



3: ShakeAlert

Extending EEW Beyond California

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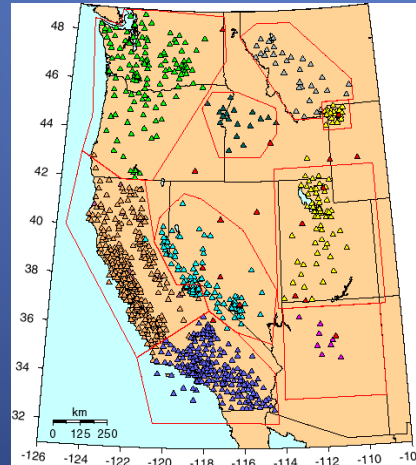


Earthquake Hazards Program

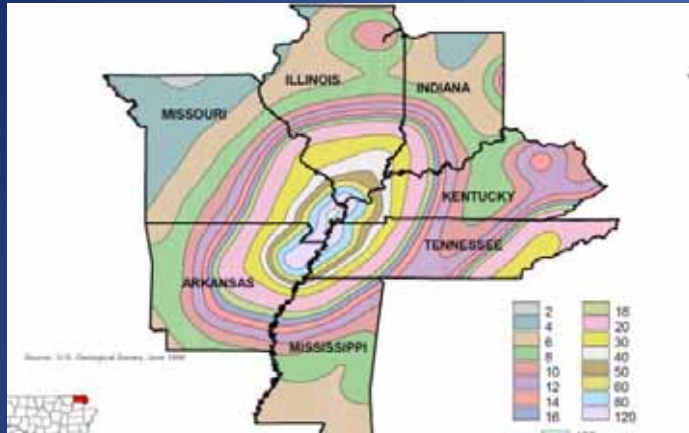


Regional Differences

- Technical Differences
 - Tectonic setting
 - Seismic rate, hazard
 - Seismic attenuation
 - Seismic monitoring capability
- Social Differences
 - Population density
 - Building stock, codes
 - Priority of seismic hazards
 - Political will to act
 - Economic base
 - Critical infrastructure

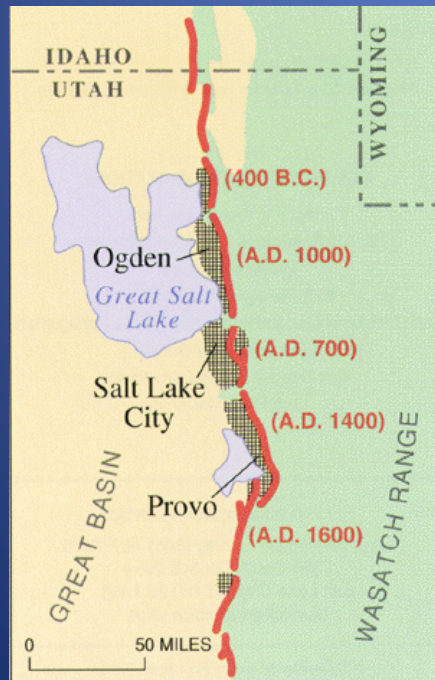
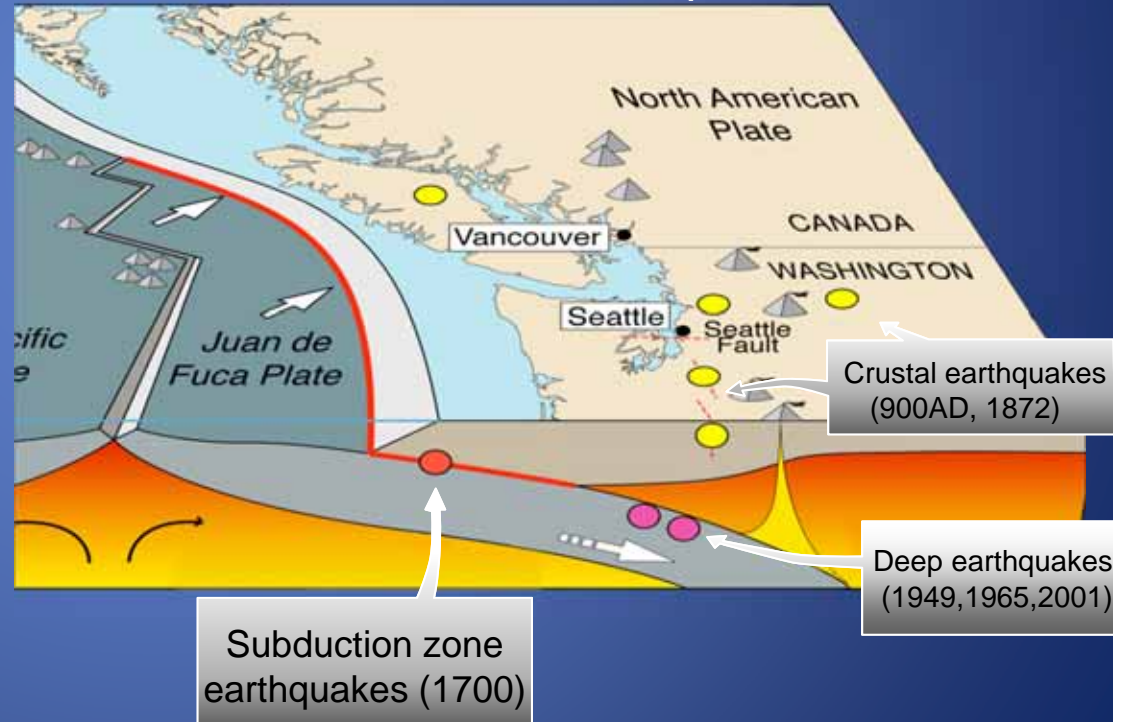


Varied Geologic Settings



New Madrid – Central U.S.

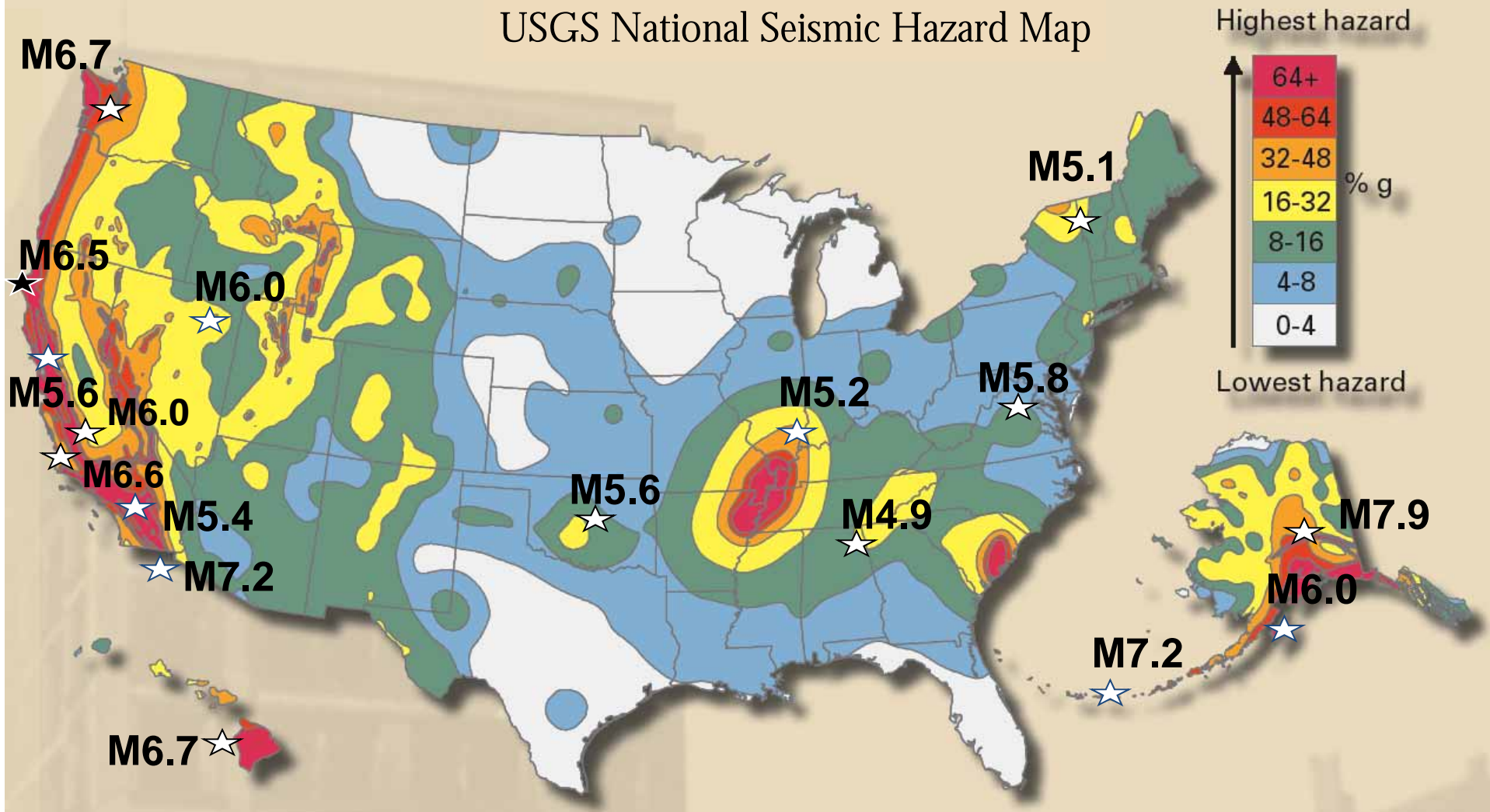
Cascadia: Three kinds of earthquakes



Wasatch Front

National Hazard Map

USGS National Seismic Hazard Map



★ Notable earthquakes in past decade

U.S. Population Distribution

The population of the United States is not distributed evenly. Instead, we tend to bunch up in communities, leaving the spaces in between more sparsely inhabited. Most Americans live in or near cities; today 53 percent live in the 20 largest cities. 75 percent of all Americans live in metropolitan areas.

This map shows population density. The relative height of each major city reflects its population in 1996.

Source: © © Thomas Nelson

Go West, Nevada is the fastest growing state, followed by Arizona, Idaho, Colorado, and Utah.

Wyoming has the lowest population density of all states in the lower 48 with an average of five people per square mile.

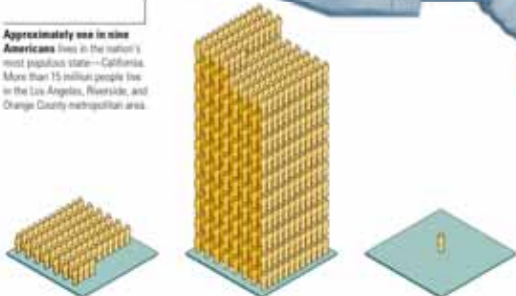
What happens in the empty spaces? Some of it is farming country. More than one quarter of America's crop land is used to grow corn. One third of what is produced is exported to other countries.

Chicago, the country's third largest city, has a population of about three million people. There are 21 states with populations smaller than this city.

Largest metropolitan area includes New York City and portions of New Jersey and Long Island with a total population of 20 million.

Population density is highest in New York City, where there are 23,000 people per square mile.

Approximately one in nine Americans lives in the nation's most populous state—California. More than 15 million people live in the Los Angeles, Riverside, and Orange County metropolitan area.



Distributing our population evenly would put an average of 76 people per square mile.

New Jersey is the most densely populated state with an average of more than 1,000 people per square mile.

Alaska is a sparsely populated state with an average of one person per square mile.

Wet. Some states are full of water. For example, Louisiana includes more than 8,000 square miles of lakes and wetlands. That's an area bigger than Connecticut and Rhode Island combined.

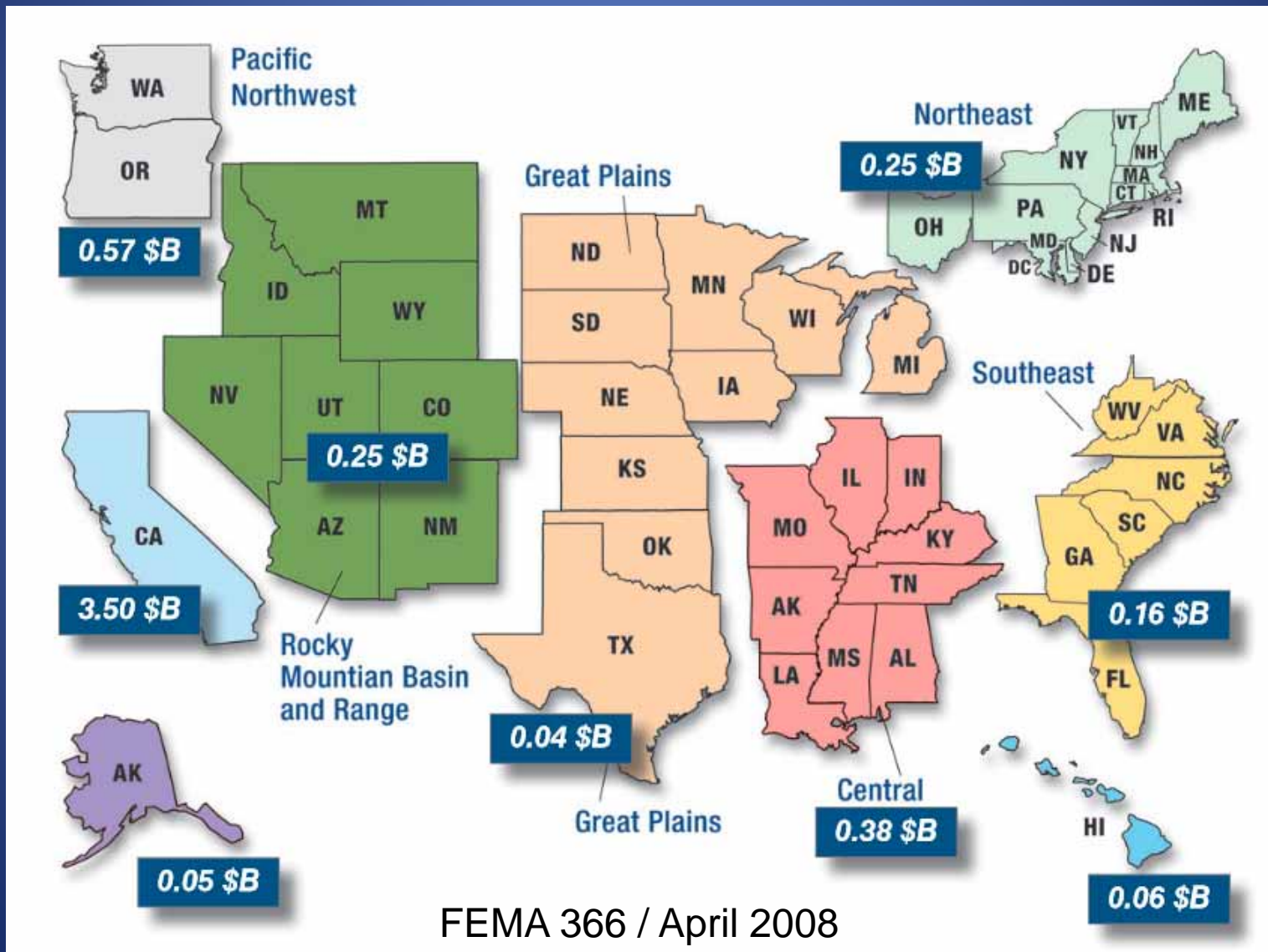
Coastal areas are home to more than half the U.S. population.

Population Distribution

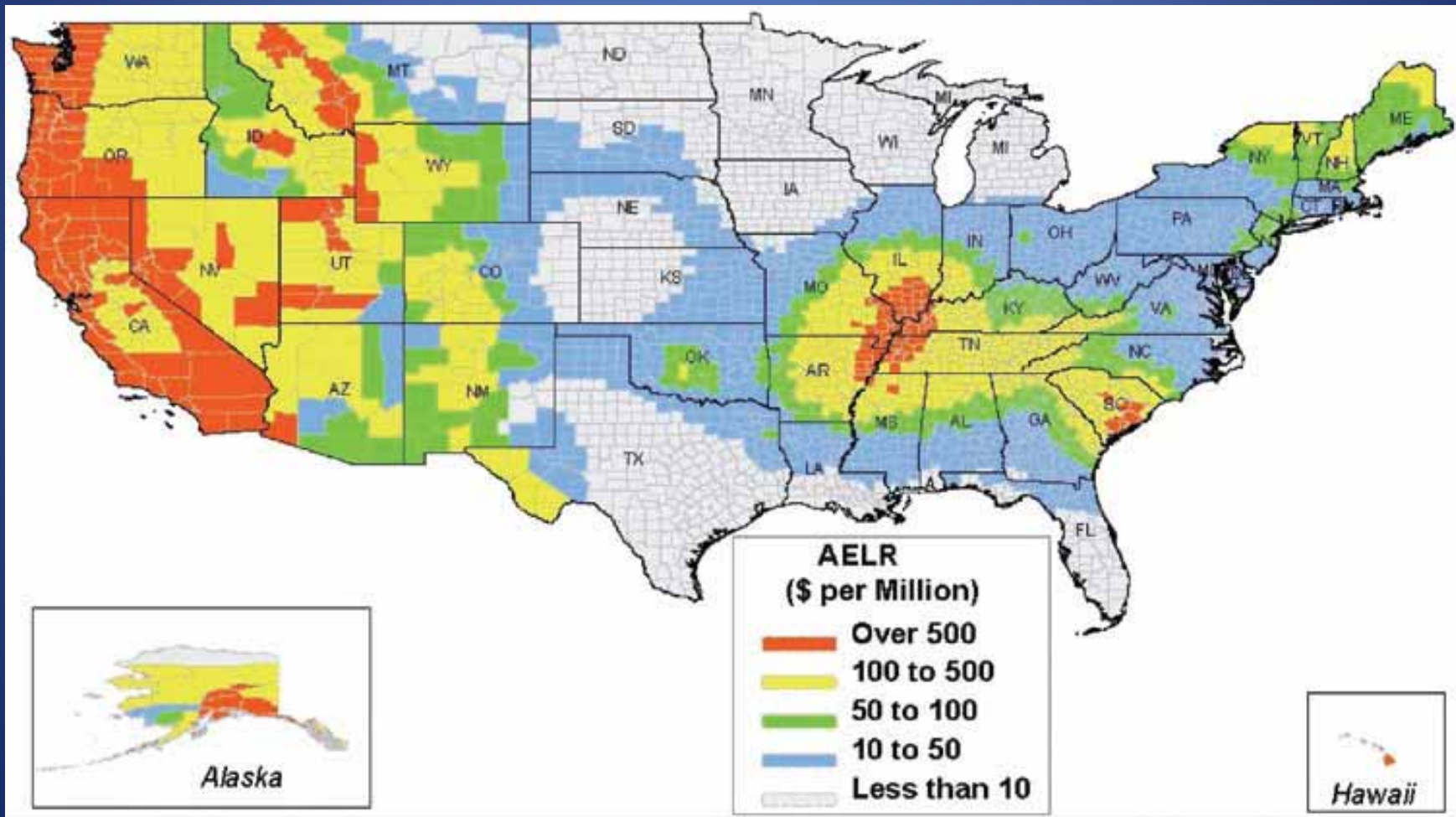
Where do we live?
Where don't we live?



U.S. Regional Seismic Risk by Annualized Earthquake Losses



Annualized Earthquake Losses by County



Annualized Casualties by State

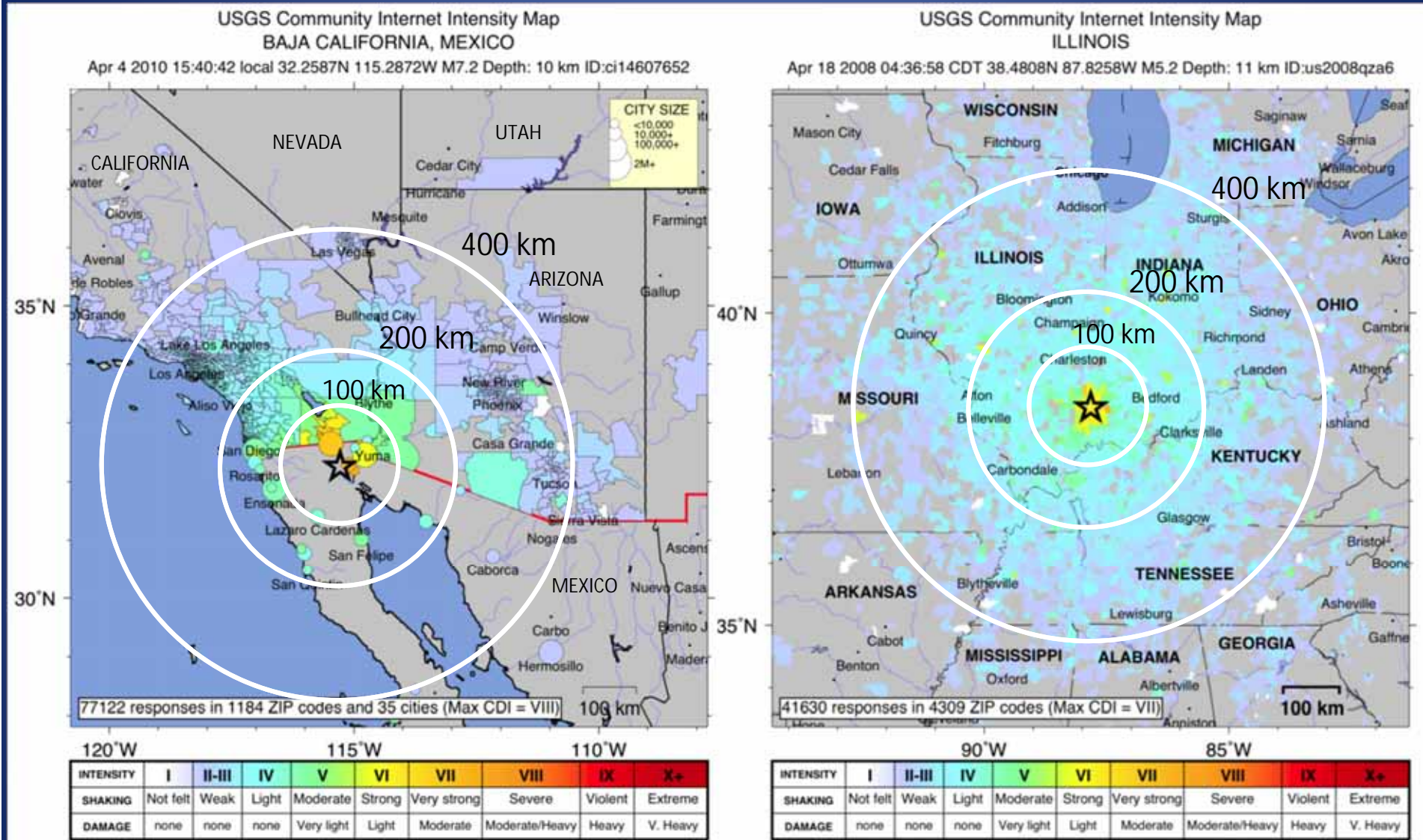
Rank	State	Day Time			Night Time		
		Minor	Life Threatening	Fatal	Minor	Life Threatening	Fatal
1	California	1891	63	122	1276	19	36
2	Washington	260	9	17	127	2	4
3	Oregon	188	7	13	85	2	3
4	Utah	86	3	6	59	2	3
5	Tennessee	89	3	5	62	1	3
6	South Carolina	64	2	4	51	1	2
7	Missouri	67	2	4	62	2	3
8	Nevada	59	2	4	33	1	1
9	Illinois	45	1	2	48	1	2
10	Arkansas	38	1	2	33	1	2
11	Alaska	28	1	2	17	0	1
12	New York	45	1	2	45	1	2
13	Kentucky	31	1	2	25	1	1
14	Georgia	32	1	1	17	0	1
15	Hawaii	21	1	1	17	0	1
16	New Mexico	15	0	1	13	0	1

Seismic Risk Factor

ANSS Circular 1188, 1999

Urban area	Earthquake hazard in %G	Population in millions	Risk factor	Number of urban stations
Los Angeles, CA	88	15.4	5.1221	1,300
San Francisco, CA	99	6.5	2.4322	1,000
Seattle, WA	34	3.3	0.4241	600
Salt Lake City, UT	29	1.2	0.1315	400
Anchorage, AK	35	0.3	0.0397	300
San Diego, CA	25	2.6	0.2457	300
Portland, OR	19	2.0	0.1436	300
Reno, NV	33	0.3	0.0374	200
Memphis, TN	14	1.1	0.0582	200
St. Louis, MO	10	2.5	0.0945	200
Santa Barbara, CA	52	0.4	0.0786	100
Salinas, CA	43	0.4	0.0650	100
San Juan, PR	30	1.0	0.1134	150
Provo- Orem, UT	19	0.3	0.0215	100
Sacramento, CA	17	1.6	0.1028	100
Las Vegas, NV	12	1.1	0.0499	100
Chattanooga - Knoxville, TN	10	1.1	0.0416	100
Stockton - Lodi, CA	18	0.5	0.0340	60
Fresno, CA	12	0.8	0.0363	60
Charleston, SC	18	0.5	0.0340	60
Albuquerque, NM	11	0.7	0.0291	50
Eugene - Springfield, OR	14	0.3	0.0159	50
Evansville, IN	11	0.3	0.0125	40
Boise, ID	7	0.4	0.0106	50
New York, NY	6	18.1	0.4105	40
Boston, MA	5	5.8	0.1096	40
Total				6,000

Attenuation: Baja and Illinois quakes felt areas



Magnitude 7.2

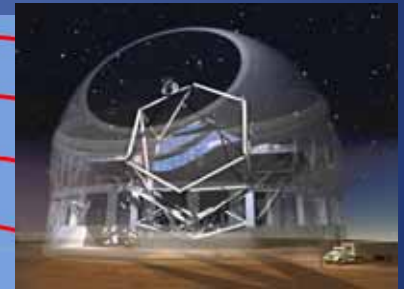
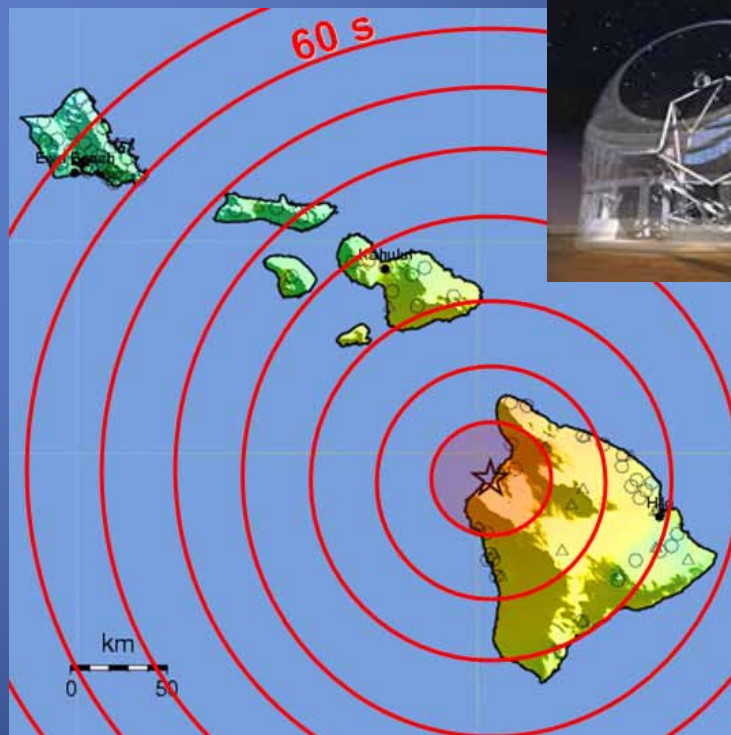
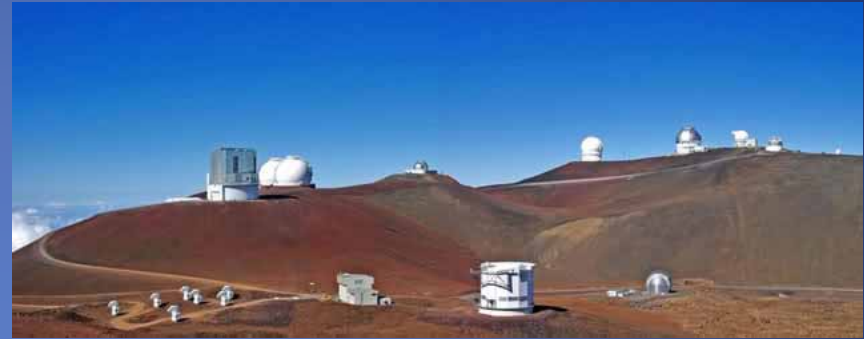
Magnitude 5.2



Figure courtesy of Dave Wald and Rob Williams, USGS

EEW in Hawai'i

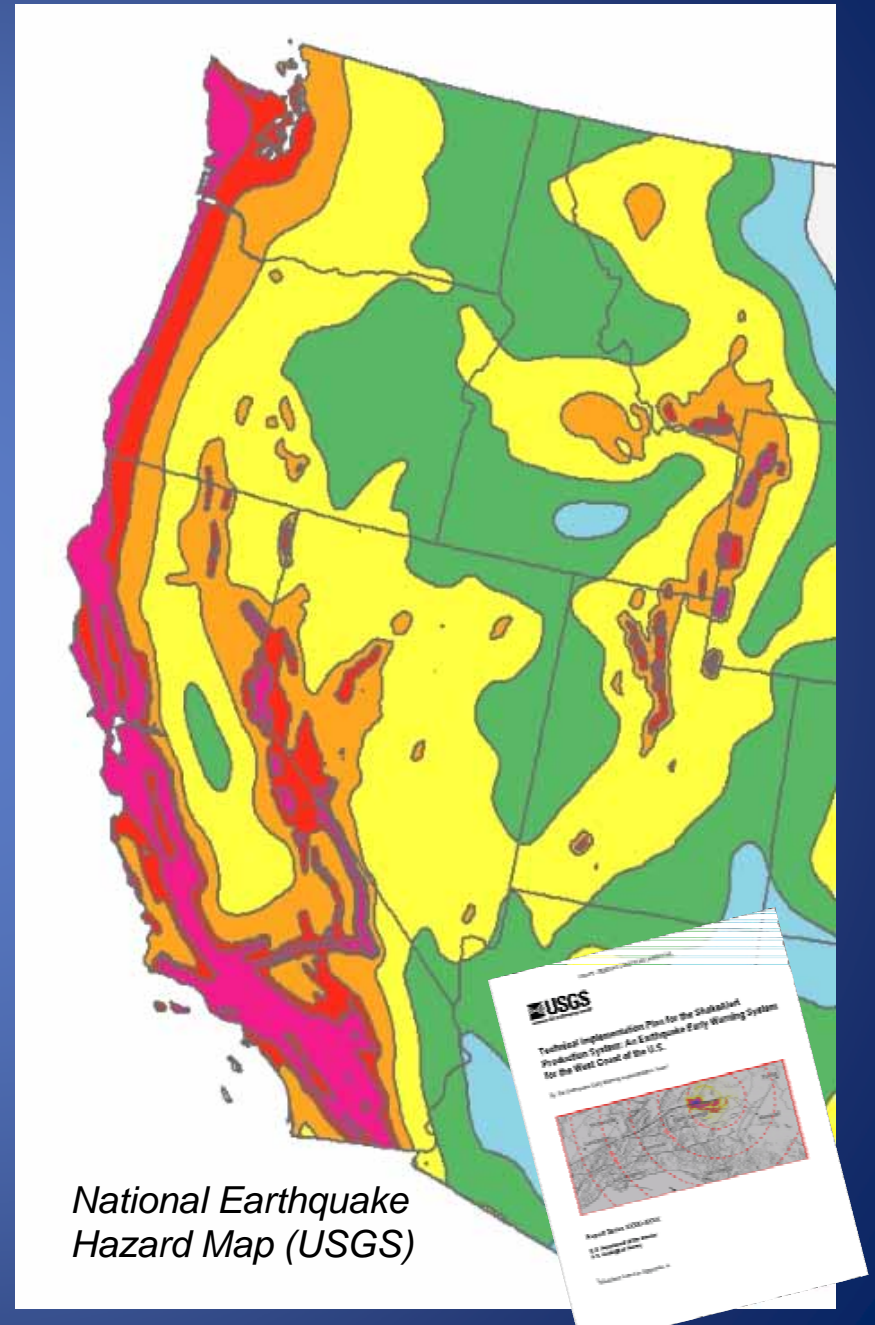
- Mauna Kea telescopes were damaged in 2006 – M6.7 Kiholo quake
- G & B Moore foundation funding TMT
- \$1B project
- Beginning 2018



ShakeAlert Technical Implementation Plan

Goal: build & operate a West Coast EEW system to...

- Issue public warnings for large earthquakes and...
- Send warning parameters to government and private sector users...
- ...as soon as ShakeAlert meets quality and reliability standards on a region by region basis



WSSPC Policy Recommendation 10-9

July 9, 2010

- WSSPC supports the development of earthquake early warning systems in those states or regions with high seismic risk and a seismic network that can, or can be enhanced to, support an early warning capability.
- WSSPC recommends that its members establish state level working or study groups on earthquake early warning that include interested scientists, engineers and emergency managers.

Some Discussion Questions

- What has been the level of support by your state/region for seismic monitoring, hazard assessment, seismic code adoption, etc.?
- What population centers or critical infrastructure would benefit from EEW in your area?
- What priority might be given to EEW?
- What barriers do you see to EEW in your area?
- Who are the stakeholders; decision makers?





Building Replacement Value

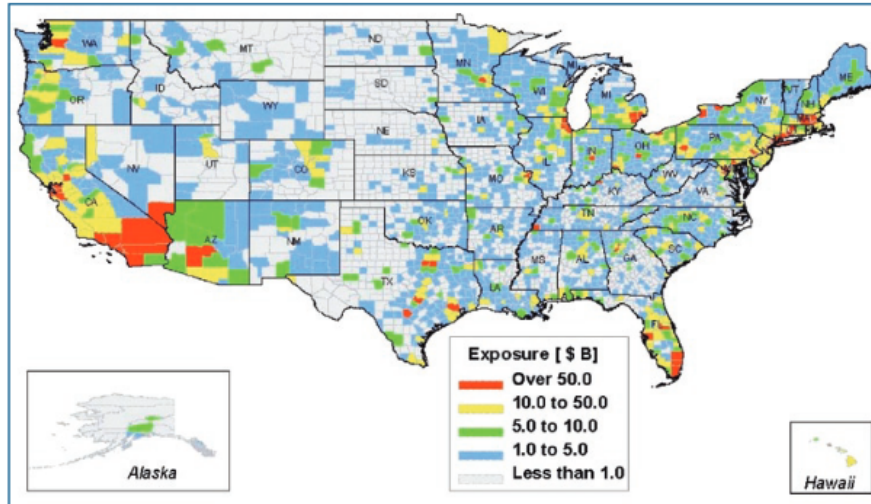


Figure 2-4
Replacement Value
of HAZUS-MH MR2
Building Inventory by
County

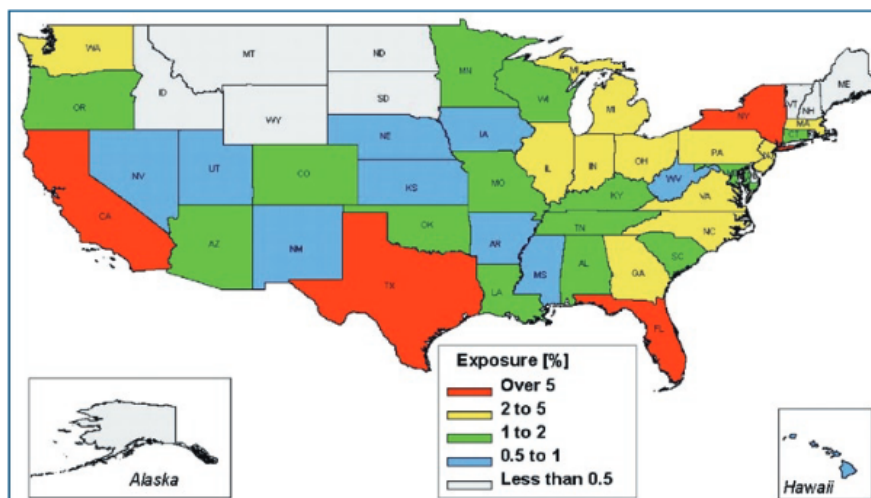


Figure 2-5
Distribution of
Building Replacement
Value by State



Est. Cost to Complete & Operate ShakeAlert

	California	Pacific Northwest	<i>West Coast Total</i>
Construction	\$23.1M	\$15.2M	<i>\$38.3M</i>
Annual M&O	\$11.4M	\$4.7M	<i>\$16.1M</i>

- New and upgrades seismic stations & GPS stations
- Significant field telemetry upgrades
- Support personnel
 - to bring ANSS (CISN) network staffing up to robust levels
 - EEW implementation and testing
 - EEW operation and user outreach
- Support for continued R & D

