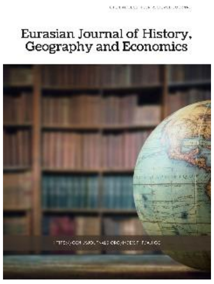

The Presence of the Field of Geodesy and Cartography Today

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ABSTRACT
The article contains information about the history of the development of the field of geodesy and cartography and its current status, as well as the methods of expressing the difference between the Geoid and the Earth's ellipsoid.

Keywords: Cartography, gravity, geodesy, topography, ellipsoid, poles, kilometer grid, scale.

Introduction. We know that as each industry develops, various changes, innovations and aspects that need legal protection begin to emerge. Because all the fields that are being created are created to improve and ease the life of mankind, as well as to make the future prosperous, and as this field is being developed, it requires constant legal regulation. We would not be wrong to say that the field of "Geodesy and Cartography", which we want to cover now, has become an integral part of human life.

For the first time, the Law "On Geodesy and Cartography Activities" was adopted in 1997. The newly revised Law of the Republic of Uzbekistan "On Geodesy and Cartography Activities" was adopted by the Legislative Chamber on February 18, 2020 and approved by the Senate on June 19, 2020. On July 2, 2020, the law was adopted and published in the "Khalk Sozi" newspaper. According to the legislation, this law came into force 3 months after its announcement in the mass media, i.e. on October 4. This regulatory document consists of 8 chapters and 48 articles.

First, let's explain the field of geodesy and cartography. Geodesy is a field of relations arising in the course of scientific, educational, production and other activities to determine the shape of the earth, external gravity field, coordinate points of the earth's surface and their changes over time. Geodesy and cartography - to determine the parameters of the shape of the earth, the external gravity field, the coordinate points of the earth's surface and their changes over time, to create, develop and maintain the state geodetic, gravimetric and leveling networks, a network of continuously operating satellite monitoring stations. , is a scientific, production and management activity aimed at creating and updating topographical, thematic maps, plans and cartographic basis for state cadastres, geospatial databases and geoinformation systems. Now let's briefly touch on the purpose of this legal document. The purpose of this law is to regulate relations in the field of geodesy and cartography. Legal documents on geodesy and cartography activities consist of this Law and other legal documents. If the international agreement of the Republic of Uzbekistan stipulates different rules than those stipulated in the legislation of the Republic of Uzbekistan on geodesy and cartography, the rules of the international agreement shall be applied.

Just like every industry has its own operating principle, this industry also has a main principle. The main principles of carrying out geodesy and cartography activities are as follows:

* *systematicity and continuity of geodesy and cartography activities;*
* *completeness, reliability and relevance of materials on geodesy and cartography;*
* *unification of conventional signs and uniform use of names of geographic objects in creating and updating maps and plans.*

The territory of the Republic of Uzbekistan, the territory of the globe, outer space, including natural and artificial celestial bodies, are the objects of geodesy and cartography.

Subjects of geodesy and cartography are as follows:

* *Cabinet of Ministers of the Republic of Uzbekistan;*
* *State Committee of Land Resources, Geodesy, Cartography and State Cadastre of the Republic of Uzbekistan;*
* *Ministry of Defense of the Republic of Uzbekistan;*
* *State and economic management bodies;*
* *Local state authorities;*
* *Legal entities with the right to carry out geodesy and cartography activities;*
* *Legal and physical entities that store materials related to geodesy and cartography.*

Types of work related to geodesy and cartography include:

1. Works related to geodesy and cartography of national importance;
2. Works related to geodesy and cartography of special importance.

With the development of society, the level of scientific and technical progress is increasing, and the structure of geodesy is also changing. During its development, geodesy was divided into a number of independent scientific and scientific technical disciplines.

The science of topography (geodesy) deals with the theory and practice of geodetic surveying works performed in order to create topographic maps, plans and profiles of the land part of small areas on the surface of the earth.

The higher science of geodesy deals with the issues of determining the shape and size of the earth at a higher level, and this science also deals with the issues of establishing geodetic grids. In its place, independent sciences such as geodetic astronomy, geodetic gravimetry, and space geodesy emerged with deep and detailed study of higher geodesy issues.

When we say the shape of the earth, its natural shape (Fig. 1) is not taken into account, only its mathematical shape is understood. Among such mathematical shapes, the closest to the natural shape of the Earth is the geoid. The concept of geoid was introduced in 1873 by I. B. Listing, a German mathematician and physicist. According to Listing, about 70% of the Earth's surface is surrounded by oceans and seas - the geoid is formed by the intersection of these water levels with land (continents and islands). At such an intersection, the geoid must be perpendicular to Earth's gravity. But since the rocks of the old Earth have different densities and weights, the geoid surface has a complex - uneven wave shape and cannot be expressed by any mathematical equation.

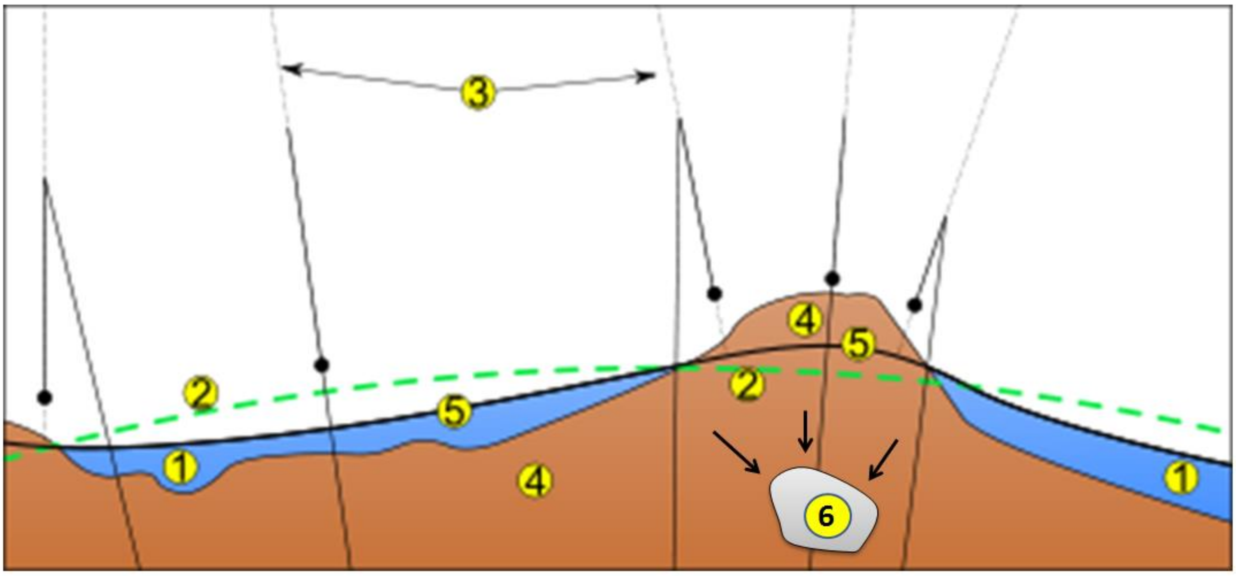

Figure 1. The diagram representing the difference between the geoid and the Earth's ellipsoid:1 World Ocean; 2- Earth ellipsoid; 3-shown lines; 4- land; 5-geoid; 6-high density rock.

Since the geoid is not represented by any simpler mathematical equation, the geoid is replaced by a simpler surface that is close to it. The closest geometric shape to the surface of the Geoid, as determined by precise measurements, has been found to be a rotating ellipse formed by rotation around its minor axis.

The dimensions of the Earth's ellipsoid were calculated by scientists of several countries using the results of geodetic measurements, some of them are listed in Table 1.

Table 1
Dimensions of the Earth's ellipsoid [4]

Surname of scientist	The year the measurements were taken	The length of the semi-major axis of the ellipsoid, m	Density of poles
Delambr	1800	6 375653	1:334, 00
Bassel	1841	6 377397.155	1:299, 15
Klark	1880	6 378249.145	1:293, 47
Xeyford	1909	6 378388	1:297, 00
Krassovskiy	1940	6 378245.0	1:298, 30
Airi	1830	6 377563.396	1:299, 32
Everest	1830	6 377276.345	1:300, 80
Fisher (Merkuriy)	1960	6 378166.0	1:298, 30
Fisher	1968	6 378150.0	1:298, 30
GPS	1967	6 378160.0	1:298, 24
GPS	1975	6 378140.0	1:298, 25
GPS	1980	6 378137.0	1:298, 25
South America	1940	6 378160.0	1:298, 25
WGS	1960	6 378165.0	1:298, 30
WGS	1966	6 378145.0	1:298, 25
WGS	1972	6 378135.0	1:298, 26
WGS	1984	6 378137.0	1:298, 25

A cartographic projection of the entire earth's surface or some large part of it on a spherical surface is a miniature similar image on paper is called a map.

The map will have certain changes in the length of the line, the area of the contours of objects, and the angles between directions. As you move away from the center of the map (the meridian of the axis), the change in scale increases, that is, the scale becomes larger. These shortcomings can be overcome to a certain extent by choosing a cartographic projection and making corrections. Like a plan, maps are detailed (outline) and topographical.

Conditionally depending on the scale of the cards: from 1:10000 to 1:100000 - called large-scale cards; Those between 1:200,000 and 1:1,000,000 are called medium scale maps, and maps smaller than 1:1,000,000 are called small scale maps.

Maps smaller than 1:100,000 are called survey maps, and those with a scale of 1:200,000 to 1:1,000,000 are called survey-topographic maps.

When creating a map, first of all, a cartographic grid is built, bounded by meridians and parallels. In addition, the map is filled with an integer multiple of kilometers parallel to the abscissa and ordinate axes, the corners of the grids have coordinates.

Table 2
Card sheet sizes and nomenclature [3]

Map scales	The size of the frame of the card sheet		Card nomenclature symbol
	By latitude	By distance	
1:1 000 000 on the scale sheet			
1:1 000 000	4°	6°	K-42
1:500 000	2°	3°	K-42-G
1:300 000	1°20′	2°	IX- K-42
1:200 000	40′	1°	K-42-XX
1:100 000	20′	30′	K-42-102
1:100 000 on the scale sheet			
1:50 000	10′	15′	K-42-102-B
1:25 000	5′	1′30″	K-42-102-V-g
1:10 000	2′30″	3′45″	K-42-102-V-a-3

Digital position data is in a horizontal plane projection and is recorded for points in space that are either located on the edges of a regular shape or otherwise distributed.

Numerical models of space used in practice are divided into several groups.

- *Regular place digital models*
- *Irregular space digital models*
- *Structural spatial numerical models*
- *Numerical models of statistical space*

Regular location numerical models are models in which the location points are aligned with triangular, rectangular, hexagonal regular geometric grid node points (Fig. 2).

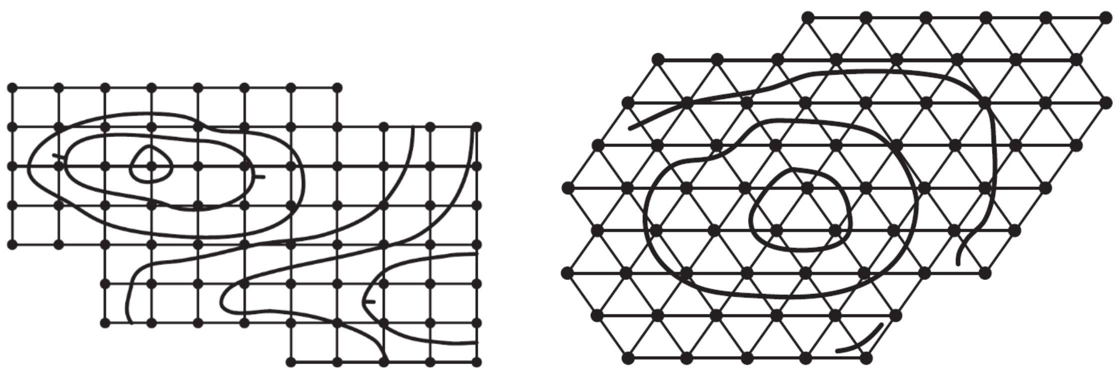

Figure 2. Numerical models of regular space on the edges of rectangular and triangular geometric meshes.

Irregular space digital models look different. Cross lines and their points on a theodolite track are an example of this. (Fig. 3, a). This model can be obtained by properly mapping the location.

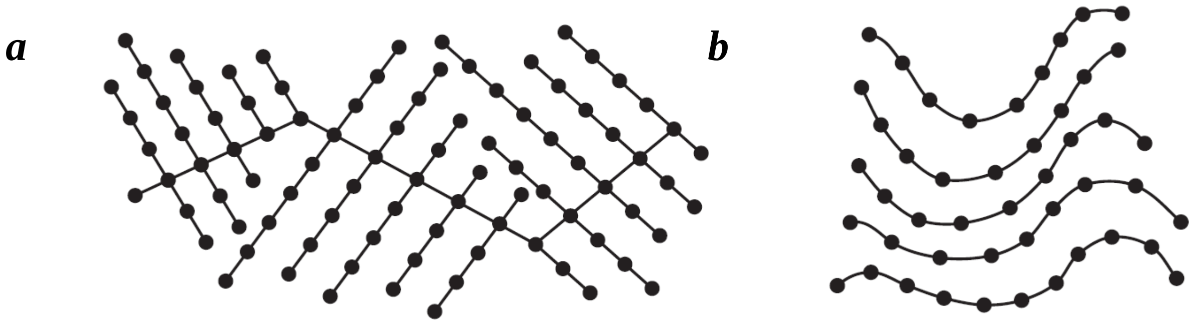

Figure 3. Irregular space numerical models:
a - along the transverse lines on the theodolite road; b - on horizontal lines.[1]

When the sum of many points determined by the coordinates xi, ui, Hi are located in the interval specified on the horizontal lines (Fig. 3, b). Irregular models of other forms are created based on large-scale plans and cards. The data is recorded by moving it along the horizontal plane of the plan using a special digitizing device (digitizer).

On maps and plans, horizontal angles and line directions are measured (or constructed) with a geodetic protractor based on the abscissa direction of the kilometer (coordinate) grid.

If the side of the angle to be measured is shorter than the radius of the protractor, then this side is lengthened using a checked ruler, and one of the sides is extended to more accurately join the zero line of the protractor. The value of the angle is calculated clockwise.

Lines drawn parallel to the abscissa axis are used on the card to measure steering angles.

The steering angle is measured from the north direction of the line parallel to the abscissa axis clockwise to the direction of the line given on the map (Fig. 4).

Lines of the coordinate grid are drawn up on maps and plans through certain intervals, in which the given direction for measuring directional angles is continued until the intersection with one of these lines. Then, if the direction angle is less than 180°, it is measured from the starting point to the line to the left (direction BC in Figure 4), or to the right if the direction angle is greater than 180° (direction DE in Figure 4). The zero line of the protractor is combined with the point of intersection of the center mark on the coordinate grid, and then the direction angle is measured. If the angle to be measured is greater than 180°, then it is counted from the southern direction of the abscissa axis, using the notes of the angle measuring scale of the protractor.

Now let's explain them separately.

Geodesy and cartographic works of national importance include:

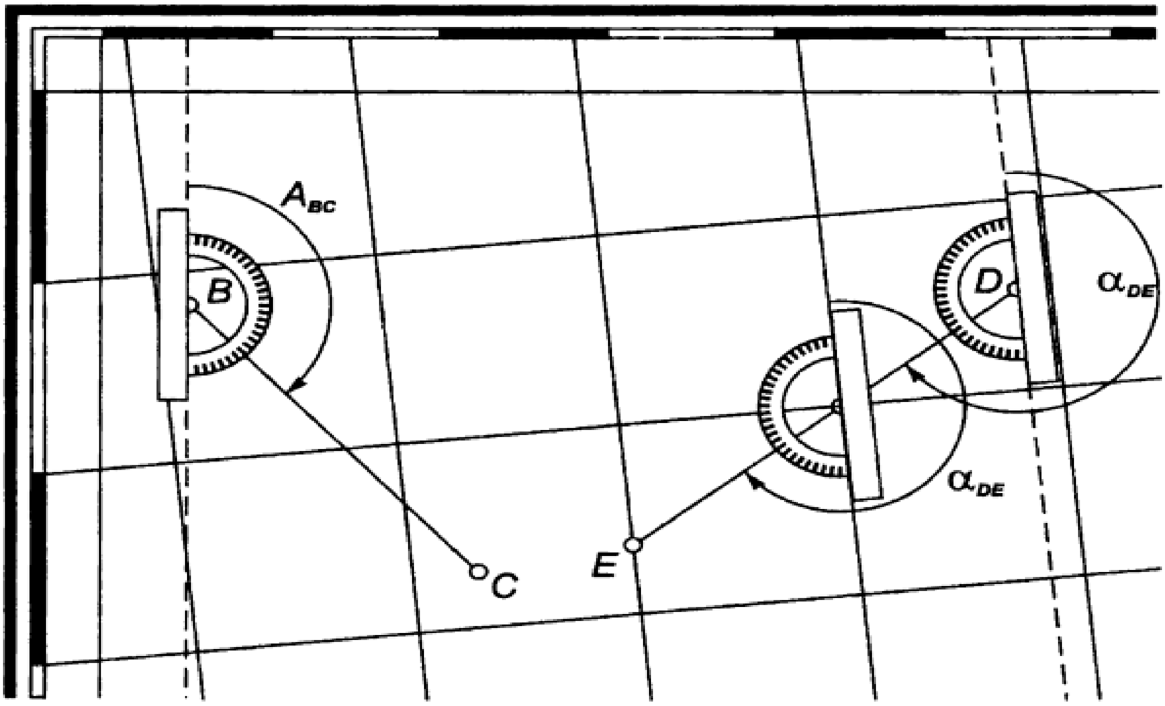

Figure 4. The scheme for determining the true azimuth and direction angle of the direction on the map.[2]

** Determination of the parameters of the shape of the Earth and the external gravity field;*

** creation, development and maintenance of state geodesy, level, gravimetry networks, geodetic densification networks;*

** creation, updating and publication of state topographic maps and plans in graphic, digital, photographic and other forms;*

** Formation and management of state cartography-geodesy activities of the Republic of Uzbekistan;*

** ensuring the unity of measurements and metrology control in carrying out works related to geodesy and cartography;*

** implementation of scientific-research, experimental-constructive and experimental-technological works in the directions listed in this article;*

** Other geodetic and cartographic work, the results of which are of national importance, carried out according to the decisions of the President of the Republic of Uzbekistan and the Cabinet of Ministers of the Republic of Uzbekistan.*

Geodesy and cartographic works of special importance include:

- *Construction and development of geodetic densification networks in engineering exploration, construction and use of buildings and structures, land surveying, state cadastre management and other works;*
- *Creation and maintenance of geographical information systems of special importance;*
- *Creation and publication of special thematic maps, plans and atlases in graphic, digital, photographic and other forms;*
- *Remote sensing of the Earth in order to provide geodesy and cartographic works during the implementation of engineering searches.*

conclusion and suggestions.

In conclusion, the State Committee on Land Resources, Geodesy, Cartography and State Cadastre of the Republic of Uzbekistan ensures the implementation of this law, its delivery to the executors, and the explanation of its essence and importance among the population. Also, the

Cabinet of Ministers of the Republic of Uzbekistan supervises the harmonization of government decisions with this Law, the revision and annulment of regulatory legal acts of state administration bodies that contradict this Law.

In the field of geodesy and cartography, as in other fields, new technologies are being used with rapid development and foreign experiences.

Our proposal is that if we study modern technologies from abroad in the field of geodesy and cartography and accelerate the use of these technologies in our republic, we will achieve accuracy of work in this field as well.

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