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Not My Fault: Similarities and differences between storm surge and tsunamis

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We are in the teeth of hurricane season and two storms have headlined the news this week. Fiona battered the Caribbean, once again knocking out much of Puerto Rico's fragile power grid. Five days later, it still packed enough wallop to batter Quebec, New Brunswick, and Nova Scotia. It is the costliest hurricane in Canadian history.

Ian is still wreaking havoc as I write. Downgraded to tropical storm category, it continues to dump rain inching across North Carolina and into Virginia. At least 48 lives have been lost and costs will likely reach tens of billions in property damage. The full extent of the impacts will not be known for weeks.

I am not a hurricane expert. When I developed a Natural Disasters class at Humboldt, I stuck to geologic disasters. But after two years, I bit the bullet and put myself on a crash course to learn something about weather hazards, the costliest and most frequent type of disaster. I learned that typhoons, hurricanes, and cyclones are all the same thing, just used in different geographic regions. The official status for Ian right now is "post tropical cyclone."

As Ian battered Florida's Gulf coast I was searching for the inevitable mention of tsunamis. I wasn't disappointed. "Hurricane Ian 'like a tsunami' as storm surge makes landfall in Florida" announced 9 News Australia. Columbia's State of the Planet reported, "…winds up to 155 miles per hour with tsunami-scale storm surges of 6 to 16 feet…"

Ever since the 2004 Andaman-Sumatra earthquake in the Indian Ocean, the media has played loose and large with the term tsunami. A quick internet news search will come up with the 'silver tsunami' (the growing population of old folks like me), debt tsunamis, the potential Republican midterm election tsunami, and last week's Wall Street "tsunami of bad news."

Using 'tsunami' to denote anything catastrophic weakens the word and makes it more difficult to have the important conversations about what tsunamis really are. By turning it into a flash term that provokes a visceral response, people are less likely to listen, plan, and take actions that will very likely save your loved ones' lives.

Setting the record straight, the overwhelming majority of tsunamis are tiny events that we would never notice without instruments. A tsunami is any event that produces a disturbance in the entire water column. The term says nothing about size or scale. Each year, roughly 15 tsunamis are detected on tide gauges, most less than an inch high. Only about 10% are large enough to cause damage or deaths.

Tsunamis are very different beasts from storm surges. The entire water column from the sea floor to the surface is involved in a tsunami, most often triggered by a very large earthquake beneath the seabed. Faulting deforms the sea floor and gravity drives waves outwards. The larger the vertical seafloor deformation, the larger the resulting waves. But the physics of small or large tsunamis is basically the same. The speed they travel at is only a function of ocean depth (see note below).

Tsunamis are waves but very different than the ocean waves you are familiar with. On our coast, wind waves typically have periods of about seven seconds. Larger storm/swell waves can reach about 20 seconds from one peak to the next. Tsunami waves arrivals are many minutes apart and often irregularly spaced. The first few surges might be 15 or 20 minutes apart and then an hour could pass before more even larger waves arrive. Some large tsunamis produce only three or four large surges. On the California coast, waves typically arrive for days.

But tsunamis are far more wavelike than storm surge. Storm surge is primarily wind driven and involve only the upper part of the ocean water. The rotating winds around the eye push winds towards or away from the coast. As Ian moved along Florida's Gulf Coast, the counterclockwise winds drove water away from land and the sea level dropped. Water rushed out of Tampa Bay for hours. But as the eye moved north, the winds in the wake of the eye were in the opposite direction, causing the water to rise. Naples and Fort Myers bore the brunt where Ian's surges pummeled the coast for nearly a day.

Tide gauges are useful tools for both tsunamis and storm surges. NOAA maintains a real-time network of instruments throughout US territorial coastlines (https://tidesandcurrents.noaa.gov/tsunami/#). A typical tsunami record shows an onset followed by oscillating waves with periods on the order of 15 to 60 minutes. In

contrast, storm surge shows a gradual onset. Depending upon the coastal location and the storm movement, it may begin as a slow lowering or rising of the water level. There are no oscillations – the surge may remain roughly constant for hours and hours and, in some cases, as long as three days.

Meteorologists can see hurricanes coming long before they hit our coast. Ian was first detected from satellite and ocean data on September 19 as a small ocean disturbance. Five days later it was large enough to become a named storm. Path projections and forecasts gave emergency planners and responders days to station supplies and to order evacuations.

Tsunamis always have a shorter trigger time than hurricanes. We can't predict earthquakes, submarine landslides, or volcanic eruptions. For areas close to the source, all we can do is educate coastal residents to recognize shaking as a sign that a tsunami may be on its way. Here on California's North Coast, a tsunami could arrive in as little as ten minutes after a great earthquake begins. There is no time to pre-position response aid and no time for a coordinated evacuation. That is why it is so important for all of us to be aware and prepare.

We have just the event to help you get started. Please visit https://rctwg.humboldt.edu/great-shakeout to learn all about the Great ShakeOut or call the RCTWG message line at 707-8266019. ShakeOut is a time to make preparedness fun - take photos of you and your co-workers doing a Drop, Cover, Hold On drill and let your kids take the lead in showing the route to high ground. Develop the muscle memory to respond when time is at a premium.

Note: There are rare exceptions to tsunami travel time like the January 15th Tonga tsunami. Its speed was controlled by the pressure wave in the atmosphere which traveled faster than the typical seafloor generated tsunami.

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/resources and may be reused for educational purposes. Leave a message at (707) 826-6019 or email rctwg@humboldt.edu for questions and comments about this column, or to request a free copy of the North Coast preparedness magazine "Living on Shaky Ground."