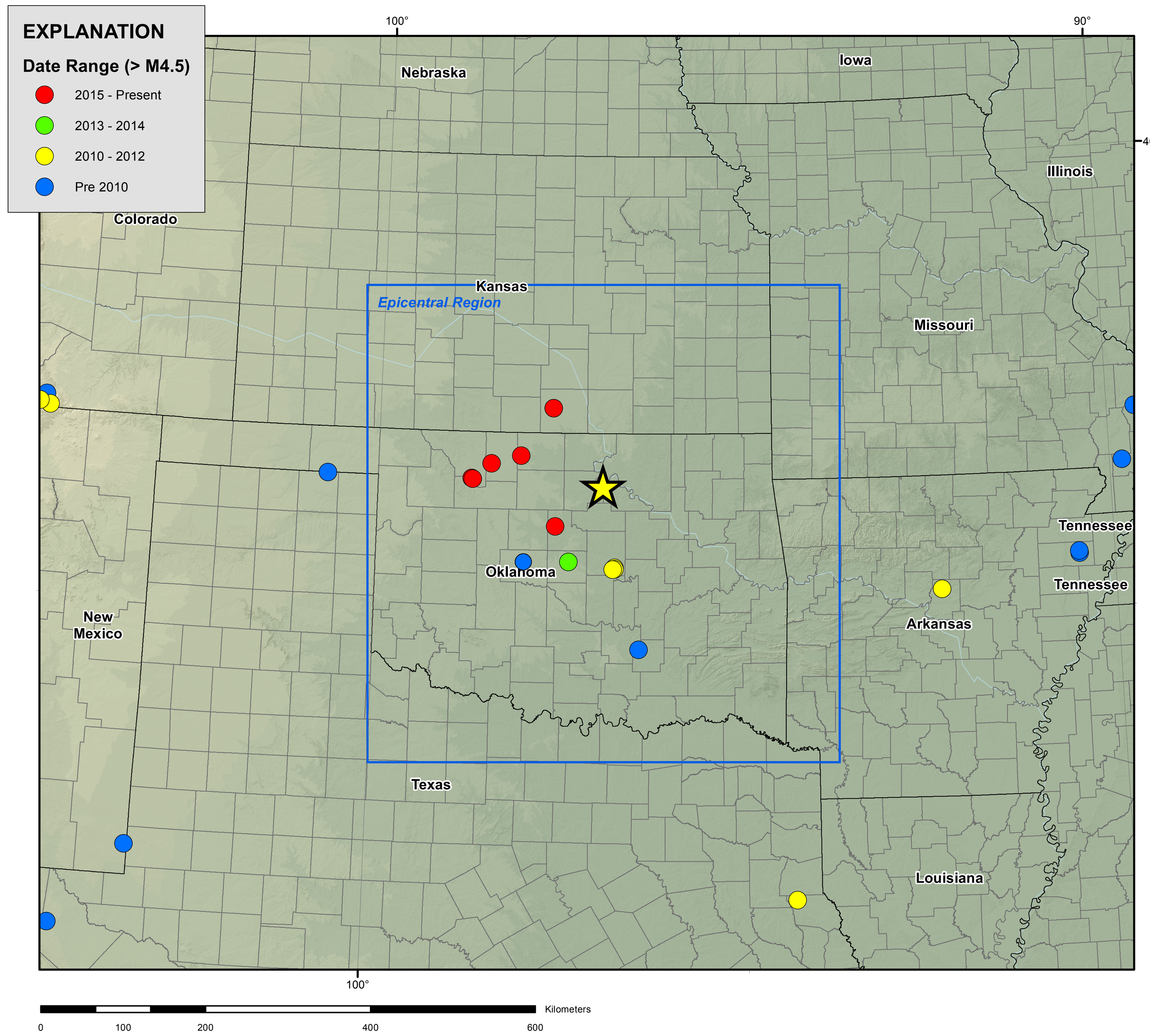
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP

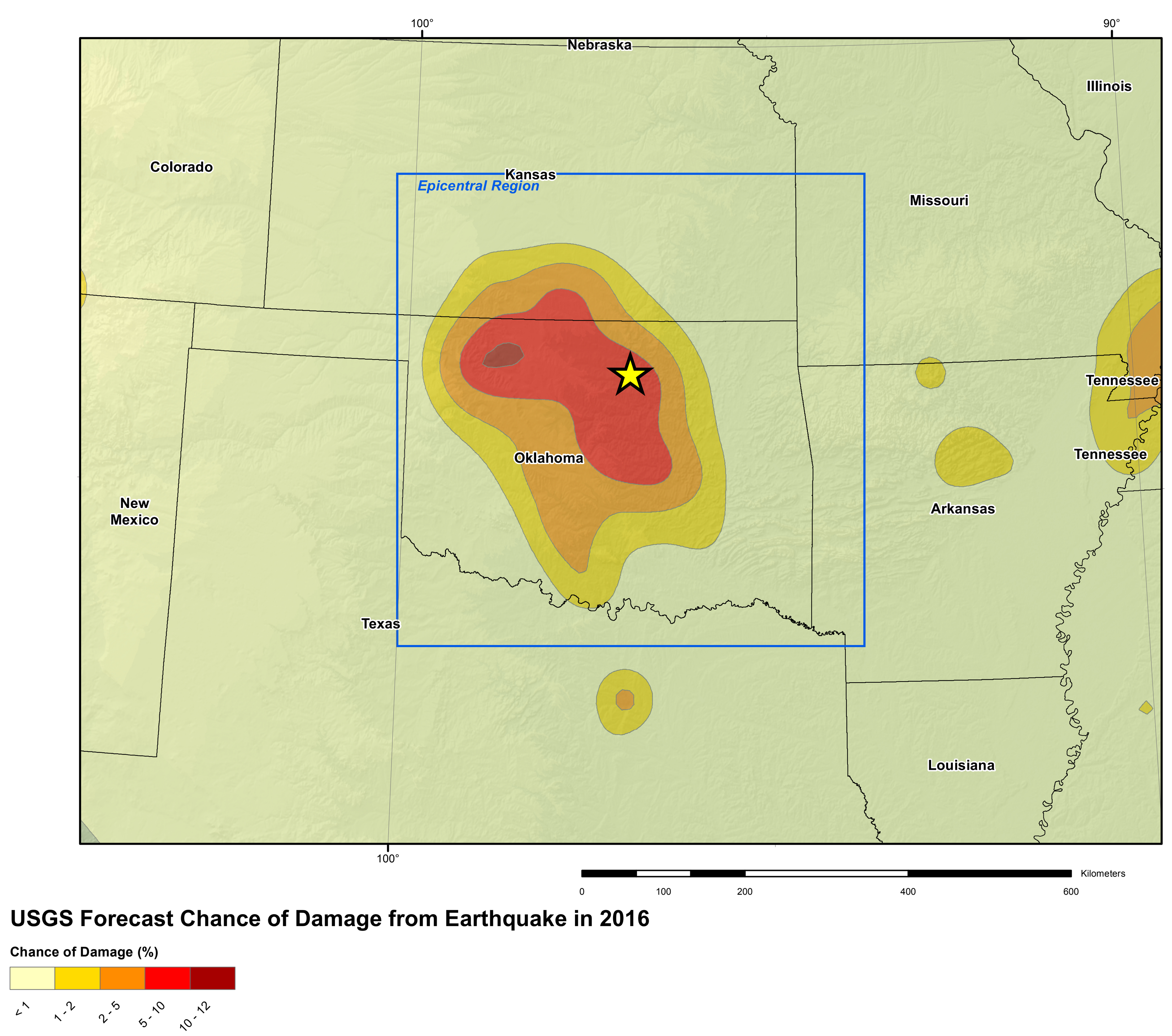
Prepared in cooperation with the Global Seismographic Network

M5.8 North Central Oklahoma Earthquake of 03 September 2016

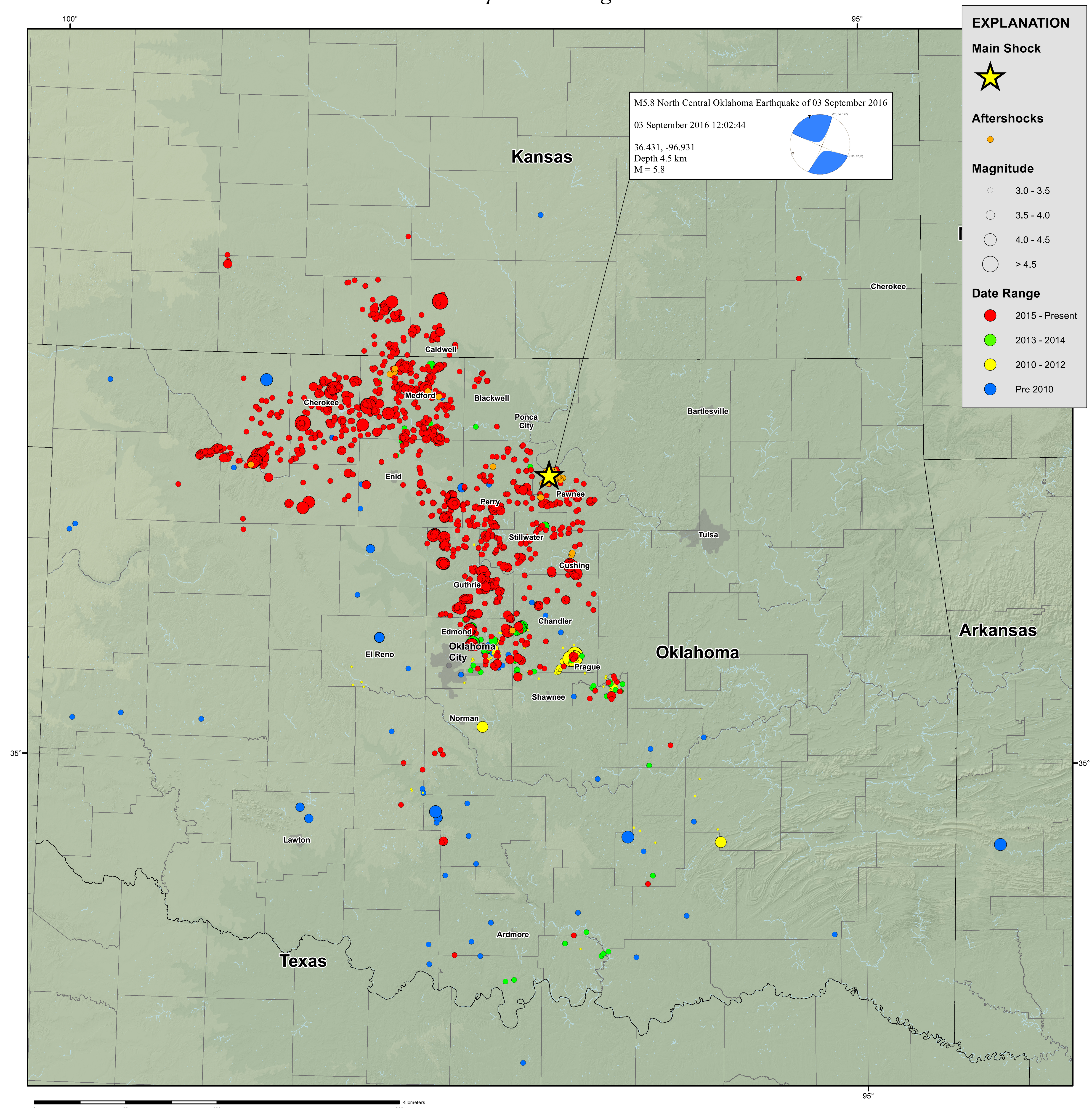
Significant Historical Earthquakes



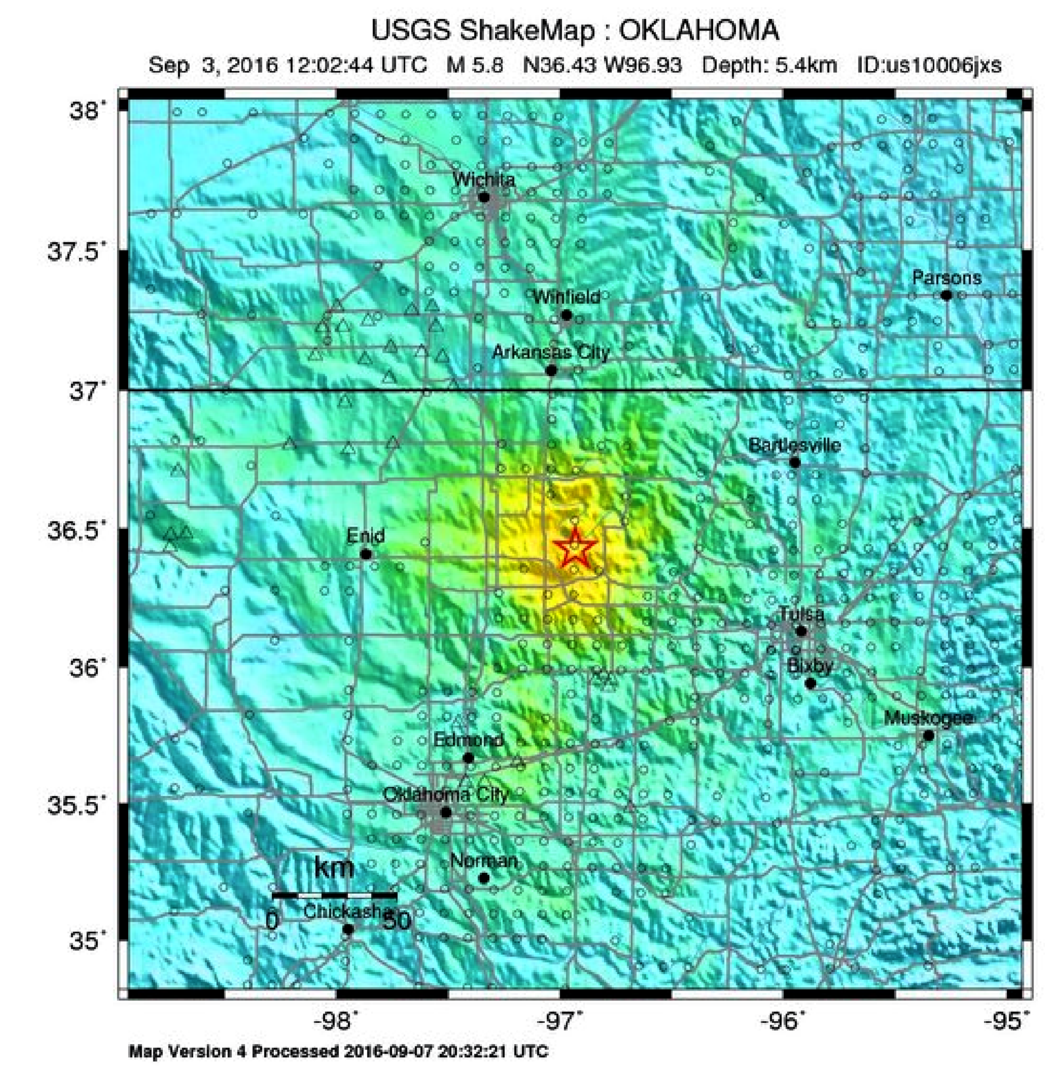
Seismic Hazard



Epicentral Region



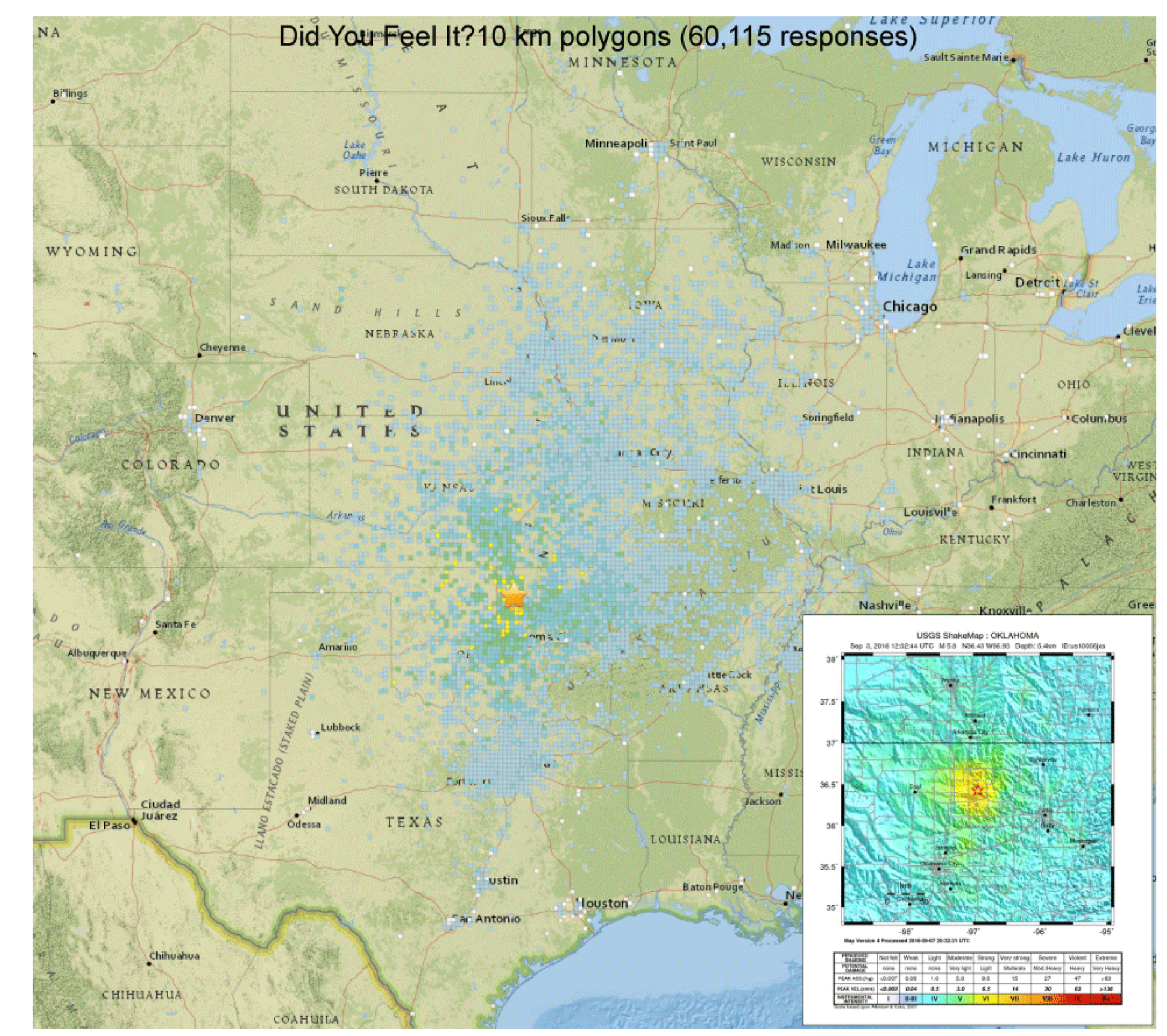
ShakeMap



PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Mod./Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<0.007	0.08	1.0	5.0	8.8	15	27	47	>83
PEAK VEL.(cm/s)	*<0.003*	*0.04*	*0.5*	*3.0*	*6.5*	*14*	*30*	*63*	*>136*
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Scale based upon Atkinson & Kaka, 2007

Did You Feel It?



TECTONIC SUMMARY

The September 3, 2016 M 5.8 Oklahoma earthquake occurred as the result of shallow strike-slip faulting about 15 km northwest of the town of Pawnee. The earthquake occurred within the interior of the North America plate, far from any plate boundaries. The preliminary focal mechanism solution for the earthquake indicates rupture occurred on either a left-lateral fault striking east-southeast, or on a right lateral fault striking north-northeast. The mainshock location aligns with a major regional SW-NE trending fault. In general, it is very difficult to correlate earthquakes to specific faults in the region and identification of the fault responsible for this event will require further study and fieldwork.

The magnitude 5.8 earthquake near Pawnee, OK, on Sept. 3, 2016 will continue to produce aftershocks. Residents in that area can expect to continue feeling earthquakes and there is the possibility of additional earthquakes capable of doing damage. As of 7PM CDT on September 4, 2016: There is a 12% chance of an aftershock of magnitude 5 or greater within the next month, and that likelihood increases to 29% if the time window is extended to include the next year. The expected numbers of aftershocks with magnitudes of 3 or greater are between 5 and 25 within the next month and between 15 and 55 during the next year. This forecast is based on patterns of past aftershocks sequences and data on the current aftershock sequence. The forecast does not include the possibility of nearby earthquakes that are not aftershocks.

Prior to the September 3, 2016 earthquake, the surrounding region of Oklahoma and Kansas has hosted close to 80 other M 4 or larger events over the preceding decade. Two of these were larger than M 5: a M 5.7 earthquake in November 2011, near Prague, Oklahoma, and a M 5.1 in February 2016 near Fairview, Oklahoma. The Prague earthquake resulted in 2 injuries, and over a dozen homes destroyed; it was felt in 17 states. The Fairview event was also broadly felt but did not cause significant damage. In the immediate vicinity of the September 3 event, a M 3.2 earthquake occurred on September 1, 2016, just to the southwest. Within an hour of the September 3 M 5.8 earthquake, 4 aftershocks have been located, the largest being a M 3.6 event 56 minutes after the mainshock. 3 of the 4 aftershocks align on the NW-SE left-lateral plane of the focal mechanism solution.

Locations across the central and eastern United States (CEUS) have been experiencing a rapid increase in the number of induced earthquakes over the past 7 years. Since 2009 rates in some areas, such as Oklahoma, have increased by more than an order of magnitude. Scientific studies have linked the majority of this increased activity to wastewater injection in deep disposal wells in several locations. However, other mechanisms such as fluid withdrawal, enhanced oil recovery, or hydraulic fracturing processes can also result in induced earthquakes. In addition, regions with frequent induced earthquakes may also be subject to damaging earthquakes that would have occurred independently of human activity. Making a strong scientific case for a causative link between a particular human activity and a particular sequence of earthquakes typically involves special studies devoted specifically to the question. Such investigations usually address the process by which the suspected triggering activity might have significantly altered stresses in the bedrock at the earthquake source, and they commonly address the ways in which the characteristics of the suspected human triggered earthquakes differ from the characteristics of natural earthquakes in the region.

DATA SOURCES

EARTHQUAKES AND SEISMIC HAZARD
USGS, National Earthquake Information Center
NOAA, National Geophysical Data Center
IASPEI, Centennial Catalog (1900 - 1999) and extensions (Engdahl and Villaseñor, 2002)
EHB catalog (Engdahl et al., 1998)
HDF (unpublished earthquake catalog, Engdahl, 2003)
Global Seismic Hazard Assessment Program
Volcanoes of the World (Siebert and Simkin, 2002)

PLATE TECTONICS AND FAULT MODEL
PB2002 (Bird, 2003)
Ji, C., D.J. Wald, and D.V. Helmberger, Source description of the 1999 Hector Mine, California earthquake; Part I: Wavelet domain inversion theory and resolution analysis, Bull. Seism. Soc. Am., Vol 92, No. 4. pp. 1192-1207, 2002.
DeMets, C., Gordon, R.G., Argus, D.F., 2010. Geologically current plate motions, Geophys. J. Int. 181, 1-80.

BASE MAP
NIMA and ESRI, Digital Chart of the World
USGS, EROS Data Center
NOAA GEBCO and GLOBE Elevation Models

REFERENCES

Bird, P., 2003, An updated digital model of plate boundaries: Geochem. Geophys. Geosyst., v. 4, no. 3, pp. 1027-80.

Engdahl, E.R., and Villasenor, A., 2002, Global Seismicity: 1900-1999, chap. 41 of Lee, W.H.K., and others, eds., International Earthquake and Engineering Seismology, Part A: New York, N.Y., Elsevier Academic Press, 932 p.

Engdahl, E.R., Van der Hilst, R.D., and Buland, R.P., 1998, Global teleseismic earthquake relocation with improved travel times and procedures for depth determination;Bull. Seism. Soc. Amer., v. 88, p. 722-743.

DISCLAIMER

Map updated by U.S. Geological Survey National Earthquake Information Center
08 September 2016
http://earthquake.usgs.gov/
Map not approved for release by Director USGS