

Geoinformatic Education of Students of Environment Protection and Forestry at the Faculty of Forestry of the Agricultural University of Cracow

P. Wezyk & K. Koziol

Laboratory GIS & Remote Sensing, Faculty of Forestry,
Agricultural University of Cracow

e-mail: rlwezyk@cyf-kr.edu.pl, rlkoziol@cyf-kr.edu.pl



Abstract

In order to become a rightful member of Information Society nowadays, it is essential to be apt at using modern Geoinformation Technology. The present situation challenged Polish higher education system, and also the Faculty of Forestry in Cracow to introduce new courses on Geoinformatics as a basis for educating students of Nature Preservation and Forestry in 1999. Even the students of the 1st year attend special courses in Computer Studies, Statistics, and the Internet. Thanks to the NFOSiGW grant in 1999, it was possible to obtain the equipment and software for the GIS and Remote Sensing Laboratory. Each year, there are between 150 and 160 students educated in geoinformatics at the Faculty of Forestry, and also people from other Polish universities and institutes, who all attend the classes. The syllabus for Geoinformatics and optional courses is: Geographic Information System, Digital Photogrammetry, Remote Sensing, Global Positioning System, basic Geostatistics, and Web-GIS. Moreover, the students took the initiative and established their own Scientific Working Group that deals with various problems of geoinformatics.

1 Introduction

Free access and using lots of pieces of information at the same time is a precondition for wealthy life and proper functioning in a modern world. There is reason for economic, social, political and finally educational changes explained in this sentence. Without a reasonably made informational zone, modern information society cannot function effectively, neither the whole state with its culture, national economy, military, science and education can function.

A well-known Japanese researcher Yonsji Masuda working on the development of societies, many years ago stated that „... civilization that we are going to build approaching the 21st century will not be a material civilization, symbolized by huge constructions, but it will be an invisible civilization. To be more precise one should call it „information-based civilization”. The term jahoka shakai (Jap. „information society”) for the first time was used in 1963 by Tadao Umesamo and has been familiar in Europe since 1978.

Information society depends not only on information (this has always been valuable) but also on the ways (technologies) of collecting and transferring data, which enhances the value of information as a product. Knowledge is nothing more but information and the first instrument of gathering it was book. Monitors and computers in libraries do not shock us any more and it is possible that there will be no traditional books there in the future (Goban-Klas, Sienkiewicz 1999).

In the information society we are about to become, a strong trend of the implementation of modern information and telecommunication systems, including spatial systems such as Spatial Information Systems or Land Information Systems in different life activities. Polish forests cover 8.9 mln ha which puts Poland in the sixth place in Europe in terms of forest cover. The National Plan of the Augmentation of Forest Cover establishes 33% forest cover in 2050. The structure of the property in Poland is definitely different than in other countries of the European Union, because 78.4% belong to State Forest National Holding.

For about 10 years a modern information system called SILP has been implemented in the Polish State Forest National Holding. Unfortunately only recently GIS technology has been implemented, i.e. the integration of attribute bases (SILP) with geometric forest digital maps (LMN) started. At the moment

over 37% of the forests owned by the State Forest National Holding has digital forest map meeting the standard (e.g. format shape, uniform projection for the whole country, etc). Every year 15% new forest areas will be covered with LMN. In a few years the Polish State Forest National Holding and National Parks will have databases and GIS systems and their viewers will be able to make complex spatial analyses. This immense technological evolution demands the education of a proper staff of engineers, educated in GIS, Photogrammetry, Remote Sensing, GPS, CAD and IT. Three Polish Faculties of Forestry, including the Laboratory of GIS and Remote Sensing of the Agricultural University of Cracow face this challenge.

2 History of Geoinformatic Courses at the Faculty of Forestry in Cracow.

Since 1995 at the Faculty of Forestry an optional (non-compulsory) course has been run in the theoretical bases of GIS, Photogrammetry and Remote Sensing (elective course „The Application of GIS and Remote Sensing in Forestry”). At the beginning practical classes (workshops) at that period had rather a demonstrative character. A basic problem was too small number of computers and GIS software licences.

At that time the Laboratory of GIS and Remote Sensing in the Chair of Forest Ecology, had high class equipment, but these were only single specimens obtained as gifts from the DAAD Foundation, the LMU University of Munich (Germany) and Agricultural University of Vienna (Austria), or were bought from the apparatus donation and research grant of KBN (Polish State Committee of Scientific Research).

Basic equipment and computer software used in those period to make most Master’s theses and scientific papers in geoinformatics, were:

- ◆ Working graphic station DEC Alpha 255 (Digital UNIX);
- ◆ Software ArcInfo ESRI (7.1.x);
- ◆ Digital Photogrammetric Station VSD;
- ◆ Software Photo-GIS and Ortho-GIS (Salamanca);
- ◆ Working station SUN with software ERDAS (LMU Germany);
- ◆ Software Monoplotting (BOKU Austria);
- ◆ PC ArcInfo ESRI (ver. 3.4+ DOS);
- ◆ Software SEM (ESRI) for PC ArcInfo;
- ◆ Receivers DGPS of Corvallis MicroTechnology : PCL5 9400 and MC-GPS;
- ◆ Software for differential correction PC-GPS (CMT) ;
- ◆ Digitiser Altek 32 (A0) and SummaSketch (A3);
- ◆ Plotter Hewlett Packard 750C (A0);
- ◆ Scanner Mustek 12000 XP;
- ◆ Arc/Info PC ver. 3.5 (ESRI);
- ◆ Arc/Info Unix ver. 7.2.1 (ESRI);
- ◆ ArcView ver. 3.1 with the extensions Spatial Analyst and 3D Analyst (ESRI);
- ◆ PC-GPS ver. 3.1 (Cornvalis MicroTechnology);
- ◆ Geo-Trans (Geosystems);
- ◆ Video Stereo Digitiser (AGH University of Science and Technology in Cracow).

4. Opening the Computer Room in the Laboratory of GIS and Remote Sensing

Due to financial help transferred within the agreement of 1999 between the National Fund of Environmental Protection and Water Management (NFOSiGW) and the Agricultural University in Cracow, the Laboratory of GIS and Remote Sensing (LGiT) was opened and equipped in computers and proper software.

Computer equipment was adjusted to the requirements of the GIS software and digital photogrammetry, bought for 16 stands. Additionally a two processor graphic station was bought to LGiT.



Fig. 1. Digital Photogrammetric Station Dephos in the Laboratory of GIS & Remote Sensing

To handle the network connection a at first server that worked in NOVELL system was installed. Unfortunately, its further use became impossible because it was impossible to handle the net licence of ArcInfo (ESRI) software. Nowadays an operation installed is Windows NT Server.

On LGiT server also the WWW service was installed (<http://argis.les.ar.krakow.pl>). It mainly referred to the courses in geoinformatics and the carried out research projects („FOREMMS”, „Kasprowy Wierch”, “QuickBird vs. forest inventory”) and education in the use of WebGIS software.

Students, through the Internet, have the access to teaching materials prepared for the individual courses of GIS. There are also lectures available as PowerPoint presentations (Microsoft). On WWW pages also the information on the topics of laboratory classes and lectures is presented.

Unfortunately the Internet service is still being under construction and its concept is being changed.

For the educational purposes and research work carried out in LGiT the following software has been bought:

- ArcGIS ArcView 8.2 + extension (3D, Spatial, Geostatistical Analysis) in a floating licence;
- ArcIMS 4.0;
- ER Mapper ver. 6.4 ERM (5 licenses) ;
- IWS ver. 2.0 (ERM);
- ArcInfo 7.1.2 ESRI (17 licences; at the moment Upgrade to version 8.1.x ArcInfo Desktop);
- ArcView 3.2a (17 licences);
- ArcView Spatial Analyst 2.0 (17 licences);
- ArcView 3D Analyst (17 licences);
- ArcView Image Analysis ERDAS (17 licences);
- ArcView Network Analyst (17 licences);
- Arc PAD + Husky fex21;
- Video Stereo Digitiser VSD-AGH (17 licences);
- MapObjects 2.0;
- SDE (ESRI);
- Dephos (KPG) Digital Photogrammetric Station.

In the framework of the agreement with the NFOSiGW also two DGPS Trimble ProXRS receivers with the TSC1 data logger and the licence of differential correction via OmniStar satellite was bought. Reference base station was installed on the roof of the building of the Faculty of Forestry was bought by another Chair. The station provides data necessary for the correction of files (DGPS post-processing), The correction of files created during field work and planning the measurement missions is done in the software Pathfinder Office (Trimble).

3 Present State of Teaching the Applications of Geoinformatics in Forestry and Nature Conservation

In the ministerial order on the teaching programme minimum in Poland for the study area „Forestry”, subjects related to broadly understood geoinformatics (geomatics) were put. The education of the students of the Faculty of Forestry, Agricultural University in Cracow, in the full range of geoinformatic subjects (Tab. 1) started in the academic year 1998/1999, in the specialisations „Forest Management (GL)” and „The Protection of Forest Resources (OZL)”.

About 100 students of „Forest Management” specialisation are going through a semester course „Geographical Information System and Photogrammetry” - 10 hours of lectures and 20 hours of laboratory classes.

The students of „OZL” specialisation (about 65 people) for two semesters participate in the courses: „Geographical Information Systems” (25 hours of laboratory classes, 10 hours of lectures) and „Photogrammetry and Photointerpretation” (20 hours of laboratory classes, 10 hours of lectures).

There are also so called “elective courses” offered, including two in the academic year 2003/2004, chosen by the students of the Faculty of Forestry of the Agricultural University (Table 2). Every year compulsory and elective classes are also attended by several undergraduate and doctoral students from other universities (the Jagiellonian University, University of Silesia), depending on the number of vacant places.

Running geoinformatic courses (420 hours in total) gives the fulfilment of compulsory didactic hours for two staff members (Dr. Piotr Wezyk, Eng. – a forestry specialist of the Agricultural University, Cracow; Dr. Krystian Koziol, Eng. – surveyor, AGH-UST, Cracow).

Table 1. Compulsory courses in geoinformatics at the Faculty of Forestry of the Agricultural University of Cracow.

Specialisation	Geographical Information Systems		Photogrammetry and Photointerpretation		GIS and Photo-interpretation	
	Lecture	Lab. classes	Lecture	Lab. classes	Lecture	Lab. classes
<i>Forest Management (GL)</i>	-	-	-	-	10	20
<i>Protection of Forest Resources (OZL)</i>	10	25	10	20	-	-

Table 2. Elective courses in geoinformatics at the Faculty of Forestry of the Agricultural University of Cracow.

Elective Course	<i>Geoinformatics – Creation and Presentation of Maps</i>	<i>DGPS Mapping Techniques</i>
Lectures	6	4
Laboratory classes - indoor	24	6
Laboratory classes – field work	-	5

During the classes in „GIS” the students consequently learn the equipments and methods of inputting the information necessary for making digital maps into the system and the relation to the descriptive bases (SILP). On concrete examples they learn: how to introduce and edit the objects in geometric (LMN) and descriptive bases. Numerous spatial analyses and simple mathematic modelling are carried out. At the end of the GIS course students are taught how to make and print map compositions.



Fig. 1 Students of the Faculty of Forestry at the Agricultural University during laboratory classes

The goal of the course „*Photogrammetry and Photointerpretation*” is to make students familiar with modern methods of getting geometric and theme information from airborne images (panchromatic and coloured spectral-zone). The applied software and equipment (VSD-AGH) allows the obtaining data in information layers and their transfer to the GIS. On the concrete examples of the mountains region the participants go through all the stages on the orientation of modelling and stereo-digitalisation of the interpreted objects, according to a proper photointerpretation key. The final element is preparing a map composition. Within the mentioned above subjects there are classes in Remote Sensing and Image Processing based on the Image Analysis and ER Mapper.

All the three subjects are compulsory and end with a written examination. Examination questions are earlier disclosed and cover 100 terms in systems of GIS and RS (Remote Sensing) and the same number of questions in Photogrammetry and photointerpretation. Credits from laboratory classes are based on partial class works (GIS) or a projects (Photogrammetry).

5. Projects Made in the Laboratory of GIS and Remote Sensing with the Participation of the Forestry Students

From 1999 up till now ten Master’s thesis using geoinformatics tools to solve biological problems were completed.

This year two further Master’s theses related to the analysis of the usefulness of Quickbird VHR images in forest management are being prepared. The following 2 Master’s thesis being prepared, deal with the application of remote sensing in the health inventory of forests.



Fig. 2. The DGPS mapping training in the city park.

Scientific projects carried out in Lab. GIS & Remote Sensing where geoinformatics techniques were applied in the last years (Internet 2004):

- The use of Geographic Information Systems and photogrammetry to assess the propagation of dust pollutants and sulphur in forest ecosystems.
- Monitoring of the processes taking place in beech woods, in changeable natural environment, using the Ojców National Park and Forest Experimental Enterprise in Krynica as examples.
- Natural and anthropogenic changes in vegetation cover in extreme climatic conditions in the Tatra Mountains, using Bystra and Sucha Woda valleys as an example (near the Kasprowy Wierch Mountain).
- 5 Frame Program of the European Union (2000-2002): „Forest Environmental Monitoring and Management System (FOREMMS)” IST - 117228
- Temporal and spatial scales of the dynamics of West Carpathian mountainous coniferous forests
- The assessment of the dynamics of deforestation in the area of Kudlon and Jaworzyna Kamienicka in the Gorce National Park, using photogrammetric techniques and GIS.
- Analysis of the ecological value of the woodlands of the Ojców National Park, using Geographic Information Systems.
- The assessment of the possibilities of using high-resolution airborne and satellite images and GPS techniques in the inventory of the forests, using selected woods in the Wood Districts of Staszow and Niepolomice.
- The usefulness of high-resolution satellite images in the method of the definition of the zones of forest damage, using the Forest Districts of Swierklaniec and Pulawy as an example.

The education in the area of geoinformatics went further than the LGiT. In 1998-1999 the staff of the Chair of Forest Ecology (Prof. Dr. Sc. Jan Greszta and Dr. Piotr Wezyk, For.Eng.) participated as the instructors in the course „Comprehensive use of information from airborne images” ordered by the Main National Surveyor within the project PHARE PL.9206-02-04/II

The opening of the Laboratory of GIS and Remote Sensing in Autumn 1999 coincided with the first World GIS-Day ESRI. On 14th November 2001) it was our third participation (www.gisday.com). GIS presentations took place.

Based on the equipment and LGiT software there are also demonstration classes organised for the participants of the *Post-diploma Course of Nature Conservation and Environmental Protection* at the Faculty of Forestry at the Agricultural University in Cracow.

On the request of students there is the Geoinformatic Section in the Students Scientific Working Group. Its members are interested in the application of modern technologies in obtaining, processing and publishing information. In the framework of the scientific club students launched two projects:

- Inventory of horse chestnut trees *Aesculus hippocastanum* in Cracow (horse chestnut trees vs. horse chestnut leaf-miner, *Cameraria ohridella*) – a great significance of white horse chestnut as a popular tree species grown in parks, streets, private gardens, alleys, and even in the open landscape in the countryside is connected with the mass occurrence of their pest and large costs of its removal ,
- Inventory of the green areas in Cracow (Cracow’s Parks) – the attempt to make an Internet, interactive guide in the parks and gardens of Cracow, using the available in the Faculty of Forestry GPS receivers, hardware and software adjusted to work in GIS and Internet servers able to reach a great number of people.

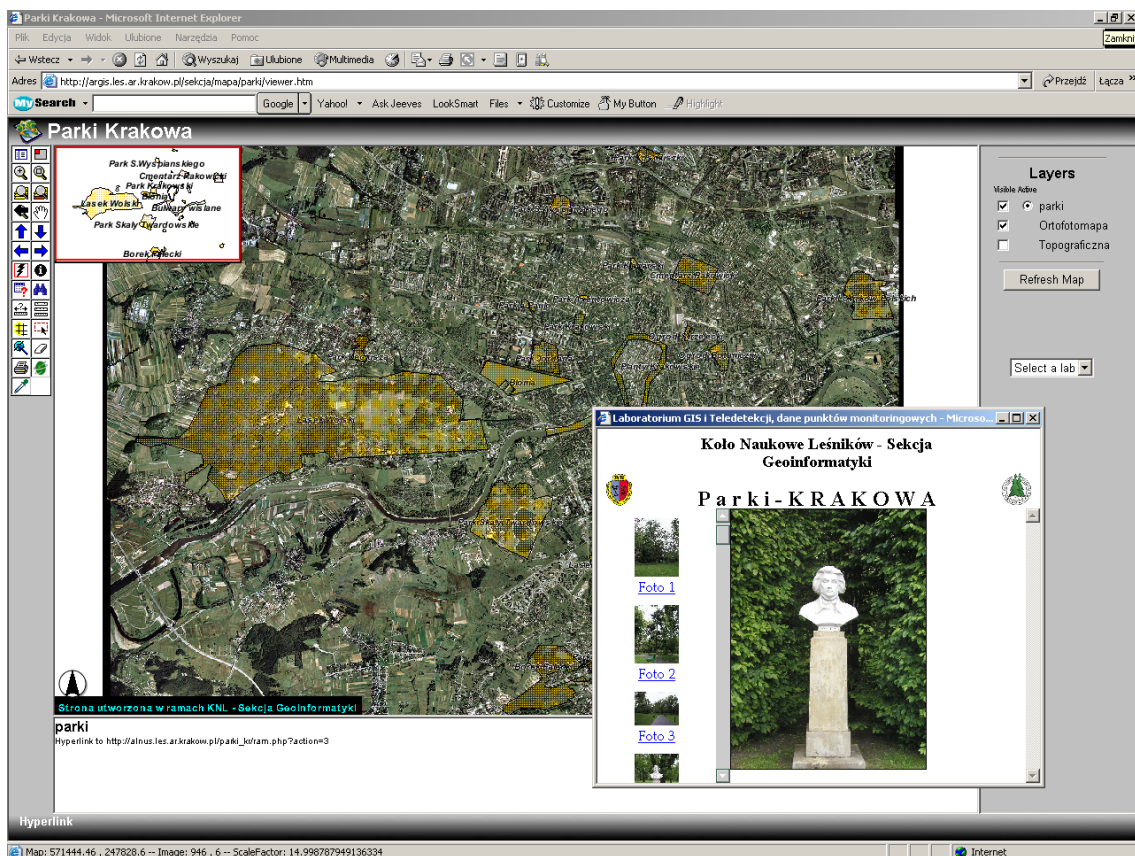


Fig. 5: The integration of ArcIMS server with IWS server and MySQL database on example of Cracow Parks

In the presentation of the results of both projects the software providing vector and raster data ArcIMS and IWS was used. The performance of the scientific club can be seen on-line through the Internet pages (<http://argis.les.ar.krakow.pl/sekcja/index.html>). At the same time the students of the scientific WG learn the possibilities of the integration of modern geoinformatics techniques to obtain the widest possible information from raster data (treated as the background), vector and descriptive databases (Fig. 5).

It is planned to create a Post-diploma Studies called „Geoinformatics in the Management and Monitoring of Environment” both for the specialists from the State Forest Holding, local administration, teachers and scientists.

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Address:

Piotr Wezyk
 Krystian Kozioł
 Laboratory of GIS and Remote Sensing (LGiT)
 Chair of Forest Ecology
 Faculty of Forestry Agricultural University of Cracow
 Al. 29 Listopada 46
 31-425 Kraków
 Tel/Fax: 12- 4171929

<http://argis.les.ar.krakow.pl>
e-mail: rlwezyk@cyf-kr.edu.pl; rlkoziol@cyf-kr.edu.pl