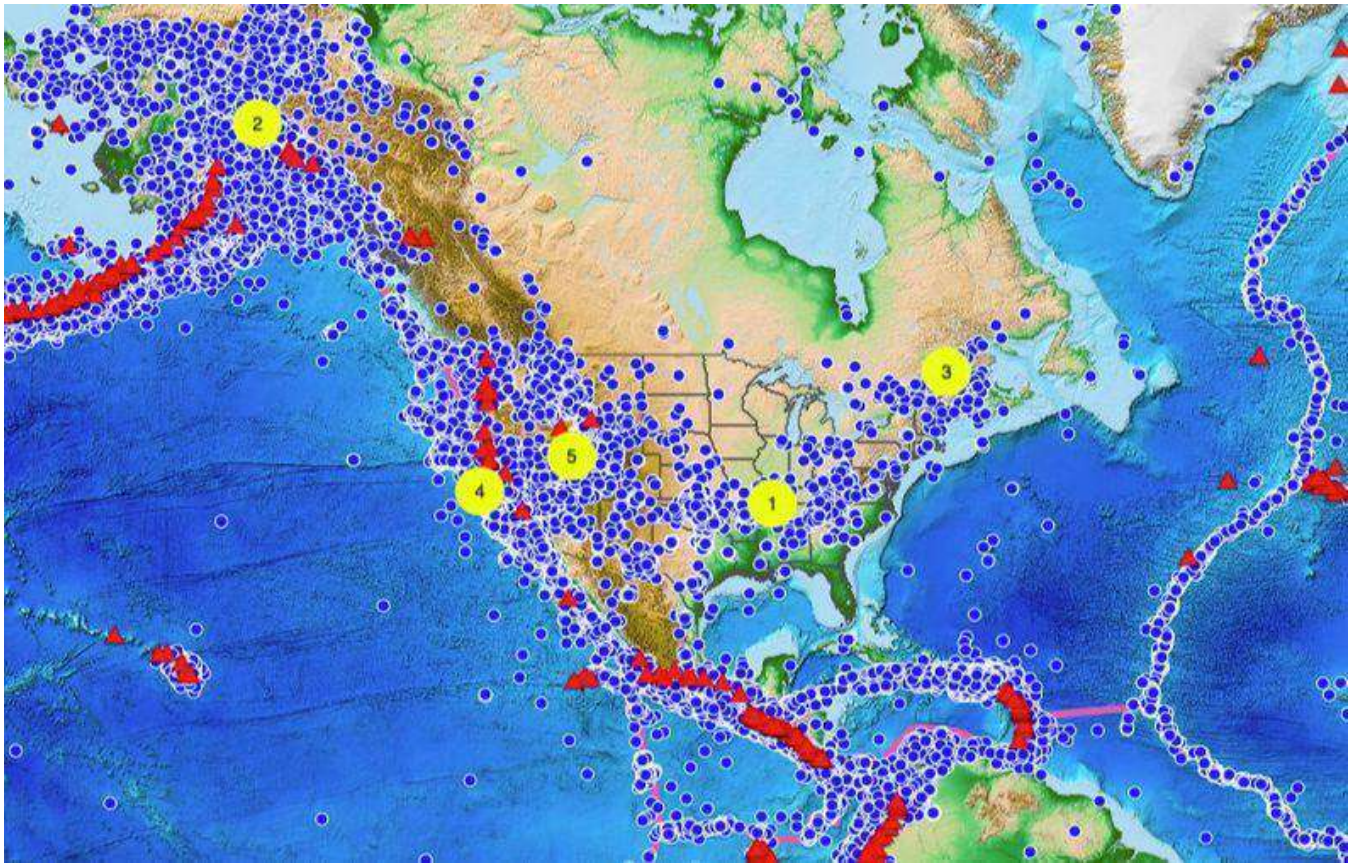
Earthquake Cases

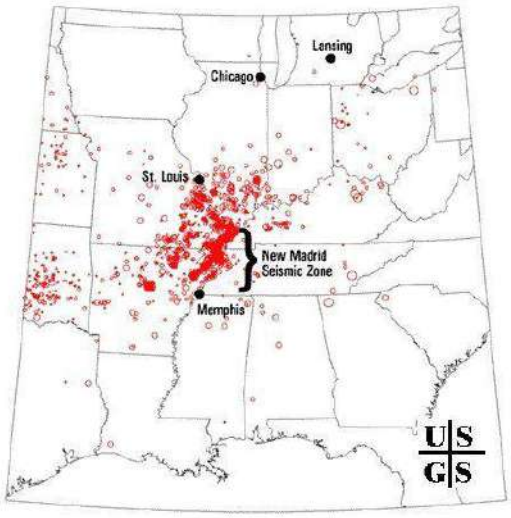


ArcGIS

Case 1: New Madrid Earthquakes 1811–1812

The New Madrid earthquakes occurred in a three-month period from 1811 to 1812. New Madrid is located in the lower southeast corner of Missouri, along the Mississippi River. During this time period, three major earthquakes of a magnitude of 7.0 or larger struck the area. The largest of these earthquakes is estimated to have released roughly 2.0×10^{12} kilojoules of energy. That is about 50,000 times the average electrical energy used by a United States household in all of 2021. The depth the earthquakes started at is unknown.

Luckily, there were not many large towns or buildings in the area. When the first earthquake struck, trees were knocked down and the ground shook. Portions of the ground lifted up, riverbanks collapsed, and water waves moved backward up the Mississippi River.

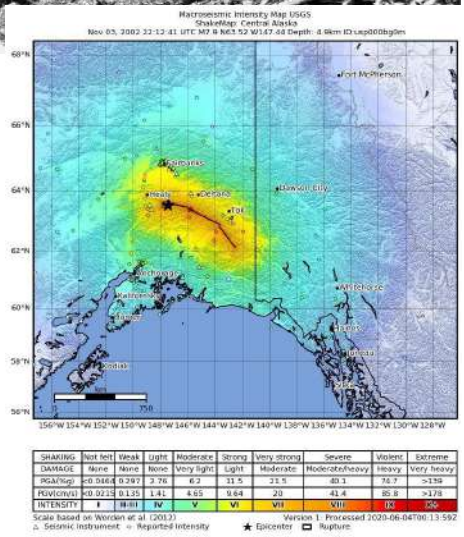


The first 1811 earthquake was strong enough to shake windows in Washington, D.C., and ring church bells in Richmond, Virginia. The second large earthquake caused cracks in the ground and even more landslides. The epicenter of the third earthquake was near New Madrid and destroyed the town. That earthquake also caused severe damage to buildings in St. Louis, Missouri. There were many notable aftershocks. The picture above shows a trench that formed during the earthquakes. The change in elevation is thought to have made the land slide into the crack that opened up during the earthquake.

There is evidence that several large earthquakes have happened in this area over thousands of years. The most recent was in the 1960s in Dale, Illinois, and was felt as far away as Boston, Massachusetts. Scientists are uncertain if and/or when another large earthquake will occur. Every year, hundreds of small earthquakes that can only be detected by seismographs happen in the region known as the New Madrid Seismic Zone.

The zone comprises a series of faults and includes the cities of St. Louis, Missouri; Memphis, Tennessee; and Little Rock, Arkansas.

Case 2: Denali Earthquake 2002



On November 3, 2002, a large 7.9-magnitude earthquake occurred about 90 miles south of Fairbanks, Alaska, 45 miles east of Denali Park. It released roughly 4.47×10^{13} kilojoules of energy. That is about 1,200,000 times the average electrical energy used by a United States household in all of 2021. The earthquake started roughly 3 miles underground.

This earthquake ruptured the Denali Fault line as well as part of the Totschunda Fault. In some places, the ground changed elevation by as much as 24 feet from its original height. The earthquake also moved roads and streams. In some places, the land shifted sideways by as much as 29 feet. Researchers think that this earthquake may have been building for more than 1,000 years. A crack in the ground formed in less than 90 seconds that was 192-210 miles long. There were also thousands of landslides and rock avalanches.

The initial earthquake caused water to sway back and forth as far away as Texas and Louisiana. It also triggered small earthquakes in California and Utah. The region was sparsely populated, so although the earthquake caused damage to houses and some water wells, there were no deaths. Thousands of aftershocks were recorded after the earthquake--more than 1,000 per day for the first week. There were about 50,000 aftershocks in total over the next few years.

Scientists have a lot of data on this earthquake because another earthquake had just happened in the area in October of the same year. Seismologists (people who study earthquakes) went to the area to place additional seismographs and other sensors to study the October earthquake and its aftershocks.

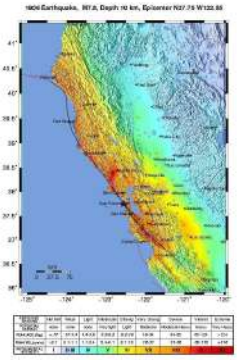
Case 3: Charlevoix–Kamouraska Earthquake 1925

On February 28, 1925, a 6.2-magnitude earthquake struck the Charlevoix-Kamouraska area in Canada, along the St. Lawrence River. It released roughly 1.26×10^{11} kilojoules of energy. That is about 3,000 times the average electrical energy used by a United States household in all of 2021. The earthquake began about 6 miles below the surface.

The earthquake damaged many structures in Quebec City, Canada, and surrounding villages. Luckily, no deaths were directly linked to this earthquake. Fifty-five aftershocks were recorded in the following weeks, ranging in magnitude from 2.0 to 5.0. The largest earthquake was felt as far away as Virginia and the Mississippi River. The earthquakes left many small cracks in the ground, as seen in the picture above. This crack was 150 feet long, 2-3 inches wide, and 2-3 inches deep when the photo was taken six weeks after the earthquake.

The earthquake occurred in the Charlevoix Seismic Zone, which is believed to contain many fault lines. More than 200 micro-earthquakes, which people generally cannot feel, are recorded at this zone every year. Five earthquakes of a magnitude of 6.0 or higher have occurred since modern-day records have been collected. This zone also has a semicircular lower-elevation area caused by the impact of an ancient meteorite that broke up large sections of bedrock when it struck. Some researchers believe that this impact crater area experiences 10 times as many earthquakes as other areas of the Charlevoix Seismic Zone.

Case 4: San Francisco Earthquake 1906



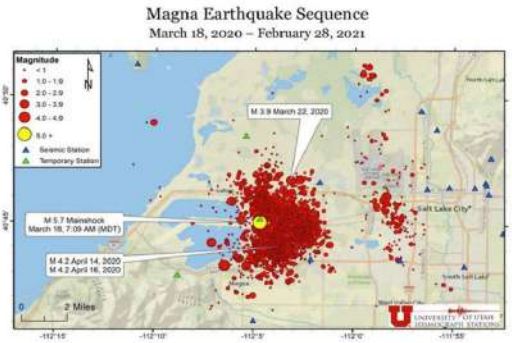
On April 18, 1906, a very strong earthquake struck San Francisco, California. Although there were no seismographs to measure the earthquake, scientists estimate that its magnitude was close to 8.0, releasing around 6.31×10^{13} kilojoules. That is about 1,600,00 times the average electrical energy used by a United States household in all of 2021. The estimated depth of the start of the earthquake is roughly 5 miles below the surface.

This San Francisco earthquake was felt as far away as Oregon, Nevada, and Los Angeles, California. During the earthquake, the ground shifted and cracked in many places. Many aftershocks were recorded. The earthquake is said to have also caused other earthquakes in southern California.

The 1906 earthquake caused massive amounts of damage to San Francisco and surrounding cities. Water mains broke open and fires broke out all around the city. Almost 30,000 buildings were destroyed (almost 80% of the city). Although the earthquakes did cause major damage, most of the destruction resulted from the fires. Some of the fires were directly related to damage from the earthquake; others resulted from mistakes made by people. Areas of the city burned for five days until firefighters were able to contain the blaze. Due to the size of the earthquake and the fires, scientists and historians believe that about 3,000 people died.

San Francisco, as well as most of the California coast, is located on the San Andreas Fault. This fault line is an active tectonic plate boundary, and earthquakes regularly occur near this fault line along the west coast of the United States.

Case 5: Salt Lake City Earthquake 2020



On March 18, 2020, a 5.7-magnitude earthquake hit Magna, a town just southwest of Salt Lake City, Utah. It released roughly 2.24×10^{10} kilojoules of energy. That is about 600 times the average electrical energy used by a United States household in all of 2021. The start of the earthquake was estimated to be 8 miles below the surface. This was the first major earthquake in the area since Salt Lake City was founded. It was felt as far away as parts of Wyoming and Idaho.

The large earthquake was part of a series of earthquakes near Magna. Over 50 aftershocks occurred in the first two hours after the initial earthquake, and over 2,300 aftershocks occurred in the next four months. Aftershocks are still occurring today, but with less frequency and intensity. These earthquakes were on the Wasatch Fault and are one of the most documented earthquake series in Utah history.

Most buildings in Salt Lake City only had minor damage, but the earthquake series did more damage to Magna. Some buildings in the town, including a school, were heavily damaged. Due to the COVID-19 pandemic, remote learning had started, so injuries to students and others at school sites were limited. The earthquake damaged power lines and caused power outages for 50,000 customers. The ground cracked in many places, damaging roads. The airport had to close and 60-70 flights were diverted. Luckily, most injuries reported were minor and no deaths were reported.

The Wasatch Fault runs through Idaho and Utah, and small earthquakes are common in the area. Since the 1980s, the people and local governments in and around Salt Lake City have been working to upgrade buildings to better withstand earthquakes.