ADVANCES IN CLIMATE CHANGE RESEARCH 4(2): 110–116, 2013
www.climatechange.cn
DOI: 10.3724/SP.J.1248.2013.110

CHANGES IN CLIMATE SYSTEM

Trends of Extreme Flood Events in the Pearl River Basin during 1951–2010

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Abstract

The study investigated the trend of extreme flood events in the Pearl River basin during 1951–2010. Stream flow data at 23 gauging stations were used for the study. The Pearson type III distribution was selected for the flood frequency analysis. Results indicate that extreme flood events increase significantly in the Pearl River Basin since 1980. At the 23 gauging stations, there are 16 (70%) stations show positive (increasing) trends in 1981–2010. Most of the 16 stations are located along the West River and North River. While 7 (30%) stations show negative (decreasing) trends, and are found in the East River and the southeast region of the West River Basin.

Keywords: flood; trend; climate change; Pearl River Basin

Citation: Wu, Z.-Y., G.-H. Lu, Z.-Y. Liu, et al., 2013: Trends of extreme flood events in the Pearl River Basin during 1951–2010. *Adv. Clim. Change Res.*, **4**(2), doi: 10.3724/SP.J.1248.2013.110.

1 Introduction

Global warming in recent decades is unequivocal, as is now evident from observations of increases in global mean surface air temperatures, widespread melting of snow and ice, and rising global sea level [*IPCC*, 2007]. Observed warming over several decades has been linked to changes in the large-scale hydrological cycle [*Bates et al.*, 2008]. In the last 20 years, floods are becoming more severe or more frequent in China (e.g., Yangtze River flood in 1991, Pearl River flood in 1994 and 1996, Haihe River flood in 1996, Minjiang River flood in 1998, Hanjiang River flood in 2003 and 2005, Huaihe River flood in 2003, 2005 and 2007), which has led to losses of about 1.5% of the gross domestic product (GDP).

The effect of extreme hydro-meteorological events caused by climate change is a public issue. Recently, the IPCC has released a special report [*IPCC*, 2012], which focused on the relationship between climate change and extreme weather and climate events, the impacts of such events, and the strategies to manage the associated risks. This report provides a careful assessment of the newest scientific, technical, and socioeconomic findings in this field. As there are great uncertainties in predicting precipitation changes in general circulation models, it is still difficult to reasonably evaluate the influence of climate change on extreme precipitation and floods [*Guo*, 1995; *IPCC*, 2012]. Thus, most of current researches focus on the detection of trends, periods and change in river flow series based on observed data [*Kundzewicz et al.*, 2005;

Received: 28 January 2013
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Cunderlik and Ouarda, 2009; *Xu et al.*, 2009]. However, only few studies on trends in flood magnitude and frequency can be found [*Collins*, 2009]. Therefore, this study is mainly to investigate the trends in the magnitude of extreme flood events using long-term stream flow records in the Pearl River Basin.

2 Data and methodology

2.1 *Study region*

The Pearl River is the second largest river (in terms of stream flow magnitude) in China with three major tributaries: West River, North River and East River. The Pearl River Basin is located in the tropical and sub-tropical climate zone with annual mean temperatures ranging from 14°C to 22°C and annual mean precipitation ranging from 800 mm to 2,500 mm. Precipitation during April–September accounts for 70%–80% of the annual total amount. Influenced by the southwest monsoon, its geographic location and landform, flood disasters happened frequently in this basin in the past. Since 1990, extreme floods have successively occurred (in the whole basin in June 1994, the Liujiang River in July 1996, and the West River in June 1998 and June 2005) [*She and Xie*, 2007], which have a seriously negative impact on the regional social and economic development.

2.2 *Data*

Daily stream flow data at 23 gauge stations in 1951–2010 were obtained from the Information Center of the Ministry of Water Resources. Figure 1 shows the geographic distribution of the 23 stations in the Pearl River Basin. Of all the stations, 16 are located along the West River, 3 along the North River, 2 along the East River, and 2 are found in the eastern region of Guangdong province and the southern region of Guangxi autonomous region. There are 4 stations controlling a catchment area of more than 100,000 km^2, 13 stations covering catchment areas between 10,000 and 100,000 km^2 and 6 stations with a catchment area less than 10,000 km^2.

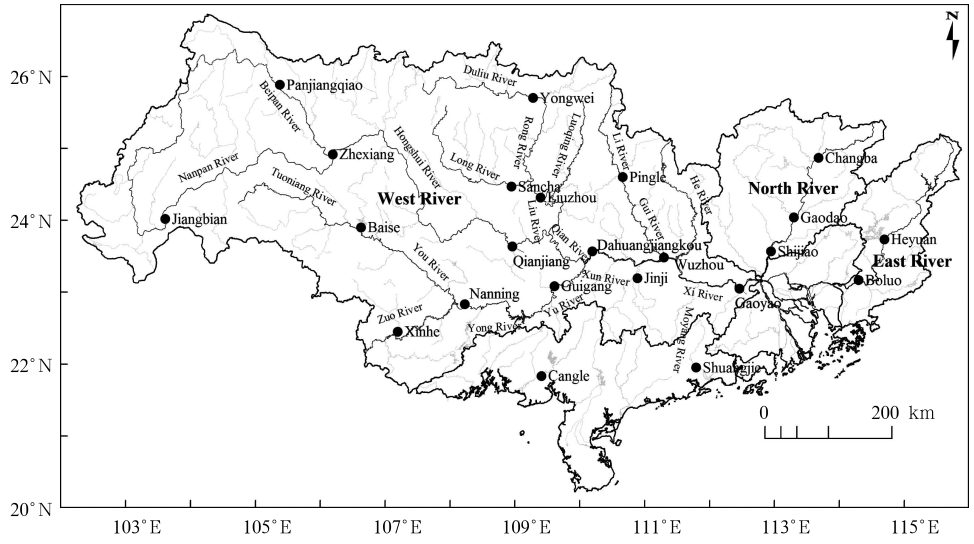

Figure 1 Geographic distribution of the 23 gauging stations in the Pearl River Basin

Meteorological data are obtained from the daily climate database with 752 basic meteorological stations nationwide from 1951 to 2010, collected from the China Surface Climate Daily Value Set on China Meteorological Data Sharing Service System (http://cdc.cma.gov.cn/index.jsp). We used the data of 89 meteorological stations located in the Pearl River Basin and nearby to calculate the annual mean temperature and precipitation during 1951–2010. Figure 2 shows that the annual mean temperature has an increasing trend during 1951–2010 and becomes significantly higher after the mid-1980s. For the annual