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The Use of Digital Maps to Work on Demarcation and the Utilization of Geographical Information Systems to Upgrade Them

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ABSTRACT: The process of delimitation and demarcation of the state border is relevant for many countries around the world. At present, accelerating the registration of state borders has become one of the priorities in improving the foreign policy of the Republic of Uzbekistan. At the joint session of the chambers of the OliyMajlis in 2016, [2] President of the Republic of Uzbekistan Sh. M. Miromonovich identified the development of cooperation with close neighbours in Central Asia as a priority of Uzbekistan's foreign policy. This was an important step towards intensifying the process of negotiations with neighbouring countries on the legalization of the state border. The analysis of the available data showed that. In the process of accelerating the delimitation and demarcation of the border, the provision of up-to-date cartographic data is insufficient; geoinformation cartographic methods are taken into account. For this reason, preparations for the demarcation process and acquaintance with the available archival materials, field surveys, creation of electronic digital maps, using modern geographic information systems are taken into account. The results of the study as a result of fieldwork in the Surkhandarya region of the state border of the Republic of Uzbekistan and the Republic of Tajikistan, an electronic digital map was created using aerial photographs. The study aims to create a demarcation map of the studied area. The object of research Results of the study the state border of the Republic of Uzbekistan and the Republic of Tajikistan Surkhandarya region.

KEYWORDS: state border, delimitation and demarcation aerospace images, maps, GIS, topographic bases, cartographic basis.

I. INTRODUCTION

The emergence of new states on the political map of the world is regularly becoming a political and theoretical topic. One of the main tasks of the state is to identify and define its borders with neighbouring countries. Delimitation, demarcation and re-demarcation are carried out by a specially formed working group to define and demarcate the state border.Delimitation is derived from the Latin word “delimitatio”, which means the conditional demarcation of borders: the mapping of state borders and the conclusion of agreements with neighbouring states on the establishment of borders.Demarcation is derived from the Latin word “demarcatio”, which means to demarcate, define a boundary, define and mark a boundary line in places according to maps formed in the process of delimitation.Demarcation and delimitation are carried out by installing special boundary markers (pillars, and foam and depths in the water) drawn on the map of the State Border in accordance with local conditions. Border signs are set by mutual agreement of the two countries, and the results of this work are formalized based on the protocol of border signs and maps. The protocol and the relevant maps are an integral part of the demarcation agreement.Redemarcation - inspection and restoration of the state borderline in re-demarcation areas and marking it with border markers based on previously drawn up, as a rule, bilateral documents.[3]

One of the most important issues in our country today is the development of rapid monitoring technologies to create a topical cartographic basis for the demarcation of telecommunications information technologies in developed countries in accordance with the technologies of geographic information systems (GIS).In the current period of profound economic reforms in Uzbekistan, the role of geo-information technologies is very high, they are important as a leading sector of production and social infrastructure.

Currently, the country is working to demarcate the state border with neighbouring countries. This requires the

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development of cartography of demarcation works, the reliability of demarcation maps created for each neighbouring country, as well as the development of their mathematical and geographical basis elements. The scope of the above work in GIS technologies determines the relevance of the research.

This scientific article is based on the system of maps created by the results of demarcation, identifies ways to effectively use the geographic information system to create a digital cartographic basis for demarcation, with their help of which mathematical and cartographic basis elements for demarcation maps are created using modern GIS technologies.The creation of demarcation maps is another topical issue, which is to provide demarcation work with high-precision geodetic technology equipment. Nowadays, the use of high-quality and high-precision electronic devices, such as electronic tachometers, etc., capable of working in the GPS is well established when moving the delimitation line to the ground, performing geodetic surveys.

II. ANALYSIS OF THE CURRENT STATE OF THE PROBLEM

It is known that Uzbekistan, located in the centre of the region, has a common border with all Central Asian countries. Its length more than 7,000 kilometres, including 2356.31 kilometres with Kazakhstan, 1476.12 kilometres with Kyrgyzstan, 1296.9 kilometres with Tajikistan, 1831.49 kilometres with Turkmenistan and 143 kilometres with Afghanistan [1].

The obsolescence of the existing delimitation maps in the study poses some difficulties in the demarcation process. Therefore, the following work needs to be done to describe the reliability and real condition of demarcation maps. When creating or updating demarcation maps, you are required to specify the following objects:

- relief objects defining the connection of the territory crossing the state border and boundary markers;
- natural and geographical location of the territory crossing the state border;
- geometric accuracy (coordinates, distances and field accuracy) sufficient to perform cart metric work on the accepted scale;
- accuracy and reliability of the details indicated on the demarcation map;
- state borderline;
- boundary markers;
- elements of the land crossing the state border (rivers, ravines, ditches, tombstones, stones, etc.).

On the demarcation map, a set of numbers of boundary markers shall be signed in Arabic numerals on the territory of both states respectively. If necessary (on a topographic basis), the numbers can also be applied within a single state. If the boundary column is located at a distance of more than 5 mm from the main group of the crossing sign, it is recommended to repeat the number of boundary markers close to it. This approach helps to better determine the location of the boundary marker elements and the crossing of the state boundary [5].

III. MATERIALS AND METHODS

The first stage of the preparation of demarcation album maps reflects the types of materials used in the creation of the map, the date of work performed, aerial photographs, field research, information on how the work is distributed among neighbouring countries.

Today, in addition to cartographic materials, aerospace images are also used as a basis for compiling and updating demarcation maps. The aerospace method of creating and updating digital electronic demarcation maps includes: updating the maps, identifying changes that have occurred; automated photogrammetric processing. Foreign software is widely used in the processing of optical decoding marks of captured or collected images. Based on the analysis, it became clear that such programs as PHOTOMOD, Mapinfo, Panorama GIS are used in the processing of optical decoding signals in the organizations of the republic. [7]

Such programs use space and aerial photographs placed in the Google system, images taken in the red, green, blue and near-infrared spectral zones, by aircrafts Landsat 7, Icons. It turned out that the program that gives the best results in the creation of demarcation digital electronic maps is the Panorama GIS program. Before decoding images taken from space, the location data is first analysed, systematized and evaluated.

Second, depending on the purpose and task of the work, expert space data collection work is performed. The focus is on the scale, spectral ranges, season and time of day of the material obtained from a distance.

Before decoding space images, they are usually magnified several times, and the objects represented in the images are

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compared with geographic and topographic maps. If there are many changes in the location details, then the images are processed in special programs.
In some literature, the evaluation of existing information changes between remote sensing materials and the geographic and topographic base has been qualitatively interpreted, using many rare terms. To increase the accuracy and efficiency of these indicators, a special scale will be developed to evaluate the changes in the following 5-point and percentage simple qualitative and quantitative levels in Table 1.

Table 1. Quantitative and qualitative indicators in assessing the level of changes that need to be made in the geographical and topographic bases.

The amount of change		Changes in quality indicators	The degree of change that needs to be included in the geography and topography
In points	In per cent		
1	0-20	partially	Partial modification
2	20-40	low	Introduction of low-level changes
3	40-60	average	Moderate recycling based on large scale space materials
4	60-80	high	Large-scale processing on the basis of large-scale space materials
5	80-100	very high	Execution and complete processing of special filming works using unmanned aerial vehicles

A. Change evaluation scale.

Initially, in preparation for the decoding of the photos, a photo scheme of the research site was created. To do this, in graphics programs, the images were cut to the desired size, they were sharpened and saved in JPG format. Then, depending on the scale of the topography, the classifiers are selected in the Panorama GIS program, the remote sensing data is transformed by connecting the topographic trapezoid and creating an orthophoto plan of the site.Decoding is the most complex process when updating demarcation maps. To do this, the indicators of the level of changes required to be included in the demarcation maps are evaluated in terms of quantity and quality.
The most optimal and effective way to quantitatively and qualitatively assess the indicators of the levels of change that have occurred over time is to use remote data. Using the stereo photogrammetric method of the obtained photographs, changes in a particular area are initially detected by volumetric observation and evaluated based on a newly developed scale.When updating maps, the deciphering principles are based on changes in the quantitative (Table 1, columns 1 and 2) and qualitative (Table 1, columns 1 and 2) levels of change that need to be included in the geographical and topographic bases.
If the change rate is very high, 5 points (or 80%) or higher, all objects in the study area will need to be re-photographed using unmanned aerial vehicles, the taken photos will be completely decoded and the results obtained are fully subtracted from the topographic bases.If the change rate is high at 4 points (or 60-80%), no new drone survey is required at the site of the study. In this case, it is sufficient to fully decipher large-scale space materials and it is sufficient to base the results obtained on it.If the change rates are averaged 3 points (or 40-60%), in which case the changes recorded in the large-scale space materials and the obtained results are returned to the topographic base.If the rate of change is low, 2 points (20-40%), then only low-level changes are made to the geography and topography, as determined by space photographs.If the change rates are partially 1 point (20%) and below, only the results of very few changes detected during the decoding of the study area are limited to the topography.
Thus, the obtained remote sensing photographs are combined, if necessary, into an orthophoto plan of the desired scale according to the location nomenclature, new objects identified on the basis of orthophoto plans and stereo pairs are included in demarcation maps according to the rate of change and the bases for each object are stored in separate layers.

IV. RESULTS AND DISCUSSIONS

In February of this year, geodetic and cartographic works at the research object were carried out using modern technologies, on the basis of which the creation and updating of topographic and cartographic bases and field measurements were carried out. Measurements were made via GPS.Unlike traditional survey methods, the

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measurement method performed by GPS is one of the important aspects to get the coordinates of the points quickly and accurately. The GPS device simultaneously uses satellite technology to replace traditional geodetic methods to determine coordinates, line lengths, angles and azimuths, and searches for the most optimal technologies. The orthophoto plan created as a result of this field research will be used in meetings with the Republic of Uzbekistan and the Republic of Tajikistan on delimitation and demarcation of the state border (see Figure 1).

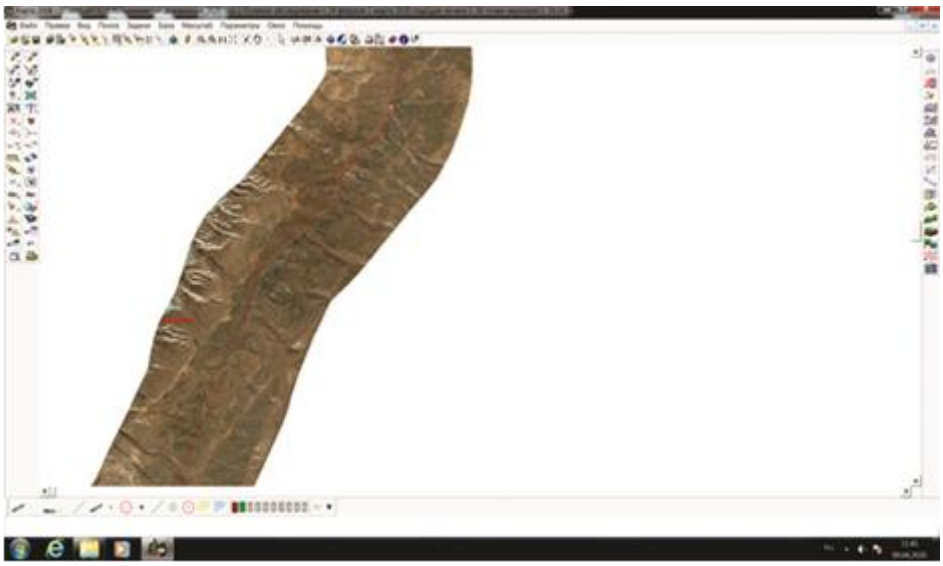

Fig. 1. Demarcation map created as a result of the survey.

In addition, a working project was developed for the agreed state line using Google Earth Pro, and their initial coordinate catalogue was created (Table 2).

Table 2.Initial coordinate catalogue.

№ points	Latitude des.hal	Longitude des.hal
1	37°11'32.49"	67°47'35.95"
2	37°15'6.25	67°49'27.54"
3	37°18'26.28"	67°50'51.04"
4	37°22'7.43"	67°50'6.31"
5	37°25'42.82"	67°48'56.99"
6	37°30'57.64"	67°51'1.76"
7	37°32'9.24"	67°51'35.85"
8	37°32'46.47"	67°51'36.84"
9	37°32'52.65"	67°51'54.75"
10	37°32'58.86"	37°32'58.86"

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Fig. 2. The location of the boundary points where the working project line is drawn.

V. CONCLUSION AND RECOMMENDATIONS

This article was written as a result of a study by the authors aimed at creating a new demarcation map to move the state borderline to the ground-based on aerial photographs. In developing the basis of demarcation electronic maps, special attention should be paid to the real situation and information from remote sensing materials, and remote sensing materials use a fundamentally new 5-point and 100% special scale to assess changes in existing information in the topographic system allows evaluation at high levels of accuracy in terms of quantity.
The role of modern geographic information systems in updating demarcation maps is invaluable. They provide a great service in clearly defining the state border, as well as a database of maps created.

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