CyberShake predictions of large southern San Andreas scenarios may need to be revised for nonlinear attenuation of surface waves

An Iwan-type Plasticity Model for 3D Simulations of San Andreas Scenario Earthquakes

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Introduction

- AWP-Iwan was developed to understand the coupled effects of off-fault plasticity and shallow crust nonlinearity, a SCEC5 research priority.
- The code uses the overlay concept to model Masing unloading and loading behavior in soils (Fig. 1).

Nonlinear Simulation of ShakeOut Scenario

- SE-NW rupturing M7.8 earthquake on the southern San Andreas fault is modeled dynamically (Roten et al., PAGEOPH, 2017).
- We use AWP-Iwan to simulate realistic nonlinear rheology in the sedimentary infill of the San Gabriel and Los Angeles basins.

Discussion and Conclusions

- Strong long-period ground motions (3s-SAs > 1g) in the Whittier Narrows corridor is caused by waveguide amplification in the linear case (Olsen et al., GRL, 2006, 2009, Fig. 2a).
- Realistic Iwan-type nonlinearity greatly reduces the amplitude of long-period surface waves causing this shaking (Fig. 2b).
- 3s-SAs at site ras are reduced from 1g in the linear case to 0.3-0.6g in the nonlinear case, depending on the choice of reference strain (Fig. 3).
- Using a single von Mises yield surface results in higher ground motions than in the Iwan model with 10 yield surfaces (0.7g at ras, Fig. 3). This suggests that low-strain (γ < γ₁) nonlinearity in the Iwan model is important.

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