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Poisson downward continuation of scattered Helmert's gravity anomalies to mean values on a raster on the geoid using least squares

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Gravity anomalies need be continued from the topography down to the geoid in order to provide input boundary values for solving the Geodetic Boundary-Value Problem. This step, called the Downward Continuation (DC), is probably the most problematic step in geoid determination methods. Inversion of the Poisson integral equation is being used for the DC in the UNB's Stokes-Helmert geoid computation approach. Given discrete input gravity data on the topography, the Poisson integral equation has to be discretized. To solve a resulting system of linear equations, different discretization methods using point to point or mean to mean formulations as well as different iterative techniques for the matrix inversion, such as Jacobi's, have been used.
The aim of this research is to come up with a technique for DC of scattered point Helmert's gravity anomalies from the topography or from the air to mean gravity anomalies on a regular raster on the geoid using a Least-Square Technique (LST). LST does not have to be solved by an iterative algorithm and can employ all available gravity data on topography and above in the vicinity of the area of interest. We have concluded, by experimenting with input gravity data on the regular grid on topography, that the best approach is to consider the capture area on the Earth surface to be composed of two parts: first an area equivalent to the target area on the geoid and the second consisting of a strip of a certain width around the target area. The width of the additional strip confirms our earlier findings, i.e. that 30' width captures the substantial part of the far-zone contribution in case of continuing Helmert's gravity anomalies. The capture area of the input data consists of the two regions described above, the estimated parameters of the LST are the mean Helmert's anomalies on a raster on the geoid.
To test the proposed approach, free-air gravity anomalies in the Auvergne area limited by -1<longitude<7 and 43<latitude<49 arc-deg, i.e. around 244000 scattered gravity values, were considered in the context of the target area on the geoid limited by 0<longitude<6 and 44<latitude<48 arc-deg. The input free-air gravity anomalies were first transformed into the Helmert space to enable us to continued them down to the geoid. The target area was then broken down into 1 arc-deg squares containing 1 arc-min mean downward continued Helmert's gravity anomalies on the geoid. 36 such squares were finally fused together after testing the fit of continued gravity values along their edges.
DC of no-topography (NT) anomalies, a.k.a. spherical complete Bouguer anomalies, will be investigated next.