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THE SIGNIFICANCE OF TRANSFORMATION PARAMETERS IN PROJECTING THE DIGITAL MODEL OF GEOSPATIAL OBJECTS

Abstract: The article describes the digital model of geospatial objects, provides various services through geodata by transforming it from local coordinates to international coordinates, the importance of the mathematical basis that provides a qualitative description of their geographic location, the analysis of existing problems, and the use of relevant models.

Key words: NSDI, Geodetic grid, Transformation, geospatial objects, satellite, Gelmert method, SK-42 and WGS-84 coordinate system, geocentric and geodetic coordinate system.

Introduction

In recent years, the rapid development of geodetic technologies using satellites and communication tools has expanded the scope of modern means of location tracking with geospatial objects at the local, regional and global levels. The development of geodetic coordinate system at the national level and the parameters of transformation to other systems in determining the location information of geospatial objects as the basic spatial information of NSDI and its application in the field of services to citizens and entrepreneurs are becoming more and more important.

The large amount of spatial data produced by state enterprises, including aerial and space photographs, their derivative materials, including the formation of basic thematic layers on the state cadastre objects, their small size, the geodetic control

points and densification networks that are used in practice for this purpose at the national level of the country requires recalculation based on parameters.

If we pay attention to international experiences, NSDI mainly has key components such as geospatial data (metadata), standards, spatial data clearing center (access network - Clearinghouse), institutional structure (Framework), cooperation (Fig. 1). [7,9,10,11].

As for geospatial information, which is one of these main components, according to the Law of the Republic of Uzbekistan "On Spatial Information" (LSI), Spatial data is divided into basic and sector-specific spatial data [LSI, Article 19], geodetic network points and cartographic bases are important for basic data. [1]

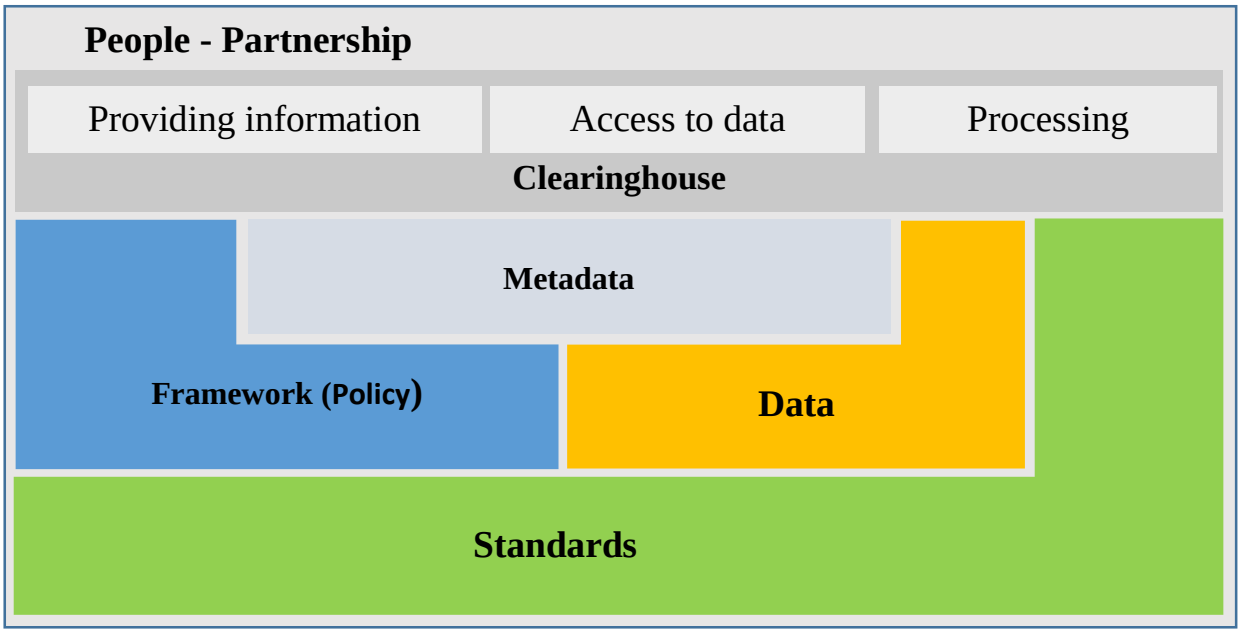


Figure 1. Main components of NSDI.

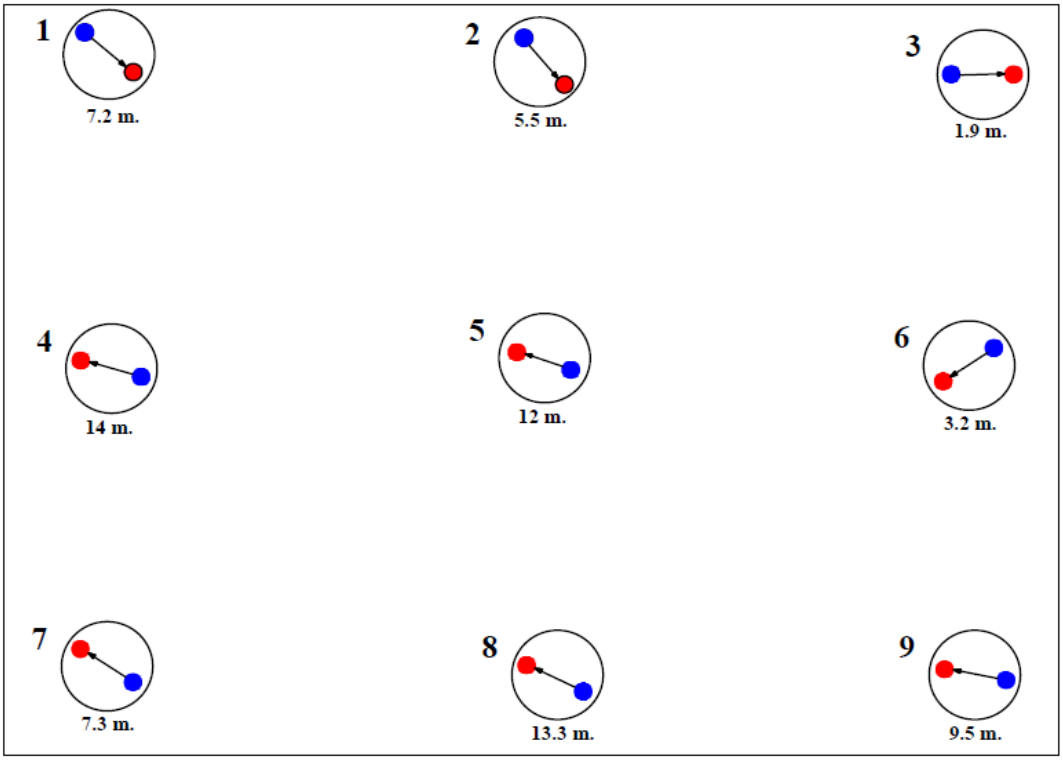
Processing of geospatial data in coordinate systems adopted in accordance with Article 18 of LSI is defined. Also, the use of open digital maps, thematic layers of the geo-information system, which provide the opportunity to view and use spatial data on web portals on the Internet, is regulated by the decision of the Cabinet of Ministers[2]. Currently, map.geoportal.uz, gis.kadastr.uz, dshk.uz, digitaltashkent.uz, age.tashkent.uz, etc. are open spatial data systems can be seen.

[1] Law of the Republic of Uzbekistan on Spatial Data (No. 702 of the Republic of Uzbekistan dated 23.07.2020)
[2] Permit of the Cabinet of Ministers of the Republic of Uzbekistan dated 14.01.2020 "Determining the limits of cartographic and geodetic materials (data), creating maps that are open for use, issuing, accounting and storing

In addition to the above practical measures, the existing geodetic grid is based on the parameters of the CK-42 coordinate system on the Krasovsky ellipsoid and the parameters of the Baltic height system of 1977 during the Soviet Union period, due to the fact that its territory is covered and the fact that the transformation parameters to the international coordinate system have not been developed leads to differences in the location of geographical objects.

In order to study its practical aspect, 2,500 hectares of experimental areas were selected from Gulistan district of Syrdarya region and Sh.Rashidov district of Jizzakh region. Transformation from the CK-42 coordinate system to the WGS-84 international coordinate system was carried out. On the basis of the obtained results, differences in the geographical location of the object from 2.1 to 14 meters were determined

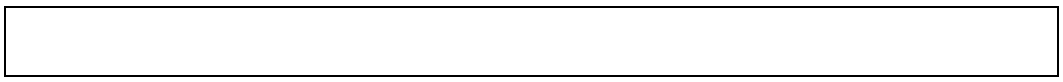
(Fig. 2).



Experimental area selected from Sh.Rashidov district of Jizzakh region

confidential cartographic and geodetic materials and ensuring the preservation of state secrets in the field of geodetic and cartographic Decision No. 22 "On Approval of the Regulations on the Procedures of Giving"

Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated 22.11.2016 No. 391 "On the establishment of state geodetic coordinates and height systems in the territory of the Republic of Uzbekistan"



map datum: ***СК-42***

map datum: ***WGS-84***

Figure 2. Differences between coordinate systems

Solution to the problem:

It shows that it is important to solve the problem, to develop parameters for the transition to the necessary coordinate system and to implement the use of geospatial data with the required accuracy, including the development of a new national coordinate system in the future, in the integration of NSDI with local or global spatial information infrastructures (GSII).

In finding a solution, the government adopted a decision on December 26, 2017 as a legal basis for the application of international geodetic coordinate systems and their wide use in the territory of the Republic of Uzbekistan. In terms of practical implementation, it is required to improve the geodetic coordinate system and introduce the national coordinate system, as well as develop the parameters for the transition to international systems.

In this regard, like advanced countries, it is possible to use methods of transformation of coordinates from one coordinate system to another, using mathematical models of Bursa-Wolf, Molodensky-Badekas.

The Molodensky method of transformation is aimed at providing transformation from one coordinate system to another without changing to rectangular geocentric coordinates by five parameters [5].

When calculating the parameters of the transition from the 1942 state reference coordinate system (RCS) to the WGS-84 system for Uzbekistan, the displacement of the center of the actual ellipsoid relative to the other three coordinates located on the X, Y, Z axes and the coefficient of linear scale change are taken into account, and the Gelmert method is based on turning the axes by angles. was used. That is, DX, DY, DZ, Rx, Ry, Rz, M are based on seven parameters.

In this:

DX, DY, DZ - values indicating a linear shift from one coordinate axis to the other coordinate axis, relative to their centers;

Rx, Ry, Rz – turning angles of initial ellipsoid axes;

M is a scale factor that indicates a linear scale change.

During the transformation, the transition from one geographic coordinate system to another geographic system is ensured by the following scheme:

In this method, the transformation was carried out using the following Bursa-Wolf formula, based on the seven-parameter Gelmert method, based on changing the location of the vectors and turning the axes at an angle, on the coordinate axis:

$$\begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} = M \begin{bmatrix} 1 & -R_z & -R_y \\ +R_z & 1 & R_x \\ -R_y & R_x & 1 \end{bmatrix} \begin{bmatrix} X_s \\ Y_s \\ Z_s \end{bmatrix} + \begin{bmatrix} \Delta X \\ \Delta Y \\ \Delta Z \end{bmatrix}, \quad (1)$$

DX, DY, DZ, Rx, Ry, Rz and scale factor M in formula 1 are transformation parameters. Based on this formula, the values of the transformation elements determined for the transition from the SK-42 spatial rectangular coordinate system to the WGS-84 spatial rectangular coordinate. The data of a total of 598 geodetic control points participated in the determination of these calculated parameters [6].

Conclusion:

Using these obtained results, as in Figure 2, errors can be reduced to 1.04 m and high accuracy is achieved. Also, in order to further improve and increase the accuracy of these results, it is necessary to carry out additional high-precision geodetic measurements in the regions of the Republic that are not sufficiently provided with geodetic points.

The above results will be achieved through the formation of geospatial data such as the results of topography-geodesic measurement works, cartographic data, and the provision of services to state enterprises, institutions, especially citizens and entrepreneurs, and the establishment of cooperation on the Internet through web and mobile geoportals or platforms.

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