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Comparison of the Selected Geopotential Models in Terms of the GOCE Satellite Orbit Computation

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In this work, the chosen geopotential models are evaluated in the aspect of the orbit modelling of the Gravity Field and Steady-State Ocean Circulation Explorer Mission (GOCE) satellite. Selected gravity field models include, among other things, the recent models from the GOCE mission and the models such as EIGEN-51C, AIUB-CHAMP03S, ITG-Grace2010s, EIGEN-5C, EGM2008, EGM96. An essential tool for comparing different geopotential models is the Torun Orbit Processor (TOP) software package, which is based on the Cowell 8th order numerical integration method. The TOP software generates a satellite orbit in the field of gravitational and non-gravitational forces (including the relativistic and empirical accelerations). The 1-day orbital arcs were computed using various geopotential models. The first set of the root mean squares (RMSs) of the differences between the satellite positions on the computed orbits and on the reference orbit was obtained. The reference orbit was the 1-day arc of the reduced-dynamic Precise Science Orbit (PSO rd) of the GOCE satellite delivered by the European Space Agency. In addition, the coefficients of given models were modified using the normal distribution, taking into account their standard deviations. Using such modified geopotential models, the corresponding orbital arcs were determined. Thus, the second set of the RMS parameters of the differences between the orbital arcs based on the modified models and the corresponding arcs without the modification of models was obtained. Both mentioned sets of RMS parameters were used to compare the geopotential models according to two criteria; the external one - fitting the computed orbit to the reference orbit, the internal one - the effect of the estimation errors of the gravity field coefficients on the orbit error.