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THE USE OF REMOTE SENSING DATA IN THE DESIGN OF DISTRICT BOUNDARIES

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The article is devoted to the planning and carrying out of cartographic works on the normalization of the area boundaries of the Republic of Belarus using medium and high resolution remote sensing data of Earth. It explains the introduction and use of actual satellite images as additional information for detection and design of accounting objects in order to improve the efficiency of work.

The spatial or territorial organization of the state is a dynamic entity. Processing actual location boundaries in some areas is more intensive, than in others. Therefore, it is important to establish a mechanism for clarifying the boundaries, dimensions, functions and competencies in the management structure of the administrative-territorial units. Shortcomings in the location of the borders of administrative-territorial units of the Republic of Belarus, including districts and regions, are a deterrent to improving the efficiency of state regulation and management in the field of land use and protection of lands.

Normalization and establishment of administrative-territorial units boundaries (ATU) started in Belarus in 2015. Nowadays the work has been finished in Minsk, Brest, and Grodno regions. The main goal of normalization and establishing the boundaries of the Republic of Belarus ATU is ensuring the efficient organization of state regulation and control, including the use and land conservation [1].

This work is carried out by the Republican Unitary Enterprise Belgiprozem Design Institute and its subsidiaries, in cooperation with land management agencies of local executive committees, and other organizations within in The State Committee on Property of the Republic of Belarus [2].

The main objectives of land management in order to normalize and establish the boundaries of districts (regions) under consideration are as follows:

- elimination of defects in the location of the border, including by combining physical (actual land use) and legal borders;
- uniform presentation of the normalized border on all planning and cartographic materials, as well as in the Land Information System (LIS) of the Republic of Belarus (LIS RB);
- preparation of Materials (as the main land management documentation) to establish the boundaries of regions and their constituent areas;
- the use of the above Materials in the prescribed manner when registering districts and regions in the ATU and TU registry and making changes to the credentials of the land cadastre of the Republic of Belarus [2].

The main task at the stage of laboratory works is to obtain high-quality cartographic material. The base scale is 1:10 000 (for activities on normalization and establishment of the boundaries of ATU, predetermining their precision and technology) [3]. Overview maps of village councils and district boundaries are in a scale of 1:50 000, area - 1: 200 000 [4].

To perform works on establishment of the boundaries the following cartographic materials are used in the Republic of Belarus:

- Map of administrative-territorial division of the Republic of Belarus;
- District land use maps of scale 1: 50 000;
- Common Registry data (coordinates of turning points of boundaries, cadastral maps duty);
- general plans of settlements;
- forest management plans;
- land management plans with the boundaries of rural settlements;
- last updates of topographical maps, plans and photoplans scale of 1: 50,000, 1: 25,000, 1: 10,000, 1: 5000-1: 500 [4].

The collected documents and materials are examined and evaluated in terms of accuracy and completeness, suitability for use.

An example of designing a normalized section of a district border is shown in Figure 1. It shows that it is advisable to draw a new border along the border of land types, for which it is sufficient to use orthophoto in office conditions without the need for fields surveys of the presented plot.

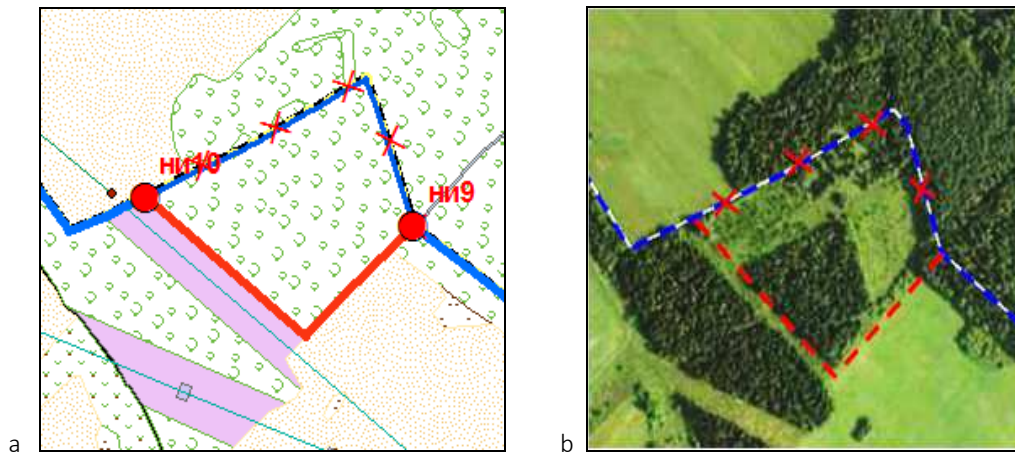


Figure 1. – Designing a normalized border section in the LIS according to:
 a) the boundaries of the types of land (shape file in LIS); b) according to the orthophoto of the area

Currently, in the Republic of Belarus the most high-precision current source of data on the Earth's surface is digital data with a spatial resolution from 5 to 50 cm. Interpretation of the data allows you to select different elements of the terrain at the time of observation with high accuracy.

However, a one-time flying around the entire area for normalization is not possible, therefore, for this type of work alternative data sources allowing to update the information are needed. Recently remote sensing data in many cases are actually the most economical, replacing the need for field surveys of problematic parts of the border [5].

Ground markings and natural boundaries can be found in the images of medium resolution. So, according to experts, the data of the American satellite Landsat 7 (8), which are freely available allow for the geometric precision scale plan 1:25 000. As part of the study the author analyzed the readability of objects on satellite images from Landsat 8 and WorldView 1 (Table 1).

Table 1. – Analysis of readability facilities on satellite images

Objects	Identification	
	Landsat 8	WorldView 1
Territory of inhabited locality (built-up areas)		
The boundaries of the settlements	When scaling the images are well read	They are well defined
The road network		
Highway	Are well read	They are well defined
Improved earth-roads	When scaling the images are well read	When zooming the picture is clearly distinguishable
Field and forest roads	Field, forest roads are deciphered with difficulty on satellite images	They are well read on pictures with minimal vegetation
Vegetation		
The contours of the forest	The contours of the forest, felling are readable	Separate areas of vegetation are well read
Hydrography		
Lakes, reservoirs, rivers	All lakes, reservoirs, rivers are well deciphered	All lakes, reservoirs, rivers are well deciphered
Bridges	If considerably long, they are read as visible gray lines on a dark background of water; if small - can not be read	Light lines are well defined
Types of land		
Border outlines of types of land	Defined with difficulty in the growing season	Can be defined in the growing season

Open access to the images of the earth surface in various resolution and ranges from the Ikonos satellite, WorldView-2, QuickBird, SPOT, IRS, Landsat determines the opportunities to use them. For the application of satellite imagery provided by free services Yandex, Google Earth, Google Maps, Bing Maps, etc. specialized software SAS.Planeta is used.

The use of remote sensing data requires evaluation of the following factors:

- Access to the territory of satellite resources (including the possibility of obtaining data on a given date);
- Possibility of identifying natural boundaries and recognition of image borders in an area;
- The accuracy of the planned position coordinated points;
- Determination of the boundaries in the desired coordinate system;
- Time and labor for the definition and specification of borders [3].

The study of satellite images of varying resolution, obtained from imaging systems, allows us to conclude that a significant portion of linear and other facilities is needed to determine the location and boundaries of design, easily distinguishable in the photographs. The accuracy of determining the coordinates of these data can not meet the requirements of 1: 10 000. However, they can be used to update the existing data with high resolution for sparsely populated areas, or areas, where intensity of economic activity varies for the early detection of these changes [5].

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