Geophysical Research Abstracts
Vol. 13, EGU2011-4544, 2011
EGU General Assembly 2011

An Application of Relative Moment Tensor Inversion to 14 local earthquakes occurred in southern Iran, Fin region

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We use relative moment tensor inversion (RMTI) in order to determine the focal mechanism of a cluster of earthquakes containing 14 events occurred close-lying in southern Iran, Fin region, with Mw>=3.5 and recorded by Iranian National Broad-Band Seismic Network (INSN) in local distances. The RMTI was implemented in both time and frequency domains. The observed data consists of relative amplitudes of the direct P phase on vertical and direct S phase on rotated horizontal components. The effect of propagation paths from the source-region to a given seismic station is minimized using relative amplitude of the corresponding phases (e.g. P-phase) recorded by a given station. The focal mechanisms of the earthquakes are then determined using a linear weighted least-squares approach for six components of the moment tensor without knowing the complete Green's functions. The calculation is done using only a simple velocity model at the source region. We conducted inversions independently using only P- or S-phase data. The focal mechanisms estimated based on only the S data are more stable compared to P data results. The focal mechanisms resulted from the inversion are validated using different synthetics tests for real geometry of the earthquake and seismic stations and are finally compared with available focal mechanisms e.g. CMT solutions. The solutions stability under the presence of different amount of noise and azimuthal gap are investigated using different synthetic tests. The presence of noise causes the inversion process to become less constrained and produce less reliable solutions. The effect of noise is significant for those events that have relatively lower signal-to noise ratio and are recorded by a smaller number of stations at different azimuths around the source area. The optimum focal mechanisms results are then selected based on relatively low RMS values and condition numbers. Decomposition of the moment tensors into double-couple and isotropic components and their subsequent analysis is used to deduce the styles of failure. Spurious non-double components were present in results from our various synthetic tests. These can be attributed to various sources such as modeling errors and station distribution and especially error in the focal mechanism of the reference event. These synthetic analyses suggest that the double-couple components may be well estimated, but the non-double-couple (CLVD and isotropic) components must be interpreted with caution. Comparing to the time-domain application of RMTI method, the usage of spectral amplitudes in frequency domain combined with polarity data proves to be flexible and effective in estimating focal mechanisms of clusters data and the method is suitable for routine implementation in seismic networks.

Key words: Earthquake clusters, deviatoric, RMTI, moment tensor inversion.