

**GIS Based-Geomorphological Characteristics of Şanlıurfa, SE Turkey**Ahmed Ekmen<sup>1</sup>, Ekrem Kalkan<sup>2</sup><sup>1,2</sup>Ataturk University, Oltu Earth Sciences Faculty, Department of Geological Engineering, Erzurum, Turkey

**Abstract** — Geomorphology, known as a science that examines and introduces landforms and the processes in charge of their creation, deals principally with the topographical features of the Earth's surface and it is concerned with the classification, description and origin of landforms. In many cases, geomorphologists have tried to model geomorphological processes, and, more recently, some have been concerned with the effect of human agency on such processes. One of the most promising systems used for geomorphological applications is the GIS. It, known as a computer based system for mapping and analyzing spatial data, is a tool for working with geographic information. In this study, the GIS has been used to investigate the geomorphological characteristics of Sanliurfa (SE Turkey) and its surrounding. The geomorphological structures of study area are high erosion surfaces in the northern, southwestern and western parts and slightly sloping floor levels in the south and southeast sections. The geomorphological map of the region was prepared within the scope of the study. In addition, numerical elevation model image, view map and slope map were obtained from the analyzes of the GIS.

**Keywords**-Şanlıurfa; Geomorphology; Geomorphological map; GIS; Relief map

**I. INTRODUCTION**

Geomorphology, defined as the scientific study of landforms and landscapes, is closely related to soil science, hydrology, geology and environmental science, and is being increasingly applied in planning, mining and hydrological sectors, and within environmental consultancy and tourism. Today, geomorphology is the study of Earth's physical land surface features, its landforms such as rivers, hills, plains, beaches, sand dunes, and myriad others. Landforms are conspicuous features of the Earth and occur everywhere. They range in size from molehills to mountains to major tectonic plates. Geomorphology investigates landforms and the processes that fashion them. Form, process, and the interrelationships between them are central to understanding the origin and development of landforms [1-2].

Modern geomorphological research is inextricably linked with geospatial technology and geographic information systems (GIS). Driven by rapid technological advances of remote sensing, geodesy, photogrammetry, computer science, and GIS, the application of analysis tools using digital information on the land surface revolutionized quantitative geomorphological research [3]. In the last three decades, GIS has increasingly influenced various fields of geomorphology. GIS are designed to facilitate spatial investigations, for example, through geostatistical analyses or the mathematical description of surfaces and are hence inherently linked to methodology and concepts in geomorphology. GIS tools support and enable many upfront research fields in geomorphology from the quantitative description of landforms to process modeling, the investigation of form-process interrelations and linkages to climate and environmental conditions, or the assessment of sediment flux [4].

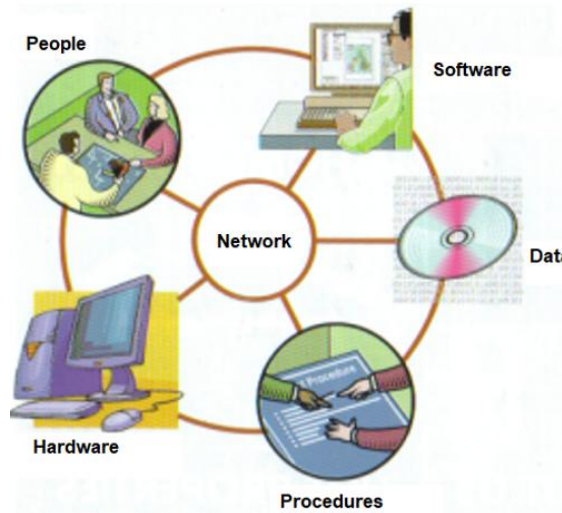
The GIS is a system that captures, stores, analyzes, manages, and presents data that are linked to location. It used in cartography, remote sensing, land surveying, photogrammetry, geography, urban planning, emergency management, navigation, and localized search engines [5]. Using the GIS software allows storage of the data in a spatially registered structure and permits cross-referencing for heterogeneous, multidisciplinary data sets. Geographic features such as rivers and lakes or geological features like faults, sample locations, and ages of rocks are all examples of layers. Each layer is independent from the others, yet all have a common geographic registration and they can be linked with each other using specific identification tags. This provides a convenient way of selecting necessary information from the database and making it ready for further analysis and decision-making [6]. Different studies have been carried out to investigate and demonstrate the applications of GIS in Earth Sciences [6-15].

Many useful GIS modeling approaches have been developed in the field of natural hazards. Rock falls, landslides, floods, avalanches, or soil erosion share inherent characteristics of hazards such as magnitude or spatial extension and depend strongly on slope angle, aspect, or other parameters which can be ideally integrated and displayed in GIS environments [16-20]. Hazard assessment using GIS often combines geomorphometric analysis with geostatistical analysis of related parameters to generate models of spatial susceptibility [4, 21-22].

The objective of this term paper is to investigate the use of GIS for investigation of geomorphological characteristics of the Şanlıurfa, SE Turkey. A GIS is needed to store, display, and bring together data sets for improved data extraction and integration. Research can benefit from GIS-based data for modeling and simulation

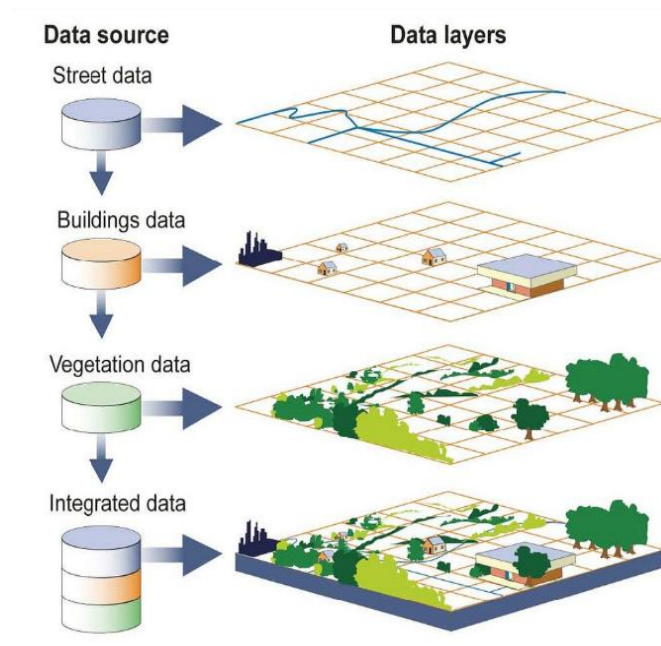
## II. GIS

A GIS is a computer system for capturing, storing, checking and displaying data related to positions on Earth's surface. This system can show different kinds of data on one map, such as streets, buildings and vegetation. Although GIS has been around since the 1960s, applications have expanded in the 1990s. Many software systems have now been developed to cover a wide range of fields such as earth and environmental sciences, natural resource management, terrain modeling, agriculture, forestry, construction engineering, land use policy and development control, population distribution, settlement, transport, education, and health planning. A working GIS integrates five key components: hardware, software, data, people, and methods (Fig. 1).



*Fig. 1. The component parts of a GIS*

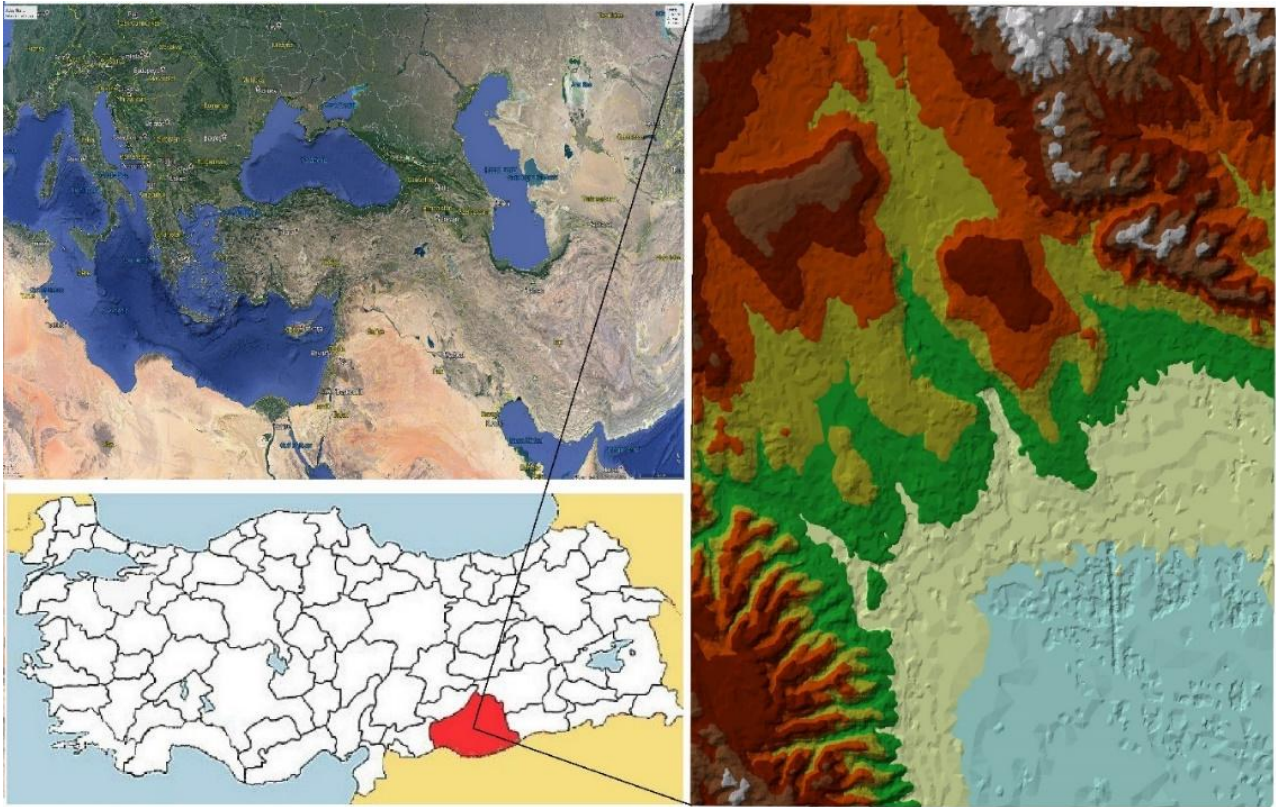
The expanded use of GIS in many areas of resource development has also necessitated the need for modern systems that incorporate analytical models with integrated powerful query languages to provide solutions to many spatial problems. Various applications have different user requirements based on vendor specifications. Some applications are the reduction of the risk of property damage in settlements, urban planning and modeling, and other socioeconomic applications. Here data layers are transformed by modeling land use dynamics to discover socioeconomic impacts [23]. The applications of GIS enable people in need to more easily see, analyze and understand pattern and relationships (Fig. 2).



*Fig. 2. Image of GIS with data source and data layers [24]*

### III. STUDY AREA

The study area covers the sheet of Şanlıurfa N41-c1 with a scale of 1/25.000. Study area including the center of Şanlıurfa and its surrounding is located between the Kızlar Village in the north, Şanlıurfa Evren Industrial Zone in the southwest and Oğulbey Village in the east. This study has been carried out the area of approximately 151 km<sup>2</sup> [25]. The location map of study area was given in Fig. 3.



*Fig. 3. The location map of study area*

In this study, GIS studies were conducted in 4 stages. The data collected during the data collection phase were converted to digital format before being used in GIS. During the data management phase, a database management system was established. This system is a computer software that manages or consolidates databases. In the data processing phase, all this information was converted to the same scale before being merged. This transformation can be temporary for image purposes, or it can be permanent and permanent for an analysis process. At the stage of data presentation, the maps made at the end of many geographical processes were visualized. The geomorphological maps provide the best communication between geographic information and user.

### IV. RESULT and DISCUSSION

In this study, the geomorphological properties of study area were investigated by using the GIS. According to the obtained results, the study area has some geomorphological structures such as the Upper Pliocene-Lower Pleistocene erosion surfaces, the Pleistocene sediments, the Holocene sediment fans and the valley floor plains. In general, there are erosion surfaces and high terraces in the north, southwest and west parts of the studied area, and slightly sloping floor flats and deposit ranges in the south and southeast parts. The geomorphological map of the study area prepared from GIS studies was given in Fig. 4

Digital height models (DHM) are a basic requirement for any GIS and it is growing as well as the possibility to generate regional or local height models for any location of the world. The DHM required for several remote sensing and GIS application is the way to produce a 3D terrain model from the contour lines. After the creation of DHM, it is also possible to create slope and curve maps, model the terrain in 3D, extract cross sections, visibility analyzes and volume calculations. There are two ways to obtain DHM mathematical parts and shape methods (Yomraloglu, 2000). The DHM obtained from the co-elevation curves was given in Fig 5.



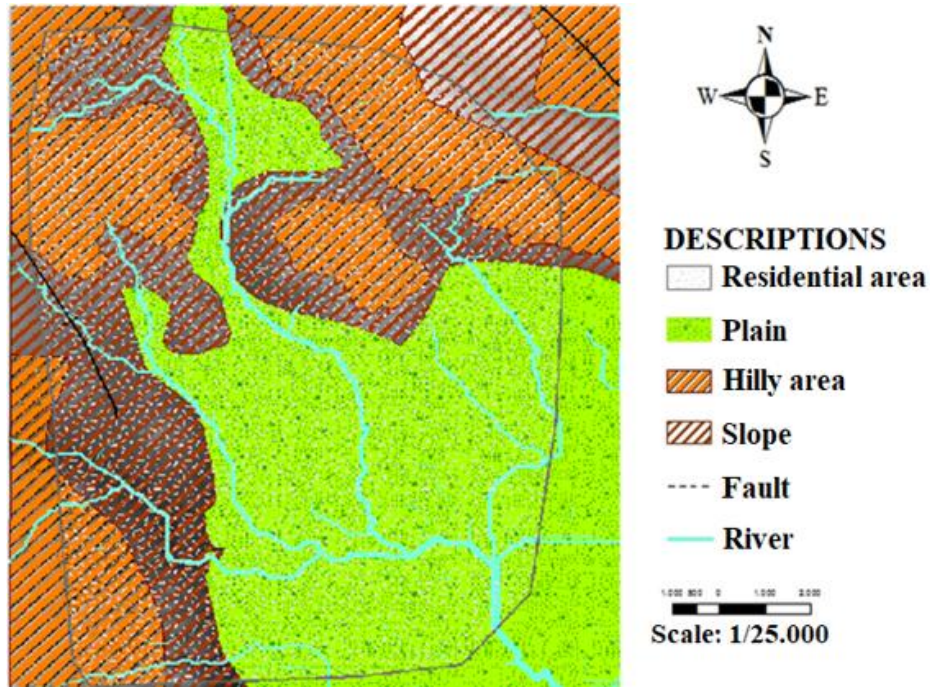


Fig. 4. Geomorphological map of the study area

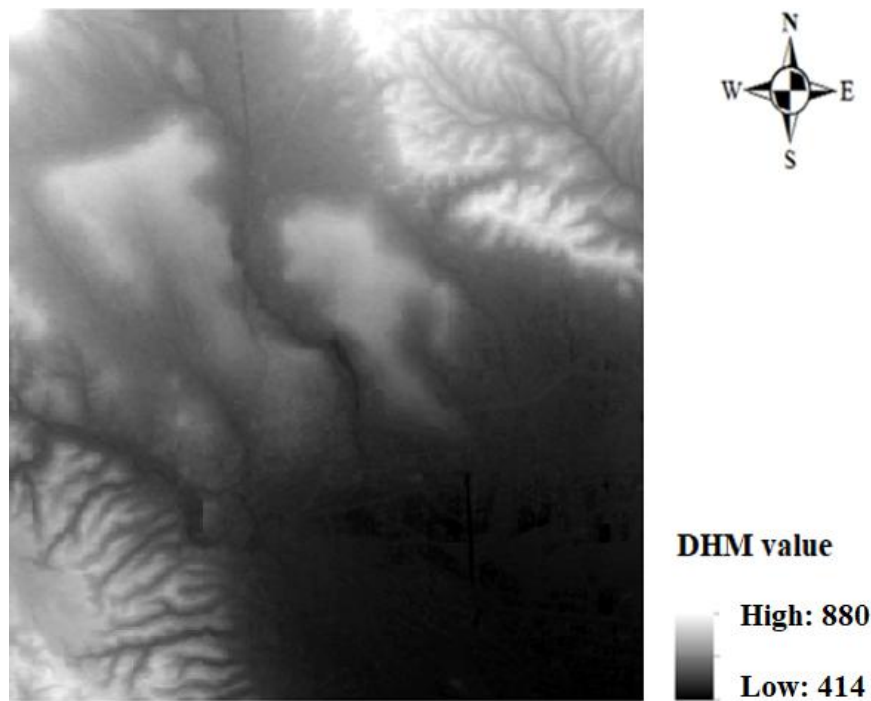
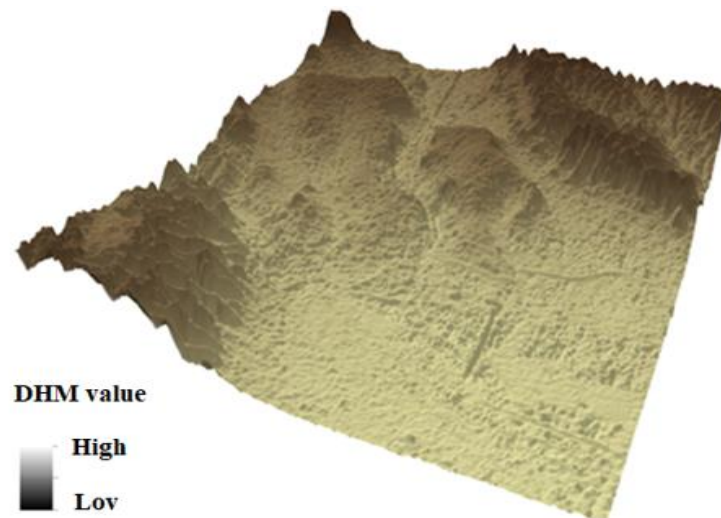


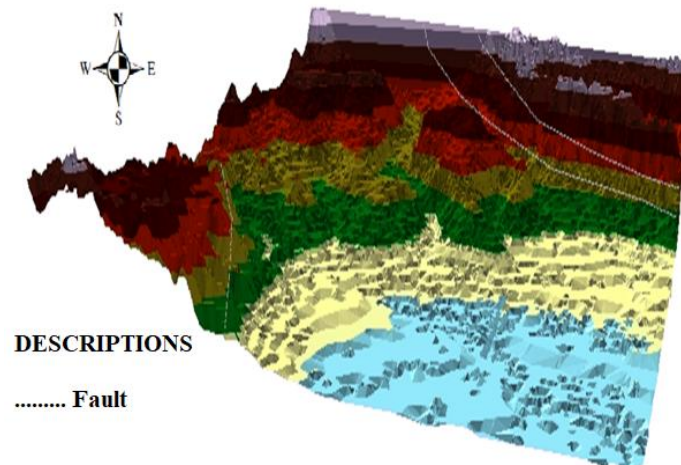
Fig. 5. The DHM image of the study area obtained from the co-elevation curves

In the study conducted within the scope of the investigation, different satellite images were used to support GIS. Although satellite images were mainly used for visual purposes, stereoscopic images were used to determine the structural elements. Visually, the satellite and the images provided by Google Earth over the internet were used, among them satellite image using a variety of color combinations 1/25.000 scale DHM overlays were created by 3D terrain images. The 3D imaging of the study area obtained with DHM was given in the Fig. 6.



*Fig. 6. The 3D imaging of the study area obtained with DHM*

The relief map, attempting to show the physical appearance of the ground, tries to show where hills, mountains, ridges, valleys, slopes, cliffs, and other variations in slope. The relief map, attempting to show the physical appearance of the ground, tries to show where hills, mountains, ridges, valleys, slopes, cliffs, and other variations in slope. There are many kinds of relief maps and the computers can create shaded relief maps automatically based on the digital information about the elevation of the land. Different lighting angles are used when creating relief maps. The aim is to reveal all the dominant structural elements in the region. Although there are different approaches to the lighting angles used in embossment maps, it is known that the lighting directions that change every 90 degrees (azimuth; 45 °, 135 °, 225 ° and 315 °) give good results (Süzen, 2012). When creating a linearity analysis map of the study area, a fault was drawn on the relief map. Because the fault was only the element of linearity in the study area. The relief map of study area was shown in the Fig. 7.



*Fig. 7. The relief map prepared for the study area*

#### IV. CONCLUSION

The GIS technology defined as a system capturing storing, analyzing, managing, and presenting data that are linked to location, is used in cartography, remote sensing, land surveying, photogrammetry, geography, urban planning, emergency management, navigation, and localized search engines. Modern geomorphological research is inextricably linked with geospatial technology and GIS. Driven by rapid technological advances of remote sensing, geodesy, photogrammetry, computer science, and GIS, the application of analysis tools using digital information on the land surface revolutionized quantitative geomorphological research. In this study, morphological characteristics of the Şanlıurfa (SE Turkey) were investigated by using GIS technology. According to the obtained results, the study area has some geomorphological structures. These geomorphological structures are the Upper Pliocene-Lower Pleistocene erosion surfaces, the Pleistocene sediments, the Holocene sediment fans and the valley floor plains. In general, there are erosion surfaces and high terraces in the north, southwest and west parts of the studied area, and slightly sloping floor flats and deposit ranges in the south and southeast parts.

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