

APPLICATION OF GEOINFORMATION TECHNOLOGIES IN THE STUDY OF CHANGES IN THE STRUCTURE OF LAND USE OF TERRITORIES

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ABSTRACT

The purpose of this paper is to develop the flow charts of the processes of implementation of the main and alternate geo-information methods, when studying the changes in the land use structure of territories based on the materials of multi-zone space imaging. The research methods are geo-information method and comparative analysis. The paper provides a review of scientific publications on the research topic, proposes the key indicators, which are used as a basis for accomplished comparative analysis of the proposed geo-information methods implementation.

The proposed methods of determination of changes in the land use structure of territories, on the basis of materials provided by the multi-zone space imaging and data from national reports on the status and use of lands in the Russian Federation, enable estimation of dynamics of urbanization of certain territories, as well as the forecast of changes in the land use structure.

Keywords: *geoinformation system, land use structure, space imaging, comparative analysis, efficient management of natural resources*

INTRODUCTION

Data of the Earth's remote sensing (ERS) became vital for mapping of peculiarities of the Earth's landscapes and infrastructures, management of natural resources and study of the environment. Thanks to the creation of the higher-end technologies of capturing and automated thematic interpretation of ERS data, the materials of space imaging in high definition became one of the most prompt, reliable and efficient information sources for monitoring of status and historical changes in the land use.

The changes in land use are an important component of global changes in the environment. Analysis and forecasting of the changes related to the use of the land resources are of great importance for regional development and land use management for the purposes of sustainable development. Further on, following the Order of the Government dated November 08, 2018 "Action Plan for Improving of the Legal Regulation of the Land Relations", the development of methods of application and implementation of remote sensing data, including for the purposes of efficient use of natural resources, is particularly one of the priorities [1].

MAIN TERMS AND DEFINITIONS

Land category means a part of the land reserves, identified by its intended use and having a specific legal regime applicable to use and protection of the same. The lands on the Russian Federation are subdivided by their intended uses into the following categories: agricultural lands, residential lands, industrial and other special lands, lands of specially protected territories and objects, forest reserve lands, water reserve lands, reserve lands [2].

Conversion (change) of the land uses may be defined by the mutually exclusive land use conditions, covering the full range of changes in the land use [3].

REVIEW OF SCIENTIFIC PUBLICATIONS ON THE TOPIC

This research topic has been regarded in various Russian papers by V. A. Malinnikov, A. P. Sizov, P. V. Klyushin, D. A. Shapovalov, V. A. Shirokova and some others.

Thus V. A. Malinnikov and V. N. Nguen recommend in their paper to use the Markov chains to forecast the conversion of the land uses [3].

The paper by A. P. Sizova and D. A. Khabarov proposes to estimate the process of land withdrawal and land return by creation of all sorts of change options in the land status (man-induced impact) at various options of land conversion from one category to the other. The matrix developed by the authors enables more efficient analysis of historical changes in biosphere and environmental properties of territories development of the Russian Federation to the authorities possessing a reliable information on the quantity of land, which have been converted from one category to some other during a number of years [4].

P. V. Klyushin, P. A. Lepkhin, V. M. Stolyarov and some others addressed in their papers the contemporary problems of efficient land use. The authors establish that the system of efficient land use should be of preserving and resource-saving nature and provide for soil conservation, limiting impacts on flora and fauna, geological rocks and other components of the environment. Recommendations on the organization of efficient environmental management in the selected research area were also given [5], [6], [7], [8].

The Model Law on Strategic Forecasting and Planning of Social and Economic Development adopted by the International Assembly of the member states of the Commonwealth of Independent States (No. 41-10 dd. 28.11.2014) also touches upon the topic of the selected research. In particular, this law states that the biosphere and environmental indicators and criteria are zonal in nature and determined by physical and geographical conditions, which are specific to various regions of the planet and states [9].

METHODS AND METHODOLOGY

MAIN PART

In this paper, the successive stages of QGIS application for assessment of a level of change in the land use structure of territories based on materials of multi-zone space imaging are used as the main geo-information method. Fig. (1) shows the flow chart of processes of implementation of the main geo-information method. Fig. (2) shows the flow chart of processes of implementation of the alternate geo-information method.

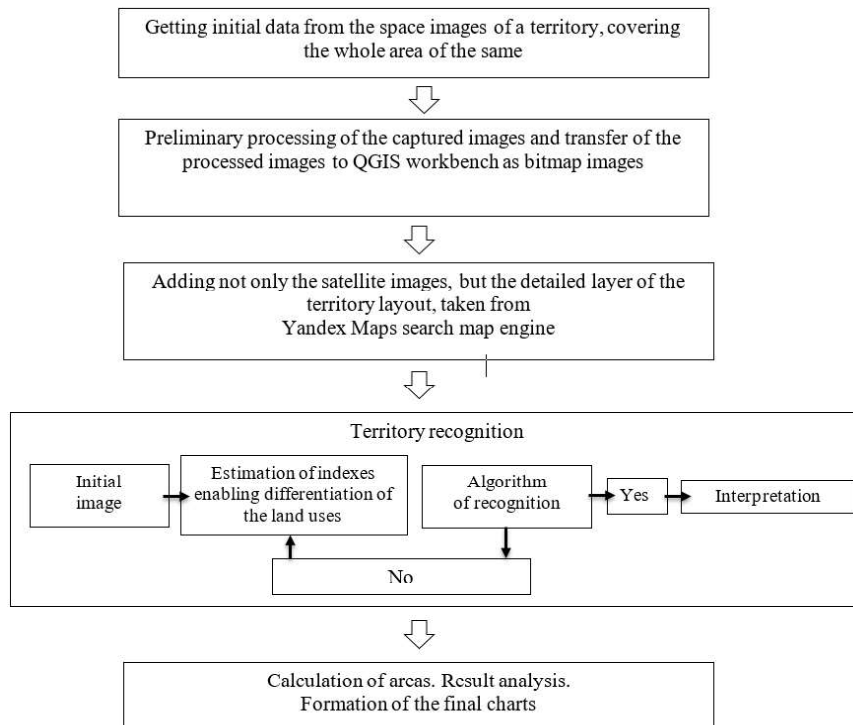


Fig. 1. Flow chart of processes of implementation of the main geo-information method

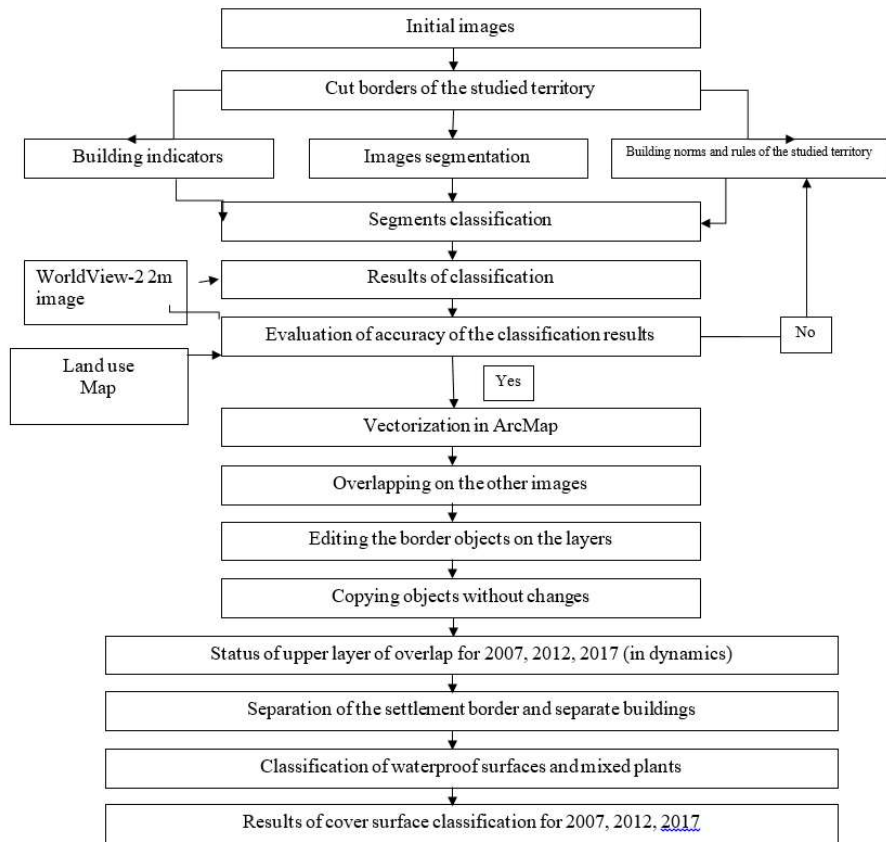


Fig. 2 Flow chart of processes of implementation of the alternate geo-information method

The result may be obtained even without GIS application, i.e. on the basis annual

National Reports "Status and Use of Lands in the Russian Federation", stating the changes in the country's land reserve structure with breakdown by 7 categories of lands (stating from/to which category the lands we converted). A. P. Sizov and D. A. Khabarov established that the process of lands withdrawal and return can be estimated by building all sort of options of the land status changes (man-induced impact) at various options of lands converted from one category to the other. Such built matrix and obtained historical changes in the land use structure also enable assessment of territories urbanization [4].

COMPARISON BETWEEN THE MAIN AND ALTERNATE METHODS

The following key indicators are proposed to compare between the main and alternate methods: GIS used during method implementation, software obtaining type, image processing method, reliability of interpretation results. They were used to carry out the comparative analysis of implementation of the main and alternate methods, when studying the changes in land use structure of territories according to materials of multi-zone space imaging, as shown in Table below.

Table 2. Comparative analysis of implementation of the main and alternate methods, when studying the changes in land use structure of territories according to materials of multi-zone space imaging

Key indicator	Main method	Alternate method
used, when implementing GIS method	QGIS	ArcMap, eCognition, IDRISI Selva
software obtaining type	free of charge	paid
processing method	spectral	spectral+texture
reliability of interpretation results	80–85 %	85–90 %

Various GIS, such as QGIS, ENVI, ERDAS Imagine and some others may be used for the study of changes of the land uses of territories with the materials of multi-zone space imaging. The proposed methods of achievement of the set aim have the same final result, further on, it is possible to forecast the changes in the land use structure by building the Markov chains with IDRISI Selva® software.

CONCLUSION

This paper addressed main terms and definitions, reviewed scientific publications on the research topic, developed flow charts of processes of implementation of the main and alternate geo-information methods, proposed the key indicators used as basis for comparative analysis of implementation of the main and alternate methods, when studying the changes in the land use structure of territories on the basis of materials of multi-zone space imaging. Using GIS incorporates high analytic opportunities, which are required during the data processing. This proves the timeliness of GIS use for the purposes of land planning and natural resources use.

ACKNOWLEDGEMENTS

We thank the GEOLINKS Conference team and especially Ms. Paolina Watt for their methodological assistance in organizing the research work.

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