



Earthquakes ★ Floods ★ Hurricanes ★ Landslides ★ Tsunamis ★ Volcanoes ★ Wildfires

The Great Southern California
Shake Out

ShakeOut Earthquake Scenario

Source Description, Surface Faulting,
and Simulated Ground Motions

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U. S. Geological Survey



School Seismic Safety Seminar
Commemorating the Field Act's 75th Anniv.
Long Beach, California
10 April 2008



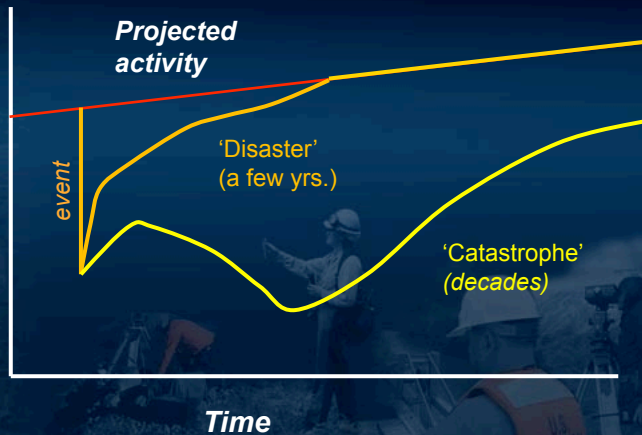
U.S. Department of the Interior
U.S. Geological Survey



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For one specific natural hazard event:

Economic Activity



A San Andreas “Big One” is *far* bigger than Northridge 1994

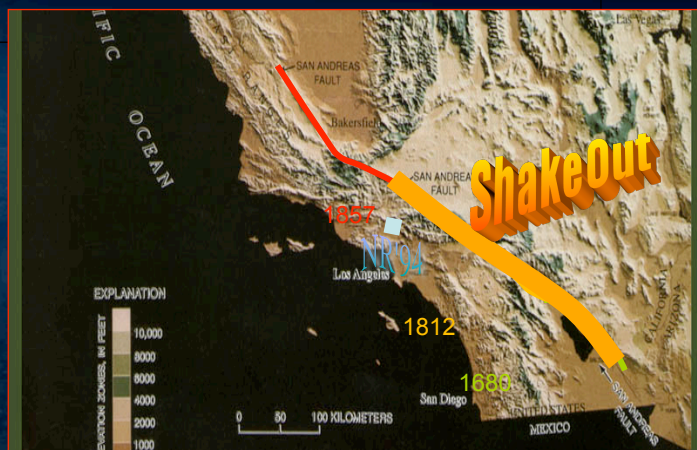
What is meant by “Big One” exactly...?

- fault length is 300 km (15 x)
- rupture duration is 90 sec (10 x)
- shaking duration is 180 sec (15 x)

M 7.8 “great” >> M 6.7
amplitude (15 x) & energy (~30 x)

ShakeOut Scenario Earthquake

- Not a prediction - a plausible event
- First step: define the rupture length



Possible early/pre-historic earthquake rupture correlations:

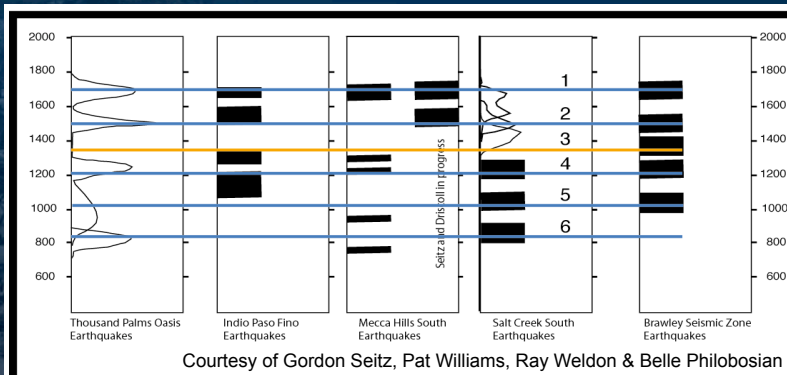
- Conservative correlations result in **6 events in 1200 years**
- Recurrence Interval ~150 years without latest 'open' interval
- Currently, elapsed time of ~ 300 years appears longer than any previous recurrence interval

Digging deep into the San Andreas fault, because the past may be the key to the future



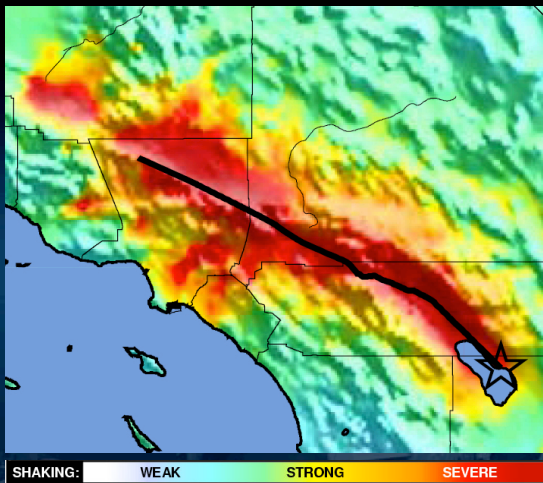
A call for the most reliable data: Hard data versus soft data

Examples: SoSAFE Project, B4 LiDAR project on San Andreas, multi-investigator trench studies



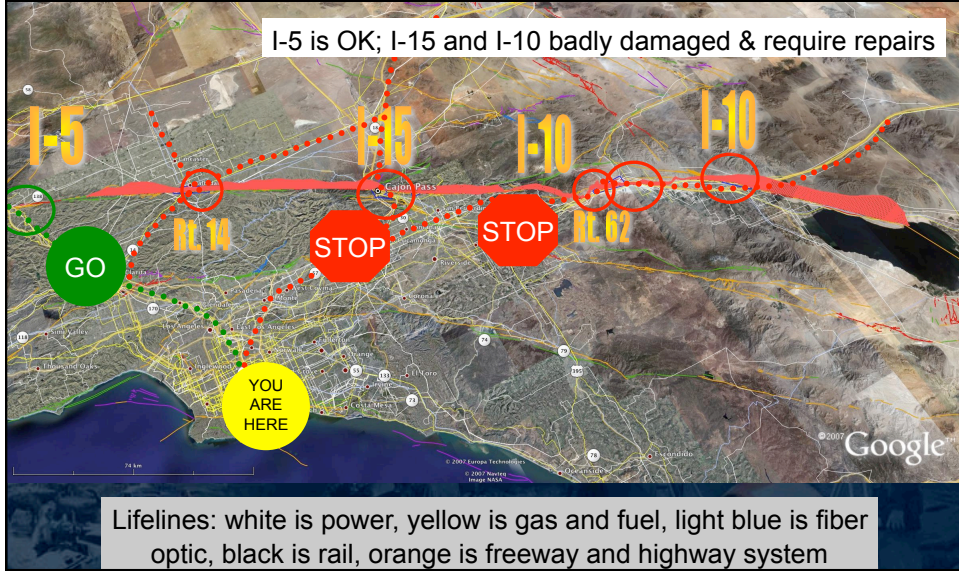
M_w 7.8 'ShakeOut' Scenario (GG'08 Nov. 13, 2008)

- San Andreas 'Really Big One' simulated earthquake
- Initiation near Bombay Beach (unilateral rupture to the NW)
- Disruption of critical lifeline infrastructure (freeway, internet, power and gas lines) along surface rupture; Slip of 3-4 meters at Cajon Pass (I-15)
- Strong shaking throughout the region, including urban areas

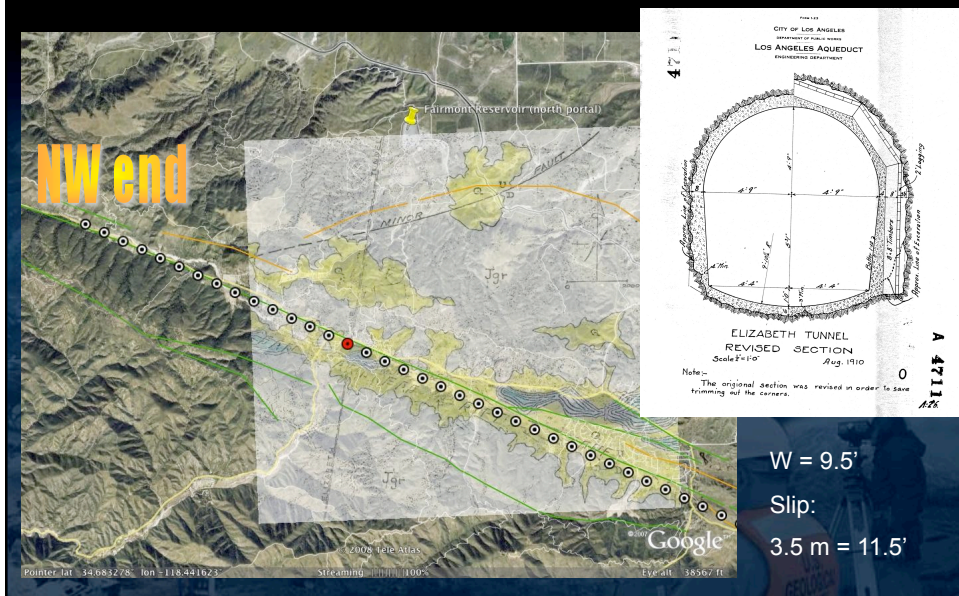


Surface Slip and Modified Mercalli Intensities for ShakeOut scenario earthquake
 Credit: Rob Graves (SCEC-CME; URS / USC) Brad Aagaard (USGS); ShakeMap
 Integration thanks to Vince Quitoriano (USGS) and Wan Lin (USGS)

Caltrans freeways and critical lifeline infrastructure fault crossings



Elizabeth Lake Tunnel (LADWP)



Cajon Pass Lifelines



Rupture unzips SE to NW, taking 90 seconds;
Shaking lasts >3 min.'s in LA & Ventura

 National Science Foundation
WHERE DISCOVERIES BEGIN
Southern California Earthquake Center





Tall Buildings



Kobe, 1995



Mexico City, 1985

Carefully modeled ground motions and had expert structural engineers assess potential damage:

- Pre-1994 welded steel moment frame
- Non-ductile reinforced concrete moment frame

And, of course...

- Un-Reinforced Masonry, e.g., San Bernardino

Structural Engineering tall building panelists' expert* opinion:

Given the ShakeOut earthquake scenario ground motions:

The fact that there were no collapses in previous US earthquakes cannot be taken as evidence that there would not be collapses in this scenario. In fact, the *possibility of some collapses is quite credible.*

- * • Ron Hamburger (Simpson Gumpertz and Heger, San Francisco)
- Jim Malley (Degenkolb Engineers, San Francisco)
- Greg Deierlein (Stanford University)
- Swaminathan Krishnan (Caltech)
- Organizer: Keith Porter (Univ. of Colorado and SPA, Boulder)

Onset and Duration of Shaking

Location	Seconds after start of earthquake that strong shaking begins at this location	Seconds after start of earthquake that strong shaking ends at this location	Duration of very strong shaking
Palm Springs	25	60	35 sec
San Bernardino	45	75	30 sec
Los Angeles (downtown)	70	125	55 sec
Orange County	70	105	35 sec
Santa Monica	85	150	65 sec
Palmdale	75	90	15 sec
Ventura	105	160	55 sec

M 7.8 'ShakeOut' - Special Concerns for Schools

Building Safety Review - Field Act

Drinking Water & Food Supplies, Shelter

Anchoring of TV's, Computers, etc.

Student Pick-up Process:

Transportation disruption severe - are parents commuters?

Can you provide overnight shelter just in case for students?

Communications - Internet & Cell phones?

ShakeCast - USGS Damage Assessment Tool
for use by District Offices