USING SATELLITE IMAGES TO INVENTORY LAND USE CATEGORIES

UTILIZAREA IMAGINILOR SATELITARE PENTRU INVENTARIEREA CATEGORIILOR DE FOLOSINȚĂ A TERENURILOR

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***Abstract**: Two short definitions of Remote Sensing might be presented as follows: "To study or measure an object without being in physical contact with it" or "feeling without touching". As defined above, the term generally implies that the sensor is placed at some considerable distance from the sensed target, in contrast to close-in measurements made by "proximate sensing." sometimes given as "in situ" sensing. Remote sensing means aerial photography too. Aerial platforms are primarily stable wing aircraft. Aircraft are often used to collect very detailed images and facilitate the collection of data over virtually any portion of the Earth's surface at any time. The scale and quality of the data collected is affected by several factors including, but not limited to, altitude of the aircraft, position of the plane, and the quality of the photographic equipment used.*

***Rezumat:** Teledetecția este prezentată prin două scurte definiții:" Studierea sau măsurarea unui obiect fără a fi in contact fizic cu el" sau "A simți fără a atinge". Aşa cum a fost definit mai sus, termenul implică în mod general faptul că senzorul este amplasat la o distanță considerabilă față de ținta pe care o detectează, in contrast cu măsurătorile efectuate de aproape, făcute prin detecție apropiată, uneori numită şi detecție "in situ. În acelaşi timp, teledetecția înseamnă şi fotografie aeriană. Platformele aeriene sunt, în mod elementar, aparate de zbor cu aripi stabile. Avioanele sunt folosite frecvent pentru a aduna imagini foarte detaliate şi pentru a facilita colectarea de date din absolut orice porțiune a suprafeței terestre, în orice moment. Scara şi calitatea datelor colectate sunt afectate de câțiva factori, care includ, dar fără a se limita la aceştia, altitudinea avionului, poziția planului şi calitatea echipamentului fotografic utilizat.*

***Key words:** Remote sensing, sensor, reflectance, resolution.*
***Cuvinte cheie:** Teledetecție, sensor, reflectanță, rezoluție.*

INTRODUCTION

Tele-detection data are perceived as a support or aid since they are used together with other information supplied by cartography, geography, statistics, cultivation technologies, soil science, forestry, and not only, resulting in maps and useful information concerning the area under study within a short time and with the possibility of monitoring the evolution of certain phenomena.

MATERIAL AND METHOD

We present below the steps in making a demand concerning a certain problem in a certain area until we get the material that best answers the beneficiary's needs. One should understand by beneficiary a State or private institution, an organisation, a farmer, or any other person wishing to use tele-detection data.

The working steps are as follows:

1. Clearly identifying the problem, the beneficiary's demand, the possibility of using tele-detection data to answer the need

If there is demand for maps to identify excess moisture areas or a comprehensive map of the geographical distribution of the population in a certain area after age or sex, then we need to know for what map we need tele-detection data, i.e. for which of the maps tele-detection could be a real support.

2. Establishing the parameters of overtaking satellite images

This aspect needs the knowledge of the features concerning vector, captor, space resolution, spectrum resolution, and image overtake time.

A vector is represented by a satellite, a plane, or a balloon, while a captor is represented by the actual image overtaking equipment (radars, special photo cameras, and special motion picture cameras) on the vectors.

Spectrum resolution is the number of spectrum channels making recordings. One should determine a certain spectrum domain for the establishment of a certain phenomenon and the sensor used, knowing that multi-spectrum sensors perceive up to 10 channels, hyper-spectrum sensors perceive up to 100 channels, and ultra-spectrum sensors perceive up to 1,000 channels (the last ones are not available in GIS in the civil domain).

We should also mention the importance of temporal resolution representing the time interval between 2 consecutive passages of the satellite over the same area. Thus, for LANDSAT it is 17 days, and for SPOT it is 26 days.

3. Choosing image overtake time

The acquisition time of satellite images should be chosen so that it allows easy identification of the phenomena or objects studied, and in the case of those phenomena and objects that cannot be directly observed, they can be interpreted through simple relations.

If one needs an inventory of areas cultivated with different crops, he should choose the periods during which the soil is not covered by vegetation or when vegetation stages are favourable to identification.

In order to carry out a study on the different soil phenomena, it is preferable to choose periods in which the soil is not covered by vegetation to make a direct interpretation of the surface state.

4. Operations made on satellite images

Satellite images are the subject of the following operations:

a. Image correction (restoration);
b. Image overlapping;
c. Increasing clarity and improving image;
d. Segmenting and mosaiquing;
e. Classifying and interpreting the image.

The interpretation stage is done on the ground of the study or of field probes taking into account the ground truth.

Photo-interpretation is also done with the help of aerial photos, and of topographic and theme maps. Photo-interpretation uses, according to the CORINE LAND COVER Programme, 44 nomenclatures for the classification of areas.

Another stage is the conversion of data from analogue into digital form before importing them into the GIS. To do so, there are two ways: digitalising and scanning.

The digitalising process consists of the transfer of graphic data from an analogue into a digital format. This can be done with the help of a digitiser connected to a computer with a specialised soft.

The scanning process is analogue with photo-copying, resulting in a file with the following extension: TIFF (TAG IMAGE FORMAT FILE).

One of the most common situations is the scanning a black and white theme map to be vectorised.

Figure 1 shows in a suggestive manner the steps from overtaking the image to the final result.

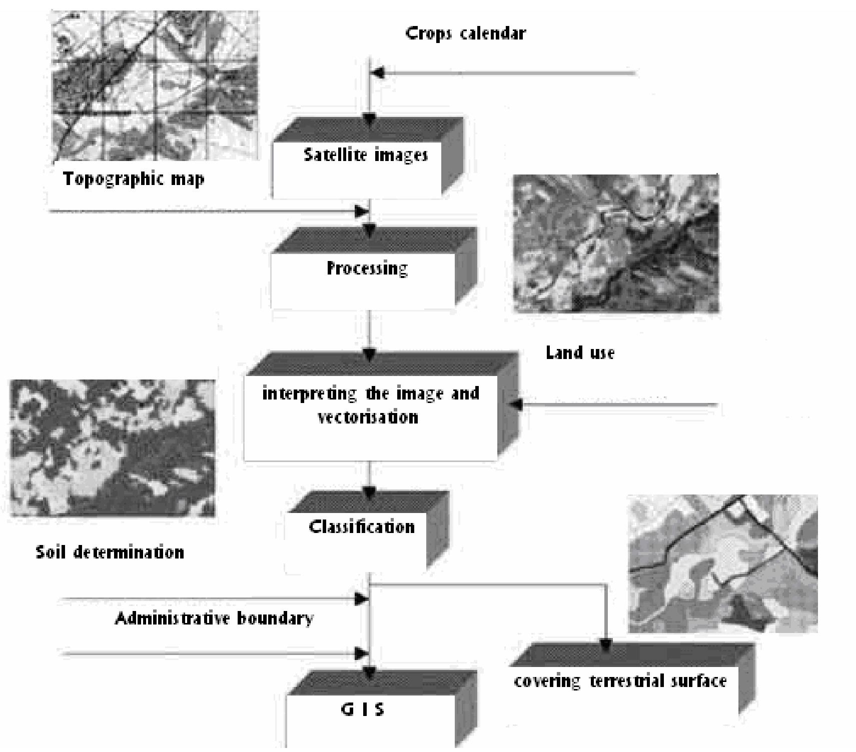

Figure 1 Steps in processing satellite images

This first step is carried out by the making up of a theme map covering the lands, in which we assign to each polygon the proper code, according to the interpretation nomenclature.

Depending the theme, we make up an interpretation nomenclature in which we specify the levels of interpretation, the themes of interest with their corresponding coding. In our case, we overtake the interpretation nomenclature of the European Union established within the CORINE LAND COVER project, as presented in Table 1.

RESULTS AND DISCUSSIONS

We should make a mention concerning the classification techniques. Classification consists of grouping data depending common characteristics. More exactly, classifying is a spectral recognition distributing continuous (quantitative) data values of the digit numbers in distinct classes. The results are theme (quality) data representing specific categories on the ground of spectrum features and/or auxiliary data sources, as well as on checking the land.

There are two types of image classification techniques: unsurveyed classification and surveyed classification. The choice of the type of survey is an automatic way of the groups derived from pixels that have similar spectrum features. The user then should analyse the groups and attach to them a type of covering terrestrial surface in order to make them understandable.

Table 1

Interpretation nomenclature

Level 1	Level 2	Level 3
1. Artificial lands	1.1. Urbanised areas	1.1.1. Continuous urban structures 1.1.2. Discontinuous urban structures
	1.2. Industrial or commercial areas and building networks	1.2.1. Industrial or commercial areas 1.2.2. Route or railway networks 1.2.3. Harbour areas 1.2.4. Airports
	1.3. Mines, dumping sites, and building sites	1.3.1. Mining exploitations 1.3.2. Dumping sites 1.3.3. Building sites
	1.4. Artificial and non-agricultural green areas	1.4.1. Urban green areas 1.4.2. Sports and leisure lands
2. Agricultural lands	2.1. Arable lands	2.1.1. Arable lands outside irrigated areas 2.1.2. Irrigated areas 2.1.3. Paddies
	2.2. Permanent crops	2.2.1. Vineyards 2.2.2. Orchards 2.2.3. Olive tree plantations
	2.3. Hayfield	2.3.1. Hayfield
	2.4. Heterogeneous agricultural lands	2.4.1. Annual crops associated with permanent crops 2.4.2. Complex plot and crop systems 2.4.3. Mainly agricultural lands doubled by natural vegetation 2.4.4. Agricultural and forestry lands
3. Forests and semi-natural environment	3.1. Forests	3.1.1. Deciduous forests 3.1.2. Coniferous forests 3.1.3. Mixed forests
	3.2. Bushy and/or grassy vegetation	3.2.1. Natural meadows 3.2.2. Thistle and brambles 3.2.3. Sclerofilous vegetation 3.2.4. Expansion bush forest and vegetation
	3.3. Little or no vegetation open areas	3.3.1. Sand beaches, sand dunes, sand 3.3.2. Nude rocks 3.3.3. Very scarce vegetation (steppe) 3.3.4. Burned areas 3.3.5. Everlasting glaciers and snow
4. Moist areas	4.1. Moist land areas	4.1.1. Marshes 4.1.2. Moisture excess areas
	4.2. Sea moist areas	4.2.1. Sea marshes 4.2.2. Salty marshes 4.2.3. Tidal areas
5. Water surfaces	5.1. Continental areas	5.1.1. Water courses 5.1.2. Lakes
	5.2. Sea waters	5.2.1. Littoral lagoons 5.2.2. Estuaries 5.2.3. Seas and oceans

Table 2

Examples of interpretation keys based on fake-colour image tonalities and colours

No.	Type of land use	Colours of fake-colour images
1	Urban areas	Lighter or darker blue + white, depending on the buildings' use
2	Quarries, building sites, nude rocks, sand, dunes	White
3	Communications (roads, railroads)	Dark blue, grey
4	Everlasting snow, glaciers (clouds)	White, bluish-white
5	Salt mines	White, grey, cyan
6	Water surfaces	Black, bluish green, lighter or darker, depending on water depth or turbidity
7	Annual crops	Red (unharvested crops), grey-pink (harvested crops), blue-white ploughed lands
8	Permanent crops	Red-pink
9	Deciduous forests	Light red
10	Resinous forests	Brown-reddish
11	Meadows, pastures, hayfields	Light pink, light red
12	Moist areas	Very dark black or red
13	Poor meadow and brambles	Grey-yellow, grey-pink, light brown
14	Burned areas	Black, dark grey, bluish

In surveyed classification, known areas help the classifier, as it is an interaction between user and classifier.

Within application presented in this paper, we recommend the use of GPS equipment and of specialised programmes to achieve a GIS.

Improvements in the field of sensors led to a continuous growth of geometrical and spectrum resolution of the data from satellites, also correlated with the increase of access degree. At present, there are satellites in different stages of development with a resolution of 1 m, or even a few decimetres. Though a little late compared to initial plans, an entire series of satellites have been launched lately.

Information from tele-detection can be used as parameters or as variables in models of global functioning with different objectives: crop forecast, impact of use changes on climate and vice-versa, etc.

In order to monitories global functioning at the level of agricultural or forestry ecosystems, other tele-detection parameters are also available. They are deducted through methods specific to digital image processing. For example, using tele-detection image classification methods in the optic field, we can characterise land coverage types, as well as their spatial arrangement.

CONCLUSIONS

By using tele-detection data, we achieve, in fact, the collecting, administering, updating, and processing space data; integrating and relationing different data through the use of information on the studied places; recognising and assessing space structures and relations; visualising and presenting results on maps, plans, and statistics.

Space tele-detection in the visible and infra-red field can supply precious information due to the possibility of getting information within a continuous space and systematic time ways.

Space tele-detection in the optic and micro-wave fields can supply information for agriculture, constituting a unique way of monitoring the evolution of vegetation over large areas and plots, due to its systematic revisiting possibility.

In the infra-red and micro-wave domains, one can get information on the structure of the vegetal cover, and on plant and soil water content.

Among the advantages of these methods are improving productivity, strategic planning, and better decision making, efficient managing and controlling activities.

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