BULETINUL INSTITUTULUI POLITEHNIC DIN IAŞI
Publicat de
Universitatea Tehnică „Gheorghe Asachi” din Iaşi
Volumul 64 (68), Numărul 1, 2018
Secţia
HIDROTEHNICĂ

ANALISYS OF LAND USE AND LAND COVER USING SATELLITE IMAGES
CASE STUDY – GALAȚI COUNTY

BY

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Received: January 18, 2018
Accepted for publication: February 22, 2018

Abstract. Remote sensing is a practical and economical alternative to the classical methods of obtaining data, like field measurements and land survey data, in order to obtain data about land use and land cover. Classical methods are time and money consuming, which is why remote sensing is currently widely used by various agencies in country and abroad, for data collection and retrieval of information. With the launch of Copernicus programme, European Space Agency put at users’ disposal, optical and SAR satellite images, that can be use, in numerous investigations and analysis.

This article contains information about Sentinel-2A optical images, as well as data acquisition and visualization. The aim of this study is to analyses the land use and land cover, using supervised classification, minimum distance algorithm.

Keywords: satellite images; Sentinel-2A; land use; land cover; minimum distance method.

1. Introduction

In remote sensing, the concepts of land use and land cover are used alternatives, but their meaning is completely different. Land cover includes everything that lies above the terrestrial crust, *i.e.* vegetation, urban areas,

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water, bared soil etc., while land use refers to the purpose of each class in part defines equivalent categories of service from cadaster.

Land use term is used in studies of global monitoring and management of soil resources, while land cover is used in various applications such as urban expansion, management activities of extraction of natural resources, the delineation of damage caused by various natural disasters such as tornadoes, earthquakes, floods, fires, etc., protection of wildlife habitats etc.

Sentinel-2 is a multispectral mission, that provide high resolution optical imagery, which has as objectives land observation, including: vegetation, soil and water cover, inland waterways and coastal areas; land use and change detection maps, disaster relief support; climate change monitoring etc. Sentinel-2A has been launched on June 2015, while Sentinel-2B was launched on February 2017. The mission has been designed as a dependable multispectral Earth observation system that will ensure the continuity of Landsat and SPOT observations and improve the availability of data for users.

2. Study Area, Materials and Methods

The study area is located in South- South Est of Galati County (Fig. 1) and comprises the municipalities of Valea Mărului, Corni, Cudalbi, Băleni, Fârţăneşti, Măstăcani, Griviţa, Costache Negri, Suhurlui, Rediu, Cuca, Scânteieşti, Folteşti, Lieşti, Pechea, Frumuşiţa, Fundeni, Tudor Vladimirescu, Piscu, Slobozia Conachi, Cuza Vodă, Smârdan, Tuluceşti, Nămoloasa, Independenţa, Scheia, Şendreni, Vânători, and also Târgu Bujor and Galaţi city.

Area of study is 2265 km2, given the elevation between 5-10 in southern county and 310 m respectively in the North.

In order to analyze land use and land cover, we used optical satellite images, taken by Sentinel-2A on 28 April 2016.

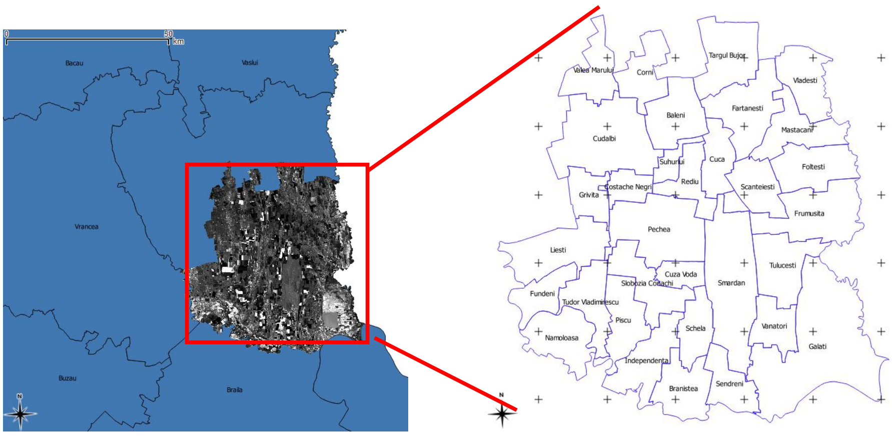

Fig. 1 – The location of study area.

Temporal resolution satellite Sentinel-2A is 10 days, but with the launch of the satellite Sentinel-2B it has been reduced to five days. The Multispectral Instrument has 13 spectral bands, from visible and near-infrared to shortwave-infrared, at different spatial resolutions (Fig. 2).

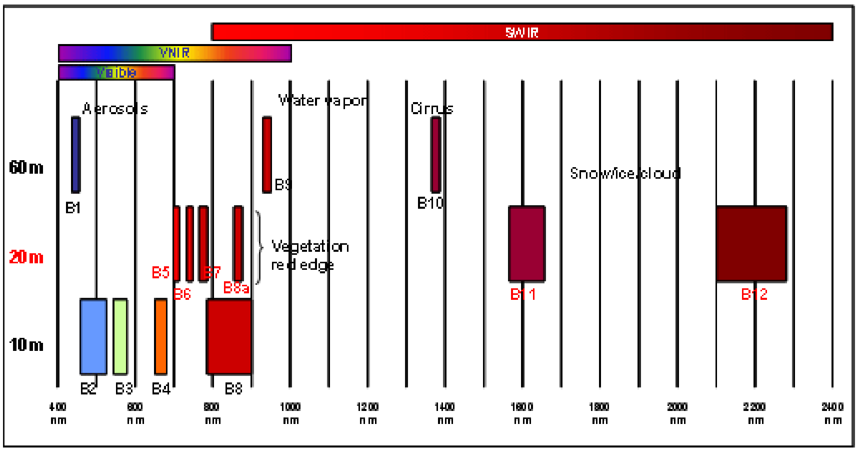

Fig. 2 – Sentinel-2A Spectral Bands
Source: [http://www.cesbio.ups-tlse.fr/us/index_sentinel2.html].

The spatial resolution of Sentinel-2A images depends on spectral bands, having values from 10 meters (B2, B3, B4 and B8), 20 meters (B5, B6, B7, B8a, B11 and B12), up to 60 meters (B1, B9 and B10).

The image used for this study was downloaded from **Sentinels Scientific Data Hub** [https://scihub.esa.int]. The preprocessing and analyzes of satellite image was made using Sentinel Application Platform (SNAP), Sentinel 2 Toolbox.

For data processing, QGIS software and "Semi-Automatic Classification Plugin" (SCP), developed by L. Congedo, were used. SCP is an open source plugin that allowed unsupervised and supervised classification. It also contains tools for downloading imagery, preprocessing, postprocessing, and tools to create new raster.

The satellite image was classified using supervised classification, minimum distance method.

Supervised classification method involves the intervention of the operator in the classification process. Classification is determined by the first class under the supervision of information after which the spectral classes. For each class of information is defined by the operator, representative samples of the collected spectral signatures. These are used in automated classification as reference standards, being compared to each pixel in the image. Supervised classification is a classification method based on pixel.

Minimum distance algorithm involves the calculation of the average spectral values for each category, within each stripe, and also calculation of

Euclidean distance from each pixel classified at the vector. After calculating the distance, the pixel is assigned to the unassigned closest spectral class.

3. Results and discussion

The satellite image used in the application has been atmospheric corrected, using Dark Object Subtraction method. Also, the image was clipped on the outline of the study area.

A first step in implementing the supervised classification is training samples. This process is a subjective one and the results depend on the experience of the analyst. The quality and precision of the final classification depend in large part on the quality formation process of the samples.

In order to classify the image, 4 spectral macro-classes and 12 spectral classes (vegetation, rare vegetation, rape, pasture, forest, soil, water, urban areas etc.) have been determined.

Effective delineation of samples for spectral signatures collection was done through digitization. Pixel value, in order to determine the samples, was equal to the value of NDVI (Normalized Vegetation Index Differences).

In the first stage of the study we realized a supervised classification, using 4 samples: vegetation, bare land, water and urban area (Fig. 3).

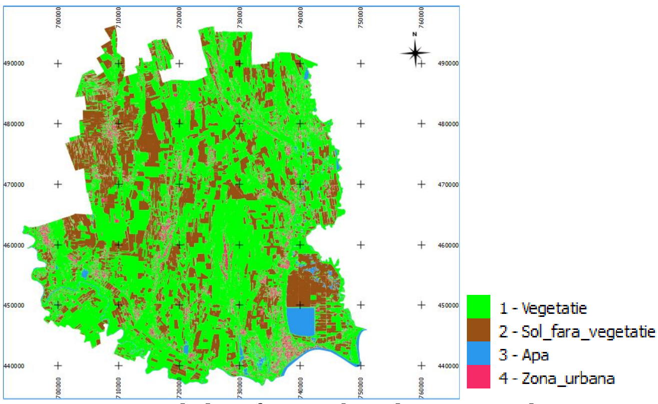

Fig. 3 – Supervised classification based on macro-classes, using minimum distance algorithm.

The vegetation comprises all the green areas within the study area: arable land under cultivation, pasture, forests etc. Soil without vegetation includes arable land without vegetation as well as discovered, completely lacking vegetation. Macro-class running waters comprise water, lakes, reservoirs or natural lakes. Macro-class "urban area" includes residential areas, industrial and commercial zone.

In Table 1 are shown the areas occupied by each macro-class and the proportion in which they are to be found in the study area. Thus, we can observe that prevails in the percentage of 58.67% of vegetation-covered areas, followed by areas without vegetation (32.44%) and urban areas (6.17%), while areas covered by water occupy a percentage of only 2.72%.

Table 1
Surfaces and percentages obtained from supervised classification, based on macro-classes, using minimum distance algorithm

Macro-class	Surface (km^2)	Percentage (%)
Vegetation	1,328.87	58.67
Bare soil	734.72	32.44
Water	61.53	2.72
Urban area	139.81	6.17
Total	2,264.95	100

In the second stage we classified the image using 12 samples, defined based on analyzes of RGB image and NDVI. For vegetation we defined 5 sample: dense vegetation, rare vegetation, pastures, forest and rape. For bare soil we defined 3 classes. Also, we defined 3 sample for water and 1 for urban area.

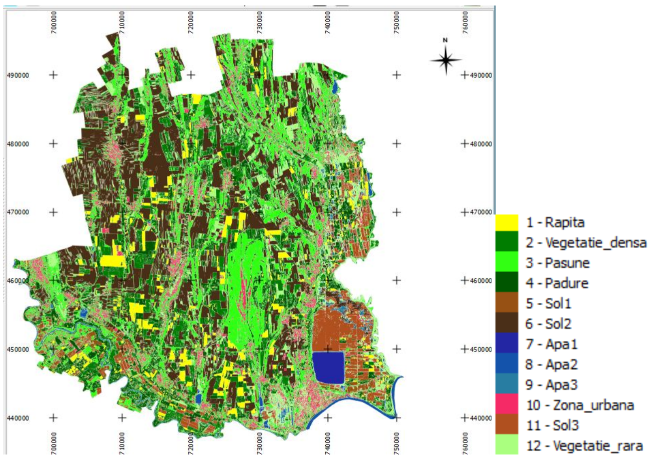

Fig. 4 – Supervised classification based on classes, using minimum distance algorithm.

In Fig. 4 is shown the result of the supervised classification, based on micro classes using minimum distance algorithm. Thus, we can see that in the study area, the vegetation-covered land predominates, followed by bare land, urban areas and area covered by water.

In Table 2 the occupied areas are presented for each class and the percentage by which they are to be found in the study area. Thus, we can see that prevails the area covered by bare soil (24.28%), followed by areas covered by pasture (20.20%). The forest occupied 14.77% from study area, dense vegetation only 11.33 %, while rare vegetation occupies 6.92%.

Table 2

Surfaces and percentages obtained from supervised classification, based on classes, using minimum distance algorithm

Classes	Surface, [km^2]	Percentage, [%]
Rape	123.47	5.45
Dense vegetation	256.66	11.33
Rare vegetation	156.627	6.92
Pasture	457.59	20.20
Forest	334.51	14.77
Bare soil 1	47.84	2.11
Bare soil 2	549.83	24.28
Bare soil 3	137.05	6.05
Water 1	20.30	0.90
Water 2	16.64	0.74
Water 3	24.59	1.09
Urban area	139.81	6.17
Total	2,264.95	100

4. Conclusion

Satellite imagery are used in agriculture, in various applications, such as the mapping of types of agricultural crops, estimation of agricultural production, soil characteristics mapping, monitoring farmers' practices etc. Crop monitoring and assessment of environmental damage constitutes one of the most used applications of remote sensing in agriculture. The satellite images also can be used to identify the types of crops and the demarcation of their land.

Sentinel optical images can be successfully used for the purpose of analysis the land use and land cover. To obtain information about land use and cover we can define macro-classes or classes, depending on the needs of users.

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ANALIZA MODULUI DE ACOPERIRE ŞI UTILIZARE A TERERENURILOR PE BAZA IMAGINILOR SATELITARE
Studiu de caz – Judeţul Galaţi

(Rezumat)

Teledetecția satelitară este o alternativă practică şi economică la metodele clasice de obținere a datelor, precum deplasările în teren şi ridicările topografice terestre, în vederea obținerii datelor despre acoperirea şi folosirea terenurilor. Aceste metode sunt consumatoare de timp şi bani, motiv pentru care teledetecția este în prezent folosită la scară largă de diverse agenții din țară şi străinătate, pentru colectarea datelor şi extragerea de informații. Odată cu lansarea programului Copernicus, de monitorizare a mediului, Agenția Spațial Europeană, a pus gratuit, la dispoziție utilizatorilor, imagini satelitare optice şi RADAR ce pot fi folosite în numeroase cercetări şi analize.

Prezentul articol cuprinde informații despre imaginile satelitare optice Sentinel-2A, modul de achiziționare a datelor precum şi vizualizarea acestora. Pentru studiul de caz s-au folosit imagini preluate de satelitul Sentinel-2A, ce au fost clasificate supervizat, utilizând algoritmul distanței minime.