Iranian Journal of Engineering Geology
Summer 2018, Vol.11, No.2

Flood zoning of Chalus basin using hydrologic model of HEC-RAS and Geographic Information System

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Abstract

In this study combination of GIS and HEC-RAS were used for flood zoning in the Chalus basin. For this purpose GIS data processing was done and the coordinate system was defined for the data and then the boundaries of the basin and sub-basin were determined with archydro. Using the extracted data TIN, DEM, mean slop and dip direction of rivers maps were produced and then using HEC-GEORAS, the data required for HEC-RAS software were prepared. Then the manning coefficient values, soil hydrologic groups and distribution maps of CN were extracted from land-use map and subsequently data transferred to the HEC-RAS and the values of manning in each of the cross sections were entered and boundary conditions were defined. Then HEC-RAS model was run in steady-state conditions. By overlaying different layers in GIS (such as the depth and velocity), dangerous areas during the flood were determined. Then the overlapping land-use map and velocity and depth layers, the land-use types at risk from flooding have been identified. Results presented that the floodplain area is equal to 8 and 24 percentage (Min. and Max). Most of the floodplain consists of rice land, building blocks, orchards, meadows and forests in the 2-year flood; therefore maximum damage happens for farmers and residences. By increasing the return period flood, the area of forest (that is placed within the floodplain) increases with higher ratio than building blocks, rice fields and pastures.

Keywords: *Chalus Basin, Zoning of flood, Land-use, HEC RAS, ARC GIS.*

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Extended Abstract:

1. Introduction

Today, the use of Arc GIS and hydrologic software has expanded in water resource management studies and flood risk zoning. Martin et al. (2012), using HEC-HMS, HEC-RAS and ArcGIS model, have investigated the flood of the Cironco River in Uganda and identified flood susceptibility flood risk maps. Damir et al. (2016) and Damir (2015) using the HEC-RAS hydraulic model and ArcGIS software and flood simulation in different return periods, provided a flood hazard zonation map for the Mert River basin in Turkey. The flood in 2012 has resulted in casualties and heavy damage to residential areas. Rahmati et al. (2016), using the hierarchical analysis process, investigated the Yasouj area flood potential map and compared its results with the HEC-RAS hydraulic model. Similar investigations were also carried out by De Hoo (2001), Napradean and Chira (2006), and Knebl et al. (2005). The results of studies carried out using the mentioned software show that the combined use of HEC-RAS and Arc GIS software has achieved acceptable results. In recent years, various regions of the country (especially the northern regions like the western cities of Mazandaran, especially Chalous) have been affected by flood. In the present study, the hydrological conditions of the Chalous basin were analyzed using the hydraulic software and geographic information system. The flood zoning was carried out in the areas around the Chalous River. The results of studies carried out using the software tools show that the combined use of HEC-RAS and Arc GIS software has achieved acceptable results.

2. Materials and Methods

In order to zoning the flood in the studied area, by preparing a topographic map (with a scale of 1:25000), the exact route of the rivers was extracted from the satellite images and entered into the Arc GIS. Arc GIS was then processed on the data and using the Archydro software, the overall boundary of the basin and sub-basins were identified. In the next step, digital elevation model (DEM), triangulated irregular network (TIN), average gradient map for each sub-basin, map of streams and direction of the streams were prepared using extracted data. Also, required information for HEC-RAS software were prepared using HEC- GEO-RAS. Then, using the land use map, Manning coefficient values, soil hydrologic groups and curve number distribution maps in sub-basins were determined and the percentage of each land use area was determined in each sub-basin. Then, by transferring of data to the HEC-RAS, the output model was implemented in a steady state. Then, by transferring the model to the Arc GIS software, the necessary processing is performed and by determining the overlapping of different layers (such as depth and speed layers), flood risk areas (in different return periods), and land use types which is at risk of flood were found.

3. Results and Discussion

In accordance with flood depth maps, flood areas can be easily identified and decided upon. Meanwhile, the depth of each part of the flood areas is determined in this type of maps, and with flood depth information and flood zones, decisions can be made to prevent the spread of flood in vulnerable areas and to reduce the depth of the flood. Accordingly, the areas of the Chalous River

show a depth of the flood and decrease the distance from the river's axis. Due to flood velocity maps, flow velocity can be investigated in all flood areas. By combining depth and speed maps, the map of the points that are threatened by floods more than other locations are provided for different return periods. Given the risk maps and the identification of high risk areas, it is possible to determine the contribution of each part of the flood areas and for different floods to evaluate the areas with the highest damage and estimate the percentage of damages in each region.

4. Conclusion

In this research ArcGIS software and its integration with the HEC-RAS model were used for flood zoning in the Chalous basin. According to the results, the most flood areas including building blocks, gardens, forest and rice field. Therefore, residential houses and commercial areas and farms and farmers will suffer the most damage. The results of the study showed that in the Chalous River, the highest and lowest levels, respectively, have 24 and 8 percent of the area of the flood susceptibility zone. The rate of increasing the percentage of flood areas in relation to the total area of the basin with different return periods is about 2%. In the flood with 2 return period, the flood area is most commonly found in building blocks, gardens, pastures and forests and the most damage to farmers and residential homes.

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