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On the role of the point grid in regional gravity field analysis

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In order to motivate regional analysis in gravity field modelling, as contrasted with spherical harmonic modelling, it is often suggested that the resolution of regional models can be adapted to the data coverage, density and variability.

However, in practice most regional approaches do not fully take advantage of this. The model resolution is closely connected to the nodal point grid, i.e. the locations of the base functions. Since formal optimization of the point grid poses a non-trivial task (the problem is non-linear and not fixed in dimension), the grid is most often simply defined a-priori, e.g. dense and uniform with an extra margin extending the data area. This choice is very flexible regarding differing data scenarios, but it quickly leads to over-parameterization and numerical problems. Contrary, our hypothesis is that an optimized, small and well-distributed grid leads to a more stable solution, which at the same time better explains the data.

Here, we propose an approach to globally optimize the point grid in a radial base function approach, i.e. the number and locations of base functions, jointly with the usual model parameters. We make use of tools from Bayesian statistics; precisely, we use the Metropolis-Hastings-Green algorithm, which is an extension of the well-known Metropolis-Hastings sampler to cases when the target density is variable in dimension. We will present the theoretical background and provide numerical results from the field of GOCE data analysis.