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THE CHARACTERISTICS OF SPATIAL DISTRIBUTION AND TYPES OF APRIL – SEPTEMBER RAINFALL IN THE PEARL RIVER BASIN

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Abstract: With rainfall data of 51 stations in April – September in the Pearl River basin during 1954 – 2003, we have applied the Principal Component Analysis method to research the spatial distribution characteristics of April – September rainfall. The results reveal the following. In the Pearl River basin, there is different precipitation varying from 600 mm to 1900 mm in April – September and precipitation decreases gradually from southeast to northwest. The standard deviation distribution decreases gradually from east to west on the whole. The rainfall distribution of the Pearl River basin has five main types: Type I: there is flood (drought) in the whole region, Type II: there is flood (drought) in the north and drought (flood) in the south, Type III: there is flood (drought) in the east and drought (flood) in the west, Type IV: there id flood (drought) in the central part and drought (flood) in the east and west, and Type V: there is flood (drought) in center and drought (flood) in north and south. The types of the flood (drought) in the whole region and flood (drought) in the north and drought (flood) in the south appear much more than the others, being 64% of the total. From the 10-year moving average, it is seen that rainfall between April and September in the Pearl River basin region is mainly dry in 1983 – 1992, and mainly dry in the east and wet in the west in 1967 – 1971 and wet in the east and dry in the west in 1979.

Key words: principal component analysis; April-September rainfall; characteristics of spatial distribution; Pearl River basin

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1 INTRODUCTION

Being one of the seven main rivers in China, Pearl River has a basin that sees frequent events of drought and flood. There have been a number of studies on the regional distribution characteristics of precipitation over South China, Southwest China and Guangdong and Guangxi [1 – 7], but few in a way that takes the basin as a whole. In this work, the basin of Pearl River is defined to be in a continental area east of 98°E and south 29.6°N, excluding the islands of Hainan and Taiwan. Monthly rainfall data of 51 evenly distributed stations for the Pearl River basin are selected from 160 nationwide stations issued by National Climate Center for the time 1954 – 2003. Primary components are computed using the methods documented in Chen and Xue [8] and Huang [9] to identify its spatial distribution for predicting precipitation over the basin.

2 TYPES OF SPATIAL DISTRIBUTION OF PRECIPITATION IN APRIL – SEPTEMBER OVER PEARL RIVER BASIN

2.1 *Pattern of drought (flood) across the whole basin (Pattern I)*

It is known from the first eigenvectors of the April – September precipitation of the Pearl River basin (Fig.1) that it is positive in most of the region. When the first primary component is positive, most of the basin is anomalously wet and 1973 is a typical year; when it is negative, most of the basin is anomalously dry and 1963 is a typical year. As shown in the running mean curve of the first primary component, it is negative for 1959 – 1968, with anomalously dry distribution across the basin; it is positive for 1969 –

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1980, with anomalously wet distribution across the basin; It is negative for 1981 – 1993, with anomalously dry distribution across the basin; it is positive for the time after 1994, with anomalously wet distribution across the basin. It is significantly negative for 1983 – 1993, which is also accompanying with significantly dry distribution across the basin.

2.2 *Pattern of drought (flood) in the south versus flood (drought) in the north (Pattern II)*

It is known from the second eigenvector of the April – September precipitation of the Pearl River basin (Fig.2) that it is positive in the north but negative in the south. Going generally east-west, the zero contour divides the whole basin into two halves, with the north in the negative zone.

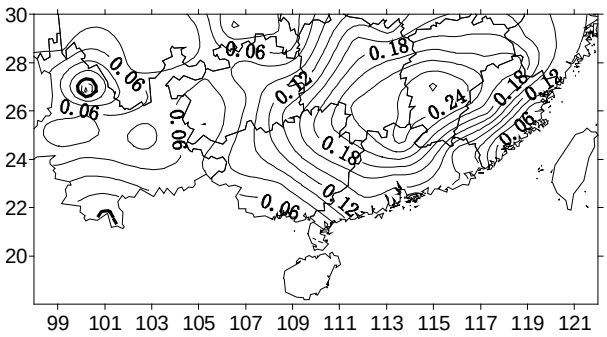

Fig.1 Distribution of the first eigenvector of the April – September precipitation of the Pearl River basin. The ordinate is for the latitude and the abscissa for the latitude.

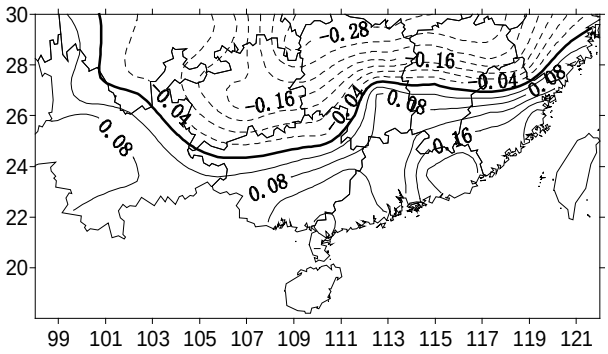

Fig.2 Same as Fig.1 but for the second eigenvector.

When this eigenvector is positive, it is wetter in the south than in the north and 1981 is a typical year; when it is positive, it is drier in the south than in the north and 1977 is a typical year. As shown in the running mean curve of the second primary component, the primary component is mainly negative for the time before 1958, showing a pattern dominated by a dry south versus a wet north; For the time after 1958, however, it is a homogeneous distribution alternating with positive and negative values, with the running mean curve mildly oscillating just around the zero line, displaying alternative appearance of drought in the south and flood in the north versus flood in the south and drought in the north.

2.3 *Pattern of drought (flood) in the east versus flood (drought) in the west (Pattern III)*

It is known from the third eigenvector of the April – September precipitation of the Pearl River basin (Fig.3) that it is negative in the east but positive in the west. The zero contour divides the whole basin into two halves, with the east in the negative zone and the west in the positive zone. The contours generally run in a north-south direction.

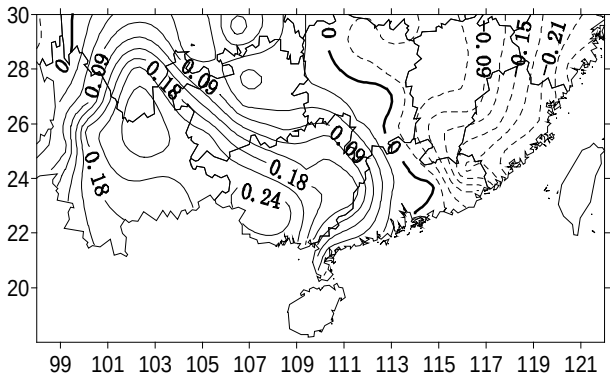

Fig.3 Same as Fig.1 but for the third eigenvector.

When the third primary component is positive, a pattern that is drier in the east than in the west is shown and 1971 is a typical year. When it is negative, a pattern that is wetter in the east than in the west is shown and 1992 is a typical year. As shown in the running mean curve of the third primary component, the primary component is mainly negative for the time before 1963, showing a pattern dominated by a wet east versus a dry west; it is mostly positive for 1964 – 1982, showing a pattern of a wet east versus a dry west; it is mostly negative for 1988 – 1992, showing a pattern of a wet east versus a dry west; and it is mostly positive for the time after 1993, showing a pattern of a dry east versus a wet west. As shown in the running mean, the third component is significantly positive for 1967 – 1971, showing that there is distribution of a dry east versus a wet west, especially so around 1970.

2.4 *Pattern of drought (flood) in the middle versus flood (drought) in the east and west (Pattern IV)*

The fourth primary component is one that is positive in both the east and west but negative in the middle (Fig.4). When the fourth primary is positive, there is a pattern that is drier in the middle than in the east and west and 1990 is a typical year. When it is negative, there is a pattern that is wetter in the middle

than in the east and west and 1979 is a typical year. As shown in the running mean curve of the fourth primary component, the curve for 1972 – 1985 is negative, showing a pattern dominated by a middle part versus dry eastern and western parts, especially so around 1979.

2.5 *Pattern of drought (flood) in the middle versus flood (drought) in the north and south (Pattern V)*

The fifth primary component is one that is generally negative in both the north and south but positive in the middle (Fig.5). When the fifth primary is positive, there is a pattern that is wetter in the middle than in the south and north and 2000 is a typical year. When it is negative, there is a pattern that is drier in the middle than in the east and west and 1965 is a typical year. As shown in the running mean curve of the fifth primary component, there are three positive and negative alternations for 1966, 1981 and 1992 and the years 1985 and 1986 are significantly negative, showing a pattern dominated by a dry middle part versus wet northern and southern parts.

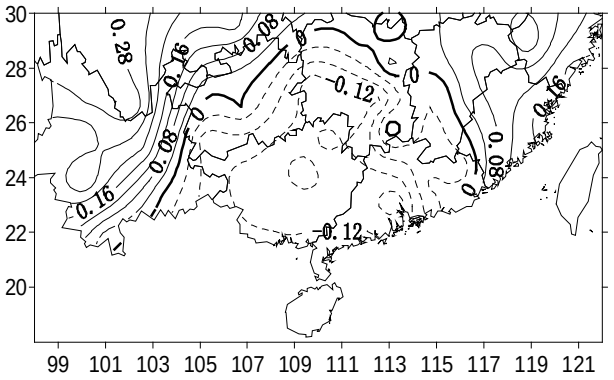

Fig.4 Same as Fig.1 but for the fourth eigenvector.

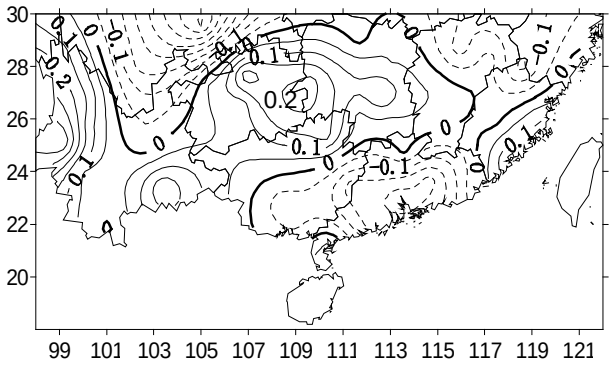

Fig.5 Same as Fig.1 but for the fifth eigenvector.

3 PATTERNS OF PRECIPITATION DISTRIBUTION IN APRIL – SEPTEMBER ACROSS THE BASIN

The April – September distribution is categorized by the magnitude of the primary component. The result shows that over the past 50 years there are a total of seven abnormal floods and three abnormal droughts, four above-average droughts and four above-average floods, on the basin scale. The abnormal floods are more than twice as many as the above-average floods and the frequency is high across the basin for the former to appear, being two times for 1973 – 1975 and three times for 1994 – 2001, respectively. There are two abnormal droughts for 1986 – 1991, which agrees well with the result of the running mean analysis. In general, the Pearl River basin tends to have the patterns in which the flood (drought) is across the whole basin or there is drought (flood) in the south versus flood (drought) in the north, and they take up 64% of the yearly total. Tab.1 gives the number of appearance of individual patterns.

Tab.1 Statistics of appearance of main patterns of April – September precipitation distribution over Pearl River basin for 1954 – 2003

Patterns	I	II	III	IV	V	Sum
Times	18	14	8	6	4	50

For analyses of other aspects, refer to the Chinese edition of the journal.

4 CONCLUSIONS

In summary, there are five main patterns of precipitation distribution in the Pearl River basin from April to September and those of basin-wide flood (drought) and drought (flood) in the south versus flood (drought) in the north take up 64% of the yearly total. Basin-wide abnormal floods appear more than twice as many as basin-wide abnormal droughts. The April – September precipitation field shows significant above-average drought distribution across the basin for 1983 – 1992; a pattern of the east being wetter than the west is more pronounced for 1967 – 1971, that of the middle being wetter than both the east and west is more remarkable for the time around 1979, and that of the north and south being wetter than the middle appears around 1985 – 1986.

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