

ACOUSTICS2008/3078 Observations and models of dynamic earthquake triggering

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Seismologists have long accepted the idea that step-function perturbations to the deformation field acting on a fault can change its likelihood of, or 'trigger', failure as fault slip. We review the observations that have led to the very recent recognition that transient perturbations (e.g., associated with seismic waves) also affect failure probabilities, and more broadly, observations of the spatial and temporal variations in both triggering deformations and triggered responses. Many of these cannot be explained by conventional models of earthquake nucleation, requiring consideration of ideas developed in other disciplines, such as those describing and explaining nonlinear dynamic elasticity from rock-mechanics. In addition to the scientific challenges, these observations and models significantly impact earthquake forecasts and hazard assessments. We focus on observations of natural earthquakes and from the rock-mechanics laboratory, and some of the explanatory models that we and others have proposed. While many of these observations and models are just being vetted now, even newer ones related to slow aseismic fault slip and non-volcanic tremor (seismic radiation that scales very differently from that from earthquakes) may lead to substantive modifications and advances. We conclude with a few tantalizing examples as a prelude to a companion presentation.