

The Great
Southern California
**Shake
Out**

November 12–16, 2008

Get Ready to ShakeOut!

Mark Benthien
Southern California Earthquake Center &
Earthquake Country Alliance



Earthquake Country Alliance
We're all in this together.

Southern California Earthquake Center

SC/EC
an NSF + USGS center

- Involves 600+ scientists at 65 institutions worldwide. Headquartered at USC.
- Focuses on earthquake system science using Southern California as a natural laboratory
- Translates basic research into practical products for earthquake risk reduction

SCEC Mission Statement

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graph LR
    A[Gather data on earthquakes in Southern California and elsewhere] --> B[Integrate information into a comprehensive, physics-based understanding of earthquake phenomena]
    B --> C[Communicate understanding to society at large as useful knowledge for reducing earthquake risk]
  
```

**Shake
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Earthquake Country Alliance

- Partnership of leading earthquake professionals, emergency managers, government officials, business and community leaders, and others.
- Partners include the USGS, FEMA, SCEC, American Red Cross, California Geological Survey, California Office of Emergency Services, California Earthquake Authority, Southern California Association of Governments, County of Los Angeles, City of Los Angeles, Caltech, UCLA, USC, Quakehold, and many others.
- **Mission**
The Earthquake Country Alliance unites leaders in government, disaster response, science, business, media, education and local communities to:
 - inspire responsibility for community earthquake safety and recovery;
 - increase awareness, preparedness, mitigation;
 - improve response and recovery planning;
 - reduce losses in future earthquakes.



Earthquake Country Alliance
We're all in this together.

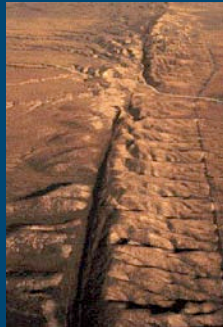
**Shake
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Objectives of this discussion

- Share with you the latest understanding of our earthquake hazards
- Provide you with earthquake safety resources and information.
- Invite you to join in the “ShakeOut”

**Shake
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The San Andreas - it's all our fault



Let's Talk About Our Faults



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Major Southern California faults in 3D

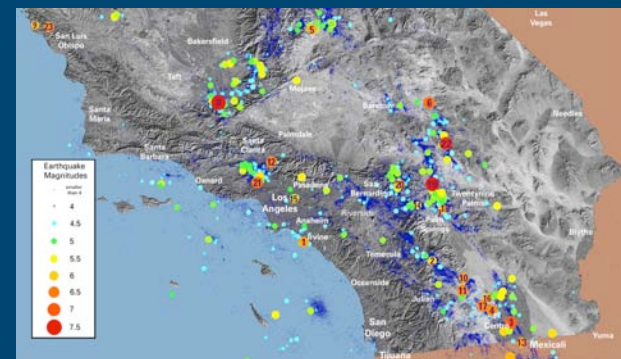
SC/EC
an NSF + USGS center
**Community Fault
Model**

The Puente Hills fault:

- Four large earthquakes in the last 10,000 years.
- A potential 7.5 magnitude earthquake on this fault will cause great devastation.
- These earthquakes occur much less frequently than San Andreas earthquakes.

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Southern California is Earthquake Country



There are over 30 earthquakes
a day in Southern California

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Northridge earthquake

- Jan. 17, 1994
- Magnitude 6.7
- 10x10 mile section of fault moved, all underground, from Southeast to Northwest
- \$40 billion
- 33+ deaths



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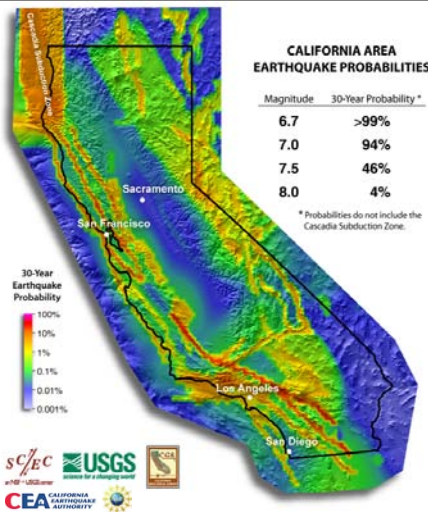
Uniform California Earthquake Rupture Forecast

UCERF Ingredients

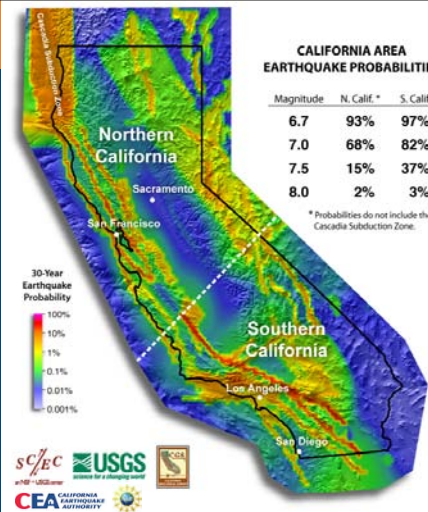
by Kevin Milner & Ned Field
using SCEC-VDO



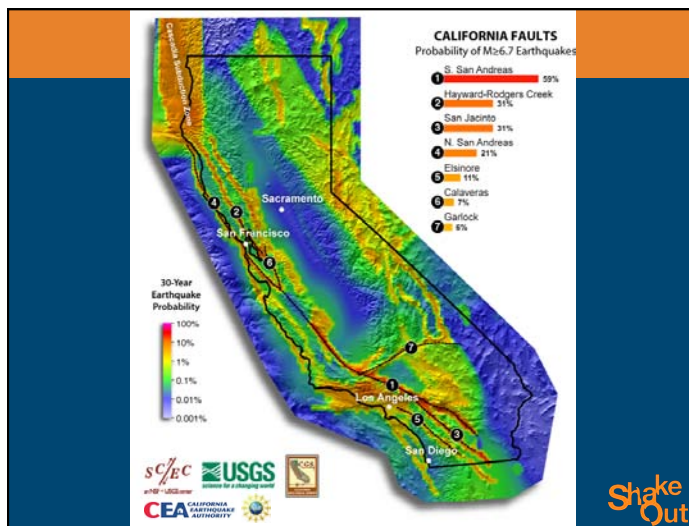
Shake Out



Shake Out

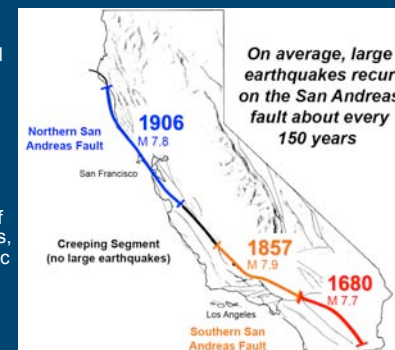


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The Next “Big One?”

- USGS Multihazard Demonstration program initial project: Comprehensive San Andreas fault scenario
- Not a prediction - but a plausible event
- Dr. Lucy Jones led a group of over 300 scientists, engineers, and others to create a realistic picture of what will happen.



ShakeOut Scenario Authors

- Lucy Jones, Chief Scientist
- Dale Cox, Project Manager
- Suzanne Perry, Staff Scientist

Urbanearth.usgs.gov

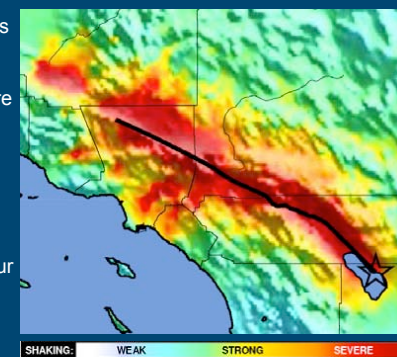
- Earthquake Scenario Coordinators:
 - Dan Ponti, Anne Wein, Rich Bernknopf, and Ken Hudnut (all at USGS), Mike Reichle and Jerry Treiman (CGS), Keith Porter and Dennis Milette (Univ. of Colorado), Jim Goltz (OES), Hope Seligson (MMI Eng.), and Kim Shoaf (UCLA)
- ShakeOut Earthquake Contributors - Source Description, Surface Faulting and Ground Motions:
 - Brad Aagaard and Ned Field (USGS), Rob Graves* (URS), Lisa Star and Jonathan Stewart (UCLA), Thomas Jordan*, Gideon Juve*, Philip Maechling*, David Okaya*, Scott Callaghan* (USC), Jacobo Bielak*, Ricardo Taborda*, Leonardo Ramirez-Guzman*, Julio Lopez*, and David O'Hallaron* (CMU) and John Urbanic* (PSC), Geoff Ely* (SDSU/UCSD), Kim Olsen*, Luis Dalguer* and Steve Day* (SDSU), Yifeng Cui*, Jing Zhu*, Timothy Kaiser*, Amit Chourasia*, and Reagan Moore* (SDSC), Chen Ji (UCSB), Swami Krishnan, Matt Muto and Jeroen Tromp (Caltech)

* participant in the SCEC/CME collaboration, funded by the National Science Foundation

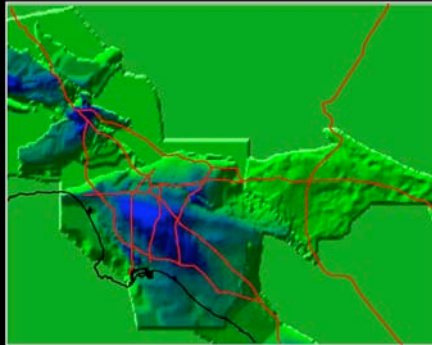
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The Next “Big One?”

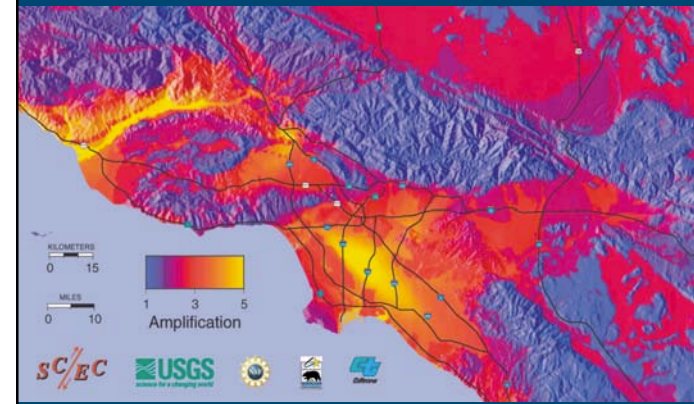
- Southernmost San Andreas
- 300 km (180 mi)
- Magnitude 7.8
- 100 seconds of fault rupture
- Ground shaking for 2 minutes!
- Strong shaking in the LA area due to thick sediments that amplify shaking
- This will likely happen in our lifetimes, and could actually happen today.



Sediment-filled valleys amplify shaking



Sediment-filled valleys amplify shaking

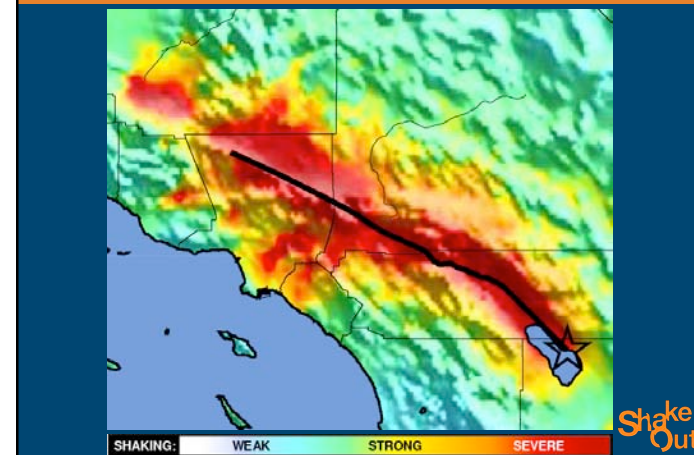


Rupture unzips SE to NW, taking 90 seconds;
Shaking lasts >3 min.'s in LA & Ventura

National Science Foundation
WHERE DISCOVERY BEGINS
Southern California Earthquake Center



ShakeOut Scenario ShakeMap



Fault Offset



Landers, California M 7.3 - 1992 earthquake; ~1 meter (3 feet) offset

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Big Fault Offset!



Wairarapa fault, New Zealand - 1855 earthquake; ~18 meter (54 feet) right-lateral offset

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Lifelines will be Severed along the Fault

- Water
- Electricity
- Gas
- Fiber Optics
- Telecommunications
- Railroads
- Interstate Highways

Cajon
Pass



**What will we do
when these items
are unavailable?**

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Damages

Earth-science effects given to 19 study groups:

- Expert panel, research team, & combinations
 - 1 HAZUS analysis
 - 4 studies of particular building types
 - 10 lifeline studies
 - 4 other studies

Earth sciences

Each groups hypothesized realistic damages

- Informed by computer models
- Grounded in historic evidence
- Acknowledge need to extrapolate from past experience and limited analysis
- Identify what can be done and what new knowledge is needed to lessen impacts

Physical damage

Societal impacts

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Buildings

- 300,000 significantly damaged (1 in 16)
 - Significant: repairs cost at least 10% of replacement cost
- 45,000 complete losses (1%)
- Most dangerous:
 - Brick
 - Older concrete
- Most numerous:
 - Older wood
- Less dangerous:
 - Steel buildings built before 1994

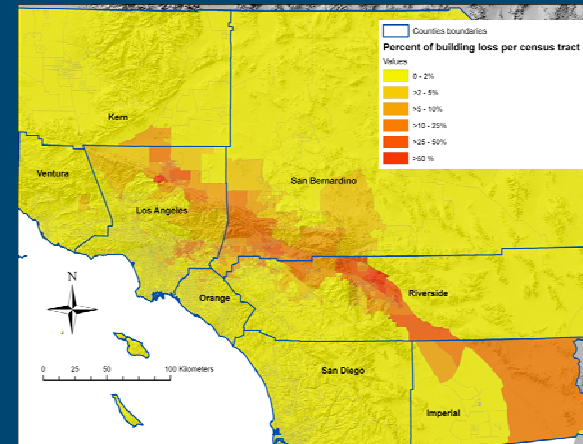


1933 Long Beach, CA



1994 Northridge CA

Percent of buildings lost



Woodframe Buildings

- Most SoCal housing is wood
- Extensive damage in past earthquakes
- Common damage:
 - Poorly anchored to foundation
 - Weak cripple walls
 - Soft story (e.g., tuckunder parking)
 - Rely on stucco & gyp board
 - Brick & stone chimneys
 - Poorly anchored brick veneer
 - Landslides
- Scenario: 175,000 wood buildings significantly damaged (1 in 25)



1992 M7.1
Mendocino



1989 M7.1
Loma Prieta

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Older Reinforced Concrete

- Older construction has less rebar, can lead to collapse
- Concrete construction has improved since 1970s, but older buildings still remain
 - 1000s of low- and midrise buildings of this type
 - 10s of highrise buildings of this type
- ShakeOut analysis:
 - 50 collapses
 - 5,000 – 10,000 people in collapsed buildings
 - 100 red tagged buildings



1971 San Fernando



1994 Northridge

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Highrise Steelframe Buildings

- Connections fractured in Northridge Earthquake
- In Kobe (1995), 10s of steel buildings collapsed.
- 600+ such buildings in study area
- Expert panel reviewed Caltech findings:
 - "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."
- Scenario: 5 collapses
 - 11-15 stories, 200,000-300,000 square feet
 - Up to 1,000 occupants each
 - 10 red tags
 - 20 yellow tags



Downtown Los Angeles



Kobe, Japan 1995

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Infrastructure Damage

Closer look at important lifelines

Telecommunications
(ASCE TCLEE: Alex Tang)

Rail
(ASCE TCLEE: Bill Byers)

Highways
(Panel + REDARS Group)

Mass transit
(Panel)

Ports of LA & Long Beach
(OU Boulder + panel)

Water supply
(Panel)

Wastewater
(Panel)

Dams
(Panel)

Surface streets
(Panel)

Electric Power
(Panel)

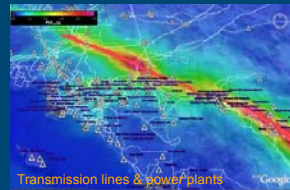
Oil and gas pipelines
(MMI Engineering + panel)

Hospitals
(ASCE TCLEE: Mark Pickett)

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Electric Power

- Panel of 10 experts from 5 agencies find:
 - Immediate loss of power throughout region
 - Collapse of some high-tension towers, damage to transformers on overhead poles
 - Generating plants taken offline for inspection
- LA, Riverside, & San Bernardino Counties:
 - 30-50% of service restored in 24 hrs
 - 75-90% restored in 3 days
 - ~100% restored within 1-4 months
- Ventura, Orange, & Imperial Counties:
 - 90% restored in 2 days
- Kern & San Diego Counties:
 - 90% restored in 24 hr



Transmission lines & power plants



1971 San Fernando Earthquake

Water Supply

- Aqueducts & tunnels cross the fault in several places
- Also sensitive to landslide & liquefaction
- Older pipes damageable by shaking, liquefaction, ...
 - Some LA water & sewer pipe is 100+ yr old
- Groundwater supply needs power, pumps, tanks, and other damageable equipment



1971 San Fernando Earthquake



1994 Northridge Earthquake

Water Supply

Expert panel: 19 representatives from 8 agencies

- Within 10 miles of fault & isolated areas: damage impairs supply for up to 6 months
- Throughout much of study area, 50% of customers lose service for up to 1 week
 - Loss of power, damage to pumps, tanks, etc.
- In Los Angeles, Riverside, San Bernardino Counties, 5% of customers lose service for 1-8 weeks



Fire Following Earthquake

- 1,600 ignitions requiring a fire engine
- 1,200 exceed capability of 1st engine
- Orange County & LA basin: dozens of large fires merge into conflagrations destroying 100s of blocks
- 200 million square feet burnt
≈ 133,000 single family dwellings
- Property loss: \$65 billion
- No Santa Ana winds, *not worst case*

1989
Loma Prieta



1994
Northridge



Economic losses

Indicator	Total Impacts (billions)
Building Damage	\$32.7
Related Content Damage	10.6
High Rise Building Damage	2.2
Related Content Damage	0.7
Fire Damage	40.0
Related Content Damage	25.0
Highway Damage	0.4
Pipeline (water, sewer, gas) Damage	1.1
Sub-total Property Damage	112.7
Business Interruption	96.2
Relocation Costs	0.1
Traffic Delay Costs	4.3
Sub-total Additional Costs	4.4
Total	\$213.3 Billion

From executive summary: Download report at www.ShakeOut.org

Deaths and Injuries

Study by UCLA:

- 50,000 injured (to ERs)
- 1,800 killed
 - 900 from fires, 900 from shake-related building and transportation damage
 - (8,300 injured, 33 killed in 1994 Northridge Earthquake)
- Up to 2/3 of hospital beds unavailable in some counties

Evacuation of Sherris Cox, 1989 Loma Prieta earthquake



Olive View Medical Center
1971 San Fernando earthquake



Social impacts

- Emergency response
- Care and feeding
- Cultural impacts
- Out migration



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Why this is not even worse

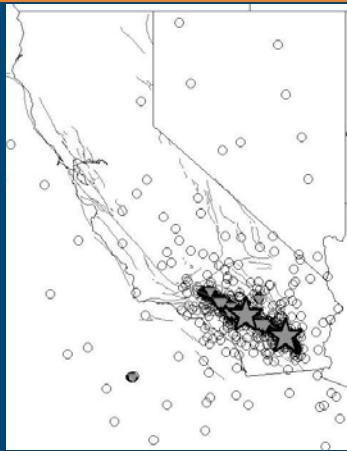
- Inherently rugged construction
- Steadily improving building codes
- Highly trained and strictly licensed engineers and contractors
- Good code enforcement
- Enormous effort to upgrade highway bridges
- Extensive seismic work done by electric power utilities

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Aftershocks will make it a bit worse

Aftershock Simulation #10

- M7.0 in Imperial County at 30 min
 - Damage in east San Diego County
- M7.2 on Cucamonga fault @ 17 hrs



It's time to get ready.

Preparing for a local disaster
(Northridge)...

...does NOT prepare us for a
potentially catastrophic event
(San Andreas)

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The Great Southern California ShakeOut

www.ShakeOut.org



The Great Southern California ShakeOut

- November 12-16, 2008
- A week of special events that will inspire southern Californians to get ready for big earthquakes
- Features a region-wide earthquake drill on Nov. 13
 - millions of participants: schools, families, community groups, business, etc.
- In association with statewide annual "Golden Guardian" emergency response exercise- largest ever this year.
- Los Angeles International Earthquake Conference
- Public Rally/Festival in downtown Los Angeles
- Hundreds of community events




Earthquake Country Alliance
We're all in this together.

ShakeOut KickOff Event, June 4




ShakeOut KickOff Event, June 4

We're All In This Together!




Goals

- Participation of at least 5 million people
 - School, Business, and Community Organization recruitment efforts will involve several millions
 - Everyone will be encouraged to "Spread the Word"
- Shift the culture and the conversation about earthquakes such that we all take greater responsibility for readiness
- Significant increase in earthquake readiness at all levels



ShakeOut Campaign Principles

Effective public education* includes these factors:

- Tailored for Diverse Groups (not one Public)
- Believable & Understandable Messages
- Consistent Messages ("Branding")
- Delivered over Diverse Channels
- "Ongoing" Coordinated Communication Stream
- Shape Risk Perceptions for Public Action
- Facilitate & Target "Milling"
- Support Actions
- Evaluate Results & Make Appropriate **Changes**

* Based on 30+ years of research by Dennis Mileti, Linda Bourque, and others)



ShakeOut Main Messages

- *Drop, Cover, Hold on*
 - Everyone must know (and practice) what to do during earthquakes
- *Secure Your Space*
 - Top heavy furniture
 - Water heaters
 - TVs & Electronics
 - Vulnerable structures
 - Etc.
- *Store More Water*
 - 1 gallon per person per day for at least 3 days and ideally up to 2 weeks
- *Have a Fire Extinguisher(s)*
 - Everyone must know proper use



www.DareToPrepare.org



www.ShakeOut.org

The Great Southern California
ShakeOut

The Great Southern California ShakeOut
November 12-16, 2008

The Great Southern California ShakeOut is a week-long series of special events organized to inspire Southern Californians to get ready for big earthquakes, and to prevent disasters from becoming catastrophes.

PARTICIPATE IN THE SHAKEOUT DRILL

Thurs, Nov. 13, 2008, 10 a.m.
Join in the country's largest-ever earthquake preparedness exercise—the Great Southern California ShakeOut Drill. [Registration](#) is free and open to everyone.

[Register Now](#)

Now take the next step—
[go beyond the Drill.](#)

BECOME A SPONSOR

ShakeOut is organized by THE EARTHQUAKE COUNTRY ALLIANCE. A public-private partnership of leading earthquake professionals, emergency managers, government agencies, businesses and community leaders. The goals of the Alliance are to educate communities on earthquake safety and recovery, increase

THE GREAT SOUTHERN CALIFORNIA SHAKEOUT IS FOR EVERYONE

Individuals
Businesses
Schools
Families
Volunteers
Community Groups

Non-Profit Organizations
Faith-Based Groups
Students
Emergency Responders
Government Agencies
Scouting Troops

ShakeOut Schedule				
12 Wednesday	13 Thursday	14 Friday	15 Saturday	16 Sunday
International Earthquake Policy Conference				
	ShakeOut Drill			
	Golden Guardian Emergency Response Exercise			
		Los Angeles Earthquake: Get Ready Rally		
		Take One More Step		



International Earthquake Conference: iec.lacity.org

Los Angeles
International Earthquake Conference

Home Conference Details Why Attend? Conference Venue Visiting L.A. Partners Contact

Register Now!

November 12 - 14, 2008

Wednesday, November 12, 2008

Before the Earthquake:

- Megacities and Earthquakes: an L.A. Story
- Life Line Security
- Messages of Preparedness & Communication
- Planning in a Seismic City
- Legislative Process
- Transportation in Earthquake Country
- How to Deal with What You Have

Thursday, November 13, 2008

- Field trips to various locations to experience the Great Southern California ShakeOut
- "Share Fair" to exchange information with the various cities present
- Gala Dinner

During the Earthquake:

The **City of Los Angeles** will host its 3-day International Earthquake Conference with a focus on Policy, Planning, & Preparedness in conjunction with the [Great Southern California Shakeout](#).

Academics, policy-makers, emergency managers, and responders from the high-earthquake-risk megacities of the world have been invited to present best practices & policies, new ideas, and cutting-edge technologies that reduce earthquake risk and minimize losses. They will discuss both policy approaches as well as present actual tools used to prepare communities and respond to disasters. All attendees will take a trip during the conference to observe different venues participating in the ShakeOut Drill on Nov. 13, such as emergency response centers, schools, major businesses, and other institutions.

Register your Participation

- Receive notification of updated information
- Receive a script for your drill
- Get connected with other participants
- Set an example for others
- Learn what else you can do to get ready

www.ShakeOut.org



ShakeOut Participation Benefits Your Business

- Opportunity to develop and practice your disaster plan
- Identify weaknesses and become a disaster resilient business
- Prepare employees at work and home

Don't be Left Out - Participate



Your Business Plan Must Include Prepared Employees

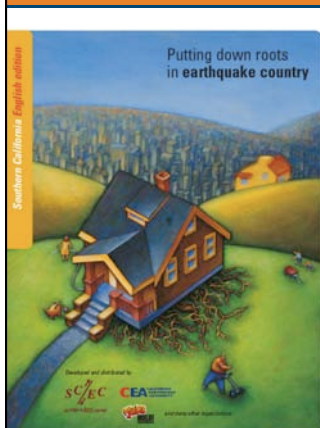
- Family Preparedness Plan
- Know where Emergency Supplies & Equipment are kept
- Up-to-date contact information
- Additional Training Opportunities (CERT-Local Fire Dept.)
- Drills
 - Evacuation
 - Drop, Cover, and Hold on
- www.DareToPrepare.org



www.DareToPrepare.org

The screenshot shows the website's layout with a sidebar on the left containing links like 'Campaign Overview', 'Secure Your Space!', 'Other Resources', 'Calendar', 'News', and 'Contact Us!'. The main content area features the 'Dare to Prepare' title, a description of the campaign, and a 'Featured News Items' section with articles about the City of Los Angeles and the San Andreas Fault.

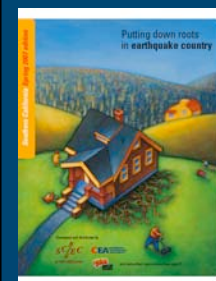
Putting Down Roots in Earthquake Country



- English and Spanish
- Earthquake science and preparedness information
- Online to read, download, or order free printed copies at www.earthquakecountry.info
- Sponsored by CEA and others



The Seven Steps to Earthquake Safety



Seven Steps image from current versions of *Putting Down Roots in Earthquake*



www.terremotos.org

¡Prepárate Hoy!

Los residentes de habla hispana del sur de California encontrarán aquí información científica sobre los terremotos y consejos prácticos sobre cómo prepararse, como parte de la campaña "¡Quiere ya prepararse!". Esta campaña está uniendo a la comunidad del sur de California para "hablar de nuestras fallas" y prepararnos juntos antes de futuros terremotos.

Este sitio se actualizará con información adicional a lo largo del 2007 -- ¡visítelo con frecuencia para obtener más consejos prácticos!

¿Por qué ahora? Hace 150 años del último gran terremoto de San Andrés en el sur de California -- un terremoto con una magnitud de 7.9 que sacudó a toda la región. Según estudios recientes, los científicos están esperando un terremoto de magnitud 7.0 o más en la parte sur de la falla de San Andrés. Un terremoto fuerte en el sur de la falla de San Andrés podría causar muchos daños a nuestros hogares y pertenencias, ocasionando lesiones serias y, quizá, hasta la muerte.

Aunque nadie puede controlar cómo se sentirá un terremoto, los residentes del sur de California pueden tomar acciones inmediatas para evitar daños considerables sujetando los objetos en sus hogares antes de que el siguiente terremoto ocurra.

Estas acciones son parte de "Los siete pasos de seguridad contra terremotos" descritos en el cuadernillo "¡Quiere ya prepararse en Tierra de Terremotos!". Siguiendo estos siete pasos, estará más seguro antes, durante y después de un terremoto.

Earthquake Country Alliance
We're all in this together

Shake Out

Spanish Newspaper Inserts

PREPÁRATE HOY Y PROTEGE A TUS SERES QUERIDOS

MITOS Y REALIDADES SOBRE LOS TERREMOTOS

HOGAR SEGURO EN TIERRA DE TERREMOTOS

Soporte por CEA

Supported by CEA

Shake Out

Shake Out

Get Ready - Secure Your Space Before Our Next Big Earthquake

Chinese **Korean** **Vietnamese**

Russian **Spanish** **Tagalog**

Secure Your...

Top Heavy Furniture

Flexible Nylon Straps

#1 BEFORE

www.DareToPrepare.org

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Secure Your...

Gas Appliances



Replace rigid gas connections to water heaters and other gas appliances, with flexible stainless-steel gas connectors.



Secure the appliance to wall studs.



Backup Plan: Keep extra flexible connectors in case of breakage and plumbers being unavailable.

#1

BEFORE

www.DareToPrepare.org

Shake Out

Fire Extinguisher(s)



- Many fires in the scenario start small and can be stopped before spreading.
 - Have a fire extinguisher at home and work.
 - Ideally, one in kitchen and one in garage.
 - Make sure everyone who lives with you knows how to use it properly.



Shake Out

Drinking Water:

1 gallon per person, per day for at least 7 days

Family of 5:
35 gallons



Need plenty at
work, in the car
and at home



Do you have enough?

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Common Building Problems

Most houses are not as safe as they could be. If your building needs the following retrofitting, consult a professional contractor or engineer.

Inadequate foundations
Unbraced cripple walls

Soft first stories
Unreinforced masonry



This cutaway diagram shows how weak cripple walls can be strengthened by properly attached plywood sheets.

#4

BEFORE

www.DareToPrepare.org

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Assessment

- Tracking participation of **individuals and families** using advance tools of a professional fundraising ("friendraising") website, capturing basic contact information and asking these questions:
 - How many people are you registering (family members or others living with you, including yourself)
 - How will you participate? (Drill at 10 a.m. on November 13, or not)
 - What will you do to get ready: Secure your space, store more water, have a fire extinguisher(s), create a disaster plan, create disaster supplies kits, other
 - What else might you do as part of the ShakeOut?
 - How many others will you invite to join the Shakeout?
- System includes "Spread the Word" and "friendraising teams" features
- Follow up survey planned to see what was actually done



Assessment

- Also tracking participation of **businesses, community groups, and schools**
 - What activities organizations are planning
 - How many employees/customers/students/etc.
 - Identifying events to announce publicly
 - Follow up surveys planned to see what was actually done
- Major statewide preparedness assessment this summer:
 - UCLA researchers
 - Funded by OES and Seismic Safety Commission
 - A follow up assessment is needed after the ShakeOut
- Proposal submitted (funding needed) by international coalition for assessment of school ShakeOut activities and results



Help us make history.

The Great
Southern California
**Shake
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www.ShakeOut.org



Sponsorship Opportunities

- Sponsors will have visibility among businesses, community groups, elected officials, government agencies, and the general public in all So Cal Counties
- Approximately \$2 million needed (financial and in-kind contributions welcomed)
- Sponsors will support events, materials, web/email resources, etc.:
 - Large public awareness media campaign including traditional PSAs and advertising, online social networking (myspace, etc.), "viral" emails, printed materials, and more, to build participation.
 - ShakeOut "friends asking friends" registration system
 - City of Los Angeles International Earthquake Conference
 - Get Ready Rally
 - "Take One More Step" – Local school and community preparedness events



Sponsors as of June 10

- U.S. Geological Survey
- National Science Foundation/ SCEC
- Federal Emergency Management Agency
- California Office of Emergency Management
- State Farm
- Dewberry
- Degenkolb
- City of Los Angeles
- Provention Consortium
- Earthquakes and Megacities Initiative
- Los Angeles Dept. of Water and Power
- Commitments in process
 - Ralphs Grocery
 - Kaiser Permanente
 - Home Depot
 - Time Warner Cable
 - Many others



Sponsorship Opportunities

Components of the *ShakeOut* can be supported individually, or sponsors can provide support for all aspects. Benefits for the following sponsorship levels are described in the Sponsorship document and online at www.shakeout.org/sponsorinfo

- | | | |
|----------------------|-----------|------------------------------------|
| • Presenting Sponsor | \$500,000 | (limited to one) |
| • Diamond Sponsors | \$250,000 | (limited to four) |
| • Platinum Sponsors | \$100,000 | |
| • Gold Sponsors | \$ 50,000 | |
| • Silver Sponsors | \$ 25,000 | Choose from <i>a la carte</i> menu |
| • Bronze Sponsors | \$ 10,000 | |



Thank you!

Mark Benthien
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 213-926-1683

