Dynamic Slip Partitioning in a Branched Oblique Fault System

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We use 3D dynamic spontaneous earthquake rupture models to investigate the physical origin of coseismic slip partitioning in oblique fault systems. The dynamics of a branched, obliquely-slipping fault system consisting of a 70 degree-dipping basal fault that branches upwards at 5 km depth to a vertical surface fault and a 45 degree-dipping surface fault are modeled under two regional triaxial stress fields that result in oblique-normal and oblique-thrust stresses on the system. In both cases, rupture propagates on only one of the shallow fault segments in a homogeneous regional stress field (the vertical one in the oblique-normal case, and the dipping one in the oblique-thrust case). However, the presence of a barrier on one of the shallow faults can induce rupture to propagate onto the other shallow fault segment, resulting in rupture propagation to all segments. When the entire system ruptures, slip spontaneously partitions into predominantly strike-slip and dip-slip segments consistent with partitioning observed in the field. In addition, slip rake angles on the shallow fault segments can differ by up to 10 degrees from the pre-stress direction, emphasizing the role of stress interactions in producing slip partitioning. The results may have implications for estimating the amount and direction of slip in future earthquakes on branched oblique fault systems.