Times-Standard
Times-Standard / Humboldt Beacon

Not My Fault: As earthquake activity continues, blame Mother Nature, not human activity

Lori Dengler/For the Times-Standard
Posted April 5, 2020

The uptick in earthquake activity continues. On Tuesday, a magnitude 6.5 earthquake struck central Idaho and last evening, a M 4.9 occurred in Southern California. This makes eight earthquakes in the past month in the 4.5 to 6.5 range in the lower 48. They were reported felt by over 114,000 people in 11 US states, two Mexican states and two Canadian provinces.

My conclusion from last week still stands. All of this activity is well within the boundaries of normal random variation considering the tectonicsof Western North America. And all of these earthquakes, with one interesting exception are what I call normal tectonic earthquakes.

The most common cause of earthquakes is tectonic force, driven by heat and pressure variations in the earth's crust. These earthquakes have been part of earth processes long before people. Many are concentrated near plate boundaries, but tectonic earthquakes can occur within plates as well. They can range in size from the smallest detectable quakes to the very largest ones.

Earthquakes can also be caused by volcanic processes and by gravity (collapse). These are typically small in magnitude and make up a very tiny percent of annual seismicity.

Induced seismicity is caused by human activity. When large reservoirs are filled or drained, the pore pressure changes can affect stress. Pore pressure pushes outward and acts in the opposite direction to regional stress and can make it easier for a fault to rupture. In August of 1975 a magnitude 5.7 earthquake occurred near Oroville dam. Over the year preceding the earthquake, water levels in the reservoir had been sharply lowered and then raised again, causing abrupt changes in load and pore pressure. The earthquake led to the tabling of the Auburn dam project over concerns that it could also induce seismic activity.

Disposal of waste fluids into deep wells can also cause earthquakes. There are over 150,000 injection wells in the US and the overwhelming majority have operated with no problems. The exception is several dozen in the Midwest that have been linked to increased earthquake activity. The poster child for induced seismicity problems is Oklahoma, where over 800 earthquakes of magnitude 3 or larger were recorded in 2015 compared to a background rate of one to two a year in prior decades before injection wells existed.

Most induced earthquakes are small, but Oklahoma experienced four earthquakes in the magnitude 5 range between 2011 and 2016. The largest two, a 5.7 and a 5.8 caused considerable damage and resulted in regulations that reduced volume and injection rate. After the regulations were in place, seismicity decreased and in 2019, only 57 M3 and larger earthquakes were detected in Oklahoma. This is still well above the pre-injection background levels.

The eight magnitude 4.5 or larger earthquakes of the past month were all located in areas where active faults have been mapped and earthquakes have occurred in the past. Three of them were in the Basin and Range tectonic province, the area extending from the Sierra's east to Utah and the Wasatch fault zone, north into Nevada and south to the Mexican border. The Basin and Range was born at about the same time as the San Andreas fault system developed and contributes to the Pacific – North American plate movement.

The North Coast M 5.2 and 5.8 were both related to the complex deformation in the Mendocino triple junction area and the relative motion between the Gorda and Pacific plate. Yesterday's 4.9 was on the San Jacinto fault, part of the San Andreas fault system and the March 7 M 5.5 at the northern end of the Gulf of California was in the transition zone between the San Andreas system and the spreading zone that has created the Gulf of California.

That leaves one earthquake without an obvious tectonic origin, the March 26th M 5 in West Texas. At first glance, a tectonic origin is possible. A magnitude 5.7 occurred in West Texas in 1995, long before any deep injection wells. It was over 100 miles away from the recent quake, but is evidence that tectonic earthquakes can occur in regionally.

But a little more sleuthing makes it unlikely. The background seismicity in the area was very low prior to 2015, when both conventional drilling activity and hydrofracturing (fracking) increased. Between 1980 and 2015, only 16 earthquakes in the 2.5 to 4 range were

reported. Between 2015 and today, 290 earthquakes occurred in the same area, most in clusters in the vicinity of injection wells. It's not a smoking gun, and it is possible the earthquake could have happened without injection. But I doubt it.

I'm not sticking my neck out when I say Mother Nature is my odds-on favorite for causing the next strong earthquake in the United States – or anywhere else. Human activities can cause problems, but natural tectonic forces are the main culprit. That means building earthquake smart and resilient.

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