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Difference Analysis of Observation Data Between E-601 Type and 20cm Caliber Small Evaporator

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Abstract

E-601 and 20cm caliber small evaporators are the most important evaporation monitoring instruments in my country. In this study, by collecting the simultaneous observation data of E-601 and 20cm caliber small evaporators from five meteorological stations in the northwest, and using the linear fitting method to explore the conversion coefficient K of two kinds of water surface evaporators in the study area is obtained. The monitoring data of E-601 type and 20cm caliber small evaporator have good correlation, the K value is between 0.5616~0.6649, the average is 0.6324, and the conversion coefficient of the two water surface evaporators increases month by month from May to September; The annual variation of water surface evaporation at the weather station is consistent, and the maximum value is in June, and there is a one-month difference between the maximum value and the temperature.

Keywords

Water surface evaporation; E-601 evaporator; 20cm caliber small evaporator; Conversion coefficient.

1. Introduction

Evapotranspiration is an important part of the balance of water and heat on the earth's surface and plays an important role in the global water cycle and energy cycle [1]. Evapotranspiration not only affects the growth, development and yield of crops, but also plays a role in regulating climate [2] and monitoring agricultural drought [3]. It is widely used in soil science, hydrology, climatology, ecology, and environmental science. [4,5]. Therefore, the study of land surface evapotranspiration has important guiding significance for climate change, rational allocation of water resources, ecological environment construction and the development of agriculture and forestry in the study area.

Water surface evaporation is the most direct data to reflect evapotranspiration, and it is also the most important ground verification data for surface evapotranspiration inversion by remote sensing. At present, the evaporation of water surface in my country is monitored by different evaporators in the weather station to obtain data similar to the evaporation of natural water bodies near the station. The mainstream evaporators in my country include 20cm caliber small evaporators and E-601 type evaporators. Among them, the data of the 20cm caliber small evaporator began in the 1950s. It has the advantages of good data continuity and wide

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distribution, and is an important basic data for climate research in my country. However, due to the defects of its own structure, the 20cm caliber small evaporator cannot represent the actual evaporation of the weather station, and some areas are gradually replaced by the E-601 evaporator. The data measured by the E-601 evaporator is closer to the actual evaporation, but its time continuity is short, and it cannot be measured in winter in the northern region, and the total evaporation data in winter and the whole year is lacking. Due to the influence of climate factors such as temperature, humidity and wind speed, seasons, terrain around the observation site, ground objects, the geometric size, structure, installation method and material of the evaporator, the measured water surface evaporation values of various instruments are very different. In order to obtain the long-term water surface evaporation, it is necessary to determine the water surface evaporation conversion coefficient of various instruments [6].

2. Data Sources

The meteorological data comes from the China Meteorological Data Network (https://data.cma.cn/). There are 5 national meteorological stations in the study area, namely Hengshan Station (53740), Dingbian Station (53725), Yanchi Station (53723), Yulin Station (53646), and Etuoke Banner Station (53529), the daily evaporation data of each meteorological station from 1990 to 2017 were selected for analysis and analysis. There is a problem that the monitoring data of two different water surface evaporators are limited, resulting in the lack of some evaporation data for both the E-601 type and the 20cm caliber small evaporator. The 20cm caliber small evaporator mainly lacks the data from May to September after 2002, and the E-601 type evaporator mainly lacks the data from January to March and October to December.

3. Result Analysis

There are differences between E-601 type and 20cm caliber small water surface evaporator in instrument structure, setting scheme and observation method. Therefore, in order to maintain the continuity and consistency of the data of each station, it is necessary to explore the conversion coefficients of the two types of water surface evaporators to unify the data. The calculation formula is:

$$E_{E\text{-}601}=K\times E_{20}$$

In the formula: $E_{E\text{-}601}$ is the water surface evaporation monitored by the E-601 water surface evaporator, E_{20} is the water surface evaporation monitored by the 20cm caliber small evaporator, and K is the E-601 type Conversion factor for evaporator and 20cm caliber small evaporator.

Through the analysis of the data of the 20cm caliber small water surface evaporator and the E-601 type water surface evaporator at the same period of five meteorological stations in Hengshan, Dingbian, Yanchi, Yulin and Etuoke Banner, the results are shown in Table 1. The conversion coefficients of the E-601 and 20cm caliber small evapotranspirators in Hengshan, Dingbian, Yanchi, Yulin and Otuoke Banners are 0.6003, 0.6421, 0.6582, 0.6649 and 0.5616, respectively, and the average conversion coefficient is 0.6324. Five meteorological stations of the correlation coefficients of the evaporator monitoring data were 0.9831, 0.9508, 0.9767, 0.9378 and 0.9619 respectively. The correlation coefficients of the two types of water surface evaporation from the five meteorological stations were 0.9529, all exceeding 0.9. It shows that the data of E-601 type and 20cm caliber small evaporator are reasonable and accurate, and have good reliability and consistency, and can be converted into each other by the conversion coefficient.

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Table 1. Conversion coefficient of water surface evaporation during non-freezing period at some meteorological stations in Mu Us Sandy Land

Site name	Station	Number of samples	K	R
Hengshan	53740	29	0.6003	0.9831
Dingbian	53725	61	0.6421	0.9508
Yanchi	53723	37	0.6582	0.9767
Yulin	53646	61	0.6649	0.9378
Otuoke	53529	21	0.5616	0.9619
total		209	0.6324	0.9529

However, considering that the conversion coefficients of E-601 and 20cm caliber small water surface evaporators are greatly affected by the environment, it is necessary to analyze the conversion coefficients of the two water surface evaporators in different months. Considering the number of samples comprehensively, Dingbian Station and Yulin Station with a large number of samples were selected to study the conversion coefficient of the non-freezing ice period from May to September. The results are shown in Tables 2 and 3. The water surface evaporation conversion coefficient of Dingbian Station from May to September is 0.6257~0.6662, and the water surface evaporation conversion coefficient of Yulin Station is 0.6348~0.6942. In addition, the conversion coefficients of the two stations increased gradually each month. The possible reason was that the small evaporator was 70 cm away from the ground, while the E-601 water surface evaporator was embedded in the ground, and the temperature began to rise sharply from May to September. The surface temperature rises rapidly, and the contribution of the surface temperature to the evaporation of the water surface increases, which leads to the gradual increase of the monitored value of the E-601 evaporator relative to the small evaporator, which causes the conversion coefficient of the two evaporators to increase month by month. increase phenomenon.

Table 2. Conversion coefficient of E-601 and small evaporator in Dingbian station from May to September

Month	5	6	7	8	9	Average
K	0.6257	0.6294	0.6491	0.6642	0.6662	0.6469

Table 3. Conversion coefficient of E-601 and small evaporator in Yulin station from May to September

Month	5	6	7	8	9	Average
K	0.6348	0.6575	0.6753	0.6865	0.6942	0.6697

Through the analysis of the conversion coefficient of evaporation at different stations, the conversion coefficient of E-601 type and 20cm caliber small evaporator is between 0.5616 and 0.6649, and the average conversion coefficient of the whole basin is 0.6324. There are differences in the conversion coefficients in different months. The conversion coefficient of Dingbian Station is 0.6257~0.6662 from May to September, and the average conversion coefficient is 0.6469; the conversion coefficient of Yulin Station is 0.6348~0.6942 from May to September, and the average conversion coefficient is 0.6697.

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4. Summary

Based on the collected and sorted data of water surface evaporation from meteorological stations from 1990 to 2017, the conversion coefficients of E-601 and 20cm caliber small water surface evaporators were explored. The results show that the conversion coefficient of E-601 type and 20cm caliber small evaporator in Mu Us Sandy Land is between 0.561 6~0.664 9, and the average conversion coefficient of the whole basin is 0.632 4. The conversion coefficient of different weather stations is affected by the environment and climate. There are certain differences, and the conversion coefficient of water surface evaporation of the two types of evaporators increases month by month from May to September.

The material, model and specification of Chinese evaporators have a significant impact on the determination of water surface evaporation. E-601 and 20cm caliber small evaporators are the mainstream water surface evaporators in my country, and they can complement each other in the monitoring data of weather stations, but at the same time, the conversion coefficients of the two are different in different regions. Using monitoring data from five meteorological stations, this study found that the conversion coefficient of E-601 and 20cm caliber small evaporators is between 0.5616 and 0.6649, which is basically consistent with the research results of Sheng Qiong. The annual average monthly conversion coefficient in Southwest China ranges from 0.65 to 0.85, and the multi-year average conversion coefficient is 0.75, indicating that the conversion coefficients of E-601 and 20cm caliber small evaporators are smaller in the north and larger in the south, and the humid area is larger than the arid area. characteristics of the district.

Due to the lack of data, the paper does not analyze the monthly conversion coefficient of each meteorological station in detail. In the later research, it is necessary to establish a water surface evaporation monitoring station in the study area to collect long-term series of two types of evaporator data. The conversion coefficient K value provides data support.

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References

[1] Tang R L, Li Z L, Sun X M. Temporal upscaling of instantaneous evapotranspiration: an intercomparison of four methods using eddy covariance measurements and MODIS data. Remote Sensing of Environment. Vol. 138 (2013), p. 102-118.

[2] Wang Tong, Tang Ronglin, Li Zhaoliang, et al. Research progress on daily-scale expansion methods for remote sensing inversion of evapotranspiration. Journal of Remote Sensing. Vol. 23 (2019) No. 5, p. 813-830.

[3] Tong Shanlin, Cui Chenfeng, Wu Ni, et al. Effects of changes in underlying surface characteristics on evapotranspiration in arid regions. Water Saving Irrigation. Vol. (2020) No. 7, p. 59-62.

[4] Ma Ji'an, Feng Kepeng, Li Wangcheng, et al. Estimation of soil evaporation in the central arid zone of Ningxia based on water surface evaporation. Journal of Irrigation and Drainage. Vol. 39 (2019) No. 10, p. 35-41.

[5] Yang Y H, Zhang Z Y, Xiang X Y. Spatial variation of reference crop evapotranspiration on Tibetan Plateau. Water Science and Engineering. Vol. 2 (2009) No. 1, p. 112-120.

[6] Hu Shunjun, Tian Changyan, Song Yudong, et al. Analysis on the conversion coefficient of water surface evaporation in the Tarim River Basin. China Desert. Vol. 25 (2019) No. 5, p. 649-651.

ISSN: 2688-8645

[7] Wang Yongliang, Zhang Xuezhi, Qiao Guangjian. Analysis of conversion coefficient of 20m2 water surface evaporation pond and different types of evaporators in plain area of Hebei Province. Hydrology. Vol. 32 (2019) No. 4, p. 58-62.