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Estimation of focal mechanism of low magnitude crustal earthquakes from Vrancea region

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An iterative inversion scheme for short period waveforms from local earthquakes is proposed, with the aim of reducing the uncertainty in the determination of the seismic moment tensor of low magnitude crustal earthquakes of Vrancea region; depth-dependent models for the quality factor of the medium, the structural parameter less known at present, are simultaneously estimated.
The procedure is developed by combining iteratively the inversion of local records for the source mechanism with the inversion for the quality factor Q, and it consists of 3 steps: (i) a preliminary estimation of the fault plane solution, using resonable models for the inelastic attenuation; (ii) determination, on the basis of this preliminary mechanism, of optimal Q(h) models along the individual ray paths; (iii) reevaluation of the seismic moment tensor by using the retrieved Q(h) models.
The inversion in the steps (i) and (iii) is performed by applying the INPAR algorithm, a method working with indirect parameterization of the seismic source. To cope with the effects of the approximation of the real medium structure by oversimplified structural models when generating the theoretical waveforms, we follow a procedure resembling bootstrap approach; this allows us to evaluate also the resolution of the orientation of the double couple component of the seismic moment tensor.
The optimum 1D model for the inelastic attenuation along each individual source-to-station path is determined (step (ii)) by fitting the normalised amplitude spectra of the records with the spectra of the synthetics, generated as response of the structure to instantaneous point sources with the same location and mechanism as the recorded event.
The synthetic seismograms needed in all three steps of the algorithm are computed by the multimodal summation technique.
The superiority of the proposed scheme in obtaining reliable estimates of the source parameters of low magnitude crustal Vrancea earthquakes is evidenced when comparing the results in step (i) with the final results. By considering the optimal attenuation models the uncertainty of the retrieved fault plane solutions is significantly reduced. The orientation of all principal axes of the moment tensor is considerably better constrained and also the statistical value of the solutions is raised, as consequence of decreasing the number of inconsistent bootstrap solutions classified as outliers and rejected before the averaging.