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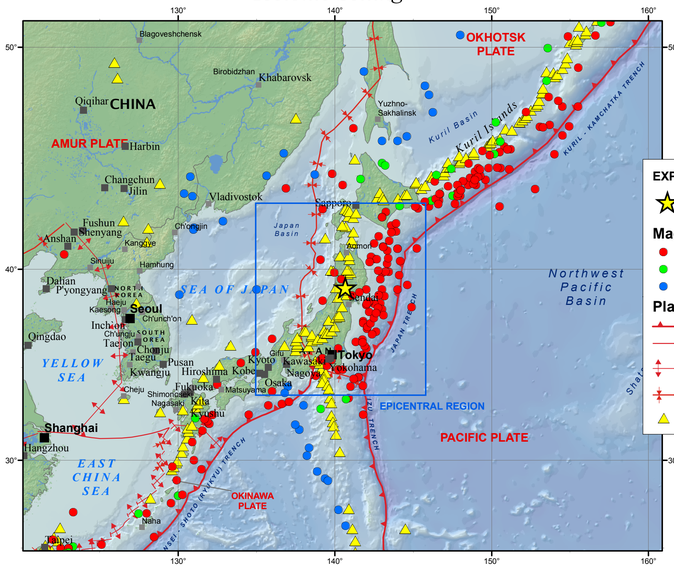
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

EARTHQUAKE SUMMARY MAP XXX

Prepared in cooperation with the Global Seismographic Network
GSN

M6.9 Northern Honshu, Japan Earthquake of 13 June 2008

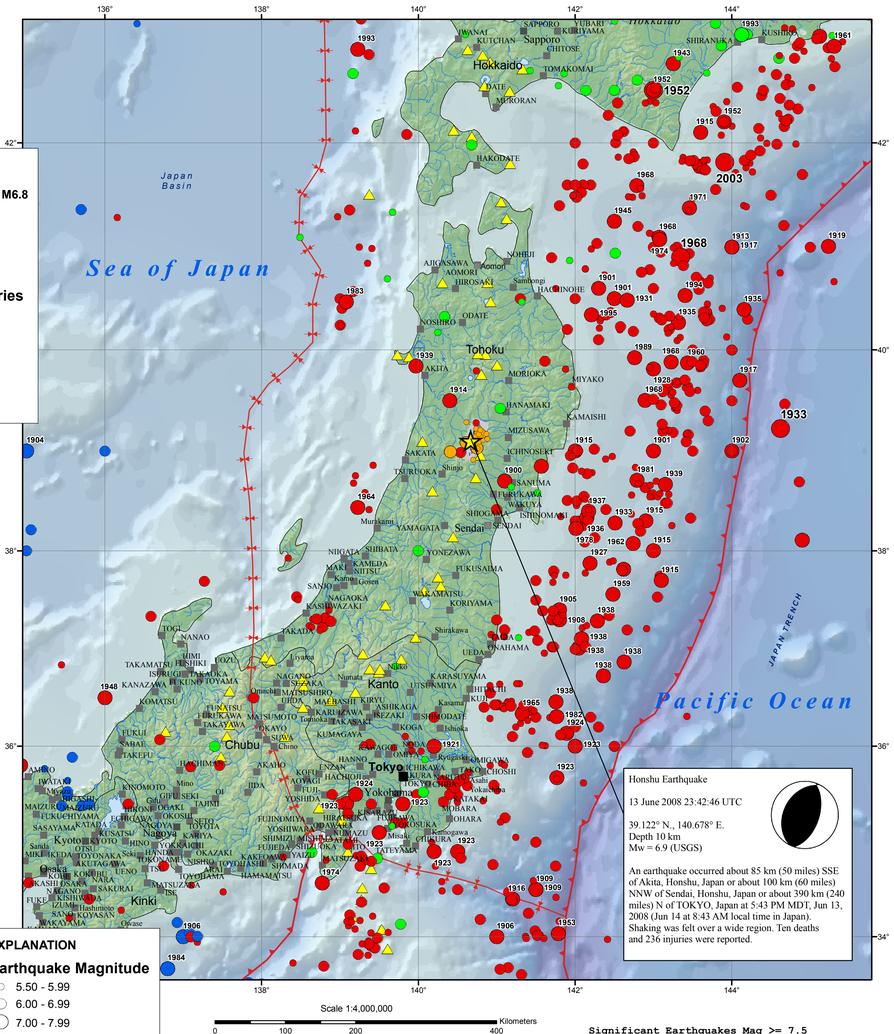
Tectonic Setting



RELATIVE PLATE MOTIONS

Plate boundary symbols indicate the general pattern of relative plate motion. The Pacific Plate, however, is moving west-northwest relative to the Okhotsk Plate at approximately 8.3 cm/yr.

Epicentral Region



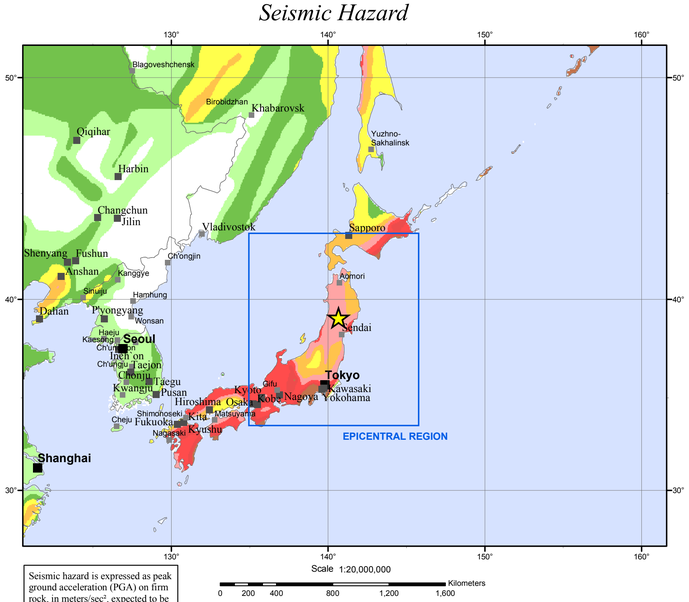
EXPLANATION

Main Shock M6.8

Mag ≥ 7.0
- 0 - 69 km
- 70 - 299
- 300 - 600

Plate Boundaries
- Subduction
- Transform
- Divergent
- Convergent
- Volcanoes

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

EXPLANATION

Earthquake Magnitude
- 5.50 - 5.99
- 6.00 - 6.99
- 7.00 - 7.99
- 8.00 - 8.99
- 9.00 - 9.99

Earthquake Depth
- 0 - 69
- 70 - 299
- 300 - 700

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 significance.

TECTONIC SUMMARY

The Mw 6.9 Honshu earthquake of June 13th 2008 occurred in a region of convergence between the Pacific Plate and the Okhotsk section of the North American Plate in northern Japan, where the Pacific plate is moving west-northwest with respect to North America at a rate of approximately 8.3 cm/yr. The hypocenter of the earthquake indicates shallow thrusting motion in the upper (Okhotsk) plate, above the subducting Pacific plate, which lies at approximately 80 km depth at this location.

The earthquake occurred in a region of upper-plate contraction, probably within the complicated tectonics of the Ou Backbone Range, known to have hosted several large earthquakes in historic times. The largest of these events occurred in 1896, approximately 70km north of the June 13th event, and killed over 200 people in the local area.

Significant Earthquakes Mag >= 7.5

Year	Mon	Day	Time	Lat	Long	Dep	Mag
1896	08	31	1706	39.500	140.700	0	7.2
1901	08	09	1833	40.600	142.300	35	7.5
1906	01	21	1349	34.000	137.000	350	7.7
1909	03	13	1429	34.500	141.500	35	7.6
1915	11	01	0724	38.300	142.900	35	7.5
1923	09	01	0258	35.405	139.084	35	7.9
1923	09	02	0246	34.900	140.200	35	7.6
1931	03	09	0348	40.484	142.664	35	7.7
1933	03	02	1731	39.224	144.622	35	8.4
1938	05	23	0718	36.458	141.755	35	7.7
1938	11	05	0843	37.009	142.045	35	7.9
1938	11	05	1050	37.108	142.081	35	7.8
1938	11	06	0853	37.287	142.283	35	7.7
1944	12	07	0435	33.750	136.000	0	8.1
1952	03	04	0122	42.500	143.000	0	8.1
1953	11	25	1748	34.034	141.786	35	7.9
1960	03	20	1707	39.871	143.435	2.1	7.8
1964	06	16	0401	38.434	139.226	13.1	7.5
1968	05	16	0049	40.903	143.346	25.8	8.3
1968	05	16	1039	41.593	142.786	11.8	7.8
1978	06	12	0814	38.224	142.009	53.3	7.7
1983	05	26	0300	40.468	139.080	20	7.7
1993	01	15	1106	43.022	144.124	102	7.6
1993	07	12	1317	42.883	139.225	20.4	7.7
1994	12	28	1219	40.530	143.403	29.2	7.8

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)
HDF (unpublished earthquake catalog) (Engdahl, 2003)
Global Seismic Hazard Assessment Program

PLATE TECTONICS AND FAULT MODEL
PB2002 (Bird, 2003)
Finite Fault Model, Chen Ji, UC Santa Barbara (2007)

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 Villaseñor, 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 Academeic 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.

USGS science for a changing world — USAID FROM THE AMERICAN PEOPLE

M 6.8, EASTERN HONSHU, JAPAN
Origin Time: Fri 2008-06-13 23:43:46 UTC
Location: 39.03°N 140.88°E Depth: 8 km

PAGER Version 6
Created: 2 days, 18 hrs after earthquake

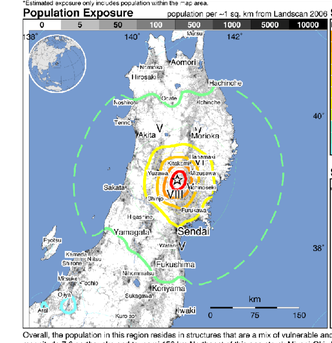
Estimated Population Exposed to Earthquake Shaking

ESTIMATED POPULATION EXPOSURE (k = x1000)	--*	402k*	5,540k*	4,288k	1,840k	422k	134k	16k	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 2006

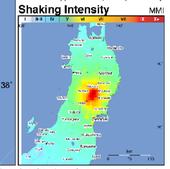


Selected City Exposure

MMI	City	Population
VIII	Ichinoseki	62k
VII	Mizusawa	81k
VII	Furukawa	76k
VII	Kitakami	93k
VI	Yokote	36k
VI	Kogota	19k
VI	Hanamaki	73k
VI	Sendai	1,037k
IV	Koriyama	346k
IV	Iwaki	357k
IV	Niigata	506k

bold cities appear on map (k = x1000)

Shaking Intensity

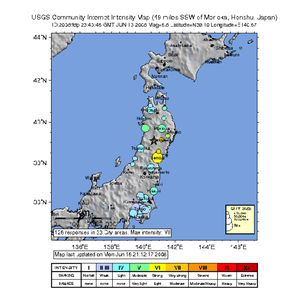


Overall, the population in this region resides in structures that are a mix of vulnerable and earthquake resistant construction. A magnitude 7.6 earthquake and tsunami 156 km Northeast of this one struck Miyagi-Oki, Japan on June 12, 1978 (UTC), with estimated population exposures of 1,303,000 at intensity VIII and 2,557,000 at intensity VII, resulting in an estimated 22 fatalities. On October 23, 2004 (UTC), a magnitude 6.6 earthquake 282 km Northeast of this one struck Japan, with estimated population exposures of 481,000 at intensity IX or greater and 360,000 at intensity VIII, resulting in an estimated 67 fatalities. Recent earthquakes in this area have caused, landslides and fires that may have contributed to losses.

This information was automatically generated and has not been reviewed by a seismologist.

http://earthquake.usgs.gov/pager Event ID: us2008tfdp

Did You Feel It?

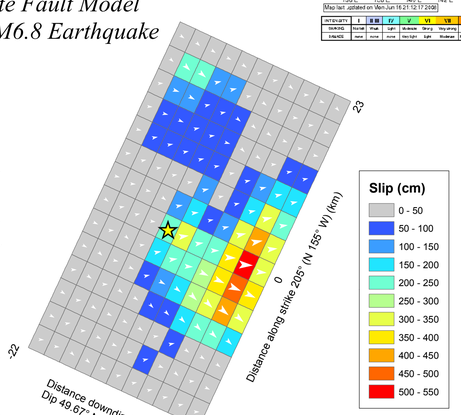


Finite Fault Model for M6.8 Earthquake

FINITE FAULT MODEL
Contributed by
Gavin Hayes, NEIC and Chen Ji, University of California at Santa Barbara

Distribution of the amplitude and direction of slip for subfault elements (small rectangles) of the fault rupture model are determined from the inversion of teleseismic body waveforms. Arrows indicate the amplitude and direction of slip (of the hanging wall with respect to the foot wall); the slip amount is also color-coded as shown. The view of the rupture plane is from above.

The strike of the fault rupture plane is N25E and the dip is 49.67 NW. The dimensions of the subfault elements are 3 km in the strike direction and 2 km in the dip direction. The seismic moment released based on the plane is 2.466 E+26 dyne.cm.



Map prepared by U.S. Geological Survey
National Earthquake Information Center
18 June 2008
Map not approved for release by Director USGS