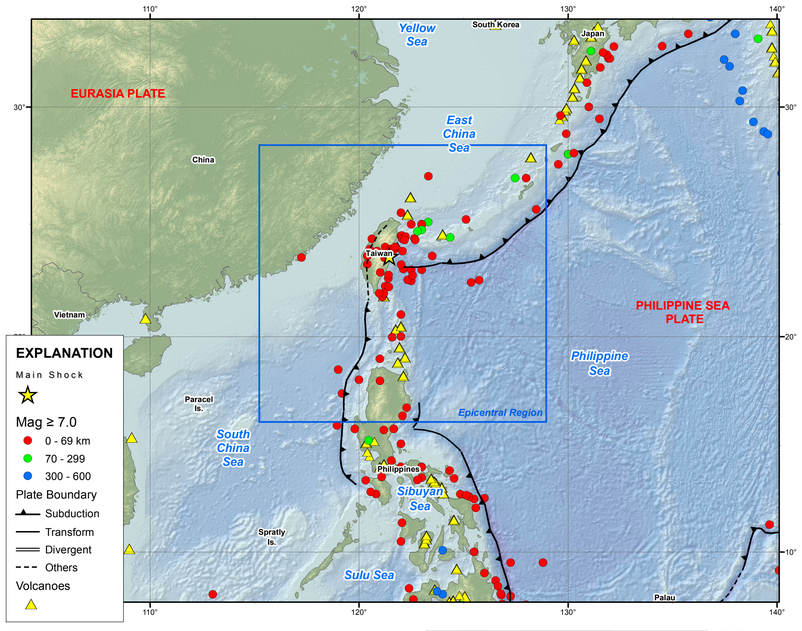
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

M6.3 Eastern Taiwan Earthquake of 31 October 2013

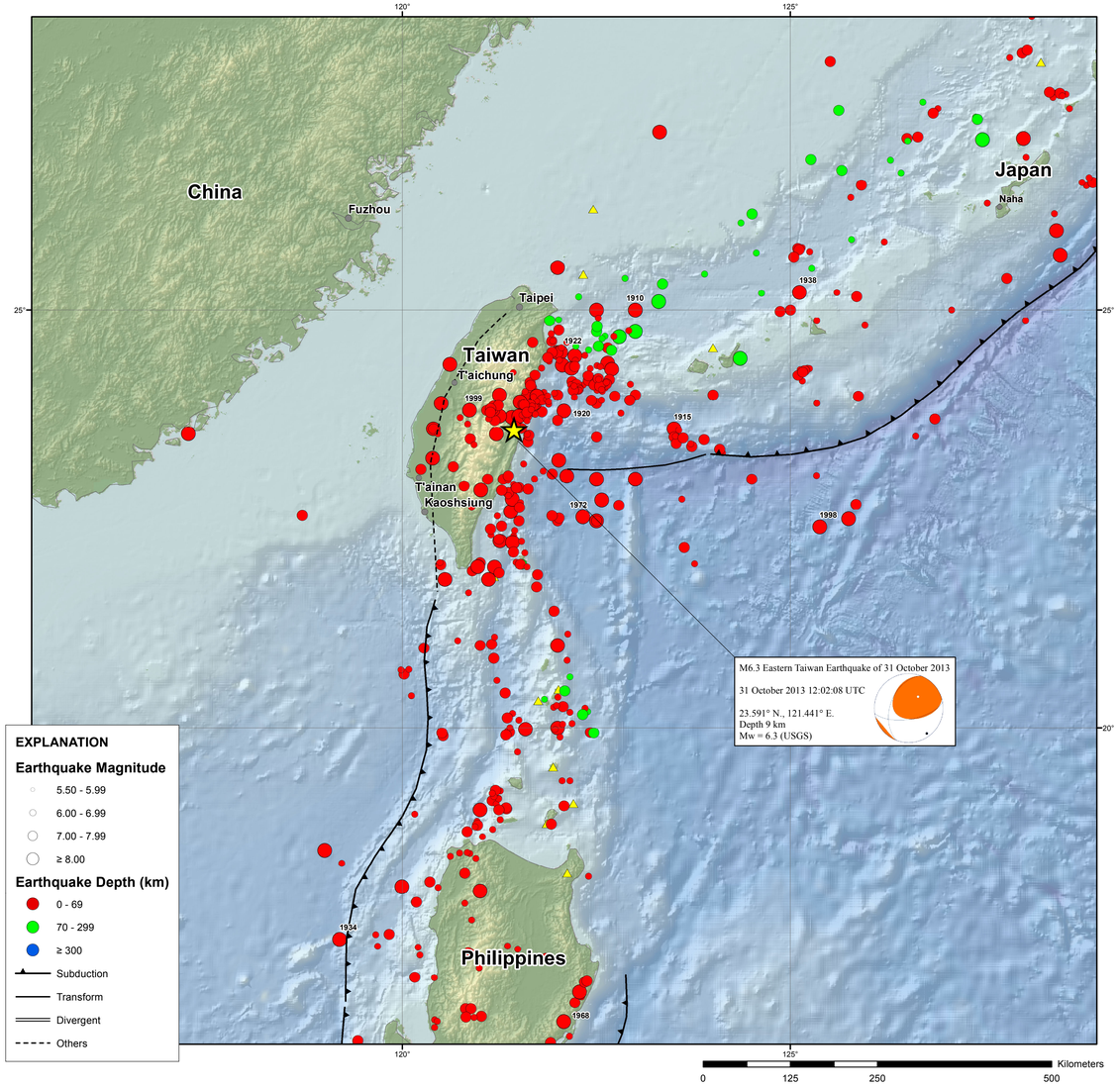
EARTHQUAKE SUMMARY MAP

Prepared in cooperation with the Global Seismographic Network

Tectonic Setting



Epicentral Region



PAGER

M 6.3, TAIWAN
Origin Time: Thu 2013-10-31 12:02:09 UTC (20:02:09 local)
Location: 23.59°N 121.44°E Depth: 12 km

Earthquake Shaking: Green Alert

PAGER
Version 4
Created: 1 hour, 48 minutes after earthquake

Estimated Fatalities

Green alert for shaking-related fatalities and economic losses. There is a low likelihood of casualties and damage.

Estimated Economic Losses

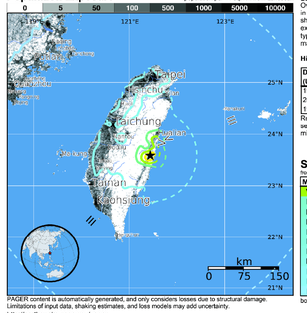
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)	- -*	21,265k	15,950k	146k	144k	15k	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	Moderate/Heavy	Heavy	V. Heavy
POTENTIAL DAMAGE: Vulnerable Structures	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy	V. Heavy

*Estimated exposure only includes population within the map area.

Population Exposure

population per ~1 sq. km from Landscan



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/pager

Structures:
Overall, the population in this region resides in structures that are resistant to earthquake shaking, though some vulnerable structures exist. The predominant vulnerable building types are adobe block and reinforced masonry construction.

Historical Earthquakes (with MMI levels):

Date (UTC)	Dist. (km)	Mag.	Max MMI(#)	Shaking Deaths
1999-10-22	100	5.5	VIII(21k)	0
2002-03-31	108	7.1	VIII(15k)	5
1999-09-20	54	7.6	X(1,052k)	2k

Recent earthquakes in this area have caused secondary hazards such as landslides that might have contributed to losses.

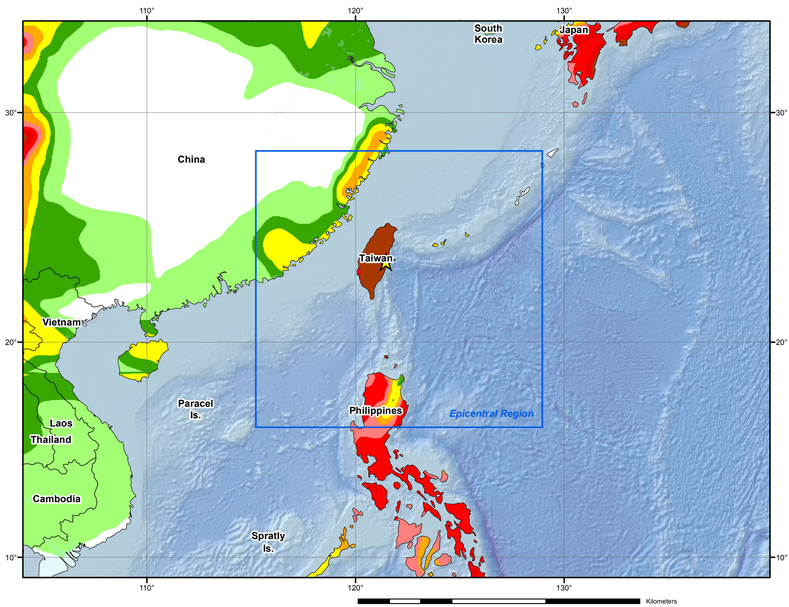
Selected City Exposure
from Cachharea.org

MMI	City	Population
VI	Hualian	350k
IV	Banqiao	543k
IV	Hsinchu	404k
IV	Taipei	7,872k
IV	Zhubei	< 1k
IV	Taoyuan City	402k
IV	Keelung	396k
IV	Taichung	1,041k
III	Kaohsiung	1,520k
III	Tainan	771k
III	Fuzhou	1,180k

bold cities appear on map (k = x1000)

Event ID: usc000ksdy

Seismic Hazard



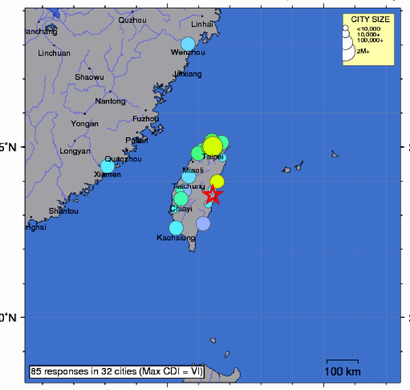
Seismic hazard is expressed as peak ground acceleration (PGA) on firm rock, in meters/sec², expected to be exceeded in a 50-yr period with a probability of 10 percent.

Peak Ground Acceleration in m/sec**2

.2 .4 .8 1.6 2.4 3.2 4.0 4.8

Did You Feel It?

USGS Community Internet Intensity Map
TAIWAN
Oct 31 2013 08:02:09 PM local 23.5908N 121.443E M6.3 Depth: 12 km ID:usc000ksdy



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

Processed: Thu Oct 31 13:56:10 2013

TECTONIC SUMMARY

The October 31, 2013 M 6.3 earthquake southwest of Hualian, Taiwan occurred as the result of shallow oblique-thrust faulting near the central-east coast of the island of Taiwan and the boundary between the Philippine Sea and Eurasia plates. East of the October 31 earthquake, plate boundary tectonics are dominated by the subduction of the Philippine Sea Plate beneath Eurasia along the Ryukyu Trench, which runs from southwest Japan to Taiwan. Some authors infer that this subduction continues beneath the east coast of Taiwan. South of the island towards the Philippines, the plate boundary reflects arc-continent collision more than traditional subduction. The October 31 earthquake occurred at the transition between these tectonic regimes, and is a consequence of the convergence between these major plates. At the location of this earthquake, the Philippine Sea plate moves to the northwest with respect to Eurasia at a velocity of approximately 77 mm/yr.

This region of Taiwan is familiar with moderate to large earthquake activity, and has hosted over 60 events of M6 or greater within 250 km of the October 31 event in the past 40 years. Seven of these were M7 or greater, including a M7.4 earthquake 40 km to the north of the October 31 event in November 1986, which caused 13 fatalities.

Significant Earthquakes Mag >= 7

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1906	04	13	1918	23.600	120.400	5	7.1
1906	06	19	1122	20.000	122.000	60	7.1
1906	10	17	0940	19.000	121.000	60	7.3
1909	04	14	1953	25.000	122.500	5	7.1
1909	11	21	0736	25.500	122.000	5	7.3
1910	04	12	0022	25.000	123.000	200	7.6
1910	09	01	0045	21.000	122.000	0	7.0
1910	11	14	0734	24.500	122.000	0	7.0
1911	02	23	1114	27.000	128.000	5	7.1
1915	01	05	2326	25.100	123.300	150	7.3
1915	02	28	1859	23.600	123.500	0	7.7
1916	08	28	0727	23.900	120.500	5	7.2
1917	07	04	0038	25.000	123.000	0	7.2
1917	07	04	0536	25.000	123.000	0	7.2
1918	02	13	0607	23.540	117.243	15	7.2
1919	06	01	0651	27.074	123.315	35	7.1
1919	12	20	1933	22.500	122.500	35	7.1
1919	12	20	2037	23.536	121.212	35	7.0
1920	06	05	0421	23.813	122.080	35	7.9
1921	04	02	0936	23.000	123.000	35	7.2
1922	09	01	1916	24.506	122.040	35	7.5
1922	09	14	1931	24.378	122.644	35	7.1
1925	04	16	1952	21.798	121.111	35	7.1
1926	06	29	1427	26.986	127.473	142	7.4
1930	12	21	1451	19.986	121.585	35	7.0
1934	02	14	0359	17.404	119.190	35	7.5
1935	04	20	2202	24.364	120.613	35	7.1
1935	09	04	0137	22.259	121.257	35	7.1
1935	12	17	1917	22.525	125.747	25	7.1
1936	08	22	1109	21.949	121.186	35	7.2
1937	12	08	0832	22.872	121.010	38.8	7.0
1938	05	23	0821	18.053	119.994	35	7.0
1938	06	10	0953	25.208	125.115	35	7.6
1938	09	07	0403	23.737	121.408	47.4	7.0
1938	12	06	2300	22.614	121.398	39	7.0
1941	12	16	1919	23.251	120.391	35	7.1
1947	09	26	1601	24.750	123.000	110	7.4
1948	03	03	0909	18.500	119.000	0	7.1
1949	12	29	0303	18.000	121.000	0	7.2
1951	10	21	2134	23.750	121.500	0	7.5
1951	10	22	0329	23.750	121.250	0	7.2
1951	10	22	0428	23.900	121.700	0	7.0
1951	10	22	0543	24.000	121.250	0	7.1
1951	11	24	1850	23.000	122.500	0	7.3
1957	02	23	2026	23.917	121.517	56.8	7.2
1958	03	11	0026	24.433	124.351	109	7.2
1959	04	26	2040	24.687	122.792	126	7.5
1959	08	15	0857	21.952	120.970	25	7.2
1963	02	13	0850	24.356	122.060	35	7.3
1966	03	12	1631	24.307	122.695	28.9	7.4
1967	10	25	0059	24.464	122.221	67.1	7.0
1968	02	26	1050	22.762	121.414	16.2	7.2
1968	08	01	2019	16.384	122.078	52.2	7.7
1968	08	03	0454	25.646	128.473	29	7.1
1972	01	25	0206	22.549	122.325	10.1	7.5
1972	01	25	0341	23.037	122.118	11.9	7.0
1975	05	23	1601	22.753	122.567	17.9	7.0
1977	03	18	2143	16.753	122.283	34	7.3
1978	07	23	1442	22.243	121.419	39.2	7.3
1978	12	23	1123	23.224	122.015	48	7.0
1986	11	14	2120	23.989	121.731	34	7.4
1998	05	03	2330	22.430	125.375	25.4	7.5
1999	09	20	1747	23.819	120.863	21	7.7
2002	03	31	0652	24.315	122.179	41.1	7.4
2006	12	26	1226	21.799	120.547	10	7.1
2010	02	26	2031	25.930	128.425	25	7.0

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

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

Base map data, such as place names and political boundaries, are the best available but may not be current or may contain inaccuracies and therefore should not be regarded as having official signifiance.

Map updated by U.S. Geological Survey National Earthquake Information Center
31 October 2013
http://earthquake.usgs.gov/
Map not approved for release by Director USGS