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ANALYSIS OF MID-SUMMER HIGH TEMPERATURE FREQUENCY ANOMALY IN GUANGZHOU

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Abstract: Using EOF, correlation analysis, the climatic characteristics are analyzed of the yearly high temperature frequency (HTF) in Guangzhou from 1951-2004, and the relationship between the mid-summer (July and August) HTF anomaly and the synchronous 500hPa heights of the region(65 – 150°E, 10 – 70°N) is also discussed. The results show that: (1) the average of HTF is 8.7 days per year in the recent 54 years in Guangzhou; high temperature occurs from May to September, and July and August have the highest frequency of occurrence; (2) there are distinct interannual and interdecadal changes in Guangzhou HTF, with an obvious increase since the 1980s; (3) the anomalous increase of mid-summer HTF in Guangzhou since the 1980s has a close relationship with the weakened westerlies in Northwest China, Mongolia, Lake Baikal and their vicinity and the intensified subtropical high in the mid-low latitude areas.

Key words: high temperature frequency; 500hPa height; correlation

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1 INTRODUCTION

Unusual sustaining high temperature processes occurred in most areas of the southern part of China in 2003-2004, which impacted not only industrial and agricultural activities, water and power supply, but also on people's health. It was reported that the high temperature process resulted in 39 deaths in Guangzhou in 2004. Therefore, on July 29, 2003, Guangzhou Meteorological Observatory began to issue high temperature warning signals to remind people of the disasters induced. In recent years, high temperature has become a hot topic. Relevant research is carried out mainly on the aspect of atmospheric circulations accompanying with high temperature processes[1-4], while seldom on the relationship between high temperature frequency and relevant circulation changes. In this article, studies are conducted of the climatic characteristics of high temperature frequency in Guangzhou and the circulation change in the corresponding period from Jan. 1951 to Dec. 2004, which is expected to support the forecast of high temperature and the issuance of warning signals.

2 CLIMATIC CHARACTERISTICS OF HIGH TEMPERATURE FREQUENCY IN GUANGZHOU

Meteorologically, the daily maximum temperature above 35°C is called "High Temperature".

The average of high temperature frequency in Guangzhou is 8.7 days per year in 54 years. High temperature occurs mainly from May to September, 78.3% of them in July and August. About 72.77% cases of high temperature lie between 35 and 36°C (Tab.1), and only 27.23% of them exceeds 36°C.

Compared with the processes that high temperature lasts for 1 or 2 days, the high temperature events lasting continuously for 3 or more days take up only a small proportion (19.6%)(Fig.1), while the occurrence of them increases dramatically since the 1980s (figure omitted).

There are obvious interannual and interdecadal changes of high temperature frequency in Guangzhou (Fig.2), thereinto, the average of high temperature cases is 8.1 days per year before the 1980s, while it increases to 12.9 days per year after that. In addition, two significant abrupt changes, a decrease in the early 1970s and an increase in the early 1980s, are detected for high temperature frequency in Guangzhou in the 54

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years.

Tab.1 Distribution of high temperature in Guangzhou from 1951 to 2004

Temp.	35°C≤*T*< 36°C	36°C≤*T*< 37°C	37°C≤*T*< 38°C	*T*≥ 38°C
Frequency	342	101	19	8
proportion	72.77%	21.49%	4.04%	1.70%

3 RELATIONSHIP BETWEEN HIGH TEMPERATURE FREQUENCY AND 500hPa HEIGHTS

The relationship between high temperature frequency in Guangzhou and the atmospheric circulations is discussed by use of the July-August averaged 500hPa heights of the region (65-150°E, 10-70°N) in 1951-2003.

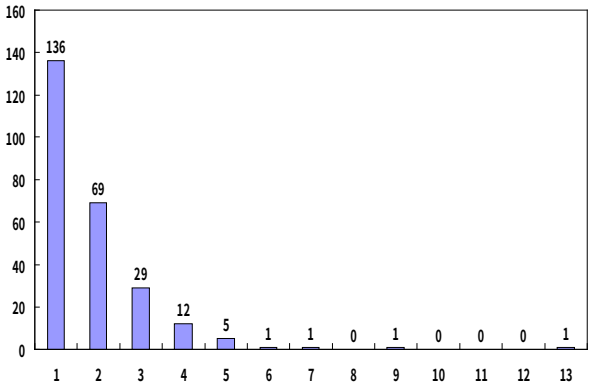

Fig.1 Frequency of sustaining high temperature process in Guangzhou (horizontal coordinate for sustaining number of days, vertical coordinate for number of high temperature process).

3.1 Interannual change of 500hPa heights

According to the EOF of the standardized 500hPa heights, the first eigenvector (Fig.3a) shows the high value areas in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas. And the relevant time coefficient (Fig.3b) tells a significant increasing trend with almost negative values before the late 1970s and positive values after that. Therefore, it is considered that, the 500hPa heights in those regions mentioned above are lower before the 1980s, indicating frequent westerlies activities and a weak western North Pacific subtropical high. Since the 1980s, the distinct increase of 500hPa heights in the regions shows the weakening of the westerlies activities and the intensification and westward stretch of the subtropical high [5-6].

The linear fitting of the first time coefficient indicates a distinct increasing trend (99% significance level) in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas in the recent 53 years. An abrupt change around the year 1979, which is detected by use of M-K method (99% significance level), proves out the significant increase in the regions since the 1980s.

3.2 Relationship between high temperature frequency in Guangzhou and 500hPa heights

The correlation coefficient of 0.459 between the high temperature frequency in Guangzhou and the first time coefficient above, together with the high value areas in the first eigenvector, reveal the close relationship between the anomaly of high temperature frequency in Guangzhou and the 500hPa heights variation in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas.

The distribution of correlation coefficient between high temperature frequency in Guangzhou and the synchronous 500hPa heights (Fig.4) shows that the regions with high correlation coefficient almost overlap that of high value in the first eigenvector in EOF, which also indicates the close relationship between the high temperature frequency in Guangzhou and the 500hPa heights in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas.

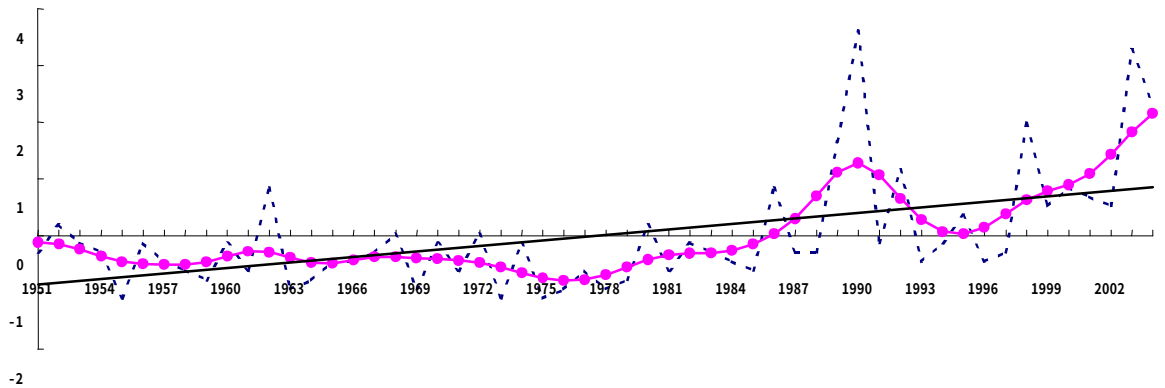

Fig.2 Yearly standardized high temperature frequency (dashed line), 11-year binomial smooth curve (dotted solid line) and fitting line (solid line)

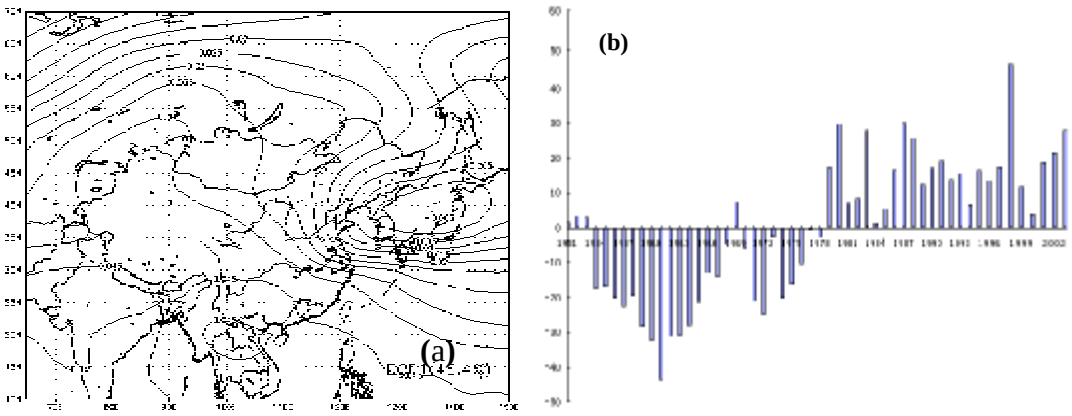

Fig.3 The first eigenvector(a) and the first time coefficient(b) of EOF of 500hPa heights

The increase of 500hPa heights means the weakening of the westerlies system in Northwest China, Mongolia, Lake Baikal and their vicinity and the intensification of western North Pacific subtropical high, which improves the chances of prevalence of the subtropical high over South China. When South China is dominated by the subtropical high, the downward flow always results in the clean sky and strong solar radiation, which is favorable for the occurrence of high temperature without evaporation [7].

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

4 CONCLUSIONS

(1) The average of high temperature is 8.7 days per year in Guangzhou in the recent 54 years. The high temperature process lasting continuously 3 or more days takes up only a small proportion of 19.6%, while the rate increases dramatically after the 1980s. High temperature occurs from May to September, 78.3% of them in July and August.

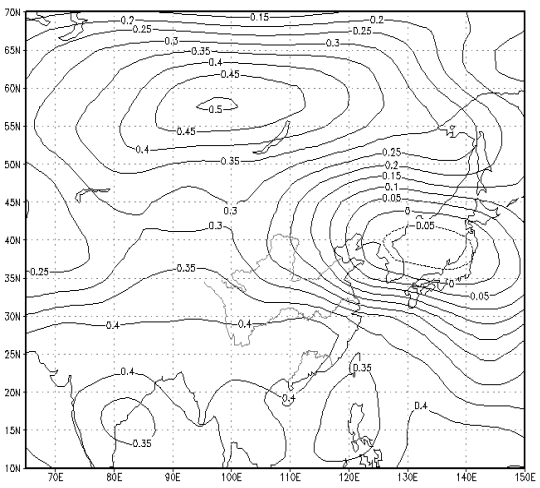

Fig.4 Distribution of correlation coefficient between high temperature frequency in Guangzhou and the synchronous 500hPa heights.

(2) There are obvious interannual and interdecadal changes of high temperature frequency in Guangzhou, with the minimum in 1970s and steady increase since the 1980s, and a significant decrease in the early 1970 and an increase in the early 1980s are detected.

(3) Using EOF of the standardized 500hPa heights, the first eigenvector and the relevant time coefficient show that, there has been a significant increase in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas since the 1980s.

(4) The distribution of correlation coefficient between Guangzhou high temperature frequency and 500hPa heights change, with high values in Northwest China, Mongolia, Lake Baikal and their vicinity and the mid-low latitude areas, shows that the increase of Guangzhou high temperature frequency since the 1980s probably has a close relationship with the weakened westerlies system in the foregoing areas and the intensified subtropical high in Northwestern Pacific.

In addition, human activities are also one of the reasons for climate change[8-9]. Since the 1980s, the deterioration of air quantity and the alteration of underlaying surfaces has been resulted from the fast urbanization in Pearl River Delta, gradual increase of population in cities, the obvious increased emission of greenhouse gases from vehicles and the rapid industrialization, which induced the heat island and greenhouse effects. Therefore, heat island effect is also one probable reason for the significant increase of high temperature frequency.

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