Hurricane Assessment

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Hurricane Ian

Executive Summary

Hurricane Ian made a series of landfalls across Cuba and the United States and will be regarded as one of the costliest tropical cyclones ever recorded. The Category 4 storm, which struck the southwest coast of Florida near peak intensity with 150 mph (240 kph) winds, left widespread and catastrophic damage near the landfall point in the greater Fort Myers / Naples / Port Charlotte region. Ian would later weaken and re-emerge in the Atlantic Ocean before making a final landfall in South Carolina as a Category 1 hurricane with 85 mph (135 kph) winds.

In the days following Ian's landfall in Florida, a team of Gallagher scientists and engineers traveled to the state during the first week of October 2022 to assess damage. The survey was conducted to:

- Better understand how the storm's hazard behaved
- Derive where the worst impacts in Florida were observed
- How properties fared from a structural engineering perspective
- Compare catastrophe model vendor wind output versus on-the-ground observed damage
- Study damage characteristics to identify the sub-peril (wind, storm surge, inland flood) driving loss costs

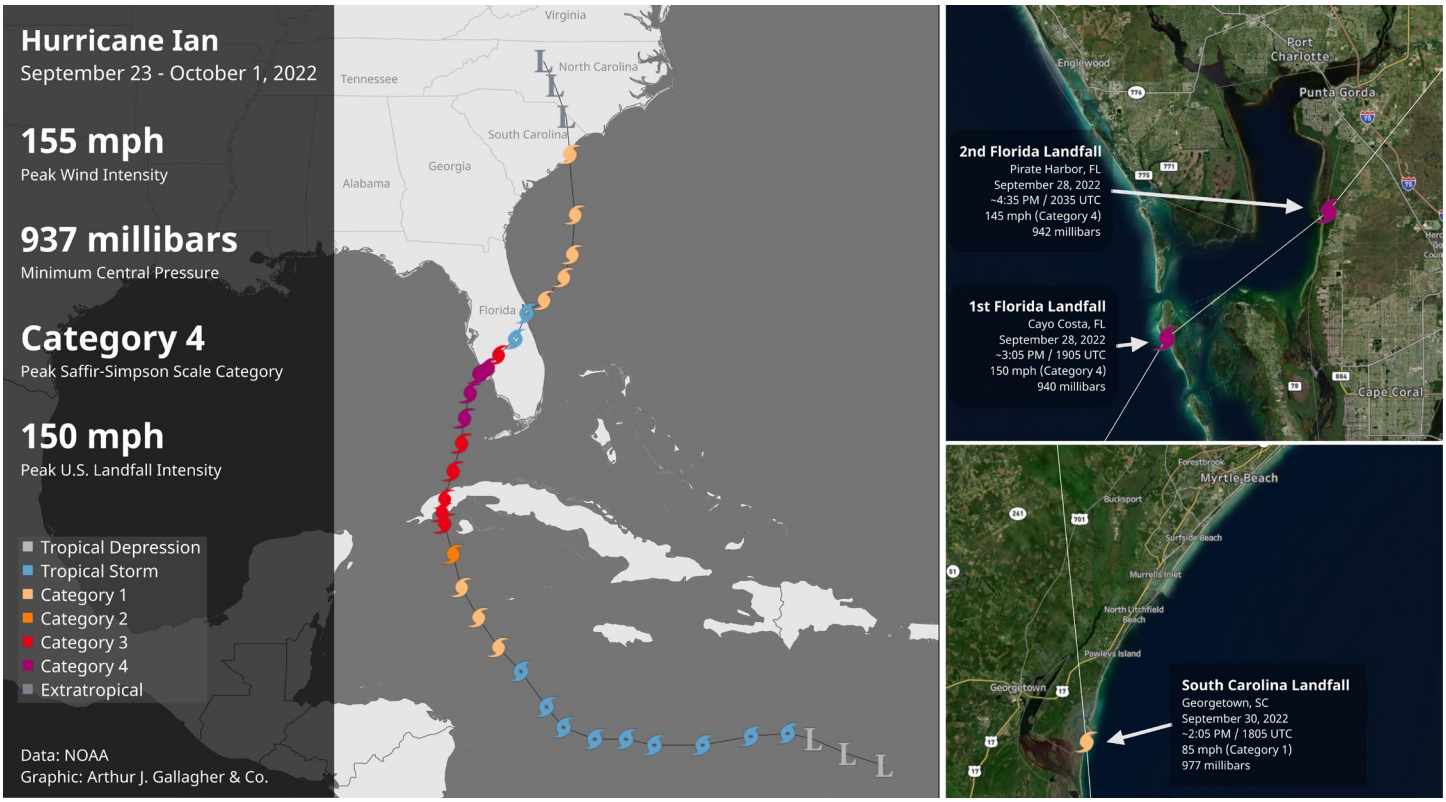
Ian struck the state of Florida during a very precarious time for the state's insurance market. Recent rating agency reviews of numerous insurance carriers' ability to ably maintain viable business operations in Florida had already put a strain on the overall market. A significant level of financial pressure has been ongoing since a series of heavy losses and subsequent claims litigation began affecting the state in 2017. This has resulted in a rapid rise in the number of active policies in Florida's state-run Citizens Insurance program; considered as the carrier of "last resort" for residential and commercial entities.

Preliminary estimates from various public reporting and available data indicates that Ian will rank as one of the costliest U.S. natural catastrophe events on record regardless of peril. It is anticipated to be one of the costliest disasters ever endured by the insurance industry.

Takeaways from the Report & Florida Damage Survey

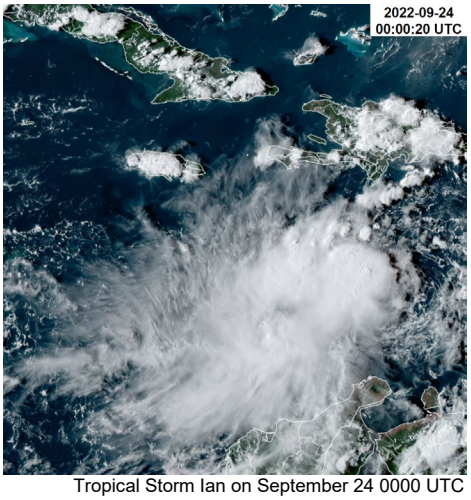
- Ian: Tied for fifth (5) strongest U.S. mainland hurricane landfall on record with 150 mph (240 kph) winds
- Wind damage in Southwest Florida was extensive though newer construction showed limited impacts
- Newer metal and tile roofs, despite a higher purchase cost than asphalt shingles, were prevalent in SW FL
- Expansive storm surge damage (>15 feet) caused considerable impacts on the coast; tracked 0.4 miles inland
- Heavy losses to coastal commercial exposure, automobiles, boats, and other marine interests
- Inland flooding left considerable damage from DeSoto to Lake Counties in Florida
- Ian to be one of the costliest U.S. catastrophe events on record; industry losses likely less than peak model range

Meteorological Overview



The National Hurricane Center (NHC) first began following the potential for a developing tropical cyclone in the Atlantic Ocean on September 19 during its afternoon Tropical Weather Outlook. The agency cited that the tropical wave was *"producing an area of disorganized showers and thunderstorms… gradual development of this system is possible"* and gave a 20% chance of development in the next 5 days as it approached the Windward Islands. The Numerical Weather Prediction (NWP) model guidance further began to indicate that quick intensification to a named storm, and perhaps hurricane, was likely.

By the morning of September 20, the NHC quickly upgraded the development probability to 70% and further upwardly revised to 90% by the evening hours as organized thunderstorm activity was occurring. The system continued to track westward through the Windward and Leeward Islands before reaching the central Caribbean Sea on September 23. Sufficient organization was established and the NHC declared Tropical Depression Nine at 6:00 UTC. *Note that the UTC times in this document come via NOAA's Preliminary Best Track Dataset.*

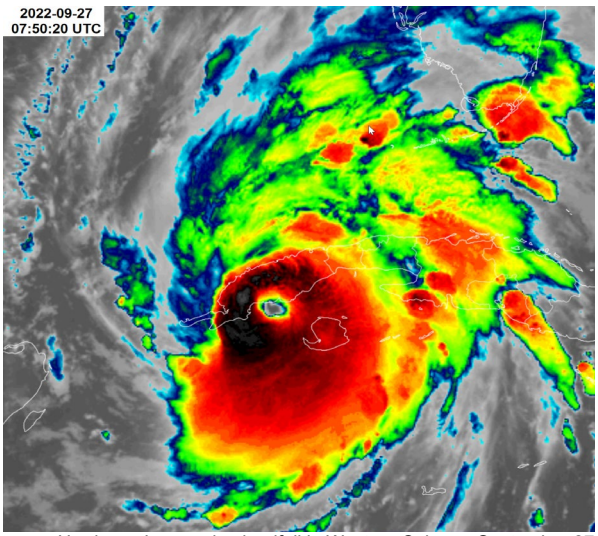


Tropical Storm Ian on September 24 0000 UTC
Source: Colorado State Uni. RAMMB / NOAA / NASA

Despite moderate wind shear and some dry air entering the main core of the cyclone, it became Tropical Storm Ian by 0:00 UTC September 24 (8:00 PM Eastern Time September 23). Ian marked the ninth named storm of the 2022 Atlantic Hurricane Season. The NHC cited that conditions were likely to become more favorable for development with Ian to reach hurricane status and take a northward turn towards Cuba and eventually the United States. This marked the beginning of several days of computer model forecast uncertainty.

Slow and steady strengthening continued on September 24 and September 25 (UTC) as atmospheric conditions slowly became more favorable for Ian to organize. Steering currents began to change as Ian started to be influenced by a weakening ridge of high pressure in the Atlantic and more by an approaching / developing frontal boundary in the United States. This marked Ian's northwest and eventual northern trajectory towards landfall in Cuba.

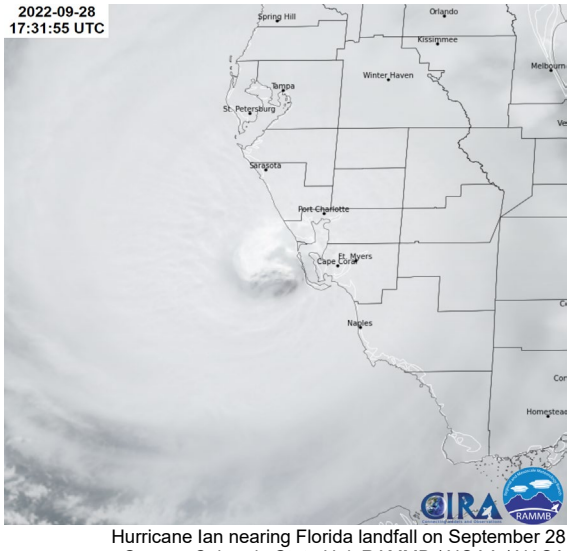
With Ian less than 24 hours away from landfall in Cuba, wind shear (which is a prohibitive factor on tropical cyclone development since it disallows thunderstorm clouds to grow vertically in the atmosphere) began to further decline as the center of circulation traversed very warm ocean waters in the eastern Caribbean Sea. Ian officially became the season's fourth hurricane on September 26 at 6:00 UTC (2:00 AM Eastern Time) with 75 mph (120 kph) winds. More rapid intensification began to occur on September 26 and 27 prior to striking western Cuba's Pinar del Rio province. Ian's first landfall officially happened near the town of La Coloma as a 125 mph (205 kph) Category 3 major hurricane at approximately 8:30 UTC September 27 (4:30 AM Eastern Time).



Hurricane Ian nearing landfall in Western Cuba on September 27
Source: Colorado State Uni. RAMMB / NOAA / NASA

Despite making landfall in Cuba, Ian did not lose much of its intensity while crossing the island. The center of circulation remained intact, and Ian would soon undergo an eyewall replacement cycle (ERC) during the day on September 27. An ERC is a standard occurrence for strong hurricanes as the center is replaced by a new one. This process aids in the expansion of the wind field as the radius of maximum winds grows away from the old center prior to the full development of the new one.

Once the ERC was complete, Ian once again started to intensify as it started to track north-northeastward. This was a notable and earlier shift towards the east than many of the NWP model guidance had suggested. The NHC forecast had originally showed the "cone of uncertainty" including an area from Fort Myers to the Florida Panhandle. The center of the forecast cone was generally near the Tampa Bay metropolitan region. However, the previously mentioned frontal boundary in the United States strengthened and dug further south towards the U.S. Southeast than most of the model guidance had originally projected. This resulted in the Fort Myers / Port Charlotte / Punta Gorda region of Florida becoming the likely landfall region.



Hurricane Ian nearing Florida landfall on September 28
Source: Colorado State Uni. RAMMB / NOAA / NASA

On September 27 and 28, Ian continued to track over very warm waters of the Gulf of Mexico while nearing Florida. During this time, the system reached major hurricane intensity and would eventually hit a peak estimated 1-minute sustained wind speed of 155 mph (250 kph) during the morning hours of September 28. This made Ian a powerful Category 4 hurricane on the Saffir-Simpson Hurricane Wind Scale, and just shy of the 157 mph (253 kph) threshold to reach Category 5 status.

With the center of Ian beginning to come ashore and incurring initial frictional effects of land during the morning and afternoon hours on September 28, this led to a very slight decline in the maximum winds prior to making its first U.S. landfall in Florida. Ian officially made its first landfall near Cayo Costa, Florida at approximately 19:35 UTC (3:05 PM Eastern Time) on September 28 with 150 mph (240 kph) winds. The center later made a second landfall on the Florida mainland at 20:35 UTC (4:35 PM Eastern Time) with 145 mph (230 kph) winds.

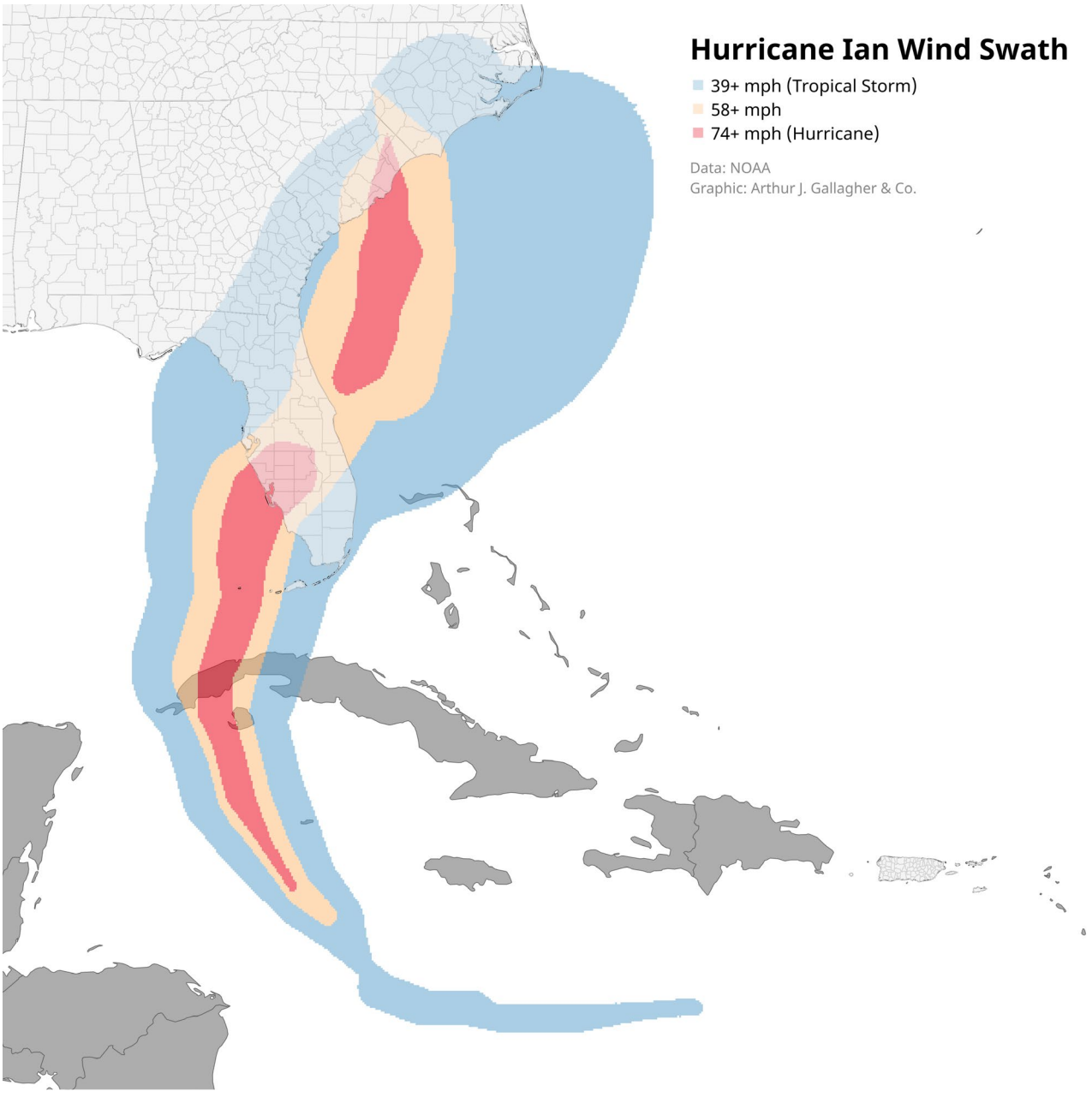
Steady weakening would commence as the storm slowly tracked northeastward across the Central Florida peninsula. Ian was downgraded to a high-end tropical storm during the morning hours of September 29 before re-emerging into the Atlantic Ocean. The steering currents began to change on September 29 and September 30 as the main trough in the eastern U.S. "split" and a new trough emerged. This caused Ian to turn northward and eventually north-northwest as it approached its final U.S. landfall in South Carolina. As the center of Ian crossed the warm waters of the Gulf Stream, it regained enough convection to become a Category 1 hurricane. Ian officially came ashore at 18:05 UTC (2:05 PM Eastern Time) near Georgetown, South Carolina as an 85 mph (140 kph) Category 1 hurricane.

Following landfall in South Carolina, rapid dissipation began over land. The storm began interacting with the noted trough and a developing surface frontal boundary. This interaction led to an absorption of Ian and a loss of its tropical characteristics. Despite dissipating, Ian's remnants combined with the front to bring heavy inland rainfall across a broad section of the Southeast and Southern Appalachia. The remnants fully dissipated by October 2.

Recap of Hurricane Ian Landfalls

Date	Landfall Location	Country	Wind Speed	Category	Sea Level Pressure
Sep. 27	La Coloma (Pinar del Rio)	Cuba	125 mph	Category 3	952 millibars
Sep. 28	Cayo Costa (FL)	United States	150 mph	Category 4	940 millibars
Sep. 28	Pirate Harbor (FL)	United States	145 mph	Category 4	942 millibars
Sep. 30	Georgetown (SC)	United States	85 mph	Category 1	977 millibars

Hurricane Ian Wind Swath



Storm Data

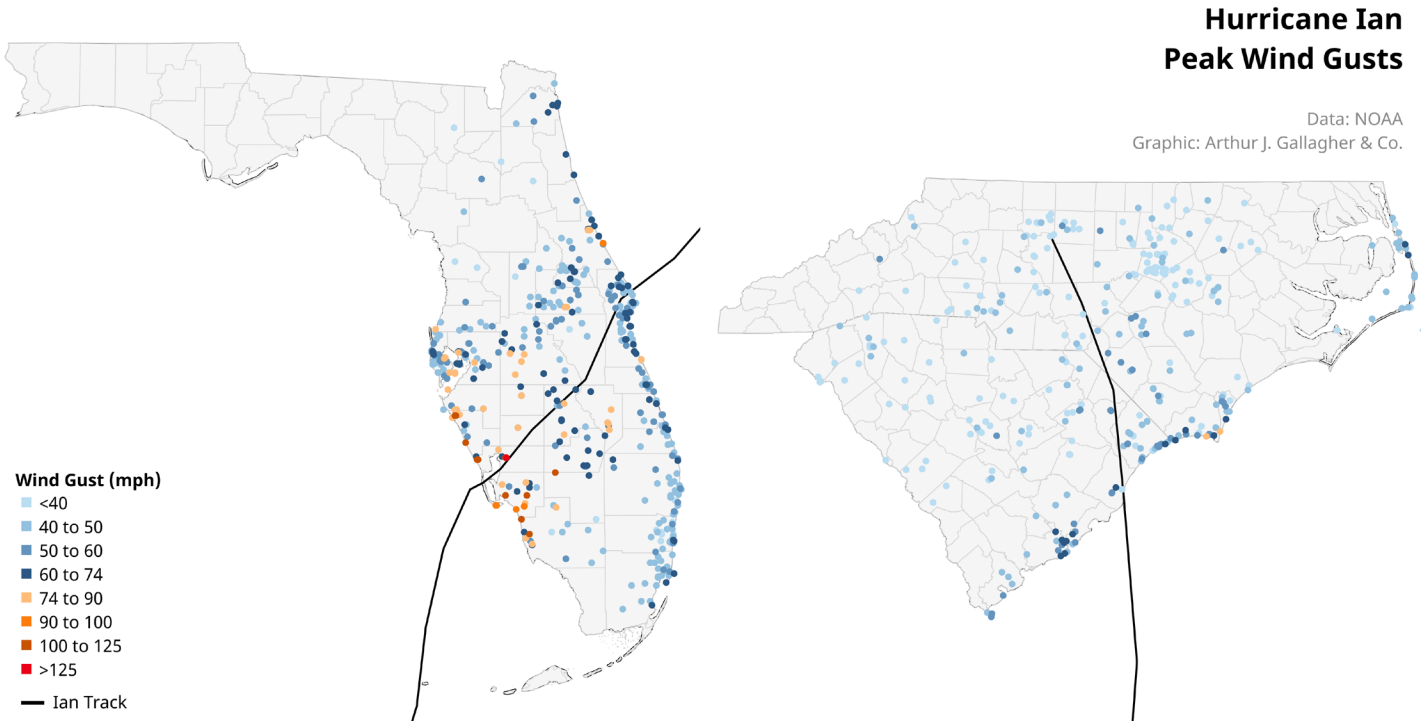
Winds

Hurricane Ian brought a broad swath of hurricane-force wind gusts across Florida and South Carolina; the two U.S. states which Ian made landfall(s). The tables below highlight observed peak wind gusts as reported by NOAA.

Location	State	Wind Gust
Punta Gorda	Florida	135 mph
Solana	Florida	135 mph
Pelican Bay	Florida	112 mph
La Belle	Florida	110 mph
Grove City	Florida	110 mph
Tarpon Point	Florida	109 mph
Naples	Florida	105 mph
Venice	Florida	104 mph
Fort Myers	Florida	100 mph
Bonita Shores	Florida	99 mph
New Smyrna Beach	Florida	96 mph
Estero	Florida	95 mph
Sarasota / Bradenton	Florida	86 mph
Daytona Beach	Florida	81 mph
Lakeland	Florida	78 mph
Tampa	Florida	75 mph

Location	State	Wind Gust
Shutes Folly	South Carolina	92 mph
Fort Sumter	South Carolina	85 mph
Oak Island	North Carolina	78 mph
Folly Beach	South Carolina	73 mph
Charleston	South Carolina	68 mph
Knotts Island	North Carolina	61 mph
North Myrtle Beach	South Carolina	58 mph
North Tybee Island	Georgia	57 mph
Fayetteville	North Carolina	56 mph
Georgetown	South Carolina	55 mph
Hilton Head	South Carolina	52 mph
Greensboro	North Carolina	51 mph
Florence	South Carolina	51 mph
Fort Macon	North Carolina	50 mph
Wilmington	North Carolina	49 mph
Cape Lookout	North Carolina	48 mph

The graphic below highlights the track of Hurricane Ian in Florida (left) and the Carolinas (right) with observed wind gusts in each of the three states. The highest gusts were found in Florida where Ian was at its strongest after landfall.



One important caveat to note during post event analysis is that the sustained wind speeds listed by the NHC in their forecast updates represent the "over the water" estimate. As soon as a storm begins interacting with land, the frictional effects typically reduce wind speeds by 10-20% almost instantaneously.

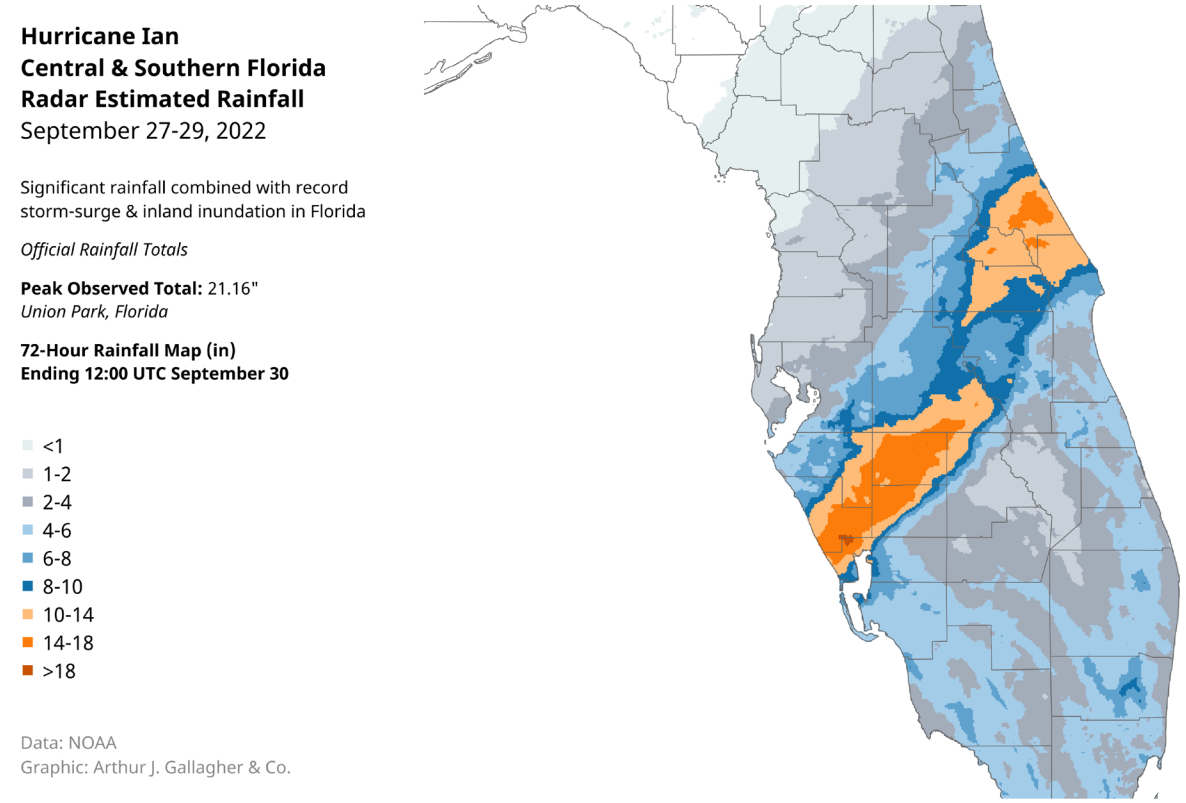
Rainfall

The heaviest rains from Ian were found in Florida as the hurricane slowed its forward motion while crossing the peninsula. Ample atmospheric moisture fueled flooding rains that caused several rivers to overflow in Central Florida before the storm tracked into North Carolina, South Carolina, and southern Appalachia. Ian and its remnants led to riverine and flash flooding in some locations.

Location	State	Rainfall Total (in)
Union Park	Florida	21.16
Spruce Creek	Florida	21.09
Ponce Inlet	Florida	20.95
North Port	Florida	19.40
Edgewater	Florida	19.02
Campbell	Florida	18.04
Nokomis	Florida	17.95
Lake Wales	Florida	16.99
Ormond Beach	Florida	16.59
Sanford	Florida	16.10
Oviedo	Florida	15.82
New Smyrna Beach	Florida	15.42
Titusville	Florida	15.03
North Fort Myers Beach	Florida	12.95
Clearwater Beach	Florida	10.69
Plantation	Florida	10.33

Location	State	Rainfall Total (in)
Charleston	South Carolina	10.75
Williston	North Carolina	8.10
Columbia	North Carolina	7.21
Hemingway	South Carolina	5.95
Charleston	South Carolina	5.63
Bath	North Carolina	5.54
Chesapeake	Virginia	5.42
Edenton	North Carolina	5.35
Virginia Beach	Virginia	5.25
Beaufort	North Carolina	5.06
South Mills	North Carolina	5.05
Murells Inlet	South Carolina	4.96
Myrtle Beach	South Carolina	4.86
Elizabethtown	North Carolina	4.75
Summerville	South Carolina	4.74
Charleston	South Carolina	10.75

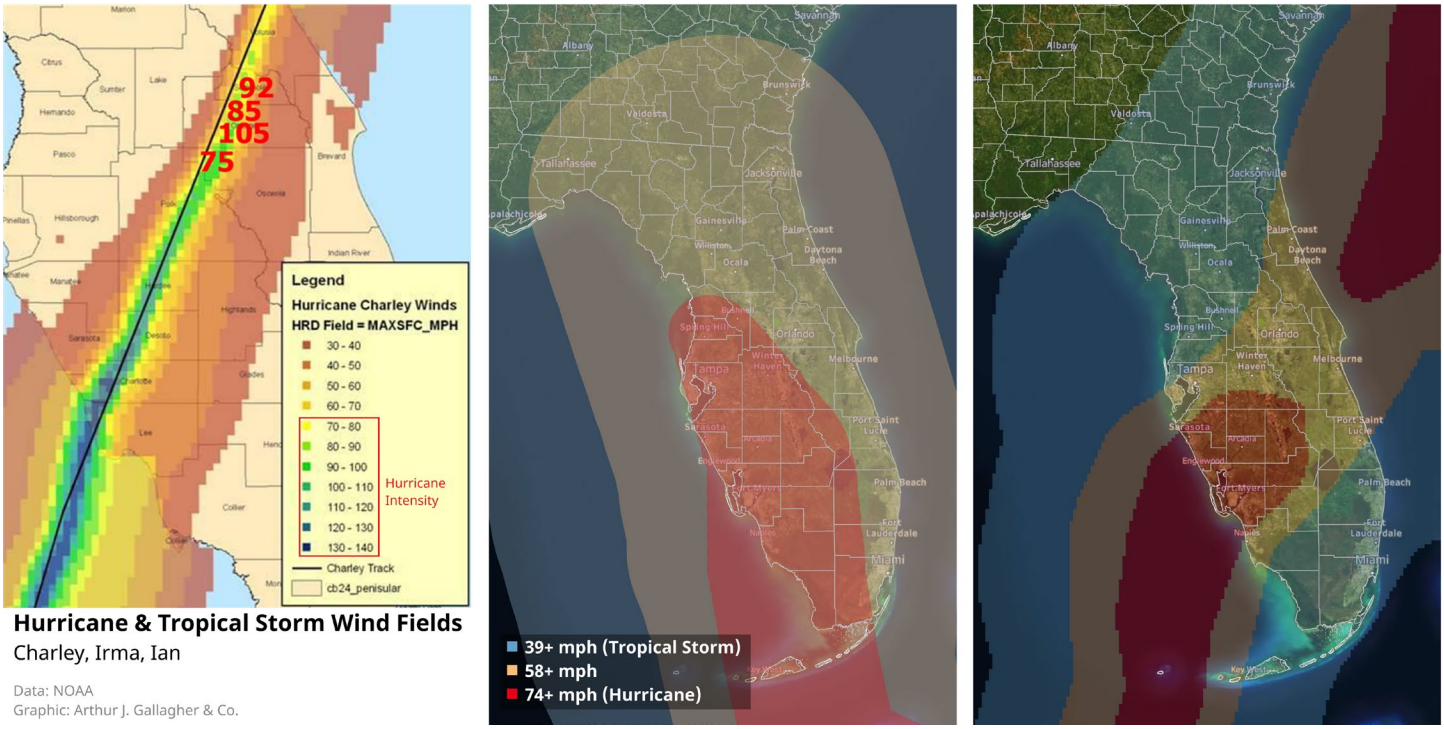
Among the heaviest rainfall initially fell in Central Florida as Ian slowly tracked across the state. The graphic below shows 72-hour rainfall totals from September 27-29, 2022.



Historical Context

The graphic below highlights wind field comparisons between Charley (2004), Irma (2017), and Ian (2022). The hurricane wind force band for Charley and Ian are substantially different, as the 25-mile (40-kilometer) hurricane wind radii for Charley would have fit entirely within the size of Ian's eye at landfall. Ian made landfall with hurricane-force winds extending 75 miles (120 kilometers) from the center of circulation.

Charley (2004) | **Irma (2017)** | **Ian (2022)**



Hurricane & Tropical Storm Wind Fields
Charley, Irma, Ian

Data: NOAA
Graphic: Arthur J. Gallagher & Co.

Ian Statistics

U.S. Mainland Hurricane Landfall Rankings

150 mph: Tied for the 5th strongest U.S. mainland hurricane landfall on record
940 millibars: Tied for 18th lowest Minimum Sea Level Pressure (MSLP) on record

Twelve (12) storms with 150+ mph winds have struck the U.S. mainland since 1851; four (4) since 2018

Six (6) Category 4 or Category 5 landfalls since 2017
Six (6) total Category 4 or Category 5 landfalls from 1969-2016

Per NOAA: Of the Top 10 costliest U.S. mainland landfalls, 5 have occurred since 2017 (Inflation-adjusted)
Ian poised to become one of the Top 3 or Top 5 costliest U.S. mainland hurricanes on record (Inflation-adjusted)

Florida Hurricane Landfall Rankings

150 mph: Tied for the 4th strongest Florida hurricane landfall on record

Fifteen (15) Category 4 or Category 5 hurricanes have struck Florida; three (3) since 2017 (Irma, Michael, Ian)

Six (6) hurricanes on record since 1851 to strike Florida with 150+ mph winds; three (3) since 2004 (Charley, Michael, Ian)

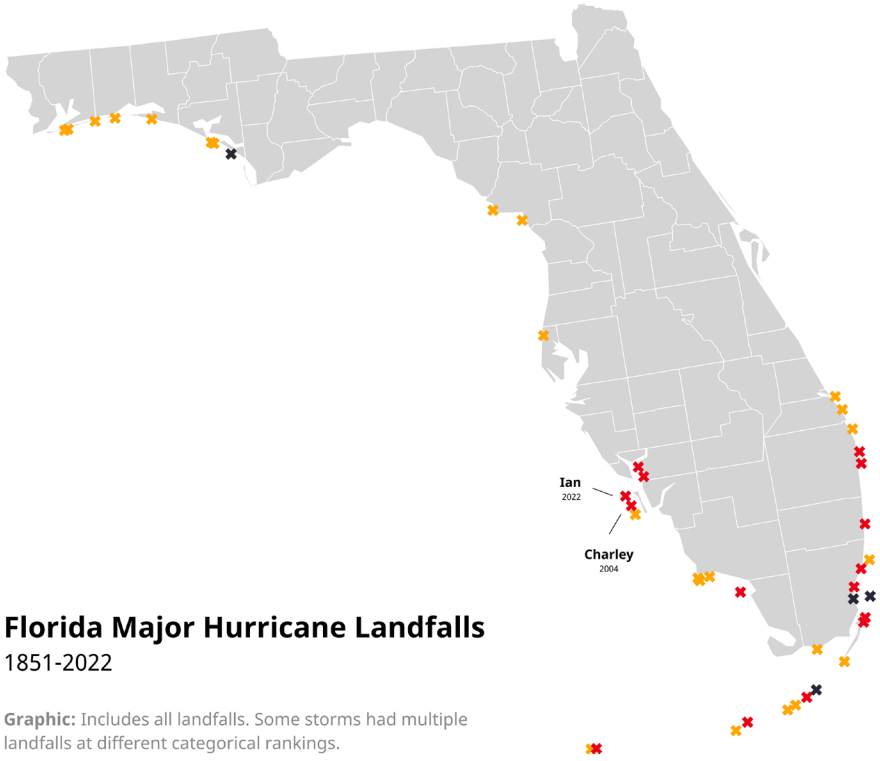
The tables below highlight U.S. mainland hurricane landfall records in NOAA's official HURDAT2 database. The table on the top shows peak estimated wind speeds and the bottom shows minimum sea level pressure (MSLP) at landfall.

Full Date Year	Storm Name	Landfall State	Category	Max Winds
September 3, 1935	Labor Day	Florida	Category 5	185
August 18, 1969	Camille	Mississippi	Category 5	175
August 24, 1992	Andrew	Florida	Category 5	165
October 10, 2018	Michael	Florida	Category 5	160
August 20, 1886	Indianola	Texas	Category 4	150
August 10, 1856	Last Island	Louisiana	Category 4	150
September 28, 2022	**Ian**	**Florida**	**Category 4**	**150**
August 29, 2021	Ida	Louisiana	Category 4	150
August 27, 2020	Laura	Louisiana	Category 4	150
August 13, 2004	Charley	Florida	Category 4	150
August 14, 1932	Freeport	Texas	Category 4	150
September 10, 1919	Florida Keys	Florida	Category 4	150
September 11, 1961	Carla	Texas	Category 4	145
September 10, 1960	Donna	Florida	Category 4	145
September 17, 1928	Lake Okeechobee	Florida	Category 4	145
September 18, 1926	Great Miami	Florida	Category 4	145

Full Date Year	Storm Name	Landfall State	Minimum Sea Level Pressure
September 3, 1935	Labor Day	Florida	892
August 18, 1969	Camille	Mississippi	900
October 10, 2018	Michael	Florida	919
August 29, 2005	Katrina	Louisiana	920
August 24, 1992	Andrew	Florida	922
August 20, 1886	Indianola	Texas	925
September 10, 1919	Florida Keys	Florida	927
September 17, 1928	Lake Okeechobee	Florida	929
September 10, 1960	Donna	Florida	930
September 18, 1926	Great Miami	Florida	930
August 29, 2021	Ida	Louisiana	931
September 10, 2017	Irma	Florida	931
September 11, 1961	Carla	Texas	931
August 18, 1916	Texas (Storm 6)	Texas	932
September 22, 1989	Hugo	South Carolina	934
August 10, 1856	Last Island	Louisiana	934
August 14, 1932	Freeport	Texas	935
September 9, 1900	Galveston (1900)	Texas	936
August 26, 2017	Harvey	Texas	937
September 24, 2005	Rita	Louisiana	937
October 15, 1954	Hazel	South Carolina	938
October 2, 1898	Georgia (Storm 7)	Georgia	938
August 27, 2020	Laura	Louisiana	939
September 28, 2022	**Ian**	**Florida**	**940**
September 22, 1948	Florida (Storm 8)	Florida	940
September 5, 1933	Cuba / Brownsville (TX)	Texas	940
August 17, 1915	Galveston (1915)	Texas	940

The graphic below highlights all of Florida's major hurricane landfalls (Category 3+) dating to 1851. Some storms, such as Ian (2022), Irma (2017), and Charley (2004) had multiple such Florida landfalls and that is shown in the table and graphic. Ian became the 37th major hurricane to strike the state of Florida in the official record and the 15th with Category 4 or Category 5 intensity.

Year	Full Name	Storm Name	Cat 3	Cat 4	Cat 5
1851	AL041851	Unnamed	115		
1871	AL031871	Unnamed	115		
1873	AL051873	Unnamed	115		
1877	AL041877	Unnamed	115		
1882	AL021882	Unnamed	125		
1888	AL031888	Unnamed	125		
1894	AL051894	Unnamed	120		
1896	AL041896	Unnamed	125		
1906	AL081906	Unnamed	120		
1909	AL111909	Unnamed	115		
1917	AL041917	Unnamed	115		
1919	AL021919	Unnamed		150	
1921	AL061921	Unnamed	115		
1926	AL071926	Unnamed		145	
1928	AL041928	Unnamed		145	
1929	AL021929	Unnamed	115		
1933	AL111933	Unnamed	125		
1935	AL031935	Unnamed			185
1944	AL131944	Unnamed	120		
1945	AL091945	Unnamed		130	
1947	AL041947	Unnamed		130	
1948	AL081948	Unnamed	120	130	
1949	AL021949	Unnamed		130	
1950	AL051950	Easy	120		
	AL111950	King		130	
1960	AL051960	Donna	120	145	
1965	AL031965	Betsy	115		
1975	AL131975	Eloise	125		
1992	AL041992	Andrew			165
1995	AL171995	Opal	115		
2004	AL032004	Charley		145 150	
	AL112004	Jeanne	120		
2005	AL042005	Dennis	120		
	AL252005	Wilma	120		
2017	AL112017	Irma	115	130	
2018	AL142018	Michael			160
2022	AL092022	Ian		145 150	



Florida Major Hurricane Landfalls
1851-2022

Graphic: Includes all landfalls. Some storms had multiple landfalls at different categorical rankings.

Table: Wind speeds in miles per hour.

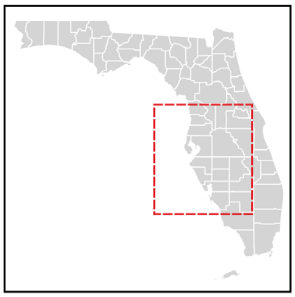
Data: NOAA (HURDAT2)
Graphic: Arthur J. Gallagher & Co.

Florida endured a length period (2006-2016) without a Category 3+ landfall. This was one of the longest "droughts" in the official record keeping. Perhaps the most active such stretch in the state's history came in a period from 1944 to 1950, when seven (7) such storms struck parts of South Florida, including five (5) at Category 4 strength. A similar occurrence today would bring substantial challenges to Florida residents and the regional re/insurance market(s) given explosive growth in population and cost of living.

Damage Survey Map: Florida

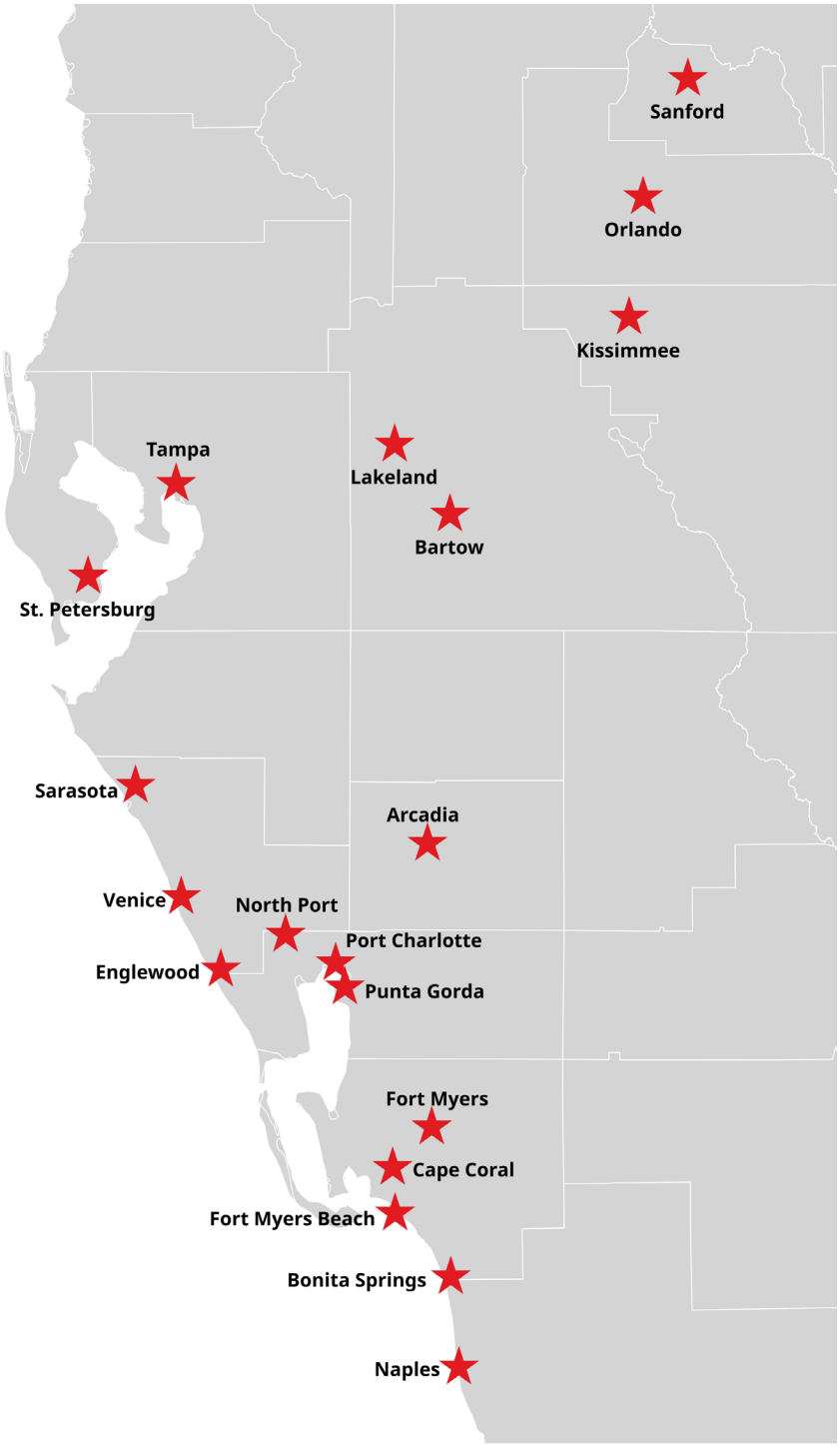
The Gallagher Re damage survey was conducted from October 4-7, 2022. Four colleagues traveled to various regions around central and southern sections of Florida to gauge a clearer understanding of how Hurricane Ian's hazard performed at various points along its life cycle from landfall near Port Charlotte through its inland track including near Orlando. This allowed varying perspectives of storm impacts such as coastal storm surge, wind damage, and inland flooding.

All photos sourced to Arthur J. Gallagher & Co. / Steve Bowen / Prasad Gunturi.



Gallagher Re
Damage Survey Locations
October 4-7, 2022

Survey Team
Steve Bowen
Adam Miron
Prasad Gunturi
Josh Freitag



Damage Survey: Wind

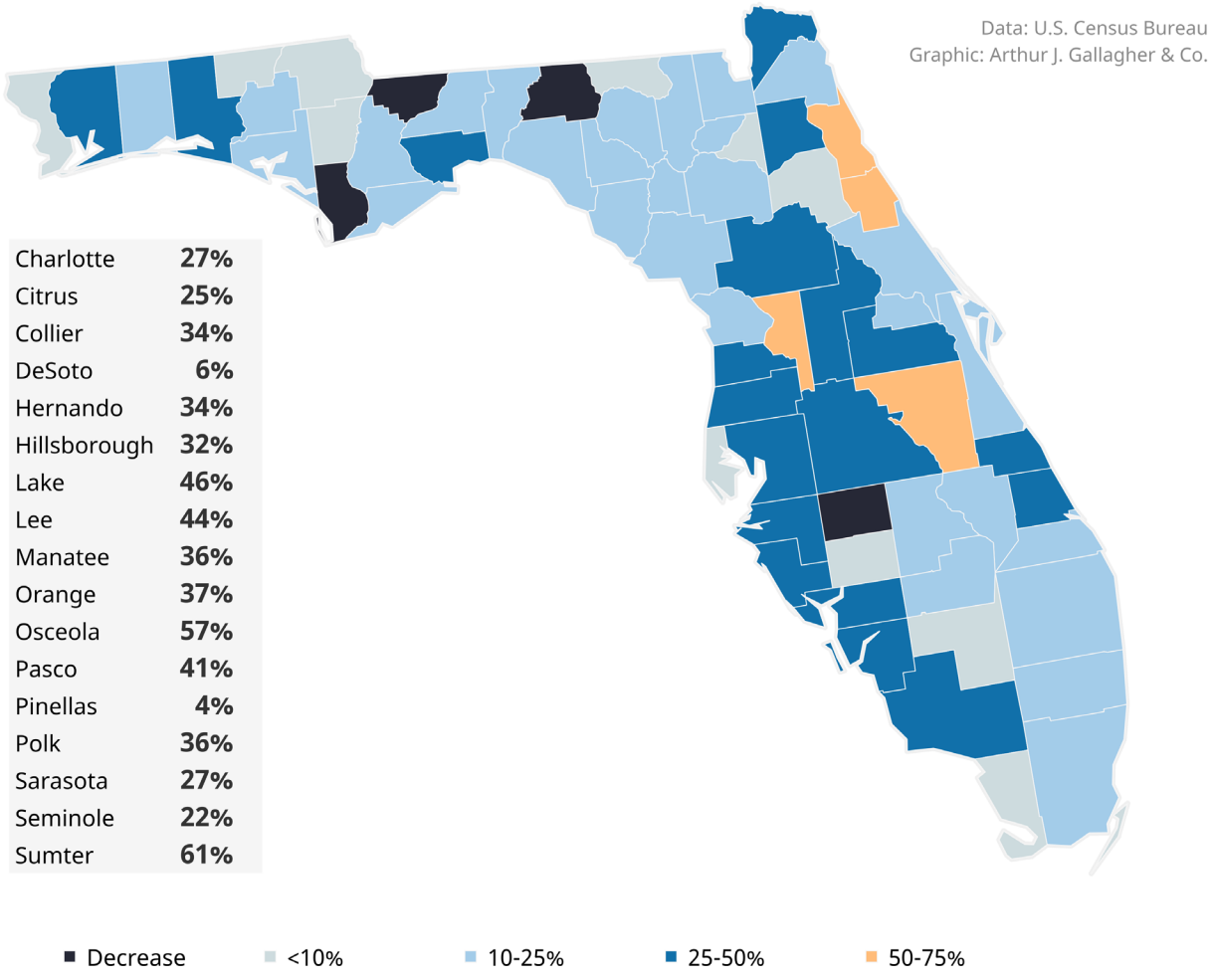
The most prolific wind-related damage from Hurricane Ian, unsurprisingly, was found in areas where the highest winds were recorded. A peak measured gust of 135 mph (215 kph) was noted at Punta Gorda's airport, with other gusts regularly topping hurricane-force of ~75 mph (120 kph) in many coastal or just-inland areas from south of Venice to near Naples. The Gallagher Re survey found ample evidence of hurricane force wind-related damage to homes, businesses, and trees / forestry.

From a performance perspective, perhaps the biggest takeaway was the success of a significant portion of the newer building stock. Many of these areas – including Port Charlotte and Punta Gorda – were heavily damaged during Hurricane Charley in 2004. The aftermath of Charley resulted in a major revision and increased stringent requirements for new construction of structures throughout Florida. The widespread impacts of Hurricane Irma in 2017 additionally resulted in a high volume of new roof installations on older stock properties. This likely aided in the success of many properties during Ian and helped reduce the probability of worst-case wind damage impacts.

It is well known that the population and subsequent housing unit stock on the Florida Peninsula has seen substantial growth in the 21st Century. Several counties, such as Lee, Charlotte, and Collier, have seen 25 to 50% of its current population move into these counties in the past 22 years alone. This means that a notable percentage of properties have been built to the newer and better code standards. The graphic below highlight percent representation of population in Florida since 2000.

Florida Population

Percentage of Population Since 2000



Among the best-performing building stock included those with metal roofs and reinforced concrete framing. This was seen across many communities in Charlotte, Lee, and Collier counties. The main examples of metal roof failure, which were typically limited, were the result of a soffit failure and increased winds / pressure that pushed the metal panels upward or outward. Examples of this were observed in single-family homes, condominium complexes, and commercial buildings. Clay tile roofs generally did well, though older constructed roofs did show signs of failure where Ian's wind gusts topped 100 mph (160 kph).

Newer installed traditional asphalt shingles were largely successful in withstanding Ian's peak wind gusts in the greater Fort Myers and Naples regions. There were no observed complete roof failures, and in nearly every instance, there were examples of shingle failures or tarps covering losses. Some of the shingle damage was likely due to inadequate installation. As seen in the photo below on the left, this was also true on Fort Myers Beach, which recorded some of the most intense winds of Ian's eyewall. The most widespread examples of asphalt roof shingle failures occurred in older building stock. This was most common with roofs older than 10 years. While the standard advertised lifespan of an asphalt shingle roof is 20 to 30 years, the prolonged sun exposure and other harsh Florida weather elements aid in the more rapid degradation.

Commercial building stock with newer constructed roofs – especially metal – did very well. This was particularly true in areas such as Englewood and North Port, where some of the highest observed wind speeds occurred. The assessment found numerous examples of commercial structures side-by-side with new and old roofs, where the old roofs performed much more poorly than the newer roofs. In one of the examples below, it is seen that even on the property with the red metal roof, there was some damage to siding from wind and wind-born debris. There were also ample instances of partially removed asphalt shingles with inadequate glue during installation.

Additional examples of roof failure to both residential and commercial structures occurred when winds either pushed out soffits or less quality thin metal roofing material. This resulted in either complete roof failure (top left) or partial failure (top right). There were also many examples of partially damaged roofs which then led to extensive indoor water intrusion and subsequent damage. Days of Florida heat accelerated the development of indoor mold on walls.

Less intense winds across inland sections of the Florida Peninsula around Kissimmee, Orlando, and Lakeland led to reduced wind-related damage in these areas. However, the robust volume of rainfall that occurred during the 24 to 48 hour period from September 28-30 left soils heavily saturated and required a lesser wind gust to knock trees down onto properties or power lines. The assessment further observed that trees shielded properties from hurricane or strong tropical storm-force winds, thereby limiting direct wind damage. The canopy of tall trees (generally taller than 60 feet (18.3 meters) in height) acted as a natural windbreak / barrier for nearby properties.

Mobile homes generally had mixed results with Ian, though a higher portion did struggle with the storm's winds either on the coast or inland. Newer construction with proper ground straps and limited open outdoor canopies did fine. Many older mobile homes were heavily damaged as winds found easy entry points and either fully or partially lifted roofs / canopies.

Properties with newly constructed solar panels performed very well during Ian. This was true regardless of whether the installations were in the peak wind speed locations or elsewhere. Homes with metal roofs performed best, and even homes with asphalt shingles with minimal tile loss did not show any obvious widespread solar panel impact.

Hurricane Ian Wind Speed versus Florida Building Code Design

Building design requirements for hurricane winds in Florida are among the strongest and most stringent standards anywhere in the world. Hurricane Ian tested the state's design requirements and the resistance of existing buildings to strong winds. Within Florida, wind design requirements for buildings vary by location, and code requires buildings along the coast to resist even more intense wind speeds compared to similar buildings inland.

As already cited in this report, Ian brought considerable high intensity wind gusts to communities such as Fort Myers Beach, Sanibel, Fort Myers, St. James City, and Cape Coral. Estimated wind gusts in some of these communities ranged from 120 to 145 mph (195 to 235 kph). Such wind speeds fell below the 700-year return period wind gust cited in Florida's existing code, which most of the post-2001 constructed homes in these cities were designed to resist. Many of the areas hardest-hit by Ian's peak winds were in areas of redeveloped following Hurricane Charley's landfall in 2004 and showed above-average performance results. However, homes built before 1995 (pre-Andrew era building code) and had not been retrofitted to meet current standards performed poorly.

Wind design takes into consideration velocity pressure/force on building components, which is directly proportional to the square of the wind speed ($p \propto v^2$). This means that a small difference between design and actual impacted wind speed will have an exponential impact on the wind pressure experienced by a building. This, of course, can lead to significant building damage.

The table below highlights return period wind speeds for various locations in Florida compared to estimated winds from Ian. The return periods are derived from the American Society of Civil Engineers (ASCE).

Location	ASCE-7 Design Standard: Mean Recurrence Interval Wind Speed			Estimated Ian Wind Speed
	50-year	100-year	700-year	
Bonita Springs, FL	117 mph	129 mph	159 mph	100 - 115 mph
Fort Myers Beach, FL	118 mph	129 mph	159 mph	120 - 140 mph
Punta Gorda, FL	113 mph	124 mph	151 mph	125 - 140 mph
Cape Coral, FL	115 mph	127 mph	155 mph	125 - 140 mph
Kissimmee, FL	105 mph	115 mph	140 mph	75 - 85 mph

Damage Survey: Storm Surge

The most substantial damage was due to the breadth of storm surge impact. This was most significant near the landfall locations on the left / east side of the center of Ian's circulation. Such locations included Fort Myers Beach, Bonita Beach, Pine Island, and Naples. The assessment included a peak water height exceeding 15 feet (4.6 meters) behind a barrier island of the main Fort Myers Beach. It led to major damage in rows of homes behind those along the immediate coast. Due to ongoing recovery efforts on Fort Myers Beach, the assessment team was not able to inspect physical damage at the "first hit" areas where so many lives were lost. It is expected that water heights were even greater than 15 feet (4.6 meters) in some spots. The assessment highlighted limited preparedness for such surge by local homeowners.

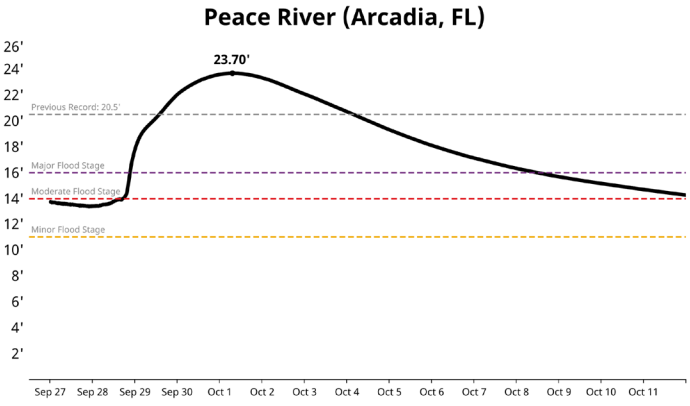
While there was limited wind damage to coastal homes and condominiums in Fort Myers, Fort Myers Beach, Bonita Beach, and Naples, there was very damaging storm surge impacts to the first level of many properties. The flat land of Florida makes it very susceptible to floodwaters traveling well inland. The survey measured storm surge traveling as much as 0.25 to 0.40 miles (0.40 to 0.64 kilometers) inland in some areas, with a high volume of homes losing its contents. Beyond physical property damage there was extensive impacts to vehicles. This assessment alone witnessed hundreds (or more) vehicles that were severely damaged or inundated along the coast. One stretch in Naples (Vanderbilt Beach) saw many luxury vehicles that were total losses. Most were flooded by the surge while parked in covered lots.

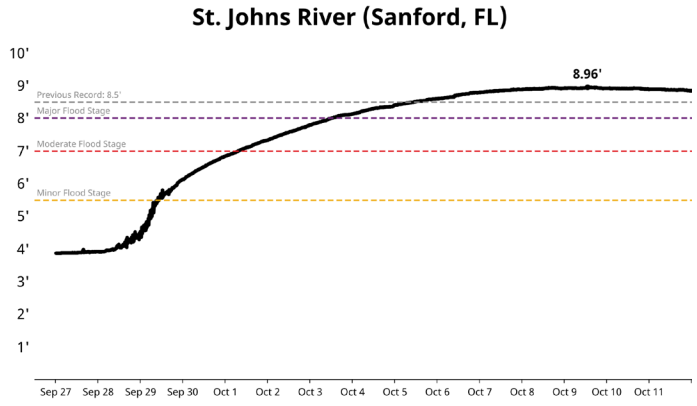
The combination of storm surge and high winds brought a very high number of boats being damaged or ground ashore. There will be a very significant coast to marine interests from Ian across Southwest Florida.

Damage Survey: Inland Flood

The torrential rains from Ian additionally led to notable inland flood damage across nearly two-dozen Florida counties. For the survey, the team focused on areas in the greater Orlando metropolitan area (Sanford and Kissimmee) as well as in Polk and DeSoto counties (Bartow and Arcadia). We observed particularly significant and ongoing major flooding in Arcadia along the Peace River. This was one full week after Ian made landfall.

Several rivers in Florida set new all-time high water crests during Ian. Two notable rivers included the Peace River (Arcadia, FL) and the St. Johns River (Sanford, FL). Note that the Peace River peaked in the days after Ian's passage, but the slow and meandering run-off and flow of the St. Johns River allowed water heights to stay at record heights more than two weeks after landfall.





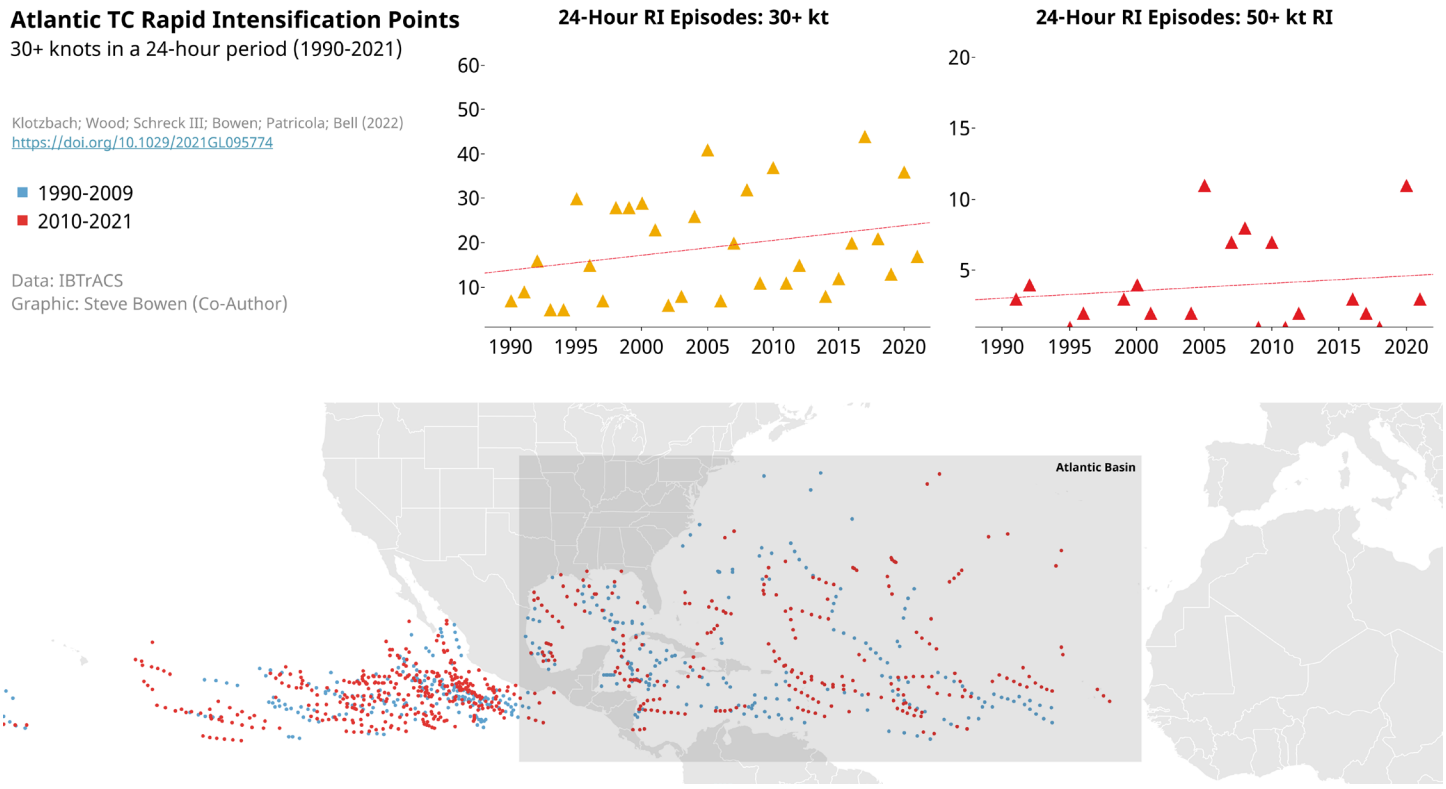
Data: NOAA | Graphic: Arthur J. Gallagher & Co.

Role of Climate Change

Hurricane Ian's development was, of course, not the result of climate change. However, the behavior of Ian includes the hallmark of the continued influence of climate change on individual events. Global tropical cyclone activity has not shown any statistically significant increase with time. Among the several factors is that the phase of ENSO can result in a seesaw effect of increased or decreased activity across various global basins. For example, La Niña tends to result in greater activity in the Atlantic Ocean but reduced storms in the Pacific Ocean.

The most notable change in cyclone activity is on the intensity, forward motion speed, and precipitation. A recent study highlighted how global tropical cyclones have shown an accelerated rate of rapid and explosive rapid intensification in the last 30+ years. Rapid intensification (RI) is defined as a storm strengthening by at least 30 knots (35 mph) in a 24-hour period; while explosive rapid intensification occurs when a storm increases by 50 knots (60 mph) in a 24-hour period. Perhaps more concerning is that these RI episodes are now happening with more frequency and up to the point of landfall. Combined with more vulnerable and growing exposure along coastlines, this is a concerning trend and likely to bring greater damage losses in the future.

Focusing solely on the Atlantic Ocean during the past 30+ years, there has been a notable uptick in the number of RI and explosive RI occurrences. Perhaps most concerning is the trend of the RI periods occurring up to the point of landfall. This is a trend that Ian continued, where intensification was occurring up until the last hour before landfall. The graphic below shows the number of 24-hour periods of 30+ knot and 50+ knot RI periods (top) as well as the mapped points of the 30+ knot periods in the Atlantic Basin (gray shaded area).



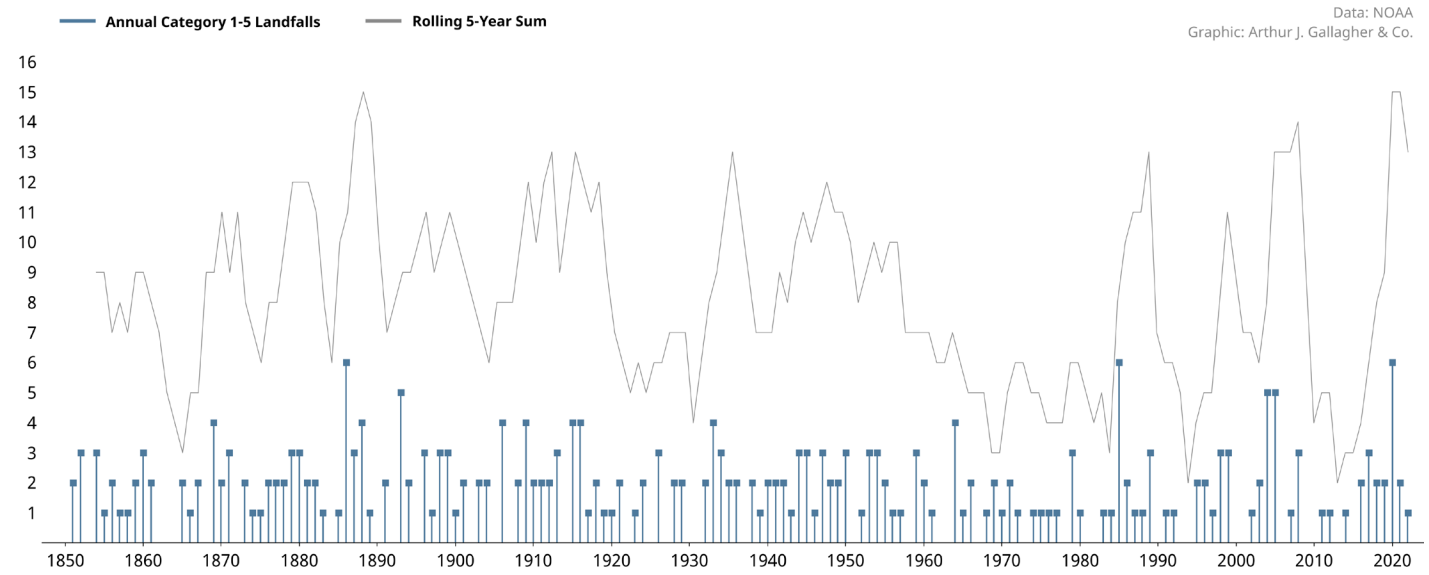
Storms are also showing signs of slowing its forward speed once coming ashore. This has brought heavier rainfall from storms and increasing the inland flood risk. Ian was another example of this phenomenon in Florida. As a reminder, for every 1°C (1.8°F) of warming, the atmosphere can hold up to 7% more moisture.

United States Mainland Hurricane Landfall Trends

Ian added to what has been an active stretch of U.S. hurricane landfalls. The tables below analyze landfall trends, which have not shown much variation dating to 1851. Note: The lack of landfall signal does not account for behavioral evolution seen in tropical cyclones due to the previously noted influence of climate change.

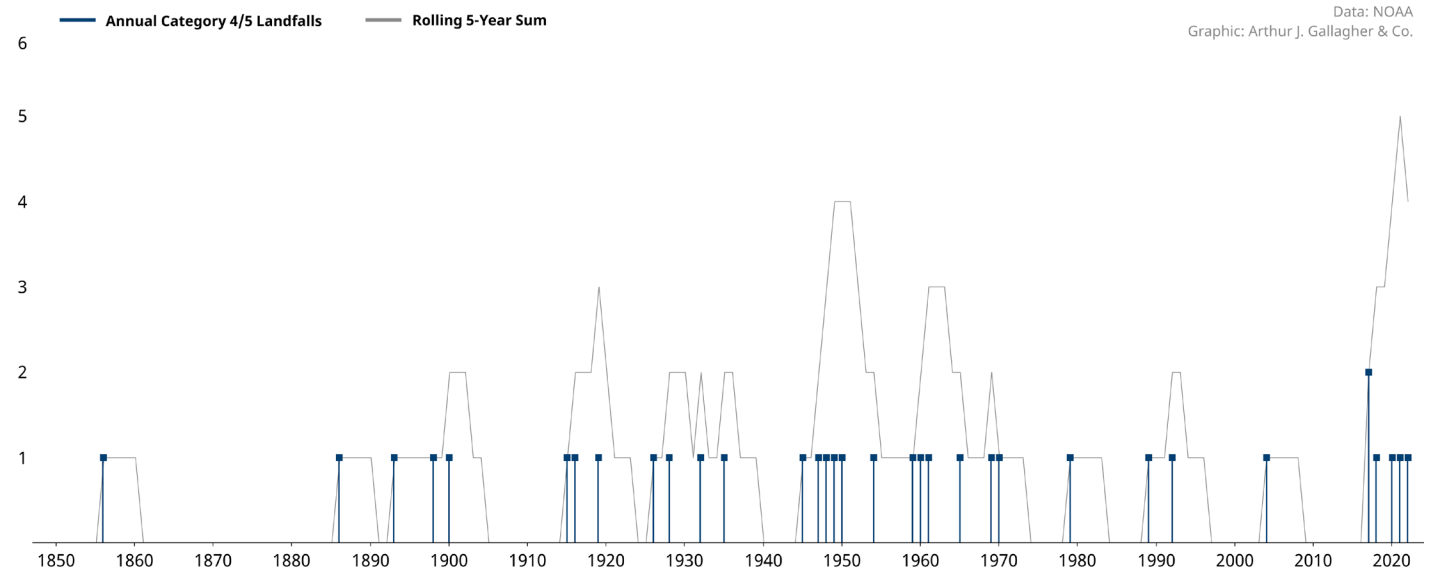
All Hurricanes

The United States mainland has experienced a very active decade of hurricane landfalls (Category 1-5). The last five years (2018-2022) has resulted in 13 such landfalls. This is just two below the 5-year rolling sum record of 15 set from 1885-1889, 2016-2020, and 2017-2021.



Category 4 / 5 Hurricanes

Despite having a lower frequency of occurrence, the strongest hurricanes (Category 4 and 5) often result in the most expensive financial losses for any natural peril in the United States. The U.S. mainland has incurred four (4) Category 4 or 5 landfalls in the past five years alone. This is down from the record 5-year rolling sum of five (5) seen in the most recent period from 2017-2021.



Financial Loss Commentary

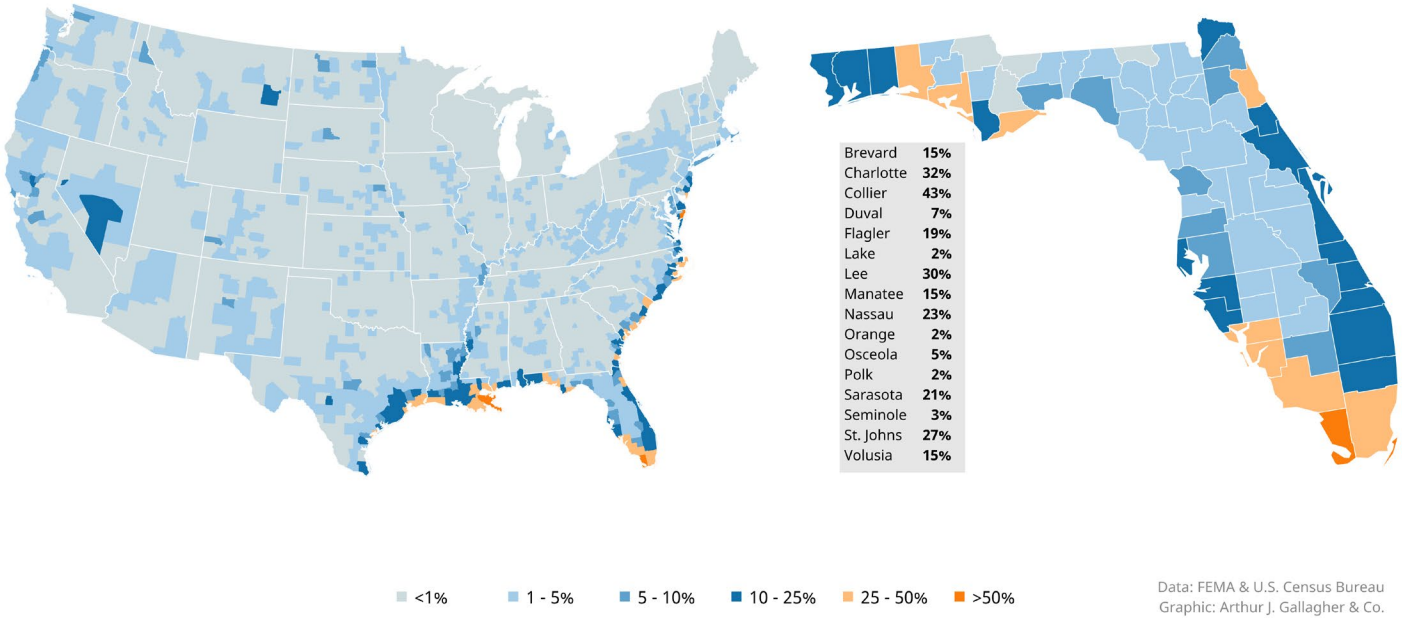
Ian will become one of the most expensive and difficult recoveries for any U.S. hurricane on record. From the physical damage standpoint to rebuilding questions to infrastructure modernization to the foundation of the Florida insurance market, there are many challenging days ahead.

The total financial cost from Ian is anticipated to result in total economic losses (including direct physical damage, direct non-physical financial loss, and net-loss business interruption) approaching or exceeding $100 billion. This total is derived based on publicly available insured loss estimates from various catastrophe model vendors and initial loss data published by Florida's Office of Insurance Regulation. This would make Ian not only one of the costliest U.S. hurricanes on record, but one of the costliest U.S. natural hazard events regardless of peril. Private and public insurance entities are facing claims payouts reaching well into the tens of billions (USD). This would place Ian among the costliest natural catastrophe events ever recorded for the re/insurance industry. Hurricane Katrina (2005) remains the costliest at $96 billion (inflation-adjusted and includes NFIP).

Given the significant water-related damage that has occurred from Ian, there will be much focus on the protection gap and how much damage will or will not be covered by insurance. This will put renewed pressure and focus on the National Flood Insurance Program (NFIP). Counties located near the landfall point in Florida – Lee, Charlotte, and Collier – have some of the highest NFIP take-up in the United States. However, despite roughly 30 to 45% of homeowners in these areas having NFIP coverage, this means many others that were outside the standard 100-year floodplain were likely to see a significant portion of water damage go uninsured. Plus, the NFIP has limits on how much a single-family home can be insured up to: $250,000 for the physical structure and another $100,000 for contents. Many properties affected by Ian likely saw damage exceed those limits, which will bring underinsurance concerns to the forefront.

The graphic below highlights NFIP take-up per county in the United States through the end of August 2022. It reiterates that most policy coverage is found along the U.S. East Coast with the highest tropical cyclone risk. However, there remains major gaps in many states – including Florida.

National Flood Insurance Program (NFIP)
Take-Up Per County: As of August 31, 2022



Data: FEMA & U.S. Census Bureau
Graphic: Arthur J. Gallagher & Co.

NOTE: Graphic is based on county-level 2021 U.S. Census Bureau Housing Units versus the number of active NFIP policies per county as made available from FEMA

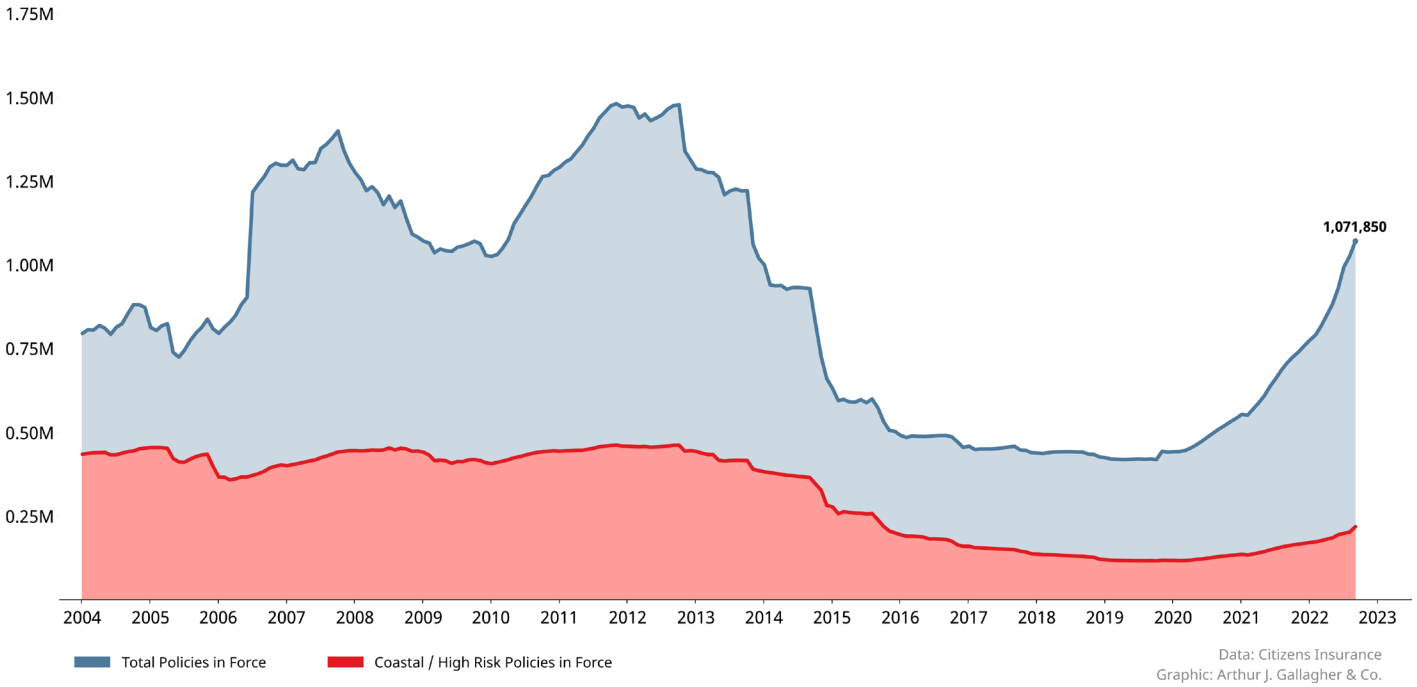
For the Florida insurance market, the impacts will bring significant challenges to what is already a difficult environment. Citizens Insurance, the Florida state-run insurance program of “last resort” for homeowner or commercial policies, now has more than 1.07 million active policies representing a total insured value of $380 billion (as of September 30). It has jumped from 436,187 policies that were in place when Hurricane Michael struck the Florida Panhandle in October 2018.

Per Florida’s Office of Insurance Regulation: At the end of Q1 2022, Citizens represented a 9% market share of Total Insured Value (TIV) based on the TIV for Florida Personal & Commercial Residential Property. The Citizens total ($258 billion) is at its highest value since the end of 2013 ($305 billion) and continues to grow.

The graphic below highlights monthly total policies in force dating to 2004. It shows Citizens reached a peak in 2013, but a near decade decline ending in late 2020. Reasons for the decline primarily included a long stretch of no major hurricanes (2006-2015) to strike Florida, a plethora of new insurers entering the market, competitive (lower) premium pricing, and lower reinsurance rates. Since late 2020, Citizens has become a much more active initiative that has taken on many new policyholders. As of mid-October 2022, Citizens now anticipates its policies-in-force count to exceed its initial estimate of 1.5 million by the end of 2023.

Some of the driving factors for the increase in Citizens take-up prior to Ian included major storm damage from Irma, Michael, Eta, and Fred that has led to prolonged loss development, the huge rise in third-party claims / Assignment of Benefits (AOB), a major increase in claims litigation, and challenges with insurer insolvency.

State of Florida: Citizens Insurance
Active Policies in Force (2004-Present)



For further information please contact

Steve Bowen
Chief Science Officer
Gallagher Re
2850 Golf Road
6th Floor
Rolling Meadows, IL 60008

E: Steve_Bowen@GallagherRe.com

Prasad Gunturi
Executive Vice President
Gallagher Re Catastrophe Analytics
8400 Normandale Lake Blvd
Suite 375 (Mailing Suite 1700)
Minneapolis, MN 55437, U.S.
T: +1 952 841 6638
E: Prasad_Gunturi@GallagherRe.com

Adam Miron
Executive Vice President
Gallagher Re Catastrophe Analytics
8400 Normandale Lake Blvd
Suite 375 (Mailing Suite 1700)
Minneapolis, MN 55437, U.S.
T: +1 952 841 6689
E: Adam_Miron@GallagherRe.com

Josh Freitag
Senior Catastrophe Model Risk Analyst
Gallagher Re Catastrophe Analytics
4350 W Cypress St
Suite 300
Tampa, FL 33607, U.S.
T: 1 704 798 9267
E: Josh_Freitag@GallagherRe.com