Investigation of a multiphysics joint inversion framework

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We present a 3-D multiphysics joint inversion framework that in a certain sense is a trade-off between “simultaneous” and “cooperative” approaches to data integration. Using a variable splitting approach, inverse problems are solved by individual inverse solvers, on individual grids, while coupling combined with interpolation is implemented separately. Up to date, first-arrival seismic tomography, gravity and magnetotelluric inverse problems are included in this framework. Magnetotelluric inversion uses the NLCG method implemented in the ModEM code (Kelbert et al., 2014). Seismic tomography is based on the Gauss-Newton method with a finite-difference eikonal solver and posterior ray tracing. Gravity inversion uses the conjugate gradient method with wavelet compression of the sensitivity matrix. Structure coupling is based on mixed-norm regularization inducing joint sparsity between the models. Among particular functionals that were studied, following numerical experiments, joint total variation and joint minimum support have proved to be the most efficient options. In the numerical experiments, we invert synthetics simulating regional datasets observed in Ireland.