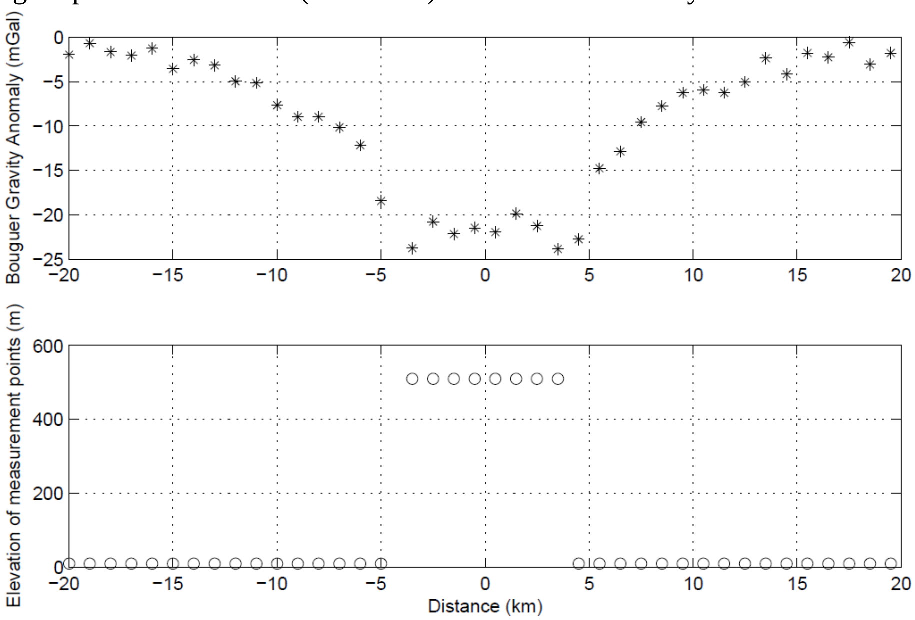
GG 450: Geophysical Methods

Homework 4: Interpretation of Bouguer Gravity

Read *Robinson & Coruh,* Chapter 9 (Its ok to skim pp. 293-299, 301-306, 313-316, 323-328)

Due Thu. February 4

1) (80 pts) Now let's use the simple Bouguer anomaly from Homework 3 to determine the density ρ_r and thickness r of the crustal root beneath the volcanic ridge (see diagram in HW 3). The figure below shows what you should have generated. "hw4.boug.txt" has my solution, but you should use your solution if it looks similar to mine. The negative anomaly over the ridge is caused by the deep crustal root, which is less dense than the surrounding mantle. This negative mass anomaly pushes up on and supports the excess weight of the ridge. To determine ρ_r and thickness r you will use the trial-and-error method to produce a theoretical Bouguer profiles that match (or bracket) the observed anomaly.



Write a Matlab script to predict the attraction of this crustal root along the survey transect. You should approximate it as a 2-D body extending very far in and out of the page, either as a long prism (using "gravprism.m"), or a cylinder ("sphere_cylinder.m"). The thickness of the root r and the depth z_1 can be estimated from the picture for HW 3.

Using a trial-and-error approach, determine the maximum and minimum values of r and ρ_r that best match the Bouguer anomaly in both shape and amplitude. Keep in mind that the crustal root is still crust, so ρ_r should be in the range of 2600-3000 kg/m^3, and therefore the effective density that you should use in your program is $\Delta\rho=(\rho_r-\rho_m)$, with ρ_m = 3300 kg/m^3. A theoretical constraint is provided by the equation for Airy isostatic compensation, $r \approx [\rho_u/(\rho_m-\rho_r)]h$, which suggests r should not be any more than 4-8 times h, or so. Plot (and label) 2-3 theoretical curves on the same plot as the simple Bouguer anomaly (above) for the range of r and ρ_r that you determine.

2) (20 pts)You should notice that it is very hard if not impossible to match the "corners" of the Bouguer anomaly seen near $x=\pm 4$ km. What is the source of this part of the Bouguer anomaly? You're explanation had better be consistent with your knowledge of the simple Bouguer approximation and/or how bodies of different sizes and depths influence gravity at the surface.

****Extra credit**** The Bouguer plate correction approximates topography everywhere, including the narrow ridge, as an infinite plate. Clearly the ridge is NOT infinitely wide, therefore the "simple Bouguer anomaly" is not extremely realistic. A better correction would be to remove the gravitational effects of the actual shape of the topography. In so doing you would produce a "complete Bouguer anomaly". Outline how you might do this using "gravprism.m".