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Not My Fault: Nothing unusual about recent seismic activity and thank goodness for DARTs

Lori Dengler/For the Times-Standard
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Some of you may have noticed what appears to be an increase in seismic activity lately. In March to date, we've had a 7.5 in the NW Pacific, a 5.7 in N. Utah, a 5.0 in W. Texas, a 5.8 and 5.2 off the North Coast and a widely felt 4.5 near Carson City Nevada.

It may be tempting to think something unusual is going on. All of this activity is well within the boundaries of normal random variation. Long spells of seismic quiescence followed what seems like a burst of earthquakes is quite typical. Anyone who frequents casinos may have observed this. It can quiet for hours and then several machines and tables all light up at once. It's much easier to remember the moments of excitement than the long dry spells.

None of these recent earthquakes were unexpected. The 7.5 (Tuesday evening just before 8 pm PDT) was in the Kuril trench subduction zone, one of the planet's most seismically active areas. Sixteen earthquakes of M7 or larger have occurred in this area since 1980 – including three M8s. We have a good reason to be concerned about Kuril Islands earthquakes. A magnitude 8.3 in November 2006 spawned a tsunami that damaged boats and piers at Citizen's Dock in Crescent City and produced over $20 million in damages. Tsunami survey teams found evidence of wave heights of nearly 30 feet on unpopulated areas of the Kurils near the epicenter.

When my phone beeped with the first message from the National Tsunami Warning Center (NTWS) 11 minutes after the Tuesday evening earthquake, it posted a Tsunami Statement (reserved for no threat or very low level threats). They were analyzing the data to see if there was a threat to Alaska or the North American West Coast. I was relieved when the first USGS notification came in a few minutes later, revising the magnitude to 7.5. Very big earthquakes are more difficult to get an accurate magnitude than earthquake in the M5-7 range. For automated locations, the seismic signal is truncated after a couple of minutes before reflections off the core-mantle boundary start arriving and complicate the seismic signal.

Truncation is not usually a problem, except for really big quakes. The difference between a large and a great earthquake is the size of the rupture zone. A typical 6 may be a mile or two in dimension, a 7 15-25 miles and the 8s and 9s may rupture hundreds of miles of fault. The rupture doesn't take place instantaneously. It starts at some point (the focus or hypocenter) beneath the surface and then grows in one or two dimensions. The grand daddy of ruptures was the December 26, 2004 Sumatra – Andaman Islands' earthquake where the rupture began off the coast of Northern Sumatra a proceeded nearly 800 miles to the coast of Myanmar (Burma). It took over ten minutes for the entire fault to break. Initial magnitude estimates put the earthquake in the upper magnitude 7-range. It didn't acquire a final magnitude until five months later and some people are still arguing if it is a 9.1 or a 9.3.

When it comes to tsunamis, it's these really big earthquakes that are of concern. So while I was relieved that the magnitude seemed to be getting smaller, I kept close watch on the USGS website to see how the magnitude responded as more data and further analysis was completed. When it comes to tsunamis, we have an important additional piece of data, NOAA's deep ocean sensors or DART instruments. I have followed the development of the DART system since 1996 when I was California's science rep to the fledgling National Tsunami Hazard Mitigation Program. At the time of the 2004 earthquake/tsunami, there were only seven instruments deployed and all were in the Pacific. The 2004 tsunami triggered a significant influx of cash and scientific development and today there are about 40 instruments in the Pacific and a handful off the East Coast and in the Caribbean as well.

I am a big fan of the DART instruments because they give us crucial information about the size of the tsunami in the deep ocean, unaffected by coastal topography and the near surface sea floor shape. The Dart measurements can be used to estimate the size of a tsunami along any coastline in the in the Pacific. In 2011, the DARTS were used to forecast a peak water height in Crescent City of 2.5 meters (8.2 feet). The actual measured height was 2.49 meters.

I'm also a DART fan because the information is public. You need to know how to navigate the web site but it didn't take long to pull up the three records that detected Tuesday evening's tsunami. The largest, off the Southern tip of the Kamchatka Peninsula, showed a clear tsunami signal but it was only 2.5 inches high. By this point I

relaxed, it was extremely unlikely that there was any threat to us on the US West Coast.

The Pacific Tsunami Warning Center (PTWC) had issued messages as well. They provide messages to Hawaii and US territories in the Pacific and Caribbean. They also issue threat messages to other nations that are part of the UNESCO's Inter Oceanographic Commission. The PTWC initial message for Hawaii put the State into a Tsunami Watch which is a bit like a Tsunami Statement but with a higher likelihood that an Advisory or Warning might be issued. They also issued a Tsunami Threat Message a tsunami might cause damage within about 600 miles of the epicenter – including Russia's Kuril Islands and the Kamchatka Peninsula. They cancelled the Watch and the Threat message about an hour after the earthquake based largely on the DART signals. NTWS was a bit slower, taking about 15 minutes to issue a statement that no tsunami threat existed.

If you are beginning to feel your head reel, I sympathize. The US has developed an awkward system of two tsunami warning centers with different responsibilities and different messaging. To further complicate matters, the US tsunami portal tsunami.gov was not being updated Tuesday night to reflect the rapidly changing situation. I had to rely on messages from tsunami colleagues through the Tsunami Bulletin Board to get updated information on PTWC messages.

Fortunately, the DART system is still fairly robust. It has been slated for elimination or significant reduction in each of the President's budgets for the past three years. The argument, we haven't had a major tsunami since 2011, so why worry about this very rare event? Tuesday evening might have gone very differently without the DART instruments. We would have waited for reports from coastal tide gauge locations that don't give nearly as good a signal as the DART instruments. I don't know if we would have gone to a higher level of alert on Tuesday without the DART data, but I know that I was far more confident in the no tsunami threat analysis for seeing the data. If we've learned anything over the past month, rare events do have the potential to threaten our lives. I feel good about where we are with distant tsunami threats, the ones that come from very far away and we have hours to prepare. The DARTs are a critical part of the system. They worked on Tuesday and I hope they will continue to work for many decades into the future.

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