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RESEARCH AND EDUCATION IN GEOMATICS AT THE FORESTRY FACULTY OF THE WARSAW UNIVERSITY OF LIFE SCIENCES

BADANIA I EDUKACJA W ZAKRESIE GEOMATYKI NA WYDZIALE LEŚNYM SZKOŁY GŁÓWNEJ GOSPODARSTWA WIEJSKIEGO

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Słowa kluczowe: geomatyka, GIS, teledetekcja, GPS, leśnictwo, badania, edukacja

In the field of geomatics, research and education activities at the Forestry Faculty of Warsaw University of Life Sciences are carried out by the Division of Geographical Information Systems and Forest Geodesy which is a part of the Department of Forest Management, Geomatics and Forest Economics.

The main research fields of the Division are:

- Identifying of the needs for forest ecosystems spatial data on three levels: forest stand, forest complex and ecological landscape to meet the requirements of contemporary forestry and nature protection.
- Studying of the Earth observation technologies and their use as source of information about forests and natural environment.
- Investigating of geospatial technologies and their use for different forestry, regional planning and land management applications.
- Utilizing of geospatial technologies for monitoring of the rural historical parks.

Among numerous research activities there are some especially worth to be mentioned:

- Remote sensing technologies and geographical information systems for environmental analysis with an emphasis on forestry, environment protection and land management.
- Quality aspects of the above mentioned applications.
- Photogrammetry and field surveying as applied in forestry (Fig. 1).
- Earth remote sensing observations for forest management and landscape ecology.
- The use of GIS for localization of outbreak foci of pine insect defoliators (Fig. 2).
- Environmental cartography and geo-visualization.
- Multimedia systems and their use in nature education.
- Inventory methods for protected areas and historic parks.

The methods and tools used by the staff of the Division:

- Field surveying techniques and GPS (Fig. 3).
- Spatial Data Analyses.
- Network Analyses (Fig. 4).
- Remote sensing images processing: VHR images, multisource images integration, archive images enhancement and processing.
- Photogrammetry.
- LIDAR data registration and analysis (Fig. 5).
- GEO – Object Based Image Analysis (Fig. 7).
- Methods of Artificial Intelligence: Expert Systems, Artificial Neural Networks (Fig. 6).
- Geostatistics.
- Landscape metrics.
- 3D visualization and analyses.

The experience of the Division is obtained in different research projects, often conducted in cooperation with forestry related institutions in Poland, for example: General Directorate of State Forest, Bureau of Forest Management, Forest Research Institute and other forestry departments.

The principles of geomatics education provided by the Division, are based on scientific and educational experience of all the staff and worldwide achievements in methods of collecting, processing and presentation of spatial information for natural environment management purposes. The courses are offered for students of various faculties: more then 11 are taught at the Faculty of Forestry and 16 – at various interdisciplinary departments.

All courses are delivered in several blocks: geomatics with elements of geodesy, geospatial data acquiring and processing, Global Positioning Systems, Geographical Information Systems, remote sensing, photogrammetry and cartography. There are also 6 blocks given in English language for international studies. Different courses are offered for students of bachelor, master and complementary master study programs.

Master and PhD students of the Faculty of Forestry, master students of Regional Planning and Management Interfaculty Study, and Tourism and Recreation Interfaculty Study conduct their research in the field of Geomatics in Forestry. Few examples of student projects from the wide scope of subjects are listed below:

- GIS application in the nature protection – Bory Tucholskie National Park case study.
- Feasibility study on the application of GIS technology for forest risks maps.
- GIS promotion system of Roztoczański National Park.
- Using GPS technology in National Parks – present and future perspectives.
- Inventory of trees with 3D visualization (Fig. 8).
- Application of network analysis for optimizing drive route to forest fire event.
- Maps published on websites as a tool for promoting Forest Departments – graphic map analysis.

From 1991 up to now, 333 master of science projects using GIS and RS had been done at the Division.

The staff of the Division supervises also PhD projects concerning use of GIS and RS for forestry, protected areas and regional management purposes. Some among recently finished PhD projects are:

- Evaluation methods of forest image maps (Olenderek, 2000).
- Investigation methods of forests and protected areas changes (Kosiński, 2001).
- GIS supported by Experts Systems and Artificial Neural Networks for forestry purposes (Tracz, 2003).
- GIS utilization for forest fire distribution analysis on the forest district territory (Krawczyk, 2004).
- GIS for biosphere reserves (Adamczyk, 2004) (Fig. 9).
- Spatio-dendrological changes in selected monumental parks in 30 years period (Grzegorzewicz, 2005).
- The role of image maps in monitoring system of post hurricane areas in Puszcza Piska forest (Norman, 2008).
- An integrated inventory method for wooded areas (Brach, 2008).

The Division of Geographical Information Systems and Forest Geodesy actively participates in International Master Study Programme "Forest Information Technology" organized by the Faculty of Forestry of the Warsaw University of Life Sciences and the Faculty of Forestry of the University of Applied Sciences, Eberswalde in Germany. Polish, German and students from other countries during 4 semester of study attend several GIS and RS related courses, which are taught by faculty staff of both universities.

Streszczenie

W artykule przedstawiono w olbrzymi skrócie naukową i edukacyjną działalność w dziedzinie geomatyki prowadzoną w latach 1991–2009 w Katedrze Urządzania Lasu, Geomatyki i Ekonomiki Leśnictwa Wydziału Leśnego Szkoły Głównej Gospodarstwa Wiejskiego. Wyliczono: główne kierunki prac badawczych; projekty zrealizowane wspólnie z polskimi instytucjami leśnymi, w tym z Dyrekcją Generalną Lasów Państwowych i Instytutem Leśnictwa; zrealizowane prace dyplomowe i doktorskie związane z wykorzystaniem na potrzeby leśnictwa GIS i teledetekcji. Zasygnalizowano udział Katedry w międzynarodowym programie studiów magisterskich pn. „Technologie informacyjne w leśnictwie".

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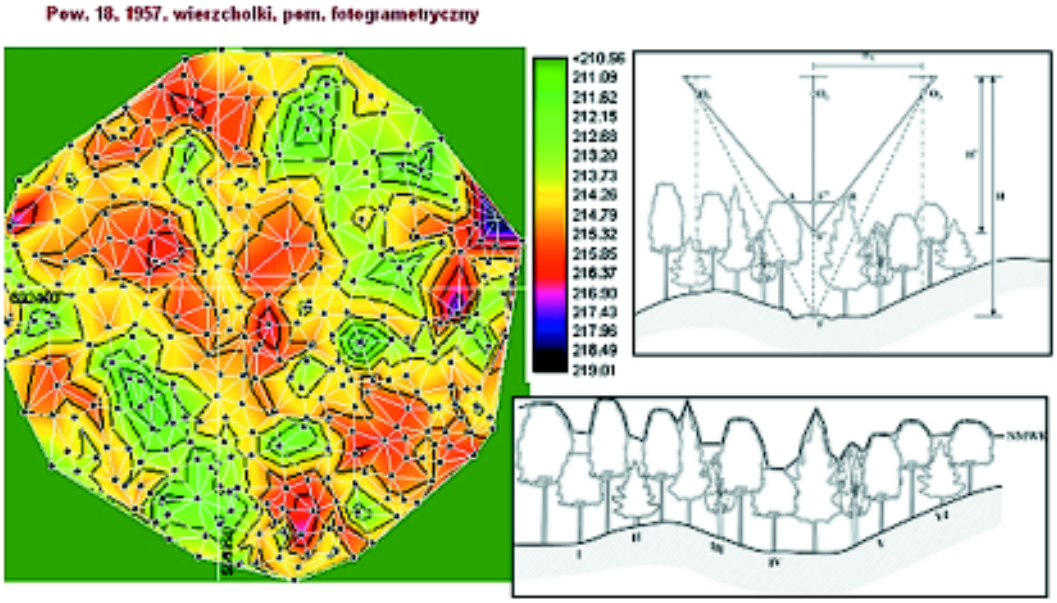


Figure 1. Forest canopy surveying and modeling. Photogrammetric method of the assessment of the forest canopy vertical structure condition and changes (Będkowski, 2005)

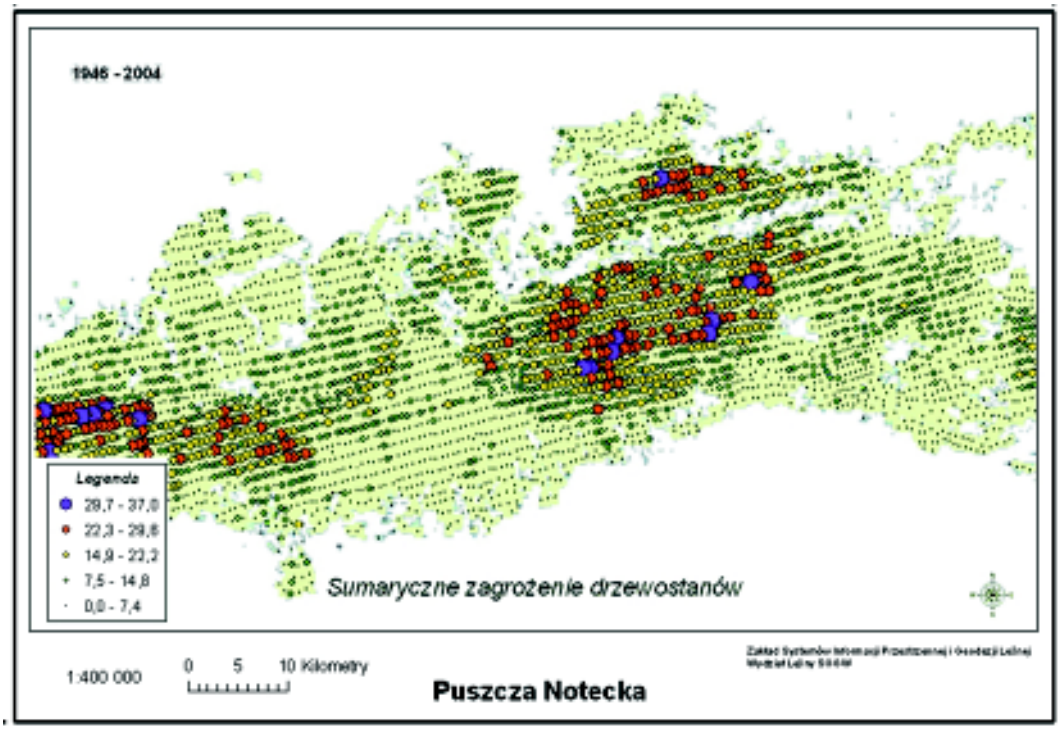
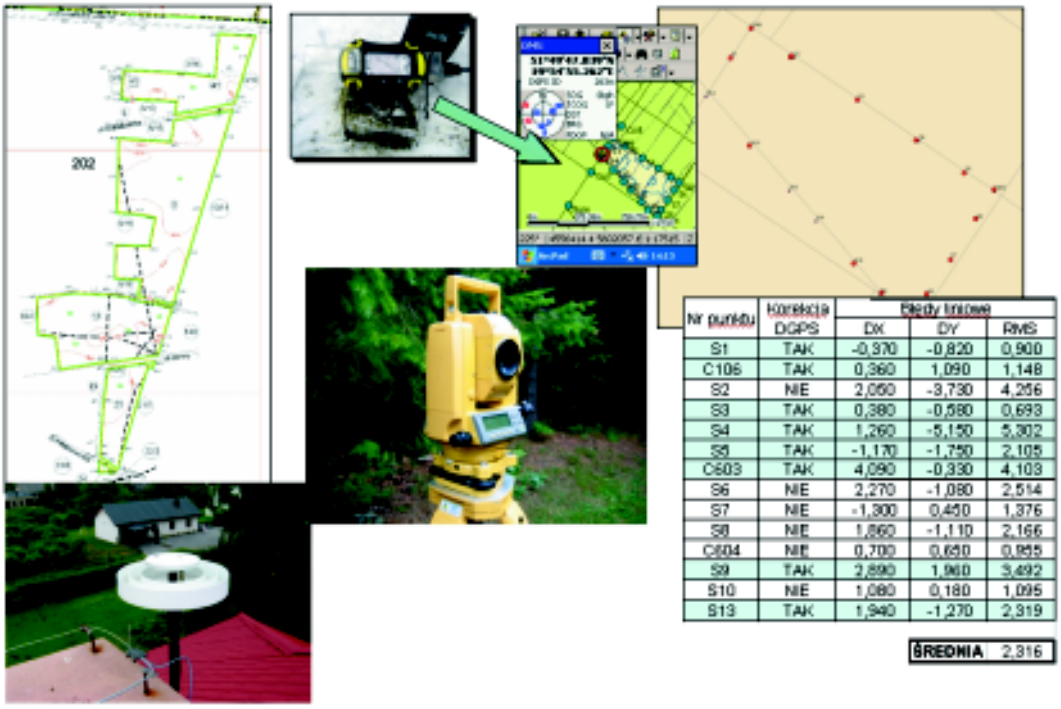


Figure 2. Forest threatening. GIS for localization of outbreak foci of pine insect defoliators: example of Notecka Primeval Forest (Mozgawa et. al., 2006)



Nr punktu	Korekcja DGPS	Błędy liniowe		
		DX	DY	RMS
S1	TAK	-0,370	-0,820	0,900
C105	TAK	0,360	1,090	1,148
S2	NIE	2,050	-3,730	4,256
S3	TAK	0,380	-0,580	0,693
S4	TAK	1,260	-5,150	5,302
S5	TAK	-1,170	-1,750	2,105
C603	TAK	4,090	-0,330	4,103
S6	NIE	2,270	-1,080	2,514
S7	NIE	-1,300	0,450	1,376
S8	NIE	1,860	-1,110	2,166
C604	NIE	0,700	0,650	0,955
S9	TAK	2,890	1,960	3,492
S10	NIE	1,080	0,180	1,095
S13	TAK	1,940	-1,270	2,319
		ŚREDNIA		2,316

Figure 3. Field surveying techniques used by students (Brach, 2005)

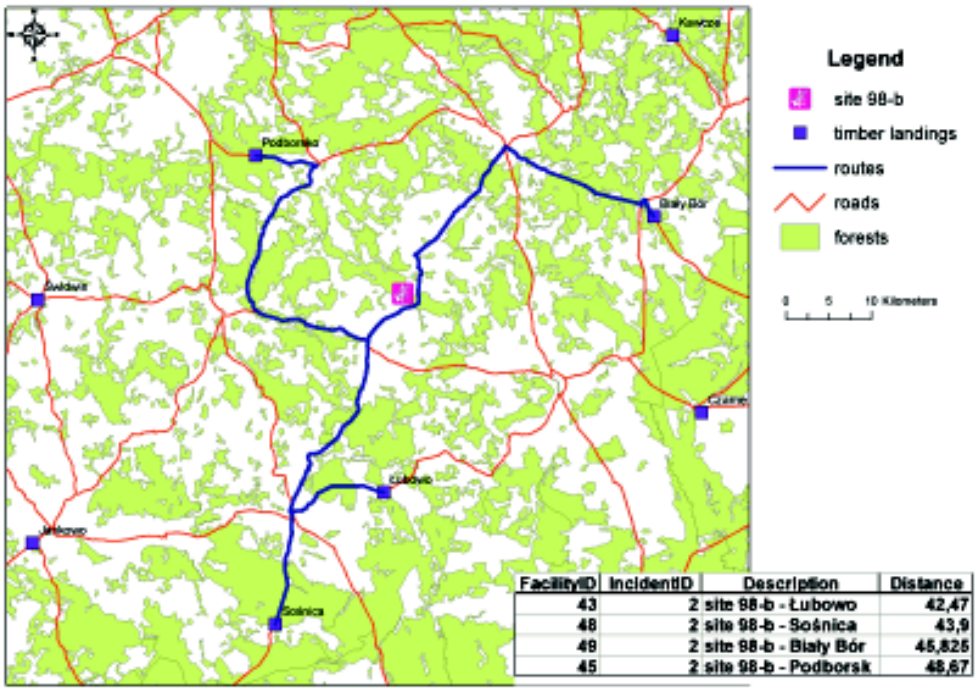


Figure 4. Example of network analyses for timber transportation (Tracz, 2006)

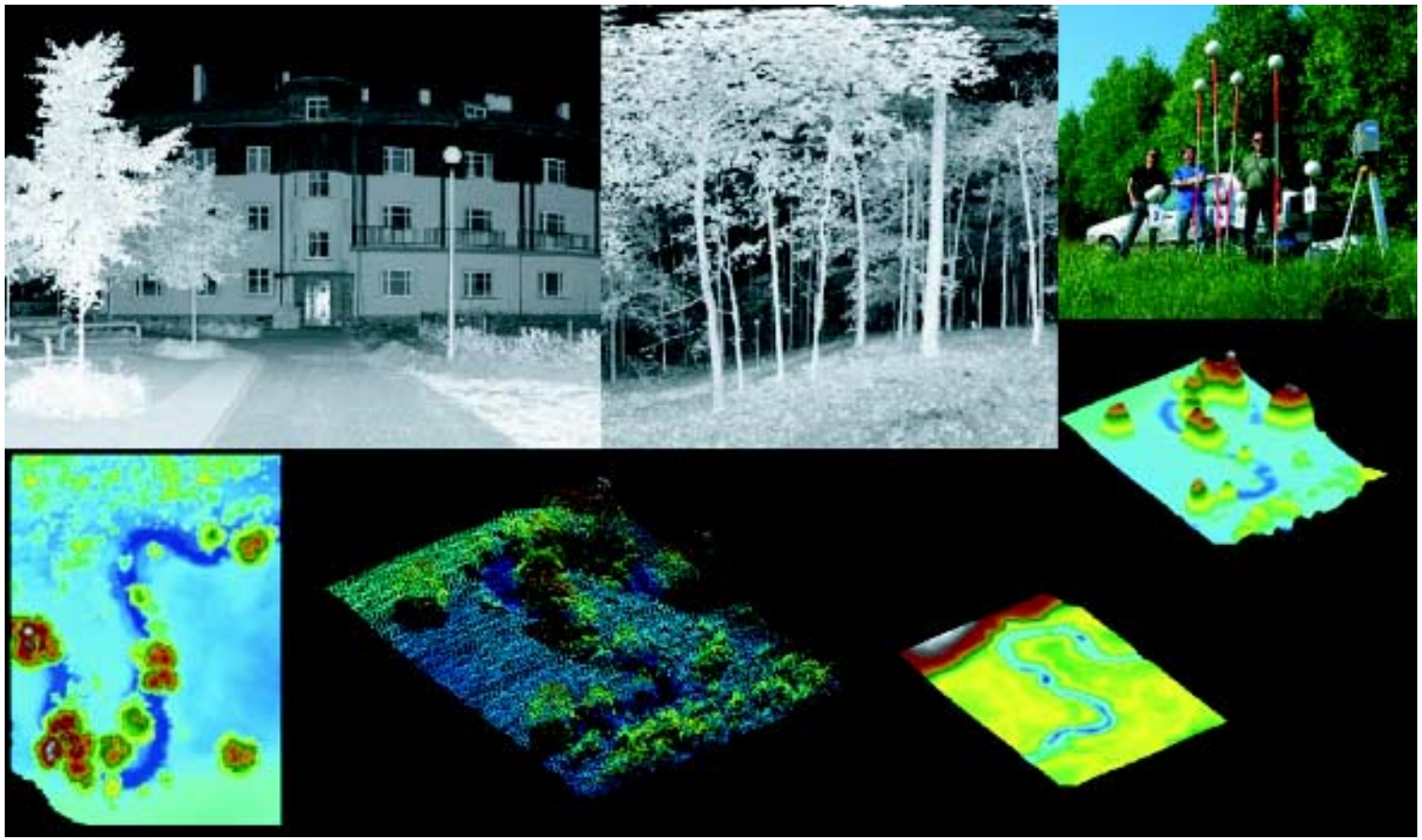


Figure 5. Using terrestrial and airborne laser scanning to analyze spatial structure and functionality of forest

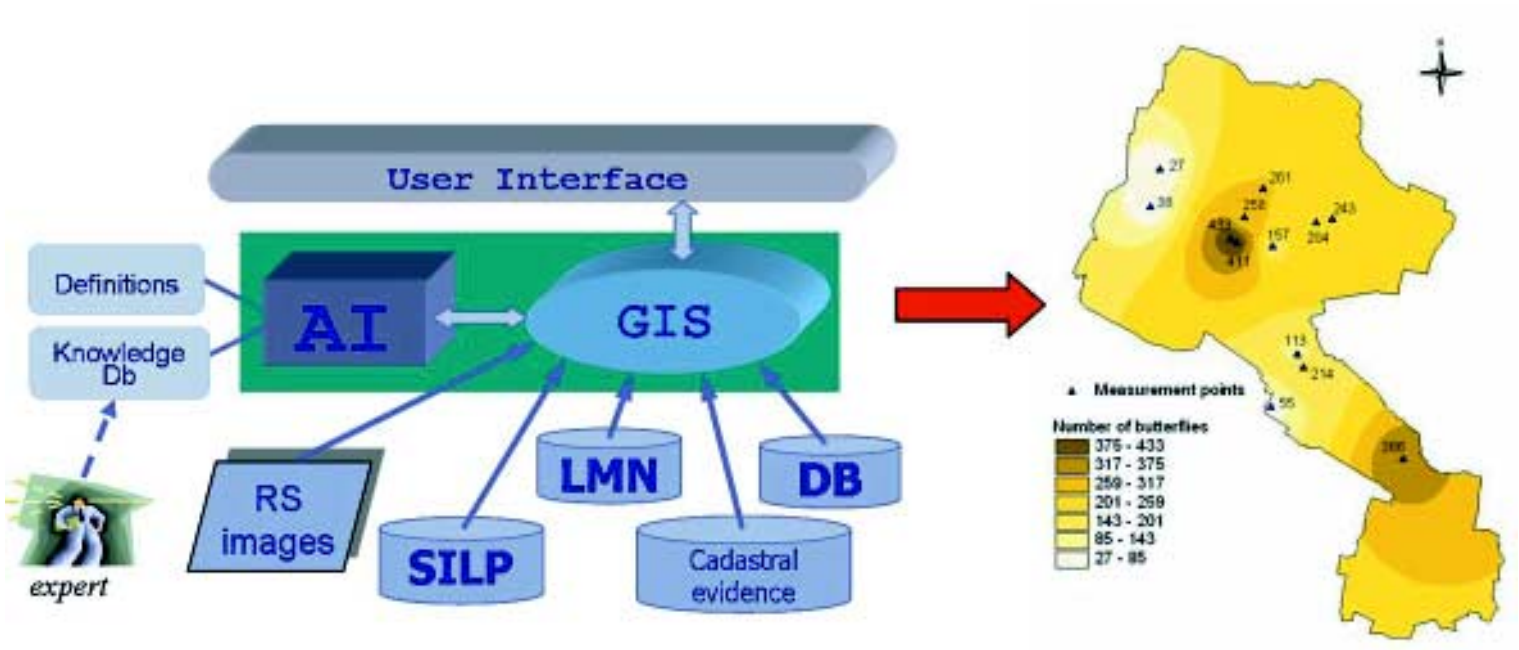


Figure 6. Example of application of AI methods for forestry purposes.
Schema and map from PhD dissertation "GIS supported by Experts Systems and Artificial Neural Networks for forestry purposes" (Tracz, 2003)

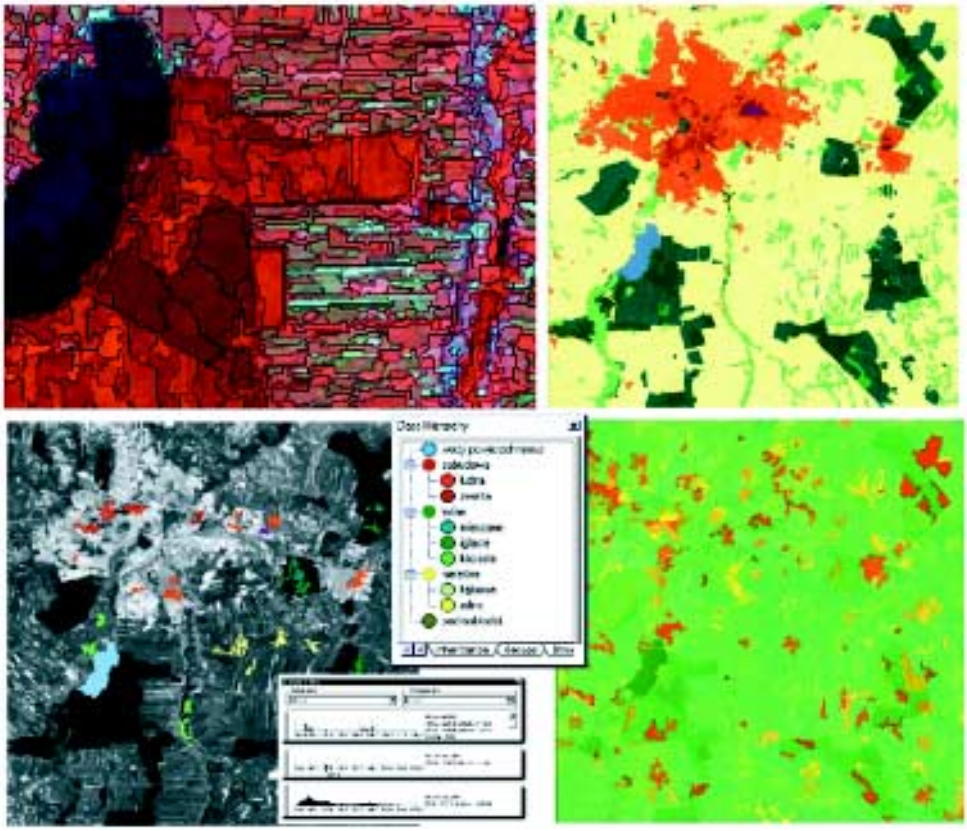


Figure 7. GEO-Object Based Image Analysis. The case of West Polesie Biosphere Reserve: image segmentation (above left), selecting training areas (below left), result of classification (above right), assessment of classification result (below right) (Adamczyk, 2006)

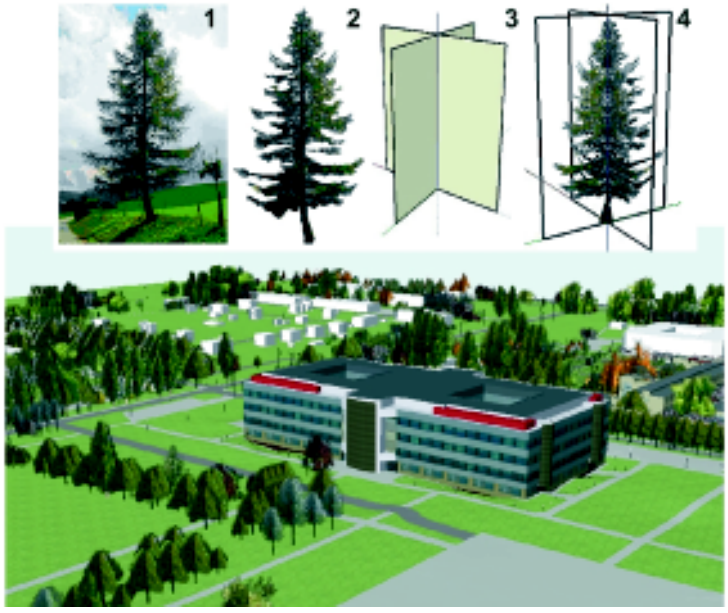


Figure 8. 3D view of the Faculty of Forestry building and tree modeling (Kowalewski, 2006)

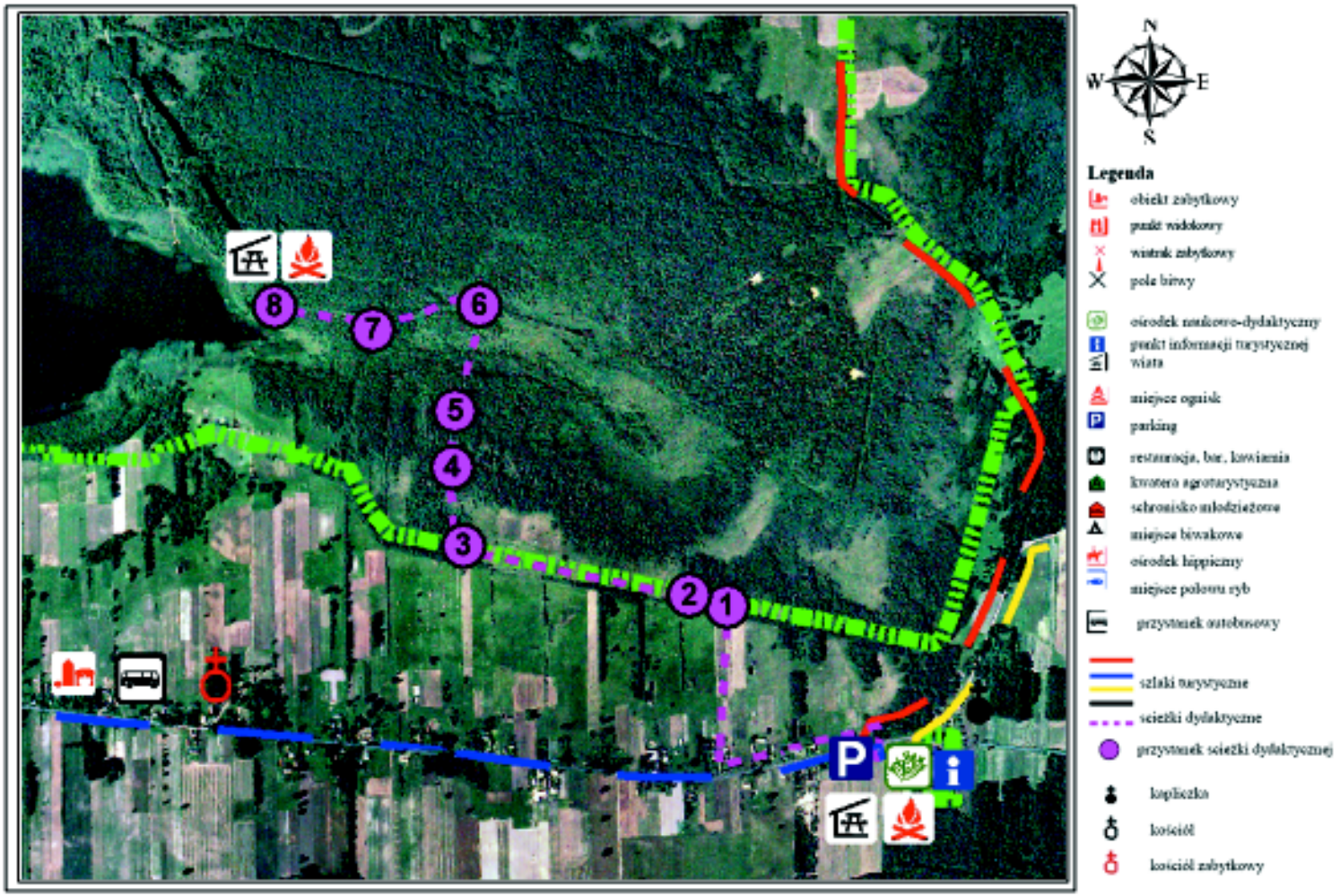


Figure 9. Tourist map based on aerial photos. Example from PhD dissertation "GIS for Biosphere Reserves" (Adamczyk, 2004)