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Remote sensing and GIS in the research and management of the Šumava region

Dálkový průzkum a geografické informační systémy ve výzkumu a hospodaření na Šumavě

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„It makes all the difference whether one sees darkness through the light or brightness through the shadows"
David Lindsay

Abstract

The focus of this paper is twofold. First, to overview the information potential of the data available from the remote sensing (RS) and geographic information systems (GIS), to show the utilization of these data in the biodiversity projects, and suggest application of the GIS in the Šumava region; current establishment of the GIS for the Šumava regions is also mentioned. Second, to demonstrate a case study carried out in cooperation with a research team from Šumava National Park, which included satellite and air born data, digital elevation model and GIS; for the purposes of landscape management, this study estimates the natural potential of the Dobrá Voda region, a former military territory.

Key words: satellite, DEM

Introduction

Geographic information systems (GIS) and remote sensing (RS) are progressive techniques penetrating a growing number of application domains, including cartography, urban planning, risk assessment, pollution control, transport management systems and nature conservation management. GIS offers the capability of integrating environmental and other spatially related data in a single system (Burrough 1986). In the integration with the RS data, GIS can successfully be used, for example, in those large-scale monitoring systems where vegetation changes are in the focus of the interest (e.g., Aldrich 1979, Seidel 1988, Piwowar 1990).

Even though application of GIS and RS has been accelerated in the Czech Republic after 1989, i.e., after being released for the East European countries, they have not become „an everyday source of information" for people in research and decision sphere yet.

What are GIS and RS?

This is just a brief overview of principles of GIS and RS as new progressive techniques applied in town planning, resource and landscape management. Only basic information has been assembled here. GIS can be defined (Chamber 1989) as a set of tools for storing, updating, retrieving, analyzing, manipulating, displaying, integrating environmental, economic and social data in a single system. It facilitates:

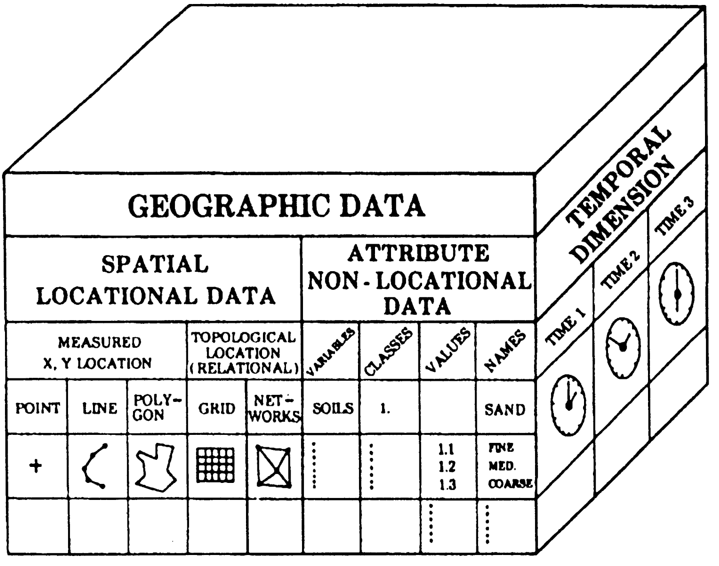

Fig. 1. – Three conceptual components of a geographic information system (GIS). (After Dangermond, 1983.)

- overlays of data for purposes of comparison
- updating of information to illustrate changes over time
- changes of scale for micro-analysis
- derivation of unavailable data through manipulation of known factors
- integration of physical and social data sets
- integration of remotely sensed data for continuous environmental monitoring
- modelling of physical, economic, and social processes for the purpose of simulation and prediction.

Each object of GIS data is described in terms of
- position with respect to a known coordinate system
- its attributes (unrelated to position)
- its spatial interrelations with other objects (topological relations)
- temporal dimension (to which time the data are related) – Fig. 1.

Which questions can be answered by GIS :

what..
where..
when..
who..
how..
what if..
is next to.. and in combination.

Remote sensing is a technology that involves the use of imaging sensors mounted on aircraft or spacecraft platforms for acquiring image data of the Earth's surface (Jensen 1986). Remote sensors usually record electromagnetic radiation which travels at a velocity of $3 \cdot 10^8$ $m.s^{-1}$ from the source, directly through the vacuum of space or indirectly by reflection or radiation to the sensor. The measured radiation and reflection depend on materials and wavelength on which a sensor works. Airborne data are usually in the form of photos, while satellite data are delivered mainly in digital form.

Which questions can be answered by RS:
what..
where..
when..

GIS for Šumava region

Several attempts within different project frames have been undertaken to build a GIS database for the Šumava region since 1990. The best part of the present database arose from two sources:

(1) the Trilateral concept project, where GIS layers have been built in the form of ARC/INFO coverages for three Šumava districts: Klatovy, Prachatice and Český Krumlov (KACEROVSKÁ, SEIDL 1993).

(2) Laboratory of RS of the Czech Nature Conservation Institute, covering the Šumava NP and Protected Area (ARC/INFO coverages).

Both parts include layers based on similar thematic map sources, ranging from administrative boundaries to natural units (e.g. geology, hydrology, protected areas, etc.). The first part of database was digitized from maps with scale 1:50,000 and lower, the second from maps with scale 1:25,000. The resulting coverages were transformed into Gauss--Kruger projection.

Some other GIS layers were prepared as the outputs from other projects, e.g. coverages of peat bogs in Šumava NP, land cover of KT, PR, CK districts, derived from Landsat 5 TM data by Institute of Landscape Ecology.

Land Cover from Satellite and Airborne Data in Landscape Management

The aim of this study was to provide enough detailed land cover classification for the planning of private farm grounds and landuse within the boundary of the Dobrá Voda former military territory , situated in the Šumava Mts. There were two objectives of the study:

To apply image analysis to satellite data (Landsat 5 TM, SPOT) and to prepare a land cover of nonforested area under the mask of military territory.

To improve the results of classification, where necessary, using digitized maps of geobotanical surveys, mapped into aerial panchromatic photography 1:5,000.

Following results have been achieved: Semisupervised classification of TM5 and SPOT(P) distinguished successfully only about 70% of the area under the mask of military territory. The most confusion classes were those, which are covered with mosaic vegetation of patches of different species growing on former bare soil and naturally regenerated areas of *Betula* and *Salix*. The miscarriage can be considered as a result of the low spatial resolution of TM and SPOT data in comparison to the size of the patches and a late vegetation term of data acquisition.

SPOT data proved to be suitable for line feature detection (edge detection). The misclassified areas were substituted for the results from aerial photography 1:5,000, into which a botanical survey had been mapped. A proposal for spatial distribution of farm grounds and land use intensity was prepared on the base of the map of land cover and potential water conditions, derived from digital elevation model (Agricultural faculty of SBU) .

Conclusions

Above mentioned GIS and RS techniques became a powerful tool in many fields especially where output information results from combination of different data sources related to Earth's surface. The information obtained using these data and techniques can be on different hierarchy, is relatively cheap and big area can be worked up in very short time with the same method's error. Unfortunately, there still does not exist a united approach both for building and using this database in the case of Šumava GIS. The biodiversity project should help to improve the situation.

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