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Simultaneous solution of the geoid and the surface density anomalies

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The main application of the land gravity data in geodesy is "local geoid" or "local gravity field" modeling, whereas the same data could play a vital role for the anomalous mass-density modeling in geophysical explorations. In the realm of local geoid computations based on Geodetic Boundary Value Problems (GBVP), it is needed that the effect of the topographic (or residual terrain) masses be removed via application of the Newton integral in order to perform the downward continuation in a harmonic space. However, harmonization of the downward continuation domain may not be perfectly possible unless accurate information about the mass-density of the topographic masses be available. On the other hand, from the exploration point of view the unwanted topographical masses within the aforementioned procedure could be regarded as the signal. In order to overcome the effect of the remaining masses within the remove step of the GBVP, which cause uncertainties in mathematical modeling of the problem, here we are proposing a methodology for simultaneous solution of the geoid and residual surface density modeling In other words, a new mathematical model will be offered which both provides the needed harmonic space for downward continuation and at the same time accounts for the non-harmonic terms of gravitational field and makes use of it for residual mass density modeling within the topographic region. The presented new model enjoys from uniqueness of the solution, opposite to the inverse application of the Newton integral for mass density modeling which is non-unique, and only needs regularization to remove its instability problem. In this way, the solution of the model provides both the incremental harmonic gravitational potential on surface of the reference ellipsoid as the gravity field model and the lateral surface mass-density variations via the second derivatives of the non harmonic terms of gravitational field. As the case study and accuracy verification, the proposed methodology is applied for identification of the salt geological structures as well as geoid computations within the northern coasts of Persian Gulf.