

INTENSIVE PRECIPITATION AND FLOOD IN NORTHEASTERN BULGARIA ON 19 OF JUNE 2014

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ABSTRACT: Intensive precipitation and flood in northeastern Bulgaria on 19th of June 2014. On 19th of June 2014 heavy precipitation in northeastern Bulgaria were detected. In the cities of Varna and Dobrich floods and landslides on the roads were caused. There are casualties. Many people remain homeless. The present work aims to describe the events from the different points of view.

Keywords: northeastern Bulgaria, intensive precipitation, flood, cause

1. INTRODUCTION

Changes in many extreme weather and climate events have been observed since about 1950. There are likely more land regions where the number of heavy precipitation events has increased than where it has decreased (IPCC, 2014). Some of these changes have been linked to human influences and discharges in some catchments imply greater risks of flooding at regional scale.

Whether natural or social causes are the most important drivers for natural disasters has been discussed (Cannon 1993; Mileti 1999). Risk analysis and risk maps are often used to support actions for disaster risk reduction (Zerger 2002; Tesliuc and Lindert 2004; Sperling and Szekeley 2005; Fernandez and Sanahuj 2012).

In Bulgaria at the end of the 20th century an increase in cases with torrential precipitation was found, especially in eastern Bulgaria and Black sea coast where the number of flood rain events has grown (Croitoru et al., 2013; Bocheva et al., 2014). As in many other countries, the effects of heavy rainfalls were exacerbated by the increased rates of deforestation, poorly maintained irrigation dams and culverts, as well as low penetration of insurance in rural areas where most of the damaged properties were located. Therefore studies should be directed to outline geographical areas exposed to natural hazards, to identify populations potentially threatened, and to prioritize areas where investments are needed.

The most significant flooding event in the recent years occurred in the summer of 2005, when torrential rains in the northern and western parts of the country caused the Yantra, Kamchiya, and Rusenski Lom rivers and their tributaries to overflow their banks. The wave of floods, which lasted from May to

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November, reached cataclysmic proportions, affecting more than 70 percent of the country and causing unprecedented economic losses. While it is difficult to precisely quantify the damages, various sources suggest that the direct losses were up to a half billion USD.

The last flood in northeastern Bulgaria was in Varna and Dobrich on 19th of June 2014. The day before, on the 18th of June, Forecast Department of the National Institute of Meteorology and Hydrology-branch Varna, in charge of eastern Bulgaria, at 13.30 local time, prepared a warning for expected intensive rainfall, thunderstorms and hail. The warning was sent to the population and to the main authorities: mayor, governor, fire and police departments. Despite of all that, there were many accidents: casualties and homelessness. That is why, in an effort to find the reasons for it, we describe the event from different points of view in this paper work.

2. METHODOLOGY

In this flood analysis study, data of precipitation sums for every 3 hours from meteorological stations Varna and Dobrich of the National Institute of Meteorology and Hydrology of Bulgaria was used. Synoptical maps from GFS models (<http://wetter3.de>), approximate soundings for Varna and Dobrich (<http://ready.arl.noaa.gov>) as well as satellite information are used. Hydrological analysis is made on the basis of different methods for calculation of the maximum flow. Calculation of important orographic parameters having a direct influence on the formation and flow of water was made as well.

3. RESULTS AND DISCUSSIONS

In the late afternoon on June 19th 2014 in Varna and Dobrich a flood was registered. This is the second biggest flood on the territory of northeastern Bulgaria since the beginning of 21st century after the flood of September 2005.

In Varna intensive rainfall and thunderstorms were detected between 18.00 and 20.00 local time, and in meteorological station about 35 mm were measured. In Dobrich the most intensive rainfall was between 21.30 and 24.00 local time with almost 43 mm total amount. The average precipitation sums for the climatological period 1961-1990 in northeastern Bulgaria are one of the smallest in the country as in Varna and Dobrich they reach a maximum during June and November (about 50 mm) and a minimum during August and September (no more of 30-32 mm).

Maps of the two gulches studied in Varna, which during the flood were overflowed, are presented in Fig.1. They are situated south-southwesterly of the meteorological station, and southerly of Varna Lake in a residential district "Asparuhovo". The average altitude varies between 126 and 131 meters. The soil is mostly gray forest soil and sandy loam. Afforestation of the gulches is mostly

deciduous forests, mixed forests, coniferous forests and natural vegetation (CORINE Land Cover 2006).

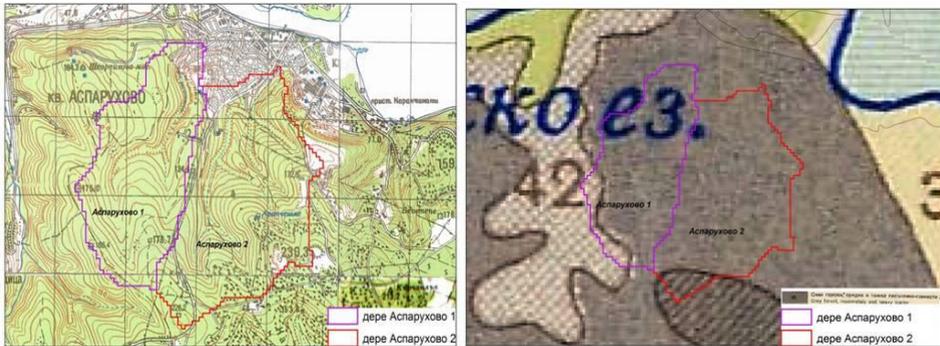


Fig. 1. Victim gulches in Varna residential district “Asparuhovo”, northeastern Bulgaria. On left - map of orography, on right – types of soil.

On Fig.2 the city river, infrastructure and flood map in Dobrich are presented. As it can be seen from the left panel, into so-called “Dobrich river” runs some streams. Along the river and some of its tributaries there are several small dams. The bed of the river and its tributaries are not well formed low shores, and these create conditions for filling of high waters.

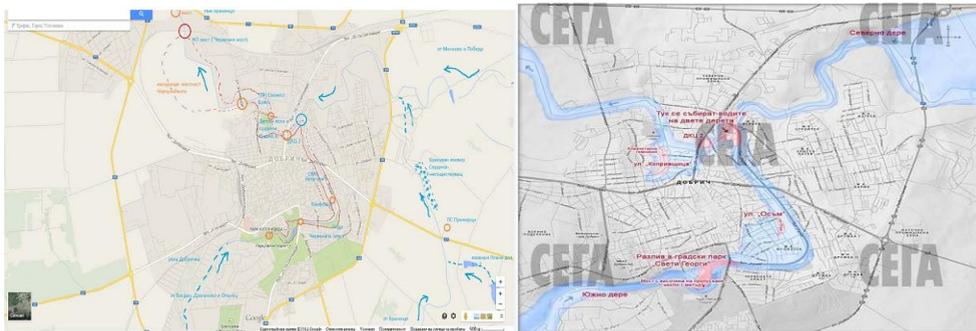


Fig. 2. Maps of infrastructure (left) and area of flood (right) in Dobrich, northeastern Bulgaria

The synoptically review of situation is characterized with a multicentered cyclonic area over Balkan Peninsula and eastern Mediterranean during the period 18-20th of June 2014. Existence of positive divergence (not shown), trough on upper-level and very high instability of atmosphere is a precondition for very strong convection (Fig.3). As a result, in many meteorological stations in eastern and northeastern Bulgaria, there are records of very intensive and torrential precipitations (Fig.4). Additionally, in this time the sea surface temperature (19-

24°C) was higher than the air temperature. Regarding the maps and soundings, it can be seen the moving of warm and humid air from the sea over the land and a formation of one meso-cyclone over eastern Bulgaria on 19th of June. That is way in many places in northeastern Bulgaria intensive precipitation and thunderstorms were detected.

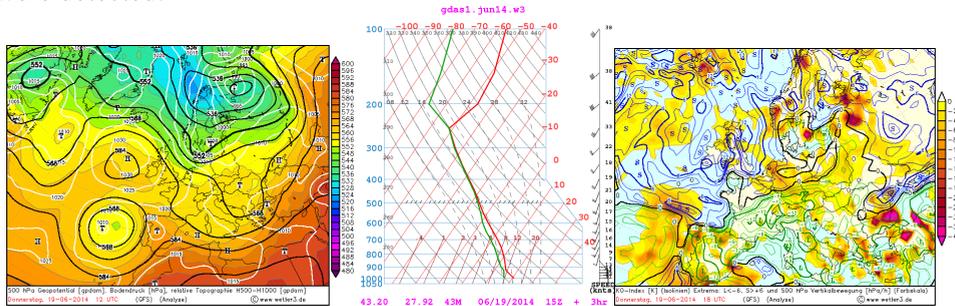


Fig. 3. GFS analyses on 19 June 2014: MSL pressure (white line) and geopotential at 500 hPa (black line) (left), 1200 UTC; Approximate soundings for Varna (Bulgaria) (middle), 1500 UTC; K0 instability index (right), 1800 UTC.

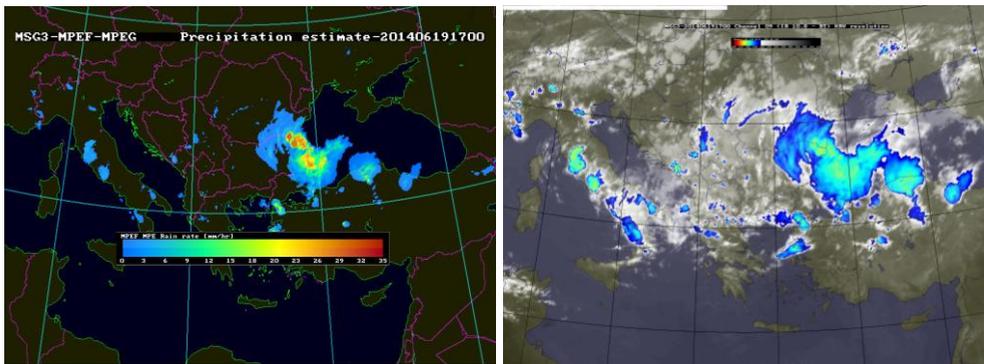


Fig. 4. MSG3 EUMETSAT-Precipitation estimate, 19.06.2014 17.00 UTC (left) and IR Satellite image with clouds temperature, 19.06.2015 17.00 UTC (right)

The maximum intensity of precipitation in Varna in the evening of June 19 reached 140 mm/h (Fig.5). In Dobrich data recording rain-gauge for the period 19.30 h - 19.06.2014 to 00.30 h - 20.06.2014 shows that the average precipitation intensity decreased from 0.96 mm/min to 0.23 mm/min. According to the definition of intensive precipitation (with physical intensity equal or more than 0.18 mm/min) it can conclude that this was very extreme event. Analyses of satellite information allow us to conclude that in the residential district “Asparuhovo” it is possible that the precipitation sums may exceed 50 mm (Fig.6).

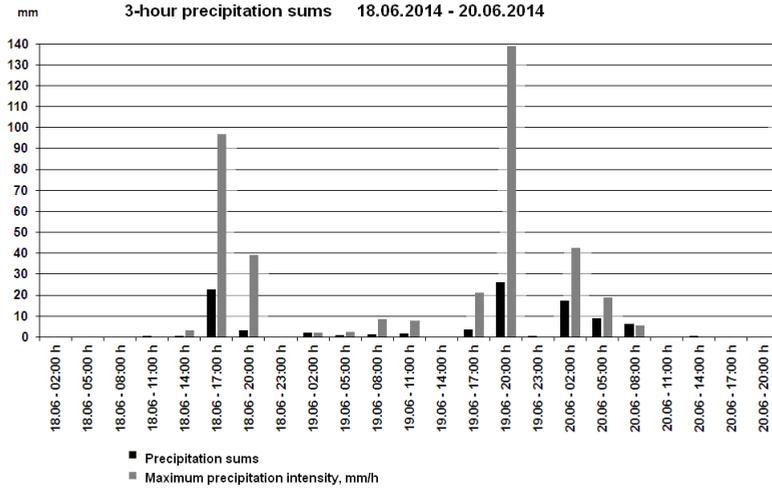


Fig. 5. 3-hour precipitation sums (black column) and rainfall intensity (green column) in Varna, Bulgaria, 18-20.06.2014

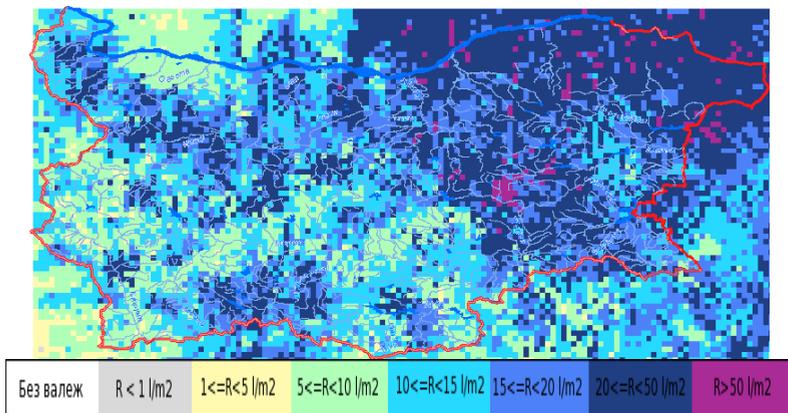


Fig. 6. Distribution of rainfall amount for 19.06.2014 using satellite information

It is very important to note that five days before the floods a slight cyclonic baric field prevailed over Southern Balkans and Mediterranean sea. The atmosphere as well was unstable and some occasional rainfalls were registered. In the end, on the period 14-20th of June 2014 total precipitation sums in Varna region reached in some places 200 mm, and in Dobrich region - 155 mm. Hydrological analyses show that the water quantities which passed through the gulches (on the basis of precipitation amount) during the most intensive rainfall (18-19 local time on 19.06.2014) reached 211391 m³, and on the basis of the cumulative (24 hour) daily rainfall (74.3 mm) respectively 618361 m³! As a result, in the lower parts of the area flow away large amounts of water and caused flooding and landslides on part of the road (Fig.7).



Fig. 7. The channel between Varna Lake and Varna Bay after the flood (left); Flooding in Dobrich (right).

4. CONCLUSIONS

According to the National Authorities and information published on the web-site of the European commission, during the floods in Varna and Dobrich regions, northeastern Bulgaria on June 19th 2014, the damages were: 14 fatalities, 1 person missing, several hundred people have been evacuated from their houses and accommodated in state facilities, several houses have been flooded and dozens of vehicles swept away.

During 2014, floods in Bulgaria were caused by heavy rainfall, calculated four times more intense than average. According to data from the European Parliament, the country has suffered damages for 311 million euros. In support are provided only 10.5 million euros.

Other parts of the country were subject to heavy rainfalls as well, but so far no one can answer the question “What led to this tragedy? ”. The biggest floods in Bulgaria are so-called rainy-river flooding type. But one of the reasons in studied event is that there are conditions for the formation of large water masses in the river valleys. In the flooded parts of the residential district “Asparuhovo” water from two small watersheds that surrounds the neighborhood was collected. These are two small rivers, which in recent years dried up. The registered rainfalls in the days before the flood are the reason for the surface layer to become moist. On 19th of June 2014 intensive precipitation rapidly formed a large amount of water masses and took away the surface soil layer. As a result, parts of the plant surface disappeared. Muddy sediments of sand and clay formed.

Another reason for these significant floods and significant increase in water level is obstructing of water flows from construction in the valleys and out of gulches, as it has been mentioned for years. In Dobrich region refuses (construction, household and natural materials) are also led to the complication and reducing of the capacity of the riverbed too.

Taking into account all this information, despite the fact that the population and the authorized institutions have been informed of the expected extreme phenomenon in advance, precautions obviously were not taken. How should

institutions operate during floods has been described in the Law on Disaster Management, as well as in the "National Programme for Disaster Protection 2014-2018", that was adopted by the Council of Ministers on 7 May-only a month and a half before the flood in Varna.

Recommendations after a disaster are made. But it is the responsibility of each of us to be more accountable.

ACKNOWLEDGEMENTS: The authors would like to thank all colleagues in Varna and Dobrich from Forecast, Meteorology and Hydrology Departments of NIMH, for their help in data analysis.

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