A COMPARATIVE ANALYSIS OF THE FLOOD PHAENOMENA OCCURING IN THE YEAR 2005 ON THE GURGHIU AND RĂSTOLIŢA RIVERS

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ABSTRACT.- A comparative analysis of the flood phaenomena occuring in the year 2005 on the Gurghiu and Răstoliţa Rivers. The average amount of rainfall to characterise the pluviometric situation of Romania in the year of 2005 was 866.5 mm/m^2/year (compared to normal climatic-647.0 mm). The excess in precipitation duration and quantity during the months of January-May, July-September, December and the deficit in June, October, November, determined an annual rainfall surplus and thus creating the proper conditions for the emerging of the flood-phaenomena that was to manifest at wide scale during this year. Considering the data offered by the Mureş Water District, although in the last 40-50 years there have occured major floods in most catchment areas, never in the past 100 years, have floods lasted over a time period so vast: from (February to September) and covered an area so large as in the zear of 2005. I have chosen to study the flood phaenomena through a comparative analysis of two referencial river basins in the county of Mureş: the Gurghiu and the Răstoliţa river basins, in order to observe the difference generated by the form, slope cathegories, vegetation covering, land use, and population distribution in the process and effects of these floods.

Key words: Răstoliţa, Gurghiu, flood, rivers, comparativ analysis

1. A comparative analysis of the Gurghiu and Răstoliţa hydrographical basins

The Gurghiu river is one of the main tributaries of the river Mures, within the county of Mures, the junction with the main collector of the county taking place nearby Reghin.

The Gurghiu river springs from a 1200m altitude flowing from the Gurghiu Mountains in the Eastern Carpathians, its course having a total length of 53 km while covering a basin area of 563 km^2.

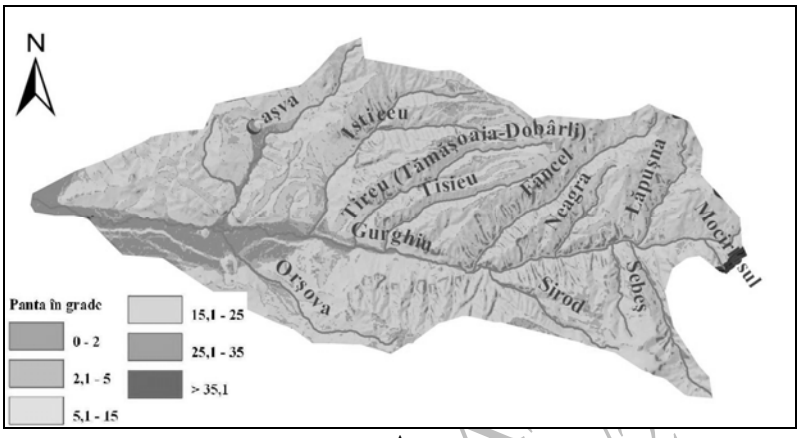
The main right-side tributaries of the Gurghiu river are Fâncel, Sebes, Şirod, Tireu, Isticeu, Caşva Glăjăriei Valley, while on the left it receives the tributaries of Lapusna and Orsova.

The hydrological stations to monitor the dynamics of the Gurghiu river are Lapusna and Ibăneşti.

The Lapusna Hydrological Station (46.46.00 and 25.13.00 N lat long E) was founded in 1979 monitoring, ever since, the river data for an area of 98 km^2, mainly situated at an altitude of 1202m.

The Ibanesti Hydrological Station (46.46.00 and 24.56.00 N lat long E) was founded in 1982. Situated at an altitude of 980m, it is to monitor an area of 407 km^2 of the river basin representing most of the Gurghiu river basin.

The year of 2005 was marked by the emergence of two extreme hydrological phaenomena represented by floods on the Gurghiu river: the first taking place during the months of March-April and the second in July.



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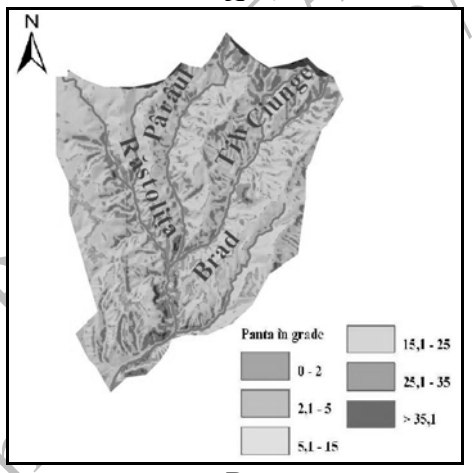

B

Figure 1. Slope cathegory maps of the two river basins
(A. Gurghiu , B. Răstolița)

Similarly to the Gurghiu river, the Răstoliţa river is one of the tributaries of the Mures river in its upper sector, crossing, like the Gurghiu, the Carpathian mountain area and the Subcarpathian one. The Răstoliţa river's left tributary streams are represented by the Bradu and Tihul creeks, while on its right side, it receives the waters of Valcăliţa and Secu creeks.

The two river basins, although similar in shape, transited units, or gradients they differ in terms of catchment size, number of tributaries, and basin orientation: while Gurghiului is oriented longitudinally E-W, Răstoliţa is predominantly oriented latitudinally, N-S.

By analysing the map corresponding to the two river basins slopes we see a higher percentage of steep slopes represented by values over 35° in the Răstoliţa river basin, while the river basin of Gurghiu is more complex from this point of view, being characterised by a variety of slope-values: predominantly slopes of 20-35 ° in the higher category, while in the lower slopes reach values of 0-5°.

In terms of vegetation covering both basins boast a smooth and very good cover of vegetation therefore causing part of the precipitation to seep easily into their roots and branches.

The difference between the two river basins in what concerns the vegetation cover is however its type: while much of the vegetation covering the river basin of Gurghiu is represented by deciduous forests, the Răstoliţa river basin is defined by a large variety of vegetation cathegoeries ranging

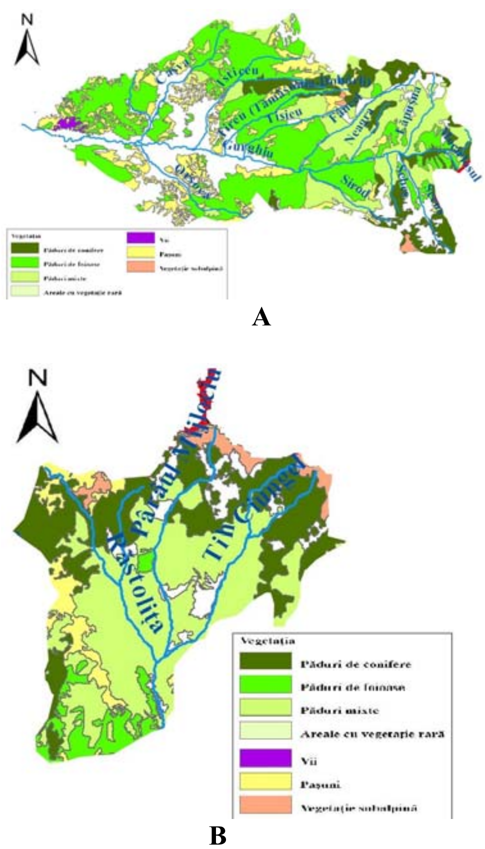

Figure 2. Vegetation map in the two river basin areas (A. Gurghiu , B. Răstoliţa)

from mixed forests to conifer ones, the latter being depicted by a larger capacity to absorb storm water, which is another factor worthy to be taken into consideration in the analysis of floods that occur in these basins (Fig. 2).

2. The flood of 11.03.2005-05.04.2005 on the Gurghiu River

The months of January and February in the year of 2005 were characterized predominantly by solid precipitation in the upper basin of the river Mures, which led to deposit a layer of snow as far as 155 cm at the meteorological station Bucin, Harghita County.

As of 15/03/2005 we assist to the establishment of a thermal anomalythe weather going into a heating process which culminated with the period of 17-18.03.2005, during which daytime temperatures have been positive between 9-19 °C and the night temperatures varied between 0-8°C.

Precipitation took a generally liquid form drifting in surges and showers up to values of 15.0 l/m^2 throughout a relatively long period of time that ranged from 03/15/2005 to 03/22/2005. The increasing river-flow rates which occurred in this period were predominantly due to the relatively sudden warming of the weather, the water transfer from the layer of snow and precipitation in the form of rain showers.

Table 1. Hydrometeorological data referring to the precipitation quantity for the period of 18 – 20.03.2005 and the snow layer registered at Lăpuşna

Day	16.03.	17.03.	18.03.	19.03	20.03.
Precipitation (l/mp)			3,7	3,2	
Snow layer (cm)	126	124	119	113	108

(source: Disaster Management Service of the County of Mureş)

As of 19.03.2005 at 12.30 there was an increase in the river flow of Gurghiu measured at the Lăpuşna hydrological station, where it recorded the amount of 4,22 m^3 / s and a level of 99 cm water layer. This output value is higher than the multiannual average flow of 1.86, and it marks the beginning of the flood.

Simultaneously, the river flow has been increasing at the Ibanesti hydrological station the values recorded on 03/11/2005 07.00 being Q = 5.09 m^3/s and H = 144cm.

The flood peak was reached on 20.03 2005 at 07.00 when the Gurghiu river flow measured at the Ibăneşti hydrological station was 44.2 m^3 / s and the water level reached the level of 166 cm, while at the hydrological station of Lapusna the flood peak is barely registered on the 03/30/2005 along the time interval of 17.00-18.00 when the river flow reached the value of 4.45 m^3 / s while the water layer was 100 cm high.

The flood ended on 05.04.2005 at about 06.00 hours for the Lăpuşna hydrological station when the river reache values close to those at the beginning of the flood: Q = 1.64 m^3 / s, H = 85 cm. For the hydrological station of Ibăneşti the flood ends on 04/05/2005 at 06.00 hours but, unlike the case of the hydrological station of Lăpuşna, here at Ibăneşti the river flow measured at the end of the flood rated values of Q = 13.2 m3 / s and H = 136 cm.

Although from the very first day of the flood, the water level measured at the hydrological station of Lăpuşna exceeded Lapusna the attention limit, the flood waters do not exceed the flooding limit, so that no damage occurred during the winter flood of 03/11/2005 to 04/05/2005 in the basin area monitored by the Lăpuşna hydrological station (Fig. 3).

On the other hand, at the Ibăneşti hydrological station, there have been recorded higher flow rates compared to those measured at the hydrological station of Lăpuşna due to a greater development of the hydrological basin and thus a gathering of flood ripples from all the tributary streams of Gurghiu the attention limit of 150 cm being exceeded in two brief periods during the flood: 1). 18.03 2005, 15.00 hours (H=151cm) – 20.03.2005, 17.00 hours (H=155 cm) şi 2). 27.03.2005, 17.00 hours (H=152) -30.03.2005, 17.00 hours (H=151 cm).

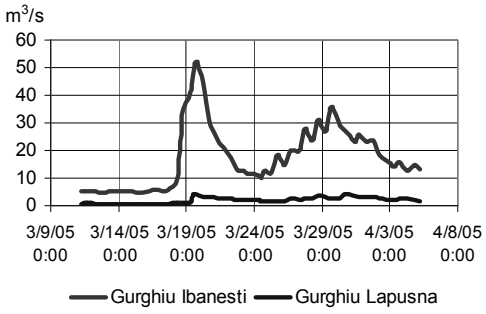

Figure 3. A comparative graph: the flood of 11.03.2005-05.04.2005 on the Gurghiu river at the Ibăneşti and Lăpuşna hydrographical stations

The compouned river flood on the Gurghiu river registered on 03/11/2005 to 04/05/2005 shows two main peaks for both hydrological stations but the form factor of 0.42 describing the Ibăneşti hydrographer reflects a lower homogeneity of the values recorded, and thus a more dinamic evolution, when compared to the form factor of the Lăpuşna hydrographer: 0.59.

Due to geographical position, upon the middle course of the river Gurghiu and to the collection of most of the tributaries of the river, the hydrological station of Ibăneşti registeres a significantly higher river flow than the station located on the upper stream of Gurghiu: Lăpuşna.

3. Comparative analysis of the floods occuring the the Gurghiu and Răstoliţa rivers in the year of 2005

Furthermore, in this article I will focus my attention on the river floods occuring in July 2005 recorded on the river of Gurghiu by the hydrological stations of Ibăneşti and Lăpuşna and in parallel on the Răstoliţa river recorded here by the hydrological station of Răstoliţa.

The flood that marks the month of July 2005 on the Gurghiu river begins on the 04.07 06.00 at the hydrographical station of Lăpuşna through a recorded rate of Q = 1.16 m^3 / s and a water level of H = 81 cm, while at the Ibănesti hydrological station the Gurghiu river flow measured 4.87 m^3 / s and a level of H = 119cm.

Main flood peak is registered on the 13.07 06.00 when the Gurghiu river flow registered a rate of 18.7 m^3 / s and a level of 142 cm at the Lăpuşna hydrological station while in parallel at the hydrological station of Ibăneşti the river flow measured 43.6 m^3 / s and the water level reached the quota of 168 cm.

Of all the flood period characterising the Gurghiu river, the water level exceeds the quota of attention stated at H = 150 cm for the hydrological station of Ibanesti for only a short period 12.07.2005, 18.00 hours to 14.07.2005, 6.00 hours.

In contrast to that, the water level measured at the hydrographical station of Lăpuşna remain above the rate of attention (H = 75 cm) for most of the time of the flood (from 12/07/2005 15.00 hours to 31.07. 2005 6.00 A.M) exceeding even the rate of flooding by values in between 125 and 142 cm for the period of 12.07.2005 15.00 to 15.07.2005 18.00 damages in this case being represented by farmland, damaging crops and roads of local importance.

The end of the flood is marked by 06.00 A.M on 31.07.2005 when the hydrographical station of Lăpuşna recorded a river flow value of 1.27 m3 / s, and a water level of 82 cm, roughly equal to the values recorded at the beginning of the flood on 07/04/2005. In parallel, at the Ibăneşti hydrographical station Gurghiu recorded a rate of Q=4.87 m3 / s and a water level of 119 cm.

Unlike the Gurghiu river flood recorded in the month of July 2005, the Răstoliţa river flood recorded in this period is extended over a larger period of time (fig. 4).

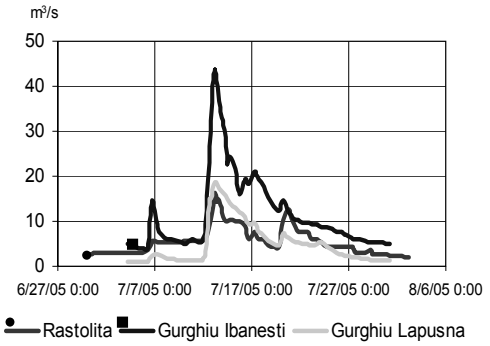

Figure 4. A comparative graph: the evolution of the greatest flood of 2005 on the rivers of Gurghiu and Răstoliţa

Thus, from 18.00 to 29.06.2005 the Răstoliţa hidrographical station recorded a rate of Q=2.37 m3 / s and a water level of 126 cm as characterising the status of the Răstoliţa river at that time was a flood which will follow an upward curve, reaching its peak flow on 13.07 2005 10.00 A.M. Q = 15 m3 / s and H = 158 cm.

Throughout the flood period the attention limit (H = 140 cm) at the hidrographical station of Răstoliţa was exceeded twice, always during periods of excess rainfall: 12.07.2005 18.00 hours – 18.07.2005 6.00 A.M and 20.07.2005, 6.00 A.M.– 23.07.2005 18.00 hours.

The flood ends on 02/08/2005 at 6.00 when the values characterising the river status recorded at the hydrographical station of Răstoliţa return to normal parameters: Q = 2.08 m3 / s and H = 124cm.

The floods recorded at the hydrographical stations of Lăpuşna (Gurghiu), Ibăneşti (Gurghiu) and Răstoliţa (Răstoliţa) are characterized by a relatively close hidrographer form factor: 0.41 for Lăpuşna, Ibăneşti 0.31, and 0.36 for Răstoliţa.

In terms of flood time span the phaenomenon occuring on the Răstoliţa river is characterized by a total of 804 hours out of which the rise time represents 2/5 while the decrease time measures 3/5 represented by 480 hours. The total volume of the July 2005 flood on the Răstoliţa river is 15,085 million mc.

The flood recorded at the Lăpuşna hydrographical station on the Gurghiu river has a total duration of 432 hours of which rise time of 60 hours representing 14% of the total time while the rest of 86% is represented by the decay time of 372 hours. The total volume of the recorded flood of the Lăpuşna hydrographical station in July of 2005 is 11.791 million cubic meters.

The Ibăneşti station recorded flood of July 2005 develops arround a total time span of 468 hours out of which 7,69%, represented by 36 hours, is the water rising time, while the rest of 92% represented by 432 hours, is the period of declining growth. The flood draws a total volume of 22.773 million cubic meters.

4. Conclusions

In terms of duration, the flood occuring on the Răstoliţa river is characterized by a double period running from the other two, and also by an equilibrium between both the growth and decay time.

Also, due to the fact that the Răstoliţa river basin is marked by a lower population density, and less townships the declared loss due to the flod phaenomena was less than in the case of the Gurghiu river basin, highly populated by a voulnerable majority.

The wave propagation speen, evolution and effects were highly influenced by the river basin form, slope cathegories, the vegetation cathegory and density and the river bed regularization.

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