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Session S04: A System-Level Approach to Earthquake Dynamics:
From Multicycle Earthquakes to Strong-Motion Simulation

Characterized Source Modeling of Surface and Subsurface Faulting for Strong Motion Prediction

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Towards realistic ground motion prediction, we construct a procedure for characterized source modeling for surface and subsurface earthquakes based on the dynamic rupture simulation. We try to explain a paradox that ground motions caused by subsurface rupture seem to be larger than ones by surface rupture at a period of 1 second (Somerville, 2003). Recent studies of kinematic source modeling show larger stress drop for subsurface asperities and smaller stress drop for surface asperities (e.g., Kagawa et al., 2004). Our dynamic rupture simulation shows that the fracture energy is gradually increasing from the subsurface- and surface-rupture earthquakes as a function of the stress intensity factor (e.g., Mai et al., 2005). Using the differences of stress drop and the scaling slope of the fracture energy Gc and stress intensity factors, we interpret that the asperities of the surface-rupture earthquakes require larger Dc than the subsurface-rupture earthquakes when an effective stress is given. We construct Kostrov-like slip-velocity functions as functions of effective stress and slip-weakening distance for asperities of surface and subsurface faulting. The surface rupture earthquakes have lower maximum slip-velocity and its peak time is longer due to the smaller effective stress and larger fracture energy. The subsurface rupture earthquakes have larger maximum slip-velocity and its peak time is shorter due to the larger effective stress and smaller fracture energy. We performed strong ground motion simulation using the characterized source model which consists of asperities and background area. The physics-based slip-velocity time functions for the models are examined in comparison with the observed records and simulated motions for the 1992 Landers earthquake (Mw

7.2) as surface faulting and the 1997 Kagoshima earthquake (Mw 6.0) as undefined-subsurface faulting. Near-source ground motion simulations show the applicability of the proposed slip-velocity functions explaining the ground motion differences between the surface and subsurface faulting at a period of 1 second.