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**REAL-TIME TECHNOLOGY FOR OBTAINING PRIMARY DATA ON THE
RELIEF OF BUKHARA CITY****Makhmudov Maksud Sheralievich**
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Abstract: This article aims to improve the mathematical foundations of digital terrain modeling within the geographic coordinate system and evaluate the effectiveness of digital terrain models in spatial data processing processes. During the research process, models and algorithms for constructing a data grid based on a geographic coordinate system, rotating objects in a geographic coordinate system to a specific angle (azimuthal), and determining coordinate data (x, y, z) after rotation were developed; geodetic and cartographic data collection, processing in a geographic information system (GIS) environment, geometric modeling based on digital terrain models (DEM) and triangulated non-uniform networks, as well as mathematical analysis of spatial data and three-dimensional visualization technologies were applied.

Keywords: geographical coordinate system, terrain, digital terrain model, DEM, GIS, geoinformation systems, x,y,z coordinates of the object, respectively Latitude (Latitude-Shirota), Longitude (Longitude-Dolgota) and Altitude (Altitude-Visota), interactive-online maps, mathematical modeling, spatial data, interpolation, three-dimensional modeling,

Introduction. In recent years, as a result of the development of geoinformation technologies, remote sensing systems, and satellite observations, the creation of digital models of the Earth's surface has become one of the most pressing scientific directions in the fields of geodesy, cartography, cadastre, and urban planning. Accurate terrain modeling plays a crucial role in the design of engineering and communication networks, the development of transport infrastructure, and the forecasting of natural processes.[1,2]

A digital terrain model (DEM) is a mathematical model that describes the elevation parameters of the Earth's surface in relation to spatial coordinates. Such models are used to determine the morphometric characteristics of the area, the angle of inclination, exposure, and hydrological processes.

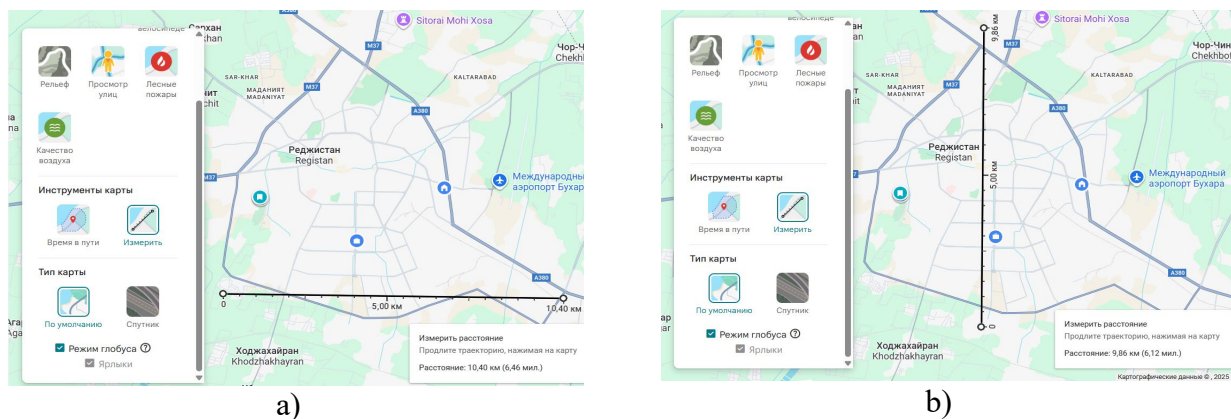
The main goal of the research. Development of technology for real-time reception, storage, processing, and visualization of initial data necessary for forming a digital model of the relief of the city of Bukhara, and based on this, assessment of the geodynamic state of the city territory, improvement of decision-making processes in the placement of engineering structures. To achieve this goal, it is planned to use GIS technologies, satellite data, remote sensing methods, and the functional capabilities of the Geoanalizator 2.0 software package.

It is known that any point (object) located on the surface of the Earth's relief has its own geoposition based on the global coordinate system, and in this system, the object's x,y,z coordinates are called Latitude (Latitude-Shirota), Longitude (Longitude-Dolgota), and Height (Altitude-Visota) respectively. For example: 39°45'21.51"N, 64°25'25.95"E, 223 m values indicate that the object is located at 39 degrees, 45 minutes, 21.51 seconds north latitude, 64 degrees, 25 minutes, 25.95 seconds east longitude, and 223 meters above the Baltic Sea level. This system is called the Geographical Coordinate System (GCS). Today, geopositional information about any object on the Earth's surface can be obtained directly from interactive online maps such as Google, Yandex, and Google Earth, which are widespread on the Internet. From these maps, the

GoogleEarth app displays latitude and longitude data as angular degrees, while Google and Yandex maps show it as a decimal - 39.755975, 64.

The technology for obtaining preliminary data on the relief of the city of Bukhara in real time is based on constructing a rectangular data grid in the geographical coordinate system, which allows for obtaining geometric data on the relief structure of the city of Bukhara in real time. To do this, it is required to set the number of columns (n) and rows (m) of the rectangular grid as input parameters, the repetitive distances between them (ΔX and ΔY), as well as the repetitive distances between horizontal secant planes (ΔH) when forming relief horizons.[3.4]

1-step. The dimensions of the city's territory are approximately determined on the Google Maps interactive map from north to south and from east to west (Fig. 1).



1.-Approximate determination of the dimensions of the city of Bukhara on the Google Earth map: a – from south to north; b – from west to east.

As shown in Figure 1, the city stretches approximately 10 km from north to south and 10 km from east to west. Consequently, the number of rows and columns in the data of a rectangular grid can be taken in an equal ratio, i.e., $\Delta X = \Delta Y = 500$ m. In this case, data on the elevations of 400 points on the relief surface relative to the Baltic Sea level can be obtained as input data based on a rectangular data grid, resulting in an isoline-geographic map of the city of Bukhara (Fig. 2).

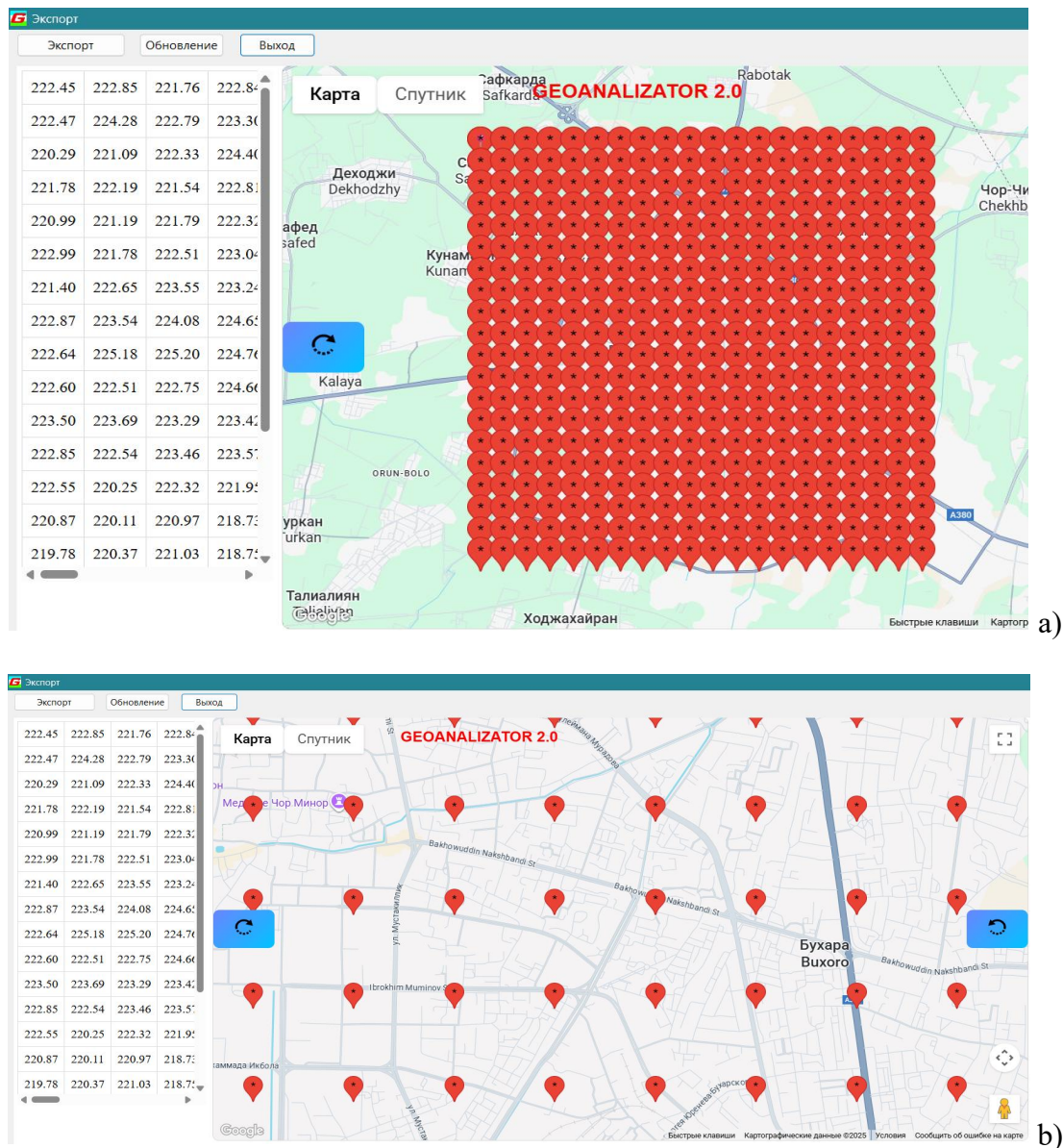


Figure 2. Obtaining information about the altitudes of the 400 points of the city of Bukhara from the Google Maps map based on a 20×20 rectangular data grid: a - general view; b - scaled view.

Data on the elevations of 400 points belonging to the nodes of a 20×20 rectangular data grid served as input data for creating a geographical map of the city of Bukhara consisting of isoline lines in the "Geoanalyzer - 1.0" program (Fig. 3).

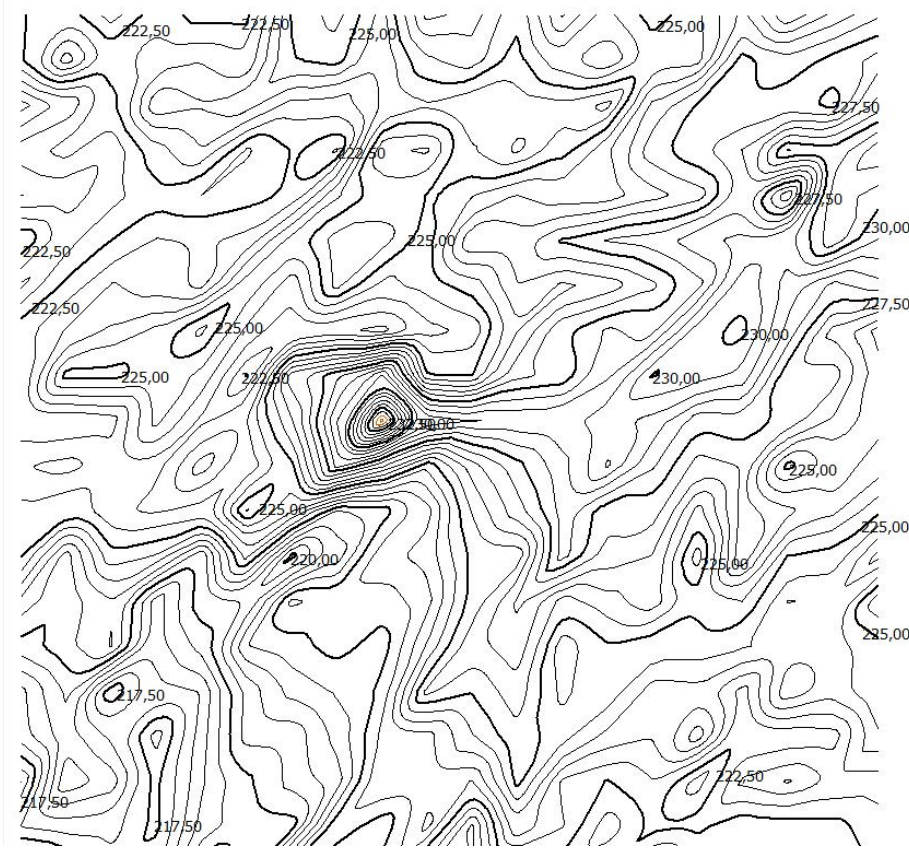


Figure 3. Geographical map of the city of Bukhara consisting of isolation lines in the "Geoanalyzer 1.0" program.

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