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Floodplain modeling

Ovidius University of Constanta (P4) –Romania

&

Technological Educational Institute of Serres, Greece

- **Scientific Staff:**
  - Dr Carmen Maftei, Professor, Civil Engineering Dept.
  - Dr Konstantinos Papatheodorou, Associate Professor, Civil Engineering Dept

- **Collaborating Scientific Staff:**
  - Eng. Gabriel Dobrica, MSc Civil Engineer

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Study area – Voinesti catchment

Location:

•Hydrological - Dambovita watershed (a primary tributary of the Danube).

•Geographically - extreme western part of the Ialomiţa Sub Carpathians (B), subdivision of Curvature Sub Carpathians Mountain (A) - Bărbuleţului Hills..

Characteristics:

•surface - 0.76km²,

•altitude varies between 420 m and 555 m

•high slopes, abrupt hillside and intense erosion processes - in the North part of basin

•lower slope occurs the lower half of the basin

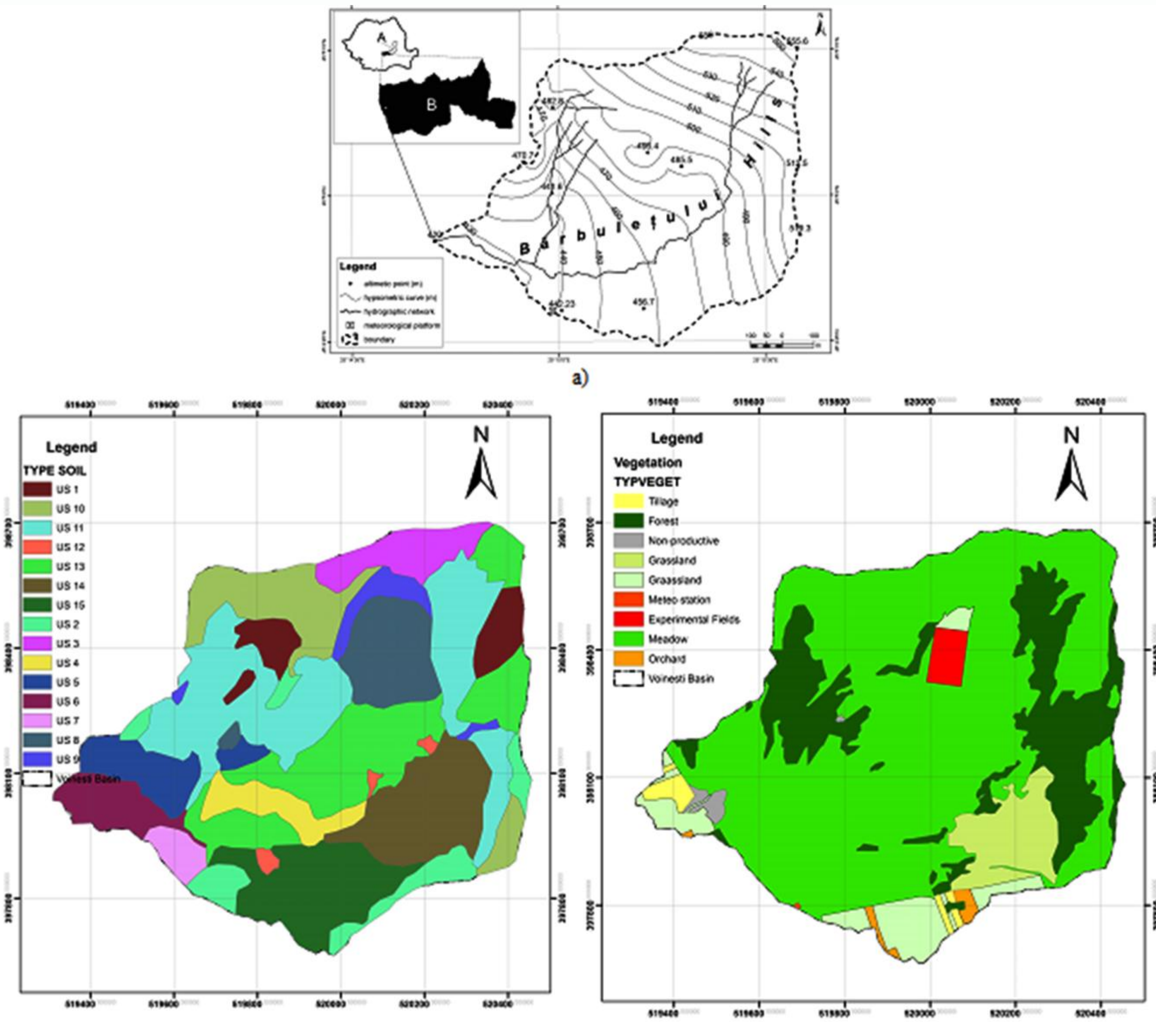
•Pedological

- fifteen soil units classified according to the degree of podzolization and erosion processes
- presence of an impermeable layer of clay marls at approx.1-3m on the upper part of the basin and at 3-12 m on the bottom part

•Land use – a) grassland area 59,10%; (b) forest area 33,10%; (c) natural meadow 3,8%; (d) other 4,01% constructions, route, tillable and orchard

•Hydrological

- the Muret River Valley
- average discharge - 1.59m^3/s - 3.81m^3/s
- the maximum discharge 16.08 m^3/s
- when significant rainfall is preceded by several days without precipitation, very little surface runoff takes place - infiltration is predominant
- On saturated soil - moderate rainfall can produce significantly strong surface runoff.



a)
b)
c)

The methodologies and models used include:

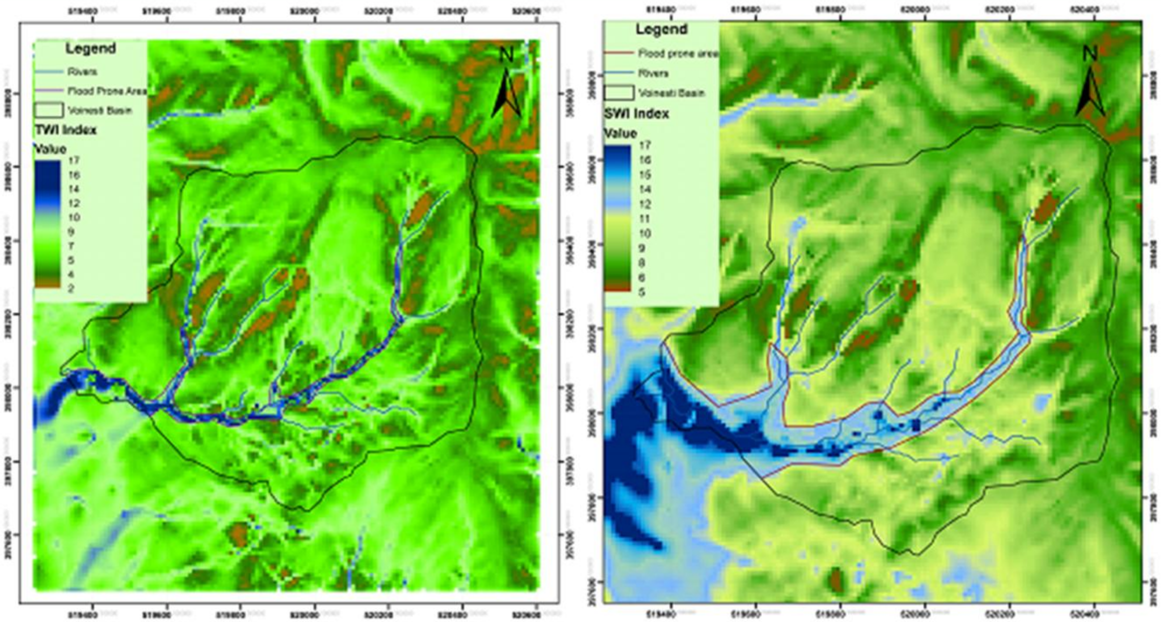
- geomorphologic models - TWI and SWI through SAGA GIS,

- HEC-RAS through ARCGIS.

They are totally different models but all take into account the spatial variability of the watershed through its main morphological characteristics.

A DEM (Digital Elevation Model) was developed using topographic maps of a 1:2500 scale

TWI and Saga WI map



TWI - most exposed areas are situated along the river valley and correspond to the higher value of TWI.

SAGA wetness index (SWI) values - flood areas are located at the low slope areas around the basin outlet (dark blue areas).

the soil texture is between medium and fine. The presence of the alluvial B horizon (in the upper third of the basin), enriched in clay, causes a poor drainage of soil. When the rain intensity exceeds the infiltration capacity of soil, the overland flow appears immediately as a thin film. When the rain intensity is low, the saturated areas are formed first. If the rainfall continues, the water cannot infiltrate and flows on the surface, in areas where the soil profile is already saturated and the amount of precipitated water is greater than the lateral transmission level. The flow on the saturated surface is facilitated not only by precipitation, but also by a lateral flow of shallow water. The presence of clay marl at a small depth in the lower part of catchment, especially on the flat zone, leads to stagnation of water and to the appearance of surface flows. To conclude, the areas where the SAGA index values varies between 10-11 are saturated zones while areas where the index is between 12 and 17 are considered as flood prone areas.

HEC model implementation and results

(1) Detailed topographic and auxiliary data and the development of digital spatial database of the entire hydrologic system in ArcGIS;

(2) Digital Elevation Model generation for the entire basin (raster and TIN). TIN is used as Digital Elevation Model required in GeoRAS environment in order to prepare data sets required as input to the HEC-RAS simulation.

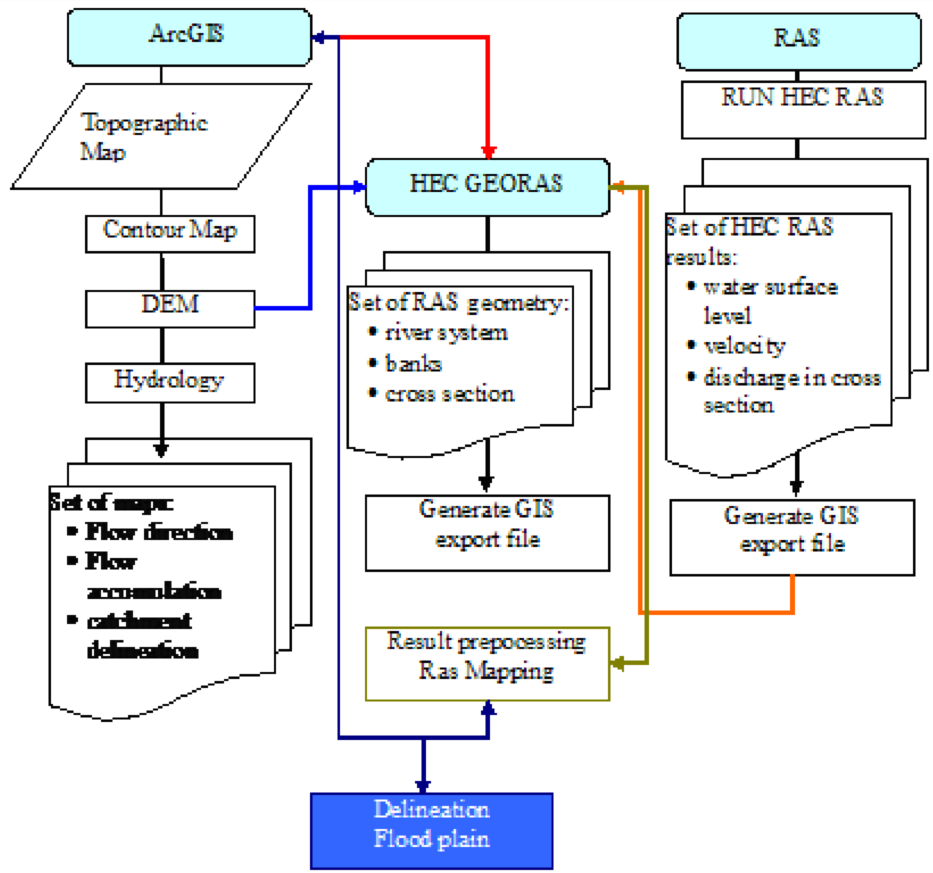
(3) Creation of entities like: river, banks, flow path, cross section;

(4) Flood plain analysis: It consists of three steps:

(a) HECGeoRAS processing to generate HEC-RAS import files,

(b) (b) HEC-RAS application,

(c) (c) Post-processing of HEC-RAS results and flood plain mapping in ArcGIS.



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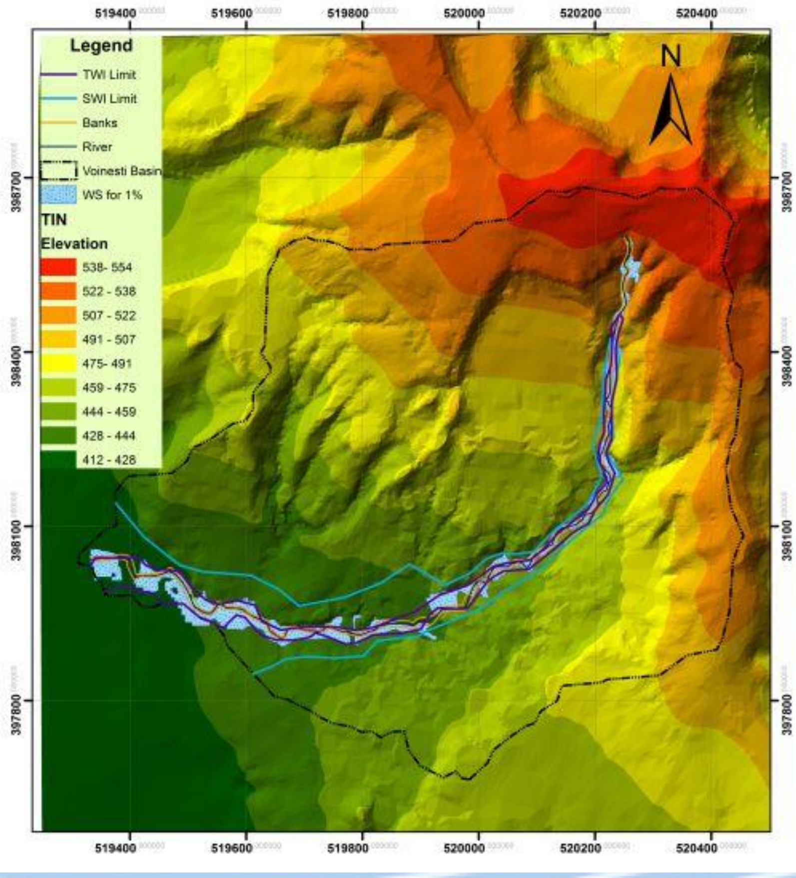
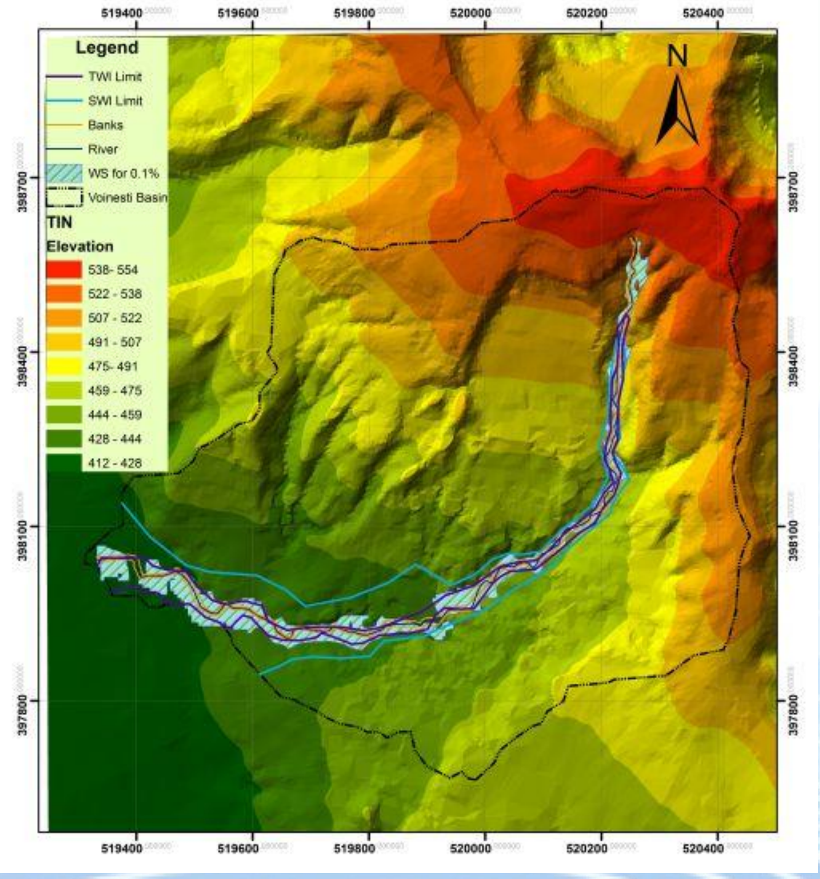
Flood maps were created considering two different scenarios: 100 and 1000 years return period (16.8 m^3/s and respectively 47.6 m^3/s). It is obvious that the riverbed transport capacity is exceeded for both scenarios considered





HEC model implementation and results

From a general perspective it seems that the flood prone areas derived from the TWI index model are in close agreement to the inundation area derived from the HEC-RAS model. Exceptions occur in the flat areas of the catchment, especially on the outlet section area and this fact can be attributed to the different way those models approach the flood issue in terms of detailed analysis. The comparison of the flood prone areas derived by SWI and HEC-RAS, shows that SWI overestimates flood prone zones, especially in the lower third of the catchment where there is a smooth, low relief.

Some additional conclusions can be deduced from the performance assessment of the models:

(a) a good representation of topography is necessary in order to improve the distribution and flux of water into the watershed; DEMs (Digital Elevation model) are often used to derive topographic data for models, and the quality of a DEM depends highly on the data sources and on the interpolation techniques;

(b) Since flash floods usually occur within small catchments on either ephemeral streams or ungauged streams it is important to know the evolution of rainfall-runoff process and the corresponding hydrological response of the catchment, in terms of the discharge hydrograph. In this case, the rainfall-runoff models can be provide the data input necessary to calibrate models able to predict the flood extent.

(c) According to the results presented in this study, the development of a flooding modeling plan to be applied in ungauged catchement should include two stages: a preliminary one and a finally one. In the preliminary stage, the TWI or SWI geomorphological model should be tested in order to locate the possible flood prone areas. In the final stage, two models must be used: a rainfall-runoff model able to provide optionally, peak discharge with different return periods and/or discharge hydrograph and a hydraulic model able to predict the flood parameters (inundation depth, extent of flooding etc).

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Thank you!