Geophysical Research Abstracts
Vol. 15, EGU2013-1365-1, 2013
EGU General Assembly 2013

The gravity field of the level triaxial ellipsoid

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Geodetic research has traditionally been motivated by the need to approximate closer and closer the physical reality. Several investigations have shown that the earth is approximated better by a triaxial ellipsoid rather than a biaxial one. Furthermore, non-spherical celestial bodies such as planets, physical satellites, asteroids and comets can be modeled by a triaxial ellipsoid. Also, the present day accuracy requirements and the modern computational capabilities push toward the study on the triaxial ellipsoid as a geometrical and a physical model in geodesy and related interdisciplinary sciences. From the viewpoint of its physical characteristics, it is assumed that the triaxial ellipsoid has mass and rotates with constant angular velocity. Also, this ellipsoid is a level (or equipotential) surface of its own gravity field. In this paper, the gravity field of the level triaxial ellipsoid is presented. An ellipsoidal coordinate system and the ellipsoidal harmonics are introduced. The gravitational potential is determined by solving an exterior Dirichlet's boundary-value problem. Hence, the gravity potential is completely and uniquely determined outside the triaxial ellipsoid. From the gravity potential the gravity vector is consequently obtained in the exterior space and on the surface of the level ellipsoid. The gravity field of the level biaxial ellipsoid is included as a degenerate case.