

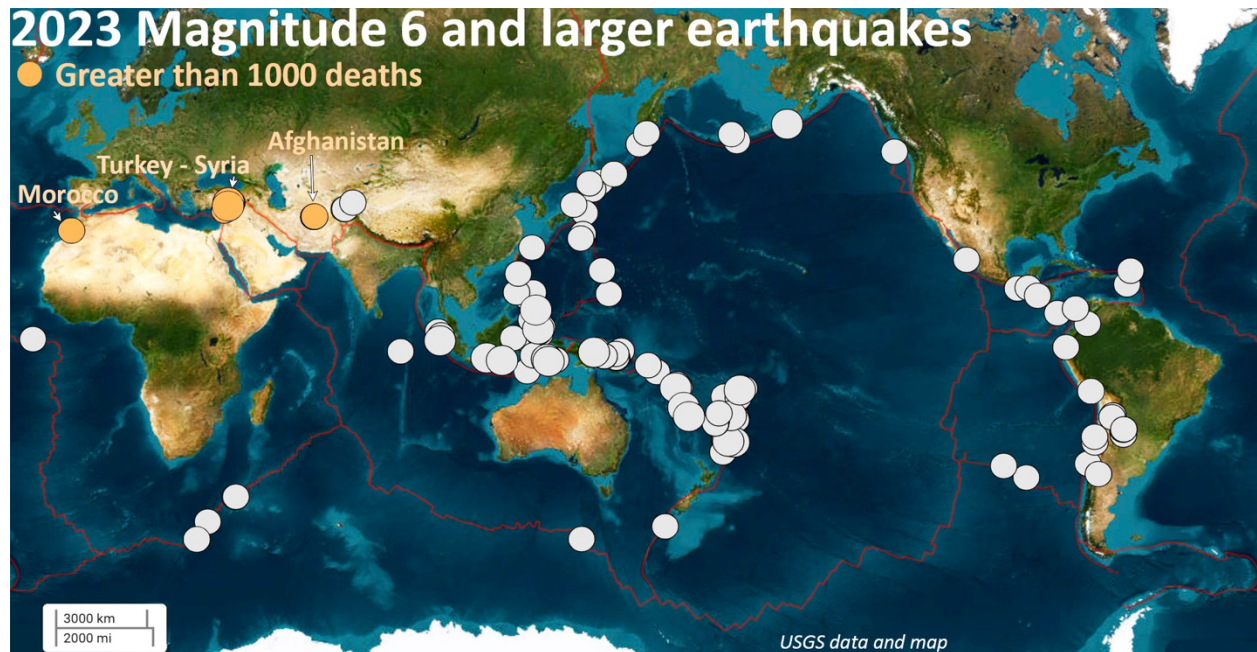
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Not My Fault: A shaky recounting of 2023

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USGS map of 2023 earthquakes of M 6 and larger. The three earthquakes with more than 1000 fatalities shown in orange.

2023 took a heavy earthquake toll. More than 64,000 people perished in earthquakes this year. The February 6th magnitude 7.8 and 7.6 earthquake pair in southern Turkey claimed top billing atop as the worst natural disaster of 2023.

For the people in southern Turkey and northern Syria, the nightmare of February 6th is not over. The two temblors struck nine hours apart on different faults within the complex triple junction region where the African, Arabian, and Anatolian plates meet. These earthquakes were not unlike the April 1992 North Coast earthquakes in the Mendocino triple junction area where a 7.2 was followed by a 6.5 and 6.7 in the next 18 hours all on different faults.

The resemblance to the 1992 Cape Mendocino earthquakes ends with the tectonic setting. The Turkey – Syria earthquakes were much larger and struck a densely populated region with many buildings under-designed for strong earthquake shaking. Strong aftershocks continue to the present, with over 600 large enough to be widely felt and 40 in the magnitude 5 to 6 range and capable of additional damage. In the past week alone, four aftershocks of magnitude 4 or larger were reported.

The losses were enormous in both Turkey and Syria. Turkey estimates 16% of the country's population were affected and losses (\$148.8 billion US \$) nearly 10% of the annual GDP. Syria impacts are harder to estimate as the greatest damage is in rebel-controlled regions but nearly 8,500 deaths and half of the population was affected. If the earthquakes had only affected a single country, it would rank as Turkey's deadliest of the last millennium and Syria's worst since 1822.

The rubble has largely been cleared in Turkey and rebuilding has begun. But the pace is erratic, and some areas have seen little progress. Where one neighborhood now features shiny new buildings, others are desolated and resemble vast parking lots. Many of the original businesses are also gone, unable to return for lack of space and customers. Others struggle in makeshift spaces near roads and thoroughfares where people still pass.

Housing is a major issue in Turkey. Tents and temporary prefab metal structures still dot the countryside. Nearly 3 million people were made homeless and over 300,000 structures damaged by the earthquakes. A United Nations report published two weeks ago estimates nearly 800,000 people are still in temporary living situations, more than a third with little protection against snow and rain. Markets and health care access is a problem for many. Those displaced have been further affected by the shut down of some post earthquake recovery programs.

The Syrian situation is more difficult because of the ongoing civil war. Much of the region had been dependent upon international aid groups before the earthquake. After the earthquake, aid access was restricted to many areas and further complicate by bans on aid to Syria by many countries including the United States. There are still no plans for an organized reconstruction effort.

2023 would have been memorable for earthquake impacts if the February 6th Turkey – Syria earthquakes were the only story of note. But 2023 was the first time since 1999 that three earthquakes claimed at least 1000 lives. In most years, the nearly 3000 deaths in the September Morocco earthquake (M6.3) and October's Herat earthquakes in Afghanistan (four M6.3 earthquakes, 1489 deaths) would have gotten top billing.

The Morocco and Afghanistan quakes shared some of the same features as Turkey. They were centered in populated areas where many buildings were not designed to resist ground shaking. But the impact was more limited because of the smaller earthquake magnitudes. They also differ in response and recovery.

Morocco mobilized the army to clear debris allowing rapid emergency response into the area. Field hospitals were established and severely wounded airlifted to hospitals out of the area. More than 500,000 people were displaced from their homes, but most have stayed in the area, living in tents provided by the government. The strategy did reduce impacts from a number of strong aftershocks but made access to services difficult.

Morocco now grapples with how to rebuild in an historic area where most of the structures were built of adobe. Officials want to require concrete and cinderblock construction that meets international building code requirements but many in the area don't want to change the character of their communities. There is also the issue of cost; the modern structures are not

affordable for many. I've been following the discussion among engineers who argue it is possible to include earthquake resilient features in adobe and traditional construction.

Afghanistan is a very different story where few outside aid organizations operate, and the government has little capacity to assist in response and reconstruction. Most trained professionals have left the country and the International community and neighboring countries have done little to help.

Why so many earthquake deaths in 2023? In terms of the total number of earthquakes, it was an average year. There were no earthquakes in the magnitude 8 range, the 7.8 in Turkey was the largest. With earthquakes, it is all about location. There were 19 earthquakes in the *M* 7 range in 2023 but only 3 caused major damage and casualties.

The 33 other deadly quakes of the year were in the magnitude 5 and 6 range. We put too much emphasis on the 'big one' in terms of concern. The 4th and 5th deadliest quakes of 2003 were a 5.9 (China 149 deaths) and a 5.7 (Nepal 153 deaths). The smallest fatal quake of the year was a 2.8, a mine collapse that killed one and injured 11 in the Czech Republic.

What most of the deadly 2023 quakes have in common is dense populations and weak buildings. In my first seismology class we were told that earthquakes don't kill people, bad buildings do. Every year earthquake statistics reprove that point.

We are fortunate to live in a place with strict building codes and many wood-frame buildings. The deadly Morocco and Afghanistan earthquakes were a bit smaller than the December 2022 Ferndale earthquake, yet our damage was orders of magnitude less. But there are a few similarities. In the first hours after the earthquake, there was confusion. Power was out throughout Humboldt County and getting information was difficult. Nearly a quarter of the population of Rio Dell was displaced from their homes and many of the damaged structures have yet to be fully repaired. Recovery assistance has been limited.

Humans are hardwired to use our own past experiences to project the future. After the 1992 Cape Mendocino earthquakes many people described every warm still day as "earthquake weather," thinking the same mild spring conditions would herald the next tremor. Residents of Rio Dell can attest that this wasn't the case. And just because the last two strong quakes were in the Rio Dell – Ferndale – Petrolia areas, doesn't mean the next one will be.

There will be a next one – tomorrow, next month, or a few years from now. We need to face the threat head on by taking actions to strengthen our homes, workplaces, and communities. Our brand-new Living on Shaky Ground magazine can help. See the link below for the digital version; print copies are coming out early next year.

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. The new 2023 edition of the preparedness magazine "Living on Shaky Ground" is posted at <https://rctwg.humboldt.edu/prepare/shaky-ground>.

