World Meteorological Organization

STUDY OF HISTORICAL FLOODS IN CENTRAL AND EASTERN EUROPE FROM AN INTEGRATED FLOOD MANAGEMENT VIEWPOINT

ROMANIA

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For the WMO/GWP Associated Programme on Flood Management

Romania is a country that is frequently submitted to flooding especially in the last years. These floodings engender important material lost even human lost and they affected the population from the different areas in Romania. The economical consequences of these floodings are very high to be supported in the context of the actual development of Romania. The areas affected of flooding had certain orographiques and climatic characteristics.

The most frequent floodings in Romania occurred by over passing the current levels or the occurrence of the torrents due to the abundant long term precipitations, the rapid melt of the snow cover, ice jams and the landslides. To these causes we can add the favorable factors, degradation or lack of dams and also the climatic change generate violent floodings besides the "traditional period" march-may.

Responsible commissions for defense against flooding:

- The Central Commission for the defense against flooding, dangerous meteorological phenomena and hydrotechnical and hydroelectrical accidents;
- The District Commissions;
- The Local Commissions;
- National Authority of Water "Romanian Waters";
- The Basin Agencies (12);
- The Water Management Systems;
- The Hydrological Services;
- National Institute of Hydrology and Water Management;
- National Meteorological Agency;
- The Civil Protection Headquarters;
- Prefects and Mayors;
- Others.

For this study were selected 3 important floods:

- Slanic river, Varbilau gauging station – 7-8 August 2002
- Viseu river, Bistra gauging station – 3-7 March 2001
- Crisul alb river, Gurahont gauging station – 6-11 April 2000

1. Slanic river– VARBILAU gauging station 7-8 August 2002

1.1 Characteristics of the catchment

Slanic river basin is situated in the center of the country, have an area of 44 km^2. and is a part of the Ialomita river basin. The length of the Slanic river is 18 km. The medium altitude of the basin is 517 m, medium slope 30‰ and a sinuosity coefficient of 1.31. The forestation area is 8.62 km^2 that represents 20% of the total area of the basin.

The graphical representation of the relief units and hydrographic network illustrates the degree of fragmentation of the relief of the upper river basin.

The geological structure, the different age of the geological formation, the petrographic constitution, so different all over the basin, leads to hydrogeological variation.

The climate is characterized by vertical contrasts and temperature inversions. Another characteristics of the climate are: long duration of the cloudless sky, small amplitude of the temperature variation and mainly föhn effect.

The soils are forest brown, forest gray, levigate black carth, salty and alkaline. The hydrothermic regime (wet in autumn and spring and with short periods of frozen in the winter) is favorable washing out the soluble soils.

The vegetation is made by hilly elements, and with the decreasing of the altitude aroused the deciduous forest (beech and durmast) with different spreading area. As it is described above, the basin area is small, the slope is relatively high, the soil is rather impermeable and because of the high intensity of the rain many flash floods occurred in this area, the flood from 07-08 August being one of them very severe.

Slanic Prahova town, situated along Slanic river was rapidly flooded, a lot of houses and roads being affected one of them being even destroyed.

On Slanic River there is 1 gauging station at Varbilau.

Regarding flood control measures, dams and bank defense concretize these.

For the flood from 07-08 August the start and the finish of the “Defense State” took place in accordance to “Defense Plans Against Flood, Dangerous Meteorological Phenomena and Hydrotechnical Accident”. Through faxes and telephone calls the Local Commissions of Defense Against Floods were alerted against enter to defense headquarters.

1.2 Hydrometeorological aspects of the flood

The year 2002 was warmer in Romania against climatological norm, being the fifth consecutive one with mean all country temperatures exceeding by 0.3-1.8°C the climatological norm. From the hydrological point of view, by a runoff slightly exceeding the normal annual values for the rivers in the northern part of the country and below these ones on the other rivers. The most significant flood waves, producing floodings with destructive socio-economic effects at local level, were recorded in the month August. The fallen precipitation amounts were concentrated on short time intervals and amounted to very high values, exceeding over values of 200 mm. In some areas, the rainfall had the character of storm, being accompanied with strong wind and hail. There were many damages (destroyed houses, dislocate fields, human lost).

In this way we can illustrate with the flood from 7-8 August 2002 on the river Slanic at the gauging station Varbilau (fig. 1). The torrential character of the rainfall was represented by large precipitation amounts, which exceeded 100 l/m^2 also with very high intensities, 42 mm in 30 min.

These precipitations amounts led to significant increases of the waters level, the peak of the maximum discharge being reached in one hour. The peak discharge on Slanic river – Varbilau gauging station has the exceeding probability of 1% with the value of 113 m^3/s (fig. 2 - b) and the level was 300 cm.

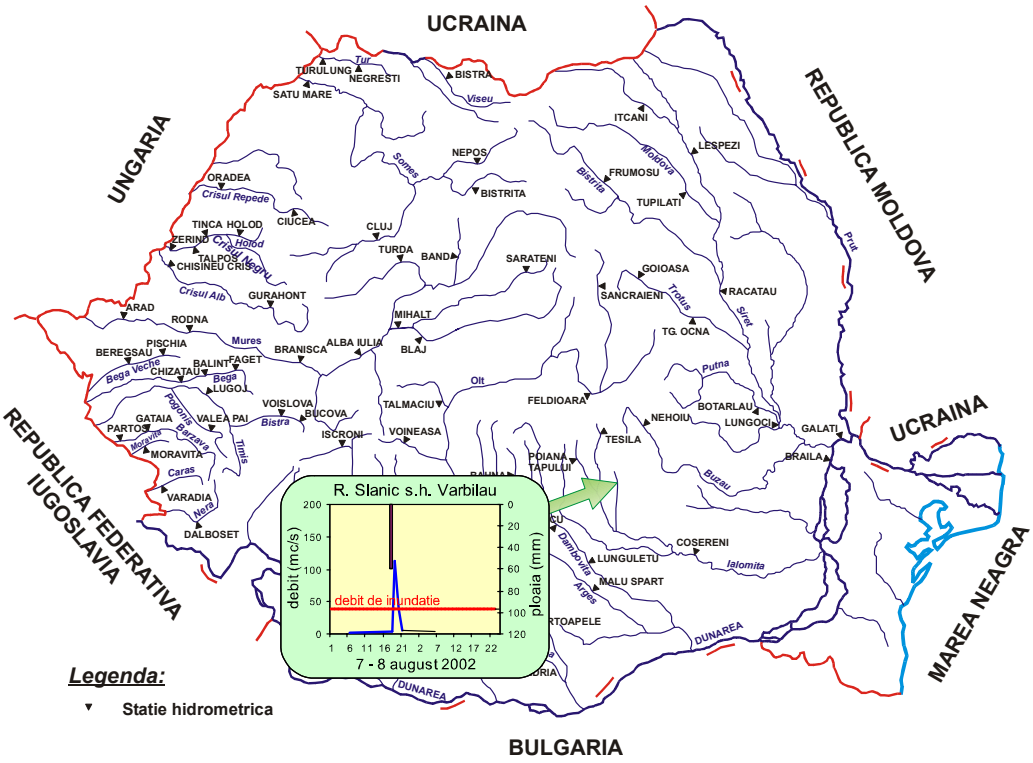
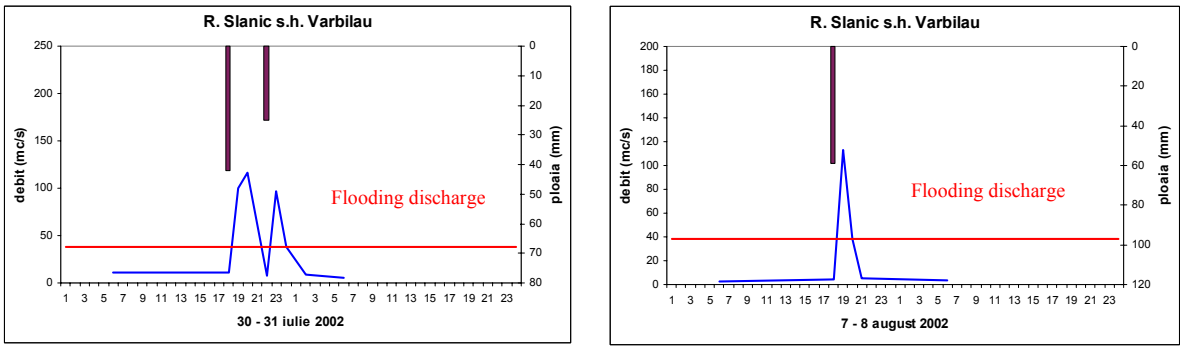


Fig 1. Localization of the Varbilau gauging station.



a b

Fig 2. Flash floods on Slanic river at Varbilau gauging station

Before this flood on 30-31 July, there was another strong flood caused also by high amount of precipitation. (Fig 2 – a). The two floods succeed at short periods of time, a series of torrents being activated by rainfall and a lot of slopes runoff was recorded.

1.3 Warning and rescue system

There is no warning system installed besides sirens in the Slanic town. The Districtual and Local Commissions, the Fire Department, work together to unblock the roads, to rebuilt the electric, telephonic and water supply affected networks. Also they save the people surprised by the rising water levels. During the flooding all the activities were coordinated by a headquarters. All the authorities civil and military were subordinate to this headquarters.

1.4 Interaction of the natural resources

This kind of damages weren't quantified for the flood in question. However, there were certain connections between flood and natural resources.

In almost the entire Varbilau basin forest and agricultural areas can be found. The division into forest, arable land and meadows depends very much on the geological and morphological structure of the basin.

The occurrence of flooding is interconnected with land use. In these last years the upper basin was highly deforested so the flood produced a big volume of dragging and suspension alluvia.

In Slanic town, the main town situated on Slanic river, 3 water supply, 2 waste water networks were affected. Because of the high level of the water in Slanic river, the water can't be evacuated so the buildings and all the facilities in area come under water for a long period of time. The river penetrate the sewage in urban area and the ground water and the emissary were contaminated

Also 5 km^2 of arable land was flooded and all the crops were totally destroyed.

1.5 Flood control measures

Flash floods have normally short duration; flood from 7-8 August on Varbilau river has a duration of 2 hours, so there was no time for apply any measure. Small area of the basin (44 km^2) doesn't allow hindcast phase that can determine the size of the phenomenon. After a very short period of time from the recorded meteorological phenomena, the flood hit its peak and so every forecast or intervention measures become useless.

All the activities developed in the disaster area were made according to the Defense Against Flooding plans. 5 bank protection and 11 dykes were affected by the flood with a total value of 237 500 €.

1.6 Population behaviour

Population responds promptly to the warnings of evacuation issued by local authorities. 30 peoples were evacuated and moved temporarily to relatives that were not hit the calamity.

1.7 Flood damages

There were no deceased people during the flood from 7-8 August 2002.

From the material damage point of view: 105 farms, 90 houses and 144 household annexes (63 totally destroyed) were affected with a total value of 50 000 €. 5 pigs and 415 poultry were dead (6 500 €). 2 bridges, 20 km of roads were totally destroyed, 8 rustic bridges (4 totally destroyed), 1 school and 1 dispensary were affected. The total amount of material lost was 292 500 €.

1.8 The removal of flood damages

District and Local Defense Commissions work together to unblock the roads, to rebuild the telephone, electric and water supply networks. Also, a set of post-flood measures was taken: immediate help, insurance payment.

1.9 Flood protection measures adopted (post flood)

Post-flood measures adopted in this case were those regarding structural and non-structural ones.

From the structural measures we can enumerate: bank works and conservation of the slopes, afforestation, rehabilitation of the river course, in urban areas works for retaining the water and delay the peak of the flood, cleaning the river bed and ditches, dams and concrete walls, interventions for releasing the falling trees and the alluvia from roads and railroads.

Regarding non-structural measures we can enumerate: hydrological warnings and forecasts based on the development of operational hydro-meteorological information systems, planning and management of the territory, elaboration of risk maps, forbidden the location of new buildings in the flooding area, economical instruments such as insurance of goods.

2. Vişeu river – Bistra gauging station 03-07.03.2001

2.1 Characteristics of the catchment

Viseu river basin is situated in the north of the country, had a total surface of 1581 km^2 and is distributed between two big relief units: 67% mountains and 33% hills. Mountain area is represented by Maramures mountains in east, Rodna mountains in the south and Viseului hills in west.

Viseu river spring from Rodnei mountains and after 82 km length flows into Tisa river. The medium altitude of the river basin is 1581 km^2. The Viseu River is made by the confluence of the Cisla and Borsa river have a medium slope of 15‰ and a sinuosity coefficient of 1.31. The forestation area is 890 km^2 that represents 56% of the total area of the basin.

Morphologically slopes that are pointed to the west characterize the high area. These slopes are obstacles for the wet air masses that get an ascensional movement followed by condensation and considerable amount of precipitation. The Viseu hills have aspects of high but contracted acme strongly eroded and fragmentized. Are made by sedimentary permeable and friable deposits, with high capacity of infiltration.

Climatically the high area is characterized by medium amount of precipitation of 1000-1400 mm and medium temperature of 2-6°C. In the hills area the medium temperature is 7°C, and medium quantity of precipitation 1000 mm.

Natural vegetation is characterized by spruce and beech forests in the mountains and durmast and deciduous forests as well as grass land were replaced by agriculture in the hill area.

In the mountain area the soils are acid brown with different degree of podzolition, with small porosity and permeability. In the hilly area the soils are marls and clays, podzolic type with low porosity and permeability, and sands and gravels with high permeability.

Along the river there are a lot of towns and villages situated very close to it and they are often flooded.

On Viseu river there are 4 gauging stations.

Regarding flood control measures, dykes and bank defense concretize these.

For the flood from 03-07 March 2001 the start and the finish of the “Defense State” took place in accordance to “Defense Plans Against Flood, Dangerous Meteorological Phenomena and Hydrotechnical Accident”. Through faxes and telephone calls the Local Commissions of Defense Against Floods were alerted against enter to defense headquarters.

2.2 Hydrometeorological aspects of the flood

From the hydrological point of view, the year 2001 was characterized by a flow slightly over the multiannual mean for most of the rivers in the west and north of the country. In the winter seasons, significant discharge increases, were mostly determined by the superposition of rainfalls, with a rapid snow cover melting, following the sudden rise of temperature. The most important discharges were recorded during the 3-7 March interval, on some of the most important rivers from the northern half of the country. The exceeding probability of the maximum discharge on Viseu river – Bistra gauging station (fig. 3) was 3% and its value was 886 m^3/s. The maximum level was 465 cm and the danger level was exceeded with 95 cm (fig. 4).

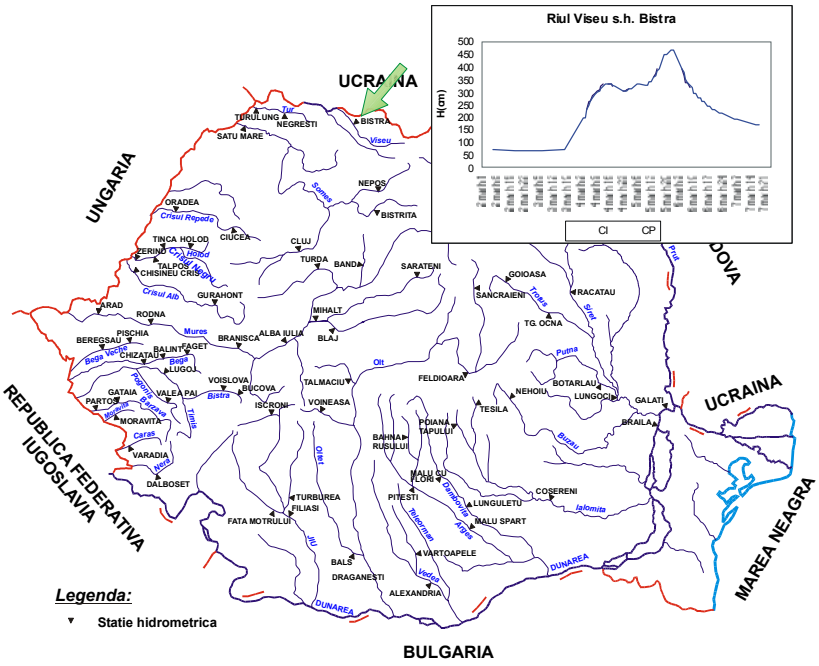
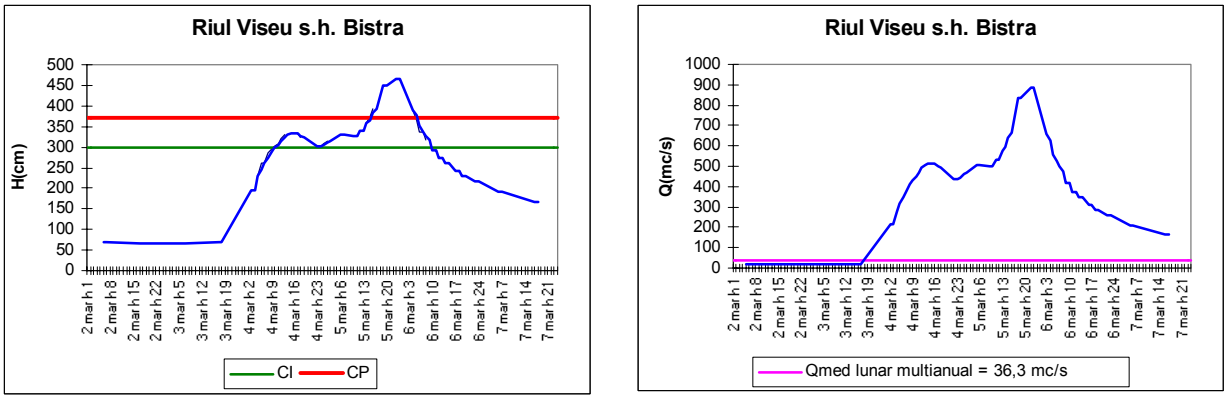


Fig 3. Localization of the Bistra gauging station.

Between 3 and 7 March 2001 the torrential rainfalls which in quantity were exceeding 150 l/m^2 and also because of the rise of the temperature up to 10°C, which cause a rapid melt of the snow cover, the maximum discharge exceeds the flooding level. The snow cover on 2 March 2001 had a height of about 29 cm and on 6 March 2001 the snow was completed melted. Also, the rise was strong because the soil was frozen into depth and so the runoff coefficients were augmented. The flood has a rapid and highly culminating discharge that caused devastating socio-economic effect al local level.



CI – flooding level

CP – danger level.

Fig 4. Flood on the interval 3 – 7 March 2001 on Viseu river, Bistra gauging station

2.3 Warning and rescue system

At the 01.March 2001 S. G. A. (Water Management System) Maramures received a hydrometeorological warning issued by National Institute of Hydrology and Water Management. From this warning result that the warming of the weather and the large amount of precipitation will produce floods. The "Alert State"

begins and the informational flux was established. On 03 March 2001 the levels of the water begins to rise, on 04 March the levels over passed the attention level and on 05 March begin to decrease. The levels recorded were the highest in the string of records data.

Local Commissions assisted by the border police, fire department, gendarmes, army subunits developed warning, evacuation, saving actions of the persons located from the flooding areas. High priority was gave to the localities affected, isolated. On the area of Bistra village there were taken also, pyrotechnical measures. The epidemiological and epizootic surveillance was established in the affected area.

2.4 Interaction with natural resources

From the point of view of interaction of the natural resources with flood a very big importance has the land use.

In almost entire Viseu river basin forest and agricultural areas can be found. The division into forest, arable land and meadows depends very much on the geological and morphological structure of the basin. Land use classes that can be found in the high mountains are mainly bare land and forest and in the low areas there are crops of different cereals like: corn, wheat, oat and grass land.

The main characteristic of this flood was the long duration in time (over 48 hours) and the recording to the gauging station of two peaks, one on 4 March and second on 5 March, the second one exceeding the danger level. This kind of floods brings mainly fine materials that are deposit in the major river bed when the speed of water decrease under the critical limit speed.

Also, because of the high humidity of the soil landslide occurred. In Bistra village 21 wells were affected by intrusion of hydrocarbon, nitrite, azote, etc. and 5 km^2 of arable land were flooded. The water washed out fertilizer deposits and the crops were compromised.

2.5 Flood control measures

On 28.02.2001, the District Commission emitted some measures regarding the actions and interventions for the Local Commissions and on 3.03.2001 a few crisis cells were established.

The entire defense against flooding works on the Viseu river are designed for a discharge with exceeding probability of 5%. The flood from 3-7 March 2001 had the exceeding probability of 3%, so the dams were overflowed. Some bank defense works were destroyed.

2.6 Population behavior

The siren that warned the population that a flood will occur in a very short period of time, begin to sound on 4th March. Immediately people begin to prepare for flooding and Local Commissions for Defense Against Flooding issued the evacuation order. All the people in danger were evacuated so no human lost were recorded.

2.7 Flood damages

No loses of life were recorded during the flood 3-7 March 2001, although the population understand the danger and conform to the indications given by the Local Commission for Defense Against Flooding, Police Department and Fire Department.

Material damages were:

- 8.15 km of bank defense – value 291 500 €;
- Houses: 74 partially destroyed (10 540 €), 1 totally destroyed (311 €);
- Household annexes: 60 partially destroyed (3 155 €), 1 totally destroyed (100 €);

- Animals: 1 (100 €);
- Water supply networks: 1 (Petrova town - 7 500 €)
- Wells: 83 (1 710 €);
- School: 1 (6 250 €);
- Bridges: 10 (440 000 €);
- Roads: 29 km (257 500 €)
- Arable land: 5 Km^2 (26 425 €).

2.8 The removal of flood damages

Intervention units that operated for minimizing and discard the flood effect and dangerous meteorological phenomena are:

- Local Defense Commissions;
- Civil Protection Inspectorate, Border Police Inspectorate – 181 military;
- Departmental Police Inspectorate – 150 military;
- Fire Department Group – 204 fire fighters;
- Departmental Gendarmerie Commandments – 55 military;
- National Defense Ministry - 40 military;
- Water Management System Maramures – 80 persons and 4 tip lorries;
- Commercial Society Roads and Bridges – 118 persons and 44 gears;
- National Roads Section: 18 persons and 9 gears;
- Electrica Commercial Society – 12 work teams;
- REMIN National Company – 3 intervention teams;
- Telecommunication – 6 intervention teams;
- VITAL Commercial Society – 2 intervention teams;
- DRUSAL Commercial Society – 3 intervention teams;
- Red Cross – food and clothes with a total value of 4 000 €.

All those above, work together to rebuild electric and telephone networks, to unblock the roads and remedy the flood effect, to repair the bank defense works and to explode the ice jams.

2.9 Flood protection measures adopted

The necessary flood protection measures for forewarning and avoiding the material damages and loses of life:

- Cleaning the snow from the roads, restore the electric, telephonic and water supply affected networks;
- Warning the tourists and the rural population about the danger of avalanches;
- Warning the population about the danger of falling the snow –pack from the roofs of the houses
- Cleaning the ditches, river beds, bridges and rustic bridges cross-sections to allow the water from the snow melt to flow;
- Assurance of the continuity at mairies, town halls, to allow the good function of the informational flux;
- Involvement of the Civil Protection Inspectorate to eliminate the ice-jams and strangulations on water courses;
- Permanent watching of the hydrological phenomena evolution and warning;
- Good communication between organisms, organizations and commissions involved in defense against flooding;
- Establishing of the areas that can be flooded in order to avoid flooding of some important objectives;
- New and big investments in defense works as: dams, dykes, bank defense, etc.
- Afforesment of the waste fields and torrents improvement works.

3. Crisul Alb river – Gurahont gauging station 6-11 April 2000

3.1 Characteristics of the catchment

Crisul Alb river basin is situated in the east of the country and has a surface of 4240 km^2. The most part of the basin is situated at the contact area of four massifs of Apuseni Carpathians and wetted by the main course with a length of 234 km. Crisul Alb river springs from the east of Bihor Mountains at an altitude of 980 m.

The upper course of the river is situated in the mountains (in the Criscior section) with a short length (about 32 km), is oriented from north to east and is characterized by a medium slope of 9-25‰. The hydrographical network is relatively dense (density coefficient is 0.8-1.2 km/km^2) and is characterized by high discharges due to high quantity of rainfall and runoff speed.

The medium course of the river has a length of 100 km and the medium slope is 1.2‰. The sequence of tectonical depressions spreaded over this section of the river produces a lot of meanders, this area being favorable to flooding.

The inferior course has a length of 100 km and has low slopes, 0.7‰ at Chisineu Cris and 0.3‰ downstream. In this area there is always danger of flooding and this is the reason for what here there are dams for the protection of agricultural area, drain channels for excess water.

Climatically in the Crisul Alb river basin is a panonic climate, characterized by a mixture of a lot of influences: mediterranean, baltic, continental with a big quantity of rainfall uniform distributed all over the year with medium temperature of 10°C. During the winter we can have sudden raise of the temperature – snowmelt combined with a large amount of precipitation that can cause severe flooding.

The forestation degree is only 30% and this low value is the main cause of the flooding.

Along the river there are a lot of towns and villages situated very close to it and they are often flooded, many people being affected.

The flooding frequency in the Crisul Alb river basin is very high, the river level over passing the flooding level every three or four years.

The hydrological network of the Crisul Alb river basin contains 30 gauging stations, 6 of them situated on the main course of the river. There is a future project to install 15 automatic gauging stations.

In the Crisul Alb river basin there are a lot of dam systems with a total length of 139.93 km that protect a surface of 534 km^2 and 2 reservoirs Chier on the river Dudita and Taut on the river Cigher both of them for water supply, flood control and irrigation.
Hydrometeorological aspects of the flood

Year 2000 was characterized by two intervals each one of it having with distinct hydro meteorological phenomena. First four months of the year occur with important floodings, determined by both snowmelt due to positive temperatures and heavy rainfalls.

An important and destructive flood occurred in April because of the rainfall from 3-6 April, but also because of the anterior precipitations that determined important increasing of the discharges with over passing the danger level with 141 cm at Gurahont gauging station on the Crisul Alb river (fig 5).

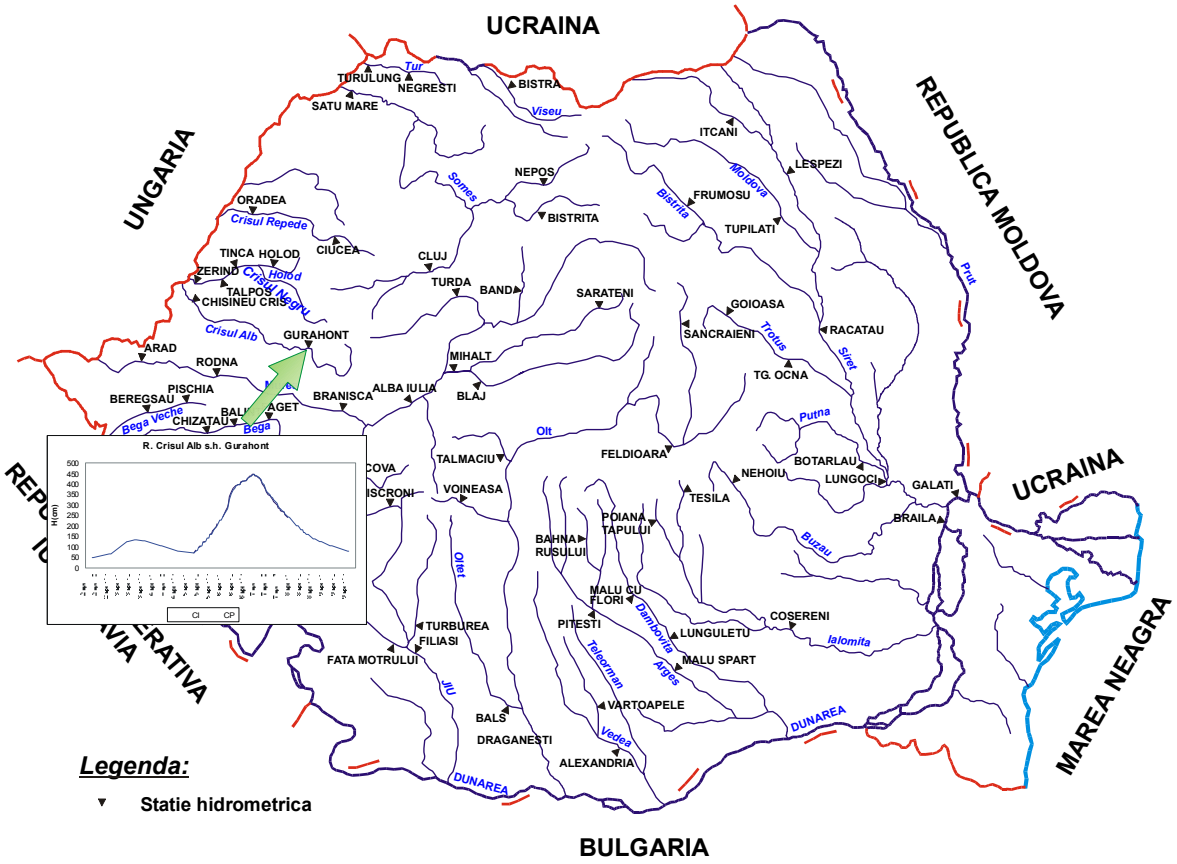
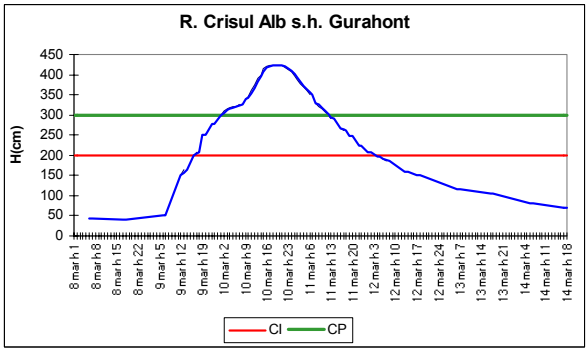
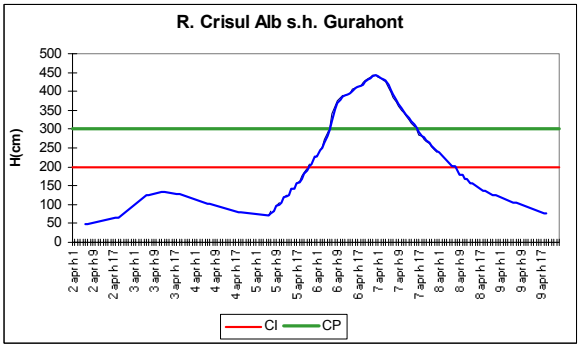


Fig 5. Localization of the Gurahont gauging station.



8-14 march 2000



6-11 april 2000

CI – flooding level
CP – danger level

Fig 6. Floods on the intervals 8-14 march 2000 and 6 – 11 April 2000 on Crisul Alb river,

3.2 Gurahont gauging station

Maximum discharge recorded on the Crisul Alb by the hydrometric network of the river on april 2000 had the exceeding probability of 2% with the value of 586 m^3/s. The level of the water was 442 cm overpassing the danger level (fig 6). Because of these maximum discharges a break in the right shore dam of the River Crisul Alb was produced, 2 km downstream the confluence with the river Cigher. The width of the break (generated by the flow of the water) variated between 70 m at 7.04.200 – 17:00 h and 147 m

at 11.04.2000 – 6:00 h. The height of the wave which overflows the dam had a maximum value of 2.28 m at 7.04.200 – 24:00 h. The flooded area , from south-east to nord-west, was practicaly between Crisul Alb river and Crisul Negru river who flows to north until the border with Hungary.

3.3 Warning and rescue system

National Institute of Hydrology and Water Management send a warning regarding massive snow falls accompanied by strong wind to Departamental Commissions which forward the warning to the Local Commissions through the Warning Centers that belongs to the Civil Protection District Inspectorate. District and Local Commissions for Defense Against Flooding unblocked the roads, rebuilt the electrical and telephonic network, the water supply and save the people surprised by avalanches or isolated.
The forester with the native people from Gurahont saved 4 timber workers. The reservoirs situated in the river basin were depleted to control the eventual floods.

3.4 Interaction of the natural resources

In almost the entire Crisul Alb basin forest and agricultural areas can be found. The division into forest, arable land and meadows depends very much on the geological and morphological structure of the basin. Land use classes that can be found in the high mountains e.g. are mainly bare land and forest and in the plain different cereal crops and grass land. Due to the highly developed economic activities and the related good infrastructure the Crisul Alb basin is densely populated and a large amount of the population lives in the direct vicinity of the main rivers branches protected by dykes. The most densely populated areas are the Varsand, Chisineu Cris, Ineu, Sebis, Brad, etc. As real urban and industrialized areas Chisineu Cris, Ineu, Sebis should be mentioned.
The alpine rivers have large differences between low and peak flows. The big lakes in the Crisul Alb basin however damp the discharge fluctuations and function like natural compensation basins.

The flood from 6-11 April 2000 occurred because of the torrential character of the rainfall (big quantity of precipitation in a relatively short period of time) superposed to a snow-pack cover, 100 cm thickness, torrents and small transport capacity of the nonpermanent water courses. However in this case, 29 km^2 of arable land were affected and 80 wells were infected.

The solid runoff was very important and the maximum solid discharge was produced before the maximum discharge of the flood.

3.5 Flood control measures

During the period 6-11 April 2000 the dams on the Crişul Alb were affected, high levels of water produced overflow and breaches into the dam by areas: Brad, Ineu, Tipari-Sintea Mare. To allow the drainage of the big volume of water accumulated inside the dams, into the right bank of the dam of the Crisul Alb a breach was created with help of Hungary.

In other points, were the dams were in danger to be overflowed the works were focused on: over rising the dams, neutralizing the infiltrations in the body of the dam, combat the slope erosions and the griphons.

3.6 Population behaviour

A lot of people lost their houses in the disaster and many others were evacuated and moved to unflooded areas to relatives and friends. There been concentrated actions to help the population with food, mineral water, drugs, clothes, blankets, etc.

3.7 Flood damages

3 persons were deceased in the flooding from 6-11 April 2000 on Crişul Alb river.

The flood also affect: 336 houses, 176 house holding annexes, 29.07 km^2 of arable land, 144.9 km of roads, 102 bridges and rustic bridges, 11 socio-economic objectives, 39.1 km of rustic roads, 5.4 km of electric network, 0.4 km railroads, 60 hydrotechnical works, 67 dead animals.
The total value of the damages was 5 500 000 €.

3.8 removal of the flood damages

National Institute of Hydrology and Water Management issued a warning regarding over passed the levels on Crisul Alb river and other rivers situated in the north of the country. Local Commissions and District Commissions made plans for evacuate the endanger people, to stint as much as possible the devastating effect of the flood.

Because of the enormous economic values and the large amount of people in the basin that are directly endangered by the flood the Ministry of environment decided in the action plan on flood defense to improve the flood forecasting systems.

3.9 Flood protection measures

The main measures proposed in this case were:

- Adequate maintenance of the river beds (especially the non-permanent) in the cross sections of bridges, platforms, release of the tree trunks, waste materials, garbage deposits;
- Adequate maintenance of ditches, draining channels of rain water;
- Bigger transport capacity of the cross sections of bridges, platforms;
- Assurance of the continuity at town-halls to allow the warning and alert the population;
- Endow the Local Commissions for Defense Against Flooding with operative materials for intervention and establish some intervention teams;
- Torrents rectify and afforesment of the slopes;
- Set up works in the upper basins and on main tributaries;
- Better systematize of towns and villages, to avoid build-up the houses in the flooding area.

4. CONCLUSIONS

Floods occur very often in Romania making a lot of damages and a lot of human lost. Even this year many floods provoke tremendous catastrophic damages and many people lost in the disaster all they have. A lot of river beds were transformed after the occurrence of the floods in “rock rivers” because in just a few minutes, a hour the most, of heavy rainfalls some small springs transformed in big rivers full of huge stones, a few tones each, and swept all in their way: houses, annexes, roads, bridges, etc. 200 towns and villages from 17 counties were affected by the floods from last week, 5000 houses and household annexes being destroyed. Also, 381 bridges, 327 km of national roads became unusable.

Unfortunately the economic situation of Romania and the present context make that a single one house was insured in case of flooding.

It is very important to make the population understand that they can protect their self against flooding and they can diminish the damages by:

- not placing the houses and annexes in the flooded area;
- following exactly the directions issued by the responsible organisms for defense against flooding;
- be always prepared;
- insurance of the houses and annexes;
- stop to the defforesment and afforesment of the waste slopes;

Here are some pictures from the last week flooding:

Nehoiu River

Trotus river

Trotus river

Jiu river