

Analysis on the Trend of Changes in Hydrothermal Conditions in Maowusu Sandy Land

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Abstract

Based on the daily data of temperature and precipitation from 7 meteorological stations in Maowusu Sandy Land from 2000 to 2020, linear regression analysis was used to clarify the characteristics of temperature and precipitation changes in the study area. The results show that the temperature in the Mu Us sandy land showed an overall upward trend from 2000 to 2020, with a growth rate of 0.09 °C / (10a) and an average temperature of 9.26 °C; The precipitation shows a fluctuating upward trend, with a growth rate of 4.06mm/a and an average precipitation of 373.75mm. Since the 21st century, there has been a discrepancy between the trend of temperature changes in the research area and global warming. The possible reason for this is the implementation of ecological engineering, which has improved the local climate characteristics of the research area and further affirmed the effectiveness of national ecological policies.

Keywords

Maowusu Sandy Land; Temperature; Precipitation.

1. Introduction

In the 1980s, domestic and foreign climatologists warned at the First World Climate Conference that the Earth was constantly warming, and climate change, as a major scientific issue for the first time, received widespread attention from international climatologists. Climate conditions are important factors that affect the stability of global ecosystems and human production and life. However, in the context of global warming, due to the influence of natural conditions and human activities, the global climate has undergone rapid changes, and the problems brought about by climate change pose a certain degree of direct or indirect threat to human economic development and living environment. Therefore, climate change has also become a hot topic of research for scholars both domestically and internationally.

Although the overall climate change situation in our country is similar to the global trend, our country has a vast territory, complex and diverse terrain conditions, uneven distribution of climate conditions, and local areas have particularity and complexity. There are certain differences in the response to global climate change in different regions and time periods [3-4]. The Maowusu sandy land is a typical agricultural pastoral ecotone in northwest China, with a very fragile ecological environment. Due to natural factors such as sparse precipitation, dry climate, strong solar radiation, and strong evaporation in the region, the Maowusu sandy land has long been plagued by water resource shortages. The rapid process of land desertification has caused serious harm to the ecological environment in the western region and the Beijing Tianjin Hebei region. Therefore, the Maowusu sandy land has always been a hot area for drought research scholars in China. This study analyzes the interannual changes in temperature

and precipitation in the Mu Us sandy land, in order to provide data support for the restoration of the ecological environment, and has certain significance in promoting the stable development of agriculture and animal husbandry, ecological environment protection, and other aspects in the study area.

2. Materials and Methods

2.1. General Situation

Maowusu Sandy Land is located in the northwest of China, in the hinterland of the Loess Plateau, spanning the northern part of Yulin City, the southern part of Ordos City, Yanchi County, and Lingwu City (37.45° -39.37° N, 107.67° -110.67° E). The Maowusu sandy land is located in the transitional zone between arid and semi-arid, and is a typical agricultural and pastoral ecotone in China. Its northwest is mainly composed of sandy land and grassland, while its southeast is mainly composed of cultivated land and grassland. The research area is mainly characterized by a temperature continental climate, with drought and uneven distribution. Rainfall is mostly concentrated from June to August, with an annual precipitation of 250-440 mm, increasing from west to southeast. The Maowusu sandy land is a typical ecologically fragile area in the northwest, and is one of the most severely desertified areas in China. It is also one of the extremely important ecological functional areas for wind prevention and sand fixation in China.

2.2. Data Source and Processing

Meteorological data is provided by the China Meteorological Data Network (<https://data.cma.cn/>) Provided, the dataset selected for this study is the Daily Value Dataset of China's Surface Climate Data (V3.0), which includes data on pressure, temperature, precipitation, evaporation, relative humidity, wind direction, wind speed, sunshine hours, and 0cm ground temperature from 699 basic meteorological stations in China since January 1951. There are a total of 7 national meteorological stations in the research area, namely Hengshan Station (53740), Jingbian Station (53735), Dingbian Station (53725), Yanchi Station (53723), Shenmu Station (53651), Yuyang Station (53646), and Etuoqi Station (53529). Daily precipitation and temperature data from each meteorological station are selected, and the monthly and annual averages of precipitation and temperature at each station in the research area are obtained through sorting and weighted averaging, and take the average values of 7 stations as the precipitation and temperature data of the Mu Us sandy land.

3. Result and Analysis

3.1. Interannual Variation Trend of Temperature

Figure 1 shows the annual average temperature variation of the Mu Us sandy land. From the figure, it can be seen that the average temperature of the Mu Us sandy land from 2000 to 2020 was 9.26 °C, showing a slow upward trend, with a growth rate of 0.09 °C/(10a). The highest annual average temperature was in 2006, with a value of 9.86 °C; The lowest annual average temperature occurred in 2012, at 8.30 °C. Based on the analysis of different trends, the temperature changes in the Mu Us sandy land from 2000 to 2020 can be mainly divided into two stages, showing a significant downward trend from 2000 to 2012, including the highest and lowest values. This also indicates that the temperature fluctuations in the Mu Us sandy land from 2000 to 2012 were significant, which is not in line with the trend of global warming, This indicates that national ecological engineering policies and human activities have had a significant impact on temperature changes in the Mu Us sandy land after 2000; After 2013, it remained stable.

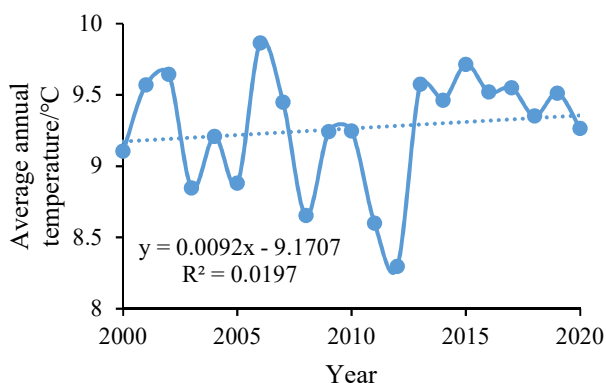


Figure 1. Annual Average Temperature Change in Maowusu Sandy Land

3.2. Interannual Variation Trend of Precipitation

Figure 2 shows the annual average precipitation variation in the Mu Us sandy land. From the figure, it can be seen that the average precipitation in the Mu Us sandy land from 2000 to 2020 was 373.75mm, with significant fluctuations in interannual distribution and an overall upward trend, with a growth rate of 4.06mm/a. The highest annual precipitation was 517.74mm in 2017; The lowest annual precipitation was 198.37mm in 2019. The precipitation in the Mu Us sandy land shows a periodic trend, with high and low values occurring every 5 years.

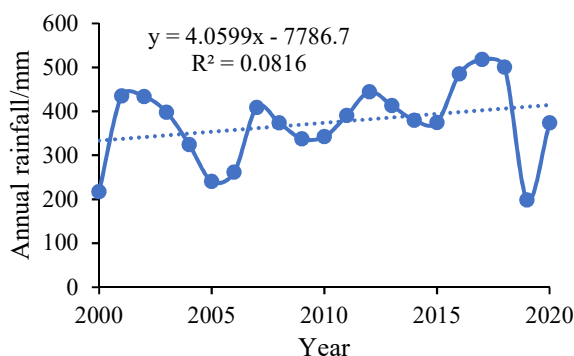


Figure 2. Annual Average Precipitation Change in Maowusu Sandy Land

4. Summary

The average annual temperature of the Mu Us sandy land from 2000 to 2020 was 9.26 °C, showing a fluctuating upward trend, with a growth rate of 0.09 °C/(10a), consistent with the trend of global warming. However, since the beginning of the 21st century, the average annual temperature of the Mu Us sandy land has shown a significant downward trend from 2000 to 2012, and has remained relatively stable since 2012, indicating that there are significant differences between the temperature changes in the Mu Us sandy land and the global temperature trends in some areas, The possible reason for this is the impact of human activities. In 1999, the country implemented a large-scale ecological project that changed the surface coverage of the Mu Us sandy land, thereby changing the local climate conditions in the study area. The average annual precipitation in the Maowusu sandy land is 373.75mm, with significant fluctuations in precipitation and an overall upward trend. The fluctuation of precipitation is an important factor in the occurrence of drought, flood, and landslides. Therefore, it is necessary to further explore the climate change patterns in the research area to provide guarantees for the production and life of the local people.

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