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Towards 3D joint inversion of full tensor gravity, magnetotelluric and seismic refraction data

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Joint inversion of different datasets is emerging as an important tool to enhance resolution and decrease inversion artifacts in structurally complex areas. Performing the inversion in 3D allows us to investigate such complex structures but requires computationally efficient forward modeling and inversion methods. Furthermore we should be able to flexibly change inversion parameters, coupling approaches and forward modeling schemes in order to find a suitable approach for the given target.

We present a 3D joint inversion framework for scalar and full tensor gravity, magnetotelluric and seismic data that allows us to investigate different approaches. It consists of two memory efficient gradient based optimization techniques, L-BFGS and NLCG, and optimized parallel forward solvers for the different datasets. In addition it provides the necessary flexibility in terms of model parametrization and coupling method by completely separating the inversion parameters and geometry from the parametrization of the individual method. This separation allows us to easily switch between completely different types of parameterizations and use structural coupling as well as coupling based on parameter relationships for the joint inversion.

First tests on synthetic data with a fixed parameter relationship coupling show promising results and demonstrate that 3D joint inversion is becoming feasible for realistic size models.