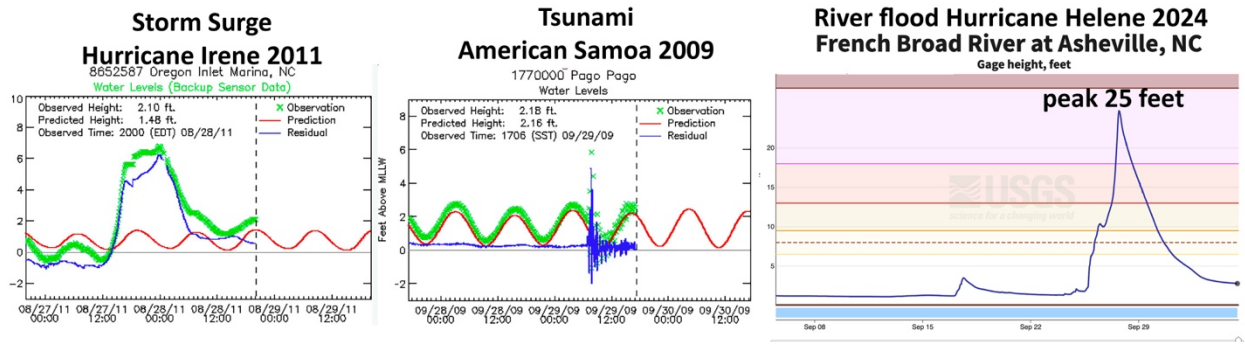
Times Standard

Not My Fault: The destructive power of water

Lori Dengler for the times-Standard

Posted October 5, 2024
https://www.times-standard.com/2024/10/05/lori-dengler-the-destructive-power-of-water/



A comparison of water level recordings from storm surges, tsunamis and river flooding. At left is storm surge along the North Carolina coast produced by Hurricane Irene in 2011; center is the 2009 Samoa tsunami as recorded at the Pago Pago tide gauge in American Samoa; and right shows the river stage near Asheville, North Carolina during Hurricane Helene.

"Water, water, every where, And all the boards did shrink;. Water, water, every where,. Nor any drop to drink" opens Coleridge's Rime of the Ancient Mariner, a poem I was introduced to as a freshman in high school. Those first lines have stuck with me ever since, and never more so than this week.

Water makes our planet habitable and is essential for life. But water is also the main component of many natural hazards. The aftermath of Hurricane, then post-tropical cyclone, Helene dominates newspaper headlines and media broadcasts. The complete tally of devastation is yet to be tallied. As I write the death toll has reached 240 and 285 people are listed as missing. Current loss estimate is 37.5 billion dollars. These numbers will go up as flood waters recede and more thorough damage estimates are completed. Helene is the deadliest hurricane to hit the U.S. mainland since Katrina and will likely make it into the top ten costliest national disasters of all time.

Why so devastating? Force, scale, and exposure. Human structures fail when force exceeds strength. Homes, roads, bridges, and other structures will all collapse when the strength of some critical component is exceeded. Hurricanes, like earthquakes when large enough, can exert crippling forces over enormous areas. The impacts on society depend upon what and how we've built in the storm's path and how many live there.

Hurricanes cause direct damage in three ways: winds, storm surge, and flooding. Hurricane force winds are too strong for a person to stand against and unless structures are built to resist those forces, can easily tear off roofs, blow buildings off weak

foundations, and knock down trees that become flying battery rams. Winds are a hurricane's advance party – knocking out communication and obstructing road access making it difficult to get information and often impossible to evacuate.

Storm surge is the result of low pressures in a hurricane's eye that cause sea level to rise. The rotating winds around the eye push water towards or away from the coast. As Helene moved along Florida's Gulf Coast, the counterclockwise winds first drove water away from land and the sea level dropped. But as the eye moved north, the winds in the wake of the eye were in the opposite direction, causing the water to rise.

While often compared to tsunamis by the media, storm surge is a very different beast. Tsunamis are true waves, successive surges of water tens of minutes apart produced by deformation of the seafloor. A tsunami involves an enormous volume of water that may move as fast as 35 mph at the coast and reach low inland areas several miles from the coast. The incoming surge may last 15 or 20 minutes, then ebb with surprising speed, pulling damaged houses and debris out to sea. The process will repeat for hours or sometimes days with surges flooding the land, receding, and repeating.

Storm surge batters the coast with high water over a period of eight to ten hours and sometimes longer. Unlike a tsunami, there is no ebb – the water just remains high. The water speeds aren't as high as a major tsunami and the surge won't extend as far inland as the recent tsunamis in Japan (2011), or Chile (2010), but the flooding can be nearly as effective in damaging infrastructure: battering and floating homes off foundations and leaving behind volumes of mud. Helene's storm surge reached over seven feet in the Tampa Bay area.

Once a hurricane hits land, it loses strength. Warm ocean waters are what fuel a hurricane and after landfall on September 26th, the winds lessened, and Helene was downgraded to a post-tropical cyclone on the 27th. But that doesn't mean the storm had lost its ability to wreak havoc. The final insult is the post-tropical cyclone rainfall phase that can drop enormous amounts of water hundreds of miles away from landfall.

Helen was enormous. No single number encompasses its size. At landfall in Florida's Big Bend area, it pelted the coast with 140 mph winds, earning a category-4 ranking. It is the largest hurricane to hit the Big Ben area since records began in 1851. The storm surge set records at many sites along Florida's coast including Cedar Key north of Tampa where it exceeded nine feet.

The worst of Helen's impacts may not have been in Florida. Florida was hit hard – over $20 billion in losses and 25 deaths have been recorded. But Helen's last assault fell as torrential rains over Georgia, the Carolinas, Alabama, Tennessee, Kentucky, Virginia, West Virginia, and even impacting states as far north as Indiana, Illinois, and Ohio. Those states have been slower than Florida to tally impacts, but we know the loss of life in North Carolina and Georgia exceeds Florida and damages may too.

Western North Carolina appears to have gotten the brunt of the rainfall. Asheville Regional Airport recorded 19.38 inches of rainfall in the first 12 hours of the storm before losing communication, more than 40% of the site's annual average. This is Appalachian country,

and the terrain played an important role. As the moist airmasses moved over hillsides, it cools and dumps rain. The rain quickly channelized turning creeks and small rivers into torrents, flooding valleys. Antecedent conditions also played a role. The ground was already saturated when Helene arrived.

The storm wasn't the only factor that may have left Tennessee vulnerable. The State does not have as strong an emergency management structure as others in the hurricane belt. Florida has arguably the most robust planning and response to hurricanes – no surprise at it is the mainland state that has been struck most frequently. Florida was quick to map areas of potential impact, order evacuations, and communicate with vulnerable populations. Of the 12 states with Helene impacts, only Florida has completed a thorough initial assessment of damages.

Over the past 15 years, Tennessee has weakened construction codes and zoning, allowing for the construction of buildings on steep slopes, lowering elevation requirement for homes in flood zones, weakened wetlands protections, and slowed adoption of national building code standards (NYT 10/3/24). Early assessments suggest these changes made many structures more vulnerable and may prevent some homeowners from receiving FEMA post-disaster assistance.

Helene is one more sign that the changing climate is playing a roll too. Hurricanes have been a part of life on the Southern Atlantic and Gulf coast for millennia, but they are becoming bigger and more frequent. Since 2000, the U.S. mainland has been struck by 8 category 4 or larger hurricanes, one more than were recorded in the last half of the 20th century. It should be no surprise; hurricanes are fueled by warm ocean water. Average ocean temperatures in the Atlantic have risen more than 2° in the last two decades.

Human civilization evolved over the past 5000 years while climate conditions for our planet were unusually stable. We've developed our cities and economies with a concept of what is normal – average temperatures, statistical repeat times for large floods and hurricanes. Sadly, our changing climate has rendered such terms of a 500-year flood or 100-year rainstorm obsolete. We are in new territory with the potential for much larger events than anything we've seen in the historic past.

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. Leave a message at (707) 826-6019 or email Kamome@humboldt.edu for questions and comments about this column or to request copies of the preparedness magazine "Living on Shaky Ground."