Times-Standard
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Not My Fault: Digging a little deeper into the new Humboldt County tsunami maps

Lori Dengler/For the Times-Standard
Posted August 23, 2020

Last Tuesday, the Humboldt County Board of Supervisors unanimously adopted the newly released California Geological Survey (CGS) tsunami maps for Humboldt County. It's worth spending more time on what these maps do and don't show and how to use them.

Tsunamis are caused in a number of different ways, but whether triggered by earthquakes, landslides, volcanic eruptions, or massive storm systems, they all involve displacement of ALL of the water above the ocean (or lake) floor and travel in the same way. It's the whole column of water that has been lifted up or dropped down that creates the tsunami and it's gravity that drives that water outward. Tsunami speed is only affected by water depth. It makes no difference whether two inches or twenty feet of water was displaced, the tsunami travels outward at around 450 miles per hour in average ocean depths, speeds up in deeper water and slows down as it nears the coast.

Figuring out when the first surges in a tsunami wave train will arrive is straightforward. All that is needed is the time that the earthquake or other source occurred and the sea floor depth along the path the tsunami travels. Estimated first wave arrival times are typically accurate within a few minutes even for sources on the other side of the ocean. But figuring our how high and how strong the surges will be is a more difficult problem.

The first tsunami models emerged in the 1980s when seismologists figured out how to couple the earthquake source/fault displacement with the water wave generation. There are three main parts to all tsunami models: source dynamics, propagation in the deep ocean, and the interaction of the tsunami and coastal landforms. Each major tsunami has been an opportunity to calibrate and revise the models.

All parts of the model are essential to getting reasonable results and, like all numerical modeling, depend on good data. Nowhere is it more important that in trying to estimate water height and penetration on land. People often ask me how high our next tsunami might be. It's easy to fall into the trap of thinking a tsunami is a great uniform wall of water that can be described by a single elevation value. Not true. The size and characteristics of the source, how much water is displaced, the shape of the sea floor, and the shape of the land all influence inundation.

Hilo, Hawaii and Crescent City, California are sometimes called "tsunami magnets" and with good reason. Both have experienced more than their fair share of losses from tsunamis. The seafloor off of Hilo Bay looks a little like a large V-shaped slot and it's easy to see how a tsunami coming from far away gets focused and amplified. Crescent City is a little more complicated – the shape of the harbor certainly contributes, but offshore and continental shelf characteristics also amplify tsunami wave heights.

The result of all these variables is that the tsunami wave heights can exceed 30 or 40 feet in one area and might be less than half that value only a few miles away. I've seen this numerous times after real tsunamis – in Peru, Chile, Papua New Guinea and Japan. The new CGS maps use better topography and bathymetry (water depth) data, resulting in more detailed and accurate maps.

People also ask what particular tsunami do the State maps model? The answer is none. They are an amalgamation of all sources that could produce a tsunami along our coast. The modelers have looked at dozens of likely earthquake sources, from great earthquakes around the Pacific Rim to the Cascadia earthquake beneath our feet. After running the models, they are combined to produce a worst-possible case that produces the maximum likely inland penetration. This is what is shown in the new Humboldt inundation map. I prefer to use the new evacuation maps that are more conservative and include an additional factor of safety. Don't worry about what the source is – the maps just released are intended to help you and your community plan to be tsunami-safe for the worst case.

One thing that the tsunami maps don't show is when the next great tsunami will occur. The CGS team did consider a 1000-year time window in their planning, so that these maps encompass rarer events such as the 2011 Japan tsunami that the older maps didn't include. They are the best information we have right now for developing personal and community evacuation plans.

What about climate change or coastal subsidence during a big local earthquake? The new CGS maps don't explicitly include sea level rise. However, the current rate of a few

inches per decade is well within the extra factor of safety that the evacuation maps include and the maps will be revised again in ten years. Subsidence, like that seen in 2011 Japan and 1964 Alaska is included. Humboldt County's setting relative to the subduction zone is different than both of those earthquakes. We are closer to the rupture surface and some models suggest much of the Humboldt coast is likely to uplift by a small amount during our next earthquake. Uplift is not included in the model. Land level changes like what was observed in 2011 Japan, are also within the map safety factor.

These maps are only the starting point to planning if you need to evacuate the next time you feel an earthquake and how to plan your evacuation route. If you feel more comfortable going a few blocks further inland than the map suggests, that is fine. Just remember to go on foot, make sure everyone in your family knows what to do, and start planning today.

Note: View the new maps at https://www.conservation.ca.gov/cgs/tsunami Jason Patton's presentation to the Humboldt County Board of Supervisors is at https://youtu.be/hayNz7j8O7s .

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