VARIATION OF AVERAGE FLOW WATER FROM CĂLIMAN MOUNTAINS BASED ON SPECIFIC VARIATION INDICATORS

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Abstract. ***The variation of the average water flow from the Căliman Mountains.*** The variation of river water runoff is a normal phenomenon, given the close link between runoff and atmospheric precipitation, both components of the water balance. The variation of the flow over a period of time can be calculated using several simple and complex indicators, among which the most important are the absolute and relative deviation, the standard deviation (deviation) and the coefficient of variation. In the Căliman Mountains, no analysis of the variation of river water flow has been made so far, this work being the first of its kind. Following this work, it was observed that the variation of water flow from these rivers in the period 1950-2010 depended strongly on the variation of climatic elements (precipitation and temperatures), but also on the characteristics of river basins, both annually and seasonally.

Keywords: variation, runoff, averages, Căliman Mountains, indicator, coefficient.

1. INTRODUCTION

Variation of river water runoff is a topic long discussed in specialized studies around the world and in Romania, there are various indicators that show in one way or another how the runoff has evolved, namely the flow of rivers in a particular region in a certain period of time. In the Căliman Mountains in the Eastern Carpathians, no such studies have been conducted on the variation of water flow from rivers belonging to this mountain group. These mountains represent a special area by its morphology, geology and positioning in the Carpathian chain (Fig. 1), with a high altitude of over 2000 m. These rivers belong to three large river basins - Siret, which collects rivers from north and east; Mureș - in the south, and Someș in the west.

The variation of the runoff from these rivers depends mainly on the size of the river basin and the average altitude, the variation being much larger where the response to climatic factors takes longer to materialize.

2. DATABASE AND METHODS

In this study, the daily flow time series are observed, observed at the 14 hydrometric stations in the Căliman Mountains (Table 1), of which 4 in the Siret basin, 3 in the Mureș basin and 4 in the Someș basin. The analysis period used to obtain conclusive values of the variation was 1950-2010.

Climatic data for the Căliman Mountains were taken from the data obtained with the ROCADA program (1961-2013), in netCDF (Network Common Data Form) format, with the help of Mr. Marius-Victor Birsan (marius.birsan@gmail.com), PhD in Geography and employee of the National Meteorological Administration (Dumitrescu, Al., Birsan, M., 2014).

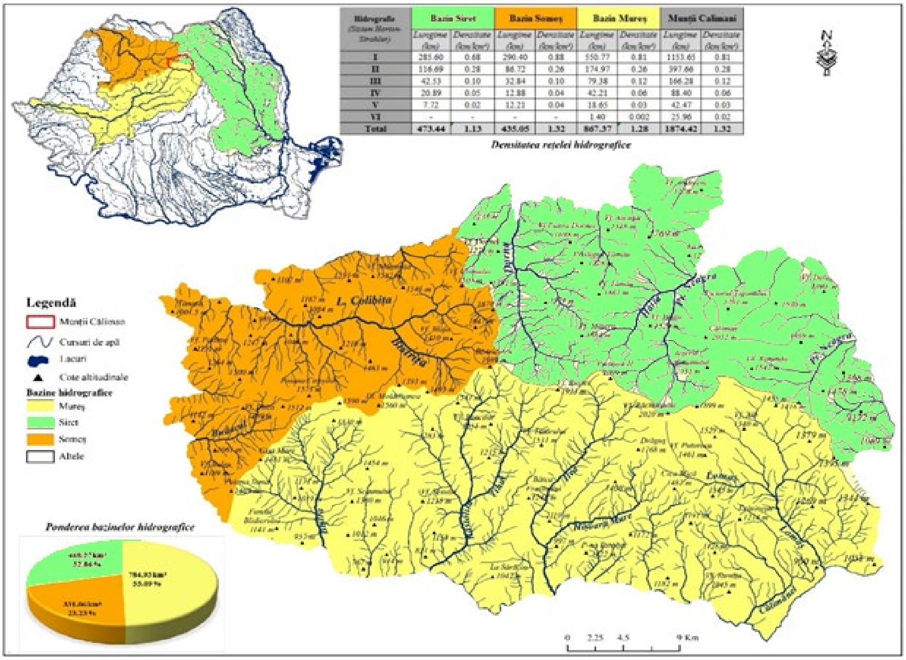

Fig. 1. Căliman Mountains and the hydrographic basins from this area

For the characterization of statistical strings in terms of the spread of individual levels, specific indicators known as variation indicators are used.

If we take into account the number of characteristic variants that are compared to obtain an indicator that measures the degree of variability, there are two types of indicators: Simple indicators, and Complex indicators.

1. Simple indicators of variation characterize the deviation of a single variant from another variant or from the average value of the characteristic.

These indicators therefore measure isolated aspects of the degree of variability and can be calculated in both absolute and relative terms.

Table 1. Main hydrometric station from Căliman Mountains

No. Crt.	River	Hydrometric station	Hydrografic basin	F (km²)	H average (m)
1	Dorna	Poiana Stampei	Siret	100	1376
3	Neagra	Gura Negrii		301	1256
5	Șărișor	Panaci		63	1427
7	Bistricioara	Bilbor		88	1123
8	Toplița	Toplița	Mureș	208	1149
9	Răstolița	Răstolița		163	1174
10	Bistra	Bistra		94	1104
11	Budac	Jelna	Someș	157	781
12	Bistrița	Mița		82	1230
13	Bistrița	Bistrița Bârgăului		612	1130

a) The amplitude of the variation (A) measures the field of scattering of the characteristic values and is obtained by comparing the variant with the largest size below which the characteristic with the minimum value variant was registered, as follows: absolute amplitude (A = Xmax – Xmin), relative amplitude (A (%) = (Xmax - Xmin) / Xmed * 100). b) Deviation of each variant of the characteristic.c from the mean value (Δi): absolute deviation (Δi = Xi - Xmed; i = 1, 2,…. N), relative deviation (Δi (%) = (Xi - Xmed) / Xmed * 100).

These indicators express the extent to which each variant of the characteristic deviates from the average value of the data string. For the analysis are especially important the maximum negative deviation, respectively the positive one, which also provides a general information on the scattering of values in relation to the average value.

2. Synthetic indicators characterize the average deviation of all values from their average. a) linear mean deviation - for distribution series with equal frequencies; b) dispersion - provides a numerical quantity with abstract character of the degree of variability existing in a group; c) Coefficient of variation (V): V = σx / Xmed; d) quadratic mean deviation (standard deviation) - characterizes the degree of variation of individual values compared to the mean.

This index represents the arithmetic mean of the squares of the differences between each value of a data string and the average value of that string, calculated based on the formula:

$$\sigma = \sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 /(n-1)}$$

where xi = string values; x = string average; n = number of string values

The quadratic mean deviation highlights the degree of scattering of the values compared to the mean of the string or, on the contrary, the degree of homogeneity when there are small variations compared to the mean (Chendeș, 2011). The lower the mean square deviation in value, the more concentrated the characteristic values are around the mean and consequently the more homogeneous the values. Conversely, the higher it is, the more dispersed the individual values are, and therefore less homogeneous. It allows, by its percentage expression, a general appreciation of the degree of average variability of the values. The lower the coefficient in value, the more representative the mean, and the more homogeneous the string. A value lower than 0.30 of the coefficient of variation attests a good degree of homogeneity of the string and of representativeness of the average value (www.stiucum.com).

3. RESULTS AND DISCUSSIONS

Maximum and minimum deviation of the average annual runoff

From the analysis of the relative deviations of the discharge values in the period 1950-2010 it can be observed that the values of the maximum deviation are much higher (in absolute value) than those of the minimum deviation.

The highest values were registered at the Poiana Stampei stations on Mița (112.40% in 1970) (Table 2). The highest values correspond to the years with a very high runoff, such as 1970, when, against the background of very high amounts of precipitation, floods were registered in the entire mountain group.

The minimum deviation with the highest value was registered at the Poiana Stampei station on the Dorna brook in 2000 (-82.66%). In the case of the minimum deviation, a year with several values cannot be highlighted (except for 1950), these being met throughout the analyzed period.

Table 2. Absolute (in m^3/s) and relative values (in %) of maximum and minimum deviations in the period 1950-2010 at the hydrometric stations from Căliman Mountains

Hydro. station	Annual average	Maximum deviation			Minimum deviation		
		Abs (m^3/s)	Rel (%)	Year	Abs (m^3/s)	Rel (%)	Year
Poiana Stampei	2,33	1,71	73,39	1997	-1,93	-82,66	2000
Gura Negrii	4,20	4,15	98,74	1970	-2,20	-52,40	1950
Panaci	0,69	0,65	93,48	1970	-0,37	-53,62	1950

Bilbor	0,96	0,64	66,67	2009	-0,61	-63,02	1961
Toplița	2,86	2,33	81,59	2010	-1,63	-56,99	1950
Răstolița	3,49	2,66	76,19	1970	-1,89	-54,01	1950
Bistra	2,39	1,57	65,52	1970	-1,02	-42,87	1950
Jelna	2,37	1,89	79,84	1980	-1,18	-49,90	1961
Mița	1,71	1,92	112,40	1970	-0,96	-56,32	2003
Bistrița B.	3,57	3,12	87,31	1970	-1,67	-46,87	1990

Table 3. Absolute (in m^3/s) and relative values (in %) of winter maximum and minimum deviations in the period 1950-2010 at the hydrometric stations from Căliman Mountains

Hydrometric station	**Winter**	**Maximum deviation**			**Minimum deviation**		
		Abs (m^3/s)	**Rel (%)**	**Year**	**Abs (m^3/s)**	**Rel (%)**	**Year**
Poiana Stampei	0,84	1,42	169,13	201	-0,71	**-84,88**	200
Gura Negrii	1,88	2,02	107,46	195	-1,10	-58,24	195
Panaci	0,36	0,32	88,24	201	-0,23	-65,19	195
Bilbor	0,45	0,84	185,63	201	-0,31	-68,59	195
Toplita	1,40	3,02	**215,48**	201	-0,98	-69,83	198
Rastolita	2,13	3,06	143,82	201	-1,29	-60,41	195
Bistra	1,65	1,46	88,69	201	-0,89	-54,19	195
Jelna	1,94	3,05	202,28	195	-1,01	-67,14	195
Mita	1,13	2,19	194,21	195	-0,88	-77,94	198
Bistrita Bargaului	2,75	3,42	124,52	195	-1,72	-62,42	195

Maximum and minimum deviation of the average seasonal runoff

Water flow deviation can be analyzed both annually and seasonally. In general, the deviations at seasonal level present higher percentage values than the annual ones, being analyzed shorter periods of time (3 months). In the case *of winter* runoff, the largest positive deviations at the stations in the study area were recorded in three years: 1957, 1958 and 2010 (Table 3), with a maximum in 2010, when deviations of +215.48% at Toplița station and +202,28% at Jelna station. These deviations were due to very high air temperatures, which caused snow melting, accompanied by significant rainfall (Hîrlav, Porcuțan, 2015). Also, these high values demonstrate the high values of the coefficient of variation this season at most stations.The minimum deviations did not show some characteristic years, varying from one station to another. The lowest value of the deviation was registered in 2000 at the Poiana Stampei station, of -84.88%.For the most part, these negative values were characterized by a persistent anticyclone regime with low rainfall and low temperatures, which meant that most of the water in the rivers was stored in a solid state.

Table 4. Absolute (in m^3/s) and relative values (in %) of spring maximum and minimum deviations in the period 1950-2010 at the hydrometric stations from Căliman Mountains

Hydrometric station	Spring	Maximum deviation			Minimum deviation		
		Abs (m^3/s)	Rel (%)	An	Abs (m^3/s)	Rel (%)	An
Poiana Stampei	4,07	3,52	86,40	1999	-3,15	**-77,34**	2000
Gura Negrii	6,66	12,41	186,32	1970	-3,71	-55,66	2003
Panaci	1,05	2,00	**190,57**	1970	-0,49	-46,35	1990
Bilbor	1,49	1,96	131,45	1970	-0,94	-63,20	1961
Toplița	5,1	7,60	146,37	1970	-3,09	-59,60	1990
Răstolița	5,92	7,87	132,85	1970	-3,47	-58,56	2003
Bistra	3,89	4,57	117,50	1970	-1,79	-46,10	1991
Jelna	3,84	3,33	86,71	1958	-2,31	-60,09	1972
Mița	2,85	4,34	152,19	1970	-1,77	-62,15	2003
Bistrița B.	5,50	7,11	129,31	1970	-3,47	-63,03	1990

Following the variation of the winter runoff in the annual profile, it can be noticed that the highest values of the runoff were achieved in different years: 1956/1957 at Gura Haitii station; 2010 at Bilbor station; 1953/1954 at Răstolița station; 1958/1959 at the Mita station.In spring, the largest positive deviations of runoff at the stations in the study area were recorded mainly in 1970 (Table 4), characterized by catastrophic floods that affected especially Transylvania, with strong influences throughout the Căliman Massif.

Table 5. Absolute (in m^3/s) and relative values (in %) of summer maximum and minimum deviations in the period 1950-2010 at the hydrometric stations from Căliman Mountains

Hydrometric station	Summ er	Maximum deviation			Minimum deviation		
		Abs (m^3/s)	Rel (%)	Yea r	Abs (m^3/s)	Rel (%)	Yea r
Poiana Stampei	2,85	3,94	138,26	195	-2,48	**-86,95**	200
Gura Negrii	5,40	5,88	108,93	195	-4,14	-76,69	195
Panaci	0,87	0,94	107,47	195	-0,67	-76,86	195
Bilbor	1,22	1,35	110,74	197	-0,89	-72,79	195
Toplița	3,14	4,16	132,38	200	-2,48	-78,95	195
Răstolița	3,59	3,60	100,25	197	-2,82	-78,64	195

Bistra	2,36	1,66	70,34	200	-1,55	-65,69	195
Jelna	2,28	6,09	**267,11**	197	-1,79	-78,53	195
Mița	1,74	3,27	187,88	197	-1,48	-85,29	195
Bistrița B.	3,61	5,38	149,03	197	-2,55	-70,63	195

Table 6. Absolute (in m^3/s) and relative values (in %) of autumn maximum and minimum deviations in the period 1950-2010 at the hydrometric stations from Căliman Mountains

Hydrometric station	**Autumn**	**Maximum deviation**			**Minimum deviation**		
		Abs (m^3/s)	**Rel (%)**	**Year**	**Abs (m^3/s)**	**Rel (%)**	**Year**
Poiana Stampei	1,52	2,66	174,67	1972	-1,33	-87,26	2000
Gura Negrii	2,87	5,13	178,85	1972	-1,85	-64,58	1961
Panaci	0,48	0,80	166,74	1972	-0,32	-66,11	1961
Bilbor	0,68	1,61	236,13	1972	-0,47	-68,38	1961
Toplița	1,72	3,60	209,31	1972	-1,03	-60,03	1963
Răstolița	2,32	2,78	119,78	1972	-1,38	-59,48	1953
Bistra	1,65	1,28	77,37	1998	-0,77	-46,91	1953
Jelna	1,41	2,60	184,40	1980	-1,00	-70,91	1951
Mița	1,11	1,76	158,61	1972	-0,95	-85,50	1951
Bistrița Bârgăului	2,41	3,01	125,03	1972	-1,52	-63,15	1951

The highest value was recorded, surprisingly, at the Panaci station on the (190,57%) in 1970, as a result of both the large amounts of precipitation that fell this season and the high temperatures that generated melting. early snowfall, materialized in several floods. The minimum deviations did not show some characteristic years, varying from one station to another. The lowest value of the deviation was registered in 2000 at the Poiana Stampei station, of 77.34%.

The largest positive summer deviations were recorded in 1955 for the rivers in the Siret basin, and 1974 for the rivers in the Mureș and Someș basins, with small exceptions (Table 5). The highest value was recorded at the Jelna station on the Budacu River (276.11%) in 1974, as a result of both the large amounts of precipitation that fell during this season, which generated more floods.

The deviations during autumn are the largest recorded in this mountain group, varying between +267,11% (1974) at Jelna station and -86,95% (1987) at Poiana Stampei station. In the rest of the stations, the highest values were registered in 1972, varying between + 125.03% at Bistrița Bârgăului station and + 236.13% at Bilbor (Table 6). The values of the negative deviation of the autumn runoff registered at Dornișoara station in 1987 (the lowest value of the deviations at all stations in all seasons), were caused by the strong drought that affected the country this year, especially during the summer and of autumn, when the river was close to drying up. These extreme values are determined by the fact that these rivers have the smallest basin areas (46 km^2, respectively 33 km^2) of all stations, which determines a very fast response to any change of such as high / low rainfall.

Weighted standard deviation of mean seasonal runoff

We also analyzed the variability of the flow with the help of the weighted standard deviation, which highlights the degree of scattering or homogeneity of the values in a data string compared to the mean of the string (Chendeș, 2011). The analysis was performed throughout the period 1950-2010 and the decades related to this period to assess the variation of discharge and what are the most important factors that influenced it. From Table 7 it can be seen that the stations with the highest values of deviation (over 1 m^3/s) were recorded at the stations with the largest basin areas, especially Gura Negrii (301 km^2), Răstolița (163 km^2) and Bistrița Bârgăului (612 km^2), with a maximum of 1,655 m^3/s at Gura Negrii station in the decade 1971-1980.

Table 7. Values of standard deviation (m^3/s) at the hydrometric stations from Căliman Mountains in the period 1950-2010 and its decades

Hydro. station	Basin surf. (km^2)	1950-2010	1950-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Poiana St.	100	0,713	0,659	0,559	0,458	**1,174**	0,889	***0,095***
Gura Negrii	301	**1,051**	**1,032**	**1,483**	0,619	**1,655**	0,557	0,620
Panaci	63	***0,171***	0,172	0,237	***0,099***	0,254	***0,069***	***0,013***
Bilbor	88	0,274	***0,166***	0,328	***0,169***	0,466	***0,065***	0,220
Toplița	208	0,777	0,800	0,841	0,469	**1,226**	**0,038**	**1,046**
Răstolița	163	0,796	0,980	**1,050**	0,536	**1,038**	0,402	**1,013**
Bistra	94	0,475	0,568	0,620	0,235	0,462	0,277	0,455
Jelna	157	0,699	0,842	0,691	0,774	**1,082**	0,354	0,299
Mița	82	0,502	0,615	0,725	0,375	0,457	0,314	0,246
Bistrița B.	612	0,918	**1,034**	**1,208**	0,645	**1,350**	0,270	0,920

We can also see the strong influence of the floods of 1970, which led to increases in deviation at all stations in this decade, but also the influence of the drought period from the mid-1981s to 1990, which led to a greater variation in runoff, especially in the case of larger river basins. At the opposite pole are the stations serving small river basins (less than 100 km^2), especially the Panaci (63 km²), Tomnatec (33 km²) and Bilbor (88 km²) stations, all located in the northeastern part of the Căliman Mountains. At these stations, deviation values of less than 0.5 m³/s were recorded throughout the analyzed period, the smallest variations (around 0.1 m³/s) being registered in the decades 1971-1980, 1991-2000 and 2001-2010. It can be seen that at the annual level, the basin area was the most important in the variation of runoff, rainfall or lack thereof being the second most important factor.

Exceptions are the stations Gura Negrii, Răstolița and Bistrița Bârgăului (Table 8), where they appear especially in the decade 2001-2010, and Mureșenii Bârgăului, where a deviation was registered, with very high values, with a maximum of 5,712 m³/s in 1950s-1960s. These values are due to the fact that this station, located in the western part, serves a river basin with low surface area and flow.*In spring*, compared to winter values, the values of the deviation are much higher, which demonstrates an accentuated inhomogeneity of values due to the strong increase of flow flows under the influence of snowmelt and very heavy rainfall this season, the most great of all seasons.

Table 8. Values of standard winter deviation (m³/s) at the hydrometric stations from Căliman Mountains in the period 1950-2010 and its decades

Hydro. stations	1950-2010	1950-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Poiana St.	0,453	0,356	***0,155***	***0,032***	0,327	0,322	0,636
Gura Negrii	0,706	0,825	0,153	0,341	0,423	***0,106***	**1,228**
Panaci	***0,135***	***0,132***	***0,025***	***0,054***	***0,031***	***0,068***	***0,114***
Bilbor	***0,197***	***0,038***	***0,030***	***0,023***	***0,115***	***0,056***	0,456
Toplița	0,712	0,371	***0,167***	0,506	0,245	***0,129***	**1,647**
Răstolița	0,769	**1,014**	0,316	***0,120***	0,279	0,460	**1,658**
Bistra	0,500	0,547	***0,187***	0,058	***0,127***	***0,167***	0,788
Jelna	0,869	0,740	0,279	0,434	0,587	0,327	***0,189***
Mita	0,659	0,531	0,444	0,068	***0,114***	0,608	0,457
Bistrița B.	**1,172**	0,885	0,740	***0,030***	0,693	0,213	**1,417**

Table 9. Values of standard spring deviation (m³/s) at the hydrometric stations from Căliman Mountains in the period 1950-2010 and its decades .

Hydro. stations	1950-2010	1950-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Poiana St.	**1,331**	0,652	**1,781**	0,823	**2,319**	0,322	***0,062***
Gura	**2,330**	**1,068**	**6,644**	0,928	**3,583**	***0,106***	0,957

Negrii							
Panaci	0,374	***0,171***	**1,063**	***0,149***	0,547	***0,068***	***0,002***
Bilbor	0,530	***0,038***	**1,283**	0,255	0,780	***0,056***	0,238
Toplița	**1,928**	0,803	**4,354**	***0,091***	**2,954**	***0,129***	**1,092**
Răstolița	**2,138**	**1,381**	**4,134**	**1,270**	**2,296**	0,460	**1,428**
Bistra	**1,267**	0,700	**2,439**	0,378	0,888	***0,167***	0,375
Jelna	**1,318**	0,693	**1,901**	0,755	**2,475**	0,327	0,603
Mita	**1,014**	0,472	**2,343**	**1,033**	0,882	0,608	0,300
Bistrița B.	**1,815**	0,787	**3,906**	**1,310**	**2,593**	0,213	0,763

The biggest variations are concentrated at the stations with large basin area, where the flow changes are bigger this season, but also at the stations from the Mureș and Siret river basins, where the temperature variation is higher. The highest values, of over 4 m^3/s, were concentrated in a single decade (1961-1970), this fact being due to the very high amounts of precipitation, respectively the huge flows from the spring of 1970. The highest values have were registered at Gura Negrii (6.64 m^3/s), Toplița (4.35 m^3/s), Răstolița (4.13 m^3/s) and Bistrița Bârgăului (3.90 m^3/s) stations (Table 9).

Close values were recorded in the decade 1981-1990, following a phenomenon opposite to the previous one - the strong drought in the middle of this decade, which caused a strong variation in flows.

Very small values, representing very homogeneous data series, were recorded in the decades 1950-1960, 1971-1980 and 1991-2000 at stations with basins and small flows in the northeastern part of the mountain group in the Siret river basin, the last of these decades presenting the most homogeneous values of water flow deviation.

In summer, the presence of higher values of deviations continues, but less and lower in value. They are concentrated only at the stations with large basin areas, reaching a maximum at the Gura Negrii station in the decade 1991-2000 (2,598 m^3/s), in the periods 1950-2010 and 1950-1960 registering at this station values of over 2 m^3/s (Table 10). The 1950s and 1960s concentrated most of the high values of deviation, due to stronger rainfall variations this summer season. The lowest values were recorded during the decade 1971-1980, this being the season with the most constant values of summer runoff flows.

Table 10. Values of standard summer deviation (m^3/s) at the hydrometric stations from Căliman Mountains in the period 1950-2010 and its decades

Hydro. station	1950-2010	1950-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Poiana St.	**1,255**	**1,420**	0,132	***0,008***	**1,327**	**1,654**	0,507
Gura Negrii	**2,061**	**2,319**	0,951	***0,066***	**1,854**	**2,598**	**1,528**
Panaci	0,326	0,371	0,152	***0,011***	0,341	0,249	***0,132***
Bilbor	0,532	0,276	0,417	***0,137***	0,719	0,633	0,497
Toplița	**1,331**	**1,166**	0,749	***0,095***	**1,227**	**1,453**	**1,690**
Răstolița	**1,228**	**1,637**	0,561	***0,122***	0,817	0,815	0,568
Bistra	0,751	0,951	0,331	***0,022***	0,267	***0,168***	0,385
Jelna	**1,463**	**1,311**	***0,082***	**1,089**	0,616	0,283	0,785
Mita	0,819	**1,039**	0,543	***0,029***	0,442	0,400	0,388
Bistrița B.	**1,570**	**1,732**	0,905	***0,013***	0,987	0,598	**1,472**

In autumn there are relatively small deviations, caused by relatively constant flows, only at Gura Negrii and Bistrița Bârgăului stations, values of over 1 m3 / s appearing, and rarely at Toplița, Răstolița and Jelna stations (Table 11). The values were kept low at the stations with small areas and flows, mostly in the Siret and Someș river basins, for the decades 1961-1970, 1991-2000 and 2001-2010.

Table 11. Values of standard autumn deviation (m^3/s) at the hydrometric stations from Căliman Mountains in the period 1950-2010 and its decades

Hydro. stations	1950-2010	1950-1960	1961-1970	1971-1980	1981-1990	1991-2000	2001-2010
Poiana St.	0,994	0,329	***0,050***	0,752	0,721	0,938	0,868
Gura Negrii	**1,312**	**1,058**	0,323	**1,692**	0,759	0,348	**1,232**
Panaci	0,224	***0,170***	***0,052***	0,271	***0,096***	***0,035***	***0,190***
Bilbor	0,364	***0,012***	***0,111***	0,526	0,250	***0,059***	0,330
Toplița	0,892	0,285	***0,008***	**1,504**	0,480	0,317	0,245
Răstolița	0,974	0,950	0,272	**1,108**	0,762	**1,179**	0,395
Bistra	0,543	0,560	***0,161***	0,799	0,566	0,287	0,273

Jelna	0,854	0,933	0,902	**1,225**	0,652	0,392	***0,003***
Mita	0,653	0,721	0,227	0,733	0,392	***0,145***	***0,159***
Bistrița B.	**1,102**	**1,205**	0,379	**1,093**	**1,125**	***0,167***	***0,028***

Variation coefficient

Another important indicator of river water flow is the variation coefficient (Cv). It emphasizes the river water oscillation during a time period.

At the level of seasonal values recorded at the hydrometric stations in the Căliman Mountains, differentiations appear depending on the hydrographic basins, in the Siret basin appearing the largest variations during winter and tomana, with a maximum at the northernmost station - Poiana Stampei (winter - 0.57; autumn - 0.64); the rest of the stations the values not reaching 0.5. At the stations in the Mureș basin located inside the momntan space, the situation is relatively similar to that in the Siret basin, here the values during autumn being much higher than those during winter. In the Someș basin there are various values of the coefficient from one station to another, which shows the positioning further west of these stations, at the edge of the mountain group. A special situation is the Jelna resort, located outside the mountain area, where the highest values are recorded during the summer (0.66), followed by autumn (0.6). It can be noted that the lowest values are recorded during spring and summer, with relatively constant values of climatic elements, while high values in winter and autumn show the strong variation of precipitation and temperatures. The attenuating factor of the variations represented by the position of the stations within the mountain group can be observed, the highest values being registered at its periphery.

4. CONCLUSIONS

The flow of water from the rivers in the Căliman Mountains in the period 1950-2010 showed important variations in this period, with maximums and minimums, with more homogeneous or more dispersed periods in terms of flow values.

Periods with highs and lows are those that overlapped with periods of low homogeneity due to strong variations in flow values from low to very high. This phenomenon is very evident in the decades 1961-1970, when the exceptional precipitations from the spring of 1970 determined the production in this area of some extraordinary floods, which determined the highest value of the maximum deviation; at the opposite pole is the 1981-1990 decade, when the severe drought in the middle of this decade caused a very sharp decrease in flows, thus appearing the largest minimum deviations. Also, a very important role in the variation of the drain has the basin surface, its values increasing greatly in the case of river basins with areas larger than 300 km2, such as Dorna (with the hydrometric situation Poiana Stampei) and Bistrița Ardelenească (with Bistrița Bârgăului station). The lowest values were recorded on courses with very small lengths and areas, such as Haita, Sarisor, Tomnatec and Bistricioara. The less water runoff is influenced by the human factor, the more dependent it will be on climate variables in recent years as a result of climate change. If man intervenes constructively in regulating the flows of watercourses, then these extremes will be lower, which will be to the benefit of all.

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