

Hurricanes in North Carolina

North Carolina has been affected by 403 tropical cyclones (of which 50 became hurricanes) from 1896 until present (2014). Due to its Atlantic coast location, many hurricanes have hit the state directly, while others have caused extensive damage merely passing near the state. Historically, North Carolina ranks fourth nationally in number of hurricanes that have impacted the state. Estimated cost in lives and damage is almost 1000 fatalities and over \$11 billion dollars, respectively.

According to statistical research from the North Carolina State Climatology Office, a hurricane makes landfall along the North Carolina coastline about every four years. Furthermore, an estimated 17.5 percent of all North Atlantic hurricanes have affected the state. Cape Hatteras is the location most affected by hurricanes, followed by Cape Lookout and Cape Fear. The Outer Banks are also often heavily impacted by hurricanes due to being geographically located in the easternmost part of the state. Furthermore, although the eastern portion of the state frequently bears the brunt of Atlantic hurricanes, remnants from Gulf and other southeastern hurricanes have historically caused significant damage in both the piedmont and mountain regions of the state.

Hurricanes have affected North Carolina between May and December, although the official hurricane season for North Carolina is June 1 – November 30, with the 80 percent of the hurricanes that have affected the state arriving between August and October. The earliest storm to hit the state was Subtropical Storm Andrea on May 7, 2007, and the latest was a tropical storm that hit the Outer Banks on December 2, 1925. The most powerful hurricane to hit the state was Hurricane Hazel, a Category 4 hurricane that landed on October 15, 1954.

One of the most active and the most costly era of hurricane activity in North Carolina has occurred in between 1980 and 2010. Of this period, Hurricane Fran stands out as the strongest hurricane as a Category 3, and Hurricane Floyd as the most deadly with 35 fatalities attributed to this storm, and record-breaking flooding in the eastern region of the state. This USGS website, <http://pubs.usgs.gov/wri/wri004093/rainfall.html>, analyzes the flooding impact from Hurricanes Dennis, Floyd, and Irene which occurred within a 6-week period between September 4 and October 17, 1999.

The list below (from the website, <http://www.midatlantichurricanes.com/NorthCarolina.html>) captures significant North Carolina hurricane history since 1954.

1954 Hurricane Hazel on October 15 became the most intense hurricane to make landfall in North Carolina during the 20th century. The Category 4 hurricane swept inland near South Carolina, making shambles of many North Carolina beach communities. Destructive winds

affected the eastern quarter of the state, with reports of 100 mph+ gusts north to the Virginia border. Isolated flash flooding occurred west of Hazel's track.

1955 Hurricanes Connie, Diane and Ione struck within six weeks causing epic flooding in eastern sections. Connie on August 11-12, Diane on August 16-17 and Ione on September 19 dumped a combined 48.9 inches at the Maysville cooperative weather station. Connie and Ione were Category 2 hurricanes at landfall, while Diane was a Category 1.

1960 Category 3 Hurricane Donna plowed just inside the Outer Banks region on September 12, making landfall at Cape Fear. Sustained winds were 115 mph at Cape Fear, and remained above hurricane force throughout Donna's 150 mile trek through the state. Rainfall totals were generally 4 to 8 inches, with some higher amounts.

1972 Hurricane Agnes made landfall on the Florida Gulf coast, before tracking through the southeastern US. Torrential rainfall pummeled the western two-thirds of North Carolina on June 20-22 causing extensive flooding.

1989 Hurricane Hugo struck near Charleston, South Carolina, on September 21-22, then gradually swung northwest, north and northeast. The Category 4 weakened to a Category 1 as it plunged more than 200 miles inland before tracking through the Charlotte area. It caused extensive damage with winds still gusting near 100 mph.

1996 Hurricane Bertha struck the state on July 12, with a peak gust of 108 mph. Hurricane Fran churned through eastern North Carolina on September 5, with sustained winds up to 115 mph. Not since 1955 had the state experienced two hurricane landfalls in the same season.

1999 Hurricane Dennis soaked the state in late August and early September followed by Hurricane Floyd on September 16. Floyd, a Category 2 storm that made landfall just west of Cape Hatteras, dumped 10 to more than 20 inches in eastern North Carolina causing record flooding and an environmental catastrophe.

2003 On September 18, Hurricane Isabel slammed Ocracoke and preceded to plow through northeastern North Carolina. Category 2 Isabel caused widespread power outages and coastal flooding. It blew down countless trees.

2011 Hurricane Irene came ashore in eastern North Carolina on August 27 as a Category 1

storm, with 85 mph sustained winds. More than 1100 homes were destroyed. Irene became only the third hurricane to make landfall on the U.S. East Coast north of Florida in this century.

The following link from the State Climate Office of North Carolina offers viewer interactive graphing of some North Carolina hurricane statistical data: <http://www.nc-climate.ncsu.edu/climate/hurricanes/statistics.php>

As discussed previously, besides hurricane damage from wind, the other destructive physical force from hurricanes is flooding. However, flood events in North Carolina are not always tied to hurricanes or subtropical storms. North Carolina is considered a water-rich state. The state is ranked number 9, nationally, with a statewide average annual rainfall of 50.3 inches per year. Sadly, though, sometimes this abundant rainfall comes with a price in the form of flooding.

This informative link contains a vast amount of information on flooding in the Tar-Pamlico basin: http://www.ncfloodmaps.com/pubdocs/Final_Basin_Plan_TarPamlico.pdf

The websites cited below contain links to additional flood mapping basin plans and the USGS North Carolina quasi real time and dynamic North Carolina Flood Watch:

http://www.ncfloodmaps.com/initial_basin_plans.htm

<http://nc.water.usgs.gov/flood/>

The websites cited below contain links to scientific articles regarding recent hurricane events in the Tar-Pamlico river basin:

<http://onlinelibrary.wiley.com/doi/10.1029/00EO00338/pdf>

http://cfdl.meas.ncsu.edu/publication/references/Tang_etal_2012_TCR.pdf