



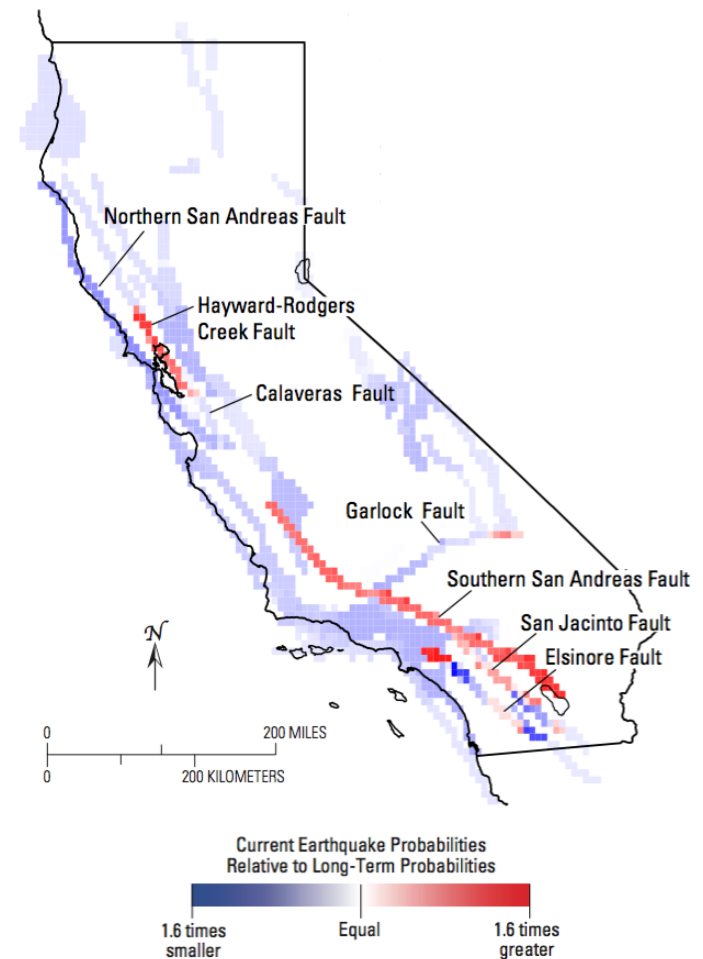
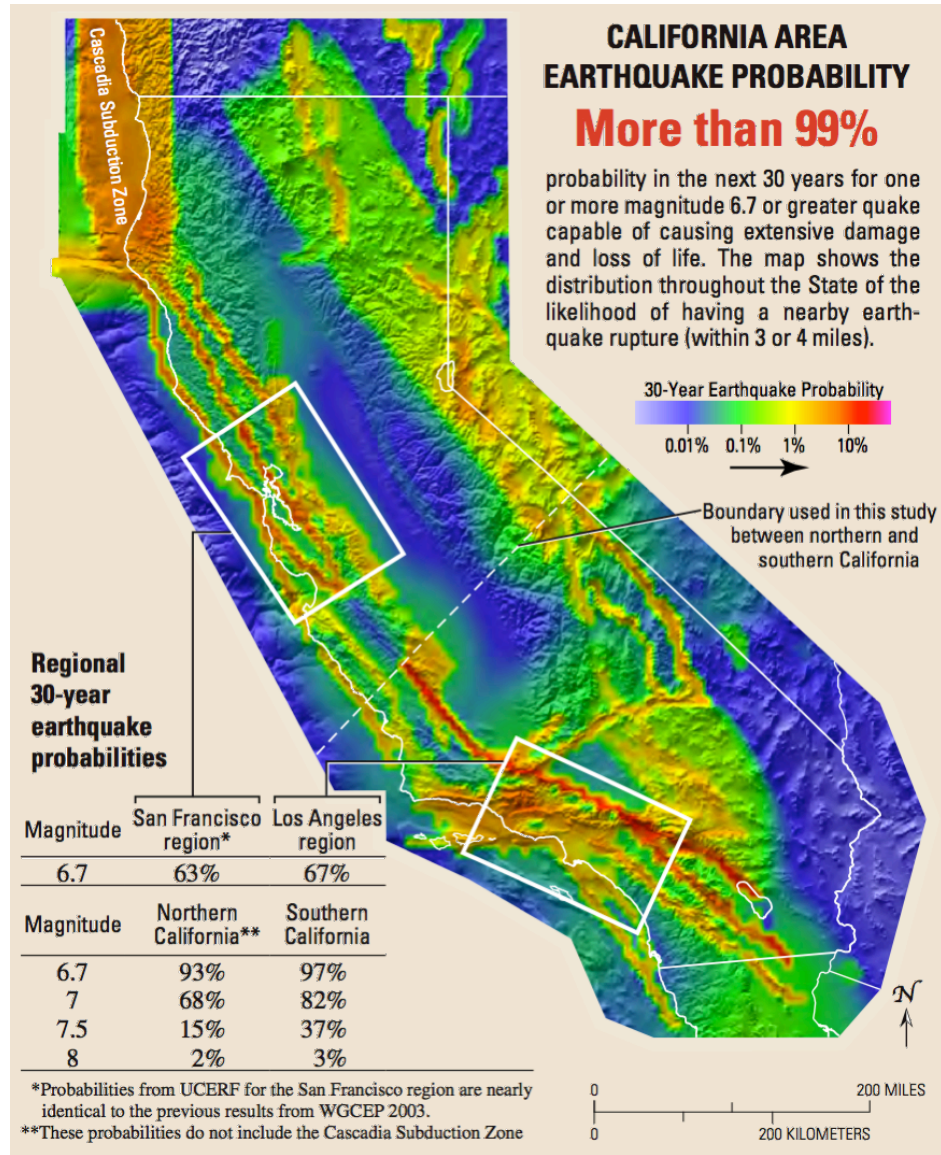
Delivering earthquake warnings to California

Richard Allen

Berkeley Seismological Laboratory

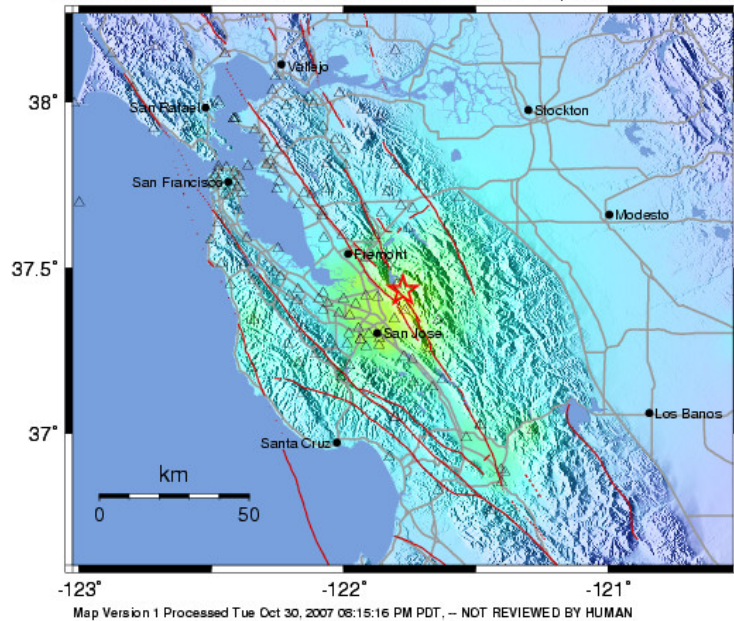


California's earthquake problem



UCERF 2008 – USGS, CGS, SCEC

What is Earthquake Early Warning?



Today: ShakeMap
in 8-10 minutes

Current realtime earthquake information

- location
- magnitude
- ground shaking distribution



Soon: AlertMap
seconds to tens of seconds
before shaking

- people move to safe zone (under table)
- slow and stop trains (BART)
- isolate hazards (equipment, chemicals)

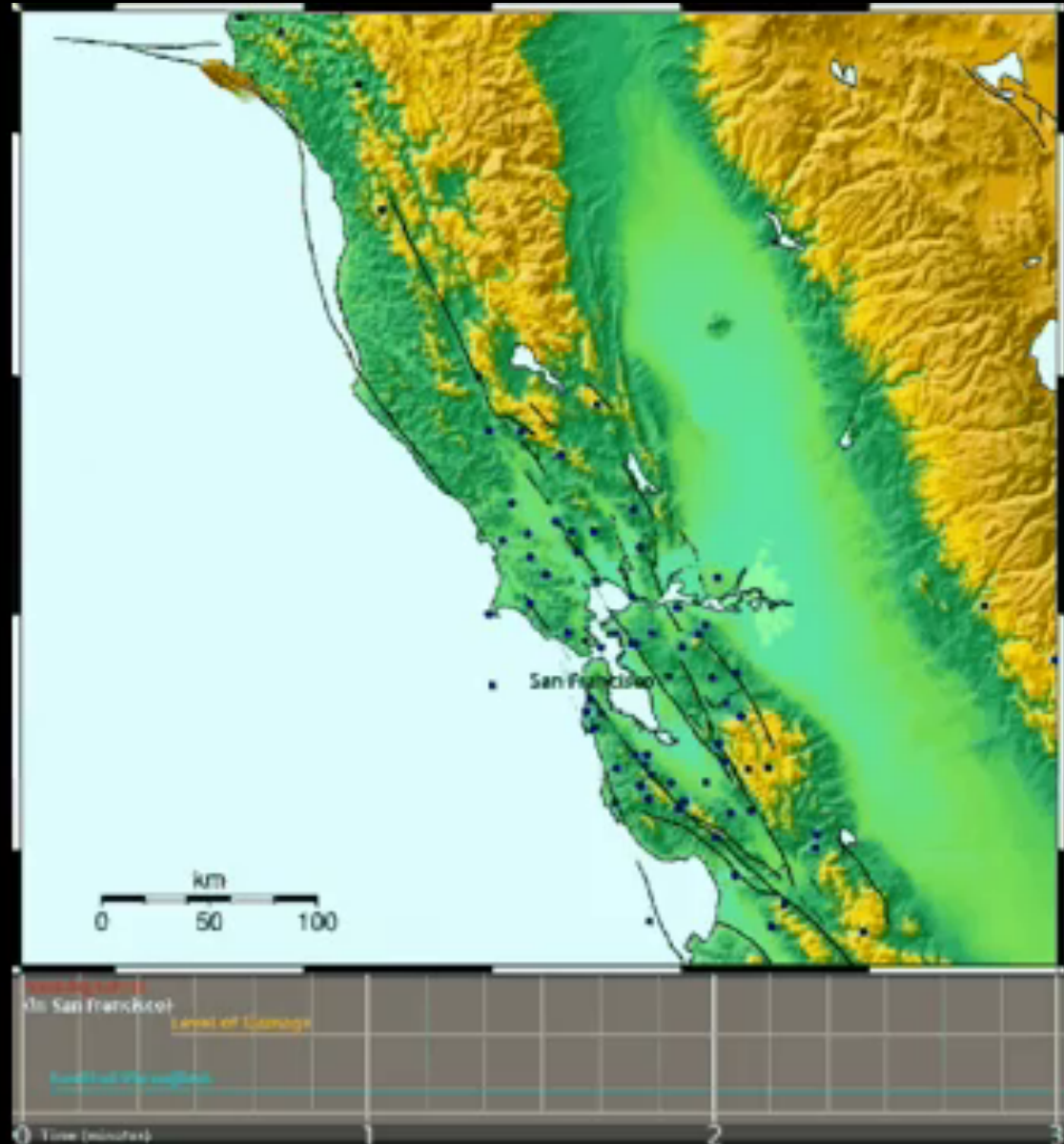
new science + modern communications

Warning timeline

Realtime animation:
Magnitude 8 on the
San Andreas fault

→ The most
damaging
earthquake for
the Bay Area

→ ~1 min warning



YouTube: <http://www.youtube.com/watch?v=Qf9DeYBlwMI>

Download mp4: http://seismo.berkeley.edu/~rallen/research/WarningsInJapan/SanAndreasFromNorth_v2_bb.mp4

The magnitude 9

Tohoku-oki, Japan earthquake

March 11, 2011

Japan's earthquake warning system

Automated TV warning

Studio in **Tokyo**



March 11, 2011

YouTube: <http://www.youtube.com/watch?v=rU1bYspMyQw>

Download mp4: http://seismo.berkeley.edu/~rallen/research/WarningsInJapan/TVwarningNHK_wSubtitles.mp4

Japan

Communicating the warning

TV and radio announcements

- 124 of 127 TV stations (98%)
- 41 AM, 35 FM radio (75%)

J-Alert messages

- 226 municipalities receive the warnings
- 102 announce them with public address systems

Cell phones

- 3 companies (Docomo, AU, Softbank)
- 52 million can receive them (47%)

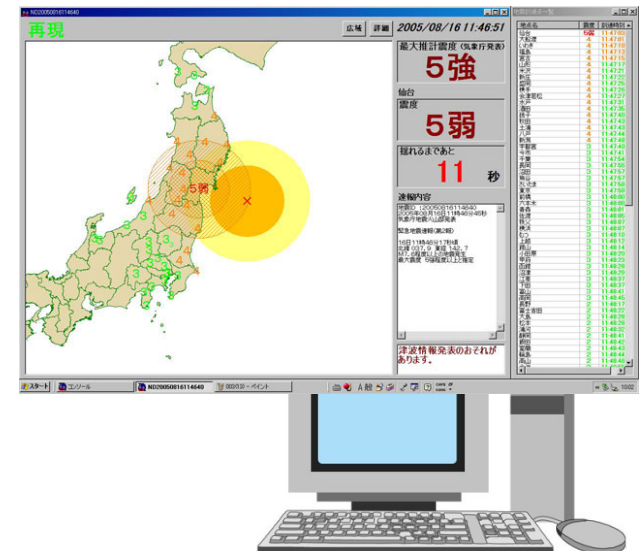
Dedicated providers serve

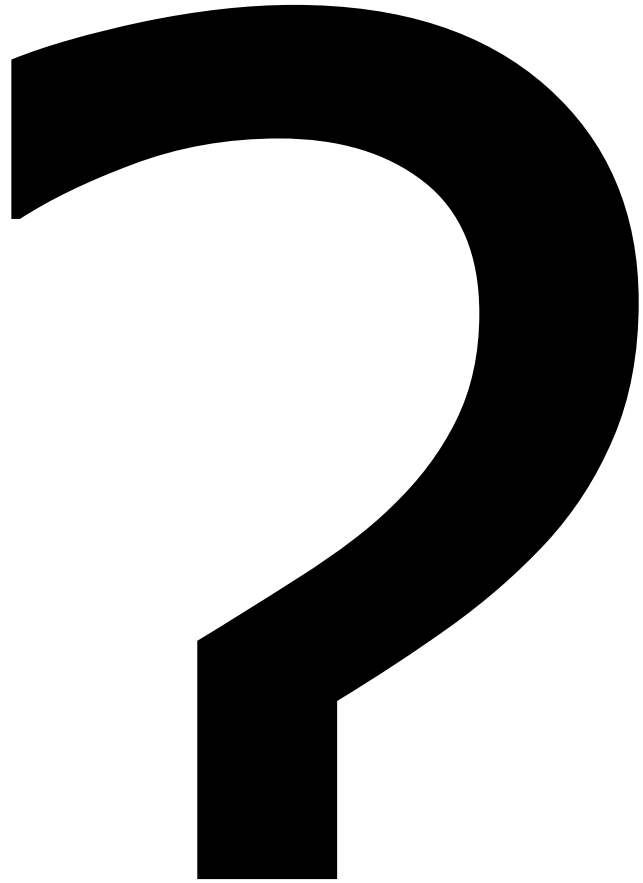
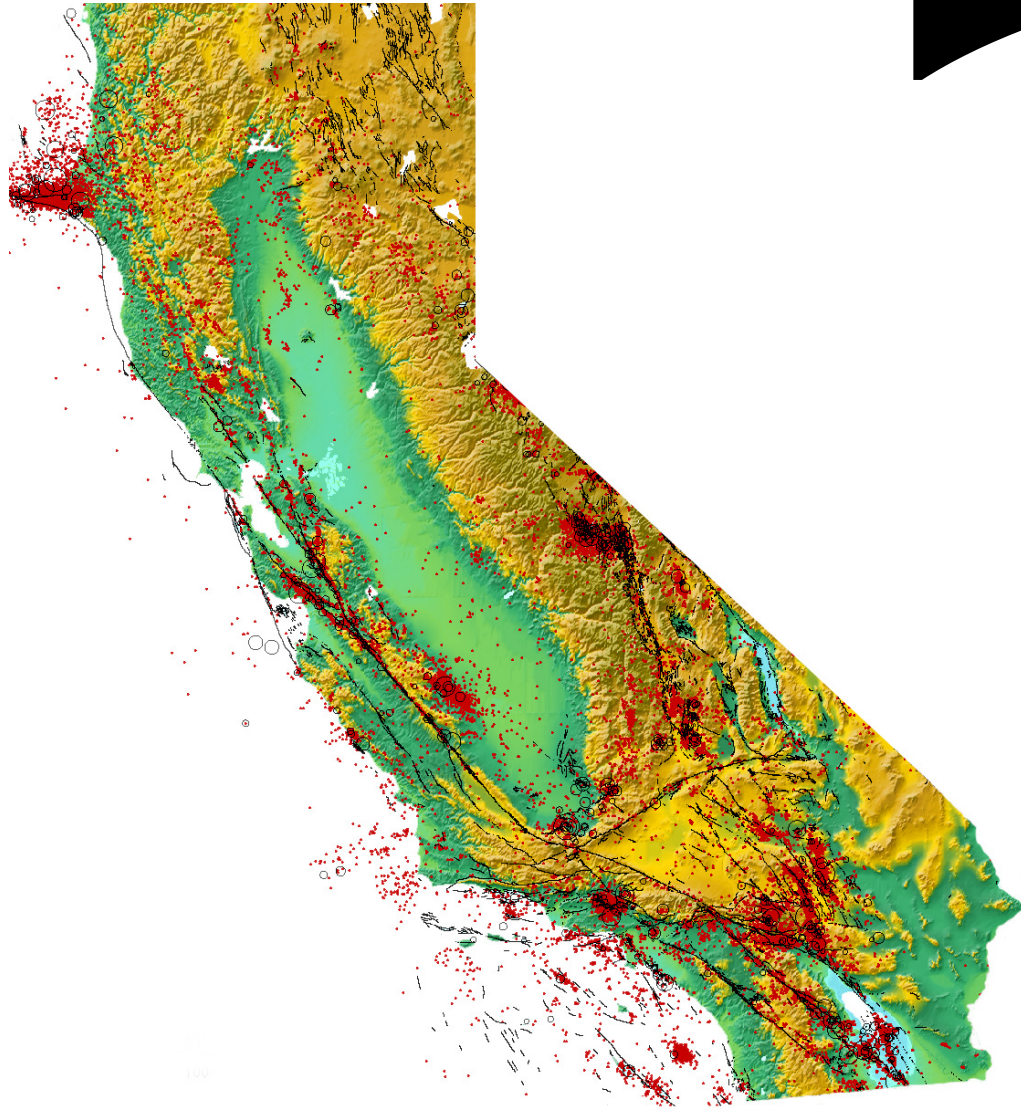
- power plants
- factories
- schools
- hospitals
- shopping malls



earthquake
location and
hazard

estimated
shaking in your
area







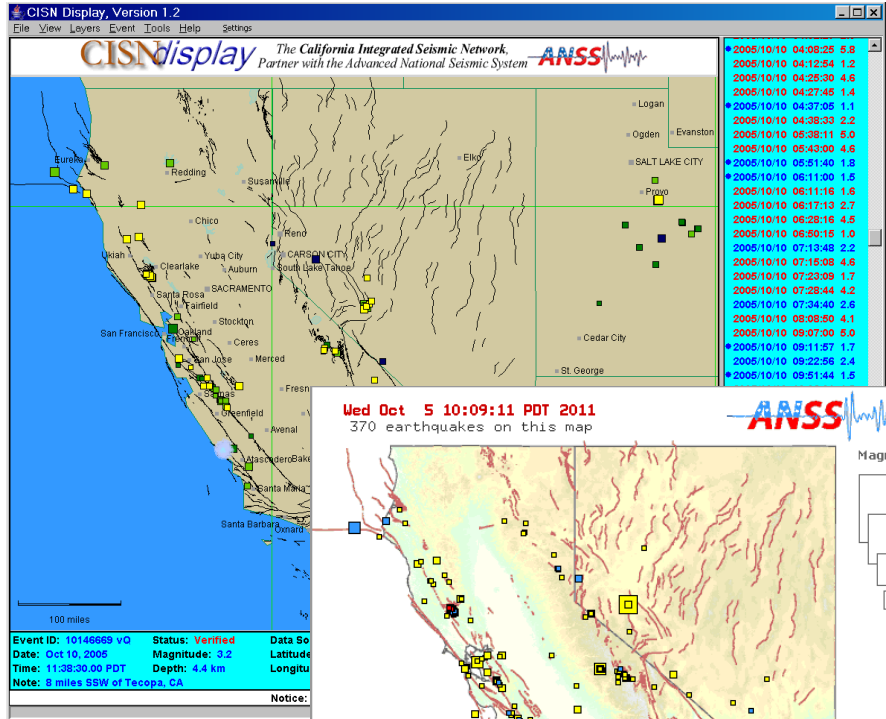
70 geophysical observatories across northern California...



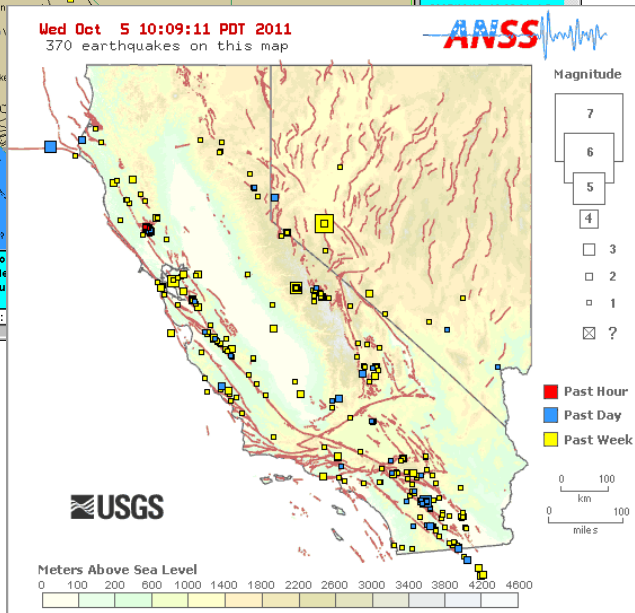
Download mov: <http://seismo.berkeley.edu/~rallen/images/bsl/BSIoverview-lab-seismi-MOBB-GPS-borehole-30sec.mov>



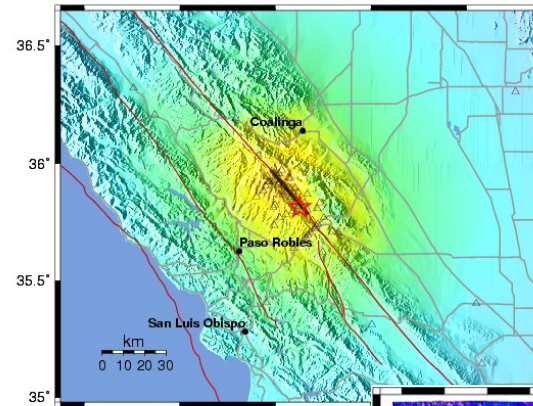
Delivering real-time earthquake information through the USGS...



Real-time earthquake information and notification



CISN Rapid Instrumental Intensity Map for Parkfield Earthquake
 Tue Sep 28, 2004 10:15:24 AM PDT M 6.0 N35.81 W120.37 Depth: 7.9km ID:51147892

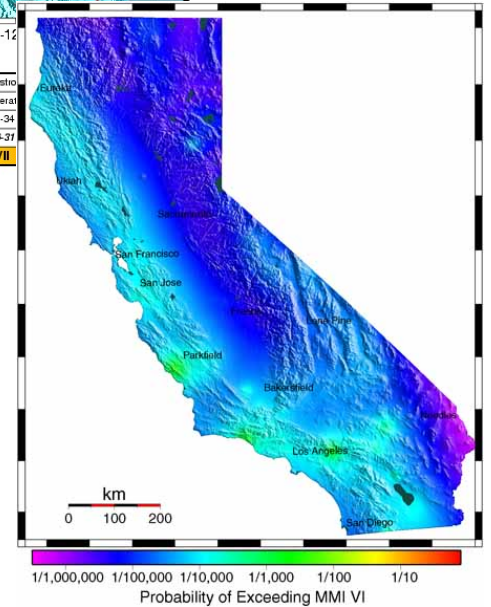


**ShakeMaps
ShakeCast**

Processed: Fri Oct 8, 2004 12:55:49 PM PDT.

	Not felt	Weak	Light	Moderate	Strong	Very strong
PERCEIVED SHAKING	none	none	none	Very light	Light	Moderate
POTENTIAL DAMAGE	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34
PEAK ACC (m/s²)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31
PEAK VEL (cm/s)		I	II-III	IV	V	VI
INSTRUMENTAL INTENSITY					VI	VII

Daily earthquake and aftershock forecasts



Shake/Alert

Progress toward California's

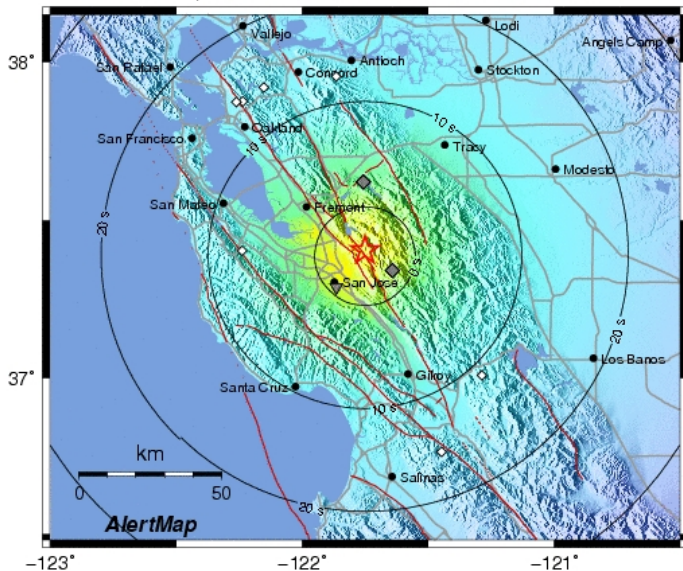
Aug 2006 – Aug 2009: USGS funds...

Phase I: Development and testing of realtime algorithms

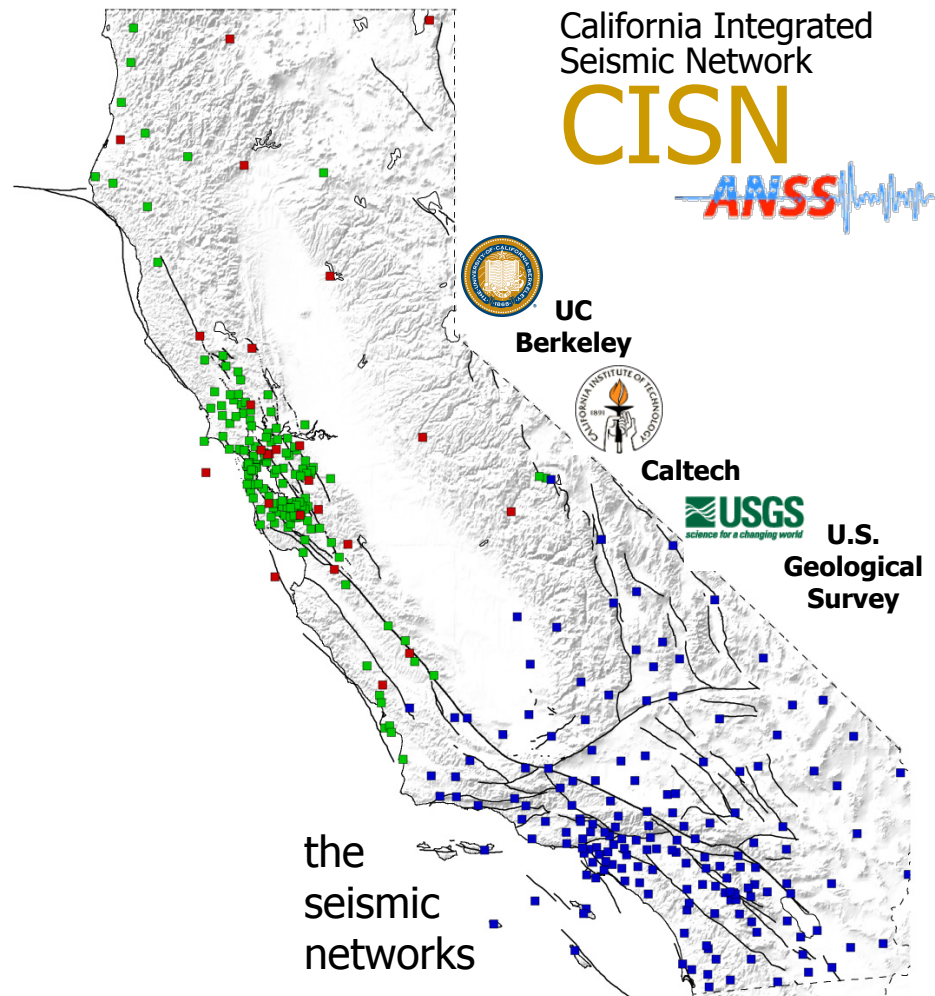
Parallel statewide testing of multiple methodologies

1st Proof of concept event:
Warning before the shaking in San Francisco

AlarmS Real-Time Hazard Map: Modified Mercalli Intensity
2007/10/31, 03:05:00 UTC — Event detected: N37.40 W121.75 M 5.2



Alum Rock earthquake
M_w 5.4, October 30, 2007



Shake/Alert

Progress toward California's

Aug 2006 – Aug 2009: USGS funds...

Phase I: Development and testing of realtime algorithms

Parallel statewide testing of multiple methodologies

Aug 2009 – Aug 2012: USGS funds...

Phase II: Implementation of an end-to-end test system

A single CISM early warning output to a group of test users

Upgrade of station hardware for faster delivery

Right now: Looking for early-adopters

Possible user groups

- transportation
- industrial sites
- public sector
- schools



Inbox — CalMail (1202 messages, 191 unread)

Get Mail

MAILBOXES

- Inbox
- CalMail (131)
- rallen10@gmail
- MobilMe (16448)
- Drafts (3)
- Sent
- Trash (5)

REMINDERS

- Notes
- To Do (11)

ON MY MAC

- 2011
- EqMsg (1720)
- Data TOCs (4)
- Ad Applicants
- Ad Personnel
- Ad C&G
- Ad BSL
- Ad BSL Contacts
- Ad BSL mngt
- Ad EPS LICB
- Ad IRIS SSANF
- Ad Sabbatical
- Travel Meetings
- RMA
- Proposals
- Papers
- Reviews etc
- gj Book
- Pj Earthquakes
- Pj Imaging

MAIL ACTIVITY

Incoming Messages... 66 of 83 596 KB/s

From	Subject	Date Received	
Research Commercializ...	Research Commercialization Introd...	Yesterday 2:22 PM	
USGS ENS	2011-09-14 20:48:47 (MI 2.0) GREAT...	Yesterday 1:51 PM	
Anne Trehu	Draft informational one-pager	Yesterday 1:40 PM	1 item
USGS ENS	2011-09-12 08:21:11 (Md 2.1) CENTR...	Yesterday 1:35 PM	
euro million	[SPAM:XXXXXXXXXX] your winning	Yesterday 1:34 PM	
Kelly Wiseman	today's lecture slides	Yesterday 1:29 PM	1 item
Maya Tolstoy	draft timetable 2012 Thompson cruise	Yesterday 1:20 PM	1 item
Harold C Macbeth	[CISN-DPS] NCSN duty seismologist Sep ...	Yesterday 1:13 PM	
John McRaney	Post-Doc Opportunities at KAUST	Yesterday 11:52 AM	1 item
Katie Kadas	It's time to renew your membership with...	Yesterday 11:48 AM	

From: Maya Tolstoy <tolstoy@ideo.columbia.edu>
 Subject: draft timetable 2012 Thompson cruise
 Date: September 14, 2011 1:19:59 PM PDT
 To: Richard Allen
 1 Attachment, 72.5 KB [Save] [Quick Look]

Here's what I just showed you. Will send you a more refined version when I have it.
 Maya

[Cascadia-20...xls \(72.5 KB\)](#)

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 Web: <http://www.ideo.columbia.edu/~tolstoy>

Desktop icons:

- bdsn_map.gif
- BARD_small.jpg
- Clio2
- hrs.station.gif
- hfn.station.gif
- 090331_Elarns-CAgrid.jpg
- mpbo.stations.gif
- time_scale1.gif
- Camtasia.dmg
- LacieLT2
- LomaPrieta.mp4
- Camtasia
- mp4Movies
- st_japanquake_timelne_2.jpg
- LomaPrieta.mp4
- Goldfinger_1661
- Alaska Airlines - Print Boar... Pass.pdf
- computerstuff.txt
- LomaPrieta.mov
- usersdisplay_movies
- National Earthquake Resilience prepub.pdf
- IMG_Z146.MOV



Download mp4: <http://seismo.berkeley.edu/~rallen/images/eewfall2011/UserDisplay20-LomaPrieta.mp4>

National Earthquake Resilience prepub.pdf
IMG_2146.MOV

Types of application

Using seconds to tens of seconds warning for...

1. Personal safety

Identifying a safe zone where you live and work

- Being mentally prepared for the shaking
- Protection from falling bookshelves, lighting etc
- Home or office: Under a sturdy table
- Outside: away from masonry and falling hazards
- Industrial plants, construction sites: away from machinery and chemicals



Types of application

Using seconds to tens of seconds warning for...

1. Personal safety
2. Automated control

Bringing systems into a safe mode

- Slowing and stopping trains
- Telling airplanes to “go-around”
- Isolating hazardous chemicals and machinery
- Putting sensitive equipment into a stable state
- Stopping elevators and opening doors at next floor
- Smart buildings: opening doors/windows, turning off gas



Types of application

Using seconds to tens of seconds warning for...

1. Personal safety
2. Automated control
3. Situation awareness

Understanding why systems are failing

- Re-routing power or communications
- Preventing cascading failures
- Initiating emergency response
 - Information available before communications are lost



Progress toward California's **Shake/Alert**

Right now: Looking for early-adopters

Possible user groups

- transportation
- industrial sites
- public sector
- schools



For more information contact:

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