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Landscape Cartography by using GIS. Case study in Gerona province (Spain)

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Abstract. The objective of this paper is the methodology development to get landscape of an area by using Geographic Information Systems (GIS) techniques and a verification afterwards by photographs taken from highways.

For this purpose, the method uses for this methodology is composed of the main components to describe the landscape, which are landform, vegetation, land use and special spaces. All these components are managed and mapped by using GIS, specifically the ArcGIS 9.3 (ArcMap and ArcCatalog). To do this, it is necessary to use both raster and feature formats. The methodology uses of various coverage extending from the contour, vertices surveying, dimensional points, administrative boundaries of the province, rivers and reservoir, vegetation and land use, human activity, aerial photo and protect area. All this information has been provided by the National Center for Geographic Information and Spain Europac. Also several ArcGIS 9.3 tools have been used, such as neighborhood statistics or surface analysis.

As a result, we apply the methodology to a specific area in Spain which is Gerona province to get landscape cartography. Afterward, we compere the landscape result with a pictures taking from AP7 highway in Gerona in order to verify that this classification corresponds with the reality.

Keywords: GIS, Landscape, highways, cartography.

1. Introduction

Nowadays the use of Geographic Information Systems (GIS) has increased and with that, the development of new technologies. Currently, there are several publications concerning to environmental and GIS [1, 2, 4, 6, 8, 9, 10, 12].

Although some GIS applications can get a very realist landscape because of using only informatics programs [1], this paper presents a mixed study by geographic information systems and knowledge of the real landscape. In order to have enough documentation from real scenery, we have taken photographs along the highway because we consider that lineal infrastructures are the best way to access and know the environment.

To carry out this proposal, we performed a practical study in the province of Gerona (Spain) taking the AP7 highway in this province such as observation areas which belong to Abertis Company that participate in OASIS (Operation of sustainability, intelligent and safety highways) project. This line infrastructure is distributed throughout the province from the south to the north have been photographed, and inventorying a variety of landscape.

2. Materials and Method

2.1. Material

In general, landscape cartography is developed based on aerial photographs from which its components are digitalized. To carry out this work is started from several coverages: contours, vertices surveying, dimensional points, administrative boundaries, rivers and reservoirs, vegetation, human activity, land use, aerial photo and protect area, which are obtained from download of National Centre for Geographic Information [3] and from Spain Europarc [5].

Afterwards data collection is made a map that integrated all the information simultaneously. To do this, we use commercial software of Geographic Information Systems (GIS), specially the ArcGIS 9.3. It is developed specifically for the graphic representation of the territory and can operate simultaneously with database and chart. These coverages are used in 31 time zone, working in both raster and feature systems, by using several applications, such as: neighbourhood statistic, surface analyst, editor, etc. in order to obtain a landscape classification cartographic of the province.

Afterwards this research, we have made field works in order to have photographic documentation of several areas of the province, with the purpose of verifying the resulting coverage with the reality. For this reason, we took panoramic photographs of 360º from the highway. At the same time than taking pictures from the car, we took position data using a GPS to georeference all the pictures and place them in the GIS.

2.2. Methodology

The study area is la Gerona province and its AP7 highway that communicates 93 km the Mediterranean coast from La Junquera to Hostalric (Fig. 1). This province is selected because it belongs to one of the pioneering Autonomous Communities in landscape in Spain.

Fig. 1: Map of Gerona province (Spain)

The landscape cartography consists of two maps: landscape of unprotected areas (natural or physical landscape components) and landscape of protected areas (composed of different types of special spaces).

First, influential components are identified in the landscape. These components are topography [2, 4, 7], vegetation [9,12], land use [9] and cultural resources [11].

Due to Gerona´s area (5,910 km^2) and some software and coverages limitations, the cartography is charted at regional scale, 1:200,000.

The following diagram (Fig. 2) shows the methodology developed for the preparation of the landscape cartography which is obtained from differentiating the landscape in protected areas (special attention areas) and unprotected (natural components).

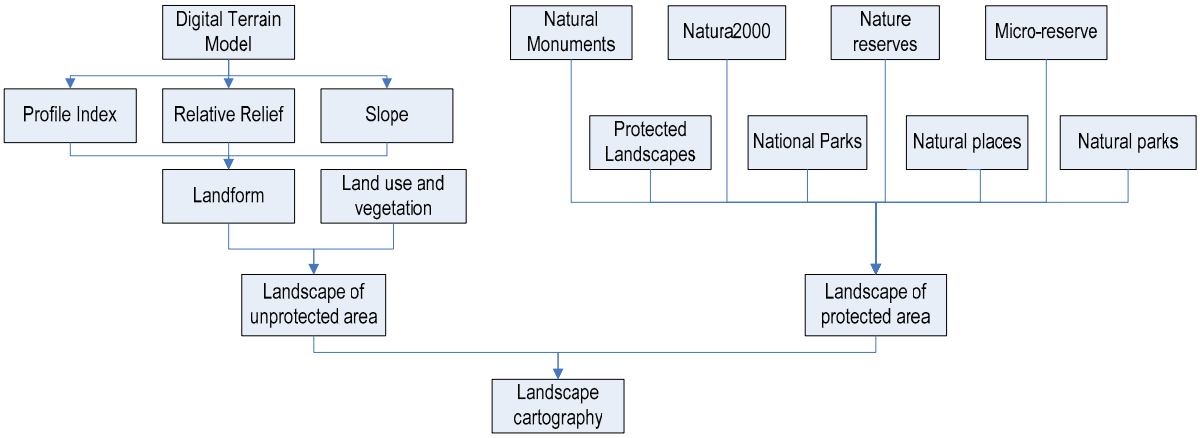

Fig. 2: Diagram of methodology developed for the preparation of the landscape cartography

The first phase of the methodology is the use of GIS to obtain a landform map. To do this, we based primarily on the methodology developed by Hammond [7], which was subsequently used with GIS by Dikau (1991) [4] in the Classification of the Landscape of New Zealand (Fig.3). Some modifications have been made due to the difference of surface and relief.

As Hammond [7], the methodology is mainly based on three parameters: the slope, the relative relief and the profile index. Each parameter is used to identify and classify some specific factors. In the case of the slope is intended to identify from plain to sloping areas; with the relative relief is estimated the relief with respect to a particular area, being able to identify the reliefs different heights; and the index profile is studied elevations from an area to surrounding areas.

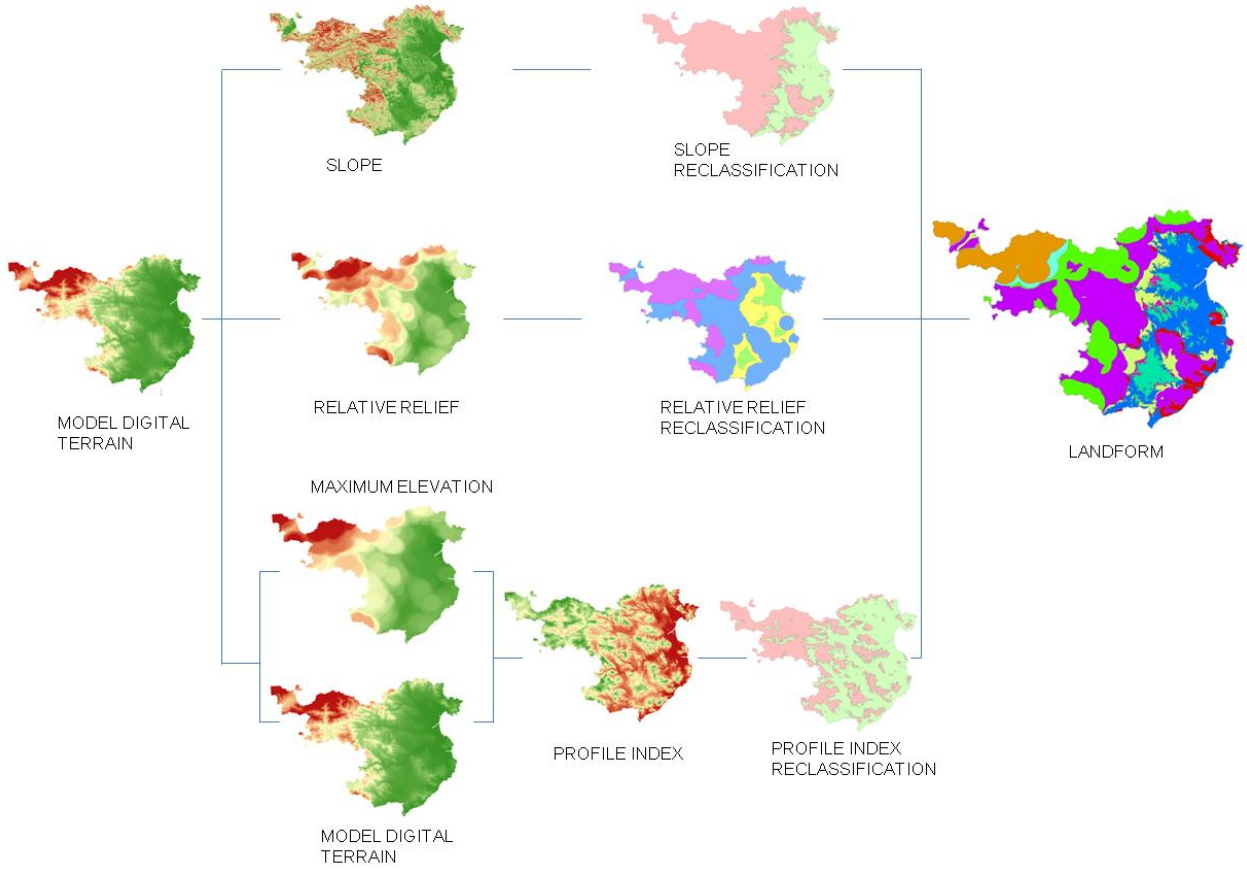

Fig. 3: Methodology to get landform by GIS [7]

By means of combinations of the three previous parameters, we obtain a classification of eight types of landform: plain, low altitude hill, hill, high altitude hill, mountain, low altitude plateau, plateau and high altitude plateau.

As mentioned above, other variables used to obtain the landscape of unprotected areas are vegetation and land use. To do this, we utilize the Corine Land Cover 2006 cartography that classifies uses and land cover at three levels. The first level is divided into five categories at the second and third level; the second level with 15 divisions grouped the 44 types of the third level. Second level is selected for the development of cartography. Below in Fig 4, is showing how to create the landscape of unprotected areas in the province of Gerona.

Fig. 4: Creation of the landscape of unprotected areas in the province of Gerona

To complete the landscape of unprotected areas is introduced the quantitative components to study of landscape areas for special attention [5]. To do this, we study the following parameters: natural monuments, protected landscapes, national parks, natural parks, nature reserves, Natura2000, micro-reserves and natural places.

With the union of the landscape coverages of unprotected and protected areas, we get the landscape cartography at the regional scale.

The result cartography is compared to the panoramic pictures taking from AP7 in order to know if the map represents the reality.

3. Result

As a result we obtain an automatic landscape classification of Gerona, and properly methodology to do this delimitation which is contrasted though the panoramic photographs. Hence, the landscape cartography represents the reality.

The following figure shows the creation of landscape cartography by means of joining unprotected and protected areas. In the case of the province of Gerona, 85 landscape units are obtained in 5,910 km^2.

Fig. 5: Creation of Landscape cartography by means of joining unprotected and protected areas in the Gerona province

It carries out through the interaction of all the coverages and their subsequent verification with field work to photograph and know in detail the study area. This work may be used for future work of the province such as environmental applications using GIS or study of the area.

4. Conclusion

After the verification with the reality though the panoramic photographs from the highway, the landscape cartography is be able to extrapolate the methodology applied to others places with similar or different superficies and also with another type of topography, vegetation and land use. It is only necessary to adapt some parameters depending of the project scale.

This tool is considered useful for further studies such as construction projects and environmental.

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