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TRANSFORMATION THROUGH CLC WITH THE CONTINUOUS RESEARCH TECHNIQUES - GIS (OPEN CODE) AND RS (GEO-WEB SERVICES)

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Abstract. Land cover has always been and still it is one of the main challenges in the field of geography. This study will be focused on “experimentation” of one of the most modern techniques of our time, becoming irreplaceable standard for decision-making in matters of land cover and the square method. Here we are talking about the standard named: CORINE Land Cover, a technique for describing the land cover, initiated by the European Union in 1985. More precisely part of this paper will be the principles of this technique and their practical application, by doing a research through these techniques for specific areas. CORINE Land Cover will be used to explain the coverage area while the square method will be used for the division of the research area. The research area has been designed through random method. In this study are given three study areas along the coastline with an area of 100 km², by making the entire research area of 300 km². Each “main” area is divided in sub-areas of 100 ha, while each of these sub-areas is divided into smaller squares with equal area of 1 ha.

There are two “main experiments” in this paper:

1. Land cover technique – to design the minimum research area we used the method of square, while for explaining the coverage we used CORINE Land Cover nomenclature.
2. Technology to implement the technique – we used the so called open source GIS software and for satellite images we used Google geo-web service.

Hypothesis and working method

Before the beginning of this research, two hypotheses have been raised:

1. Despite the techniques and technologies used to reach the GJBDH for land cover, the result for the given territory should be roughly the same.

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2. The land cover in the three study-sample areas will be uniform, exactly the ratio surface-category will be more or less the same for each sample area.

The study itself is divided into several main parts:

The part that deals with research methods and analysis of the study. In this study were used the following: GIS method, statistical one- for extracting sample and field observation method to confirm the classification made by GIS and RS;

The part that deals with the designation of the study area through the random method, namely the designation of three study areas along the Albanian coastline, with an area of 100 ha for each of the areas, with a total study area of 300 ha.

Nowadays the implementation of the Geographic Information System can in practice be made by a wide range of international software systems, which have gained users in almost all sectors of industry, academic and governmental ones.

As with other programmes /software, within GIS we also have two types of softwares in terms of their licensing, distribution and other functions:

- Software produced by large GIS companies, mainly with **encrypted codes** such as: ESRI products; MapInfo products; Geomedia etc;
- Software produced by large GIS companies, as well as various independent experts, mainly **open source** programmes such as: Quantum GIS (QGIS); Grass; Jump GIS; GeoServe etc;



Fig. 1 Map of the research cases along Albanian coastline

In the academic world, mainly for research but also because of the issue of product license requirement for some GIS applications, the use of “**open source**” GIS applications is spreading at large.

In our research with open source software we conducted the main processes of this research.

5. We created the vector base;
6. We have created an alphanumeric base;
7. We have created thematic maps;
8. We have used geo-web services for satellite imagery;
9. We have produced alpha-numerical and graphical analysis;

Exactly we have created three main files, one file for each study area-example.

In the research and analysis of processes, phenomena and spatial elements , Geo-web services or geospatial web-services that deal with geographic data are modern and irreplaceable tools in contemporary geography .

These web services provide:

1. Access to the geographic information database;
2. Perform geographic calculations;
3. Perform complex geographic calculations;
4. Transform alphanumeric and geographic messages;

The communication between the client and the web-service is mainly done in this way:

- ✓ The client contacts the server and requires the service functions;
- ✓ The server shows a list with the services provided;
- ✓ Client requests data;
- ✓ The server shows the data;
- ✓ WMS - Web Map Service
- ✓ This service generates maps and converts them into images (raster);
- ✓ Type of answer: RASTER;
- ✓ WFS - Web Feature Service
- ✓ This service generates geographic entities. If the service is a 'transaction' then data manipulation is also allowed;
- ✓ Type of response: VECTOR;
- ✓ WCS - Web Coverage Service

Tab 1. Nomenclature of CORINE Land Cover detailed with levels and categories

Level 1	Level 2	Level 3
1 Artificial surfaces	11 Urban fabric	111 Continuous urban fabric 112 Discontinuous urban fabric
	12 Industrial, commercial and transport units	121 Industrial or commercial units 122 Road and rail networks and associated land 123 Port areas 124 Airports
	13 Mine, dump and construction sites	131 Mineral extraction sites 132 Dump sites 133 Construction sites
	14 Artificial, non-agricultural vegetated areas	141 Green urban areas 142 Sport and leisure facilities
	21 Arable land	211 Non-irrigated arable land 212 Permanently irrigated land 213 Rice fields
2 Agricultural areas	22 Permanent crops	221 Vineyards 222 Fruit trees and berry plantations 223 Olive groves
	23 Pastures	231 Pastures
	24 Heterogeneous agricultural areas	241 Annual crops associated with permanent crops 242 Complex cultivation patterns 243 Land principally occupied by agriculture, with significant areas of natural vegetation 244 Agro-forestry areas
	31 Forests	311 Broad-leaved forest 312 Coniferous forest 313 Mixed forest
3 Forest and semi natural areas	32 Scrub and/or herbaceous vegetation associations	321 Natural grasslands 322 Moors and heathland 323 Sclerophyllous vegetation 324 Transitional woodland-shrub
	33 Open spaces with little or no vegetation	331 Beaches, dunes, sands 332 Bare rocks 333 Sparsely vegetated areas 334 Burnt areas 335 Glaciers and perpetual snow
	41 Inland wetlands	411 Inland marshes 412 Peat bogs
	42 Maritime wetlands	421 Salt marshes 422 Salines 423 Intertidal flats
5 Water bodies	51 Inland waters	511 Water courses 512 Water bodies
	52 Marine waters	521 Coastal lagoons 522 Estuaries 523 Sea and ocean

- ✓ This service generates geospatial coverage that appear as data with spatial changes (GRID);
- ✓ Type of response: GRID;
- ✓ SOS - Sensor Observation Service (Web-service Observation Service)

- ✓ This web service generates metadata and observations from heterogeneous sensor systems;
- ✓ Type of response: XML

The CORINE Land Cover nomenclature was used for land cover designation.

But what is CORINE Land Cover?

During 1985 for the first time in the European Union, the so-called CORINE program was initiated. CORINE in English means: **Coordination of Information On The Environment**. It was initially launched as a prototype project for many environmental issues.

There are three CORINE main goals:

1. Collect and process environmental information;
2. Coordinate collection and processing;
3. Ensure that data are consistent and compatible.

In this case, we have used it to monitor the transformation of coastal area in Albania's coastline to observe changes that have occurred in land cover during the last 10 years. CORINE Land Cover for land cover explanation provides its explanations in three levels of categories:

- First level, with a total of 5 categories;
- The second level, where each first level category is divided into several more detailed categories, altogether 15;
- The third level, where each category of second level is divided into several more detailed categories in total 44;

Since our research is mainly deals with spatial data, the practical implementation of the Geographic Information System (GIS) is indispensable.

The main roles of the Geographic Information System in our research are:

- a.* Appropriate software selection for project / research;
- b.* Selection of data source for satellite imagery;
- c.* Selection of the sample - research areas of this study;
- d.* Creation of an alphanumeric database for land cover;
- e.* Implementation of quality control of vectorization of the research area / example by the mathematical models used in the GIS;
- f.* Incorporating the legend according to CORINE Land Cover in our research;
- g.* Digitalization of land cover for our smallest unit, square with surface area of 1 ha according to the nomenclature of CORINE Land Cover;
- h.* Creating thematic maps for all three categories of CORINE Land Cover nomenclature, for all survey areas - example;

- i. Creating dynamic questionnaires - spatial analysis after the completion of the digitalization process of land cover;
- j. Presentation of these questionnaires / analysis in the form of reports;

Tab 2. Statistical analysis of CLC for case Durrës

Level	Correlation	
	Durrës	Total in three samples
Level I	0.873	0.9374
Level II	0.8785	0.9396
Level III	0.8797	0.9403

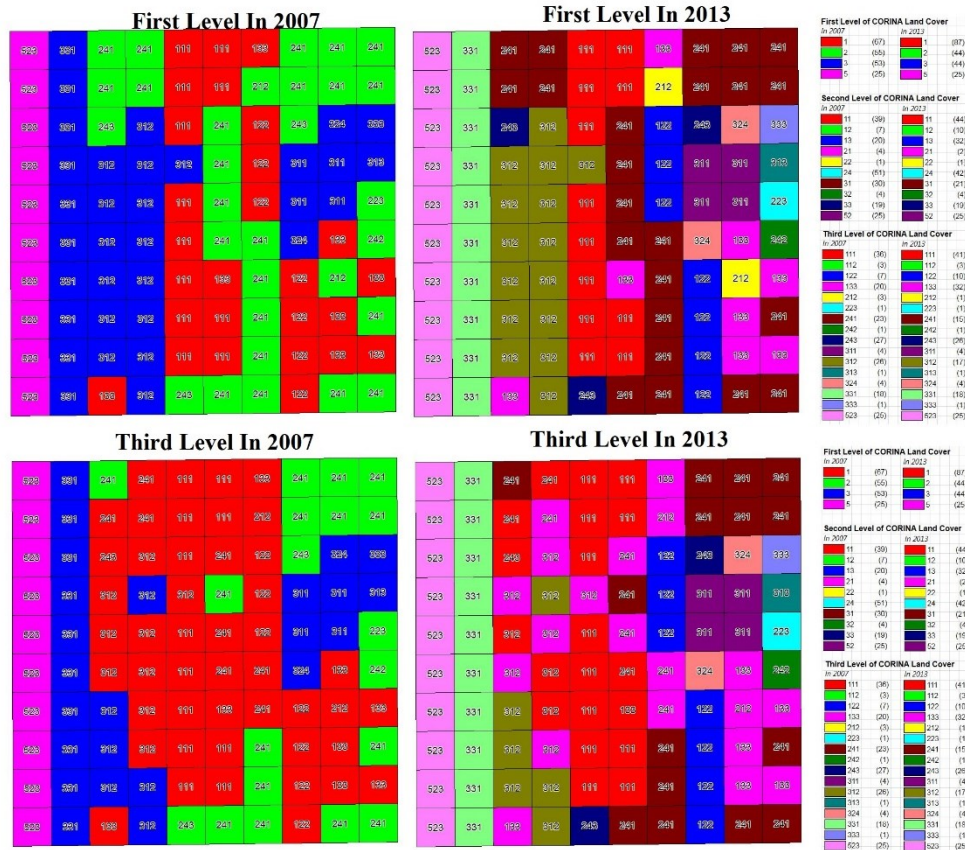


Fig 2 CLC changes in Durrës sample between 2007 - 2013

2. Analysis

The statistical analyses conducted, conclude that there was spatial transformation in the Albanian coast line based on the CLC nomenclature. If sample area for the Durres coast is analyzed, for the period 2002/2014 it can be concluded that the first level first category has increased from 27 cases to 47, while the second and third categories are reduced. The second level category is reduced from 30 to 19, while the third category of first level ranges from 33 to 24 cases. Only the fourth category of first level has remained the same (narrow coastal line, beach with sea water). Such a trend of change is for both the second and the third level. To confirm the trend of change, the correlation between the two periods by categories was also performed (Figure 2). Correlation values show the compliance of variables in changing the use of coastal areas (Durres- in our case). From the analysis and the results obtained can be concluded that the methodology for creating CORINE Land Cover for 1 ha area is possible.

Even though officially CLC at the European level has been digitized using the geometric primitive "polygon" in a minimum size of **25 ha** (year 2006) and **5 ha** (2012), the square method (**1 ha**) has shown that it provides opportunities and good conditions to gain scientific results. The final result of the CLC for **1 ha** is valid, applicable, accurate and verified. It was found that this scientific method in geography creates the possibility of gaining the most accurate results that help all the other disciplines that have as a subject of their study land cover in different areas, while it provides quality data for the environmental institutions, quality monitoring and management and ease on decision making.

It was also found that the CLC is the perfect methodology for analyzing and monitoring the transformation of different areas/zones (in our case the coastal line) at different time periods. It was found that modern technology enables these results to be extracted with the help of open source software and geo-web servers, while reduction of the processing area to **1 ha** by gaining a grid map (GRID Format) provides the opportunity to gain detailed geo-database of the CLC data that elevate at higher level the geographic scientific analyses, as well the permanent monitoring and management of spatial transformations.

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