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The analyse of the maximum runoff in Someşul Mic catchment area

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Abstract:
In the first part of the paper is characterized, catchment Somes Mic, from point of view the hydro morphological and morphometric.
Further, the paper presents the hydrologic analysis of maximum runoff in the Somesul Mic catchment area for 2005. Rainfall together with sudden melting of snow layer due to warming air temperatures led to a rapid increase of levels and flows at hydrometric stations from area analyzed.
Finally the paper presents the conclusions and some considerations on water resources management from catchment Somesul Mic.

Keywords: catchment area, rainfall, runoff, hydro morphological characteristic

1. INTRODUCTION

The hydrographical network of Someşul Mic River is part from Someş-Tisa catchment, located in NW part of a country. The total area of Someş – Tisa catchment area is of 22380 km², and the hydrographical network contains a number of 580 watercourses and is an average density of 0.35 km / km².

The Someşul Mic catchment has an area of 3773 km². On the mountainous surface, the area is of 1218 km², on the Northern Part represented of Cluj and Dej Hills the area is 1312 km², and in the Southern part of the catchment with Transylvania Plain, the surface is 1243 km².

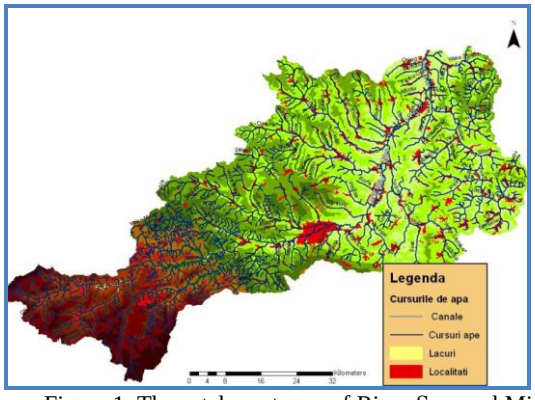

Figure 1. The catchment area of River Someşul Mic

The catchment area of River Somes Mic has an average altitude of 594 m, reflecting the uniform spatial distribution of the three major landforms of the area analysed: Apuseni Mountains, Cluj and Dej Hills, respectively Transylvania Plain.

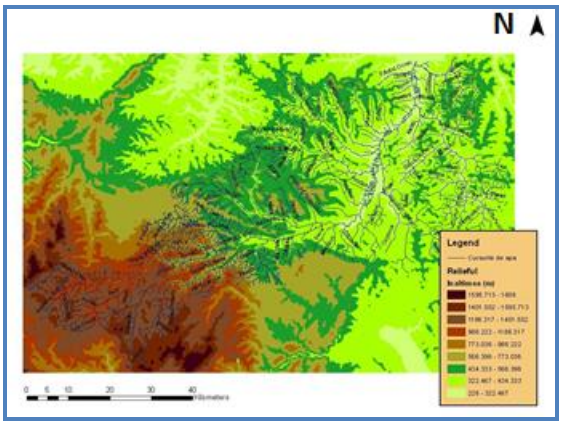

Figure 2. The synoptic map of Someşul Mic catchment

The main water reserve of the catchment area of Someşul Mic River is due to the development in two phases of some important hydro technical arrangements in the superior part of the basin.

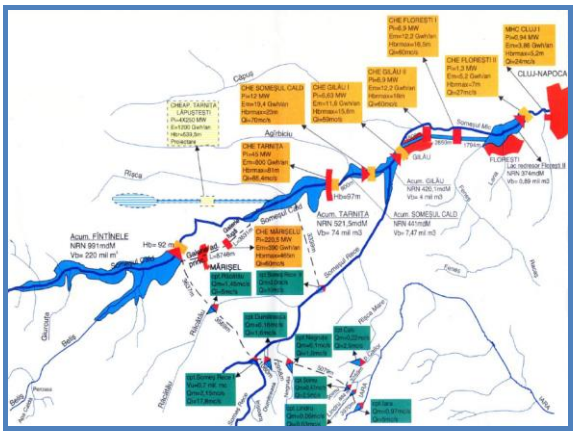

Figure 3. The scheme of arrangement of the superior catchment area of River Someşul Mic

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In the first period (1968-1980) there have been three reservoirs realized such as: Gilău, Tarnița and Fântânele, then later in the second period (1980-1990) several catchements and derivations have been given in use, but also the Someşul Cald reservoir.

The dam from Fântânele reservoir it's a heavy dam, which has on the upstream side a concrete mask and the height of dam is 92 meters. The lake formed behind the dam stores a 225 mil. m³ volume and has an area of 826 hectares.

Fântânele storage was realized in order to upper regularization of discharge water from hydrographical basins: Someşul Cald, Someşul Rece and Iara, in order to produce electricity through CHE Mărişelu hydroelectric power plant and also to mitigate flooding waves. The multiannual average water discharge of the lake is 12,68 m³/s.

For water supply in Fântânele reservoir and in other reservoirs from the upper basin of Someşul Cald river and Someşul Mic river, some catchments and derivations were build in the Someşul Rece river basin (Dumitreasa, Negruța and Răcătău) and in the Iara Superioară (Iara, Lindrul, Șoimul and Calul).

The main axis is Iara-Fântânele, the water transfer of this catchments system has a total length of 21 km of which: 4,7 km length between Iara and Șoimul, 4,9 km length between Șoimul and Negruța, 4 km length between Negruța and Someşul Rece I, 3,7 km length between Someşul Rece I and Răcătău and 3,7 km length between Răcătău and Fântânele reservoir [2].

The dam from Tarnița storage is situated on the Someşul Cald river, has a height of 97 m and behind the dam water was accumulated which formed a lake with a volume of 74 mil. m³ from which 13,79 mil. m³ is useful water capacity.

This reservoir is useful for: annual regularization of water discharge, production of electricity, ensuring the necessary minimum water discharge of 0,9 m^3/s in Gilău I section and 6,0 m^3/s downstream of the Floreşti II dam, mitigating the flooding waves and supplying water in the basin. The multiannual average of water discharge from Tarnița storage is 14,99 m³/s, which is part from the multiannual average discharge of Someşul Cald river in Tarnița dam section (8,32 m³/s).

The Someşul Cald dam fall into the heavy dams category, which has a height of 34 m and behind it a lake was formed, which has a surface of 78 ha and a volume about 7,47 mil. m³. This reservoir was realized in order to: produce electricity, recovery the flows resulting from CHE Tarnița hydroelectric power plant, take out an insurance against flood, supply the water in the basin and so on. Also this lake is used for tourism and recreational purposes.

The Gilău dam belongs to a special type of dams because in the central part it has a concrete structure (divided into 9 parts) which continues on the right bank with a dam consist from local materials with a concrete core and on the left bank with a close dike. The height of dam is 23 m, the area of the lake is 37,8 ha and the volume of water is 4,2 mil. m³.

The purposes of achievement of this reservoir are: flood prevention, flooding wave's mitigation, electricity generation, recovering flows resulted from CHE Someşul Cald hydroelectric power plant and feeding water from the basin.

2. THE HYDRO-METEOROLOGICAL CHARACTERISTICS

It makes an analysis of the maximum runoff for 2005, using measured data from 13 the gauging sites from the drainage basin of the River Someşul Mic.

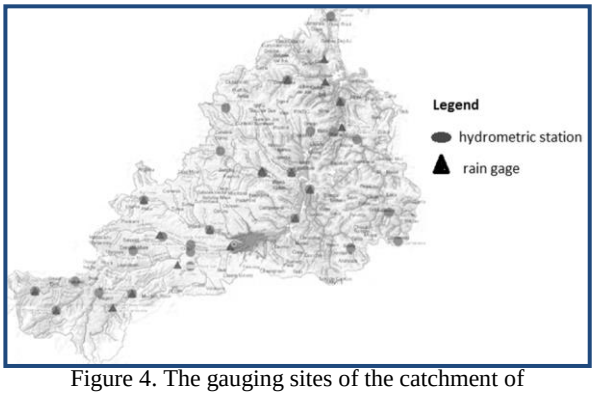

Figure 4. The gauging sites of the catchment of River Someşul Mic

Knowing the genesis and mechanisms for flood give us the possibility of preventing and fighting the damaging effects that they may cause.

The flood from hydrographical basin of the Someşul Mic River produced in 15-22 March 2005 due to the sudden melting of the snow layer which had a considerable thickness (135 cm at Smida hydrometric station, 100 cm at Poiana Horea, 50 cm at Dangaul Mare and almost 20 cm in other places from the basin). [5]

As we can observe in the figures below the amounts of rainfall were significant and over them overlapped sudden melting of existing snow layer.

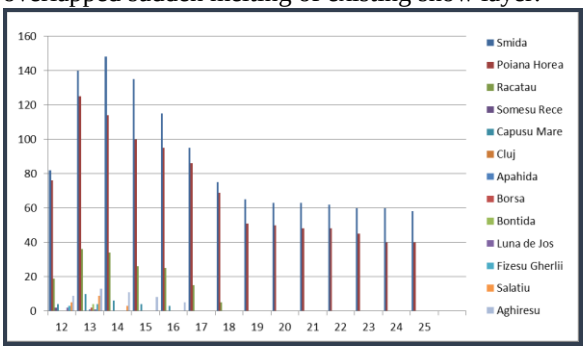

Figure 5. The snow layer in centimetre

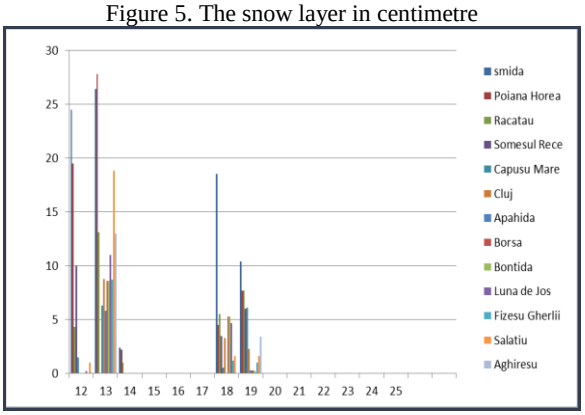

Figure 6. The raifall amount in liters / sqm

3. RESULTS AND CONCLUSIONS

Rainfall together with sudden melting of snow layer due to warming air temperatures (fig. 7-8) under the influence of warm and humid air masses of Mediteranean origin led to a rapid increase of levels and flows at hydrometric stations from area analyzed.

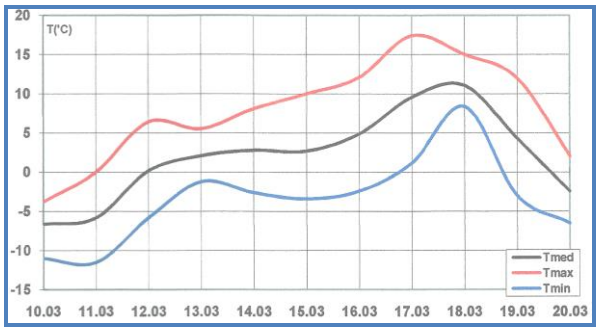

Figure 7. The air temperature at Cluj station

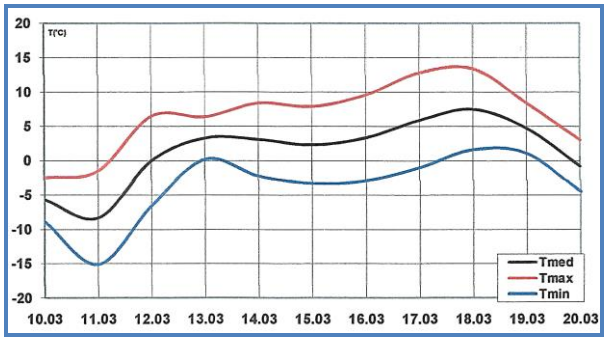

Figure 8. The air temperature at Dej station

Most of the water reserve was quickly conceded and it was driven by runoff, which led to increased levels and flows of water on streams from the lower basins.

The average of flow layer have recorded values between 13 mm at Aghireşu hydrometric station and almost 32 mm at Căpuşu Mare station. The values of runoff coefficients and flow layer fit into allowable limits and close to normal values of these parameters from hydrographical basin.

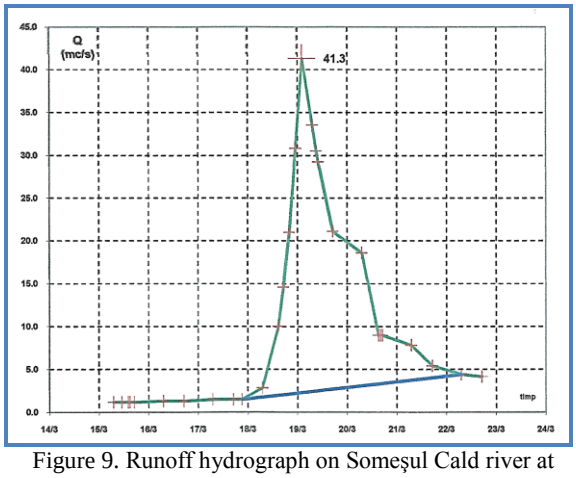

Figure 9. Runoff hydrograph on Someşul Cald river at Smida station

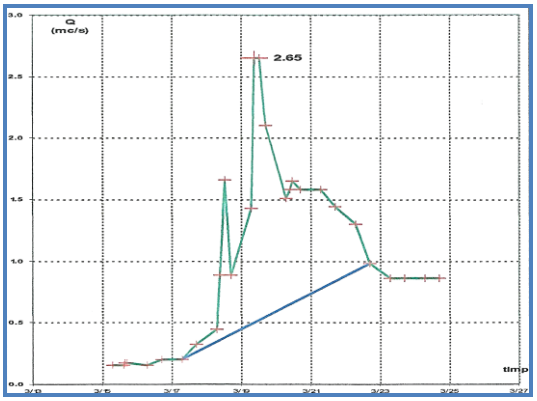

Figure 10. Runoff hydrograph on Răcătău river

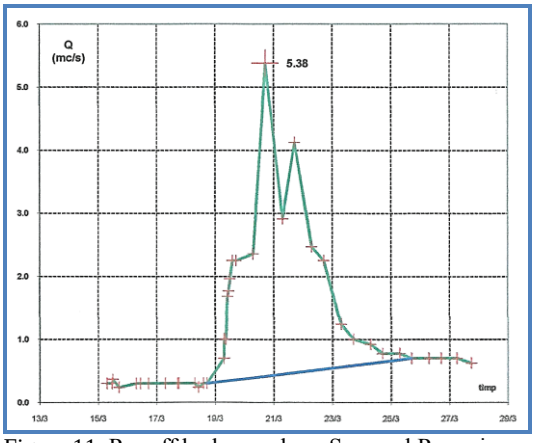

Figure 11. Runoff hydrograph on Someşul Rece river

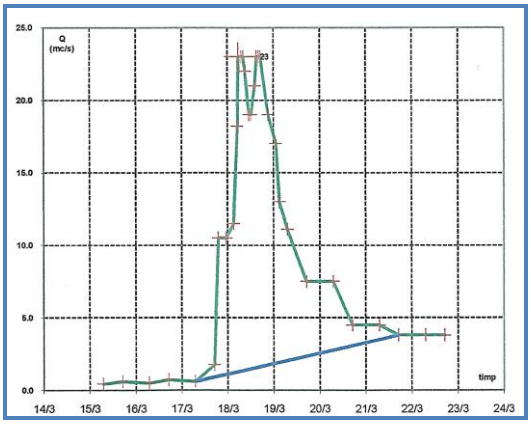

Figure 12. Runoff hydrograph on Căpuş river at Căpuşu Mare hydrometric station

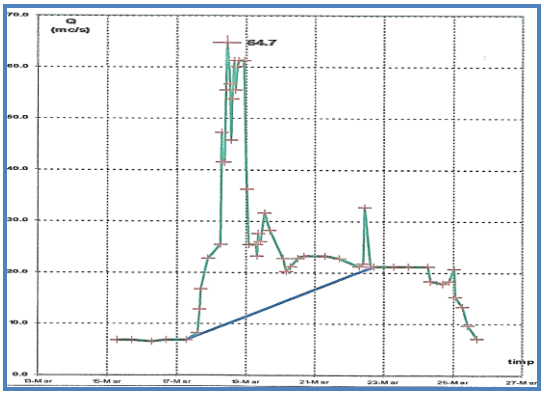

Figure 13. Runoff hydrograph on Someşul Mic river at Cluj-Napoca hydrometric station

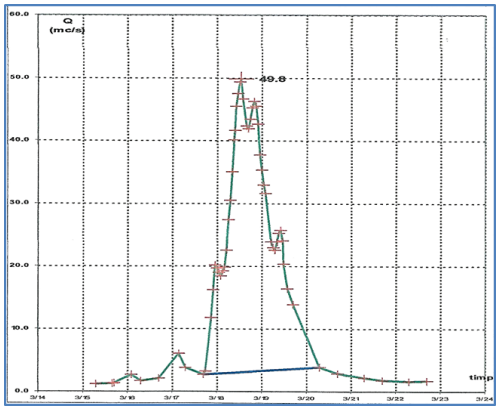

Figure 14. Runoff hydrograph on Lonea river

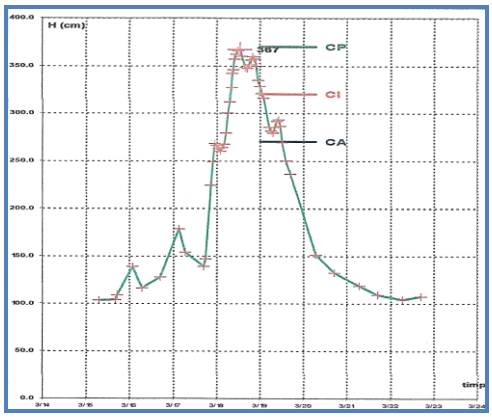

Figure 15. Level water hydrograph on Lonea river at Luna de Jos hydrometric station

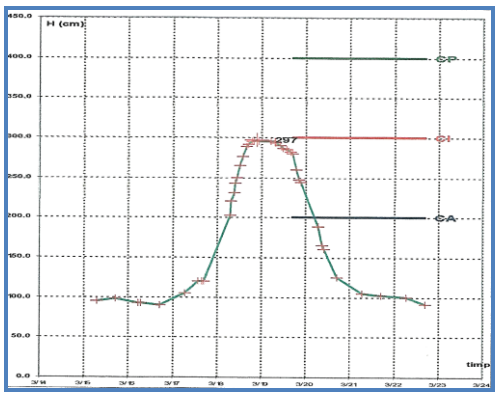

Figure 16. Level water hydrograph on Someşul Mic river at Salatiu station

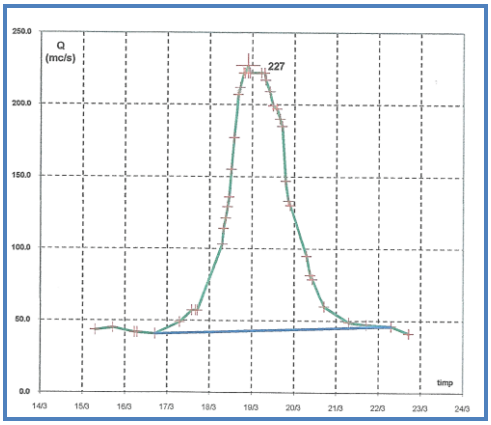

Figure 17. Runoff hydrograph on Someşul Mic river at Salatiu station

We can observe that medium layer of basin runoff was heigher than the layer of precipitation, resulting that formation of the flood was largely caused to the existing water reserve in the snow layer.

Peaks of level water were recorded on 18 March 2005 due to natural propagation process of flood wave resulted from the melting of snow from the previous day. Increased flow and water levels on rivers from Someşul Mic hydrographical basin occurred and due to rainfall which fell and led to accelerate the formation of the flood wave.

The flood of 2005 produced in Someşul Mic hydrographical basin was mainly nival type with two evolutionary stages:

- in first stage (15-17 March) a slight increase of water levels and water flows has been produced due to gradual melting of snow layer;
- in the second stage water levels with an accelerated rate have been increased because of the sudden rise in air temperature but also due to increased rainfall.

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