

## Water, Not Wind

In the wake of Hurricane Michael's unprecedented and tragic path of destruction from the Florida Panhandle through to Virginia, and flash flooding that stretched even farther north, the contrast to Florence's fresh-in-the-memory events is stark.

Michael rapidly escalated in a remarkably short time frame to a sustained 155 mph wind, Category 4 hurricane at landfall on Florida's panhandle, and maintained hurricane status well into Georgia, cutting a swath of destruction and especially on the coast. Three days later, all the damage to lives and property was done with a death toll of 43 in Florida alone,<sup>1</sup> and over 50 across the US.<sup>2</sup> Florence more slowly approached the North Carolina coast, eventually making landfall as a 90 mph Category 1 at Wrightsville Beach. It was the cause of 47 deaths<sup>3</sup> and surge, rain and river flood-related damages estimated at \$28.5 billion, stretching inland 200 miles from the coast.<sup>4</sup> The worst of the damage occurred many days after landfall as the slow-moving system meandered its way northeast, dumping unprecedented rain in North Carolina and beyond.

Both events brought forces to bear in ways and in places—one in the form of wind, the other water—that had *never* been experienced before. Unfortunately, our minds, our finances and our regulations are not equally prepared to handle what's coming in the future with respect to the hazards and exposures to these two meteorological risks. Large amounts of still, flowing or falling water are, for most, a more familiar part of life and lack the movie-like, rapidly destructive, and less ubiquitous impact of a destructive wind. With a nod to reruns regarding Noah and his Ark, how many movies have been made about persistent, heavy rain, or the destructive power of the storm surge? Throw in some wind? We have been blessed with no fewer than six Sharknado movies.

As a collective, we are much more attuned to wind events. Tropical cyclones are categorized strictly on the basis of sustained wind speeds: a "depression" graduates to a "storm" when one-minute sustained winds exceed 39 mph and a "storm" becomes a "hurricane" at 74 mph. At this point the Saffir-Simpson scale that places hurricanes into 5 categories begins and scales to a Category 5 being everything above 157 mph. No reference to water . . . *none*. This imbalance in attention is not limited to the legacy

---

1

<https://www.tallahassee.com/story/news/2018/11/29/43-and-counting-deconstructing-death-toll-hurricane-michael/2124902002/>

<sup>2</sup> <https://www.foxnews.com/us/hurricane-michael-killed-at-least-35-in-florida-45-total>

<sup>3</sup> <https://www.newsobserver.com/news/local/article218984940.html>

4

<https://www.insurancebusinessmag.com/us/news/catastrophe/hurricane-florence-costs-hit-11-figures-113190.aspx>

scale that is used to categorize storms, but extends to how they are prepared for and responded to.

Florida is a case in point. After Hurricane Andrew, which hit Florida in 1992, the state instituted a stricter building code in the early 2000s that required new buildings to use tougher nails and have more puncture-resistant walls, among other changes. The code focused on fortifying structures for the forces of wind, with new construction in the southern portion of the state required to withstand 175-mile-an-hour winds. In the coastal Panhandle counties, the requirement is lower, for 120 to 150 miles an hour, and the rules for certain kinds of reinforcement have been applied to houses built more than a mile from shore only since 2007. In the case of Michael, of the coastal housing structures that held up to the wind, many suffered severe water damage and in some cases had entire floors relocated by water currents. Florida's Atlantic coast is no better positioned with respect to the risk from surge, rain and river water than the panhandle, even if the wind codes hold up.

Even the financial aspects of tropical storm resiliency are predisposed for wind damage while leaving greater vulnerability to water. Property insurance policies routinely cover wind damage even in higher risk locations, but flooding insurance is often excluded unless special provisions exist. This disconnect is the key reason why FEMA's National Flood Insurance Program came into existence: to both provide financial incentive for a market failure, and to bring a level of incentive for communities to engage and invest in flood preparation and resiliency provisions. Unfortunately, the adoption and impact has been limited, leaving up to 85% of the flood damage value from Florence uninsured.

All of the above detail serves not as a retrospective review, but as a prologue to a far more alarming reality.

Even with no increase in the frequency of tropical storms or their severity in terms of wind,<sup>5</sup> the events will get wetter. Multiple contributors drive this. The speed with which cyclones travel is slowing down, and this trend is expected to continue as the climate changes.<sup>6</sup> The water-holding capacity of the atmosphere will rise with increasing temperature due to the Clausius Clapeyron effect, although the severity to which this occurs is an active area of scientific research.<sup>7</sup> All other things being equal, storms will move slower and carry more water as they make landfall and meander from there in a path of destruction.

Florence's extreme impact came from exactly this combination. Harvey's impact on Houston in 2017? Same phenomenon. These are the recent instances exemplifying

---

<sup>5</sup> <https://www.popsci.com/hurricane-extreme-charts-climate-change>

<sup>6</sup> <https://www.nature.com/articles/s41586-018-0158-3>

<sup>7</sup> <https://www.nature.com/articles/srep38752>

how slow, wet cyclones are getting slower and wetter. In reality, rainfall is often the greatest cause of damage and loss of life from tropical cyclones.<sup>8</sup> The other reality is that hurricane status isn't a prerequisite for this outcome. In the last 30 years, three of the top four rain-producing events in the US mainland, and eleven of the top eighteen, were "only" tropical storms at landfall. Much of this impact is many miles inland as one edge of the storm sits over water and quickly flushes it toward the storm's inland side. The slower a storm moves, the more water it will flush onto poorly prepared areas that will experience floods for the first time, and in previously flooded areas in ways that have never been experienced before.



Blue markers -- tropical storm landfall  
 Red markers -- hurricane landfall with number indicating category

Of course, if water, and not wind, is the chief taker of lives and destroyer of value (and likely to become worse over time), a combination of the aforementioned precipitation and storm surge in coastal areas will be an even more destructive cocktail. Hurricane Isaac (2012) delivered a 132-inch storm surge in Louisiana when it made landfall as "only" a Category 1 hurricane. Tropical Storm Debby (2012) delivered a 78-inch storm surge in Florida compared to Category 4 Hurricane Harvey's 72 inches. Just as precipitation events will grow in intensity, all other things being equal, surge events are set for the same amplification as sea-level rise creates more than just an increase in occasional nuisance flooding.

Again, while wind resilience has moved the needle to some degree in our tropical storm preparation, water from below and water from above is where the biggest threat resides and where the lesser attention to resilience exists.

<sup>8</sup> <https://journals.ametsoc.org/doi/abs/10.1175/WAF-D-14-00014.1>



This won't just be a southeastern US phenomenon either. Sandy was "only" a Category 1 event at landfall, but the water inundation from the sea in New York and New Jersey was catastrophic. Precipitation from unremarkable tropical storms and longer residual effects from hurricanes that made landfall in faraway places are going to become more common.

In order to be ready in the context of lives and property, knowing where the risks are and where climate change will amplify them will be critical for individuals and communities, insurers and investors, and the policy-delivering and funding entities we trust to enable the right outcome.