

Broadband Strong Ground Motion Simulation of the 12 November 1999 and 17 August 1999, Turkey Earthquakes.

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The main objective of this study is to determine the source characteristics of the Düzce and Kocaeli Earthquakes such as source size, asperity location and asperity size and also compare these findings with empirical scaling relations obtained from worldwide earthquakes. The possibility of supershear rupture propagation during the Düzce earthquake is also examined by performing numerous inversions changing the first time-window propagation velocities at each time.

The waveform inversion of the 12 November 1999 Düzce, Turkey Earthquake was performed for the frequency range of 0.1-0.5 Hz. using the multiple time-window linear waveform inversion methodology. For the inversion, strong motion records of the Düzce Earthquake from 8 stations within 50 km epicentral distance were used. In order to calculate the theoretical Green's function between each subfault and each station in 1D velocity structure, the discrete wave number method together with the reflection-transmission matrix method were used.

The best source model was characterized by 3 asperities; a large asperity near the hypocenter and two smaller asperities: one, closer to the surface in the eastern part of the fault plane and the other in the western bottom of the fault plane. First time-window propagation velocity was found as 4.8 km/s in the eastern propagation, where it was 2.9 km/s in the western propagation. A simplified version of this source model was used for getting higher frequency simulation through Empirical Green's Function (EGF) Method. The EGF simulation results show that the high frequency radiation area is slightly larger than the initial asperity area we selected based on final slip distribution results. The main asperity area was estimated as 15km x 11.5km. Furthermore the, the rupture velocity in the asperity area was found to be closer the S wave velocity, which is consistent with the inversion results.

The findings of the Düzce Earthquake were also compared with the self-similar scaling relationships derived from the results of worldwide large earthquakes. The relation between the seismic moment, average slip and the combined area of asperities are in good agreement with those indicated in the scaling relationships, where the calculated rupture area is slightly smaller than the area found from the empirical relationship.

In order to get the broadband simulation of the 17 August 1999 Kocaeli earthquake, the EGF simulation has been performed at 5 stations using the available aftershock records as Green's function. The rupture process result of the Kocaeli Earthquake was used to set up an initial source model for the forward simulation of this earthquake. The EGF simulation results indicate that the strong motion records at 3 stations located in and around the Istanbul city are mainly controlled by the largest asperity near the hypocenter, where the station SKR has the main contribution from the eastern asperity.