from the Real World

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December 3-5, 2012, Maui, HI

Fernando, CA (M6.5)
agua, Nicaragua (M6.3)
Mugu, CA (M5.9)
agua, Nicaragua (M5.8)
dale, CA (M5.5)
Turkey (M6.8)
Italy (M6.5)
cia, Romania (M7.4)
eninsula, Japan (M6.7)
gi-Ken-oki, Japan (M7.4)
a Barbara, CA (M5.1)
op, CA (M5.8)
, CA (M5.5)
rial Valley, CA (M6.6)
more, CA (M5.5 and 5.8)
ka, CA (M7.0)
moth Mt., CA (M6.5, 6.5, 6.7)
ley, CA (M5.6)
nga, CA (M6.7)
n Mt., Idaho (M6.9)
an Hill, CA (M6.2)
ago, Chile (M7.8 and 7.2)
co City, Mexico (M8.1 and 7.5)
esville, Ohio (M5.0)
Island, Alaska (M7.7 and 6.5)
Palm Springs, CA (M6.0)
ant Valley, CA (M6.0 and 5.5)
Salvador, El Salvador (M5.4)
ern Taiwan (M6.8)
Prieto, Mexico (M5.4)
of Plenty, New Zealand (M6.2)
ier, CA (M5.9)
rstition Hills, CA (M6.3)

1988 Gorman, CA (M5.2)
1988 Alum Rock, CA (M5.1)
1988 Saguenay, Quebec (M6.0)
1988 Armenia, USSR (M6.9)
1989 Acapulco, Mexico (M6.8)
1989 Loma Prieta, CA (M7.1)
1989 Newcastle, Australia (M5.5)
1990 Upland, California (M5.5)
1990 Bishop's Castle, Wales (M5.4)
1990 Manjil, Iran (M7.7)
1990 Central Luzon, Philippines (M7.7)
1991 Valle de la Estrella, Costa Rica (M7.4)
1991 Sierra Madre, CA (M5.8)
1992 Erzincan, Turkey (M6.8)
1992 Roermond, Netherlands (M5.8)
1992 Desert Hot Springs, CA (M6.1)
1992 Cape Mendocino, CA (M7.0, 6.0, & 6.5)
1992 Landers-Big Bear, CA (M7.6 and 6.7)
1992 Cairo, Egypt (M5.9)
1993 Scotts Mill, OR (M5.3)
1993 Nansei-oki Hokkaido, Japan, (M7.8)
1993 Agana, Guam (M8.2)
1993 Klamath Falls, OR (M5.7)
1994 Northridge, CA (M6.6)
1994 Tohoko-oki, Hokkaido, Japan (M8.1)
1995 Great Hanshin (Kobe), Japan (M7.2)
1995 Pereira, Colombia (M6.5)
1995 Sakhalin Islands, Russia (M7.2)
1995 Antofagasta, Chile (M7.4)
1995 Manzanillo, Mexico (M7.6)
1996 Duvall (Seattle,), WA (M5.3)
1997 Calico, CA (M5.0)
1997 Umbria, Italy (M5.5)

1998 Adana-Ceyhan, Turkey (M
1999 Armenia, Colombia (M5.0)
1999 Puerto Escondido, Mexico
1999 Western Washington (M5.
1999 Izmit, Turkey (M7.4)
1999 Duzce, Turkey (M7.2)
1999 Central Taiwan (M7.6)
1999 Athens, Greece (M5.9)
1999 Algeria (M5.5)
1999 Hector Mine, California (M
2000 Napa, CA (M5.2)
2000 Tottori, Japan (M6.7)
2001 Gujarat, India (M7.6)
2001 Seattle, WA (M6.8)
2002 San Simeon (Paso Robles
2007 West Sumatra, Indonesia
2007 Niigata (Kashiwazaki), Jap
2008 Wells, Nevada (M6.3)
2008 Sichuan, China (M8.0)
2009 L' Aquila, Italy (M6.3)
2010 Haiti (M6.9)
2010 Chile (M8.8)
2010 Baja California, Mexico &
2011 Christchurch, New Zealand
2011 Tohoku (Sendai), Japan (M
2011 Mineral, Virginia (M5.9)
2011 Van, Turkey (M7.2)

n the Real World: Summary

quake hazard and loss estimation and earthquake risk
gement practices have been rigorously tested in recent years by
uakes in Japan, Chile, New Zealand, and Italy.

e countries all have state-of-the-art earthquake engineering
ologies and practices, and they provide crucial real-world lessons
 state of hazard and loss estimation and risk management.

e earthquakes indicate that most of the current best practices for
l and loss estimation, including insurance modeling, are
quate. All resulted in estimates for earthquake hazard and damag
ere either severely underestimated, or sometimes, grossly
ated.

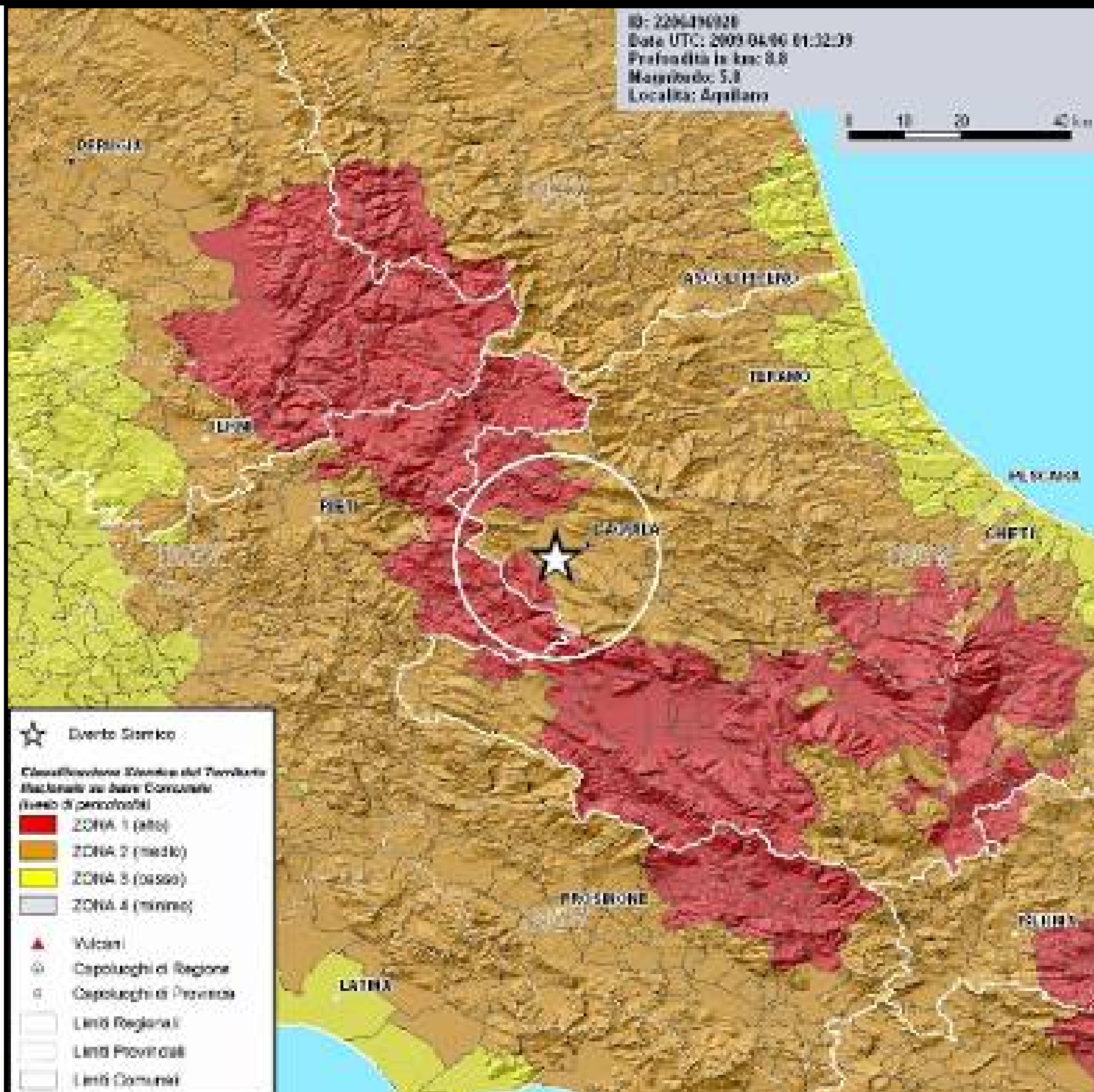
1994 Northridge (M6.7), 1999 Hector Mine (M7.1)

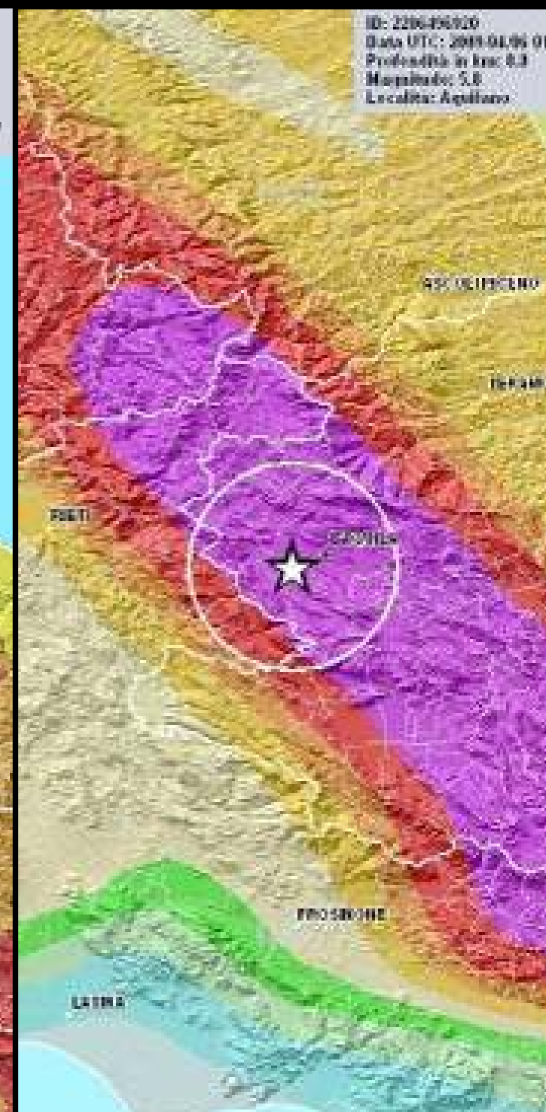
A Few of California's Earthquakes that occurred on New Faults

... Last Four Very Damaging Earthquakes in the ...s Angeles Region have One Characteristic in ...nmon. They all occurred on unknown faults.

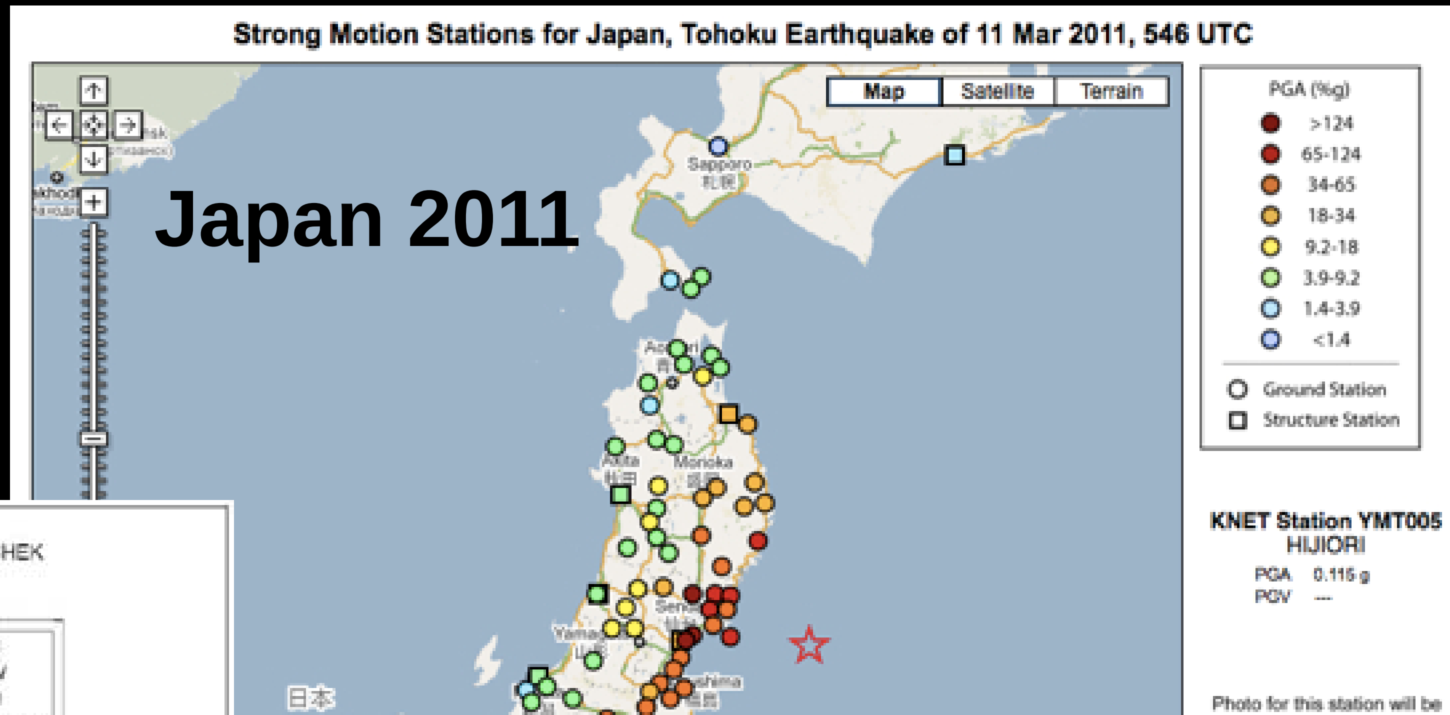
Before the Northridge earthquake, the fault map of the Los Angeles included only the faults indicated by the lines (only major faults are shown). The blocks are the recently defined and understood "blind thrust" faults. That has dramatically altered the risk in Los Angeles Now, essentially every building is very near or on top of a fault.

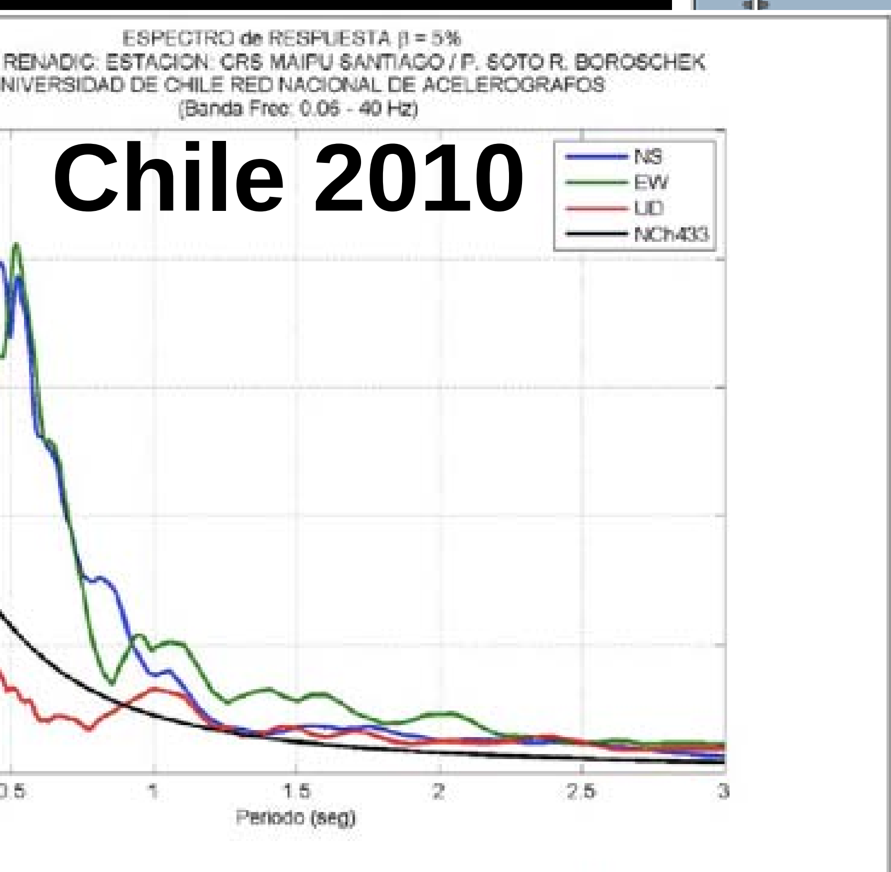
History of Earthquakes in the Region, the Hazard Ma
and the Building Code Maps Are Inconsistent
This is not unusual throughout the world



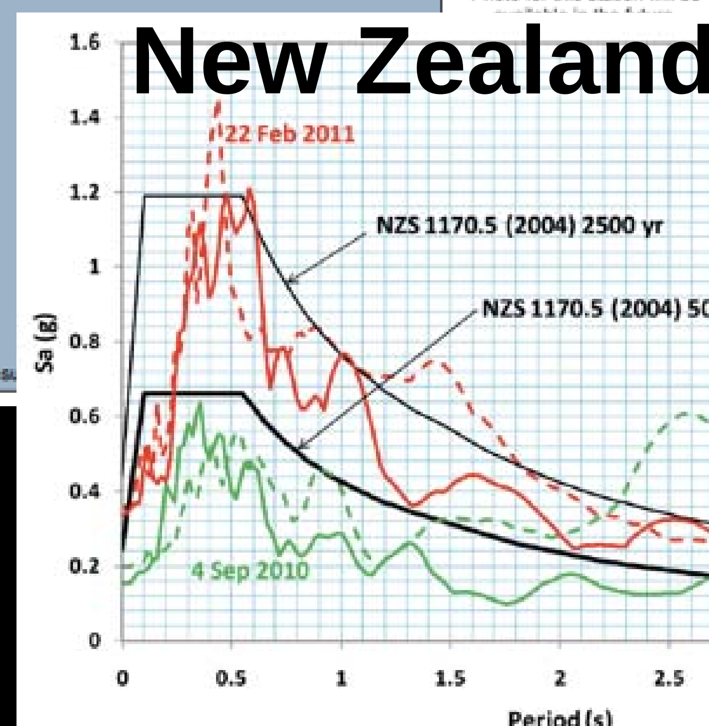


three earthquakes the ground motions exceeded substantial
d predictions and the code requirements for design





ón Espectro de Diseño Norma Chilena NCh433 – Estación CRS
MAIPU RM. (Ver Nota General)



Stein, R.J.Geller, & M.Liu (2012)., "*Why earthquake hazard maps*
and what to do about it". *Tectonophysics* 562-563, 1–25, 2012.

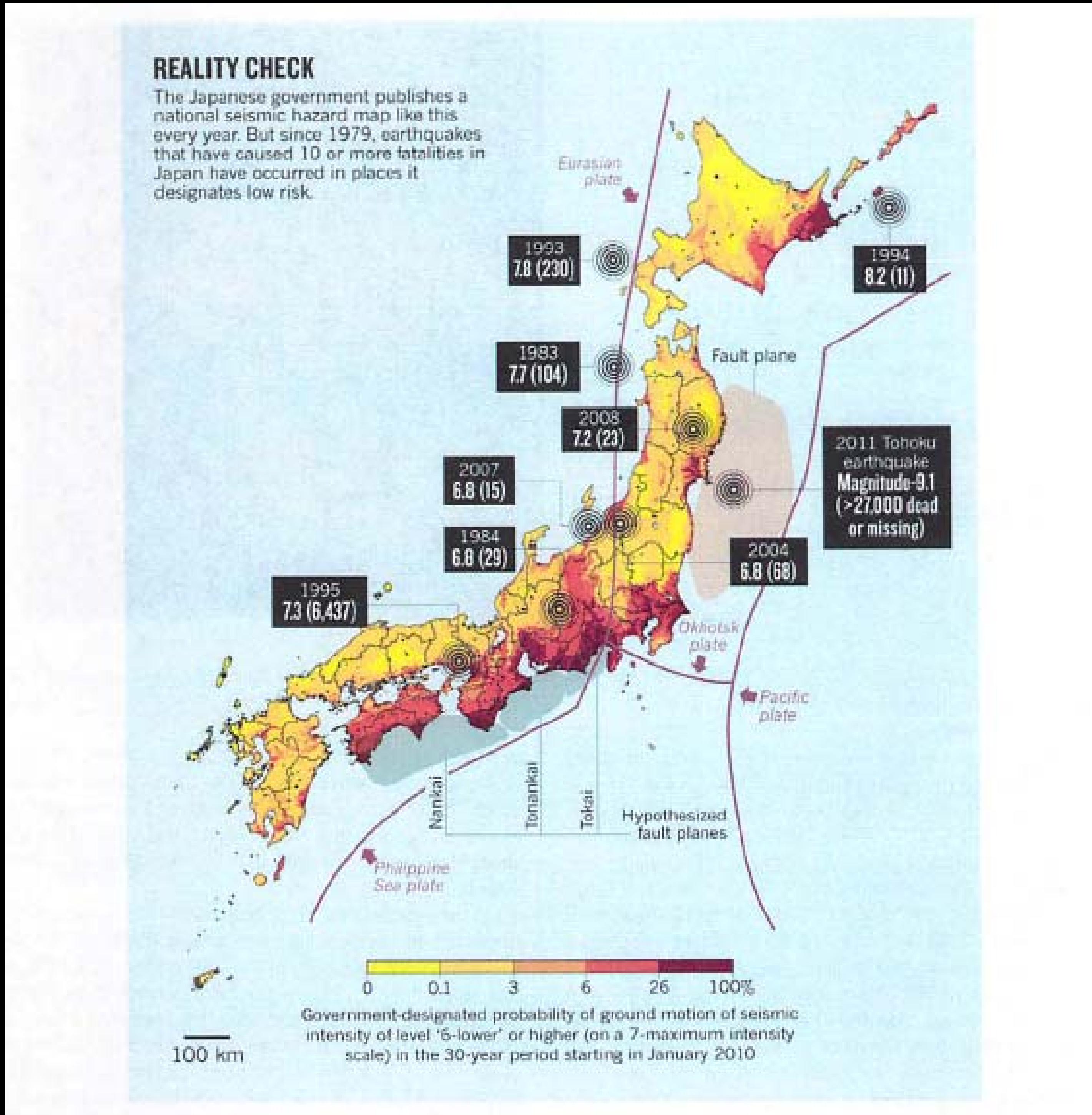


Fig. 1. Comparison of Japanese government hazard map to the locations of earthquakes since 1979 that caused 10 or more fatalities (Geller, 2011).

Stein, RJ.Geller, & M.Liu (2012). ; "*Why earthquake hazard maps ... and what to do about it*". *Tectonophysics* 562-563, 1–25, 2012.

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the uncertainties in hazard map predictions should be assessed ...y communicated to potential users. Recognizing the uncertainties ... enable users to decide how much credence to place in the map... them more useful in formulating cost-effective hazard mitigation ...es.

...nd, hazard maps should undergo rigorous and objective testing to ...are their predictions to those of null hypotheses, including ones b...iform regional seismicity or hazard. Such testing, which is comm... in similar fields, will show how well maps actually work and hop...produce measurable improvements. There are likely, however, lin...well hazard maps can ever be made because of the intrinsic varia...thquake processes."

thquake Hazard Maps, Ground Motion, and the Co

ould add two more improvements:

d available historical and archaeological data

nplify the maps and use extensive engineering judgment, as we u
in the past.

- Be conservative, or the next earthquake will embarrass you
- Be proactive with the code requirements, not reactive, as we h
  been for a long time

大津浪記念碑

高き住居は
児孫に和楽
想へ惨禍の
大津浪
此処より下に
家を建てるな

図2-16　三陸大津波の教訓を伝える石碑(1).

図2-17　三陸大津波の教訓を伝える石碑(2

Stone Monument of Large Tsunami

se at the heights is well-being for your children and grand ch
member the large Tsunami that caused a great terrible disas
Don’t build your house under this level.

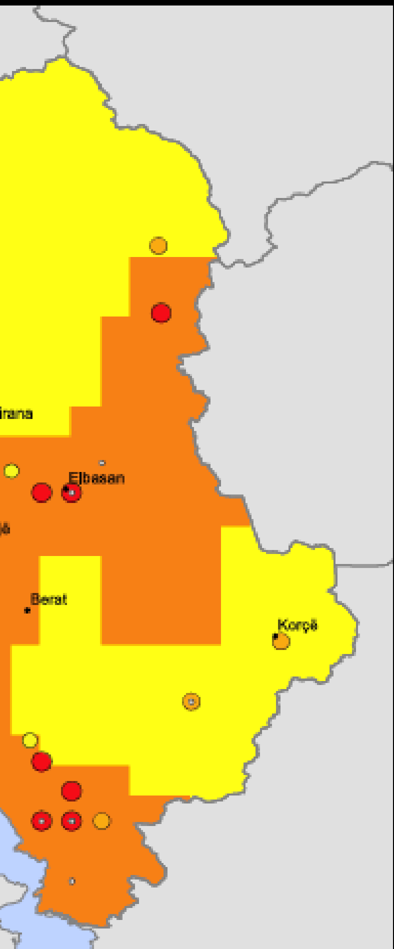
tone monuments were build on the position which Sanriku tsunami run-u
1896

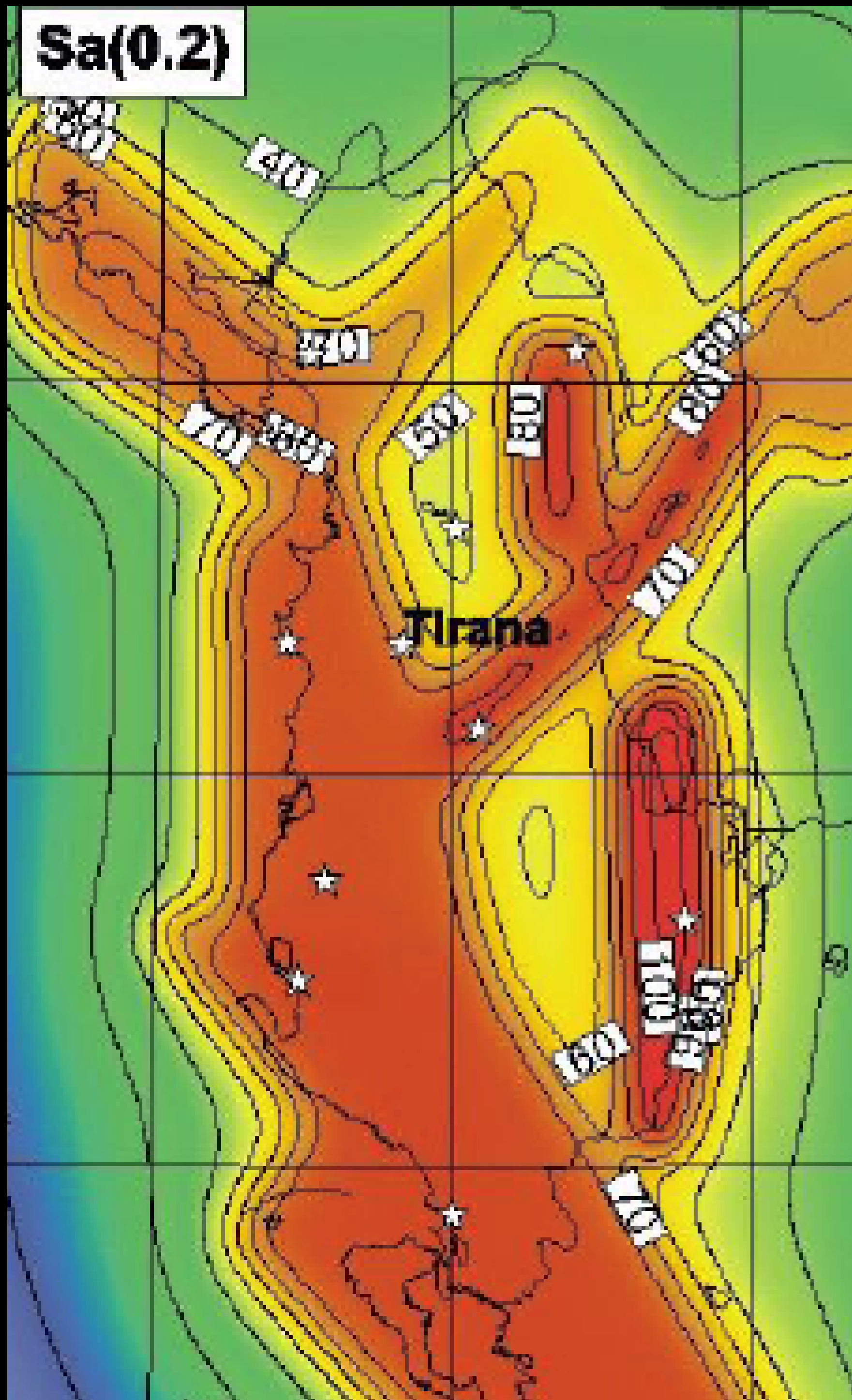
e of many similar WB projects (Turkey, China, Philippines
le, Bulgaria, Romania, El Salvador, etc)

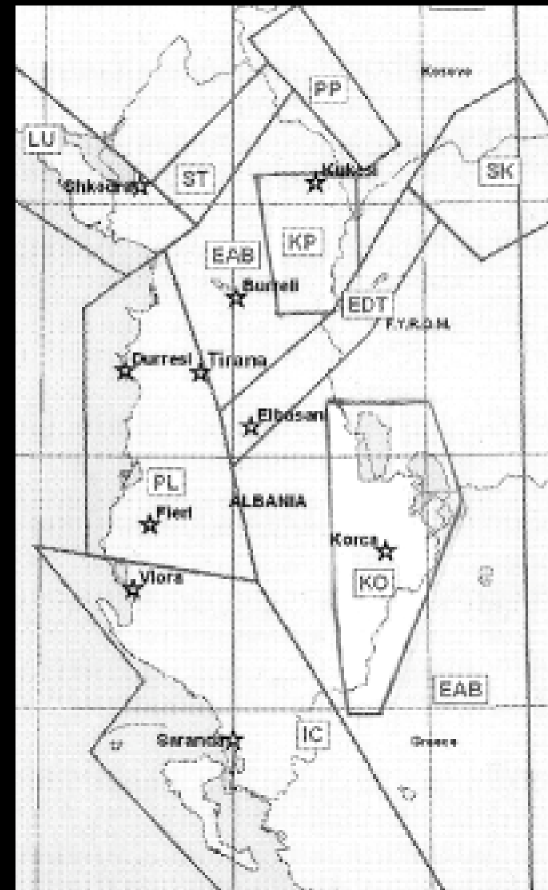
sessed residential buildings country-wide risk for an onlin
assessment tool for homeowners (Europa Re)

pidly surveyed hundreds of buildings and design/construc
ctices based on experience; custom construction classes

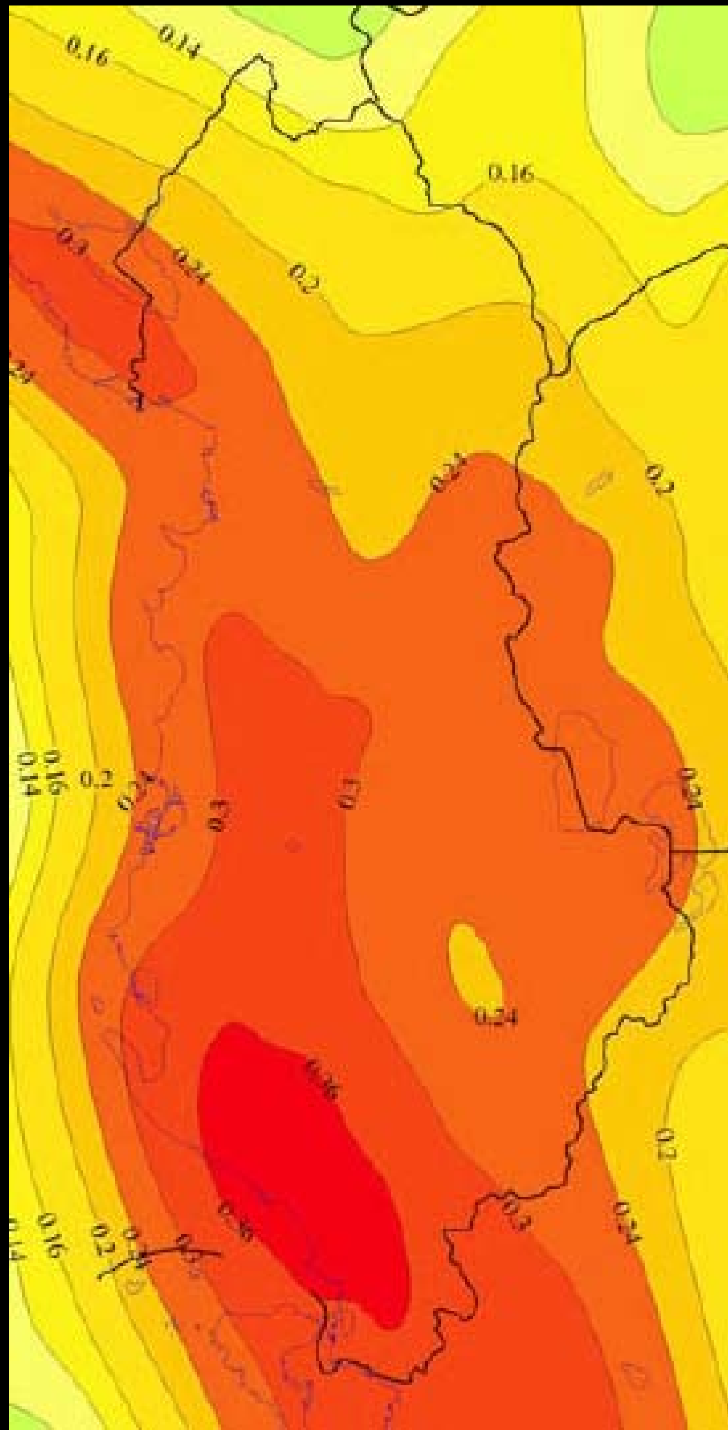
Bank Albania Project: some of the hazard maps that we reviewe
making a Hazard Map recommendation for the country







Bank Albania Project: some of the hazard maps that we reviewe making a Hazard Map recommendation for the country

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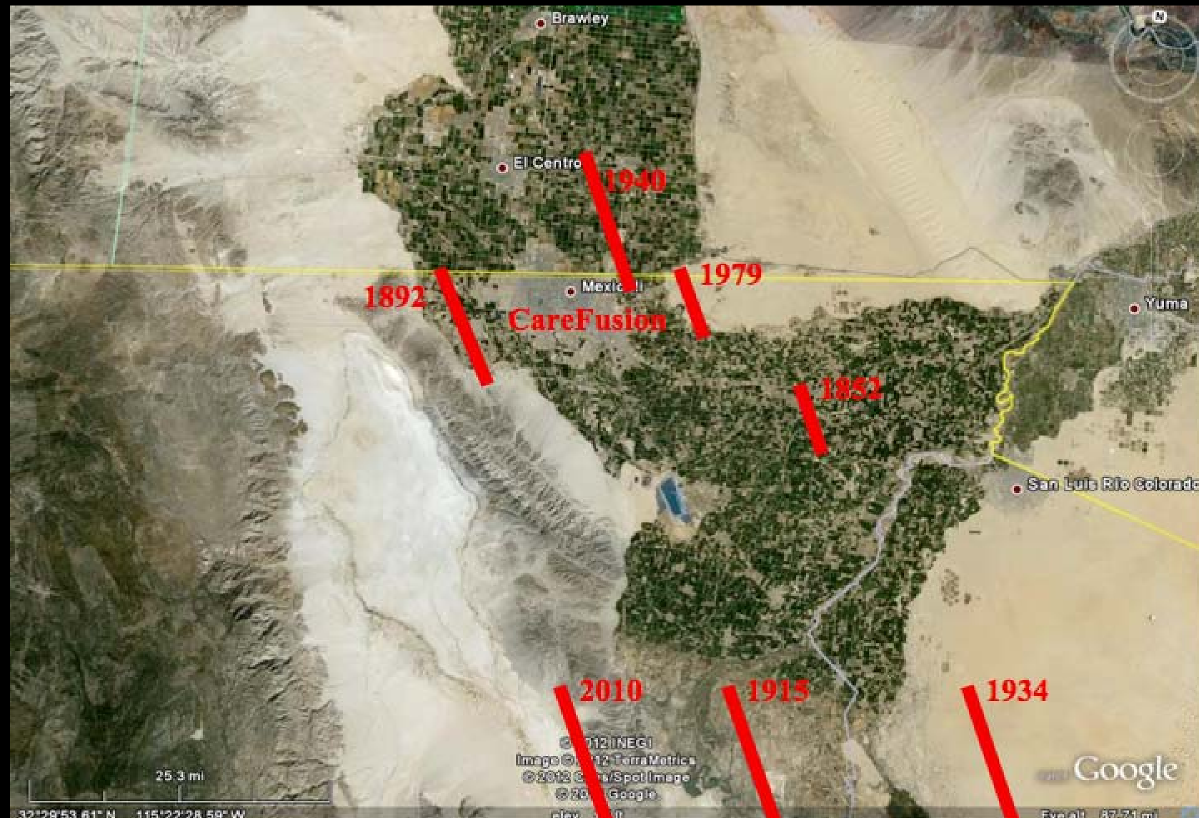
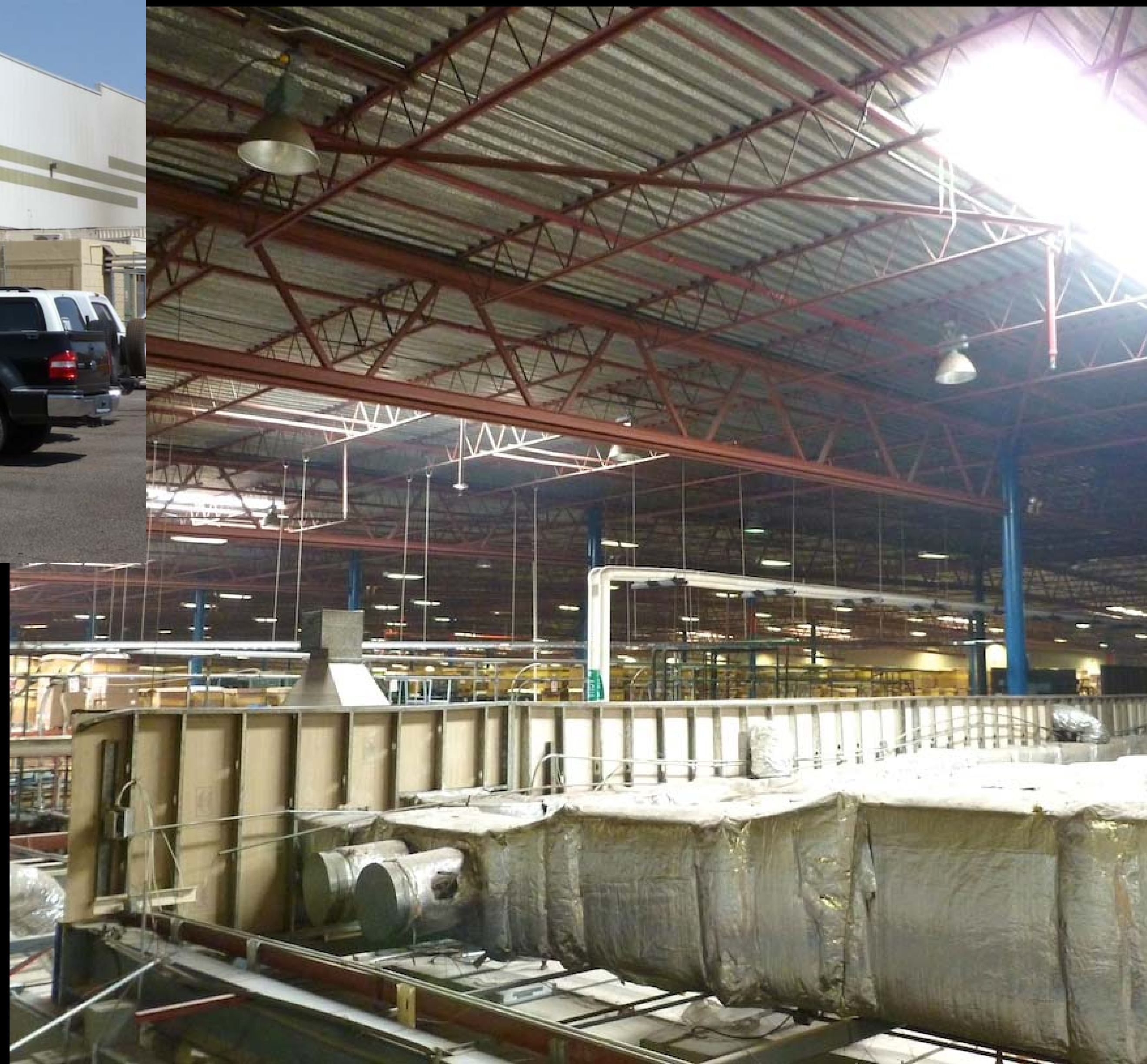
THQUAKE DAMAGE EVALUATION
A FOR CALIFORNIA

IED TECHNOLOGY COUNCIL

l by
Emergency Management Agency



Modeling Practices



Event Description		Magnitude	Mean Gross Loss	90th Percent
hern Coastal CA Offshore C2	002	7.0	$87,822,310	$225,681
hern Coastal CA Offshore C2	002	6.7	$73,677,087	$208,725
thern Coastal California B1	001	7.0	$53,008,378	$166,200
hern Coastal CA Offshore C2	001	7.0	$49,977,025	$160,356
thern Coastal California B1	001	6.9	$49,529,787	$156,259

Earthquake EP Results without Business Interruption

al bility	Return Period (years)	Aggregated Exceedance Probability			Occurrence Exceedance Probability		
		Ground Up	Gross	Client Loss	Ground Up	Gross	Client Lo
0%	10,000	$41,557,553	$37,127,412	$7,009,095	$41,227,579	$37,127,011	$4,410,9
0%	5,000	$36,766,890	$32,720,020	$5,387,705	$36,503,092	$31,902,470	$4,410,9
7%	1,500	$27,573,418	$22,906,290	$4,436,236	$27,386,964	$22,891,814	$4,410,9
0%	1,000	$24,236,227	$19,821,356	$4,411,294	$24,076,123	$19,820,846	$4,410,9
3%	750	$21,805,323	$17,487,081	$4,410,978	$21,662,461	$17,337,574	$4,410,9
0%	500	$18,307,346	$13,728,940	$4,410,924	$18,188,771	$13,728,331	$4,410,8
0%	250	$12,241,387	$7,787,674	$4,410,760	$12,162,040	$7,732,080	$4,410,7
%	175	$9,182,037	$4,774,597	$4,410,620	$9,121,780	$4,733,440	$4,410,5
0%	100	$4,820,828	$451,735	$4,410,271	$4,786,345	$451,705	$4,410,2
3%	75	$3,034,710	$0	$3,024,813	$3,011,501	$0	$3,018,7
0%	50	$1,317,179	$0	$1,314,050	$1,306,154	$0	$1,306,5
0%	25	$165,105	$0	$164,741	$163,721	$0	$163,54
Annual Loss					$168,445	$85,476	$82,96
d Deviation					$1,553,061	$1,175,845	$528,06
ent of Variation					9.2200	13.7564	6.3646

ary, we have observed the following lessons for risk modeling and loss
n over the last few years:

t practices are not very good – at least not in the real world.

ults are only as good as the models, which are deficient in hazard, stru
structural modeling. Almost all modeling of business interruption due t
rom equipment systems and other non-structural effects has little to d
rvations in the real world, unless done by competent earthquake/struc
s.

g, as conducted today, is insufficient for smaller portfolios. It can, and
grossly insufficient for single-site analysis. The only good modeling an
ave observed were based on detailed walk-downs and observations b
nt earthquake/structural engineers.

g results can rarely be used to make business decisions regarding bu
, loss control programs, business interruptions, market-share loss, etc
gain, are based on competent engineering

.

nary, we have observed the following lessons for risk modeling and los
on over the last few years:

pically, the people running the models and the people supplying the m
ta are not qualified to do either, especially in the insurance industry.

ost models are proprietary and the modeling companies are extremely
uctant to divulge even basic information on the models. Therefore, it i
solutely necessary to have independent reviews of the results produc
odels. Again, the independent reviewers must have adequate experie
al-world earthquake and structural engineering, and they must unders
ects of real earthquakes on the types of properties being analyzed.

Modeling Practices

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nary, we have also observed that all of the above issues can be resolv
y easily, with the possible exception of hazard modeling. Even that, h
mproved. Some of the key improvements are:

ualified engineers to develop the input data and to run the models. Th
must be developed by highly trained earthquake engineers with substa
n experience, complemented by direct experience from earthquake
igations.

modeling requires extensive experience with different types of structu
non-structural features. This includes equipment systems, which often
verall business interruptions. Judgment and experience are more impo
anything else except the correct input to the models.

modeling also means keeping up with new lessons from earthquakes
g a lot of room for interpretation of the results. Modeling results need
sive interpretation and re-working that must be based on experience a
nent. In short, modeling and loss estimates need reality checks.


xerox


k assessment of key facilities to determine major risk
ntributors within the system for a possible M9 earthquake

rted by evaluating control and emergency centers & maj
ostations; expanded to power generation & natural gas
ilities

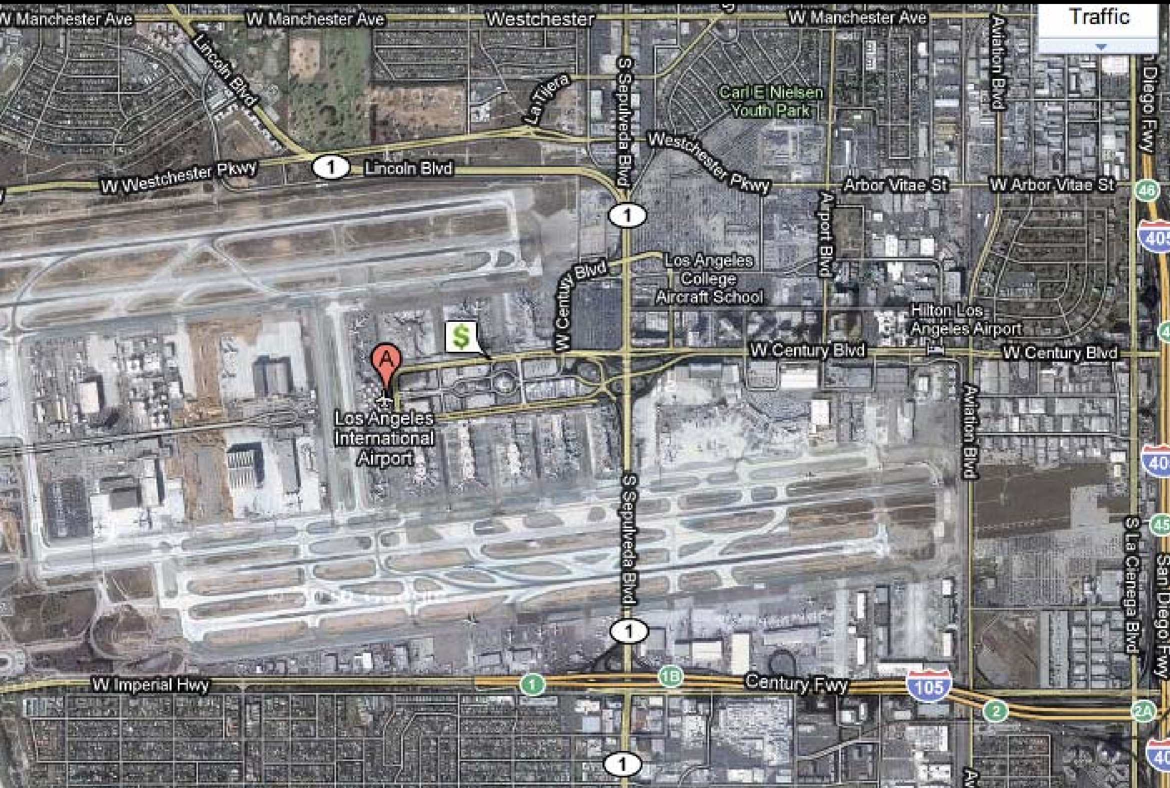
ey findings: Critical equipment unanchored, leading to najor BI., some structures problematic -- most easy to emedy

eed to integrate EQ planning into their regular business ractices

lient is reconsidering their risk management program in ght of the findings

complex system involving hundreds of buildings, massiv
frastructure - and all dependent on fuel supply, water,
ommunications, etc.

tructures, equipment, dependencies (fuel, power, etc)


W Manchester Ave
W Manchester Ave
Westchester
W Manchester Ave
Traffic
Lincoln Blvd
La Tijera
S Sepulveda Blvd
Carl E Nielsen
Youth Park
Aviation Blvd
San Diego Fwy
W Westchester Pkwy
Lincoln Blvd
Westchester Pkwy
Arbor Vitae St
W Arbor Vitae St
Airport Blvd
W Century Blvd
Los Angeles
College
Aircraft School
Hilton Los
Angeles Airport
W Century Blvd
W Century Blvd
Los Angeles
International
Airport
S Sepulveda Blvd
Aviation Blvd
S La Cienega Blvd
San Diego Fwy
405
W Imperial Hwy
Century Fwy
105