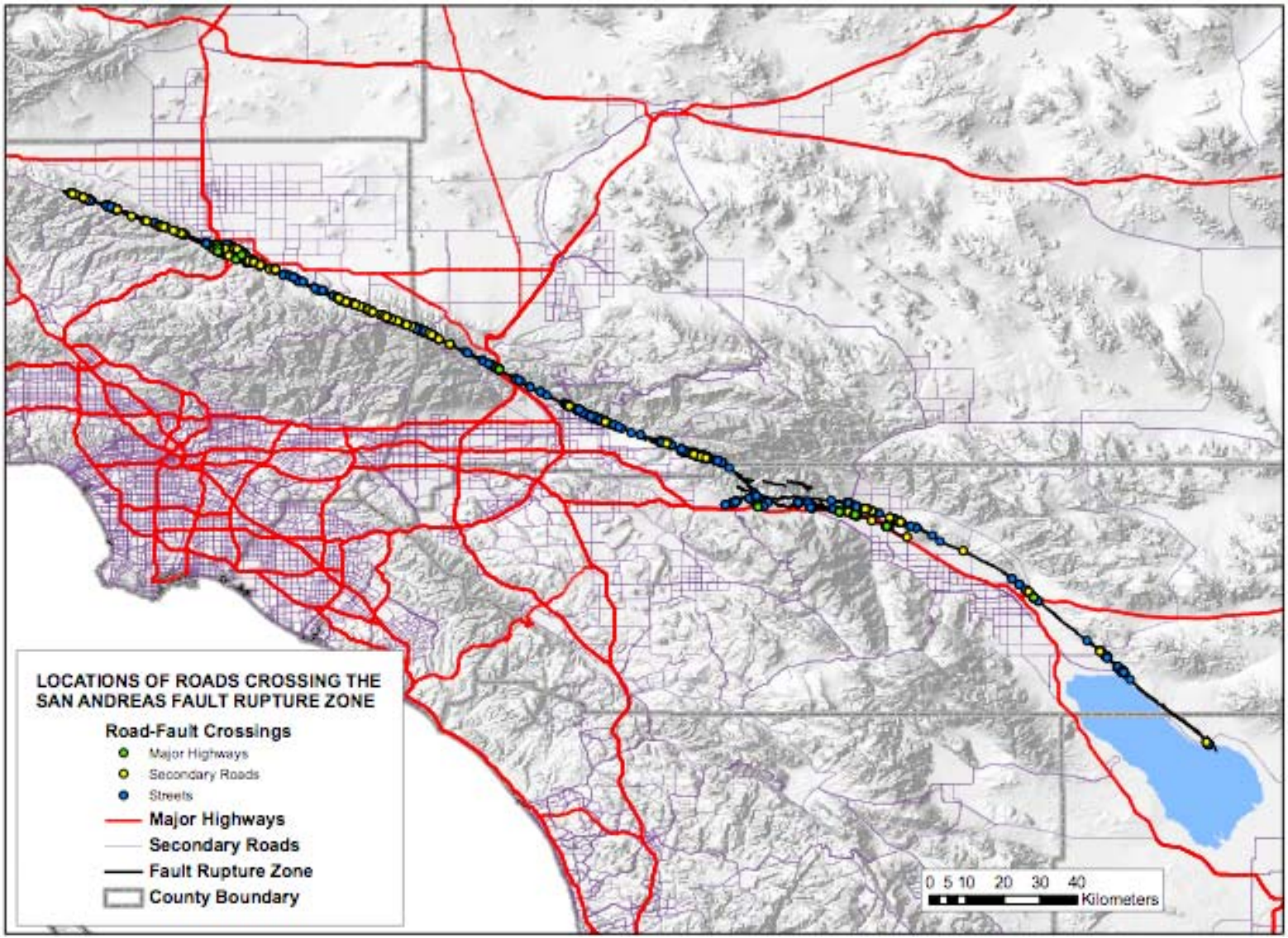
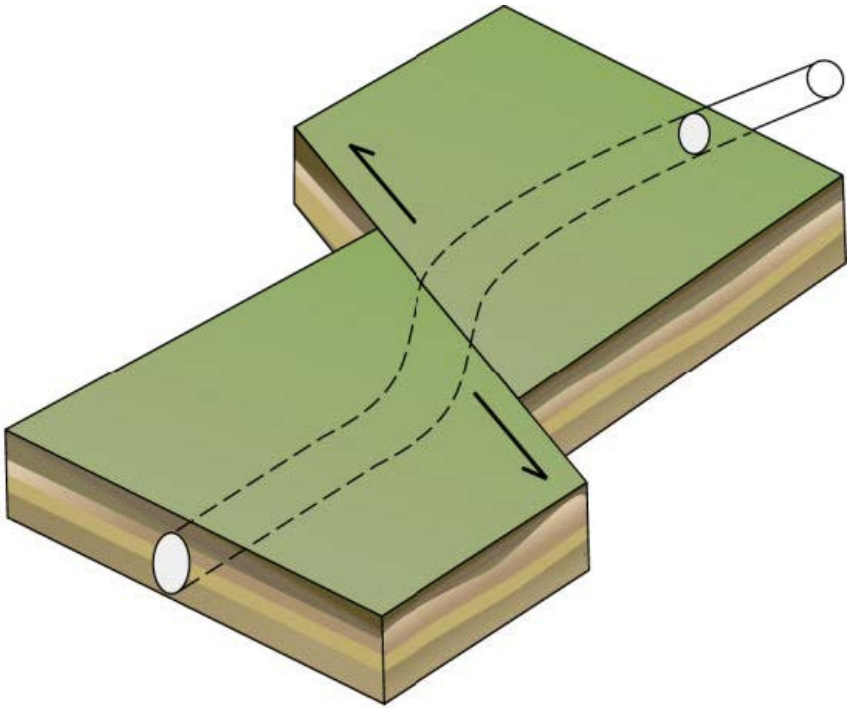
Infrastructure System Risk

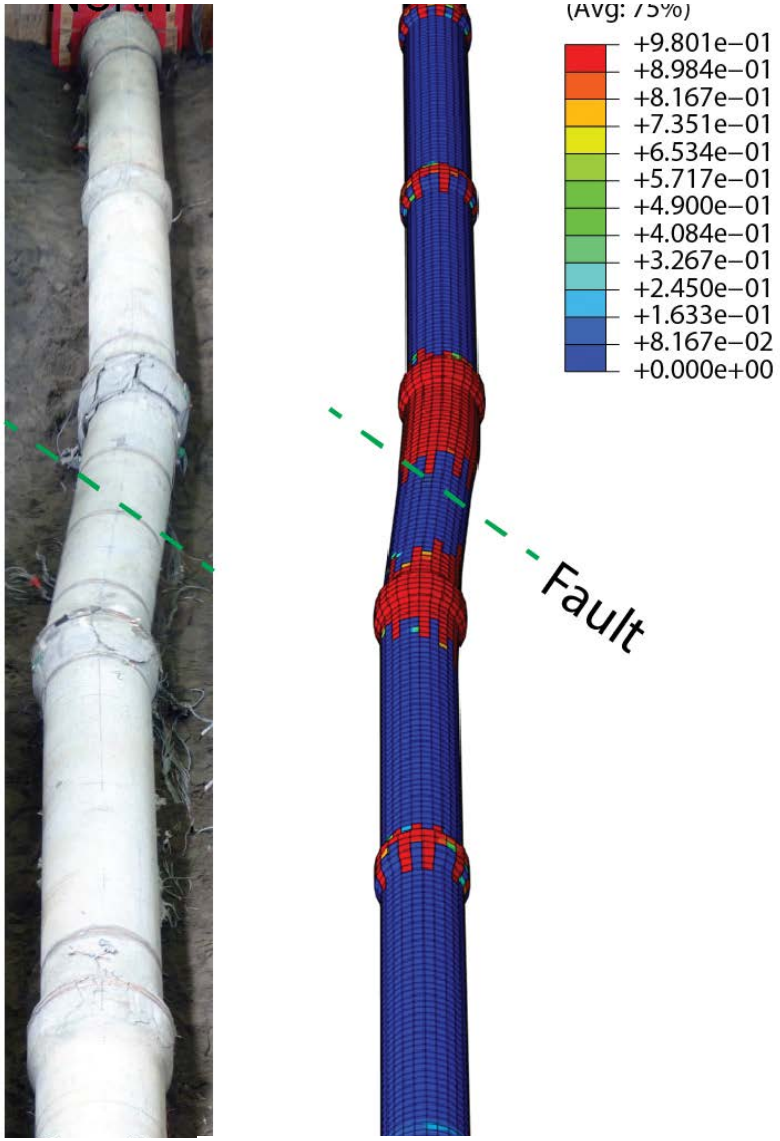
Risk to infrastructure crossing faults



From 2008 ShakeOut

Ground displacements for buried infrastructure



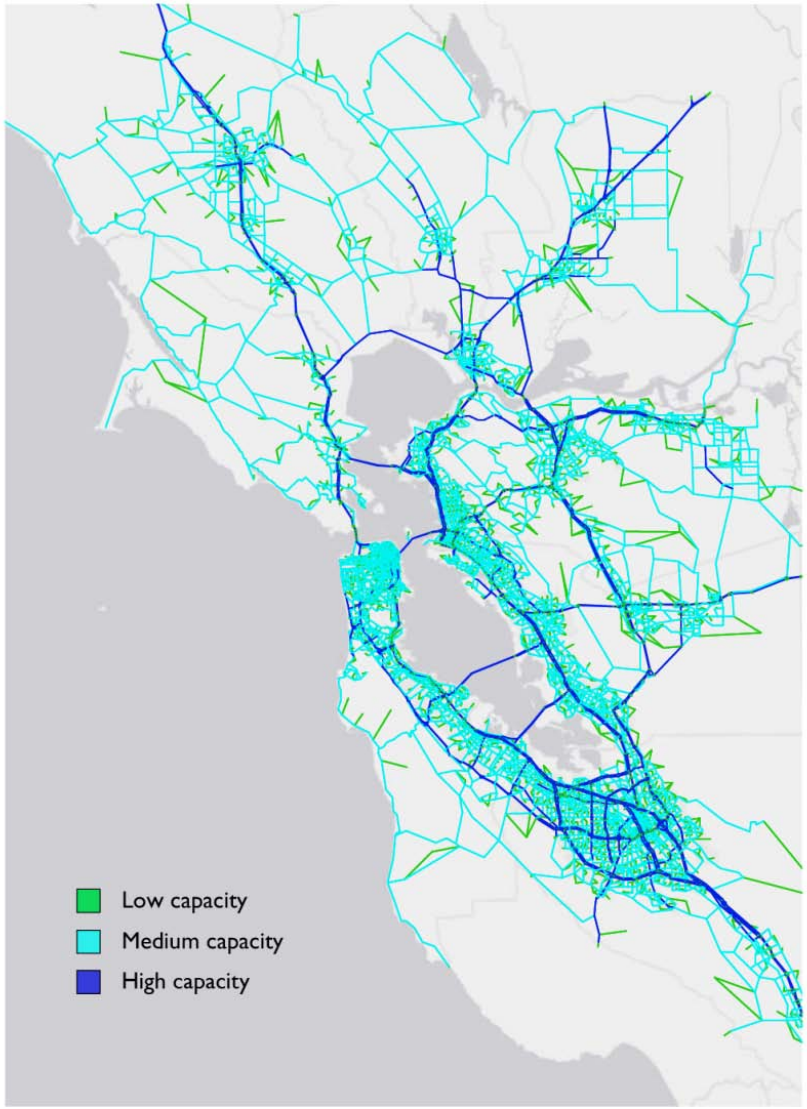


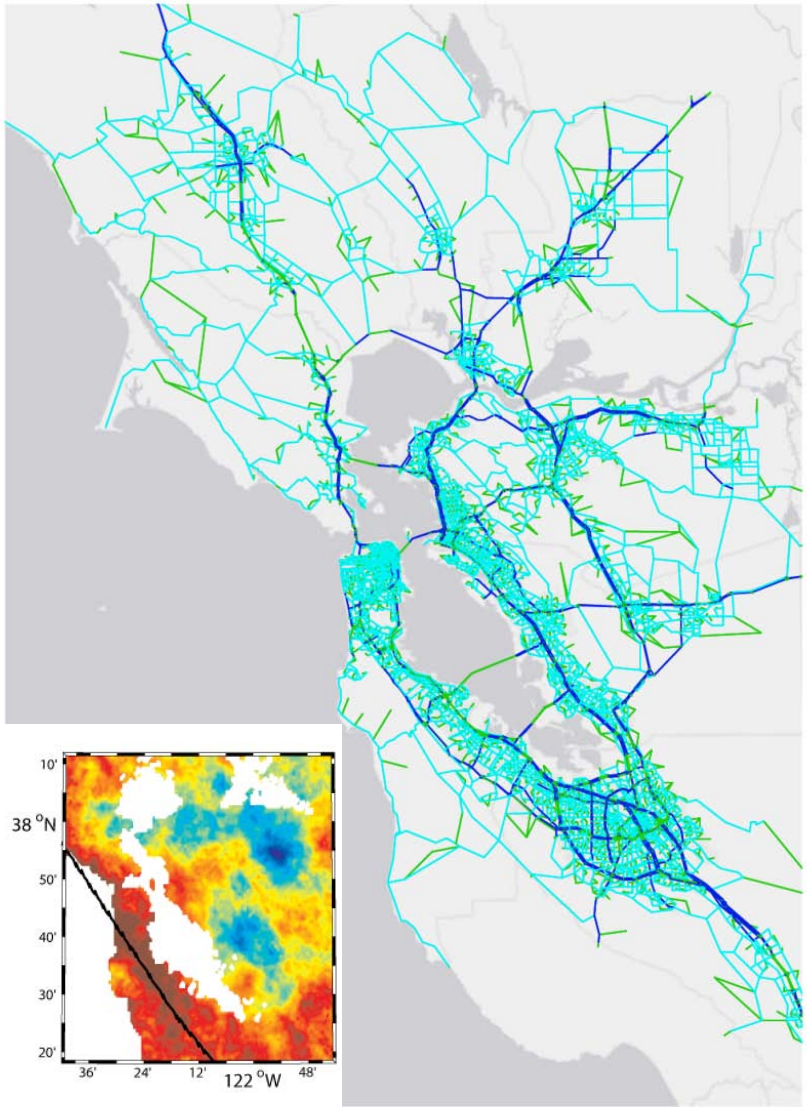
Damage to buried infrastructure is sensitive to near-surface localized displacements, or ground strains at off-fault locations.

Implications for shallow on-fault displacement models?

From O'Rourke and colleagues, NEES

Understanding interactions in damage to infrastructure systems





Miller and Baker (2012)

Reducing epistemic uncertainties for critical infrastructure risk

	Aleatory	Epistemic	Required Dataset
Ergodic (on soil surface)	$\phi_{0,G}$, τ_0, ϕ_{Amp}, ϕ_{S2S}, ϕ_{P2P}, τ_{L2L}		Global: Multiple recordings at different sites (on soil surface) from earthquakes in multiple source regions
Fully non-ergodic (single-path on soil surface)	$\phi_{0,G}$, ϕ_{Amp}, τ_0	ϕ_{S2S}, ϕ_{P2P}, τ_{L2L}	Path-specific on soil surface: Multiple recordings at one site (on soil surface) from earthquakes in one location
Partly non-ergodic (single-site on soil surface)	ϕ_{P2P}, $\phi_{0,G}$, ϕ_{Amp}, τ_{L2L}, τ_0	ϕ_{S2S}	Site-specific: Multiple recordings at one site (on soil surface) from earthquakes located in different source regions
Partly non-ergodic (single-site on baserock)	ϕ_{P2P}, $\phi_{0,B}$, τ_{L2L}, τ_0	ϕ_{B2B}	Baserock-specific: Multiple recordings at one site (on baserock) from earthquakes located in different source regions

From Abrahamson and colleagues

Potential research questions for SCEC5

- Can we perform analysis of infrastructure damage under suites of regional ground motion simulations (ground shaking, fault displacement, landslide, liquefaction)? How can we validate such regional-scale calculations?
- Can we use observed damage to infrastructure to validate simulated ground motions?
- Can we predict surface strains to predict damage to buried infrastructure, using spatially coherent high-frequency ground motions?
- Can surface rupture displacement simulations provide insights for vulnerability of buried infrastructure crossing faults?
- How do CyberShake-type simulations constrain site and path effects for seismic risk assessment of critical infrastructure?
- Do insights from the above questions provide support for engineering research initiatives around the concept of community resilience?
- How can we obtain realistic spatially distributed high-frequency ground motion needed for studying the vulnerability of infrastructure systems?
- Can the deterministic basis of CyberShake-type simulations for the low-frequency range be extended to higher frequencies to reduce the epistemic uncertainty of the spatial and temporal distribution of ground motion?