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Our Ocean Backyard

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A Tsunami Downtown?

Two weeks ago the Sentinel carried a story with the title: “California updates tsunami hazard maps for 7 counties”. These new maps were prepared by the California Geological Survey – as distinct from the U.S. Geological Survey - and include an update for Santa Cruz County. They are based on “improved computer modeling”. We have entered an era where we now have models for just about anything you can imagine. Modelers attempt to mimic or simulate complex natural processes with mathematical models. For climate and coasts, today we have models for Antarctic ice sheet collapse and sea-level rise, slope stability and coastal cliff failure, shoreline erosion, flooding and many other natural processes. And as sit turns out, it’s very difficult to actually model very complicated natural processes.

From my own experience, there are often different models for the same processes that have been developed by individuals or groups that may use different inputs or values for the components in their models. As a result, not surprisingly, we get different outputs or projections depending upon our assumptions or the numbers we use.

I have a good friend and colleague who has developed a coastal change model that projects the future position of the shoreline based on different sea-level rise scenarios, wave conditions, and the material making up the coastline, among other components. When I questioned him about the use of models, he responded with “Gary, models are models, they’re all wrong, but maybe some of them are useful”. He also added that “all models should be assumed to be wrong until they are proven to be right”. I found myself in complete agreement with him, but I don’t necessarily think other modelers would admit to these two statements.

I will confess right now that I am not a modeler. I got lost with calculus and differential equations, and early on in my career as a scientist decided to focus on actual observations and those processes and geological materials that I could actually see, measure and document. This brings me back to the new tsunami maps for Santa Cruz County based on “improved computer modeling”, which I assume means more complex or different mathematics or calculus.

In one example of the updates, new modeling shows that a subduction zone earthquake in the Aleutian Trench in the north Pacific could unleash a tsunami that would raise water levels 18-25 feet above the Santa Cruz Boardwalk, more than double the height generated by the modeling scenario in 2009 by the California Geological Survey.

You can go on-line and find the areas in Santa Cruz that this new model predicts would be flooded by a tsunami from a large subduction zone earthquake in Alaska: <https://www.conservation.ca.gov/cgs/tsunami/maps/santa-cruz>

This would include all of downtown Santa Cruz from Neary’s Lagoon on the west, across the San Lorenzo River and past Ocean Streeton the east, and then all the way inland from the Main Beach to the Highway 1 bridge. The police and fire stations as well as city hall and the county courthouse would all be flooded in this model. The Twin Lakes neighborhood from the shoreline to Murray Street and from the harbor past Schwann Lake would all be flooded. The Pleasure Point neighborhood all the way inland to Portola Drive is mapped as at the mercy of their tsunami model. These bluff top areas range in elevation from 30 to 50 feet.

I would be one of the first ones to say that we shouldn’t take tsunamis lightly, although what is more valuable and useful from my perspective than a mathematical model with its uncertainties and assumptions - especially after looking at the new map - is what has actually happened during historic tsunamis along the Santa Cruz coastline.

Over the past nearly 200 years or so of somewhat reliable news reporting in California there have been just six tsunamis that have been considered destructive. On average that’s about one every 33 years. Over this 200-year period, 17 lives have been lost due to tsunamis along our state’s entire coast. This is far less than the number of people killed by dog bites or bee stings and a very small fraction of the yearly fatalities from automobile accidents (3,500), guns (3,200) or drug overdoses (4,900).

The two tsunamis that have been the most damaging to the California coast historically were both generated by very large subduction zone earthquakes in the Aleutian Trench off Alaska, which is the same source area that the California Geological Survey used for their recent model. These have been called the holiday earthquakes. The first of these took place on April Fool’s Day in 1946 and was big, magnitude 8.6; and the second, an even larger earthquake of magnitude 9.2 occurred on Good Friday in 1964. This was the second largest earthquake ever recorded on Earth.

The 1946 event produced two tsunami waves in Santa Cruz, one at 10:15 am and the second at 11:51 am, with maximum heights along the shoreline later documented at about ten feet. There was apparently only a single tsunami fatality along the entire California coast from the April Fools’ tsunami, and it just happened to be in Santa Cruz. This was the only tsunami death ever reported in Santa Cruz County or Monterey Bay.

About 10:15 in the morning on that 1st day of April in 1946, Hugh Patrick, a 73-year-old man walking along the shoreline near Lighthouse Point was drowned when the water level rose quickly to ten feet above normal as the first wave hit. His walking companion was also knocked over by the wave, but was unsuccessful in attempting to rescue his friend. Hugh Patrick’s body was recovered in the kelp beds a half mile west of Lighthouse Point 17 days later. Another man, Ury Afanasief of San Francisco, was swimming when a surge dashed him against the rocks but he managed to fight his way out.

Men on the municipal wharf reported the water receding at a terrific pace a little after 10:00 am and suddenly returning at an appalling speed and surging high on the beach. Four surges were reported, the last at 11:50 am, which all but topped the Esplanade along Main Beach, rising to an elevation of ten feet above normal and covering all of the Main Beach. More to come on the tsunami history and risk in Santa Cruz.