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3-D Modelling of wave propagation resulting from the 2004 Parkfield earthquake

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The 2004 Mw=6.0 Parkfield earthquake took place in a very well instrumented area producing a substantial amount of high-quality near-field recordings. Taking advantage of the rare luxury of having a large number of near field ground motion recordings distributed around the fault zone, we model the 3-D wave propagation resulting from this earthquake using well established slip and 3-D models of the structure. The model covers a rectangular area of about 55 km by 33 km in fault parallel and fault normal directions, respectively. Using a grid spacing of 100 m in our 4^{th} order explicit finite difference code, we could properly resolve frequencies of up to 1 Hz with a minimum of 8 grids per wavelength for shear waves, except in the immediate vicinity of the fault where fault trapped waves dominate the records. We assess the effects of various simulation parameters such as slip model (Liu et al., 2006; Ji et al., 2005; Ji, 2004), rise time (constant or variable), source time function (decreasing exponential and trapezoidal), rupture velocity and the earth model (1D vs 3D) on the resulting waveforms. We also investigate the ground surface distribution of engineering parameters such as peak ground velocities, peak ground displacements, spectral accelerations at specific periods on the earth surface. An outstanding feature is that at high frequencies fault normal components near the edge of fault segments dominate the velocity and acceleration fields. Fault parallel component are reduced by the nodal plane that coincides with fault. The 1966 Parkfield earthquake is also modeled using the more recently available slip models (Custodio et al., 2007) and the regional 3-D model of the velocity structure (Thurber et al., 2006). The difference in the orientation of rupture

propagation is clearly observed in the engineering parameters like PGV and PGA.