Urban models definition through Image processing and morphological features

The case study of Catalonia, Spain

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Keywords: Image processing, morphology, urban models, GIS, sprawl

Introduction

In the last few decades, urban sprawl refers to the outgrowth of urban areas caused by uncontrolled, uncoordinated and unplanned growth. The rapidity of urban dynamics has a significant impact on the spatial patterns associated with the growth and expansion of Spanish metropolitan areas [1]. The increase of large peri-urban areas, in the last decades, sprawled on the territory, inevitably has brought the cancellation of a clearly identifiable boundary between city and rural area [2]. In Mediterranean countries, the cultural landscapes created and maintained by traditional primary activities are rapidly becoming degraded due to abandoned land and villages, intensification of agricultural activities, and urban sprawl [3, 4].
Spain has been urbanizing large amounts of land, while the total population has hardly increased. This effect has been very important in the coastal scenery along the Spanish Mediterranean coast, where the actual dynamics in the urban growth process, strongly are requesting new ways to analyze and quantifying urban developing phenomena. In recent decades, there has been considerable debate in the Metropolitan Region of Barcelona, Catalonia, regarding the role of spatial planning in influencing general land-use trends. There is a widespread belief amongst geographers, environmentalists, planners and some politicians that spatial planning of the metropolitan region has not been particularly successful in reducing urban pressures on rural areas [5]. The great transformation of land use in Catalonia has generated changes in the structure and function of the landscape. There is less cultivated land, more forest area, and a more dispersed urban fabric. Small villages that were primarily rural until the mid-20th century have been converted into low-density residential suburbs [6].
Remote sensing methods have been widely applied in mapping land surface features in urban areas [7, 8]. In general, remote sensing techniques can provide spatially consistent datasets that cover large areas with both high detail and high temporal frequency, including historical time series. And together with GIS helps us to analyze the data spatially, offering possibilities of generating various options (modelling), thereby optimizing the whole planning process [9, 10]. These information systems also offer interpretation of physical (spatial) data with other socio-economic data, and thereby provide an important linkage to explore the

apparent links between urban sprawl, spatial planning and changing land use in the rural-urban fringe. Under these considerations, this study explores and discusses the use of modern technologies techniques to evaluate the capability of using image processing and morphological features indicators for mapping the urban models of Catalonia region in Spain.

Objectives

The techniques of satellite remote sensing and GIS are integrated to quantify and analyze land use and land cover models using Landat TM data. Under previous considerations, this investigation had three major objectives:

- Extracting urban areas and provides a methodology for automatically classification of continuous, based on the physical characters and through the use of remote sensing and geographical information system (GIS) techniques.
- Define agglomeration by using morphological indicators such as metrics of dimension, shape, density, dispersion, fragmentation of the composing parts of the urban structures.
- Automatically classify homogeneous areas, based on shape and distances indicators, by using cluster analysis, and consistently with conceptual models previously theorized depending on them concepts such as compactness and sprawl.
- A comparison between the obtained urban models, depending on different levels of complexity and compactness, or dispersion, of the settlements.

Data and Methodology

The first step is fixed on the remote sensing of artificial areas. Data sources will be based on the Landsat 7 satellite images taken from Global Land Survey 2000 collection, which provide multi-spectral images, at 30m, and panchromatic image at 15m [12]. Masked process was applied on the mosaic images by using the administrative boundaries of autonomous community of Catalonia (1).

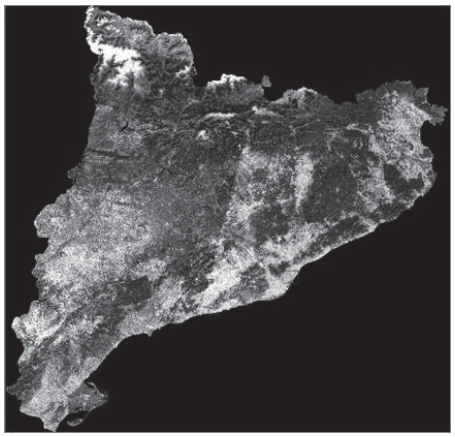

Figure 1: Landsat multi-spectral image of autonomous community of Catalonia

Pixel-based image analysis, drawing upon ENVI 4.2, was used to classify Landsat 7 images together with data derived from other image processing software. After the initial classification of different land cover uses, a subset of only artificial area was integrated. In coming processes will illustrate method to group between urban settlements based on inner distances and in particular concerning edge to edge distances.
Once defined urban agglomerations we applied indicators of morphology on the composing parts of the structures, and in particular we used indicators of dimension, shape, density, dispersion, fragmentation [13]. Based on the previous results, cluster analysis was applied to define automatically the homogeneous areas consistently with conceptual models previously theorized depending on them concepts such as compactness and sprawl.
Additionally, it will discuss about the degree of physical continuity of settlements in order to clarify the strong and weak relations between urban areas [16]. Finally we will map the results for Catalonia in order to better understanding the actual trend of urbanizing phenomena in the generation of the models of land occupation.

Acknowledgments

This paper was developed as part of conducted research under Project "DEVELOPMENT OF A PLATFORM FOR THE PROSPECTIVE MODELLING OF PROCESSES OF URBANISATION IN COASTAL AREAS", the authors acknowledge the financial support from the Spanish Ministry of Science and Technology, MICINN, Call for aid in the Fundamental Research Project unoriented, en el in the context of some national programs of I+D+i (2008-2011). Call 2009. (CSO2009-09057).

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