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Not My Fault: Lessons and questions from Antelope Valley

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The Antelope Valley earthquake (7/8/2021) was centered midway between Lake Tahoe and Mono Lake and other than toppling items off shelves in the epicentral area and triggering a few landslides, caused no damage or injuries. Yet according to the USGS, this earthquake is considered "significant."

What makes for a significant earthquake? The USGS has developed an algorithm including magnitude, damage estimates, and Did You Feel It (DYFI) responses. What put the Antelope Valley quake over the top was the 25,957 felt reports, putting it into the top twenty for DYFI responses.

The July 8th earthquake was felt over a very large area. Most DYFI responses were clustered in the Reno to Bay Area region, but a few felt it from San Diego to Seattle and east to Montana, Colorado, and New Mexico. The prize winner for distance was from the small town of Mitchell, Nebraska 850 miles away from the epicenter.

Are these reports credible? The USGS also models the felt area based on the location of the earthquake, magnitude, fault characteristics and regional geology. Their model puts much of California and Western Nevada in the felt area but is more limited than the actual reports.

Can we trust the voluntary reports of ordinary people? Earthquake shaking is an ideal citizen science subject as it requires no training to describe shaking and shaking impacts. But anyone can log onto the USGS DYFI site and input information and certainly some people might make up reports. Here's where numbers and the pattern matters. It's easy to screen out one report of major damage in an area where twenty others said the shaking was weak.

What do I think of the far flung felt reports for Antelope Valley? There were more than 100 individual felt reports from areas at least 325 miles away from the epicenter. They all report weak shaking. The number and the consistency in what they report makes me believe most of them. I am convinced the Antelope Valley earthquake was felt over a very large area.

The earthquake was also a test for Earthquake Early Warning. California, Oregon, and Washington have all implemented a system that designed to provide a few seconds of warning before the strongest shaking arrives. The system depends on a dense network of seismographs that detects the first seismic waves only a few seconds after the fault rupture begins. Algorithms then estimate the epicenter location, magnitude and felt area in another second or two. Quickly sending an alert to participants in the ShakeAlert system and people who have downloaded the MyShake App.

To activate public messaging, an earthquake must be of magnitude 5 or larger (4.5 for MyShake) and produce noticeable shaking where you are located. The Antelope Valley earthquake met these criteria, yet few received notification and none before the shaking occurred.

The earthquake revealed several problems in the system. ShakeAlert was activated, but not until 25 seconds after the earthquake and long after shaking hit the epicentral region. Second, the first magnitude calculated was only a 4.8, far smaller than the actual size.

What went wrong? Station density and coordination between the California and Nevada networks. To work effectively, ShakeAlert needs seismic stations spaced every ten or so miles. The San Francisco Bay Area and Southern California meet this requirement, but less densely populated areas do not. The University of Nevada, Reno runs the Nevada network and Nevada is not yet a full partner in the early warning system.

The limited number of stations that did pick up the earthquake misinterpreted the signals as three separate earthquakes in the upper magnitude 4 range as opposed to a single M6. MyShake subscribers in the Mammoth Lakes and Stockton areas did get an alert, but for much weaker shaking than they felt and only after the waves had arrived. ShakeAlert is still in the development stage and Antelope Valley provided an excellent test. The solution is more seismic stations and improved coordination between California and Nevada networks.

Antelope Valley also provides interesting geologic insights (https://temblor.net/earthquake-insights/tectonic-mystery-swirls-as-earthquake-rocks-california-nevada-border-12960/). Geoscientists weren't surprised about the location of the earthquake. The San Andreas system gets much more press attention than other fault systems in the

State, but Eastern California is also seismically active. I've written about the Eastern California Shear Zone (ECSZ) before (Not My Fault 5/31/2020). It is part of the complex North American – Pacific plate boundary, accommodating nearly a quarter of the plate motion as its more famous western neighbor.

The Temblor report highlights an enigma. High precision GPS systems detail real-time plate motion. Data from the crest of the Sierras and Fallon, Nevada about 80 miles away show the Sierran block is moving a third of an inch per year to the north relative to Nevada. This shearing motion creates the faulting the shear zone. Over the long term, one would expect the fault slip on the faults in the shear zone to match the measured GPS rates.

But they don't. The mapped deformation on surface faults show much less slip than what might be expected. The explanation? The ECSZ makes the San Andreas system look simple. In the San Andreas, relatively few faults all oriented in the same direction accommodate the motion. In Eastern California, the faults are discontinuous, in a variety of orientations and slip directions and don't leave clear cut traces on the land surface.

It's been a fascinating tectonic time for the Eastern part of the State, and we've been lucky to escape major damage. But the next event could be larger, closer to populated areas, or in our neck of the woods. Antelope Valley is a good reminder to refresh your emergency supplies and review your plans.

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."