ESSENCE AND APPLICATION OF THE SPATIAL DATA INFRASTRUCTURE

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Abstract: *Spatial data infrastructure (SDI) is the infrastructure that facilitates the discovery, access, management, distribution, reuse, and preservation of digital geospatial resources. The aim of this paper is to present the nature and concept of spatial data infrastructures, which have helped to build understanding about the importance of the relationships within different levels of SDIs to support the interactions and partnerships of the spatial data communities.*

Key words: *GEOINFORMATION TECHNOLOGY, GEOGRAPHIC INFORMATION SYSTEM, DIGITAL ELEVATION MODEL, LIDAR TECHNOLOGY.*

1. Introduction

The emergence of spatial data infrastructures (SDIs) is closely associated with the efforts of collecting and producing geospatial data, as well as the advancement of surveying and computer technologies. In the past decades, a large amount of geospatial data, such as remote sensing images and GPS locations, have been collected by government agencies. Meanwhile, the fast development of geographic information systems facilitates the derivation of various data products from the collected data, such as topographic maps, land cover data, transportation networks, and hydrographic features.

Spatial Data Infrastructure (SDI) is an initiative intended to create an environment in which all stakeholders can co-operate with each other and interact with technology, to better achieve their objectives at different political/administrative levels. SDIs have become very important in determining the way in which spatial data are used throughout an organisation, a nation, different regions and the world.

Spatial Data Infrastructure is a strategically important issue for the countries of the European Union. Spatial Data Infrastructure (SDI) includes the following elements: technology, standards, policies and human resources.

The integration of information from satellite imagery with various other information layers allows:

• syncing a variety of data;

• verifiability check;

• updating and creating the opportunity to provide the basis for effective and sustainable governance.

The co-location of data from space and land-based sources, as well as permanent land-based monitoring (land cover and land use), enables information to be secure and reliable, end-to-end services and effective results from the accompanying analyzes, forecasting models and estimates.

2. Bulgarian spatial data infrastructure

The Bulgarian Spatial Data Infrastructure (BIPD) is a prototype geoportal as a free public benefit service. One of the main goals of BIPD is to present databases, services and operational capacity to Bulgarian organizations with priority:

• sustainable development strategy Europe 2020;

• Danube strategy;

• Earth Observation Program - Global Monitoring for Environment and Security; in integration with the development of the GALILEO satellite navigation system;

• European directives and regulations for the harmonization of spatial data, data quality assurance, land monitoring, risk management and security.

The initiative is part of a framework agreement between the Executive Agency "Electronic Communications Networks and Information Systems" (ESMIS), now State Agency for Electronic Governance (EAU) to the Council of Ministers and the Agency for Sustainable Development and Eurointegration (ASDE) as well as in the execution of tasks under an agreement between ASRE and the Joint Research Center (JRC) Commission. An experimental data geography [4], an element of applied research and development projects, including the 7th Framework Program of the European Union, has been developed. One of the objectives is to facilitate and accelerate the implementation of the requirements of European Parliament Directive 02/07 / EC establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).

The experimental geoportal is user-oriented. The user can open and observe different thematic maps as well as digital satellite images attached to the map of the Republic of Bulgaria. Apart from the thematic card material, attribute data tables are also included, and for more and more diverse information, a link to other websites (Wikipedia) is provided.

The database is continuously complemented by new layers of information coming from different state, scientific and municipal structures. They are presented in a timely manner electronically with the appropriate degree of accuracy.

The first phase of the pilot project - a spatial database for the trans-European transport corridors passing through Bulgaria - is based on satellite images with a 15 m and 30 m satellite resolution from the LANDSAT satellite.

To improve image accuracy, it is also necessary to take into account various types of interference. "The effect of disturbance impacts on the quality of the information processed, resulting in its destruction or aging, which increases the degree of uncertainty in the decision-making process" [1].

Currently finished layers of land cover from satellite images with 5 m resolution SPOT satellite, as well as very high resolution 0.70 m and 1 m from satellites Ikonos and Quickbird for cities, ports and other important sites.

3. SmartSDI Information System.

The SmartSDI system creates and maintains a database of geospatial data and services available in government, as well as information about their administrators. The system offers input, editing and intelligent search tools in the database, these functionalities being implemented in separate modules. The web-based professional implementation of the system, as well as its functional scope, allow use and development within the national geoportal. The main activities include:

• Performing quality control of the accuracy and reliability of spatial data;

• Validation of terrestrial and distance methods for measurement of areas according to ISO standards;

• modeling of requirements and business processes (administrative and system level) through UML;

• inventory of databases and creation of metadata using XML schemas;

• object-oriented analysis, classification and retrieval of geo-objects from satellite and airplane images;

• processing and interpretation of data from satellite and aerospace imaging, in visible, infrared, radar and radiometric spectra. To date maps of land cover have been prepared on different scales for the needs of the most important trans-European corridors with a 10 km buffer and functional urban areas;

• Performing ground observations with radiometric instruments for the assessment of soil moisture for the early diagnosis and reduction of the effects of soil over-wetting, dredging and flooding;

[1] Lazarov L.I., The basics of the electronic war, Veliko Varnovo, 2018, p. 37

• Voice technology for monitoring, control, control and security.

The user can open and observe thematic digital maps [3] as well as digital satellite imagery from any point along the routes of the trans-European transport corridors attached to the map of the Republic of Bulgaria. The integration of information from satellite imagery with various other information layers allows the synchronization of various databases, verifying their authenticity, updating and enabling the basis for effective and sustainable management.

4. *Web SmartCover GIS.*

The SmartCover Information System and its accompanying architecture provides spatial data services in the web GIS environment. SmartCover is unique to Bulgaria and the European Union because it contains cross-border spatial data and services harmonized under the INSPIRE directive. On the other hand, SmartCover is based on a terrestrial layer (land use) layer developed under the global ISO 19144-2 (LCML) [8] standard, thus maintaining coordination and updating of different layers of spatial data and integrating thematic databases into a common harmonized information package. One of the main tasks of SmartCover Architecture is to be an information platform for integrated risk management, territory and citizens' protection as well as regular monitoring of changes and effective absorption of European, regional and national funds.

ASURE and ReSAC are involved in the development of comprehensive spatial planning resources in the border administrative districts between Bulgaria and Romania, covering a large part of the lower Danube region. The co-operation is under the cross-border cooperation program and under the project "General Strategy for Sustainable Territorial Development of the Romania-Bulgaria Region (SPATIAL)".

More detailed technical activities include creating and building systems and information services. The developed services allow the integration of new harmonized spatial databases and other services to be the basis for the creation of information systems at the state / local level. The database will provide the necessary information for a complete set of indicators at the statistical level - Fig. 1.

A specific result of the project is the creation of a comprehensive common land cover database for the cross-border area, based on the philosophy of Land Cover Meta Language - LCML (ISO 19144-2) and fully in line with the principles of the INSPIRE Directive. The Common Specification will provide more effective cross-border analysis and reporting.

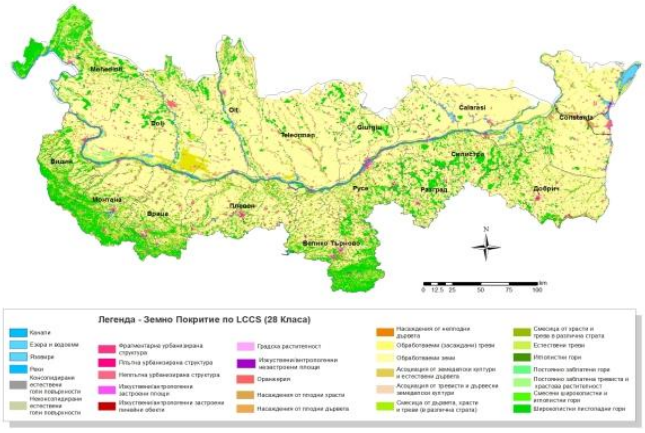

Fig. 1. *Ground cover database.*

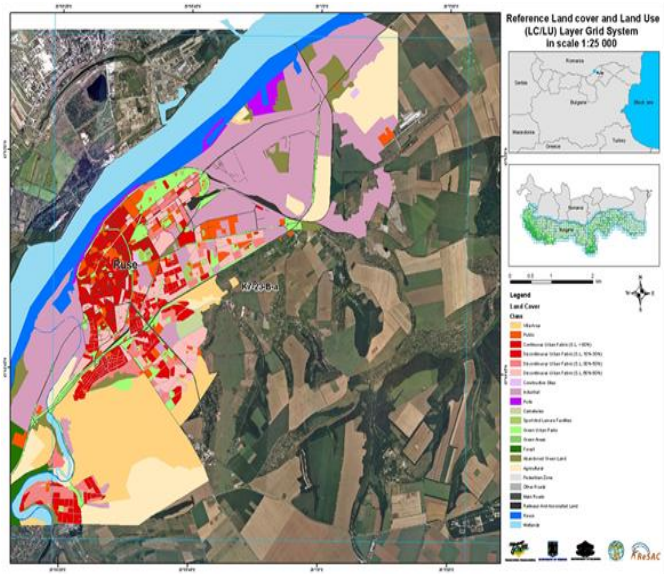

Fig. 2. *Extract from land cover / land use (based on LCCS / FAO) for the city of Rousse.*

5. *Ground cover "reference layer - Bulgaria"*

The Bulgarian initiative for the development of a national land cover database, using the FAO-LCCS methodology, is an example of applying good world practices in assisting in local (national) decision-making. The reference database - a layer of terrestrial coverage on the territory of the Republic of Bulgaria is entirely prepared by specialists from the Agency for Sustainable Development and Eurointegration (ASDE) and the application center for satellite imagery - ReSAC.

The Earth Cover Reference Layer is based on satellite images from Landsat satellite (USA) from 2011, with a resolution of 30 m. Information on the altitude and the slope of the area is provided on each spatial object (Figure 3.9). The authenticity of the interpreted data has been verified and an accuracy of 85% has been achieved.

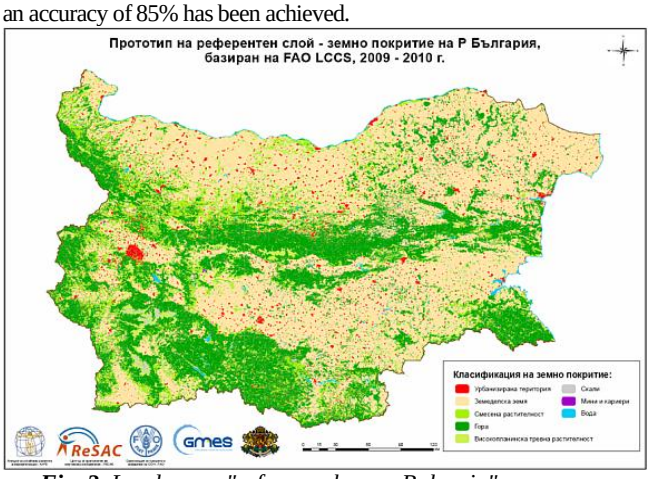

Fig. 3. *Land cover "reference layer - Bulgaria".*

Bulgaria is the first Member State of the European Union to launch a land cover database based on the world-wide accepted LCCS methodology for the territory of the whole country, updated for the period 2009-2013.

The LCCS-based reference database for Bulgaria is one of the first attempts to be combined with a similar approach at local and national level to the global approach to land management and monitoring and land use.

This database is in line with the GLOBCOVER international project, in which, apart from the European Union, the United States, Russia, Canada, etc. (Figure 3.10) participate. The reference layer includes updated information on the relief (SRTM v.4, by DG JRC) and the main types of land cover, thus creating an appropriate product for planning and managing the site.

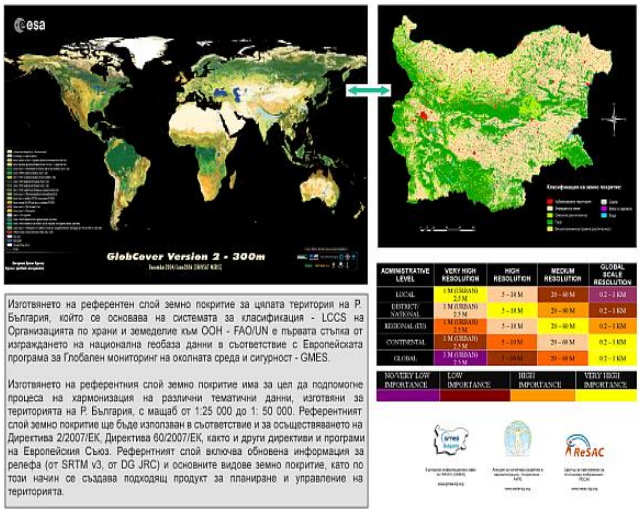

Fig. 4. The reference database for Bulgaria as part of the GLOBCOVER international project.

In partnership with the state administration, municipalities, civic associations, scientifically-applied organizations, universities and scientific institutes from the Bulgarian Academy of Sciences, ASURO participates in the progressive building of operational capacity to fulfill the requirements under Directive 2007/02 / EC and under the Global Monitoring for Environment and Security (GMES).

Global monitoring is also used in the field of intelligence. "Coordination is needed when planning and conducting intelligence in remote areas"[2].

One of the results is the preparation of maps of the terrestrial coverage of the regional cities in Bulgaria based on high resolution satellite imagery. The maps are 1: 5000 scale, using images with a spatial resolution of 0.5 to 1 m from different satellites - "Ikonos", "Quickbird" and "Eros".

Work on the preparation of more detailed maps of the land cover for the district towns, which will enable the map of the town, the regulation map, the thematic maps of the infrastructure, as well as the maps of the lands, the natural environment and the agricultural properties around the cities.

[2] Yankov Y.I., Human intelligence - essence, advantages and limits of info gathering, Collection of reports from the Annual University Scientific Conference, V. Varnovo, 2010, p.2

Conclusion

1. Spatial data infrastructure presents a solution to the problems of resource discovery and data redundancy. It provides a unified platform where people can go and search geospatial data, maps, services, and other digital resources. As multiple government agencies are sharing their data on one platform, SDI reduces data redundancy and the extra efforts in collecting duplicated geospatial data.

2. Spatial data infrastructures heavily rely on computer and information technologies, and are continuously evolving with the technological advancements.

Similarly, we may see the emergence of new technologies that can improve SDIs in various aspects, and some of these technologies are already being tested in research labs.

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