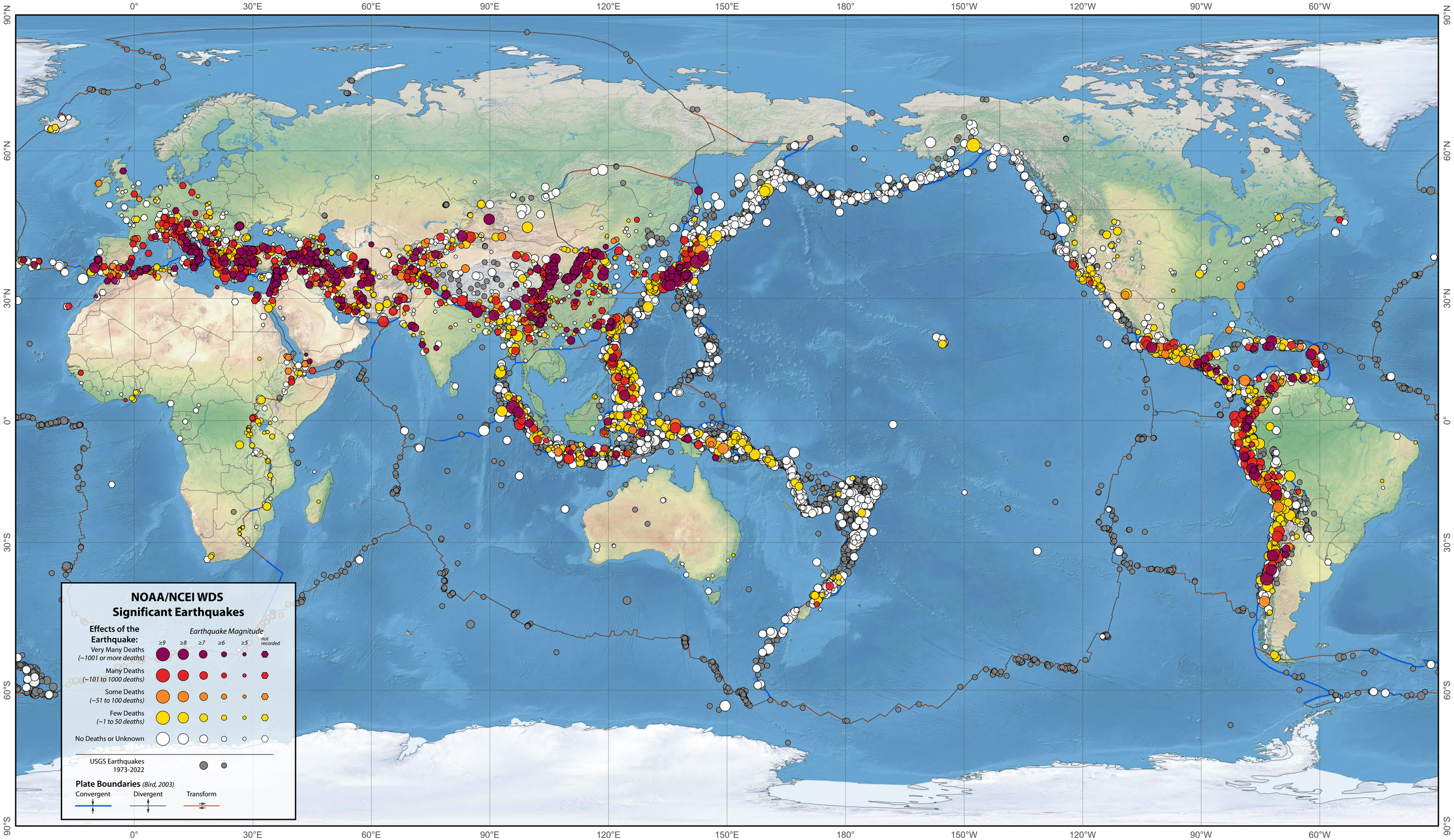
Significant Earthquakes 2150 B.C. to A.D. 2022



Patterson Cylindrical Projection

Symbol drawing order: more deaths on top of fewer deaths;
smaller magnitude earthquakes on top of larger magnitude earthquakes.

unesco
Intergovernmental Oceanographic Commission

ITIC

NOAA

ICSU
WORLD DATA SYSTEM

March 2022

NOAA's National Centers for Environmental Information (NCEI) and co-located World Data Service (WDS) for Geophysics and the International Tsunami Information Center (ITIC), a NOAA-UNESCO/IOC Partnership, have collaborated to produce a map showing significant earthquakes. These data are from the NCEI Significant Earthquake Database that includes information on destructive earthquakes from 2150 B.C. to A.D. 2022 that meet at least one of the following criteria: moderate damage (approximately $1 million or more), 10 or more deaths, magnitude 7.5 or greater, Modified Mercalli Intensity X or greater, or the earthquake generated a tsunami.

There are approximately 6,200 earthquakes in the database. The global distribution of these earthquakes is 17% East Asia, 17% Europe, 13% Central and South Pacific, 13% Middle East, 10% South America, 8% North America and Hawaii, 8% Southern Asia, 5% Central Asia and the Caucasus, 4% Central America and the Caribbean, 3% Africa, 2% Kamchatka and the Kuril Islands. These events caused approximately 8 million casualties and over USD $1.8 trillion (2020 dollars). These figures should be much higher, but in many events the actual number of fatalities and dollar damage is not known.

Erroneous statistical conclusions can be drawn from the numbers of earthquakes taken from the Significant Earthquake Database, 2150 B.C. to the present. The reporting of large or destructive earthquakes is not homogeneous in space or time, particularly for periods prior to the 1900s. Because this database mainly lists those earthquakes that have caused death or damage, the number of earthquake reports is dependent on the written history available for a particular region, as well as on the rate of development of population centers and related structures. Therefore, it is misleading to use the numbers of significant earthquakes in that publication to suggest statistically that there has been an increase in worldwide seismic activity since 1900 or for any time period.

Instrumental seismology is a young science. The first calibrated instruments to measure seismic waves traveling through the earth did not appear until the late 1800s. At that time, seismologists became aware of the vast numbers of earthquakes occurring throughout the world, but because of the insensitivity of their instruments they were able to locate only the large magnitude events.

The 1960s saw two major advances. First, a network of seismological observatories, the Worldwide Standardized Seismograph Network (WWSSN), was installed by the United States Government, principally to monitor underground nuclear tests. These sensitive instruments could detect and identify earthquakes anywhere in the world from about magnitude 4.5.

Second, computers became available in the late 1960s. Computers allowed seismologists to leave inaccurate and cumbersome graphical methods of locating earthquakes, and to process the increasing volume of new network data more rapidly than ever before. Prior to 1962, only hundreds of earthquake epicenters were determined each year by Government and academic institutions, but the number increased to the thousands using computerized location methods. In some special local studies, more than 100,000 earthquakes per year were identified and located.

In summary, using the data in the Significant Earthquake Database, 2150 B.C. to the present to suggest that there has been an increase in worldwide earthquake activity is misleading and erroneous. The above observations and reporting factors must also be considered when making statistical studies based on that historical data report.

The events in the NCEI Significant Earthquake Database were gathered from the U.S. Geological Survey, NOAA Tsunami Warning Centers, UNESCO IOC International Tsunami Information Center, national and government databases and reports, earthquake and tsunami catalogs, post-event reconnaissance reports, journal articles, newspapers, internet pages, email and other written documents. For a complete listing of references used to compile the database, please visit: http://www.ngdc.noaa.gov/hazard.

Table 1. Earthquakes causing 10,000 or more deaths since 1900

Date				Magnitude		*Damage
Year	Mon	Day	Location	MS or Mw	Deaths	$USD million
1905	4	4	Kangra, India	7.8	19,000	
1907	10	21	Karatag, Tajikistan	7.4	12,000	
1908	12	28	Messina, Italy[T]	7.0	78,000	116
1915	1	13	Avezzano, Italy	7.5	29,978	60
1920	12	16	Gansu, China	8.3	200,000	25
1923	9	1	Kanto, Japan[T]	7.9	142,807	600
1927	5	22	Gansu, China	7.6	40,912	
1931	8	10	Xinjiang, China	8.0	10,000	
1934	1	15	Bihar, India	8.0	10,600	
1935	5	30	Quetta, Pakistan	7.5	60,000	25
1939	1	25	Chillan, Chile	8.3	30,000	920
1939	12	26	Erzincan, Turkey[T]	7.7	32,700	20
1948	10	5	Ashkhabad, Turkmenistan	7.2	110,000	25
1960	2	29	Agadir, Morocco	5.9	13,100	120
1962	9	1	Buyin-Zahra, Iran	7.2	12,225	30
1968	8	31	Dasht-e-Bayaz, Iran	7.1	10,488	35
1970	1	4	Yunnan, China	7.8	10,000	
1970	5	31	Northern Peru[T]	7.9	66,794	530
1972	12	23	Managua, Nicaragua	6.2	10,000	2,968
1974	5	10	Yunnan, Sichuan, China	7.1	20,000	
1976	2	4	Chimaltenango, Guatemala[T]	7.5	23,000	2,147
1976	7	27	Tanghsan, China	7.5	242,769	5,600
1978	9	16	Tabas, Iran	7.4	20,000	50
1988	12	7	Spitak, Armenia	6.8	25,000	16,200
1990	6	20	Rasht, Iran[T]	7.3	40,000	7,200
1993	9	29	Latur, India	6.2	11,000	300
1999	8	17	Kocaeli, Turkey[T]	7.6	17,118	20,000
2001	1	26	Gujarat, India	7.7	20,005	2,623
2003	12	26	Bam, Iran	6.6	31,000	500
2005	10	8	Kashmir, Pakistan	7.6	76,213	6,680
2008	5	12	Sichuan, China	7.9	87,652	86,000
2010	1	12	Port-au-Prince, Haiti[T]	7.0	316,000	8,000

[T] The earthquake generated a tsunami

*These earthquakes all caused damage, but the dollar amount is not always available. The amount listed is the value at the time of the event.

Table 2. Earthquakes causing $2.5 billion or more damage since 1900

Date				Magnitude		*Damage
Year	Mon	Day	Location	MS or Mw	Deaths	$USD million
1972	12	23	Managua, Nicaragua	6.2	10,000	2,968
1976	5	6	Friuli, Italy	6.5	978	3,600
1976	7	27	Tangshan, China	7.5	242,769	5,600
1979	4	15	Montenegro[T]	6.9	131	2,700
1980	10	10	El Asnam, Algeria[T]	7.7	5,000	5,200
1980	11	23	Southern Italy	6.9	4,689	20,000
1985	9	19	Michoacan, Mexico[T]	8.1	9,500	4,000
1988	12	7	Spitak, Armenia	6.8	25,000	16,200
1989	10	18	Loma Prieta, California, USA[T]	6.9	62	5,600
1990	6	20	Rasht, Iran[T]	7.3	40,000	7,200
1994	1	17	Northridge, California, USA[T]	6.7	60	40,000
1995	1	16	Southern Honshu, Japan[T]	6.9	5,502	100,000
1997	9	26	Central Italy	6.0	14	4,525
1999	8	17	Kocaeli, Turkey[T]	7.6	17,118	20,000
1999	9	7	Athens, Greece	6.0	143	4,200
1999	9	20	Chi-Chi, Taiwan	7.7	2,297	14,000
2001	1	26	Gujarat, India	7.7	20,005	2,623
2003	5	21	Northern Algeria[T]	6.8	2,287	5,000
2004	10	23	Honshu, Japan	6.6	40	28,000
2004	12	26	Banda Aceh, Indonesia[T]	9.1	1,000	**10,000
2005	10	8	Kashmir, Pakistan	7.6	76,213	6,680
2006	5	26	Java, Indonesia	6.3	5,749	3,100
2007	7	16	Honshu, Japan[T]	6.6	9	12,500
2008	5	12	Sichuan, China	7.9	87,652	86,000
2009	4	6	L'Aquila, Italy	6.3	309	2,500
2010	1	12	Port-au-Prince, Haiti[T]	7.0	316,000	8,000
2010	2	27	Maule, Chile[T]	8.8	402	**30,000
2010	9	3	Christchurch, New Zealand	7.0		6,500
2011	2	21	Christchurch, New Zealand	6.1	185	15,000
2011	3	11	Honshu, Japan[T]	9.1	1,475	**220,000
2011	6	13	Christchurch, New Zealand	6.0	1	3,000
2012	5	29	Emilia Romagna, Italy	5.9	17	15,800
2013	4	20	Sichuan, China	6.6	196	6,800
2015	4	25	Kathmandu, Nepal	7.8	8,957	6,000
2016	4	15	Kumamoto, Japan	7.0	50	20,000
2016	4	16	Muisne, Ecuador[T]	7.8	663	3,300
2016	8	24	Central Italy	6.2	299	5,000
2017	9	8	Chiapas, Mexico[T]	8.2	98	4,000
2017	9	19	Central Mexico	7.1	369	8,000
2018	6	17	Osaka, Japan	5.5	5	7,000
2019	7	6	Ridgecrest, California, USA	7.1		5,300
2021	2	13	Fukushima, Japan[T]	7.1	1	7,700

[T] The earthquake generated a tsunami

*The amount listed is the value at the time of the event

**Earthquake and tsunami effects could not be separated, but the majority of the damage was from the tsunami.

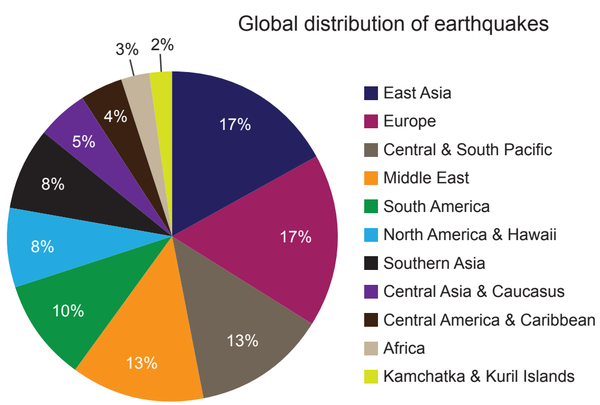


Table 3. Earthquakes with magnitude Mw 8.6 or greater since 1900

Date				Magnitude	Deaths			**Damage ($USD million)		
Year	Mon	Day	Location	Mw	Earthquake	Tsunami	Total	Earthquake	Tsunami	Total
1906	1	31	Northern Ecuador[T]	8.6	*1,000	*1,000	*1,000			
1922	11	11	Atacama, Chile[T]	8.7	500	200	700			
1946	4	1	Unimak Island, Alaska, USA[T]	8.6	0	168	168		26	26
1950	8	15	Assam, India	8.6	1,530	0	1,530	20		20
1952	11	4	Kamchatka, Russia[T]	9.0		10,000	10,000		1	1
1957	3	9	Andreanof Islands, Alaska, USA[T]	8.6	0	[I]2	[I]2			
1960	5	22	Central Chile[T]	9.5	*2,000	*2,226	*2,226	*1,000	*1,000	*1,000
1964	3	28	Prince William Sound, Alaska, USA[T]	9.2	15	124	139	284	116	400
1965	2	4	Andreanof Islands, Alaska, USA[T]	8.7	0	0	0		0.01	
2004	12	26	Banda Aceh, Indonesia[T]	9.1	1,000	226,899	227,899	*10,000	*10,000	*10,000
2005	3	28	Nias, Indonesia[T]	8.6	1,303	10	1,313			
2010	2	27	Maule, Chile[T]	8.8	402	156	558	*30,000	*30,000	*30,000
2011	3	11	Honshu, Japan[T]	9.1	*1,475	*1,8428	*1,8428	*220,000	*220,000	*220,000
2012	4	11	Sumatra, Indonesia[T]	8.6	10	0	10			

[T] The earthquake generated a tsunami

*Tsunami and earthquake effects could not be separated

**These earthquakes all caused damage, but the dollar amount is not always available. The amount listed is the value at the time of the event.

[I] Two indirect fatalities, a reporter and a pilot, in a small chartered plane crashed in the ocean near Oahu while trying to cover the tsunami's arrival.

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