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MONTHLY AVERAGE FLOW IN RÂUL NEGRU HYDROGRAPHIC BASIN

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ABSTRACT. Monthly average flow in Râul Negru hydrographic basin Râul Negru hydrographic basin represents a well individualised and relatively homogenous physical-geographical unity from Braşov Depression. The flow is controlled by six hydrometric stations placed on the main collector and on two of the most powerful tributaries. Our analysis period is represented by the last 25 years (1988 - 2012) and it's acceptable for make pertinent conclusions. The maximum discharge month is April, that it's placed in the high flow period: March – June. Minimum discharges appear in November - because of the lack of pluvial precipitations; in January because of high solid precipitations and because of water volume retention in ice. Extreme discharge frequencies vary according to their position: in the mountain area – small basin surface; into a depression – high basin surface. Variation coefficients point out very similar variation principles, showing a relative homogeneity of flow processes.

Keywords: monthly average flow, space-time variation, flow principles, occurrence frequency, variation coefficient

1. INTRODUCTION

Râul Negru collects its tributaries from the eastern sector of Braşov Depression and from its mountainous slopes: Bodoc, Nemira, Vrancea and Întorsurii Mountains. The hydrographic basin presents two representative, almost equal relief levels. The mountainous margin has relatively steep slopes and well developed piedmonts. The alluvial compartment from the depression has an almost horizontal relief.

The hydrographic network has a similar development on both river sides, which has a length of 88 km. Its longitudinal slope decreases from 55 m/km on upper river part, to below 1 m/km before its confluence with Olt River. It's most important tributaries are Caşin River, on right, and Covasna River, on left.

Flow genesis is determined by climatic conditions, which evolution can be monitored by Lăcăuţ (1770 m) and Târgu Secuiesc (568 m) meteorological stations. Precipitations regime presents maximum values in June (173 mm at Lăcăuţ Station, 85 mm at Târgu Secuiesc Station), but some differences appear for minimum values: October at Lăcăuţ Station (40 mm) and December at Târgu Secuiesc Station. The highest monthly average temperatures appear in July (over 17°C at Lăcăuţi and 10°C at Târgu Secuiesc). The lowest months are January in the

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mountain area, and February in the depression. Negative temperatures period has 5 months in the mountain area and 3 at Târgu Secuiesc.

These genetic factors determine water flow regime for all rivers in the hydrographic basin and also the space-time repartition for water resources.

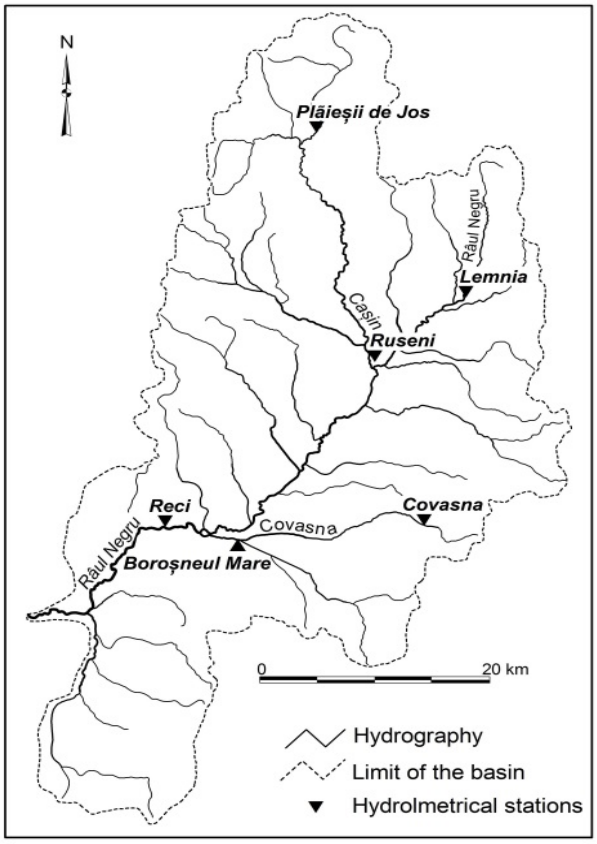

Fig. 1. The Râul Negru hydrographic basin

2. DATA BASE AND METHOD

To analyse monthly average flow parameters, we took into consideration the discharge from six different hydrometric stations – Lemnia and Reci on Negru River, Plăieşii de Jos şi Ruseni on Caşin River, and Covasna and Boroşneul Mare on Covasna River. The time period use for this analysis is 1988 – 2012. This time period was chosen because some hydrometric stations had been liquidated in the last years, so diminishing hydrometric control over river basin. Some stations needed prolonged time periods for data homogenization.

Our analysis is based on variation graphics for multiannual monthly average discharges, frequency and cumulative frequency graphics, but also on calculating variation coefficients.

3. RESULTS

3.1. Space-time variation

Monthly flow principles were analysed on all three main rivers that are controlled by two hydrometric stations.

Table 1. Data from hydrometric stations

River	Hydrometric station	Founded	Length	L. up.	A	H med
			km	km	Km^2	m
Râul Negru	Lemnia	1999	57,2	30,8	101	892
Râul Negru	Reci	1932	80,9	7,1	1698	760
Caşin	Plăieşii de Jos	1983	21,6	32,4	85,0	954
Caşin	Ruseni	1949	51,7	2,3	476	830
Covasna	Covasna	1987	10,0	18,0	31,0	1150
Covasna	Boroşneul Mare	1952	23,9	4,1	232	739

Their location, the relative homogenous physical-geographical conditions and a not too big hydrographic basin surface (2320 km^2) determine similar parameters for river's flow.

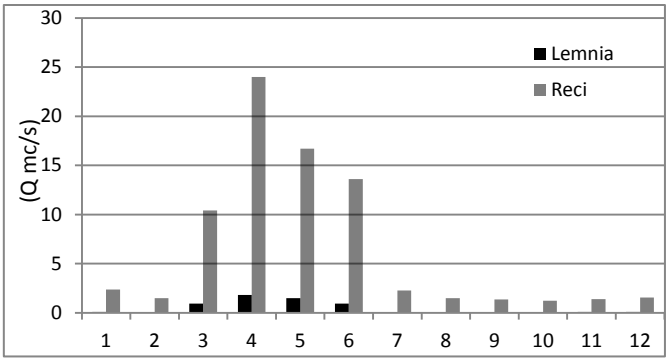

Fig. 2 Multiannual monthly average flow on Râul Negru

The highest river discharges appear on all rivers in April. This phenomenon is determined by early snow layer melting together with spring rainfalls. High flow appears also in March, May and June. Usually, the discharges from March are equal or lower than those from May or June. There can be also observed that, with the exception of Boroşneul Mare Station, all discharges from May are lower than those from June. This thing is determined by early summer rainfalls quantities that are higher than those from late spring.

From June till November, monthly average discharges constantly decrease. With the exception of Lemnia and Plăieşii de Jos stations, which are placed only in the mountain area, annual monthly minimums appear in November. Sometimes, depletion reserves curve has a very homogenous form. The lowest discharge values or the two mountainous stations appear in January. The genetic factors of this phenomenon are strong water freeze, retention of high water quantities in ice formations, and solid precipitations. The discharges from February are very close to those from January. We can observe that water flow in December is slightly higher than that in November at all stations. This phenomenon can be determined by the slightly rainfalls increase in the last part of the year, and because of late snowfall occurrence.

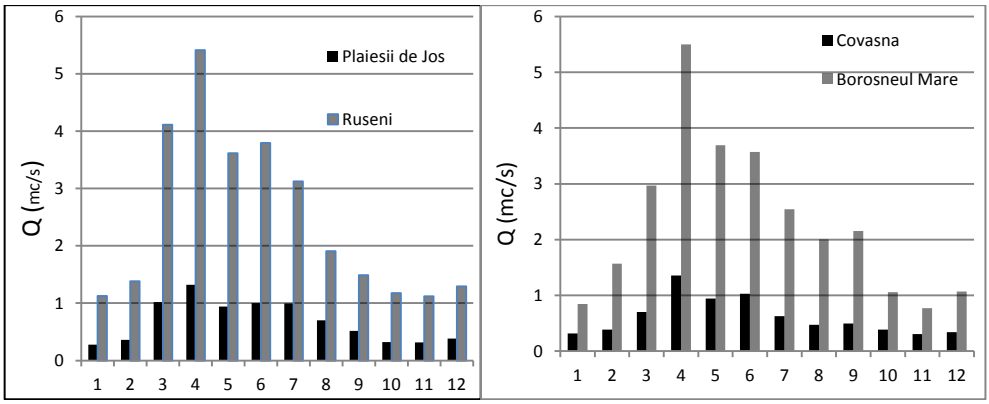

Fig. 3. Multiannual monthly average flow on Caşin and Covasna Rivers

Because of river's high basin surface, and because of its strong tributaries between the two stations, Negru River has monthly discharges with low relation. The relation between the discharges from the two stations (Lemnia and Reci) presents big variations. The highest values appear in January and September (20 and 19, respectively). In March, April and June, the values are low (11, 10 and 11, respectively). For the other two rivers – Caşin and Covasna, the values are almost constant. For Ruseni/Plăieşii de Jos stations, and also for Boroşneul Mare/ Covasna stations, the monthly values are 3 and 4. This represents a remarkable flow conditioning on these rivers, even though there are high surface hydrographic basins.

3.2. Frequency

To analyse discharge frequency, we took into account the months with minimum and maximum multiannual monthly discharge (April and November). The maximum flow month on the main river presents some discharge variations from 0,30 to 4,65 at m^3/s Lemnia Station, and 4,00 to 44,1 m^3/s at Reci Station, respectively.

Maximum frequencies at Lemnia Station appear in the third inferior part of the variation gap, and at Reci Station they appear also for average discharges. 6th degree polynomial trends indicate two peaks for the upstream station and three for the downstream station. The cumulative frequencies graphics are similar for the two stations, with a more pronounced increasing trend for Reci Station.

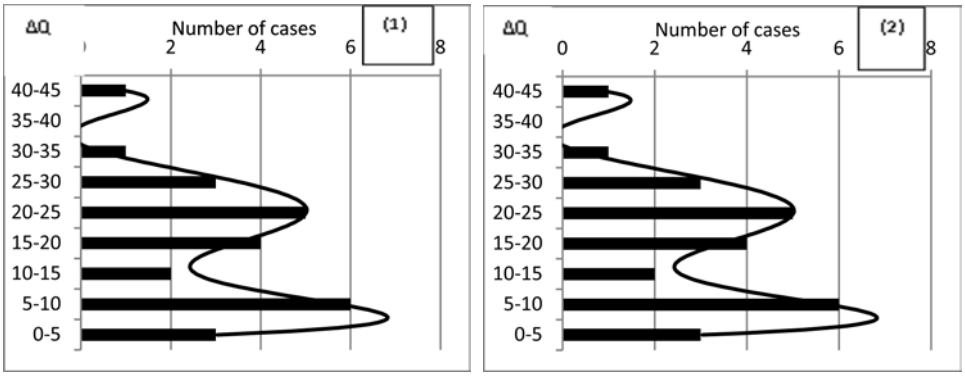

Fig. 4. Discharge frequency in April at Lemnia (1) and Reci (2) Stations

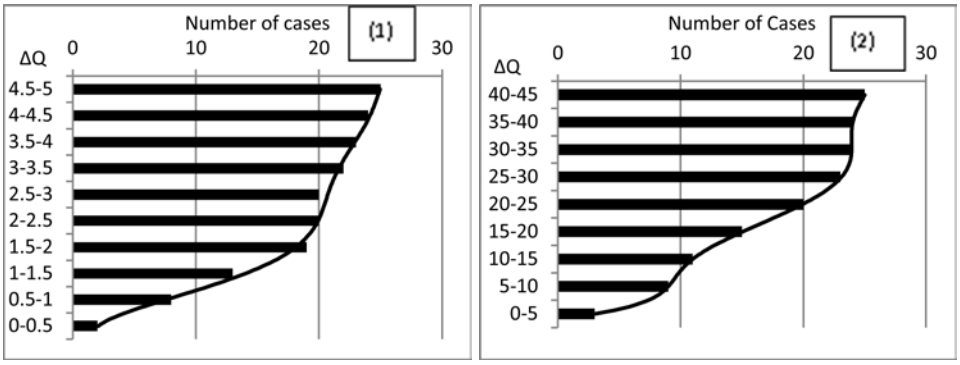

Fig. 5. Discharge cumulative freqency in April at Lemnia (1) and Reci (2) Stations

The extreme discharge values from November at both main stream stations are as follow: 0,054 m^3/s and 0,766 m^3/s at Lemnia Station, 1,39 m^3/s and 7,48 m^3/s at Reci Station. The upstream station presents a high frequency peak for discharges of 0,1 – 0,2 m^3/s. High frequencies at Reci Station appear in the lower half of variation gap. 6th degree polynomial trends are similar. Cumulative frequency graphics present a high increase of small values and a high inflection in the upper variation gap.

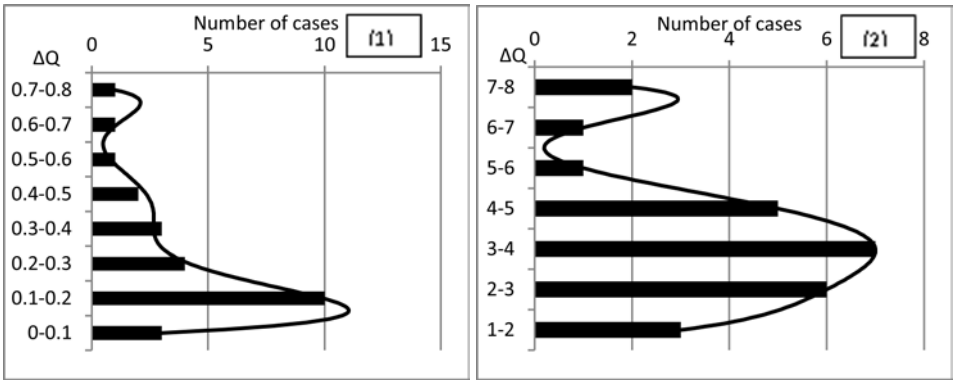

Fig.6. Discharge frequency in November at Lemnia (1) and Reci (2) Stations

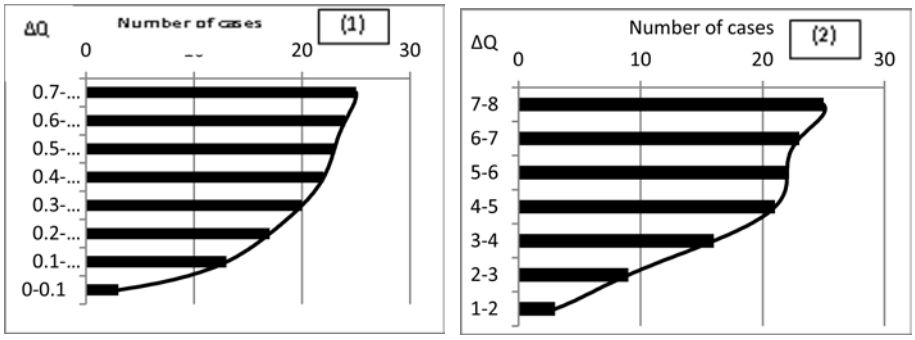

Fig. 7. Discharge cumulative freqency in November at Lemnia (1) and Reci (2) Stations

Similar is also the individual and cumulative frequencies distribution on main tributaries, and the graphic and polinomial trends rate, because of the hydrographic basins and of the small distances.

An interesting comparation can be made between monthly flow percentages in the years 1950 – 1967 (Ujvari, 1972) and the present period: 1988 – 2012. High values increase of over 1% appears on June (1,06%), July (1,41%), September (1,07%) and October (1,28%). Values of less than 1% appear in January, November and December. The highest percentual decrease appears in May (- 2,95%), followed by April (- 1,49%). Values of less than 1% appear also in February, March and August. We can observe that the increase period is September – January, and the decrease – February – May. It can be sure that these changes have a direct connection firstly with precipitation regime modification.

3.3. Variation coefficient

Variation coefficients analysis has been made on all three rivers in the maximum (April) and minimum flow (November) months. We can observe that variation principles are the same, which shows flow genesis homogeneity in the entire Râul Negru hydrographic basin.

C_V smaller values for high flow appear at upstream stations (for Negru and Covasna streams). C_V value of 0,65 appears all year on Caşin Stream. From these we can conclude that flow genesis in April isn't uniform even in the mountain area. This fact underlines the importance of snow melting in flow formation. For poor drainage, C_V values are higher for upstream stations than those from downstream for Râul Negru and Caşin streams. An opposite situation appears on Covasna Stream. At Boroşneul Mare Station, flow variation is higher than that from other streams (1,02 in April and 0,70 in November).

Table 2. Cv values in months with extreme flow

Hydrometric station	Maximum flow	Minimum flow
	April	November
Lemnia	0.53	0.65
Reci	0.62	0.44
Plăieşii de Jos	0.65	0.82
Ruseni	0.65	0.58
Covasna	0.48	0.61
Boroşneul Mare	1.02	0.70

C_V values comparison for the same hydrometric station presents more obvious variation principles. C_V values for upstream stations are always smaller in April than November. For the downstream stations, the highest flow values month presents a higher C_V value than the with the lowest month.

4. CONCLUSIONS

We can observe in the Râul Negru hydrographic basin a remarkable homogeneity of flow genesis and control. Physical-geographical conditions maintain a constant space-time flow process course. The small differences that appear are determined by the local topoclimate, the slope and bed morphology, the vegetation characteristics, etc.

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