The role of hydro-technical works in diminishing flooded areas. Case study: the June 1985 flood on the Miletin River

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Abstract

Hydro-technical constructions are very important in diminishing flooded areas and associated damage in the event of a flood. The case study for the Miletin River in the Moldavian Plateau (Eastern Romania) focusses on the historical floods of June 1985. The floods recorded at the Miletin River hydrometric stations are: 106 m^3/s for Nicolae Balcescu station and 204 m^3/s for Şipote station. Our analysis involves a series of simulations of a flood flow constant using the hydrological data associated with the 1985 flood. The mathematical modelling base is the high-grade terrain model (LiDAR raster type). Two flood scenarios have been carried out: the first one was based on the running of a constant flow considering the present hydro-technical constructions and works; the second scenario implied running the same flow, but without hydro-technical constructions. Bands of flooding associated to the two scenarios were generated. Flooded areas and damages were determined considering the modification of the bed by these works. Comparative analysis of flooded areas scenarios reveals, in the case of the same amount of precipitation, a downward trend in flood flows due to the presence of the hydro-technical constructions.

Keywords: hydro-technical constructions, flood, HEC-RAS, GIS, Miletin River

1. Introduction

The most common hydrological risk phenomena that occur annually throughout the world are floods. Numerous researches have been made to combat and prevent them. The most common solutions to manage flood-sensitive areas are hydro-technical works. Depending on the need, cross-cutting hydrographic works (dams) to control flows, or longitudinal hydrographic works (dykes) which strengthens the banks and regulates the leakage regime may be carried out on the river. To highlight the contribution of hydro-technical works to removing the land from the flood threat it is necessary to map the areas susceptible to these hydrological hazards. Numerous studies have been conducted worldwide to identify floodable areas using different methods. Thus, studies have been carried out by comparing flood simulation methods such as HEC-RAS, FLO2D, LISFLOOD-FP or CAESAR-LF on the Rafina and Peneios rivers (Greece) (Dimitriadis et al., 2016), on the Johor River (Malaysia (Md Ali et al., 2015), in Morocco on the Bouregreg River (Zellou & Rahali, 2017), and for the identification of areas flooded by the Hurricane Irene in the United States (Renschler & Wang, 2017).

This research aims at simulating the July 1985 flood on the Miletin River, an affluent of the Jijia River in the Moldavian Plateau (North-Eastern Romania) (Figure 1). The Miletin River basin has an area of 681 km^2, with the length of the river equal to 90 km. For comparison, two flood simulations were made, in the first case considering the defensive constructions and mechanisms implemented after the year 1985, while for the second simulation these hydro-technical works were eliminated. The aim was to highlight the floodable areas and the potential damages, as well as the contribution made by hydro-technical works to reduce the risk of flooding.

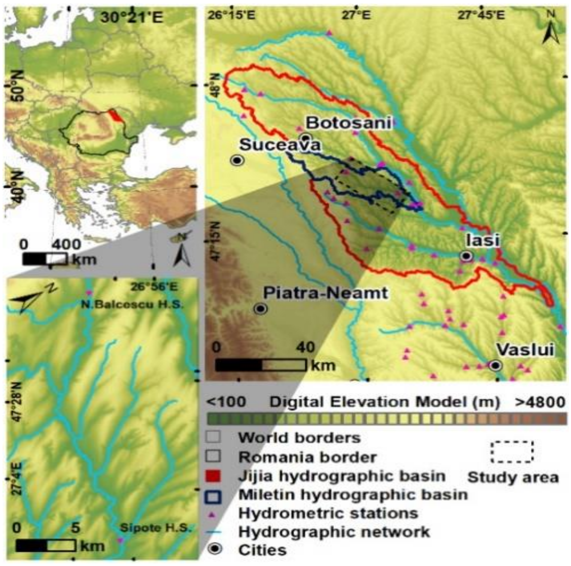

Figure 1. Location of the study area

2. Methods

To achieve the research goal, two flood simulations were created using the hydraulic HEC-RAS model, LiDAR data, as well as the flows recorded in July 1985. The first simulation was done with the current topography including hydro-technical works, while in the second one the hydro-technical works in the topography were removed. Performing flood simulations involved obtaining vector layers (talweg, banks, floodplain, land use) that were extracted from LiDAR except for the land use (extracted from orthophotoplan). This data was processed in ArcGIS GIS software. In the second stage, the ArcGIS export for HEC-RAS was made, in HEC-RAS being carried out the modeling by creating a geometry and introducing the flows recorded at the two hydrometric stations (106 m^3/s at Nicolae Balcescu station and 204 m^3/s at Sipote station). In the last stage we compared the two obtained flood bands.

3. Results

Following the flood simulation in HEC-RAS it is noted that there are small differences between the two bands.

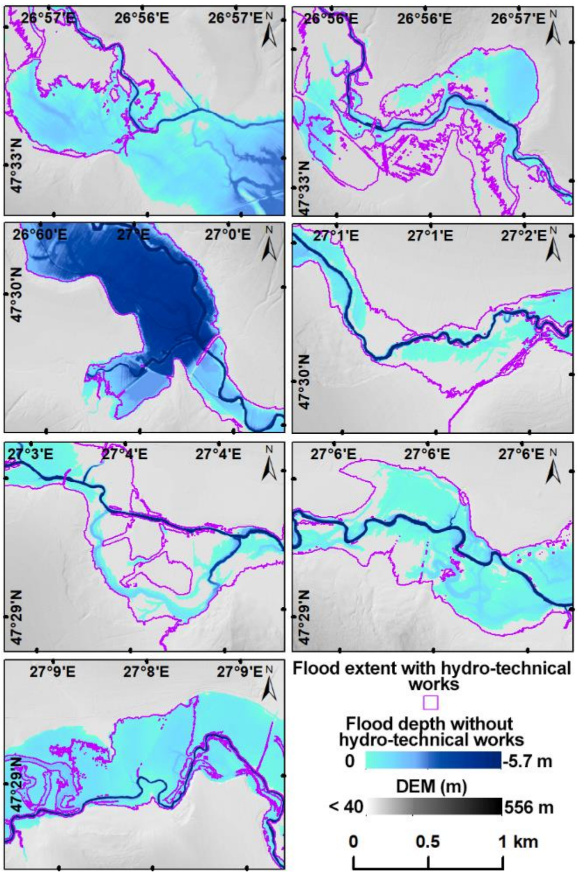

Figure 2. Areas affected by floods resulting from the application of the HEC-RAS method, by simulating two scenarios

The flooded band obtained considering the hydro-technical works has an area of 12.48 km^2, and the one obtained not considering them has an area of 13.72 km^2, the difference being of about 1 km^2. The maximum flood depth is 5.79 m in case of the first scenario, respectively 6.12 m in the second scenario, the difference being of 0.33 m (Figure 2).

In both cases, the villages Chitoveni, Prisacani, Campeni, Prajeni, Luparia, Plugari and Chiscareni record the flooding of some parts of their territories, but they are all very poorly affected. In terms of land use, in both cases, the largest flooded areas are pastures (approximately 6.5 km^2), the differences between the two scenarios being insignificant. The second category of land use affected on a larger area is arable land with values of approximately 3.6 km^2 and 4 km^2, respectively.

4. Conclusions

Using the flows recorded on the Miletin River in July 1985 and applying the HEC-RAS method and LiDAR data a comparative analysis between the bands of flooding simulated in two scenarios was performed.

The flooded bands do not differ greatly, but we can see that the hydro-technical works reduce the flooded areas, in particular their main purpose being to protect the cities and villages. Potential damage targets some land use categories (pastures and arable land) but not dwellings or other facilities.

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