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ASSESSMENT OF HAZARDOUS HYDROMETEOROLOGICAL PHENOMENA AFFECTING AGRICULTURAL CROPS

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Annotation
In the article hydrometeorological hazards affecting agricultural crops on the example of the Republic of Karakalpakstan were studied. Based on the temperature data observed at the selected meteorological stations, the spring and autumn frosts and summer thermal temperatures were analyzed. Trends in hydrometeorological hazards were also studied.

Keywords: hydrometeorological hazards, spring frost, autumn frost, thermal depression, climate change.

Introduction

As a result of climate change, the frequency of dangerous hydrometeorological events is increasing and the level of their negative impact is increasing. Dangerous hydrometeorological phenomena, including spring and autumn black frosts, summer heat, have a negative impact on the productivity of agricultural crops. Due to the increase in frequency and severity of dangerous Hydrometeorological events as a result of climate change, the study of dangerous Hydrometeorological events becomes important in the development of agricultural economy in the region and the development of measures related to food security. From this point of view, monitoring

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of these dangerous Hydrometeorological phenomena, studying the trends of changes in their indicators are one of the urgent issues.

Literature Review

The issues of studying the synoptic processes and dangerous Hydrometeorological phenomena of Central Asia and assessing their impact on agricultural crops have been considered in the scientific researches of many scientists. Including it was studied by N.A.Agaltseva, Yu.N.Ivanov, S.V.Myagkov, T.A.Ososkova, A.V.Pak, E.V.Petrova, T.Yu.Spektorman, G.N.Trofimov, V.O.Usmonov, V.F.Usmonov, V.Chub, A.Alautdinov, G.Holboev, O.Sultashova and other scientists. The main goal of this article is to evaluate dangerous hydrometeorological phenomena affecting agricultural crops based on the analysis of data from a meteorological station located in the Republic of Karakalpakstan. The following tasks have been set to achieve the goal:

• Determining the indicators and periods of spring black frost observed in the years 2005-2019 at the Nukus, Kungrad, Chimbay meteorological stations located in the Republic of Karakalpakstan;
• assessment of autumn black frost periods and their repetitions observed at selected meteorological stations;
• to study the repetition of hot air temperatures observed in the summer season at selected meteorological stations;
• assessment of tendency in spring and autumn black frosts and changes in summer thermal temperatures.

Materials and Methods

Black frost is a dangerous meteorological phenomenon, the frequency and intensity of which is determined by the combined effect of meteorological and climate, as well as physical and geographical factors. According to synoptic conditions and formation conditions, adjective, radiation and mixed adjective-radiation types of black frosts are distinguished [6, 7].

Information on black frost is also used to assess the risk of freezing of the area, and to optimize the distribution of agricultural crops throughout the area. Also, this type of information will be necessary to assess the conditions for plant vegetation in different regions of the republic from an agro climatic point of view, and to determine the terms of planting crops. In addition, such information is useful for assessing the probability of death of flowers and ovaries of fruit plants, assessing the productivity and quality of agricultural products, and calculating underutilized heat resources.

A dangerous Hydrometeorological event is considered when the air temperature is higher than +40°C. High air temperature or sweltering heat depends on the natural geographical location, climate, topography and other factors. This phenomenon is observed mainly in the summer months in the Central Asian region. When high temperatures occur, the water demand of agricultural crops increases, and prolonged periods of high temperatures can result in crop death or reduced productivity.

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Leads to a significant decrease. When high summer temperatures occur, it is necessary to implement agrometeorological measures [1, 5, 8].

In the article, indicators of dangerous Hydrometeorological phenomena, including spring and autumn black frosts and hot summer days, were studied according to the data of recent years. Daily air temperature data observed in 2005-2019 at Nukus, Kungrad, and Chimbay meteorological stations located in the Republic of Karakalpakstan were used in the work.

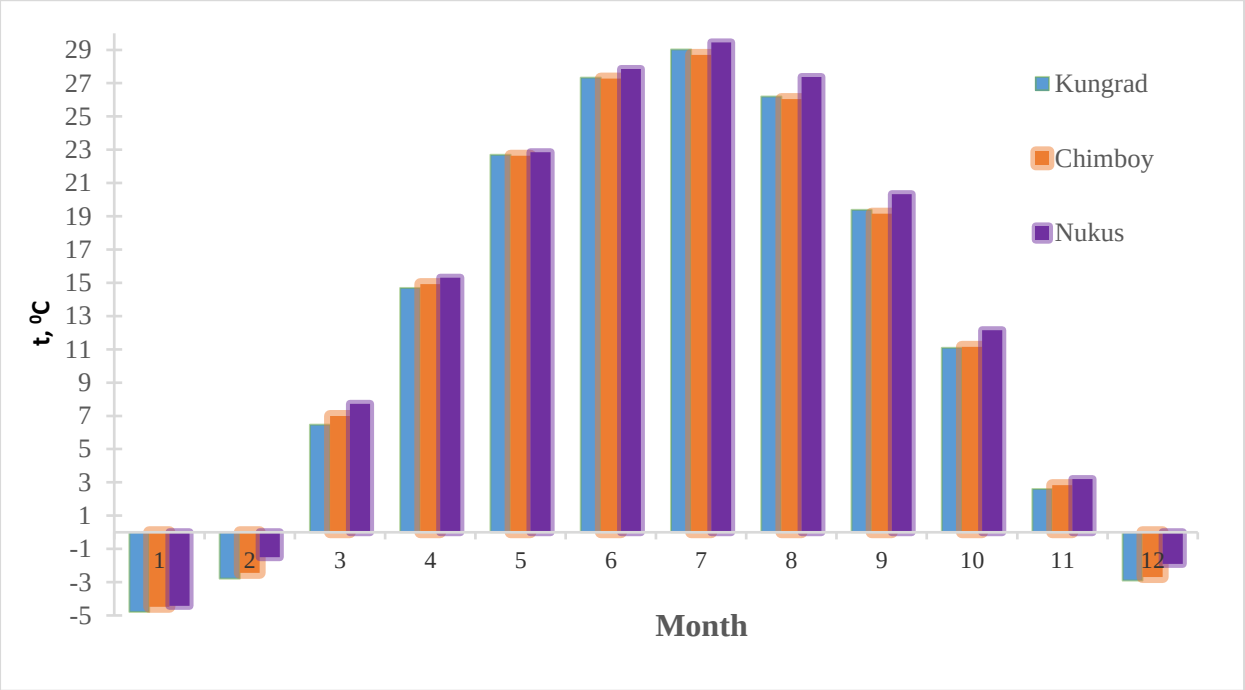

Figure 1. Graph of average monthly air temperatures observed at Nukus, Chimbay and Kungrad meteorological stations in 2005-2019

Results and Discussion

The average monthly air temperatures observed in 2005-2019 at the Nukus, Chimbay, Kungrad meteorological stations located in the Republic of Karakalpakstan were studied (Fig. 1). The maximum average monthly temperature observed at these meteorological stations corresponded to the months of July and was found to be +29.7 °C at the Nukus meteorological station and +28.6 and +28.9 °C at the Kungrad and Chimbay meteorological stations, respectively.

The minimum average monthly air temperature was observed in January and was -4.6°C in Nukus, -4.2°C in Chimbay, and -4.9°C in Kungrad. When comparing the average monthly air temperatures observed at these meteorological stations, it can be seen that there is not much difference between them.

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Table 1 Spring Black frost periods observed in the Republic of Karakalpakstan in 2005-2019

Meteorological station	The last black frost dates of spring			Last spring black frost dates (according to V.E. Chubb)		
	The earliest spring black frost date	Average	Latest spring black frost	The earliest spring black frost date	Average	Latest spring black frost
Nukus	11.03.2019	01.04	17.04.2008	13.03.1985	01.04	09.05.1993
Chimbay	12.03.2019	05.04	17.04.2008			
Kungrad	28.03.2010	06.04	22.04.2019	18.03.2002	07.04	30.04.1989

Based on the data of the selected meteorological station in the Republic of Karakalpakstan, the spring black and cold periods observed in 2005-2019 were summarized (Table 1). In the table, the earliest period of spring black frost was observed at the Nukus meteorological station on 11.03.2019. In Chimbay and Kungrad, the earliest period of this dangerous Hydrometeorological event was observed on 12.03.2019 and 28.03.2010, respectively. The average duration of the last black frost in spring is 1.04 in Nukus. it was determined that it corresponds to the date. The average duration of spring black frost at Chimbay and Kungrad meteorological stations was 5.04 and 6.04, respectively. The latest black frost observed in the spring was recorded at the Nukus meteorological station on 04/17/2008. At Chimbay and Kungrad meteorological stations, this indicator was recorded on 04/17/2008 and 04/22/2019, respectively. The results obtained in the work were compared with previously studied periods of black frost at selected meteorological stations. According to it, we can see that the earliest date of the last black frost in spring was observed 2 days earlier at the Nukus meteorological station compared to the old period (1971-2005). In 2005-2019, early spring black frost was detected at Kungrad meteorological station on April 22, 2019, while V.E. Chub observed early spring black frost in Kungrad meteorological station in 1971-2005 on April 30, 1989. It can be seen that in the next period, the spring black frost happened 8 days earlier. At the Nukus meteorological station, the latest black frost in spring moved forward by 11 days compared to the base period. At the Kungrad meteorological station, the latest black frost period in spring in the data of 2005-2019 was observed 8 days earlier compared to the data of V. E. Chub. There was no significant change in the average duration of the studied black frost compared to the base period. These dates corresponded to 01.04/02.04 in Nukus and 06.04/07.04 in Kungrad.

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Table 2 Autumn black frost periods observed in the Republic of Karakalpakstan in 2005-2019

Meteorological station	Black frost dates in autumn			The latest autumn frost date (according to V.E.Chub)		
	The earliest autumn black frost	Average	Latest autumn black frost	The earliest autumn black frost	Average	Latest autumn black frost
Nukus	01.10.2017	18.10	30.11.2006	26.09. 2000	15.10	10.11. 1974
Chimbay	30.09.2017	15.10	22.11.2016			
Kungrad	29.09.2017	12.10	30.11.2006	26.09. 2000	14.10	1.11. 1984, 1997

The duration of the autumn black frost was also studied on the basis of meteorological data from 2005-2019 at the meteorological stations involved in the work (Table 2). The earliest occurrence of autumn black frost was observed at the Nukus meteorological station on 01.10.2017, and it was found that it occurred at the Chimbay and Kungrad meteorological stations on 09.30.2017 and 09.29.2017, respectively. The average values of the first autumn black frost periods observed in 2005-2019 at the selected meteorological stations were also determined. At the Nukus Hydrometeorological station, the average autumn black frost was on October 18, and at Chimbay and Kungrad meteorological stations, the first autumn black frost periods were observed on October 15 and October 12, respectively. The latest occurrence periods of autumn black frost were also studied. According to him, this indicator of autumn black frost occurred at the Nukus meteorological station on November 30, 2006, at the Chimbay meteorological station on November 22, 2016, and at the Kungrad meteorological station on November 30, 2006. The studied indicators of autumn black frost were compared with the results of the base period 1971-2005 by V.E.Chub. According to the results of the comparison, the earliest autumn black frost was observed at the Nukus meteorological station 5 days later than this year. The period of early autumn black frost at the Kungrad meteorological station has shifted by 3 days compared to the base period. When comparing the latest black frost periods in autumn, it was found that this indicator was 20 days later than the base period at the Nukus meteorological station. Similar periods were observed at Kungrad meteorological station on 30.11.2006 in the studied period, and 01.11.1984/1997 in the base period. It was found that the latest occurrence of autumn black frost was 29 days later than the base period in the current period. The average duration of autumn black frost in the current and base periods differed during 1-3 days.

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Table 3 The number of days of temperature above 40 °C observed in the Republic of Karakalpakstan in 2005-2019 (N)

Meteorological station	The highest value		Average	Meteorological station	40°C high temperature (according to V.E.Chub)		Average
	N_{max}	Year			N_{max}	Year	
Chimbay	15	2019	8,7	Chimbay	13	1983	4,9
Nukus	15	2012/ 2015	10,1	Nukus	14	1984	7,3
Kungrad	23	2012	13,2	Jaslyk	17	2005	5,1

In the work, the recurrence of hot days with air temperature above +40°C at selected meteorological stations was also studied (Table 3). As a result of the analysis, it was found that the maximum number of days with an air temperature of +40°C was recorded in Chimbay in 2019 and in Nukus in 2012 and 2015. At the Kungrad meteorological station, this indicator was 23 days in 2012. The average annual frequency of hot meteorological was 8.7 days at the Chimbay meteorological station, 10.1 and 13.2 days at the Nukus and Kungrad meteorological stations, respectively. It can be seen that the duration of the maximum recurrence of heat in the Chimbay meteorological station has increased by 2 days in the current period (15 days) compared to the base period (13 days). We can see that the maximum number of hot days at the Nukus meteorological station has increased by 1 day compared to the previous period.

Conclusion

Based on the data observed in 2005-2019 at the Nukus, Chimbay, Kungrad meteorological stations located in the Republic of Karakalpakstan, the indicators of spring and autumn black frosts and summer thermal temperatures were determined and analyzed. As a result of the analysis, the period of late spring black frost was observed at the Nukus meteorological station in the current period on 11.03.2019 and occurred 2 days earlier than the base period (1971-2005). The earliest period of autumn black frost was observed at the Nukus meteorological station in the current period on 01.10.2017 and was observed 5 days later compared to the base period. The maximum annual recurrence of summer heat occurred in Nukus on 15 days in 2019, and in Kungrad meteorological station on 23 days in 2012. It can be seen from the above analysis that there have been changes in the duration of dangerous hydrometeorological events and their recurrence in the Republic of Karakalpakstan in recent years.

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