Systematic error of the geoid model in the Rocky Mountains

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After one year long investigation of the differences between the latest UNB model of the North American geoid against the GPS and levelling reference points, the main source of the error was finally detected. The error was hidden in the improper compilations of the mean free-air gravity anomalies. Our experiment, conducted over one part of the Rocky Mountains revealed that if the mean free-air anomalies are computed using simple Bouguer anomalies, the result is systematically biased due to the biased location of gravity observation points. After a detailed investigation of the behaviour of the terrain correction vis-a-vis the terrain itself, the following conclusion was reached: the observed gravity points in the Rocky Mountains were chosen at such locations where the terrain correction is in average larger then the real mean terrain correction as computed in the same area. Surprisingly, the effect of this bias on the geoid can amount to a few meters. It is possible to reduce greatly this systematic influence by compiling the free-air anomalies from complete instead of simple Bouguer anomalies. This is unfortunately a very time consuming process, because the mean terrain correction has to be computed carefully, usually from many individual points.

In this contribution, a brief theory of the anomalous gravity field introduces the problem. Then the conclusive experiment is described and its numerical results are presented. Finally, conclusions are drawn and suggestions for curing the problem are made.