AN APPLICATION OF GRASS TO THE STUDY OF THE ANTROPIC PRESSURE ON THE ITALIAN COASTS

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1. INTRODUCTION

The coastal environment represents a complex natural system strongly conditioned both from the anthropic action and the natural agent. It is closely connected to the fluvial net that, with its solid contribution, feeds the beaches, balancing the destructive action of the seas storm. During the last few decades the deterioration of the coastal environment is exploded on world-wide scale in all its gravity. An obvious effect is the regression of the river line and the set up of the erosive phenomena. The natural balance of a coast field can be remarkably modified from the man action both taking part on the solid transport of the water course and constructing dams along the rivers, and from a wrong management of the beaches, construction for defence of the same-selves which paint-brushes, artificial reefs. other obstructions, and with the elimination of the flora of dunes and the removal of certain marine plants that, in many cases, act just as defender of the sand, and with the realization of several infrastructures for tourist installations, wharves, etc. Moreover during the last century the Italian coastal system has assisted to a strong anthropical process that has remarkably transformed the natural and environmental territory. The realization of great streets and railway infrastructures, often too much close to the beaches, and the numerous processes of urbanization that have carried to the expansion of the coastal cities, have constituted the assumption of the creation, in the greater part of the territory, of a linear coastal takeover. In spite of this constant aggression, our coasts still conserve elements of important naturalness, that must be conserved and appreciates. They are constituted from morphologic and environmental emergencies that interrupt the linear city agglomeration. Therefore a clean radical change of direction on the politics of development of the coastal city centers become necessary to safeguard and to appreciate the little areas still not built up. In Italy there are beaches that withdraw rapidly for metres. The coast is more and more used as an endless and indestructible good on which to work indefinitely without any consequence. This delicate sector has been progressively attacked instead of managing it as a precious good that should last for along time in order to have a better economic result. In order to favour a constant monitoring of anthropic impact in Italian coasts has been elaborated an informatic tool that helps to see the actual situation and to control constantly its evolution in time.

2. METHODOLOGY

The purpose of this study is to get a numerical quantification and in percentage terms of the problems of coastal anthropic impact and to provide a methodology to analyse risks on Italian coasts. The data consists of the following elements:

- Italian coast line, UTM-WGS84, scale 1:25.000, vectorial format;
- Layer of Italian communes, UTM-WGS84, scale 1:25.000, vectorial format;
- Italian DEM, 20 meters of details, raster format;
- Corine Land Cover (CLC2000), Italian land use, year 2000, scale 1:100.000, vectorial format. Level of deepening: 3;
- Italian hydrography 1:250000, vectorial format.



The Corine Land Cover. From 1985 to 1990 the European Commission has realized the CORINE Programme (Coordination of Information on the Environment) with the main aim to obtain harmonized and coordinated environmental information to European level. Besides collecting geographic data base in harmonized shape (coasts, administratives limitations, industries, nets of transport, etc.), the CORINE Programme previews the analysis of the more important environmental parameters which the cover and use of the soil (CORINE Land cover), atmosphere emissions (Corineair), the definition and the extension of natural environment (CORINE Biotopes), mapping of the erosion's risks of the soil (CORINE Erosion). The Corine Land Cover (CLC) is an integrated plan of

the CORINE Programme specifically devoted to the survey and the monitoring, t a compatible scale with the communitary needs, of the characteristics of the territory, with particular attention to the protection requirements. The objective of the CLC is to supply information about the cover of the soil and its changes in time. The information are comparable and homogenous for all the countries. The cartography of the soil cover makes reference to spatial units, either homogenous or composed by elementary zones that belong to a same class of meaningful surface regarding the scale. The cartography is at 1:100.000 scale, with a legend of 44 voices on 3 hierarchical levels. The first level comprises 5 generl classes embracing the principal cover categories on the planet (artificial surfaces, agricultural areas, forest and seminatural areas, wetlands and water bodies). The second level has a legnd of 15 voices and the third level of 44 voices. The legend, proposed as immutable for reasons of homogeneity to European level, can be integrated to subsequent levels of deepening at a regional scale.

LEVEL 1	LEVEL 2	LEVEL 3
	1.1 Urban fabric	1.1.1 Continuous urban fabric
1 Artificial surfaces		1.1.2 Discontinuous urban fabric
	1.2 Industrial, comercial and transport units	1.2.1 Industrial or commercial units
		1.2.2 Road and rail networks and
		1.2.3 Port areas
		1.2.4 Airports
	1.3 Mine, dump and	1.3.1 Mineral extraction sites
	construction sites	1.3.2 Dump sites
	1.4 Artificial, non-	1.4.1 Green urban areas
	agricultural vegetated areas	1.4.2 Sport and leisure facilities
2 Agricultural areas	2.1 Arable land	2.1.1 Non-irrigated arable land
		2.1.2 Permanently irrigated land
		2.1.3 Rice fields
	2.2 Permanent crops	2.2.1 Vineyards
		2.2.2 Plut trees and berry plantations
	2.3 Pastures	2 3 1 Pastures
	2.4 Heterogeneous agricultural areas	2.4.1 Annual crops associated with
		permanent crops
		2.4.2 Complex cultivation patterns
		2.4.3 Land principally occupied by
		agriculture, with significant areas
		of natural vegetation
3 Forest and seminatural areas	3.1 Forests	3.1.1 Broad-leaved forest
		3.1.2 Coniferous forest
		3.1.3 Mixed forest
	3.2 Scrub and/or herbaceous vegetation associations	3.2.1 Natural grasslands
		3.2.2 Moors and heathland
		3.2.3 Sclerophyllous vegetation
		3.2.4 Transitional woodland-shrub
		3.3.1 Beaches, dunes, sands
	3.3 Open spaces with little or no vegetation	3.3.2 Bare rocks
		3.3.3 Sparsely vegetated areas
		3.3.4 Burnt areas
and the second		4.1.1 Inland marshes
	4.1 Inland wetlands	T.T.T manu maisnes
		4.1.2 Peat bogs
4 Wetlands		
	4 O Manifirm	4.2.1 Salt marshes
	4.2 Maritime	4.2.2 Salines
and the second second	weadings	5.1.1 Water courses
	5.1 Inland waters	5.1.2 Water bodies
5 Water bodies	And the second second	5.2.1 Casatal Janaana
	5 2 Marine waters	5.2.1 Coastal lagoons
	o waters	

In order to study an area including all the coastal communes, we will consider all the communes in a range of 10 km from the line of coast towards hinterland. Once fixed the area to analyze and created a new layer, it will be possible to determine, for any commune, the typology of land use. We will study the dimension of anthropic process in every single commune on the Italian coastal system. Later, some kind of risk, such as, for example, sea-storms and river overflow, will be also analyzed.

3. THE PROTOTYPE

A prototype of the study outlined in the previous section has been realized through GRASS, release 6.1. We here present some details of the study concerning the Isle of Elba. We have imported the coast line, the Italian communes and the CLC of Elba in shape size by using the "v.in.ogr" tool.



Around the line of coast a buffer of 1 km has been built

by using the "v.buffer" tool. The "v.overlay" tool has been used to perform an <u>and</u> that is an intersection between the buffer and the communes. In this way the layer of the



communes within 1 km buffer has been produced. The same action has been made with the buffer and the

CLC, thus obtaining the layer of CLC within 1 km buffer. By using the function \underline{or} of the "v.in.ogr" tool the union between the communes and the CLC has been performed, producing a new layer with the data of both the source layers.



Then we have analyzed the anthropic phenomena obtaining the layer of percentage of artificial surfaces compared with the communal surface of a portion of Italian coast to examine.



The next Section will be devoted to discuss, by considering some communes located on the whole Italian coast line, the representation of the dimension of the anthropic modelling process. Here, we now pass to illustrate the metodology adequate to perform a further study concerning the analysis of the risks on the Italian coasts.

A first kind of considered risk has been sea-storms. To analyse this kind of risk the Italian DEM has been imported. A classification of the shares adequate at the study has been adopted and joined to layer of the Communes-CLC, thus obtaining a layer including the informations integrating Communes, CLC and shares.



In black are highligted the areas subjected to the sea storm risk, that is, those coastal zones falling back in the first two bands of the classification of the shares (0-1m, 1-2m) with a stronger anthropic concentration, in particular category 1.1 of the CLC (urban fabric).

Another type of risk considered it has been the one of the river overflow phenomenon. In order to analyze this type of risk it has been created the Slope. Such information has been inserted in the hydrographic layer obtaining, for every river, a segmentation deriving from the slope. Later, the overflow risk level for every river has been estimated, calculating the percentage of slope in proximity of the coasts.



In black an area that presents an high sensibility to the river overflow phenomenon is evidenced. The sensibility has been calculated by considering the slope percentage of the rivers that intersect the artificial surfaces.

4. THE ANTHROPIC PHENOMENA STUDY

For what concerns the analysis of the soil use of Italian coast line of 10 Km, from the calculation of the percentage of the soil use in the first level of Corine Land Cover (in which the use of the soil comes subdivided in 5 classes) turns out, as it can be noticed from the graph to cake, that 58.7% of the coastal territories is occupied from agricultural areas, 32.4%

from forest and seminatural areas, 6.6% from artificial surfaces, remaining 1.6% from water bodies and 0.8% from wetlands.

Percentage of the soil use in Italian coast line.



Therefore we calculated the percentages of soil use, always in Italian coast line, relative to artificial surfaces for every commune.

A further study concernes the calculation of the value of the areas and of the percentage of level 3 regarding level 1, considering, for artificial surfaces, continuous urban fabric, discontinuous urban fabric, industrial or commercial units, road and rall networks and associated land, port areas, airports, mineral extraction sites, dump sites and excluding green urban areas and sport and leisure facilities (1.4.1 and 1.4.2) which resulted not much useful for the purposes of this study. Therefore it has been calculated also the area and the percentage of level 2 regarding level 1 considering: urban fabric, industrial, commercial and transport units, mine, dump and construction sites.

In this way we obtained the percentage of the soil use in Italian seaboard and those relative to the artificially modelled territories in every municipal district and type of anthropic process which characterizes the place.

Finally we examined three simple towns with different distribution of the soil use and, in order to draw the attention to the different percentages, we created the graphics of the three levels of the Corine; the towns considered are: Genova, Maratea and Porto Torres.

In the graphics we observe for example that the commune of Genova has an high percentage of artificial surfaces (26%), a lot of these is made up by urban fabric (84%) and, in detail, of discontinuous urban fabric (71%).

Percentage of the soil use in Genova coast line 1° level Corine Land Cover



Percentage of the soil use in Genova coast line 2° level Corine Land Cover



Percentage of the soil use in Genova coast line 3° level Corine Land Cover



The commune of Maratea has only 2% of artificial surfaces distributed among urban fabric (45%) and industrial, commercial and transport units (37%), precisely between discontinuous urban fabric and industrial or commercial units.

Percentage of the soil use in Maratea coast line 1° level Corine Land Cover



Percentage of the soil use in Maratea coast line 2° level Corine Land Cover



Percentage of the soil use in Maratea coast line 3° level Corine Land Cover



Finally, the commune of Porto Torres presents 14% of artificial surfaces and most of them is made up of industrial, commercial and transport units (70%), or to say better of industrial or commercial units (48%) and port areas (23%).

Percentage of the soil use in Porto Torres coast line 1° level Corine Land Cover



Percentage of the soil use in Porto Torres coast line 2° level Corine Land Cover



Percentage of the soil use in Porto Torres coast line 3° level Corine Land Cover



5. CONCLUSIONS

A methodological approach to the study of the anthropic impact on the Italian coasts by using GRASS has been presented. For the Authors it has been the first application of GRASS and, in some sense, it has constituted a sort of experiment with a double goal: (1) testing the adquateness of GRASS to our needs and our skill; (2) testing the quality of the results obtained. The results obtained agree with the study performed by using other technologies, so we consider GRASS reliable. An additional effort has been necessary in order to use the GRASS commands, whose 6.1 release results to be a bit less friendly with respect to other tools. However, we found good answers to both the goals and we expect in the next future to extend this experience to other applications.