Study on Land Use and Precipitation Changes in the Main Urban Area of Kunming in the Past 40 Years

Yan Zhang1,4, Yi Luo3,4, and Hong Su 2,4*

1School of Information Science and Technology, Yunnan Normal University, Yunnan, 650500, China
2School of Communication, Yunnan Normal University, Yunnan, 650500, China
3Faculty of Geography, Yunnan Normal University, Yunnan, 650500, China
4GIS Technology Research of Resource and Environment in Western China, Ministry of Education, Yunnan Normal University, Yunnan, 650500, China

*Corresponding author’s e-mail: lysist@ynnu.edu.cn

Abstract. Based on the land use data of Kunming main city in 1980, 1990, 2000, 2010 and 2020 and the precipitation data of Kunming meteorological station in 1980-2019. Used anomaly analysis and Mann-Kendall methods to analyze land use changes and precipitation trends in the main urban area of Kunming. The results show that under the background of urbanization, the land use change in Kunming main city is obvious, and the construction land area is obviously increased. The annual precipitation level showed a downward trend, the annual precipitation days decreased significantly, and the extreme precipitation days increased. The change of land use has obvious influence on precipitation events.

1. Introduction

Land use change is an important part of the global climate change and the main influence factors. The change of land use affects the precipitation and runoff of the watershed by affecting the coverage ratio of the permeable surface to the impervious surface of the city, and then affects the hydrological cycle process of the entire watershed. At present, the impact of changes in land use types on regional climate change has become an issue of widespread concern [1-4]. NOSETTO MD [5] used the SWAT model to study the impact of land use change on the water cycle process in the southern hemisphere, and concluded that land use change is an important factor affecting the water cycle. Zhao and Zeng [6] found that in northern China, an increase in ground albedo and a change in surface heat flux and a decrease in surface roughness may lead to a decrease in precipitation and an increase in temperature. Luo and Li [7] found that impervious surfaces such as asphalt and cement would increase the temperature of surface runoff. The expansion of urban land scale is one of the characteristics of China's urbanization. In recent decades, land use in the main urban area of Kunming has changed significantly under the background of urbanization. Large areas of permeable surfaces such as cultivated land and grassland have been transformed into impervious construction land. This change has an impact on climate change in the main urban area of Kunming. This paper uses the remote sensing monitoring data of land use provided by the Institute of Geographic Sciences and Natural Resources Research of the Chinese Academy of Sciences and the monthly precipitation data provided by the National Meteorological Data Center to study the
changes in land use and precipitation in the main urban area of Kunming, and analyze the main urban area of Kunming. The impact of land use changes on precipitation.

2. Research data and Methods

2.1. Data

2.1.1. Land use data
Land use data comes from the Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences (http://www.resdc.cn/Default.aspx) at the end of 1970 (1980), at the end of 1980 (1990), 2000, 2010, 2020. Remote sensing monitoring data of land use in China, with a resolution of 1km. Data production is based on Landsat TM/ETM remote sensing images of each period as the main data source, which is generated through manual visual interpretation.

2.1.2. Precipitation data
The precipitation data comes from the National Meteorological Data Center (http://data.cma.cn/) China's surface climate data monthly data set, including total monthly precipitation, monthly precipitation > 0.1mm precipitation days, and maximum daily precipitation data. The data set is compiled and compiled from the national monthly information file of the ground report reported by each province in accordance with the "National Ground Climate Data (1961-1990) Statistical Method" and the "Ground Meteorological Observation Specification".

2.2. Methods

2.2.1. Acquisition of land use classification
The remote sensing monitoring data of land use status in China is based on provinces. The data includes 6 primary types and 25 secondary types of cultivated land, forest land, grassland, water area, residential land, and unused land. First, the ArcGIS software uses the vector boundary of the main urban area of Kunming to crop the original data image, and then exports the data to perform area statistics on land types.

2.2.2. Statistics of precipitation data
The monthly data set of China's surface climate data is in "txt" format. It needs to be imported into excel to remove the data with unqualified quality codes, and then calculate the total monthly precipitation, the number of monthly precipitation days and the maximum daily precipitation separately.

2.2.3. Mathematical Statistics
This study used anomaly analysis and Manner-Kendall nonparametric trend test to test and analyze the precipitation data.

3. Results and analysis

3.1. Land use changes in the main urban area of Kunming
From 1980 to 2020, land use changes in the main urban area of Kunming are obvious. It can be seen from Figure 1 that from 1980 to 2000, the land use change in the main urban area of Kunming can be divided into three stages. In the first phase, from 1980 to 1990, the land use change in the main urban area of Kunming basically showed a stable state during this period, and no large-scale change of each land type occurred. In the second stage, from 1990 to 2010, the utilization area of water and grassland remained stable, while the area of woodland and arable land showed a downward trend, and the construction land showed a clear upward trend. The third stage is from 2010 to 2020, in this stage, the waters are still in a relatively stable state, the grassland has changed from a stable to a downward trend, and the downward trend of cultivated land and woodland is more obvious, and the same construction
land has an even more significant upward trend. From Figure 2 we can also see that the proportion of land use types in Kunming’s main urban area remained basically unchanged from 1980 to 1990, but since 2000, construction land began to expand, from 8% in 1990 to 23% in 2020. An increase of about 2.9 times, while the area of arable land decreased from 19% in 1990 to 11%, a decrease of 8%. The two types of land have undergone major changes. This is because from 1980 to 1990, the main urban area of Kunming was in the recovery period of economic and urban development, and the rate of urbanization was low, so the land use type changed little. However, after 1990, the urbanization of the main urban area of Kunming continued to accelerate, and the land. The types of utilization began to change, especially after 2010, the development of urbanization became more intense, and the area of urban land expanded more rapidly.
3.2. Precipitation change in the main urban area of Kunming
Analyzed the changes in precipitation in the main urban area of Kunming from 1980 to 2019. It can be seen from Figure 3 that the annual precipitation in the main urban area of Kunming has changed periodically in the past 40 years. It can be seen from the average annual precipitation every 10 years that the average annual precipitation in 2000-2020 is lower than the average annual precipitation in 1980-1989 and 1990-1999, indicating that the precipitation in the main urban area of Kunming since 2000. The level shows a downward trend. This change in annual precipitation is consistent with the obvious changes in land use in the main urban area of Kunming since 2000, indicating that the increase in construction land area in the main urban area of Kunming after 2000 has had an impact on precipitation events.

Analyzed the changes in the number of annual rainfall days in the main urban area of Kunming from 1980 to 2019. Use Manner-Kendall nonparametric trend test to test the annual rainfall days in the main urban area of Kunming from 1980 to 2019. The test results show that from 1980 to 2019, the number of annual rainfall days in the main urban area of Kunming passed the significance test with a confidence level of 99%, showing a significant downward trend.

Analysis of changes in the annual maximum daily precipitation in the main urban area of Kunming from 1980 to 2019. It can be seen from Figure 4 that before 2000, the annual maximum daily precipitation was basically around 75mm, and there were only four cases where the annual maximum daily precipitation was lower than 50mm or higher than 100mm in 20 years. After 2000, the annual maximum daily precipitation fluctuated significantly. There were 4 times when the precipitation was higher than 100mm and reached the heavy rain level, and the annual maximum daily rainfall was below 50mm 3 times. The change in maximum daily precipitation reflects the increasing frequency of extreme precipitation events.

From 1980 to 2019, in the context of land use changes in the main urban area of Kunming, precipitation was significantly affected. The expansion of construction land and the reduction of vegetation area have reduced precipitation infiltration and increased precipitation runoff, which in turn affects the hydrological cycle process, resulting in a decrease in precipitation and a decrease in annual rainfall days and an increase in extreme precipitation events.
4. Conclusion
By analyzing the changes in land use and precipitation in the main urban area of Kunming from 1980 to 2020, we can draw the following conclusions: (1) Since 1980, with the development of urbanization, land use in the main urban area of Kunming has undergone significant changes, especially after 2010, land use types have changed more drastically; (2) The changes in land use types in the main urban area of Kunming are mainly changes in construction land, cultivated land, and forest land. According to the changes in data, we can infer that the construction land in the main urban area of Kunming is mainly converted from cultivated land and forest land; (3) The changes in precipitation events in the main urban area of Kunming are affected by changes in land use. The annual precipitation level decreases, the number of annual rainfall day decreases, and the frequency of extreme rainfall events increases.

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