

Eric Dunham

Associate Professor

Department of Geophysics

Stanford University

New Developments in Earthquake Simulations

Our ability to simulate earthquake processes has exploded in the past decade. This talk reviews earthquake physics and simulations of earthquake rupture propagation and longer-term fault slip histories, with an emphasis on new frontiers in the field. We explore conditions for seismic vs aseismic slip during fluid injection and diffusion through permeable fault damage zones, using coupled simulations of frictional sliding and poroelastic off-fault response. We then turn to the interplay between frictional sliding in the brittle crust and viscoelastic deformation and flow in ductile fault roots in the lower crust and upper mantle. Issues related to crustal stress levels, heat production and thermomechanical feedbacks, and the nature of deformation across the brittle-ductile transition are highlighted. Finally, we move offshore to study subduction zone earthquakes and outstanding questions related to tsunami generation. These questions are tackled using simulations that simultaneously capture earthquake rupture dynamics, seismic waves in the solid Earth, acoustic waves in the ocean, and surface gravity waves (tsunamis).