THE EFFECT OF GLOBAL WARMING ON THE BIGGEST VALLEY OF UZBEKISTAN

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ABSTRACT

The article analyzes the changes in the climate of the biggest valley in Uzbekistan, Fergana Valley, by processing data from some meteorological stations of the area. As the warming measure, the average temperature observed in the Fergana Valley meteorological stations during the period between 1930 and 2018 and the deviation of the amount of rainfall to the average temperatures for the last twenty years are accepted.

KEY WORDS: *global climate change, temperature, precipitation, statistical estimates, trends.*

1. INTRODUCTION

The problem of global warming is one of the most important topics in the human agenda today. Global climate change means not only an average annual rise in temperature on this planet, but also a change in all geo-systems, the occurrence of a rise in the World Ocean, the melting of ice and permanent glaciers, the increase in precipitation in one plane, the change in the regime of rivers flow and other changes associated with climate instability. One of the important tasks of humanity to tackle this problem and achieve a fair solution is to maintain economic and environmental balance in the world. Undoubtedly, the global climate is severely affected by human activities. In this regard, efforts should be made together to limit the negative impacts of human activities on the environment.

2. THE DEGREE TO WHICH THE SUBJECT IS STUDIED

It has been recognized that global warming that began in the 20th century is not the same as it has been in the last 1000 years. Average annual air temperature is $0.6 \pm 0.2°C$ per 100 years. However, this warming has not been the same for over 100 years and is divided into three parts of the 20th century: 1) 1910-1945; 2) a slight cooling observed in 1946-1975 and 3) a relatively severe warming period after 1976. As a result, the decade of the 1990s was the hottest decade of the century, and 1996 was the hottest year. The 10 hottest years of this century were followed by 1983, and 8 after 1990. The average temperature, calculated for 2000 year and 1961-1990 years, was higher than the norm and became 22nd of the consecutive years. [17]

According to the data of P.R. Sektorman and S.P. Nikulina [8] in the flatland of the Republic of Uzbekistan, in 2000 it became hotter to $1,13°C$ than in the norm in 1961-1990 years. Together with 2000 year and 1941 year became the hottest year of the last century. 4 year out of 6 years (1995, 1997, 1999 and 2000 years), when the temperature anomaly was greater than $1°C$, it was the last decade of the last century. Alternatively, in the summer months, a decrease in the maximum temperature was noted in most meteorological stations. And the largest values of temperature rise came to winter. In the last decade (1991-2000), the average annual temperature in winter was higher than the norm in the entire territory of Uzbekistan, in some regions this difference was $1,2-1,5°C$; in spring and summer, a slight decrease in temperature was noted [8].

As for the changes in the amount of precipitation, according to the results of the calculation of L.I. Molosnova, O.I. Subbotina and S.G. Chansheva [6,8] , 1941-1950 years were ten years with a minimum of precipitation; decades rich in moisture are 1951-1960 and 1981-1990 years. In general, it was noted that in 1961-1990 there was an increase in precipitation in the flat part of Uzbekistan. And in 1991-2000 years the amount of precipitation was more than the norm even in the mountain and foothill regions.

On the precipitation, it is worth noting again that the presence of a trend in its annual amount is also controversial in the scientific literature. For example, as V.E. Chub [9] points out, the meteorological stations have a tendency for their precipitation content to be viewed separately. In the book "Climate Change" by T.O.Ososkova, T.Yu.Spektorman va V.E.Chub, it is noted that for the last 100 years there has been no increase or decrease in the amount of precipitation in Tashkent which is the capital of Uzbekistan [7]. But G.E. Glazirin indicated that there is such a trend and noted that its reliability is at the level of 99% for the winter months (X-III) [1,2]. The presence of a positive trend in the amount of precipitation is confirmed by Z.N. Fatkhullaeva and S.X. Yuldasheva [5] on several meteorological stations.

L.A. Karandaeva and B.K. Tsarev noted that the trend of precipitation on the data of several meteorological stations in the mountainous regions is positive and much greater [3]. V.E. Chub also noted in his next book that the amount of precipitation is increasing on the territory of the Republic [10]. The presence of a trend in the amount of precipitation, and the fact that its amount is close to 1 mm/y, was also calculated on the data of the meteorological stations of Namangan city located in the southern part of Fergana Valley. The trend in the amount of precipitation by seasons is determined by the following formulas: winter (XII-II) – $y = 0,32t + 54,9$, spring (III-V) – $y = 0,14t + 69,1$, summer (VI-VIII) – $y = 0,16t + 16,6$, autumn (IX-XI) – $y = 0,34t + 28,3$, year $y = 1,0t + 168,3$. This confirms the correct execution of the calculation that the sum of the quantities of the coefficients in the expression by seasons is equal to the annual coefficients. The trend in the amount of precipitation is greater in winter and autumn, it has smaller values in spring and summer, that is, in winter and autumn it is about 0,32-0,34 mm/y, in spring and summer it is about 0,14-0,16 mm/y, and in the year it is about 1,0 mm. So, this situation is happening with the fact that the current air temperature is rising, and if the above process is typical for all arid regions, then it is necessary to re-analyze the reverse views on today's climate heat. This is also confirmed by paleogeoraphical data. The study of these problems on the example of the climate of the Fergana Valley and the question of improving the system of utilization of climatic resources in line with the future climatic conditions will be of paramount importance and will determine the relevance of this study.

The purpose and objectives of the study. The main objective of the study is to investigate the climate change in Fergana Valley during the period of climate warming and to evaluate its impact on the environment. To achieve this goal the following tasks have been set: 1) collecting the data on the climate of Fergana Valley and determining their indicators; 2) processing the collected data using statistical methods, evaluating temperature and precipitation amounts and changes in them; 3) identifying and evaluating the trend in Fergana Valley climate, including temperature and precipitation levels during global climate warming.

Research Methods. Data processing used standard methods of mathematical statistics and computer programs. The Ferghana Valley climate data were collected and processed using mathematical and statistical methods. Changes in the climate of the Ferghana Valley, including temperature and precipitation were determined by integral differences and linear trend methods.

Main results and their analysis. Continuing research on temperature changes across the world and Uzbekistan, this article describes how the Ferghana Valley has experienced many years of temperature changes between 1930 and 2018 and the rainfall change in 1947. Based on our research data in 2018, calculations show that the average monthly temperature fluctuated from -16.3°C to 34.2°C during the observation years. The lowest average annual temperature of January was -2.26°C, with the highest average temperature being 26.3°C (Table 1).

Table 1

The main indicators of air temperature in Fergana Valley (1930-2018)

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
T$_{average}$	-2,3	1,35	7,74	14,6	20,1	24,5	26,3	24,4	19,0	11,9	4,60	0,06	12,7
Max	4,7	16,4	14,5	30,2	30,6	33,2	34,2	32,3	27,5	22,7	14,4	5,3	20,2
Min	-16,3	-19,4	-9,1	-1,2	3,2	8,3	12,6	4,7	4,1	-6,8	-19,3	-15,9	-1,8

In winter, for the colder period of 1946-1975, as well as for the warming period of 1976-2018, the Fergana Valley temperature charts are also presented (picture 1). It turns out that in these two periods, the difference in the average monthly temperature scales in autumn and winter is large. For example, it was 6,8°C in November, and 4,53°C in January. This condition is repeated in other months.

Picture 1. In the Fergana Valley, the air temperature was colder (1946-1975) and the variability in the warming periods (1976-2018).
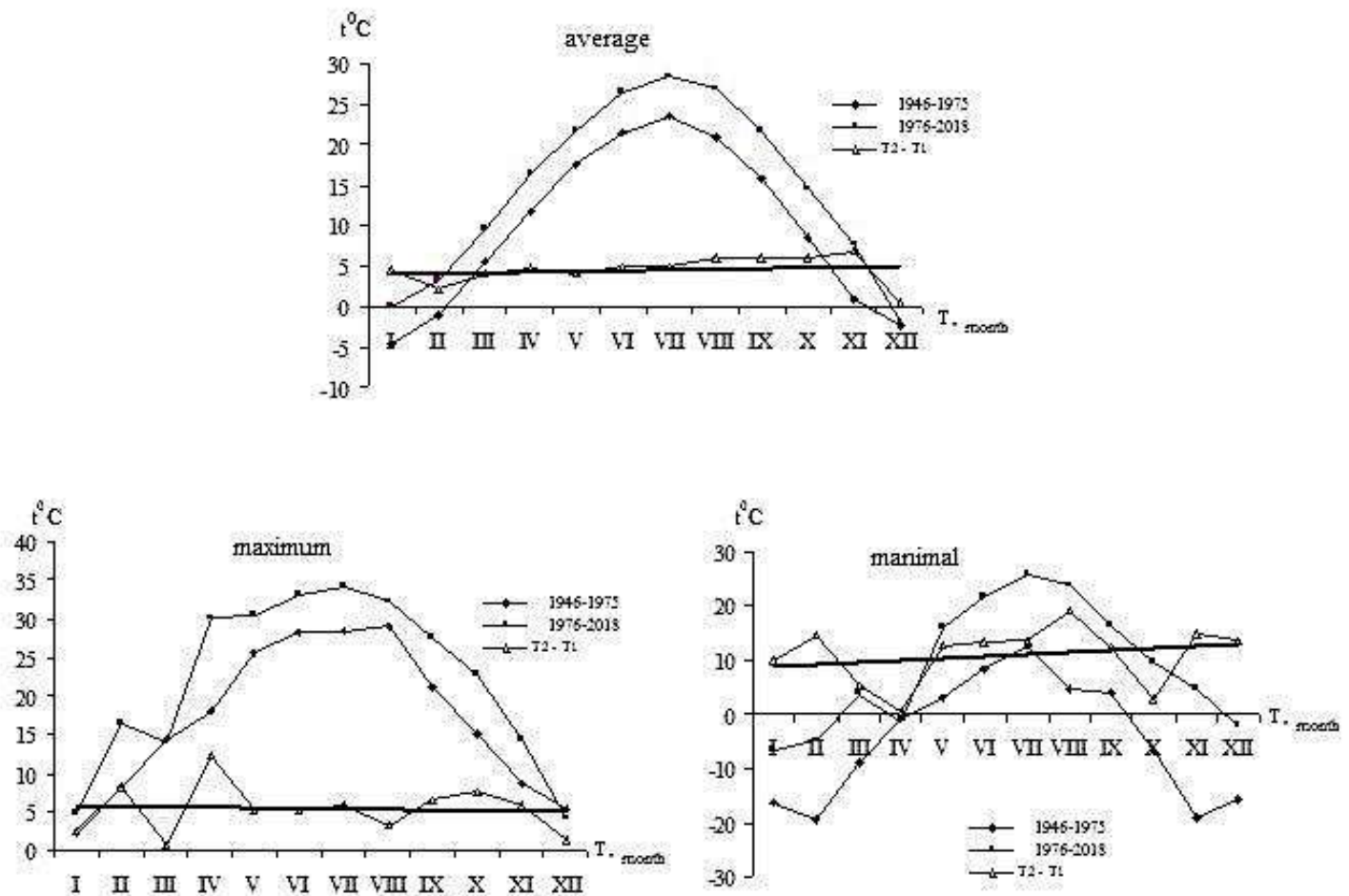
Monthly weather there are also changes in the maximum indicators of each. The biggest change was observed in April, when the temperature increased by 12,2°C during the warm-up period compared to the cold period, while in March the increase was 0,6°C.

The increase in the lowest air temperature indicators was 19,1°C in August and 0,4°C in April respectively.

Analysis of the meteorological data obtained on precipitation showed that the average amount of precipitation per year in the autumn period was 149 mm, the maximum was 347 mm, the minimum was 54,7 mm. The maximum amount of precipitation by months was 108 mm in February (in 1951 year), the lowest indicator of the amount of precipitation was observed in all months except March, which in this month amounted to 0,3 mm.

The largest of the values of the average amount of precipitation was 20,9 mm in April, the minimum was 1,97 mm in August (Table 2).

Table 2
Distribution of the amount of precipitation within a year

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Average	17	18,2	20,9	15,9	14,6	8,09	5,17	1,97	3,15	10,8	14,6	19
Max	79,9	108	73,7	60	68,1	32	45,4	14,5	24,6	44,2	82	79,1
Min	0	0	0,3	0	0	0	0	0	0	0	0	0

Average monthly and annual precipitation indicators were calculated for the cold in 1947-1980 and for the warming periods in 1981-2010. It turns out that the difference in the indicators of the precipitation amounts of these two periods is huge. The average amount of precipitation increased in the warming period compared to the previous period to 3,69 mm in May, 3,54 mm in September, 6,65 mm in December (significant in July, August, November). In all the remaining months, the decrease is noticeable (Table 3).

Table 3
Change in the amount of precipitation in the selected periods

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1947-1980-X_1	19,5	20,2	22,9	16,3	12,9	9,65	4,94	1,92	1,49	11,2	14,4	15,9
1981-2018-X_2	14,1	16	18,6	15,4	16,6	6,32	5,43	2,03	5,04	10,3	14,9	22,5
X_2-X_1	-5,34	-4,14	-4,31	-0,92	3,69	-3,32	0,49	0,12	3,54	-0,96	0,57	6,65

Determination of the trend in the amount of precipitation was carried out on the basis of seasonal quantities. The trend in the amount of precipitation by seasons is determined by the following formulas: winter (XII-II) – $y = -0,06t + 55,8$, spring (III-V) – $y = -0,08t + 53,8$, summur (VI-VIII) – $y = -0,1t + 18,4$, autumn (IX-XI) – $y = -0,09t + 31,4$, year $y = -0,32x + 159,5$. This confirms the correct execution of the calculation that the sum of the quantities of the coefficients in the expression by seasons is equal to the annual coefficients. The trend in the amount of fat is negative and much smaller (picture 2).
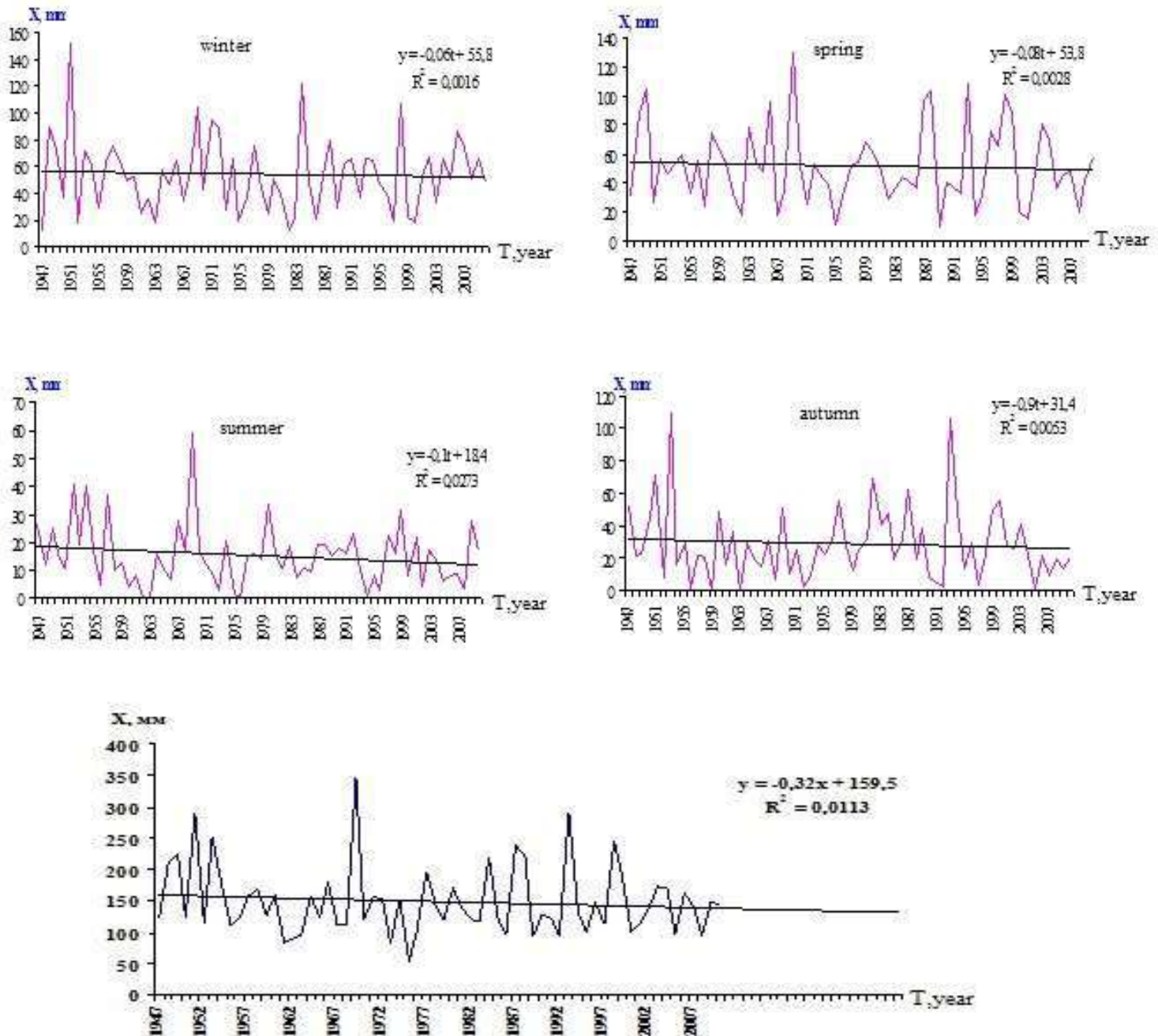
Picture 2. Linear trend graph for the change in precipitation amount (20 years)

CONCLUSION

Based on the above analysis, it can be concluded that changes in the values of meteorological indicators in the Fergana Valley are observed in accordance with global climate warming. This situation will continue in later periods. As a result, with the rise in air temperature, precipitation in the form of precipitation and a slight increase in evaporation can occur, a decrease in the accumulation of winter snow in the mountains, a decrease in the area of the glacier. This leads to a quantitative reduction and shortage of water resources in the Fergana Valley.

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