



## THE INFLUENCED FLOW REGIMES

*G. PANDI<sup>1</sup>*

**ABSTRACT. The influenced flow regimes.** The presence and activities of humanity influences the uniform environmental system, and in this context, the rivers water resources. In concordance with this, the natural runoff regime suffers bigger and deeper changes. The nature of these changes depending on the type and degree of water uses. The multitude of the use cause different types of influence, whit different quantitative aspects. In the same time, the influences have qualitative connotations, too, regarding to the modifications of the yearly water volume runoff. So the natural runoff regime is modified. After analyzing the distribution laws of the monthly runoff, there have been differenced four types of influenced runoff regimes. In the excess type the influenced runoff is bigger than the natural, continuously in the whole year. The deficient type is characterized by inverse rapports like the first type, in the whole year. In the sinusoidal type, the influenced runoff is smaller than the natural in the period when the water is retained in the lake reservoirs, and in the depletion period the situation inverts. At the irregular type the ratio between influenced and natural runoff is changeable in a random meaner monthly. The recognition of the influenced regime and the grade of influence are necessary in the evaluation and analysis of the usable hydrological river resources, in the flood defence activities, in the complex scheme of the hydrographic basins, in the environment design and so on.

**Keywords.** -natural regime, influenced regime, water use, influence degree, regime types

### 1. INTRODUCTION

The completely natural conditions existed within geosystem at mesoscale confer special laws for riverbed flow processes. The flow regime represents the whole of the laws and the features for this process during a year. Any river stream, no matter the size and location is characterized by the flow regime.

The climatic factor, consequence of the solar energy influx distribution, is the main factor of the flow control. The precipitations are water suppliers, which provide water for riverbed directly as surface flow, and indirectly as subsurface flow. The surface flow is characterized by discontinuous water supply and a fast reaction time of the river, whereas continuity and a slow reaction time characterize the subsurface flow. The temperature influences the flow by precipitations, state of aggregation, evaporation intensity and existence of the ice formations within riverbeds.

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<sup>1</sup> Babeş-Bolyai University, Faculty of Geography, Clinicilor Street 5-7, 400006, Cluj- Napoca, e-mail: pandi@geografie.ubbcluj.ro



There are many others natural, non-climatic factors that influence the flow: tectonics and petrography for geology; altitude, morphometry, morphology, aspect, hypsometry for relief; state, structure and texture for soil; types of associations, degree of coverage, rainfall interception, evapotranspiration for vegetation; are many other factors that hallmarked on the river flow regime.

In this very complex context of horizontal and vertical zonality, in addition with local and regional conditions, the rivers have a great variety of flow regimes. Of course, zonal distribution of solar energy prevails and due to this, climatic zones have specific flow regimes.

The great relief units, especially the mountain massifs but the oceans and the seas (on the shore areas) as well cause characteristic flow regimes. What is characteristic for spatial and temporal distribution of water drained off quantities is an infinite combination of general and local factors. Thus, there are relatively few rivers with a flow regime typical, well defined. These rivers are small usually having hydrographic basin located within the same climatic zone and the same relief unit (relatively homogenous).

## **2. FACTORS THAT INFLUENCE NATURAL FLOW REGIME**

The human society has a constant upward influence over the environment, from which it belongs. The influences follow three major ways:

- the areas where the man influence natural processes are extended;
- more and more natural processes are influenced;
- the influence degree of processes is growing.

Of course, water resources make no exception in this respect. Throughout all ages, humanity settled their habitats near waters. The using of water resources has exponentially grown and in the same times, a continuous alteration of aquatic bodies has produced. Today, there is a strong debate over the influencing of natural hydrologic cycle, not only at micro and mesoscale level, but throughout the globe as well.

The rivers are water bodies the most susceptible to human influence. The riverbeds are widespread over huge continental areas. The water from rivers is easy to use and due to a continuous dynamics is purging itself.

Various activities carried out by humans within riverbeds or riverbeds surroundings areas modify the natural flow regime laws during time and space. There is a great variety of activities carried out, classified here under various criteria:

- The way of flow influencing
  - water consumption activities
  - redistribution of flow during time activities
  - transfer the water from a reservoir to another.
- The time of flow influencing
  - permanent activities (industrial type)
  - seasonal activities (agriculture type)



- The type of human activity
  - activities related to following domains: urban, industrial, agricultural, energy supply, transport and recreation.
- According to characteristic of used water
  - activities for which are very important: water quantity, water quality, water surface and potential energy.

### 3. THE DEGREE OF FLOW INFLUENCING

Demographic boom in the world, widespread of intensive farming and industrialization process have determined a great stress upon natural water resources, especially water provide by rivers. Consequently, the more and more rivers suffer a strong influence and pressure from human part.

The type and magnitude of activities influence the degree and character of the flow. For the most activities this typification is combined, consequently they have multilateral influences over the natural flow regime of the river.

Dam lakes have the most spectacular influence for the rivers flow; these lakes redistribute water resources during time. The activities of industrial consumption of water and transfer pipes from a reservoir to another can have major influences as well.

To represent in which degree is influenced the natural flow it is necessary to compare the value of water quantity drained off and the value of natural flow. For these recordings it is necessary to be used values taken on the spot or/and medium values of the same time interval. Thus, temporal and/or spatial relations with a role for water amounts qualitative assessment are obtained.

Representation of flow's influencing degree can be expressed in absolute values, in flow capacities and volume units. However to express the flow's influencing degree as relative values is more evident, the quantity of influenced water being the random variable.

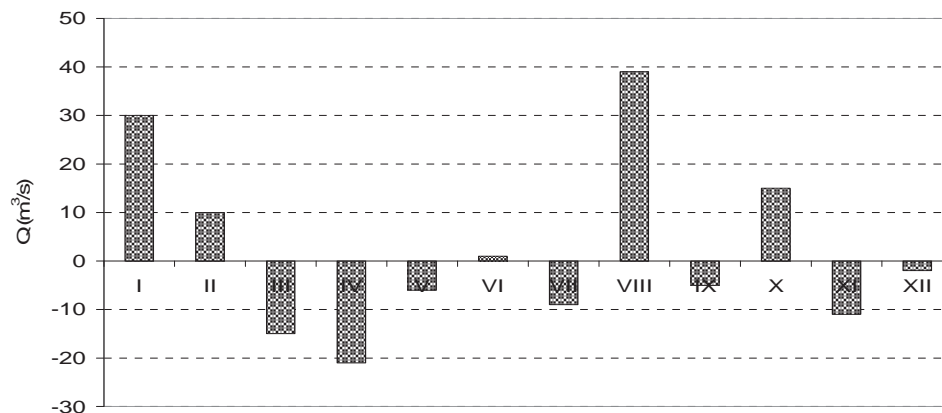
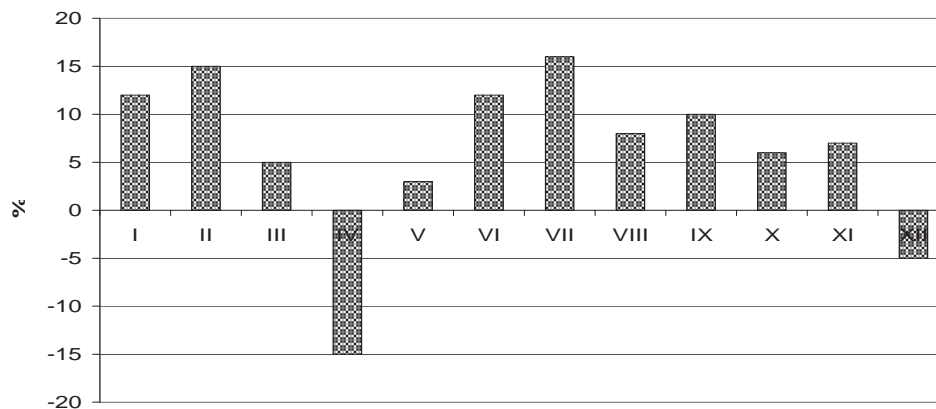


Fig. nr. 1. Representation of influencing degree in absolute values



**Fig. nr. 2. Representation of influencing degree in relative values**

#### **4.THE TYPES OF INFLUENCED FLOW REGIME**

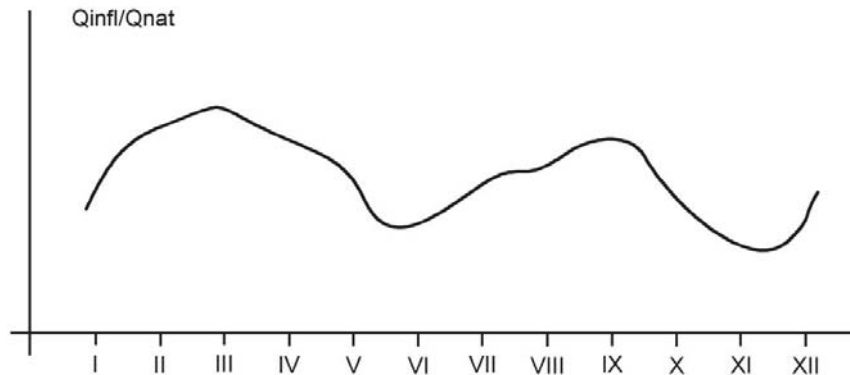
For the rivers, having an influenced flow regime the quantities of water drained off depends in a great or small manner by the assets existence and exploitations. The distribution during time of water necessities is a function of social and economical systems functionality. Consequently, the distribution laws of water quantities drained off during a year depends of the way and measure of natural flow regime.

The human component of the environment stays under laws not as rigorous as those corresponded to natural phenomena. There are many temporal ways to capture and return, or to redistribute some quantities of water, function of social and economical necessities.

On the base of a great number of influenced hydrographs analysis, in various years, located downstream from the influenced riverbeds areas, four types of influenced flow regime were distinguished.

##### **4.1. Excedentary type**

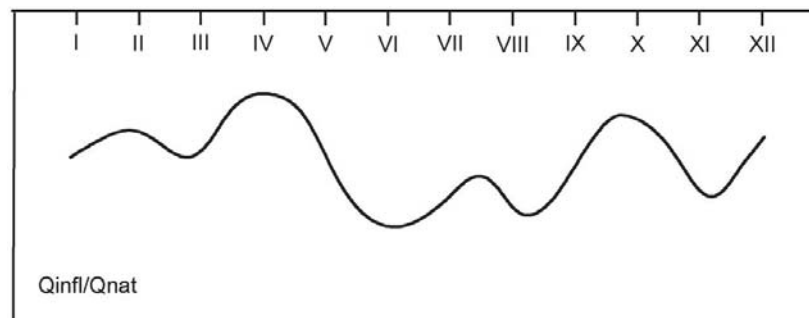
The deviation has positive values throughout a year ( $Q_{infl} > Q_{nat}$ ). The characteristic influenced flows are higher compare to the corresponded natural ones for every month of the year. This type is typical for rivers that receive an additional water supply from the others hydrographics basin located in proximity.



**Fig. nr. 3. Excedentary type model of influenced flow**

#### 4.2. Deficitary type

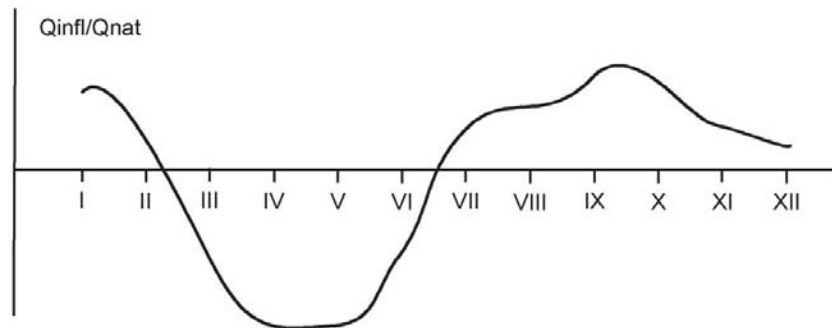
The deviation has negative values throughout a year ( $Q_{infl} < Q_{nat}$ ), therefore monthly influenced flows drained off are smaller than those corresponded to natural ones. This type is characteristic for the areas downstream where are water intakes made in riverbed, where from a quantity of water is conducted to a near hydrographyc basin or to an areas with a constant consume of water. In addition, this type is found downstream of dam lakes that usually provide water constantly for consume. The influence degree is not very high for this type also.



**Fig. nr. 4. Deficitary type model of influenced flow**

#### 4.3. The sinusoidal type

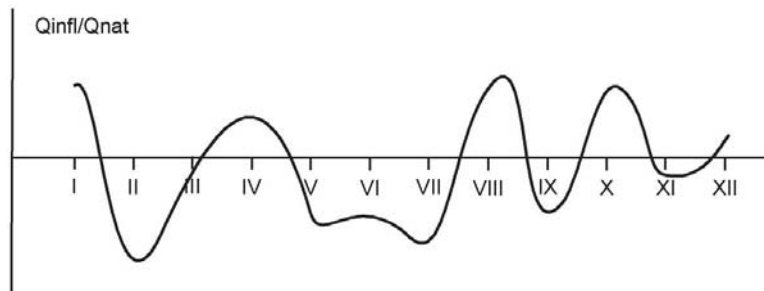
Is characteristic for downstream areas of dam lakes having a dominant role of redistribution of the water with time, the regularization having an annual periodicity. This kind of water accumulation can have an energetic or water supply function. In this accumulation, the water saved during the excedentary period of spring is subsequently restored to the riverbed during the period with deficitary flow autumn-winter. For the months when the water is saved, the influenced flows have a magnitude less than those natural, and for the months when water is evacuated the ratio reverse the order, the variation graphic having a sinusoidal shape. The influencing degree has a greater value during the water lakes accumulation period compare with the period when water is released.



**Fig. nr. 5. Sinusoidal type model of influenced flow**

#### **4.4. Irregular type**

This type is characterized by randomly alternation of the ratio between monthly influenced flows and natural ones. The quantity of water drained off can have a greater value or a smaller one in comparison to that natural depending on the social and economical, food and defence against flooding necessities. This type characterizes downstream areas of the dam lakes that have the role to attenuate high floods waves, where a period of accumulation is followed by a period when the water is released. Here the influenced degree can have extremely great values.



**Fig.nr.6 Irregular type model of influenced flow**

### **5. CONCLUSION**

From the smallest water streams to the very large rivers, the natural flow regime is more frequently and more intense influenced. It can be said that the influenced regime became a characteristic of rivers flow, particularly for areas having a great number of people. Consequently, the characteristic values of the flow, average values, but especially those extreme, do not form homogeneous series easy to use for statistics calculations and dynamic analysis. Eventually series of hydrological data make up having other characteristics in comparison to those usual for hydrology and water management activities. In order to analyse an assess usable hydric resources of a river, for activity of defence against flooding, for complex arrangement of hydrographic basins for environment planning, etc., it is necessary to take into account besides the natural laws those laws induced by social and economical necessities.



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