UDC 551.515

CLIMATE AND HYDROLOGICAL CHANGES IN XINJIANG (CHINA) AND THEIR IMPACTS

Yu Zhikun

Belarusian State University, Nezavisimosti., 4,
220083, Minsk, Belarus, yuzhikun3322@gmail.com

Based on the findings, combined with literature review and modeling predictions, the climate and hydrological changes of Xinjiang were systematically analyzed, and the impact of climate change on the ecology and development of drylands was examined. The results show that temperature and precipitation will also tend to increase in the 21st century, but the overall pattern of dry climate in Xinjiang will not change; the frequency and intensity of extreme climate change events in Xinjiang will further increase in the future.

Keywords: *China; Xinjiang; climate; hydrology; arid areas; ecosystem.*

КЛИМАТИЧЕСКИЕ И ГИДРОЛОГИЧЕСКИЕ ИЗМЕНЕНИЯ В СИНЬЦЗЯНЕ (КИТАЙ), И ИХ ПОСЛЕДСТВИЯ

Ю Жикунь

Белорусский государственный университет, Независимости, 4,
220083, Минск, Беларусь, yuzhikun3322@gmail.com

На основе полученных данных в сочетании с обзором литературы и прогнозами моделирования были систематически проанализированы климатические и гидрологические изменения Синьцзяна, а также рассмотрено влияние изменения климата на экологию и развитие засушливых территорий. Результаты показывают, что температура и количество осадков также будут иметь тенденцию к увеличению в 21 веке, но общая картина засушливого климата в Синьцзяне не изменится; в будущем частота и интенсивность экстремальных проявлений изменения климата в Синьцзяне будут еще больше увеличиваться.

Ключевые слова: *Китай; Синьцзян; климат; гидрология; засушливые районы; экосистема.*

Introduction. Since the 21st century, Xinjiang's "warm and humid" climate and its impacts have attracted widespread attention and discussion from the scientific community and the public. Based on the searched data, combined with literature review and model simulation predictions, Xinjiang's climate and hydrological changes were systematically analyzed, including changes in temperature, precipitation, extreme events, glaciers, lakes and river runoff. This

paper systematically reviews the impact of hydrological changes on the ecology and development of Xinjiang from aspects such as mountainous areas, basin topography, regional water vapor sources and sinks under the influence of climate, and their impact on precipitation and water vapor cycle processes.

Data and Methods. Observed daily value temperature, maximum and minimum temperatures, and precipitation data were provided by the National Meteorological Information Center of the China Meteorological Administration (http://www.nmic.gov.cn/). Calculate the extreme climate index of warm days, warm nights, cold days, cold nights, maximum Tmax, minimum precipitation, number of heavy rain days. Potential evapotranspiration (PET) is estimated using the Penman-Monteith (P-M) equation and actual evapotranspiration (AE) is estimated using Budyko theory (Fu, 1981; Yao et al., 2020 a). This article uses the analytical solution of Budyko theory proposed by Fu (1981), which can be expressed as:

$$\frac{ET}{P} = 1 + \frac{PET}{P} - \left[1 + \left(\frac{PET}{P}\right)^{\overline{w}}\right]^{1/\overline{w}}$$

Results. Based on observational meteorological records and multisource data, it is revealed that Xinjiang has experienced a significant warming and wetting trend since 1961. The annual average temperature change trends in Xinjiang from 1961 to 2018 was higher than the global land and national levels, with a warming rate of about 0.30 ºC. /10 a; the annual precipitation has an obvious increasing trend, with an increase rate of 9.9 mm/10 a. The increase is more significant in mountainous areas, showing obvious "humidification altitude dependence" characteristics, and at the same time, the inter-annual variability of precipitation has increased. Extreme high temperature events in Xinjiang have increased significantly, extreme cold events and cold waves have decreased significantly, and precipitation changes have shown an extreme trend. The climate has changed significantly since the 21st century, manifested by a sudden increase in temperature and maintenance of high temperature fluctuations, and a slowdown in the increase in precipitation. Xinjiang's climate is experiencing both "warm-humidification" and "warm-drying", with most areas showing signs of a "wet-dry transition" and extreme events occurring frequently.

The forecast results show that both temperature and precipitation will also show an increasing trend in the 21st century, but the overall pattern of arid climate in Xinjiang will not change; in the future, the frequency and intensity of extreme warm events and extreme precipitation events in Xinjiang will further increase, and the frequency and intensity of extreme cold events will increase further. If it decreases further, the amount of heavy precipitation and

the frequency of heavy precipitation events will increase significantly. The above studies show that Xinjiang has had significant hydrological and ecological effects on global climate change in recent decades, and may intensify in the future, with potential impacts on the region's ecology, water resources security, and sustainable socioeconomic development. This result can provide scientific and technological support for the comprehensive assessment of the impact of hydrology, water resources and ecological environment in Xinjiang under the background of climate change.

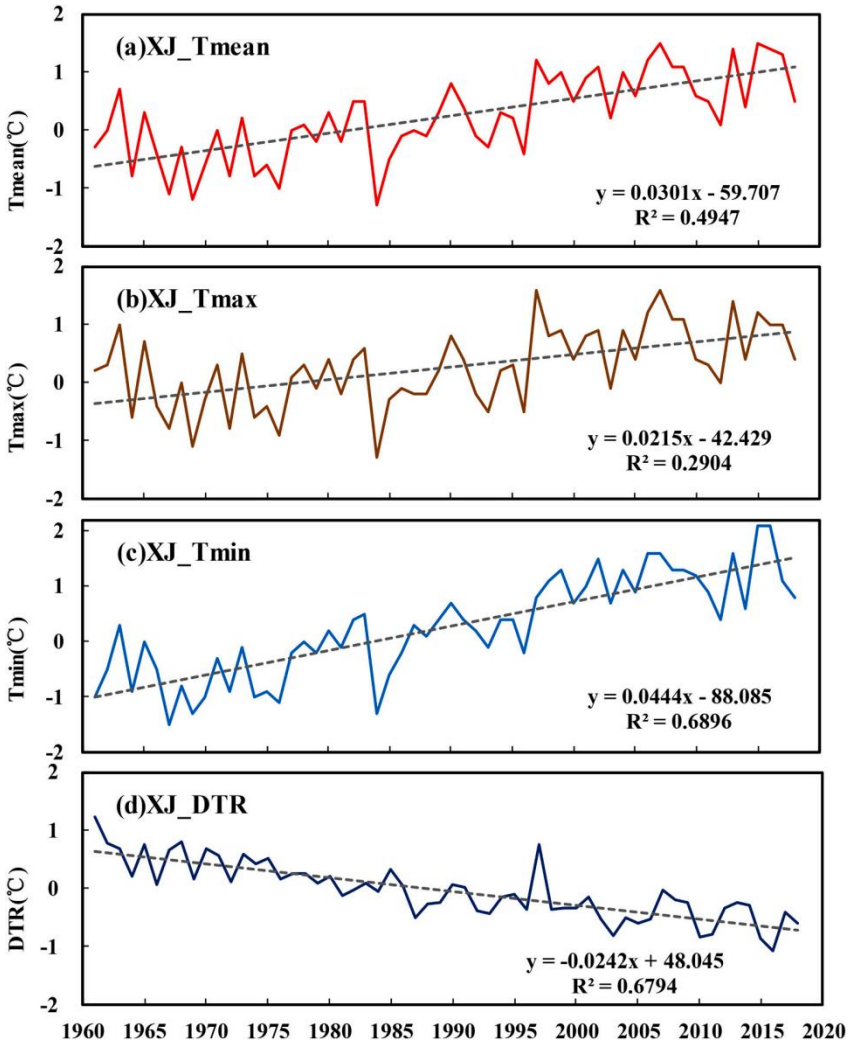

Fig. 1. Time series of annual air temperature value (Tmean, a) anomalies, maximum (Tmax, b) and minimum (Tmin, c) air temperature anomalies and DTR (d) in XJ. The anomaly was calculated based on 1971-2000 climatological data.
Source: https://data.cma.cn/site/subjectDetail/id/101.html

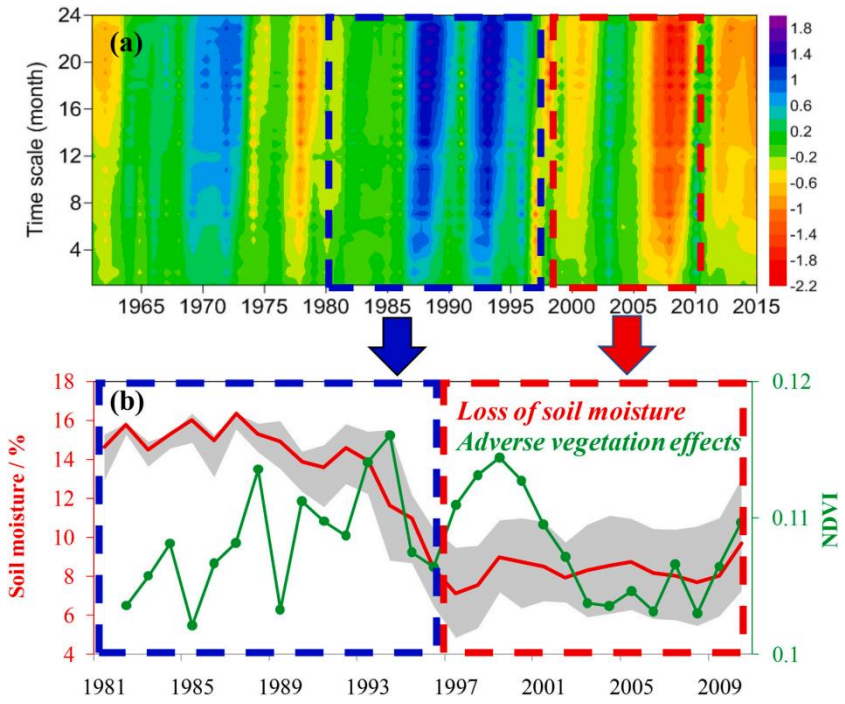

Fig. 2. (a) Change in SPEI at different timescales (1 to 24 months) in XJ during 1961- 2015. *(b)* Evolution of soil moisture (red solid line) and vegetation NDVI (green solid line) in XJ during 1982-2010. Red dotted line represents the warm – humid climate during 1985-1997; blue dotted line represents the climatic wet – to – dry shift since 1997. Gray shadow represents soil moisture at each depth (0 - 50 cm) in XJ.
Source: https://data.cma.cn/site/subjectDetail/id/101.html

Conclusions. At present, there is still a lack of first-hand monitoring data in high-altitude areas and desert hinterlands, which limits the understanding of the interaction processes and mechanisms of Xinjiang's mountain-oasis-desert climate and hydrological systems. In the future, we need to comprehensively consider the three major ecological and water cycle processes of Xinjiang's mountains, oases and deserts, establish a long-term and continuous monitoring system, and improve the impact and adaptation system of the climate-ecological-economic-social system, which will help us deal with climate warming and A comprehensive assessment of its impact on hydrology, water resources and ecological environment in Xinjiang.Make more reasonable predictions about the hydrology and climate of this special situation in Xinjiang.

References

1. Wei Guanghui. Some thoughts on water resources and ecological security in the Tarim River Basin in Xinjiang [J]. China Water Resources, 2021(05):28-30.

2. Yang Pengnian. Analysis of water resources status and response measures in Jimunai County, Xinjiang [J]. Shaanxi Water Conservancy, 2020(10):19-21.