The Big Ten earthquake scenarios for Southern California

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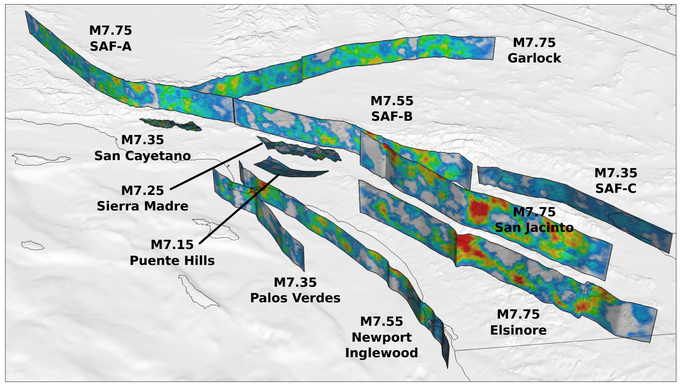
Abstract

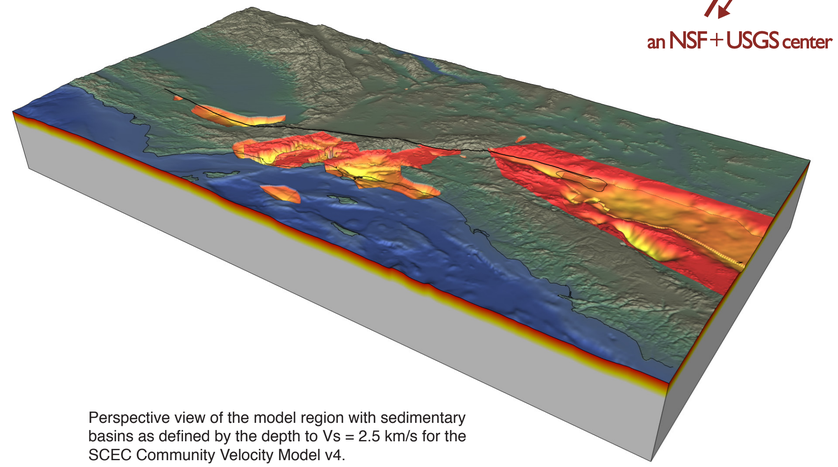
The Big Ten project is generating a hierarchy of simulations for roughly ten of the most probable large (M > 7) ruptures in Southern California, with the objective of understanding how source directivity, rupture complexity, and basin effects control ground motions. The ruptures and moment-magnitudes are selected from events with relatively high probability rates in the Uniform California Earthquake Rupture Forecast, Version 2 (UCERF2) model. The event set is being used to coordinate multiple types of large-scale simulations (requiring high performance computing), as well as multiple groups of researchers, around a common set of earthquake scenarios. The geoscience goals of the Big Ten project are to: (1) Understand the roles of source directivity, rupture complexity, and basin effects on ground motions, and evaluate how these factors control hazard curves from the CyberShake project; (2) Improve simulation capabilities by incorporating new codes that can model geologic complexities including topography, geologic discontinuities, and source complexities such as irregular, dipping, and offset faults; (3) Use dynamic rupture simulations to investigate the effects of realistic friction laws, geologic heterogeneities, and near-fault stress states on seismic radiation and thereby improve pseudo-dynamic rupture models of hazardous earthquakes; and (4) Use realistic earthquake simulations to evaluate static and dynamic stress transfer and assess their effects on strain accumulation, rupture nucleation, and stress release. We present simulations of four NW rupturing parallel faults to observe basin wave propagation effects.

CyberShake Slip distributions



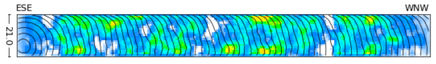
Perspective view of the Big Ten source faults colored by final slip (0: white, to 10 meters: red) for a single rupture variation from the CyberShake catalog.

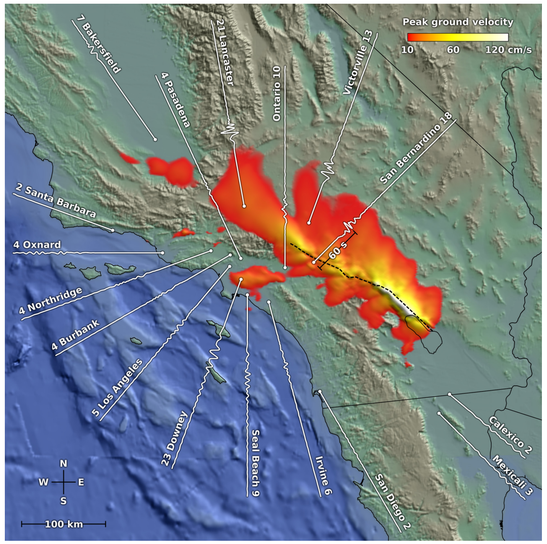
SCEC CVM4 Basin model



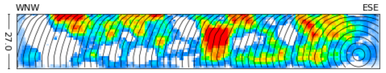
Perspective view of the model region with sedimentary basins as defined by the depth to Vs = 2.5 km/s for the SCEC Community Velocity Model v4.

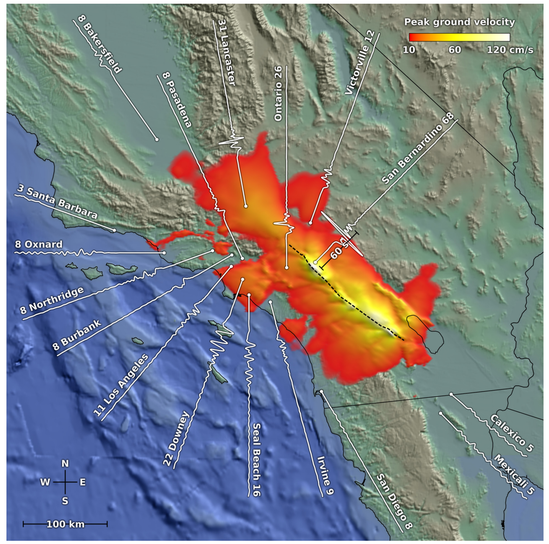
M7.65 "TeraShake" scenario



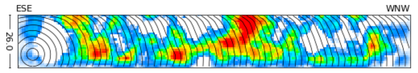


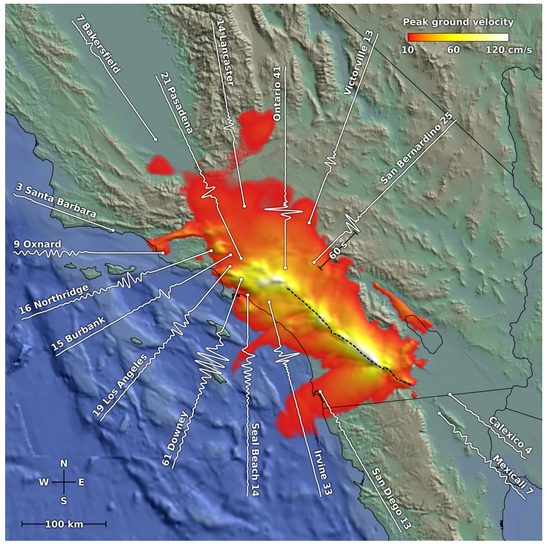
M7.75 San Jacinto scenario





M7.75 Elsinore scenario





M7.55 Newport Inglewood scenario