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A combined amplitude-spectra time-traces inversion: theory and application to weak local earthquakes at the south-central chilean margin

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A semi-automatic iterative inversion technique for local earthquakes has been developed to achieve the retrieval of robust moment tensor solutions of a large number of weak local earthquakes. The process consists of three steps, once data have been preprocessed. The first inversion step implies a robust amplitude spectra inversion of selected and lowpass-filtered body-wave phases, where a global minimum is retrieved by applying a gradient method and a grid search for starting models. The retrieved moment tensor has an ambiguity in terms of its polarity. In a second step, the best moment tensor solution is used to predict phase corrections of synthetic time traces by cross correlating observed and synthetic data. The sign ambiguity is resolved by testing both solutions in the time domain after shifting Green functions to time-lags of either maximal or minimal cross correlation coefficients, and selecting the one with the smaller misfit. Finally, the last inversion aims to improve the stability and reliability of the results by adding those time traces, that have a small misfit in step 2. A combined, nonlinear and iterative amplitude-spectra and time trace inversion is performed using the previous best moment tensor as starting model. The method is applied to new seismicity data from the TIPTEQ experiment at the south-central Chilean margin between -39 and -37 latitude. More than 500 earthquakes have been recorded during a deployment of at times 120 short period land stations and 10 ocean bottom stations from February to October 2005. We present test cases to demonstrate the inversion approach and discuss the retrieved moment tensors in terms of the tectonic and geodynamic settings. The TIPTEQ project is funded by the German BMBF and DFG through the R&D-program GEOTECHNOLOGIEN, grant 03G0594C.