Mapping and Monitoring of urban growth using remote sensing imagery analysis: the case of Chania, Crete

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Urbanization is an anthropogenic phenomenon that has been recognized as a threat to human health, to social relations, to climate, to natural environment and to economy. Urban development has profound effects on biodiversity and ecosystem functioning at local, regional, and global scales. Thus, being able to map the urban areas and monitor urbanisation trend is of highly importance to both scientists and policy makers.

Traditional methods for urbanisation mapping based on gathering demographic data, censuses and maps using samples are impractical and unsatisfactory for urban management purposes. However, remote sensing and Geographic Information Systems (GIS) can help to solve these problems by providing up-to-date spatial information. The present study aims to study the urban expansion of the city of Chania for a period of 20 years based on multispectral remote sensing imagery analysis. Chania is located in the island of Crete in Greece and the second on population city of the island. Crete is a great tourist destination with special natural landscape and large agricultural production.

Urban expansion mapping for the study site has been based on a time series analysis of Landsat TM images and a GIS built up to facilitate an efficient data analysis. The use of image classification applied to the TM observations for mapping urban growth is examined. As a means of accuracy assessment, the resulting land cover estimates were compared with independent estimates obtained from the visual interpretation of digital orthophotography of the Landsat TM images. An attempt is also made to relate results from this study to any relevant for the study area significant social, economic, political, scientific, natural phenomena and events.

KEYWORDS: urbanisation, urban growth, Landat TM, image classification, Crete, Greece

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1. INTRODUCTION:

Urbanization is an anthropogenic phenomenon that has been recognized as a threat to human health, to social relations, to climate, to natural environment and to economy. Urban development has profound effects on biodiversity and ecosystem functioning at local, regional, and global scales. Thus, being able to map the urban areas and monitor urbanization trend is of highly importance to both scientists and policy makers. The present study aims to study the urban expansion of the city of Chania and the wider area around it, for a period of 35 years based on multispectral remote sensing imagery analysis.

Figure 1: Chania Prefecture, aerial photo

2. STUDY SITE:

Chania is located in the island of Crete in Greece and is the second on population city of the island. Crete is a great tourist destination with special natural landscape and large agricultural production.

3. DATA:

Urban expansion mapping for the study site, has been based on a time series analysis of Landsat TM, Landsat MSS images and a GIS data base, which was built up to facilitate an efficient data analysis. There were used images of the dates: 1975, 1984, 1990, 2000 and 2010.
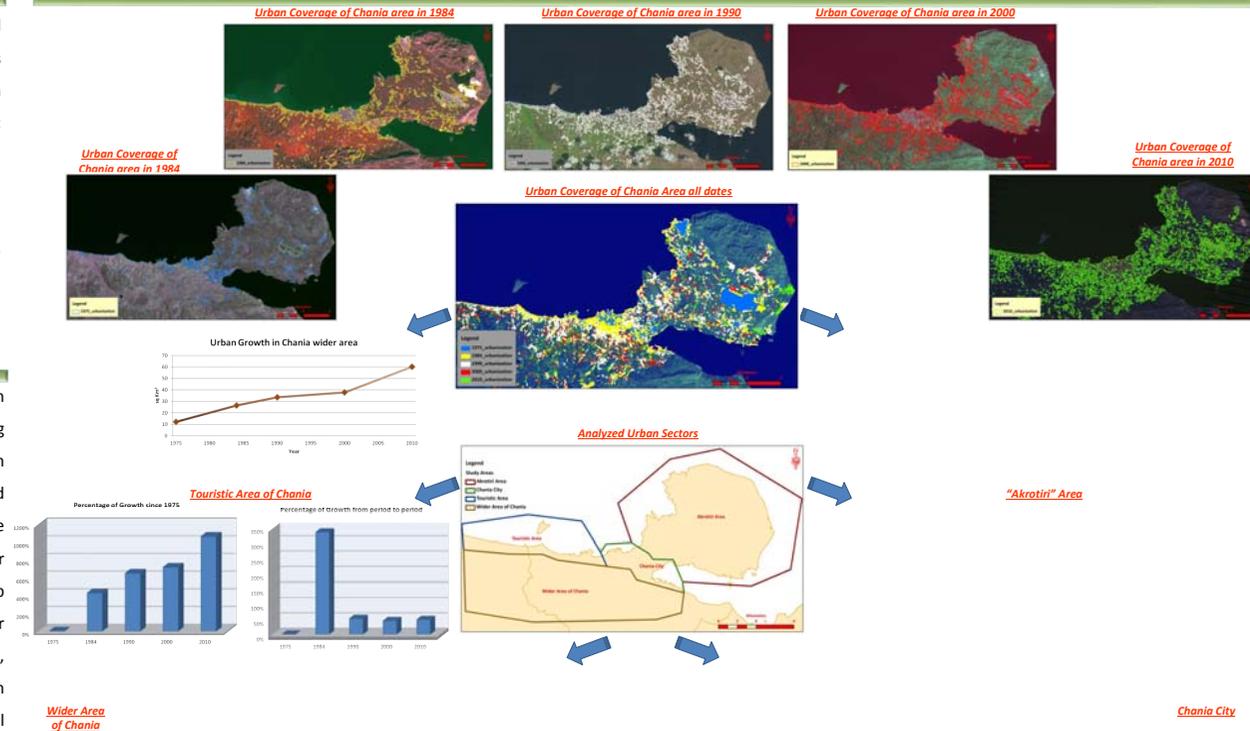

Figure 33 Chania Prefecture, Landsat TM 2010

4. METHOD:

Traditional methods for urbanization mapping based on gathering demographic data, censuses and maps using samples are impractical and unsatisfactory for urban management purposes. However, remote sensing and Geographic Information Systems (GIS) can help to solve these problems by providing up-to-date spatial information. For this project the image classification, using Arc Map conversion tool, applied to the TM and MSS observations for mapping urban growth. As a means of accuracy assessment, the resulting land cover estimates were compared with independent estimates obtained from the visual interpretation of the Landsat TM images.

5. RESULTS:

Urban Coverage of Chania area in 1984
Urban Coverage of Chania area in 1990
Urban Coverage of Chania area in 2000
Urban Coverage of Chania area in 1984
Urban Coverage of Chania Area all dates
Urban Coverage of Chania area in 2010
Urban Growth in Chania wider area
Analyzed Urban Sectors
Touristic Area of Chania
Percentage of Growth since 1975
Percentage of Growth from period to period
"Akrotiri" Area
Wider Area of Chania
Chania City

6. CONCLUSIONS

Analyzing the urban growth of Chania city and the wider area, interesting conclusions are arising. Since 1975 till 1984 and then till 1990, there was a steep growth of the urban area, almost 150% during 16 years. A more smooth growth there was found from 1990 till 2000 and meaning 13% during the 10 years and another steep growth the last 10 years till 2010 that was measured almost 60%. Two very important events were took place in 1974 and in 2001-2002. In 1974 strong social and political events took place that effected the social structure and in 2001-2002 Greece joined the Euro Zone. Both events brought structural changes in the economy and as a result was the financial development. Financial growth drove the development of the country and the communities in all directions.

An interesting part of the analysis is how the sectors of the area developed. All sectors followed the 1st steep growth from 1975 to 1990. The touristic area that used to cover the 6% of the urban area has more than 1000% urban growth till 2010 and now covers the 12% of the urban area. The city of Chania was expanded over 350% the last 35 years with the 250% performed till 1984. The south-east part of the study area is expanded more than 1600% following a smooth urbanization with average 120% each period. This growth was effected by the national road construction which started in 1990. Finally in Akrotiri area the growth reaches the 300%. From the chart we define 2 periods of growth, the second (56%) was effected by the University of Crete that was built in the area. Land uses, environment, ecosystem, climate changed.

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