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HYDROLOGICAL HAZARDS IN THE EASTERN PART OF THE GETIC PIEDMONT

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Abstract

By analysing the hydrological data from 9 hydrometric stations (Milcoiu - Topolog, Buzeşti - Vedea, Ciobani - Cotmeana, Dărmăneşti - Râul Doamnei, Piscani - Râul Târgului, Mioveni - Argeşel, Priboieni - Cârcinov, Gura Foii – Potop, Malu cu Flori - Dâmboviţa), we obtained an impotant assessment of significant floods (genesis, frequency, duration) and drying up phenomena. Of all the extreme phenomena, the most representative have a short presentation, taking into account the causes and effects of them. It also has watched the impacts, and measures or environmental engineering works carried out to mitigate the negative effects. Particularly significant is the map with the spatial distribution of the two extreme phenomena (arising out of the use of data and field observations). The data obtained are being systematised with the help of a geographical information system, enabling to compare the phenomena in order to sustain an efficient management.

Keywords: hazard, flood, drying up, river, impact.

1. INTRODUCTION

Hydrological regime of rivers, there are two extreme moments, represented by maximum flow (producing floods) and minimum flow (resulting in drying up). The two phenomena have caused over time damages and influenced morphodynamical beds.

For the eastern part of the Getic Piedmont (between Olt and Dambovita rivers), we used data from measurements of water flow coming from 9 representative hydrometric stations: Milcoiu (Topolog river), Buzeşti (Vedea river), Ciobani (Cotmeana river), Dărmăneşti (Râul Doamnei), Piscani (Râul Târgului), Mioveni (Argeşel river), Priboieni (Cârcinov river), Gura Foii (Potop river) and Malu cu Flori (Dâmbovița river), for the period 1970-2010.

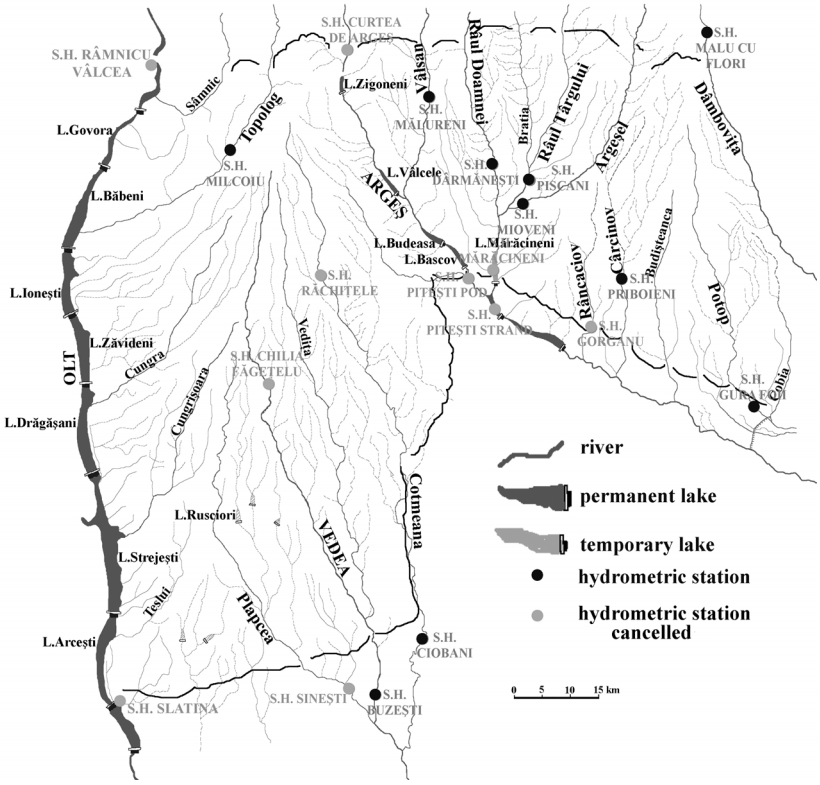


Figure 1. Hydrometric stations network

2. FLOODS

There are significant differences between the occurrence of these phenomena on large and small rivers, in terms of intensity and duration. If floods on large rivers are rarely catastrophic nature and lasts several days, possibly forecasting and adoption of protective measures, for small rivers are specific exceptional floods pf very short duration, without the possibility of immediate prevention.

Floods study was performed taking into account the first two floods, for each year, in the period 1970-2010.

2.1. Genesis and frequency of floods

Rain floods are predominant (70%) and occur in the warm season of the year, driven by heavy or long term rains. Pluvio-nival floods are less frequent (30%), meeting especially in spring, but sometimes can take place in winter.

Analyzing the seasonal flood frequency, it is noted that most occur in summer (40-45% of all cases) and spring (38-40%). Winter occurred 14 to 28% of all floods considered, while in autumn season floods recorded the fewest (4.8%). Compared to the mentioned, there are some exceptions: Milcoiu (Topolog), Dărmăneşti (Râul Doamnei) and Gura Foii (Potop), where the frequency of floods of autumn (11-16%) is equal to or more than the winter.

The low frequency of floods in autumn meets in September and October (no floods on the Cârcinov), and in November and December there were no floods on the Vedea river.

Table 1. Seasonal frequency of the floods (%)

No	River	Hydrometric station	F (km²)	H (m)	Season			
					W	S	S	A
1.	Topolog	Milcoiu	427	894	10,3	30,9	42,6	16,2
2.	Vedea	Buzeşti	495	303	28,2	38,5	28,2	5,1
3.	Cotmeana	Ciobani	444	325	28,6	38,8	24,5	8,2
4.	Râul Doamnei	Dărmăneşti	566	1162	12,2	34,7	40,8	12,2
5.	Râul Târgului	Piscani	843	825	16,7	33,3	44,4	5,6
6.	Argeşel	Mioveni	228	668	16,1	25,8	45,2	12,9
7.	Cârcinov	Priboieni	75	458	14,3	39,3	42,9	3,6
8.	Potop	Gura Foii	196	348	11,1	40,7	37,0	11,1
9.	Dâmboviţa	Malu cu Flori	668	1182	10,0	30,0	48,3	11,7

F – basin area, H – basin average altitude, W – winter, S – spring, S – summer, A - autumn

2.2. Floods elements

Total average time of the flood varies between 132 hours at Piscani (on the Râul Târgului), 207 hours at Gura Foii (on the Potop), 265 hours at Dărmăneşti (on the Râul Doamnei) and at Ciobani (on the Cotmeana) and 334 hours at Milcoiu (on the Topolog).

The maximum total duration of the floods varies function of the size and shape of hydrographic basin, having values between 318 hours on the Râul Târgului (at Piscani hydrometric station, in August 1997), 398 hours on the Potop (Gura Foii, in November 1985), 504 hours on the Vedea (Buzeşti, October 1972) and 947 hours on the Topolog (Milcoiu, in May 1991).

The average increasing time enhances from 40-42 hours on the Râul Târgului and Vedea, to 64-66 hours on the Cotmeana and Cârcinov, to 75 hours on the Potop and 89 hours on the Topolog.

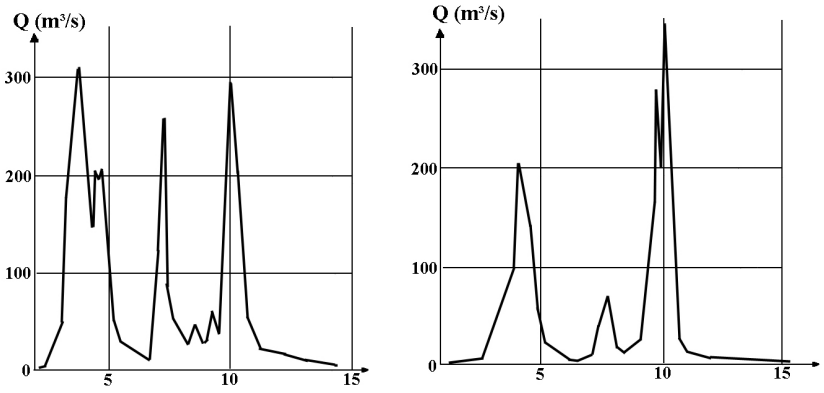
Timpul mediu total de manifestare a viiturii oscilează între 132 de ore la Piscani (pe Râul Târgului), 207 ore la Gura Foii (pe Potop), 265 de ore la Dărmăneşti (pe Râul Doamnei) şi la Ciobani (pe Cotmeana) şi 334 de ore la Milcoiu (pe Topolog).

2.3. Exceptional floods

In the Piedmont region between Olt and Dambovita, the largest floods were produced in 1970, 1972, 1975, 1979, 1991, 1995, 1996 and 2005, with annual differences of amplitudes from one river basin to another.

Flood of July 1970 was particularly important in some smaller arteries, with springs in the plateau (Vedea 412 m^3/s at Buzeşti and Cotmeana 526 m^3/s at Ciobani), when there were absolute maximum flow in the entire period of observations.

Flood in October 1972 looks like a flood compound in which one can follow a sequence of three floods (3-4, 7-9 and 10-11 October). Maximum flows changed values from the existing maximum insured, up to that time. Recalculating them at a number of stations (on the rivers Argeş and Vedea) has led to increases of 15-20% for the 1% insurance flow (Haraga&Nițulescu, 1973).

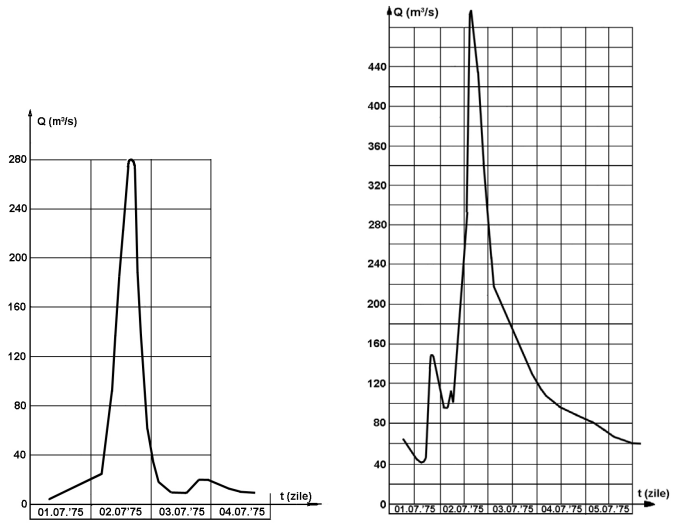


Cotmeana – Ciobani Potop – Gura Foii

Figure 2. Floods hydrograph in October 1972

Flood of May 1973 at the highest peak in the period of direct observations in the Topolog basin (405 m^3/s), with exceeding probability 1-2%.

Flood of July 1975 is the most important. The main causes were the following (Stănescu *et al*., 1976): high degree of saturation of the soil before the rainfall in early July (in the third decade of June, the total amount of rainfall has ranged between 40 and 70 mm, which is 30-50% of monthly values); the high degree of filling of the basin (at the time of the establishment of the high flood leaking were from 1.37 on Râul Doamnei-Dărmăneşti to 3,54 Vâlsan-Mălureni times higher than multiannualy average rates); particularly large amounts of rainfall in 1-3 July 1975 (between 100 mm and 167,9 mm, monthly average quantity exceeding twice); temporal and spatial distribution of relatively uniform rainfall (to produce almost simultaneously); particularly high intensity rain on relatively long periods (0.45 mm/min in 48 minutes at the Curtea de Argeş and 0,52 mm/min in 60 minutes at Deduleşti).



Argeşel – Mioveni Dâmboviţa – Malu cu Flori

Figure 3. Floods hydrograph in July 1975

Flood in June 1979, due to extreme precipitations of 100-120 mm (in the eastern half of Cândesti Piedmont, in the Potop basin) in the range of 21 to 23 June. Absolute maximum flow on the Râul Târgului, Piscani, reached 543 m^3/s.

Flood of July 1991, produced by heavy rainfall (Stăncescu&Goți, 1992), when rainfall amounts recorded in this month were 2-3 times higher than the monthly average. There were exceeded the inundation

levels on a series of rivers (Râul Târgului, Argeşel, Vedea) and danger levels (on the Râul Doamnei, Cârcinov, Potop, Dâmbovița).

Flood of May 1995, fallen as a result of rainfall in the range of 21-24 May, there have been significant increases in levels and debits (on May 23) on rivers from Vedea and Argeş basins. Flows recorded were exceeding probability of 20-50% for the Argeş and 5% in the Vedea (to Buzeşti).

Flood from December 1995 - January 1996 recorded, at some stations, comparable with the maximum flow in winter months during their period of existence: the Dâmboviţa on Malu cu Flori 88.2 m³/s (the maximum absolute value for the winter months); the Râul Doamnei, Dărmăneşti 70 m^3/s comparable with 75 m^3/s in January 1971. Moreover, in January, some stations have registered their maximum value for the winter months: the Cotmeana, Ciobani 114 m^3/s; the Vâlsan, Mălureni m^3/s; the Râul Târgului, Piscani 139 m^3/s; on Argeşel, Mioveni 68 m^3/s; the Cârcinov, Priboieni 48,8 m^3/s.

Floods from March to September 2005 has affected the rivers: Vedea (with the maximum flow rate of Buzeşti, reached 226 m^3/s, the third value of the whole string of observations), Vâlsan, Dâmbovița and Cârcinov, with monthly exceedings of danger and inundation levels.

Particularly significant is how the natural and fitted river basins reacts to the appearance and spread of floods. In some models, is watching a number of parameters (Diaconu&Şerban, 1994) which concerns: (a) effective rain which contribute to the formation of the flow; (b) flows hydrograph in small basins; (c) the spread of the spill by channel; (d) operation of accumulation lakes within a river basin.

3. RIVERS DRYING UP

In the studied region, the drying up phenomenon is specific to the particular rivers with springs in piedmont. He is mainly a consequence of the two categories of factors: climatic and litologic. In the first category, a pivotal role have the meteorological droughts, which entail, on the one hand, the disappearance of pluvial supply, and on the other hand, reduce the depletion of underground water reserves and lowering the phreatic level which cannot be intercepted by rivers. During the winter, persistent extremely low temperatures may lead to near-total freezing water (till close to bed riverbeds) on the smaller rivers with gradients, debits and slow speeds and with poor underground supply, the drying up winter. In general, the drying up of the winter period, as the duration and frequency, is weaker than in the warm period of the year. Litological formations, by its characteristics (degree of permeability and cracking), favors the water seepage and, in the absence of sufficient superficial supply, total loss occurs in the river water, till its drying up.

Whereas the amounts of the annual average rainfall in the Getic Plateau from east of the Olt indicate his ejection fraction slipping along with altitude between 750 mm and 550 mm in the north to the southern periphery, resulting in an important role of the litological factor in the rivers drying up, represented by pleistocene formations (loose rocks such as sands, gravels and boulders) and those of the alluvial fans where the water seeps easily. The actions undertaken on large deforested surfaces intensified the torrential processes, which had the effect of diminishing the capacity of riverbeds to intercept the phreatic water.

Among the rivers, monitored by hydrometric stations, which registered a higher frequency of drying up, are Vedea, Cotmeana, Râncaciov and Potop.

On the Vedea, at Chilia-Făgeţel station, drying up phenomenon has occurred in all those 30 years, look at the time that there has been an annual average frequency of 2.73, with an average of 49 days. The longest period during Vedea (as mentioned) was completely lacking water, totaled 199 days, over the course of six months (16.VI - 31.XII) in 1965. In terms of the frequency ranges for duration of droughts, which do not exceed 10 days (35%), followed by the remarkable, with slightly over 100 days (25%) and those with 11 to 20 days (15%). The cast during the year, emphasize especially droughts in summer-autumn and winter.

On the Cotmeana River, at Richiţele station, drying up is a major feature of the hydrological regime, with an average annual frequency of 1.4. This phenomenon lasted an average of 44 days. The longest drought was maintained but the 92 days, the river being deprived of water between 1 august and 31 October 1974. Maximum frequency (57%) presents the longer droughts of 41 days, followed by those that were maintained below 10 days (28%). In terms of distribution during the year, we mention the fact that the section has been manifested by all means both drought of summer-autumn and winter.

In the case of Râncaciov river, the drying up has a lower frequency in the period 1964-1990 with only one year of drought. Incidentally, the year 1968 experienced three periods of river drying up, the longest duration of 12 days (10-21. VII).

The Potop river, at Gura Foii station, registered significant drying up phenomena in 1994, when they succeeded six such intervals (26-30 June, 7-8 July, 17-25 August, 2-21 and 23-30 September, 1-5 October),

with the longest period of 20 days. Also in 2000, the river has dried up during the period 17-28 august, but the determining role of the anthropic factor. Thus, on 16 august, near the village Crânguri was a barrage by the inhabitants of the municipalities for providing animals water and watering the gardens. On 22 august, it was again another dam for water retention in the Valea Mare commune, the purpose being the same as in the situation before.

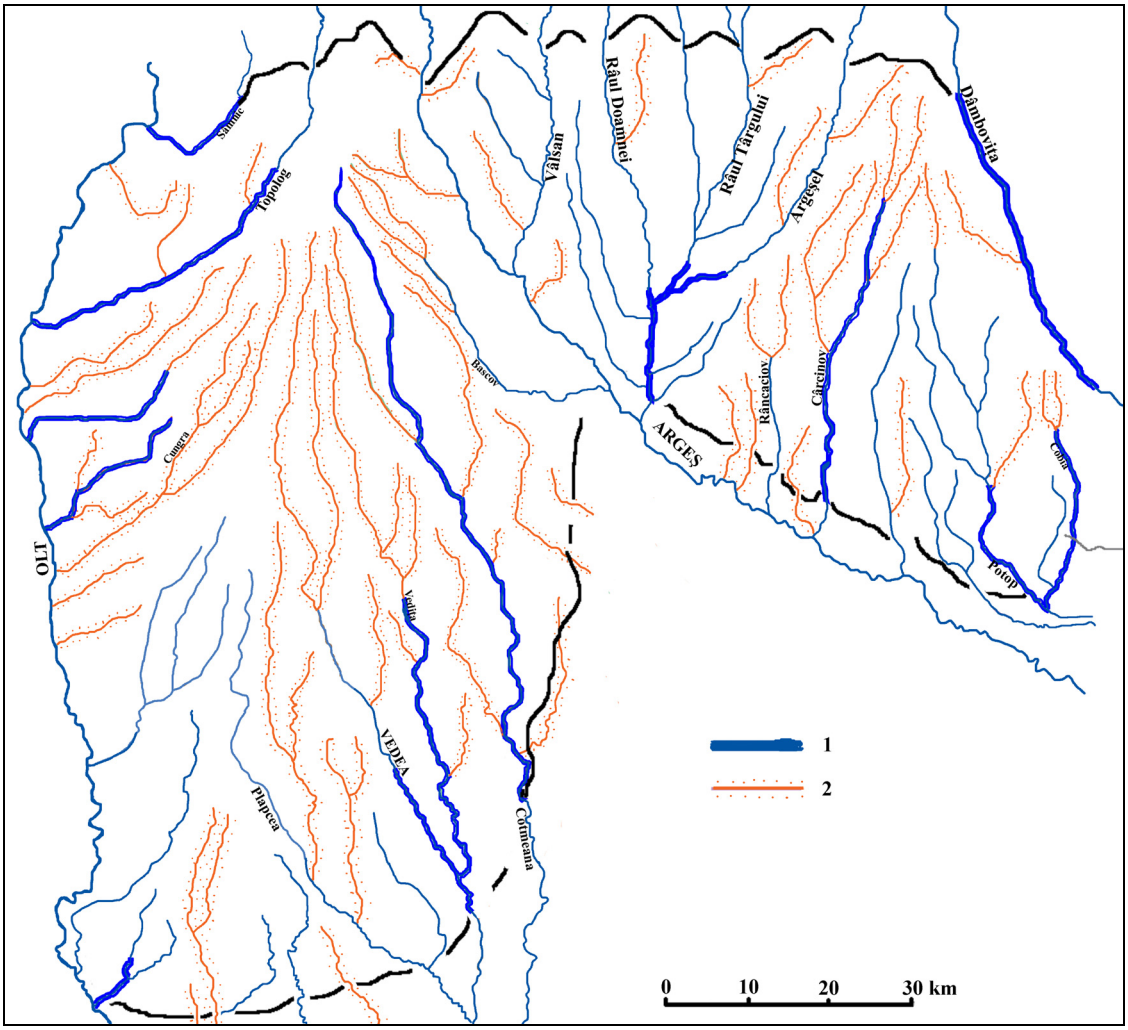


Figure 4. Hydrological hazards
1. river flood; 2. river with annualy drying up

4. NEGATIVE IMPACT

Large values of flows of the rivers produce excedptionally floods in the neighborhood localities of water courses, causing the evacuation of population, animals and material goods. For example, in May 1970, the Olt river waters have inundated several homes in settlements Vultureşti, Curtişoara, Verguleasa; in July 1975, small water courses, Cârcinov, Budişteanca, Băila, Budeasa caused flooding of localities Topoloveni, Ştefăneşti, Leordeni, Călineşti, Goleşti, Beleți-Negreşti, Bogați, Suseni, Dobreşti, Merişani, Mărăcineni.

Also, during the floods, the capacity erosion of rivers is increasing (in the summer of 1960, the waters of the Râul Doamnei, by correcting its meanders to Ciumeşti, destroyed over 15 hectares of arable land), being transported large quantities of sediment that accumulates in reservoirs, contributing to fast clogging them.

Regarding the rivers drying up, Plapcea Mică, Vedița, Sâmnic, Trepteanca, Cungrea are drying up each year, usually for longer periods, and Vedea for an interval of 2-5 years and only on certain sectors. A special case was the Argeşel river in 1946, when it dried up on portions of tens of kilometers down to Nămăieşti.

Figure 5. July 2005 - damage in Topliţa (A); affected bridge to the entry in Mioveni (B)

5. HYDROTECHNICAL WORKS

Protection of flooded areas is accomplished by works undertaken on water projects in catchment areas and rivers. A special role in the alleviation of floods waves have the *permanent and temporary reservoirs* (Govora, Băbeni, Ioneşti, Zăvideni, Drăgăşani pe râul Olt; Budeasa, Bascov, Mărăcineni în bazinul Argeşului).

The embankments represents another means of protection to flooded areas. The works are local and are executed on a shore or on both sides. Local levee works strictly on one shore are found in: Băiculeşti-Mănciuleşti (the left bank of Argeş) - 5.8 km; Râul Doamnei (insurance 5%) on the right bank (3 m from shore) - 1,9 km, for the railway defense. On both sides, there are: on Râul Doamnei downstream Mărăcineni Lake - 1 km, to the defense of railway; to Sabar, Leordeni-Glâmbocata - 2,5 km.

The works of the regularized riverbeds were made both on the Argeş river and on the main tributaries and the less important. The works are of a strictly local character (on the lengths of 1-5 km) or more general (on the great lengths, up to 28 km – Topoloveni-Boţeşti) and are executed at a single bank or on both sides (most often).

6. CONCLUSIONS

Hydrological hazards analysis is closely related to climate change. But changing environmental conditions, especially by deforestations, generates an enhancement of hazards impact. In these conditions, it is evident that the use of the geographical information systems could improve the prevention activity and the evaluation of frequency and magnitude of the extreme hydrological phenomena.

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