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THE GEOID IN THE RUSSIAN TERRITORY

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The aims of the research are what is the geoid; description of how the WGS geoid gives a rough estimate of the geoid height N and how to get the remaining smaller part of N so that we in total know N with an accuracy 1 cm.

Nowaday the GNSS positioning is widely used for many applications. The main goal of surveyors for many years is the easy determination of geodetic heights, via GNSS measurements.

The geoid is an equipotential surface of the Earth's gravity field that is closely associated with the mean ocean surface. WGS 84 EGM96 to n = m = 180 is used in calculating the elevations of the geoid above referents-ellipsoid the WGS 84 for determining the components of the perturbation of the gravitational field of the Earth and the field average gravity anomaly. For determination of the geoid height the ellipsoidal and orthometric heights are used. The ellipsoidal height is referred from the surface of any reference ellipsoid to the point of interest along ellipsoidal normal. The orthometric height is referred from the geoid to the point of interest along the curved plumbline. The geoid height or geoid-ellipsoid separation is referred from the surface of any reference ellipsoid to the geoid along the ellipsoidal normal. The transformation of ellipsoidal heights to orthometric heights therefore requires that the geoid height refer to the same reference ellipsoid. In the case of GPS-derived ellipsoidal heights the geocentric WGS84 ellipsoid is used. Therefore, the geoid model must refer to this ellipsoid or another that is compatible. The determination of the geoid height at each point can be calculated using a wellknown formula (1):

$$N = h - H\,, \tag{1}$$

where N is the geoid height, h is the ellipsoidal height, H is the orthometric height. The elevation of the geoid above the ellipsoid for n = m = 180 is calculated by the next formula:

$$N = \frac{GM}{r\gamma}\left[\sum_{n=2}^{n_{max}}\sum_{m=0}^{n}\left(\frac{a}{r}\right)^{n}\left(\bar{C}_{n,m}\cos m\lambda + \bar{S}_{n,m}\sin m\lambda\right)\bar{P}_{n,m}(\sin\varphi')\right]\,, \tag{2}$$

$$r = \frac{a\sqrt{1-e^2}}{\sqrt{1-e^2\cos^2\varphi'}}\,, \tag{3}$$

$$e^2 = \frac{a^2-b^2}{a^2}\,, \tag{4}$$

$$\varphi' = \tan^{-1}[(1-e^2)\tan\varphi]\,. \tag{5}$$

The computations were based on a data set consisting of 5’ × 5’ mean gravity anomalies and topography information from different sources. The topography was represented by detailed digital terrain model. The gravimetric geoid undulations were compared to geoid heights obtained by GPS/leveling for some points and European geoid EGG97 for western region of Russia, with geoid height derived from recent geopotential models.