

THE PROCEEDINGS

OF

*THE CHINA ASSOCIATION FOR
SCIENCE AND TECHNOLOGY*

VOL. 5

Edited by

**FENG Changgen LI Shengcai SHEN Aimin
WANG Yajun SU Qing**



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THE PROCEEDINGS OF

THE CHINA ASSOCIATION FOR SCIENCE AND TECHNOLOGY

VOL.5

**Part A: Selected papers presented at the 10th Annual Conference of the China Association for
Science and Technology** (September 17-19, 2008, Zhengzhou, Henan, China)

**Part B: Selected papers published in Chinese journals sponsored by the member societies of the
China Association for Science and Technology**

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Introduction of the Content

This monograph (the Proceedings of the China Association for Science and Technology, Vol.5) collects 19 selected papers presented at the 10th Annual Conference of China Association for Science and Technology, Zhengzhou, Henan, September 17-19, 2008, and 74 selected papers published in Chinese journals sponsored by the member societies of the China Association for Science and Technology. These papers cover the following aspects: Mechanics, Chemistry and Chemical Engineering, Electrics and Communication, Biology, Agricultural Science, Forestry, Ecology, Medicine and Pharmacology, Environmental Science and Technology, Safety Science and Technology, and Miscellaneous. Many novel research results on these fields achieved during the last few years are mentioned in the Proceedings.

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Preface

To enlarge the service and influence of the Chinese scientific papers to the researchers and other users of the English-language world and promote the international exchange between Chinese and foreign scientists, the English-language Proceedings (the Proceedings of the China Association for Science and Technology) has been inaugurated in series since 2004. Collected in this volume are 93 English papers selected from the 10th Annual Conference of the China Association for Science and Technology held in Zhengzhou, Henan, China, September 17-19, 2008, and the Chinese journals which are sponsored by the 170 member societies (their names are listed in the back of this Proceedings) of the China Association for Science and Technology.

The Annual Conference of the China Association for Science and Technology has entered its tenth one since 1999. It is gratifying that the ten annual conferences have won the high recognition of the Chinese government and the scholars from home and abroad. The Conferences provide a forum for the open exchange of information and ideas in the fields of science and technology.

The papers cover the following aspects: Mechanics, Chemistry and Chemical Engineering, Electrics and Communication, Biology, Agricultural Science, Forestry, Ecology, Medicine and Pharmacology, Environmental Science and Technology, Safety Science and Technology, and Miscellaneous.

It is sincerely hoped that, as a consequence of this conference, the academic exchange between specialists and scholars would be continued and strengthened.

In addition, we greatly appreciate the authors for providing the excellent papers describing their latest achievements in their researches.

The Editors
December, 2008
Beijing, China

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Part A

**Selected papers presented at the 10th Annual Conference of the China
Association for Science and Technology
(September 17-19, 2008, Zhengzhou, Henan, China)**

Abnormal Variations of Meteorological Elements

Before Earthquakes in Chongqing

HAN Shigang

(Chongqing Meteorological Administration, Chongqing 401147, China)

Abstract: The paper introduces four great earthquakes in Chongqing which respectively happened in Small Nanhai on June 10 in 1856, Yubei Tongjing on November 20 in 1989, Rongchang Xuxi on August 13 in 1997, and Rongchang Town on August 17 in 1999. And then this paper studies the abnormal meteorological elements before these three earthquakes according to the study of the relationship between drought and earthquake and the study on the 5 abnormal indexes of meteorological elements which are daily average air pressure, daily average temperature, daily maximum temperature, daily minimum temperature and daily precipitation before earthquakes, and draws a conclusion: there is only one fault, which is not large, in Chongqing and main fault zones are distributed in Huaying Mountain, Yao Mountain, Jinfo Mountain and Changshou, Zunyi, Guizhou province; the width and depth of this fault zone is not large compared with other fault zones in China, and the earthquakes of Ms5 and above happens on this fault occasionally in Chongqing; the indexes of the relationship between drought and earthquake are not fit for Chongqing because the earthquake magnitude of Chongqing is not strong and dry weather is frequent in Chongqing. But before earthquakes, there were some slight changes in annual average temperature; the earthquakes of Chongqing are basically fit for the five abnormal indexes of meteorological elements before earthquakes. According to the five abnormal indexes of meteorological elements before earthquake, weather system and earthquake system can work together to establish an earthquake warning system basic on abnormal meteorological elements in some domestic areas where large earthquakes are likely to happen.

Keywords: Chongqing earthquakes; abnormal meteorological elements; earthquake warning system

1 Introduction

Chongqing is located on the eastern edge of Sichuan basin and the crust is made of hard granites. Chongqing never happened very large earthquake (\geq Ms7) in history, but there were 4 earthquakes of Ms5 and above in modern times. According to study, there are obvious abnormal changes in meteorological elements before earthquakes^[1-3]. This paper is going to study and analyze the abnormal changes in meteorological elements before earthquakes of Ms5 and above Ms5 according to the information of the earthquakes in Chongqing.

2 Introduction of Chongqing Earthquakes

From Table 1, Chongqing has no very large earthquake (\geq Ms7) in recent history. There was only one small fault. The main fault zones are distributed in Huaying Mountain, Seven Yao Mountain, Jinfo Mountain of Chongqing and Changshou, Zunyi of Guizhou province. The width and depth of this fault zone is not very large compared with others in China. Affected by the fault, Chongqing happened only 4 earthquakes of Ms5 and above Ms5 which respectively happened in Small Nanhai on June 10 in 1856 at Ms6.25, Tongjing, Yubei district on November 20 in 1989 at Ms5.2 and Ms5.4 (double earthquakes), Xuxi, Rongchang Town on August 13 in 1997 at Ms5.2, and Rongchang Town on August 17 in 1999 at Ms5.0.

The earthquake of Small Nanhai happened more than a hundred years ago. According to the record in “Qian Jiang Xian Zhi” published in the twentieth year in the Guang Xu Period of Qing Dynasty, there were signs a few days before earthquake—“for several days, sunshine became dull and stream rose from the earth”. In the sixth year in the Xian Feng Period of Qing Dynasty, on May 8 in 1856, lunar calendar (June 10 in 1856, solar calendar), at about 11 o'clock, suddenly a thunder-like sound came; constructions were shaking and going to collapse, tiles were falling down and big waves were created in pools. Tragedy came upon, stones burst forth and flied around to attack people and tens of people's houses collapsed. After then, Yansai Lake became present beautiful condition. This earthquake is the largest one in the recent history of Chongqing. Due to lack of detailed enough information of weather, this paper won't discuss it in detail. On November 20 in 1989, an earthquake broke out in Tongjing,

Yubei district at Ms5.2 and Ms5.4 (double earthquakes) with epicenter 500 meters west to Tongjing Chang and the intensity of epicenter was VII degree. In this earthquake, many houses collapsed, roads were interrupted, bridges cracked, 3 people lost their life and about 150 people were wounded, and caused huge loss in economy. This earthquake caused landslides, crated many hot springs and brought great changes to the geological environment of Tongjing^[4].

On August 13 in 1997, an Ms5.2 earthquake happened in Xuxi, Rongchang town. Before that, there was no record of the earthquake above Ms5.0 in history. After then, earthquake clustering of above Ms4.0 happened in Rongchang district and the earthquake above Ms4.0 happened every year until the last Ms4.0 earthquake of April 21st in 2003. After that, seismic activity gradually slowed down^[5]. On August 13th in 1997, an Ms5.2 earthquake broke out in Rongchang town with high population density. This earthquake was located in south of Sichuan basin, and seismic source was about 8 km, and epicentral intensity was VII, and macroscopic epicenter was located in the area of Xuxi and Guang Shun Xiang, Rongchang town. Main seismic damages were represented as incompact tiles, collapsed chimneys and cracks on the wall, etc^[6]. Not long after that, on August 17 in 1999, another Ms5.0 earthquake broken out in Rongchang, Rongchang city with intensity VI and caused certain damage this time. (Fig.1)

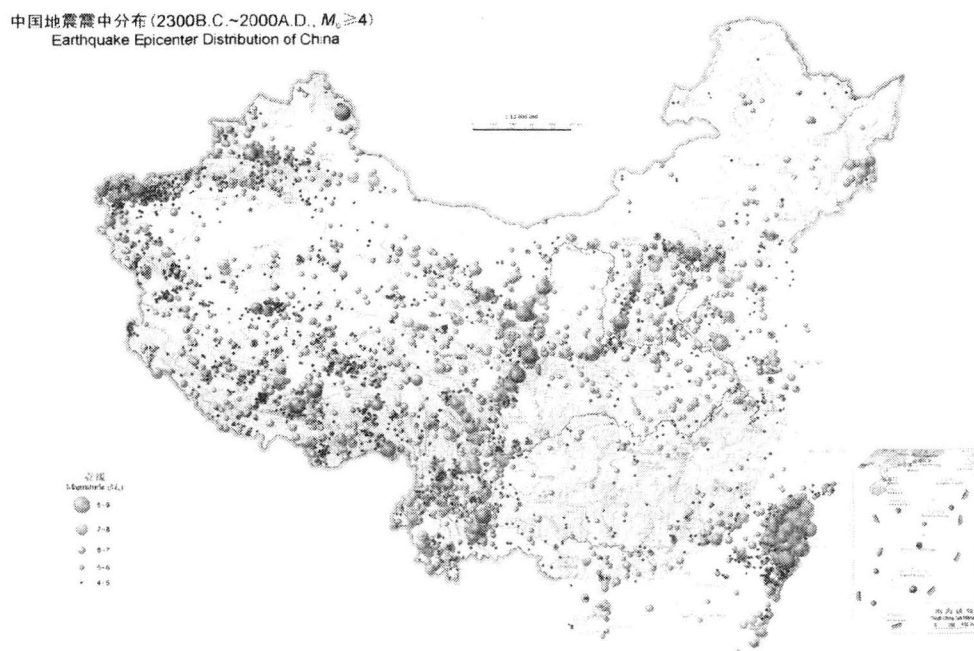


Fig.1 Earthquake epicenter distribution of China

3 Changes of Average Temperature Before Chongqing Earthquakes

China has made outstanding achievements in the study of the relationship between drought and earthquake^[7], middle-term drought-flood anomalies before large earthquake^[8] and the forecast of earthquake. The magnitude of Chongqing earthquakes is small and drought often happens in Chongqing, almost every year. Given a decade for example, Chongqing would have been in droughts for 8 years, so the relationship between weather and earthquake is not obvious. But through analysis, we can still discover slight changes in average annual temperature before earthquake. Table 1 shows that in the two years before Tongjing earthquake in 1989, the average annual temperature of Yubei district suddenly increased by 0.2 °C, average annual temperature in the two years before Rongchang earthquake in 1997 increased by 0.1 °C, and the average temperature in the three years before earthquake also suddenly increased by 0.5 °C, average annual temperature in the two years before Rongchang earthquake in 1999 increased by 0.3 °C. Through analysis, we find average temperature rose obviously in the two or three years before Chongqing earthquakes of Ms5.0 or above. But this theory is not true when it is reversed. It

means we can't say the rise in average temperature is the sign of earthquake in the next two or three years. While average temperature is lower than a common value in many years, if the average temperature suddenly turned to be higher than the common value in one year, this would be the sign we must pay attention to and it would be probable to have the earthquake of Ms5.0 or above in the next two or three years. This is one of the features of the changes in average temperature before Chongqing earthquake.

Table 1 Average temperature of Yubei and Rongchang

Year	Yubei			Year	Rongchang		
	Average temperature /°C	Normal temperature /°C	Anomaly departure/°C		Average temperature /°C	Normal temperature /°C	Anomaly departure/°C
1981	16.8	17.1	- 0.2	1991	17.4	17.5	- 0.1
1982	16.5	17.1	- 0.6	1992	17.2	17.5	- 0.3
1983	16.9	17.1	- 0.2	1993	17.1	17.5	- 0.4
1984	16.6	17.1	- 0.3	1994	18.0	17.5	+ 0.5
1985	16.8	17.1	- 0.3	1995	17.6	17.5	+ 0.1
1986	16.6	17.1	- 0.5	1996	16.9	17.5	- 0.6
1987	17.3	17.1	+ 0.2	1997	17.8	17.5	+ 0.3
1988	16.9	17.1	- 0.2	1998	18.5	17.5	+ 1.0
1989	16.5	17.1	- 0.6	1999	17.8	17.5	+ 0.3

4 Analysis on Short-term Abnormal Meteorological Elements Before Chongqing Earthquake

4.1 Five Abnormal Indexes of Short-term Meteorological Elements Before Earthquakes

The abnormality of five indexes of short-term meteorological elements before earthquakes is the concept put forward by our famous seismologist Mr. Geng Qingguo basic on his many years' study. This theory points out that within one month before a large earthquake (\geq Ms5.0), five meteorological elements are abnormal, which are daily average air pressure, daily average temperature, daily maximum temperature, daily minimum temperature and daily precipitation^[9]. Its feature is that within the 30 days before an impending earthquake, compared with the meteorological elements on the same day over past 20 years, the meteorological elements before an impending earthquake successively have low pressure, high temperature (or low temperature) and a large amount of precipitation. That means daily average pressure reaches the minimum value of average pressures on the same day over past years; daily average temperature, daily maximum temperature and daily minimum temperature separately reaches the extremum of the maximum temperatures and minimum temperatures on the same days over past years, and daily precipitation (snowfall) reaches the maximum value of the daily precipitations (snowfalls) on the same days over past years.

The analysis on short-term abnormal meteorological elements should pay attention to by following items^[9]: firstly, at least 20 years or longer related weather records are needed and the analysis on the records of less than 20 years is not stable. Secondly, it must be the comparison among the same kind meteorological elements of the same time and same date in past years, and the data of different kinds of elements of different date is not comparable. Thirdly, from the day when the first index is found abnormal to the day when five indexes are found abnormal, and to the day when Ms5.0 and above earthquake happens, the whole process shouldn't be longer than 30 days. Fourthly, the abnormality of five indexes is only a necessary condition for a short-time impending earthquake, not a sufficient condition nor a necessary and sufficient condition. The accuracy using this way to forecast earthquake is only about 20% and there will be many false alarms. We need to integrate many kinds of forecasts methods by analyzing all kinds of signs to improve the accuracy of earthquake forecast.

4.2 Analysis on the Five Abnormal Indexes of Meteorological Elements Before Chongqing Earthquake

Table 2 shows that the Ms5.2 and Ms5.4 earthquakes (double earthquake), which happened in Tongjin,

Yubei district on November 20th in 1989, doesn't meet all the five abnormal indexes of meteorological elements before earthquake. As for air pressure, from November 2nd to November 4 in daily average air pressure is lower than other average air pressures on the same days over the past years; but through statistics, daily maximum temperature and daily average temperature don't reach the extremum on the same day over past years; daily minimum temperature is 17.4 °C on November 1st and reaches the extremum on same day over past years. Daily precipitation is 10.9 mm on November 13 in the maximum value on the same day over past years. We can see that the pressure, minimum temperature and precipitation meet judging conditions, but average daily temperature and daily maximum temperature don't meet conditions. The distance between Tongjing weather station and Yubei weather station is great, and Tongjing weather station is located at the top of mountain, and Yubei weather station is at the foot of mountain, and the difference of altitudes between these two places reaches as many as a few hundred meters, and temperature difference between two places reaches a few degree. These two factors are maybe the reason why average daily temperature and daily maximum temperature fail to meet the conditions of abnormal meteorological elements of short-term impending earthquake.

Table 2 Analysis on the five abnormal indexes of meteorological elements before Chongqing earthquake

Earthquake	Pressure /hPa	Average temperature /°C	High temperature /°C	Low temperature /°C	Precipitations /mm
Yubei Tongjin	959.7–1989.11.2★				
Ms5.2 and Ms 5.4 on 1989.11.20	959.1–1989.11.3★ 959.6–1989.11.4★	–	–	17.4–1989.11.1▲	10.9–1989.11.13▲
1997.8.13	959.7–1997.8.4★		26.5–1997.7.15★		
RongchangXuxi Ms 5.2	958.7–1997.8.5★	32.3–1997.8.6▲	27.7–1997.7.18★	27.6–1997.8.5▲	54.5–1997.7.14▲
	962.1–1999.8.7★	19.9–1999.7.19★			
1999.8.17	960.9–1999.8.8★	22.3–1999.7.22★	24.5–1999.7.22★		
Rongchang Ms 5.0	962.2–1999.8.13★	23.9–1999.7.23★ 21.3–1999.7.24★	25.7–1999.8.4★	20.7–1999.7.22★	46.6–1999.7.23▲

Note: ★ is the minimal data, ▲ is the maximal data.

On August 13th in 1997, an Ms5.2 earthquake happened in Xuxi, Rongchang. Within the month before earthquake, five meteorological elements successively represented abnormity, which met the conditions of abnormal meteorological elements of short-term impending earthquake. As for air pressure, from August 4th to August 5 in the pressure reached the minimum value of daily average pressures on the same day over past years; daily average temperature reached 32.3 °C on August 6 in the maximum value of daily average temperature on the same day over past years; daily maximum temperature reached 26.5 °C on July 15th and 27.7 °C on July 18 in and they reached the minimum value among the maximum temperatures on the same day over past years; daily minimum temperature reached 27.6 °C on August 5 in the maximum value among the minimum temperatures on the same day over past years. Daily precipitation reached 54.5 mm on July 14 in the maximum value of the precipitation on the same day over past years.

On August 17th in 1999, an Ms5.0 earthquake happened in Rongchang town. Five meteorological elements successively represented abnormity in the month before earthquake, which met the conditions of abnormal meteorological elements of short-term impending earthquake. As for air pressure, from August 7th to August 8 in daily average pressure reached the minimum value of the average pressures on the same days over past years, and it reached extremum again on August 13 in 5 days later; daily average temperature was 19.9 °C on July 19 in the

minimum value of average temperatures on the same day over past years, and it reached minimum value 3 days later on July 22nd, 23rd and 24th; daily maximum temperature reached 24.5 °C on July 22nd, the minimum value of maximum temperatures on the same day over past years. It reached maximum value again on August 4th; daily minimum temperature reached 20.7 °C on July 22nd, the minimum value of minimum temperatures on the same day over past years; Daily precipitation reached 46.6 mm on July 23rd, the maximum value of the precipitations on the same days over past years.

5 Assumption of Building Earthquake Warning System Basic on Abnormal Meteorological Elements Before Earthquake

Through the above analysis, some meteorological elements are obviously abnormal before earthquake. This theory has provided foundation for the earthquake warning system basic on the signs before earthquake. Now China has set up a perfect weather observation network which possesses the weather records of past 20 years and longer. Weather system and earthquake system can work together to establish an earthquake warning system basic on abnormal meteorological elements in some domestic areas where large earthquakes are likely to happen. Computers will be applied to deal with the weather records of each station to sort out the stations which meet the conditions of five abnormal indexes of meteorological elements before earthquake, and then analyze other records of signs before earthquake to make earthquake forecasts, which can large improve the accuracy of earthquake forecasts of our country.

6 Conclusions

1) There is only one fault, which is not large, in Chongqing and main fault zone are distributed from Huaying Mountain, Yao Mountain, Jinpo Mountain in Chongqing to Changshou and Zunyi in Guizhou province; the width and depth of this fault zone is not large compared with other fault zones in China, and the earthquakes of Ms5 and above happens on this fault occasionally in Chongqing.

2) The indexes of the relationship between drought and earthquake are not fit for Chongqing because the earthquake magnitude of Chongqing is not strong and dry weather is frequent in Chongqing. But before earthquakes, there were some slight changes in Annual average temperature;

3) Chongqing earthquakes basically meet the conditions of five abnormal indexes of meteorological elements before short-term impending earthquake. According to these indexes, Weather system and earthquake system can work together to establish an earthquake warning system basic on abnormal meteorological elements in some domestic areas where large earthquakes are likely to happen.

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