MRF Super Resolution Approach for Mapping Gravity from Grace Satellite Data

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The gravity field of the Earth is the most important measurement that provides it's inner and outer mass balances. The problem with homogenous gravity data coverage used to measure the gravitational field is the cost and effort required in such observations with the use of expensive gravimeters. Hence the possibilities of using open source gravity data for such studies could be handful. Yet the spatial resolution of gravity data represented in regular tessellation structures adds on limitations. This study attempts to sharpen the resolution (super-resolution) of the GRACE (Gravity Recovery and Climate Experiment Satellite Mission) open source gravity data, based on the principles of the Markov Random Fields (MRF) for the Sri Lanka region. It further stresses the importance of the prior probability estimation for the gravity data classification and super resolution. Three datasets have been used for this study; the GRACE only gravity field models GGM05s, BGI Gravity database (both open source data) and the CG-6 gravimeter observation especially for the "Balangoda" region for validation purposes. Mathematical relationships between different parameters were executed in the study and are presented. The Markov Neighborhood Normalization was applied to the gravity data and further the maximum likelihood classification (MLC) with prior and without prior estimations was applied to the data separately. It was observed that better results could be obtained with the prior estimations in the classification process using the MRF neighborhoods. Trend analysis between gravity and elevation shows that the southern part of Sri Lanka has lower gravitation than the northern parts. Further the central hill region shows the lowest gravity readings in the island. It is obvious that for these trend analyses the resolution of the gravity is a concern. Finally it has been observed that according to the theoretical relation between gravity and the elevation, the results for the southern parts of the island obtained by the study had certain deviations from the rest. The final super resolution gravity map was compared with EGM2008, GECO, EIGEN-6C4-2014 and Tongji-Grace02s gravity models and it preserved the same pattern carried out by the original data and it showed a minimized mean error of 2.4090 mGal with the Tongji gravity model. Further the CG-6 observation was also compared with BGI land gravity data to validate the BGI open source data.

Keywords: gravity, GRACE and BGI Gravity data, super resolution, MRF