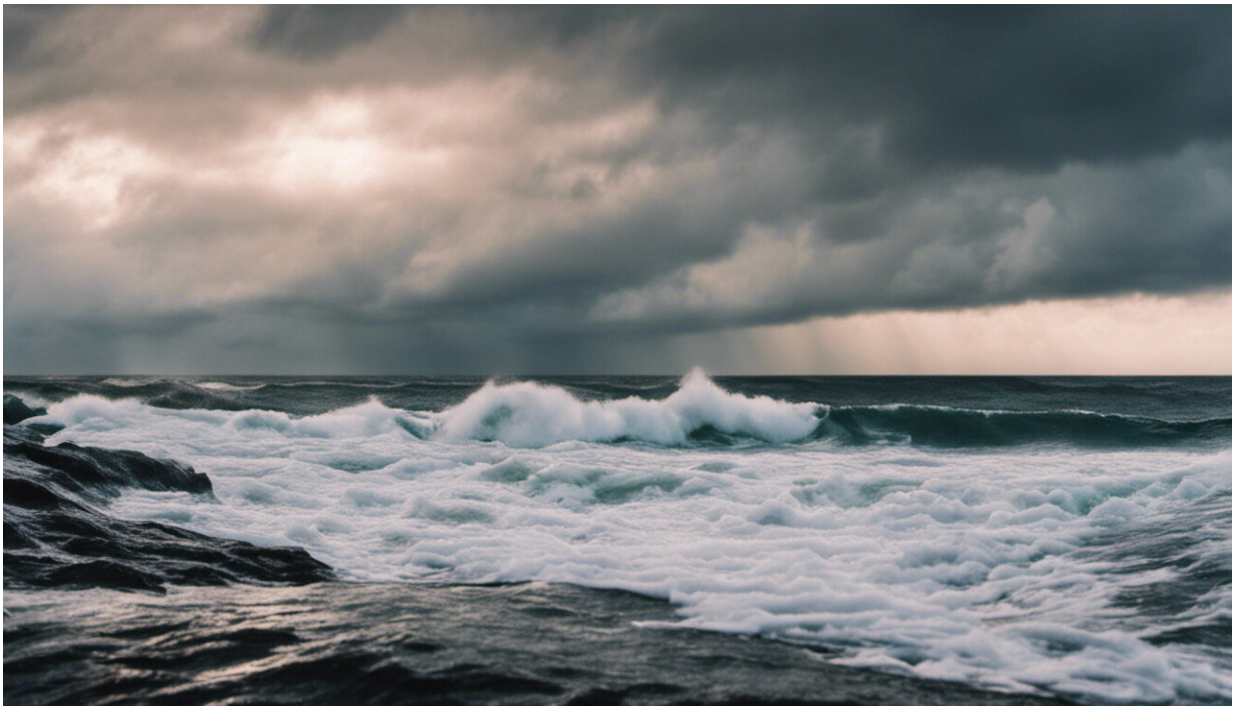
Misunderstood storm surge threat can be every bit as deadly as a tsunami

July 24 2019, by Anitha Karthik



Credit: AI-generated image (disclaimer)

One of the most powerful tropical storms ever recorded, Typhoon Haiyan, rampaged across the central Philippines in 2013, causing the deaths of more than 7,000 people. The devastating consequences were not simply the result of a 7.5 metre "storm surge" but also down to the fact that few people actually knew what it meant when there were

warnings of the phenomenon, and the threat it posed to the population.

Storm surge does not occur as inland flooding caused by heavy rainfall, or as coastal flooding that occurs any time low-lying land is inundated by seawater. Storm surge is an abnormal rise in water levels over the estimated high tide. Simply put, it is ocean water forced by powerful hurricane winds towards the coast. Such hurricane-force winds are always hazardous to coastal communities and infrastructure, but often the most devastating consequences for local populations are due to storm surge.

What is unique about storm surge?

Storm surges are unique in their characteristics, because of their high sensitivity to the slightest change in storm parameters such as speed, pressure, intensity, direction of approach, position of the coast or the depth of the ocean.

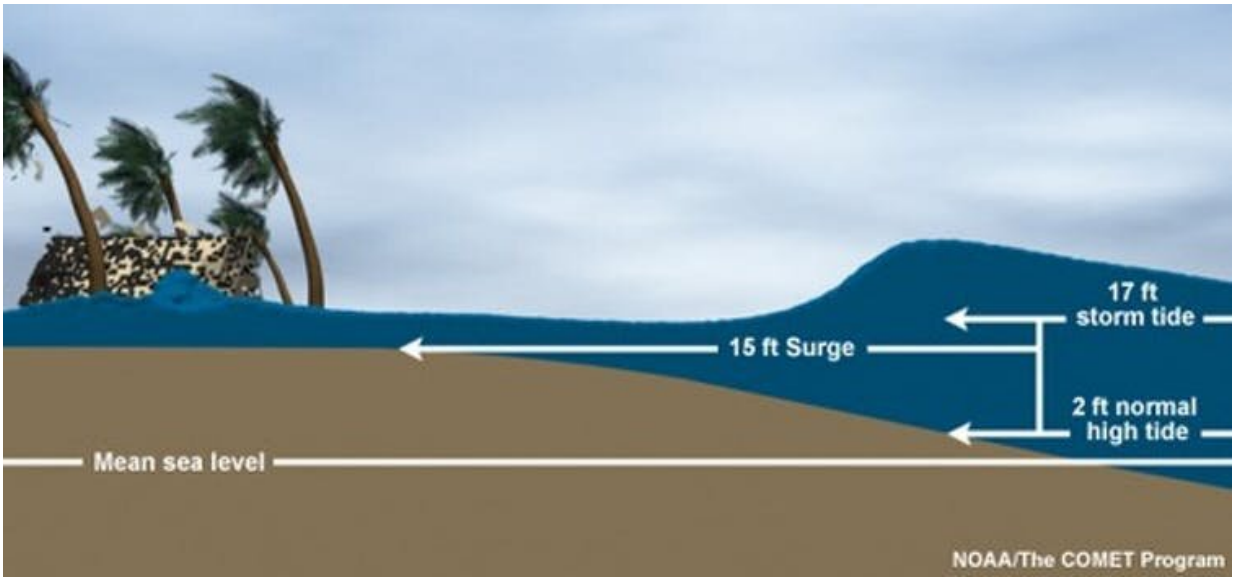
Storm parameters tend to change rapidly during the lifecycle of a hurricane, increasing uncertainty around storm surge water levels. Despite being regarded as a secondary hazard, storm surge often poses more of a threat than strong hurricane winds, usually regarded as the primary hazard.

Coastal areas are largely altered by various other factors such as erosion and depletion of storm buffers such as reefs, wetlands and salt marshes through day-to-day interaction with the dynamics of the sea. So the coastline is constantly changing, making it more vulnerable and paving the way for new inundation levels from the next storm surge.

Sometimes storm surge is confused with tsunamis (as both involve a wall of water rushing towards the coastline), or storm tides, which are a combination of storm surge and tide over and above the normal water

level. Both phenomena result in coastal inundations and can cause substantial loss of life and economic damage.

Tsunamis can be seismic, meaning they can result from the vibrations of the Earth such as earthquakes, or non-seismic—caused by phenomena such as meteorites or asteroids. But storm surge is only associated with tropical or extra-tropical cyclones where heavy winds trigger the abnormal rise in water levels.



Storm surge is an abnormal rise in water level over the estimated high tide, forced by hurricane winds on to the land. Credit: National Hurricane Center/NOAA, Author provided

A typical effect of a tsunami is the receding of the sea—identified during the Boxing Day tsunami of 2004 – before it banks up to create a huge wall of water. This was also witnessed during Hurricane Irma in 2017, when the storm exhibited a "negative storm surge effect." This

happens when seawater is sucked away from the shore uncovering the seabed or leaving it in a dry state.

Is storm surge decreasing?

A study from 2018 claimed that the death rate from storm surges is decreasing thanks to improved forecasting technologies, early warning systems, coastal protections and speedy evacuations. However, recent storms like Cyclone Idai remind us that storm surge has not gone away. Counting deaths attributed to storm surge over a period of time seems to give a misleading picture of reduced impact, plus signs of a decreasing trend may not indicate the actual risks associated with storm surge.

In 2018, Edward Rappaport, acting director of the US's National Hurricane Center, carried out an analysis on direct deaths from Atlantic tropical cyclones over three decades from 1970-1999. His study recorded that most of cyclone-related fatalities were associated with rainfall and not attributable to storm surges. The 1,800 deaths from Hurricane Katrina in 2005, and significant economic damage that occurred during Hurricane Sandy in 2012, majorly altered his claim, and he later reported that 49% of deaths from Atlantic hurricanes are directly associated with storm surge.

The increase in tropical cyclone-generated storm surges that occurred around the world between 2015 and 2018 and the human and economic cost that resulted, clearly contradicts any claim that death rates from storm surges are decreasing.

During the course of Cyclone Idai, which struck Zimbabwe and the coast of Mozambique on March 14, 2019, mud houses were washed away and sea defences were damaged. Towns were cut off from rescue operations, and the death toll exceeded 800 people with hundreds reported missing. Winds of up to 177kmph (106mph) resulted in 90% of the city of Beira

in Mozambique being destroyed.

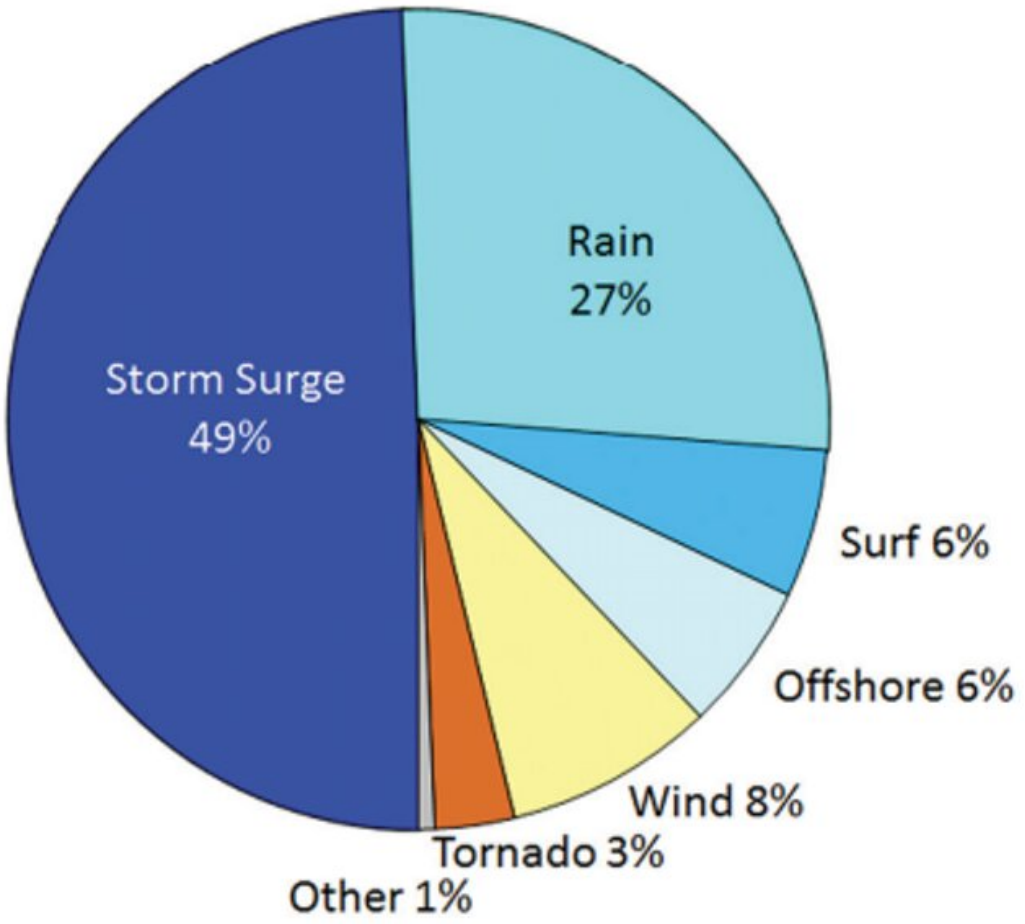


FIG. 1. Cause of death in the United States directly attributable to Atlantic tropical cyclones, 1963–2012.

Credit: NHC

With airports closed, rescuers could only reach survivors by land, which not only protracted the rescue process but also complicated the

deployment of food, water and emergency medical services. This is what typically happens when a storm surge hits.

Cyclone Idai is a deadly example of the power of a storm surge, and the cities in its path are still recovering from the impact, with the death toll expected to exceed 1,000. This would certainly indicate that storm surge is not a declining trend. Which is all the more reason to help people in vulnerable parts of the world to understand what storm surge is and just how much a threat to life it can be.

Provided by The Conversation