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Estimation of Dynamic Rupture Parameters of the 1999 Duzce, Turkey Earthquake

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The 1999 Kocaeli(Mw:7.4) and Duzce (Mw:7.1), Turkey Earthquakes have in common a specific rupture characteristic: Ruptures propagated eastward from hypocenters by supershear rupture velocity. Dynamic rupture properties of the Kocaeli Earthquake have been studied by several researchers. In order to better understand propagation characteristics of the northern branch of the NAFZ as well as judging whether or not the supershear propagation is a systematic feature of this fault zone, rupture dynamics of the 1999 Düzce, Turkey Earthquake has been investigated.

The parameterization of the dynamic model, that describes the friction law and stress state on the fault, has been constrained with the slip distribution on the fault plane calculated from the kinematic waveform inversion of near field strong motion records. These parameters have been used as input for dynamic code.

Dynamic stress drop was calculated by iterative dynamic rupture simulation by assuming an initial stress drop distribution through kinematic inversion results and changing the stress drop distribution until the slip distribution from dynamic model and that of kinematic model match to each other.

Strength excess parameter was estimated by a trial and error scheme from a series of dynamic rupture simulation until the total rupture time be equivalent to the total rupture time of kinematic model.

Calculation of slip weakening distance and its definition for dynamic simulation is still subject under investigations. Recent investigations showed that Dc varies in rough proportion to the total slip, so it is variable in space. In this sense, critical slip weakening distances is assumed to be between 10- 30% of the total slip of kinematic model and the first time peak slip-velocity of kinematic model correspond to time of the slip-weakening distance.

For the calculation a full dynamic rupture simulation code, namely Support Operator Rupture Dynamic Code(SORD) developed by, Ely et.al,(2008) has been employed.

The results of this study will be used for a full dynamic rupture simulation for the generation of low frequency velocity ground motion and are expected to provide important insight into the nature of the rupture-induced directivity and super-shear rupture observed in this earthquake.