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COORDINATE SYSTEMS AND HEIGHTS IN GEODESY

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Abstract:

In the geographical coordinate system, the location of the projection of a point on a level surface is determined by two coordinates - angles: latitude and longitude. The latitude of a point is the angle formed by a vertical line at a given point and the plane of the equator. Geographical coordinate system. In the geographical coordinate system, the origin is the center of the Earth, taken as a ball, and the coordinate planes are the plane of the earth's equator and the plane of the zero (initial) meridian.

Keywords: Coordinate, Geography, Cavity, Point, Equator, Meredian

Geographical coordinate system. In the geographical coordinate system, the origin is the center of the Earth, taken as a ball, and the coordinate planes are the plane of the earth's equator and the plane of the zero (initial) meridian. In the geographical coordinate system, the location of the projection of a point on a level surface is determined by two coordinates - angles: latitude and longitude. The latitude of a point is the angle formed by a vertical line at a given point and the plane of the equator. This angle is measured from the equator plane to the north and south, varying from 0° to 90°. Latitude can be northern (+) and southern. The longitude of a point is a dihedral angle enclosed between the plane of the initial (Greenwich) meridian and the plane of the meridian passing through this point. From the initial zero meridian, the longitude is counted to the east and west, up to ± 180 °. Accordingly, the longitude is called east (+) and west (-).

To directly determine the geographical coordinates of a point on the map, lines of meridians and parallels are used. Meridian is the line of intersection of a flat surface (ellipsoid or ball) with planes passing through the axis of rotation of the Earth. A parallel is a line of intersection of a flat surface with planes perpendicular to the axis of rotation of the Earth and parallel to the equator. The system of geographical coordinates is convenient for studying the entire physical surface of the Earth or significant parts of it, but inconvenient for solving many engineering problems. The Gauss projection gives an image of the earth's surface with discontinuities, but its value is that due to small distortions it brings the map closer to the plan and allows you to use a system of flat rectangular coordinates in each zone, which is convenient for solving engineering problems.

Geographical coordinates determine the position of a point relative to the earth's equator and one of the meridians taken as the initial. Geographical coordinates can be obtained based on astronomical observations or geodetic measurements. In the first case, they are called astronomical, in the second – geodetic. In astronomical observations, the design of points on the surface is carried out by vertical lines, in geodetic measurements - by normals, so the values of astronomical and geodetic geographical coordinates differ somewhat.

The rapid development of mathematics, physics and celestial mechanics in the XVII-XVIII centuries required high measurement accuracy, which could only be achieved using new coordinate systems. This, in turn, caused the need to determine the shape of the Earth, which became the main scientific task of higher geodesy. The ellipsoid of the Earth began to be perceived as a figure of the Earth, the shape and dimensions of which correspond with the necessary accuracy to the shape and dimensions of the Earth. The equation of the surface of a biaxial ellipsoid of rotation has the form: where a and b are the major and minor axes of the ellipsoid, respectively. The equation corresponds to a system of rectangular coordinates in space, the beginning of which coincides with the center

Flat rectangular coordinates The Gauss projection allows you to calculate geographical coordinates from rectangular coordinates and vice versa. In this projection, the intersection point of the axial meridian with the equator line forming a right angle is taken as the beginning of each zone. They are taken as coordinate axes. The axial meridian serves as the x-axis of the abscissa, and the equator line serves as the y-axis of the ordinates. The positive direction of the abscissa axis is the direction from the equator to the north, the positive direction of the ordinates is to the east. In mathematics, the left coordinate system is used (numbering of quarters counterclockwise), in geodesy - the right system. But, since the names of the coordinate axes are also opposite, the signs of the coordinates of the points located in the blocks of the same name coincide, which allows you to apply the trigonometry formulas without any changes in this system.

Zonal system of flat rectangular coordinates (Gauss-Kruger projection) This projection was proposed by Gauss in 1828, and formulas convenient for practical calculations were developed by Kruger by 1912. In Russia, the Gauss-Kruger projection has been adopted since 1928. The essence of the projection is as follows. The surface of the terrestrial spheroid is divided by meridians into zones of 6 ° in longitude, starting from the zero meridian, and

numbered in the direction to the east, there are 60 zones in total. The cylinder is cut into two halves and the image is unfolded to the plane.

In a transversely cylindrical projection, the distortions will be in line lengths: the zones on the cylinder are wider than on the ball. As for the axial meridian, there will be no distortion of it, since it touches the surface of the cylinder, but the further the arc segments are located from the axial meridian, the greater the distortion in the line lengths. The width of the zone at the equator is about 670 km, i.e. the extreme points of the zone are 335 km away from the axial meridian. Distortions in line lengths reach: at a distance of 100 km – 1/8000 of the measured line length, at 300 km -1/800. For the latitudes of the territory of Russia, these distortions in the worst case are about 1/1000. If distortion (of the order of 1/1000) is unacceptable, then a zone division of 3 ° in longitude is carried out, and then linear distortions on the territory of our country do not exceed 1/8000.

For a territory located in the northern hemisphere, x abscissae are positive everywhere, and y ordinates can be both positive and negative. Negative ordinates make it difficult to process geodetic materials and their counting on the map may not coincide with the direction of longitude in the geographical system. That is, the axial meridian and the origin of the y coordinate are transferred to the west from the zone by 500 km . To avoid this, the ordinate of the axial meridian is taken not for 0, but for 500 km. Additionally, the ordinates of the point record indicate the zone number due to the fact that in all sixty zones the coordinate systems are the same. Therefore, the value of the coordinates of the point must be supplemented with the number of the zone in which this point is located. This number is assigned ahead of the ordinate.

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The polar coordinates of a point on a plane are called plane polar coordinates. The polar coordinate system is formed by a directed straight beam OX. The origin of coordinates - the point O - is called the pole of the system, the line OX - the polar axis.

The position of any point in the polar system is determined by the radius vector r (polar distance S) - the distance from the pole to the point - and the polar angle β at point O, formed by the OX axis and the radius vector of the point and counted from the OX axis clockwise.

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