

## DEVELOPMENT ANALYSIS OF THE TIMISOARA BASED ON SATELLITE IMAGES

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### Abstract

*In this paper it is studied the development of Banat's University of Agricultural Sciences and "King Michael I of Romania" Veterinary Medicine between the years of 1987 – 2013 based on images taken from earth satellite. The analysis of this images are made using a program called ArcGIS. With the use of this program was obtained six normalized differences indexes and two combinations of spectral bands; in which it is possible to see how the area of USAMVB Campus had developed in 26 years.*

*Satellite imagery consists of images of Earth or other planets collected by artificial satellites.*

*Interpretation and analysis of satellite imagery is conducted using specialized remote sensing applications. Remote sensing refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation). Satellite imagery is also used in seismology and oceanography in deducing changes to land formation, water depth and sea bed, by color caused by earthquakes, volcanoes, and tsunamis.*

*Because the total area of the land on Earth is so large and because resolution is relatively high, satellite databases are huge and image processing (creating useful images from the raw data) is time-consuming. Depending on the sensor used, weather conditions can affect image quality: for example, it is difficult to obtain images for areas of frequent cloud cover such as mountain-tops.*

**Key-words..** algorithm , remote sensing, supervised classification, unsupervised classification.

### INTRODUCTION

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object and thus in contrast to in situ observation. In modern usage, the term generally refers to the use of aerial sensor technologies to detect (figure 1) and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation). It may be split into active remote sensing, when a signal is first emitted from aircraft or satellites) or passive (e.g. sunlight) when information is merely recorded. An overview about passive sensors detect natural radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include

film photography, infrared, charge-coupled devices, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR and LiDAR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

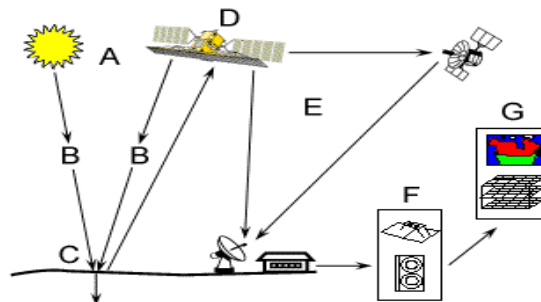


Figure 1. Principle of remote sensing

Energy Source or Illumination (A)  
Radiation and the Atmosphere (B)  
Interaction with the Target (C) Recording of  
Energy by the Sensor (D)  
Transmission, Reception, and Processing (E)  
Interpretation and Analysis (F)  
Application (G)

## MATERIALS AND METHODS

With ArcGIS program were made on the classification of images Timisoara.

In the following we briefly describe the Geographic Information System, the Timisoara city and the types of image classification.

The Geographic Information System is a collection of located, collected, stored and managed geographic data with the use of the computer, data which can be used to perform various spatial analyses. The special GIS operations over the spatial information make from these instruments more than just efficacy instruments for making maps, but especially, irreplaceable instruments for analyzing the information that refer to the terrestrial surfaces. GIS maps must be made exploiting all available resources based on rigorous analysis of their content and the costs involved, seeking assurance required with maximum efficiency. The information obtained from remote sensing is contained by the cosmic or aerial images, which can be interpreted for many purposes.

Timișoara is the capital city of Timiș County, in western Romania. One of the largest Romanian cities, with a population of 319,279 inhabitants (the third most populous city in the country, as of 2011), and considered the informal capital city of the historical region of Banat, Timișoara is the main social, economic and cultural center in the western part of Romania.

Timișoara lies at an altitude of 95 m on the southeast edge of the Banat plain, part of the Pannonian Plain. The rich black soil and relatively low water table make this a fertile agricultural region. Due to the hydrography projects undertaken in the 18th century, the city no longer lies on the Timiș River, but on the Bega canal.

The climate which defines Timișoara city is the temperate-oceanic climate (Köppen: Cfb)

and can be regarded as humid continental (Dfb) when using an isotherm of 0 °C (32 °F). The city characterizes the Southern-Eastern part of The Pannonian Basin.

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“In other words, spectral classification aims to objectively mapping the areas of image radiometric characteristics (reflectance and / or remittance) similar.

Following the classification of image data resulting thematic qualitative representing specific categories based on spectral properties and / or auxiliary data sources, as well as the verification of land” ( Popescu, et al.,2014 ).

Two common applications of remotely-sensed images to rangeland management are the creation of maps of land cover, vegetation type, or other discrete classes by remote sensing software such as:

1. In *unsupervised classification* ( *figure2*), image processing software classifies an image based on natural groupings of the spectral properties of the pixels, without the user specifying how to classify any portion of the image. Conceptually, unsupervised classification is similar to cluster analysis where observations (in this case, pixels) are assigned to the same class because they have similar values. The user must specify basic information such as which spectral bands to use and how many categories to use in the classification, or the software may generate any number of classes based solely on natural groupings.

Unsupervised classification yields an output image in which a number of classes are identified and each pixel is assigned to a class. These classes may or may not correspond well to land cover types of interest, and the user will need to assign meaningful labels to each class. Unsupervised classification often results in too many land cover classes, particularly for heterogeneous land cover types, and classes often need to be combined to create a meaningful map. In other cases, the classification may result in a map that combines multiple land cover classes of

interest, and the class must be split into multiple classes in the final map. Unsupervised classification is useful when there is no preexisting field data or detailed aerial photographs for the image area, and the user cannot accurately specify training areas of known cover type. Additionally, this method is often used as an initial step prior to supervised classification (called hybrid classification). Common clustering algorithms include K-means clustering, ISODATA clustering, and Narendra-Goldberg clustering.

1. *K-means algorithm* requires the following actions: analyst determines the average number of clusters according to which automatically clusters are established central pixels, pixels surrounded by a multidimensional space that generates vectors expressing the average distances of each pixel in relation to center of a cluster. Actually reporting occurs each pixel to a class.

The result of K-means algorithm is an image different from the original, in which groups of pixels (clusters) are identified by means of conventional colors, making it possible to interpret them in accordance with reality for land” (Popescu, et al.,2014).

2. *Iterative Self Organizing Data Analysis algorithm* requires the number of clusters can readjustment every iteration of algorithm. As in the previous case, the result of the algorithm is established through a Isodes new image the clusters are represented by conventional colors” ( Popescu, et al.,2014 ).

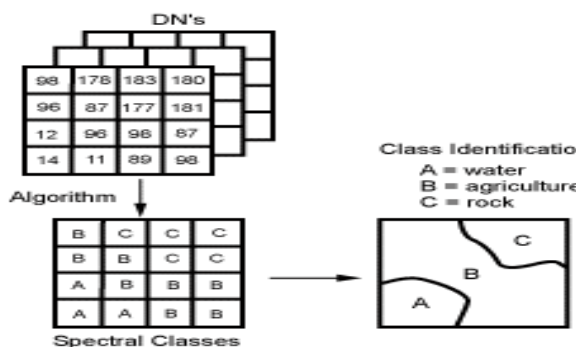


Figure 2. Unsupervised classification

In *supervised classification (figure 3)*, the image processing software is guided by the user to specify the land cover classes of interest. The user defines “training sites” – areas in the map that are known to be representative of a particular land cover type –

for each land cover type of interest. The software determines the spectral signature of the pixels within each training area, and uses this information to define the mean and variance of the classes in relation to all of the input bands or layers. Each pixel in the image is then assigned, based on its spectral signature, to the class it most closely matches. It is important to choose training areas that cover the full range of variability within each land cover type to allow the software to accurately classify the rest of the image. Some of the more common classification algorithms used for supervised classification include the Minimum-Distance to the Mean Classifier, Parallelepiped Classifier, and Gaussian Maximum Likelihood Classifier.

1. *Minimum Distance to Means* algorithm are based on the determination of the center of each group of pixels that represent the area of interest, then each pixel is reported by the vector distance from the area of interest and is assigned to the nearest class” ( Popescu, et al.,2014 ).

2. *Parallelepiped algorithm*: a pixel is assigned a grouping if its spectral values fall between the minimum and maximum thresholds that are found in the training data for that group. The values of digital number of the pixel are automatically generated relative to a space around the groups of pixels area of interest, the system of two axes rectangular (rectangle) or three axes (parallelepiped)” ( Popescu, et al.,2014 ).

3. *Gaussian Maximum Likelihood algorithm* is based on the use of probability theory to compare the spectral values of each pixel in part to "mark" statistics in each area of interest. Basically probabilities are calculated conditional on belonging to a class or another” (Popescu,et.al.,2014).

Supervised classification can be very effective and accurate in classifying satellite images and can be applied at the individual pixel level or to image objects (groups of adjacent, similar pixels). However, for the process to work effectively, the person processing the image needs to have a priori knowledge (field data, aerial photographs, or other knowledge) of where the classes of interest (e.g., land cover types) are located, or be able to identify them directly from the imagery. This method is often

used with unsupervised classification in a process called hybrid classification. Unsupervised classification can be used first to determine the spectral class composition of the image and to see how well the intended land cover classes can be defined from the image. After this initial step, supervised classification can be used to classify the image into the land cover types of interest.

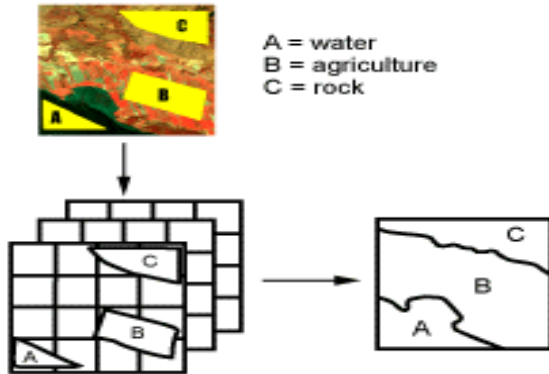


Figure 3. Supervised classification

## RESULTS AND DISCUSSIONS

In the following paragraphs are described two band combination of Landsat 5 and Landsat 8: Landsat 5 Band Combination 742 (figure 4) - This band combination provides a "natural-like" rendition, while also penetrating atmospheric particles and smoke. Healthy vegetation will be a bright green and can saturate in seasons of heavy growth, grasslands will appear green, pink areas represent barren soil, oranges and browns represent sparsely vegetated areas. Dry vegetation will be orange and water will be blue. Sands, soils and minerals are highlighted in a multitude of colors. This band combination provides striking imagery for desert regions. It is useful for geological, agricultural and wetland studies. If there were any fires in this image they would appear red. This combination is used in the fire management applications for post-fire analysis of burned and non-burned forested areas. Urban areas appear in varying shades of magenta. Grasslands appear as light green. The light-green spots inside the city indicate grassy land cover - parks, cemeteries, golf courses. Olive-green to bright-green hues normally indicate forested areas with coniferous forest being darker green than deciduous.

Landsat 8 Band Combination 753 - This band combination also provides a "natural-like" rendition while also penetrating atmospheric particles, smoke and haze. Vegetation appears in shades of dark and light green during the growing season, urban features are white, gray, cyan or purple, sands, soils and minerals appear in a variety of colors. The almost complete absorption of Mid-IR bands in water, ice and snow provides well defined coast lines and highlighted sources of water within the image. Snow and ice appear as dark blue, water is black or dark blue. Hot surfaces such as forest fires and volcano calderas saturate the Mid-IR bands and appear in shades of red or yellow. One particular application for this combination is monitoring forest fires. During seasons of little vegetation growth the 7 4 2 combination should be substituted. Flooded areas should look very dark blue or black, compared with the 3 2 1 combination in which shallow flooded regions appear gray and are difficult to distinguish. This band combination also provides a "natural-like" rendition while also penetrating atmospheric particles, smoke and haze. Vegetation appears in shades of dark and light green during the growing season, urban features are white, gray, cyan or purple, sands, soils and minerals appear in a variety of colors. The almost complete absorption of Mid-IR bands in water, ice and snow provides well defined coast lines and highlighted sources of water within the image. Snow and ice appear as dark blue, water is black or dark blue. Hot surfaces such as forest fires and volcano calderas saturate the Mid-IR bands and appear in shades of red or yellow. One particular application for this combination is monitoring forest fires. During seasons of little vegetation growth the 7 4 2 combination should be substituted. Flooded areas should look very dark blue or black, compared with the 3 2 1 combination in which shallow flooded regions appear gray and are difficult to distinguish. Below are presented two image classifications (Figures 5 and 6), which were processed from Landsat TM satellite image of 2013 covering Timisoara metropolitan area, processing performed using ArcGIS software v10. The image from which we started this paper is presented below:

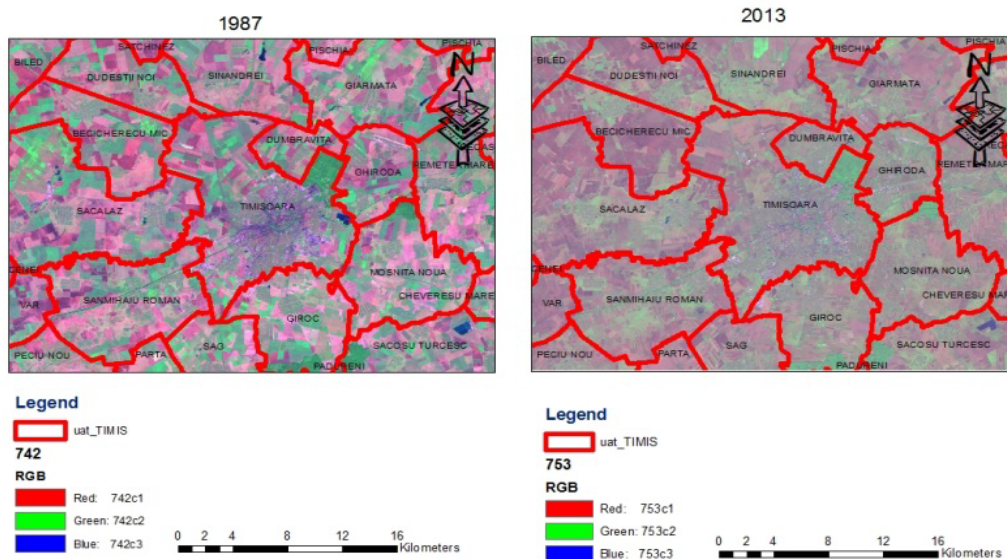


Figure 4. Landsat 5 and Landsat 8 Band Combination (False Color)

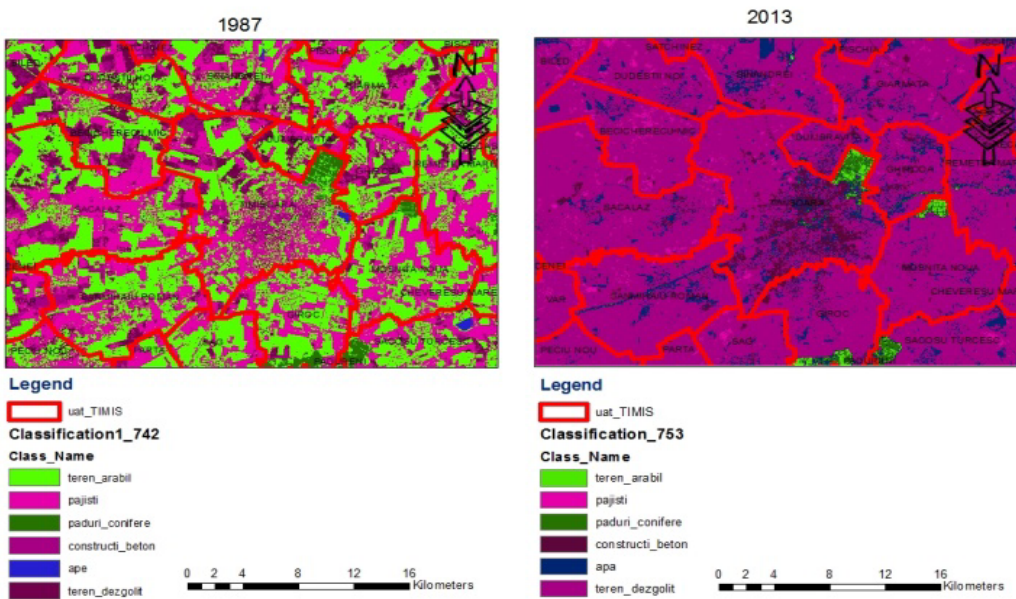


Figure 5. Comparative evolution of the studied area based on supervised classification using six thematic classes

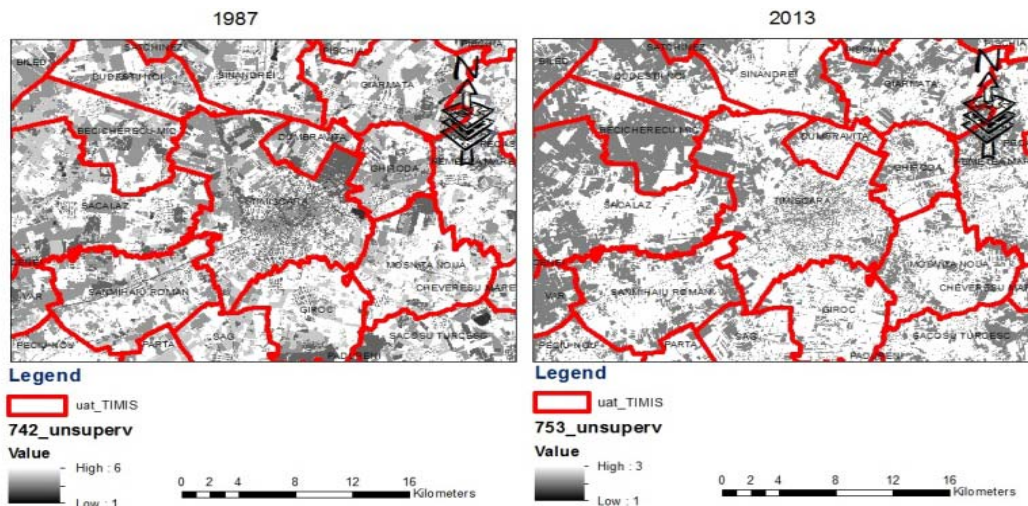


Figure 6. Comparative evolution of the studied area based on unsupervised classification using six thematic classes

## CONCLUSIONS

In this paper are two sets of conclusions with advantages and disadvantages for each image classification as follows:

For unsupervised classifications the advantages are:

- Does not require knowledge of the analyzed region .
- Human errors are minimized .
- Pixels are spectrally separated from.
- The analyst has control over the number of classes, iterations, etc.

And the disadvantages:

- Classes obtained not accurately reflect the categories of land.
- Limited control over the identity of classes.
- Spectral properties of classes may change over time.

For supervised classifications the advantages are:

- Control of class identity.
- Specific classes with specific identities.
- Classes obtained reflect the categories of land.
- Classification errors can be detected.

And the disadvantages:

- Analyst requires classification.
- The regions of interest are in the general information related to the pitch and spectral properties not .
- Inters regions may not be representative.
- Achieve ROI takes time.

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