

“Devastating Tsunamis Did Not Follow Russia Earthquake”

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By Nikk Ogas

WASHINGTON, D.C.—When a magnitude 8.8 earthquake struck offshore of the Kamchatka Peninsula in eastern Russia on July 29, tsunami warnings quickly followed. The quake is tied with two other historic temblors to be the sixth largest ever recorded, sparking fears of devastating waves like the ones that followed the 2011 Tohoku temblor in Japan and the 2004 Indian Ocean quake.

But, so far, the tsunami waves have been nowhere near as catastrophic.

Multiple factors can influence how tsunamis manifest on distant shores, from the geology of the initial quake to the shape of the coastline. Here’s what we know so far about the Russia megaquake and why the resulting tsunamis have been less destructive than feared.

This quake occurred in a seismic hotbed

The powerful earthquake occurred in a subduction zone, where one tectonic plate dives under another. In these settings, vast amounts of energy build up on large faults—called megathrusts—between the plates. That energy is periodically and suddenly released in violent earthquakes. Subduction zones are associated with the largest temblors on earth, including the ones in Japan and the Indian Ocean.

This quake occurred about 21 kilometers deep along the Kuril-Kamchatka subduction zone. There, the Pacific plate slides under the Okhotsk plate at a rate of about 75 millimeters each year, which is relatively fast in geological terms. What’s more, this plate boundary forms a relatively shallow angle in the rock that’s closer to horizontal than not.

“That means you have a lot of area that is at the right temperature and at the right depth for conditions to slip,” says geologist Rich Briggs of the U.S. Geological Survey in Golden, Colo.

Essentially, the powerful temblor occurred in a region that’s known for being “an earthquake factory,” Briggs says. “It’s a place where a lot of things come

together to host earthquakes.” In fact, Kamchatka experienced a magnitude 7.4 quake less than two weeks ago and a magnitude 7.1 last year. It also produced the fifth-largest quake in history: a magnitude 9.0 in 1952.

“What we don’t know yet is exactly how this earthquake rupture today relates in space to these previous large earthquakes, such as the one in 1952, but it appears to be filling in a gap on the fault zone, releasing the energy stored there,” geologist Lisa McNeill of the University of Southampton in the United Kingdom said in a statement.

Hours after the earthquake, the Klyuchevskoy volcano on the Kamchatka Peninsula started erupting. It’s the largest active volcano in the northern hemisphere and one of the most active in the region. But it’s difficult to say whether the quake caused the eruption, Briggs says.

“There have been lots of earthquakes that have not caused eruptions, so in this case, where there’s [ongoing activity], it’s hard to untangle what the relationship is.”

How this quake birthed tsunamis

The Russia quake did trigger tsunamis, though they weren’t as destructive as those produced by some other megathrust quakes. Offshore temblors can whip up powerful waves, and this is especially true for subduction-zone earthquakes, which can lift large areas of the seafloor and displace vast amounts of water.

Notably, the Kamchatka earthquake’s point of origin, or its hypocenter, was located at a relatively shallow depth in the crust—about 21 kilometers deep. When a really large fault area that’s located close to the seafloor gets pushed up, it can raise a huge body of water and trigger a tsunami, Briggs says.

Waves of around three to five meters high reportedly struck the Kamchatka Peninsula, with video footage showing the coastal town of Severo-Kurilsk being inundated by the sea. Around six hours after the earthquake, the first tsunami waves reached Hawaii, with reports of waves up to 1.5 meters high. Waves arrived in California in the early morning, with Crescent City reportedly experiencing meter-high waves.

Millions across the Pacific region were ordered to evacuate when tsunami warnings and advisories were issued. But far-off locations like Hawaii and California saw only small waves of up to roughly 1.5 meters. Many of the warnings and advisories were later lifted or downgraded. Their issuance may have partly been due to caution since tsunami waves can be unpredictable, and even small waves can be dangerous.

The tsunami was also small for a megathrust quake due to the earthquake’s depth. The Kamchatka quake had a shallower hypocenter than the Tohoku and Indian Ocean quakes, but it was much weaker. Unlike what occurred during those other great temblors, fault motion during the Kamchatka quake does not seem to have reached all the way to the seafloor, Briggs says.

So the quake was less effective at displacing water for a tsunami, and the resulting waves were less capable of devastating far-off regions.

"To push a big wave all the way across the Pacific, you really need a monster source, and this one is just knocking on the door of that," Briggs says.

Something similar occurred in 2010, when a magnitude-8.8 struck Chile and caused near-shore devastation while generating tsunami waves that were relatively weak at long distances.

The form of the coastline itself also matters. Narrow bays and steep shorelines can amplify tsunami waves, compressing them and making them more destructive.

So far, the tsunami reports roughly fit what's expected for this size and location of earthquake, Briggs says.

There's a small chance of a bigger quake to follow

Smaller quakes have already occurred in the main quake's wake. As of 4 a.m. UTC (coordinated universal time), there have been at least 24 of these aftershocks with magnitudes above 5, including a magnitude 6.9. And the USGS (U.S. Geological Survey) aftershock forecast shows that there's about a 60 percent chance that an aftershock of magnitude 7.0 or larger occurs in the next week.

There's also "a small chance that any earthquake can be followed by a larger one, and so that's why we always suggest that people stay on alert," Briggs says. On July 20, this same region was struck by a magnitude-7.4 event, with this week's quake happening less than two weeks later. "That's an example right there," he says.

Fortunately, the risk of a larger quake striking the region decreases with each passing day. According to the USGS, on average, there's only a 5 percent chance that a temblor will be followed by a larger one nearby in the next week.

"These don't happen super often," Briggs says. But, when they do, "it's a reminder of what subduction zones around the world are capable of."