

# Hurricane Andrew: The 20 miles that saved Miami







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There will never be another hurricane named Andrew. The last hurricane to be named Andrew was so ferocious that the World Meteorological Organization retired the name after the 1992 hurricane season. Andrew left a path of destruction from the Bahamas to the Gulf Coast of the US, but it is truly infamous for its impact on South Florida. One of only three hurricanes to be at Category 5 intensity upon its landfall in the US, Hurricane Andrew upended homes, businesses and lives in the Miami suburbs. (The 1935 Labor Day hurricane, which impacted the Florida Keys, and Hurricane Camille, which hit Mississippi in 1969, are the two other hurricanes to make landfall at Category 5 intensity.) Andrew changed building codes and hurricane-risk management, and was a stark and devastating reminder of Mother Nature's power for the residents of South Florida.

## Hit hard 25 years ago

Hurricane Andrew's 1992 rampage caused USD 26.5bn in economic damage (1992 USD), destroying more than 25,000 homes and damaging an additional 100,000. Roughly 60% of Andrew's economic damage, or USD 15.5bn, was borne by the insurance industry. Non-insured losses from Andrew included uninsured and underinsured residential properties, as well as damage to government property (including the Homestead Air Force Base), agriculture, beaches and marinas. This protection gap — the difference between economic and insured losses — calls attention to the remarkable weight carried by society when natural catastrophes like Andrew occur.

Despite improvements in catastrophe modeling in the 25 years since Andrew's landfall, and the development of innovative insurance solutions to provide coverage that is more comprehensive to insurance buyers, the protection gap persists, and has unfortunately widened over time. Root causes of the protection gap include poor risk awareness, unaffordability of insurance, regulatory/legal frameworks that impede insurance market development, and limits to insurability. With all that said, is South Florida really ready for another Andrew?

South Florida has transformed quite a bit since it was pummeled by Andrew. Migration to the area has quickened and the population of Miami-Dade County has increased nearly 35% since 1992. According to the most recent Census, the Miami metropolitan area is the eighth-most populous and fourth-largest urban area in the US. Moreover, the development of condominiums and high-rises along the coast seems to be never-ending. The Miami-Fort Lauderdale-West Palm Beach Metropolitan Statistical Area, with a GDP of USD 318bn (2015), accounts for nearly 2% of overall US-economic productivity.

Since Andrew, the region has taken significant measures to address its vulnerability. In December 1992, the Federal Emergency Management Agency (FEMA) released a detailed report on building performance during Andrew and, based on observed performance successes and failures, developed concrete recommendations to mitigate future hurricane damages.<sup>1</sup> FEMA recommendations focused on stronger building materials, construction techniques, building-code compliance, workmanship standards and inspections. As a result, Miami-Dade (together with neighboring Monroe and Broward Counties) now maintains the nation's highest wind standards when it comes to building codes. Moreover, hurricane awareness and preparedness in the area are more widespread than ever.

With these changes in mind, the 25th anniversary of Andrew's landfall serves as an opportunity to better understand present-day hurricane risk. What if Hurricane Andrew hit in 2017? Is South Florida a sitting duck for the next Andrew? And, what would be different this time around? The insurance industry has developed the tools to answer these questions.

<sup>1</sup> [https://www.fema.gov/media-library-data/20130726-1611-20490-1856/fia22\\_complete.pdf](https://www.fema.gov/media-library-data/20130726-1611-20490-1856/fia22_complete.pdf)

# What if Andrew occurred today?

To determine what Andrew would look like in 2017, we ran Andrew's 1992 footprint on our in-house market portfolio for the state of Florida, in Swiss Re's state-of-the-art tropical cyclone model. Swiss Re's tropical cyclone model contains every historical event in the National Oceanic and Atmospheric Administration's HURDAT database between 1891 and 2008, along with 199 probabilistic tropical cyclones for each historical tropical cyclone, resulting in more than 220,000 realizations of Atlantic tropical cyclones. The market portfolio is a representation of all insured property values (residential, commercial and automotive), along with coverage terms. It is worth noting that South Florida is one of the most-developed regions of the US; combined residential values in Miami-Dade, Broward and Palm Beach Counties are around USD 660bn, and commercial values are around USD 550bn.

If Andrew were to barrel through South Florida in 2017, taking an identical track and at the same intensity, the insured losses alone would increase to between USD 50bn and USD 60bn, due to a combination of increased development and asset values. If we assume a similar coverage percentage by the insurance industry, the physical damage would exceed USD 80bn to USD 100bn, before accounting for long-term economic impacts such as lost tax and tourism revenues. Lofty uninsured losses in South Florida would undoubtedly affect its economic growth over several years, hindering its capability to recover. These figures are comparable to or exceed other notoriously costly hurricanes, including Katrina, Sandy, Ike and Wilma.

As hurricane/reinsurance professionals, an even scarier hypothetical lingers in our minds: What if Andrew made landfall about 20 miles north of its historical landfall location in Fender Point, Fla.? This would place Andrew's eye directly over Miami, an area far more populated, developed and commercialized compared to Homestead, yet arguably no less vulnerable or prone to hurricanes. A landfall location 20 miles north is not merely hypothetical; Miami has experienced direct hits from hurricanes in the past.

One benefit of catastrophe models is the ability to model the financial impact of hurricanes that have not necessarily occurred in the historical record, but are physically possible. From our catalog of probabilistic tropical cyclone tracks, we selected six probabilistic tracks that are of comparable intensity and size to Andrew; the only significant difference is that these probabilistic tropical cyclones make landfall further north than Andrew, in the city of Miami. The six probabilistic tracks are shown in the figure below (red lines).

The calculated model losses to the insurance industry are of a magnitude not yet observed; they range from USD 60bn to USD 180bn. Assuming again a 60% insurance-industry coverage rate, the economic damage from these storms would range from USD 100bn to USD 300bn. By way of comparison, if the 1926 Great Miami Hurricane, a Category 4 hurricane that struck Miami and Miami Beach, recurred today under current conditions, it would produce losses right in the middle of the range: USD 122bn in insured losses and an estimated USD 200bn in economic losses.

Both the 1926 Miami Hurricane and Andrew approached South Florida from the east, so we therefore analyzed those historical scenarios and probabilistic storms. But it is important to remember that hurricanes can approach South Florida from almost innumerable directions, and bring along devastating wind, storm surge and rain.

Hurricanes Wilma and Donna approached from the west and south, respectively; the 1935 Labor Day hurricane snuck just beneath Miami, approaching the Keys from the south, and riding up the west coast of Florida.

The numbers above reflect the impact from the storm across all hazards brought to shore by a hurricane, including wind damage and storm-surge flooding. Andrew truly gained infamy for its ferocious winds that shattered windows, blasted off roofs, flattened homes and flipped cars; yet, for a Category 5 storm, Andrew's damage due to storm surge, or the piling up of water on land due to the storm's onshore winds, was relatively *minor*. Though the former Burger King headquarters in central Biscayne Bay logged 16.9' of storm surge, much of South Florida experienced surge of only 4'-6'.<sup>2</sup> In terms of spatial extent, Andrew was a rather small storm. An hour prior to landfall, Andrew's radius of maximum wind was 11 nautical miles. As a result, Andrew's surge affected only a short stretch of the Florida coastline. The National Hurricane Center tropical cyclone report for Andrew reports only USD 96m (1992 USD) in NFIP losses.<sup>3</sup>

However, global sea level is on the rise due to climate change, and this exacerbates the effects of storm surge.<sup>4</sup> The first satellite to precisely measure ocean topography from space (TOPEX/Poseidon) launched 14 days before Andrew's landfall in Florida.<sup>5</sup> TOPEX and successor satellite missions have continuously measured sea level since August 1992, observing a global increase of 3.4 millimeters per year.<sup>6</sup> This translates to 3.34" since Andrew, and the impacts of this are evident; Miami Beach now frequently experiences sunny-day floods during king tides. Though regional trends may differ from global trends, additional water would certainly allow storm surge to penetrate farther inland when the next Andrew hits.

How much of an impact does 3.34" of sea level rise have on the financial impact of storms? In 2009, Swiss Re published the first work in the Economics of Climate Adaptation (ECA) series, and one case study focused on the tri-county area in South Florida.<sup>7</sup> The moderate sea-level rise scenario for the 2030s in the ECA study is the same amount of sea level rise that has occurred between 1992 and present day. By the 2030s, the annual expected loss from hurricane-related storm surge is expected to nearly double, from USD 6bn to USD 11bn. Although 3" may sound insignificant, the ECA analysis demonstrates that even a slight change in sea level can have large financial implications.

It is also critical to recognize that major surge losses are possible without both a Category 5 hurricane and sea level rise. Hurricane Ike (2008) decimated the Bolivar Peninsula when it came onshore as a strong Category 2 hurricane. Hurricane Isaac (2012), a Category 1 hurricane at landfall, produced a storm tide of 17' in Plaquemines Parish, La., and Hurricane Sandy (2012) produced a storm tide of 13' at the Battery in New York City.<sup>8</sup> Minor hurricanes and tropical storms are more than capable of producing major coastal inundation.

Resiliency efforts to address this ever-increasing flood risk remains paramount, and an ongoing area of focus. Similar to pre-Katrina New Orleans, Miami depends on man-made structures to control the flow and displacement of large amounts of water. The failure of these structures could quickly double or triple the estimated loss figures. Fortunately, Miami recently embarked on an experiment to expand its flood protection program.<sup>9</sup> As much as USD 400m will go toward sea pumps, improved road infrastructure, and seawalls.

<sup>2</sup> <http://www.nhc.noaa.gov/1992andrew.html>

<sup>3</sup> <http://www.nhc.noaa.gov/1992andrew.html>

<sup>4</sup> <https://sealevel.nasa.gov/>

<sup>5</sup> <https://sealevel.jpl.nasa.gov/missions/topex/>

<sup>6</sup> <https://sealevel.nasa.gov/understanding-sea-level/key-indicators/global-mean-sea-level>

<sup>7</sup> [http://media.swissre.com/documents/rethinking\\_shaping\\_climate\\_resilient\\_development\\_en.pdf](http://media.swissre.com/documents/rethinking_shaping_climate_resilient_development_en.pdf)

<sup>8</sup> [http://www.nhc.noaa.gov/data/tcr/AL092012\\_Isaac.pdf](http://www.nhc.noaa.gov/data/tcr/AL092012_Isaac.pdf)

<sup>9</sup> <http://miamibeachfl.gov/publicworks/scroll.aspx?id=27280>

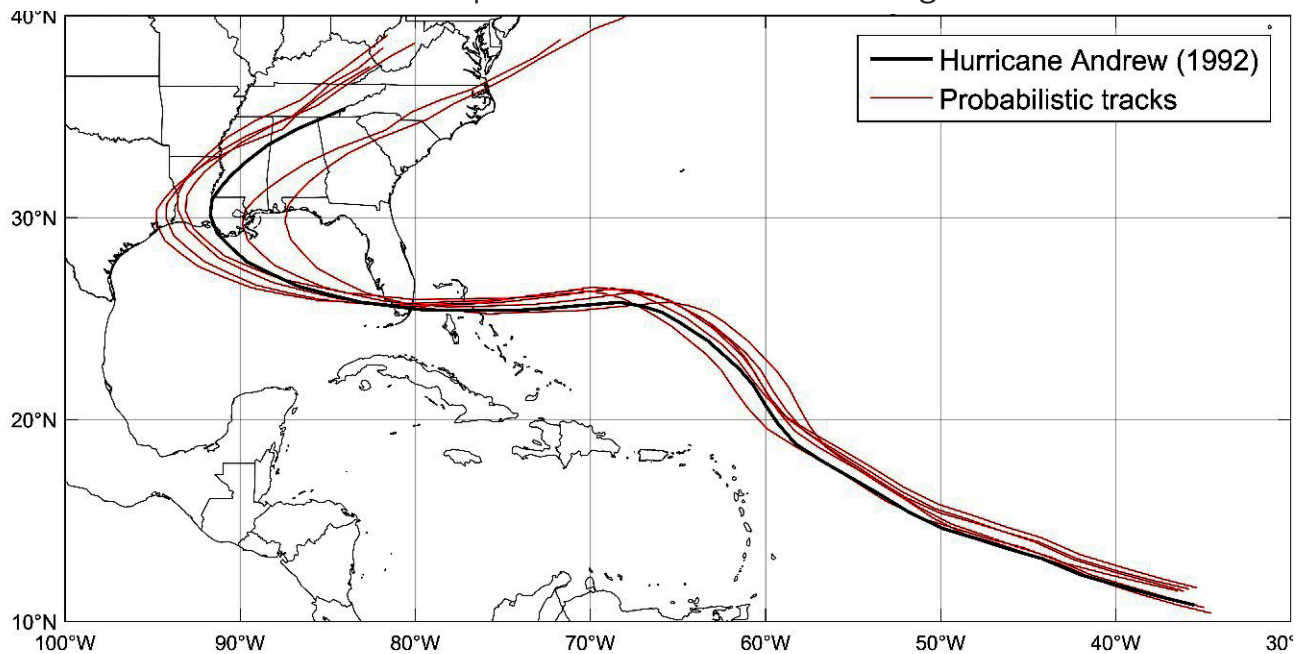
Miami-Dade County is also a member of The Rockefeller Foundation's 100 Resilient Cities network; 100RC provides access to partners in academia, public, private and non-profit sectors that offer service and tools in disaster-risk finance, infrastructure development, land-use management, and environmental justice.

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In addition to physical resilience, financial resilience is key to post-hurricane recovery. Through a variety of financial instruments, homeowners, small-business owners, corporates, and governments can prepare themselves for the worst-case scenario. Homeowners and small businesses can purchase traditional insurance policies to protect their property, and now, parametric or index-based plans to cover additional incurred expenses. StormPeace is a recent entry in the parametric homeowners' insurance space, offering policies that utilize hurricane intensity and mobile technology to determine and alert consumers about claims payments. These claims payments can be put towards a variety of costs, such as hotel stays post-event and lawn-debris cleanup. Corporates and primary-insurance carriers can utilize a combination of instruments, such as multi-year policies, parametric insurance and catastrophe bonds, to optimize their insurance programs and maximize their value. Even governments, who bear much of the uninsured costs of natural disasters, are becoming insurance buyers, leveraging multi-year coverages to stabilize their annual insurance premium budgets, and parametric products to recover intangible costs such as emergency services and debris removal. For example, New York City's Metropolitan Transit Agency (MTA), the agency responsible for subways, commuter rails and other transportation infrastructure, recently sponsored a catastrophe bond for protection against storm surge and earthquake. The triggers are based on reported water levels at various tidal gauges for storm surge, and ground shaking at various locations for an earthquake.

The last decade or so in Florida has been eerily quiet on the hurricane front; the dearth in major hurricane activity is unprecedented in modern times. However, this should not lead to the misperception that the risk posed by hurricanes to South Florida, or the state as a whole, has diminished or dissipated in any way. The results of our analysis suggest quite the opposite: it is more important than ever to better understand hurricane risk, to learn about new solutions to close gaps in your coverage, and to consider if your current insurance instruments are sufficient to cover financial needs in the event of a significant loss, like an Andrew.

## Hurricane Andrew and probabilistic tracks making landfall over Miami



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