Geophysical Research Abstracts
Vol. 13, EGU2011-1996-1, 2011
EGU General Assembly 2011

Joint inversion of receiver function, surface wave dispersion, and magnetotelluric data for 2D crustal modeling

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The joint inversion of earthquake seismic (receiver function and Rayleigh dispersion) and natural magnetotelluric (electric and magnetic fields) data is presented for improved crustal imaging. The inversion methodology uses a Gauss-Marquardt-Levenberg algorithm to minimize a multi-component objective function: measurement (difference between calculated and observed measurements), Tikhonov (difference between adjacent parameters of same type), and cross-gradient (differences among adjacent parameters of disparate types). The 1D seismic and 2D magnetotelluric models are solved simultaneously using synthetic data from 15 magnetotelluric stations and 3 seismic stations. The truncated singular value decomposition and Tikhonov procedures are applied to guarantee inversion stability and convergence, whereas the cross-gradient procedure identifies common structure among disparate parameters. These synthetic tests show improvement in the crustal image when compared to more traditional inversions demonstrating the potential benefits of the joint inversion of seismic and magnetotelluric data.