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modern global models of the earth's gravity field: analysis of their accuracy and resolution

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Introduction: Accurate knowledge of the fine structure of the Earth's gravity field extends opportunities in geodynamic problem-solving and high-precision navigation. In the course of our investigations have been analyzed the resolution and accuracy of 33 modern global models of the Earth's gravity field and among them 23 combined models and 10 satellite models obtained by the results of GOCE, GRACE, and CHAMP satellite gravity mission. The Earth's geopotential model data in terms of normalized spherical harmonic coefficients were taken from the web-site of the International Centre for Global Earth Models (ICGEM) in Potsdam.

Theory: Accuracy and resolution estimation of global Earth's gravity field models is based on the analysis of degree variances of geopotential coefficients and their errors. During investigations for analyzing models were obtained dependences of approximation errors for gravity anomalies on the spherical harmonic expansion of the geopotential, relative errors of geopotential's spherical harmonic coefficients, degree variances for geopotential coefficients, and error variances of potential coefficients obtained from gravity anomalies.
Delphi 7-based software developed by authors was used for the analysis of global Earth's gravity field models.

Experience: The results of investigations show that spherical harmonic coefficients of all matched. Diagrams of degree variances for spherical harmonic coefficients and their errors bring us to the conclusion that the degree variances of most models equal to their error variances for a degree less than that declared by developers. The accuracy of normalized spherical harmonic coefficients of geopotential models is estimated as 10-9. This value characterizes both inherent errors of models, and the difference of coefficients in various models, as well as a scale poor predicted instability of the geopotential, and resolution.
Furthermore, we compared the gravity anomalies computed by models with those obtained from ground-based gravimetric measurements carried out on different sites of Russia. According to the results obtained there is quite good conformity between models by their standard deviation and RMS error at the distribution close to the Gaussian.
The difference between modern global gravity field models and point values of gravity anomalies on territories of Russia with different amplitudes range from -20 mGal to +14 mGal, the standard deviation ranges of from 7.5 mGal to 10 mGal

Conclusion: All appropriate solutions for the geopotential coefficients based on the available terrestrial data are in good agreement with those obtained from satellite data within the mean square error of each result.
The actual accuracy characteristics of analyzing models are close to the declared ones but not reach them by the required resolution. The accuracy of normalized spherical harmonic coefficients of geopotential models is estimated as 10-9. This value characterizes both inherent errors of models, and the difference of coefficients in various models, as well as a scale poor predicted instability of the geopotential, and resolution. Spherical harmonic coefficients of higher degrees are considered as matching parameters of observations.

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