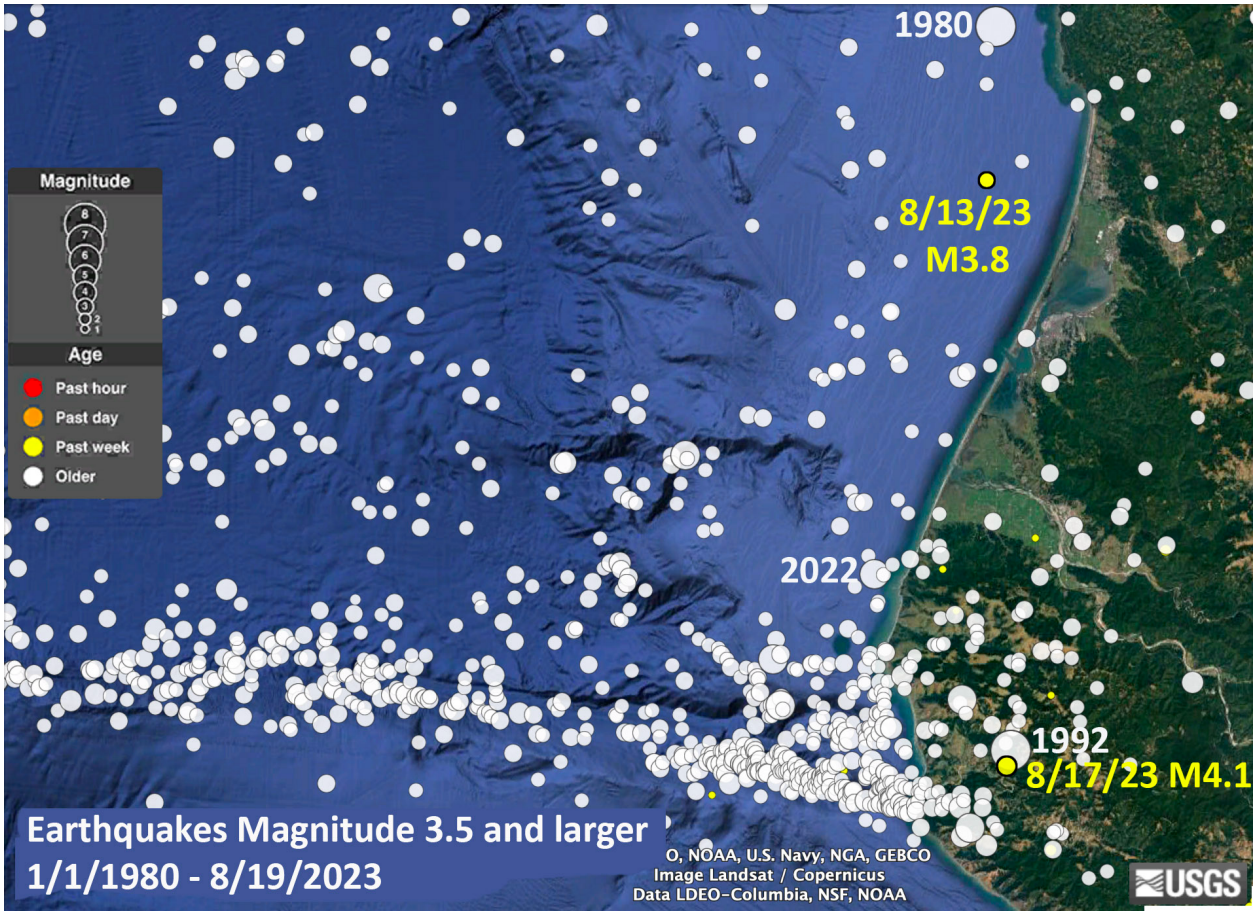
Times Standard

Not My Fault: Two modest quakes and a review of earthquake basics

Lori Dengler for the Times-Standard

Posted August 19, 2023
https://www.times-standard.com/2023/08/19/lori-dengler-two-modest-quakes-and-a-review-of-earthquake-basics/



USGS epicenter map of M≥3.5 earthquakes 1980 to present, earthquakes of the past week shown in yellow and labeled.

I was at Clam Beach with my dog walking friends last Sunday when my phone buzzed announcing a magnitude 3.7 nine miles west of McKinleyville. My friends and I were nearly as close to the epicenter as anyone on land could have been. None of us felt a thing.

On Thursday I was working at my desk when a similar text arrived. This time the earthquake was a magnitude 4.1 in the triple junction area near Petrolia. I didn't notice it either.

It was no surprise that I didn't feel either quake. If I were sitting or lying on the sand, I might have felt the 3.7, but it would take a larger earthquake for anyone walking, jogging, or

otherwise involved with outdoor activities to notice. The 4.1 was more than 40 miles away from me, too far for most people to notice an earthquake of this size.

For such modest earthquakes, I was surprised by the barrage of questions, comments I was asked, and the misinformation posted on social media. Here's my response.

• I felt two bumps. Were there two quakes?
There was only one earthquake in each case. All earthquakes are the result of rock fracture, even the small ones. When rock breaks, it produces compressional or P waves and side to side (transverse) S waves. Both sets of waves start out at the same time, but P waves are faster so the further away from the source, the more of a lag between the two. P waves are also a bit weaker – if you only felt one pulse, it was probably S.

Animals are much better at sensing vibrations than you are. It's not unusual for your dog, cat, or other fur/feathered companion to act disturbed a few seconds before you notice shaking. In most cases, they are reacting to the P wave that was too weak for you to notice.

Larger earthquakes can produce surface waves too. If you are outside during a big earthquake, you might notice the ground roll like waves on the ocean. It takes magnitudes in the 6 and higher range to produce this visible ground roll. I've never been lucky enough to witness them.

• It felt very different than other quakes – why?
Six hundred people filed a felt report with the USGS after the 3.7, most in the Trinidad to Arcata area, although it was felt by a few as far away as Ferndale and Orick. It was closer to many than other recent earthquakes, somewhat deep for our area, and coming at you from a different direction. All of these factors make ground shaking feel different.

The 3.7 was 13 miles beneath the surface, putting it in the mantle beneath the crust. The seismic waves traveled most of the way in competent mantle rock almost straight up towards you from the source region. They lost little energy from spreading out or interacting with more complex and heterogeneous crustal rocks.

The earth acts as a filter to seismic waves. Just like your neighbor's sound system, higher frequencies are attenuated and far away, only the bass remains. It's the high frequencies that make an earthquake feel sharp and abrupt so this likely felt less rolling than last December's quake.

Only 98 felt reports came in after the 4.1 and it was described as much weaker and rolling. No surprise – the earthquake was further from populated areas.

• Why didn't my App alert me?
I am glad you are aware of earthquake alert Apps. The Apps are based on a network of seismographs that detect, locate, estimate the shaking strength, and send out alerts via smartphones to people in the stronger shaking area all within a few seconds of the initial rupture. People 15 to 20 miles or greater away from the epicenter should get a short text to expect shaking a few moments before the stronger S wave arrives. If you are closer to the earthquake source, the alert will reach you after the shaking starts.

MyShake only triggers for earthquakes of magnitude 4.5 and larger and the USGS WEA (Wireless Emergency Alert) system requires M 5.0 or bigger. Both send alerts to areas where shaking will be noticeable. Neither quake last week met the threshold. You may occasionally get an alert for an earthquake that ends up being in the M3 range, but only because the initial magnitude estimate was larger.

• Why did the magnitude change?
The initial magnitude is always preliminary and usually based on automated procedures. For last Sunday's earthquake, the computer determined magnitude was 3.7 and it was revised to a 3.8 upon review by seismologists. Thursday's 4.1 did not change. For larger earthquakes, it may take hours or even weeks to get the best estimate of magnitude, but it is unusual for the final values to differ by more than a few tenths of a magnitude unit than the initial estimate.

• Why was there no tsunami alert?
Neither earthquake was large enough to generate a tsunami. Magnitude is related to the size of the fault and the amount of slip. Earthquakes need to be at M6 or larger to generate any tsunami and at least a 7.5 to produce a significant one.

Anyone who felt this earthquake could quickly ascertain it was small. Length of shaking is best proxy for magnitude than how sharp or weak it may have felt. When the shaking is over by the time you realize it's a quake, you can put this into the "no tsunami."

The earthquake that goes on and on and seems endless is at the other end of the spectrum. The longer the shaking lasts, even if it is very weak and rolling, the more likely a tsunami will soon follow. There will be no question in your mind that it is going on a long time, and you should realize this is the alert for people in the tsunami hazard zone to head to high ground.

What about the inbetweeners? I'd put last December's 6.4 into this category. When in doubt, drill it out. It's hard to estimate earthquake shaking length and there could by a tsunami. Use it as an opportunity to practice your evacuation plan and develop the muscle memory to do the right thing when it really matters. Check the National Tsunami Warning Center's twitter feed on your phone while you are evacuating – they will post a "no tsunami threat" statement, within four to five minutes after the earthquake.

Neither of these earthquakes changed the underlying regional stresses to make a larger quake more or less likely. On the North Coast, there is always a small but real chance of a potentially damaging quake. Think of these two quakes as reminders to check your emergency plans and supplies.

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/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. Downloadable copies of the North Coast preparedness magazine "Living on Shaky Ground" are posted at https://rctwg.humboldt.edu/prepare/shaky-ground.