

Effect of urbanization on local climate in Changzhou City in recent 60 years

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Abstract: Based on the meteorological data from the weather stations of Changzhou for the period 1952-2011 and the statistical yearbook, the change trends of the mean temperature, min-mean temperature, max-mean temperature and precipitation of Changzhou are analyzed. Then the data about the development of the city such as the population, ecology, arable land and build-up area are analyzed. The results show that: the effect of urbanization on temperature is more obvious. The differences between gross production, arable land at the end of year, build-up area, road area at the end of year and temperature are highly significant. Through analyzing the trend of climate change and the data of urbanization over the past 60 years in Changzhou, the effects of the rapid development of urbanization on local climate change are noticeable.

Keywords: Changzhou; urbanization; climatic effect

1 Introduction

The IPCC Fourth Assessment Report 2007 states that human activities are likely to be the main cause of global warming. This possibility is above 90%. Currently there are a large number of studies about the impact of urbanization on local climate. Wei et al preliminary revealed the impact and variation of urbanization of Nanchang on local climate by analyzing the characteristics of climatic factors of Nanchang during 1971-1979 such as annual temperature, wind, precipitation, solar radiation and so on. Ji et al studied the effects of urbanization on temperature of cities along the Yangtze River downstream such as Anqing, Wuhu and Nanjing. The results show that: the

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Lake (41375160), evaluation of solar energy resources and the related studies of efficiency and effectiveness of photovoltaic (1213013) and effect of urbanization on climate change—a case study of Yangtze River delta (2010JDXM027).

development of medium-sized cities is rapid in recent decades. As the economy growing and the rate and intensity of consumption of resources and energy increasing, the annual average maximum temperatures of these cities are also rising. Yin et al identified that urbanization in Shanghai was speeding up and the local climate characteristics were changing, particularly the significant changes in precipitation, by studying the effects of urbanization on rainfall in Shanghai.

With the development of urbanization, the original natural surface is substituted by the intensive buildings, industrial areas and road blocks and viaducts. Thus, urbanization is a place where the intervention of human activities on the natural environment is the most intense and the change in the natural environment is greatest. Urbanization has an important impact on local climate.

2 Data

2.1 Meteorological data

This paper analyzed the year and month data of mean temperature, mean minimum temperature, mean maximum temperature and precipitation from the weather stations of Changzhou during 1952-2011.

2.2 Urban development data

Urbanization is a subject which refers to study the changes of urban population, architecture and urban land use in a period of time. According to the Changzhou 60 years statistical data, selecting 1952-2011 Changzhou data of total population, GDP, industrial production and arable land as the urban development data and combining with meteorological data, the effects of urbanization on local climate are analyzed.

2.3 Methods

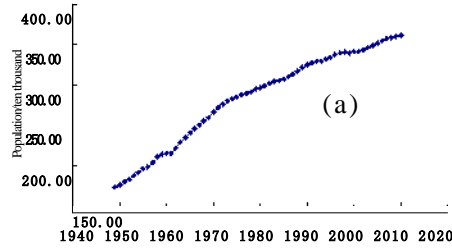
Using the moving-average method, five-year moving average value is researched. Correlation analysis is performed with SPSS software.

3 Results

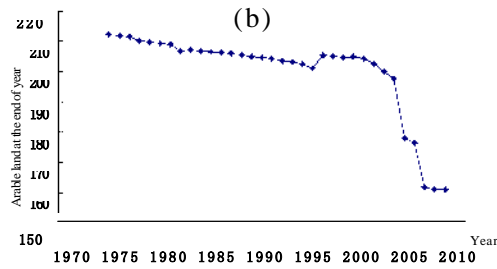
3.1 The process of urbanization

In the figures it can be observed that the trends of the total population, build-up area and the road area at the end of year are on the rise, while the trend of the arable land

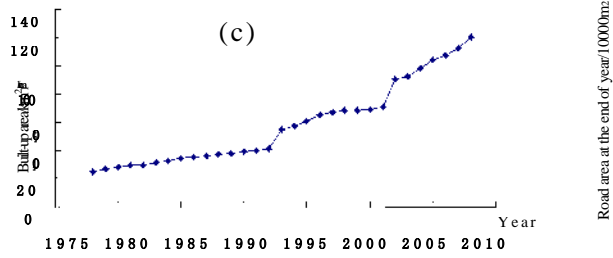
at the end of year is on the declining (see Fig.1).



(a) total population



(b) arable land at the end of year



(c) build-up area



(d) road area at the end of year

Fig.1. Annual variations of four urbanization indexes in Changzhou

The urbanization level is 16.9% in 1951. After the fluctuation of 30 years, the urbanization level is 17.6% in 1979, and then continues to rise, reaching 74.9% in 2008. The certain differences exist in the pace of the development of urbanization in Changzhou over the past 60 years.

3.2 Climate change

3.2.1 Annual mean precipitation

The variation of the annual mean precipitation in Changzhou is regularly fluctuant. The linear trend equation of the annual average rainfall from the selected data is computed as $y=0.5662x-34.858$.

3.2.2 The annual mean temperature, min-mean temperature and max-mean temperature

There are increasing trends in the time series of the annual mean temperature, min-mean temperature and max-mean temperature. In the 1970s and 1980s the trends of the annual mean temperature, min-mean temperature and max-mean temperature are significant with a declining rate but an increasing rate in the 1990s, while the trends are slight with a decreasing rate in the 2000s. In general, the trends are gradually rising.

3.3 The relationship between urbanization and climate change

Fig.2 demonstrates that the fluctuations of the total population, road area at the end of year and GDP are regular with the mean temperature increasing year by year and tend to become large over time.

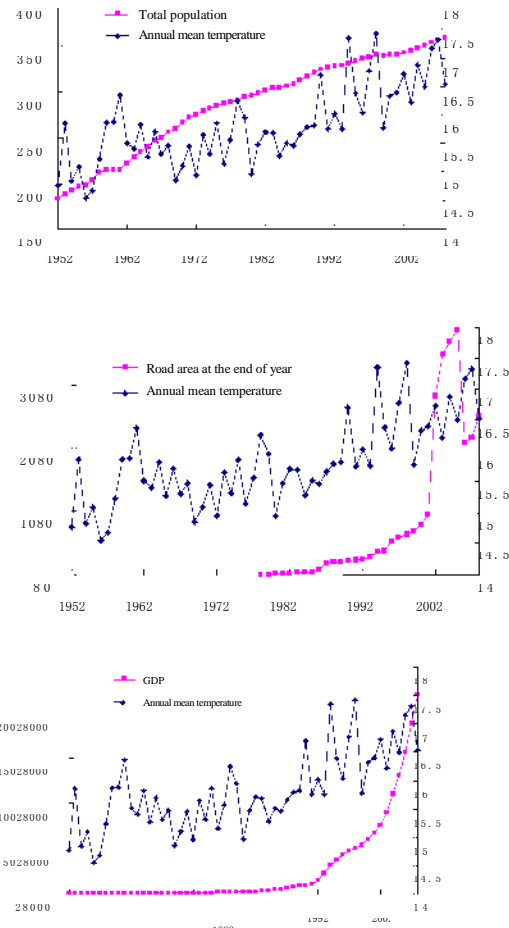


Fig.2. Trends of annual change of mean air temperature, total population, road area at the end of year and GDP

The differences are highly significant between the total population, GDP and industrial production, arable area at the end of year, build-up area and road area at the end of year and temperature through correlation analysis. The correlation coefficients are 0.670, 0.656, 0.654, -0.593, 0.687 and 0.513, respectively.

4 Conclusions and Discussion

The advancement of urbanization brings about the rising trends of the population in Changzhou, build-up area and road area at the end of year. There are highly significant differences between the total population, GDP, industrial production, arable area, buildings area and road area at the end of year and temperature. The effects of the rapid development and advancement of urbanization on local climate change are great. In order to protect our increasingly fragile environment, the impact of human activities on the environment needs to be minimized while developing economy such as strictly controlling the emission of greenhouse gas, saving energy, speeding up the industrial transformation and promotion and adopting lower energy consumption and high-tech industrial development. This can realize the sustainable development and the harmony between man and nature.

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