D105-007 **Room: 201A** **Time: May 23 15:02-15:15**

Bouguer anomaly revisited: a neoclassical approach to the free-air anomaly

Kyozo Nozaki[1]

[1] OYO

http://www.jpgu.org/meeting/

Introductory remarks:

The subject of this presentation is the generalization of the classical Bouguer anomaly [e.g. Garland (1965), p.50; Bouguer (1749)] based on the notion of the generalized Bouguer anomaly proposed by Nozaki (2006). The reduction level laterally varies in height depending on the position of the gravity station. Also it does not coincide with a boundary of a Bouguer plate above the geoid. The basic concept of the generalization is that the topographic masses, whose gravity effect has to be removed, are bounded by the physical surface of the Earth and the reduction level that would guarantee the independence of any constant density of the topographic masses. One of the main purposes is to supplement the logical defects of the current or modern definition of the Bouguer anomaly [Heiskanen and Moritz (1967), p. 131] from the geophysical viewpoint of investigating subsurface density structures. In this point, it is a kind of review of the so-called gravity anomaly including the Bouguer anomaly.

In the presentation, the author treats the topographic masses explicitly by applying the Bouguer reduction to the observed gravity and the Poincare-Prey reduction [e.g. Heiskanen and Moritz (1967), p. 146] to the reference gravity within the Earth's materials. Also, the author defines a new gravity anomaly, named the generalized Bouguer anomaly, by the difference between these two reduced gravities at a common datum level of an arbitrary elevation. The reasons are that

(1) there do exist attracting topographic masses above the geoid on land,

(2) we preferably need a background density field as the reference,

and importantly, for the nature of the geophysical subsurface investigations,

(3) the centrifugal (inertial) forces due to the Earth's rotation should be excluded exactly from the new gravity anomaly to be defined (i.e. the generalized Bouguer anomaly).

This treatment of the topographic masses is a good contrast to that of the free-air anomaly or Faye anomaly in physical geodesy, in which they are dealt with implicitly and the definition of the gravity anomaly is made at two distinct levels: e.g. the geoid and the normal ellipsoid. Although this treatment is somewhat old fashioned and maybe against the current, it is a quite natural and rational extension of the classical Bouguer anomaly from the geophysical viewpoints of studying subsurface density structures (or density anomalies). Also, despite that the figure of the Earth is not the main subject of such a generalization, this approach gives new perspectives to the theory of modern physical geodesy, which totally mediates between the geophysical and geodetic gravity anomalies.

Results:

(1) The upward continuation of the generalized Bouguer anomaly from the specific datum level Hd0 (Nozaki, 2006) to the station level, namely, the station level density-free Bouguer anomaly, is the gravity disturbance (say, the Bouguer disturbance) which contains no inertial term, thus suitable for geophysical purposes of subsurface investigations.

(2) The station level density-free Bouguer anomaly can be computed under a complete remove-restore process of the topographic masses, thus has no indirect effect on the geoid computation, etc.

(3) The equation of the station level density-free Bouguer anomaly has an intimate tie to the fundamental equation of physical geodesy (cf. Figure 1), thus consistent also with the geodetic framework.

Acknowledgements: The author thanks to Professor Emeritus Shozaburo Nagumo, Professors Shuhei Okubo and Yoichi Fukuda for helpful comments and encouragements.

References:

Bouguer,P. (1749): La Figure de la Terre, Paris.

Garland,G.D. (1965): The Earth's shape and gravity, First edition, 183 pp., Pergamon Press, Oxford.

Heiskanen,W.A. and H.Moritz (1967): Physical Geodesy, 364 pp., Freeman and Company, San Francisco.

Nozaki,K. (2006): The generalized Bouguer anomaly, EPS, 58, 287-303.

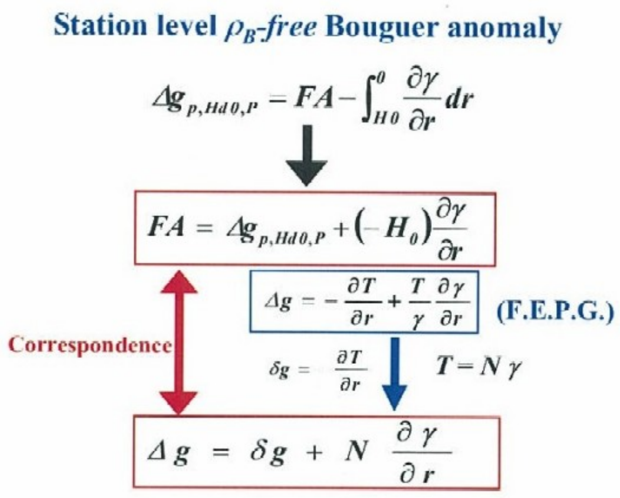

Figure 1. Correspondence between the equation of the *station level density-free (ρ_B-free) Bouguer anomaly* and the fundamental equation of physical geodesy.

T denotes the disturbing potential, N the geoid height, γ the normal gravity, r the vertical coordinate positive upward, Δg the gravity anomaly, δg the gravity disturbance, FA the free-air anomaly and H_0 the elevation (orthometric height) of the normal ellipsoid. There exists an intimate tie between the equation of the *station level ρ_B-free Bouguer anomaly* $\Delta g_{p,Hd0,P}$ (uppermost equation) and the fundamental equation of physical geodesy (F.E.P.G.) via the Bruns' formula $T = N\gamma$ and the gravity disturbance δg. FA corresponds to Δg, $\Delta g_{p,Hd0,P}$ to δg and ($-H_0$) to N.