Source Parameters Determination for Earthquakes in Greece using Regional Data

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Focal mechanism solutions for small earthquakes

1. Focal mechanism solution indicating normal type faulting for an earthquake of magnitude Mw=4.2 that occurred at 2008/02/25 near the town of Ag. Konstantinou, northwestern of Athens.

2. Focal mechanism solution indicating right lateral strike slip motion for an earthquake of magnitude Mw=3.2 that occurred in the Northwestern part of Turkey at 2008/02/10.

3. Focal mechanism solution indicating right lateral strike slip motion for an earthquake of magnitude Mw=4.1 that occurred in the Northern Aegean Region at 2008/08/03.

Data Used and Inversion Method followed

In the present study synthetic for regional distances were generated using the reflectivity and frequency wavenumber summation technique proposed by Zeng and Anderson (1995). This code is based on the generalized reflectivity and transmissivity-coefficient method and crucial the 10 fundamental green functions as it is described by Herrmann and Wang (1985). The methodology computes differential seismograms directly in a layered elastic half-space. First the medium velocity difference was considered with respect to the velocity change in the layer and then it is multiplied with the original elastic wave field. The obtained differential waves propagate directly to the receiver using the generalized R/T matrix method. The synthetics are calculated using the discrete seismograms summation and frequency technique (Boucher, 2003). Then the 10 green functions are combined and produce the 3 components of motion: the tangential, radial and vertical component, as proposed by Just and Herrmann (1985). The inversion of the waveforms is performed using the codes of Lichten et al. (2003).

The obtained deviatoric moment tensor is decomposed in two parts: the Double Couple component and the CLVD. For the selected earthquakes we retrieved waveforms at seismological distances of 0° – 10° with good signal to noise ratio. In the inversion approach data from the new seismological network of the University of Athens were used combined with data from stations operated by the Universities of Patras and Thessaloniki, Meteor, NOA, and Geotest. The selection of the original waveforms was always influenced by the factor that the selected data should be able to provide the best possible seismological coverage needed for waveform modeling. In all the studied events we used at least two stations, minimizing the effect of the uncertainty of the velocity model used along one single ray path. In many cases with good quality data more than 7 stations were used. The station identification codes, locations and instrument corrections are available on the internet.

The next step after the data were downloaded was the instrument response correction. Next, the waveforms were integrated in order to produce pure displacement. The regional broad-band data were band-pass filtered in frequencies between 0.01-0.05 Hz for events with Mw < 5.0 and 0.00-0.05 Hz for events with Mw > 5.0. Horizontal components were rotated to radial and transverse. The three displacement components were cut in the same starting time (nearly 10 sec before the first arrival).

The results of the moment tensor inversion (Agiokas et al., 2007), combined with maps are available on line through the www.geophysics.gu.ste.gr web.

Statistics Results

Source parameters were calculated for 383 moderate size, mainly earthquakes that occurred during the time period from June 2003 to April 2008 (time period of available recordings for moderate events). Before 2003 there were no available regional waveforms. Source parameters of 111 earthquakes were calculated between 2007-2008 but until July 2008 more than 90 events were modeled.

Results

Using the above mentioned methodology the following results were obtained:

1. 383 focal mechanism solutions were calculated during the time period 2003-2008.

2. The good quality of the solutions is succeeded using data from local and regional networks. For small earthquakes, data from at least three stations (3 component) were used, while usually more than 6 for stronger ones. The use of local data permits the calculation of moment tensor solutions for small events with Mw < 4. In most of the solutions the Double Couple component is high.

Different type of mechanisms are constrained that can be related with the seismotectonic characteristics of the regions where they occurred.

Recent Significant Earthquakes

20080106 Mw=6.1 Leonidio

20080214 Mw=6.7 Methoni

20080220 Mw=6.0 Methoni

20080608 Mw=6.4 Andravida

Moment Tensor Solutions for the time period 2003-2008

Focal mechanism solutions during the time period 2003-2008. The color bar of the focal mechanisms represents the occurrence time of the earthquake.