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STATISTICAL ESTIMATION OF THE FLOW VARIABILITY OF SMALL RIVERS IN THE MIDDLE ZERAVSHAN BASIN

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Annotation. This article addresses the issues related to statistical assessments of the variability in the runoff of small rivers in the Middle Zeravshan basin. For this purpose, the average monthly and annual water discharges were used, based on information from 11 hydrological stations located on small rivers and water resources in the Middle Zeravshan basin. Calculations to estimate the coefficient of variation for river runoff were carried out in two periods: the first calculation period included the base climate period (1961–1990), and the second calculation period included 1991–2018. Based on the analysis of the results obtained, an increase in the value of the coefficient of variation (C_v) in the second calculation period relative to that in the first calculation period was revealed.
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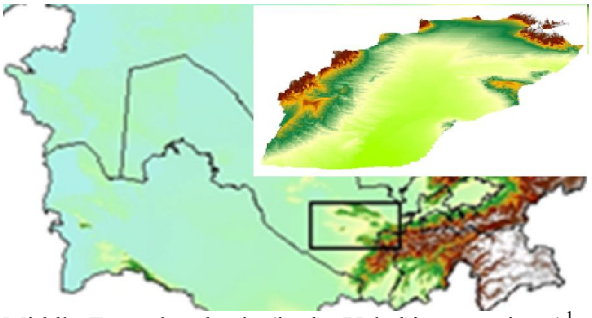
Key words: river basin, river, flow rate, series of random variables, flow variability, coefficient of variation, statistical assessment.

1. Introduction.

Today, as a result of the process of global climate change, the shortage of water resources on our planet, especially in arid regions, is becoming increasingly noticeable. Since the second half of the twentieth century, global climate change, or more precisely, global warming, has been observed. As a result, the air temperature rises, and under the influence of this process, the flow-generating efficiency of atmospheric precipitation decreases. Such changes occur in the Central Asian region, including the Zarafshan River basin. At the same time, these changes also affect the variability in river flow [1, 2, 8]. To effectively organize the use of small river and stream water resources in the Middle Zarafshan basin, an assessment of the variability in their flows is one of the current hydrological issues. Thus, issues of river flow variability have been considered in the research of many scientists. In particular, studies performed by K.P. Voskresensky, V.L. Shults, O.P. Sheglova, V.E. Chub, Z.S. Sirlibaeva, F.H. Hikmatov, L M. Karandaeva, and S.A. Haydarov aimed to study this problem for the rivers of the Aral Sea basin [15, 16, 17]. However, in these studies, the issue of river flow variability has not been studied in detail as is needed for the small rivers and streams in the Middle Zarafshan basin [1, 2, 4, 5].



Middle Zeravshan basin (in the Uzbekistan territory)[1]

Goals and objectives of the work. The main purpose of this study is to statistically assess the variability in the average monthly and annual flow rates of the small rivers and streams in the Middle Zeravshan basin. To achieve the goal set in the study, we used perennial water consumption data observed at 11 hydrological stations on rivers in the Middle Zarafshan basin (Table 1). These hydrological data

[1] ttps://earth.google.com/web/@39.67080204,66.87110598,940.

series were processed and generalized. The series of general observations was divided into two periods: the first period was the base climate period (1961–1990), and the second period was the accounting period (1991–2018).

Materials and Methods.

Data from the Center of the Hydrometeorological Service of the Republic of Uzbekistan and hydrometeorological stations and scientific research on the Middle Zarafshan basin were used. The study used geographical comparisons, mathematical statistics, modern methods of hydrological calculations and forecasts, and computer technology.

Key results and discussion.

The amount of river flow varies from year to year; thus, if a river has a large amount of water in one year, then it may have less water in the second year. These changes are mainly due to climatic factors, including air temperature and the amount of atmospheric precipitation. It should be noted that these changes are not subject to a specific law. However, the monthly or annual flow rate fluctuates around the average amount, calculated for a series consisting of multiyear observations. The amplitudes of the oscillations of these quantities have different values in different rivers, depending on the type of saturation of the rivers [18, 19].

Table 1. Information on small rivers and creeks in the Middle Zeravshan basin

№	River observation point	F, km^2	H, m	Observation years	Q_{max} Observed months
1	Urgutsoy – Urgut town	25,1	1710	1949–89, 2006–2018	II-IV
2	Omonkutansay- Omonkutan village	57,8	1601	1969–2018	II-VI
3	Okdaryo –Ogalik village	70,9	1384	1985–2018	II-V
4	Sazagansay –Sazagan vil.	26,8	1456	1949–2002	II-V
5	Tegirmonsoy –Sagishmon village	39,3	1143	1959–1984	III-V
6	Tusunsoy -downstream	1100	939	1938–1962, 1976–2018	III-V
7	Oktepasoy –Ocha village	43,8	1570	1964–1987, 2000–2018	II-V
8	Karagachsay –Mavlon vil.	34,7	1257	1978–2018	II-V
9	Kuksaroysoy – from the mountain	247	1070	1976–1985	II-V
10	Maydonsoy –Olmaota village	62,5	1138	1983–2002	II-IV
11	Beglarsoy –Yangi Okchob vil.	180	1340	1964–2018	II-V

The variability in the annual flow rate of rivers can be described by the coefficient of variation that characterizes the degree to which the annual flow rate (Q_i, m3/s) changes relative to its norm (Q_0, m3/s). It is calculated using the following expression:

$$C_v = \sqrt{\frac{\sum_{i=1}^{n}(K_i-1)^2}{n-1}},$$

where K_1- is the modulus coefficient of the current, the value of which is calculated by the expression $K_i = \frac{Q_i}{Q_0}$ [3, 9, 10, 14]. In the initial phase of the study, the average annual water consumption in the studied rivers was correlated to the same observation years as the corresponding accounting periods. At the same time, the existing interruptions in the rows were restored using various methods. The average annual water consumption was then calculated for each accounting period as well as for the total follow-up series (Table 2).

As shown in this table, the average perennial water consumption for the accounting periods in all rivers except the Oktepasay (Ocha village) and Sazagonsay (Sazagonsoy village) rivers differed significantly. The reason for this difference can be explained by the increasing influence of human factors on their flows from each year [19, 21]. The variability in the average annual water consumption of all studied rivers of the Middle Zeravshan basin

was statistically assessed. The values of the coefficient of variation (C_v) for the annual flow series of each river were calculated using the above expression (Table 3).

The values of the coefficients of variation we determined were compared with the results of other researchers. It is known that in V.E. Chub's 2007 monograph, the coefficient of variation (C_v) was calculated for all small rivers in the Central Zeravshan basin [7, 10, 11, 12, 13, 22]. The largest values of the coefficient of variation were for the Tegirmonsoy - Sagishmon q. (C_v = 1.64) and Tusunsoy - tributaries (C_v = 1.02). In contrast, in Sazagonsay and Karagachsay, C_v <0.5. According to the results of our calculations, the first value of the coefficient of variation in the first calculation period, i.e., 1961–1990, occurred for Tegirmonsoy (C_v = 1,511). In the second accounting period (1991–2018), the calculated values of the coefficient of variation met the condition C_v <1.0 for all rivers. During this calculation period, the value of the coefficient of variation for Urgutsay, Tegirmonsoy and Beglarsay decreased compared to that in the first accounting period. In contrast, in rivers such as Akdarya and Qayragachsay, the values of the coefficient of variation increased compared to that in the first accounting period.

Table 2. Mean annual water discharges of the small rivers in the Middle Zeravshan basin

№	River observation point	Q_{med}, m^3/s		
		I	II	III
1	Urgutsoy – Urgut town	0,395	0,467	0,432
2	Omonkutansay- Omonkutan village	0,748	1,029	0,884
3	Okdaryo –Ogalik village	0,830	0,950	0,875
4	Sazagansay –Sazagan village	0,322	0,364	0,342
5	Tegirmonsoy –Sagishmon village	0,286	0,353	0,318
6	Tusunsoy - point	1,457	1,394	1,427
7	Oktepasoy –Ocha village	0,303	0,314	0,308
8	Karagachsay –Mavlon village	0,223	0,371	0,298
9	Kuksaroysoy – from the mountain	0,805	1,00	0,899
10	Maydonsoy –Olmaota village	0,414	0,600	0,503
11	Beglarsoy –Yangi Okchob village	0,492	0,666	0,579

Note: I - the first base climate period (1961–1990); II - the second climate period (1991–2018); III - general climate period (1961–2018)

Table 3. Coefficient of variation (C_v) for the annual runoff of the rivers in the Middle Zeravshan basin

№	River observation point	C_V^*	I Climate period	II Climate period	III General climate period
1	Urgutsoy – Urgut town	0,531	0,617	0,378	0,500
2	Omonkutansay- Omonkutan vil.	0,588	0,438	0,464	0,484
3	Okdaryo –Ogalik village	0,523	0,333	0,523	0,477
4	Sazagansay –Sazagan village	0,459	0,550	0,474	0,512
5	Tegirmonsoy –Sagishmon vil.	1,64	1,511	0,827	1,157
6	Tusunsoy - downstream	1,02	0,895	0,899	0,888
7	Oktepasoy –Ocha village	0,797	0,878	0,550	0,725
8	Karagachsay –Mavlon village	0,422	0,581	0,840	0,837
9	Kuksaroysoy – from the mountain	-	0,609	0,485	0,549
10	Maydonsoy –Olmaota village	0,746	0,706	0,526	0,627
11	Beglarsoy –Yangi Okchob village	0,739	0,822	0,622	0,720

note: C_v^* – V.E. Chub (2007) data; I, II, III – *author's data*

No significant changes were observed in the calculated values of the coefficient of variation for the general calculation period, i.e., in 1961–2018. These results were compared with the results of calculations performed for both accounting periods for the small rivers of the Middle Zeravshan basin. These comparisons showed that the values of C_v decreased in Tosinsoy and slightly increased in Qayragachsay. This process can be explained by the impact of the reservoir built in Tosinsoy. In Kayragachsay, this situation was due to changes in its flow formation zone. Analysis of the results of the calculations showed that the values of the coefficient of variation for the remaining rivers varied in the range of 0.477 to 1.157. In general, the values of the coefficients of variation determined by different authors for different accounting years are similar to each other. In this study, based on the identified tasks, the coefficients of variation of the monthly flows with high water content during the flood period in the rivers of the study area were also calculated (Table 4).

Table 4. Coefficients of variation for monthly water discharges of the rivers in the Middle Zeravshan basin during the flood period

T.p.	River observation point	Month, Variation coefficients C_v				
		II	III	IV	V	VI
1	Urgutsoy – Urgut town	0,636	0,480	0,611	0,411	0,479
2	Omonkutansay- Omonkutan village	0,715	0,725	0,561	0,595	0,577
3	Okdaryo –Ogalik village	0,837	0,632	0,604	0,756	0,887
4	Sazagansay –Sazagan vil.	0,762	0,644	0,591	0,610	0,817
5	Tegirmonsoy –Sagishmon village	2,200	2,038	1,852	1,914	1,321
6	Tusunsoy -downstream	0,745	1,673	1,600	1,161	1,302
7	Oktepasoy –Ocha village	1,018	1,136	0,967	0,943	0,782
8	Karagachsay –Mavlon vil.	0,851	0,750	0,703	0,663	0,751
9	Kuksaroysoy – from the mountain	0,523	0,505	0,320	0,414	0,300
10	Maydonsoy –Olmaota village	0,794	0,717	0,743	0,771	0,803
11	Beglarsoy –Yangi Okchob vil.	0,824	1,012	0,886	0,856	1,026

Note: 1,2,3... indicate the order of the rivers in Table 1

The coefficients of variation during the flood period for the small rivers in the Middle Zeravshan basin varied in February, March and April in the range of 0,320 to 2,200 (Figure 1).

In the following May and June, the values of C_v decreased. However, in some rivers, such as Kayragachsay and Maidonsay, the values of S_v increased. This, in our opinion, is due to the heavy rains that are sometimes observed in May and June. In Urgutsoy, the change in the coefficients of variation decreased slightly in March and rose again in April, while in Tegirmonsoy, the values of Sv decreased by months, i.e., from February to June.

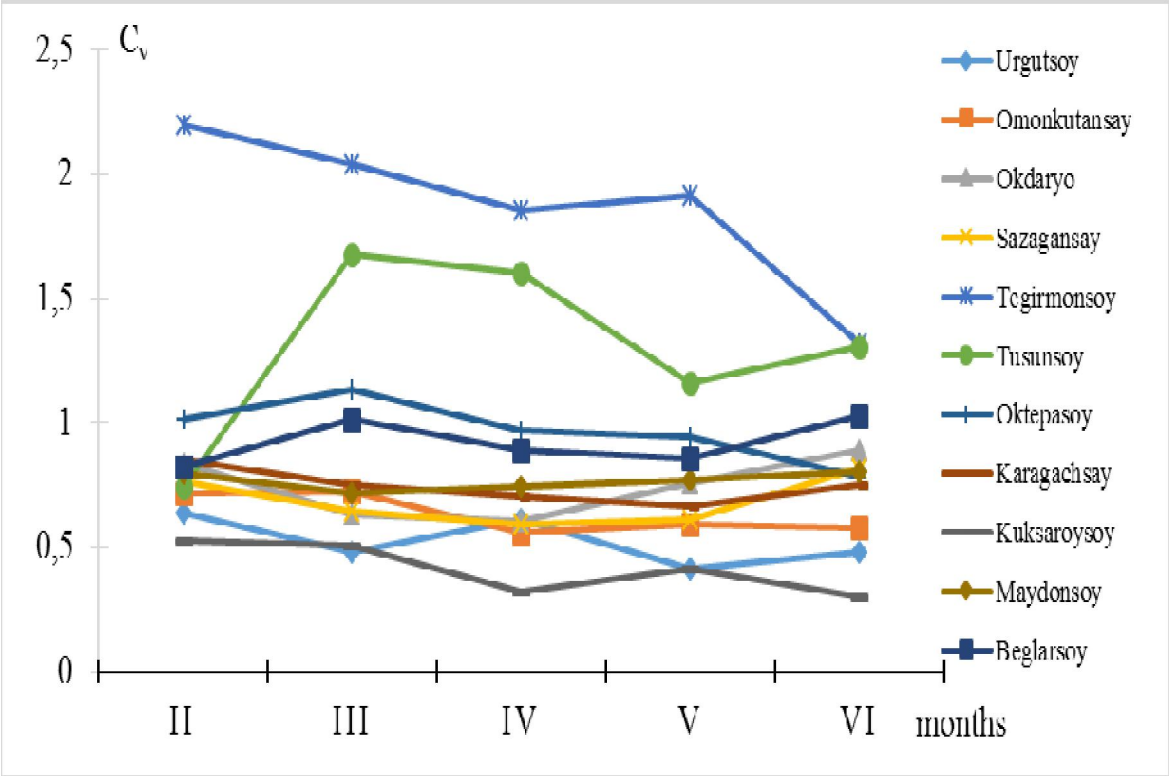


Fig. 1. Change in the coefficient of variation for the monthly discharges of the rivers in the Middle Zeravshan basin during the flood period

Conclusion.

1. The issues of interannual fluctuations in the average monthly and annual flows of rivers and streams in the Middle Zeravshan basin were studied. Their variability was statistically assessed by calculating the coefficient of variation.
2. The coefficients of variation for the average annual water consumption of rivers for 1991–2018 varied in the range of 0.378 to 0.899, and the values calculated for the total for 1961–2018 varied in the range of 0.477 to 1.157. These values of the coefficients of variation were compared with those in the E.V. Chub data. With a few exceptions, it was shown that the difference was not significant.
3. Most of the average annual flow of all small rivers and streams in the Middle Zeravshan basin flows between February and May. Their flows decrease sharply during the summer months, and sometimes the streams dry.

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REFERENCES

[1]. Resurrection K.P. Rate and variability of the annual flow of rivers in the Soviet Union. L .: Gidrometeoizdat, 1962.246 p.

[2]. Ziyaev R.R., Hikmatov F.H., Mardiev I.A., Yuldoshova Z.O. Statistical assessment of the

impact of climatic factors on the formation of the Zarafshan river floodplain // Information of the Geographical Society of Uzbekistan. Volume 56, 2019. - p. 211-215.

[3]. Rasulov A.R. Hikmatov F.H., Aytbaev D.P. Fundamentals of hydrology. -Tashkent: University, 2003. -p. 110-113.

[4]. Ratkovich D.Ya. Long-term fluctuations in river flow. L .: Gidrome-teoizdat, 1976.255 s.

[5]. Chub V.E. Climate change and its impact on hydrometeorological processes, agroclimatic and water resources of the Republic of Uzbekistan. -Tashkent: "VORIS NASHRIYOT", 2007. -133 p.

[6]. Shults V. L., Mashrapov R. Hydrography of Central Asia. –Tashkent, 1969.-p. 128-134.

[7]. Shiklomanov I.A. Investigation of land water resources: results, problems, prospects. L .: Gidrometeoizdat, 1988.-152 p.

[8]. Hikmatov F.H. and others. Hydrometeorological conditions and water resources of the Zarafshan basin. Monograph. -Tashkent: Science and Technology, 2016. - 275 p. nine.

[9]. Hikmatov F.H. and others. Hydrometeorological conditions and water resources of the Zarafshan basin. -Tashkent: Science and Technology,2016.-276 p.

[10]. Hikmatov F.H., Aytbaev D.P. Statistical methods in hydrometeorology -Tashkent: University, 2007. -88 p.

[11]. Hikmatov F., Haydarov S.A., Hakimova Z.F., Ganiev Sh.R., Erlapasov N.B. Assesment of the flow rate of the Zarafshon river according to climatic factors // International Jurnal of Psychosocial Rehabilitation. May, 2020, Volume 24. - Issue, 2020. –P. 5438-5449.

[12]. Hydrological knowledge. Volume 14. Central Asia. Issue 3. Bass. R. Amu Darya. L .: Gidrometeoizdat, 1967 323 p.

[13]. Irrigation of Uzbekistan. Volume III. Tashkent: Fan, 1979, 357 p.

[14]. Ganiev Sh.R., Valieva Sh. Ravotkhodzhinskoe water distribution structure and canals that take water from it // Young scientist. Science Magazine. –Kazan, ISSN: 2072-0297 No. 8 (88) April 2015

[15]. Ganiev Sh.R., Isaeva M.M. Annual shaking of the stream of rivers (As an ehample of middle Zarafshan) // Young scientist. International scientific journal. - Kazan, ISSN: 2072-0297 No. 11 (91) June 2015

[16]. Ganiev Sh. R. The meteorologikal study of the vater basin of the middle Zerefshan Rivers // Young scientist. International scientific journal. - Kazan, ISSN: 2072-0297 No. 12 (116) June 2016

[17]. Ganiev Sh.R. The average perennial statement of the stream flows in the mountains and their evaluations // Young scientist. International Scientific Journal - Kazan, ISSN: 2072-0297 No. 10 (196) March 2018

[18]. Irrigation of Uzbekistan. Volume IV. Tashkent: Fan, 1979.357 p.

[19]. SHIRINBOEV D.N., GANIEV SH.R., R.R. ZIYAEV Hydrological Regime of Irrigation Canals in Zarafshan Oasis // International Journal of Advanced Research in Science, Engineering and Technology. 2021 volume 8, Issue 4, ISSN: 2350-0328

[20]. Chub V.E. Climate change and its impact on the natural resource potential of the Republic of Uzbekistan. Tashkent: NIGMI, 2000.252 p.

[21]. Shirinboyev D.N., Ganiyev Sh., Hikmatov F., Haydarov S. Assessment of the impact of anthropogenic networks on changes in the flow of the Zarafshan River // TEST Engineering & Management. 2019. –P. 15137-15145.

[22]. CA Water-Info. URL:http://www.cawater-info.net.html.

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