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The secular gravity field change caused by the inner core's super rotation

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The inner core's super rotation is confirmed by various studies based on seismic data. The super rotation is in fact the precession effect. Previous studies have established the model of the gravity field change caused by the inner core's super rotation (precession) under the assumption that the inner core is a uniform ellipsoid. Present study is a further improvement of the previous work. The anisotropic symmetric axis of the ellipsoidal inner core coincides with its self-rotation axis, which has an angle 10.5° tilted to the Earth's rotation axis. Because of the precession effect of the inner core, whose mass density is larger than that of the outer core, the Earth's gravity field is subject to variation. The gravitational field generated by the homomorphous rotational symmetric layer-uniform ellipsoidal inner core is established first in the inner core-fixed coordinate system and then in the Earth-fixed coordinate system. Under the assumption that the inner core's super rotation rate is $0.27 \sim 0.53^\circ a^{-1}$, calculations show that, due to the inner core's super rotation, in the year of 2006, on the Earth's surface the gravity field variations have the maximum value $0.12 \sim 0.23\,\mu$Gal, minimum value $-0.12 \sim -0.23\,\mu$Gal, global mean value $-1.62 \times 10^{-5} \sim -2.38 \times 10^{-5}\,\mu$Gal, and global average intensity $0.083 \sim 0.164\,\mu$Gal. The gravity variations have linear trend in recent decades. Calculations also show that, the gravity variations on the surface corresponding to the GOCE satellite altitude (250 km) have the maximum value $0.17 \sim 0.33\mu$Gal and the global average intensity $0.12 \sim 0.23\ \mu$Gal in 20 months. Based on the present study, it can be drawn out the conclusion that it is possible to detect the inner core's super rotation (precession) using temporal gravity data, e.g., data provided by conducting gravimeters or GOCE satellite system.