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Finite-Element Simulation of Earthquake Shaking and its application to Predicting Seismically Triggered Landslides

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We used a 3D finite-element analysis based on a finite-fault slip model to simulate the strong motion from the 2006 Kiholo Bay earthquake in Hawaii to compare with the landslide distribution in the Kohala Mountains of the northern coast of the island of Hawaii. High concentrations of rock and soil slides occurred there in response to shaking from the M 6.7 earthquake. We mapped landslides at 1:24,00 scale from 1: 12,000-scale color aerial photography. We compared the landslide distribution in the Kohala Mountains to simulated velocity and dynamic shear strain at 3 Hz and 5 Hz upper-bound frequencies. The highest velocities occur on ridge tops and convexities within the canyons, but the highest shear strains lie within the canyons where most of the landslides occurred. Maximum velocities at both 3 and 5 Hz were rather poor predictors of the landslide locations, but higher levels of dynamic shear strain correlated much more closely with landslide locations. Although the velocity simulations predicted topographic amplifications on the ridge tops and other convexities, they were much less effective than shear strain in predicting the landslide locations. Dynamic shear strain appears to be a good measure of slope deformation during the earthquake and therefore correlates well with the process of landslide dislocation from the steep slopes.