FLASH FLOODS AND PEAK DISCHARGE ESTIMATION

THE SELŠKA SORA RIVER FLASH FLOOD IN SEPTEMBER 2007, W SLOVENIA

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INTRODUCTION

In alpine environment, flash floods are more and more frequent events, devastating large areas and causing high economic damages. In many cases, post-event analyses on hydrologic and hydraulic aspects of flash floods are not a trivial task. Different strategies have been developed and applied for real case studies (e.g. Marchi et al., 2009).
In September 2007, a weather front that passed over large parts of Slovenia, yielded extreme rainfalls that caused several severe flash floods in several parts of Slovenia (Rusjan et al., 2009). During 18 September 2007, in several gauging stations extreme rainfall amounts were measured, e.g. 297 mm in 6 h, 240 mm in 4 h, 157 mm in 2 h, 95 mm in 1 h. The post-event analyses were on one hand oriented towards estimation of the return period of measured rainfall amounts (Rusjan et al., 2009), and on the other hand towards estimation of peak discharges during the flash floods (Marchi et al., 2009). Since the flash flood hit most devastately the area in the Selška Sora River valley around the town of Železniki, the before mentioned analyses focused to this part in NW Slovenia.

THE FLOODED AREA DETERMINATION IN THE AREA CLOSE TO THE TOWN OF ŽELEZNIKI

The flooded areas along the Selška Sora River and its tributaries were mapped in the field in the first days following the flash flood on 18 September 2007. The official topographic maps in the scale 1:5,000 were used for this purpose.

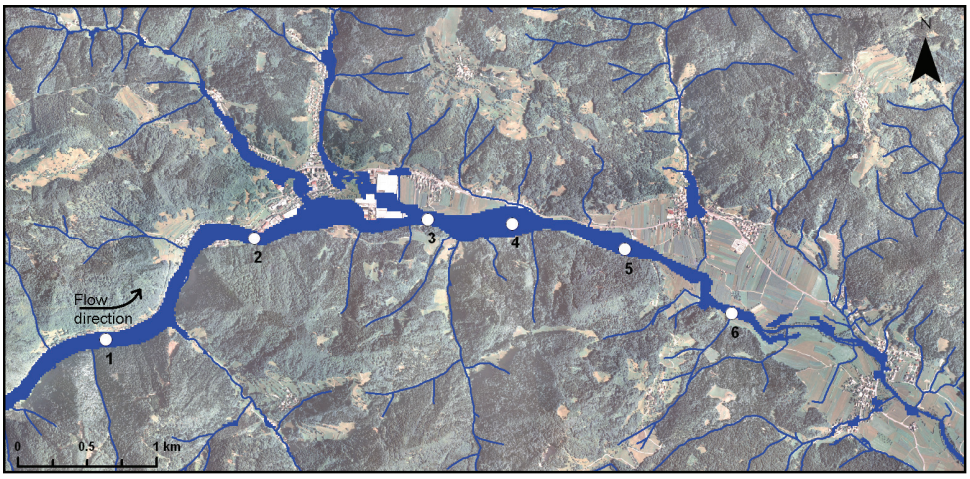

Fig. 1 The recognised flooded areas (blue/dark coloured areas) in the Upper Selška Sora River valley and 6 river cross sections used for peak flood discharge estimation (numbered 1 through 6).

Later on, SPOT satellite images were used for identification of flooded areas by applying machine learning techniques to different input data such as the Normalized Difference Vegetation Index

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(NDVI), relief and its derivates, distance from river network and land use (Lamovec and Oštir, 2010). A final result of such an analysis is shown in Fig. 1.

THE FLASH FLOOD PEAK DISCHARGE ESTIMATION

We estimated flood peak discharges during the 18 September 2007 flash flood around the Town of Železniki by selecting 6 river cross sections, as shown on Fig. 1. In each of these cross sections, the edge of the flooded area was determined from satellite images (see Fig. 1). The estimated values of flow parameters in these cross sections are given in Table 1.

Tab. 1 Estimated flow parameters in selected 6 measuring cross-sections of the Selška Sora River.

Parameter in cross section #	#1	#2	#3	#4	#5	#6
Flow cross-sectional area (m^2)	177	144	99	100	146	69
Wetted perimeter (m)	116	88	93	194	137	80
River channel longitudinal slope (-)	0.001	0.009	0.012	0.018	0.004	0.011
Manning roughness coefficient ($m^{-1/3}s$)	0.03	0.07	0.043	0.03	0.03	0.03
Hydraulic radius (m)	1.5	1.6	1.1	0.5	1.1	0.9
Flow velocity (m/s)	1.2	1.9	2.6	2.9	2.1	3.1
Discharge (m^3/s)	205	273	258	285	302	217

The flow cross-sectional area, the wetted perimeter and the Selška Sora River channel longitudinal slope were determined using DEM 12.5. The Manning roughness coefficients were determined from our past experiences with hydraulic modelling taking field conditions into account, and were not measured in any way. The other hydraulic parameters i.e. flow velocity and flood discharge were determined using the Manning-Strickler equation.

The longitudinal slope varies a lot between measuring cross sections, and is the weakest member in this estimation – their values should not be much different from the general river valley slope. Something near it can be said about the hydraulic radius and their values also vary a lot between measuring sites, and are also rather low, as concluded from our past flood experiences. As a consequence, flow velocities are rather low for a flash flood, and peak discharges are therefore rather underestimated. For comparison, we may quote estimated peak discharges from extrapolation of measuring data from the gauging station in the Town of Železniki, and these were (Rusjan et al., 2009): below 300 m^3/s upstream of Železniki (cross sections #1 & #2 on Fig. 1 and in Table 1), and ~ 300 m^3/s downstream of Železniki (cross sections from # 3 to # 6 on Fig. 1 and in Table 1).

We may therefore conclude that DEM 12.5 is not a good basis for flash flood peak discharge estimations with an acceptable accuracy, as shown on the example of the September 2007 flash flood in the Selška Sora River valley in NW Slovenia. The DEM 12.5 is so rough that channel bottom in some cross sections can not be easily recognised. The step forward for such an analysis may be to use officially available DEM 5 or sooner or later in future available LIDAR data.

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