GIS and Remote Sensing in Diachronic Study of Agriculture in Greece

Maria Androulidaki[a], Michail Salampasis[b], Vagis Samathrakis[c], Christos Batzios[d]

a Alexander Technology Educational Institute of Thessaloniki, Thessaloniki, Sindos 57400, marand@civil.auth.gr

b Alexander Technology Educational Institute of Thessaloniki, Thessaloniki, Sindos 57400, cs1msa@it.teithe.gr

c Alexander Technology Educational Institute of Thessaloniki, Thessaloniki, Sindos 57400, sbagis@farm.teithe.gr

d Aristotle University of Thessaloniki, Thessaloniki 54101, batzios@vet.auth.gr

Abstract

A basic control factor of diachronic monitoring of land use is the recording of land use in different time periods. The agricultural cadastre and the recording of cultivated land with the use of a GIS will facilitate the calculation of subsidies, the control of irrigations, the guarantee of quality of biological products, the land control, the damage assessment from meteorological phenomena etc. Data that can be used are the statistical elements, the aerial photographs and the satellite pictures. The use of aerial photographs is ideal for the follow-up of changes that occur in the use of ground of rural extents; pasture lands and forests over a long period of time. The technique of three-dimensional visualization facilitates the use of Tele-Surveying technologies. Tele Surveying is useful in recognizing objects and ground characteristics with the observation from receptions above the ground. A more modern extension of using aerial photographs is the utilization of satellite pictures. As the relevant technology progresses it allows henceforth the reception of digital photographs from very long distance with high precision. The observation of changes in earth's anaglyph with the use of Remote Sensing is the most recent trend in relevant research field. Serves specifically in regions with changes in bents, with problem of landslips, floods etc. Case studies of applying these technologies in Greece are presented and critically discussed. Rural land recording, precious material in the hands of institutions for the realisation of controls, forecasts and finally for making better political decisions that will help agricultural growth, Greek economy and environmental protection are deliberated.

Key words: GIS, Remote Sensing, Aerial photos, Satellite pictures, Agriculture

1 Introduction

Land process techniques are analysed with examples and comments corresponding to each method. Case studies of applying these technologies in Greece are also presented and critically discussed. It is argued that GIS and Remote Sensing give the suitable tools of recording and processing of all the above forms of data. Furthermore, while the technological capabilities exist and many of them are supplementary, Institutes of Higher Education in Greece have already in their studies respective courses and proper equipments, so the new scientists should be prepared and be ready to use these new technologies. All this, can cause important difference in the efficiency and effectiveness of the Greek agricultural sector. Rural land recording, precious material will be gathered in the hands of institutions for the realisation of controls, forecasts and finally for making better political decisions that will help agricultural growth, Greek economy and environmental protection.

2 Methods of process

A basic control factor of diachronic development in land use is the utilization of the recording capability in different time periods. There are various recording methods supplementary each other.

2.1 Collection of statistical data

A basic initial approach can be achieved by processing the statistical data collected with the responsibility of public institutions e.g. the Greek National Statistical Service. The systematic recording on annual base with concrete specifications provides initial material for research. The basic research can be specialized in individual sectors by analyzing additional data, which should be collected from other relevant institutes or with local research (e.g. using questionnaires) (Androulidaki, 2003).

2.2 Aerial photographs

Aerial photogrammetry is the use of aerial photographs to make accurate measurements in surveying and mapmaking. Accuracy is a very important factor for aerial photographs. They must be prepared with specific approach, specialized cameras and flight routes.

We can use recent and older photographs, to find out the changes that occur through the years to an area. This is useful in many cases. The official source of aerial photographs in Greece is Greek Military Geographic Service. All the country had been photographed several times, but not very often. This means that if you need a photo from a specific year you may not find it. The archive is available for everyone and researchers can order the photographs from the qualified army department. There is also another source for general pictures; The Google earth site offers, for free, satellite views. During the last year the Google earth accuracy in Greek area was improved a lot. It is possible to use them as additional information (http://earth.google.com).

Aristotle University of Thessaloniki made a survey to find out the land use of a University's land property called Polyzova. The problem was that the Prefecture of Thessaloniki characterizes the area as reforestable. The use of aerial photographs gave enough evidences to prove that there was never a forest in this specific area. The first photography used for comparison was of year 1945 and the second one from 1997. In the older picture, grassland and the absence of any kind of forest were observed. In the newer picture, there is also obvious the absence of any forest, while deforciants have fabricated agricultural and construction activities on University's property. Furthermore, another recent picture, of the same area, utilized from http://earth.google.com with more resolution gave us our results in larger scale (Anastasiadis et al., 2005).

Picture 1: Aerial photo from Polyzova area (1997)

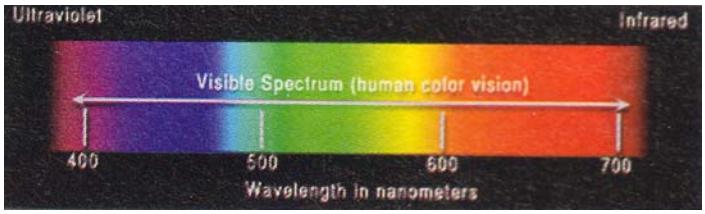
Picture 2: Satellite photo from Polyzova (2007), Source: http://earth.google.com

The use of a simple picture is the basic approach. Conventional photogrammetry uses two photographs of the same region taken from neighbouring points and when they are half overlapping each other constitute a Stereo Pair. With the use of stereoscope, we have three-dimensional representation of earth's anaglyph resulting in a very clear observation of regions interests to us. The human eye capability of seeing in three dimensions can be simulated with Stereophotogrammetry (Patias, 1991). In the previous example the stereo pairs provided us with more information about the exact flora in Poluzova.

When the survey area should be extended in size, it is possible to use many consecutive pictures. This is called Photomossaic. For example, the use of Photomossaic is necessary when we study a waterlogged area along a river.

Telesurveying is the science of recognizing objects and land characteristics by observing electromagnetic receptions of identified regions utilizing of certain areas of the electromagnetic spectrum. The highest possible precision of picture characteristics can be achieved after using the existing various codes and telesurveying techniques. We consequently can record photographic, even invisible parts of the spectrum. In infrared photography we use the ability of the camera to record the invisible part of the electromagnetic spectrum like ultraviolet and infrared radiation. This photographing can be done either with an analogue way with the use of infrared film, or digitally using a special filter.

Digital technology gives us respective possibilities with the use of computers. Environmental studies (aquatic resources and soil, studies relative with fires, earthquakes, frosts, volcanoes) can be realised, while with the use of specific infra red and thermal films the study of the atmosphere can be studied.



Picture 2: Visible spectrum, Source: Kontogeorgis, 2006

2.3 Satellite pictures – Remote sensing:

The utilization of satellite pictures becomes a more modern use of aerial photographs. The photographs are taken from earth satellite. Henceforth, the advanced technology allows the reception of digital photographs from very long distance with very high precision.

In the previous example, http://earth.google.com is mentioned. This source is valid for general use, but not for scientific purpose. The site uses a mosaic from several satellites to achieve pictures without clouds. The colors are not natural and the contrast is increased. Instead, many satellites offer, nowadays, high quality earth photos. Quickbird-2 (from 2001) and Ikonos-2 (from 1999) have the best high resolution Satellite Imagery. Internet site http://glovis.usgs.gov provides easy access to pictures of several satellites. Some of them are free of charge while it is also possible to purchase online pictures with higher resolution.

The use of Telesurveying techniques can also be applied, with the use of computer programs that relay the data directly to GIS systems. The observation of changes occurring in earth's relief made with the use of Remote Sensing is the latest trend. It serves specifically in regions with changes in bents, with problem of landslips, floods, etc. Earth's atmosphere affects measures in a different way depending on the wavelength, due to sun radiation absorption. The spectral reflectance of vegetation depends on the plant humidity.

Remote sensing, for example, can be used in the following case. The study area is called 'Paradisos Xanthi', Northeast Greece. In this village (Paradisos), the springs of Nestos's river flow. Pictures 3 and 4 are satellite pictures utilized with Teravue software. In north and west part of the area forests exist while in the southeast part is tillage land. The slopes of the mountain, the village Paradisos and the river Nestos are also visible. Picture 4 utilizes the infrared method and is much more helpful to identify the land usage. In infrared pictures, the areas with vegetation appear in red colour (near infrared spectrum), which is preferable for telesurveying. The computer software needs at least the combination of three satellite pictures to give the infrared analysis.

After using semiautomatic Teravue classification, picture 5 presents the estimated land use of the area Paradisos (Monget, 1997).

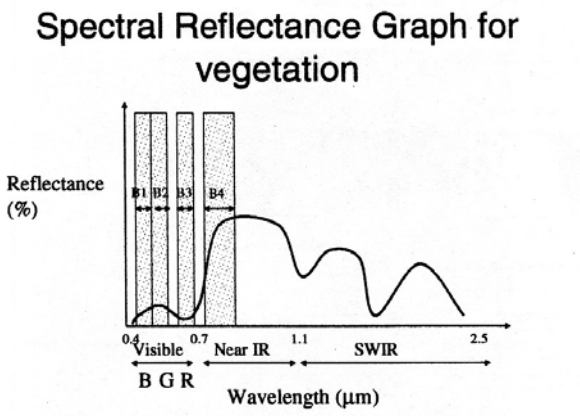


Fig 1: Spectral reflectance graph for vegetation
Source: Monget, 1997

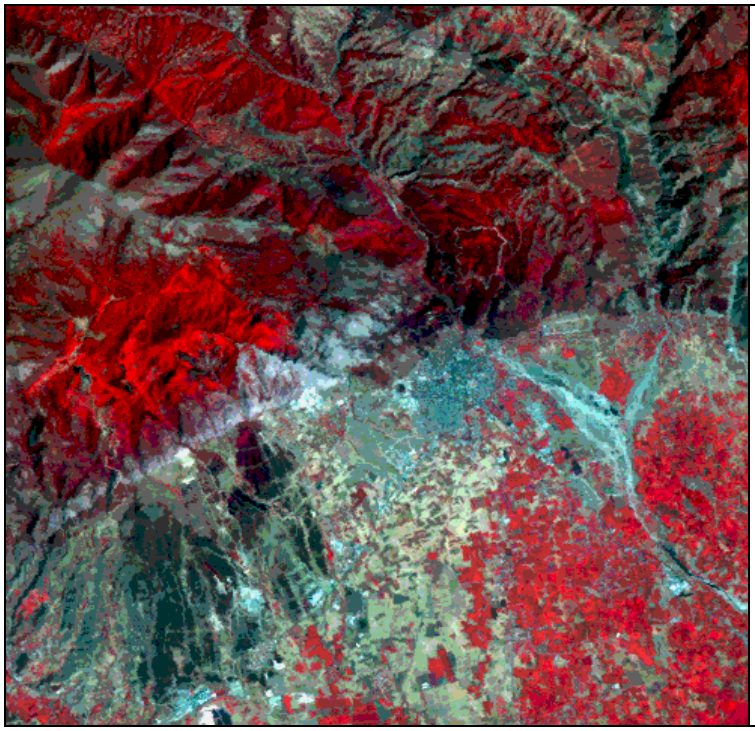
Combination of satellite images in visible spectrum

Paradisos Xanthi area

Androulidaki and Giannopoulos (2006)

Teravue software

Picture 3: Combination of satellite images in visible spectrum



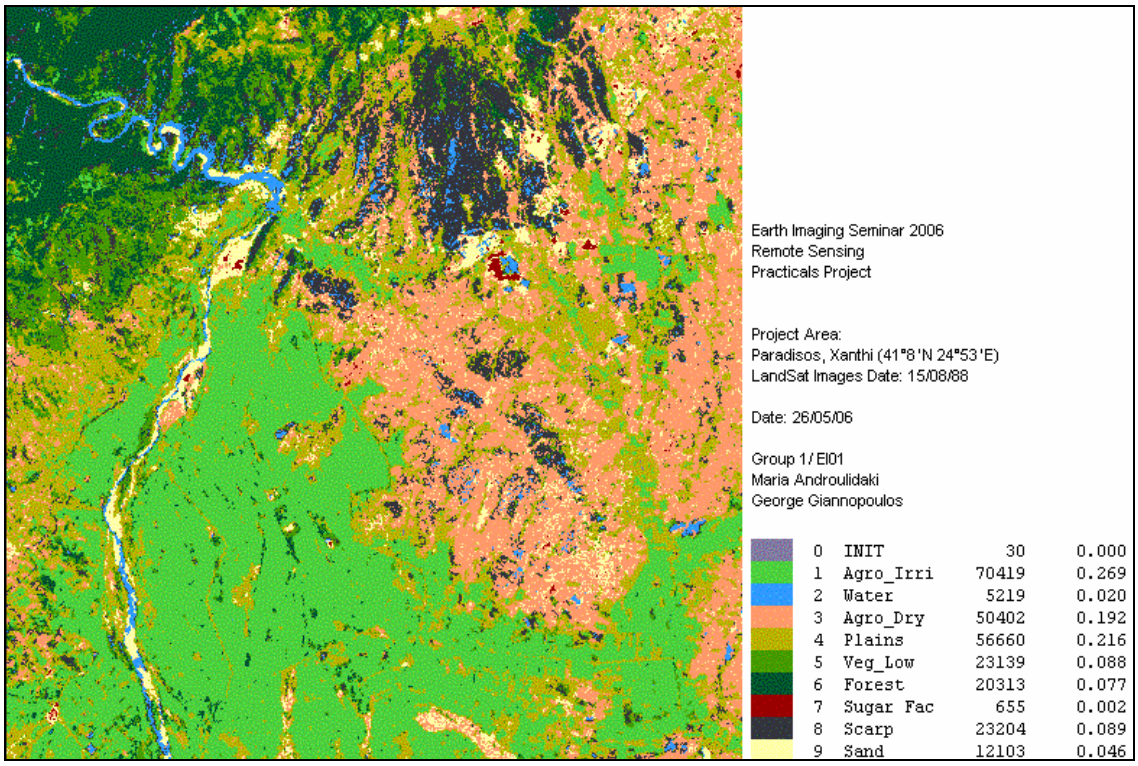
Combination of satellite images in near infrared spectrum

Paradisos Xanthi area

Androulidaki and Giannopoulos (2006)

Teravue software

Picture 4: Combination of satellite images in near infrared spectrum



Picture 5: Remote sensing final results, Paradisos Xanthi, Teravue software, 2006

3 Conclusions

The future of modern mapping is Remote sensing, Satellite pictures, Aerial photogrammetry and Geographic Information Systems either alone or combined. In this paper, some ideas for better environmental research and few examples from researches in the Greek country were presented. Governments such the Greek are advised to utilize the experience presented herewith and the solution of environmental or land use problems could be facilitated.

4 References

Anastasiadis, A., Androulidaki, M., Manolakakis, G., 2005. Environmental Research for new University Installations in Polyzova area, Aristotle University of Thessaloniki, Thessaloniki.

Androulidaki, M., Giannopoulos, G., 2006. Image Processing applied to Remote sensing, Seminar organized by the Aristotle University of Thessaloniki and Democritus University of Thrace (20-27 May 2006), Xanthi, Greece

Androulidaki, M., 2003. Geographic Information Systems in the organization, treatment and management of Education via anthropocentric and territorial approach, Doctoral thesis, Division of Geotechnical Engineering, Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki.

Kontogeorgis, A., 2006. Digital infrared, Photographer, issue 141, Athens, pp. 66-69.

Monget, J., 1997. Classification Techniques in Remote Sensing and Cartography, Ecole des Mines, Paris.

Patias, P., 1991. Photogrammetry Introduction, Ziti Publications, Thessaloniki.