ShakeMap & ShakeCast for Earthquake Planning & Response

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Golden, Colorado

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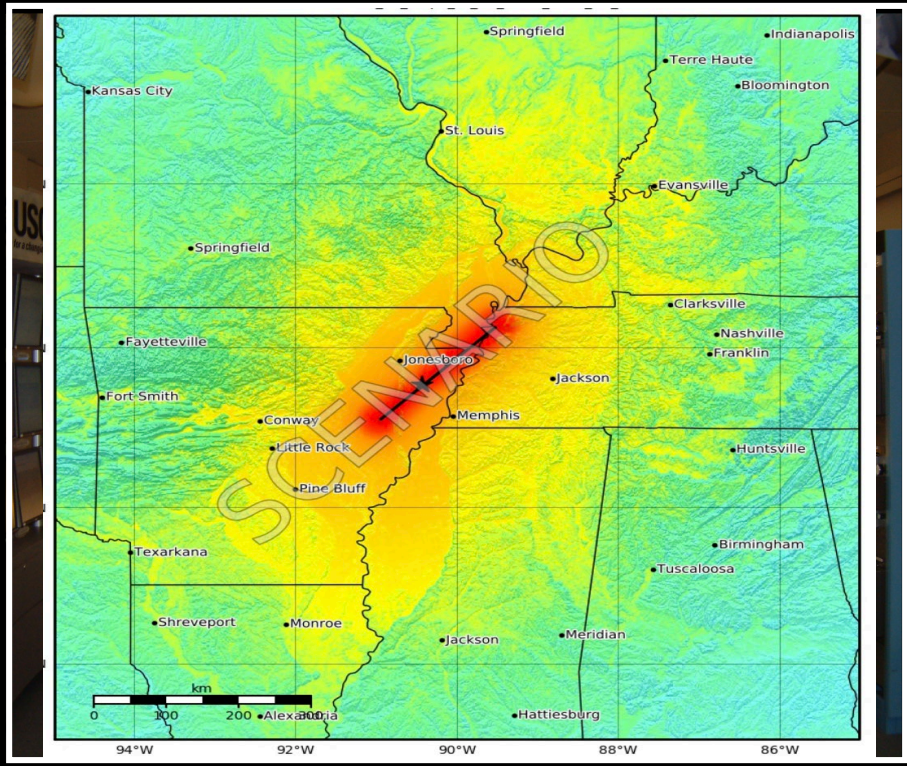
Earthquake Summit 2022
March 3
Saint Louis Science Center



Outline

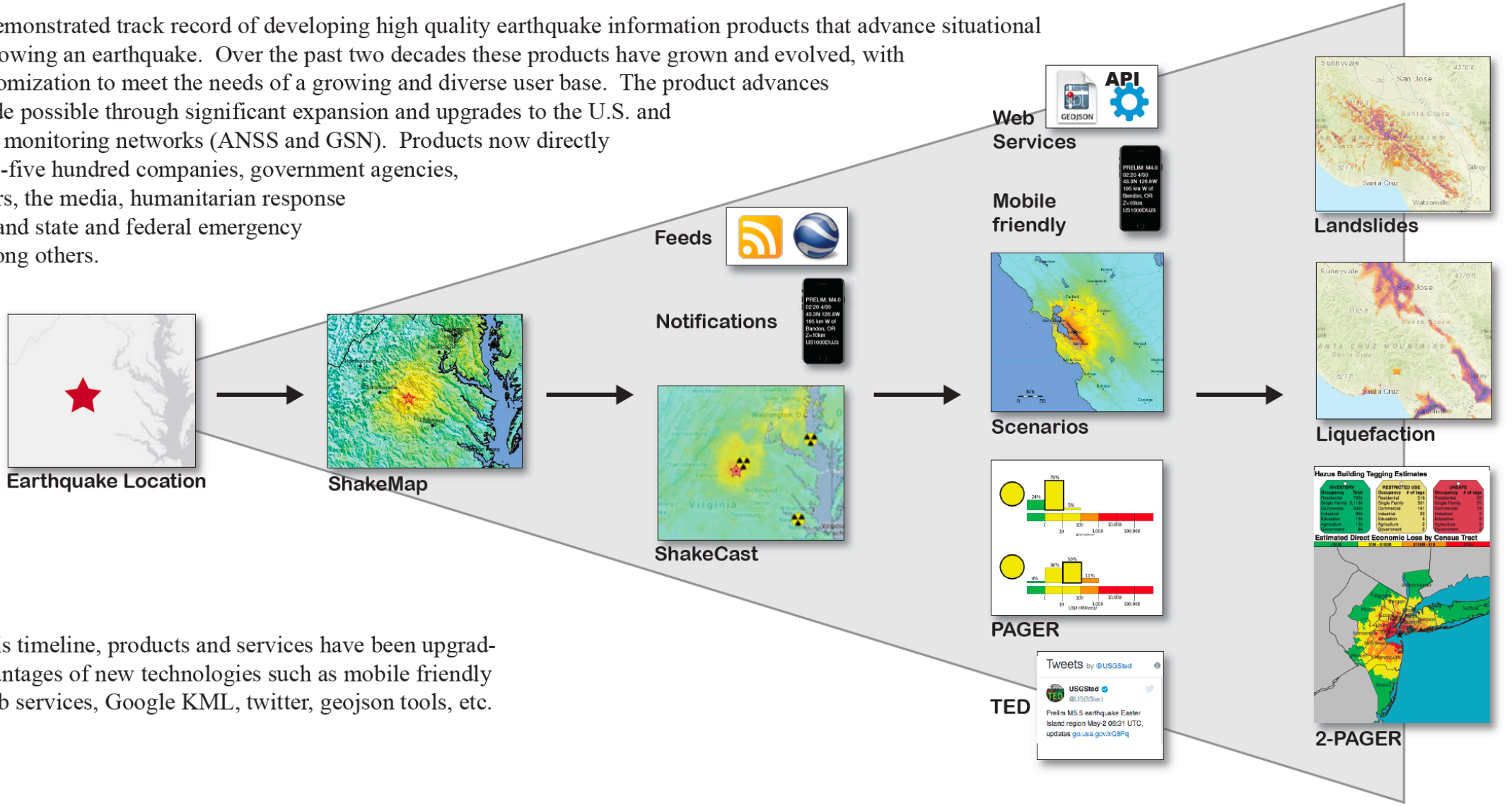
- Background on the USGS real-time **Earthquake Information System**
- **ShakeMap** Ingredients
- **ShakeCast** for Planning & Response
  - Background
  - Uses & Users
  - Specific Role of ShakeCast for Transportation
- **Earthquake Scenarios**

USGS

Growth of Earthquake Information and Products Over Time

Courtesy of Lisa Wald, USGS

USGS has a demonstrated track record of developing high quality earthquake information products that advance situational awareness following an earthquake. Over the past two decades these products have grown and evolved, with increased customization to meet the needs of a growing and diverse user base. The product advances have been made possible through significant expansion and upgrades to the U.S. and global seismic monitoring networks (ANSS and GSN). Products now directly inform fortune-five hundred companies, government agencies, utility operators, the media, humanitarian response organizations and state and federal emergency managers, among others.



Throughout this timeline, products and services have been upgraded to take advantages of new technologies such as mobile friendly web pages, web services, Google KML, twitter, geojson tools, etc.

TIME	PRE-1997	1998-2004	2005-2010	2011-2017	2018

USGS Earthquake Program/NEIC Web Presence

USGS

USGS All Earthquakes, Pas Week

2340 earthquakes.

☐ Only List Earthquakes Shown on Map

Format: Magnitude | Sort: Newest First

0.6	7km SSW of Idyllwild, CA 2020-10-16 08:40:49 (UTC-06:00)	14.4 km
1.5	54 km NNW of Petersville, Alaska 2020-10-16 08:24:52 (UTC-06:00)	23.0 km
1.8	13km NE of Coso Junction, CA 2020-10-16 08:19:03 (UTC-06:00)	1.9 km
1.7	9 km NNW of Perry, Oklahoma 2020-10-16 08:05:57 (UTC-06:00)	6.7 km
2.2	14 km NW of Venetie, Alaska 2020-10-16 08:04:31 (UTC-06:00)	11.8 km
2.4	67 km S of Shungnak, Alaska 2020-10-16 07:28:53 (UTC-06:00)	0.0 km
0.9	15km N of Borrego Springs, CA 2020-10-16 07:14:12 (UTC-06:00)	4.0 km
1.9	4km SE of Charter Oak, CA 2020-10-16 07:10:21 (UTC-06:00)	4.3 km
1.9	16 km E of Happy Valley, Alaska 2020-10-16 07:03:37 (UTC-06:00)	46.8 km
1.3	8 km NNE of Ames, Oklahoma 2020-10-16 06:59:49 (UTC-06:00)	5.9 km

First 'Product' = Earthquake location & magnitude: Available within **< 3-8 mins** domestically & **< 15** mins globally. Other products then follow…

300 km / 200 mi

44.147°N : 95.187°W

Leaflet | Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

USGS science for a changing world CISN

Earthquake Hazards Program

← Latest Earthquakes

Overview

Interactive Map

Regional Information

Impact

Felt Report - Tell Us!

Did You Feel It?

ShakeMap

PAGER

Ground Failure

Technical

Origin

Moment Tensor

Focal Mechanism

Finite Fault

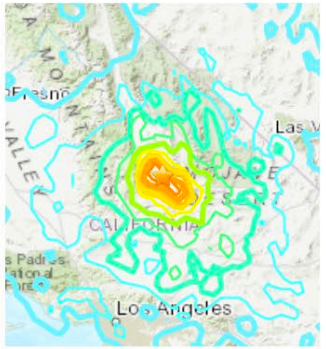
Waveforms

M 7.1 – 2019 Ridgecrest Earthquake Sequence

2019-07-06 03:19:53 (UTC) | 35.770°N 117.599°W | 8.0 km depth

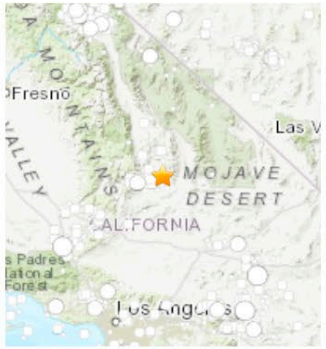
Plus, feeds, API's, Alerting

Interactive Map



Contributed by CI [5]

Regional Information



Contributed by CI [5]

Felt Report - Tell Us!

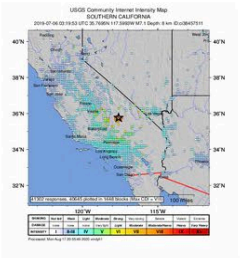
0	4	1	3	0	2

Responses

Contribute to citizen science. Please tell us about your experience.

Citizen Scientist Contributions

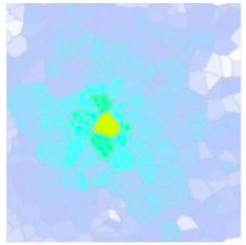
Did You Feel It? VIII



Community Internet Intensity Map

Contributed by US [7]

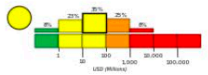
ShakeMap IX



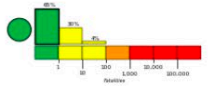
Estimated Intensity Map

Contributed by ATLAS [3]

PAGER YELLOW



Estimated Economic Losses



Estimated Fatalities

Contributed by US [7]

Ground Failure

Landslide Estimate

Limited area affected

Little or no population exposed

Liquefaction Estimate

Limited area affected

Little or no population exposed

Contributed by US [7]

Origin

Review Status

REVIEWED

Magnitude

7.1 mw

Depth

8.0 km

Time

2019-07-06 03:19:53 UTC

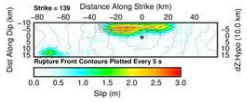
Contributed by CI [5]

Moment Tensor

Fault Plane Solution

Contributed by CI [5]

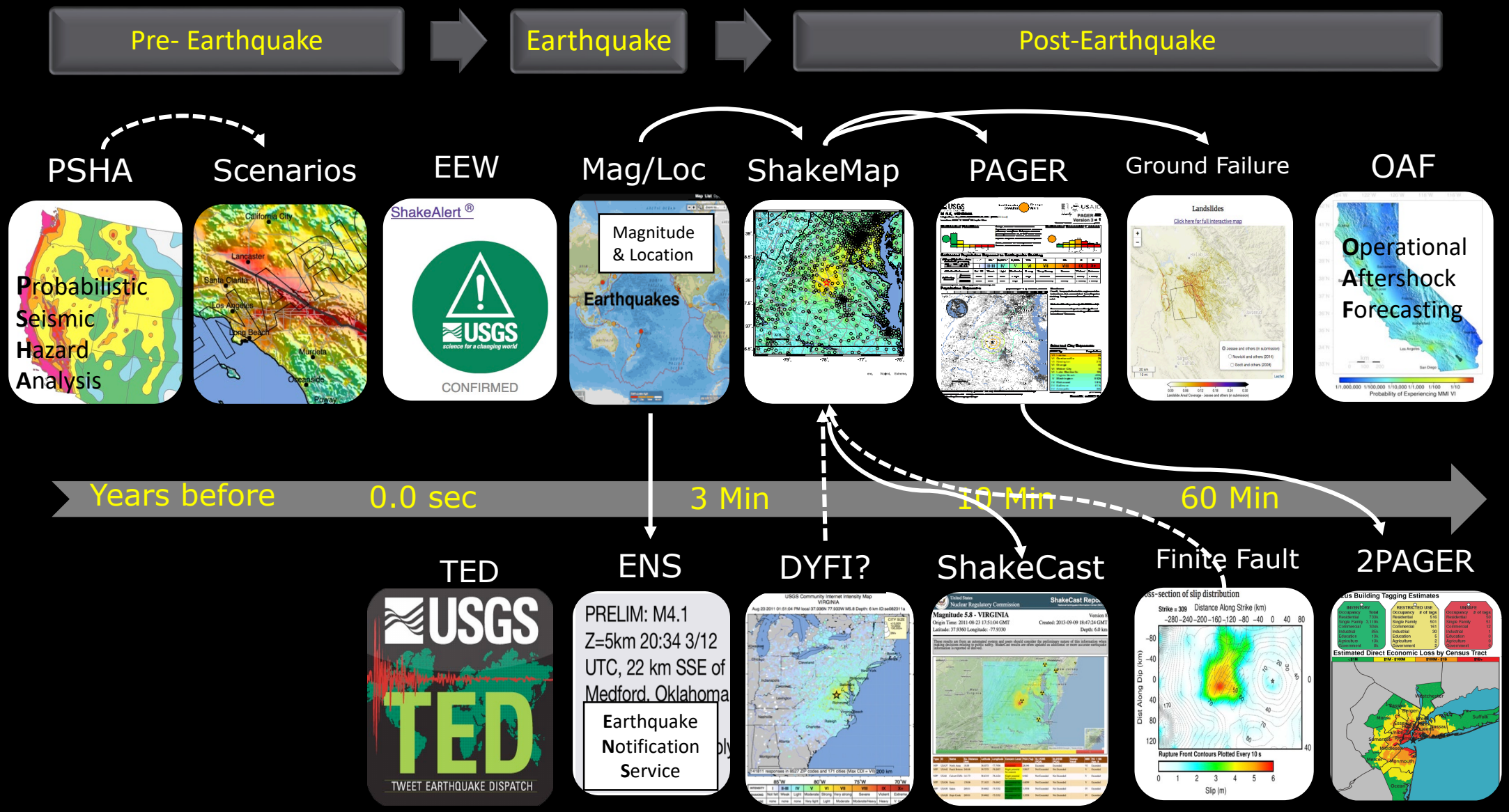
Finite Fault



Cross-section of slip distribution.

Contributed by US [7]

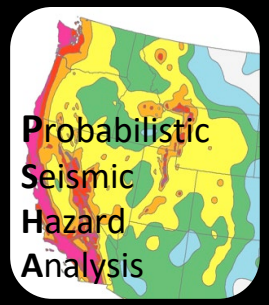
USGS Earthquake Information System



USGS Earthquake Information System

Pre- Earthquake → Earthquake → Post-Earthquake

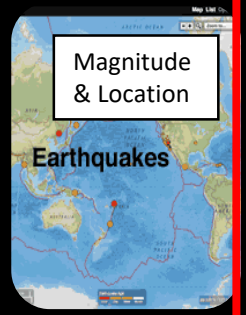
PSHA



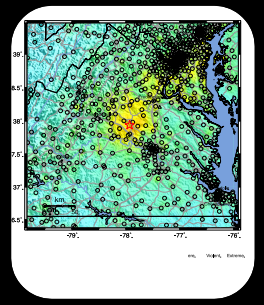
Scenarios

EEW

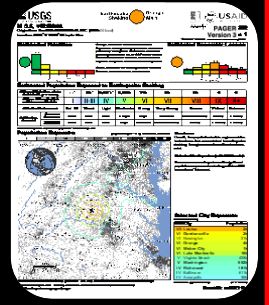
Mag/Loc



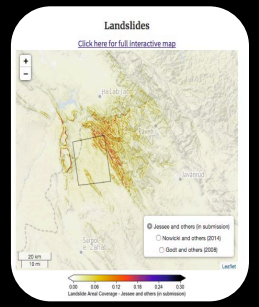
ShakeMap



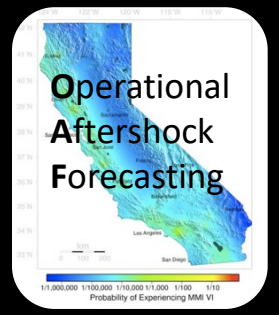
PAGER



Ground Failure

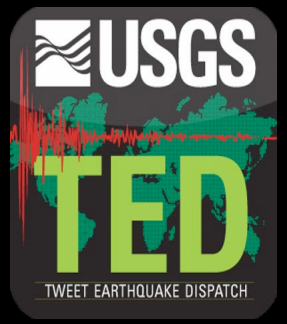


OAF

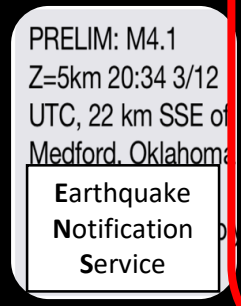


Years before → 0.0 sec → 3 Min → 10 Min → 60 Min

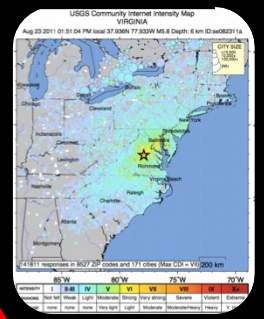
TED



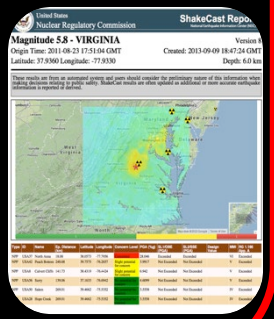
ENS



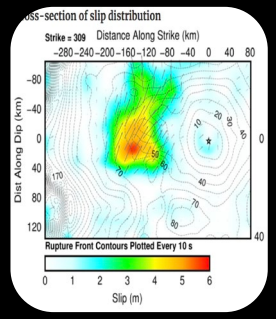
DYFI?



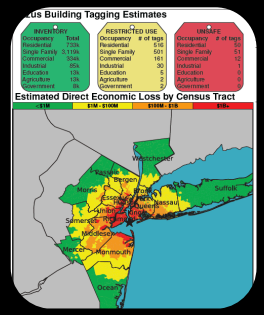
ShakeCast



Finite Fault



2PAGER



ShakeCast

PAGER (Prompt Assessment of Global Earthquakes for Response)

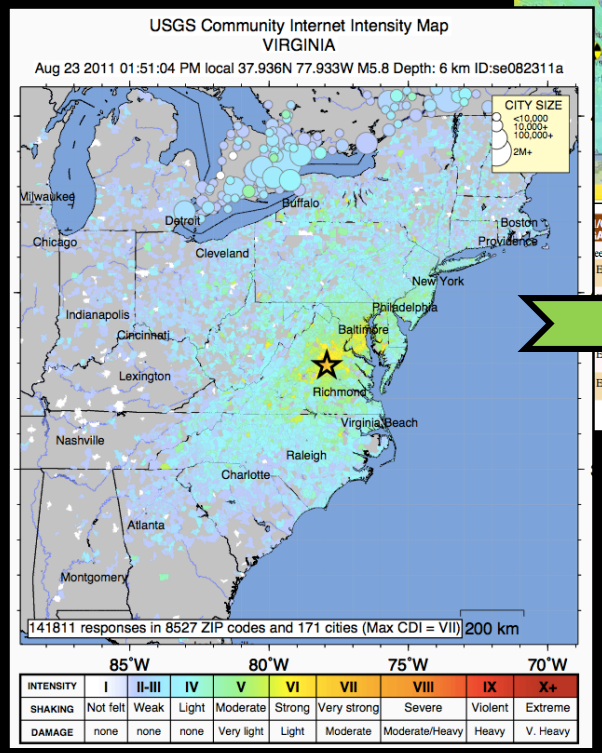
United States Nuclear Regulatory Commission

ShakeCast Report
National Earthquake Information Center (NEIC)

Magnitude 5.8 - VIRGINIA
Version 8
Origin Time: 2011-08-23 17:51:04 GMT
Created: 2013-09-09 18:47:24 GMT
Latitude: 37.9360 Longitude: -77.9330
Depth: 6.0 km

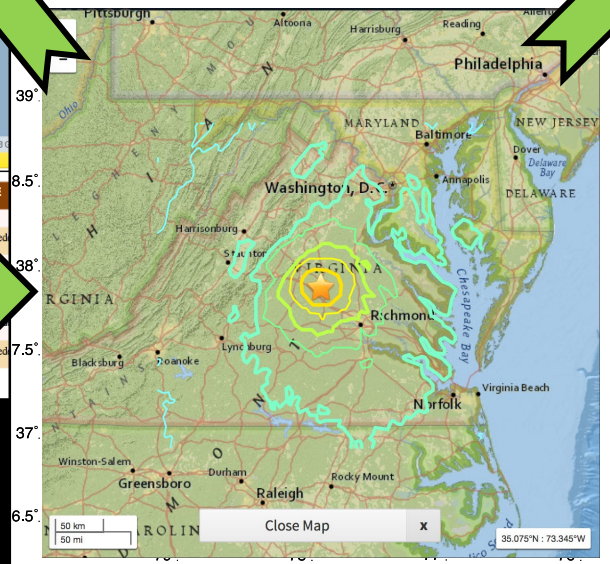
These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.

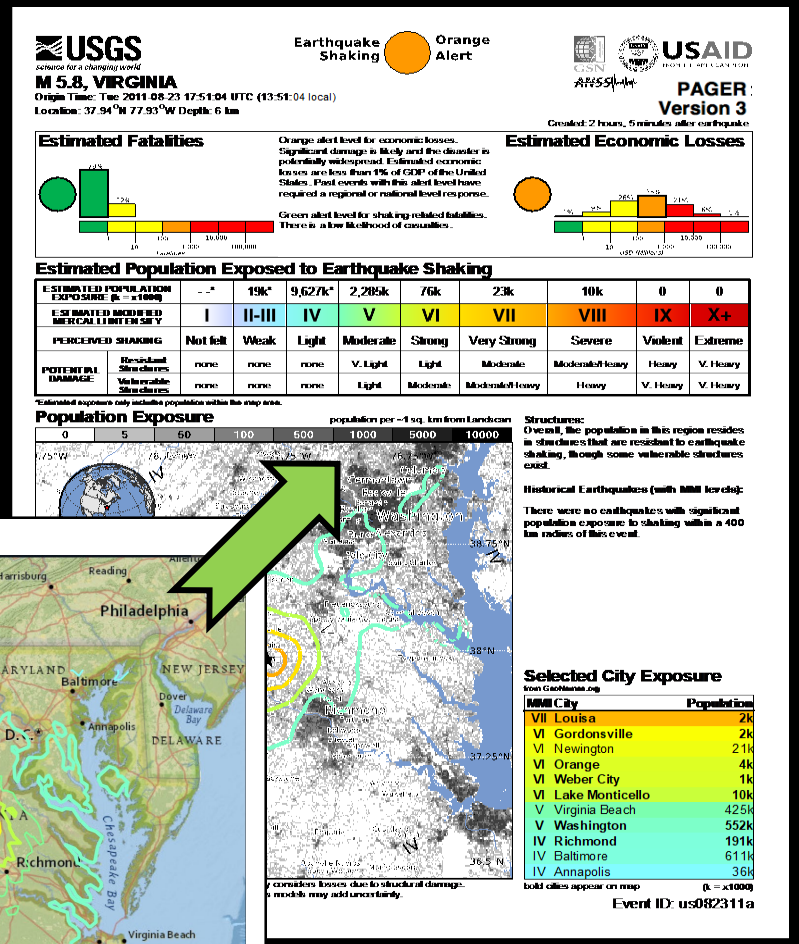
"Did You Feel It?"



INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+
SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

ShakeMap



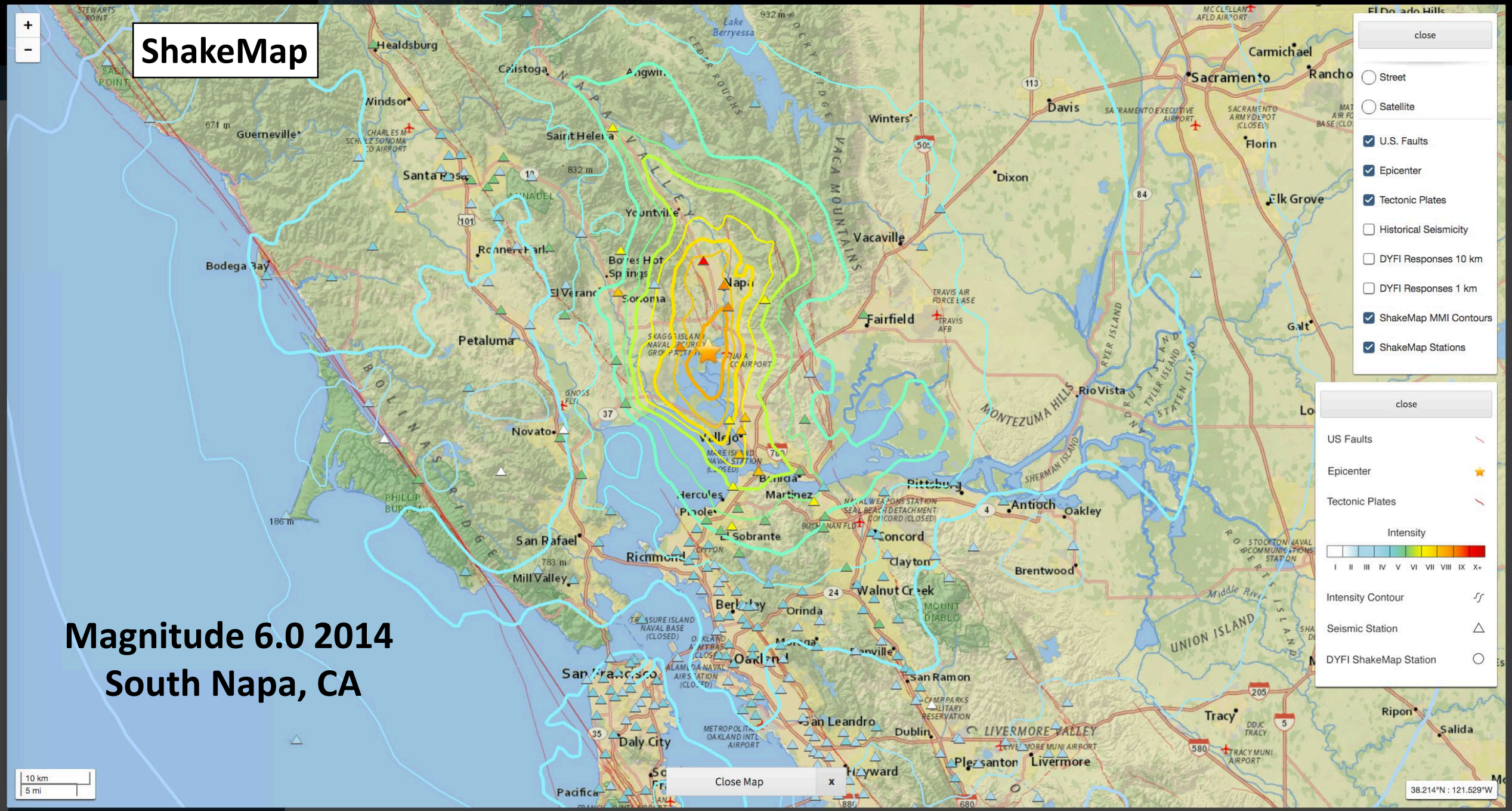


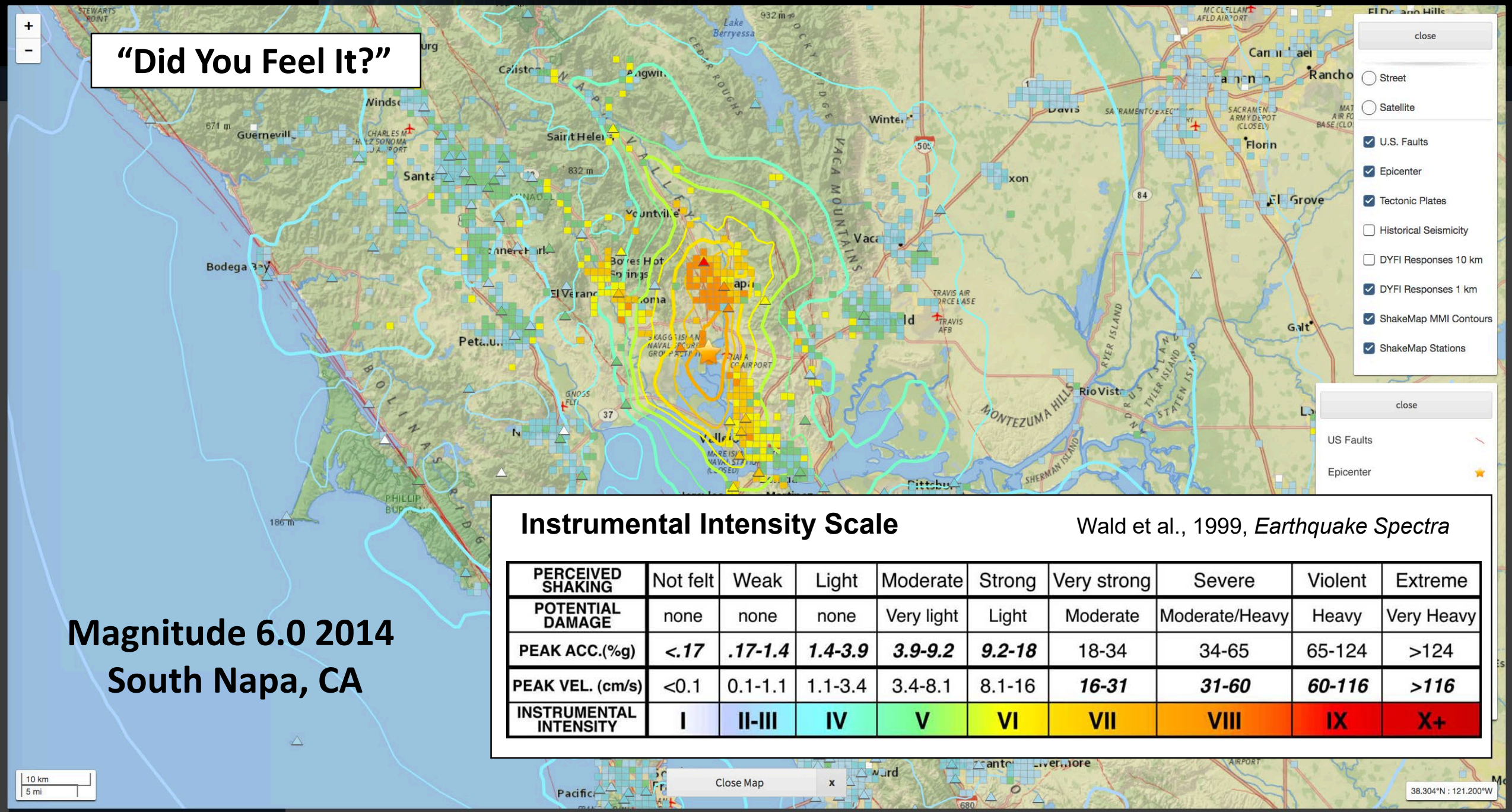
ESTIMATED POPULATION EXPOSURE (k = x1000)		-- *	19k*	9,627k*	2,285k	76k	23k	10k	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy
	Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

0	5	50	100	500	1000	5000	10000

USGS


ShakeMap
Magnitude 6.0 2014
South Napa, CA
close
Street
Satellite
U.S. Faults
Epicenter
Tectonic Plates
Historical Seismicity
DYFI Responses 10 km
DYFI Responses 1 km
ShakeMap MMI Contours
ShakeMap Stations
close
US Faults
Epicenter
Tectonic Plates
Intensity
I II III IV V VI VII VIII IX X+
Intensity Contour
Seismic Station
DYFI ShakeMap Station
Close Map
x
10 km
5 mi
38.214°N : 121.529°W
Napa
Vallejo
Sonoma
Fairfield
Vacaville
Petaluma
Novato
Sacramento
Davis
Dixon
Winters
Healdsburg
Calistoga
Windsor
Santa Rosa
Guerneville
Bodega Bay
Saint Helena
Yountville
Rohnert Park
Bodega Bay
Sebastopol
Martinez
Pittsburg
Antioch
Oakley
Concord
Clayton
Walnut Creek
Brentwood
Richmond
San Rafael
Mill Valley
Berkeley
Orinda
Moraga
Oakland
San Francisco
San Leandro
Dublin
San Ramon
Livermore
Pleasanton
Hayward
Daly City
Pacifica
Tracy
Ripon
Salida
Galt
Elk Grove
Florin
Carmichael
Rio Vista
Lake Berryessa
NAPA VALLEY
VACA MOUNTAINS
MONTEZUMA HILLS
LIVERMORE VALLEY
UNION ISLAND
BOLINAS RIDGE



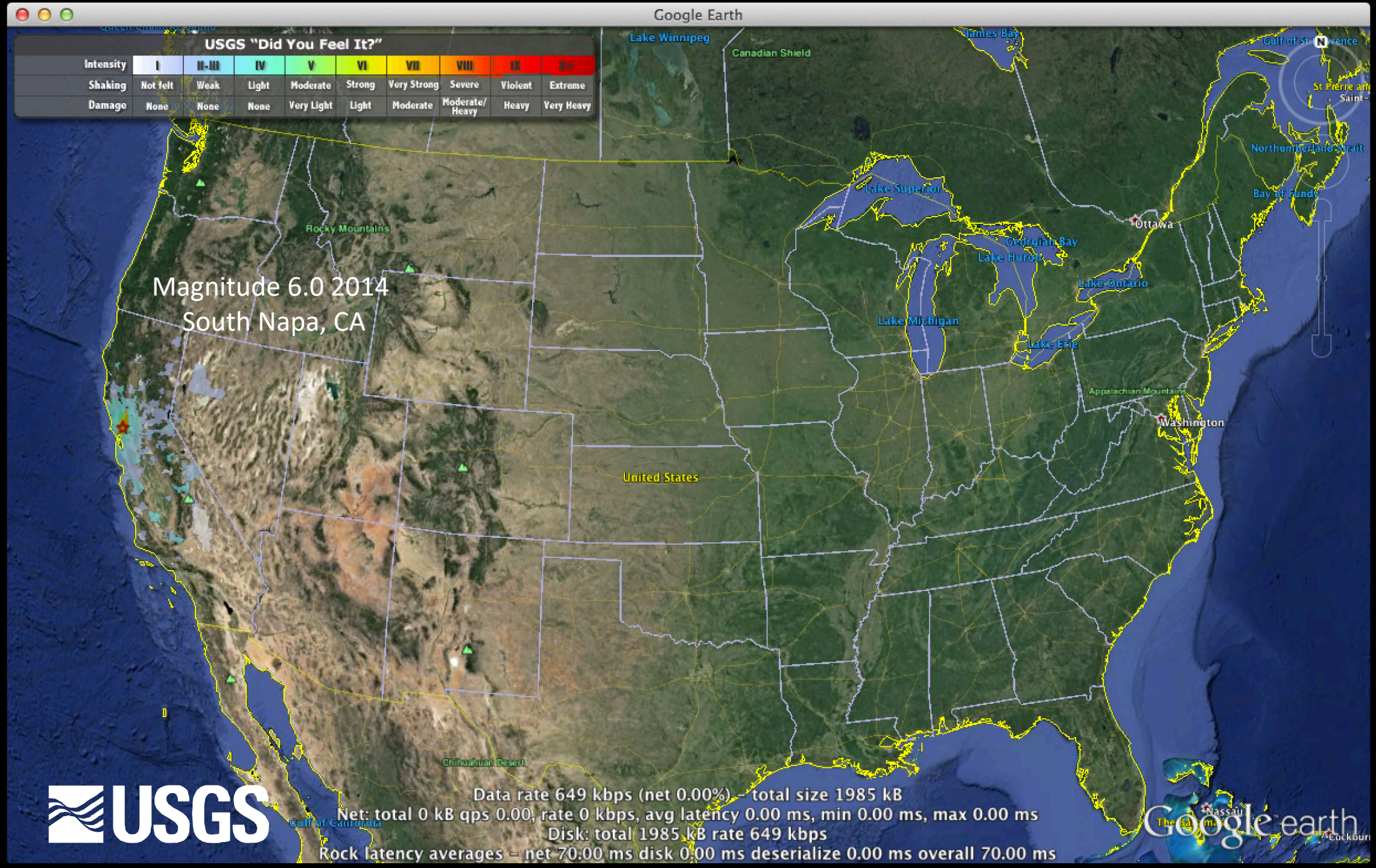
"Did You Feel It?"

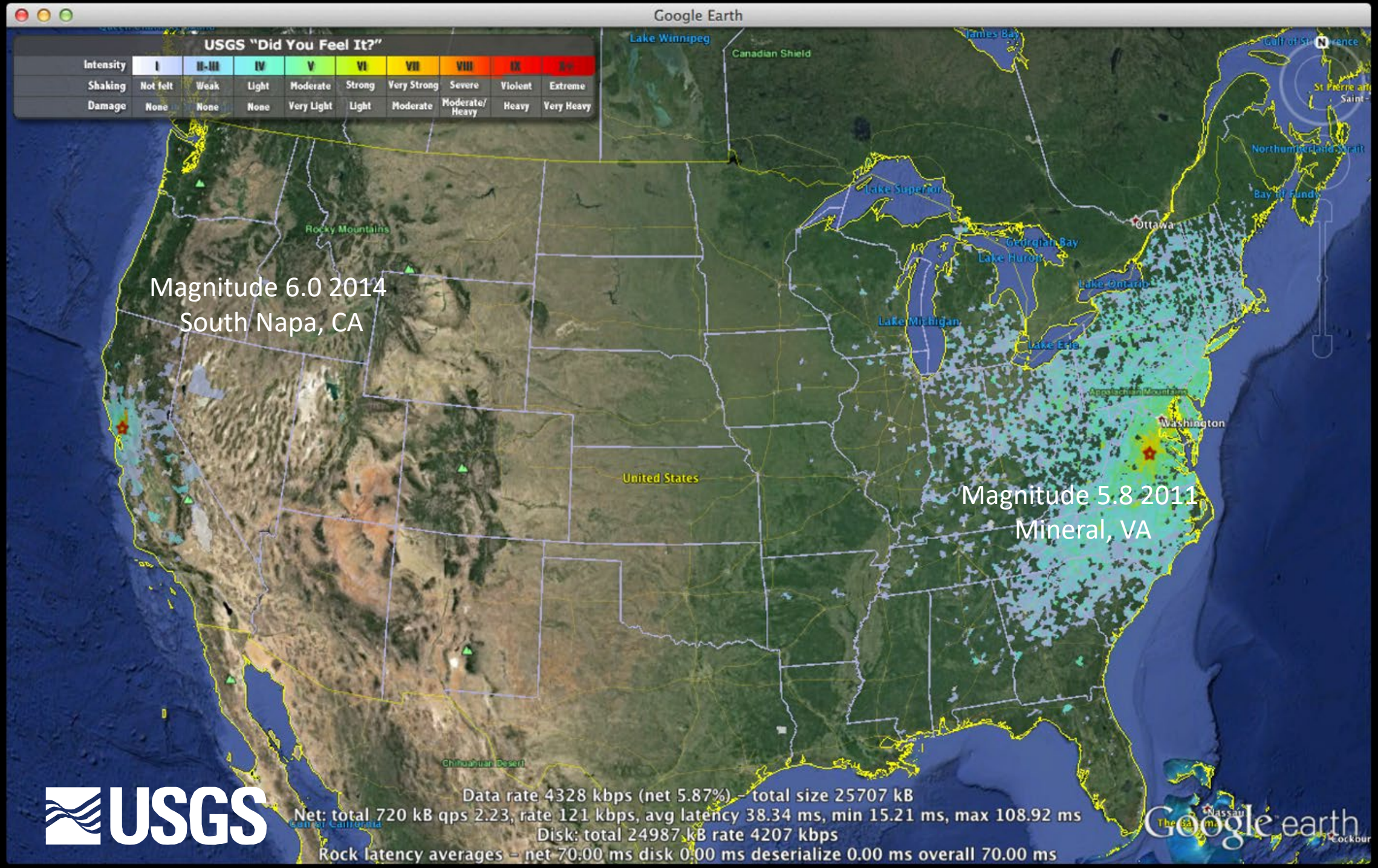
Instrumental Intensity Scale

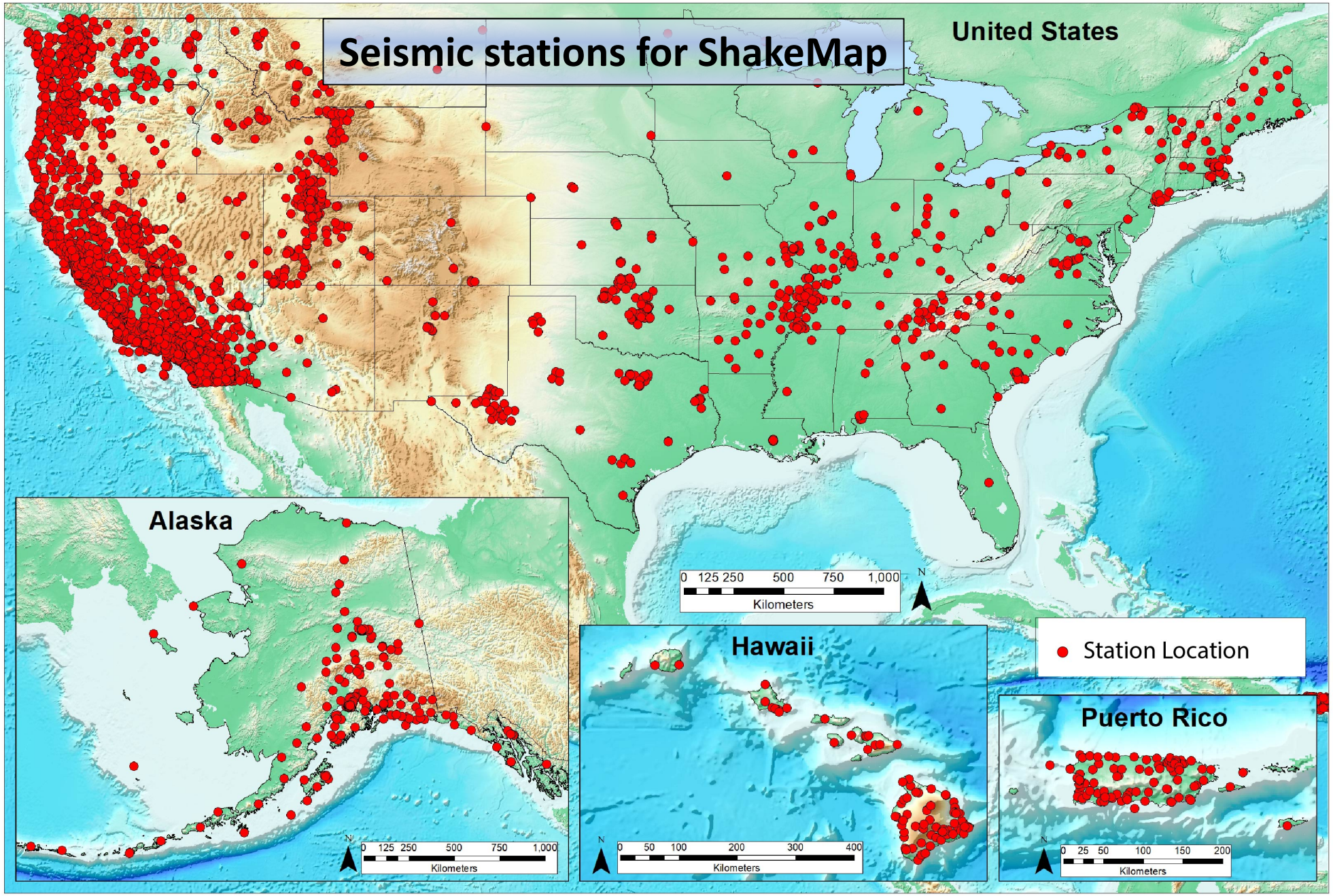
Wald et al., 1999, *Earthquake Spectra*

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	*<.17*	*.17-1.4*	*1.4-3.9*	*3.9-9.2*	*9.2-18*	18-34	34-65	65-124	>124
PEAK VEL. (cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	*16-31*	*31-60*	*60-116*	*>116*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Magnitude 6.0 2014 South Napa, CA


Google Earth
USGS "Did You Feel It?"
Intensity | I | II-III | IV | V | VI | VII | VIII | IX | X+
Shaking | Not felt | Weak | Light | Moderate | Strong | Very Strong | Severe | Violent | Extreme
Damage | None | None | None | Very Light | Light | Moderate | Moderate/ Heavy | Heavy | Very Heavy
Magnitude 6.0 2014
South Napa, CA
Lake Winnipeg
Canadian Shield
James Bay
Rocky Mountains
Lake Superior
Georgian Bay
Lake Huron
Lake Ontario
Lake Michigan
Lake Erie
Ottawa
Appalachian Mountains
Washington
United States
Chihuahuan Desert
Gulf of California
Nassau
Data rate 649 kbps (net 0.00%) - total size 1985 kB
Net: total 0 kB qps 0.00, rate 0 kbps, avg latency 0.00 ms, min 0.00 ms, max 0.00 ms
Disk: total 1985 kB rate 649 kbps
Rock latency averages - net 70.00 ms disk 0.00 ms deserialize 0.00 ms overall 70.00 ms
USGS
Google earth


Google Earth
USGS "Did You Feel It?"
Intensity | I | II-III | IV | V | VI | VII | VIII | IX | X+
Shaking | Not felt | Weak | Light | Moderate | Strong | Very Strong | Severe | Violent | Extreme
Damage | None | None | None | Very Light | Light | Moderate | Moderate/ Heavy | Heavy | Very Heavy
Magnitude 6.0 2014
South Napa, CA
Magnitude 5.8 2011
Mineral, VA
Lake Winnipeg
Canadian Shield
James Bay
Rocky Mountains
Lake Superior
Georgian Bay
Lake Huron
Lake Michigan
Lake Ontario
Lake Erie
Ottawa
Washington
United States
Chihuahuan Desert
Data rate 4328 kbps (net 5.87%) - total size 25707 kB
Net: total 720 kB qps 2.23, rate 121 kbps, avg latency 38.34 ms, min 15.21 ms, max 108.92 ms
Disk: total 24987 kB rate 4207 kbps
Rock latency averages - net 70.00 ms disk 0.00 ms deserialize 0.00 ms overall 70.00 ms
USGS
Google earth



Alaska: Geographic Coordinate System: GCS_North_American_1983
Projected Coordinate System: Alaska Albers Equal Area Conic

US, HI, PR: Geographic Coordinate System: GCS_WGS_1984
Datum: D_WGS_1984

Hillshade: Amante and Eakins (2009), ETOPO1

← Latest Earthquakes

Overview
Interactive Map
Regional Information

Impact
Felt Report - Tell Us!
Did You Feel It?
ShakeMap
PAGER
Ground Failure

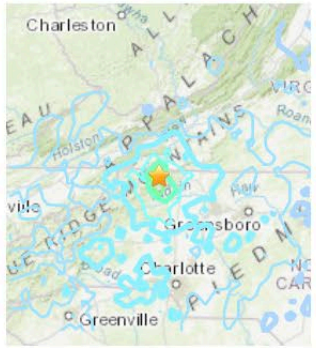
Technical
Origin
Moment Tensor
Waveforms
Aftershock Forecast

Download Event KML

M 5.1 – 4 km SE of Sparta, North Carolina

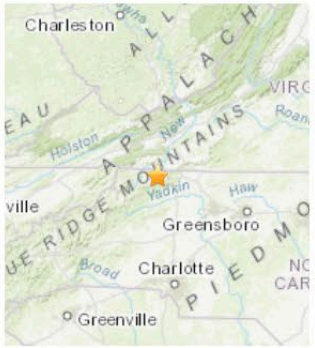
2020-08-09 12:07:37 (UTC) | 36.474°N 81.087°W | 4.1 km depth

Interactive Map



Contributed by SE [2]

Regional Information



Contributed by SE [2]

Felt Report - Tell Us!

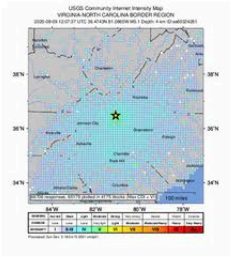
0 6 6 7 0 6

Responses

Contribute to citizen science. Please tell us about your experience.

Citizen Scientist Contributions

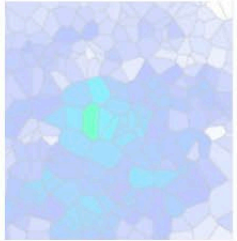
Did You Feel It? VII



Community Internet Intensity Map

Contributed by US [3]

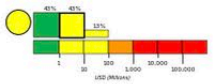
ShakeMap VII



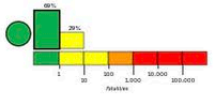
Estimated Intensity Map

Contributed by US [3]

PAGER YELLOW



Estimated Economic Losses



Estimated Fatalities

Contributed by US [3]

Ground Failure

Landslide Estimate

Little or no area affected

Little or no population exposed

Liquefaction Estimate

Little or no area affected

Little or no population exposed

Contributed by US [3]

Origin

Review Status
REVIEWED

Magnitude
5.1 mw

Depth
4.1 km

Time
2020-08-09 12:07:37 UTC

Contributed by SE [2]

Moment Tensor

Fault Plane Solution

Contributed by US [3]

Aftershock Forecast

Be ready for more earthquakes.

Our model of the expected numbers and odds of future earthquakes.

Contributed by US [3]

View Nearby Seismicity

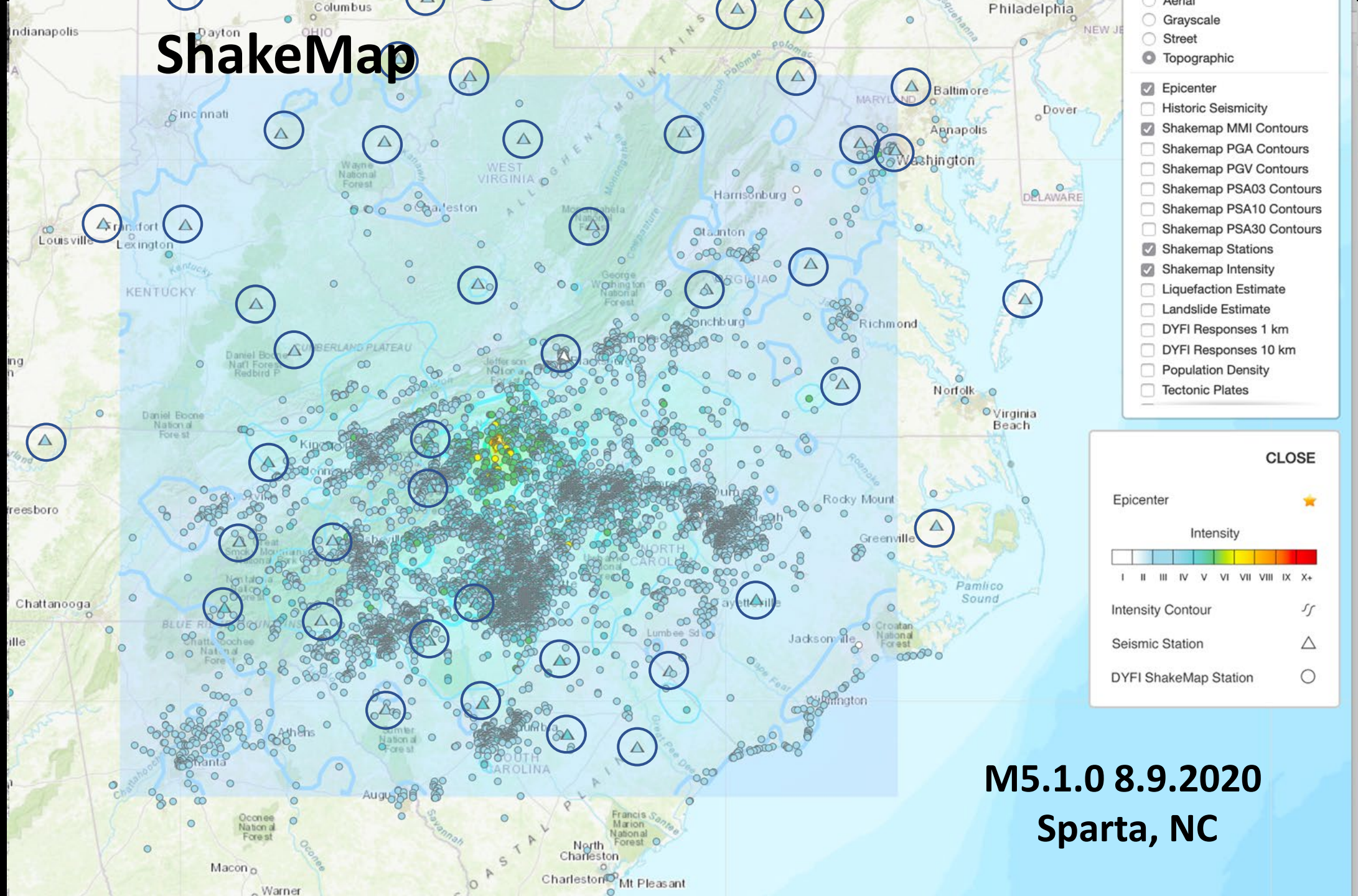
Time Range
± Three Weeks

Search Radius
250.0 km

Magnitude Range
≥ 2.0

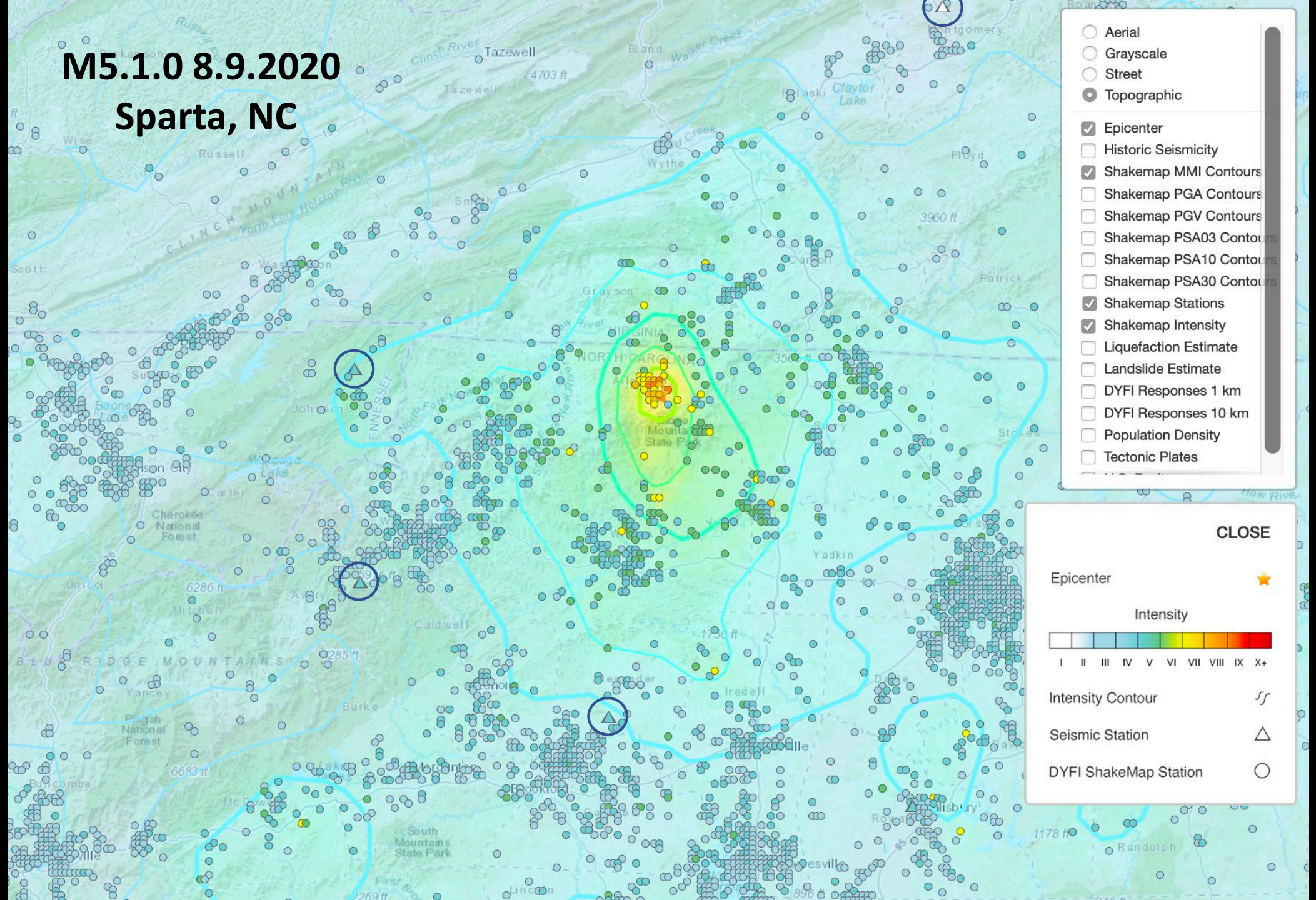
ANSS Comcat

ShakeMap



M5.1.0 8.9.2020
Sparta, NC

M5.1.0 8.9.2020
Sparta, NC



PAGER

USGS science for a changing world

Earthquake Shaking — Yellow Alert

USAID FROM THE AMERICAN PEOPLE

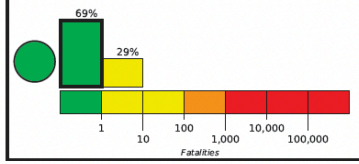
M 5.1, Virginia-North Carolina border region

Origin Time: 2020-08-09 12:07:37 UTC (Sun 08:07:37 local)
Location: 36.4743° N 81.0865° W Depth: 4.1 km

PAGER Version 11

Created: 9 weeks, 4 days after earthquake

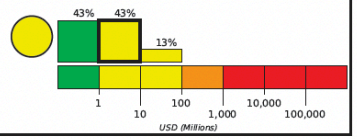
Estimated Fatalities



Yellow alert for economic losses. Some damage is possible and the impact should be relatively localized. Estimated economic losses are less than 1% of GDP of the United States. Past events with this alert level have required a local or regional level response.

Green alert for shaking-related fatalities. There is a low likelihood of casualties.

Estimated Economic Losses



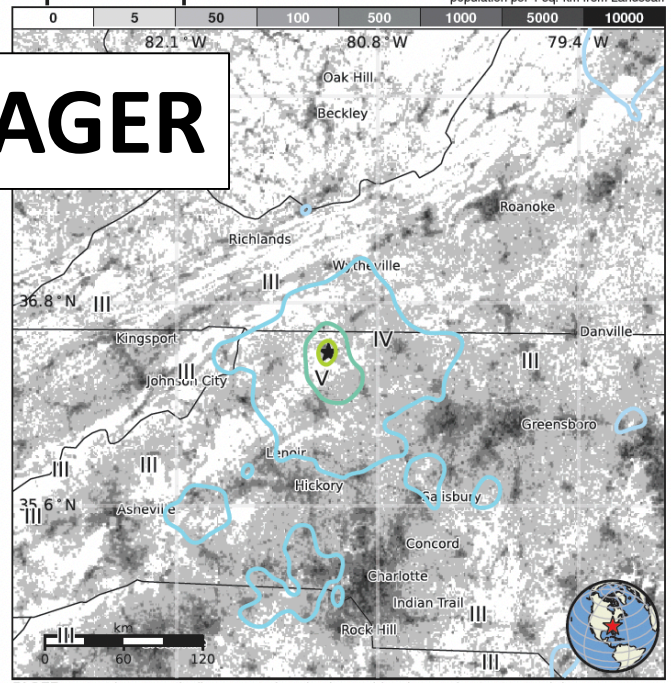
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		–*	10,274k*	999k	26k	4k	2k	0	0	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	None	None	None	V. Light	Light	Moderate	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per 1 sq. km from Landscan



Structures

Overall, the population in this region resides in structures that are resistant to earthquake shaking, though vulnerable structures exist. The predominant vulnerable building types are unreinforced brick masonry and reinforced masonry construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1974-08-02	316	4.9	V(12k)	–
1973-11-30	268	4.6	V(190k)	–
1980-07-27	317	5.0	VI(50k)	0

Selected City Exposure

from GeoNames.org

MMI	City	Population
VI	Sparta	2k
V	Hays	2k
V	Thurmond	2k
V	Jonesville	2k
IV	Elkin	4k
IV	Fairplains	2k
III	Winston-Salem	230k
III	**Greensboro**	**270k**
III	**Charlotte**	**731k**
III	Durham	228k
III	Fayetteville	201k

bold cities appear on map. (k=x1000)

PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
https://earthquake.usgs.gov/earthquakes/eventpage/se60324281#pager

Event ID: se60324281

TwoPAGER

USGS science for a changing world

Earthquake Shaking — Yellow Alert

FEMA

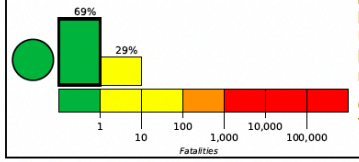
M 5.1, 4 km SE of Sparta, North Carolina

Origin Time: 2020-08-09 12:07:37 UTC (Sun 08:07:37 local)
Location: 36.4835° N 81.1053° W Depth: 5.0 km

Hazus-PAGER Version 1

Created: 1 week, 3 days after earthquake

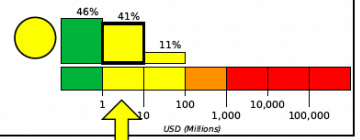
PAGER Estimated Fatalities



Yellow alert for economic losses. Some damage is possible and the impact should be relatively localized. Estimated economic losses are less than 1% of GDP of the United States. Past events with this alert level have required a local or regional level response.

Green alert for shaking-related fatalities. There is a low likelihood of casualties.

PAGER Est Economic Losses

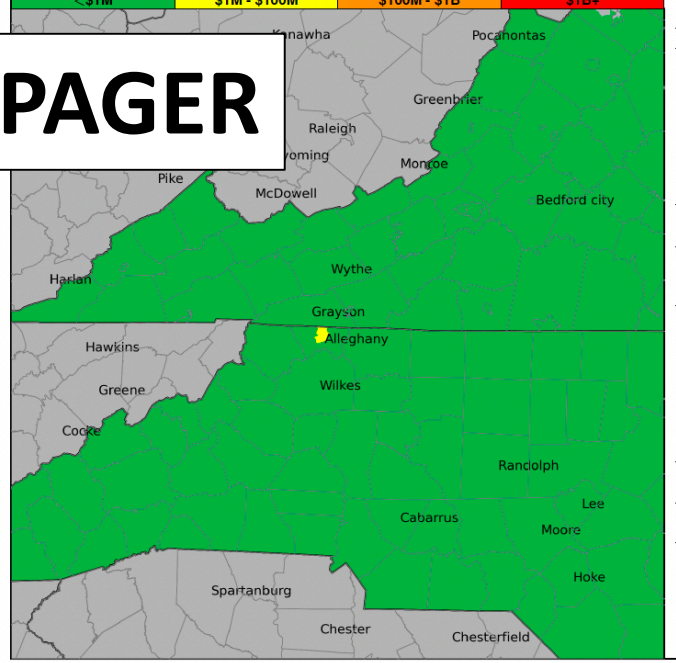


Hazus Estimate

Hazus Building Tagging Estimates

INSPECTED		RESTRICTED USE		UNSAFE	
Occupancy	# of tags	Occupancy	# of tags	Occupancy	# of tags
Residential	37	Residential	0	Residential	0
Commercial	2	Commercial	0	Commercial	0
Industrial	0	Industrial	0	Industrial	0
Education	0	Education	0	Education	0
Agriculture	0	Agriculture	0	Agriculture	0
Government	0	Government	0	Government	0

Estimated Direct Economic Loss by Census Tract



Direct Economic Losses by County

County	State	Total ($M)
Alleghany	NC	3
Wilkes	NC	0
Grayson	VA	0
Surry	NC	0
Ashe	NC	0
Galax city	VA	0
Carroll	VA	0
Total (234 counties)		**3**

Non-Fatal Injuries by County

County	State	Population	Total NFI
Alleghany	NC	11k	0
Wilkes	NC	69k	0
Grayson	VA	16k	0
Surry	NC	74k	0
Ashe	NC	27k	0
Galax city	VA	7k	0
Carroll	VA	30k	0
Total (234 counties)		**17,537k**	**0**

Shelter Needs by County

County	State	Total House holds	Displ House holds	Total People
Alleghany	NC	5k	0	0
Wilkes	NC	28k	0	0
Grayson	VA	7k	0	0
Surry	NC	30k	0	0
Ashe	NC	12k	0	0
Galax city	VA	3k	0	0
Carroll	VA	13k	0	0
Total (234 counties)		**6,801k**	**0**	**0**

Earthquake Debris

Category	Tons (millions)
Brick / Wood	0.000
Reinforced Concrete / Steel	0.000
Total	**0.000**
Truck Loads (@25 tons/truck)	**4**

Hazus-PAGER content is automatically generated. Limitations of input data may add uncertainty.
https://earthquake.usgs.gov/earthquakes/eventpage/se60324281#pager
gis.fema.gov

Event ID: se60324281

Overview: What is ShakeCast?

- **Open-source USGS software**; user installs (or USGS hosts).
- ***Automatically* retrieves ShakeMap & compares shaking levels with unique facility fragilities**.
- **Generates & delivers report of inspection priorities** (hierarchical lists of facilities likely impacted).
- **Sends notifications & reports to specified personnel/responders**.
- Raises post-earthquake situational awareness in first min. to hrs. following an earthquake.

South Carolina State Department of Transportation

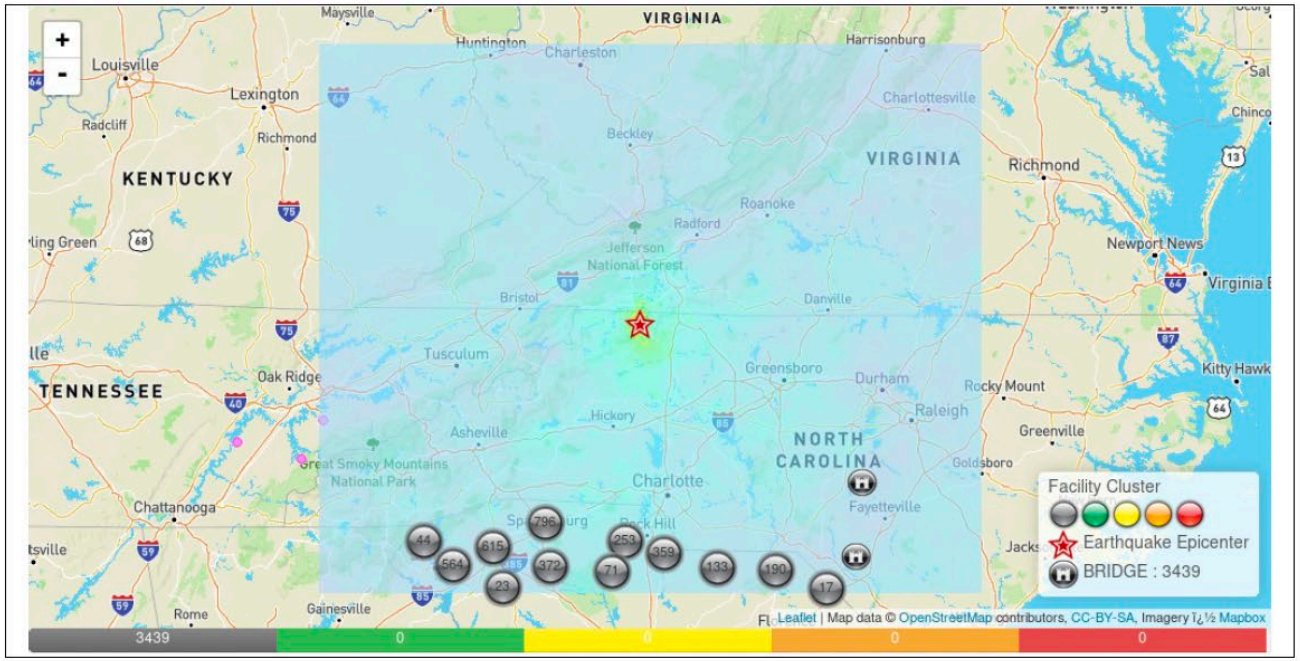
ShakeCast Report
National Earthquake Information Center (NEIC)

Magnitude 5.1 - 2 km SSE of Sparta, North Carolina, Version 7

Origin Time: 2020-08-09 08:07:37EDT Process Time: 2020-08-10 10:55:38EDT

Latitude: 36.4835 Longitude: -81.1053 Depth: 5.0 km

These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.



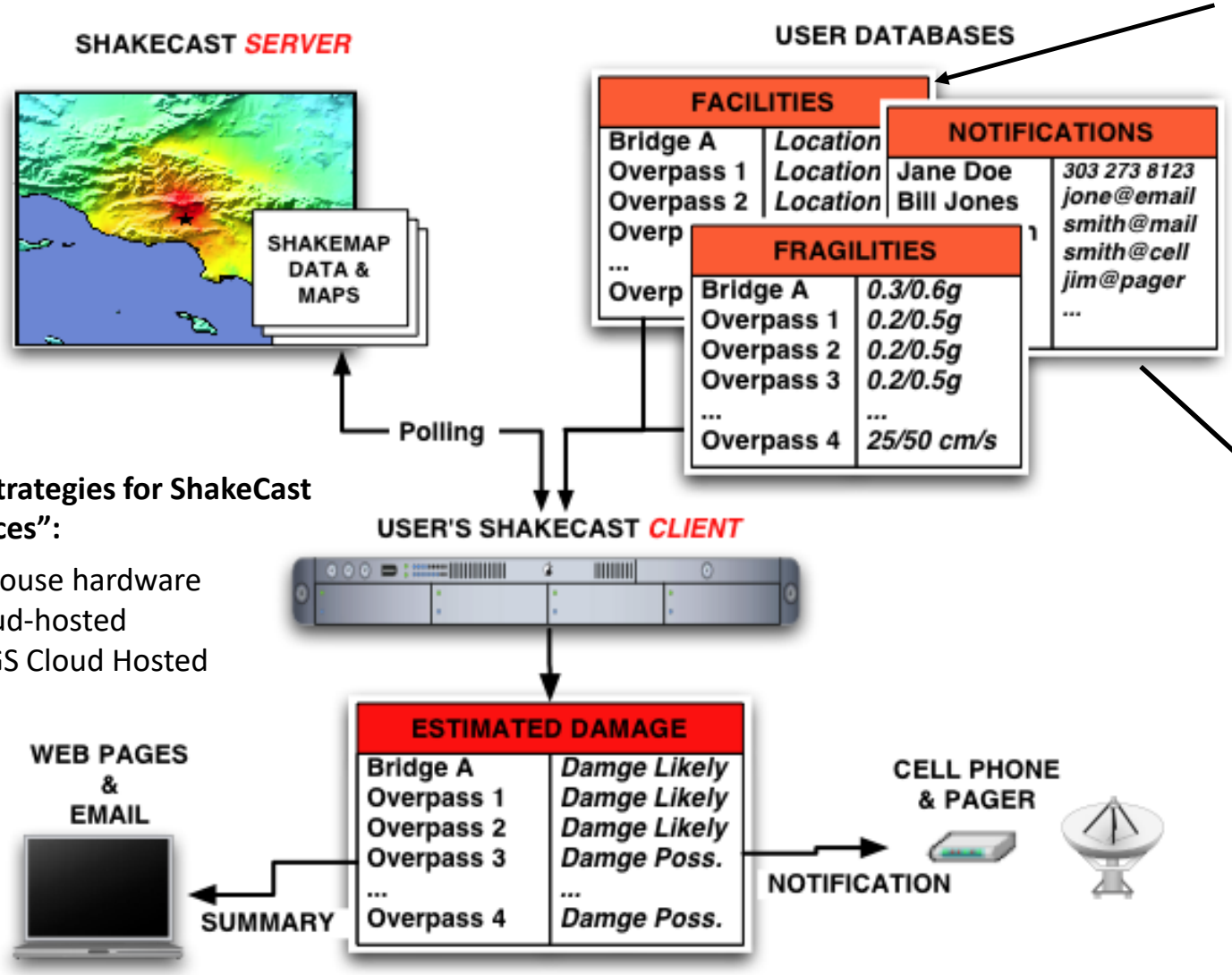
Type	ID	Name	Ep. Distance (km)	Inspection Priority	PGA (%g)	PGV (cm/s)	PSA 1s (%g)	MMI	Vs30 (m/s)
BRIDGE	45_000000000007516	000000000007516 - NORTH PACOLET RIVER	146.79	Below Threshold	0.7986	0.5531	0.542	IV	491.1
BRIDGE	45_000000000009105	000000000009105 - CROWDERS BRANCH	148.12	Below Threshold	1.445	0.9774	0.8077	IV	360
BRIDGE	45_000000000005878	000000000005878 - CROWDERS CREEK	148.72	Below Threshold	1.11	0.8563	0.801	IV	334.2
BRIDGE	45_000000000005238	000000000005238 - STREAM	148.86	Below Threshold	1.043	0.6061	0.5023	IV	591.7
BRIDGE	45_000000000008701	000000000008701 - BR CATAWBA RIVER	149.08	Below Threshold	0.8164	0.5703	0.5561	IV	484.2
BRIDGE	45_000000000000618	000000000000618 - BEAVER DAM CREEK	149.08	Below Threshold	1.211	0.861	0.7571	IV	383.5

ShakeCast Schematic

13,157 State Bridges
(Modified Hazus SA 1.0 sec)

13,082 Local Bridges
(Hazus SA 1.0 sec)

380 Buildings
(Hazus - PGA)



Three Strategies for ShakeCast "Instances":

- In-house hardware
- Cloud-hosted
- USGS Cloud Hosted

345 Notification recipients

- District Maintenance and Construction
- Traffic Management Centers
- District & Headquarters Emergency Ops Centers
- Structure Construction
- Structure Maintenance & Investigations
- Executive Management
- Public Affairs

California Department of TRANSPORTATION

ShakeCast Report

National Earthquake In

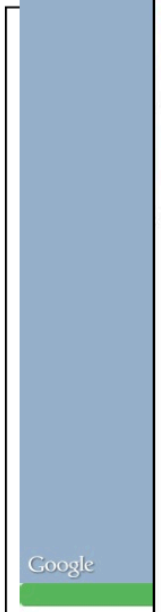
Magnitude 6.7 - Northridge

Origin Time: 1994-01-17 12:30:55 GMT

Created: 2014-02-21

Latitude: 34

These results
making decisi
information is



Type	ID
BRIDGE_ST	53 279
BRIDGE_ST	53 279
BRIDGE_ST	53 279
BRIDGE_ST	53 279
BRIDGE_ST	53 221
BRIDGE_ST	53 220
BRIDGE_ST	53 220
BRIDGE_ST	53 220

United States Department of Veterans Affairs

ShakeCast Report

National Earthquake Information Center (NEIC)

Magnitude 5.1 - 2.4 km (1.5 mi) WNW of Brea, CA

Version 3

4:09:41 GMT

Created: 2014-03-29 04:33:23 GMT

e: -117.9222

Depth: 1.94 km

ed system and users should consider the preliminary nature of this information when

USGS science for a changing world

Dam & Public Safety ShakeCast Report

SOUTHERN CALIFORNIA EDISON An EDISON INTERNATIONAL Company

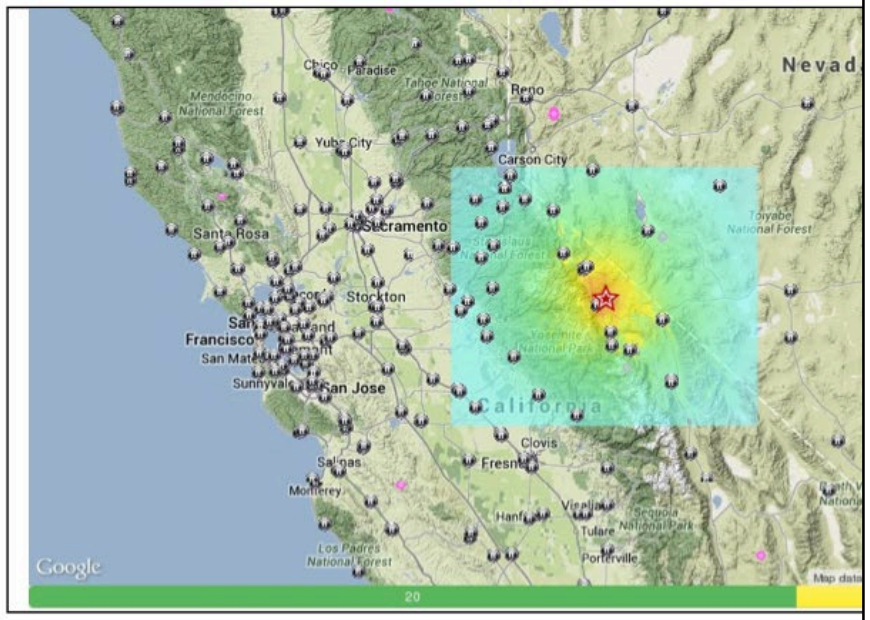
Magnitude 6.8 - Mono Lake

Origin Time: 2012-10-10 12:00:00 GMT

Created: 2

Latitude: 38.0320 Longitude: -119.0640

These results are from an automated system and users should consider the preliminar
making decisions relating to public safety. ShakeCast results are often updated as addit
information is reported or derived.



Name	Ep. Distance (km)	Review / Inspection Priority	PGA (%g)	PGV (cm/s)	PSA
Lundy Lake Dam	13.7	Moderate	32.84	33.24	65.73
Vermillion Valley Dam	73.79	Low	6.24	4.33	13.15
Tioga Lake Dam	20.08	Low	18.23	10.6	38.55
Saddlebag Dam	19.71	Low	18.79	11.02	39.88
Rhinedollar Dam	18.27	Low	19.37	11.46	41.29

IAEA International Atomic Energy Agency

Nuclear ShakeCast International Seismic Safety Centre (ISSC)

M 6.3 - KYUSHU, JAPAN

Version 1

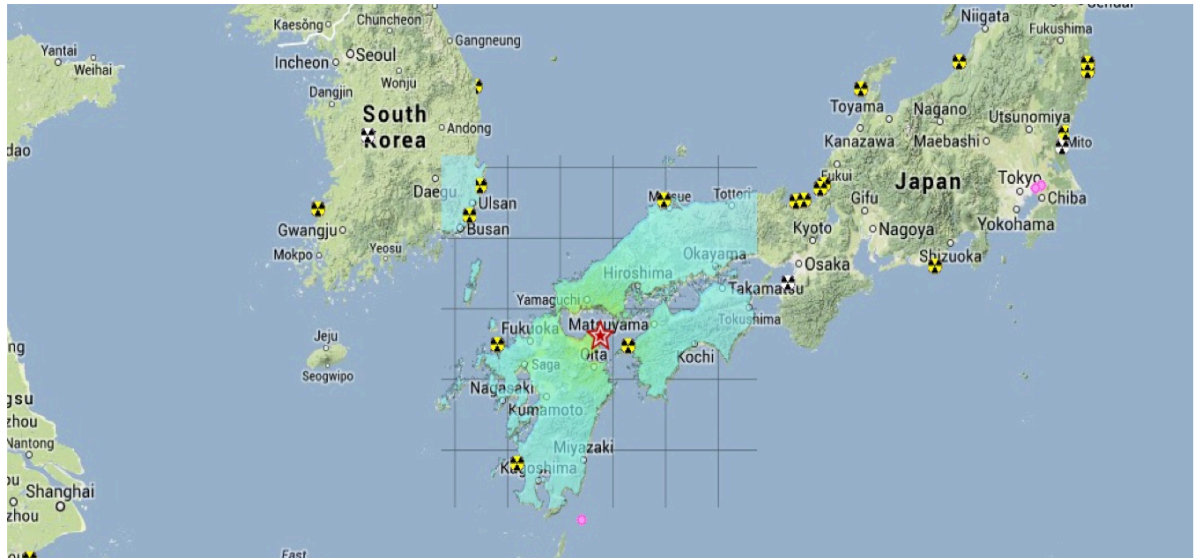
Origin Time: 2014-03-13 17:06:51 GMT

Created: 2014-03-13 17:28:23 GMT

Latitude: 33.6827 Longitude: 131.7366

Depth: 82.92 km

These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as addtional or more accurate earthquake information is reported or derived.



ShakeCast: Sample Critical Users

Agencies

- U.S.NRC
- U.S. Fish & Wildlife Service
- The Montana Department of Natural Resources & Conservation (Montana DNRC)
- US Army Corps of
- State of California Department of Conservation
- Division of Oil, Gas, and Geothermal Resources
- United States Department of Veterans Affairs
- IAEA.org International Atomic Energy Agency

Transportation

- Caltrans
- WSDOT
- LA Metro
- UDOT Keeping Utah Moving
- Nevada DOT
- Idaho Transportation Department
- Oregon Department of Transportation
- Oklahoma Department of Transportation

Business

- Walmart
- Target
- Travelers
- amazon Global Security prepare. secure. protect.
- aem
- Boeing 1916 | 2016

Lifelines/Utilities

- Alameda County Water District — Serving the cities of Fremont, Newark, and Union City, California
- County of Los Angeles Public Works — Public Service That Works
- Southern California Edison — An Edison International Company
- Santa Clara Valley Water District
- San Francisco Water Power Sewer — Services of the San Francisco Public Utilities Commission
- The Metropolitan Water District of Southern California
- East Bay Municipal Utility District
- Los Angeles Department of Water & Power
- Sempra Energy
- Department of Water Resources
- Puget Sound Energy

Critical Facilities

- FERC Federal Energy Regulatory Commission
- Alyeska pipeline Service Company
- Department of Energy Hanford
- OSHPD
- Raytheon
- Sandia National Laboratories
- NASA Jet Propulsion Laboratory California Institute of Technology

Education

- USC University of Southern California
- Los Angeles Unified School District Board of Education

Emergency Management

- Utah Emergency Management
- The Church of Jesus Christ of Latter-Day Saints
- RIMES Regional Integrated Multi-Hazard Early Warning System

Engineering

- MRP Engineering
- Degenkolb
- U.S. Resiliency Council — Rating Building Performance in Natural Disasters
- Infra • Terra
- Port of Long Beach — The Green Port

SHAKECAST WORKBOOK: FOR FACILITIES, FRAGILITIES, NOTIFICATIONS

ShakeCastInventory.xlsm

Facility Worksheet

General User

Facility ID	Facility Type	Facility Type Description	Fac
Must be unique for a facility type	Select the facility type from the drop-down list	This field is automatically populated based on the Facility Type field selection	Lon nam cha
More Info	More Info	More Info	
1	BRIDGE	Bridge	Go
2	CAMPUS	Multi-building campus	De

Welcome | Facility XML | Notification XML

ShakeCastInventory.xlsm

Facility Fragility Parameters

Select from library of default HAZUS models to auto-populate fragility parameters, *or* enter fragility parameters manually

HAZUS Model Building Type Label	HAZUS Model Building Type Description	METRIC	METRIC:ALPHA:GREEN	METRIC:BETA:GREEN	METRIC3	METRIC:ALPHA:YELLOW	METRIC:BETA:YELLOW	METRIC4	METRIC:ALPHA:ORANGE	METRIC:BETA:ORANGE	METRIC5
Select label from the drop-down list. Select USER_DEFINED to manually enter fragility parameters	This field is automatically populated based on the HAZUS Model Building Type Label field selection										
More Info											
GENERIC	Generic Default Settings using MMI Value	MMI	3	0.64	MMI	5	0.64	MMI	7	0.64	MMI
C1LH	Concrete Moment Frame Low	PGA	21	0.64	PGA	35	0.64	PGA	70	0.64	PGA

Welcome | Facility XML | Notification XML | User XML

METRIC2	METRIC:ALPHA:GREY	METRIC:BETA:GREY
MMI	0.01	0.64
PGA	0.01	0.64

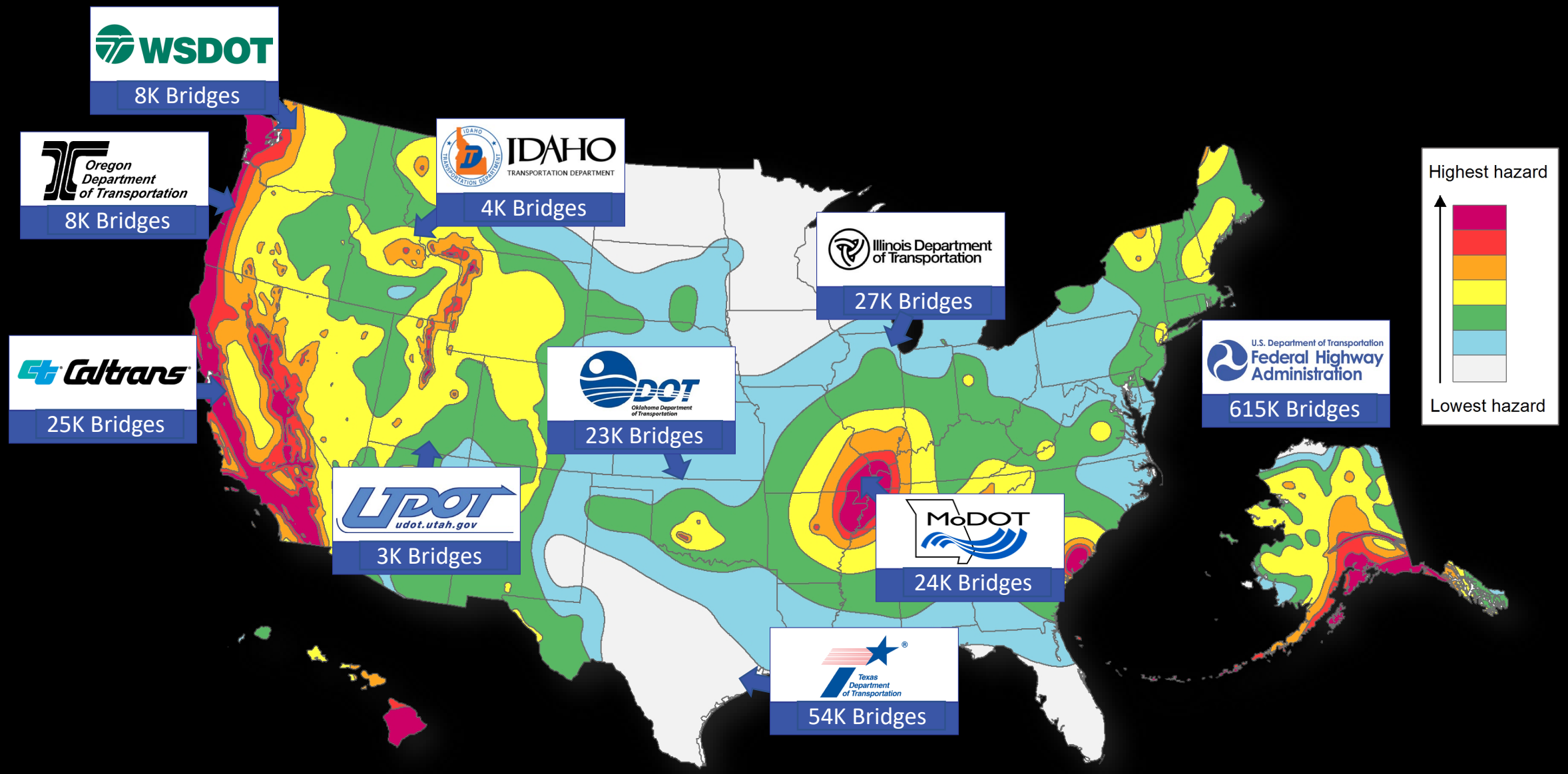
Facility Attributes

Attributes

Facility Attributes allow you to group and filter facilities. This field also allows you to further personalize your facility information

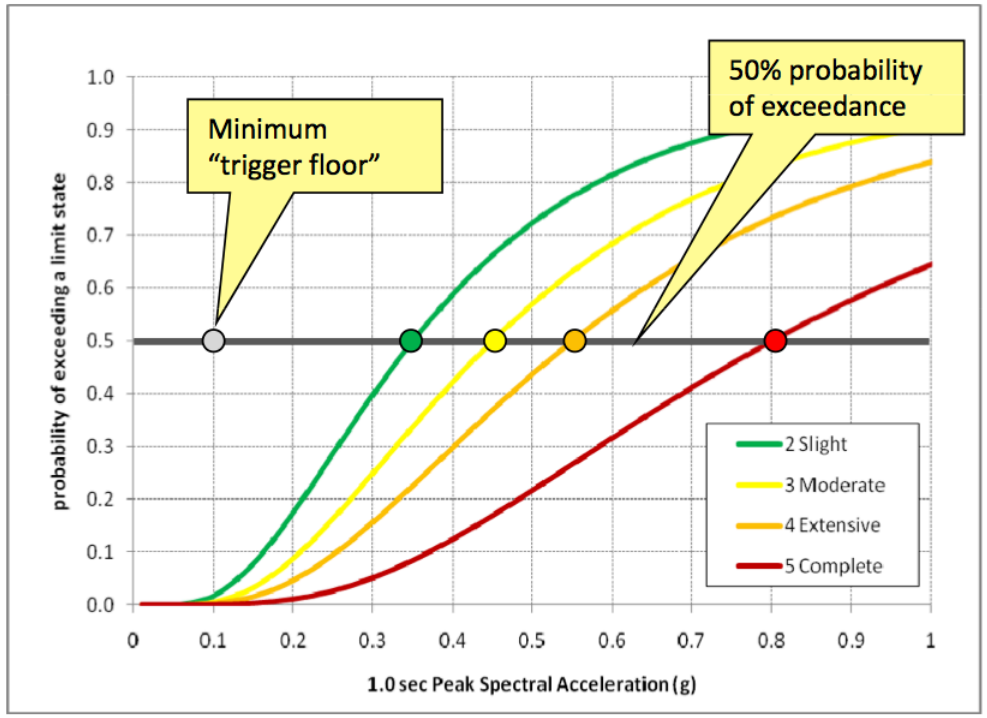
W1H
W2H
S1LH
S1MH
S1HH
S2LH
S2MH
S2HH
S3H
S4LH
S4MH
S4HH
✓ C1LH
C1MH
C1HH
C2LH
C2MH
C2HH
PC1H
PC2LH
PC2MH
PC2HH
RM1LH
RM1MH
RM2LH
RM2MH
RM2HH
MHH
W1M
W2M
S1LM
S1MM
S1HM
S2LM
S2MM
S2HM
S3M
S4LM
S4MM
S4HM
C1LM
C1MM
C1HM
C2LM
C2MM
C2HM
PC1M
PC2LM
PC2MM
PC2HM
RM1LM
RM1MM
RM2LM
RM2MM
RM2HM
MHM

Transportation Pooled Fund (TPF)



Bridge Fragility

- Bridge fragility method is based upon work originally published by Basöz and Mander.
- Method was implemented in FEMA's HAZUS-MH software.
- Uses data from National Bridge Inventory (NBI) as inputs:
  - Year built
  - Year improved or retrofit
  - Angle of skew
  - Bridge type
  - Number of spans
  - Maximum span length
  - Total bridge length
  - Deck width



[Courtesy: Loren Turner, Caltrans]

Federal Highway (FHWA) National Bridge Inventory (NBI)
→ Parsed directly into ShakeCast fragility look-up tables

UT12_sc.csv

	A	B	C	D	E	F	G	H	I	J
1	external_facility_id	facility_type	facility_name	description	lat	lon	METRIC:PSA10:GREEN	METRIC:PSA10:YELLOW	METRIC:PSA10:ORANGE	METRIC:PSA10:RED
2	001001C	BRIDGE	001001C - BEAVER RIVER	1-span; 3; 02; 10 deg skew; 7.3 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1945;	38.26633	-112.63272	10	39.94	51.36	79.89
3	001002F	BRIDGE	001002F - BEAVER RIVER	1-span; 5; 04; 0 deg skew; 7.6 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1985;	38.27233	-112.61356	10	115	138	195.5
4	001003C	BRIDGE	001003C - BEAVER RIVER	1-span; 3; 10; 0 deg skew; 18.3 m Max Span Length; NBI Class 310; HAZUS Class HWB24; Built 1923;	38.25233	-112.78919	10	40.25	51.75	80.5
5	001004E	BRIDGE	001004E - BEAVER RIVER	1-span; 1; 19; 5 deg skew; 6.1 m Max Span Length; NBI Class 119; HAZUS Class HWB4; Built 1998;	38.22219	-112.93053	10	114.78	137.74	195.13
6	001005F	BRIDGE	001005F - BEAVER RIVER	1-span; 5; 04; 0 deg skew; 10.7 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1985;	38.25097	-112.71367	10	115	138	195.5
7	001006V								137.04	211.79
8	001007F								97.58	138.24
9	001008V								137.04	211.79
10	001009E								128.99	175.89
11	001010C								51.75	80.5
12	001011E								97.58	138.24
13	001012V	BRIDGE	001012V - NORTH CREEK	2-span; 3; 19; 30 deg skew; 3.7 m Max Span Length; NBI Class 319; HAZUS Class HWB24; Built 1965;	38.25438	-112.71414	10	37.46	48.16	74.91
14	001013V	BRIDGE	001013V - DRY WASH	4-span; 4; 19; 34 deg skew; 1.8 m Max Span Length; NBI Class 419; HAZUS Class HWB16; Built 2005;	38.30611	-113.01	10	104.6	127.85	174.34
15	001014V	BRIDGE	001014V - DRY WASH	4-span; 3; 19; 15 deg skew; 2 m Max Span Length; NBI Class 319; HAZUS Class HWB14; Built 2005;	38.31694	-113.00972	10	97.95	134.69	208.15
16	003001F	BRIDGE	003001F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 14.9 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1930;	41.97614	-112.21631	10	115	138	195.5
17	003002F	BRIDGE	003002F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 14.9 m Max Span Length; NBI Class 504; HAZUS Class HWB4; Built 1991;	41.94397	-112.19711	10	115	138	195.5
18	003003V	BRIDGE	003003V - MALAD RIVER	1-span; 3; 19; 0 deg skew; 7 m Max Span Length; NBI Class 319; HAZUS Class HWB24; Built 1980;	41.88611	-112.1885	10	40.25	51.75	80.5
19	003004D	BRIDGE	003004D - DEEP CREEK	3-span; 2; 04; 0 deg skew; 6.7 m Max Span Length; NBI Class 204; HAZUS Class HWB10; Built 1941;	41.96553	-112.72233	10	114.89	140.42	191.47
20	003006C	BRIDGE	003006C - WEST CANAL	1-span; 3; 02; 0 deg skew; 7 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1950;	41.72006	-112.23975	10	40.25	51.75	80.5
21	003008D	BRIDGE	003008D - HIGHLINE CANAL	1-span; 1; 01; 45 deg skew; 7 m Max Span Length; NBI Class 101; HAZUS Class HWB3; Built 1950;	41.72542	-112.20142	10	96.7	116.04	164.4
22	003009V	BRIDGE	003009V - WEST CANAL	2-span; 3; 19; 30 deg skew; 3 m Max Span Length; NBI Class 319; HAZUS Class HWB24; Built 1980;	41.72339	-112.20075	10	37.46	48.16	74.91
23	003010V	BRIDGE	003010V - FAUST VALLEY WA	2-span; 3; 19; 21 deg skew; 3.4 m Max Span Length; NBI Class 319; HAZUS Class HWB24; Built 1965;	41.71964	-112.42217	10	38.89	50	77.78
24	003011F	BRIDGE	003011F - WEST CANAL	1-span; 5; 04; 0 deg skew; 11.6 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1915;	41.75553	-112.16964	10	115	138	195.5
25	003012A	BRIDGE	003012A - CORINNE CANAL	1-span; 7; 02; 15 deg skew; 9.4 m Max Span Length; NBI Class 702; HAZUS Class HWB3; Built 1948;	41.75588	-112.12811	10	113.02	135.63	192.14
26	003013C	BRIDGE	003013C - CORINNE CANAL	1-span; 3; 02; 0 deg skew; 6.1 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1950;	41.77056	-112.12889	10	40.25	51.75	80.5
27	003014F	BRIDGE	003014F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 15.2 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1960;	41.77044	-112.14261	10	115	138	195.5
28	003015D	BRIDGE	003015D - WEST CANAL	1-span; 1; 07; 0 deg skew; 9.1 m Max Span Length; NBI Class 107; HAZUS Class HWB3; Built 1988;	41.77947	-112.16369	10	115	138	195.5
29	003016D	BRIDGE	003016D - HAMMAND MAIN	1-span; 1; 07; 45 deg skew; 6.7 m Max Span Length; NBI Class 107; HAZUS Class HWB4; Built 1993;	41.73333	-112.09944	10	96.7	116.04	164.4
30	003017C	BRIDGE	003017C - WEST CANAL	1-span; 3; 02; 0 deg skew; 10.4 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1950;	41.79217	-112.16031	10	40.25	51.75	80.5
31	003018D	BRIDGE	003018D - WEST CANAL	1-span; 1; 07; 0 deg skew; 10.4 m Max Span Length; NBI Class 107; HAZUS Class HWB4; Built 1991;	41.81389	-112.15883	10	115	138	195.5
32	003019D								138	195.5
33	003020F								138	195.5
34	003021C								116.04	164.4
35	003022F								138	195.5
36	003023C								51.75	80.5
37	003024C								51.75	80.5
38	003025D								116.04	164.4
39	003026F								138	195.5
40	003028C								50.86	79.12
41	003030D								129.06	182.83
42	003031F								45.29	70.46
43	003033C	BRIDGE	003033C - CORINNE CANAL	1-span; 3; 02; 0 deg skew; 8.5 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1945;	41.65478	-112.14066	10	40.25	51.75	80.5
44	003034F	BRIDGE	003034F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 9.1 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1978;	41.65539	-112.15997	10	115	138	195.5
45	003035V	BRIDGE	003035V - MALAD RIVER	1-span; 3; 19; 0 deg skew; 9.1 m Max Span Length; NBI Class 319; HAZUS Class HWB4; Built 2001;	41.65339	-112.16275	10	115	138	195.5
46	003037F	BRIDGE	003037F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 14.6 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1969;	41.66872	-112.15556	10	115	138	195.5
47	003038E	BRIDGE	003038E - CORINNE CANAL	1-span; 1; 19; 0 deg skew; 6.1 m Max Span Length; NBI Class 119; HAZUS Class HWB3; Built 1967;	41.67778	-112.14158	10	115	138	195.5
48	003039C	BRIDGE	003039C - CORINNE CANAL	1-span; 3; 02; 0 deg skew; 7.9 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1945;	41.68322	-112.14175	10	40.25	51.75	80.5
49	003040C	BRIDGE	003040C - MALAD RIVER	1-span; 3; 02; 0 deg skew; 11.6 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1945;	41.68328	-112.15561	10	40.25	51.75	80.5
50	003041C	BRIDGE	003041C - BEAR RIVER	3-span; 4; 09; 0 deg skew; 22.9 m Max Span Length; NBI Class 409; HAZUS Class HWB15; Built 1945;	41.83264	-112.05875	10	87.69	87.69	128.61
51	003042F	BRIDGE	003042F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 14.9 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1965;	41.69736	-112.16183	10	115	138	195.5
52	003043F	BRIDGE	003043F - CORINNE CANAL	1-span; 5; 04; 0 deg skew; 6.7 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1977;	41.70503	-112.14242	10	115	138	195.5
53	003044F	BRIDGE	003044F - MALAD RIVER	1-span; 5; 04; 0 deg skew; 15.2 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1965;	41.72658	-112.15078	10	115	138	195.5
54	003045E	BRIDGE	003045E - WEST CANAL	1-span; 1; 19; 45 deg skew; 10.1 m Max Span Length; NBI Class 119; HAZUS Class HWB3; Built 1988;	41.7255	-112.19556	10	96.7	116.04	164.4

description

1-span; 3; 02; 10 deg skew; 7.3 m Max Span Length; NBI Class 302; HAZUS Class HWB24; Built 1945;

1-span; 5; 04; 0 deg skew; 7.6 m Max Span Length; NBI Class 504; HAZUS Class HWB3; Built 1985;

1-span; 3; 10; 0 deg skew; 18.3 m Max Span Length; NBI Class 310; HAZUS Class HWB24; Built 1923;

1-span; 1; 19; 5 deg skew; 6.1 m Max Span Length; NBI Class 119; HAZUS Class HWB4; Built 1998;

South Carolina State Department of Transportation

ShakeCast Report

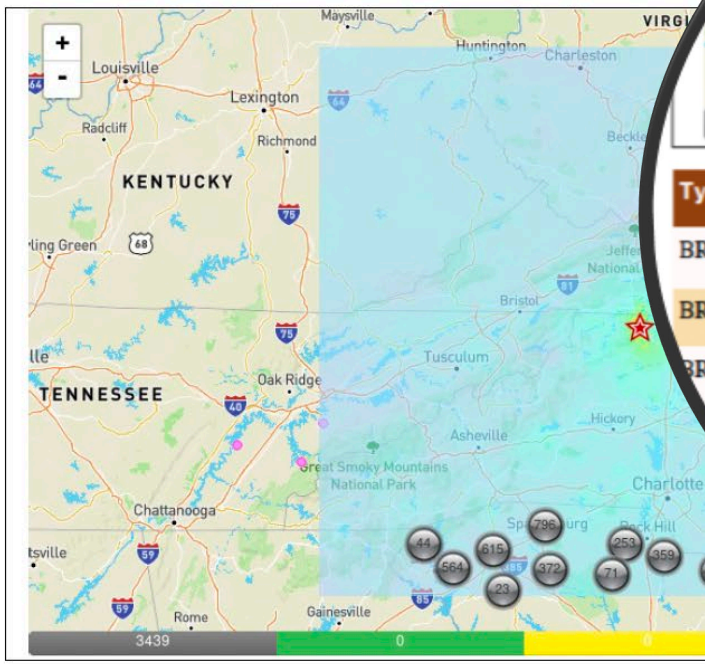
National Earthquake Information Center (NEIC

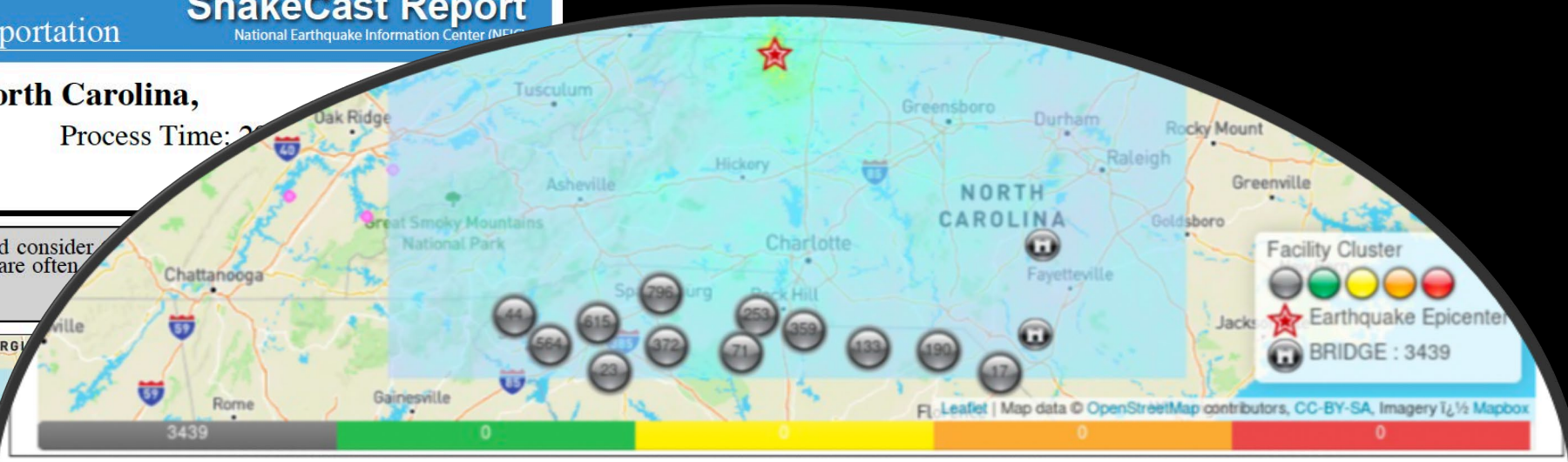
Magnitude 5.1 - 2 km SSE of Sparta, North Carolina,

Origin Time: 2020-08-09 08:07:37EDT Process Time: 2

Latitude: 36.4835 Longitude: -81.1053

These results are from an automated system and users should consider making decisions relating to public safety. ShakeCast results are often information is reported or derived.





Type	ID	Name	Ep. Distance (km)	Inspection Priority	PGA (%g)	PGV (cm/s)	PSA 1s (%g)	MMI	Vs30 (m/s)
BRIDGE	45_000000000007516	000000000007516 - NORTH PACOLET RIVER	146.79	Below Threshold	0.7986	0.5531	0.542	IV	491.1
BRIDGE	45_000000000009105	000000000009105 - CROWDERS BRANCH	148.12	Below Threshold	1.445	0.9774	0.8077	IV	360
BRIDGE	45_000000000005878	000000000005878 - CROWDERS CREEK	148.72	Below Threshold	1.11	0.8563	0.801	IV	334.2
BRIDGE	45_000000000005238	000000000005238 - STREAM	148.86	Below Threshold	1.043	0.6061	0.5023	IV	591.7
BRIDGE	45_000000000008701	000000000008701 - BR CATAWBA RIVER	149.08	Below Threshold	0.8164	0.5703	0.5561	IV	484.2
BRIDGE	45_000000000000618	000000000000618 - BEAVER DAM CREEK	149.08	Below Threshold	1.211	0.861	0.7571	IV	383.5
		000000000006949 - TRIB OF CRAWFORD LAKE	149.32	Below Threshold	1.909	0.9854	0.7038		
		000000000006207 - CROWDERS CREEK	149.37	Below Threshold	0.9264	0.659	0.619		
		000000002874 - CROWDERS	149.38	Below Threshold	1.243	0.6735			
		TAWBA	149.58	Below Threshold					

Planner

New plan
Planner hub
Assigned to me

Pinned
ES Earthquake Spectra Editor

Recent
CM ShakeCast TPF Project P...
CM MO DOT Plan
CM NRC Plan
CM TPF ShakeCast LIVE
CM IL DOT Plan
TD To do
CM Caltrans Plan
CM FERC Plan
CM TX DOT Plan
ShakeMap Atlas updates
ShakeCast Customer Su...
Planner
Project Plan
CM VA Plan
ShakeCast Development...
CM OFDA Plan
CM FHWA Plan

CM ShakeCast TPF Project Plan

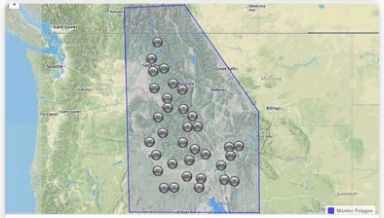
Board Charts Schedule ...

SG YS +27 Members Filter (0) Group by Bucket

Idaho DOT

Add task

Deployment notes
idahoDOT.png
2



Preliminary Bridge Inventory Files
facility_sc_id.jpg
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2021_Q4
SC_ID_2021Q4.png
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Illinois DOT

Add task

Development notes
ILDOT.png
2

2021_Q4
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4

Illinois Plan
Illinois Specific Plan
1

Missouri DOT

Add task

Deployment notes
MO_DOT_logo.png
3

Preliminary Bridge Inventory Files
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Missouri Plan
Missouri Specific Plan
1

Oklahoma DOT

Add task

Deployment notes
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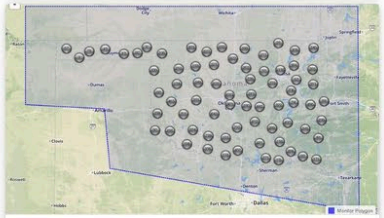

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Oregon DOT

Add task

Deployment notes
logo-ODOT.jpg
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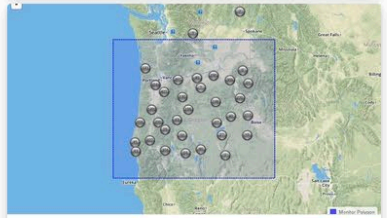

Preliminary Bridge Inventory Files
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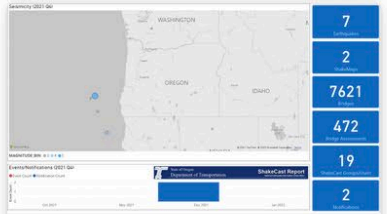

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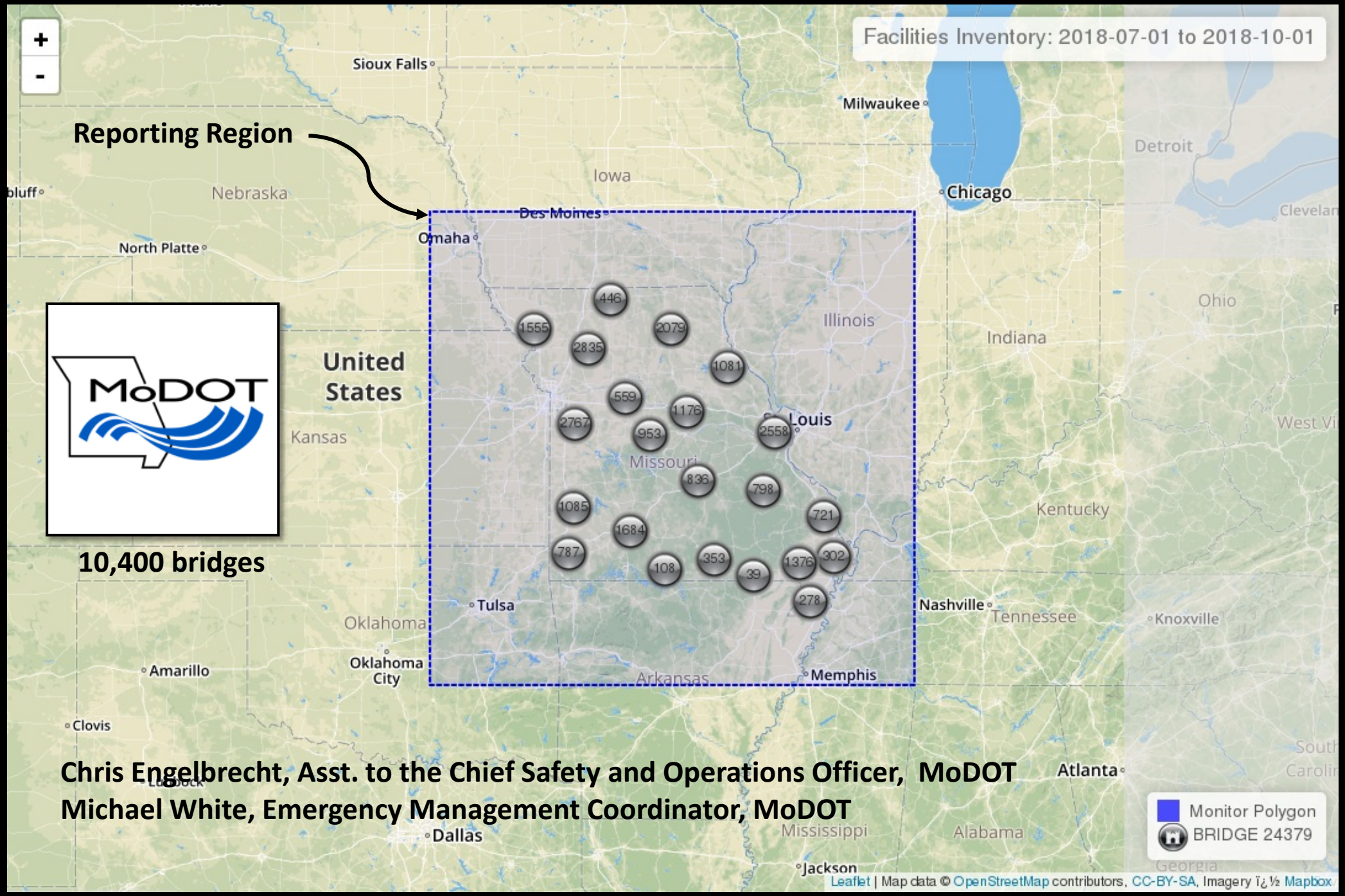


10,400 bridges

Chris Engelbrecht, Asst. to the Chief Safety and Operations Officer, MoDOT
Michael White, Emergency Management Coordinator, MoDOT

Planner

New plan
Planner hub
Assigned to me

Pinned
ES Earthquake Spectra Editor

Recent
CM MO DOT Plan
CM ShakeCast TPF Project P...
CM NRC Plan
CM TPF ShakeCast LIVE
CM IL DOT Plan
TD To do
CM Caltrans Plan
CM FERC Plan
CM TX DOT Plan
ShakeMap Atlas updates
ShakeCast Customer Su...
Planner
Project Plan
CM VA Plan
ShakeCast Development

CM MO DOT Plan

Board Charts Schedule ...

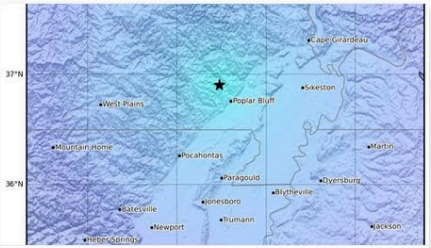
SG YS +27 Members Filter (0) Group by Bucket

To do

Add task

Recent Events

Add task



POTENTIAL IMPACTS: BRIDGE, 7 km SSE of Williamsville, Missouri (nm60363582 Version 1)

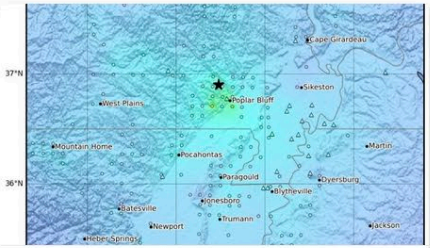
intensity.jpg

4

SG Shakecast, GS

Significant Events

Add task



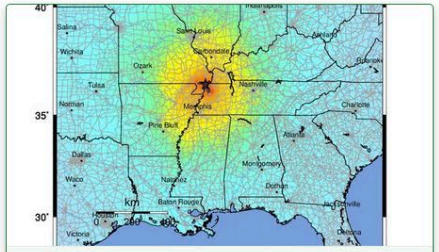
POTENTIAL IMPACTS: BRIDGE, 8 km SSE of Williamsville, Missouri (nm60363582 Version 2)

intensity.jpg

3

Scenario ShakeMap

Add task



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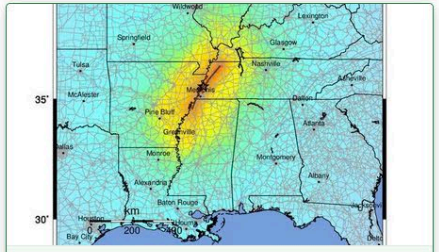

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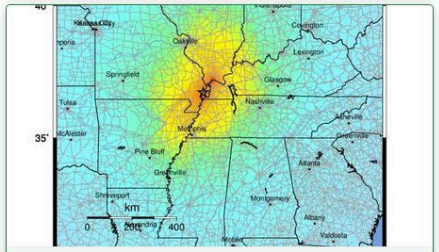


M7.5 bssc2014ceus_0_45_m7p5_se

Add new bucke

← Latest Earthquakes

Overview
Interactive Map
Regional Information

Impact
Felt Report - Tell Us!
Did You Feel It?
ShakeMap
PAGER

Technical
Origin
Moment Tensor
Waveforms

Download Event KML
View Nearby Seismicity

Earthquakes
Hazards
Data & Products

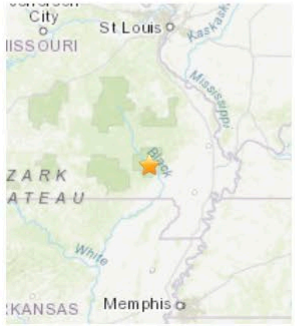
M 4.0 – 7 km S of Williamsville, Missouri

2021-11-18 02:53:03 (UTC) | 36.908°N 90.543°W | 16.5 km depth

Interactive Map

Contributed by NM [1]

Regional Information



Contributed by NM [1]

Felt Report - Tell Us!

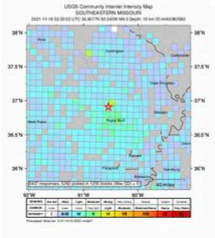
0 0 5 4 3 7

Responses

Contribute to citizen science. Please tell us about your experience.

Citizen Scientist Contributions

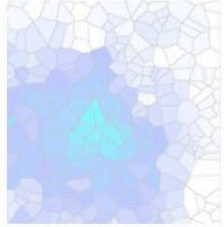
Did You Feel It? V



Community Internet Intensity Map

Contributed by US [2]

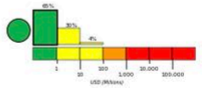
ShakeMap V



Estimated Intensity Map

Contributed by US [2]

PAGER GREEN



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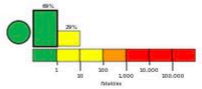


Estimated Fatalities

Contributed by US [2]

Origin

Review Status
REVIEWED

Magnitude
4.0 mw

Depth
16.5 km

Time
2021-11-18 02:53:03 UTC

Contributed by NM [1]

Moment Tensor

Fault Plane Solution

Contributed by US [2]

View Nearby Seismicity

Time Range
± Three Weeks

Search Radius
250.0 km

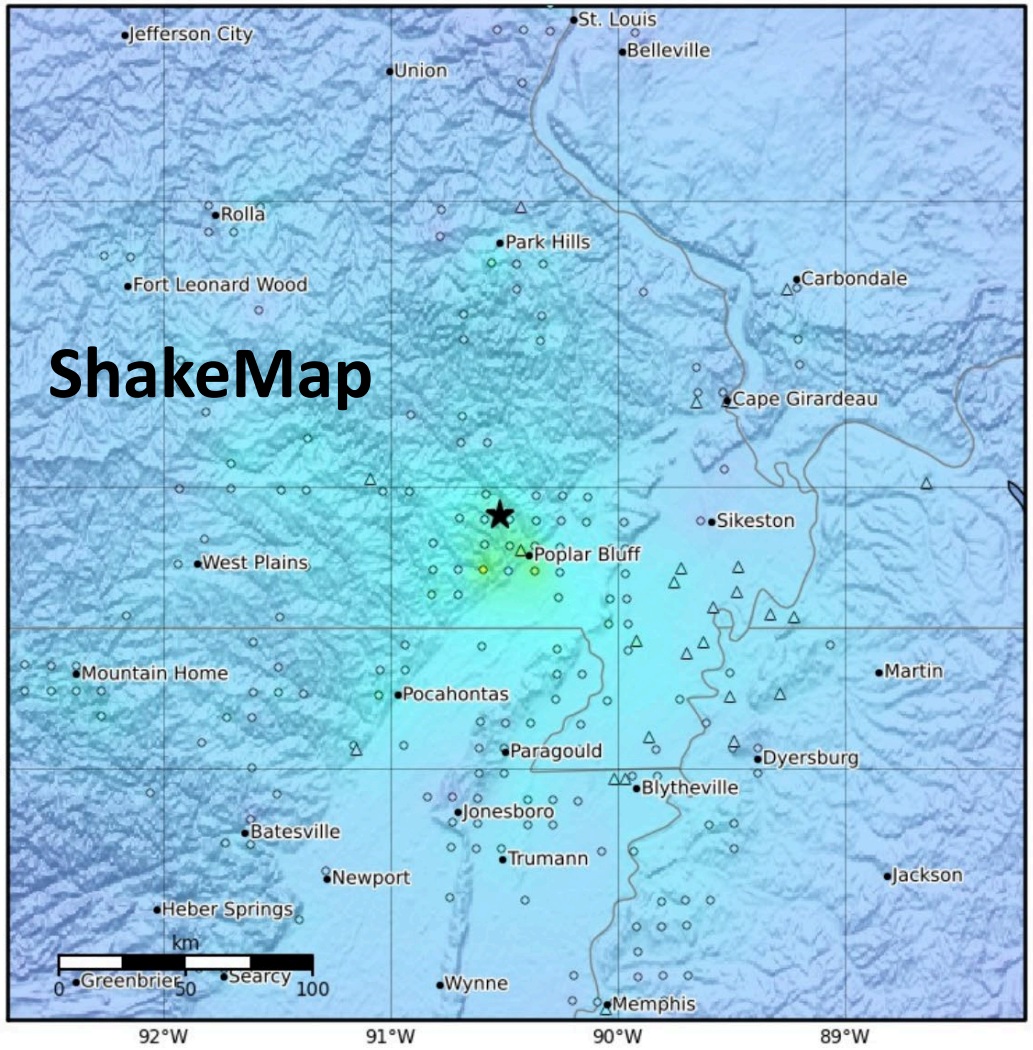
Magnitude Range
≥ 1.0

ANSS Comcat

For More Information

- Impact Summary
- Technical Summary

Macroseismic Intensity Map USGS
ShakeMap: 19 km NW of Poplar Bluff, Missouri,
Nov 18, 2021 02:53:03 UTC M4.0 N36.90 W90.52 Depth: 16.9km ID:nm60363582



SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0066	0.0795	0.954	4.99	8.76	15.4	27	47.4	>83.2
PGV(cm/s)	<0.0028	0.0383	0.524	3.03	6.48	13.9	29.6	63.4	>136
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Atkinson and Kaka (2007) Version 2: Processed 2021-11-18T03:45:35Z
△ Seismic Instrument ○ Reported Intensity ★ Epicenter

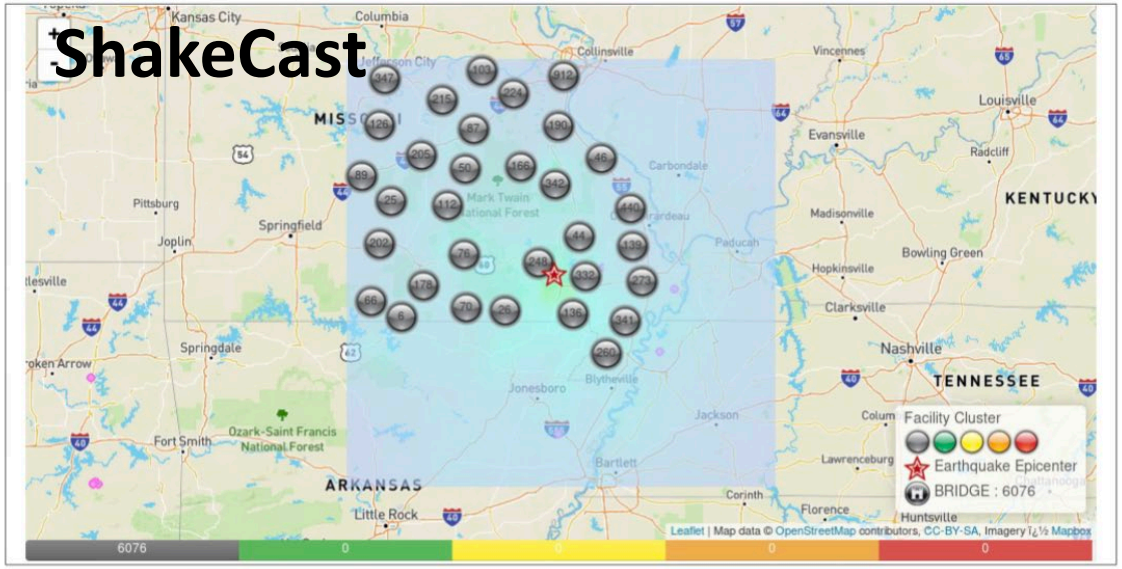
MoDOT State of Missouri Department of Transportation

ShakeCast Report

National Earthquake Information Center (NEIC)

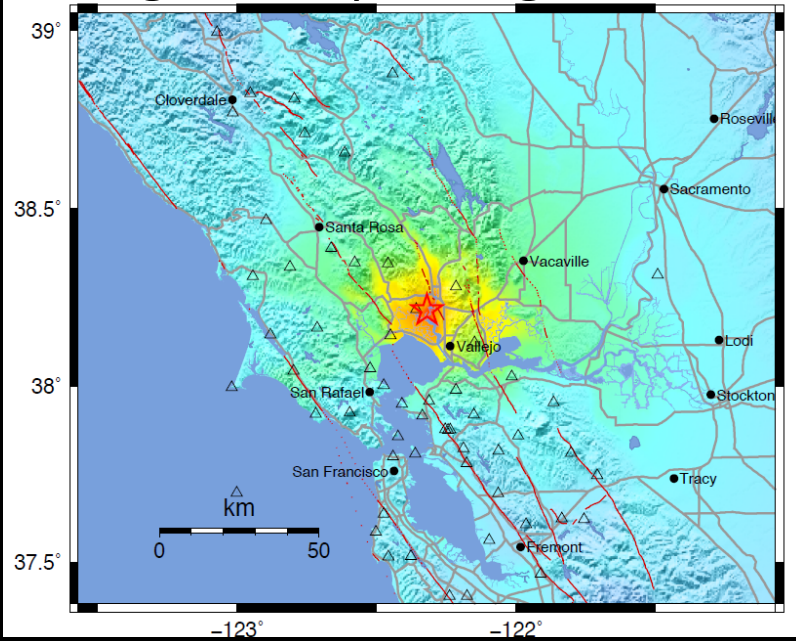
Magnitude 4.0 - 19 km NW of Poplar Bluff, Missouri, Version 2
Origin Time: 2021-11-17 20:53:03CST Process Time: 2021-11-17 21:50:07CST
Latitude: 36.9007 Longitude: -90.5238 Depth: 16.9 km

These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.



Type	ID	Name	Ep. Distance (km)	Inspection Priority	PGA (%g)	PGV (cm/s)	PSA 1s (%g)	MMI	Vs30 (m/s)
BRIDGE	P0931	7979 - ESSMAN SPR	1.64	Below Threshold	7.294	1.185	0.2925	IV	693.6
BRIDGE	P0873	7944 - SWIFT CR	1.69	Below Threshold	7.446	1.229	0.3035	IV	673.3
BRIDGE	W0191	9435 - CR	2.74	Below Threshold	7.235	1.167	0.2785	IV	848.7
BRIDGE	P0874	7945 - LIGETT CR	2.82	Below Threshold	7.039	1.118	0.2752	IV	736.9
BRIDGE	A3274	2771 - BLACK RVR	3.77	Below Threshold	7.847	1.515	0.5104	IV	333.9
BRIDGE	900032	34798 - MILLER CR	3.78	Below Threshold	6.768	1.057	0.2559	IV	805.4
BRIDGE	A7303	31371 - BLACK RVR	3.85	Below Threshold	7.847	1.515	0.5104	IV	333.9
BRIDGE	A3273	2770 - UP RR	4.02	Below Threshold	7.847	1.515	0.5104	IV	333.9
BRIDGE	A7302	31372 - UP RR	4.02	Below Threshold	7.847	1.515	0.5104	IV	333.9
BRIDGE	100016	34519 - CANE CR	5.5	Below Threshold	6.788	1.22	0.3797	IV	466.1
BRIDGE	K0020	5632 - SMALL CR	5.58	Below Threshold	6.979	1.177	0.2908	IV	616
BRIDGE	80023	32537 - CANE CR	5.59	Below Threshold	6.872	1.168	0.3032	IV	617
BRIDGE	X0659	9753 - HOCKINBERRY CR	6.08	Below Threshold	6.857	1.141	0.276	IV	708.6
BRIDGE	A6444	28994 - CANE CR	6.35	Below Threshold	7.772	1.57	0.5332	IV	337.5
BRIDGE	A6443	28996 - CANE CR	6.39	Below Threshold	7.772	1.57	0.5332	IV	337.5
BRIDGE	A6644	29346 - KEARBY CR	6.44	Below Threshold	7.949	1.644	0.5238	V	373.8

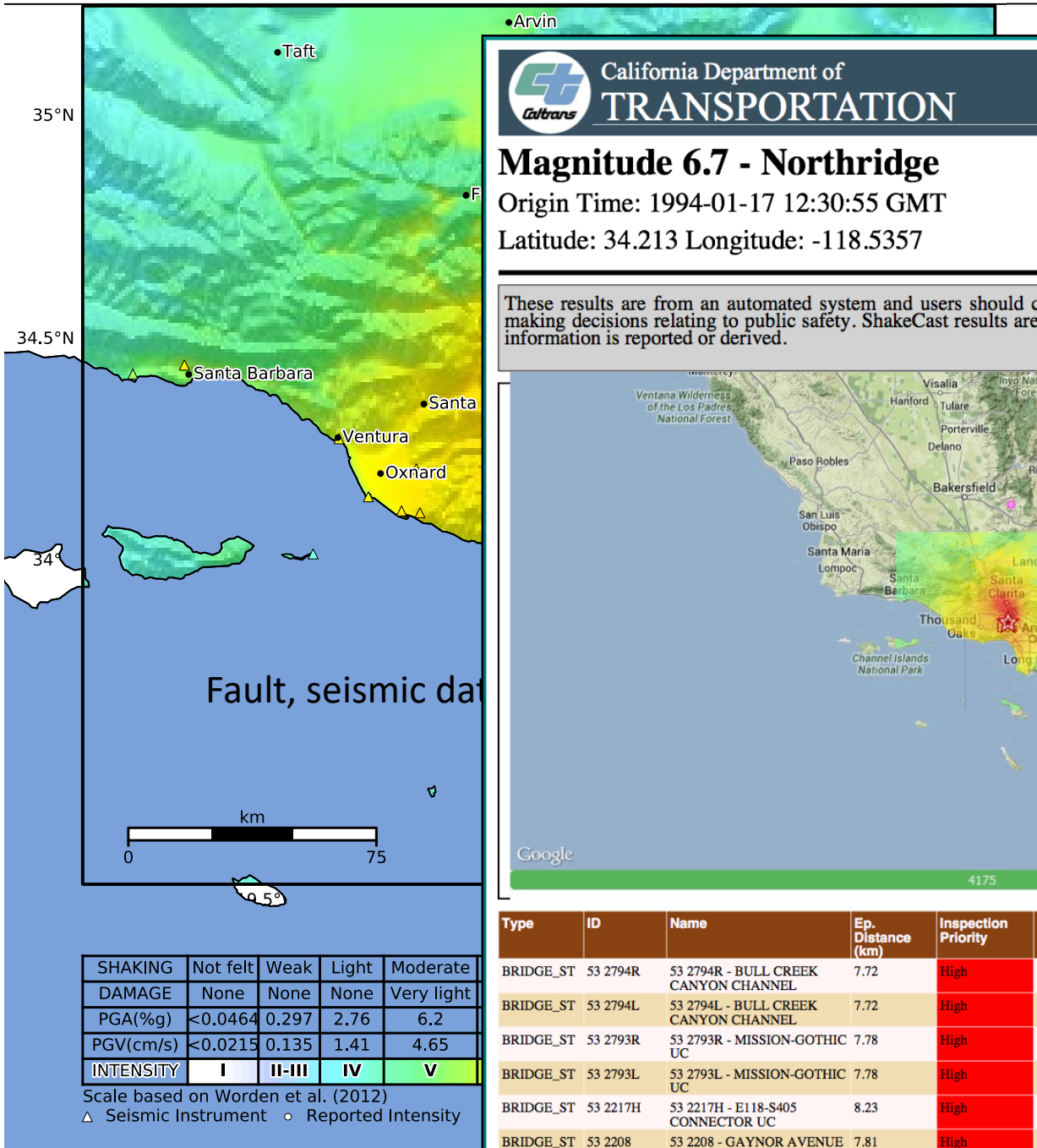
Mag 6.0 Napa, August 2014



ShakeCast identified the 9 bridges that sustained minor damage. They were in the top 40% of a list of 87 total. Over 2,700 state bridges were in the ShakeMap region.

Courtesy L. Turner, Caltrans

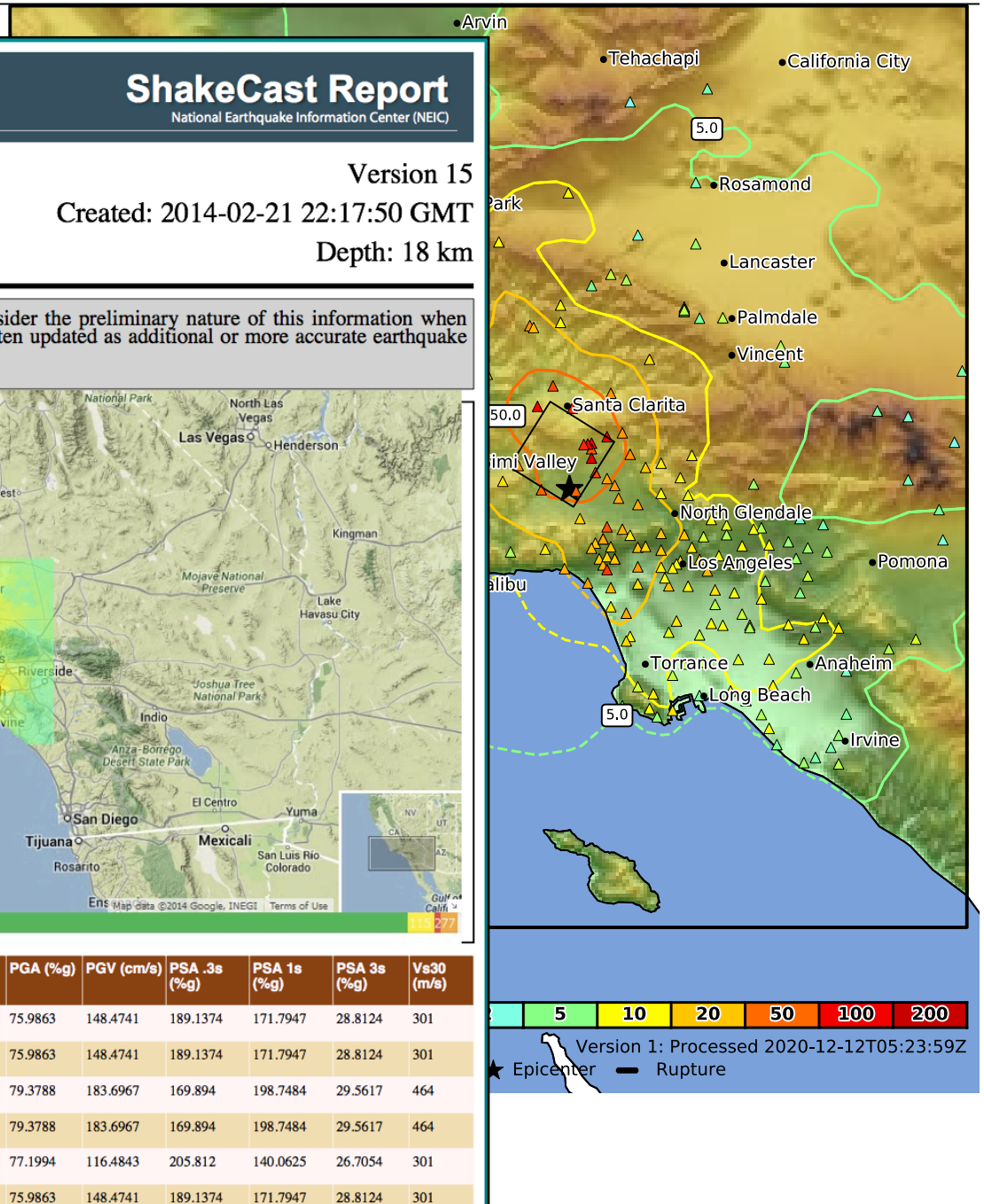
Macroseismic Intensity Map USGS
ShakeMap: 1km NNW of Reseda, CA
Jan 17, 1994 12:30:55 UTC M6.7 N34.21 W118.54 Depth: 18.2km ID:ci3144585



SHAKING	Not felt	Weak	Light	Moderate
DAMAGE	None	None	None	Very light
PGA(%g)	<0.0464	0.297	2.76	6.2
PGV(cm/s)	<0.0215	0.135	1.41	4.65
INTENSITY	I	II-III	IV	V

Scale based on Worden et al. (2012)
△ Seismic Instrument ○ Reported Intensity

Peak Ground Velocity Map USGS
ShakeMap: 1km NNW of Reseda, CA
Jan 17, 1994 12:30:55 UTC M6.7 N34.21 W118.54 Depth: 18.2km ID:ci3144585



2	5	10	20	50	100	200

Version 1: Processed 2020-12-12T05:23:59Z
★ Epicenter ▬ Rupture

California Department of TRANSPORTATION

ShakeCast Report

National Earthquake Information Center (NEIC)

Magnitude 6.7 - Northridge

Version 15

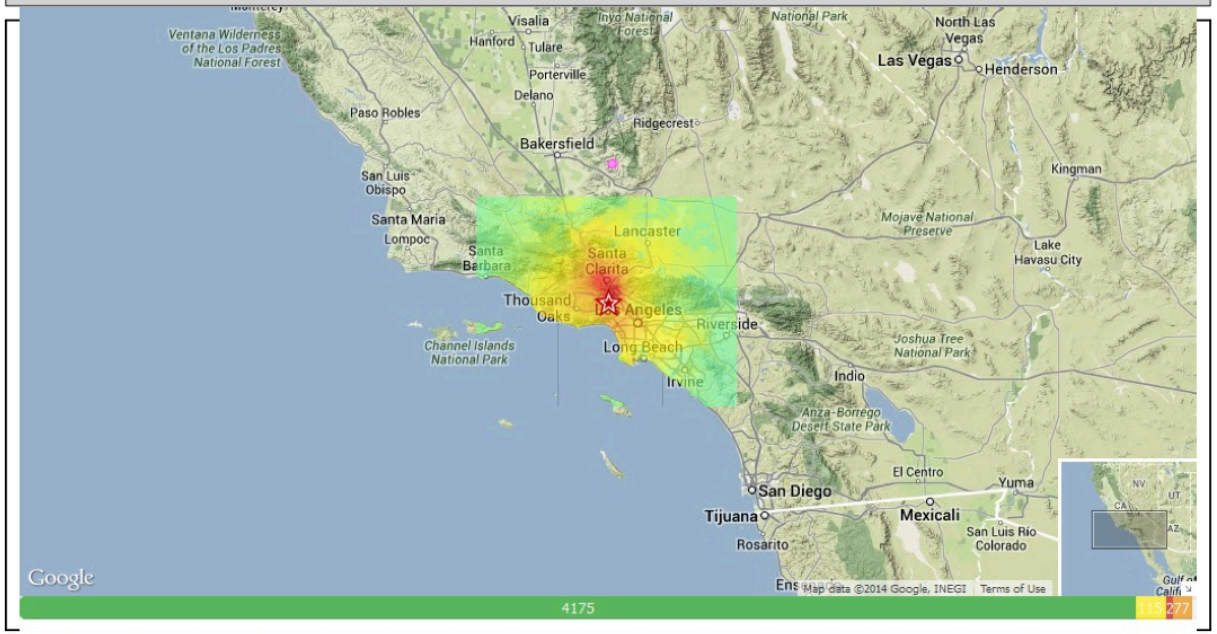
Origin Time: 1994-01-17 12:30:55 GMT

Created: 2014-02-21 22:17:50 GMT

Latitude: 34.213 Longitude: -118.5357

Depth: 18 km

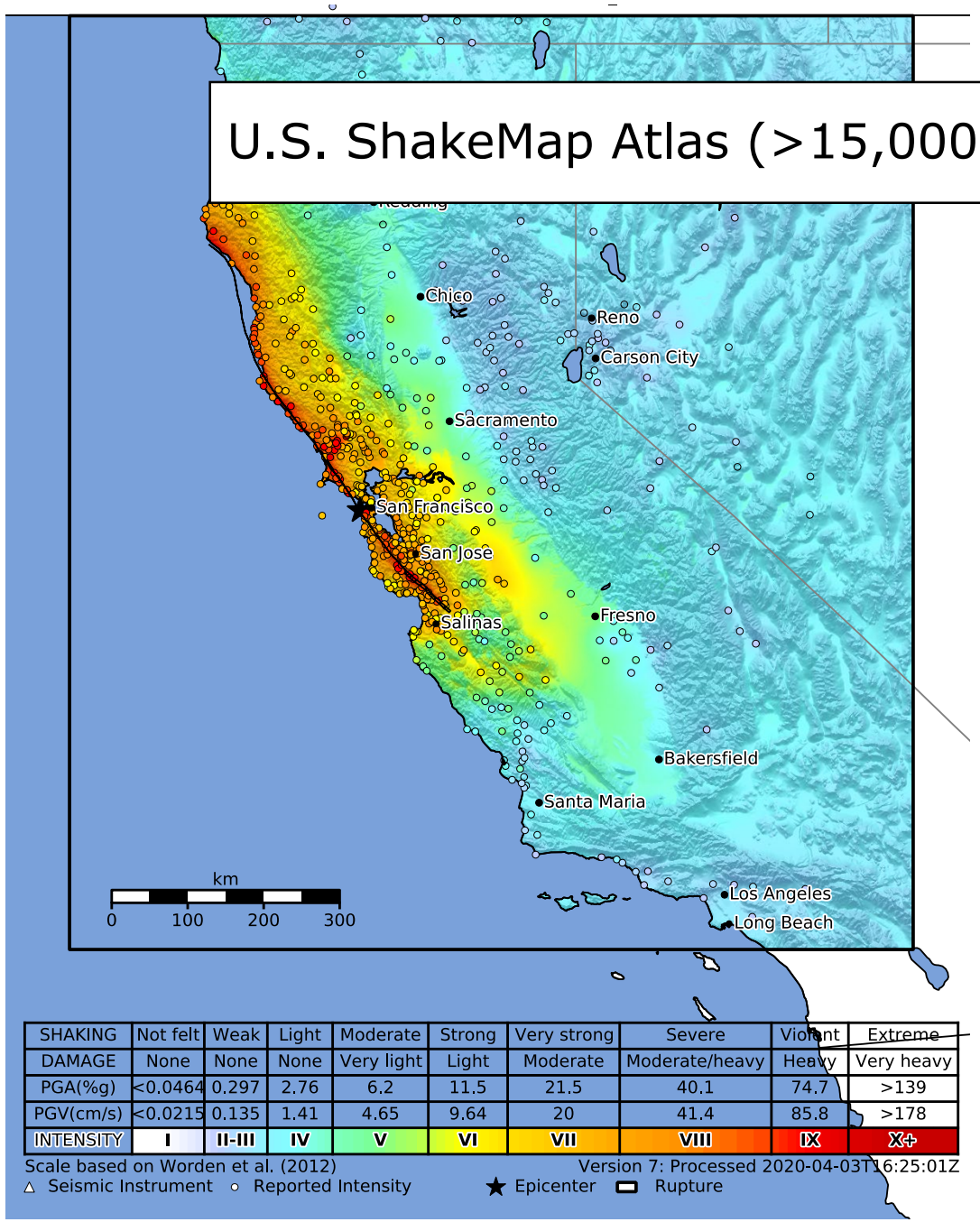
These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.

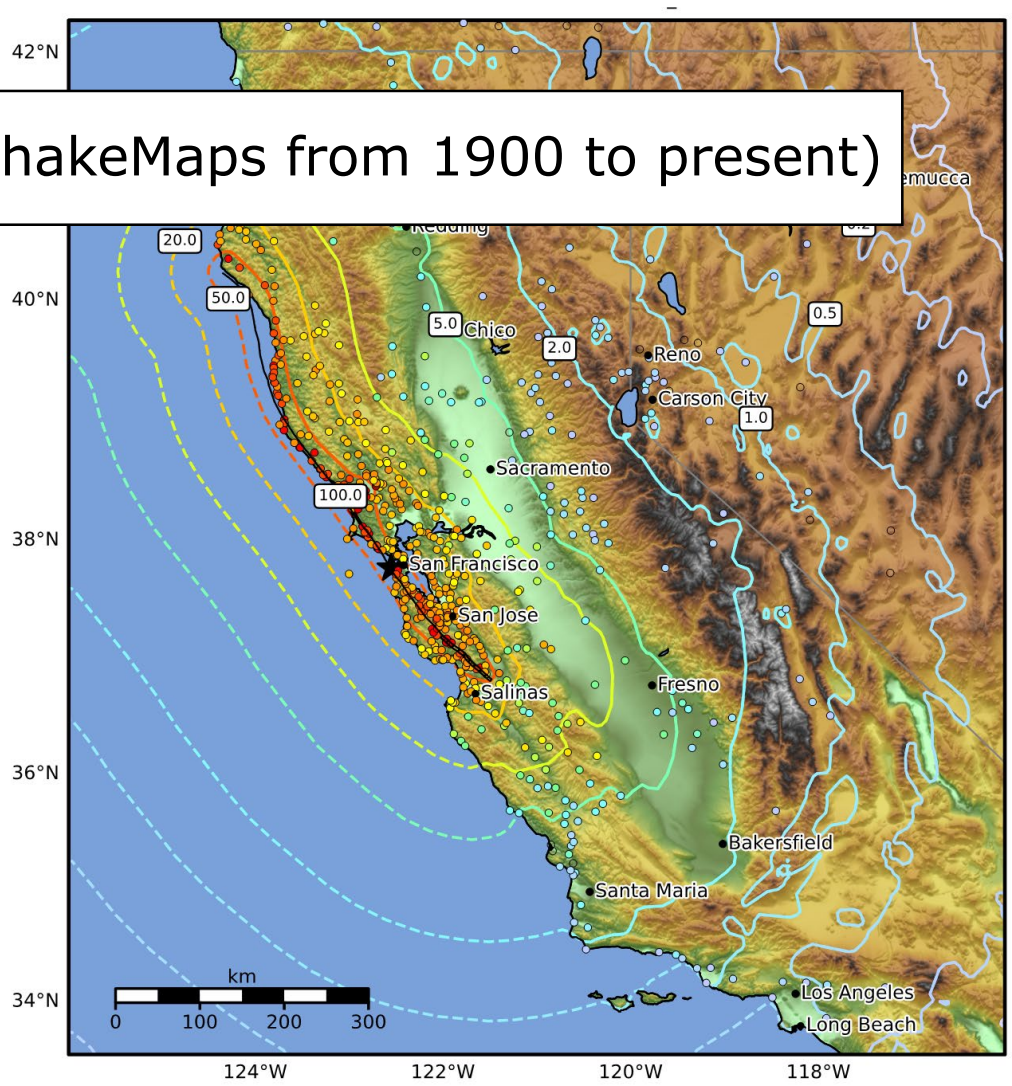


Type	ID	Name	Ep. Distance (km)	Inspection Priority	MMI	PGA (%g)	PGV (cm/s)	PSA .3s (%g)	PSA 1s (%g)	PSA 3s (%g)	Vs30 (m/s)
BRIDGE_ST	53 2794R	53 2794R - BULL CREEK CANYON CHANNEL	7.72	High	X+	75.9863	148.4741	189.1374	171.7947	28.8124	301
BRIDGE_ST	53 2794L	53 2794L - BULL CREEK CANYON CHANNEL	7.72	High	X+	75.9863	148.4741	189.1374	171.7947	28.8124	301
BRIDGE_ST	53 2793R	53 2793R - MISSION-GOTHIC UC	7.78	High	X+	79.3788	183.6967	169.894	198.7484	29.5617	464
BRIDGE_ST	53 2793L	53 2793L - MISSION-GOTHIC UC	7.78	High	X+	79.3788	183.6967	169.894	198.7484	29.5617	464
BRIDGE_ST	53 2217H	53 2217H - E118-S405 CONNECTOR UC	8.23	High	X+	77.1994	116.4843	205.812	140.0625	26.7054	301
BRIDGE_ST	53 2208	53 2208 - GAYNOR AVENUE	7.81	High	X+	75.9863	148.4741	189.1374	171.7947	28.8124	301

1906 Great San Francisco Earthquake (M7.8)

U.S. ShakeMap Atlas (>15,000 ShakeMaps from 1900 to present)





SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based on Worden et al. (2012) Version 7: Processed 2020-04-03T16:25:01Z

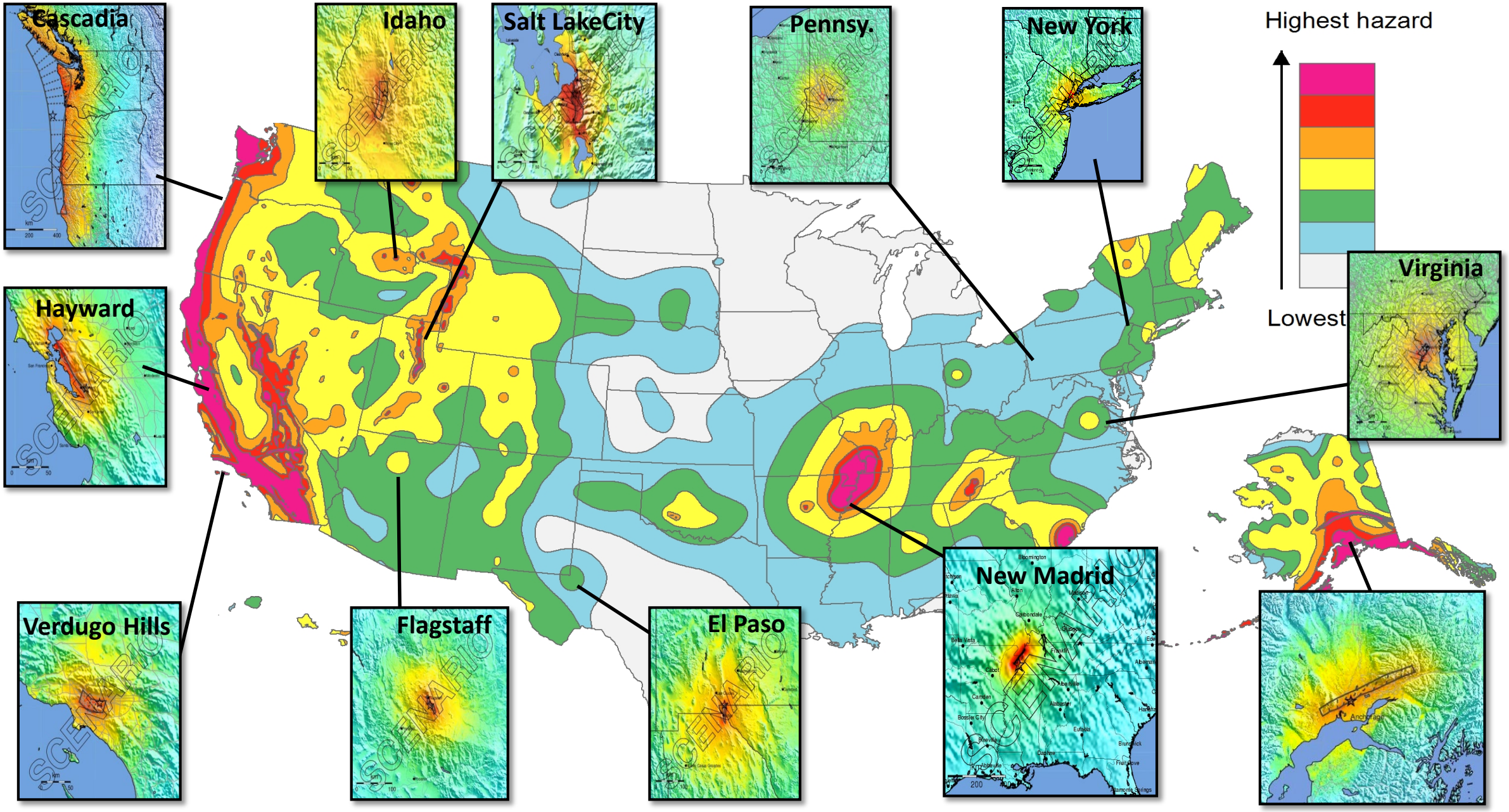
△ Seismic Instrument ○ Reported Intensity ★ Epicenter ▭ Rupture

PGA (%g)	0.1	0.2	0.5	1	2	5	10	20	50	100	200

Scale based on Worden et al. (2012) Version 7: Processed 2020-04-03T16:25:01Z

△ Seismic Instrument ○ Reported Intensity ★ Epicenter ▬ Rupture

USGS National Seismic Hazard Map & Example Scenarios (>800 available online)



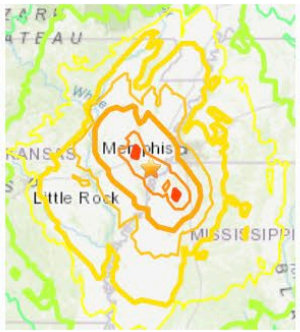
Overview
Interactive Map
Regional Information
Impact
ShakeMap
Technical
Origin
Download Event KML
Earthquakes
Hazards
Data & Products
Learn
Monitoring
Research
Search...
SEARCH

M 7.5 Scenario Earthquake - Marianna_RLME

2017-05-12 18:52:32 (UTC) | 34.913°N 90.530°W | 19.2 km depth

This event is a scenario (it did not occur) and should only be used for planning purposes.
More information about scenarios

Interactive Map

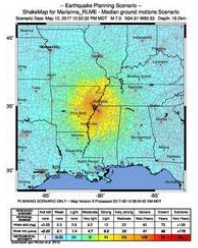


Contributed by US [1]

Regional Information

Contributed by US [1]

ShakeMap IX



Estimated Intensity Map

Contributed by US [1]

Origin

Review Status
AUTOMATIC

Magnitude
7.5

Depth
19.2 km

Time
2017-05-12 18:52:32 UTC

Contributed by US [1]

For More Information

- Impact Summary
- Technical Summary

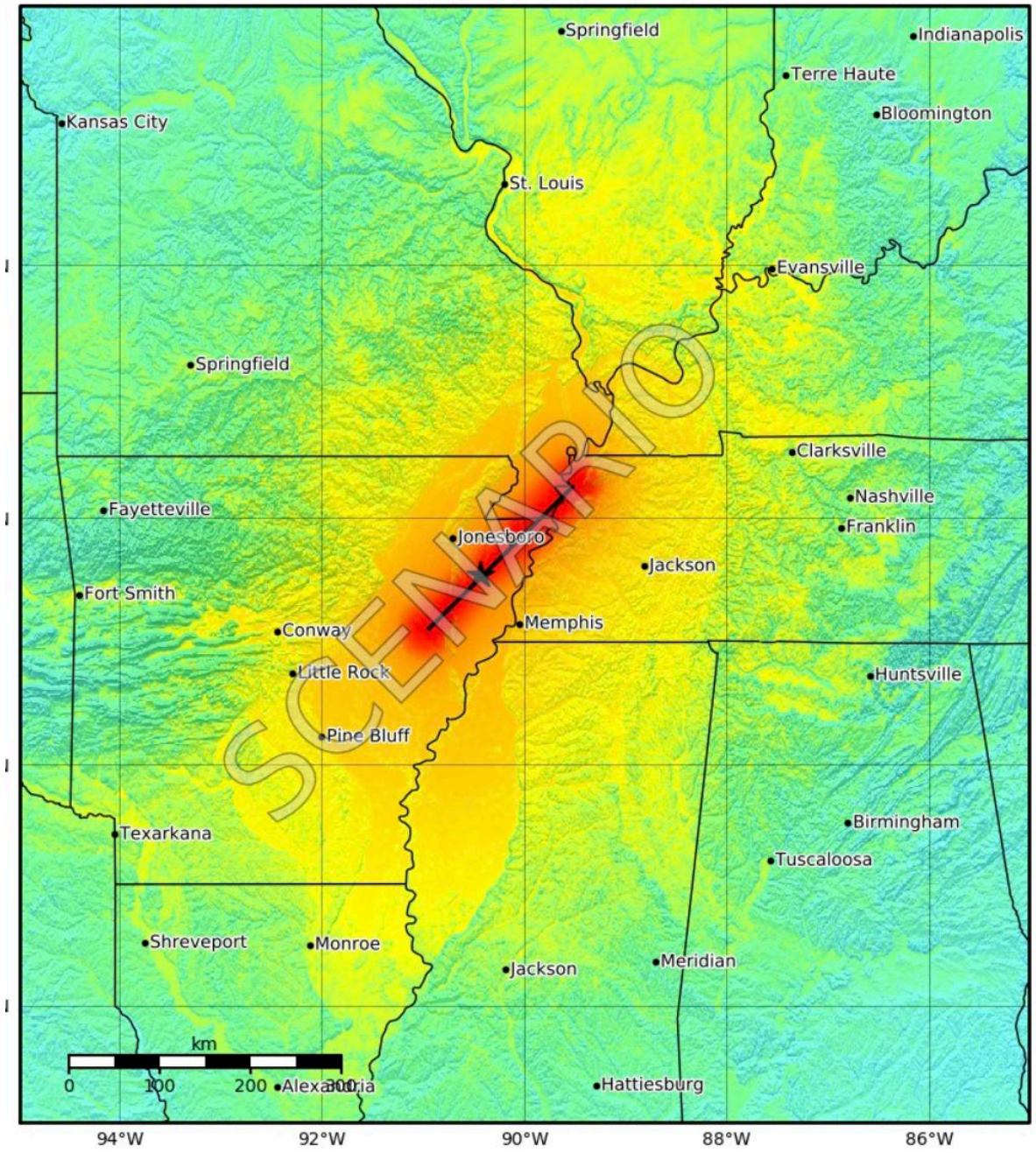
Contributors

1. USGS National Earthquake Information Center, PDE

Additional Information

- ANSS Comprehensive Earthquake Catalog (ComCat) Documentation
- Technical terms used on event pages

USGS ShakeMap: New Madrid southern fault
Feb 07, 2019 18:05:00 UTC M7.7 N35.54 W90.44 Depth: 15.0km
ID:newmadrid_33_m7p7_se_for_FEMA_2019_mt_se



MoDOT State of Missouri Department of Transportation

ShakeCast Report
National Earthquake Information Center (NEIC)

Magnitude 7.7 - New Madrid southern fault

Version 1

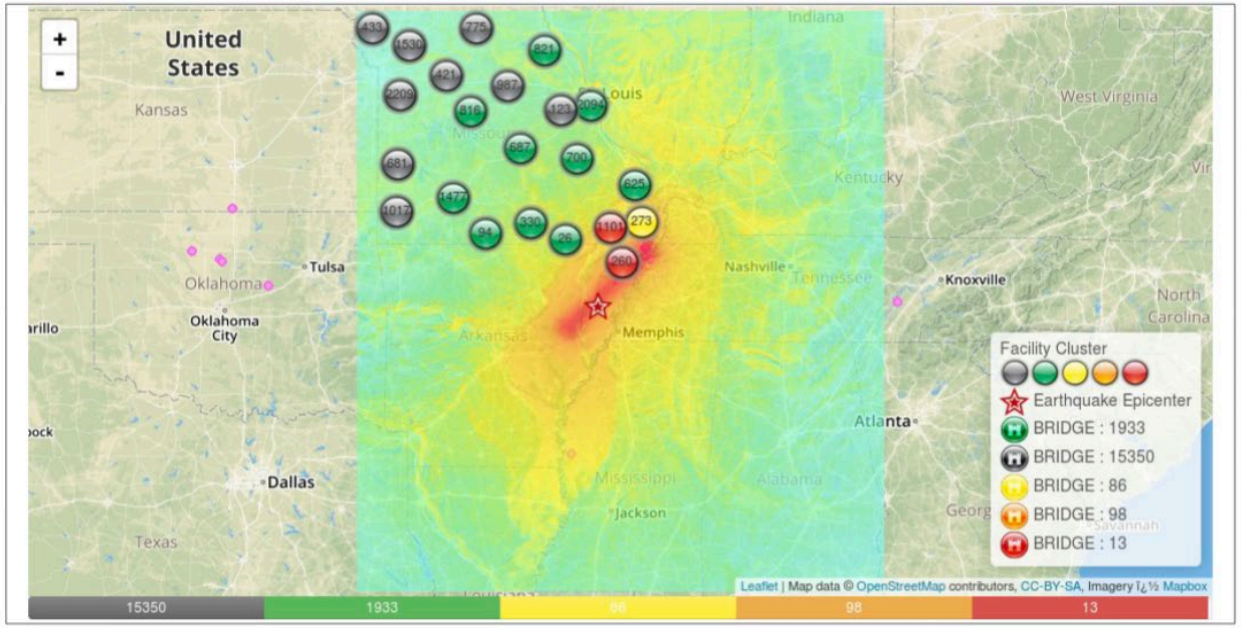
Origin Time: 2019-02-07 11:05:00 GMT

Created: 2019-01-30 15:35:49 GMT

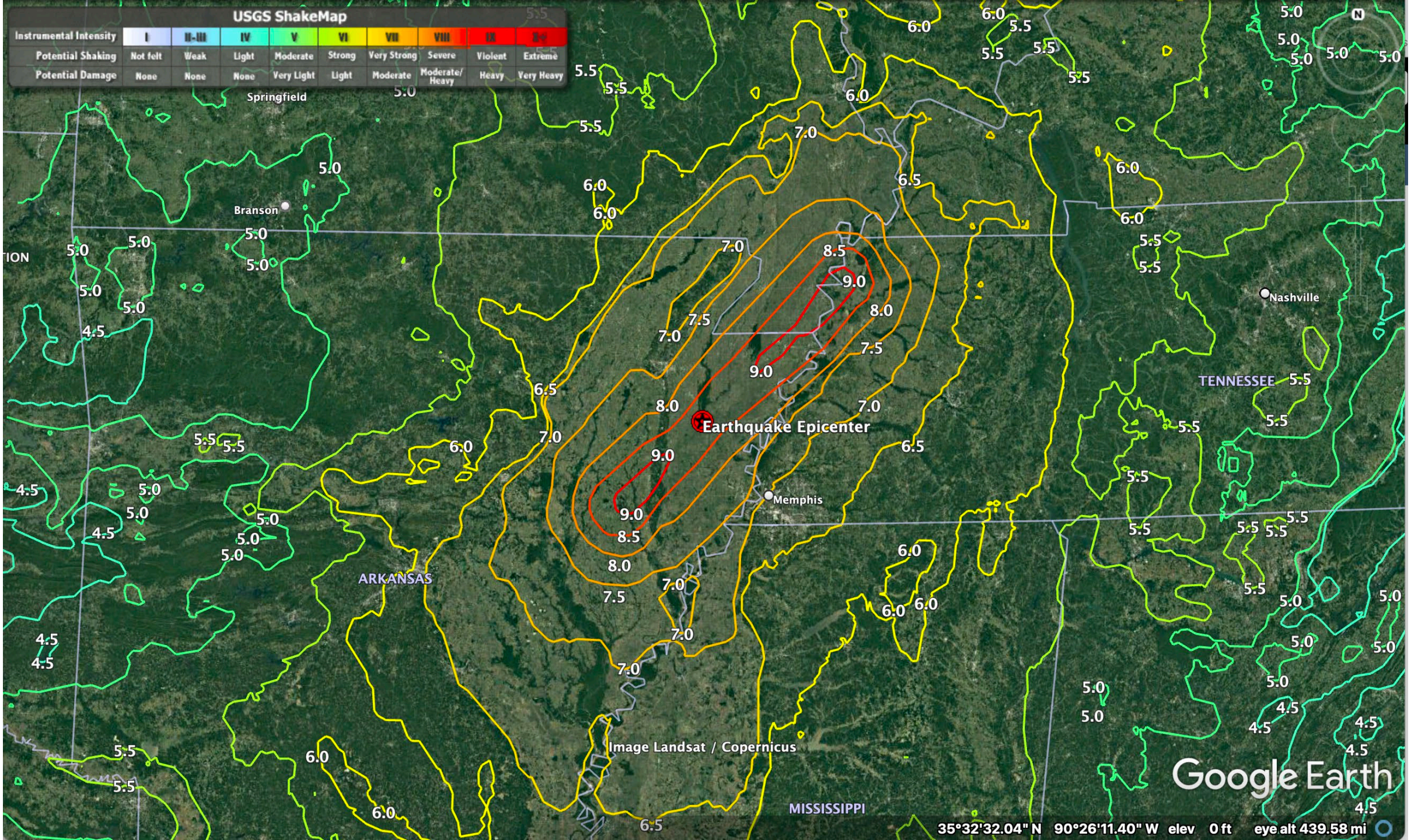
Latitude: 35.5426 Longitude: -90.4365

Depth: 15.0 km

These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.



Type	ID	Name	Ep. Distance (km)	Inspection Priority	PGA (%g)	PGV (cm/s)	PSA 1s (%g)	MMI	Vs30 (m/s)
BRIDGE	X0034	9506 - COUNTY DTCH	73.7	High	72.32	90.88	76.58	IX	214
BRIDGE	X0509	9695 - DRAIN DTCH NO 8	75.14	High	75.43	85.81	72.62	IX	224.3
BRIDGE	P0132	7513 - PEMISCOT BYU	75.99	High	74.62	100.7	84.33	IX	217
BRIDGE	G0457	4649 - PEMISCOT BYU	77.51	High	79.24	92.77	78.19	IX	227.5
BRIDGE	L0474	6294 - MAIN DTCH	77.79	High	78.04	97.72	82.06	IX	224
BRIDGE	3010009	21331 - DRAIN DTCH	78.23	High	79.24	92.77	78.19	IX	227.5
BRIDGE	L0477	6296 - OLD FRANKLIN DRAIN	82.14	High	79.39	104.8	87.6	IX	225.3
BRIDGE	G0458	4650 - MAIN DTCH NO 6	82.2	High	73.73	92.93	78.22	IX	217
BRIDGE	H0187	4890 - DRAIN DTCH NO 3	84.52	High	70.38	94.58	79.4	IX	211.2
BRIDGE	L0472	6293 - DRAIN DTCH NO 3	85.58	High	75.07	96.06	80.69	IX	219.4
BRIDGE	A1937	1629 - DRAIN DTCH NO 3	85.65	High	75.07	96.06	80.69	IX	219.4
BRIDGE	F0175	4450 - MAIN DTCH	94.81	High	70.69	83.21	70.51	IX	215.6
BRIDGE	J0291	5332 - DRAIN DTCH NO 6	99.7	High	80.42	86.94	73.52	IX	239.6


USGS ShakeMap
Instrumental Intensity
I
II-III
IV
V
VI
VII
VIII
IX
X+
Potential Shaking
Not felt
Weak
Light
Moderate
Strong
Very Strong
Severe
Violent
Extreme
Potential Damage
None
None
None
Very Light
Light
Moderate
Moderate/ Heavy
Heavy
Very Heavy
Springfield
Branson
Nashville
Memphis
Earthquake Epicenter
ARKANSAS
TENNESSEE
MISSISSIPPI
Image Landsat / Copernicus
Google Earth
35°32'32.04" N 90°26'11.40" W elev 0 ft eye alt 439.58 mi

USGS
science for a changing world

Earthquake Shaking Red Alert

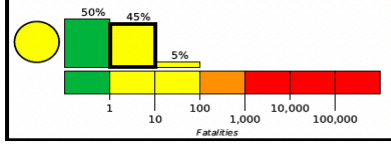
USAID FROM THE AMERICAN PEOPLE

M 6.0, Scenario New Madrid M6.0 Aftershock

Origin Time: 2019-02-08 03:05:00 UTC (Thu 21:05:00 local)
Location: 36.2600° N 89.5200° W Depth: 12.0 km

PAGER
Version 1

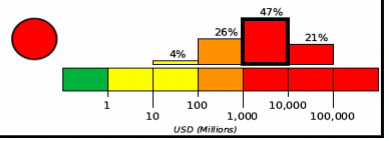
Estimated Fatalities



Red alert for economic losses. Extensive damage is probable and the disaster is likely widespread. Estimated economic losses are less than 1% of GDP of the United States. Past events with this alert level have required a national or international level response.

Yellow alert for shaking-related fatalities. Some casualties are possible.

Estimated Economic Losses



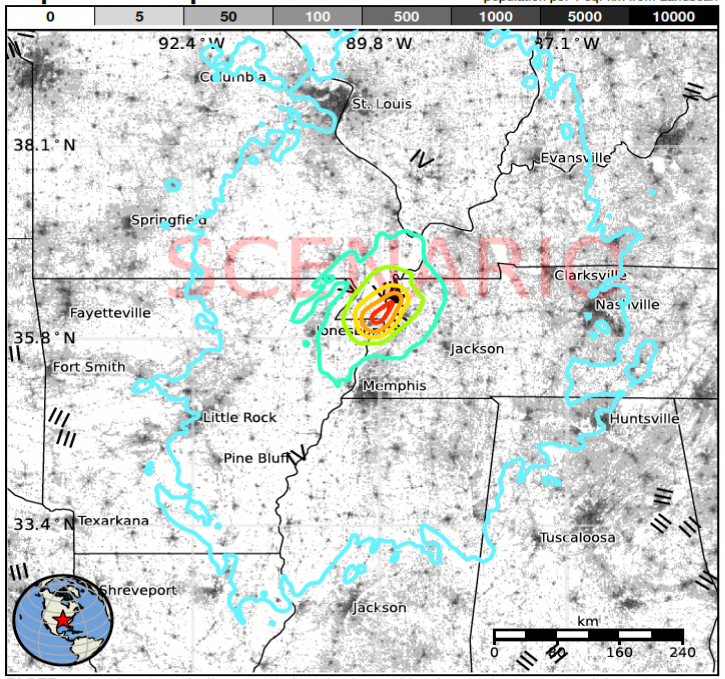
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k=x1000)		–*	19,142k*	12,424k	242k	77k	9k	28k	9k	0
ESTIMATED MODIFIED MERCALLI INTENSITY		I	II-III	IV	V	VI	VII	VIII	IX	X+
PERCEIVED SHAKING		Not felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	Resistant Structures	None	None	None	V. Light	Light	Moderate	Mod./Heavy	Heavy	V. Heavy
	Vulnerable Structures	None	None	None	Light	Moderate	Mod./Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per 1 sq. km from Landscan



Structures

Overall, the population in this region resides in structures that are resistant to earthquake shaking, though vulnerable structures exist. The predominant vulnerable building types are unreinforced brick masonry and reinforced masonry construction.

Historical Earthquakes

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1976-03-25	112	4.5	IV(32k)	–
1976-03-25	100	5.0	VI(59k)	–
1987-06-10	319	5.1	VI(1k)	0

Selected City Exposure

from GeoNames.org

MMI	City	Population
IX	Caruthersville	6k
VIII	Steele	2k
VIII	Ridgely	2k
VIII	Blytheville	16k
VIII	Gosnell	4k
VII	Hayti	3k
IV	**Nashville**	**531k**
III	**Little Rock**	**194k**
III	Indianapolis	830k
III	**Jackson**	**174k**
III	Montgomery	206k

bold cities appear on map. (k=x1000)

PAGER content is automatically generated, and only considers losses due to structural damage. Limitations of input data, shaking estimates, and loss models may add uncertainty.
http://earthquake.usgs.gov/data/pager/

Event ID: usnewmadrid_m6p0_se_for_Fury_2019_se

MoDOT State of Missouri Department of Transportation

ShakeCast Report

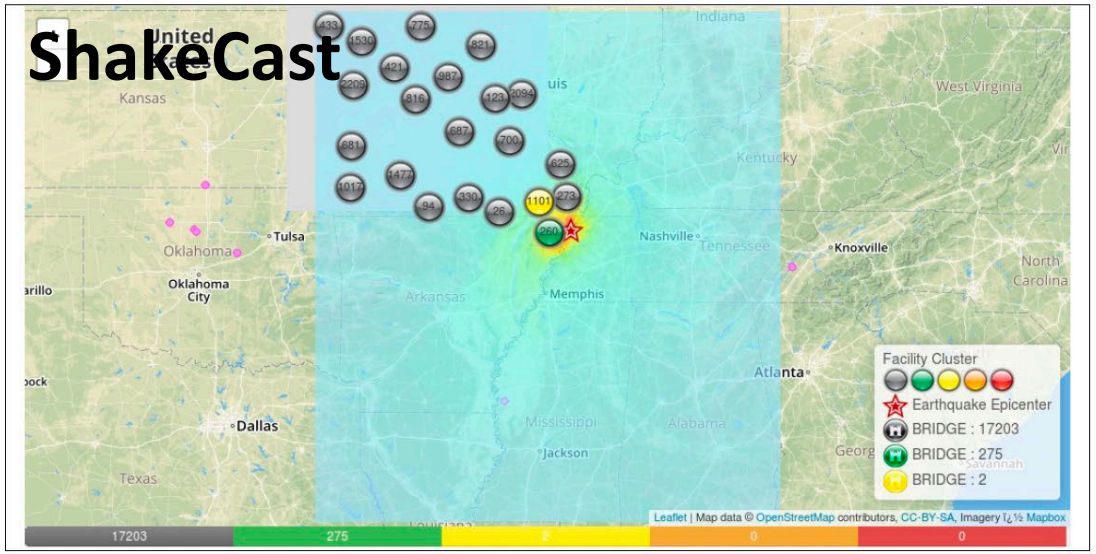
National Earthquake Information Center (NEIC)

Magnitude 6.0 - New Madrid M6.0 Aftershock

Version 1

Origin Time: 2019-02-07 20:05:00 GMT
Created: 2019-01-29 15:54:07 GMT
Latitude: 36.2600 Longitude: -89.5200
Depth: 12.0 km

These results are from an automated system and users should consider the preliminary nature of this information when making decisions relating to public safety. ShakeCast results are often updated as additional or more accurate earthquake information is reported or derived.

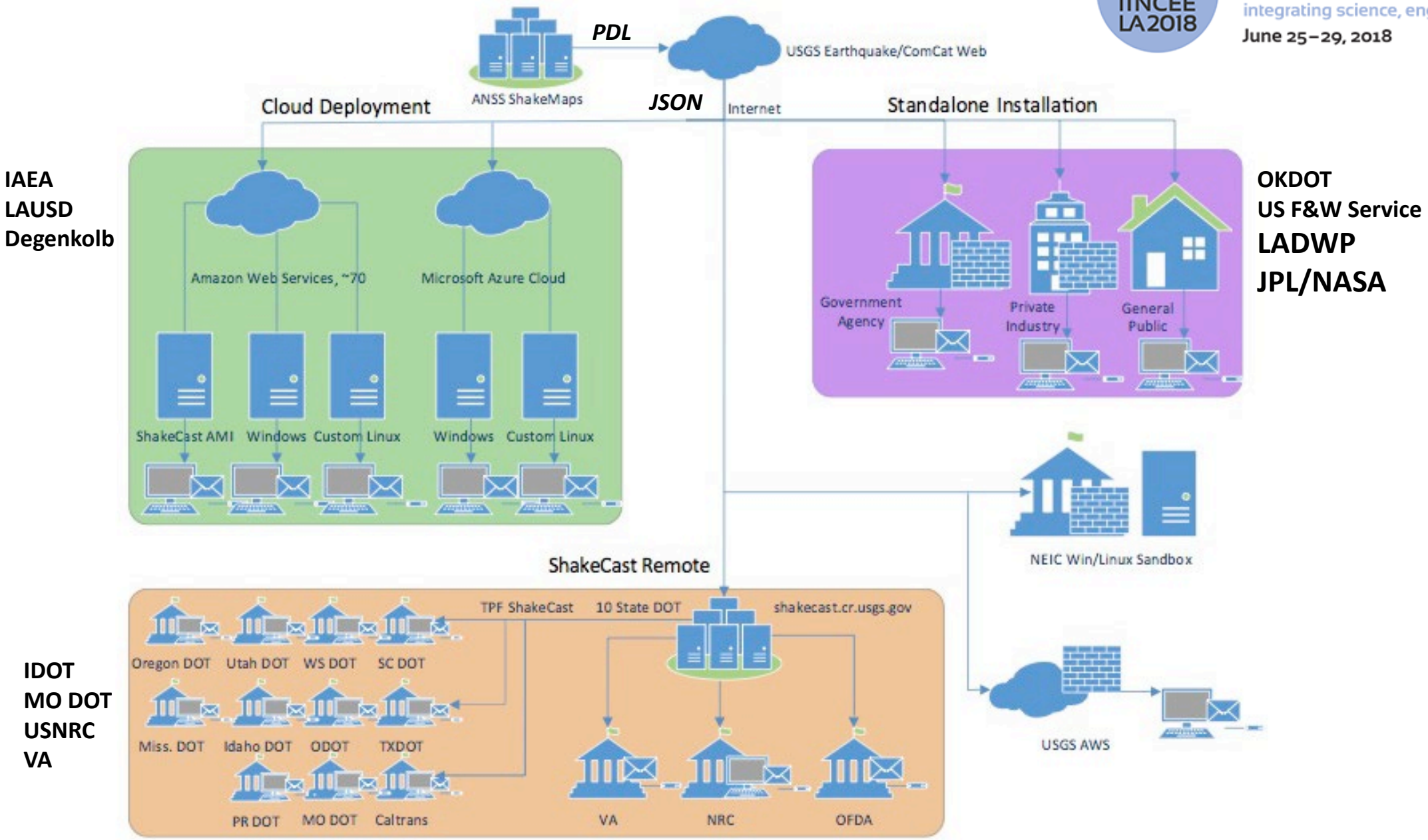


Type	ID	Name	Ep. Distance (km)	Inspection Priority	PGA (%g)	PGV (cm/s)	PSA 1s (%g)	MMI	Vs30 (m/s)
BRIDGE	L0472	6293 - DRAIN DTCH NO 3	29.52	Moderate	53.76	31.92	28.97	IX	219.4
BRIDGE	L0477	6296 - OLD FRANKLIN DRAIN	32.73	Moderate	62.11	39.38	35.74	IX	225.3
BRIDGE	S0883	8886 - MAIN DTCH NO 8	15.31	Low	42.37	19.11	17.49	VII	232
BRIDGE	1870003	32243 - DRAIN DTCH	16.84	Low	59.5	33.17	30.06	VIII	228.9
BRIDGE	A1820	1511 - IS 55	16.89	Low	41.04	19.77	18.15	VII	217.8
BRIDGE	A2481	32429 - COUNTY RD 362	16.91	Low	68.29	39.72	35.97	IX	237.3
BRIDGE	750027	14786 - DRAIN DTCH	17.09	Low	39.37	18.21	16.75	VII	220.3
BRIDGE	A6786	29424 - LATERAL DTCH NO 5	17.15	Low	63.16	38.42	34.9	IX	221.4
BRIDGE	A6787	29443 - LATERAL DTCH NO 5	17.21	Low	63.16	38.42	34.9	IX	221.4
BRIDGE	A1844	1535 - LATERAL DTCH NO 27	17.66	Low	39.73	18.59	17.08	VII	224.3
BRIDGE	A2415	2085 - IS 155	17.66	Low	64.64	38.71	35.11	IX	227.6
BRIDGE	A1743	1435 - LATERAL DTCH NO 27	17.71	Low	39.73	18.59	17.08	VII	224.3
BRIDGE	A1843	1534 - LATERAL DTCH NO 27	17.74	Low	39.73	18.59	17.08	VII	224.3
BRIDGE	A1700	1396 - MISSISSIPPI RVR COUNTY	17.89	Low	64.03	35.52	32.15	IX	238

* MMI level may extend beyond map boundary; some facilities may not appear on the map due to space restriction

SHAKECAST WEB TOPOLOGY

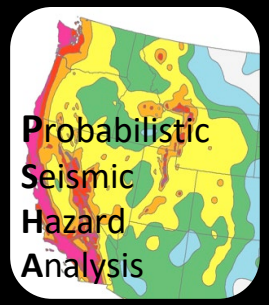
11th National Conference on Earthquake Engineering
integrating science, engineering, & policy
June 25–29, 2018



USGS Earthquake Information System

Pre- Earthquake → Earthquake → Post-Earthquake

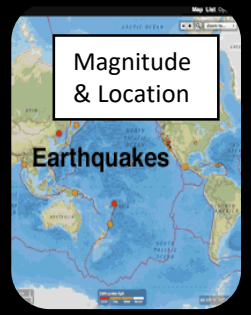
PSHA



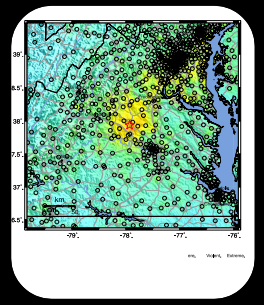
Scenarios

EEW

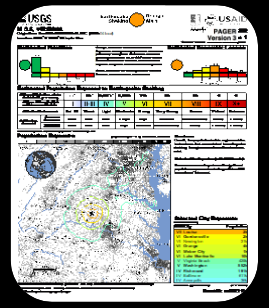
Mag/Loc



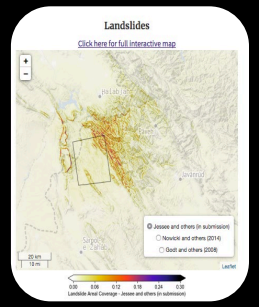
ShakeMap



PAGER



Ground Failure



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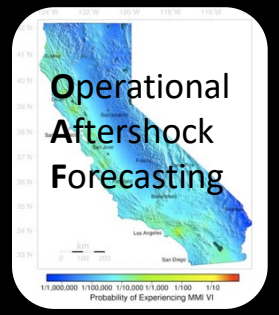
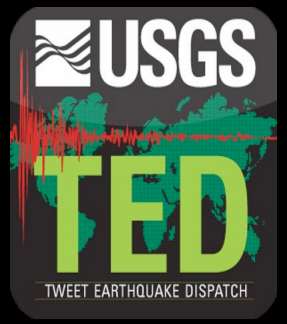
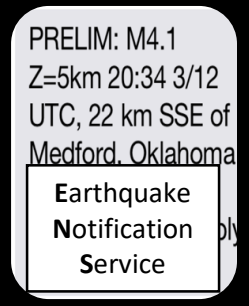


Years before → 0.0 sec → 3 Min → 10 Min → 60 Min

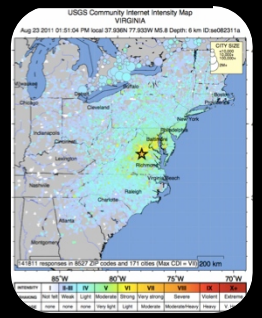
TED



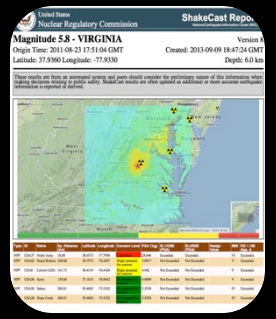
ENS



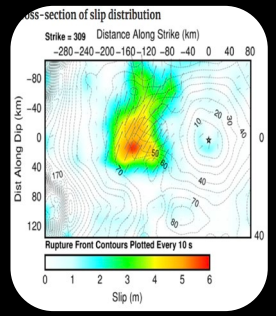
DYFI?



ShakeCast



Finite Fault



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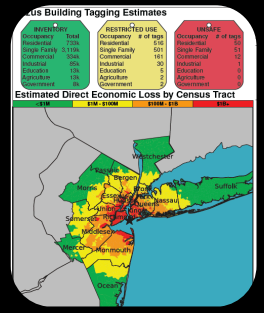
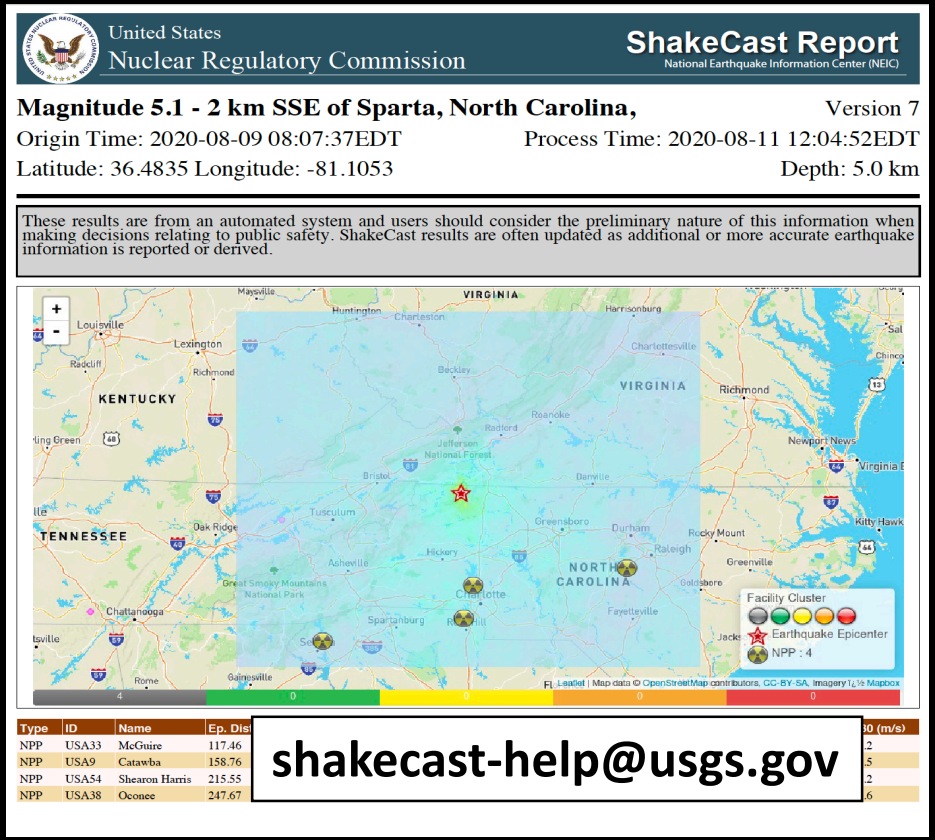
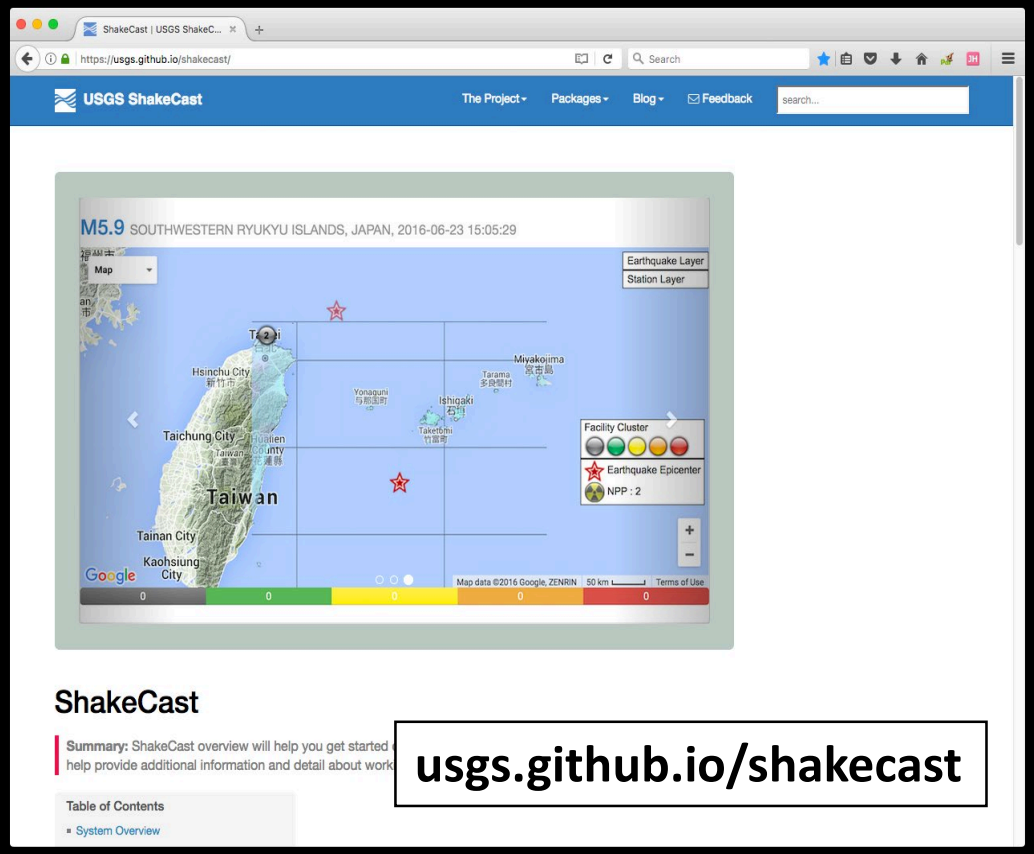


Questions?



shakecast-help@usgs.gov



usgs.github.io/shakecast