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SPECIAL TOPIC ON REGIONAL CLIMATE CHANGE

Analysis on Changes of Basic Climatic Elements and Extreme Events in Xinjiang, China during 1961–2010

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Abstract

By using the observation data from 89 weather stations in Xinjiang during 1961–2010, this paper analyzed the basic climatic elements including temperature, precipitation, wind speed, sunshine duration, water vapor pressure, and dust storm in the entire Xinjiang and the subareas: North Xinjiang, Tianshan Mountains, and South Xinjiang. The results indicate that from 1961 to 2010 the annual and seasonal mean temperatures in the entire Xinjiang show an increasing trend with the increasing rate rising from south to north. The increasing rate of annual mean minimum temperature is over twice more than that of the annual mean maximum temperature, contributing much to the increase in the annual averages. The magnitude of the decrease rate of low-temperature days is larger than the increase rate of high-temperature days. The increase of warm days and warm nights and the decrease of cold days and cold nights further reveal that the temperature increasing in Xinjiang is higher. In addition, annual and seasonal rainfalls have been increasing. South Xinjiang experiences higher increase in rainfall amounts than North Xinjiang and Tianshan Mountains. Annual rainy days, longest consecutive rainy days, the daily maximum precipitation and extreme precipitation events, annual torrential rain days and amount, annual blizzard days and amount, all show an increasing trend, corresponding to the increasing in annual mean water vapor pressure. This result shows that the humidity has increased with temperature increasing in the past 50 years. The decrease in annual mean wind speed and gale days lessen the impact of dust storm, sandstorm, and floating dust events. The increase in annual rainy days is the cause of the decrease in annual sunshine duration, while the increase in spring sunshine duration corresponds with the decrease in dust weather. Therefore, the increase in precipitation indicators, the decrease in gales and dust weather, and the increasing in sunshine duration in spring will be beneficial to crops growth.

Keywords: Xinjiang; temperature; precipitation; dust storm; extreme climate event

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1 Introduction

The IPCC AR4 pointed out that in the past 100 years the global climate has been experiencing significant changes characterized by global warming [*IPCC*, 2007]. This warming has also been observed in China [*ECSNARCC*, 2011]. In the past 50 years, the climate in the northwestern China has turned from dry and

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warm to wet and warmer [*Xu*, 1997; *Shi et al.*, 2002; 2003; *Li et al.*, 2003; *Song and Zhang*, 2003; *Yu et al.*, 2003; *Zhang and Shi*, 2002; *Yang*, 2003; *Hu et al.*, 2002]. Especially in Xinjiang a strong change has taken place [*Zhao*, 2006]. Due to its unique geographical position and vulnerable ecological environment, Xinjiang is very sensitive to climate change [*Hu et al.*, 2001]. *Shi* [2003] pointed out that the climate in Xinjiang changed abruptly in 1987 and in most areas obvious climate changes have been observed except in the Taklimakan Desert. By using the latest meteorological data, this paper analyze the spatial and temporal characteristics of climate changes in Xinjiang to provide references for the development in society, economy, agriculture, ecological environment, etc.

2 Data and methods

The data used in this paper are from quality-controlled observations of 89 weather stations in Xinjiang from 1961 to 2010, including daily mean temperature, maximum temperature, minimum temperature, precipitation, mean wind speed, sunshine duration, and water vapor pressure. The time period for daily precipitation is from last 8:00 pm to 8:00 pm. The entire Xinjiang encompasses all the selected stations. North Xinjiang, Tianshan Mountains, and South Xinjiang refer to the stations marked in Figure 1.

The average value for one element is the arithmetic average of all weather stations inside the region. The average value of 1971–2000 is taken as the reference mean value. One year refers to the 12 months from January to December; spring is from March to May, summer from June to August, autumn from September to November, and winter from last December to February. Annual blizzard days and blizzard amounts refer to the days and amounts accumulated from July to next June.

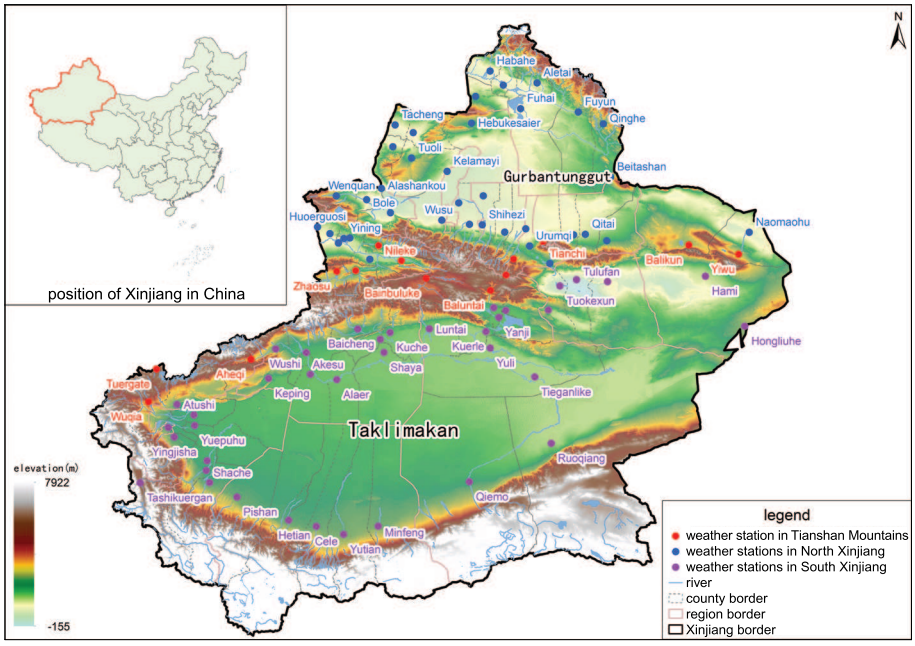

Figure 1 Distribution of 89 meteorological stations in Xinjiang

3 Trends in temperature

3.1 *Mean temperature*

During 1961–2010, the annual mean temperatures in Xinjiang and the subareas (North Xinjiang, Tianshan Mountains and South Xinjiang) show a significant increasing trend with a rate of 0.32°C per decade (0.37, 0.34 and 0.26°C per decade respectively), which is higher than the global rising rate of 0.13°C per decade [*IPCC*, 2007] and the rate of 0.22°C per decade over whole China for the same period [*ECSNARCC*,