= Hurricane Otto (2010) =

Hurricane Otto produced days of torrential rain over much of the northeastern Caribbean in October 2010 . Otto originated as a subtropical cyclone lingering north of Puerto Rico on October 6 , and transitioned into a tropical storm the next day , the fifteenth of the 2010 hurricane season . Accelerating toward the northeast , Otto strengthened into a Category 1 hurricane on the Saffir ? Simpson scale on October 8 , attaining peak winds of 85 mph (140 km / h) . The storm began weakening due to incompatible surroundings and became extratropical west of the Azores on October 10 . Otto was the first Atlantic tropical cyclone on record to transition from a subtropical storm since Tropical Storm Laura in 2008 .

Drifting near the northeastern Caribbean for several days , Otto and its precursor disturbance brought prolonged rainfall to the Leeward Islands , the Virgin Islands , and Puerto Rico , triggering widespread flooding and numerous mudslides . Damage from the storm ? in particular to roads , property and infrastructure ? exceeded $ 22 million (2010 USD) , but there were no fatalities . After recurving toward the northeast , Otto proceeded across the open Atlantic without affecting any other landmasses .

= = Meteorological history = =

In late September , a large area of disturbed weather associated with two tropical waves formed just east of the Lesser Antilles . The disturbance drifted very slowly west @-@ northwestward , inhibited by strong wind shear that eventually caused the westernmost wave to dissipate . Albeit weak , an elongated remnant trough , or area of low pressure , persisted for several days , stalling over the extreme eastern Caribbean Sea as a nearby upper @-@ level cyclonic vortex retrograded to its north . By October 5 , the trough had drifted northward into a more favorable atmospheric environment over the Virgin Islands , which allowed the lowest pressures to extend to the surface . The low became well defined , interacting with the adjacent upper vortex to produce a wide convective band ? a concentrated region in which strong showers and thunderstorms can form ? over the northeastern Caribbean . Over the next day , the system continued to acquire a prominent subtropical structure : it developed a markedly larger wind radius than typically seen in pure tropical cyclones . Satellite observations also revealed that although the lower wind circulation was distinct , it had become intertwined with the cyclonic vortex aloft to its southwest , confirming the hybrid nature of the system . The National Hurricane Center (NHC) thus classified the system as a subtropical depression at 06 : 00 UTC on October 6 , when it was 265 mi (425 km) north @-@ northwest of San Juan , Puerto Rico .

The depression slid slowly northwestward between the contiguous upper vortex and a large high @-@ pressure region over the central Atlantic . A region of lighter wind shear ahead , as well as an anticipated weakening of the upper cyclone , prompted the NHC to introduce the possibility of a tropical transition . Later , satellite observations showed a rapid improvement in the depression 's structure ; convective banding wrapped completely around the broad inner wind field , which produced gusts to 65 mph (110 km / h) . Accordingly , the NHC upgraded the depression to Subtropical Storm Otto at 21 : 00 UTC on October 6 , about 215 mi (345 km) northeast of Grand Turk . Although satellite images continued to display a classical subtropical cyclone , with Otto 's center and the vortex aloft nearly collocated , data from a Hurricane Hunters aircraft indicated a weak warm convective core was developing within the mid levels of the circulation ? a feature normally present at the upper levels of tropical cyclones . Moreover , a contraction of the large wind field reaffirmed that Otto was entering the final stages of its tropical transition . Although convective activity briefly weakened overnight , weakening shear and considerably warmer sea surface temperatures permitted small patches of thunderstorms to refire on the morning of October 7 . As Otto meandered northward , temperature contrasts from forecast models indicated that the warm core within the circulation had ascended to the upper levels of the cyclone . In consequence , a burst of deep , tropical convection with extreme cloud top temperatures of approximately ? 112 ° F (? 80 ° C) occurred over the center . Having shed the last of its subtropical characteristics , Otto

became a warm @-@ core system and was operationally declared tropical at 1200 UTC that day .

Over the course of October 8 , Otto began to accelerate to the northeast under the increasing influence of a vertically deep trough off the US East Coast . Conditions aloft remained conducive , and the storm 's convection deepened symmetrically over the center to form a large , well @-@ defined central dense overcast . By 1200 UTC , Otto 's winds had reached 75 mph (120 km / h) while a mid @-@ level eyewall began to form , prompting the NHC to upgrade the storm to a Category 1 hurricane south of Bermuda . Further strengthening ensued as the newly formed hurricane proceeded over the warm waters of the central Atlantic ; microwave imagery revealed the eye , though obscured , was vertically well established , marking Otto 's peak strength with estimated winds of 85 mph (140 km / h) .

Upon peaking in intensity , Otto had become fully embedded within the deep @-@ layered flow to its southwest . Racing northeastward , the hurricane entered an area of progressively cooler waters and adverse upper atmospheric conditions , which eroded its cloud pattern and disrupted the circulation . With maximum winds dropping below 70 mph (110 km / h) , Otto was reduced to a tropical storm late on October 9 . Convective activity came to a near halt due to relentless wind shear and a lack of tropical moisture , leading specialists to conclude the storm was entering an extratropical transition . The next day , the cool dry air infiltrated the weak warm core , and Otto began to develop frontal banding features . With these characteristics , Otto became an extratropical cyclone on October 10 , and the NHC discontinued advisories on the storm . The post @-@ tropical system decelerated near the Azores over the next week , where it eventually degenerated into a remnant low that recurved sharply southeastward before completely dissipating west of Morocco on October 18 .

= = Preparations and impact = =

Otto and its precursor disturbance produced days of prolonged rainfall and gusty winds across the northern Leeward Islands , the Virgin Islands , and Puerto Rico . Localized flooding and rough sea conditions caused extensive road damage , infrastructure failures , and some beach erosion along coastlines . During the passage of the storm , numerous residents were left without water and power , and a state of emergency was declared for several Caribbean nations . Schools , businesses and some government offices across all of the Virgin Islands and Saint Kitts and Nevis were closed until storm conditions abated . The weather system ultimately accounted for substantial monetary losses throughout these areas , pinned at over $ 22 million (2010 USD) . In addition , Otto was widely regarded as one of the wettest storms in the history of the northeastern Caribbean , repeatedly shattering various rainfall records .

= = = Leeward Islands = = =

In Saint Lucia , downpours triggered torrential flooding along the island 's easternmost coast from October 5 through October 6 . In Dennery Quarter , flash floods affected about 500 households ; among them , 400 had their houses flooded or severely damaged . Several residences had to be evacuated , and some people were trapped in their homes . Residents also suffered from the absence of drinking water , lack of electricity , and the inability to prepare meals due to the loss of kitchen equipment and other utensils . In response , the area was declared a disaster zone ; a total of EC $ 500 @,@ 000 ($ 185 @,@ 185 USD) was approved to assist flood victims , as well as an additional US $ 44 @,@ 194 allocated from the Disaster Relief Emergency Fund of the International Federation of Red Cross and Red Crescent Societies .

Intermittent torrents battered Saint Kitts and Nevis for at least four days ; a total of up to 10 @.@ 99 inches (279 mm) of precipitation was recorded during that time . Several homeowners reported significant flooding , and a number of persons had to be rescued from their homes . Gusty winds generated rough sea conditions along coastal regions , resulting in some beach erosion and the collapse of a sidewalk section . Rains and associated floods topped a number of culverts and bridges , washed out the sides of some roadways , and damage to some utility lines , followed by

significant disruptions to electricity services . The exact amount of damage to the territory remains unknown , however .

In the U.S. Virgin Islands , heavy rainfall associated with Otto shattered numerous records for October across the US Virgin Islands , with a maximum total of 21 @.@ 52 in (547 mm) reported in Red Hook , Saint Tomas . The rain flooded roads and prompted officials opened shelters on all three islands on October 6 . In Saint Croix , a roadway section leading into Enfield Green collapsed , temporarily cutting the neighborhood off to traffic until a makeshift roadway was created the next day . In La Vallée , on the island 's north shore , floods and landslides affected low @-@ lying areas . Traffic on Saint Thomas and Saint John initially remained unhindered ; however , as the rain continued for several days , flooding , rockslides and asphalt erosion forced authorities to close several roads and highways . Damage estimates from the storm reached $ 2 million across the islands .

In the British Virgin Islands , a flash flood warning was in effect during the presence of Otto from October 6 to 8 . Torrential floods across the islands overturned several cars , and caused extensive damage to utility lines and drainage pipes ; dozens of people in Tortola ? specifically in Road Town ? were temporarily left without power and water . In total , an estimated 24 @.@ 98 inches (634 mm) of rain was recorded , and the government declared a state of emergency for the entire territory . Floods from the storm were regarded as the worst in the history of the British Virgin Islands . In total , damage across the islands was estimated at US $ 10 @.@ 5 million , considerably higher than losses ensured by major Hurricane Earl earlier in the year .

Widespread flooding from Otto was responsible for substantial increases in damage to the road network across Sint Maartin initially wrought by Earl , amounting to NA?1.5 million ($ 838 @,@ 000 USD) . On the French side of the island nation , torrents and associated floods in Saint Martin were accountable for similar property infrastructural damage ; monetary losses there totaled ? 800 @,@ 000 ($ 1 @.@ 12 million USD) .

= = = Puerto Rico = = =

Rain began to pour across several parts of Puerto Rico on October 5 , persisting for up to five days in some areas . The greatest amount of rainfall during the six @-@ day period of October 3 to 8 was registered at Rio Portugues in Ponce , with 17 @.@ 86 inches (454 mm) recorded . Due to the rainfall , the Government of Puerto Rico issued the closure of more than 40 roads , and an additional 19 streets were partially secured . Subsequent widespread flooding affected at least 295 roads , 14 of which suffered significant damage . In all , damage to road infrastructure was preliminarily estimated at US $ 6 @.@ 5 million . In addition , the municipality of Ponce reported copious losses in agriculture , later estimated at US $ 1 @.@ 5 million .

Following the overflow of the Arecibo River on October 7 , a neighborhood in Utuado was cut off from surrounding communities after gushing waters severely damaged its main road . Shortly thereafter , a landslide lugged a utility pole along the road , making it impossible for larger vehicles ? including ambulances ? to access the site . Landslides trapped fourteen families in the municipality of Ponce ; a residence alongside a road suffered significant damage and had to be evacuated . In Cayey , a district was isolated from neighboring areas due to the collapse of a bridge . In the area , burst riverbanks triggered floods across local streets , which trapped dozens of families in their homes . Severe flooding contaminated water supplies , leaving an estimated 45 @,@ 000 people without drinking water in the wake of the storm . In response , the government declared a state of emergency for the entire island . Authorities opened 120 shelters , and several flood victims had to be rescued .