

= Hurricane Earl (1998) =

Hurricane Earl was an atypical , short @-@ lived Category 2 hurricane that caused moderate damage throughout the Southeast United States . It formed out of a poorly organized tropical disturbance over the southwest Gulf of Mexico late on August 31 , 1998 . Tracking towards the northeast , the storm quickly intensified into a hurricane on September 2 and made landfall early the next day near Panama City , Florida . Rapidly tracking towards Atlantic Canada , the extratropical remnants of Earl significantly intensified before passing over Newfoundland on September 6 . The remnants were absorbed by former Hurricane Danielle two days later .

Moderate beach erosion occurred along the coasts of Louisiana , Mississippi , Alabama , and Florida as waves reached 20 ft (6 @. @ 1 m) . Throughout Florida , nearly 2 @, @ 000 homes were damaged and a few were destroyed . Severe flooding caused by storm surge and heavy rains was the main cause of damage in the state . Offshore , two men drowned after their boat capsized during the storm . A minor tornado outbreak took place in relation to Earl in Florida , Georgia , South Carolina , and North Carolina . A tornado in South Carolina killed one person after completely destroying the occupants home . In all , three people were killed by Earl and damages were \$ 79 million (1998 USD ; \$ 104 @. @ 4 million 2009 USD) .

= = Meteorological history = =

Hurricane Earl originated out of a strong tropical wave that moved off the west coast of Africa on August 17 . By August 23 , a weak area of low pressure developed within the wave and well @-@ developed convective activity was present as it tracked through the Lesser Antilles . Once in the Caribbean Sea , strong wind shear produced by the outflow of Hurricane Bonnie inhibited further development of the system . As it remained well @-@ defined , satellites easily followed the low pressure into the Gulf of Mexico . By August 31 , the storm had become sufficiently organized for the National Hurricane Center (NHC) to classify it as Tropical Depression Five . At this time , the depression was located roughly halfway between Merida and Tampico , Mexico .

Operationally , the NHC immediately classified the system as Tropical Storm Earl based on a Hurricane Hunter Reconnaissance mission that found flight @-@ level winds of 49 mph (79 km / h) , corresponding to surface winds of 40 mph (65 km / h) . Due to the existence of multiple circulation centers , the initial movement of the storm was uncertain , but forecasters anticipated a general northward movement . In post @-@ season analysis , it was determined that the system intensified into Tropical Storm Earl while located about 575 miles (925 km) south @-@ southwest of New Orleans . Initial advisories on Earl relocated the center of circulation several times before focusing on the true circulation center .

By September 1 , the storm began to consolidate , with reconnaissance flights finding an elongated center and surface winds of 60 mph (95 km / h) . Moderate wind shear inhibited convective development in the western portion ; however , outflow in other areas of the storm improved , leading to further development . A northwest track , fully identified by this time as a mid @-@ tropospheric ridge located over Florida , strengthened . Remaining disorganized , Earl continued to intensify as the center of circulation was located close to deep convection . The NHC stated in their fifth advisory on the storm that Earl did not appear to be fully tropical due to the lack of organization . Around 1200 UTC on September 2 , Earl intensified into a hurricane despite having an atypical structure ; the wind field of the storm was asymmetric and the strongest winds were located well to the southeast of the center .

Several hours after becoming a hurricane , Earl further intensified into a Category 2 hurricane on the Saffir ? Simpson Hurricane Scale ; this observation was based on a flight @-@ level winds of 119 mph (192 km / h) , which corresponded to surface winds of 100 mph (155 km / h) . The storm did not feature an eye or partial eyewall . The central barometric pressure continued to fall despite the fact that the storm was beginning to weaken . Around 0000 UTC on September 3 , the central pressure decreased to 985 mbar (hPa ; 29 @. @ 09 inHg) ; however , winds also decreased to 90 mph (150 km / h) . As Earl neared landfall , cloud tops significantly warmed , indicating weakening ,

and the overall structure of the storm became less organized .

Around 0600 UTC (1 : 00 am EDT) on September 3 , Hurricane Earl made landfall near Panama City , Florida with winds of 80 mph (130 km / h) . Shortly after landfall , the storm weakened to a tropical storm and rapidly accelerated as it quickly underwent an extratropical transition . By this time the NHC issued their final advisory on Earl . Several hours later , Earl finished its transition and continued to rapidly track through the Southeast United States . After entering the Atlantic Ocean , the remnants of Earl began re-intensify due to the effects of a baroclinic zone . Relatively cool sea surface temperatures near Atlantic Canada prevented tropical development ; however , during a 36-hour span , Earl rapidly intensified , as the central barometric pressure decreased by 40 mbar (hPa ; 1.0 @ 18 inHg) to 957 mbar (hPa ; 28.0 @ 26 inHg) . By the time the system made landfall over eastern Newfoundland , sustained winds had intensified to 65 mph (100 km / h) . On September 8 , the remnants of Earl significantly weakened and were soon absorbed by a larger extratropical cyclone associated with the remnants of Hurricane Danielle .

= = Preparations = =

As Earl tracked towards the northeastern Gulf of Mexico on September 1 , a hurricane warning was issued for coastal areas between Pascagoula , Mississippi and Cameron , Louisiana . Additionally , hurricane watches extended out to Destin , Florida and High Island , Texas from the edges of the warning respectively . Early the next day , a tropical storm warning was issued for areas between Pascagoula , Mississippi and Destin , Florida . In response to the eastward movement of the hurricane , the hurricane watch and warning was discontinued for areas west of Morgan City , Louisiana . Additionally , the hurricane warning was extended eastward to Destin , Florida , a tropical storm warning was issued east of Destin to Apalachicola , Florida , and a tropical storm watch was declared for areas between Morgan City and Cameron , Louisiana . Several hours later , the hurricane warning was again extended eastward to the mouth of the Suwannee River . All watches and warnings were discontinued for areas west of Pascagoula , Mississippi and due to the asymmetrical structure of Hurricane Earl , a tropical storm warning was issued as far south as the Florida Keys . Continuing uncertainty in the track of Earl prompted the issuance of a hurricane watch and tropical storm warning for areas between Pascagoula , Mississippi and Grand Isle , Louisiana , including the city of New Orleans . After Earl made landfall in Florida , all watches and warnings were discontinued in relation to the storm .

Offshore , several oil and natural gas rigs were evacuated due to the proximity of Earl . An estimated 10,000 workers were evacuated from both onshore and offshore rigs . The storm forced many Florida residences to evacuate , especially people living in the barrier islands along the Florida Gulf Coast . About 30 Air Force jets from Eglin Air Force Base were sent to Oklahoma to protect them from the storm . A mandatory evacuation was issued for 20,000 residents in Leon County as well as all barrier islands along the Florida coast due to the risk of substantial flooding . Franklin County was briefly under a mandatory evacuation order on September 2 , the reasons for the lifting of the order are unknown . State parks along the Florida Panhandle were also closed and highways became congested with thousands of residents and tourists evacuating the barrier islands .

Along the Louisiana coastline , voluntary evacuation orders were given out . A state of emergency was declared for portions of southeast Louisiana as tides in relation to the storm were forecast to reach 7 to 10 ft (2.0 @ 1 to 3.0 m) . Emergency shelters were opened throughout Plaquemines Parish , schools were closed in many areas , and the floodgates around New Orleans were shut . An estimated 5,000 people evacuated to inland areas throughout Louisiana . In Nueces County , Texas , work crews worked quickly to clear garbage along the streets and picked up trash cans to avoid possible problems with clogged drains . Throughout the Alabama and Mississippi coasts , schools were closed due to the storm .

= = Impact = =

Throughout the Southeast United States , Hurricane Earl killed three people and caused \$ 79 million (1998 USD ; \$ 104 @. @ 4 million 2009 USD) in damages .

= = = Florida = = =

Ahead of Hurricane Earl 's landfall in Florida , several tornadoes were spawned along the outer bands of the storm . The first tornado to touch down was a brief F0 that caused no known damage . The second tornado , rated F1 , caused moderate damage to three homes and two buildings that were under @-@ construction along its 3 mi (4 @. @ 8 km) path . During a 15 @-@ minute span , three brief F0 tornadoes touched down in unpopulated areas , causing minor tree damage . Several hours later , a strong F1 tornado touched down in Port Canaveral . The tornado damaged 14 cars , eight condominiums , four businesses , a mobile home , and a fire station . In all , the tornado caused \$ 6 million in damages and injured one person . On St. George Island , an F1 tornado damaged six homes , leaving \$ 150 @, @ 000 in damages . High waves , estimated at 16 to 20 ft (4 @. @ 9 to 6 @. @ 1 m) caused a boat to capsize off the coast of Panama City , drowning both occupants .

Upon making landfall in Florida early on September 3 , Earl produced a storm surge up to 12 ft (3 @. @ 7 m) in the Big Bend , inundating coastal communities . Torrential rains , peaking at 16 @. @ 36 in (416 mm) around Panama City , fell throughout the Florida Panhandle . Significant beach erosion was recorded in Walton County , Carrabelle Beach and Alligator Point . The most extensive damage occurred in Bay County where 1 @, @ 112 structures damaged by flooding and three were destroyed . In Panama City , upwards of 5 ft (1 @. @ 5 m) of water flooded homes . An estimated 7 @, @ 100 residents in Bay County lost power during the storm . Florida officials temporarily shut down numerous major roadways , including State Road 77 due to high water . Portions of two roads in coastal Liberty County were destroyed due to beach erosion . In Gulf County , 300 homes were damaged by high winds and floodwaters . An estimated 8 @, @ 700 people lost power in the county during the storm . At Port St. Joe , Earl 's storm surge inundated 14 businesses and caused a water main break in the Lighthouse Utilities facility . In Franklin County , storm surge damaged 136 homes and 15 businesses and led to a temporary closure of the St. George Causeway . A lighthouse on St. George Island was also destroyed by the storm .

At least 50 people were stranded in Alligator Point after floodwaters washed out the main access route to the town . In Wakulla County , 216 homes and businesses were damaged by high winds and flooding . Severe flooding in coastal Taylor County caused significant damage in nine communities . County officials reported that 66 structures were damaged by Earl . Five homes were destroyed and 39 others were damaged by flooding in Dixie County . In Highlands County , one person was injured after being struck by lightning . On September 3 , the strongest tornado spawned by Earl in Florida touched down in Citrus County . Rated F2 , the tornado tracked for 5 mi (8 @. @ 0 km) , destroying eight homes and damaging 24 others . Several trees and power lines were also downed . Two people were injured in one of the destroyed homes and damages from the tornado amounted to \$ 500 @, @ 000 . In all , Hurricane Earl killed two people and caused \$ 73 million (1998 USD ; \$ 96 @. @ 5 million 2009 USD) in Florida .

= = = Southeastern U.S. = = =

In Louisiana , moderate beach erosion occurred as tides reached 3 @. @ 5 ft (1 @. @ 1 m) above mean sea level . Rainfall was relatively light , peaking around 2 in (51 mm) in Morgan City , as only the outer bands of Earl affected the state . The highest winds occurred along the coast , with sustained winds reaching 30 mph (45 km / h) and gusts reaching 44 mph (71 km / h) in Venice , Louisiana . Only minimal damage resulted from the storm in Louisiana , with monetary losses amounting to \$ 32 @, @ 000 . However , losses due to the large @-@ scale evacuation of oil and natural gas rigs was estimated to be several million dollars . Earl had limited impacts in Mississippi , with only areas along the immediate coast recording tropical storm @-@ force wind gusts . In Alabama , Earl produced moderate rainfall , with areas along the Georgia state line receiving more

than 5 in (130 mm) . Despite the center of Earl passing close to the state , winds were only recorded up to 40 mph (65 km / h) , resulting in scattered power outages and downed trees . Portions of Alabama State Route 28 were temporarily shut down due to debris covering the road . In all , damages in the state amounted to \$ 120 @, @ 000 .

Ahead of Earl , an onshore flow related to the storm produced 6 to 8 ft (1 @. @ 8 to 2 @. @ 4 m) swells along the Georgia coast , causing significant damage to marinas . The Mar Lin Marina sustained the most damage from this event ; all the docks were destroyed , 30 boats were damaged and six were destroyed . Damages to the marina and boats amounted to \$ 1 @. @ 3 million . Heavy rains fell throughout central areas of the state , with the highest amounts nearing 10 in (250 mm) . Because Earl rapidly weakened upon landfall , the highest winds in Georgia only reached 54 mph (87 km / h) . Numerous trees and power lines were downed , resulting in scattered power outages . Throughout Georgia , an estimated 10 @, @ 400 people lost power due to Earl . Several streets were flooded due to the rains , resulting in traffic accidents . One tornado was spawned by Earl in Georgia ; rated F2 on the Fujita scale , the tornado tracked for 8 mi (13 km) in Screven County . Estimated at 350 yd (320 m) in width , the tornado destroyed five mobile homes and a business , severely damaged 15 additional mobile homes and caused some damage to five others . Seven people were injured by the tornado and damages amounted to \$ 435 @, @ 000 . Several major highways were temporarily closed due to high water or debris covering the road . Numerous homes sustained damage from fallen trees in several counties . In all , damages from Earl amounted to \$ 2 @. @ 3 million in Georgia .

The extratropical remnants continued through the Southern United States , tracking through the Carolinas late on September 3 . Sustained winds in South Carolina reached 50 mph (85 km / h) and gusted up to 70 mph (110 km / h) . Widespread rainfall , generally amounting between 2 and 4 in (51 and 102 mm) , fell in areas previously saturated by Hurricane Bonnie , this triggered minor flooding along roads . Inland , isolated amounts of 10 in (250 mm) of rain fell . The first tornado related to Earl touched down in Choppee , located in Georgetown County . The tornado was rated F0 and was only briefly on the ground before it dissipated . The second tornado to touch down in the state was also the strongest in relation to Earl . Rated F2 , the tornado tracked for 18 mi (29 km) through Beaufort and Colleton Counties , destroying 13 homes and damaging 13 others . One mobile home was flipped in the air and was completely destroyed once it hit the ground , instantly killing the occupant of the home . Numerous trees were uprooted and snapped along its path . In all , the tornado killed one person , injured four others and caused \$ 360 @, @ 000 in damages . A brief F1 tornado touched down several hours later , damaging the roof of a barn and uprooting several trees before dissipating . The most damaging tornado spawned by Earl was a 430 yd (390 m) wide , F2 tornado that struck the Fairlawn subdivision near Moncks Corner . Along the tornado 's 7 mi (11 km) track , 21 homes were destroyed and 73 others were damaged . Nine people sustained injuries due to the tornado and damages amounted to \$ 2 @. @ 8 million .

Still recovering from Hurricane Bonnie , the remnants of Earl produced widespread rain over North Carolina , triggering flooding . Upwards of 6 in (150 mm) fell in localized areas , causing small streams to overflow their banks . In Union County , up to 15 roads were shut down due to flooding , a few cars were also washed off roads at the height of the floods . In Charlotte , several roads were flooded . The Carteret Community College , which was severely damaged by Bonnie , was again damaged by Earl . High winds from the storm damaged temporary protective measures , allowing rain to flood the interior of the building , causing water damage to the structure and materials inside . In front of the Crystal Coast Civic Center , gabriiform , installed to stabilize the beach , was damaged by the storm , resulting in significant beach erosion . Two short lived tornadoes touched down in North Carolina from Earl . The first , an F0 , damaged at least 15 mobile homes , overturned sheds , destroyed a porch and two campers . No injuries resulted from the tornado and damage amounted to \$ 50 @, @ 000 . The second and stronger of the two tornadoes , rated F1 , only touched down for a few seconds ; however , it destroyed one home and severely damaged a neighboring home . According to eye @- @ witness reports , the tornado lifted the home 20 to 25 ft (6 @. @ 1 to 7 @. @ 6 m) off the ground before the home broke apart and fell to the ground .

= = = Elsewhere = = =

The initial tropical disturbance passed through the Yucatán Peninsula on August 29 and inflow bands to the south of Earl continued rainfall across southeast Mexico until early September 2 . The highest rainfall total was reported from Belizario Dominguez / Moto , where 12 @.@ 94 in (329 mm) of precipitation fell .

The extratropical remnants of Earl produced strong winds and heavy rains throughout Newfoundland and Nova Scotia on September 6 . Sustained winds were recorded up to 56 mph (90 km / h) and rains totaled between 2 and 4 in (51 and 102 mm) throughout Newfoundland . On Nova Scotia , rainfall peaked at 4 @.@ 62 in (117 mm) on Cape Breton Island . The highest recorded total on Newfoundland reached 3 @.@ 54 in (90 mm) in northwestern areas of the island .

= = Aftermath = =

On September 4 , President Bill Clinton approved disaster declarations for six counties in Florida . Bay , Dixie , Franklin , Gulf , Taylor , and Wakulla counties were approved for Individual Assistance . Residents in the designated counties were eligible to receive federal funding for three months following the storm . By September 8 , State Farm had received 200 auto and 720 homeowners claims from the affected region , most of which were partial damage claims . Allstate had received 80 auto and 587 homeowners claims from Florida and 540 claims from Georgia . Additionally , Nationwide reported that up to 1 @,@ 000 claims had been filed from Florida .

Following the impacts of Hurricane Opal in 1995 , Earl and later Hurricane Georges , the state of Florida undertook a recovery project to restore the eroded beaches along the Panhandle coast . In October United States Department of Transportation provided \$ 2 million in funds to repair damaged and destroyed roads in Florida . On December 3 , an additional \$ 1 @.@ 7 million was provided to repair funds . The United States Military allocated \$ 2 @.@ 2 million to repair damage from Hurricane Earl to training academies and naval ports . The Florida Senate provided \$ 25 @,@ 740 in emergency funds to Hurricane Earl victims . By the end of the disaster declaration , the Federal Emergency Management Agency provided \$ 1 million in public assistance and \$ 600 @,@ 000 in disaster mitigation .