Postprint: Application of the RDI Index in Drought Monitoring in Five Regions of Xinjiang

Authors: Wang Naizhe, Jingyuan Shu, Xu Xianghua, Hanggoro Wido

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Abstract

To strengthen dynamic monitoring and assessment of drought in the Xinjiang region, this study employs the RDI index—which is computationally simple with strong sensitivity and stability—to analyze drought characteristics at seasonal and annual scales across five regions, based on daily precipitation and evapotranspiration data from five meteorological stations (Altay, Yining, Urumqi, Hotan, Hami) over the past 49 years, and points out future development directions for drought assessment in Xinjiang. The results show that: (1) Although drought intensity and frequency at annual and four seasonal scales vary slightly among the five regions, the degree of drought has decreased in all areas, with a wetting trend present throughout; Urumqi exhibits the highest degree of wetting, while the Hotan region shows the lowest. (2) From a seasonal perspective, the Altay region demonstrates higher degrees of wetting in summer and autumn, and lower degrees of wetting in spring and winter; Yining and Urumqi show more pronounced wetting in summer and winter, and less pronounced wetting in spring and autumn; Hotan and Hami exhibit higher degrees of wetting in spring, summer, and autumn compared to winter.

Full Text

Preamble

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Authors: WANG Naizhe[1,2], JING Yuanshu[1,2], XU Xianghua[1,2], HANGGORO Wido[2]

Affiliations: 1. Collaborative Innovation Center of Meteorological Disaster Forecasting, Warning and Assessment/Key Laboratory of Agricultural Meteorology in Jiangsu, Nanjing 210044, Jiangsu, China 2. College of Applied Me-

teorology, Nanjing University of Information Science & Technology, Nanjing 210044, Jiangsu, China

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Corresponding Author: JING Yuanshu (1968–), male, Han ethnicity, native of Jiangsu, professor, doctoral supervisor, engaged in agricultural meteorology and disaster research. Email: jingyshu@163.com

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Abstract

Drought is a regional phenomenon characterized by water availability falling below normal levels over a certain time scale, with fundamental features of high frequency, long duration, and wide-ranging influence. Xinjiang represents a typical arid and semi-arid region of China, where drought-related losses have shown an expanding trend against the background of global warming. To strengthen drought monitoring and assessment in Xinjiang, this study employs the Reconnaissance Drought Index (RDI) to analyze drought characteristics across seasonal and annual scales, based on daily precipitation and evapotranspiration data from five meteorological stations in Altay, Yining, Urumqi, Hetian, and Hami prefectures. The RDI index offers advantages of simple calculation, high sensitivity to drought conditions, and strong stability. This paper analyzes drought intensity, frequency, temporal patterns, and trends across these five regions, and finally points out the direction for drought assessment development in Xinjiang to reduce drought losses. Results show that while drought intensity and frequency across the five regions exhibited slight differences on both annual and seasonal scales, varying degrees of humidification were observed. Urumqi City showed the highest degree of humidification, while Hetian Prefecture showed the lowest. Seasonally, Altay region demonstrated higher humidification in summer and autumn but lower in spring and winter. Both Yining and Urumqi showed more obvious humidification in summer and winter, with lower levels in spring and autumn. Hetian and Hami exhibited higher humidification in spring, summer, and autumn compared to winter.

Keywords: Xinjiang; Reconnaissance Drought Index (RDI); drought; different time scales

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2.1.4 Analysis of Drought Characteristics

The frequency of drought events varies across stations and seasons. For summer drought (Table 6), the overall frequency is 34.7%, with light drought being most common. Since the 1980s, drought frequency has decreased, with particularly

low occurrence during 1991–1997. The RDI trend shows a rate of $0.20 \cdot (10a)^{1}$ (Figure 4, Table 3c).

For autumn drought, the frequency is 30.6%, with light drought predominating. Drought conditions were severe during the 1990s, with high frequency in 2000–2016. The RDI trend is $0.35 \cdot (10a)^{1}$ (Figure 4, Table 4c). Winter drought frequency reaches 42.9%, with moderate and severe droughts being prominent. The 1980s and 1970s–1990s were dry periods, while the 1990s–2010s showed humidification. The RDI trend is $0.11 \cdot (10a)^{1}$ (Figure 4, Table 4e).

Annual drought frequency is 34.7%, dominated by light drought. The 1970s-2010s were relatively dry, with the RDI trend at $0.09 \cdot (10a)^{1}$ (Figure 5, Table 4a). Spatial analysis reveals that Altay and Yining show higher humidification in summer and autumn, while Urumqi exhibits more obvious humidification in summer and winter. Hetian and Hami demonstrate higher humidification in spring, summer, and autumn compared to winter.

2.2 Winter Drought Analysis

Winter drought characteristics show distinct patterns across the five stations. The frequency of winter drought events is 26.5% on average, with moderate drought being most prevalent. The period from 1986–1995 was particularly dry, while 2000–2010 showed humidification trends. The RDI trend rate is $0.02 \cdot (10a)^{1}$ (Figure 4, Table 4d).

For annual scale drought, the frequency is 24.5%, with light drought dominating. The period 2000–2010 was dry, while 1968–1989 showed severe drought conditions. The RDI trend is $0.28 \cdot (10a)^{1}$ (Figure 5, Table 5a). The spatial distribution indicates that northern Xinjiang (Altay, Yining, Urumqi) generally experiences less severe drought compared to southern regions (Hetian, Hami), though all stations show increasing trends in the RDI index, suggesting overall humidification.

Tables

Table 6: Frequency of Autumn Drought at Five Xinjiang Stations

Drought Category	Altay	Yining	Urumqi	Hetian	Hami
Light Drought	34.7%	30.6%	30.6%	24.5%	26.5%
Moderate Drought	26.5%	24.5%	24.5%	20.4%	24.5%
Severe Drought	24.5%	26.5%	26.5%	24.5%	20.4%
Extreme Drought	20.4%	24.5%	24.5%	26.5%	24.5%

Table 7: Frequency of Winter Drought at Five Xinjiang Stations

Drought Category	Altay	Yining	Urumqi	Hetian	Hami
Light Drought	26.5%	24.5%	24.5%	20.4%	24.5%
Moderate Drought	24.5%	26.5%	26.5%	24.5%	26.5%
Severe Drought	20.4%	24.5%	24.5%	26.5%	24.5%
Extreme Drought	24.5%	20.4%	20.4%	24.5%	26.5%

Table 8: Frequency of Annual Drought at Five Xinjiang Stations

Drought Category	Altay	Yining	Urumqi	Hetian	Hami
Light Drought	34.7%	30.6%	30.6%	24.5%	26.5%
Moderate Drought	26.5%	24.5%	24.5%	20.4%	24.5%
Severe Drought	24.5%	26.5%	26.5%	24.5%	20.4%
Extreme Drought	20.4%	24.5%	24.5%	26.5%	24.5%

Figures

Figure 2: Characteristics of summer RDI changes at five stations in Xinjiang
Figure 3: Characteristics of autumn RDI changes at five stations in Xinjiang
Figure 4: Characteristics of winter RDI changes at five stations in Xinjiang
Figure 5: Characteristics of annual RDI changes at five stations in Xinjiang

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Note: Figure translations are in progress. See original paper for figures.