Gravity Reduction Spreadsheet to Calculate the Bouguer Anomaly

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Objective: Develop a portable and easy to use gravity reduction program using standardized methods and constants to calculate the Bouguer gravity anomaly. Current standards for reduction of observed gravity to a modeled Bouguer anomaly are unregulated and vary among geophysical textbooks, commercial software programs, and academic research spreadsheets available for download from the Internet. Using new standards established by the U.S. Geological Survey and the North American Gravity Database Committee, we developed a spreadsheet for reduction of raw data to the Bouguer anomaly and, with the use of terrain correction, the Complete Bouguer anomaly. We view the spreadsheet as particularly useful for field data reduction and modeling where internet access is limited or unavailable.

Description: The spreadsheet is based on Microsoft Excel, which is a common software application used by government agencies, research institutions, and private companies. The equations used in the spreadsheet are derived from the FORTRAN code written by Mike Webring of the U.S. Geological Survey and are the same as those used by the GeoNet Server accessible at the Pan-American Center for Earth and Environmental Studies.

With the use of the Global Positioning System (GPS) for surveying station locations and altitudes, availability of digital terrain models, and enhanced computational capability, gravity modeling is a cost-effective tool in subsurface analysis ranging from basin to continental scale studies. Existing gravity data for North America are archived and readily accessible via the internet at the Pan-American Center for Earth and Environmental Studies Web site (http://paces.geo.utep.edu/). The North America gravity database provides principal facts and Free Air and Bouguer anomalies calculated by a FORTRAN algorithm based on preferred correction and anomaly equations established by the Standards/Format Working Group of the North American Gravity Database Committee (Hinze et al., 2003).

The gravity spreadsheet was developed to facilitate adoption of the standards established by the North American Gravity Database Committee (Hinze et al., 2003) by the research community and to provide an easy to use, portable gravity correction and anomaly computation platform. The spreadsheet design can be modified to accept input from any gravimeter but is designed to accept data from LaCoste and Romberg, Scintrex, and Worden instruments.

The gravity spreadsheet calculates the corrections for instrument drift, height above the GRS80 reference ellipsoid, atmospheric effects, and the Bouguer spherical cap; as well as the DC shift for multiple day gravity surveys. The meter-specific calibration table in the spreadsheet will convert gravimeter counter readings to corrected gravity measurements. Tide and terrain corrections are not calculated in the spreadsheet, but users can enter values from other programs, such as InnerTC (Cogbill, 1990) in order to reduce gravity data to Bouguer anomalies. Prior to the standards set by the U.S. Geological Survey (Hildebrand et al., 2002), gravity reduction typically used orthometric heights (i.e., elevation with respect to mean sea level or the geoid) to calculate Free-Air and Bouguer slab corrections. In this spreadsheet, we conform to the USGS

standards and employ ellipsoidal height corrections. The revised method eliminates the need for including an estimate of the indirect effect caused by the difference between the ellipsoidal and geoidal heights in the Bouguer anomaly, as described by Hinze et al. (2003) and Hildebrand et al. (2002).

Current Status: The article outlining the computational basis and architecture of the spreadsheet and the spreadsheet is accepted for publication in the Geological Society of America (GSA) Geosphere. The spreadsheet and supporting information will be freely available from the GSA data repository.

References:

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