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SPACE TECHNOLOGY IN THE GIS-ASSESSMENT OF SUBURBAN DEVELOPMENT IN KAZAN CITY

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Abstract

The complex research of conditions and factors of forming and country building development of the Russian city conducted in work both in retrospective, and at the present development stage allowed to reveal a series of regularities. Work is based on creating a series of GIS-maps with space technologies use which display dynamics of Kazan country building change for two extensive historical periods (from 12th century the 20th century; from the second half of the 20th century till present) in software ArcGIS. For creating the physical map of the Kazan residential suburb pictures of SRTM (Shuttle radar topographic mission) of the official site of United States Geological Survey [1] method were used by radar interferometry. Besides, in work the experience of geoportal application of the Kazan (Volga) federal university activemap.kpfu.ru in a cartographical research of the Kazan country building which allowed to create additional GIS-maps of cottage building of the territory for its further economic evaluation is provided. In work four primary factor groups which influence forming the Kazan country building are allocated: natural (the territory is subject to various exogenous processes, such as erosion, abrasion, flooding, bogging, karsts and suffosion, sag of soil), social and economic (historical aspects and level of market prices of the territory), technical (capacities of municipal infrastructure), ecological (recreational potential of the territory).

Keywords: GIS, space technology, suburban development, Geoportal, residential construction.

1. Introduction

Territorial designing of the cities is inseparably linked with designing near the adjacent territories, that is residential suburbs. Thus, the city and confidants of the territory to it can constitute single, so-called, "the city - the area" [2].

In this work we will consider residential suburbs as the territory which is located along border of the cities, is intended for placement in them an economic and social infrastructure. It promotes development of the cities. The

residential suburb can provide quality of the urban environment. The city can't function and develop normally without residential suburbs, also, as the residential suburb can't exist without the city [3].

Specialists note that the territory of a residential suburb includes the earth, adjoining border (city line) of the city and intended [4]: a) for development of the territory of this city; b) the territories of the rural and residential locations entering a residential suburb; c) placement of industrial, warehouse and municipal facilities; d) objects of engineering and transport infrastructures; e) gardening and country cooperatives; f) vacation spots of urban population; g) farming and accomplishment of protective and sanitary hygienic requirements. Borders of residential suburbs are determined in case of development of the master plan or site planning and building of the settlement. Lands which are behind line of the cities, constituting the single social, natural and economic territory with the city and not being a part of lands of other settlements [4] are a part of residential suburbs. The main task of a residential suburb consists in that in its territory elements which are connected with the cities rationally were placed. It shall carry out their requirements, taking into account economy, natural, ecological and architectural-landscape features of its certain sites [4].

The residential suburb performs certain functions in relation to the city among which the most important in our opinion [4]: environment-forming – provides the city with the environmentally friendly environment (depends on the sizes, structure of the city and a natural zone in which from is); natural and reserved – isn't always carried out, but is based on availability of natural and reserved objects within a residential suburb; cultural and educational – is based on the nature sanctuaries which are present at this zone and properties of a natural landscape, interesting for the purpose of education (rare and endemic species of plants, geological exposures, etc.); and also recreational – the territory of a residential suburb it is spontaneous or organized it is used in the recreational purposes; agricultural – an agricultural residential suburb partial provides the city with food; production – placement of industrial production, warehouses, highways, etc.; reserve – a zone of further development of the city and B'day.

2. Materials and Methods

For detecting the main tendencies of country building development in the city of Kazan series of maps which can be divided into 3 groups were developed and created.

Treats the first group series of maps which show how country building developed in different historical periods. 2 periods were considered: First period: formations of country building since the 12th century to the middle of the 20th century; second period: formation of country building from the second half of the 20th century to our time. The choice was caused by the fact that the sketch of the city changed under the influence of change of the environment.

During 1955-1957 the Kuibyshev water reservoir was built. It cardinally changed a city appearance, many territories were flooded, some sections became closer to water objects.

These maps were created in the software of ArcGIS 10.2.2 [5].

Before it were found a large number a map of different times which will serve as a basis. The majority of maps were loaded from the website of the ministry of town planning and architecture [6,7,8,9,10,11]. Then, process of creating maps began:

1. In the ArcGIS 10.2.2 [5] program the basis of spatial data in which future layers of a map will be created was created.
2. Loading and a binding of raster maps which were found earlier and their adding in the database. maps were executed in a coordinate system of Pulkovo of 1942 for the 9th zone.
3. creating layers in the database began with the layer displaying dynamics of development of a residential suburb during the period since the 12th century to the middle of the 20th century.
4. Vectorization of raster maps began. The first the territories which arose in the 12-13th centuries, further, in process of development of the city of Kazan were digitized, sections which were built up later were digitized. To distinguish an age of the built-up territory, the main means in the cartographical image as color was used. The most ancient parts the cities were shown round by a dark shade, the youngest - lighter. The layer has polygon type.
5. At the following stage of operation, were the layer which shows building of the territory, its structure is created. Polygons digitized the main quarters of the city.
6. Also the layers of roads and water objects, a layer displaying landscape features of the territory as the woods and swamps have been created. The layer of roads has linear type of mapping, water objects - polygonal and linear type.
7. The following step on creating the map was creating a layer of "Border". Borders of the territory can be divided into two categories: border of the city of Kazan in the middle of the 20th century and border of the city district now. The layer of borders has linear type.
8. Then the editing stage has begun, objects have been signed, a configuration stage, elements of the map have been located in the correct order that the map essence was clear.

On the map (fig. 1) it is visually visible how building around the city of Kazan was formed. As, once residential suburbs, became a part of the city.

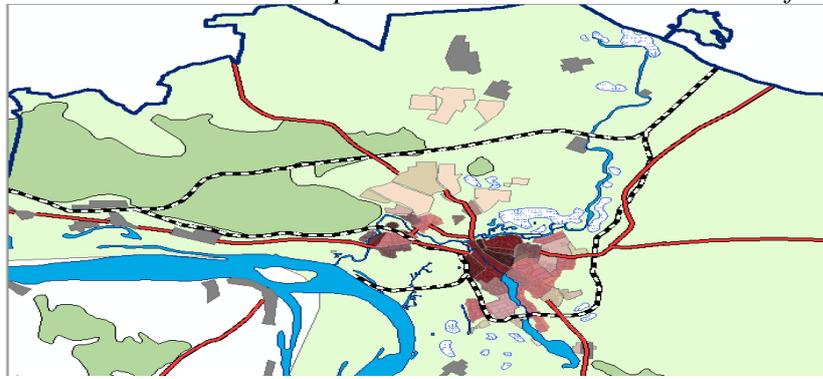


Fig. 1. The fragment of the map of country building forming since the 12th century to the middle of the 20th century (created by Stepanova A. S.).

This process can be observed also in the present therefore, a series of maps which reflects development of suburban sites was developed and created, beginning with a half of the 20th century and proceeding still. A series of maps has the same practical character, as well as maps of the early period. The same layers were created. Borders of a research increased on the area, were considered the territory of all city district of Kazan together with a residential suburb which stretched from the downtown for 25 km. The rapid growth of the city and the next sites caused by economic development of the region, and also increase in population led to the fact that the territory of a research was considered within Prikazansky district. Country building development developed under the influence of various factors. The second group of maps is devoted to the main conditions which influence country building forming. The landscape card, the map of exogenous processes, the map of water potential, the map of transport availability, the ecological card, the map of infrastructure, and also the map of types of lands were developed. Let's consider the principle of creating such maps. During their creation thematic mapping was used. During creating the physical map pictures of SRTM of the official site of United States Geological Survey - USGS in .geotiff a format were used. SRTM-(Shuttle radar topographic mission) - radar survey of the most part of the territory of the globe, except for the most northern and most southern latitudes, and also oceans, made in 11 days in February, 2000 by means of special radar system. Two radar sensors of SIR-C and X-SAR, it was collected more 12th terabyte of data (that is approximately equal to amount of information of library of the congress) [1]. During this time by means of the method called by a radar interferometry (radar interferometry) the huge number of information on Earth relief was built, its handling continues still. But a certain amount of information is already available to users [12]. The main stages of loading of pictures of SRTM from the website of United States Geological Survey it is standard: registration on the website; the choice of a full range of tools for search and the order of aerial photographs of EarthExplorer; at

last, displays of the field of search of an object where it is necessary to enter the name of a geographical object. (Rice

2).

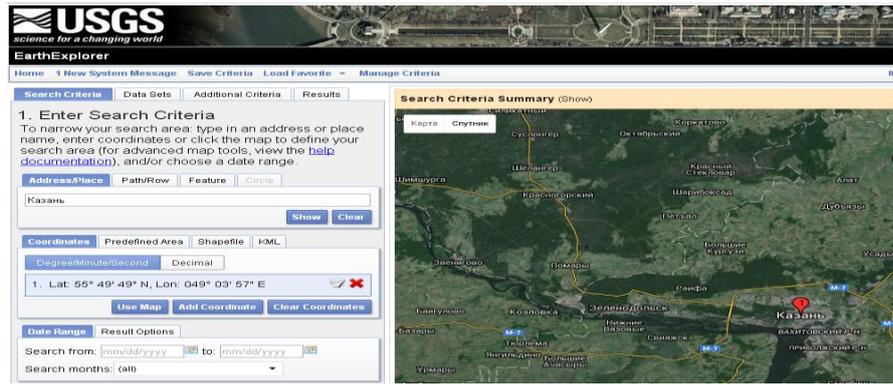


Fig. 2. Search of a picture of SRTM in the Earth Explorer tool kit.

After SRTM data set conclusion on the screen there is a found territory picture allowing to see what area on the map it covers. (Fig. 3).

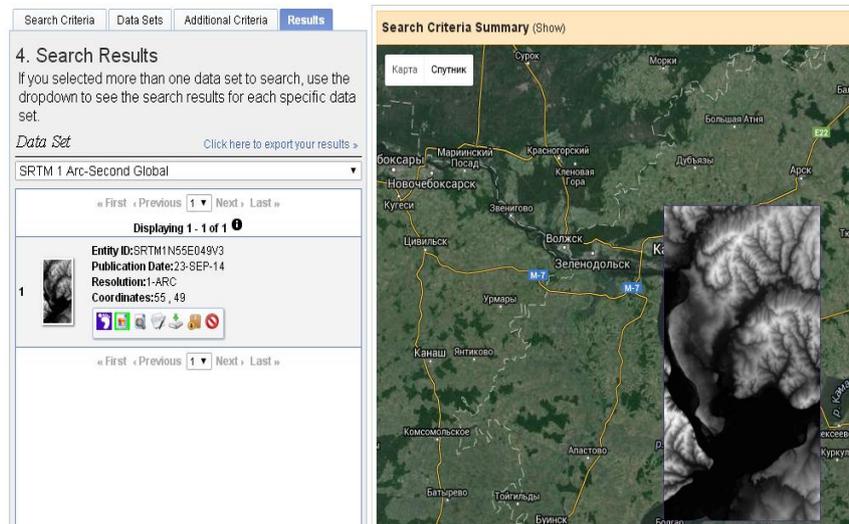


Fig. 3. SRTM-territory picture.

After that process of creating maps began:

Pictures were loaded in the software of ArcGIS 10.2.2, the coordinate system "Pulkovo 42" was set, then are spliced among themselves by means of the ArcGIS 10.2.2 ArcTools tool kit (ArcToolbox-Control of data - the Raster - the Set of raster data - the Mosaic); then changed quantity of intervals and their color in properties of a layer and, at last, imposed on the received isoline layer (ArcToolbox-Spatial Analyst-the Surface - Isolines).

3. Results

For creating the physical map of Prikazansky district, a set of layers for the Republic of Tatarstan from the website OpenStreetMap [13] has been created. From this set the administrative units entering Prikazansky district have been allocated: the city district Kazan, High-mountain, Verkhneuslonsky, Zelenodolsk, Laishevsky and Pestrechinsky

Experience of application of the KFU geoportal in case of a research of country building of Kazan allowed to create to authors the cartographical layer including 43 cottage settlements with their detail characteristics. (Fig. 6). Collection of the database was carried out on the basis of the software of "MapSurfer GS". The program is a part of the program complex "ActiveMap GS" and represents the multifunction software tool for visualization of spatial data, publications and displays of geoinformation resources, development of the user portal applications on the basis of web technologies [14].

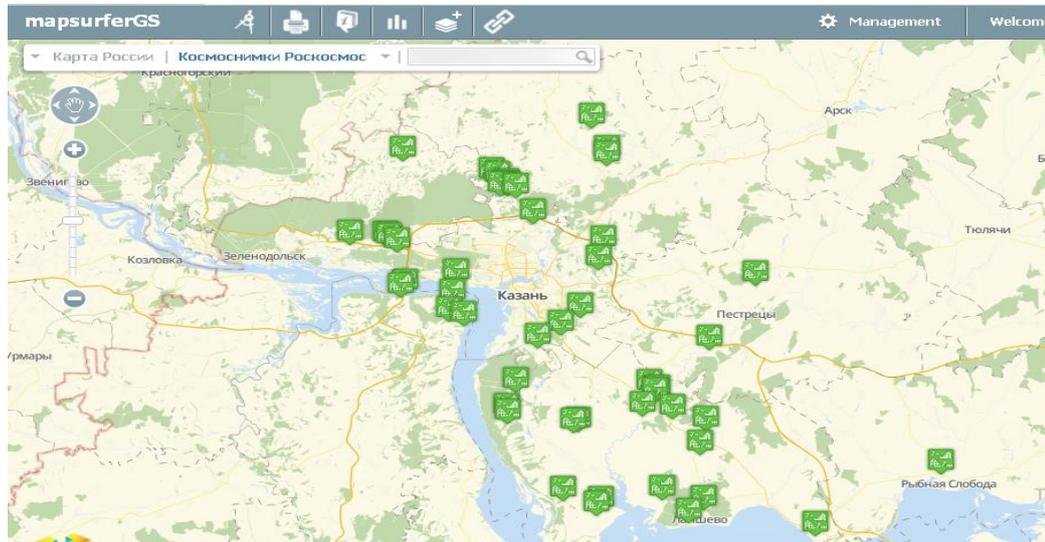


Fig. 6. "Cottage Building of the Kazan Residential Suburb" map, 2016.

But the map can see that cottage settlements are widespread in borders of the Kazan agglomeration.

Thanks to the software of "Map Surfer GS" it is possible to analyze in a complex major factors of country building forming, to consider its development and from the point of view of the environment, and social and economic development of the territory, etc.

4. Conclusion

The Kazan residential suburb as a part of country building were created since ancient times. It served as reserve lands the city of Kazan, in process of its development, became its part. Residential suburbs arose as a result of such processes as growth of the cities, growth and change of population of the territory, but special impact on their forming was exerted by an industrial revolution. New settlements which developed into the city territory later began to arise, or, even became the city. Led an industrial development to growth of economy and the territory, but harmful affected the environment. The ecology of the city became gradually worse. In atmospheric air, in water objects, in the soil of the beginning more pollutants were found, the state of health of the population worsened. It is one of the reasons of outflow of the population it became farther from industrial zones, the new territories developed. The

territory of country building went beyond a residential suburb. One more reason of forming of country zones can be considered growth of the population, the city psychology exchanged, more and more people thought of acquisition of individual housing, far from noisy the city, but at the same time, it shall be to it in close proximity, have good infrastructure, be located in the environmentally friendly place, and also have low cost value. The cottage construction began to develop. For the choice of the place of the cottage settlement, the system of estimates of country lands was developed. To provide complex assessment of the territory, in work also GIS space technology are applied. They visually allow to estimate the territory, to reveal favorable spaces for building, and also to see various negative factors. Technology GIS, also widely use in development evaluation of the territory, in the interactive mode it is possible to see how it was created in the city territories.

5. Discussion

Now, forming of a country zone of the city of Kazan is at a stage of intensive development. The territory of a country zone plays a large role in city economy. It performs a number of important functions, in its territory place industrial complexes, recreational rest areas, grow up various crops. Now, country zones even more often take away on a construction of the innovative cities - satellites of Kazan as Smart City, Innopolis, Himgrad, etc. It makes a huge contribution to a scientific modern research of Kazan, the Russian city with international value.

Acknowledgments

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