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Research Article

Research on the Differences of Climatic Characteristics of Different Levels of Gale Disasters in Northern Xinjiang

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Abstract

Disaster damage index and disaster grades are constructed by using multi index method on the basis of overall consideration, based on the disaster data of 671 wind disasters taking place in 38 counties (cities) in Northern Xinjiang from 1980 to 2019, and by selecting six disaster factors including the death toll, the number of collapsed houses, the number of collapsed sheds, the number of damaged green houses, the number of livestock deaths and the affected area caused by each wind disaster event. The results show that in space, wind disasters are the most frequent in Bortala Mongol Autonomous Prefecture and Altay Prefecture, and the losses caused by wind disasters are the most severe along Tianshan Mountain in Northern Xinjiang and Altay Prefecture. In terms of time, wind disasters in Northern Xinjiang are mainly concentrated in spring and summer (from March to August), of which April and May are the months with the highest frequency. In recent 40 years, the occurrence times and extent of harm of wind disasters in Northern Xinjiang have shown a linear growth trend; the occurrence times of wind disasters at various grades and the extent of harm have increased significantly during the years around 2000; it is found, upon examination, there was a sudden change of climate in the late 1990s, and the increase rate is inversely proportional to the grade of wind disaster. Therefore, the wind disasters in Bortala Mongol Autonomous Prefecture, Altay Prefecture and the area along Tianshan Mountain in Northern Xinjiang from April to May each year are the areas in Northern Xinjiang with the highest wind disaster risk. The study can provide scientific basis for wind disaster prevention and control in Northern Xinjiang.

Keywords

Wind Disasters, Disaster Damage Index, Grades, Temporal and Spatial Distribution, Northern Xinjiang

1. Introduction

Wind disaster is a common natural disaster caused by wind, which has a serious impact on human social economy, agricultural and animal husbandry production and daily life. Xinjiang is one of the areas with frequent winds in China, where the wind is strong, the number of days is large, and the duration is long. Therefore, wind disasters have also become a major meteorological disaster in Xinjiang [1]. Desert area in Xinjiang is wide, wind and sandstorm are frequent, which can easily damage the surface soil structure of cultivated land, expose the root system of crop seeds or seedlings, and cause

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damage and even death of tall crops and mature crops such as lodging and falling grains [2-8]; Hot, dry winds also enhance transpiration of crops, making them more vulnerable to drought [9]. Xinjiang loses thousands to millions of mu of farmland every year due to wind disasters. Winter winds are often accompanied by cold waves, and sometimes people and animals in pastoral areas are frozen to death due to wind and snow, and poor visibility. Wind disasters not only harm agricultural and animal husbandry production, but also cause damage and collapse of houses, greenhouses and livestock sheds, and even casualties [10-12]. In recent years, the losses and impacts caused by wind disasters have shown an upward trend, which is increasingly harmful to economic development and the safety of people's lives and property [13]. The frequency and damage caused by wind disasters in northern Xinjiang are higher than those in southern Xinjiang. In-depth study of the hazard assessment methods and development trends of the current wind disaster in northern Xinjiang is of great significance for protecting people's lives and property safety and restoring the ecological environment [14-16].

Scholars have carried out research work on the assessment of wind disasters and the analysis of disaster factors and causes in Xinjiang. Mansur Sabiti et al. [17, 18] selected the number of deaths caused by wind disasters, the area of farmland affected by the disaster, the amount of economic losses and the number of dead livestock as disaster indicators, compared and analyzed the number and proportion of wind disasters at various levels in the five cities and prefectures of southern Xinjiang from 1949 to 2008, and analyzed the causes of the spatial pattern of wind disasters from the perspective of bearers. During the study period, the number of wind disasters occurred most in April and May in southern Xinjiang. The number of wind disasters is increasing year by year, and the rate of growth of wind damage losses is faster than the growth rate of the bearer. Under the overall background of global climate change and temperature rise, the average wind speed in Xinjiang are decreasing year by year [19]. However, the frequency of extreme winds is increasing [20]. Cao Xing et al. [21] used linear regression method to analyze the windy days and average wind speed of Dabancheng wind area, the most representative area of northern Xinjiang from 1981 to 2010, and found that the number of days and intensity of windy weather gradually decreased, and suddenly decreased in 1997 and 2001, respectively. Chen Hongwu et al. [22] found that from 1961 to 1999, the number of windy days in northern Xinjiang showed an overall decreasing trend, but the decrease was small. In terms of the causes of wind damage, researchers generally believe that high-altitude low-pressure troughs and ground cold fronts are the main impact systems that cause wind disasters and high winds. Momentum downward transmission and variable pressure winds are the main causes of the formation and development of high winds [23, 24].

Many research results mainly focus on the assessment of the hazards of wind disasters, and the factors and causes of disasters. But after 2012, there was less research on wind damage. Whether the change trend of wind disaster hazards in northern Xinjiang is consistent with the trend of its disaster causing factors is unknown. For the assessment of the hazards of wind disasters, previous studies have only focused on major wind disasters, so the relevant samples are relatively less. Moreover, these studies generally adopt the method of assigning a single disaster element to a certain disaster level after exceeding the specified threshold, which lacks scientific nature and lacks the overall consideration of each disaster element. Therefore, this paper adopts the method of multi-index comprehensive consideration to construct the wind damage index, and explores a relatively objective and comprehensive assessment method, which provides a certain scientific basis and theoretical basis for the prevention and mitigation of wind disaster in northern Xinjiang.

2. Overview of the Study Area and Data Methodology

2.1. Overview of the Study Area

Xinjiang is located in the northwest region of China (32°22′ - 49°33′N, 73°21′ - 96°21′E). Because the Tianshan Mountain Range runs through the center, Xinjiang is divided into two parts: northern Xinjiang and southern Xinjiang. The geographical elements of northern Xinjiang are, from north to south: the Altai Mountains, the Junggar Basin, and the northern slopes of the Tianshan Mountains. Administratively, it includes Urumqi City, ChangjiHui Autonomous Prefecture, Shihezi City, Altay Prefecture, Ili Kazakh Autonomous Prefecture, Tacheng Prefecture, Bortala Mongol Autonomous Prefecture (referred to as Bo Prefecture), and Karamay City [25]. By the end of 2018, it had a total of about 3.97 million hm^2 of arable land, accounting for 76% of the whole Xinjiang, and mainly sowed wheat, corn, cotton and other crops vulnerable to wind damage. In 2018, the total agricultural output value of northern Xinjiang was 81.8 billion yuan, accounting for about 57% of the whole Xinjiang (excluding the Bingtuan), and the total output value of animal husbandry was 57.1 billion yuan, accounting for about 66.7% of the whole Xinjiang [26]. The number of windy days in this region is the largest in Xinjiang, of which the average annual windy days in Alashankou City are 161 days, and the largest annual number reaches 188 days. The extreme value occurs in Dabancheng City, which is in the airflow channel of northern and southern Xinjiang, with a maximum of 202 days a year, with an average of 150 days per year [27].

In order to visually analyze the spatial distribution characteristics of wind disasters in northern Xinjiang, this paper divides northern Xinjiang into five areas: Altay region, Tacheng area (Tacheng City, Emin County, Yumin County, and Tory County), Ili River Valley, Bozhou and northern Xinjiang along the Tianshan Mountains (Karamay City, Wusu

City, Shawan County, Shihezi City, Urumqi City, Changji Prefecture) according to the topography and geomorphology, climatic conditions and activity characteristics of strong wind weather processes (Figure 1).

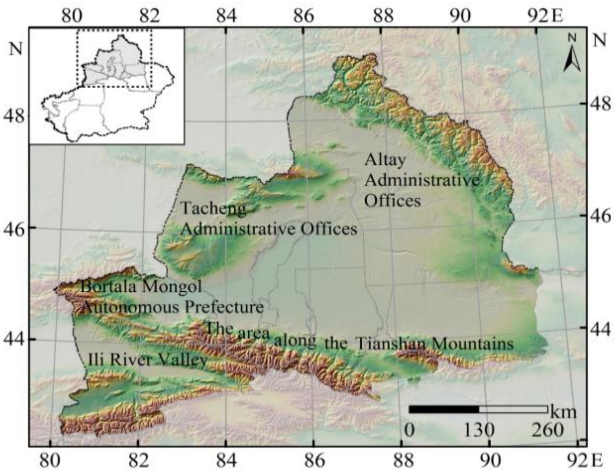


Figure 1. *Overview of the study area.*

2.2. Data and Material

Based on the wind disaster information recorded by the Civil Affairs Department of Xinjiang Uygur Autonomous Region, this paper compiled 671 disaster records from 1980 to 2019 in 38 counties (cities) in northern Xinjiang, including occurrence time (year, month and day), occurrence area (county/city), death toll (persons), collapsed houses (rooms), collapsed sheds (rooms), number of damaged greenhouses (rooms), number of dead livestock (heads), and affected area (hm^2). If there is one wind disaster in a county (city) area on a certain day, the number of wind disasters is recorded as 1 [28].

2.3. Analytical Methods

According to the above six disaster elements of a certain wind disaster event, this paper uses the linear combination method to construct the disaster damage index, and then uses the percentile method to calculate the hazard level threshold. In this paper, linear regression analysis was used to determine the changes in the occurrence of wind disasters (total number and the occurrence of four grades of general, heavier, severe and extra heavy) and the annual disaster damage index in northern Xinjiang, and the cumulative anomaly detection method was used to analyze the climate changes in the occurrence of annual wind disasters and the annual disaster damage index.

(1) Construction of disaster damage index

Since there are 6 factors to express the disaster situation of a certain wind disaster, namely the number of deaths (persons), collapsed houses (rooms), collapsed sheds (rooms), number of damaged greenhouses (rooms), dead livestock (heads), and affected area (hm^2), in order to facilitate the comparison of the strength of each wind disaster event, this paper needs to construct a disaster damage index (Z_i) that can comprehensively express the six disaster elements. In the construction of Z_i, the weight of each disaster element is determined by the ratio method, and then based on the weight of the disaster element, the value of Z_i is obtained by dimensionless linear summation.

Assuming that there are m disaster elements, each disaster element consists of n samples, so that the evaluation matrix $X_{n\times m}$ of the disaster elements of the wind disaster can be obtained. Then the wind damage index Z_i is calculated as follows [28]:

$$Z_i = a_1\frac{X_{i1}}{\overline{X}_1} + a_2\frac{X_{i2}}{\overline{X}_2} + a_3\frac{X_{i3}}{\overline{X}_3} + a_4\frac{X_{i4}}{\overline{X}_4} + a_5\frac{X_{i5}}{\overline{X}_5} + a_6\frac{X_{i6}}{\overline{X}_6} \quad (1)$$

In the above formula, i =1, 2, …, n, n represents the total number of wind disaster events (n =671); a_1, a_2, …, a_6 represents the weights of the six disaster elements, and $\overline{X}_1$, $\overline{X}_2$, …, $\overline{X}_6$ represents the average of the six disaster elements. The formula for calculating the weight a_j of the j th disaster element is defined as follows:

$$a_j = \left(\sum_{i=1}^{n} X_{i,j}/X_{ja}\right)\Big/B \quad (2)$$

In the above formula, X_{ja} is the maximum value of the j th disaster element, $\sum_{i=1}^{n} X_{i,j}/X_{ja}$ represents the cumulative value of the dimensionless dimension of the j th disaster element, and $B=\sum_{j=1}^{m}\sum_{i=1}^{n} X_{i,j}/X_{ja}$ represents the sum of the dimensionless of m disaster elements.

Using the disaster data of 671 wind disasters in 38 counties (cities) from 1980 to 2019, this paper calculates the weights, average values and maximums corresponding to the six disaster elements according to the ratio method (Table 1), and obtains the disaster damage index of wind disasters by calculating the linear combination (Equation 1).

Table 1. *The weight, average value and the maximum value of disaster factors.*

	Deaths (persons)	Collapsed homes (houses)	Collapsed sheds (seats)	Damaged green-houses (seats)	Livestock deaths (heads)	Crops affected area (hm^2)
Weight coefficient	0.12	0.12	0.09	0.18	0.08	0.42
Average value	0.07	19.47	5.24	62.98	116.16	2386.81
Maximum value	6	1740	650	3781	15897	61697

(2) Determination of the threshold of the hazard level

The percentile method is used in determining the wind disaster damage index rating. The percentile method is a statistical measure of the central tendency used to reflect ordinal data, which refers to the value at each quantile after a set of ordinal data is divided 100 in 100 equal points with 99 points [29]. A percentile is a positional indicator, expressed in P_r. A percentile divides all observations of a population or sample into two parts, theoretically there are *r*% of observations smaller than it, and (100-*r*)% of observations larger than it, so the percentile is a cut-off value.

After the sample data with the hazard index n are arranged in order from smallest to largest, the formula for calculating the *r* th percentile P_r is as follows.

$$P_r = X_{[d]} + (X_{[d+1]} - X_{[d]})(d - [d]),\quad d = 1 + (N-1)r\% \tag{3}$$

Where: d represents the position of the percentile P_r; $[d]$ represents the integer part of d; $X_{[d]}$, $X_{[d+1]}$ represent data on ranks of $[d]$, $[d+1]$, respectively. 100-*r* is assigned of 10%, 25%, and 50% to obtain the corresponding thresholds of the four grades of disaster damage index Z_i (Table 2).

Table 2. *Classification standard for wind disaster grades.*

Percentiler (%)	Disaster exponent Z_i	Disaster grade
$r \le 50$	$Z_i \le 0.25358$	Mild (Grade 1)
$50 < r \le 75$	$0.25358 < Z_i \le 0.85280$	Moderate (Grade 2)
$75 < r \le 90$	$0.85280 < Z_i \le 2.52013$	Severe (Grade 3)
$r > 90$	$Z_i > 2.52013$	Extremely severe (Grade 4)

(3) Cumulative anomaly detection method for abrupt climatic change

Abrupt climatic change refers to the average value of the climate element sequence above 10a, and the obvious difference between the two segments before and after occurs, and the sequence accumulation anomaly method is commonly used to detect the abrupt point of the climate element [30]. For a sample time series $x(t)$, $t = 1, 2, \ldots, n$, with length n, the cumulative anomaly of point j at some time in the sample is:

$$I(j) = \sum_{t=1}^{j} [x(t) - \bar{x}] \tag{4}$$

Where $j = 1, 2, \ldots, n$, $\bar{x} = \frac{1}{n}\sum_{t=1}^{n} x(t)$.

Plotting $I(j)$ as a curve that changes with time j is called a cumulative anomaly curve. The moment a point corresponding to the maximum value of $I(j)$ is the abrupt change point, and the sample anomaly is close to the *x* axis.

3 Results and Analysis

3.1. Spatial Distribution

We add up the number of wind disasters of each grade in a certain area, and then divide it by the number of counties (cities) to which the region belongs, and then get the average number of wind disasters in the area. The total number of occurrences of wind disasters in each county (city) shows (Figure 2a), the number of wind disasters in five regions in the past 40 years has an obvious spatial pattern. The most frequent area of wind disasters in northern Xinjiang is Bozhou, with an average of 38.3 wind disasters per county (city).

By summing the wind disaster damage index of a single county (city) every year, we obtain the annual disaster damage index of the county (city), which can reflect the severity of the disaster in the county (city) in the current year. We add up the annual disaster damage index of a county (city) in the past 40 years and divide it by 40 years to obtain the annual average disaster damage index. After calculation and analysis, we find that Qitai County and Shihezi City have the highest annual average disaster damage index, reaching 1.24 and 1.10 respectively, which are the most affected counties (cities) in northern Xinjiang in the past 40 years (Figure 2b).

We sum the annual disaster damage index of each county (city) to which a region belongs and divide it by the number of counties (cities) to obtain the regional average annual disaster damage index. After calculation, it can be seen that the area along the Tianshan Mountains and the Altay region in northern Xinjiang are the areas most affected by wind disasters in northern Xinjiang, with an average annual disaster damage index of 0.54 and 0.50 respectively.

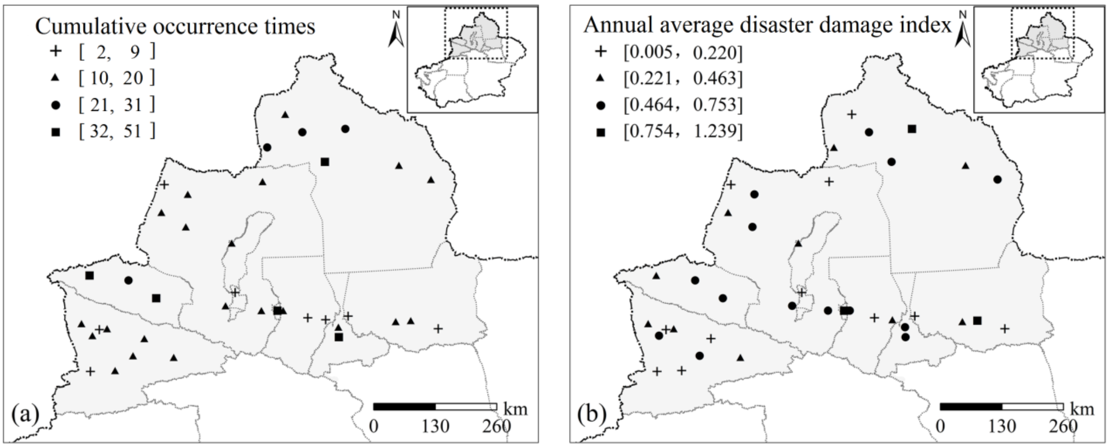
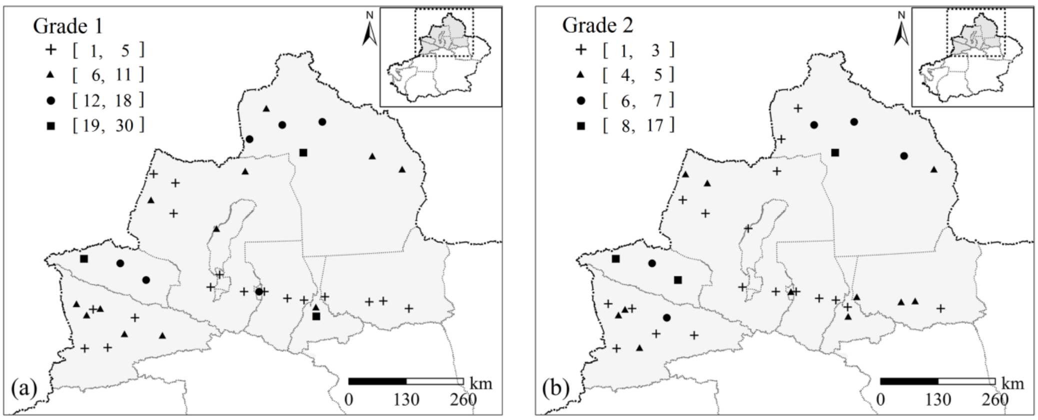


Figure 2. *Spatial distribution of cumulative occurrence times and annual average disaster damage index.*

In this paper, it can be seen that the number of occurrences of Grade 1 wind disasters in various regions and counties (cities) in the past 40 years (Figure 3) shows that the number of Grade 1 wind disasters is the largest in Bozhou (regional average 22), followed by Altay (14.3 on average), the number of occurrences in Ta'e Basin, Ili River Valley and Northern Xinjiang along the Tianshan Mountains is similar, about 5.6 times; in a single county (city), the number of Grade 1 wind disasters in Wenquan County (30 times) and Fuhai County (29 times) is more. In terms of Grade 2 wind disasters, Bozhou had the most occurrences at this time (12.0 on average), followed by Altay (6.0 on average), with Jinghe County and Fuhai County having more occurrences, 17 and 14 respectively. In terms of Grade 3 wind disasters, the Altay region had the highest number of occurrences (4.0 on average). From the perspective of individual counties and cities, Shihezi City has the highest number of Grade 3 wind disasters (9 times). In terms of Grade 4 wind disasters, five regions had an equal number of occurrences.



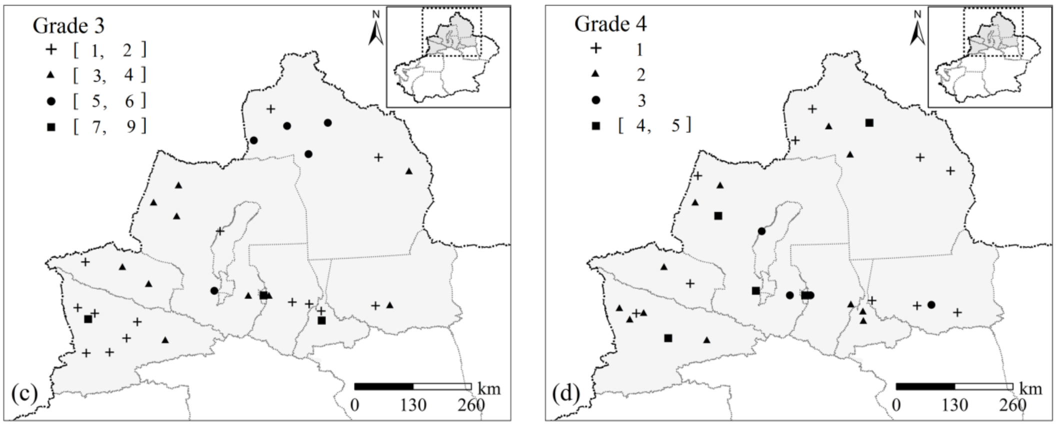


Figure 3. Spatial distribution of the occurrence times of various grades of wind disasters.

The main reasons for this spatial pattern are the different climatic characteristics of each region due to topography and the difference in the scale of agriculture and pastoralism in each region. The Urumqi-Dabancheng Valley is an airflow channel between northern and southern Xinjiang, which forms an altitude difference with the adjacent Turpan Basin. When the cold air goes south, the cold air is affected by the topography of the mountain range to form a pile, and when the accumulation reaches a certain level, it pours out from the bealock, causing the wind speed to increase significantly. Therefore, the Dabancheng area is one of the windiest areas in Xinjiang, with an average annual windy days of 150 days [21]. The cultivated land area along the Tianshan Mountains in northern Xinjiang totals more than 1.3 million hectares. Therefore, when windy weather occurs, it is more likely to form severe wind disaster. The Habahe, Jimunai, and Buxel in northwestern Xinjiang are also areas where winds are more frequent in Xinjiang because they have multiple wind outlets and river valleys [31]. Combined with the long winters in the region and the fact that high winds sometimes accompany blizzards, these areas have seen large-scale house collapses and casualties caused by blizzards. Bozhou, which is also a windy weather area, has only 180,000 hectares of arable land. Therefore, although there are many wind disasters in this area, the damage is relatively small.

3.2. Monthly and Seasonal Variation

From 1980 to 2019, there were 671 wind disasters in northern Xinjiang. April is the month with the highest frequency of wind disasters of all Grades, followed by May (Figure 4). The most frequent season is spring, followed by summer, and less frequent in autumn and winter. Among them, a total of 335 Grade 1 wind disasters occurred, and 216 occurred in spring (March to May), accounting for 64% of the year; A total of 99 occurrences occurred in summer (June to August), accounting for 30% of the year; It occurs 20 times in autumn (September to November) and winter (December to February), accounting for 6% of the year. There were 168 Grade 2 wind disasters, 71% in spring and 23% in summer. A total of 101 Grade 3 wind disasters occurred, accounting for 75% in spring and 20% in summer. A total of 67 Grade 4 wind disasters occurred and 57 occurred in spring, accounting for 85% of the year; Summer, autumn and winter account for 7%, 3% and 4% of the year, respectively. The study found that the higher the Grade of wind disaster, the greater the proportion of it occurring in the spring. This shows that not only spring is the most frequent season for wind disasters in northern Xinjiang, but also the more harmful the wind disaster, the more likely it is to occur in spring.

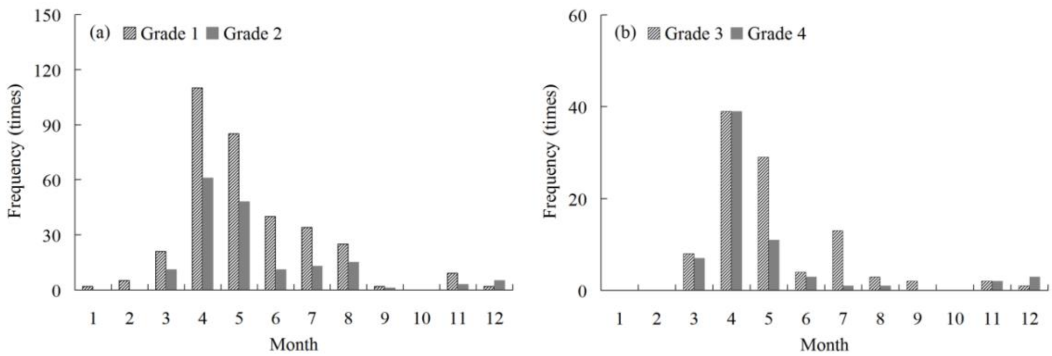


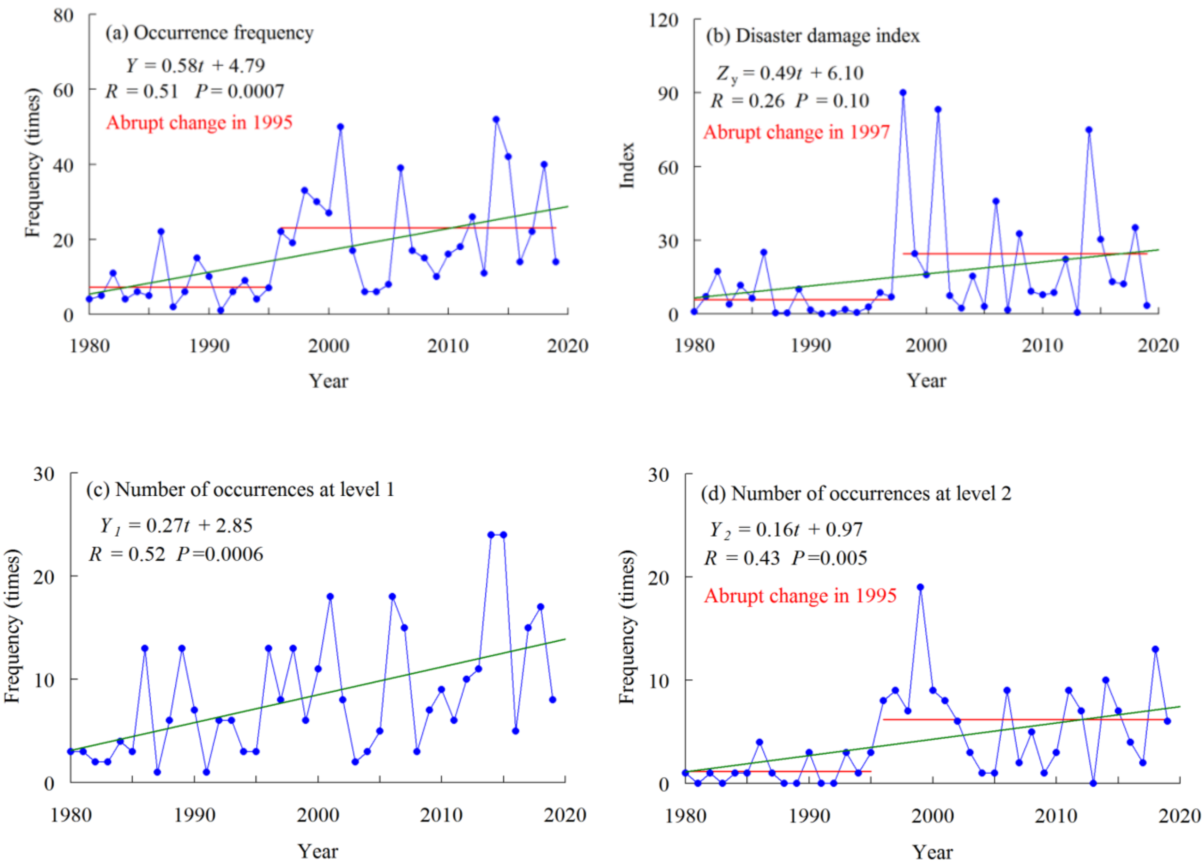
Figure 4. Monthly distribution of the occurrence times of wind disasters in Northern Xinjiang.

The monthly and seasonal changes of disaster factors and carriers are the main reasons for the high frequency of wind disasters in spring. The frequent alternation of cold and warm air in April and May makes the weather system unstable, and winds are generated, developed and moved very quickly [27]. The pressure gradient between regions increases, and windy weather is frequent. The average number of windy days in spring in Alashankou, Dabancheng and Tacheng Lao feng kou in northern Xinjiang was higher than 40 days [32]. In addition, the most important crops in northern Xinjiang are wheat, corn and cotton. April - May coincides with the jointing and gestation stage of winter wheat, and the sowing and emergence of cotton, spring wheat and maize. When windy weather occurs, the wind can easily cause devastating damage to these crops. From June to August, the atmosphere is unstable, and there are more gusty winds. However, crops are in the development stages of male pumping, flowering, milk ripening, etc., and their disaster resistance is relatively good. From September to February, the atmospheric layer is relatively stable, there are few windy weather, and the ground is strongly radiated and cooled to form a deep inversion layer, and there are fewer wind disasters.

3.3. Interannual Variation

Analyzing the disaster data of wind disasters in 38 counties (cities) in northern Xinjiang from 1980 to 2019, we can find that the annual occurrence of wind disasters in northern Xinjiang showed a tendency rate of 5.8 times/10a, and the linear growth tendency rate of the annual disaster damage index was 4.9/10a, and there was a large sudden increase around 2000 (Figures 5a and 5b). The cumulative outlier test showed that the number of wind disasters occurred abruptly in 1995, with an average of 7.3 times in 1980 to 1995, 57% less than the 40a average, and an average of 23.1 times from 1996 to 2019, 37.5% more, and the average value after the abrupt change was 3.2 times that before the abrupt change.

In terms of grading (Figures 5c-5f), the development trend of the annual occurrence frequency of wind disaster of Grade 1, 2 and 3 is in line with the growth trend of the total number. Grade 4 has a linear growth trend, but not significantly. Among them, the number of Grade 1 wind disasters increased the fastest, with a tendency rate of 2.7 times/10a; The linear growth tendency rate of the occurrence of Grade 2 wind disasters was 1.6 times/10a, and the linear growth tendency rate of the occurrence of Grade 3 wind disasters was 1.1 times/10a.



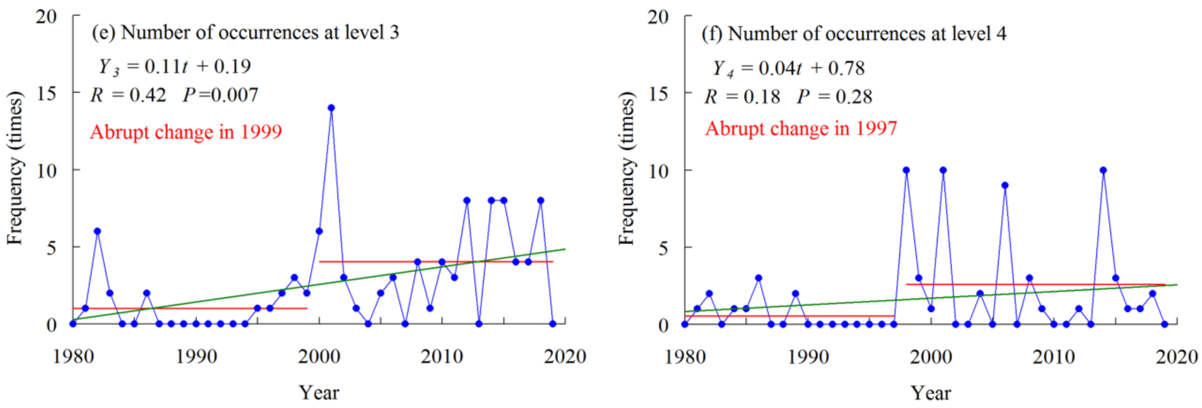


Figure 5. *Inter-annual variation of the occurrence times and annual disaster damage index of wind disasters in Northern Xinjiang.*

The number of Grade 2 wind disasters increased significantly and abruptly in 1999. The cumulative averaging test showed that it had anabrupt change in 1995, with an average of 1.2 times in 1980 to 1995, 71% less than the 40a average, and a mean of 6.2 times in 1996 to 2019, which was 48% more. After the abrupt change, it averaged 5.2 times higher than before the abrupt change. The number of Grade 3 wind disasters increased sharply and abruptly in 2001, and the cumulative anomaly test showed that it had anabrupt change in 1999, with an average of 1 occurrence in 1980 to 1999, 60% less than the 40a average, and an average of 4.1 times in 2000 to 2019, 64% more. After the abrupt change, it averaged 4.1 times higher than before the abrupt change. The number of Grade 4 wind disasters increased sharply and dramatically in 1998, and the cumulative anomaly test showed that it had a sudden change in 1997, with an average of 0.6 times in 1980 to 1997, 65% less than the 40a average, and an average of 2.6 in 1998 to 2019, 53% more. After the abrupt change, it averaged 4.3 times more than before the abrupt change.

The main reasons for the increase in the number of wind disasters and the increase in the annual disaster damage index should be considered from the two aspects of disaster causing factors and the development trend of the bearer. The causative factor of wind damage is wind. However, a large number of studies have shown that the number of windy days and average wind speed in northern Xinjiang have shown a trend of decreasing in the past 40 years [13-16, 19-22]. Therefore, the main reason for the increase in the number of wind disasters and the increase in hazard is the development of the bearer. Among the disaster factors selected in this paper, there was no obvious linear trend of death, number of collapsed houses, number of collapsed shed circles, number of damaged greenhouses, and number of dead livestock, and the development trend of the affected area was consistent with the trend of the number of wind disasters and the annual damage index. Therefore, this paper mainly analyzes the relationship between the affected area and the sown area in northern Xinjiang (Figure 6). In the past 40 years, the sown area in northern Xinjiang showed a linear growth trend of a tendency rate of 683.87 khm^2/10a, and the disaster-stricken area showed a linear growth trend of a tendency rate of 19.794 khm^2/10a, and the two development trends were positively correlated. The percentage of the affected area to the sown area (disaster damage ratio) also indicates the degree of damage caused by the wind disaster. The disaster damage ratio in the 1980s was 0.50%, and the disaster damage ratio in the 1990s, 2000s and 2010s was 1.13%, 1.96% and 1.51%, respectively. It can be seen that since the 1990s, while the sown area and the disaster-stricken area in northern Xinjiang have increased linearly, the disaster damage ratio has been relatively stable and the change is small. This also shows that the main reason for the increase in the affected area is the increase in the sown area.

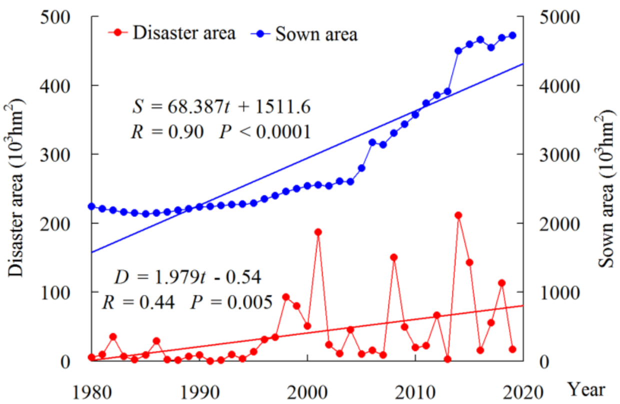


Figure 6. *Inter-annual variation of sowing area and affected area in Northern Xinjiang.*

4. Conclusions

This paper proposes the wind damage index. It constructs a comprehensive analysis and evaluation index of wind disaster damage from six dimensions: number of deaths, number of collapsed houses, number of collapsed shed circles, number of damaged greenhouses, number of livestock deaths, and affected area, which is an overall measurement and description of the degree of disaster damage in northern Xinjiang in the past 40 years. According to the probability density distribution of wind disaster damage index in northern Xinjiang, this paper divides the wind hazard grade into four grades: general, heavier, severe and extra heavy.

In the past 40 years, the number of wind disasters in the five regions has an obvious spatial pattern. Bozhou is the region with the most frequent wind disasters in northern Xinjiang, with an average of 38.3 wind disasters per county (city), followed by Altay region (26 regional averages). The areas with the highest number of wind disasters of Grade 1, 2 and 3 are also in Bozhou and Altay, which is in line with the distribution of the total number of times. The number of Grade 4 wind disasters was comparable in the five regions. From the perspective of the degree of damage caused by wind disasters, the annual average disaster damage index along the Tianshan Mountains and Altay region in northern Xinjiang is the highest, and the damage caused by wind disasters is the most serious. Among the single counties and cities, Qitai County and Shihezi City had the highest disaster damage index.

Wind disasters in northern Xinjiang mainly occurred in spring and summer (March to August), accounting for 94.2% of the total. In particular, there are more windy weather in April and May, and it is during the period of crop sowing and seedlings, which is more likely to form large-scale wind disasters.

The number of annual wind disasters in northern Xinjiang showed a significant growth trend of 5.8 per decade. The number of general, heavier and severe wind disasters has a significant growth trend, and the growth rate is inversely proportional to the grade of wind disasters. Between 1995 and 1999, the total number of wind disasters, the number of Grade 2, 3 and 4 wind disasters and the annual damage index of wind disasters in northern Xinjiang all changed abruptly. After the abrupt change, the average annual number of wind disasters and the annual average damage index increased significantly. This shows that since the end of the 90s of last century, the number of occurrences and the damage caused by heavier and above Grades wind disasters in northern Xinjiang have increased significantly.

Conflicts of Interest

The authors declare no conflicts of interest.

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