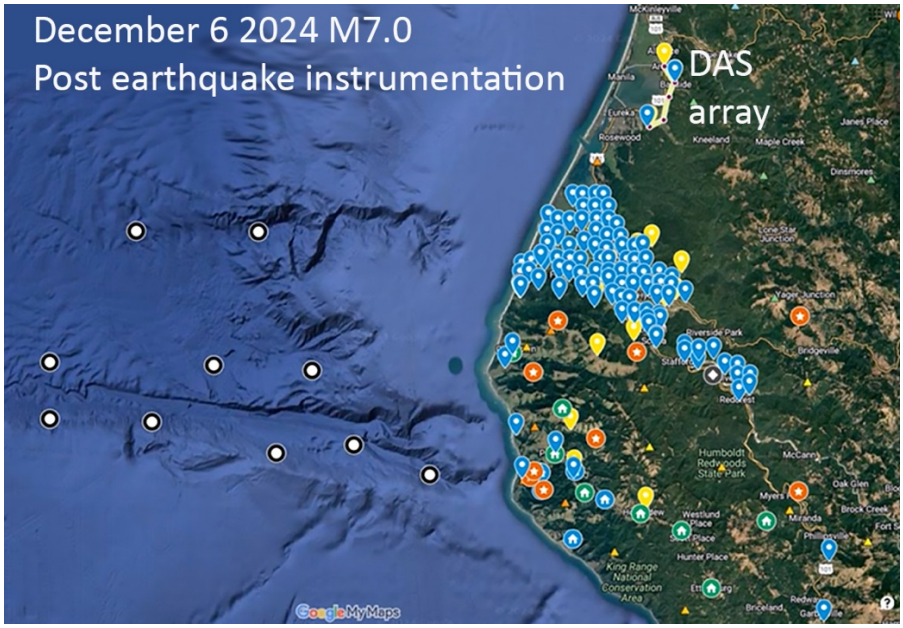
Times Standard

Not My Fault: The State of Northern California Earthquake Hazards Research

Lori Dengler for the Times-Standard

Posted February 1, 2025
https://www.times-standard.com/2025/02/01/lori-dengler-the-state-of-northern-california-earthquake-hazards-research/



An overview of instruments deployed by the USGS and other research groups after the December 5, 2025, magnitude 7 Mendocino fault earthquake. The optic fiber DAS array runs along Old Arcata Road and Myrtle Avenue in the upper right.

This week was the USGS Northern California Earthquake Hazards Workshop (NCEHW). I joined other earthquake hazards professionals for three days of virtual talks and discussions about the latest research and key vulnerabilities in our part of the State.

I am not a fan of virtual meetings. I like face-to-face interaction and staring at a computer for three days can be numbing. I make an exception for NCEHW as the organizers do a great job of structuring sessions with provocative titles such as “I’m afraid I can’t do that Dave: responsible use of machine learning and artificial intelligence,” and keeping talks to less than 15 minutes.

For me it’s a quick way to get up to steam on current research directions and top issues in my field. There were plenty of talks that were over my head, but it was still great to get a taste of what the next generation of earth scientists are working on. I’ll recap several themes that I hope you find interesting.

In the realm of ‘over my head’ is Artificial Intelligence, but I am getting a better feel for how it works, its benefits, and limitations. A better term is ‘machine learning’ as the technique is neither artificial nor independent of the decisions people make in setting up its architecture.

The crux of machine learning is pattern recognition and to do so requires data to train the algorithms on what is considered successful and what is false.

Computers are really good at crunching vast quantities of data at high speed. One area where machine learning has advanced seismology is in identifying very small earthquakes that are impossible for the human eye to recognize. Doing so requires good data and recognizing how the training process can bias results. Machine learning is here to stay. It is important to understand underlying assumptions and to think of it as a useful tool with limitations.

The workshop wasn't just leading-edge science like machine learning. Two sessions took a broader perspective looking at vulnerability and recovery after an earthquake. Infrastructure like roads, bridges, power, and communications are always disrupted in strong earthquakes. We all agree that fire, police, and medical are on the list of critical first responders. I doubt if very many of you would put schools on the same list.

Schools don't play a role in life-safety response, but they are critical to community response and recovery. We learned a lot about school closures during Covid and the deleterious impacts on child health and academic progress. What wasn't as widely published was the effect on parents and their ability to work.

The people most impacted by school closures are middle class and lower income workers. These are people in the food industry, transportation, manufacturing, and construction. They run emergency medical services like acute care, physical therapy, drive ambulances and staff nursing homes. They are essential to almost every business and organization. These are the folks upon whose shoulders society functions and if they don't have a safe affordable place for their children, they can't go to work, and our world can't function.

There was a fascinating presentation at the NCEHW by Melanie Gall of Arizona State University about the ALICE (Asset Limited, Income Constrained, Employed) Project and how vulnerable many American are to even a slight disruption in their income. Just under half of the population can't afford an extra $400 dollars of unexpected costs at any time. One of the most common causes of unexpected costs is children out of school.

Natural disasters are tipping points and can quickly slide a middle-class family into poverty. There is a wealth of data from the hurricane, wildfire, and flood communities, and earthquakes are no different. These are also the workers most needed in recovery and reconstruction. It's time to rethink schools as critical infrastructure for societal health and resilience.

For pure scientific "gee whiz," I'd put the session on dendrochronology (tree rings) on the top of my list. Trees are important timekeepers over windows of seismic interest – when was the last or next to last big earthquake. Strong shaking can damage trees and affect growth, showing up as a distinct anomalies in ring patterns. It was fascinating to hear Allyson Caroll of Cal Poly Humboldt find evidence for past San Andreas earthquakes in redwoods and Jessie Pearly of the Nature Conservancy extrapolate ages for both Cascadia and northern San Andreas ruptures from trees killed in massive landslides.

The NCEHW put a spotlight on the North Coast. After all, we've dominated the shaking scene of the past four years. Two late breaking sessions on our December 5th M7 earthquake featured

16 talks covering a broad range of topics from post-earthquake reconnaissance to how the earthquake may have triggered slip on adjacent fault systems.

This earthquake triggered one of the largest post event deployments ever. More than 120 instruments were installed on shore in the first two days following the earthquake and nine ocean bottom sensors offshore. These dense instrument arrays allow for much better detection of aftershocks and post mainshock deformation. It will take months to fully analyze all the information, but this is the most intense scrutiny a North Coast quake has ever received.

Sometimes one gets really lucky and has instruments in place before a quake. The North Coast Distributed Acoustic Sensing (DAS) array was up and running BEFORE December 5th and caught the M7 mainshock. DAS uses telecommunication optic fibers as seismic detectors and we've been fortunate for the USGS, Cal Poly Humboldt and telecom companies' collaboration to test this new technology. The December 5th sequence has produced a wealth of data confirming DAS can not only detect earthquakes but may also reveal detail on deep structures. It will yield even more information as the current 9-mile-long cable will be expanded into a much larger network as more optic fiber lines are installed along other roads in Humboldt County.

The week's sessions didn't only emphasize new technology such as DAS. Several presentations looked backwards, albeit using a modern lens. I wrote about the December 21, 1954, M6.5 earthquake enigma last summer. We've gotten much closer to some answers. Peggy Hellweg recently retired from the Berkeley Seismological Laboratory has been using her new-found free time to reinvestigate the quake. She has found many of the original recordings and rounded up a number of experts to relocate the earthquake, the type of faulting, and the impacts on the local community. All signs point to a location beneath Fickle Hill and quite possibly on the Cascadia subduction zone interface.

Why is any of this important to people who aren't seismologists? This is the data we need to make informed decisions about earthquake risk and take actions to reduce them. In December 2022 we saw firsthand how one earthquake could knock the wind out of a community. Rio Dell is still recovering from the insult of a M6.4 that took direct aim at the core of the community. The more detail we can uncover about where our faults are, how frequently they rupture, the ground motions they produce, and our societal impacts, the better we can plan ahead of time.

Almost all of the work reported in this week's NCEHW was supported to some degree by the federal government. The USGS is a federal agency and many of the studies were funded by the National Earthquake Hazards Reduction Act or by NSF. Studies like these provide data for building codes, seismic design, and land use planning. They have led to ShakeAlert and earthquake early warning. Sarah Minton, research geophysicist at the USGS, emceed the NCEHW and closed with the remark, "If it did happen, it could happen." I would add – and it will happen again.

Lori Dengler is an emeritus professor of geology at Cal Poly Humboldt, and 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/taxonomy/term/5 and may be reused for educational purposes. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column or to request copies of the preparedness magazine "Living on Shaky Ground."