

Not My Fault: An unprecedented tsunami from the Tonga Islands

Lori Dengler/For the Times-Standard

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My phone awoke me at 5AM Saturday morning. The call is from Ryan Aylward at the Eureka NWS office. The only reason Ryan would call at this time of day is because of a tsunami. I groggily get the bare particulars – massive volcanic eruption, Tonga, tsunami advisory, 7:30 to 8AM.

I'm not very coherent at 5 and it feels like hours to get my computer up and begin to sort out the details. I read through the alert bulletin – it says a Tsunami Advisory was in effect for the entire West Coast. Reading further is the statement that an earthquake of magnitude 1 occurred in the Tonga Islands area.

The oddity of this statement is testament to how unusual an event this is. There is such a thing as a M1 – dozens are recorded every day in the Geysers Geothermal area where an extremely sensitive array of instruments is deployed. But they are teeny – basically cracks emitting a small amount of energy and not capable of being felt let alone producing a tsunami. Earthquakes under 6.5 almost never cause tsunamis and we never need to worry about distant tsunami hazards until quakes hit the mid-7 range.

In the 74-year history of US tsunami warning centers, there had never been a volcanic-generated tsunami worthy of issuing a bulletin about. The software for sending alerts is predicated on an earthquake source and the warning center folks had to put something in the earthquake magnitude field in order to send it out.

Normally, the earthquake triggers the tsunami alerting process. An audible alert goes off and computer screens flash in the tsunami warning centers whenever an earthquake above a certain magnitude occurs and that initiates the analysis and bulletin dissemination. For US earthquakes, it typically takes five minutes or less to get an initial bulletin out. If the earthquake is further away, that initial bulletin may take ten minutes.

This morning, the first tsunami bulletin from the National Tsunami Warning Center was issued at 3 AM PST. It was a statement – an earthquake of M1 had occurred in the

Tonga Islands area at 8:27 PM PST the day before and “Earthquakes of this size are known to generate tsunamis potentially dangerous to coasts outside the source region.” At 4:53 AM bulletin #2 announces that a Tsunami Advisory is in effect for all the US and Canadian West Coast and Alaska. The Pacific Tsunami Warning Center issued similar Advisories for Hawaii. This time the volcanic source was included, and Ryan at the NWS deemed it worthy of waking me up.

A Tsunami Advisory means a modest tsunami is possible. The tsunami is unlikely to flood areas much above the highest tide level but is capable of producing strong currents that can damage boats, harbors and catch beach combers unaware. It means stay out of the water and away from beaches, but no evacuation of residences and businesses is necessary.

Why did it take over eight hours for an Advisory to be issued? I don't know what happened in the warning center offices, but my guess is that until the tsunami passed one of the deep ocean pressure sensors, triggered a tide gauge, or someone saw a video post from Tonga, no one at the centers was aware of the eruption. In some counties like Japan and the Philippines, weather, tsunamis, earthquakes, volcanoes, and other hazards are all handled by a single agency. But in the US, different agencies or departments with agencies are focused on discipline-based threats. Today's eruption tsunami will certainly push closer connections.

I am well aware of the volcanic nature of the Tonga Islands. Like most islands in the Pacific, they owe their existence to volcanic activity. But I knew very little about the volcanoes in Tonga and hadn't noticed that the primarily underwater volcano Hunga-Tonga-Hunga-Ha'apai located 40 miles north of Nuku'Alofa, Tonga's capital, had begun erupting in December. It has shown frequent but modest activity over the past few decades. The volcano is a remnant of a larger volcanic system that with no major eruptions in the past few centuries but features prominently in the oral histories of the native peoples.

On December 20th, Hunga-Tonga-Hunga-Ha'apai belched a large ash plume visible from Nuku'Alofa. It was large enough for the Volcanic Ash Advisory Center to issue an advisory to air traffic. Satellite imagery showed the island increased in size. Another large ash eruption occurred on January 13. At 4:20 PM local time in Tonga, activity abruptly increased sending ash, steam and gas 12 miles into the air and raining volcanic debris onto Nuku'Alofa. Shortly afterwards, tsunami surges of up to eight feet

flooded low-lying areas. A number of buildings have been reported damaged but no injuries at this time.

By the time the US tsunami centers issued their first bulletin, the tsunami was approaching Hawaii. By the time I got my computer up and running, I could pull up coastal tide gauges and underwater deep pressure data and watch the tsunami progressing across the Pacific.

After an hour or two, it became clear to me that this tsunami looked very different than typical earthquake caused ones. It was particularly evident on the DART instruments. Beginning in the late 1990s, NOAA began deploying pressure sensors on the ocean floor. These instruments now called DART, are located in deep water far from coastal topography so that they can measure the true tsunami signal unaffected by coastal amplification. They are an important tool in the warning arsenal for forecasting likely tsunami heights.

I have looked at a lot of DART graphs for earthquake tsunamis. They tend to start out with larger amplitudes and then decay and disappear over the next hour. Today's tsunami is lasting much longer on the deep-sea instruments – four hours now and still counting. We don't know for sure yet why it is lasting so long – whether it has to do with the eruption itself or complex interaction with the sea floor. But it likely means that today's tsunami will last even long than usual, and my guess is that I will still be seeing traces in a few days.

On the California coast, Port San Luis recorded the highest water level so far – at just over 4 feet with Crescent City and Point Arena tied for second at 3.7.

I am sure to have more on this next week.

Lori Dengler is an emeritus professor of geology at Humboldt State University, an expert in tsunami and earthquake hazards. The opinions expressed are hers and not the Times-Standard's. All Not My Fault columns are archived online at <https://kamome.humboldt.edu/resources> and may be reused for educational purposes. Leave a message at (707) 826-6019 or email rctwg@humboldt.edu for questions and comments about this column, or to request a free copy of the North Coast preparedness magazine "Living on Shaky Ground."