CHANGES OF CLIMATE EXTREMES IN CHINA

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Abstract. Changes in China’s temperature and precipitation extremes have been studied by using observational data after 1950. The results reveal that mean minimum temperature has increased significantly in China during the past 40 years, especially in the winter in northern China. Meanwhile, nation-wide cold wave activity has weakened and the frequency of cold days in northern China has been reduced significantly. Mean maximum temperatures display no statistically significant trend for China as a whole. However, decreasing summer mean maximum temperatures are obvious in eastern China, where the number of hot days has been reduced. Seasonal 1-day extreme maximum temperatures mainly reflect decreasing trends, while seasonal 1-day extreme minimum temperatures are increasing.

A statistically significant reduction of much above normal rain days in China has been detected. Contrarily, an increasing trend was detected in much above normal of precipitation intensity (precipitation/number of precipitation days) during the past 45 years.

1. Introduction

China is strongly influenced by the East Asian monsoon. During the winter-half year (Oct.-Mar.), the climate is mainly cold and dry. Cold waves, strong winds and low temperatures are the major extreme climate events. During summer period, the rain belt moves gradually from the south to the north. The climate in eastern China is hot and humid. Large precipitation variability is one of the major features of the East Asian summer monsoon climate. In some years, rainfalls are abundant enough to cause flood, while in other years they are too deficit to support agriculture. Drought and flood are outstanding climate issues of concern to both the Chinese government and general public.

Previous studies on climate change have focused on mean temperature and total precipitation, yet climate extremes can result in severe social economic disasters. We have less information about how they varied or changed. Using several indicators of climate extremes, this study focuses on their changes using China’s meteorological records. Changes are assessed through an examination of linear trends in climate extremes.

2. Data Source and Methods

2.1. DATA SOURCE

Several long-term meteorological data sets were used in this study. Monthly statistics were derived from a meteorological data set that consists of 369 Chinese observation stations. They have very good spatial coverage over mainland China. The data period is from 1951 through 1995. It includes variables such as monthly precipitation totals, mean maximum and minimum temperatures, monthly extreme maximum and minimum temperatures, and other variables. Monthly precipitation totals served as cross-check for the daily precipitation for many stations. Possible biases caused by station relocations or by the influence of urban heat island were minimized by examining changes of station latitudes and longitudes, and the population of the observation cities. Random errors were also controlled by analyzing the spatial consistency of anomalies as by (Zhai and Ren, 1997). After rejecting 121 stations with poor data quality, 248 stations were used in this study.

Investigation of changes of extreme precipitation requires short-time scale data. A primary Chinese data set was used, which contains daily precipitation and temperature observations. This data set includes data from 196 Chinese stations during the period from 1951 through 1995.

Precipitation data from many stations were found incomplete. Moreover, the spatial coverage is not adequate in western China. Therefore, another daily precipitation data set with 321 stations was added. After removal of the duplicates, 361 stations remained. Karl et al. (1995) indicated that time dependent missing daily data can bias precipitation trend analyses if assumed to zero or at the daily average of the month. For handling missing data, the following procedure was used: if there were more than 20 days of precipitation data missing during a year, the statistics of that year were assumed missing. Stations were rejected with more than 5 years of random missing or 3 years of consecutive missing data. Exceptions were made for very limited station data in the Tibetan Plateau. Missing data was more serious here, but it usually happened in dry season. This should not be expected to introduce important biases to trends of our study. Stations with significant relocations or in the regions with high population density network were also rejected. To ensure the quality of daily precipitation data, annual precipitation totals for all the stations were generated and were cross-checked with those reported from other data sets. Through the above considerations, 296 stations of daily precipitation in China were finally selected in this study. Small amounts of random missing data should not introduce important biases in trends especially since data are used to generate the indicators in large regions that consist of many stations. All the stations selected in the study are plotted in Figure 1.