Study on climate change in the source region of the Yangtze River from 1957 to 2010

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Introduction

The source region of Yangtze River is a typical sensitive area of climate change, where is in the middle area of Qinghai-Tibet Plateau. In recent years, especially after 1980s, climate has changed more extremely and abnormally in the source region of the Yangtze River. As a typical sensitive area of climate change, the study of climatic factors variance has become more important to reveal their regulations as precipitation (P), temperature (T) and actual evapotranspiration (ETa).

Research objectives

Based on the combination of MWT and SLOPE, the main research objective is to unveil how the climatic factors change in the source region of the Yangtze River. And the detailed objectives are as follows:

① To employ the Morlet wavelet as “mother function” decomposed climatic factors’ series into several obvious periods and to calculate the exact wavelet coefficient variances. Furthermore, by the results, it can identify the whole regulation of precipitation, temperature and actual evapotranspiration in the source region of Yangtze River.

② To use SLOPE among the each climatic factors, it can quantitatively calculate their variance since 1957. And it can represent the whole situation of the climatic change in different parts of the study area.

Methods

1. Wavelet method

$$C(a,\tau)=\frac{1}{\sqrt{a}}\int_{-\infty}^{\infty}f(t)\psi^{*}\left(\frac{t-\tau}{a}\right)dt$$

After experiments of the all wavelets, we employed the Morlet wavelet as the transforming method.

2.SLOPE method

$$Slope=\frac{n\times\sum_{i=1}^{n}x_i y_i-(\sum_{i=1}^{n}x_i)(\sum_{i=1}^{n}y_i)}{n\times\sum_{i=1}^{n}x_i^2-(\sum_{i=1}^{n}x_i)^2}$$

When the value of slope is positive, it means that the parameter time series has a positive or increasing trend in this time interval. However, when the value of slope is negative, it means that the parameter time series has a negative or decreasing trend in this time interval.

Results

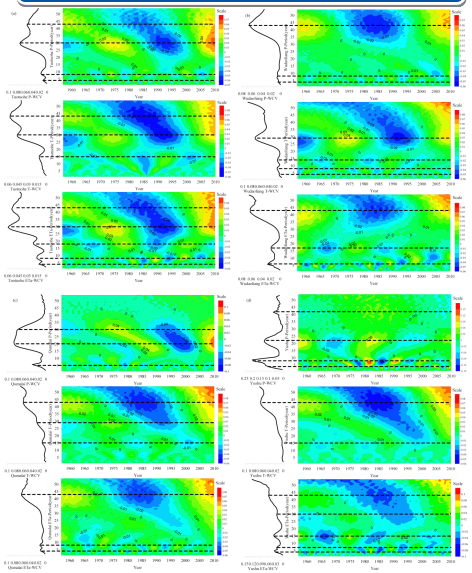

Fig.1 Wavelet Coefficients contour and variance of precipitation, temperature, actual evapotranspiration of meteorological stations as Tuotuohe (a), Wudaoliang (b), Qumalai (c) and Yushu (d) in the source region of the Yangtze River

(WCV-Wavelet Coefficient Variance, P- precipitation, T-pemperature, ETa-actual evapotranspiration)

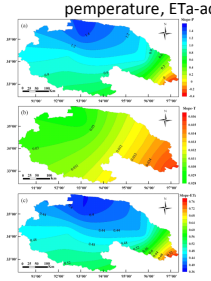

Fig.2 The slope contours of annual precipitation (a), annual average temperature (b) and annual actual evapotranspiration (c) from 1957 to 2010 in source region of Yangtze River

Conclusions

① The four meteorological stations, called Tuotuohe, Wudaoliang, Qumalai and Yushu respectively, have different periods and trend. The detailed periods of each station can be shown as follows:

(a) In the station of Tuotuohe, the precipitation has periods of 4 years, 8 years, 29-30 years and 43 years. The temperature has periods of 15-16 years, 29-30 years and 43 years. The actual evapotranspiration has periods of 4 years, 8 years, 18 years, 29-30 years and 43 years.

(b) In the station of Wudaoliang, the precipitation has periods of 4 years, 8 years, and 43 years. The temperature has periods of 4 years, 8 years, 15-16 years and 29-30 years. The actual evapotranspiration has periods of 5-6 years, 16-17 years and 43 years.

(c) In the station of Qumalai, the precipitation has periods of 4-5 years and 20-30 years. The temperature has periods of 15-16 years, 29-30 years and 43 years. The actual evapotranspiration has periods of 4 years, 8 years and 43 years.

(d) In the station of Yushu, the precipitation has periods of 4 years, 8 years, 22 years and 42-43 years. The temperature has periods of 15-16 years and 43 years. The actual evapotranspiration has periods of 4 years, 7-8 years, 15-16 years, 29-30 years and 43 years.

② SLOPE method quantitatively calculate the whole situation of the climatic change in different parts of the study area since 1957. According to the contours, it can be concluded as follows: **Firstly**, the precipitation had an increase of 55.52 mm in most of the entire study area, while it had a decreasing change of 53.60 mm in the southeast area. **Secondly**, the temperature has an increase of 1.67 ℃ in the entire source region of Yangtze River. In the southeast region, it has the most drastically temperature rising with 1.94 ℃. **Thirdly**, the actual evapotranspiration has an increase of 25.03 mm in the entire source region, with the rank from 19.44 to 41.04 mm. According to the analysis, it indicates that the whole source region has been driven into warm-wet state with increasing temperature and precipitation. **However**, it also can be presumed that some area has been driven into warm-arid state with increasing temperature and higher actual evapotranspiration, especially in the southeast area.

References

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