

THE RAINFALLS AND FLOODS PRODUCED IN THE HYDROGRAPHIC AREA OF SIRET IN THE YEAR 2005

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Key words: abundant rainfalls, floods with historical character, maximal flows

1. GENERAL PRESENTATION OF THE CLIME AND HYDROLOGICAL CHARACTERISTICS FROM THE HYDROGRAPHIC AREA OF SIRET IN THE PERIOD JANUARY – JULY 2005 (ESPECIALLY FOR THE MONTH JULY).

The rainfalls registered in the first decade of the July 2005 in the central and curved area of the Oriental Carpathian Mountains brought to exceeding floods, especially in the hydrographic basins of Bistrita, Trotus, Putna, Rm. Sarat and on the inferior stream of the river Siret.

As an effect, these floods generated in the period 11-16.07.2006, calamitous floods, with material damages and human casualties. There were affected the basins and subbasins hydrographic of Bicaz, Tarcau, Trebes, Tazlau, Susita, Putna, Rm. Sarat and on the inferior sector of the river Siret, where the flood was produced by conduction, especially on the river Trotus.

The first 6 months of the year 2005 were characterized, in general, by an rainfall excess over the monthly average.

Excepting for March, the other months, almost on the entire surface of hydrographic basin of Siret, the rainfall values were over the monthly average.

The excess character was obvious in May and in June when the monthly average outdated with over 15% in the most hydrometric stations of monitoring.

Important quantities of rainfall were able to re-do the humidity deficit from the ground, registered in the anterior year, and to realize, in the mountain area an excess of humidity.

In the first decade of the month July 2005 there were rainfalls all most every day, moderate values, but with some local intensifications in sub basins Moldova and Bistrita (in the middle sector

on the 1.07.2005), in the Vrancea area on the 4.07.2005 and almost generalized on the 7.07.2005.

In some areas, these kind of rainfalls generated extreme floods on some water streams with small dimensions (Voronet, Sucevita) and on the abrupt and deforest slopes.

These kind of rainfalls were generalized starting with 10.07.2005 in sub basins Bistrita and Trotus.

In the period 10-14.2005 the most affected areas were the middle and inferior hydrographic basin of Bistrita (subbasins Bistricioara, Schit, Bicaz, Tarcau, Cujești, Cracau, Nechita, Trebes) and basin Trotus (including Tazlau), Sușita, Putna, Rm. Sarat, Sarata, Buzau.

While in the superior area of the hydrographic basins of Bistrita, on the stream of the river Siret, from upstream of the confluence with the river Bistrita and in the sub basins Suceava, Somuz, Moldova, Bistrita Superioara, the rainfalls didn't exceeded unless some exceptions 30-40 l/m², in the middle and inferior sector these had very high values.

High amount of rainfalls felt at N. Balcescu – Roman (78.6l/m²) and at Leghin, on the Ozana River (127.6l/m²), didn't have an hydrological relevance, because there had an isolated character, on the ensemble, the amount was low. In the central – west and south-west of the hydrographic basins of Siret, the high quantities of rainfalls of 100l/m² were generalized and there were historical floods on the water streams in these areas.

At the most part of the hydrometric stations of monitoring were exceeded the defense quote, and in some parts, the floods had an calamitous effect.

In the next chart, there are presented the maximal flows and the rainfalls produced in the distance 10-15.07.2005.

Quote and flows produced in the floods from 12-15.07.2005.

Nr. Crt.	River	Hydrometric station	CA	CI	CP	H _{max} (cm)	Q _{max} (m ³ /s)	Date hour	Precip. Totală (mm)	Q _{med mult} July
1	Siret	Adj. Vechi	250	350	450	315	1285	13/12	50,0	185
2	Siret	Cosmești	250	300	350	490		13/13	90,3	-
3	Siret	Lungoci	600	650	700	840	4560	14/7	100,4	256
4	Bistrita	Frumosu	250	300	350				36,8	49,3
5	Bistrita	Straja	300	400	500	440	650	12/22	160,2	72,9
6	Bistrita	Frunzeni	200	250	300	310	1200	12/22	71,3	82,5
7	Bistricioara	Tulghes	150	200	250				64,0	4,07
8	Bistricioara	Bistricioara	100	180	250	150	102	12/20	123,6	8,06
9	Putna	Tulghes	100	200	250	233	51,3	12/14	64	1,74
10	Schit	Ceahlău	0	50	150	25	29,5	12/20	112,5	0,67

Nr. Crt.	River	Hydrometric station	CA	CI	CP	H _{max} (cm)	Q _{max} (m ³ /s)	Date hour	Precip. Totală (mm)	Q _{med mult} July
11	Bicaz	Bicaz Chei	150	200	250	195	54.5	12/15	81.3	3.54
12	Bicaz	Taşca	220	270	320	300	188	12/8,30	106.9	6.17
13	Cracău	Magazia	100	170	220				63.0	1.20
14	Cracău	Slobozia	250	300	350	272	86.8	13/12	90.7	2.02
15	Trebeş	Mărgineni	80	150	250	640	130	13/9		
16	Negel	Măgura	80	150	250	118	8.80	13/6		
17	Bărnat	Bacău	200	250	300	253	68.8	13/11		1.44
18	Trotuş	Lunca de Sus	80	120	200	150	22.9	12/15	60.0	1.08
19	Trotuş	Ghimeş Făget	150	250	300	148	58.1	13/1	82.5	4.74
20	Trotuş	Goioasa	150	200	300	260	257	12/17	29.8	8.45
21	Trotuş	Tg. Ocna	200	300	380	580	1260	12/19	46.8	21.7
22	Trotuş	Oneşti	300	350	450	524	1680	12/24	151.6	30.5
23	Trotuş	Vrânceni	300	350	450	540	2800	13/7	162.1	41.3
24	Sulta	Sulta	100	200	230	131	57.5	12/2	30.2	1.39
25	Ciobănuş	Ciobănuş	130	200	250	180	55.3	13/12		1.66
26	Uz	Cremenea	150	200	250	242	229	12/21	44.8	5.00
27	Asău	Asău	150	250	300	220	136	12/12	32.0	2.72
28	Uz	Dărmăneşti	150	200	300	170	46.8	12/24	154.9	5.93
29	Dofteana	Dofteana	170	250	300	324	186	12/19	184.5	1.13
30	Slănic	Ciresoiaia	150	200	250	230	117	12/19	109.6	1.47
31	Oituz	Ferăstrău	180	250	350	300	349	12/21	155.6	3.49
32	Caşin	Haloş	300	370	450	510	400	12/20	218.2	2.47
33	Tazlău	Tazlău	200	250	300	227	153	12/19	165.3	1.83
34	Tazlău	Scorteni	200	250	300	320	490	12/21	162.4	3.84
35	Tazlău	Helegiu	200	300	350	320	1600	12/24	140.0	8.10
36	Tazlău S.	Lucăceşti	150	250	300	430	514	12/20	150.2	1.73
37	Putna	Lepşa	250	300	350	305	177	12/19	175.0	2.10
38	Putna	Tulnici	250	300	350	300	213	12/20	133.6	5.10
39	Putna	Colacu	275	325	375	495	1510	13/23	199.5	13.4
40	Putna	Mirceşti	400	450	550	621	1120	13/7	103.5	10.3
41	Putna	Botârlău	500	550	650	822	1323	13/15	100.0	16.8
42	Zăbala	Nereju	150	200	250	186	238	12/7,30	45.0	4.76
43	Năruja	Herastrău	75	125	175	185	192	12/6	220.4	2.14
44	Vizăuţi	Vidra	100	150	200	500	200	13/11		
45	Milcov	Reghiu	200	250	300	330	345	12/20	63.5	0.98
46	Milcov	Goleşti	300	350	400	530	572	13/18	8.7	1.21
47	Râmna	Gr. Tufei	200	250	300	460	354	13/10	23.6	0.45
48	Râmna	Jilşte	200	250	300	570	666	13/9	109/2	0.62
49	Rm. Sărat	Tulburea	200	250	300	330	253	12/22	146.2	1.40
50	Rm. Sărat	Puieşti	300	400	500	655	857	13/12	91.2	1.59
51	Rm. Sărat	Tătaru	400	450	500	500	182	14/9	94.8	2.07

With some exceptions determined by the distractions of measuring, the flooding of the emplacements of the watchers houses and the call off of the phones, Directia Apelor Siret, had monitorized the floods in good conditions.

These situations were registered at the hydrometric stations from: Ceahlău, Ghimes, faget, Goioasa, Tg. Ocna, Vrancea of the river Trotus, Sulta - river Sulta, Ciobănuş - river Ciobănuş, Asău - river Asău, Ciresoiaia - river Slanic, Scorteni and Helegiu, - river Tazlău, Ciuruc - river Susita, Lepşa - river Putna, Nereju - river Zabala, Herastrău - river Năruja, Reghin - river Milcov.

We can dignify 3 streps in the line-up of the phenomenons.

- the flood from the middle hydrographic basin of the river Bistrita and the transiting of the flows until the confluence with the river Siret
- the flood from basins hydrographic of Trotus and Vrancea area
- the flood from the inferior stream of the river Siret

2. THE FLOOD FROM THE MIDDLE HYDROGRAPHIC BASIN OF THE RIVER BISTRITA AND THE TRANSITING OF THE FLOWS UNTIL THE CONFLUENCE WITH THE RIVER SIRET

The amount of rainfall falled in the middle and inferior basin of the river Bistrita were higher the those from the superior hydrographic basin. In the period 11-14.07 felt 160.2 l/m² at Straja, 123.6

l/m² at Bistricioara, 112.5 l/m² at Ceahlău, 106.9 l/m² at Bicaz Chei, 119.9 l/m² at Cujeşti, 90.7 l/m² at Roznov, Slobozia, 164.0 l/m² at Borlesti, 146.3 l/m² at Buhusi, 168.7 l/m² at Garleni, 157.4 l/m² at Luncani.

The highest flow registered at hydrometric station Straja, concentrated on a surface of hydrographic basin of 1051 km² (of cca. 3000 km² that are in the downstream of the dam Bicaz), it was of 650 m³/s (including the values overflows from the dam Izvorul Muntelui).

This flow, with transfer flows through hydroelectric power plan Stejaru, and with the flows afferent for the downstream areas, were about 1400 m³/s in the section of confluence with the river Siret.

The maneuver effectuated through the system of accumulation Pangarati - Bacău were warn by S.C. Hidroelectrica S.A. and there were no important events untill the confluence with the river Siret.

The abundant and concentrated rainfall from the hydrographic sub basin of the river Trebes produced historical floods in the north sector of the town of Bacău, because of the fissuring of some dams from the Negel and from the lack of dams of protection from the river Trebes.

The maximal flow registered on the Negel River at Magura was of 26 m³/s, and on the Trebes River of 152 m³/s.

The biggest flow from the Trebes River couldn't be taken by the bridge from the Margineni area, fact that produced a remuu in the upstream and the flooding of the inferior stream stemed of the river Negel and the fissure of the protection dams.

Because of the overflow and floods produced in the north area of the town Bacau, the maximal flow, of the river Trebes felt towards the downstream, so that the hydrographic station Bacau from the river Barnat (the inferior course of the river Trebes) these was of 68.0 m³/s.

3. THE FLOOD FROM BASINS HYDROGRAPHIC OF TROTUS AND VRANCEA AREA

In the hydrographic basin of the river Trotus, the rainfalls were special in these period. The

highest amount or rainfall were registered in Halos – river Casin, (218.2 l/m²), Tazlau – river Tazlau (185.3 l/m²), Scorteni – river Tazlau (162.4 l/m²), Lucacesti – river Tazlau Sarat (150.2 l/m²), Dofteana (184.5 l/m²).

The values of the extreme flows produced at the hydrometric stations of monitoring are situated in the expectance of exceeding of 05.-2 %.

A comparative situation regarding the highest flows produced and the highest flow with different expectations of exceeding, are presented in the following chart:

Highest flows produced at some hydrometric stations from the hydrographic basin of Trotus, comparative with the values of different probabilities of exceeding.

Nr. crt	Râul	Stația hidrometrică	Q _{max} (m ³ /s)	Q _{max} cu probabilit de depășire %(m ³ /s)					Încadrare virtuală %
				0,5	1	2	5	10	
1	Trotuș	Goioasa	257	940	765	610	435	320	
2	Trotuș	Tg. Ocna	1260	1385	1200	1025	795	625	0,5 - 1
3	Trotuș	Onești	1680	1900	1550	1250	875	650	0,5 - 1
4	Trotuș	Vrânceni	2800	2920	2500	2120	1670	1340	0,5 - 1
5	Sulfa	Sulfa	57,5	300	245	195	140	105	-
6	Ciobănuș	Ciobănuș	55,3	325	265	210	150	110	-
7	Asău	Asău	136	380	310	245	170	115	5 - 10
8	Uz	Cremenea	229	565	460	375	260	195	5 - 10
9	Dofteana	Dofteana	186	285	230	185	130	95,0	2
10	Slănic	Cireșoia	117	285	230	185	130	95,0	5 - 10
11	Orituz	Ferăstrău	349	435	370	300	220	160	1 - 2
12	Cașin	Halos	400	735	600	485	340	250	2 - 5
13	Tazlău	Tazlău	153	765	620	495	355	260	-
14	Tazlău	Scorteni	470	1280	1040	840	590	435	-
15	Tazlău	Helegiu	1700	1785	1515	1240	910	660	0,5 - 1
16	Tazlău S.	Lucăcești	451	655	542	430	300	210	2

The rainfalls felt in the hydrographic basin from the Vrancea area, generated floods with calamitous character. The highest quantities felt in the mountain area and piedmont: Herastrau – 220.4 l/m², Colacu – 199.5 l/m², Lepsa – 175.0 l/m², Tulburea – 146.2 l/m².

The fast concentration of the rainfall from the deforested slopes from the higher areas, and the additional infusion of rainfall, from the middle the amplification of the hydrograph of flood from the downstream.

The highest floods registered were of 1510 m³/s on the river Putna at the hydrographic station Colacu, 572 m³/s on the river Milcov at the hydrographic station Golesti, 666 m³/s on the river Golesti at Jiliste and 857 m³/s on the river Rm. Sarat at Puiești.

These exceptional flows generated the destructions of the dams in some areas, floods and accumulation of water amount, in the lowest areas, without drains. Like that we can explain the phenomenon of diminution of the affluent flow in the inferior sectors of the rivers Putna and Rm. Sarat.

The appreciation of the degree of the natural attenuation of the floods towards the downstream, it was difficult .

A special characteristic in this period were the rainfalls hard core, very rich and active that generated the floods in the superior streams of the rivers: Asau, Ciobanus, Oituz, Casin, Zabala, Naruja, Ramna. In the case of the floods from the Vrancea area, the highest flows produced, were situated, in many cases in classes of probabilities exceed that are of 05.-1 % that are presented in the following chart.

The maximal flows produced at some hydrographic stations from the Vrancea area, in comparison with the values of different probabilities of exceeding.

Nr. crt	Râul	Stația hidrometrică	Q _{max} (m ³ /s)	Q _{max} cu probabilit de depășire % (m ³ /s)					Încadrare virtuală %
				0,5	1	2	5	10	
1	Putna	Tulnici	213	710	595	475	340	240	<10
2	Putna	Colacu	1510	1350	1100	880	630	460	0,5
3	Putna	Mircești	1120	1710	1390	1110	790	585	2
4	Putna	Botârlău	1323	2090	1795	1500	1130	805	2,5
5	Sabula	Nereju	238	790	675	570	430	325	<10
6	Năruja	Herastrău	192	600	495	380	270	180	5 - 10
7	Milcov	Reghiu	345	565	460	370	260	195	2 - 5
8	Milcov	Golesti	572	920	780	670	525	420	2 - 5
9	Râmna	Gr. Tufei	354	705	590	470	335	235	2 - 5
10	Râmna	Jilște	666	590	490	385	265	180	>0,5
11	Rm. Sărat	Tulburea	253	690	560	450	320	235	10
12	Rm. Sărat	Puiești	857	950	775	620	440	325	0,5 - 1
13	Rm. Sărat	Tătaru	182	610	525	440	335	255	-
14	Siret	Lungoci	4630	4510	3950	3425	340	1160	-

4. THE FLOOD FROM THE INFERIOR STREAM OF THE RIVER SIRET

The calamitous floods from the inferior sector of the river Siret, were generated by a big infusion of water from the hydrological basin of Trotus (flow of 2860, registered in the section Vranceni) corresponding to a probability of exceeding of 0.5 % that superposed over the flood from the river Bistrita, transited through the lakes from downstream of Bacau, with maximal flow of 1600 mc/s.

The reservoirs from the inferior stream of the river Bistrita and those from the river Siret reduced the hydrograph of flood, but didn't assured the trench of the attenuation, enough to avoid the damages.

About the natural attenuation in the channel, the approximation showed that this is of 4% on the inferior stream of the river Trotus and 5 % on the Siret in the sector Adjud – Calimanesti.

These possibilities of attenuation depend of a series of hydromorfological factors, in which we mention:

River Trotus

- a. the flow from the superior stream of the river (upstream of Agas) were reduced , and the flood didn't had any support in the beginning area.
- b. the CFR bridge and the railway bed from the Adjud area determined local floods, that produced attenuations of the peak of the flood.
- c. the considerable beam of the hydrographic basin, allow a fast concentration of the comparative drain with the hydrographic basins.

River Siret

On the area Adjud from the confluence with river Trotus (downstream Adjud) and accumulation Calimanesti, the degree of attenuation is high.

The channel transited flows were 1400 -1600 mc/s (evaluated in accumulation Beresti) and 4000 m³/s.

The filling of the channel till the superior level determined a certain attenuation of the flood peak.

On some approximations, about of circulation of the maximal flow made for the probability of exceeding of 1% we can appreciate that the attenuation on this part off of the river Siret (Adjud – Calimanesti), the attenuation is of 5%.

There were taken in consideration the sections of the river Siret situated at the principal confluence (with rivers Trotus, Zabrauti , Susita)

According to the dates from HIDROELECTRICA Piatra Neamt, for the balance of the levels in accumulation Calimanesti it was disposed the eviction of some flows until 4000 mc/s.

The approximation made in the downstream of accumulation Calimanesti, in the section Cosmesti and Movileni that indicate the fact that on this sector, the extreme flows were betwin 5000-5500 m³/s, at the disposal from the dam

Calimanesti adding the lateral aport (Zabrauti , Susita).

These especial high flows generated destructions of the dams, in same critical points.

In the monitoring section Lungoci, situated in the downstream of the confluence with the rivers Barlad and Putna, the highest flow didn't exceeded 4650m³/s.

According with the limnimetric key, made upon the calculation in the section Cosmesti the maximal flow evacuated from accumulation Calimanesti was of 4500 m³/s without lateral aport).

From the analysis of the hydrographs of the affluent flow and defluent from accumulation Calimanesti, same as the hydrograph of the flood from the hydrographic station Lungoci, we can get to the following conclusions:

1. Hydrograph of the flood evaluated from the dam Beresti (and confirmed at the hydrometric station Adjudu Vechi) indicated the high flows on the river Siret at the confluence with river Trotus on the period 12-13.07.2005.
2. The maximal flow registered on the river Trotus at hydrometric station Vranceni was at 2800 m³/s. This value got diminished in the accumulation Calimanesti because of the natural attenuations on the downstream and of the floods produced in the railway area.
3. The river Barlad didn't had an important aport of water (Qmax = 155 m³/s) and didn't influenced very mach the flows of the river Siret.
4. At the confluence with river Putna, the flows from this river were dropping because of the losses and of the exceeding of the highest moment at the hydrometric station Botarlau
5. In the section Lungoci weren't observed unless the flows the remain after the floods from the section Calimanesti – Lungoci .
6. On the river Rm. Sarat (the inferior sector), the maximal flows were dropping because of the fissure of the dams and the overflows.

As a conclusion of the mentioned aspects in this essay, the rainfalls registered in the first part of the month July 2005 were in some areas of the hydrographic basin Siret extremely concentrated and of an high intensity. These led to composite floods in an very short time that generated historical floods an material damages and human casualties that are situated in the field of disaster.

BRIEF

The first 6 months of the year 2005 were characterized by abundant rainfalls, that re-do the humidity deficit from the ground, and in some areas created an excess.

As a result the abundant rainfalls felt in the period 10-12 July, especially in the middle and inferior hydrographic basin of the river Bistrita, in the hydrographic basin of Trotus and in the Vrancea area produced floods with maximal flows that reached probabilities of exceeding of 0.5 – 2%, that produced floods on large areas, with human casualties and material damages.

On the inferior stream of the river Siret, in the downstream of accumulation Calimanesti, the increased flows that came from the river Trotus, cumulated with the ones from the river Bistrita, transited through pools existed, got to the values of over 4500mc/s.

The exceptionally flows destroyed portions of the dams from the river Siret and produced floods.

In this essay is presented the way of formation, propagation, monitoring and administration of the floods with historical character.

REZUMAT

Primele 6 luni ale anului 2005 s-au caracterizat prin precipitații bogate care au refăcut deficitul de umiditate din sol, iar pe alocuri, au creat un exces.

Ca urmare ploile abundente căzute în perioada 10-12 iulie, cu deosebire în bazinul hidrografic mijlociu și inferior al râului Bistrița, în bazinul hidrografic Trotuș și în zona Vrancei, au produs viituri de amploare cu debite maxime care au atins probabilități de depășire de 0,5-2 %, care au generat inundații pe suprafețe mari, soldate cu victime omenești și pagube materiale deosebit de mari.

Pe cursul inferior al râului Siret, în aval de acumularea Călimănești, debitele foarte mari provenite de pe râul Trotuș, cumulate cu cele de pe râul Bistrița, tranzitate prin lacurile de acumulare existente, au ajuns la valori de peste 4500 mc/s.

Aceste debite de excepție au distrus porțiuni din digurile de pe râul Siret și au produs inundații deosebit de grave. În lucrare se prezintă succint modul de formare, propagare, monitorizare și gestionare a acestei viituri cu caracter istoric.

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