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Optimized regional gravity recovery by Bayesian Monte Carlo inversion

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In regional approximation approaches for satellite gravity recovery, the shape and the location of the basis functions is usually pre-defined. Only very few approaches exist, starting with the pioneering work of Barthelmes, where the shape or the location are optimized (or rather estimated under some optimization criterion or loss function).

Bayesian inference, augmented by Monte Carlo sampling, provides a powerful inversion tool in geodesy and geophysics. In earlier work we have shown how Bayes estimators for so-called quasi-linear models can be efficiently computed by Monte Carlo integration. Quasi-linear models are a special class of non-linear models, which can be formally written in matrix-vector formulation but where the coefficient matrix depends on a subset of the unknown parameters. The estimators for expectation and covariance of the parameters turn out as weighted means of the individual sample least-squares solutions. A weighted Bayesian model averaging is realized.

Here will show how the basis function locations in a regional gravity recovery can be optimized by Bayesian Monte Carlo inversion. A particular advantage of this approach is that any sophisticated gravity recovery software, such as the Bonn University GROOPS program, can be easily integrated.