On the current definition of the Bouguer anomaly

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The Bouguer anomaly has been reviewed in the geophysical and geodetic context of gravity anomaly from a standpoint of studying subsurface density structures. The main purpose is to remove the intrinsic defects involved in the current definition of the Bouguer anomaly, such as the residual centrifugal acceleration due to the Earth's rotation. Starting from the classical concept of the Bouguer anomaly, a new approach to the free-air anomaly has been shown based on the newly introduced concept of 'station level density-free Bouguer anomaly' that bases on the notion of the generalized Bouguer anomaly (GBA) proposed by Nozaki (2006).

The results indicate that (1) The station level density-free Bouguer anomaly is nothing but the gravity disturbance (say, the Bouguer disturbance) in a rigorous sense, (2) This gravity anomaly is not affected by any centrifugal (inertial) acceleration reflecting the mass-attraction only, thus suitable for geophysical purposes of studying subsurface density structures, (3) The equation of the station level density-free Bouguer anomaly is free from the assumption of the Bouguer reduction density and is valid in a rigorous sense even though the moved or removed topographic masses by the terrain and Bouguer corrections are completely restored, (4) This equation is equivalent to the fundamental equation of physical geodesy, thus consistent with the current framework of physical geodesy, and (5) These facts mediate between the geophysical gravity anomaly (typically, the gravity/Bouguer disturbance or the Bouguer anomaly in the classical sense) and the geodetic gravity anomaly (typically, the free-air anomaly in the Molodensky sense).