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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Exceptional floods in the Prut basin, Romania, in the context of heavy rains in the summer of 2010" *by* Gheorghe Romanescu and Cristian Constantin Stoleriu

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Dear referee, thank you for your interests about our article,

General comments

The paper copes with the exceptional floods that hit Central Europe and particularly Romania in summer 2010. The work shows interesting flood data for the examined area (though partially presented by the authors in previous works), but it does not constitute a clear contribution to the understanding of these phenomena in the Prut basin, also for its complicated river network. In fact, though the work contains a lot of information on water levels and discharges observed during huge floods, these are mainly

ranked values, roughly compared to similar past events but not statistically defined. In other terms, the paper is too much focussed to the simple inventory of flood values in several gauge stations, and poor attempts to link them to physical reasons or to probabilistic interpretation have been made by authors. Thus, the readability of the paper is not good enough, mainly in the paragraph of the results.

Specific comments

Specifically, though the paper is mainly devoted to flood events, the context of heavy rains of the summer of 2010 (as in the title) is poorly described and could be largely improved. This could be done, for example, by coupling flood diagrams with rainfall histograms, when possible, or by comparing cumulative rainfall values recorded in this event with rainfall that caused other historical floods (also cited in the work). Anyway, the main drawback of the paper is the weak connection between rainfall and floods. In fact, though the period claimed as characterized by intense rainfall is 21 June -1 July 2010, a long set of summer flood (or water level) values is offered to the reader, neither providing any kind of link with triggering precipitation, nor any estimation of the return periods of the rainfall or flood values. Actually, the results are only described by means of simple ranks among critical events. To improve the paper, the paragraph devoted to the results should present at least some evaluations on the estimated frequencies (and not only on critical cases) of the flood values, thus providing more statistical sound to the work. On the other side, the interesting information on water stages and floods overcoming the specific thresholds is described too simply. The valuable data base can be better employed, for example, by combining the temporal overcoming of the higher thresholds in the flood diagrams with the occurrence of the main damages and casualties. This could also provide material for a further interesting discussion on false and missing alarms in the Prut River. Moreover, the work suffers from too much citations, not everywhere appropriate, and from figures affected by some inaccuracies. In brief, though well documented as regards the discharge values, the structure of the work is disorganised enough, with a scarce employment of statistical methodologies

and a long section devoted to the results, which consist principally in a list of flood values, with no link to occurrence frequencies. As a result, the scientific approach of the work is not statistically accurate. Thus, a substantial revision of the paper is needed to improve the quality of the work and provide effectiveness to the flood analysis of the 2010 event in the Prut River.

Technical corrections

Line 18: avoid the word “etc.” in the abstract; line 34: change “Earth” with “earth”. Lines 61, 153 (and others): I don’t understand if the authors use properly the terms “tidal bore” in rivers, except in the case of backwaters actually induced by reservoirs or confluences. Try to be more accurate. Line 76, Figure 2, legend: change “Km” with “km”; avoid decimal ciphers in elevation values. Line 83: it’s not clear why the mean altitude assume different values. Line 84: from the figure, the maximum width of Prut basin seems not to be 30 km (even in the lower reaches). Improve the sentence. Lines 101-103: the sentence is trivial (except, maybe, for the presence of the several ponds, which should be recalled). Anyway, the differences among the discharges for the various sections seem very small for such a large river. Lines 107-118: The cited methodologies are not useful for analysing floods, but for recording and collecting data. The paragraph contains too much references and not all perfectly focussed on the issue. The sentence needs a better explanation. Lines 126: it’s not usual the call to the Berg intensity scale. If possible, add a reference. Line 132: the CA, CI and CP flood threshold levels should be clearly defined. Line 141: change “1915” with “1914”, as noted in the table 1. Line 144, Table 1: the parameter “0 mira level”, and mainly its unit “mrBS”, should be better explained (or changed). Line 165: the use of the term “significant” should be associated to statistical analysis. Line 175, Figure 4: the values in the legend should not show decimal ciphers. Line 175, Figure 4: can the areal extension of the rainfall analysis be enlarged to the whole Prut basin? Line 177, Figure 5: it’s useless to span the graphs before and after the period 20 June – 31 July, that could be better centered with no temporal amplification. Line 235, figure

6: it’s not useful to extend the graphs after 1 July. Line 274, figure 7: the temporal amplification can be easily avoided. Line 303, figure 8: the temporal amplification is useless. The legend (“X scale, 0-24 hours”) has no meaning. Line 324: the term “significantly” should be associated to statistical analysis. Lines 325-327: the sentence “This value was recalculated.” should be better explained. Line 339: the sentence “.allowing the mitigation of 1%.” is not clear. Line 373: there are some words repeated (“was eliminated gradually”). Line 430: it can be used directly the acronym “NRL”, previously defined in line 335. References in Romanian language should report the words “(in romanian)” at the end of the citation.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-289, 2016.

Authors’ answer: The paper represents an analysis of the situation caused by the flood in 2010 within Prut basin. In the future we intend to analyse the hydrological context of the last 50 years for Prut basin. In this moment we do not have all hydrological data (such as levels, flow rates) for the entire Prut basin. We are in discussion with an official institution in order to obtain hydrological data. The strongest floods from 2010 were registered in the Danube basin (see Table 1). For Romania, we underlined the floods from the basins of Prut, Siret, Moldova and Bistrita rivers. The majority of floods in Romania are influenced by climate factors, which manifest at local and European level (Birsan, 2015; Birsan and Dumitrescu, 2014; Birsan et al., 2012; Chendes et al., 2015; Corduneanu et al., 2016). During the last decade of June (June 20, 2010) and the end of July (July 30, 2010), a baroclinic area was localized in Northern Moldavia. This favored the formation of a convergent area of humidity. In this case, a layer of humid, warm and instable air was installed between the topographic surface and 2500 m of altitude. The high quantity of humidity has its origins from The Black Sea, situated 500 km away. The warm tropical air is generated by the Russian Plain, overheated by a strong continentality climate. The cold air from medium troposphere, inducted by the cut-off nucleum that generated atmospheric instability, overlapped this structure

of the low troposphere (Hustiu, 2011). The synoptic context was disturbed by local physical-geographical factors, especially by the orography of Eastern Carpathians, which led to extremely powerful heavy rains: e.g. 100-200 mm in 24 hours at the sources of Jijia (representing the amount that normally falls during June and July) or 40-60 mm in 24 hours at the Romanian frontier with Ukraine and the Republic of Moldova. The quantity of rainfall during 24 hours were 2-3 higher than the normal values for this period (Hustiu, 2011) (see Figure 4 - Deviation of monthly rainfall amounts (May-July 2010) from the yearly values - CPC, source data NOAA) There were 6 main periods extremely rainy in Romania, located especially in the Moldavian hydrological basins (Prut and Siret): 21-23 June, 25-26 June, 28-30 June, 3-4 July, 6-7 July and 9 July. Rainfall quantities recorded in June were higher. The flash floods registered in Northern Moldavia in 28-29 June 2010 were generated by convective systems with slow spreading. Even if the rainfalls from June 29th were lower, the floods had devastating effects because they came on the context of the increasing water levels from 28 June 2010. Climate convection was organized as a mesocyclone extended over Northern Moldavia (the departments of Suceava and Botosani) (Hustiu, 2011). Methodology: Data on the deviation of rainfall quantities were obtained from the Climate Prediction Center NOOA and from the scientific literature (Hustiu, 2011). Line 18: word "etc." was deleted (Abstract section); Line 34: it was replaced the letter E with e. Lines 61, 153 (and others): it was replaced “tidal bore” with “backwaters”. Line 76, "Km" was replaced with "km"; and the decimals from legend were deleted. Line 83: The situation observed at line 83 is an unfortunate manner of writing for describing the mean altitude within Prut catchment basin. The phrase was adjusted as follow: "The mean altitude of the midstream sector of catchment area is 130 m, and for the downstream sector is 2 m.". Line 84: In BrateÈŹ Lake sector is registered 12 km width. Lines 101-103: It’s about the water discharge from affluent basins. In this case, the water volumes were cumulated from all the accumulations that contributed to diminishing floods. Lines: 107-118: The paragraph was modified according to the requests of R1. Line 126: Berg et al., 2009. Line 132: These were

explained as requested by R1. Line 141: Changed “1915” with “1914”. Line 144, Table 1: "0 nivel mira" was translated to 0 meter level of tide pole and "mrBS stand for meters level reported at Black Sea" Line 165: the term "significantly" was replaced with “high discharge value”. Line 175: The decimals from Figure_4’s legend were deleted. After de correction operated on article’s text and figures, Figure_4 become Figure_5. Line 175, Figure_4 (now Figure_5) represent a zoom on north-eastern part of Romania, where a large amount of precipitations were registered. Lines 177, 235, 274, 303: Figures 5-8 (after de correction operated on article’s text and figures, Figures 5-8 become Figures 6-9). Line 324: the term “significantly” was replaced with term “remarkable” Lines 325-327: this value was recalculated through reconstitute discharges. Line 339: The phrase “The reservoir was constructed with a mitigation level of 550 million.m3, allowing the mitigation of a 1% tidal bore from 2,940 to 700 m3/s. The damming infrastructure constructed downstream from the hydrotechnical nodes prevents the flooding of approximately 100,000 ha of floodplain area” was replaced with “The provision of an attenuation water volume (550 million m3) within the lake basin is efficient in retaining a 1% probability flood (reducing it from 2,940 m3/s to 700 m3/s). Together with the embankments located on the dam downstream sector, it helps preventing the flooding of 100,000 hectares of meadow.” Line 373: The repeated words were deleted. Line 430: was used directly the acronym “NRL”. References in Romanian language were specified with “(in romanian)” at the end of the citation.

Please also note the supplement to this comment:
http://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2016-289/nhess-2016-289-AC2-supplement.pdf

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Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., doi:10.5194/nhess-2016-289, 2016.

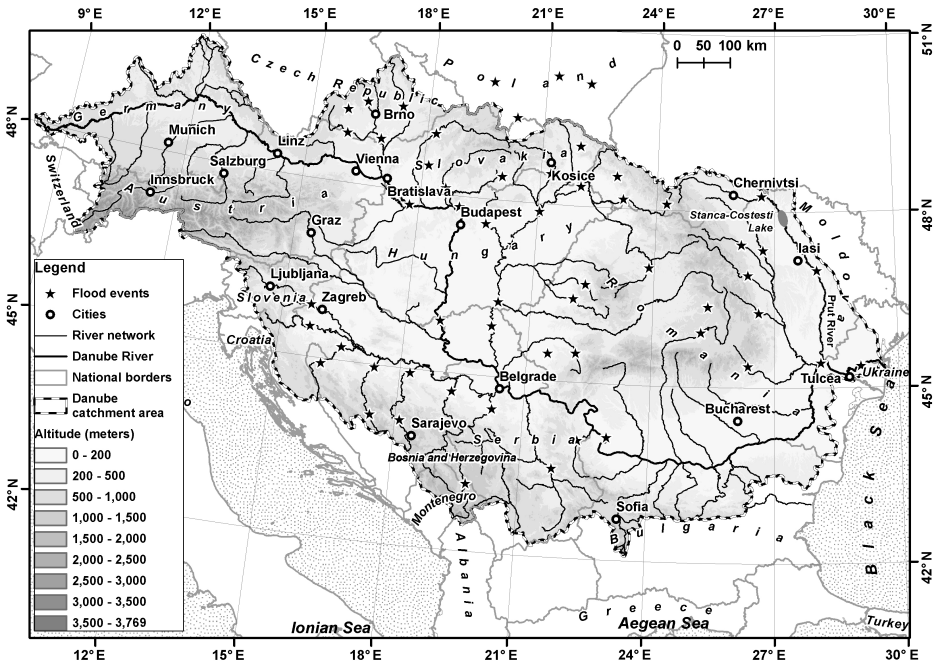

Fig. 1.

C7

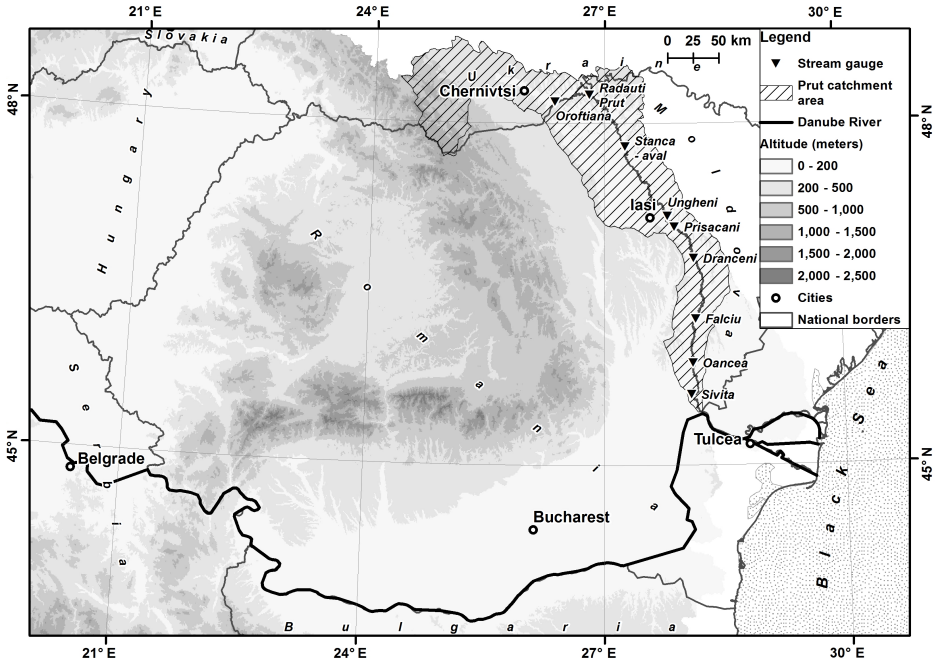

Fig. 2.

C8

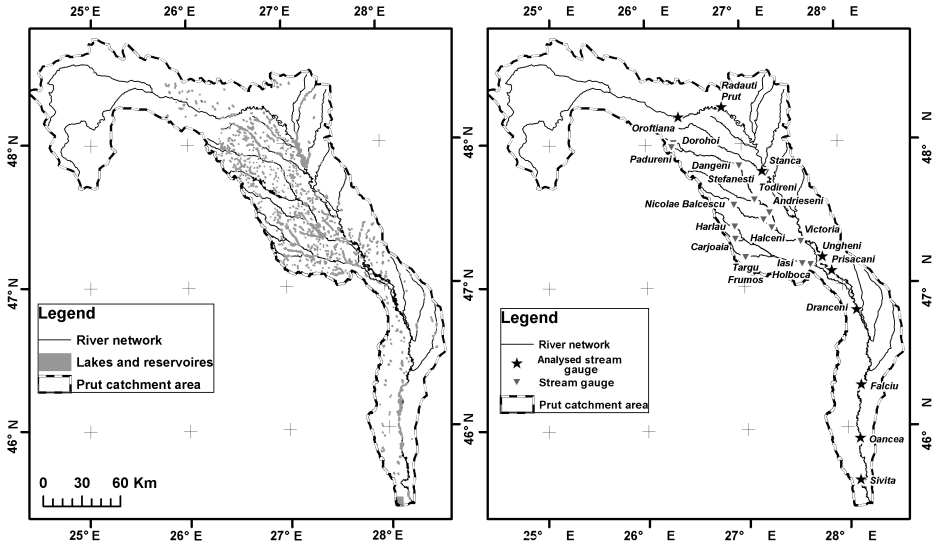
25° E
26° E
27° E
28° E
48° N
47° N
46° N
Legend
River network
Lakes and reservoires
Prut catchment area
0 30 60 Km
Radauti Prut
Orofiana
Dorohoi
Padureni
Dangeni
Stefanesti
Stanca
Todireni
Andrieseni
Nicolae Balcescu
Harlau
Victoria
Halceni
Carjoaia
Ungheni
Prisacani
Targu Frumos
Iasi
Holboca
Drancehi
Falciu
Oancea
Sivita
Legend
River network
Analysed stream gauge
Stream gauge
Prut catchment area

Fig. 3.

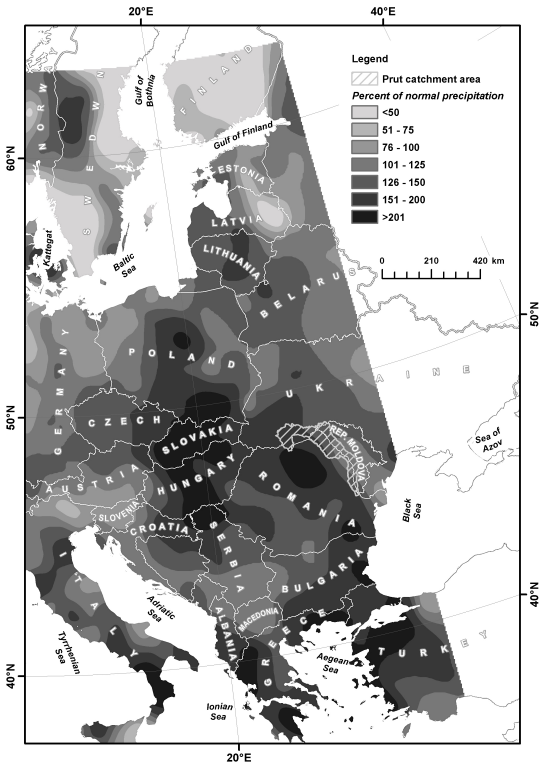
20°E
40°E
60°N
50°N
40°N
Legend
Prut catchment area
Percent of normal precipitation
<50
51 - 75
76 - 100
101 - 125
126 - 150
151 - 200
>201
0 210 420 km
NORWAY
SWEDEN
FINLAND
Gulf of Bothnia
Gulf of Finland
ESTONIA
LATVIA
LITHUANIA
Kattegat
Baltic Sea
BELARUS
POLAND
GERMANY
CZECH
SLOVAKIA
UKRAINE
Sea of Azov
AUSTRIA
HUNGARY
ROMANIA
Black Sea
SLOVENIA
CROATIA
SERBIA
BULGARIA
ITALY
Adriatic Sea
ALBANIA
MACEDONIA
GREECE
TURKEY
Tyrrhenian Sea
Aegean Sea
Ionian Sea

Fig. 4.

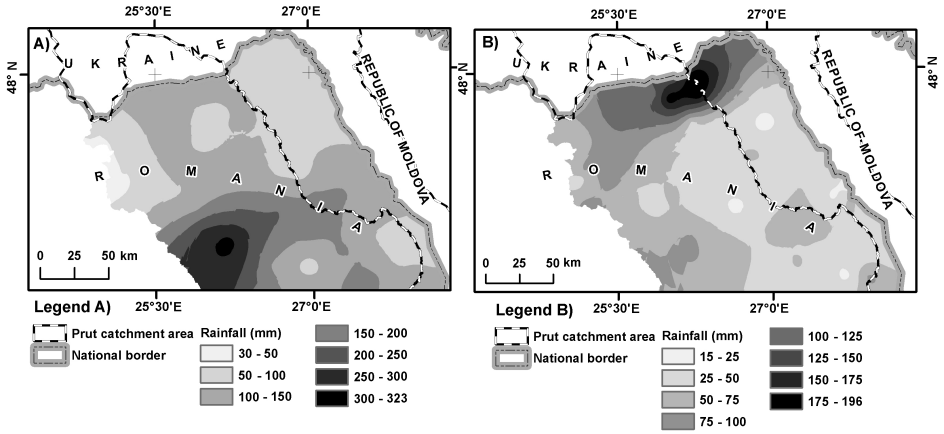
A)
B)
25°30'E
27°0'E
48° N
UKRAINE
ROMANIA
REPUBLIC OF MOLDOVA
0 25 50 km
Legend A)
Prut catchment area
National border
Rainfall (mm)
30 - 50
50 - 100
100 - 150
150 - 200
200 - 250
250 - 300
300 - 323
Legend B)
Prut catchment area
National border
Rainfall (mm)
15 - 25
25 - 50
50 - 75
75 - 100
100 - 125
125 - 150
150 - 175
175 - 196

Fig. 5.

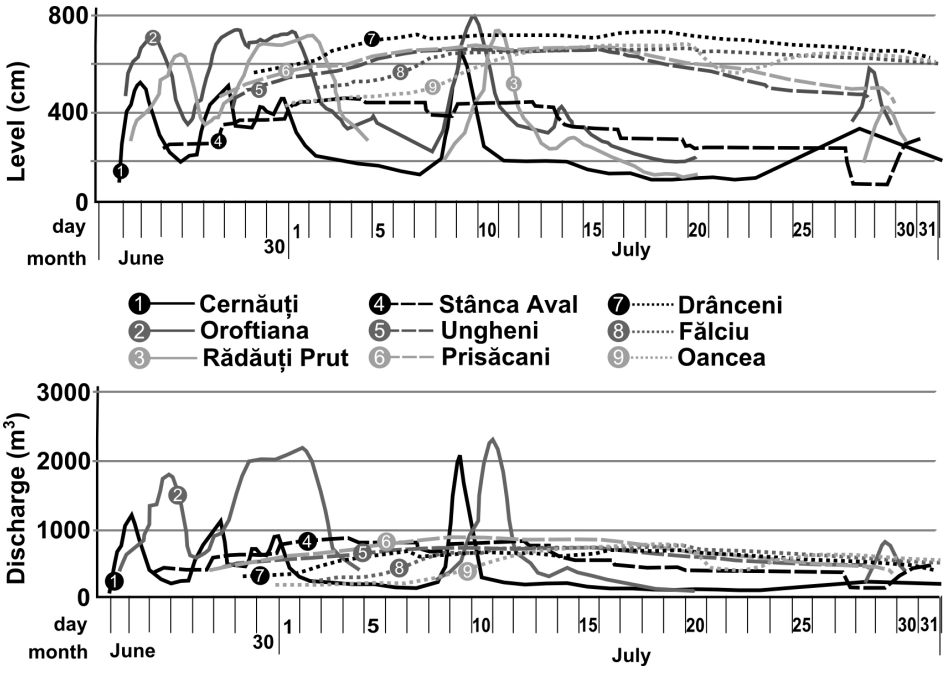
Level (cm)
800
400
0
day
month
June
July
30
1
5
10
15
20
25
30
31
1 Cernăuți
2 Oroftiana
3 Rădăuți Prut
4 Stânca Aval
5 Ungheni
6 Prisăcani
7 Drânceni
8 Fălciu
9 Oancea
Discharge (m3)
3000
2000
1000
0

Fig. 6.

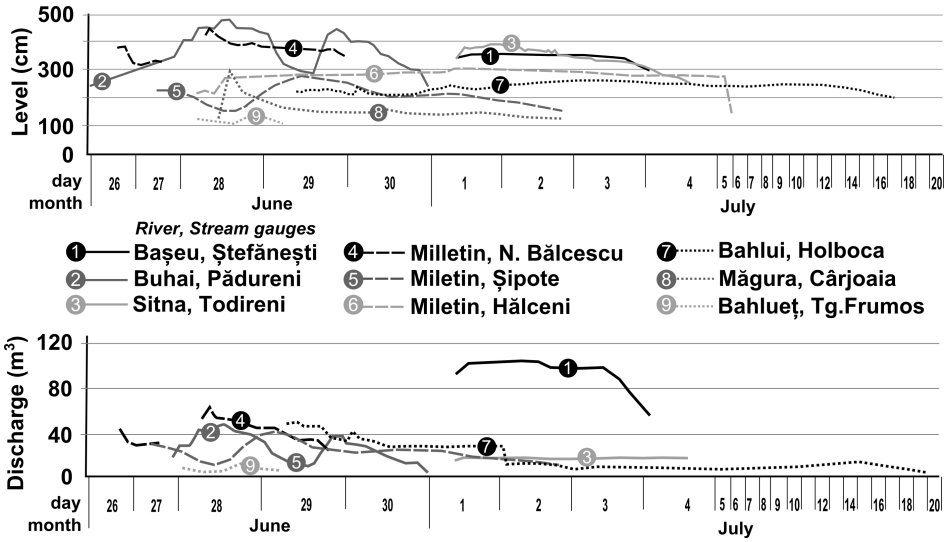
Level (cm)
500
300
100
0
day
month
26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 12 14 16 18 20
June
July
River, Stream gauges
1 Bașeu, Ștefănești
2 Buhai, Pădureni
3 Sitna, Todireni
4 Milletin, N. Bălcescu
5 Miletin, Șipote
6 Miletin, Hălceni
7 Bahlui, Holboca
8 Măgura, Cârjoaia
9 Bahlueț, Tg.Frumos
Discharge (m3)
120
80
40
0

Fig. 7.

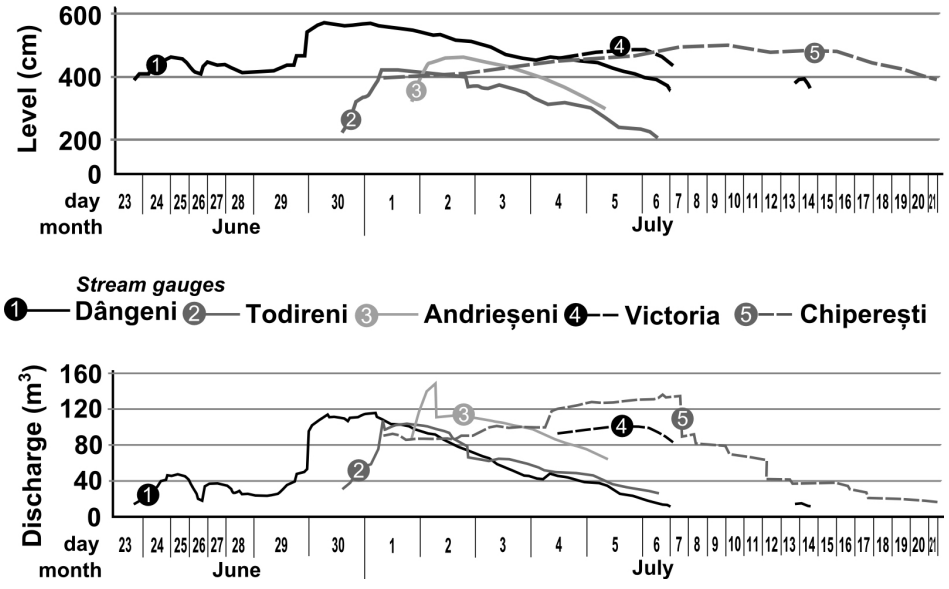
Level (cm)
600
400
200
0
day
month
23 24 25 26 27 28 29 30 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
June
July
Stream gauges
1 Dângeni
2 Todireni
3 Andrieșeni
4 Victoria
5 Chiperești
Discharge (m3)
160
120
80
40
0

Fig. 8.

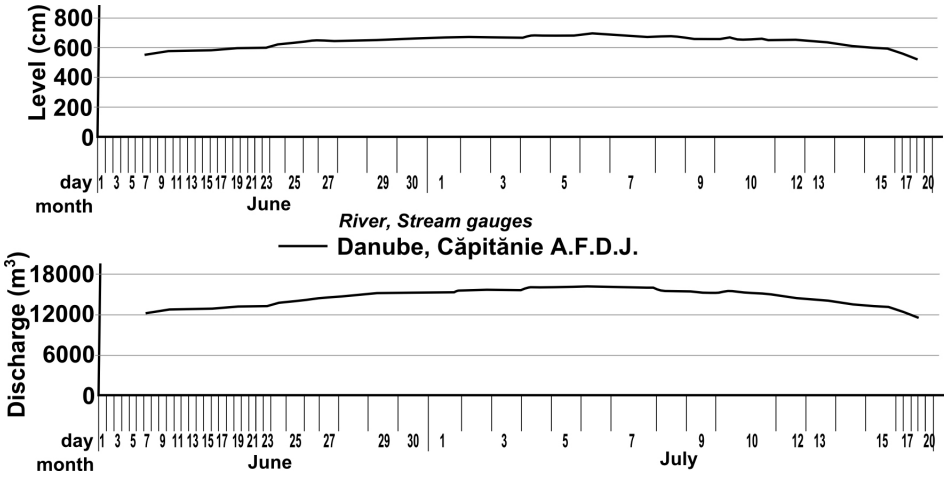
Level (cm)
800
600
400
200
0
day
month
June
River, Stream gauges
Danube, Căpitănie A.F.D.J.
Discharge (m3)
18000
12000
6000
0
July

Fig. 9.