

## The hydrological modelling of Bârzava river basin

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**Abstract:** The floods represent the phenomena through which a specifically land is covered with water, as the effect of the lift of the level over the elevation of the land. Flood is a spatial phenomenon, which could be presented using a geospatial tool like GIS (Geographic Information System). Global Mapper is more than a visualization instrument, by being able to display the most usual type of raster, elevation and vector data. Thus, we can extract DTM and the area of interest and using GIS application we can process data and analyse hydrological basins.

In order to determine the extent of inundation, was used HEC Geo-RAS with Arc GIS. HEC RAS is software for hydraulic model with the input data are river geometry, manning value, and also water discharge

**Keywords:** hydrographical basin, GIS, digital elevation model

### 1. INTRODUCTION

Extreme events like floods and droughts are of concern for any country in the context of the damage caused to life as well as property. The accidental floods are determined by anthropogenic causes: the improvement of the river basin that may lead to the amplification of the natural maximum levels, contradict exploitation of the discharges of high waters of the reservoirs or to unleash some new phenomenon through impairment or fissure some constructions and hydro technical systems.

Thus, due to the strengthening effect that dikes create, they transfer the flood risk from upstream to downstream, leading in case of breaking to the amplification of the destructive potential of the river in case of high water.

The social negative effects produced by the floods contains: the possibility of generation of casualties, create the panic among populations, danger of producing epidemics, destruction of the cultural values.

In Romania, the previous concept of defence against flooding led to excessive embankments along the rivers on great lengths, blocking the space of the river in the flood plain, that lead to the increasing of the frequency and amplitude of the floods in the downstream area.

For this study to use Global Mapper and ArcGIS software. Global Mapper is software On the left bank of the river Bârzava, downstream of the confluence with rill Fizes, beside

capable of displaying raster data sets, elevation and vector data for allowing the users to edit and to export the results easily and in multiple formats.

To use the software, an internet connection is required, selecting the ASTER satellite and processing the initial image into a 3D image that will be used for making analysis. [5]

The Geographic Information System (GIS) has the possibility of automated processing of spatial data and spatial modeling. Using this tool in hydrology is important, facilitating the determination of morphometric parameters and geomorphology for river basins.

### 2. AREA STUDY

Bârzava river basin (fig.1) drains a relatively small area in Banat Hydrographical Area. The area drained by Bârzava River and its tributaries on Romanian territory is 1202 km<sup>2</sup>. Bârzava, whose spring is in Semenic Mountains placed at 1190 m altitude, has a general SSV-NNE flow direction, presenting a narrow valley, deep, lacking of flood channel and with an average slope of 15 m/km.

Bârzava river bed was regularized on relatively small sector, totalizing 66 km, and from its tributaries. 79 km of dikes on the right shore and 76 km on the left shore have been built for flood protection.

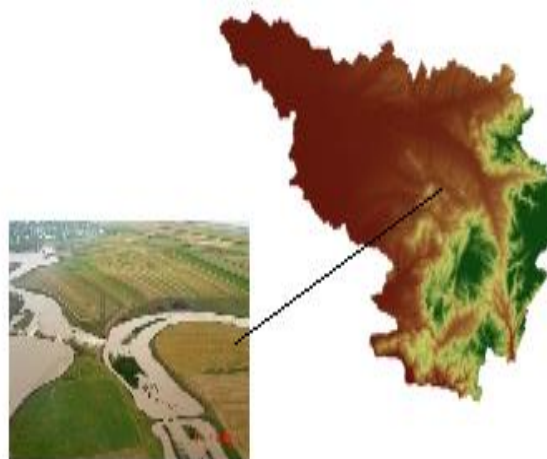


Figure 1. Bârzava river basin and Ghertenis Polder

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Ghertenis locality is located the nonpermanent accumulation Ghertenis, with a total volume of 17.7 million cubic meters.

The accumulation has role to attenuate flood wave on the river Barzava and has two compartments:

- first compartment has the role to flood mitigation up to 5 %
- the second compartment has the role to flood mitigation between 5% and 1 %.

Between the two compartments is an overflow of concrete with a length of 123 m with trapezoidal cross section.

The polder is made up of two compartments and bounded by dykes, which have a trapezoidal section and are made of land from the regulation of the riverbed. (Fig. 2)

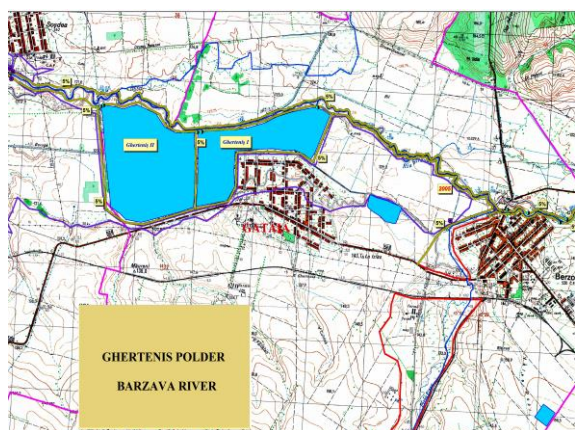


Figure 2. Two compartments of Ghertenis Polder

Table 1- Technical characteristics of the lateral accumulation Ghertenis

	Comp. I P - 5%	Comp. I P - 5-1%	Comp. II P - 5-1%
Water level (cm)	610	665	730
H (mdMB)	125.85	126.40	124.85
Volume (mil.mc)	6.300	7.300	10.400
Surface (ha)	208.00	208.00	248.00

The total volume accumulated in the 1% insurance is 17.700 mil. m<sup>3</sup>. When the water level in compartment I exceeds 126 meter (625 cm), flooding of compartment II starts.

The maximum volume accumulated in compartment I (during the maximum discharge) is 7.300 mil. cubic meter, and in compartment II 10.400 mil.m<sup>3</sup>. (figures 3 and 4).

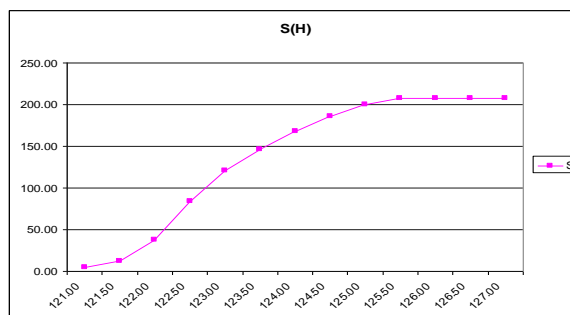
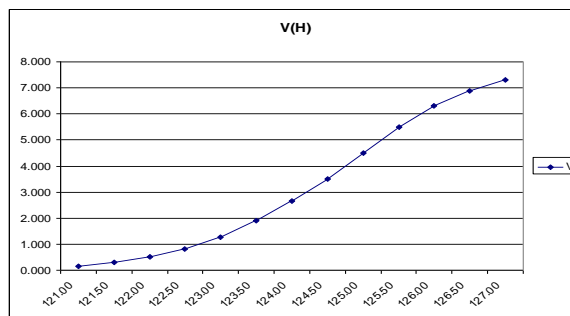


Figure 3. S(H) and V(H) characteristic curves for compartment I

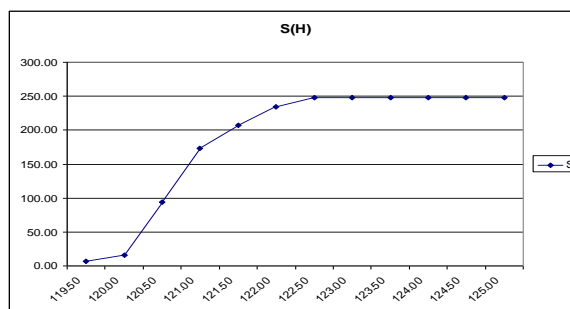
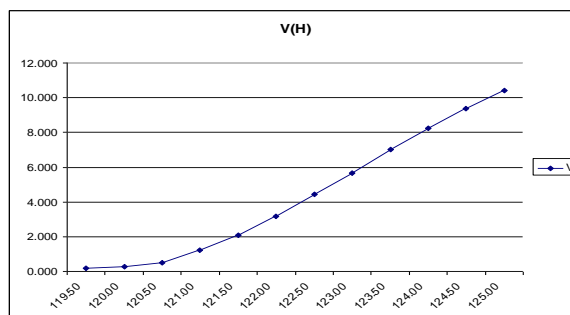


Figure 4. S (H) and V(H) characteristic curves for compartment I

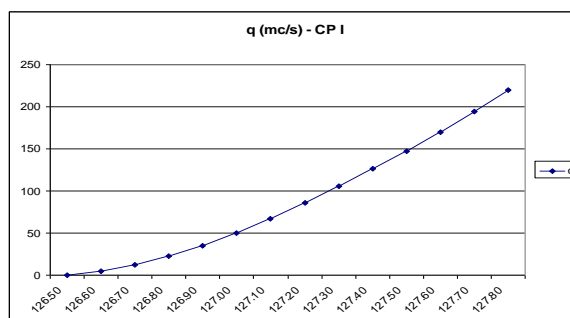


Figure 5. Admission discharge in the two compartments

### 3. METHODOLOGY

Watershed delineation is the process of identifying the natural drainage pattern in the river basin for delineating the streams, demarcating the contributing watershed area and subdividing a large river basin into small subunits called sub basins. ASTER DEM at 30m resolution as shown in figure 5 is used to perform watershed delineation.

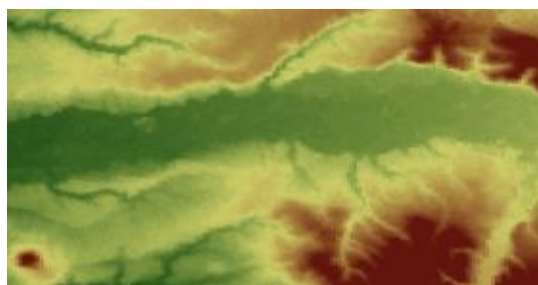
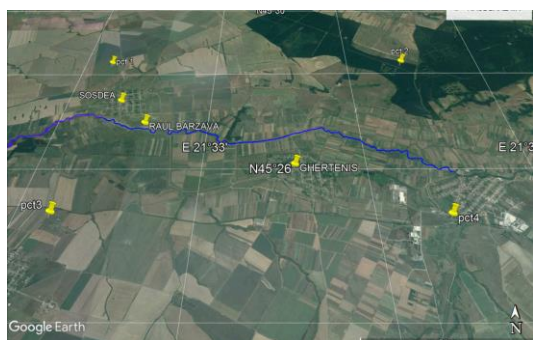


Figure 6. DEM - the area between Ghertenis and Gataia, Bărzava River

For identifying the actual stream network in the river basin, the images from Global Mapper were georeferenced and mosaiced in ArcGIS software. From these mosaicked images, the actual stream network was manually digitized in the vector format. Then, we take DEM file and will convert into TIN (Triangular irregular Network) format and then use HEC-Geo RAS for River cross-section and Long-Section for Floodplain and the exported data to HEC-RAS for further processing.

HEC Geo RAS prepares the geometric data for import into HEC-RAS and the simulation results exported from HEC-RAS. (figure 6).

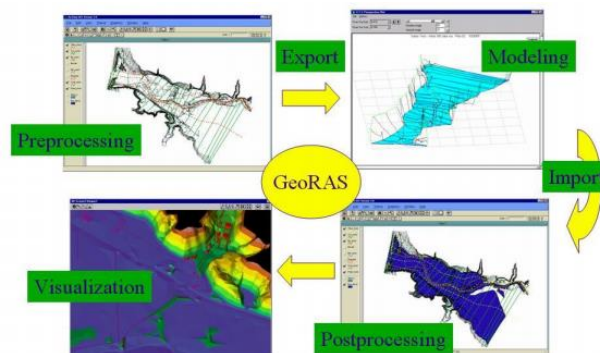


Figure 7. The modelling algorithm

HEC-GeoRAS is a set of procedures, tools, and utilities for processing geospatial data in ArcGIS using a graphical user interface.

The interface allows the preparation of geometric data for import into HEC-RAS and processes simulation results exported from HEC-RAS. To create the import file, the user must have an existing digital elevation model (DEM) of the river system in the Arc-Info TIN format. The user creates the different themes like the Stream Centerline, Flow Path Centerlines (optional), main channel banks and Cross Section Cut Lines referred to as the RAS Themes. (Figure 7)



Figure 7. Triangular irregular Network for area study

### 4. DISCUSSIONS AND CONCLUSIONS

On the sector Gataia – Ghertenis, using GIS for hydrologic/hydraulic modelling usually involves the steps: pre-processing of data, model execution and post-processing of results.

The geometry file for HEC-RAS contains information on cross-sections, river banks and other physical attributes of river channels. The pre-processing using HEC-GeoRAS involves creating these attributes in GIS, and then exporting them to the HEC-RAS geometry file. So before creating river attributes in GIS, let us first create empty GIS layers using the RAS Geometry menu on the HEC-GeoRAS toolbar.

Cross-section cut lines are used to extract the elevation data from the terrain to create a ground profile across channel flow. (Figure.8)



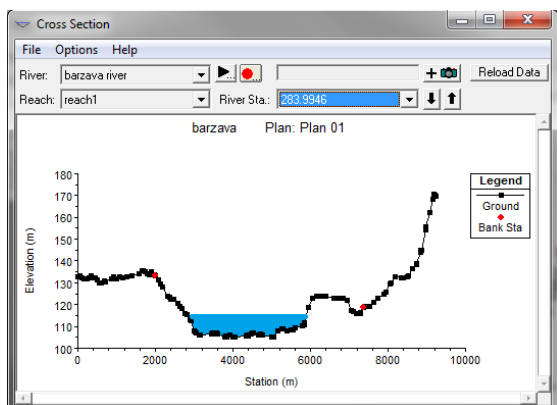
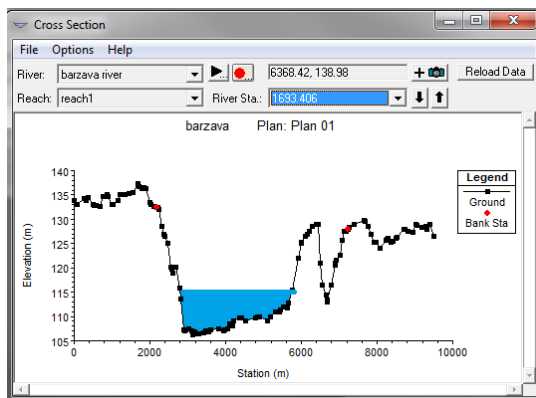
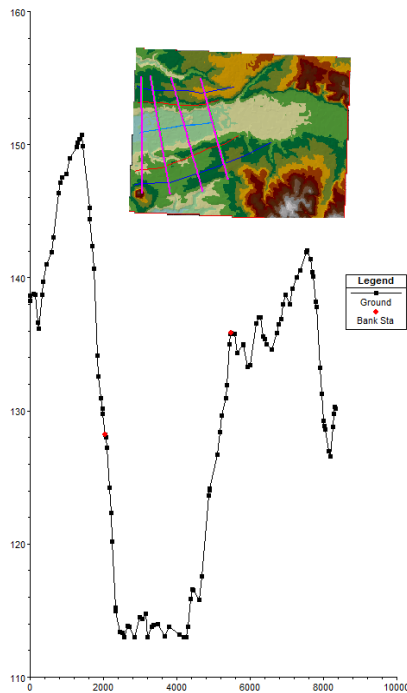


Figure 8. The cross-sections on the Bârzava River River

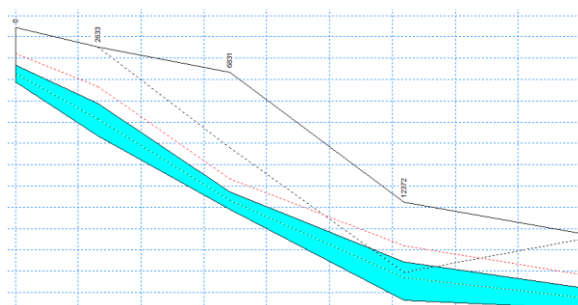


Figure 9. The longitudinal profile on the Bârzava

### RRRiver

The control slider performs the following functions:

a. Limits debit flow as follows:

- the flood frequency 1% allows a downstream transit of 134.00 mc / s.
- the flood frequency 5% allows a downstream flow of 120.00 mc / s.

b. Raises the upstream water level so that from 126.50 constructions, the flooding discharge will pass over the weir into compartment I of the flood control reservoir.

The compartment I is dimensioned to fully mitigate flood waves with probability 5%. The accumulated volume is 6.300 mil.m<sup>3</sup>

	River	Defense parameters		
		Attention	Alert	danger
		Level (mdMB)	Level (mdMB)	Level (mdMB)
Gherteniș polder	Barzava	125.10	126.05	127.00

In the case of flood waves exceeding the probability of 5% to 1% inclusive, their flood mitigation is achieved in both the polder compartments.

When the water level in compartment I exceeds 126.00, the water spill begins in compartment II. It is dimensioned to be able to fully mitigate the flood waves with 1% assurance. In this situation, compartment I accumulates a volume of 7,300 mil.mc, and compartment II the maximum volume of 10,400 mil.mc.

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