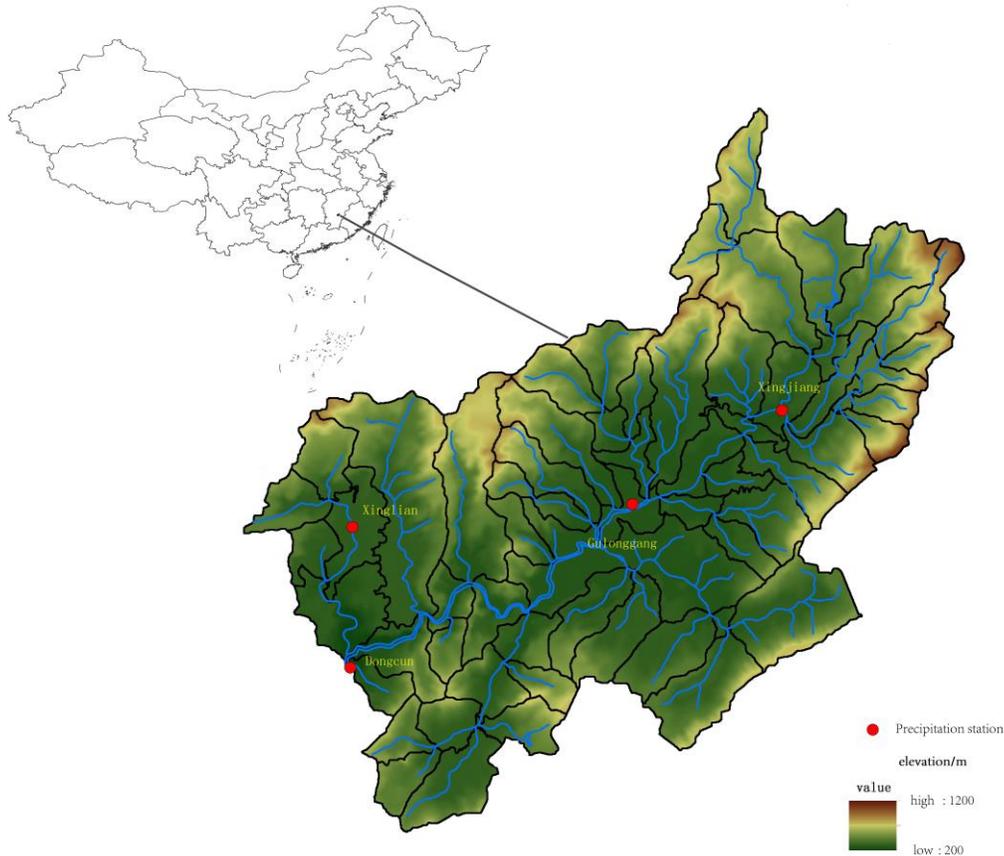
Location :

- It is located in the upstream of Ganjiang River, northeast of Xingguo County, Jiangxi Province, china , is a tributary of Ganjiang River ,basin area 579 km^2.

- The outlet is located in the southwestern tip of Dongcun hydrology station.

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Climate Character

- The basin has mid subtropical monsoon humid climate, with the annual average temperature of 18.9℃.

- The annual average precipitation is about 1602mm, of which 44.8% is distributed in April to June.

Geomorphology

- In the basin, the area ratios of low hills, middle hills, high hills, low mountains and valley plain were 21%, 27%, 42% and 10%, respectively.

➢ **Vegetation**

- The main vegetation types are evergreen broad leaved forest and coniferous forest.

➢ **Soil**

- The soil types are mainly paddy soil and brown red soil, with red soil and limestone soil distributed in some regions.

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➤ **Soil and water conservation**

- It is one of the first batch of comprehensive management of small watershed in south China.

- From 1983 to 2015, large-scale management in small basin was conducted .

- To date, the water and soil loss situation has been significantly controlled in Lianshui basin.

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塘青鱼脊山一带治理前后对比
1984. 10. —1994. 6.

塘青水库一带治理前后对比
1984. 5. —1998. 6.

2.2 Rainfall data

This study is based on ten years (from 2000 to 2009) monthly rainfall data from four precipitation stations of Lianshui basin (Table 1).

Tab. 1 The rainfall data of 4 precipitation stations in Lianshui basin (mm)

Rainfall station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Dongcun	65.70	85.63	138.97	177.47	237.32	285.36	142.76	168.69	83.65	79.41	70.13	37.83
Gulonggang	62.91	83.11	146.33	184.60	226.18	288.33	143.53	140.11	61.44	75.83	73.84	40.93
Xingjiang	56.50	73.58	145.27	175.81	234.21	265.52	136.77	111.80	55.06	74.72	70.83	34.51
Xinglian	60.61	88.25	137.99	194.31	223.71	324.23	145.37	138.51	82.01	73.06	67.23	38.21

2.3 Calculation of R-factor

$$R_{year} = \sum_{i=1}^{12} 0.0125 P_i^{1.6295}$$

where R_{year} is the annual R (MJ·mm·(hm²·h·a)⁻¹), P_i represents the average monthly rainfall from January to December (mm).

2.4 Coefficient of variation(C_v)

$$C_v = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(R_i - \overline{R})^2}}{\overline{R}}$$

- where R_i is the annual R (MJ·mm·(hm^2·h·a)$^{-1}$), $\overline{R}$ represents the mean annual R

2.5 Trend coefficients

$$r_{xt} = \frac{\sum\limits_{i=1}^{n}(x_i - \bar{x})}{\sqrt{\sum\limits_{i=1}^{n}(x_i - \bar{x})^2 \sum\limits_{i=1}^{n}(i - \bar{t})^2}}$$

where the x_i is the R value of the i year; $\bar{x}$ is the mean value of the sample; $\bar{t}$ is the mean value of the natural sequence; n is the length of the R value sequence, which is the number of time series; r_{xt} is the trend coefficient.

3. Results and analysis

3.1Distribution characteristics of R
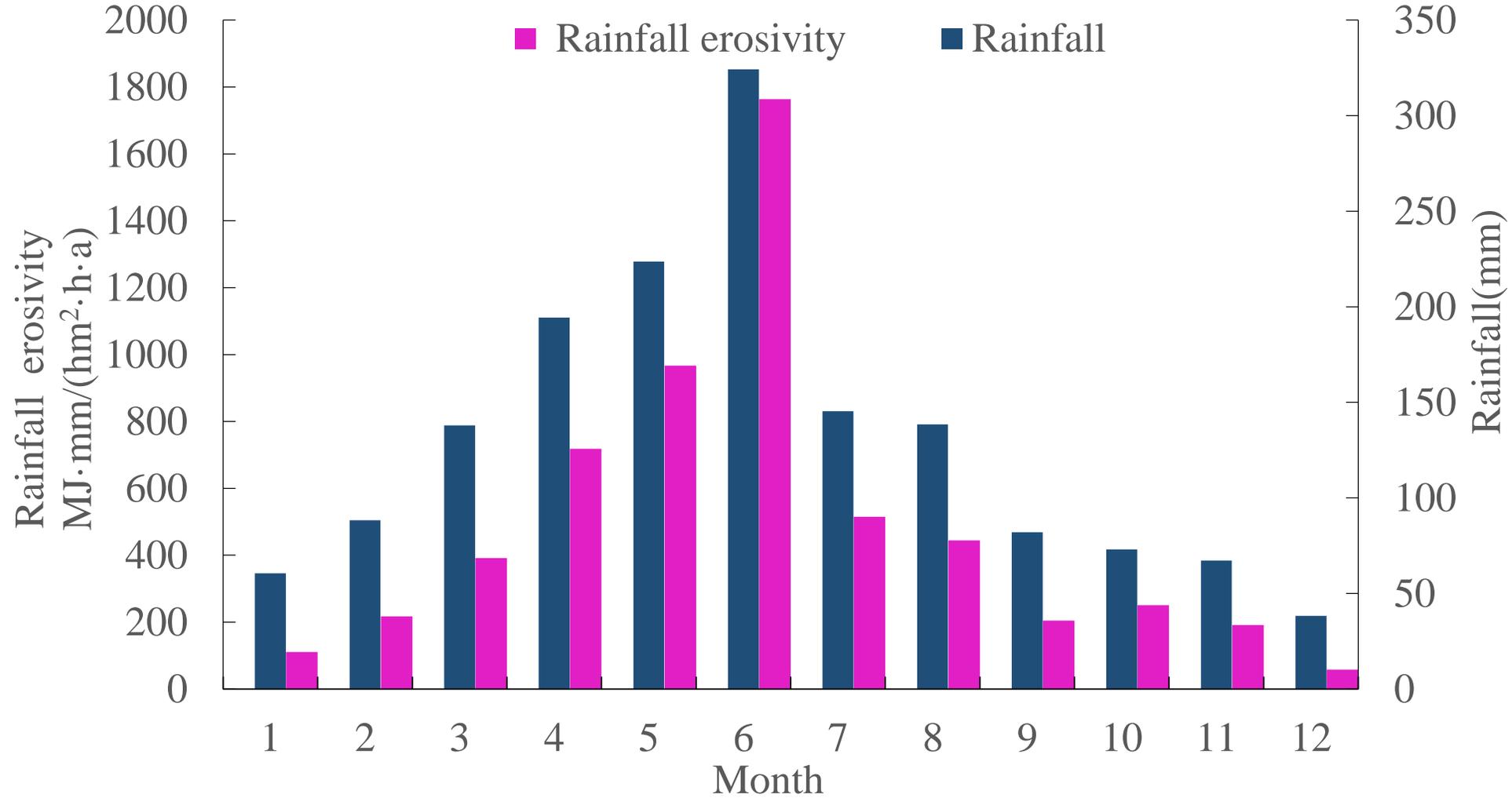
3.2 Inter-annual distribution characteristics of R
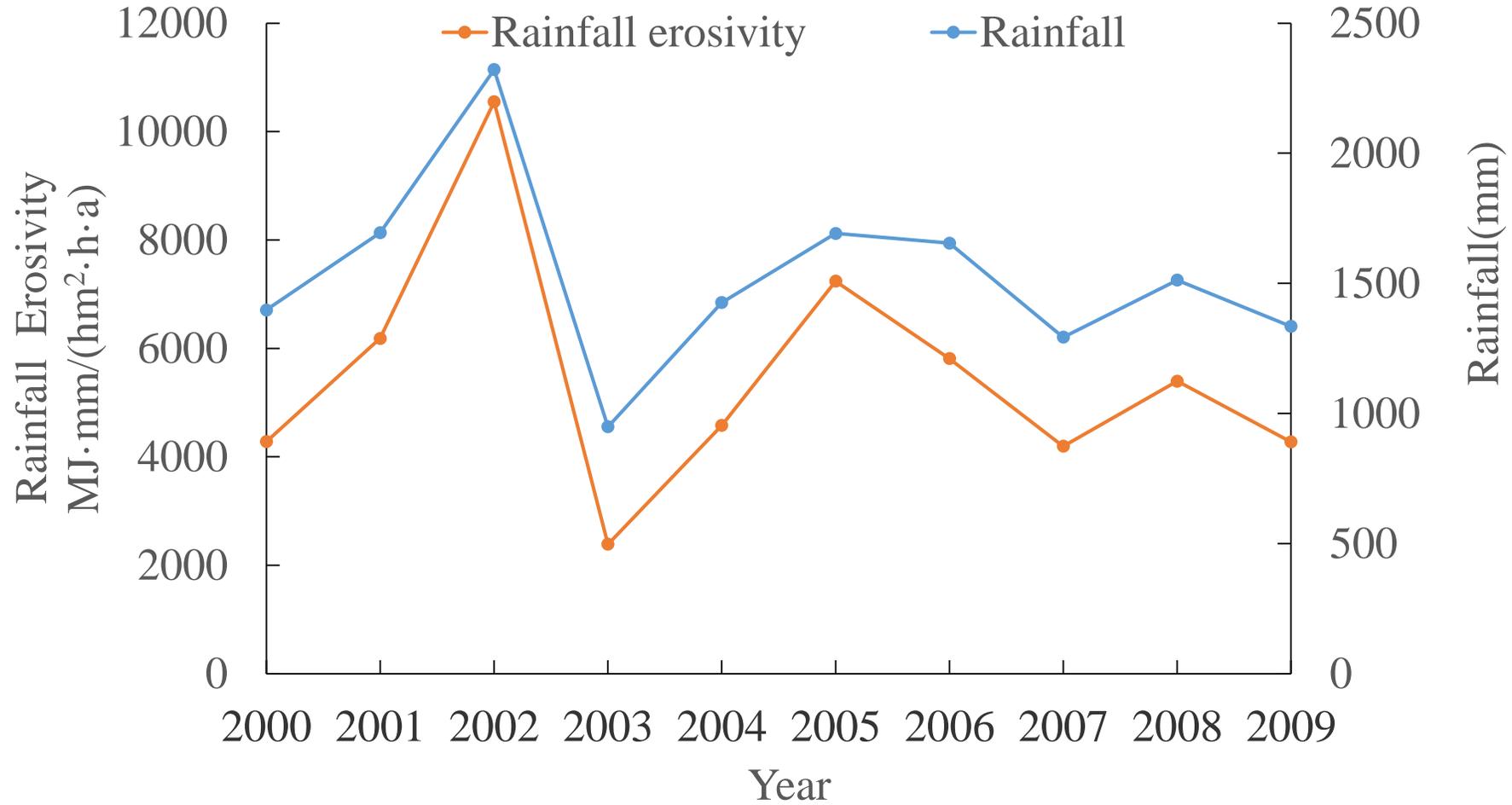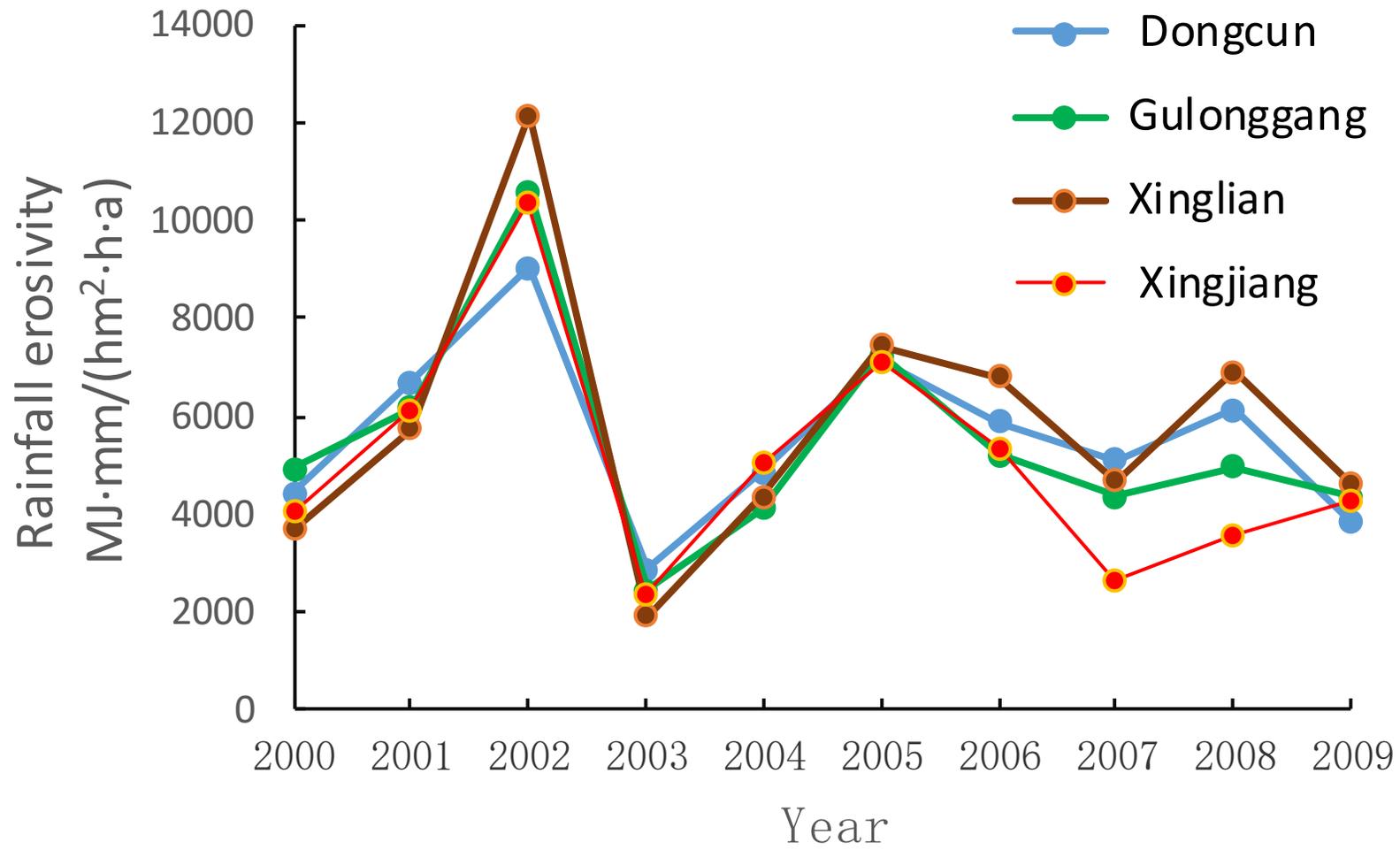
Descriptive statistics of annual R-factor at the sites in Lianshui basin

| Station Name | Annual R $[MJ\cdot mm\cdot (hm^2\cdot h\cdot a)^{-1}]$ | | | C_v | r |
	Mean	Max (2002)	Min (2003)		
Dongcun	5600.46	9029.72	2857.08	0.32	-0.0002
Gulonggang	5439.43	10610.87	2422.93	0.41	-0.2580
Xingjiang	5087.95	10377.07	2364.39	0.47	-0.3392
Xinglian	5831.41	12184.14	1904.12	0.48	-0.0218
Mean value	5489.81	10550.45	2353.61	0.42	-0.1548

3.3 Spatial variation characteristics of R value
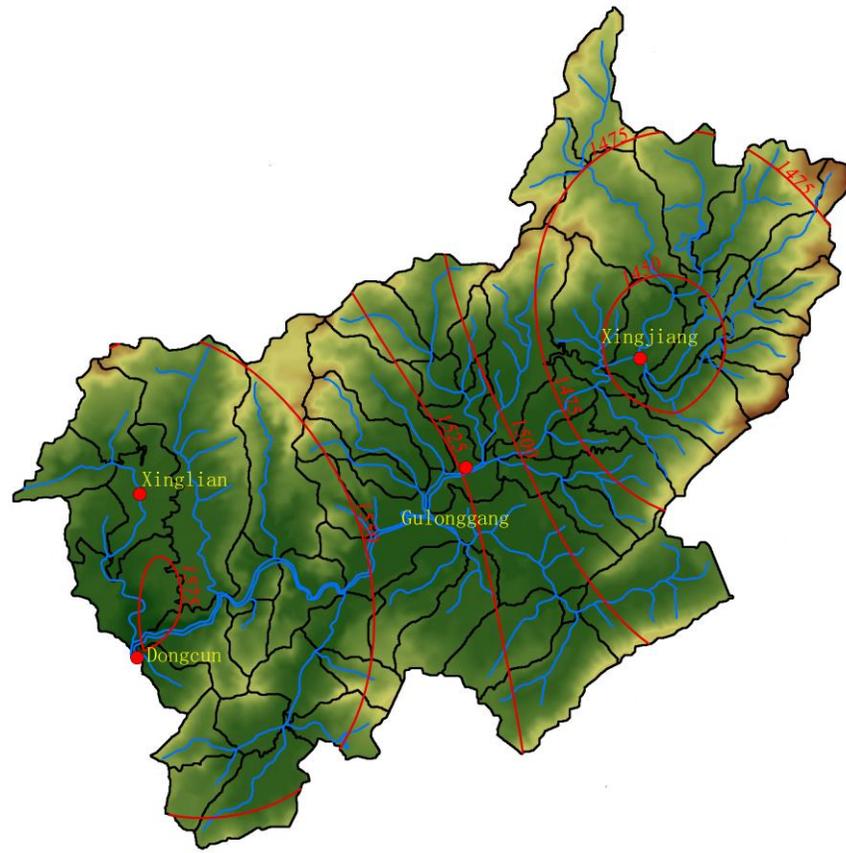
Fig.5 Spatial distribution of rainfall contour

Fig.6 Spatial distribution of R contour

4.Discussion and conclusion

- The distribution of rainfall and R was consistent, shown as a single peak, and R value was mainly concentrated in April to June, accounting for about 56.8% of the entire year. R value peaked in June, accounting for about 24.78% of the annual R value.

- There was no significant difference among the R values across stations.

- It showed that R values increased from the northeast to the southwest of the basin

- the R value was generally decreased(2000-2009)

Thank you for your attention !

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Red soil region

- The red soil region is located in the tropical and subtropical zones south of the Yangtze river valley ,covers a total area of 1.18 million square kilometers, about 12.3% of total land territory of china.

- The main types of soil erosion in this region are water erosion and erosion caused by human activities .

- annual precipitation is very high ,which is 1.9-2.8 times higher than the national mean value, furthermore ,70% of that precipitation occurs as rain storms from April to September

- The rainfall erosion force in this region is three times higher than that in any other regions of china .
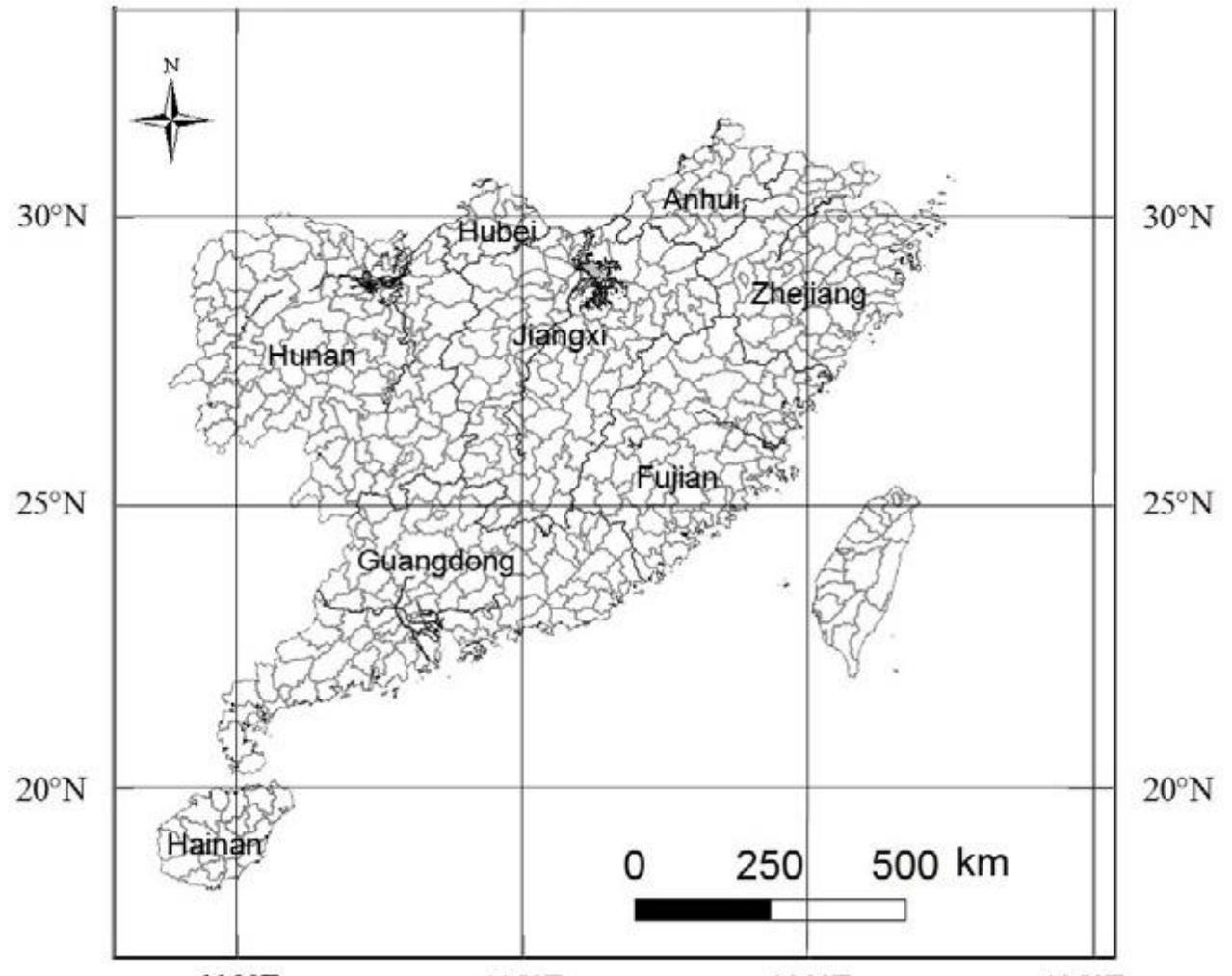
Observed streamflow and sediment discharge during 1956-2009 in the Gangjiang river basin

Streamflow
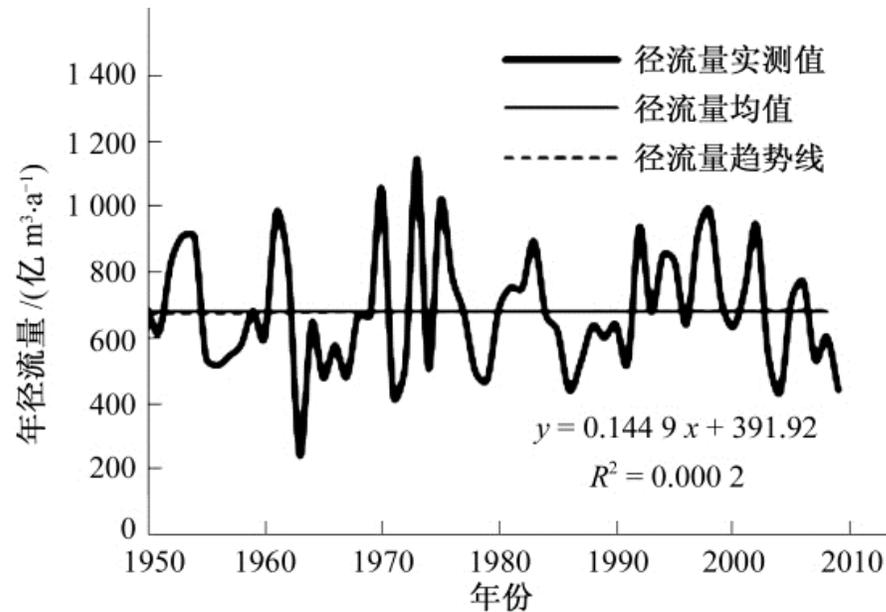
Sediment discharge
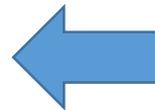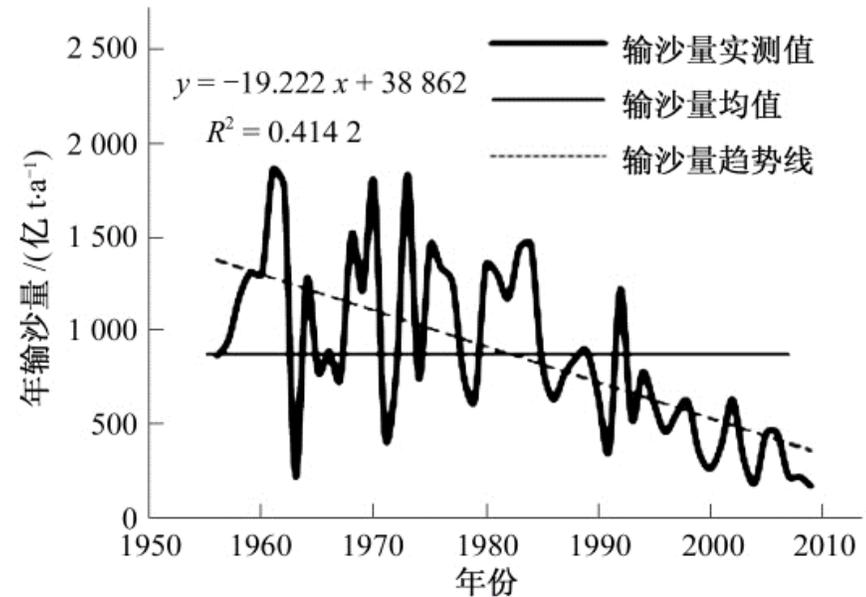
- The calculation of R value can be divided into two categories, the classical method based on EI_{30} and the simple calculation model

- In Lianshui basin, Tiangang et al. compared plenty of models, i.e. **the monthly rainfall model of Zhou** (Zhou et al. 1995), **the daily rainfall model of Zhang** (Zhang et al. 2002), **the monthly rainfall model of Wu** (Wu et al. 1994), **modified daily rainfall model of Shi** (Shi et al. 2006), **the monthly rainfall model of (Wischmeier W H**, Smith D D 1958) and **CREAMS model** (Knisel W G. CREAMS 1980), showing that the monthly rainfall model of Wu had a higher effective coefficient and a lower relative deviation and therefore was relatively ideal (Tian et al. 2010).

- In this study, monthly rainfall model of Wu was thus used to calculate the rainfall erosion force.