

Analysis of Meteorological Elements and Climate Change in Poyang Lake Basin

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Abstract: In our study, five stations of Poyang Lake were selected: Nanchang, Boyang, Jingde, Lushan and Jing'an. The three observational values of temperature, precipitation and evaporation in these five stations from 1988 to 2017 were analyzed. Through average, extreme value, linear regression and cumulative anomaly analysis, the interannual temperature variation trend of the five stations is consistent and is expected to continue to rise over the next 20 years; precipitation shows different changes in different periods; evaporation is decreasing year by year. This study is of great significance to the maintenance of ecological function and security of Poyang Lake.

1. Introduction

Global climate change refers to a significant change in the statistical sense of the average state of climate or a long period of climate change (typically 30 years or more). In addition to having a bad impact on natural and social ecology, it has also brought adverse impacts on hydrological and water resources systems. It create the distribution of precipitation is more uneven, the intensity of rainstorm is increased, rainstorm, and flood occur frequently, which leads to the imbalance of seasonal flow[1].

In the past 50 years, the climate of the Poyang Lake Basin has undergone significant changes, which will affect the variation of water volume and evapotranspiration in the basin[2]. In order to maintain the ecological function and safety of Poyang Lake, it is of great significance to study the process of ecological climate change in typical wetlands under changing environment and the Countermeasures for its regulation and control [3]. Min Qian et al. [4] used folding algorithm to analyze the evaporation characteristics of Poyang Lake in the past 50 years. Guo Hua et al. [5] used M-K trend test to analyze the change trend of evaporating dish evaporation and reference crop evapotranspiration in Poyang Lake from 1961 to 2000. Liu Jian et al. [6] applied the complementary correlation evaporation model to estimate the actual evaporation and variation of stations in the Poyang Lake Basin from 1955 to 2001. In the previous studies, many analyses of climate change in Poyang Lake were done, but not many people studied the relationship between climate factor variables. So in this study, we want to know how climate elements interact with each other.

1.1. Profile of the Study Area

The Poyang Lake basin is located in a subtropical humid monsoon climate zone with an average annual temperature of 17.1 °C. The average annual precipitation is 1632 mm, with obvious seasonal and regional differences [7]. The precipitation in the main flood season from April to June accounts for 44% of the whole year, and the precipitation from the dry season from October to February is only 22.4% That has led to uneven distribution of runoff in the Poyang Lake Basin during the year.





Figure 1. Geographical location of Poyang Lake Basin

2. Data Collection and Processing

2.1. Data Collection

Considering the evenness of the distribution of stations in the research area, 5 national reference stations in the watershed were selected, they are Nanchang station (58606), Boyang station (58519), Jingdezhen station (58527), Lushan station (58506), Jingan station (58600), respectively. Daily data of temperature, rainfall and evaporation in the five stations from 1988-2017 were collected (Figure 1).

2.2. Data Processing

2.2.1. Data pre-processing. After we collected the data, we pre-processed the data and modified some errors in the data. In the case of data loss, we use interpolation to simulate the missing data. However, when the value of the data is too small to process, we replace it with zero.

2.2.2. Calculation and drawing figures. Calculated and got monthly data and yearly data according to the daily data; Made figures according to the monthly and yearly data;

Perform regression analysis and dispersion analysis to make clear how the factors changed with time going by.

3. Analysis and Result

3.1. Temperature Analysis

From Figure 2 it can be seen that the temperature from January to July was rising, and then the temperatures decreased month by month. The highest temperatures at all five stations occurred in July and the lowest temperatures occur in January. Except for December, trend value of other months are positive, which represents temperature in those months have risen with years going by. According to the trend value, we can also find that the temperature in spring and fall increased more than that in 1988, and the temperature in spring was higher than that in autumn during the last 30 years.

From Figure 3, It can be seen the annual average temperature increased or decreases, but on the whole, the temperature of each station shows a growing trend. The annual average temperature of stations 58527, 58600, 58606 and 58519 ranged from 17 °C to 19 °C from 1988 to 2017, but the annual average temperature of stations 58506 ranges from 11 °C to 13 °C from 1988 to 2017. We can clearly see that the temperature of station 58506 was lower than that of the other four stations, the reason why the temperature of 58506 station is lower than other stations is that this station is located in Lushan Mountain[8], the elevation is higher, and the temperature is lower than other stations due to the influence of terrain. respectively. From Figure 4, we can see there is a good linear relationship between temperature and year. It tells us temperature is on the rise during the past 30 years.

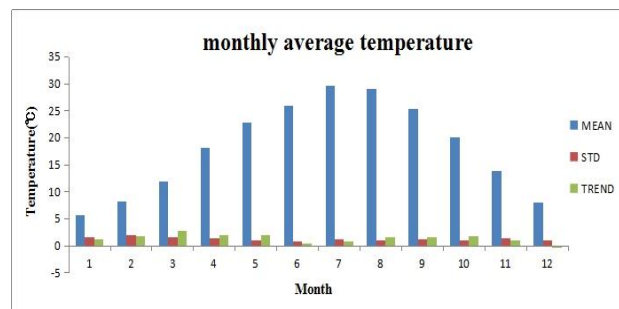


Figure 2. Monthly Average Temperature

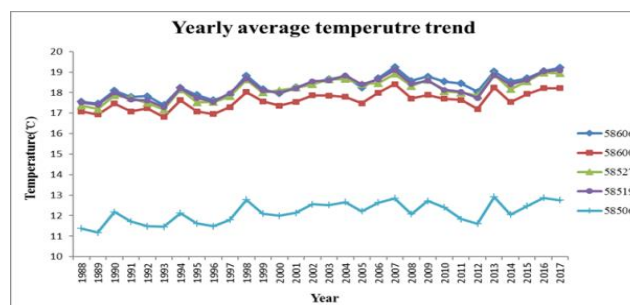


Figure 3. Inter-annual Variation of Thee Tmperature in Each Station

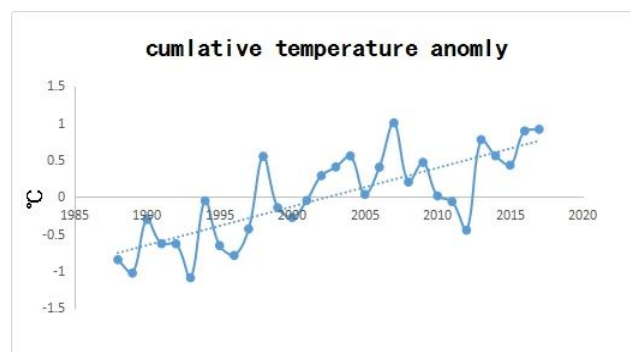


Figure 4. Cumulative Temperature Anomly

3.2. Evaporation Analysis

The evaporation capacity of the stations 58519, 58527 and 58606 has been largely missing since 2002, so the data from 1988 to 2001 are taken as the representative to analyze. Overall, the monthly evaporation at the five stations ranged from 489 mm to 2383 mm. The highest monthly evaporation occurred in June with a value of 2382 mm, while the lowest monthly evaporation occurred in January with a value of 354 mm. Trend showed negative numbers for five stations in October, November and December. It can be seen that under normal circumstances, the evaporation volume tends to decline in winter of future years (Figure 5).

According to the annual evaporation volume, the maximum annual evaporation volume is 1780.2mm, and the minimum annual evaporation volume is 789.4mm. The years in which the maximum evaporation capacity of the five stations appeared were different. The station 58506 was in 2004, the station 58519 was in 1990, the station 58527 was in 2001. In terms of the minimum evaporation, station 58519 and station 58600 both appeared in 1999. station 58527 and station 58606 both appeared in 1993. station **598506** appeared in 2012 (Figure 6).

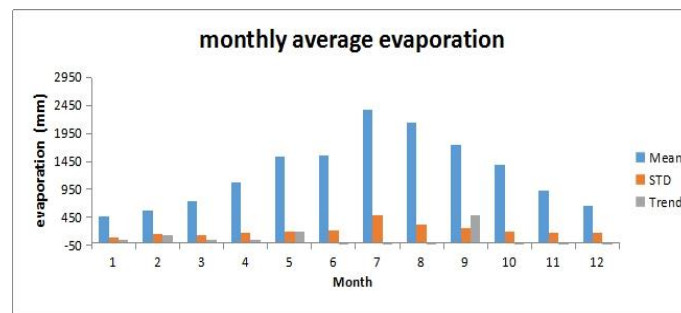


Figure 5. Monthly Average Evaporation

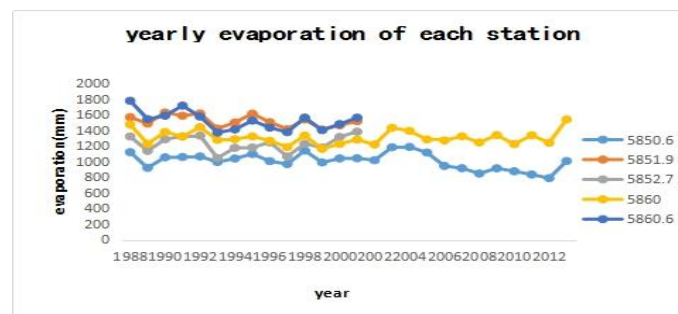


Figure 6. Inter-annual Variation of The Evaporation in Each Station

3.3. Precipitation Analysis

Ological stations in the Poyang Lake Basin from 1988 to 2017, we can know the characteristics of monthly average precipitation changes in this basin. The average precipitation in June was 662.72mm, accounting for 18.4% of the annual precipitation, which was the average maximum precipitation month; the average precipitation in December was 108.48mm, accounting for 3.0% of the annual precipitation, which was the smallest average precipitation. From January to June, the monthly average precipitation increased month by month, while precipitation from July to December decreased. In addition, due to the summer season from June to September, extreme precipitation weather was very prone to occur[9], resulting in a relatively large standard deviation of monthly average precipitation. By analyzing the trend value, we can find that the average monthly precipitation of 1-5 month is usually a negative value (Figure 7).

The average annual precipitation in the Poyang Lake Basin from 1988 to 2017 was 3587.1 mm, the highest precipitation in 1998 was 4762.8 mm, and the lowest precipitation in 2007 was only 2432.8 mm. Using the cumulative anomaly to analyze the annual precipitation characteristics of the Poyang Lake Basin from 1988 to 2017, we can see that the cumulative anomaly curve of precipitation in Poyang Lake area from 1988 to 2017 has increased in 1992-1999. And the trend of the curve in 2014-2015 has also increased, and the precipitation has also increased. In 1988-1992 and 1999-2009, the trend of the curve decreased, which was also the decrease in precipitation (Figure 8).

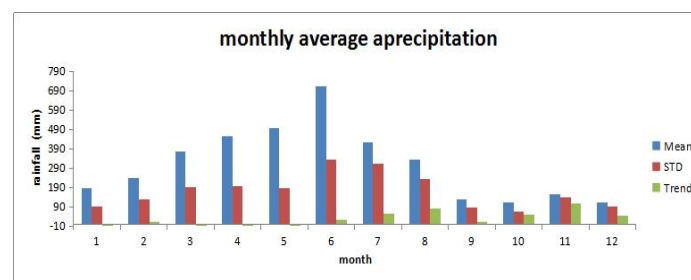


Figure 7. Monthly Average Precipitation

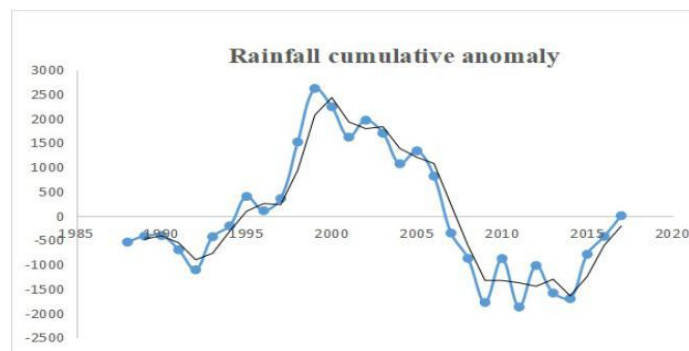


Figure 8. The Cumulative Anomaly Four Station

3.4. Comparison Between Climate Factors

As is shown in Figure 9, both precipitation and temperature went up and then went down. For temperature, it is higher in fall than that in spring, but for precipitation it is another way around. From Figure.11, we can see, annual distribution of temperature and evaporation are almost as same as Figure 10. We can understand why Figure 11 is similar to Figure 10. In our work, there are some differences with the previous research and questions about the results we got. We will try to explain them at this part. Compared to other 4 stations, station 58506 has lower temperature, more precipitation and higher evaporation. This is because the station is located in Lushan Mountain, its elevation is higher than other stations. Since the data of evaporation is taken from the evaporating dish experiment[10], it is much higher than the actual natural evaporation. The rainfall is concentrated in April-June because the area is heavily affected by plum rain.

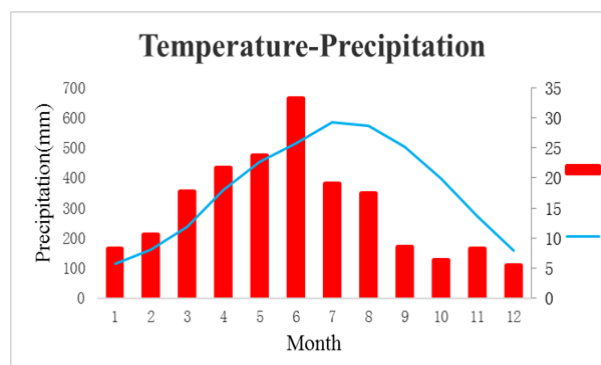


Figure 9. Comparison of Distribution of Temperature and Precipitation

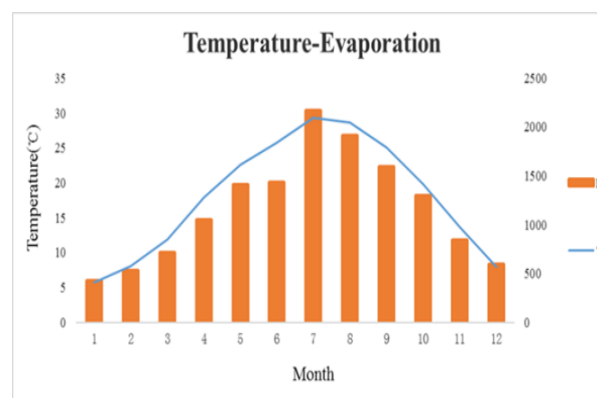


Figure 10. Comparison of l distribution of temperature and evaporation

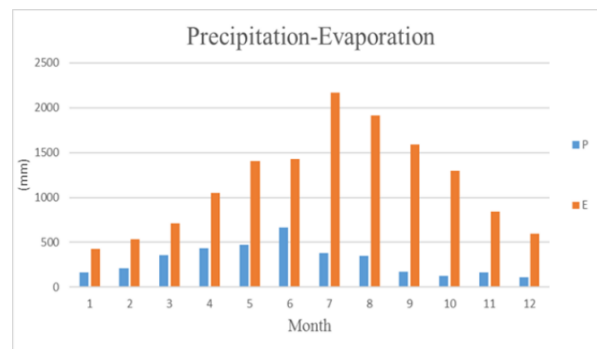


Figure 11. Comparison of distribution of evaporation and precipitation

4. Conclusion

From the above analysis we can get the following conclusions. Temperature went up from January to July and then went down. The highest temperature appears in July and the lowest occurred in January. Temperature in fall is higher than that in spring. Precipitation is mainly concentrated in March to June and the highest Precipitation occurred in June. The dry season is from September to December. The annual distribution of evaporation varies with temperature. The inter-annual trend of temperature of the five stations are the same. Temperature went up from 1988 to 1997, and increased in the following 20 years. It went down from 1988 to 1995, increased during 1995 to 2004 and decreased in the following 13 years. In the past 30 years, evaporation has been declining year by year. This should be caused by the combined effects of changes of temperature and precipitation.

5. Acknowledgement

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