The Climate Change of Southwestern China

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ABSTRACT

Since China has already entered into an industrializing age, the environment issue in China has become a major concern in Chinese people’s mind. China’s modern urbanization has brought the rapid urban modernization. However, the climate started shifting more and more obviously in recent ten years. Since 2008, Yunnan, South Sichuan province have continuously suffered the winter droughts that are said to be the worst in a century in over five years, and a series of disasters such as forest fire and hydroponic come year after year. In order to know how significant of the change has happened in recent years. This study will mainly focus on the climate change pattern by examining the annual average (min/max) temperature and precipitation over this region by ten weather stations in Yunnan province. Moreover, by examine the rain, snow and fog days record, it can be also concluded whether or not the record can prove that the hypnosis is correct.

1. Introduction

In the beginning, this study will be given a hypothesis which indicates that the drought happened in Yunnan province is caused by climate change, and the climate change is represented by reducing winter precipitation, increasing winter season’s monthly average temperature. The drought usually starts from January and ends in April. However, it more concentrates in January, February, and March. To observe the actual change, we need to show and analysis the trend of the precipitation and min/max temperature of the annual summary (uptrend or slump over recent 10 years and 50 years) by creating line figures and using trend line tool. Later on, the study would focus on the three winter months. Yunnan province does not have much annual range on temperature, but does have very big annual range on precipitation. The precipitation highly concentrated in the summer due to South Asian and East Asian monsoon, but few dispersion of precipitation can happen in winter because of the local convection. Besides checking the annual precipitation, we can also check the total days of rain
and snow and might expect some decreases because the rain can happen over a whole summer period. Nevertheless, in winter, the inter-annual precipitation difference can be very big because some years’ winter might not have any precipitation but some years’ might be normal. In winter, there are might have some snowfall as well due to the cold waves from Siberia.

Figure 1. The location of the ten stations in Yunnan province.

2. Data

The database provides the climate data from 1942 until 2013 (not all stations). It includes the annual average minimum temperature and annual maximum temperature, annual average wind speed, annual total precipitation, and total days of rain, snow, thunderstorms, hail, and fog during the year. However, not all years have the data. Some years might miss the precipitation data while some years miss the temperature data. The data was published on TuTiempo.net which is a Spanish website specialized for recording global climate history. The database is originally collect and aggregated from NNDC Climate Data Online. Not only do they provide the annual summary of the climate pattern, but also it can expand much more detail for each year. For each month, it gives a table which includes the summary of each single day over the whole month.
3.1 Precipitation

Based on those ten stations data, eight of stations shows an obvious negative slope of the linear trend lines except Dali and Chuxiong. In these stations which have down sloping trends, most of stations have record low or high frequent low precipitation in recently five years. For example, Zhaotong is the typical one that only 335.22 mm in 2011. (See figure 2). From 2009 to 2012, all annual precipitation amounts are below 600 mm which is the highest frequency of the low precipitation in the history. Even though Zhaotong does not show the negative slope of the linear trend line. However, in the recently four years, all annual precipitation amounts are below 850 mm which is also a record low in the history. The slope of the linear trend lines of Lincang, Mengzi, Kunming, Jinghong are all negative. They all have high frequency of the continuous low annual precipitation in recent five years. (See figure 3)

![Precipitation of Zhaotong (1942-2013)](image)

Figure 2. Precipitation of Zhaotong with the trend.
3.2 Annual Total Raining Days, Snow days, and Fog days.

Raining days can intuitively indicate the climate change of this region. Since Yunnan is affected by the monsoon deeply in the summer. Therefore, the rainy day in summer is almost constant every year because the thunder shower might happen every day. However, winter is the dry season in Yunnan. The rain predominantly caused by convection or cold front. Therefore, the inter annual variance of the rain days mostly contributed by winter rain days. Since a certain portion of the precipitation caused by snow in the winter and the high altitude station such as Deqen is easier to get snow, the snow days can be changed through fifty years. By looking at the ten stations data, all stations have negative slope of the trend line. Mengzi and Chuxiong have very steep negative trend line. (See Figure 4) The rain day has been decreased a lot especially in recent five years. Deqen has a very steep downward slope of the trend for snow days. (See Figure 5) Fog can directly reflect the humidity of the place. In Yunnan, fog is usually radiation fog and usually happens from November to February in the next year. The dense forest causes the high humidity. (Huang, Zhang 2011) Even though the winter is the dry season in Yunnan, the forests’ transpiration and many uneven valleys can bring more moisture to create fog and scatter shower since the temperature lag between day and night is very large. (Guo, Lu et al. 2008) By looking at the figures about the annual total fog days, almost all the stations’ figures show the critical negative slope of the trend line. (See Figure 6)
Figure 4. Inter annual rain days amount of Mengzi

Figure 5. Inter annual snow days amount of Deqen
3.3 Annual Average Temperature, Minimum Temperature, and Maximum Temperature.

Global warming has become a major concern all around the world. Almost everywhere in the world can show the warming trend especially the ecologically fragile areas. By looking at the figures, it can show whether or not Yunnan is affected by global warming. All stations have positive slope of the trend line. Deqen has the steepest slope of the average maximum temperature since it has highest altitude with a large amount of glacial zone and most ecologically fragile regions. Once the climate of Deqen warmed up a little bit, the glacial will start to melt and melt faster later on which creates a positive feedback loop. (See figure 7) Beside this, four other stations (Ruili, Baoshan, Chuxiong, and Mengzi) show the steepest slope of the average minimum temperature trend line among the three trend lines (min, avg, max). (See figure 8) Overall, the minimum temperature has been increased by 1-3 Celsius degree through fifty years. The average maximum temperature and average temperature has been increased less than that.
Figure 7. Interannual average temperature figure of Deqen.

The Interannual Min, Max, and average temperature of Deqen

The Interannual Min, Max, and Average Temperature of Chuxiong

Figure 8. Inter annual average temperature figure of Chuxiong
4. Conclusion

The characteristic of the climate change of Yunnan province is the humidity and precipitation decrease and the temperature increase which directly reflect the indication and tendency of the continuous drought and over five years. Mostly, the large increment of the minimum temperature shows the winter temperature has increased obviously. A more in depth said, since winter is the dry season, giving precipitation (rain or snow) can decrease the winter overall temperature significantly (snow can cause low temperature even more significantly). But if the humidity and precipitation (days of raining, snowing, and fog) has been decreased, the winter would be very warm and dry. Rain, snow, and fog days’ sharp decline can indicate the vegetation might have been destroyed severely in that area. People need to pay much attention on the destruction of forest vegetation causes the large effect on drought because Yunnan’s topography is complicated than any other provinces. Cutting down trees may cause many kinds of seriously and permanently landscape and soil changes. (Huang, Zhang 2011) Therefore, Yunnan has experienced more frequent drought in recent winters. If people do not care about this disaster and prevent the drought happen again, it will become unredeemable in the future.

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