

Not My Fault: The global earthquake story of 2021

Lori Dengler/For the Times-Standard
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2021 was a notable for the Western Hemisphere. The largest quake of the year was in Alaska and the deadliest was in Haiti. There were a few surprises and, sadly, reaffirmation of what we have known for many years - earthquake casualties are mainly caused by poorly built structures.

Great earthquakes have a magnitude 8 or larger. We had three in 2021. A magnitude 8 releases an enormous amount of energy - on the same order as US annual energy consumption or a 5-megaton nuclear explosion. The mode of energy release differs, earthquake energy primarily goes into fault rupture and heat produced along the fault zone and only a small part is released as the seismic waves that we feel, but it is still an impressive number.

Sixty-two great earthquakes have occurred since 1950, less than one per year. 2021 enters an elite club of only three years that tallied up more than two. A M8.1 occurred in the Kermadec Islands north of New Zealand in March, an 8.2 struck south of Alaska's Peninsula in late July, and an 8.1 in the Southern Atlantic in August. These three quakes make 2021 number seven in terms of annual seismic energy output since 1970. The good news is that they were too far from population centers to cause significant damage.

The July 29th M8.2 Chignik earthquake was the largest. It is also the largest US quake since 1965, and the largest earthquake anywhere in the world since 2018. It was centered on the Alaska-Aleutian subduction zone south of Alaska in an area seismologists call the Shumagin gap, where no great earthquakes had occurred for many decades prior to 2020.

Seismic gaps are zones along active plate boundaries with a notable absence of recent seismicity, and perhaps ripe to produce a major earthquake. The Shumagin gap is of particular concern to the US West Coast because a great earthquake could focus tsunami energy at us. The Shumagin area began to stir in July 2020, when a magnitude 7.8 earthquake occurred near the eastern edge

of the gap. Seismologists agreed that it probably wasn't large enough to fill the gap and speculated similar-sized or larger earthquakes were still likely.

In October 2020, a M7.6 earthquake occurred about 50 miles SW of the first quake. It was a strike-slip earthquake and not on the plate boundary, so didn't resolve the gap issue. This year's M8.2 was likely on the subduction interface. It was felt strongly in the towns and villages on the Peninsula and offshore islands. Minor damage was reported at Sandpoint and Perryville. It was over much of the State and as far away as Fairbanks over 700 miles distant. It's still unclear if the gap is now filled.

The 8.2 triggered a tsunami warning for coastal areas from the eastern Aleutians to Southern Alaska. A modest tsunami was observed (under a foot at Sand Point) and was detected as far away as Hawaii and the Central California coast. The most interesting observations were within Humboldt Bay where a few inch-high tsunami persisted for more than a day. Fishing boats attempting to cross the bar at the entrance to Humboldt Bay noted unusual cross currents at the time of the tsunami. The lesson is that even a very small tsunami adds to the potential hazard in the tricky bar crossing.

The March 4 M8.1 in the Kermadec Islands also produced a tsunami and a series of tsunami alerts for New Zealand and the SW Pacific. The lack of instrumentation in the source area made it difficult to assess the tsunami threat for several hours. It likely reached heights of eight or more feet in uninhabited Raoul Island but elsewhere the heights were modest.

We don't tend to think of the Atlantic as a seismically active region, but it has two earthquake hotspots. The third great quake of the year (August 12 M8.1) was in the South Sandwich chain where the South American plate subducts beneath the Scotia plate. The earthquake was centered far offshore of Argentina near uninhabited Montagu Island and not reported felt by anyone.

The August 8.1 also produced a tsunami, with a peak height of 2.5 feet on South Georgia Island 470 miles away. Small tsunami signals were detected in Azores, Madagascar, and in Alaska making this the first tsunami observed in four oceans since 2004 following the Indonesia M9.1. It is a reminder that all oceans are connected and that tsunamis do occasionally occur in the Atlantic.

The second Atlantic hotspot is the Caribbean, and it produced the deadliest quake of the year. On August 14th, a 7.2 earthquake rocked Haiti. Located on Haiti's Tiburon

Peninsula, it produced strong shaking affecting over one million people many living in structures not built to resist earthquakes. The death toll hit 2,248 making this the deadliest quake of the past three years.

The Caribbean is a complex geologic region where the South American plate subducts beneath the Caribbean plate along the Lesser Antilles arc. The 7.2 Haiti quake was associated with the transform boundary region between the Caribbean and North American plate. It was on the same fault that produced the January 13, 2010, M7.0 earthquake killing at least 100,000 people. The lower casualty numbers in 2021 are because it was 60 miles west of the 2010 epicenter and further from the densely populated metropolitan area of Port-au-Prince.

The Haiti earthquake accounted for more than 90% of earthquake deaths in 2021; without it this year would have had the fewest casualties since 1971. 2021 also illustrates the complexity of sequences and fault relationships. The Alaska earthquake is part of a sequence that began 18 months ago, and it is still not clear if it is over. The Haiti earthquake was on the same fault system as the 2010 earthquake but not directly adjacent. It leaves a gap of about 30 miles between the two ruptures – a spot quite capable of producing another M7 earthquake.

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