COMPARATIVE STUDY OF THE FLASH FLOOD WAVES FROM THE SUMMER AND AUTUMN OF 2014 ON BÂRZAVA RIVER IN THE GĂTAIA-PARTOȘ SECTOR

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ABSTRACT. Comparative study of the flash flood waves from the summer and autumn of 2014 on Bârzava River in the Gătaia-Partoş sector. In the summer and autumn of 2014, in the lower basin of Bârzava river, three flash flood waves formed following a large precipitation quantity fallen in the upper river basin as well as in the field area. The first flash flood occurred at the beginning of August (31 July - 5 August in Gătaia hydrological station), the second flash flood was measured between 15 and 19 September (in Gătaia hydrological station), while the last flash flood occurred at the end of October, this passing through the Gătaia hydrological station between 23 and 29 October. As the number of high waters and flash floods affecting mainly the field area of the Bârzava hydrographical basin knows an increased intensification in the last decades, we consider important the analysis of the flash floods in order to determine new protection plans against flash floods. Based on the available hydrometrical and climatologic data, we propose to analyse the main indicators characterising the three flash flood waves and, also, to emphasise the impact that the hydrotechnical fittings from the lower basin of Bârzava river have on the maximum water runoff.

Keywords: Bârzava, flash flood, Gătaia, Partoș, flow, volume, propagation.

1. INTRODUCTION

With a reception surface of 971 km^2 and a length of 127 km (Ujvari, 1972), Bârzava river springs from Semenic Mountains and flows towards South-West, being one of the important water courses from the Banat hydrographical space. The studied sector, the one between Gătaia and Partoș, is found in the field area, in the South of Timiș county, where the river records very reduced slopes.

Bârzava hydrographical basin has known very early various stages of hydrotechnical fittings, in the upper and lower areas. In the mountainous area of Bârzava, permanent barrier lakes (Văliug, Gozna, Secu), adduction channels (Semenic, Nera etc.) or hydro-power plants (Grebla, Crăinicel, Breazova) have been commissioned, while in the lower basin, side temporary barrier lakes (Ghertiniș), derivation hydrotechnical knots (Birda), but also a vast system formed

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of irrigation, drainage or adduction channels and dams, all having mainly economic purposes, have been built (Fig. 1).

We consider important for our study the hydrotechnical fittings located downstream from Gătaia. Firstly, the Hydrotechnical knot from Birda stands out, being built after the floods from 2005 and feeding Birdanca stream with water. Morilor Channel (Italian) was built starting with 1802 (Barbu, 2013) and has a length of 13.56 km.

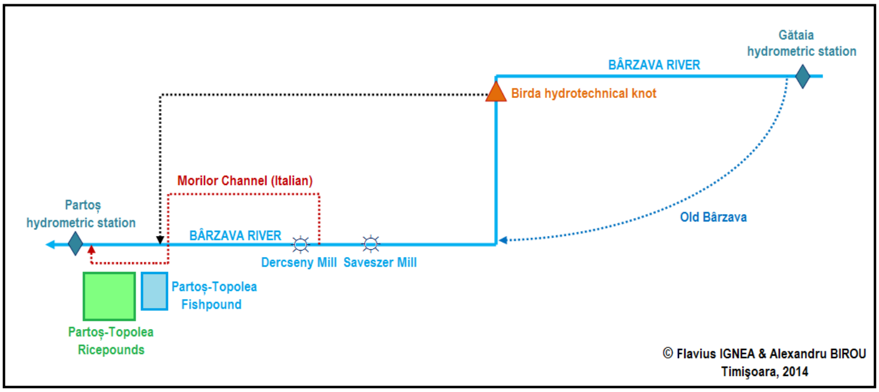

Fig. 1. ***Synoptic layout of Bârzava river between the Gătaia hydrological station and the Partoș hydrological station***

Dercsény Mill, which, although non-operational, maintains a level difference of 5 meters (Dordea et al, 2005) so that Morilor Channel is gravitationally fed with water from Bârzava, carrying it to the fisheries and the rice plantation from Partoș (Olaru, 2006) (Fig. 1).

2. DATA AND METHODOLOGY

The hydrological data used in our study come from the automatic hydrometric stations from Gătaia and Partoș, these being available in real time on the official internet page of the "Romanian Waters" National Administration (www.rowater.ro), but without being homologated. The multi-annual average flows used for the calculation of the basic flow of the flash floods were provided by the Banat Basin Administration from Timisoara. The precipitation values recorded at Semenic, Reşiţa and Banloc were taken over from the available database at the address http://rp5.ru/.

Last but not least, we mention the fact that a part of the data used at the reconstitution of the hydrographs came from our own measurements performed during the flash floods at the Gătaia hydrological station and subsequently correlated with the limnimetric key achieved based on the data from the "Romanian Waters" National Administration.

3. GENESIS AND TYPIFICATION

Regarding the flash flood waves study, the specialty literature underlines two major aspects, the flash flood genesis and the aspect of the flash flood hydrograph. Following the analysis of the precipitation quantity fallen at the three meteorological stations from the hydrographical basin of Bârzava river, during the occurrence of flash flood waves, we determined that all the three flash floods had pluvial origin. We consider important to mention that the precipitations fallen reached very high values compared to the local climate.

The first flash flood was formed mainly because of the high quantities of precipitations fallen in the field (Banloc) while the second and the third flash flood had as basis the rains fallen in the mountainous Banat (Semenic and Reșița). The amount of the precipitations fallen at the three meteorological stations from Bârzava basin was 215.1 mm for the first flash flood, 299.9 mm in the case of the second flash flood, and only 164.4 mm in the case of the flash flood from October (Fig. 2).

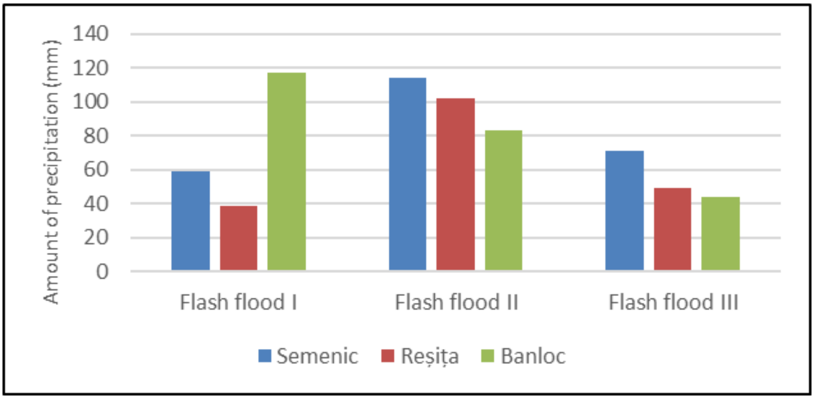

Fig. 2. ***The total amount of precipitations recorded during the three flash flood waves analysed***

Pandi (2010) has notices the fact that the flash floods generated by rains having a high continuity and intensity are monowave, having a single flash flood wave, this aspect being characteristic of the three flash floods formed in the summer and the autumn of 2014 in Bârzava basin.

4. FLASH FLOOD WAVE PARAMETERS

4.1. Flow

A first parameter analysed is ***the basic flow (Q_b)*** that, according to Pișota et al. (2010), is represented by the double of the multi-annual average flow of the water course from the analysed section. Based on the ABA Banat data, we have determined that the multi-annual average flow of Bârzava river, calculated for the 2000-2012 range, is of 6.45 m^3/s at the Gătaia hydrological station and of 6.95 m^3/s at the the Partoș hydrological station. In this context, the basic flow at the Gătaia hydrological station is of 12.9 m^3/s and at the Partoș hydrological station is of 13.9 m^3/s. The analysis of the ***maximum flow (Q_{max}) is of major importance***, this representing the value of the maximum point between the increase and decrease branch of the flash flood hydrograph (Pandi, 2010, b). During the first flash flood, the maximum flow at the Gătaia hydrological station was of 94 m^3/s and at the Partoș hydrological station was of 84.4 m^3/s.

The second flash flood was characterised by lower maximum flows, these being of 66.6 m^3/s at the Gătaia hydrological station and of 56.18 m^3/s at the Partoș hydrological station (figure 3). During the last flash flood, the maximum flow at the Gătaia hydrological station reached the value of 93.25 m^3/s, while at the Partoș hydrological station this was of 74.2 m^3/s.

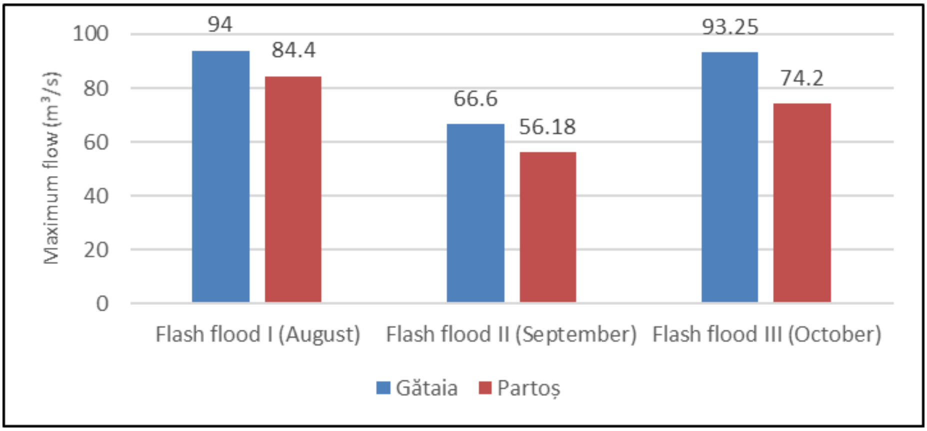

Fig. 3. ***The value of the maximum flow recorded at the Gătaia and Partoș hydrological stations during the three flash floods from the summer and autumn of 2014***

During the three cases, we noticed value differences between the Gătaia hydrological station and the Partoș hydrological station, the values recorded at the first station being higher than the ones from the downstream station (the Partoș hydrological station). We consider that these differences are mainly due to the existing hydrotechnical fittings between the Gătaia hydrological station and the Partoș hydrological station.

The Birda hydrotechnical knot and Birdanca stream contribute to the breaking of the flash flood, and, to a smaller extent, contribute to the decrease of the maximum flow of the flash flood and the former Dercsény Mill and the Italian Channel. Dordea et al. (2005) mention that the former Morilor Channel, the current Italian Channel, can take over a maximum flow of 3 m^3/s. We also mention the old course of Bârzava river (between Gătaia and Berecuța) that takes over a part of the water quantity measured at the Gătaia hydrological station.

4.2. Time

The second parameter analysed within our study is time. The specialty literature (Pişota et al., 2005, Zăvoianu, 2006, Teodorescu, 2009, Pandi, 2010, a, b) reminds of three types of time*:* ***the increase time (T_i)***, representing the duration between the excess of the basic flow and the reaching of the maximum flow, ***the decrease time (T_d)***, between the maximum flow and the end of the flash flood, as well as the ***total time (T_t)***, representing the amount of the first two time categories (figure 4, table 1).

Regarding the flash floods recorded at the Gătaia hydrological station and the Partoş hydrological station, a fourth time category was identified as the ***stationary time (T_s)*** representing the time range where the maximum flow maintains the constant value (Table 1).

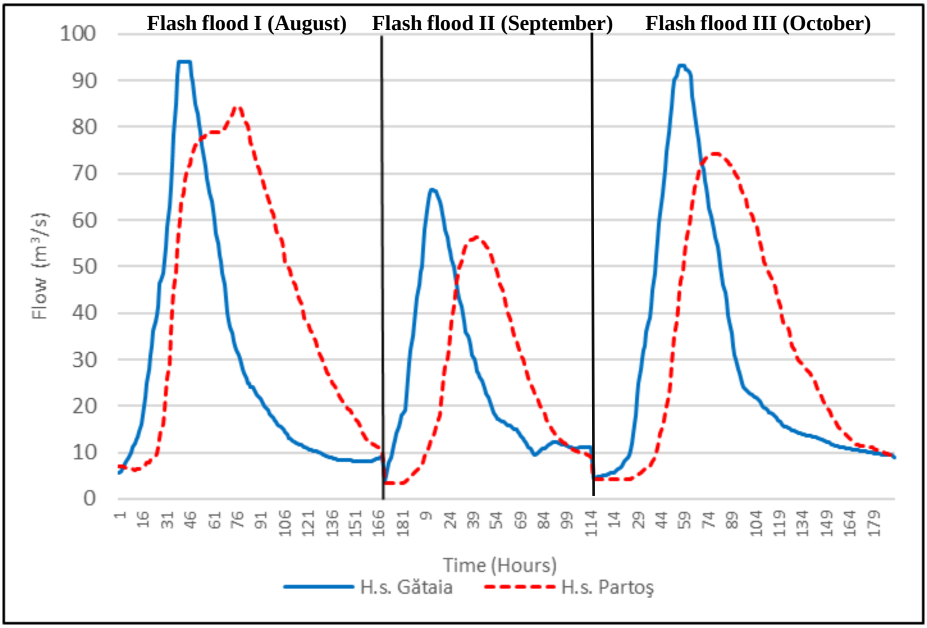

Fig. 4. ***Hydrographs of the three flash flood waves formed in the lower basin of Bârzava river in the summer and autumn of 2014***

In the case of the first flash flood, the total propagation time (T_t) was with 24 hours higher at the Partoş hydrological station than at the Gătaia hydrological station, and in the case of the second flash flood the difference between the two stations was of 9 hours. Regarding the third flash flood, the total time recorded at the Gătaia hydrological station was higher than the one at the Partoş hydrological station, the difference being of 8 hours this time. Regarding the other types of time, the values are dictated by the total time, as we can notice from table 1.

Table 1. ***Duration in hours of the increase time (T_i), the stationary time (T_s), the decrease time (T_d) and the total time (T_t) for the three floods formed in the summer and autumn of 2014***

No.	*Flash flood*	*H.s.*	T_i	T_s	T_d	T_t
1	I	Gătaia	30	8	82	120
2		Partoș	49	3	92	144
3	II	Gătaia	26	1	62	89
4		Partoș	31	3	64	98
5	III	Gătaia	31	4	118	153
6		Partoș	36	5	104	145

4.3. Volume

One of the most important aspects of a flash flood is represented by its volume (W) expressed in million m^3. Like in the case of time, regarding the volume of a flash flood, we can distinguish three (or four) different types of volumes (figure 5), these being calculated based on the flow and the time.

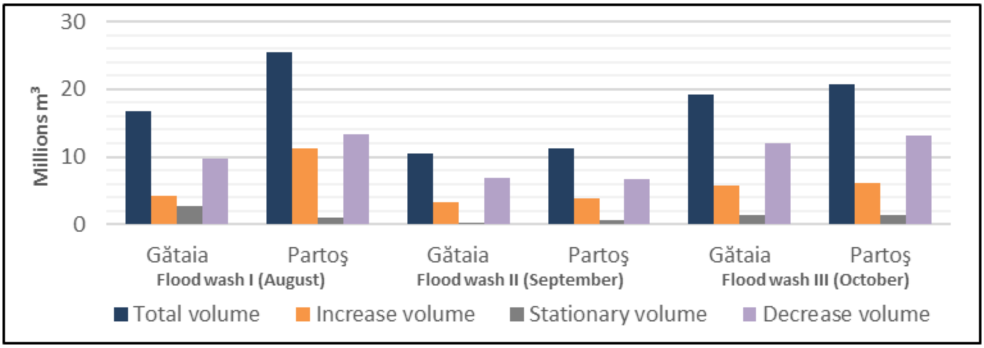

Fig. 5. ***The value of the four types of volumes recorded at the Gătaia and Partoș hydrological stations during the flash floods from the summer and autumn of 2014***

During the three cases, the total volume recorded at the Partoș hydrological station was higher than the one calculated at the Gătaia hydrological station. As we may notice in figure 5, the first flash flood was characterised by a total volume of 16.72 mil. m^3 at the Gătaia hydrological station and by a volume of 25.37 mil. m^3 at the Partoș hydrological station downstream. In the case of the second flash flood, the total volume at the Gătaia hydrological station was of 10.44 mil. m^3 and at the Partoș hydrological station of 11.16 mil. m^3. During the third flash flood, the total volume recorded at the Gătaia hydrological station was of 19.12 mil. m^3 and at the Partoș hydrological station of 20.63 mil. m^3.

The volume differences between the two hydrometrical stations were caused mainly by the different moment when the flash flood crossed the area, in the case of the first two waves this being higher at the Partoș hydrological station than at the Gătaia hydrological station.

Also, due to the channel system and the narrowing of Bârzava river bed in the area of Partoș, we notice the occurrence of the remuu phenomenon, determining the decrease of the flow speed of the water, thus the increase of the total time when the flash flood wave passed by the area. As the time when the flash flood passed by increased, the water volume accumulated upstream from the Partoș hydrometrical station increased as well.

The major river bed contributes to the significant increase of the flow section and the temporary storage of a water volume from the flash flood peak, volume that is discharged during the decrease of the water levels (Zăvoianu, 2006). The vegetation of Bârzava river bed play a very important role to the time increase and also to the flash flood volume, this aspect being noticed by Teodorescu as well (2010).

4.4. The form coefficient

The form coefficient represents the report between the total volume of the flash flood and the rectangle volume surrounding the flood hydrograph (Pandi, 2010, a) and indicating the fact that the large flash floods, generally monowave, are sharp and relatively short (Teodorescu, 2005). In the case of the three studied floods, the form coefficient varies between values ranging from 0.37 (the third flash flood, the Gătaia hydrological station) and 0.57 (the first flash flood, the Partoș hydrological station) as we may notice from table 2.

Table 2. ***The form coefficient of the flash floods formed in the lower basin of Bârzava river in the summer and autumn of 2014***

No.	*Flood wash*	*H.s.*	*Form coefficient (γ)*
1	I	Gătaia	0.41
2		Partoș	0.57
3	II	Gătaia	0.48
4		Partoș	0.56
5	III	Gătaia	0.37
6		Partoș	0.53

4.5. Flash flood wave propagation time

The flash flood propagation time in the river bed represents a very important parameter, its knowledge being very important for the prediction of the water level increase, as well as the measures to be taken downstream (Zăvoianu, 2006). In the case of Bârzava, the propagation time decrease of the flash flood is conditioned mainly by the development degree of the river bed vegetation. As we move forward to the autumn season, the more the flash flood propagation time decreases, its speed increases. For the first flash flood (August) the propagation time was 36 hours, for the second flash flood (September) the propagation time was 27 hours and for the last flash flood (Octomber) we had only 21 hours.

5. CONCLUSIONS

The three floods formed between the summer and the autumn of 2014 were the result of a large precipitation quantity, the first being mainly due to the precipitations from the field area, while the last two flash floods had as main cause the precipitations from the basin mountainous area.

The analysis of the flash floods revealed the fact that the total time of the flash floods may vary between 89 and 153 hours, the highest values being specific of the Partoș hydrological station. Regarding the total volume, this exceeded 10 mil. m^3 in all the cases, the highest values being recorded, also, at the Partoș hydrological station.

The vegetation is a factor influencing the propagation time or the flash flood speed. As the vegetation is poorly developed, the flash flood speed increases and the propagation time decreases.

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