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The temporal-spatial variations of climatic factors in the northwest Yunnan, China

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Abstract. Climate is an important factor that affects the production and life. The ecological environment in the northwest Yunnan is fragile, which is greatly affected by climate change. This study is based on the analysis of climatic indexes from 1950 to 2013 in northwest Yunnan, Using SPSS means to deal with the data. The results show that: There was no significant change in temperature in northwest Yunnan during 64 years, and the change of temperature was positively correlated with ground temperature, rainfall, evaporation and relative humidity. This study provide theoretical reference for the study of climate change characteristics and regularity in this region Climate change has become a global issue of common concern in the international community, and climate change affects all aspects of production and life. Studying climate change process is the premise and foundation to solve the problem of climate. Climate is a broad concept that consists of many climatic factors. Including temperature, rainfall, evaporation, sunshine hours, and relative humidity and so on. Among these factors, the research on the temperature and rainfall is representative. By studying the influence of temperature and rainfall in the south of Xinjiang can provide suggestions for the ecological restoration of this climate sensitive area. At present, the study of climate change involves not only various climatic factors, but also different time scales and different spatial scales. The combination is more detailed and more extensive coverage, and the study of climate change more clearly and completely. In recent 50 years, the temperature and rainfall in the oasis and desert area of northwestern China have been increasing, which is typical for the continental arid climate in the warm temperate zone. Although with the progress of science and technology, the research method is more scientific and the research content is extensive, the majority of the research is still limited to the research of rainfall, temperature and evaporation. But there is little analysis about other factors. Therefore, based on the data of 7 major climatic indicators in northwest Yunnan by standard processing, using regression analysis and the model establish to analyze temporal changes of climate in the northwest Yunnan during the past 64 years. And through the above methods to establish the temperature and other climate indicators of the linear correlation. On the one hand, reveal the temporal-spatial patterns of climate change, identify the history of climate change and assess regional climate change trends. On the other hand, it also provides the forecast and scientific basis for the development of agricultural economy.

1. Materials and methods

1.1 Study area

Northwest Yunnan is located at latitude 26.25 -29.25, Longitude 98.13 -101.45.Northwest Yunnan is located in the southeastern edge of Qinghai-Tibet Plateau and the northwestern margin of the Yunnan-Guizhou Plateau of China in terms of geographical location. The terrain is high in the north and low in the south, the mountain is in the north-south direction. The altitude difference is large, and complex landform pattern is widely distributed in the high mountains and deep valleys. In the division of climatic zones, the plateau mountain climate and the subtropical monsoon climate are the common function in this area, so it shows little rain in winter and rainy in summer of monsoon characteristics.

1.2 Data description

In this study, the data of seven meteorological stations in northwest Yunnan, this seven meteorological stations are: Deqin station, Shangri-La station, Weixi station, Ninglang station,

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Lijiang station, Yong sheng station and Huaping station. The data cover daily meteorological data for the 64 years from 1950 to 2013. The meteorological data includes rainfall, temperature, sunshine hours, ground temperature, evaporation, relative humidity and snow cover days in seven meteorological stations in 64 years.

1.3 Model building

SPSS software was used to establish the regression model of 7 meteorological elements: $Y = \beta + r_1\overline{R} + r_2\overline{GT} + r_3\overline{S} + r_4\overline{E} + r_5\overline{RH} + r_6\overline{SC}$

Among them, Y represents the average annual temperature, $\overline{R}$ represents the average annual rainfall, $\overline{GT}$ represents the average annual ground temperature, $\overline{S}$ represents the average annual sunshine hours, $\overline{E}$ represents the average annual evaporation, $\overline{RH}$ represents the average annual relative humidity, $\overline{SC}$ represents the average annual snow cover days, and r1, r2, r3, r4, r5, r6 are the influence factor weights of all indexes. The average annual temperature was used as the dependent variable, and the other indexes were the independent variables. The weight of each factor in the model was calculated by regression analysis, in order to compare the effects of all climate indexes to temperature.

2. Correlation analysis of climatic factors

Constructing the relationship between temperature and other factors(Table 1).The associated probability of ground temperature, rainfall, evaporation and relative humidity is less than the default significance level of 0.05 through the extraction and analysis of the various parameters, it showed that the above four independent variables had significant effect on temperature. And the weighting factor B has a positive correlation with its corresponding Sig. value, the more obvious, the greater the weight. According to the results of regression analysis, the sunshine hours and the snow cover days are much larger than 0.05, then the correlation is not significant, so the sunshine hours and the snow cover days are taken as the independent variables of temperature change. Therefore, the original model is changed according to the actual verification results, and the final model expression is formed:

$$Y = 4.096 + 0.259\overline{R} + 0.662\overline{GT} + 0.259\overline{E} + 0.081\overline{RH}$$

Table 1. the statistical parameters of the elements

Independent variables	Mean	The standard deviation	Sig.	B
Rainfall/mm	879.110185	±161.1425934	0.002	0.259
Ground temperature/℃	14.925653	±4.4015728	0.000	0.662
Sunshine hours/h	2247.656899	±218.2903360	0.445	-0.039
Evaporation/mm	1922.057761	±485.5652905	0.045	0.124
Relative humidity/%	67.042248	±3.6486507	0.049	-0.081
Snow cover days/d	12.3516	±18.26597	0.328	0.054

Note: the associated probability of Sig <0.05, indicating that the independent variables in the regression model in the role of significant; B is the weight factor

Through the verification, the results show that the independent variables of ground temperature, rainfall, evaporation and relative humidity and the dependent variable temperature have different degrees of correlation. Besides, the relative humidity was negatively correlated with temperature, ground temperature and evaporation, and the other meteorological indexes were positively correlated and correlated with each other (Table 2).

Table 2. Correlation coefficient of each variable r

	Temperature/℃	Rainfall/mm	Ground temperature/℃	Relative humidity/%	Evaporation/mm
Temperature/℃	1				
Rainfall/mm	0.916***	1			
Ground temperature/℃	0.985***	0.907***	1		
Relative humidity/%	-0.742***	0.568***	-0.722***	1	
Evaporation/mm	0.828***	0.635***	0.831***	-0.752***	1

Note: Sig.= 0.00

3. Conclusion And Discussion

Under the background and trend of global warming, the annual average temperature has not been greatly affected in the northwest Yunnan. The annual average temperature is about 11.6 ℃ in the recent 64 years, the temperature fluctuation is small and the change is not significant. There is no significant rise trend and the spatial distribution of annual average temperature did not change. In addition to the negative correlation between relative humidity and temperature, the temperature was positively correlated with other indexes. In the positive correlation, whether the weight factor or the correlation coefficient, showing the law that the intensity of the relationship is gradually decreasing between temperature and ground temperature, rainfall, evaporation. On the one hand, the climate in the northwest Yunnan is controlled by the southern subtropical monsoon climate and the northern plateau alpine climate with large differences between north and south, and the temperature gradually decreases from north to south. on the other hand, the northwest Yunnan Province is located in the west of the Cross Mountains, the mountains are staggered and the topography is complex and various, so the distribution of different climatic factors in different regions is different. It is also because of the differences in regional topography such as the direction of mountains, rivers, lakes, the formation of local climate distribution. Under the interaction of these factors, the five major climatic factors interact to form the related factors. This paper studies climate change in northwest Yunnan from 1950 to 2013, analyzes the climatic factors in detail, and explores the related models of temperature change based on integrated climate change in northwest Yunnan, which aims to provide reference for the natural climate in the development of agriculture and forestry industry in northwest Yunnan, and to apply the climate diagnostic analysis to the decision-making service of the primary industry. In addition, there are many influence factors of climate formation, and the results of the analysis of indicators to a certain extent by the impact of linear deviation. So that the coefficients should also be modified in the field research in the future.

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