Analysis of Short-term Heavy Precipitation in Ulanqab City from 2017 to 2022

Qiang MA *

Ulanqab Meteorological Bureau, Jining 012000, China

Abstract Based on the data of hourly precipitation in 11 national stations and 262 regional stations in Ulanqab City from 2017 to 2022, the annual, monthly and daily variations of short-term heavy precipitation in Ulanqab City were statistically analyzed. The results show that the frequency of short-term heavy precipitation in Ulanqab City was high in the south and low in the north, and was closely related to the terrain. Short-term heavy precipitation in Ulanqab City was mainly concentrated from June to August, of which it was the frequentest in July. Short-term heavy precipitation mainly occurred from the afternoon to evening, and was concentrated from 13:00 to 20:00, especially at 19:00. The rainfall in Ulanqab City ranged mainly from 20 to 30 mm, accounting for 74.7%, and the rest accounted for 25.3%.

Key words Short-term heavy precipitation; Terrain; Rainfall

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The terrain of Ulanqab City is composed of four parts from north to south: Mongolian Plateau, Ulanqab hills, Yinshan Mountains and loess hills. The terrain is complex, with rolling hills and ravines, and various kinds of disastrous weather occur frequently. In the main cultivation period of agricultural production in summer, short-term heavy precipitation has caused devastating harm to agricultural production. In recent years, with the global warming, the extreme weather in Ulanqab City has gradually increased, and the casualties and property losses caused by short-term heavy precipitation weather disasters have gradually increased. Many scholars have studied and analyzed the temporal and spatial distribution of short-term heavy precipitation[1-2]. In this paper, based on the data of short-term heavy precipitation in Ulanqab City, Inner Mongolia from 2017 to 2022, the annual, monthly and daily changes of short-term heavy precipitation were comprehensively analyzed, so that forecasters can better understand the specific distribution of short-term heavy precipitation in Ulanqab City, and provide scientific basis for short-term heavy precipitation forecast and service in the future.

1 Data sources

In this paper, the hourly data of precipitation in 11 national stations and 262 regional stations in Ulanqab from 2017 to 2022 were used. According to the definition of short-term heavy precipitation by China Meteorological Administration (hourly precipitation ≥20 mm), the short-term heavy precipitation in Ulanqab was statistically analyzed. From 2017 to 2022, there were 684 times of short-time heavy precipitation.

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* Corresponding author.

2 Spatial distribution of the frequency of short-term heavy precipitation process

The frequency of short-term heavy precipitation in Ulanqab City from 2017 to 2022 is shown in Fig. 1. It can be seen that the frequency of short-term heavy precipitation in Ulanqab City was 62 times in the past year, and the distribution of the stations was uneven. The frequency of short-term heavy precipitation was the highest in Fengzhen City, up to 116 times, and it was the lowest in Chahar Right Wing Rear Banner (only 32 times). That is, it was higher in the south and less in the north. At the same time, the frequency of precipitation was inversely correlated with the altitude.

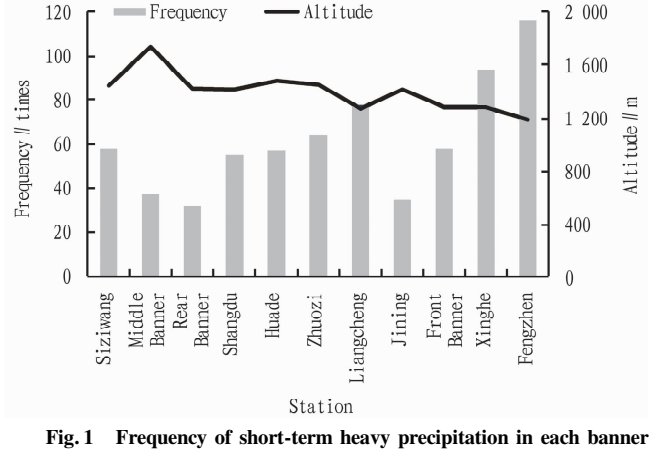

Fig. 1 Frequency of short-term heavy precipitation in each banner and county in Ulanqab City from 2017 to 2022

3 Temporal distribution of short-term heavy precipitation

3.1 Annual variation In Ulanqab City, 684 times of short-term heavy precipitation from 2017 to 2022 were analyzed. From

Fig. 2, it can be seen from that the frequency of short-term heavy precipitation was low in 2017 and 2019 and high in 2018 and from 2020 to 2022. The maximum appeared in 2018, up to 152 times. The frequency of short-term heavy precipitation was stable from 2020 to 2022, and it is expected that the frequency of short-term heavy precipitation in Ulanqab City will not change much in the next two or three years.

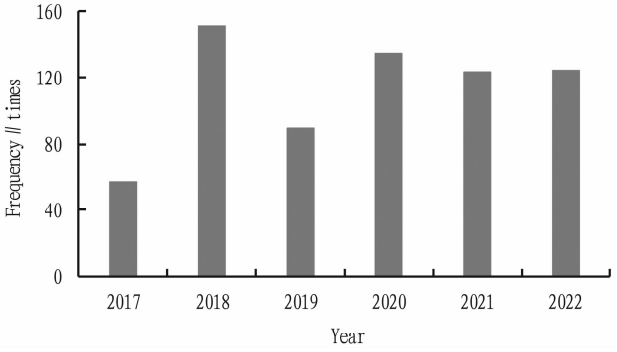

Fig. 2 Annual variation of the frequency of short-term heavy precipitation in Ulanqab City from 2017 to 2022

3.2 Monthly variation As shown in Fig. 3, the monthly variation of the frequency of short-term heavy precipitation in Ulanqab City had a single peak. The highest frequency appeared in July, reaching 396 times, followed by August, and it was low in May and September. That is, the short-term heavy precipitation was mainly concentrated in July and August, which often led to urban waterlogging.

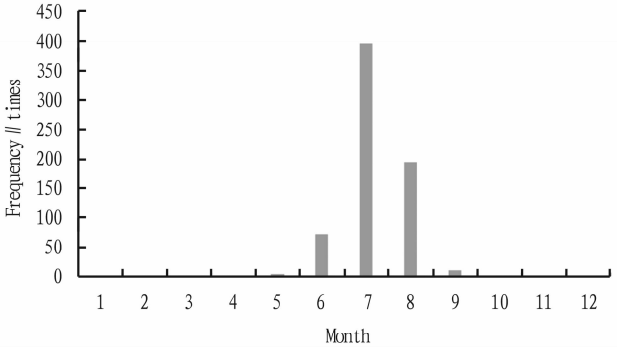

Fig. 3 Monthly variation of the frequency of short-term heavy precipitation in Ulanqab City from 2017 to 2022

3.3 Diurnal variation Seen from Fig. 4, the daily variation of the frequency of short-term heavy precipitation in Ulanqab City had a single peak. It rose rapidly from 12:00 to 20:00, among which it was the highest at 19:00 and lower from 21:00 to the morning of the next day. Therefore, the short-term heavy precipitation was mainly concentrated from 13:00 to 20:00.

4 Frequency of rainfall of various levels

As shown in Fig. 5, the rainfall mainly ranged from 20 to 30 mm, accounting for 74.7%, and the rest accounted for 25.3%. Among them, the frequency of rainfall above 50 mm was 13 times, accounting for 1.9%.

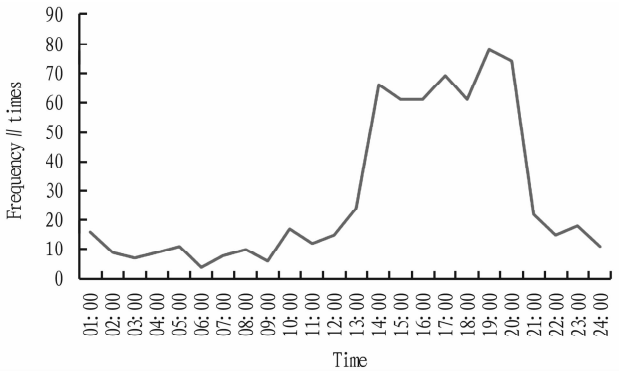

Fig. 4 Daily variation of the frequency of short-term heavy precipitation in Ulanqab City from 2017 to 2022

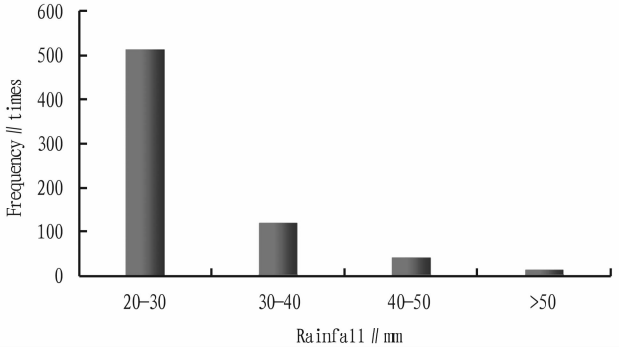

Fig. 5 Changes in the frequency of rainfall of various levels in Ulanqab City from 2017 to 2022

5 Conclusions

(1) The frequency of short-term heavy precipitation in Ulanqab City from 2017 to 2022 was high in the south and low in the north, and was inversely correlated with the altitude to a certain extent.

(2) The frequency of short-term heavy precipitation in Ulanqab City was stable from 2020 to 2022.

(3) In Ulanqab City, short-term heavy precipitation may occur from May to September, and was mainly concentrated from June to August. The frequency of short-term heavy precipitation was the highest in July (396 times), followed by August.

(4) During a day, short-term heavy precipitation in Ulanqab City mainly occurred from the afternoon to evening (mainly from 13:00 to 20:00), especially at 19:00. It occurred less frequently from 21:00 to the morning of the next day.

(5) The rainfall in Ulanqab City was mainly 20 – 30 mm, accounting for 74.7%, and the rest accounted for 25.3%, among which the frequency of rainfall above 50 mm was 13 times, accounting for 1.9%.

References

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