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QUANTITATIVE DYNAMICS OF AIR TEMPERATURE AND ATMOSPHERIC PRECIPITATION IN THE CHIRCHIQ-OHANGARON RIVER BASIN UNDER CONDITIONS OF MODERN CLIMATE WARMING

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Abstract. The article analyzes the trends in air temperature and precipitation changes in the Chirchiq-Ohangaron river basin based on data from seven meteorological stations for the baseline (1961-1990) and current (1991-2020) climatic periods. Statistical and correlation-regression methods were applied. The results show that the mean annual air temperature increased by an average of 0.9 °C, while precipitation increased by an average of 24 mm during the current period. The findings are of practical importance for water resources management and long-term planning in the basin.

Keywords: climate change, air temperature, precipitation, climatic period, meteorological station, Chirchiq-Ohangaron basin, hydrometeorological monitoring.

According to World Meteorological Organization data, the average annual air temperature at the Earth's surface has been rising by approximately 0.15–0.20 °C per decade since 1975, resulting in accelerated melting of polar and mountain glaciers and an increasing frequency of extreme hydrometeorological events. The high-temperature seasons recorded in the last decade, particularly in 2021–2025, testify to the persistent nature of these changes in the climate system. These processes require in-depth scientific analysis not only at the global scale but also at the level of individual river basins, since the regional dynamics of air temperature and atmospheric precipitation directly affect the water regime of rivers.

The Central Asian region, including the territory of Uzbekistan, is one of the zones particularly sensitive to climate change, since the bulk of the region's water resources is formed from mountain glaciers and snow reserves. The Chirchiq-Ohangaron basin is one of the basins of strategic importance for providing drinking water, irrigation, and hydropower supply to the Tashkent region and the capital. For this reason, quantitatively determining the long-term dynamics of air temperature and precipitation in this basin has become a practical necessity.

An analysis of the relevant scientific literature shows that the issue of changes in Central Asian rivers under climate warming conditions has been addressed in the works of a number of researchers, including V.Y.Chub, G.Y.Glazirin, V.G.Konovalov, L.M.Karandayeva, F.Kh.Khikmatov, and others. Nevertheless, a systematic quantitative assessment of air temperature and precipitation in the Chirchiq-Ohangaron basin across the baseline and current climatic periods, in relation to the altitude gradient, has not yet been sufficiently covered, which determines the relevance of this research direction.

The aim of the study is to determine the quantitative changes in air temperature and atmospheric precipitation in the baseline (1961-1990) and current (1991-2020) climatic periods, based on data from meteorological stations located in the Chirchiq-Ohangaron river basin, and to assess the patterns of their distribution by altitude. To achieve this aim, the following tasks were set: bringing the data of the basin's meteorological stations into unified long-term series; calculating the average long-term air temperature and precipitation values for both climatic periods; determining their difference (Δ); and analyzing the obtained results in relation to the altitude gradient.

The scientific novelty of the study lies in the fact that, based on unified 60-year (1961-2020) long-term series from seven meteorological stations in the Chirchiq-Ohangaron basin, the quantitative differences in air temperature and precipitation between the baseline and current climatic periods were determined, and the altitude-dependent trends of these differences were elucidated for the first time within a single methodological approach.

The article is based on long-term observation data from seven meteorological stations located in the Chirchiq-Ohangaron river basin: Qovunchi (Yangiyul), Tashkent, Tuyabuguz, Piskom, Soqoq, Dukant, and Oygaing. The selected stations cover the basin's various altitudinal zones (from 341 to 2151 meters), making it possible to study the vertical distribution of climatic indicators. Short-term gaps occurring in the observation series of some meteorological stations were restored using standard methods accepted in hydrometeorology. As a result, unified, continuous 60-year observation series covering 1961-2020 were formed for all stations. In line with the research objective, this long series was divided into two conditional accounting periods: the baseline climatic period (BCP, 1961-1990) and the current climatic period (CCP, 1991-2020). Such periodization is a widely used approach in world hydrometeorological practice for comparing climate norms.

For each meteorological station, the long-term average annual air temperature and average annual precipitation values for the BCP and CCP periods were calculated separately. Then the difference (Δ) between the two periods defined as the difference between the average long-term value of the corresponding indicator in the current period and its average long-term value in the baseline period was determined. A positive Δ value indicates an increase in the indicator in the current period, while a negative value indicates a decrease.

At the next stage of the research, the relationship between air temperature and precipitation and station altitude (H, m), expressed as $\rho = f(H)$, was studied separately for the BCP and CCP periods based on correlation-regression analysis. The relationship lines constructed for both periods were compared with each other, and the trend of change in temperature and precipitation differences (Δ) with altitude was determined. All calculations applied are based on statistical comparison methods accepted in hydrometeorological practice.

The average annual air temperature values for the BCP and CCP periods at the seven meteorological stations located in the basin, and their difference, are given in Table 1.

Table 1

Change in the average annual air temperature in the Chirchiq-Ohangaron basin across different climatic periods

No.	Meteorological station	Altitude, H (m)	BCP, °C	CCP, °C	Difference, Δ (°C)
1	Qovunchi (Yangiyul)	341	13.4	14.6	1.2
2	Tashkent	466	14.1	15.2	1.1
3	Tuyabuguz	500	14.1	15.2	1.1
4	Piskom	1258	9.5	9.8	0.3
5	Soqoq	1351	10.8	11.6	0.8
6	Dukant	2001	7.7	8.5	0.8
7	Oygaing	2151	2.3	3.0	0.7
	Sum	-	**71.9**	**77.9**	**6.0**
	Average	-	**10.3**	**11.1**	**0.9**

The table data show that at all seven stations of the basin, the average annual air temperature recorded in the CCP was higher than in the BCP. The average increase across the basin amounted to 0.9 °C. The highest change was recorded at the Qovunchi (Yangiyul) station (Δ=1.2 °C), which

is located in the lowest-altitude zone of the basin (341 m). The lowest change was observed at the Piskom station (Δ=0.3 °C, altitude 1258 m).

A comparative analysis of the ρ=f(H) relationship lines constructed separately for the BCP and CCP periods, aimed at determining the pattern of change in air temperature with altitude, showed that the temperature difference (Δ) between the two periods consistently decreases with increasing altitude. Specifically, in the lower part of the basin at H=350 m, the rise in temperature during the CCP amounted to ΔT=1.1 °C, while in the high-mountain zone at H=2150 m this indicator decreased to ΔT=0.7 °C. This trend is also confirmed by calculations based on data from individual stations and shows that the average temperature rise across the basin is ΔTy=0.9 °C.

The change in atmospheric precipitation amounts in the basin during the BCP and CCP periods is given in Table 2.

Table 2

Change in the average long-term precipitation amount in the Chirchiq-Ohangaron basin under conditions of climate warming

No.	Meteorological station	BCP, mm	CCP, mm	Difference, Δ (mm)
1	Qovunchi (Yangiyul)	369	377	8
2	Tashkent	304	334	30
3	Tuyabuguz	427	439	12
4	Piskom	926	970	44
5	Soqoq	876	965	89
6	Dukant	987	952	-35
7	Oygaing	839	858	19
	Sum	**4728**	**4895**	**167**
	Average	**675**	**699**	**24**

An analysis of the table results shows that at six of the seven stations in the basin, the precipitation amount recorded during the CCP increased compared to the BCP, while only at the Dukant station was a decrease of 35 mm recorded. The largest increases were observed at the Soqoq (89 mm) and Piskom (44 mm) stations. The average precipitation amount across the basin increased by 24 mm during the CCP compared to the BCP.

According to the results of studying the altitude distribution of precipitation, as altitude increases, the annual precipitation amount increases almost in parallel during both accounting periods, so that the difference (Δ) between the BCP and CCP periods remains relatively stable regardless of altitude. Specifically, at H=350 m this difference amounts to Δ=24 mm, while at H=2150 m it equals Δ=25 mm; that is, unlike the temperature difference, the change in precipitation amount is almost independent of altitude.

The obtained results confirm that the rising trend of air temperature in the Chirchiq-Ohangaron basin is consistent with global climate warming processes. The average increase of 0.9 °C determined for the basin is of the same order as the average long-term warming rates for the Earth's surface cited in the introduction, which testifies that regional climatic processes are developing within the context of global trends.

The decrease in temperature change with altitude: that is, the relatively higher warming rates recorded in the lower zones and relatively lower warming rates in the high-mountain zones deserves particular attention. This phenomenon may be related to factors such as the heat-exchange characteristics of the atmospheric layer in low- and high-altitude zones, the solar radiation regime, and the influence of snow-ice cover on the local climate; however, confirming this hypothesis requires additional, more in-depth hydroclimatic research in the basin.

The overall increasing trend observed in atmospheric precipitation dynamics, particularly the relatively large increase recorded at the Soqoq and Piskom stations, may be explained by the intensification of moisture-circulation processes in the mountainous part of the basin. At the same time, the single negative trend recorded at the Dukant station (-35 mm) is an exception to the overall trend, and this may well be related to the local relief characteristics of the station's location or local factors in the observation series; determining the causes of this anomaly could constitute a separate research topic.

The fact that the changes in temperature and precipitation have different characters in relation to altitude: the temperature difference decreasing with increasing altitude, while the precipitation difference remains relatively stable indicates the necessity of assessing both indicators separately, taking the altitude gradient into account, when modeling hydrological processes in the basin. This, in turn, is of practical importance for forecasting the water regime of the basin's rivers and for developing water resource management strategies, since the flow of mountain rivers largely depends on the temperature and precipitation regime in the upper zones.

In conclusion, it can be said that the observation data of the seven meteorological stations located in the Chirchiq-Ohangaron basin were analyzed and brought into unified 60-year long-term series covering 1961-2020. It was determined that the average annual air temperature in the basin rose by an average of 0.9 °C in the current climatic period (1991-2020) compared to the baseline period (1961-1990). The highest value of the temperature rise (1.2 °C) was recorded at the Qovunchi (Yangiyul) station in the lowest-altitude zone of the basin, and the lowest value (0.3 °C) at the high-mountain Piskom station, which shows that the temperature change has a character inversely proportional to altitude. It was found that the amount of atmospheric precipitation in the basin increased by an average of 24 mm in the current period compared to the baseline period, with an increase recorded at six of the seven stations and a decrease at one (Dukant). It was determined that, unlike the temperature difference, the change in precipitation amount has a stable character in relation to altitude, that is, it changed by almost the same amount (24-25 mm) in the lower and upper parts of the basin.

The obtained results confirm that the climate changes observed in the Chirchiq-Ohangaron basin are consistent with global climate warming trends and can serve as a practical basis for managing the basin's water resources, planning irrigation systems, and assessing hydropower potential. The fact that changes in air temperature and precipitation have different characters with respect to altitude indicates the need to specifically take the altitude gradient into account when developing hydrological forecasting models in the basin.

REFERENCES

1. Алексеевский Н.И., Фролова Н.Л., Христофоров А.В. Мониторинг гидрологических процессов и повышение безопасности водопользования. – М.: Изд-во МГУ, 2011.
2. Глазырин Г.Е., Хикматов Ф.Х., Аденбаев Б.Е., Юнусов Г.Х. и др. Методика исследования гидрологического режима горных рек: монография. – Ташкент: Fan va texnologiyalar, 2016.
3. Расулов А.Р., Ҳикматов Ф.Ҳ., Айтбаев Д.П. Гидрология асослари. – Тошкент: Университет, 2003.
4. Спекторман Т.Ю. Сценарий изменения климата для территории Узбекистана и зоны формирования стока рек Сырдарьи и Амударьи // Изменение климата: причины, последствия и меры реагирования. Бюллетень № 9. – Ташкент, 2015.
5. Фролова Н.Л. Гидрология рек (антропогенные изменения речного стока): учебное пособие. – М.: Географический факультет МГУ, 2006.

6. Хикматов Ф.Х., Юнусов Г.Х., Хакимова З.Ф., Зияев Р.Р., Эрлапасов Н.Б. Закономерности формирования водных ресурсов горных рек в условиях изменения климата. – Т.: «Инновацион ривожланиш нашриёт-матбаа уйи», 2020.
7. Чуб В.Е. Изменение климата и его влияние на гидрометеорологические процессы, агроклиматические и водные ресурсы Республики Узбекистан. – Ташкент: НИГМИ, 2007.
8. Щеглова О.П., Хикматов Ф.Х. Климатическая модель формирования стока рек в горных бассейнах рек Средней Азии // Изв. АН УзССР. Сер. техн. наук. – 1982. – № 6.