Spatiotemporal Variation Characteristics of Dry-Hot Wind Events in the Hexi Region over the Past 50 Years: Postprint

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Abstract

To investigate the variation trends and impact scope of dry-hot wind events in the Hexi region under the background of global change, based on the national meteorological industry standard for spring wheat in the Hexi region, and using daily maximum temperature and relative humidity at 14:00 from June to July during 1960–2017 at 13 meteorological stations in the Hexi region, the spatiotemporal variation characteristics of dry-hot wind events were analyzed. The results show that: Except for areas with higher altitudes where no dry-hot wind events occurred, all other regions exhibited an increasing trend with significant differences in growth magnitude. After 2000, the increase in severe dry-hot wind events became more pronounced, and the occurrence intensity of dry-hot wind events increased rapidly. The high-value areas of dry-hot wind occurrence did not change significantly across decades, but the number of occurrence days showed obvious variations. The spatial distribution pattern of dry-hot wind events in the Hexi region shows more occurrences in the west and fewer in the east, more in the north and fewer in the south. Lower altitude areas had more years meeting the annual type standard for dry-hot wind. The number of stations affected by a single dry-hot wind process and the duration have increased and extended, with the occurrence scope of dry-hot wind events further expanding to higher latitude and higher altitude areas.

Full Text

Spatiotemporal Variation of Dry-Hot Wind Events in the Hexi Region in Recent 50 Years

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Abstract

Based on national meteorological industry standards, using daily maximum temperature and relative humidity data at 14:00 from June and July recorded at 13 meteorological stations in the Hexi region from 1960 to 2017, this study analyzes the spatiotemporal distribution and evolution characteristics of dry-hot wind events. The purpose is to explore the changing trends and impacts of dry-hot wind events in the Hexi region under global climate change. The results indicate: Except for high-altitude areas, dry-hot wind events show an overall increasing trend with significant regional differences in increase rates. After 2000, the intensity of dry-hot wind increased rapidly, particularly for severe dry-hot wind events. While the spatial area of high-frequency occurrence zones remained relatively stable across decades, the number of occurrence days changed significantly; The frequency of dry-hot wind is higher in the western and northern parts than in the eastern and southern parts, and is also higher in low-altitude areas; The affected area of dry-hot wind events has expanded, the duration has prolonged, and dry-hot wind tends to extend toward higher latitudes and altitudes.

Keywords: dry-hot wind; spatiotemporal variation; climate change; annual type grade; Hexi Region

3 Results

3.1 Temporal Variation Characteristics

3.1.1 Trend of Dry-Hot Wind Days The spatial distribution of average annual frequency and days of dry-hot wind in the Hexi region from 1960 to 2017 is shown in [Figure 2: see original paper]. Both frequency and days exhibit a pattern of high values in the west and north, and low values in the east and south. Areas with elevations below 1300 m show higher dry-hot wind frequency, accounting for 36% of the region, while areas above 1300 m account for 24%. The average number of dry-hot wind days in low-altitude areas is 2.8 days, with some stations recording up to 4.8 days during the 1960-2017 period.

The climatic tendency rate of dry-hot wind days from 1960 to 2017 is $%&' ()*+ <!' =¨、(cid:137) >?@{uf(cid:152) ，(cid:128) v w $ d・(10a)^-1. The rates vary by period: 0.9 d・a^-1, 0.7 d・a^-1, and 0.8 d・a^-1 for different subregions. At elevations above 1750 m, the frequency decreases significantly. The trend analysis reveals that after 2005, dry-hot wind days increased sharply, with an additional 22 days compared to the previous period. The rate of increase reached 1.3 d・(10a)^-1 during 2000-2010, and 1.8 d・(10a)^-1 in recent years, with event durations typically lasting 4-5 days.

[Figure 6: see original paper] illustrates the interannual distribution of dry-hot wind intensity indices at different stations, while [Figure 7: see original

paper] shows the interannual variation of dry-hot wind process durations. The data indicate that the 2000s witnessed the most significant increase, with severe events occurring in 2004 and 2010. In 2017, the region experienced 12, 10, and 11 days of dry-hot wind at different intensity levels, representing increases of 31%, 44%, and 29% respectively compared to the 1980s. The proportion of stations experiencing severe dry-hot wind increased by 53% in low-altitude areas and 75% in mid-altitude regions during this period.

3.2.4 Annual Type Grade Classification of annual dry-hot wind severity shows that years with severe conditions increased significantly after 2000. The correlation coefficient between dry-hot wind days and agricultural yield reduction is ($P<0.05$), indicating statistically significant negative impacts on crop production. The period from 2000 to 2010 represents a critical transition, with the frequency of severe dry-hot wind events showing a dramatic rise compared to the 1960s-1990s baseline.

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