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Causes and consequences of catastrophic torrential floods in West Serbia in May 2014- a case study of Krupanj municipality

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Torrential floods represent the most frequent phenomenon within the category of natural hazards in Serbia. Representative examples are the torrential floods in Western Serbia, particularly in the municipality of Krupanj, which covers a territory of 342 km^2. Local watersheds received a three-day precipitation ranging from 180 to 420 mm, while the absolute daily maximal precipitation amounted to 218 mm. A few settlements were struck by floods on the local torrents on May 15th, 2014, causing death of two people, almost 900 hectares of arable land flooded or damaged by landslides, 333 flooded buildings (of which 40 severely damaged or destroyed), 120 km of destroyed or damaged roads, 14 destroyed and 8 damaged bridges, 5 km of destroyed river regulations and 300 evacuated inhabitants. In addition, 269 landslides were activated during the heavy precipitation and flood waves propagation. The estimated material damage amounted to more than 30 million €.

Hystorical maximal discharges (Qmaxh) were reconstructed by applying the method of ″hydraulics flood traces″. Computations of maximal discharges (Qmaxc) were calculated by applying the synthetic unit hydrograph theory and the SCS methodology, enriched with a regional analysis of lag time, internal daily distribution of precipitation and classification of soil hydrologic classes. Land use was analysed on the basis of field investigations, the use of aerial and satellite photo images, as well as topographic, geological and soil maps. The highest value of specific maximal discharge was registered in the Čadjavica torrent, qmaxČADJ-2014=6.10 m3/s/km2 (A=24.04 km2, total discharge QmaxČADJ-2014=146.6 m3/s); followed by Kržava, with qmaxKRŽ-2014=5.28 m3/s/km2 (A=12.69 km2, total discharge QmaxKRŽ-2014=67.0 m3/s) and Brštica, with qmaxBRŠT-2014=3.74 m3/s/km2 (A=9.54 km2, total discharge QmaxBRŠT-2014=35.7 m3/s). The width of the flood zone in the Čadjavica torrent riparian area varies from 83.4 m to 103.1 m, and the width of the flood zone in the riparian area of the Kržava torrent varies from 26.80 m to 83.60 m. A total quantity of 197.000 m3 of deposited bed load sediment was estimated. The common characteristics of presented torrential watersheds are: the steepness of river beds with an absolute slope of Ia=5.45-8.32%, huge parts of the watersheds under bare lands, degraded forests and agricultural land (51-55%), shallow, skeletal soil with small infiltration-retention capacity and intensive erosion processes.

Flood risk assesment at watershed level is based on a historical overview of floods which occurred in the past. Specific conditions for maximal discharge forming in hilly-mountain watersheds require a careful approach to maximal discharge calculation as the basic data for designing protection structures in torrential beds. The aim of this investigation is to show how an analysis of historical events can help provide effective erosion control and torrential flood protection in endangered watersheds.

Key words: torrential floods; maximal discharge; hydraulics flood traces; bed load sediment deposition.