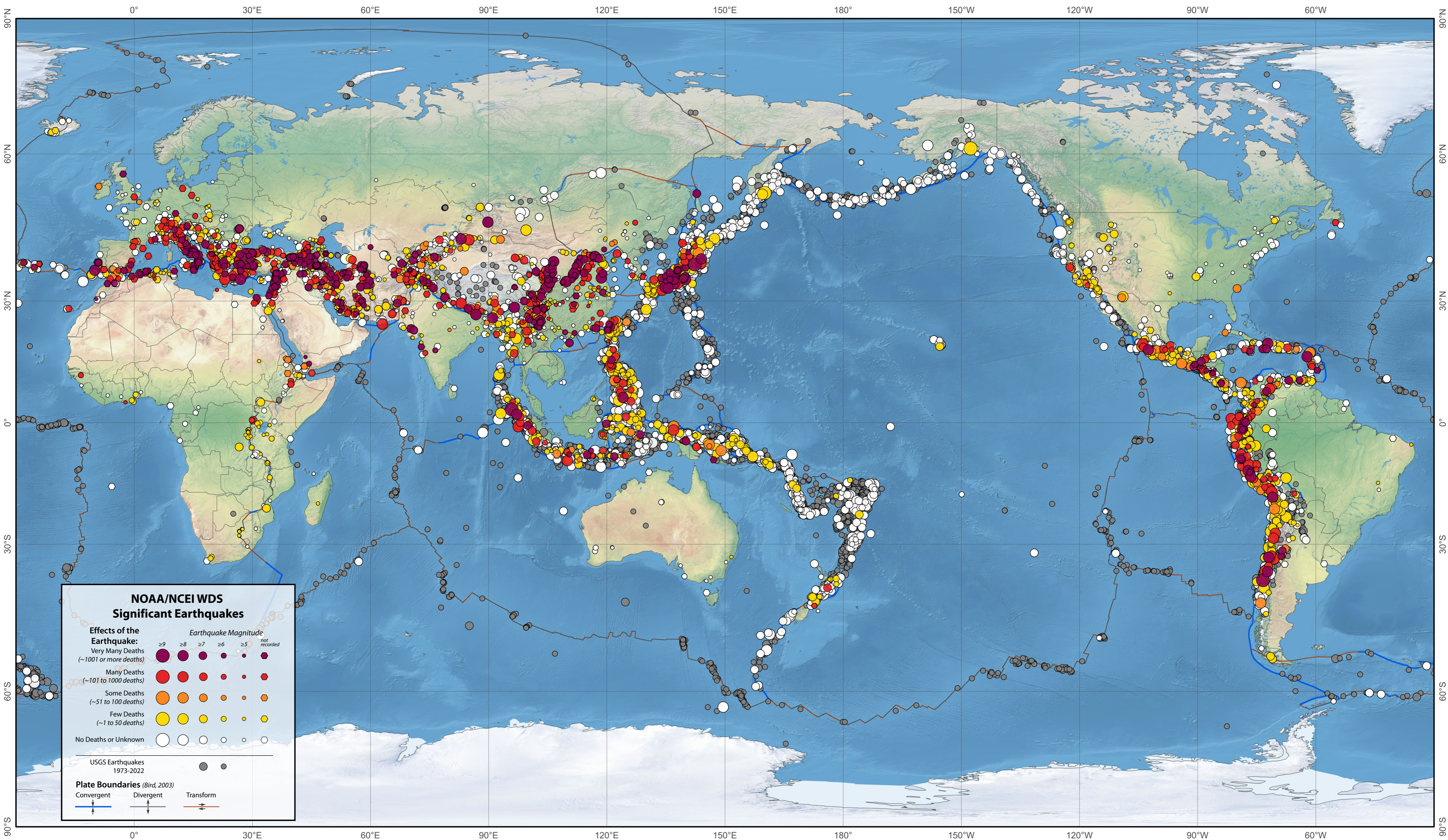


Significant Earthquakes 2150 B.C. to A.D. 2022



Patterson Cylindrical Projection

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

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>.

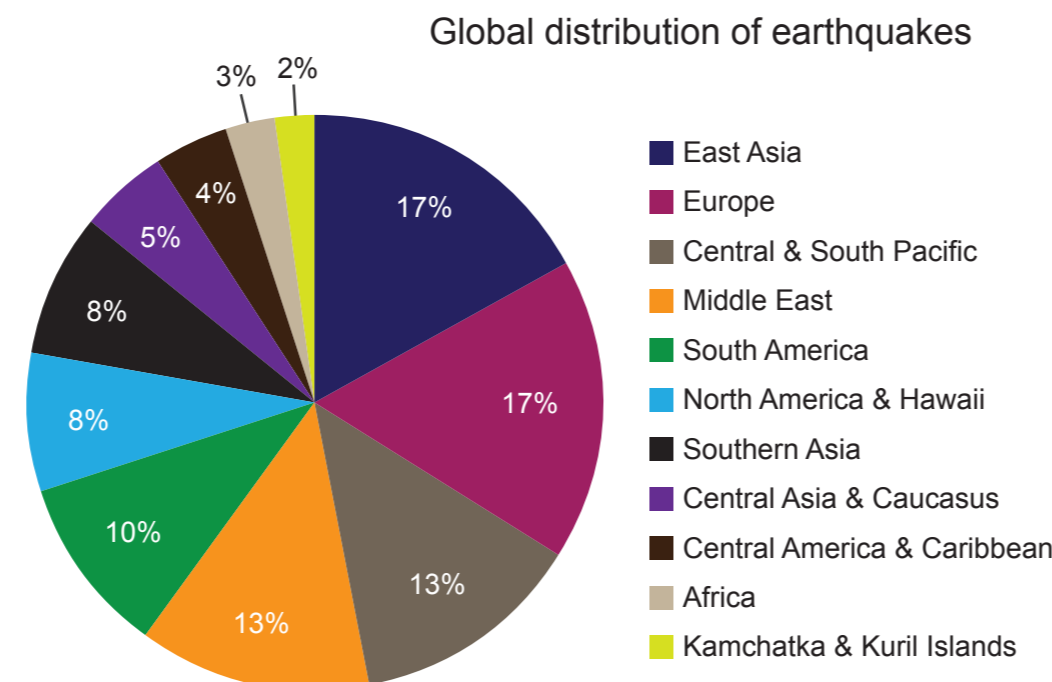


Table 1. Earthquakes causing 10,000 or more deaths since 1900

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

^TThe 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

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

^TThe 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

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

^TThe 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.
¹ 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.