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A least-squares collocation procedure to merge local geoids with the aid of satellite-only global gravity models: the Italian-Swiss geoid case study

M. Gilardoni (1), M. Reguzzoni (2), and D. Sampietro (1)

(1) DIIAR, Politecnico di Milano - Polo Territoriale di Como, Como, Italy (maddalena.gilardoni@mail.polimi.it), (2) DIIAR, Politecnico di Milano, Milan, Italy

Neighbouring countries often have national geoids that do not fit to each other, typically showing a discontinuity along the border. This discontinuity is mainly due to the different height datum used, producing biased local geoids which can also have different accuracies and spatial resolutions. In addition, each local geoid has its own border effects giving rise to unwanted features. In some applications, for instance in case of international civil engineering works, a merging between two neighbouring geoids is necessary. Obviously this procedure cannot be done by simply averaging overlapping areas, completely disregarding biases.
To solve this problem the availability of a global geoid coming from satellite data, such as one of the GOCE models or a GOCE-GRACE combined model, can be of great importance. These models in fact are not affected by local biases (local reference systems) since they do not make use of any ground gravity data or levelling. Basically this means that these models can provide the long wavelengths of the resulting merged geoid, in this way removing national biases or other systematic effects. On the other hand, the short wavelengths will directly come from a combination of the available local geoids. This merging strategy is implemented by a unique collocation procedure, also taking into account the estimation error covariance matrix of the global model spherical harmonic coefficients.
In this paper the solution to the problem is first described from the methodological point of view and then applied to the merging of the Italian and Swiss geoids. Particular attention is dedicated to the estimate of the signal covariance function, which is adapted to the Alpine area characteristics and is derived by a proper variogram to be independent from local geoid biases.