Spatiotemporal Evolution of Drought Events and Its Contribution on Vegetation Growth in The River Source Region

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Introduction

The three-River headwaters (TRH) is the birthplace of the Yangtze River, the Yellow River, and the Lancang River. This study used spatial analysis and MK method to analyze the spatial and temporal changes of TRH drought and vegetation index. Based on the copula multi-condition joint distribution method, the response of TRH vegetation cover change to drought climate change was investigated. The drought climate change over the past 58 years, the characteristics of vegetation change after the 21st century and the response of vegetation-drought were explored. These may be important theoretical support and reference for the future construction of the TRH basin ecosystem.

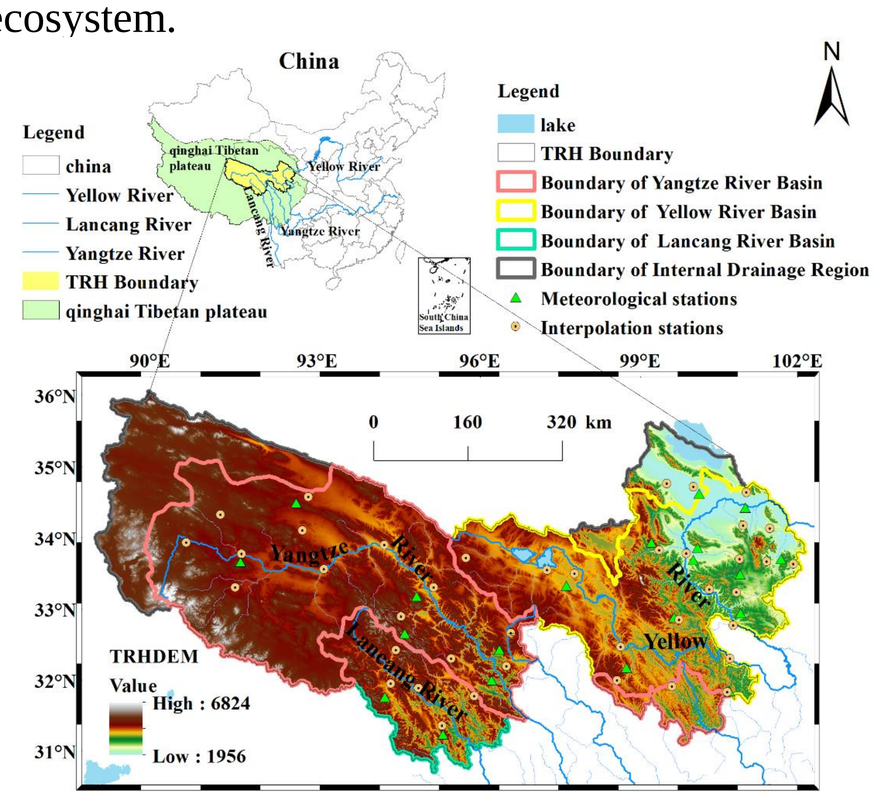

Figure 1: The location of Three-River headwaters region ,the distribution of meteorological stations in TRH

Methodology

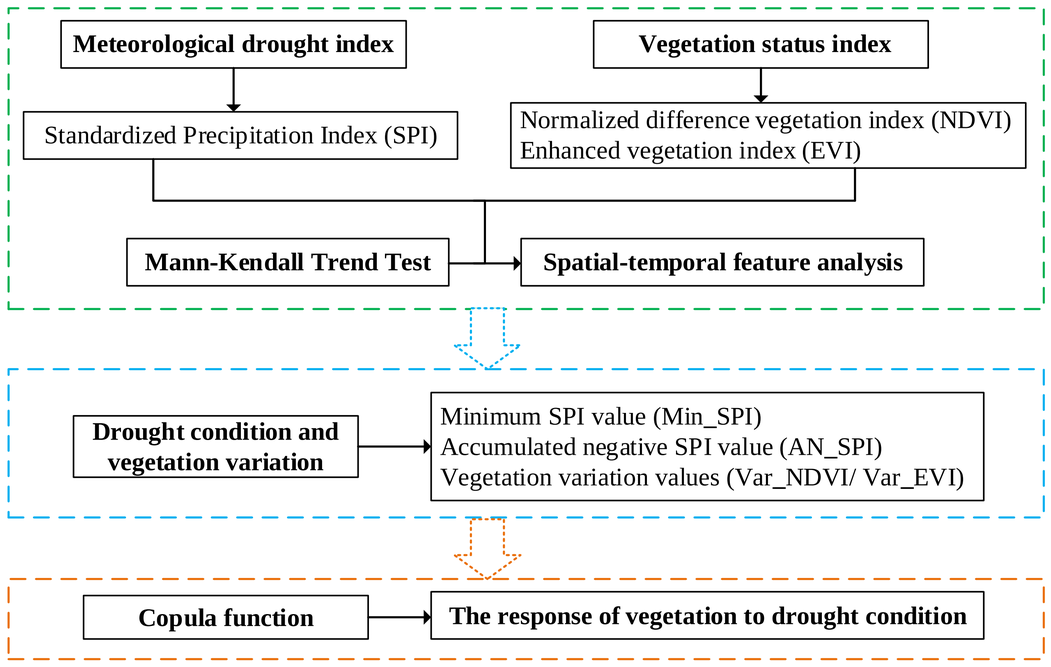

Figure 2: The architecture of the copula joint distribution model .

Figure 2 shows a copula joint distribution model is constructed for studying multiple nonlinear responses of drought condition and vegetation variation. Specifically, copula model is introduced to develop the dependent structure of drought condition and vegetation variation series. The marginal distribution of each concerned variable is fit with the appropriate distribution. The response analysis based on copula is derived with the conditional joint distribution.

Experiments

◆ Spatial distribution characteristics of SPI

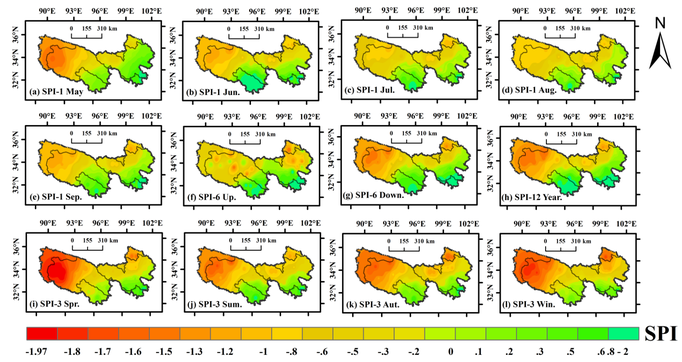

Figure 3: Spatial distribution of SPI in TRH.

◆ Trend characteristic of SPI

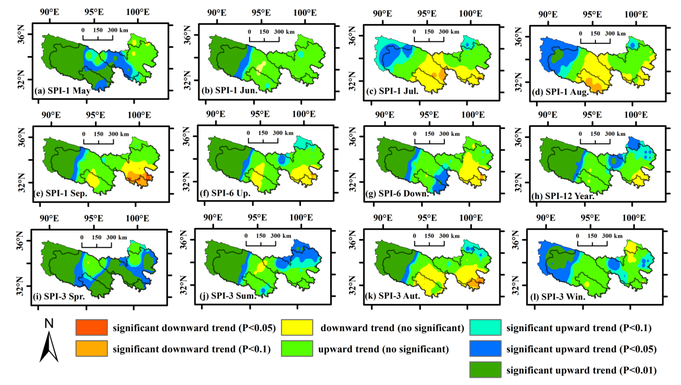

Figure 4: Using the Mann-Kendall (MK) trend test method, the monthly, seasonal, and interannual trends of the SPI.

◆ Temporal evolution characteristics of NDVI/EVI

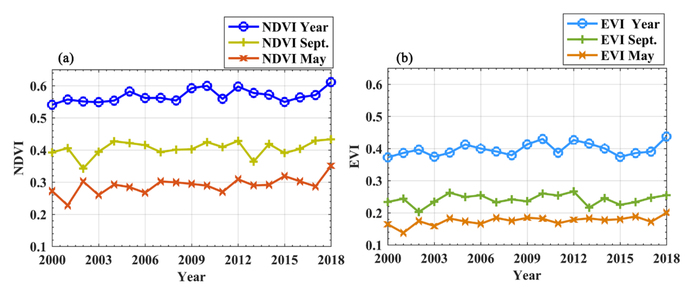

Figure 5: Time evolution distribution of vegetation index (NDVI/EVI).

◆ The response of vegetation coverage to the climate change

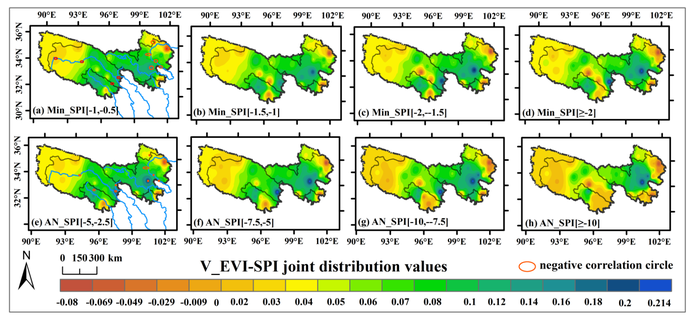

Figure 6: Based on the spatial distribution results of copula combined NDVI/EVI and Min_SPI3/ AN_SPI3 values.

Conclusion

The main conclusions of the study are summarized as follows:

(1) The SPI at different time scales in the past 58 years shows that the drought degree in the TRH region is gradually slowing down.

(2) The vegetation coverage in the east is significantly better than that in the northwest.

(3) The variation of EVI in the growing season is significantly more affected by drought for different vegetation indices and SPI characteristic variables. AN_SPI shows a more prominent impact than Min_SPI, especially the Lancang River and the area north of the Yangtze River.

(4) It is feasible to build a vegetation-drought multidimensional response model based on copula.

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