A MORPHOMETRIC ANALYSIS USING GIS TO DEDUCE GEOMORPHOLOGICAL PROCESSES - NATURAL HAZARDS, AT ZAKYNTHOS ISLAND

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ABSTRACT

In order to understand the geomorphic processes on the island of Zakynthos, we made an altimetric and slope analysis in GIS environment. The spatial distribution of these variables reflects tectonic, erosional processes and vegetational distribution. The existance of environmental alteration is mainly due to natural processes and human impact. In the first factor we included mass movements, soil and coastal erosion and flood events caused by the increased erosion due to the local fires, while in the second tourism growth, wastes, mining, etc. Such analysis can be used in local and regional level to develop long term environmental policies and prevent landscape deterioration.

ΜΟΡΦΟΜΕΤΡΙΚΗ ΑΝΑΛΥΣΗ ΜΕ ΧΡΗΣΗ GIS ΓΙΑ ΤΗ ΜΕΛΕΤΗ ΓΕΩΜΟΡΦΟΛΟΓΙΚΩΝ ΔΙΕΡΓΑΣΙΩΝ - ΦΥΣΙΚΩΝ ΚΑΤΑΣΤΡΟΦΩΝ ΣΤΗ ΝΗΣΟ ΖΑΚΥΝΘΟ

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ΠΕΡΙΛΗΨΗ

Με στόχο την κατανόηση των γεωμορφολογικών διεργασιών στη νήσο Ζάκυνθο, πραγματοποιήσαμε ανάλυση υψομέτρων και κλίσεων με τη χρήση GIS. Η χωρική κατανομή αυτών των μεταβλητών αντανακλά τις τεκτονικές και διαβρωσιγενείς διεργασίες, καθώς και την κατανομή της βλάστησης. Η ύπαρξη περιβαλλοντικών εναλλαγών οφείλεται κυρίως στις φυσικές διεργασίες και στις ανθρωπογενείς επιδράσεις. Τέτοιου είδους αναλύσεις μπορεί να χρησιμοποιηθούν σε τοπικό και περιφερειακό επίπεδο για την ανάπτυξη πολιτικής περιβάλλοντος.

Introduction

The island of Zakynthos is characterized by two "isopic zones" the Pre-Apulian and the Ionian zone (Aubouin, J., Dercourt, J., 1962) and post Alpine deposits (Horstmann, G., 1967, Mirkou, R.M., 1974, Sorel, D., 1976, Dermitzakis, M., et al, 1977, Dermitzakis, M., 1977, Underhill, J., 1989). Muller-Miny (1965) made the first geomorphological observations of the island of Zakynthos.

The structure of the island and the distribution of the different lithologies (limestones, marls, evaporitic rocks, allouvials), the climate conditions, determinate the geomorphology of this island.

The main geomorphological units in the island of Zakynthos are a) the Vrachionas mountain in the western part, b) the intermediate unit from Alikes to Laganas, c) the Skopos mountain in the southeastern part of the island.

The aim of this paper is to deduce geomorphological processes and natural hazards using morphometric analysis.

Methodology

The first step in this work was the collection of the data concerning topography, (scale 1:50.000, Geographical Military Service), geology (1:50.000, Institute of Geology and Mineral Exploration) and information from fieldwork relative to vegetation distribution and the occurrence of natural hazards.

The second step was the conversion of primary data in digital format and the creation of the corresponding databases.

The third step was the analysis of these data. This step includes the slope calculation in the whole island (Fig. 1), using a 250m cellular grid. The other information layers were also used in order to complete the cell data base. Each cell was updated with information from external database concerning fields such as vegetation and lithology.

The final step was the construction of different thematic maps and diagrams to present and analyse the geomorphological processes and the natural hazards of the island.

The morphometric analysis

The automation of geomorphometry using GIS techniques is a very important tool in the analysis of the landscape parameters. The island's slope analysis (Chart 1) showed the domination of low values that range from 0 to10%. Table 1 shows the number of cells (size of 0,0625 Km^2) within given % slope ranges.

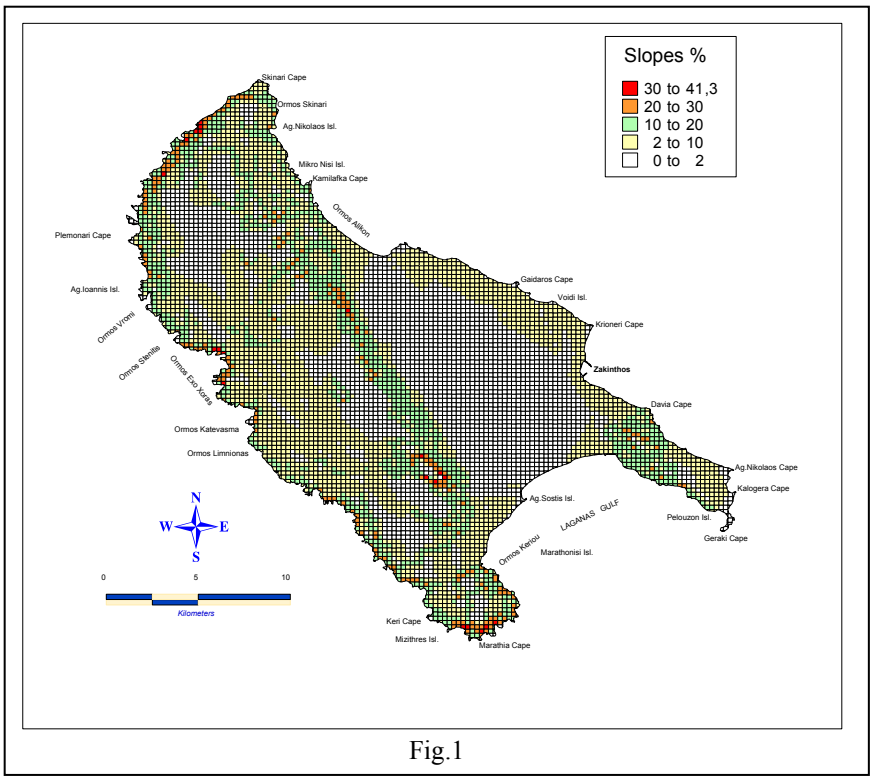
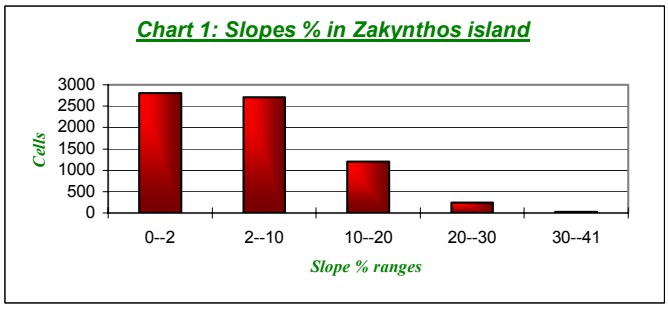


Fig.1

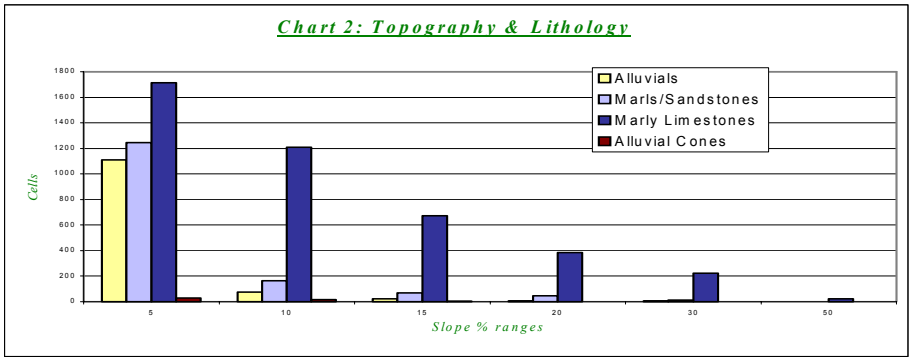
Moreover we have correlated the slope distribution with the lithological units (Fig.2, Chart 2) and it is evident that the allouvial and marl formations are present in low slopes, the allouvial cones in medium, while the limestone formations in medium and high slopes. Chart 2, shows the slope distribution in the four lithological categories. The category "Marly limestones" covers the biggest part of the island and due to this, gives the maximum values.

TABLE 1	
Slopes %	
Slope Range	*Cells*
0-2	2.801
2-10	2.714
10-20	1.200
20-30	240
30-41	21

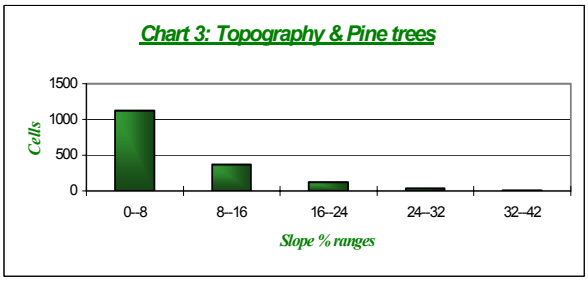
The vegetation distribution is also related to the lithological factor (fig.3), the geomorphology (fig.4) and the local climatic conditions. In figure 3 we may observe the relation between the lithological formations and the



vegetational cover. It is obvious (Charts 3,4,5) that the categories of Pine trees and

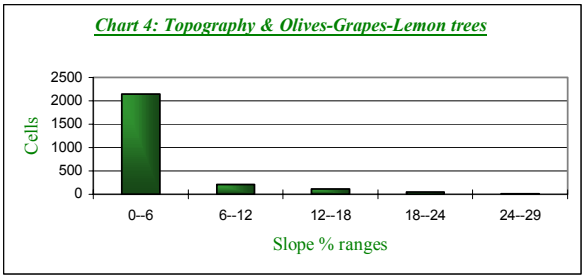


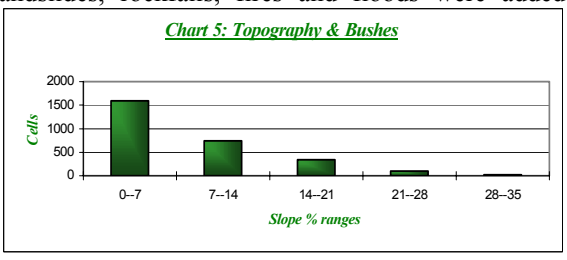
olives, grapes and lemon trees are mainly correlated low topographic slopes. The category of Bushes mainly appears in low slopes values, but it has a more normal



distribution as is shown in the following chart (chart 5). Figure 4 shows that all categories of vegetation are present in low topographic slopes, while only bushes are developed in high slopes.

The dominant erosional process depends on the topography, the drainage development, the geology and the climate. In the island of Zakynthos these processes are also controlled by the occurrences of fires. Figure 5 shows the existence of the main natural hazards and their relation to the vegetation distribution. In this map we present the earthquake epicenters and the disasters that have occurred. Moreover, major dissaster events as landslides, rockfalls, fires and floods were added to this map. According to the information retrieved from the data base, the flood event in Katastari village has happened slightly after the major fires in the surrounding area destroyed most of the vegetation.





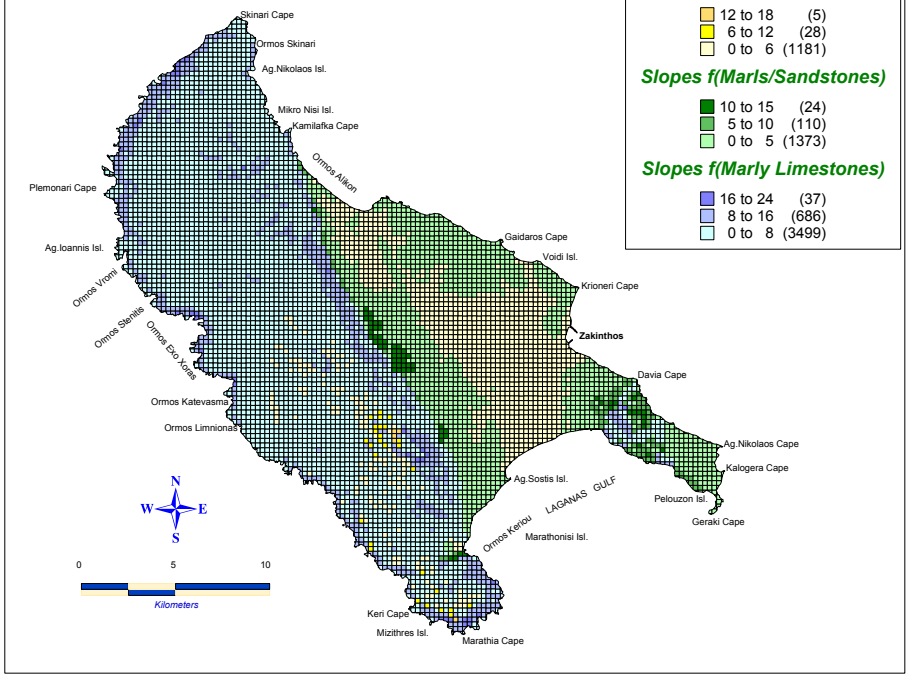

Slopes f(Allouvials)
12 to 18 (5)
6 to 12 (28)
0 to 6 (1181)
Slopes f(Marls/Sandstones)
10 to 15 (24)
5 to 10 (110)
0 to 5 (1373)
Slopes f(Marly Limestones)
16 to 24 (37)
8 to 16 (686)
0 to 8 (3499)
Skinari Cape
Ormos Skinari
Ag.Nikolaos Isl.
Mikro Nisi Isl.
Kamilafka Cape
Ormos Alikon
Plemonari Cape
Ag.Ioannis Isl.
Ormos Vromi
Ormos Stenitis
Ormos Exo Xoras
Ormos Katevasma
Ormos Limnionas
Gaidaros Cape
Voidi Isl.
Krioneri Cape
Zakinthos
Davia Cape
Ag.Nikolaos Cape
Kalogera Cape
Ag.Sostis Isl.
LAGANAS GULF
Pelouzon Isl.
Geraki Cape
Ormos Keriou
Marathonisi Isl.
Keri Cape
Mizithres Isl.
Marathia Cape
N
W
E
S
0
5
10
Kilometers

Fig.2

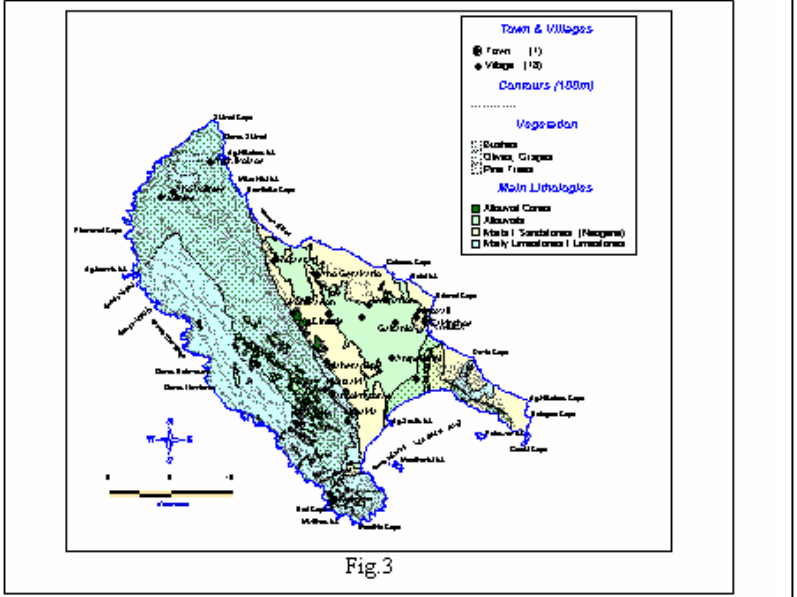

Town & Villages
Town (1)
Village (10)
Contours (100m)
Vegetation
Bushes
Olives, Grapes
Pine Trees
Main Lithologies
Alluvial Cones
Alluvials
Marls | Sandstones (Neogene)
Marly Limestones | Limestones

Fig.3

Conclusions

The island's morphology is strongly affected by the tectonic activity. The slope distibution shows that areas with high slopes are associated with the main large faults of the island. A characteristic example is the slope category 10-20% that appears as a linear stucture in figure 1. Eastern of this linear stucture, topographic slopes are very

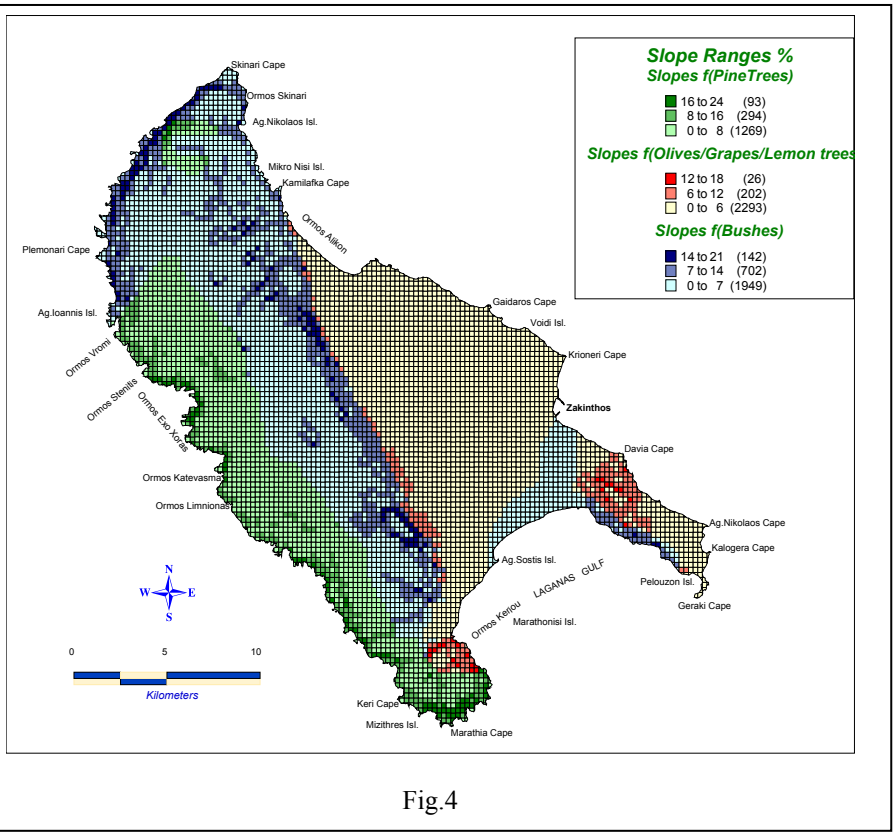


Fig.4

low (0-2%).

Natural hazards in Zakynthos island are stongly associated to other hazard events. It is obvious that both earthquakes and general tectonic activity in combination with the morphology of the area (high slopes), produce other hazards, such as rockfalls and land-slides. Moreover, fire events result to floods and erosion problems. Finally vegetation distribution is related to slope, lithology and natural hazard distribution (Fig. 3, 4, 5).

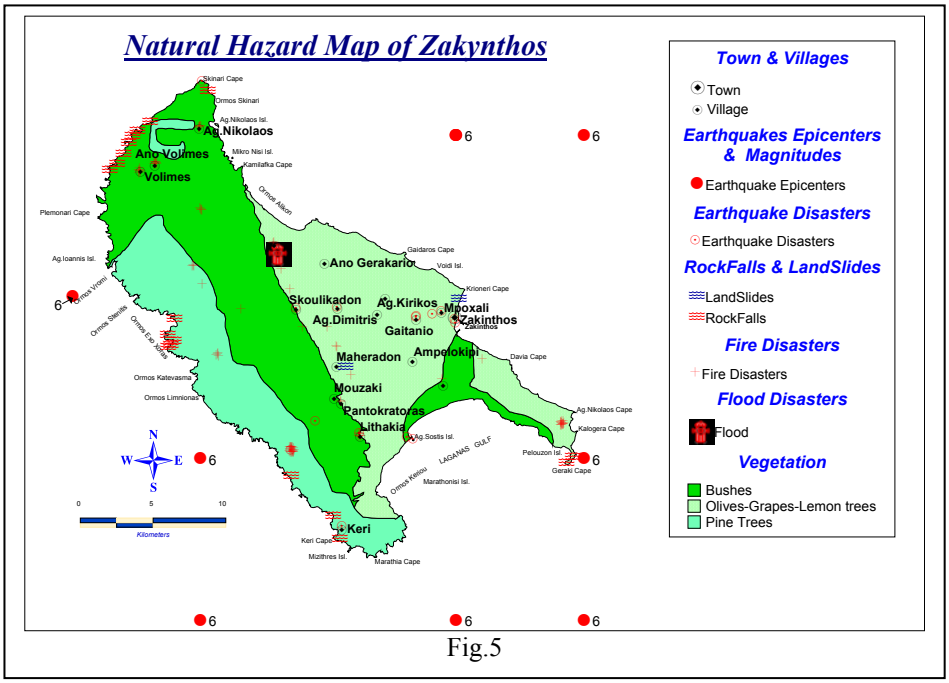


Fig.5

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