TIMIŞ RIVER FLOODING IN BANAT (ROMANIA) IN 2005

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ABSTRACT

Flooding that occurs in the Banat basin is a natural and frequent phenomenon on the water courses in this catchment area, where 1,085 km of the water courses are dammed and there are also numerous hydrotechnical and water management works. Although these works are well made and are intended to protect against floods, a review of these natural phenomena occurring in Banat highlights the fact that over a period of approximately 250 years, major flooding has occurred with a frequency of about once every 30 years, and in some cases these phenomena occur every few years, for example the floods of 2005 which occurred just five years after the floods of 2000. In almost every month in 2005 (February-September), throughout Romania, river water volumes exceeded the capacity that water defences were built to handle. The most important floods in Banat occurred in April. In April 2005 heavy rains were recorded in the Banat region: Oraviţa (226.4 mm), Resiţa (205.3 mm), Lugoj (201.2 mm), Caransebeş (200.6 mm). These rain falls exceeded previously recorded maximum monthly levels. This rainfall combined with snow melt - the thickness of snow layers in the mountains at that time exceeded one meter (Ţarcu - 126 cm, Semenic - 26 cm) – led to historically significant flooding from April to September 2005, affecting extensive areas and resulting in casualties and significant property damage.

ZUSAMMENFASSUNG: Vom Timiş-Fluss im Jahr 2005 im Banat (Rumänien verursachte Überschwemmungen.

Die Überschwemmungen, die im Einzugsgebiet des Timiş-Flusses im Banat stattgefunden haben, stellen ein häufig auftretendes, natürliches Phänomen an den Fließgewässern dieses hydrographischen Raumes dar, in dem 1085 km von Wasserläufen eingedeicht und zahlreiche wasserbauliche sowie wasserwirtschaftliche Maßnahmen durchgeführt wurden.Obwohl diese Arbeiten sachgemäß durchgeführt wurden und den Zielen des Hochwasserschutzes dienen, zeigt die Analyse dieser natürlichen, im Banat stattgefundenen Ereignisse, dass sich die Jährlichkeit der außergewöhnlichen Hochwässer von einem 250 jährlichen Hochwasser auf einen Zeitraum von 30 Jahren reduziert hat. Es gibt Fälle, in denen sich derartige Ereignisse auch im Zeitraum von einigen Jahren wiederholen, so wie es das Hochwasser von 2005 zeigte, das nach nur fünf Jahren auf jenes von 2000 folgte. Fast in jedem Monat des Jahres 2005 (Februar - September) wurden die Wasserstände der Sicherheitsbemessung für Hochwässer im Lande überschritten, wobei die größten Hochwässer im Banat im April gemessen wurden.

Die für das Banat heftigsten Regenfälle des Jahres 2005 wurden im April an folgenden meteorologischen Stationen registriert: Oraviţa (226,4 mm), Reşiţa (205,3 mm), Lugoj (201,2 mm), Caransebeş (200,6 mm). Sie überschritten den bis dahin monatlich gemessenen Höchststand. Die Regenfälle überlagerten sich mit der Schneeschmelze in den Gebirgen, wobei die Mächtigkeit der Schneedecke auch über 1 Meter Höhe lag (Ţarcu -126 cm, Semenic - 26 cm). Die im Zeitraum April bis September 2005 registrierten Überschwemmungen waren dann von besonderer Bedeutung, wenn sie an fast allen Flüssen auftraten. Dabei erreichten einige unter ihnen auch historische Abflüsse, die große Flächen erfassten und zu Opfern sowie einem beträchtlichen materiellen Schaden führten.

REZUMAT: Inundaţii în Banat (România), datorate râului Timiş în 2005.

Inundaţiile care au avut loc în bazinul Banat constituie un fenomen natural frecvent pe cursurile de râu din acest spaţiu hidrografic, unde sunt 1.085 km de curs de râu, care sunt îndiguiţi, precum şi numeroase lucrări hidrotehnice şi de gospodărire a apei. Deşi aceste lucrări sunt bine realizate şi au ca scop apărarea împotriva inundaţiilor, o analiză a acestor fenomene naturale petrecute în Banat, scot în evidenţă faptul că pe un interval de aproximativ 250 ani, periodicitatea acestor inundaţii majore este de circa 30 ani, existând şi cazuri când aceste fenomene se produc la intervale de numai câţiva ani, cum este şi exemplul inundaţiilor din 2005 petrecute la doar cinci ani după cele din 2000. Aproape în toate lunile anului 2005 (februarie-septembrie) s-au produs depăşiri ale cotelor de apărare pe cursurile de apă din ţară, cele mai importante inundaţii înregistrate în Banat au fost în luna aprilie.

Ploile torenţiale căzute în 2005, în Banat, în aprilie au fost înregistrate la staţiile meteorologice: Oravița (226,4 mm), Reşiţa (205,3 mm), Lugoj (201,2 mm), Caransebeş (200,6 mm) au depăşit nivelul maxim lunar înregistrat. Aceste precipitaţii combinate cu topirea stratului de zăpadă existent în munți cu grosimea de peste un metru (Țarcu -126 cm, Semenic - 26 cm), inundaţiile înregistrate în perioada aprilie-septembrie 2005 au fost cele mai importante, când au avut loc pe cele mai multe râuri, unele cu debite istorice, afectând arii extinse şi au dus la victime şi pagube materiale deosebit de importante.

INTRODUCTION

Floods are natural and recurring events in rivers and streams. Floods are usually described in terms of their statistical frequency, such as a "100-year flood" or "100-year floodplain" describes an event or an area subject to a 1% probability of a certain flood occurring in any given year. The frequency of flood depends on the climate, the material that makes up the banks of the waterway, and the channel slope. When substantial rainfall occurs in a particular season each year, or where the annual flood is derived principally from snowmelt, the floodplain may be inundated nearly every year, even along large streams with very small channel slopes. In regions without extended periods of below-freezing temperatures floods usually occur in the season with the highest precipitation (USA Agency, 1991), (Balica, 2007).

In 2005 Banat rivers had the highest recorded water levels of all the existing observations of most hydrometrical stations in the region, prompting additional discharge at dams on the Timiş and Bârzava rivers downstream of Lugoj in Gătaia. The Bega River and the Timiş River, which are united by a hydraulic node transition because of the Topolovăţ flood, had the highest volume recorded during observations in 2005.

During almost all months of 2005 water levels exceeded the capacity of flood mitigation defenses along waterways. During the major flooding period between April to September 2005 there were significant floods on most rivers, some with water rising to historical levels and causing property damage and loss of life. Although in the past 40-50 years there have been significant flooding events - though never as large as a 100-year event - flood-level water flows have not occurred over such an extended period of time, February to September 2005 in this case. Other flood events, such as those in 1970 and 1975, were concentrated in much smaller geographic areas than the 2005 flood event (Nichita et al., 2005).

RESULTS AND DISCUSSIONS

Timiş River geography and characteristics

The Timiş River (Figs. 1 a and 1 b), the main hydrographical artery in the western part of Romania, springs from the Semenic Mountains at an altitude of approximately 1,135 m. The Timiş River also collects runoff waters and snowmelt from the slopes of the Banat Mountains, the Ţarcu Mountains, the Godeanu Mountains and the Poiana Ruscă Mountains, as well as the Piedmont Hills of Lugoj and Pogăniş. These runoff areas create a hydrographical basin of 5,795 km² of surface area (Arba et al., 2013).

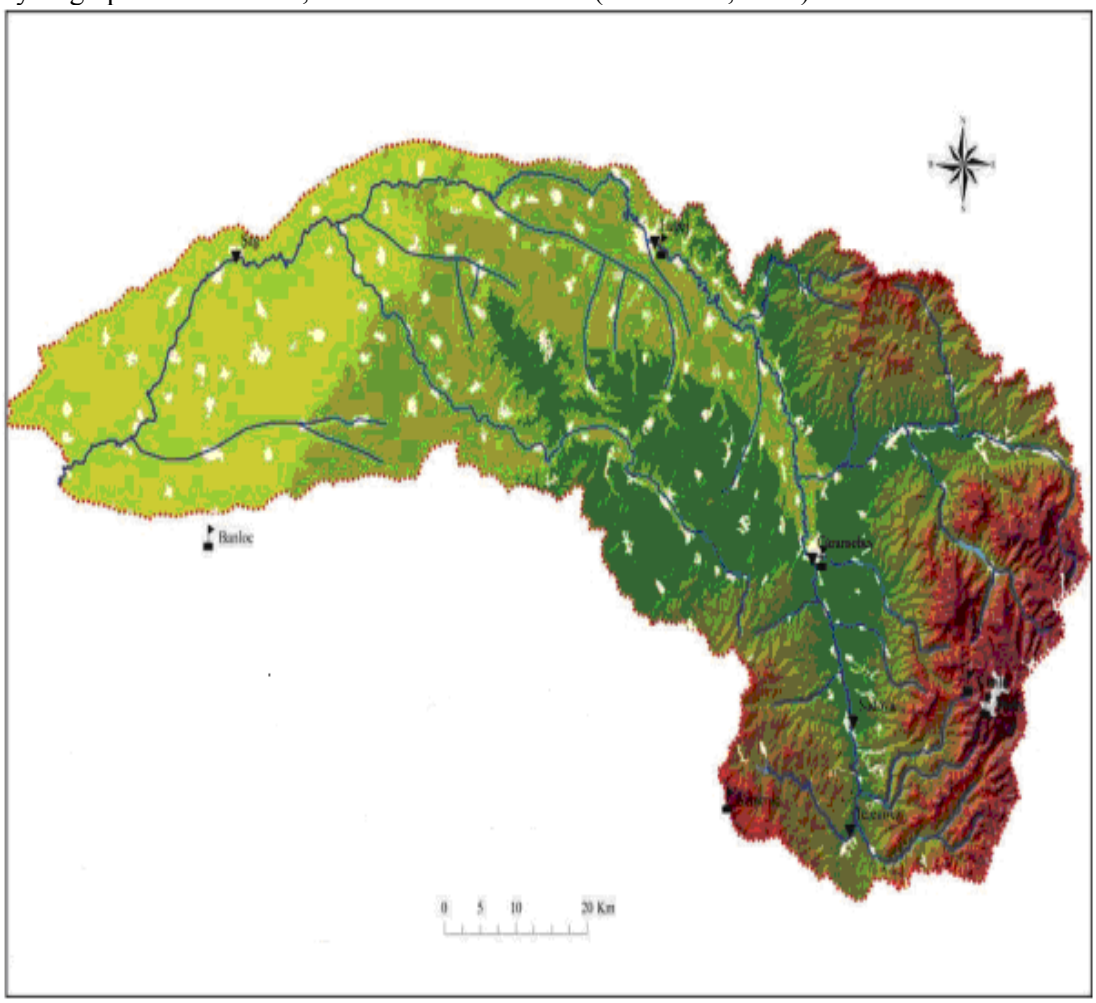

Figure 1a: The map of the hydrographical basin of Timiş River.

Figure 1b: The map of the hydrographical basin of Timiş River.

The Timiş River is the largest waterway in the Banat hydrographic area with a watershed basin area of 10,352 km², 5,795 km² of which is in Romania. With a total length of about 340 km, nearly three quarters (244 km) of the Timiş is in Romania. About 970 km of the Banat basin is divided with 824 km on the Timiş River, and 146 km on the Bega River in the area where the Timiş and Bega interconnect (Fig. 2).

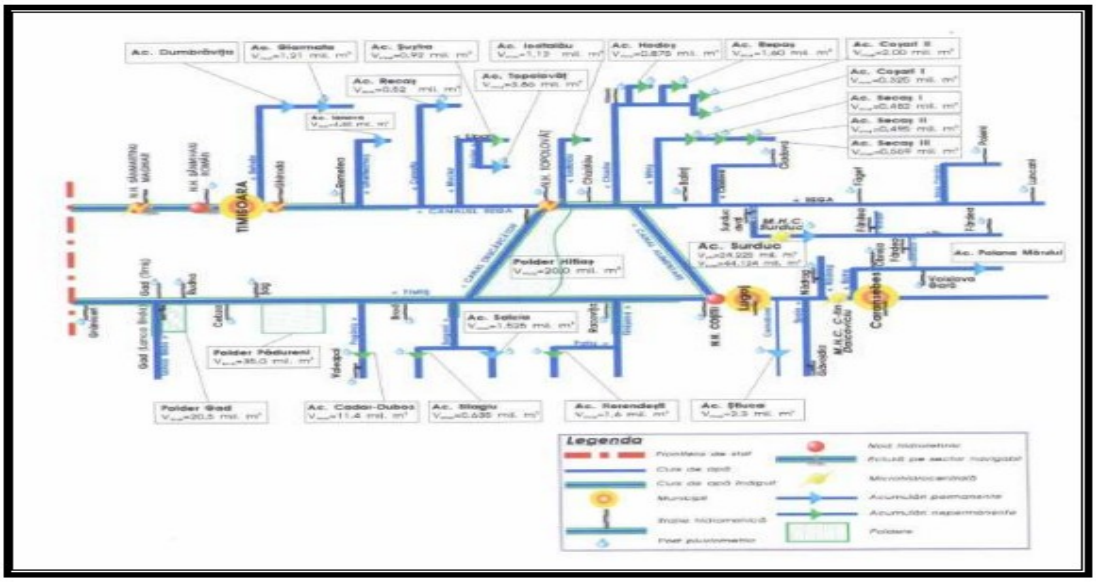

Figure 2: Bega-Timiş Interconnection (Banat Water Directorate, Romania).

The Timiş River is formed by the confluence of three rivers: the Semenic, the Grădiştei, and the Brebu. The Brebu Stream springs originate in a massif mountainous area in the north-eastern part of the Brebu watershed. After passing the man-made Trei Ape Lake, the Timiş River flows northwest to southeast through a narrow valley with slopes greater than 20 m/km. At the Teregova Depression between the Caransebeş and Mehadia Mountains the Timiş turns north. Here the slopes are a more moderate 5 m/km. In this part of the Timiş River the most notable waterways feeding into the Timiş are the Pârâul Rece, the Feneş, the Bolvaşniţa, the Sebeş, the Axin and especially the Bistra. After the Bistra the Timiş River again changes direction northwest to Lugoj. Contributing waterways along this stretch include the Măcicaş, the Vâna Ohaba, the Spaia, the Cernabora and the Nădrag, which is the largest. The lower course of Timiş River meanders through a wide valley with a low slope, crossing the Timiş Plain to leave the country at Grăniceri. The Grăniceri area is often threatened by flooding and consequently has many hydrotechnical works to handle this regular flooding. Finally, the Timiş River flows into the Danube in Serbia near the town Pancevo. (Udo et al., 2011)

HYDROLOGICAL AND METEOROLOGICAL CHARACTERIZATION

The year 2005 was characterized by a slightly lower average temperature across the country, specifically 0.1º C lower than temperatures in the reference period of 1961-1990. It is worth pointing out this near-normal average temperature for 2005 includes noteworthy positive temperature deviations between 0.2-2.4º C during six months of the year (January, May, July-September, December), and lower temperature values of 0.3-2.60º C in the remaining six months of the year (February-April, June, October, November). Throughout the country the average amount of rainfall was 866.5 mm in 2005 compared to a normal average rainfall of 647.0 mm. Precipitation was above average in January-May, July-September, and December but below average in June, October, and November. Overall, the average rainfall in 2005 was 33.9% percent higher than the average rainfall during the reference period (Ministry of Environment and Water Management, 2005).

In April 2005, precipitation values recorded at 12 meteorological stations in the Banat physiographic zone exceeded normal values, in some cases by 200 mm (Fig. 3). Most of these excessive rainfall amounts were recorded in three short intervals during the second half of April. Rainfall in May was concentrated in the southern part of the country with heavy and intense precipitation events exceeding normal amounts by 100 mm at many stations from the Romania river basins (Stănescu et al., 2006).

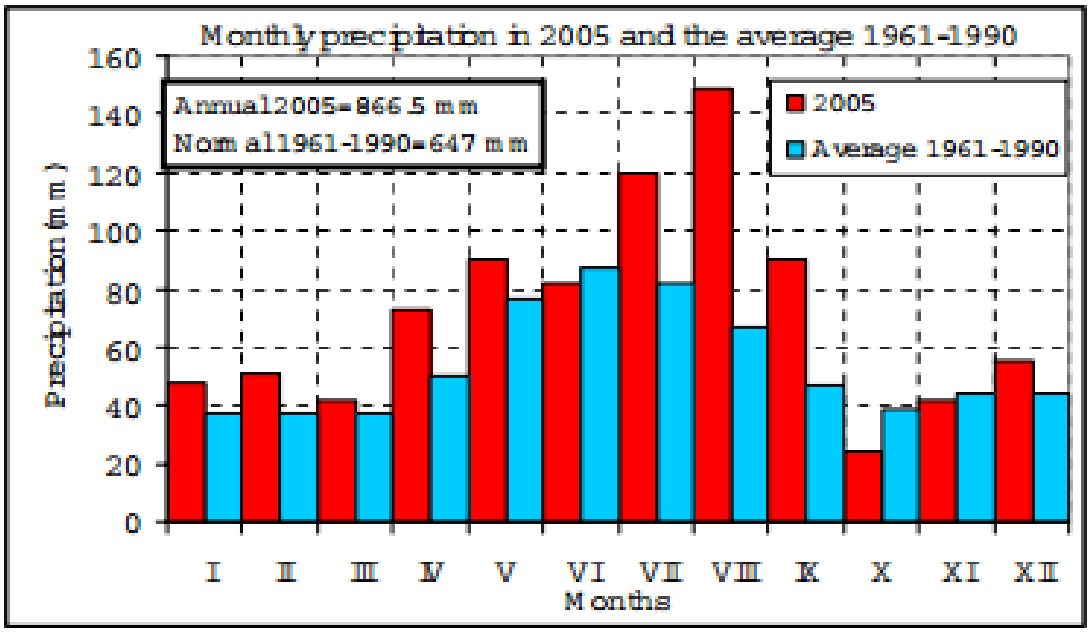

Figure 3: Monthly precipitation in 2005 and the normal amounts (after ANM-Romania).

To define hypothetical flood areas this analysis used hydrological data (levels and flows recorded at the hydrometric stations of Caransebeş and Lugoj) collected prior to 2005, which was a year with one of the fastest rising freshets and largest floods in the past few decades. In this analysis, waterways where streams were modified, altered, dammed, or otherwise regulated, were not taken into account. Only natural, unmodified floodplains of the Timiş River were analysed. From 2000 to 2005 there were no significant hydrological events recorded on the Timiş River, however, in April 2005 the Timiş River had a very large flood event, both in terms of effects on the environment, and in terms of the scale of physical damage, especially in the low plain of Banat. During the analysis period in the early 2000's the most important factor contributing to excessive water resources, and consequently to excessive water flows, was rainfall. The quantity of rainfall was also a determining factor in the impacts of water flows (Arba, 2010).

The flood of Timiş River basin in April 2005

In April 2005 temperatures across Romania were close to normal. Rainfall was above average in Maramureş, Crişana, Banat, Transylvania, Dobrogea, Muntenia and northern and central Moldova, while precipitation was nominally deficient in other areas. The greatest precipitation amounts (more than 200 mm) in April 2005 occurred in Oraviţa (226.4 mm), Resiţa (205.3 mm), Lugoj (201.2 mm), Caransebeş (200.6 mm), all localities in the Banat region. A handful of weather stations recorded highest-ever precipitation amounts for a 24-hour period: Resiţa (79.2 mm), Caransebeş (67.6 mm), Bozovici (66.4 mm), Timişoara (63.0 mm); (Ministry of Environment and Water Management, 2005).

The worst flooding of the last 35 years occurred in 2005, primarily due to high quantities of precipitation, which were generated by intense cyclonic air movement across the entire European continent. High air temperatures also helped set the stage for record flood conditions. Last, but not least, extreme water flows were augmented by sudden snow melts. The combination of these causes led to several successive record-level flash floods along the inferior course of the Timiş River. Water spilling over the dam canopy (Fig. 4a) at Crai Nou led to accelerated erosion and the formed two breaches around the dam on the right bank of Timiş River. (Stănescu et al., 2006)

Figure 4a: Effects of 2005 floods.

These historically high water flows led to flooding on river lands, which in turn led to flooding (Fig. 4b) around Crai Nou, and to a lesser extent at Rudna, Cruceni, Foeni, Ionel, Otelec and Sînmartinul Sârbesc. The effects of this record hydrological event were exacerbated by a transversal landfill on Serbian territory between the Timiş River and the Bega River. (Ministry of Environment and Water Management, 2005).

Damages produced by flood events in 2005

In 2005 flooding, spills, and damage to the dams and other water management improvements, small leaks on the slopes and other dangerous weather phenomena affected all Romanian counties and 1,734 localities with a total damage loss estimated at 5,975,201 RON. There were 76 deaths, 93,976 houses and ancillary buildings were damaged, 1,063 social and economic programs and objectives were impaired, and over 656,392 hectares of agricultural land were damaged. A total of 630 defensive hydrotechnical structures, mainly dikes and riverbank stabilization measures, were also badly damaged, necessitating immediate reconstruction work.

In the Banat area the total of damage loss in counties Caraş-Severin was 363,209 RON and in Timiş it was 406,069 RON. (Ministry of Environment and Water Management, 2005)

Figure 4b: Effects of 2005 floods.

CONCLUSIONS

Natural phenomena such as torrential rains that occur during the spring months, combined with snow melt, are very dangerous because of the physical and economic damage it can cause due to flooding, including loss of life. Flood conditions are a product not only of excessive water flows due to heavy rain, but a river's ability to adequately handle water volumes far in excess of normal. In low-lying areas or plains where river slope is relatively low (typically areas where people have built settlements) water-flow velocity tends to drop in relation to the hydrographical network upstream.

In order to mitigate the effects of record water flow events it is necessary to accurately forecast weather with enough time for water management authorities to take structural and non-structural measures in advance of any potentially destructive hydrological events.

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