

Dorian makes U.S. & Canada landfalls; Bahamas reels

Hurricane Dorian became the strongest landfalling Atlantic Ocean hurricane on record as it struck the Great Abaco and Grand Bahama Island in the Bahamas as a 185 mph (295 kph) Category 5 storm on September 6. The storm caused catastrophic damage in the Northern Bahamas, and as many as 1,300 people remain unaccounted for on Great Abaco and Grand Bahama Island. Dorian would later strike Cape Hatteras, North Carolina in the U.S. as a Category 1 storm and a final landfall in Nova Scotia, Canada as a post-tropical cyclone with winds of 100 mph (160 kph). Storm damage in the U.S. was widespread, but not nearly as significant as initially feared. Wind-related impacts were notable in Atlantic Canada. Total economic losses in the Bahamas alone were expected to well into the billions of dollars (USD); while combined damage costs in the U.S. and Canada were also likely to top USD1 billion.

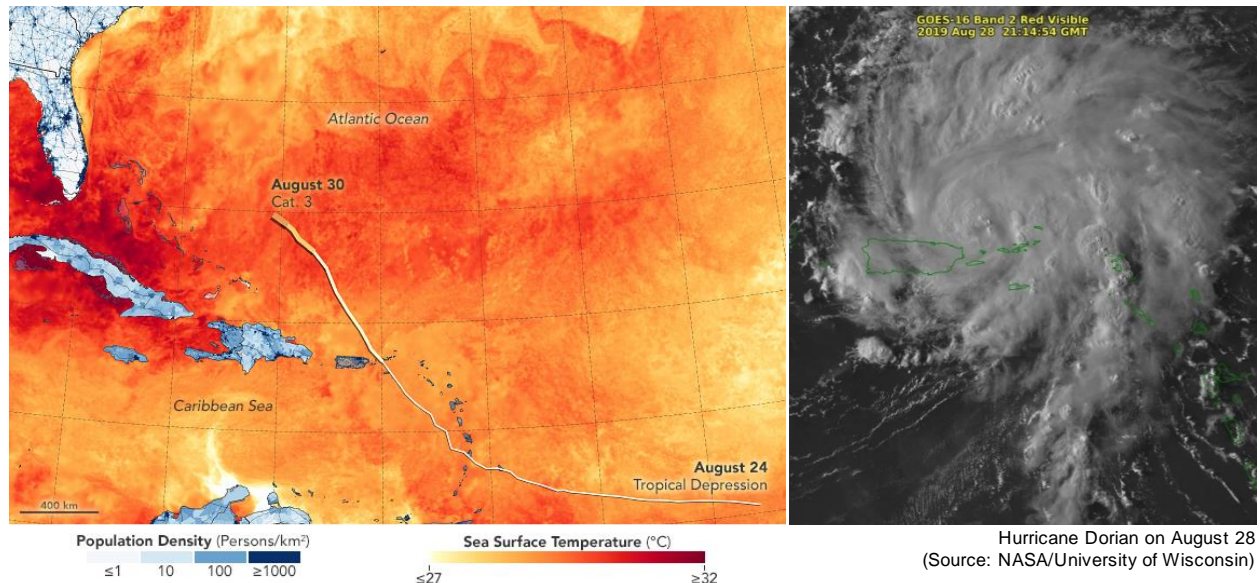
Meteorological Recap



The National Hurricane Center (NHC) began monitoring a cluster of disorganized thunderstorms in the central tropical Atlantic Ocean on August 23. As this cluster further shifted westward, the NHC noted that a closed low-level circulation was evident and there was sufficient convection to declare the system Tropical Depression Five on August 24. Hours later, further development warranted an upgrade to Tropical Storm Dorian – the fourth named storm of the 2019 Atlantic Hurricane Season.

Dorian would strengthen to a 50 mph (85 kph) storm on August 25 as the storm expanded in size on satellite imagery despite only a very small segment of the storm's center maintaining tropical storm-force winds – just 25 miles (40 kilometers). It would further intensify to an initial peak of 60 mph (95 kph) winds, a strong tropical storm, on August 26 as it tracked very near the island of Barbados. However, this intensity would be short lived as an Air Force Reconnaissance aircraft determined that the core of Dorian was struggling in a very dry atmospheric environment. Dry air continued to enter the mid-level center of circulation which caused Dorian to slightly weaken back to a 50 mph (85 kph) system as it tracked into the Caribbean Sea on August 26 into August 27.

Hurricane and Tropical Storm watches and warnings were issued across the eastern and central Caribbean Islands during this time. By August 28, dry air continued to impede much consistent intensification as Dorian tracked west-northwest towards Puerto Rico. However, the storm unexpectedly developed a new center of circulation dozens of miles (kilometers) to the north.

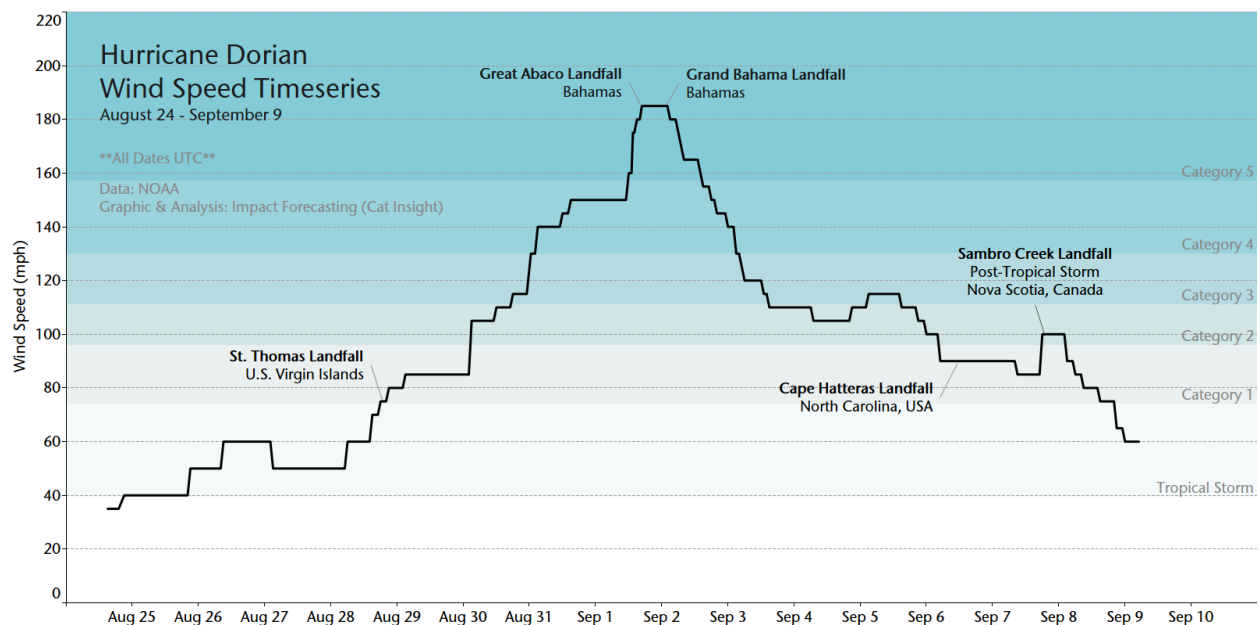


The new center caused Dorian to track further towards the northwest – much more to the east than initially forecast. This led to the storm's core missing the mountainous terrain of Puerto Rico and/or Hispaniola on August 28 and instead tracking directly over and very near the U.S. and British Virgin Islands. On St. Thomas, hurricane-force wind gusts were recorded as Dorian officially reached Category 1 hurricane status with 75 mph (120 kph) winds during the afternoon hours. A peak gust of 111 mph (179 kph) was noted at an elevated station on Buck Island, located just south of St. Thomas.

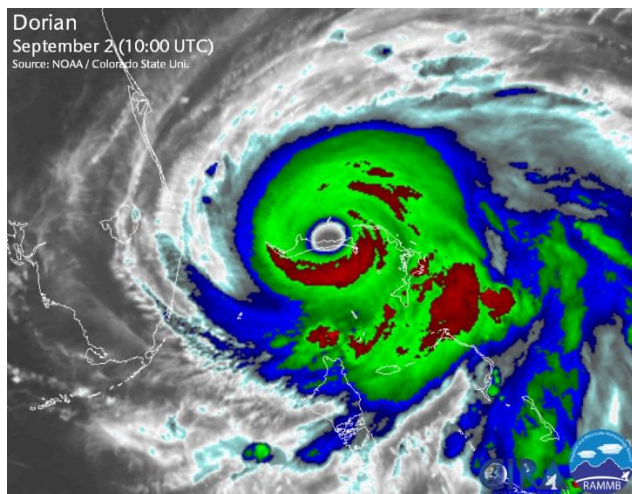
During this time, Dorian began to get better organized as it escaped the dry air environment and entered the open waters of the Atlantic Ocean while tracking towards the Bahamas on August 28 and 29. Steady intensification was ongoing as the cyclone traversed very warm ocean waters in an area with low vertical wind shear.

By late on August 29 into August 30, the core structure of Dorian began to rapidly evolve as it entered a very favorable atmospheric and oceanic environment. This resulted in explosive intensification. During a 57-hour period from August 30 (03:00 UTC) to September 1 (12:00 UTC), Dorian strengthened from an 85 mph (140 kph) Category 1 storm to a 160 mph (260 kph) Category 5 storm while approaching the Northern Bahamas. This coincided with 59-millibar drop in minimum central pressure. With Dorian reaching Category 5 strength, this marked the fourth consecutive year in which the Atlantic Ocean featured a storm of such intensity – the first time in the Satellite Era (since the 1960s).

As Dorian approached the Bahamas on September 1, the steering currents pushing the cyclone westward began to collapse and caused the forward motion to substantially slow. However, during this time, Dorian also reached its peak intensity with 185 mph (295 kph) winds. At approximately 12:40 PM local time (16:40 UTC) on September 1, Dorian made landfall at peak intensity at Elbow Cay on the Bahamas' Great Abaco Island with a minimum central pressure of 911 millibars. Wind gusts were estimated at up to 220 mph (350 kph). This tied the 1935 Labor Day Hurricane as the strongest Atlantic hurricane landfall since official records began in 1851.

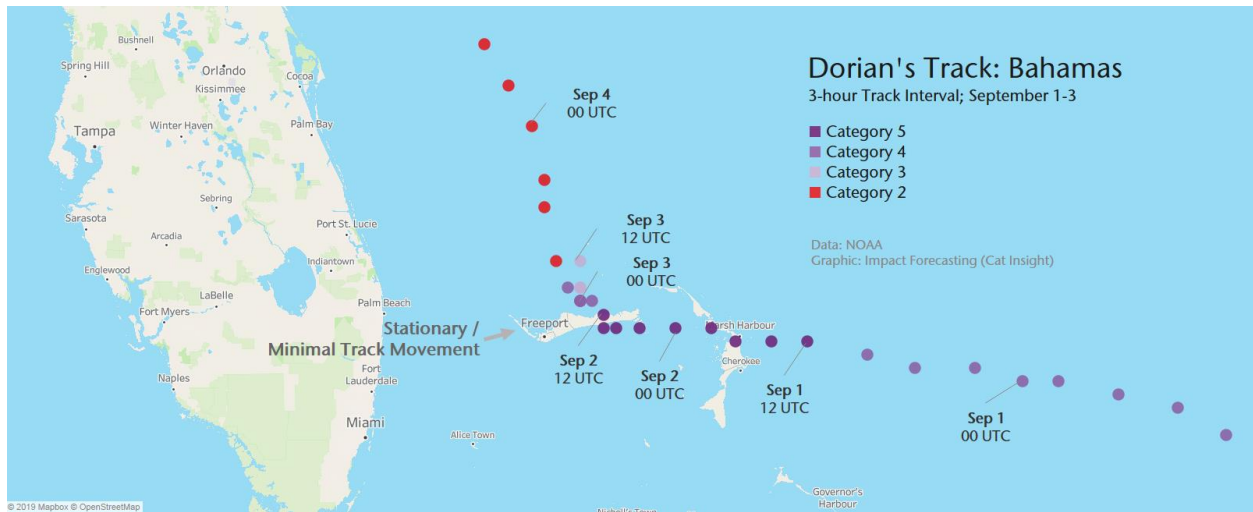


After striking the Abacos, the forward motion continued to slow down as it meandered westward towards Grand Bahama on September 1 into the early morning hours of September 2. During this time, catastrophic damage from exceptional wind gusts, 20+ feet (6.1 meters) of storm surge, and nearly three dozen inches (914 millimeters) of rainfall occurred across the Abacos.

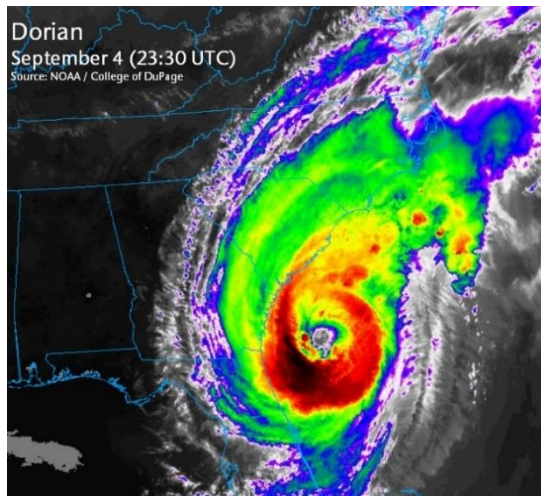


When Dorian officially made landfall on Grand Bahama at approximately 10:00 PM local time on September 1 (02:00 UTC September 2), it maintained its peak intensity with 185 mph (295 kph) winds, though the minimum central pressure slightly rose to 915 millibars. Despite making separate landfalls in the Bahamas at maximum intensity and at Category 5 wind speeds, Dorian would only very slowly track westward – if at all – during the next 36 to 48 hours (see graphics below). Only slight weakening occurred during this time; primarily due to upwelling (a phenomenon caused by deeper, typically cooler, waters mixing to the surface), though Dorian would maintain Category 5 intensity for 26 consecutive hours.

During this incredible stretch of time, parts of Grand Bahama were within the eyewall for nearly two straight days. This led to catastrophic effects from an estimated 20-foot (6.1-meter) storm surge, winds gusting beyond 200 mph (320 kph), and torrential rains. Gradual weakening finally began to occur on September 3 as Dorian would finally drop to below major hurricane status after 93 consecutive hours. A deep dip in the jet stream (known as a mid-latitude trough) reached the U.S. Southeast during the day and began to “pull” the hurricane northward away from the Bahamas. The NHC issued tropical-based watches and warnings in Florida for the first time.



Gradual weakening would see Dorian fall to a strong Category 2 on September 4 with 105 mph (165 kph) winds as some dry air filtered into the center of the system. However, by the second half of the day on September 4, Dorian started to track over the Gulf Stream with hurricane-force winds just dozens of miles (kilometers) off the Florida coastline. Tropical storm-force wind gusts did impact Florida's East Coast from Brevard County northward to the city of Jacksonville through September 5. Dorian did undergo a slight intensification as the central pressure dropped and an eye feature became more prevalent. A combination of the trough "pulling" Dorian northward and rounding the western periphery of a ridge of high pressure kept the hurricane tracking towards the U.S. Southeast coast.

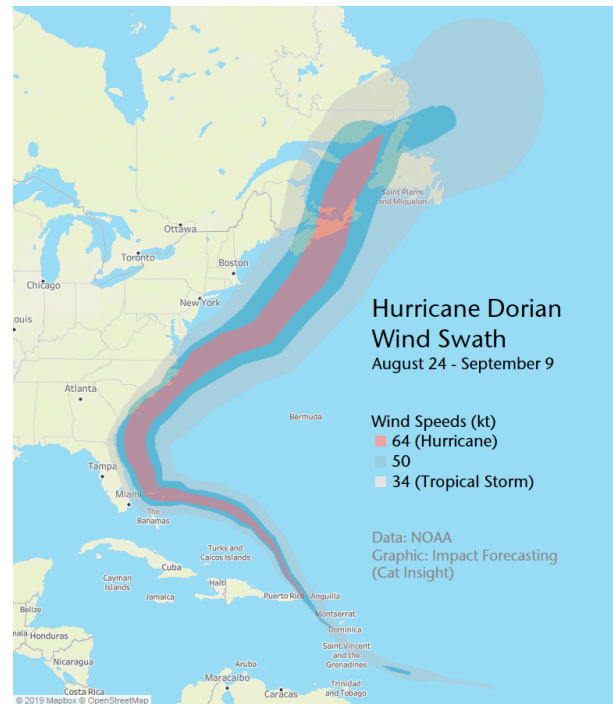


As Dorian further shifted northward and gained more latitude while crossing the Gulf Stream (a conveyor belt of very warm sea surface temperatures that hovers along the U.S. Southeast coast from Florida to North Carolina), its wind field continued to expand. This is fairly standard practice for tropical cyclones as they gain latitude and approach the mid-latitude westerlies and/or experience an eyewall replacement cycle – in which Dorian also completed. The tropical storm-force wind field expanded from 140 miles (220 kilometers) while at peak intensity on September 1/2 to 195 miles (315 kilometers) on September 4. The hurricane-force wind field spread from 45 miles (75 kilometers) to 70 miles (110 kilometers). The closeness of the track to the coast brought up to hurricane-force wind gusts in Florida and Georgia.

By the evening of September 4 and into September 5, Dorian began pushing storm surge heights of several feet (meters) into coastal sections of Georgia, South Carolina, and North Carolina. As the circulation of Dorian interacted with the mid-level frontal boundary situated along the U.S. East Coast, this led to an enhancement of rainfall across the Carolinas. The cyclone would maintain its Category 2 intensity as it crept closer to the coastline of both South Carolina and North Carolina on September 5 into September 6.

Dorian would come perilously close to the South Carolina coastline on September 5 – less than 50 miles (85 kilometers) from Charleston – as near-hurricane force wind gusts and multiple feet of storm surge were recorded. The storm's center would wobble and meander close to South Carolina and southern North Carolina but did not ever officially come ashore.

As the day unfolded on September 5, the cyclone would regain some intensity as it traversed the last portion of the Gulf Stream. These warmer waters allowed the core of Dorian to better organize and it once again regained major hurricane status for a short period of time on September 5 before more negative atmospheric conditions returned. A combination of increased wind shear and mid-latitude westerlies led to a deterioration of the storm structure late on September 5 into September 6 as it continued to track even closer to the North Carolina coastline. On September 6 at 8:35 AM local time (12:35 UTC), Dorian officially made its lone U.S. landfall at Cape Hatteras, North Carolina. The Category 1 hurricane had winds of 90 mph (150 kph) and a minimum central pressure of 956 millibars. Dorian became the second consecutive 90-mph (150-kph) hurricane to strike North Carolina in as many years; Florence (2018) caused an estimated USD25 billion in economic damage during its lifecycle, mostly in North Carolina.



After making landfall in North Carolina, the steering currents became much stronger as Dorian became absorbed by the mid-latitude westerlies and an approaching mid/upper-level trough. This caused a significant increase in forward motion towards the northeast and eventually north-northeast and began an expected transition from a tropical to an extratropical cyclone on September 6 and September 7. During this time, the Canadian Hurricane Center began issuing Hurricane and Tropical Storm watches and warnings for most of Atlantic Canada.

Dorian fully completed its extratropical transition while paralleling the U.S Northeast coastline and approaching Nova Scotia in eastern Canada. As this transition occurred, the wind field significantly expanded, and the wind speeds increased to 100 mph (160 kph) due to baroclinic forcing. *Baroclinic forcing occurs due to differences of temperature or pressure between atmospheric and oceanic conditions. This baroclinic nature allows for a transfer of energy and can lead to strengthening of weather systems such as Dorian (2019) or Sandy (2012).*

Dorian made its final landfall in Sambro Creek, Nova Scotia – located about 15 miles (25 kilometers) south of Halifax – at approximately 7:15 PM local time (22:15 UTC) on September 7 as a 100 mph (160 kph) hurricane-strength post-tropical cyclone with a minimum central pressure of 958 millibars.

After striking Nova Scotia with powerful winds and heavy rains, Dorian and its remnants tracked further towards the northeast and brought further impacts to parts of Nova Scotia, Prince Edward Island, Newfoundland, New Brunswick, and Quebec. By September 9, Dorian had been fully absorbed by a larger frontal system in the far North Atlantic Ocean.

Storm Records

Below is a list of official records established by Hurricane Dorian and other storm factoids:

- **Strongest Winds at Landfall (tie):** Hurricane Dorian's 185 mph (295 kph) sustained winds at landfall on Great Abaco Island in the northwest Bahamas tied as the strongest winds at landfall on record in the Atlantic Ocean. It tied the 1935 Labor Day Hurricane.
- **One of the Five Strongest Atlantic Storms:** Dorian tied for the second-strongest hurricane, in terms of wind speed, on record in the Atlantic Ocean. The hurricane tied for second place with the 1935 Labor Day Hurricane, Gilbert (1988), and Wilma (2005); and was just 5 mph shy of the 190 mph (305 kph) winds confirmed in Hurricane Allen (1980).
- **Strongest Storm on Record in the Bahamas (Wind Speed & Pressure):** Dorian well surpassed the previous strongest Bahamian landfall; the 1932 Bahamas Hurricane with 160 mph (260 kph) sustained winds. It also was had the lowest pressure (911 millibars) of any landfalling Bahamian storm since 1980.
- **Strongest Storm on Record Located East of Florida and North of the Caribbean:** Dorian was the strongest storm based on wind speed and minimum central pressure in this part of the Atlantic.
- **Tied for 9th Lowest Pressure in the Atlantic Ocean (1980-):** At 910 millibars, Dorian ties Hurricane Ivan (2004) for the ninth-lowest pressure in the modern era.
- **Record Rapid Intensification:** Dorian intensified by 35 mph (55 kph) from 150 mph (240 kph) to 185 mph (295 kph) in a matter of nine hours on September 1. This was a rate of intensification never previously recorded for a hurricane at this intensity.
- **2nd-Least 24-hour Distance Traveled by a Category 3+ Storm in the Atlantic Ocean (1950-):** Based on a historical analysis of Atlantic storm motion during 24-hour intervals of major hurricanes (Category 3+), Dorian became the second slowest-moving such storm on record since 1950, only trailing Hurricane Betsy in 1965 (~12 miles). It moved at just 1.3 mph (2.0 kph) during one 24-hour stretch near the Bahamas; or just ~25 miles (40 kilometers).
- **First Time in Satellite Era with Four Consecutive Years with a Category 5 Atlantic Storm:** When Dorian became a Category 5 storm on September 1, 2019 became the fourth consecutive year with such a storm in the Atlantic Ocean. This marks the first time on record in the Satellite Era (since the 1960s) to have four years in a row with a Category 5: Matthew (2016), Irma (2017), Maria (2017), Michael (2018), and Dorian (2019).

Storm Data

Rainfall

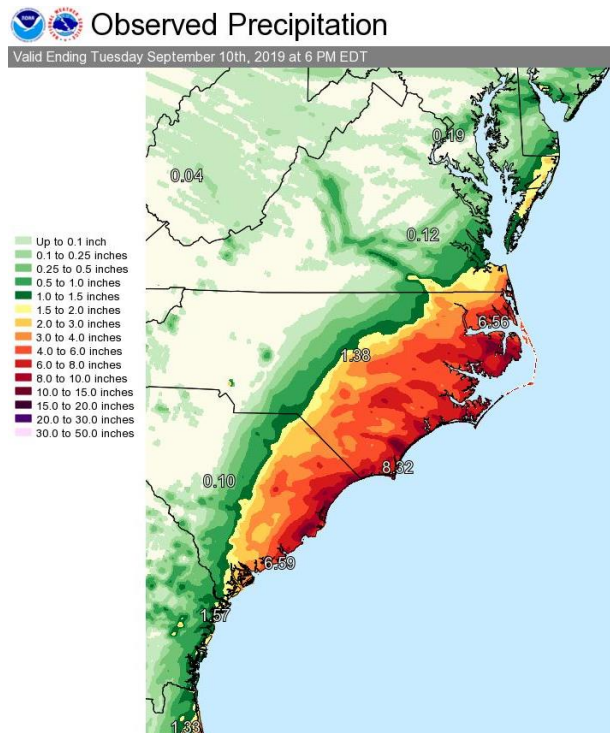
Below are preliminary and unofficial rainfall totals from Dorian in the Caribbean and North America.

Location	mm	inch
Martinique		
Ducos	121	4.8
Rivière-Pilote	120	4.7
Fonds-Saint-Denis cadet	104	4.1
Fort de France Colson	130	5.1
Sainte-Marie	94	3.7
Lamentin	79	3.1
Guadeloupe		
La Providence Petit-Bourg	174	6.9
Capesterre-Belle-Eau	72	2.8
Sainte-Rose	68	2.7
Saint-Martin		
Princess Julianna Airport	86	3.4
Saint Lucia		
G.F.L. Charles Airport	18	0.7
Hewanorra Airport	16	0.6

Location	mm	inch
United States		
McClellanville, SC	270	10.64
Cainhoy, SC	250	9.84
North Myrtle Beach, SC	204	8.02
Myrtle Beach (Airport), SC	195	7.68
Socastee, SC	191	7.52
Huger, SC	188	7.40
Charleston, SC	154	6.05
Wilmington, NC	151	5.95
Palm Coast, FL	144	5.68
Georgetown, SC	144	5.65
Deland, FL	115	4.54
Sunset Beach, NC	106	4.18
Lake Mary, FL	100	3.92
Daytona Beach, FL	66	2.58
Savannah, GA	60	2.38

Location	mm	inch
Canada		
Oxford, NS	138	5.43
Lower Sackville, NS	138	5.43
Hammonds Plains, NS	133	5.24
Baccaro Point, NS	131	5.17
Belmont, NS	129	5.08
Moncton, NB	121	4.76
St. Paul, NB	120	4.72
Mechanic Settlement, NB	117	4.61
Miramichi, NB	115	4.53
Kentville, NS	110	4.35
St. Ignace, NB	110	4.33
Bonshaw, PE	103	4.06
Berwick, NB	98	3.86
Dorchester, NB	97	3.82
Big Tracadie, NB	96	3.78

* NB – New Brunswick, NL – Newfoundland and Labrador, NS – Nova Scotia, PE – Prince Edward Island, QC – Quebec



Wind Gusts

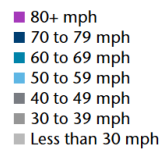
Location	mph	kph
United States		
Cedar Island, NC	110	177
Hatteras High School, NC	101	163
Oregon Inlet, NC	99	159
Jannette Pier, NC	98	158
Buxton, NC	91	146
Fort Macon, NC	89	143
Winyah Bay, SC	87	140
Duck, NC	87	140
Beaufort, NC	85	137
Avon, NC	84	135
Chesapeake Light Tower, VA	83	134
Cape Lookout, NC	82	132
Frisco, NC	78	126
Nags Head, NC	78	126
Cedar Island, NC	76	122

Location	mph	kph
...		
Fort Fisher, NC	74	119
James Island, SC	74	119
Elizabeth City, NC	70	113
Cape Henry, VA	70	113
New Smyrna Beach, FL	69	111
Charleston, SC	67	108
Folly Beach, SC	67	108
Piney Island, NC	66	106
Wrightsville Beach, NC	65	105
Norfolk, VA	64	103
Isle of Palms, SC	63	101
St. Augustine Beach, FL	62	100
Jacksonville, NC	62	100
Juno Beach Pier, FL	61	98
Myrtle Beach, SC	60	97

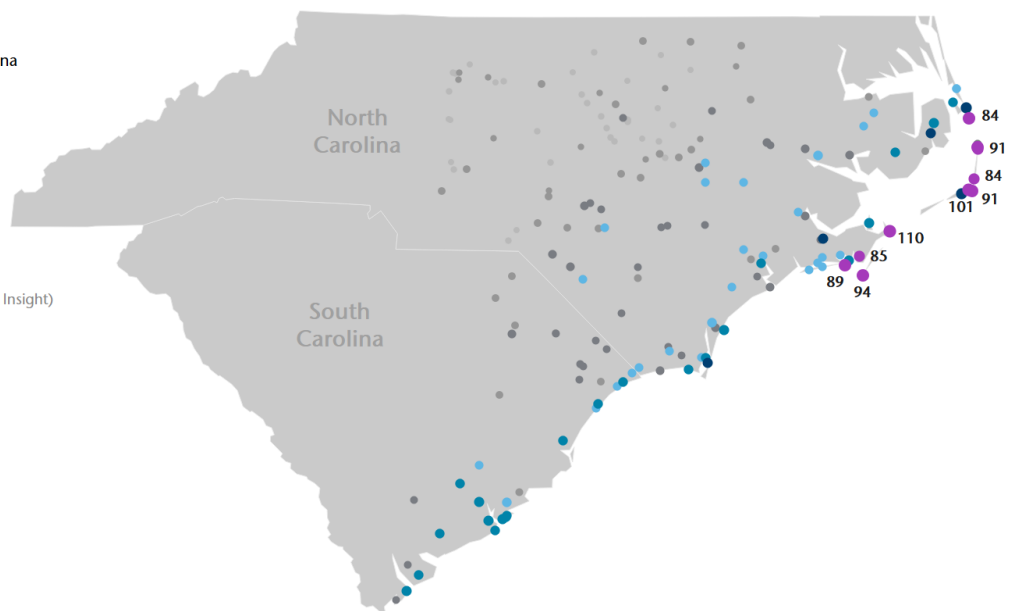
Location	mph	kph
Canada		
Wreckhouse, NL	98	157
Beaver Island, NS	90	145
Green Island, NL	89	143
Sluce Point, NS	89	143
Osborne Head, NS	88	141
Grand Etang, NS	85	137
Yarmouth, NS	81	130
Heath Point, QC	80	128
Port aux Basques, NL	80	128
North Cape, PE	76	122
East Point, PE	75	120
Halifax Kootenay, NS	75	120
Hart Island, NS	75	120
Magdalen Islands, QC	75	120
Baccaro Point, NS	74	119

Peak Wind Gusts

North Carolina & South Carolina



Data: NOAA
Graphic: Impact Forecasting (Cat Insight)



© 2019 Mapbox © OpenStreetMap

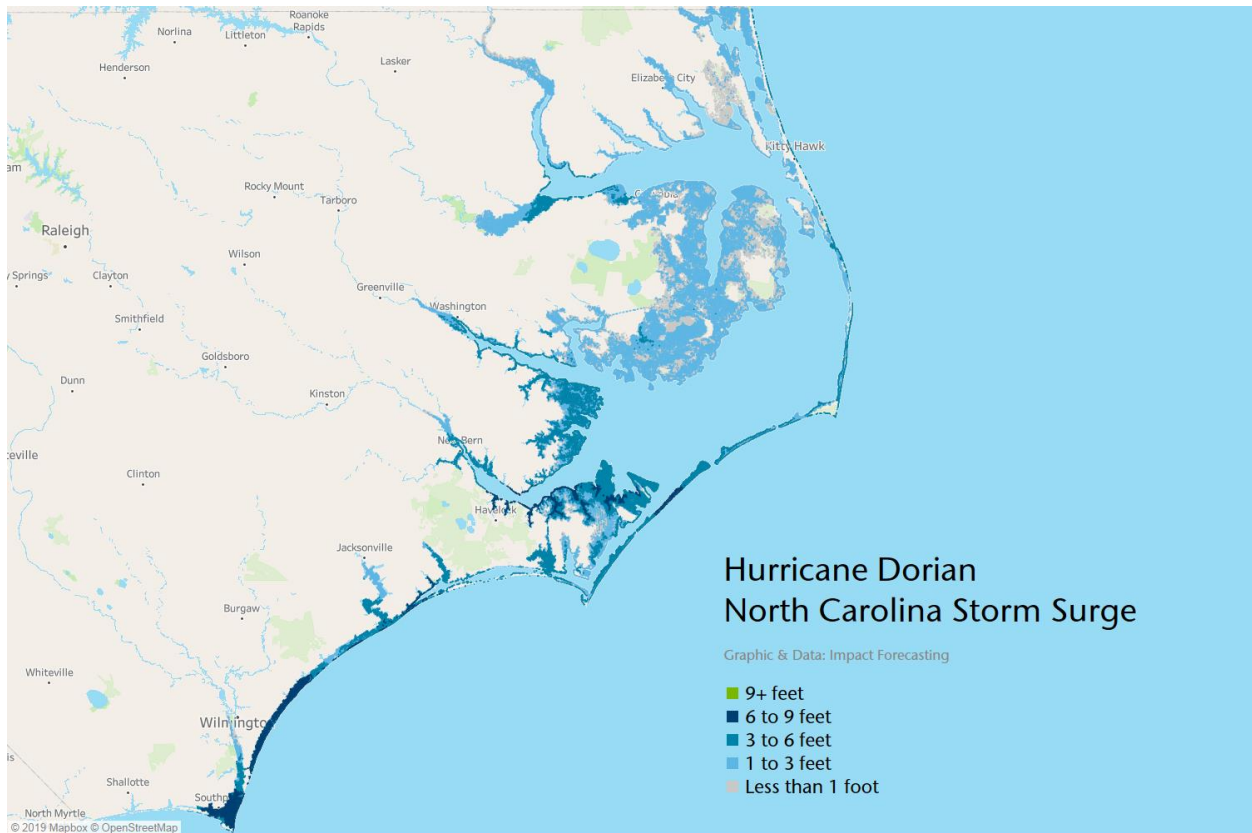
Storm Surge

Location	Inundation (ft) ¹	Storm Surge (ft) ²
United States		
USCG Station (Hatteras), NC	5.35	5.55
Oregon Inlet Marina, NC	4.18	3.15
Chesapeake Channel, VA	3.61	3.63
Duck, NC	3.51	3.37
Oyster Landing, SC	3.47	4.08
Sewells Point, VA	3.11	3.60
Fernandina Beach, FL	2.55	4.26

Location	Inundation (ft) ¹	Storm Surge (ft) ²
Springmaid Pier, SC	2.52	3.14
Port Canaveral, FL	2.24	2.11
Mayport, FL	2.13	3.09
Fort Pulaski, GA	2.05	4.01
Wrightsville Beach, NC	2.01	2.36
Charleston, SC	1.93	3.55
Wilmington, NC	1.56	2.46
Beaufort, NC	1.41	2.08

¹ Inundation above Mean Higher High Water (MHHW): The average of the higher high-water height of each tidal day observed over the National Tidal Datum Epoch. This means the height of water levels in areas that are not typically wet due to standard tidal cycles.

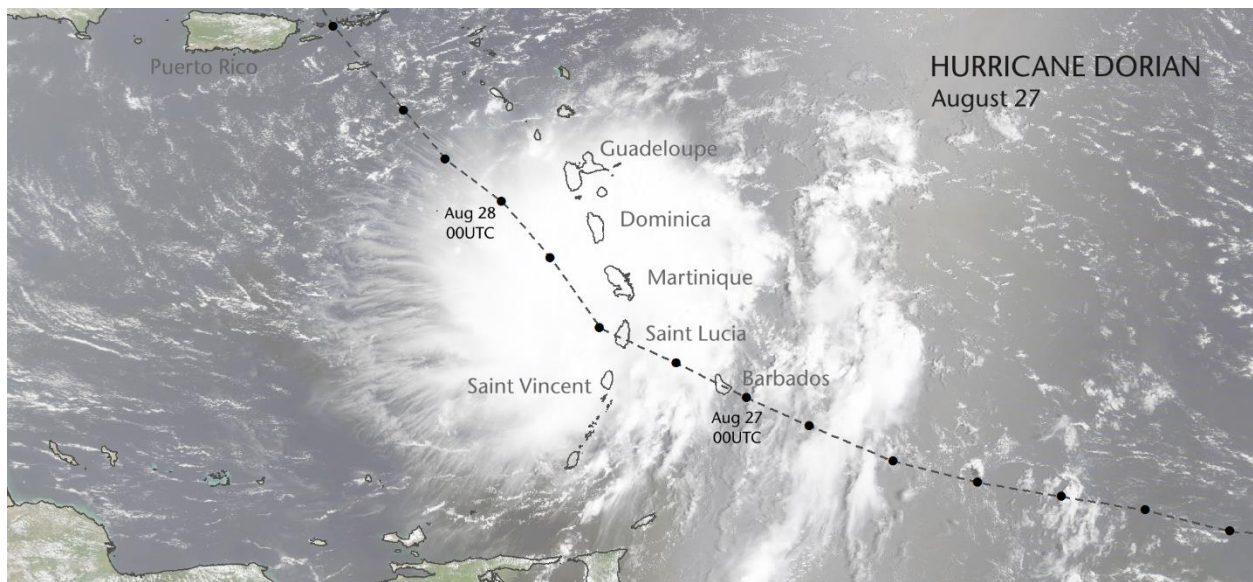
² Storm Surge: An abnormal rise of water generated by a storm, over and above the normal astronomical tide, and is expressed in terms of height above predicted or expected tide levels.



Event Details

Caribbean

The impact of Dorian in **Barbados** was largely limited. The local government suspended all public services and opened 38 shelters, although the eventual toll was negligible. The National Emergency Management Organization (NEMO) of **Saint Lucia** reported that virtually no losses occurred on the island. Meteorological Service of **Dominica** reported preliminary rainfall totals exceeding 100 millimeters (4.0 inches); impacts were minor and were limited to local power outages and mudslides.

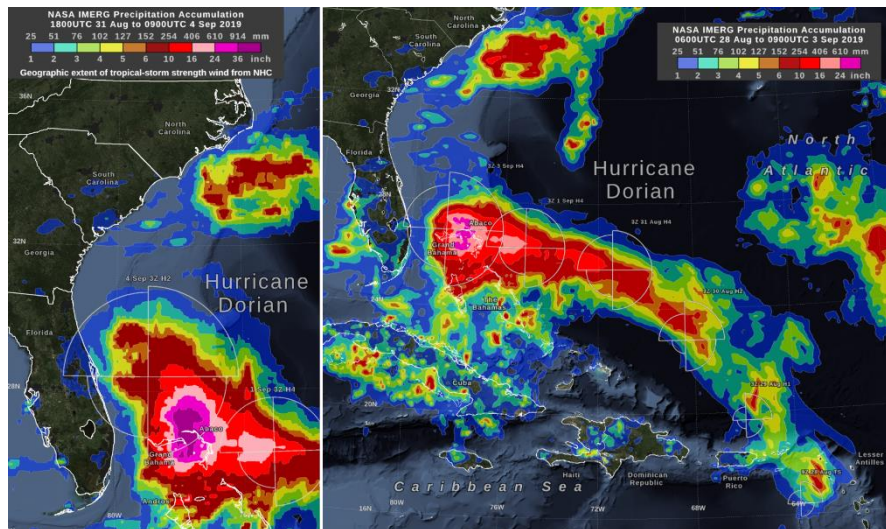


The most notable impacts felt on **Martinique** and **Guadeloupe** were due to intense rainfall on August 27-28 from the outer bands of the storm, as Dorian passed through the chain of the Windward Islands. Rainfall intensity rates in Martinique locally exceeded 60 millimeters (2.4 inches) per hour, particularly in the southern part of the island; which led to localized flooding and landslides. Roughly 4,000 homes in Martinique lost power and some minor damage was reported to homes and local businesses. The gusts of wind seldom exceeded 100 kph (62 mph) and marine hazards remained limited to high waves in the Saint Lucia Channel with maximum size of 5.0 meters (16 feet).

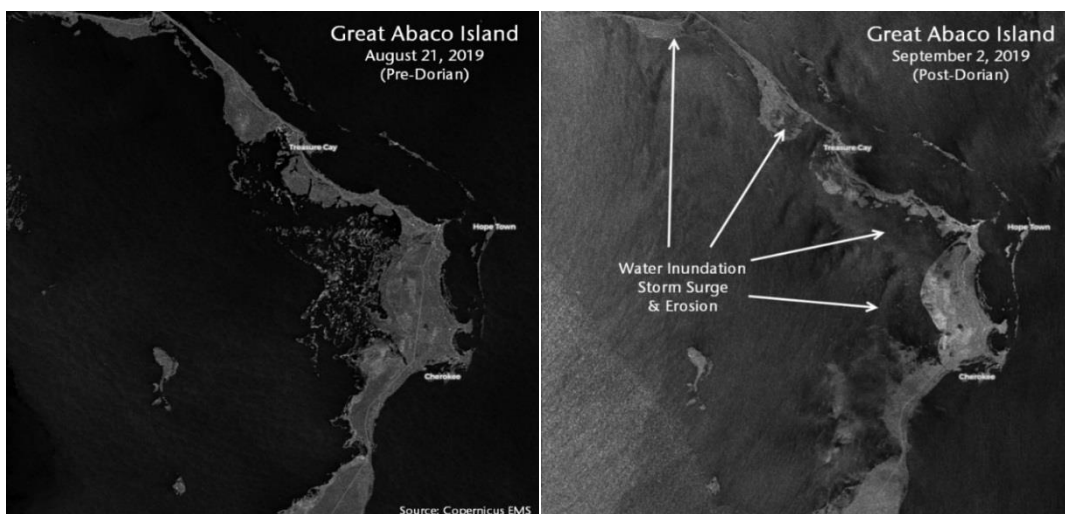
Largely minor damage was reported in the **Virgin Islands** which suffered from strong winds and rainfall during the passage of the storm. The islands of Saint Thomas and Saint John experienced complete blackouts as toppled trees and electricity poles disrupted power service. At the peak of the event, beyond the island-wide blackouts in Saint Thomas and Saint John, as many as 25,000 customers lost electricity in Saint Croix. Multiple roads were damaged and some structural damage, including damage to one mall, was noted in the capital city, Road Town. Impacts of Dorian were minor in **Puerto Rico** as well with the most significant impact being power outage to 23,000 households. Peak winds of 62 mph (100 kph) were cited in Culebra, and only 35 mph (56 kph) in San Juan. One fatality occurred when a man fell off his roof while preparing for the storm's arrival.

Bahamas

Striking as a Category 5 storm on September 1, Hurricane Dorian affected the Northern Bahamas for two consecutive days at near-peak intensity before tracking north towards the eastern coast of the United States. Dorian became the strongest storm on record to make landfall in Bahamas and caused catastrophic damage, particularly in the Abaco Islands and Grand Bahama. During the period from August 31 to September 4, the total accumulated rainfall over Grand Bahamas and Abaco Islands exceeded 36 inches (914.4 millimeters).



Dorian affected **Abaco** islands with 1-minute sustained wind speeds of 185 mph (295 kph), wind gusts reaching 200 mph (320 kph). Storm surge estimates ranged from 18 to 23 feet (5.5 to 7.0 meters). Initial reports from the area indicated significant coastal and inland flooding and severe damage in parts of Great Abaco – most notably to the north. Areas with predominantly non-engineered houses, like The Mudd and Pigeon Peas, were destroyed. In Marsh Harbour, the largest town on Great Abaco Island, nearly 60 percent of all homes were damaged. The Leonard M. Thomson International Airport on the island was completely flooded by up to 6.0 feet (1.8 meters) of water and rendered non-operational. The Treasure Cay airport was reportedly functional although with limited access due to flooded roads. Several docks on the island also suffered damage and an estimated 99 percent of boats in Elbow Cay had sunk.



After striking the Abacos, Dorian tracked west and made landfall on **Grand Bahama** later on the same day. The storm became nearly stationary over Grand Bahama while remaining at near-peak intensity for the next two days and brought heavy rainfall, strong gusts and high surge to the island. Within five hours of the storm's landfall, the Grand Bahama International Airport was inundated. Further, the flooding caused the main hospital on the island to cease operation. Homes and roads in Freeport, the largest town on the island of Grand Bahama, suffered extensive damage. According to the UN Office for the Coordination of Humanitarian Affairs (OCHA), 75 to 100 percent of buildings in parts of central and eastern grand Bahama were destroyed. Elsewhere, the island of **New Providence**, the most populous island of the Bahamas, experienced a complete disruption of power supply on September 2.



Source: U.S. Coast Guard (left) & U.S. Customs and Border Patrol (right)

It is worth mentioning that the Bahamas has some of the strongest building codes and best guidelines for enforcement in the world for an area that is of particular risk to tropical cyclones. Most buildings in the Bahamas are required to have metal reinforcements for roof beams that can withstand sustained winds of up to 150 mph (240 kph). This is equivalent to a high-end Category 4 hurricane. It was also seen in a majority of the Grand Bahama building stock, where most buildings were constructed of masonry and reinforced concrete. However, a large number structures on Great Abaco were of unreinforced wood frame construction and extremely vulnerable in low-lying areas. This enhanced the risk of major damage.

Furthermore, Dorian's extreme and long-duration winds – in addition to enormous coastal storm surge and flying/floating debris – took a severe toll on even the best build structures in the Northern Bahamas. This proves that even the best structures built to stringent codes can be vulnerable in upper echelon-type storm events.

Initial estimates indicated that more than 76,000 people in the Bahamas were affected by Hurricane Dorian and were in need of assistance. At the time of this report, at least 50 people were reported dead in Abacos (42) and Grand Bahamas (8). However, the death toll was expected to substantially rise as 1,300 people remained unaccounted for by government officials. According to the International Federation of Red Cross and Red Crescent Societies, at least 13,250 homes were destroyed in the affected region; or 45 percent of all homes. This total, too, was expected to rise as further assessments are conducted. Additionally, sea water carried inland due to storm surge contaminated fresh water wells, creating a shortage of potable water. An initial assessment by the World Food Programme indicated that 14,500 people in Abaco and 45,700 people in Grand Bahamas were in urgent need of food supply.

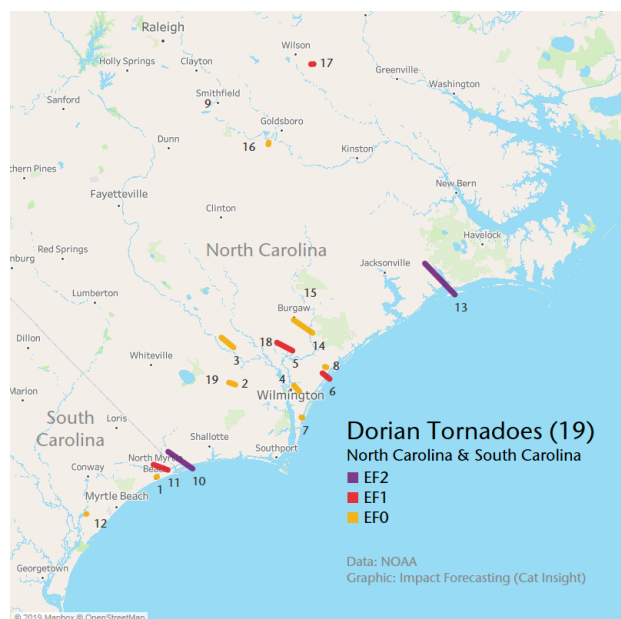
United States

The impacts of Hurricane Dorian in the United States were not as significant as initially feared; especially if early intensity and forecast track forecasts had verified. Regardless, the combination of hurricane-force winds, coastal storm surge, heavy rains, and isolated tornadoes were all responsible for damage in parts of Florida, Georgia, South Carolina, North Carolina, and Virginia – where states of emergency were declared prior to Dorian's arrival. At least nine fatalities were directly attributed to Dorian.



The most significant storm-related damage was incurred in **North Carolina** due to coastal flooding. The Outer Banks were particularly impacted as storm surge waters reached up to 7.0 feet (2.1 meters) in height, notably on Ocracoke Island as Dorian neared landfall on September 6. The floodwaters led to widespread inundation and property damage across the Outer Banks, with hundreds (if not thousands) of properties and vehicles being directly affected. Substantial infrastructure damage also occurred, and an analysis by the National Park Service Incident Management Team found that major wave erosion had completely reshaped many of the barrier islands of the Outer Banks. High winds – including a maximum wind gust of 110 mph (177 kph) on Cedar Island – across eastern sections of the state further led to nearly 235,000 power outages at the peak of the event as trees and power lines were downed. Heavy rains led to some instances of isolated flash flooding.

Another damaging aspect to Dorian in North Carolina were the more than 15 confirmed tornado touchdowns, including two rated EF2. The worst damage occurred on Emerald Isle, as a waterspout over water eventually came ashore and caused severe impacts to dozens of mobile homes, RVs, and other structures. A second waterspout which came ashore occurred near Tubbs Inlet in Sunset Beach, NC. Significant damage from the EF2 twister left dozens of homes severely damaged or destroyed. A preliminary report by the North Carolina Department of Transportation cited a damage cost of USD50 million to state roads and highways; significantly less than the USD266 million incurred by Hurricane Florence in 2018. Three people were killed in the state.



Further impacts were felt from Florida to Virginia, though not as significantly as initially feared. In **Florida**, tropical storm-force and hurricane-force wind gusts were cited along coastal areas from West Palm Beach to Jacksonville as sporadic power outages and downed trees were cited. Six storm-related fatalities were reported. Coastal storm surge of a few feet did cause notable beach erosion and some inundation, including around Fernandina Beach, though the core of Dorian stayed far enough from shore to minimize most impacts. In **Georgia**, the biggest damage came from downed trees and power lines – which resulted in roughly 20,000 outages – though impacts were largely minimal. However, lost business due to Dorian's threat during the Labor Day weekend is estimated to cost the tourism industry at least USD35 million around Savannah alone.

Dorian impacts in **South Carolina** were modest compared to initially anticipated, though the storm did lead to nearly 300,000 power outages at the peak of the event. Winds gusting to nearly 90 mph (150 kph) were recorded primarily along the coast in addition to multiple feet of storm surge. Areas around Charleston and Myrtle Beach did record wind and storm surge impacts, with local officials citing wind damage as greater than during Hurricane Matthew in 2016 due to its slow forward motion. Torrential rains resulted in further inland flood damage. In **Virginia**, tropical storm-force wind gusts – including a peak gust of 83 mph (134 kph) at Chesapeake Light Tower – resulted in nearly 50,000 power outages. Heavy rains and coastal flooding also affected eastern parts of the state, including Norfolk.

Canada

In Canada, Dorian resulted in notable damage with its expanding wind field and notable rainfall west of the storm's track. The province of **Nova Scotia** encountered destructive hurricane-force wind gusts along the southeastern, Atlantic coast between Yarmouth and Cape Breton. Major electricity provider reported more than 400,000 customers (around 76 percent) were temporarily left without power as Dorian swept through the region; likely breaking the record for the province. Strong winds toppled trees and power lines across the region, damaged roofs and incurred additional damage by flying debris. A construction crane fell on a building in downtown Halifax just prior to the storm making landfall.

All flight at Halifax Stanfield International Airport were cancelled in the afternoon of September 7, along with some flights at JA Douglas McCurdy Sydney Airport. Many ferry services between Nova Scotia and Newfoundland were postponed or cancelled, while notable disruption occurred on lines between the Prince Edward Island and the Canadian mainland.



Source: Nova Scotia Power

Notable rainfall totals were observed across the region - southwestern to central Nova Scotia, south and eastern New Brunswick, and western Prince Edward Island recorded storm totals reaching between 50 and 140 millimeters (2.0 and 5.5 inches). Additionally, considerable impact was reported due to storm surge along the Atlantic coast, with Halifax recording a surge of 1.5 meters (4.9 feet).

Significant damage was also reported from **Newfoundland**. At least 3,500 customers without power at the peak of the storm. Most of the damage has been caused by large, heavy trees being blown into the power lines due to the extreme high winds. Instances of damaged roofs were observed in Port aux Basques, where gusting winds peaked at 128 kph (80 mph). At least 78,000 customers were left without power in **New Brunswick** and 51,000 in **Prince Edward Island**.

Miscellaneous

Hurricane Dorian became the fifth Category 5 hurricane in the Atlantic Ocean in the past four seasons. The graphic below puts into context where these storms have traversed. Remarkably, four of the five storms (Dorian, Michael, Maria, and Irma) made official landfalls while at Category 5 intensity and left catastrophic damage in its wake.

Strongest Atlantic Hurricanes by Pressure

Rank	Hurricane	Year	Pressure (millibars)
1	Wilma	2005	882
2	Gilbert	1988	888
3	Labor Day	1935	892
4	Rita	2005	895
5	Allen	1980	899
6	Camille	1969	900
7	Katrina	2005	902
8	Mitch	1998	905
9	Dean	2007	905
10	Maria	2017	908

Strongest Atlantic Hurricanes by Sustained Winds

Rank	Hurricane	Year	Sustained winds (mph)
1	Allen	1980	190
2	Labor Day	1935	185
	Gilbert	1988	
	Wilma	2005	
	Dorian	2019	
6	Mitch	1998	180
	Rita	2005	
	Irma	2017	
9	11 storms	various	175

Strongest Atlantic Landfalls by Pressure

Rank	Hurricane	Year	Territory/State	Pressure (millibars)
1	Labor Day	1935	Florida	892
2	Gilbert	1988	Mexico	900
3	Camille	1969	Mississippi	900
4	Dean	2007	Mexico	905
5	1924 Cuba	1924	Cuba	910
6	Dorian	2019	Bahamas	910
7	Janet	1955	Mexico	914
8	Irma	2017	Barbuda	914
9	1932 Cuba	1932	Cuba	918
10	Michael	2018	Florida	919

Strongest Atlantic Landfalls by Sustained Winds

Rank	Hurricane	Year	Territory/State	Sustained winds (mph)
1	Labor Day	1935	Florida	185
	Dorian	2019	Bahamas	
3	Irma	2017	Barbuda	180
4	Janet	1955	Mexico	175
	Camille	1969	Mississippi	
	Anita	1977	Mexico	
	David	1979	Dominican R.	
	Dean	2007	Mexico	
9	1932 Cuba	1932	Cuba	165
	Gilbert	1988	Mexico	
	Andrew	1992	Florida	

Financial Loss

Damage assessments are well underway across the Bahamas, United States, Canada, and the Caribbean as officials try to fully take stock of the direct physical damage and interruption costs associated with Hurricane Dorian. It will likely take weeks until a full initial assessment is completed. The economic damage toll in the Bahamas – the Abaco Islands and Grand Bahama Island – is expected to reach well into the billions of dollars (USD). Many areas sustained near total destruction and will require a complete rebuild. The islands will require significant international assistance given the tens of thousands of residents which are now homeless and needing basic life necessities.

The economic cost in the United States and Canada is expected to exceed USD1 billion. While a notable financial impact, this is significantly less than initially feared given early track and intensity guidance. depending on how closely Dorian approaches the coastlines of North and South Carolina.

From an insurance industry perspective, there remains considerable uncertainty as to the expected cost in the Bahamas. The Bahamas Insurance Association (BIA) notes that insurance penetration on Grand Bahama and Great Abaco is higher than most other Bahamian islands outside of New Providence, which is home to the capital (Nassau). BIA tentatively suggested that payouts resulting from Dorian could be “significantly higher” than the USD400 million in payouts that resulted from Hurricane Matthew in 2016.

The Bahamas has already received a USD11 million payout as a member of the Caribbean Catastrophe Risk Insurance Facility (CCRIF). Dorian triggered the payout. The agency notes that the Bahamas has three separate tropical cyclone policies with the CCRIF: North West, South East, and Central. The North West policy was the one triggered by Dorian. Since its inception in 2007, the CCRIF has made 38 payouts worth roughly USD140 million to 13 of its 21-member governments.

About Aon

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