ISSN: 2414-1895 DOI: 10.6919/ICJE.202109_7(9).0003

Analysis of the Evolution Pattern of Water Surface Evaporation and the Influencing Factors in Yulin in the 21st Century

Liangyan Yang[1,2,3,4,a], Lei Shi[1,2,3,4]

[1]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co., Ltd., Xi'an 710021, China;

[2]Shaanxi Provincial Land Engineering Construction Group Co., Ltd, Xi'an 710075, China;

[3]Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi'an 710021, China;

[4]Shaanxi Provincial Land Consolidation Engineering Technology Research Center, Xi'an 710075, China.

[a]1025972293@qq.com

Abstract

Using weather station data to analyze the annual evapotranspiration and influencing factors in Yulin City from 2000 to 2019, and discuss the dominant meteorological factors affecting the changes in evapotranspiration. The results show that from 2000 to 2019, the annual evapotranspiration in Yulin City has an obvious upward trend, with a growth rate of 9.89mm/a; the correlation between evapotranspiration and meteorological factors on a daily scale is as follows: temperature>pressure> wind speed > relative humidity. Generally speaking, temperature is the main meteorological factor affecting the evapotranspiration changes in Yulin City.

Keywords

Yulin City; Evapotranspiration; Meteorological Factors; Correlation.

1. Introduction

Evapotranspiration is an important part of the surface water cycle and an important process to maintain the balance of surface energy and water [1]. Studies have shown that about 60% of the precipitation that reaches the surface of the earth through condensation is vaporized into the atmosphere through evapotranspiration, and the proportion is as high as 90% in arid areas [2]. At the same time, surface evapotranspiration directly or indirectly affects crop production, vegetation growth and economic development in the study area. The study of surface evapotranspiration has important guiding significance for the ecological environment protection, agricultural development and water resources utilization in the region [3,4]. At present, the acquisition of surface evapotranspiration is still in the development stage. With the rapid development of remote sensing quantitative inversion of surface evapotranspiration technology, a large number of measured evapotranspiration is required to verify the inversion results. However, the measured evapotranspiration data is very scarce, which seriously affects the results. The development of research on surface evapotranspiration. Meteorological factors are the main factors affecting surface evapotranspiration, and the meteorological factors are easy to obtain. This study takes Yulin City as the research object, uses the monitoring data of Yulin City Meteorological Station from 2000 to 2019, counts the evapotranspiration in the study area for many years, and analyzes the correlation between evapotranspiration and meteorological factors, aiming to detect water surface evaporation in Yulin

ISSN: 2414-1895 DOI: 10.6919/ICJE.202109_7(9).0003

City The evolution law of the quantity and the main influencing factors provide data support for the agriculture, economic development and ecological environment restoration of Yulin.

2. Data source and processing method

2.1 Data source.

The meteorological data in this study is the daily value data provided by the China Meteorological Data Sharing Service Network (http://data.cma.cn/) (China Surface Climate Data Daily Value Data Set V3.0), and the meteorological site is Yulin City, The site number is 53646, and the time span is 2000-2019. Meteorological data mainly include daily evapotranspiration, average temperature, average wind speed, relative humidity, average air pressure, etc. Among them, the measurement method of daily evapotranspiration includes small evaporating pan and E-601 evaporating pan. In order to ensure the uniformity of data, this article uses Liu Xiaoning According to the research results of [5], the conversion coefficient of the two was selected as 0.58, and the conversion coefficient was uniformly converted into small evaporating pan data. Use EXCEL to sum up the daily evapotranspiration in Yulin City from 2000 to 2019, and get the annual evapotranspiration at Yulin Station.

2.2 Research methods.

This study uses the trend line analysis method to study the change trend of annual evapotranspiration in Yulin City from 2000 to 2019, and calculates the slope of the trend line slope between the annual evapotranspiration and the time series. If Slope>0, it means that the annual evapotranspiration changes with time. An upward trend, Slope<0 means that the annual evapotranspiration has a downward trend over time, and the greater the absolute value of the slope, the more obvious the change in the annual evapotranspiration. The calculation formula is:

$$Slope=\frac{n*\sum_{i=1}^{n} i*ET_i-\sum_{i=1}^{n} i\sum_{i=1}^{n} ET_i}{n*\sum_{i=1}^{n} i^2-(\sum_{i=1}^{n} i)^2} \quad (1)$$

In the formula: Slope represents the change slope of annual evapotranspiration; n is the number of years in the monitoring period, and the value is 20 in this study; ET_i represents the evapotranspiration in the i-th year.

3. Result analysis

3.1 The changing law of annual evapotranspiration in Yulin City

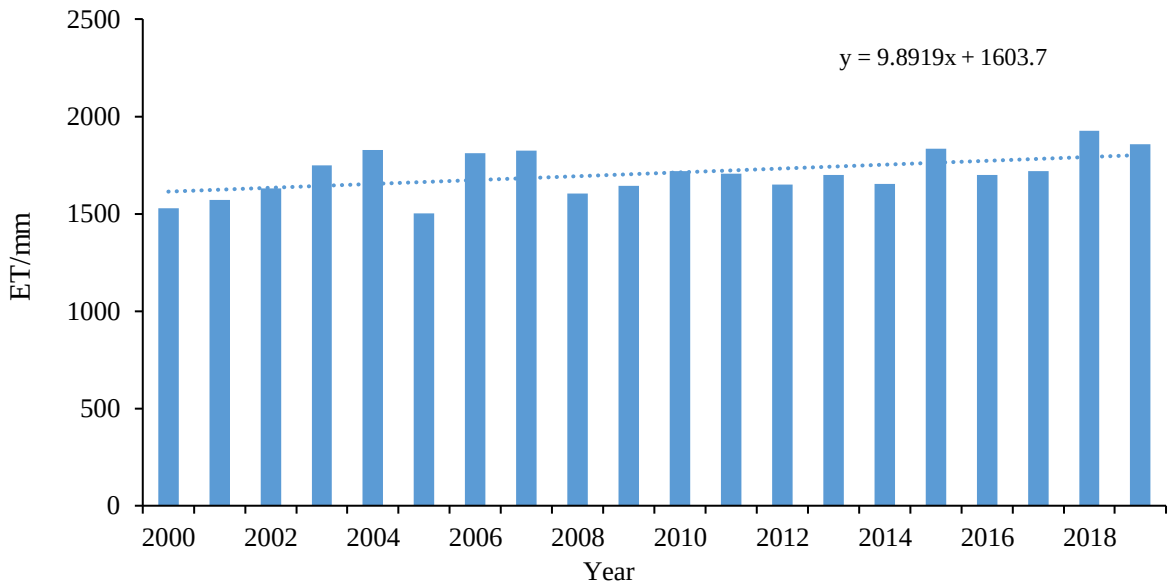

Fig. 1 Variation curve of evapotranspiration in Yulin City from 2000 to 2019

ISSN: 2414-1895 DOI: 10.6919/ICJE.202109_7(9).0003

It can be seen from Figure 1 that the multi-year evapotranspiration in Yulin City is 1500-2000mm, of which the evapotranspiration in 2003 was the smallest at 1502mm, and the evapotranspiration in 2016 was the largest at 1926mm, and the average evapotranspiration in 20 years was 1715mm. In order to further study the change trend of annual evapotranspiration in Yulin City, this paper uses trend line analysis to calculate the change rate of annual evapotranspiration in 2000-2007 and 2008-2019 (Table 1). It can be seen from the table that during 2000-2007, its annual evapotranspiration fluctuated greatly, and its growth rate was rapid, with an average growth rate of 35.7 mm/a; in 2006, its annual evapotranspiration decreased significantly, and then in 2008-2019, The annual evapotranspiration in Yulin City has increased year by year, with a growth rate of 20.3 mm/a. The 20-year average growth rate of annual evapotranspiration in Yulin City is 9.9mm/a. The above data shows that in the past 20 years, except for the low value of evapotranspiration in 2008, the annual evapotranspiration in Yulin City has gradually increased.

Table 1. The rate of change of annual evapotranspiration in Yulin City

Time period	2000-2007	2008-2019	2000-2019
Annual evaporation rate change	35.7 mm/a	20.3 mm/a	9.9mm/a

3.2 Analysis of influencing factors of evapotranspiration

Surface evapotranspiration is a complex physical process, which is closely related to air temperature, humidity, wind speed, and atmospheric pressure. In order to further explore the factors that affect evapotranspiration, this article counts the daily data of Yulin Meteorological Station for the whole year of 2019. Except for some missing data, a total of 330 sets of data are included. Use meteorological data to analyze the correlation between evapotranspiration and meteorological factors (Table 2). It can be seen from the table that on a daily scale, evapotranspiration has a significant correlation with air temperature and air pressure. The correlation coefficients are 0.6817 and 0.6049, respectively, but they are positively correlated with air temperature and negatively correlated with air pressure; they have no obvious correlation with wind speed and humidity. The correlation coefficients are 0.1025 and 0.0913 respectively. The overall correlation between evapotranspiration and various meteorological factors is air temperature>pressure>wind speed>relative humidity.

Table 2. Correlation between evaporation and various meteorological factors in Yulin City

Correlation coefficient	Air temperature	Air pressure	Wind speed	Relative humidity
ET	0.6817	0.6049	0.1025	0.0913

4. Conclusion

Using weather station data to analyze the evapotranspiration and influencing factors in Yulin City from 2000 to 2019, the dominant meteorological factors affecting the changes in evapotranspiration were discussed. The results show that the average evapotranspiration in Yulin City from 2000 to 2019 was 1715mm, and the annual evapotranspiration showed a gradual increase in 20 years, and the overall growth rate was 9.89mm/a; the evapotranspiration has a significant correlation with temperature and pressure. The correlation coefficients are 0.6817 and 0.6049 respectively, which are not significantly correlated with wind speed and humidity. The correlation between evapotranspiration and meteorological factors on the daily scale is air temperature>pressure>wind speed>relative humidity. Generally speaking, temperature is the main meteorological factor affecting the evapotranspiration changes in Yulin City.

ISSN: 2414-1895 DOI: 10.6919/ICJE.202109_7(9).0003

Acknowledgments

This work was supported by the Scientific Research Item of Shaanxi Provincial Land Engineering Built-up Group (DJNY2021-33).

References

[1] Zhang Ronghua. Analysis of evapotranspiration characteristics and water volume changes in the Weihe River Basin [D]. Beijing Normal University, 2013.

[2] Wang Tong, Tang Ronglin, Li Zhaoliang, et al. Research progress on daily-scale expansion methods for remote sensing inversion of evapotranspiration [J]. Journal of Remote Sensing, 2019, 23(5): 813-830.

[3] Han Jingyan, Zhao Yong, Wang Jianhua, et al. The impact of different land use types on potential evapotranspiration in the Beijing-Tianjin-Hebei region [J]. Journal of Geographical Sciences, 2019, 29(6): 922-934.

[4] Yang Liangyan. Remote sensing estimation of evapotranspiration in arid areas based on the optimized SEBAL model [D]. Chang'an University, 2019.

[5] Liu Xiaoning, Wang Shuqing, Wu Zengxiang, et al. Comparative analysis of two evaporation observation data in my country [J]. Journal of Applied Meteorology, 1998(3): 66-73.