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# Joint inversion scheme with an adaptive coupling strategy – applications on synthetic and real data sets

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Joint inversion strategies for geophysical data have become increasingly popular since they allow to combine complementary information from different data sets in an efficient way. However, for joint inversion algorithms that use methods that are sensitive to different parameters it is important that they are not restricted to specific survey arrays and subsurface conditions. Hence, joint inversion schemes are needed that 1) adequately balance data from the different methods and 2) use links between the parameter models that are suited for a wide range of applications.
Here, we combine MT, seismic tomography and gravity data in a non-linear joint inversion that accounts for these critical issues. Data from the different methods are inverted separately and are joined through constrains accounting for parameter relationships. An advantage of performing the inversions separately (and not together in one matrix) is that no relative weighting between the data sets is required. To avoid that the convergence behavior of the inversions is profoundly disturbed by the coupling, the strengths of the associated constraints are re-adjusted at each iteration. As criteria to control the adaption of the coupling strengths we used a general version of the well-known discrepancy principle. Adaption of the coupling strengths makes the joint inversion scheme also applicable to subsurface conditions, for which the assumed relationships are only a rough first order approximation. So, the coupling between the different parameter models is automatically reduced if for some structures the true rock property behaviors differ significantly from the assumed relationships (e.g. the atypical density-velocity behavior of salt).
We have tested our scheme first on different synthetic 2-D models for which the assumed parameter relationships are everywhere valid. We observe that the adaption of the coupling strengths makes the convergence of the inversions very robust and that the final results are close to the true models. In a next step the scheme has been applied on models for which the assumed parameter relationships are invalid for some structures. For these structures deviations from the relationships are present in the final results; however, for the remaining structures the relative behaviors of the physical parameters are still approximately described by the assumed relationship. Finally, we applied our joint inversion scheme on seismic, MT and gravity data collected offshore the Faroe Islands, where basalt intrusions are present.