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TROPICAL CYCLONES AFFECTING NORTH CAROLINA SINCE 1586 - AN HISTORICAL PERSPECTIVE

JAMES E. HUDGINS

National Weather Service Office
Blacksburg, Virginia

Scientific Services Division
Eastern Region Headquarters
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Carlos M. Gutierrez
Secretary

National Oceanic and
Atmospheric Administration
Conrad C. Lautenbaucher, Jr.
Under Secretary and Administrator

National Weather Service
John L. Hayes
Assistant Administrator

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Editor's Note

This Memorandum replaces the **NOAA Technical Memorandum NWS ER**-92, "A Historical Account of Tropical Cyclones that have Impacted North Carolina Since 1586" written by James E. Hudgins. This memorandum is updated to give a complete list of storms through 2005. In addition many of the track figures were updated for more detail and presentation quality. Also included are radar and satellite pictures where available especially with many of the systems since the 1990s and later.

Section 2 contains the summary of all the storms. A couple storms have been removed from the previous Memorandum (NWS ER-92) because the storms were either reclassified as nontropical or did not affect North Carolina. In addition a new storm was added during 1856 to indicate two systems with different dates rather than only one storm from the previous publication. The bibliography does not include the list of sources from the previous memorandums, but it is listed in appendix D.

1. INTRODUCTION

This report is a compilation of the tropical cyclones for which historical information could be found that have struck North Carolina, had any effect on the state, or passed close enough offshore to have been a serious threat to the coastal area during the period from 1586 through the 2005 hurricane season. The decision as to whether some early storms met these criteria was made rather subjectively, since information as to both path and effects was incomplete and highly variable.

The storms are ordered chronologically, earliest to latest. Each storm is titled with the date(s) it affected North Carolina, the storm name (for storms after 1950), the intensity of the storm (refer to appendix A), and a figure showing the track of the storm. The intensity of the storm or category of the hurricane is the intensity at the time the storm was influencing North Carolina. Each storm has a description of where and what affect it had on North Carolina, if known. In addition to the storm tracks, are satellite and radar pictures where available for the more current storms. Maps depicting the geographical breakdown (Fig.1) of the state by elevation, as well as the counties and some of the more important reference locations (Fig. 2) are also included.

Where available, information on maximum (or near maximum) wind speed experienced in connection with the storm is given. Prior to about 1870, actual measurements were not made, so only descriptive statements gleaned from news accounts are given. All too often, these described the winds as having been the strongest in the memory of the oldest inhabitants. In the days of the U. S. Signal Corps, and even the Weather Bureau until about 1940, the highest wind given for a storm was usually the "maximum velocity," which was an average over a minute period. In recent years, the highest sustained wind used by the Weather Service is an average over a 1-minute period. When available, the speed of the highest instantaneous gust is also listed. It should be kept in mind that where a value for “maximum velocity” is given, the 1-minute average and the peak gusts probably would be higher.

The descriptions of the early storms may reflect their severity or the amount of material which could be located. Even in the early 20th century, the availability of news accounts varied greatly. The likelihood of the occurrences of unrecorded significant storms is high prior to about 1870. Therefore, there may be many storms in the 17th, 18th, and 19th centuries which were not recorded.

The principle source of descriptive information prior to about 1910 was files of North Carolina newspapers, none of which are complete prior to 1879. Other sources include books, scientific journals, and technical reports. Early newspaper accounts were usually delayed, due to temporary breakdown of communications and disruption of travel as a result of the storms. For a number of cases, North Carolina newspapers carried lengthy dispatches of storm news from Savannah, Georgia, Charleston, South Carolina, Norfolk, Virginia, and New York City, New York, with little or no information on the storm

effects in North Carolina; this may also have been due to poor communications with immediate coastal regions, and especially the Outer Banks of North Carolina.

With the advent of the Saffir/Simpson Scale (Simpson and Riehl 1981) (appendix A) in 1971, hurricanes are categorized by using the numbers one through five based on the intensity of the hurricane. The Saffir/Simpson Scale is based on wind speed, storm surge, or central pressure of the hurricane. The scale also gives potential property damage and expected flooding. Based on the Saffir/Simpson Scale, hurricanes affecting North Carolina from 1899-2005 have been categorized in this publication.

Some of the hurricanes before 1899 have one word descriptions such as “major”, “great” or “extreme.” These descriptive words were based mostly on property damage and/or deaths associated with the storms. The descriptive abbreviations used in this report are also listed in appendix A. Appendix B breaks the history into geographical region. A summary of the tropical cyclones broken down by month is found in appendix C. Appendix D lists the sources of information used by James Stevenson in the **NOAA Technical Memorandum NWS ER-83** and James Hudgins in the **NOAA Technical Memorandum NWS ER-92.**

2. TROPICAL CYCLONES AFFECTING NORTH CAROLINA

2.1. Sixteenth Century

Accounts of storms that affected North Carolina during the first two centuries following the discovery of America are few. The three known 16th century storms, all very likely tropical hurricanes, occurred within a six year period. They are known because of the expeditions to Roanoke Island.

June 23-26, 1586

Sir Francis Drake arrived offshore at Roanoke Island, and “...there arose a great storm (which they said was extraordinary and very strange and last three days together) and put our fleet in great danger.”

August 31, 1587

“There arose such a tempest at northeast that our Admiral (Drake), then riding out of harbor, was forced to cut his cables and put to sea, where he lay beating off and on six days before he could come to us again.”

August 26, 1591

Roanoke Island was again beset by a severe storm. “For at this time the wind blew at northeast and direct into the harbor so great a gale that the sea broke extremely on the bar, and the tide went out forcibly at the entrance.”

2.2. Seventeenth Century

Three hurricanes also appeared to have affected North Carolina during the 17th century, all occurring within a 4-year period. The first storm was originally recorded as two separate storms, due to confusion of dates from the change to the Gregorian calendar.

September 6, 1667

A great storm struck at least the northern part of the Outer Banks, destroying the corn and tobacco crops, and demolishing or damaging a number of buildings. There are detailed accounts of the storm in Virginia, but only fragmentary accounts for North Carolina. Twelve days of rain was said to have followed the storm in Virginia.

August 18, 1669

A hurricane was reported to have struck the northern Outer Banks.

August 6, 1670

The northern Outer Banks again felt the fury of a hurricane.

1699

In addition, a severe hurricane hit South Carolina on an unknown date in 1699. It probably also had some effects on North Carolina.

2.3. Eighteenth Century

September 16-17, 1713

There are several accounts of a violent hurricane affecting Charleston, South Carolina and northward at this time, with the following remark indicating the storm's greatest violence may have struck the Cape Fear section: “ships were drove from their anchors far within land, particularly a sloop in North Carolina was drove three miles over marshes into the woods.”

August 13, 1728

A severe storm was reported to have done much damage at Charleston, South Carolina. Many ships were lost, one as far north as few miles off Ocracoke.

October 18-19, 1749

A severe hurricane moved through the middle Atlantic coastal waters, and caused damage as far south as Ocracoke, where nine ships are said to have been lost. Very high tides were reported on the Outer Banks.

August 18, 1750

Referred to in Colonial accounts as the “Great Storm of August 18, 1750”, this terrible tempest, among other damage, wrecked or drove five ships of the Spanish Flota onto the North Carolina coast. A letter from Governor Dobbs to the Earl of Loudoun, July 10th, 1756, states, “Last summer...I found a violent storm about five years ago had carried away Beacon Island, which was near two miles long, and all the banks here in time may be liable to the like fate...” Possibly this was the storm of August 18th, 1750, or one of the September, 1752 storms.

September 15, 1752

This storm was very destructive at Charleston, South Carolina, but accounts of its effects in North Carolina are confused, and difficult to separate from those of a second storm on September 30th.

September 30-October 1, 1752

On the southern North Carolina coast: “The wind blew so hard it stemmed the Gulf Stream in its northern course and threw it on the shores.” “At 9 o'clock the flood came rolling in with great impetuosity and in a short time the tide rose 10 feet above the high water mark of the highest tide.” This was presumably at or in the vicinity of Wilmington. This appears to have been the storm that destroyed the Onslow County seat, then on the coast, so that it was rebuilt at an inland location.

Years of 1753, 1757, 1758, 1761

Five other storms, known to have caused damage in nearby areas, may have been felt to some degree in North Carolina. These occurred on: September 1753, October 1757, August 23, 1758, May 4, 1761 and June 1, 1761.

September 23, 1761

A hurricane of great intensity raked the coast of North Carolina, causing much damage both ashore and at sea. A new inlet cut at a place called the Haul-Over, between Cedar House and Bald Head, was 18 feet deep at high water and nearly a mile wide. This inlet remained open for more than 100 years.

1766

A hurricane on the Virginia coast on September 11th, 1766, may have struck in North Carolina.

September 6-7, 1769

Unprecedented tides and winds of terrible force attended this hurricane on the North Carolina coast. Information was available primarily for the New Bern area, where the Governor spoke of the "calamities arising from the extreme violence of the late storm" and the destruction of the banks of their two rivers. The tide was said to have risen 12 feet higher than ever before and the wind blew so that nothing could stand before it. Two-thirds of the effects of New Bern were destroyed; houses in town were undermined by water and floated away or collapsed. One entire street of houses was swept off with some of the inhabitants. Many thousands of trees were blown down. Many houses were said to have blown down in the general area, including the Court House of Brunswick County. Damage was probably general throughout at least the coastal area, for in response to his request for aid to New Bern, the House of Representatives informed Governor Tryon: "But the calamities, losses and misfortunes occasioned thereby being general, we cannot...think of granting them (New Bern) assistance in preference to any other part of the Province..."

September 2, 1775

The Congress advanced forty shillings to each volunteer from Pasquotank County, North Carolina, for the purchase of corn and other provisions... "the same being almost totally destroyed by a storm of the 2nd day September last (1775), the notoriety of which this Congress being sensible of . . ."

August 10, 1777

One meteorological source lists a tropical storm or hurricane as having occurred in the Carolinas. No confirmation could be located.

August 11, 1778

At New Bern there came "a violent gale of wind attended by heavy rain, which continued with great fury until morning." There was not much damage in town, but it was feared that many vessels had suffered considerable damage at Ocracoke Bar. Corn and fodder in the New Bern area were almost ruined, having been stripped by the wind. Apparently there followed an extended period of rainy weather, for "...the rains continued forty days and forty nights at least and the damage has occasioned scarcity."

August 10, 1781

A storm of moderate intensity was well reported at Charleston, South Carolina, where at

least two ships were sunk. At Wilmington, gales were reported with veering directions indicating a path moving northward inland.

October 7-8, 1783

Available wind reports indicate that a hurricane center moved northward through eastern North Carolina, causing extreme damage in the Wilmington-Cape Fear area and as far west as Winston-Salem, where the storm "during the night assumed the proportions of a hurricane, damaging buildings, fences and blowing down many trees in the woods."

September 23-24, 1785

A hurricane center appears to have passed over Ocracoke Bar, causing a major break in the sand dunes and drowning a large number of cattle.

July 23-24, 1788

Widespread damage to the central coastal area of North Carolina was caused by a storm whose center apparently passed east and north of the Cape Hatteras. One report indicated six vessels destroyed, eleven driven ashore and two dismasted at Ocracoke Inlet. Another report listed 22 out of 30 ships dismasted. Many vessels were stranded in the Pamlico Sound as the northwesterly gales forced the water out of the sound.

April 10, 1789

In the Albemarle Sound area there was "a very violent gale of wind, with an amazing rise of tide, supposed to be about nine feet above common high water mark." A number of ships which headed out of the Chowan River area for ports to the north were lost along the Outer Banks. At least two of these wrecks resulted in the death of the entire crew. It is not known whether this storm was of tropical or extratropical origin but the date suggests the latter.

August 2, 1795

Severe in at least the Cape Hatteras-Ocracoke area, this hurricane drove eighteen vessels of the Spanish fleet onto shoals at Cape Hatteras.

September 5, 1797

This storm apparently affected the entire North Carolina coast, for it caused damage at least as far south as Charleston, South Carolina, and caused the loss of a sloop as far north as Currituck Inlet.

2.4. Nineteenth Century

September 7-8, 1804

This severe hurricane caused more than 500 deaths by drowning in South Carolina, but was very likely much less intense when it reached North Carolina. The center apparently moved inland between Savannah, Georgia, and Charleston, South Carolina, and followed a northeast course through North Carolina and Virginia to eastern Maryland.

September 28, 1806

A hurricane struck the coast, wrecking a large number of ships at Ocracoke Inlet.

September 10, 1811

Known as the “Cuba Hurricane”, this storm was accompanied by a very severe tornado at Charleston, South Carolina, in which many were killed and damage was very heavy. Inland at Columbia, South Carolina, it was “...a perfect hurricane...” and “...never before equaled here within the recollection of our oldest citizen.” From its severity over inland South Carolina, it can be assumed that this storm caused some damage in North Carolina.

August 27-28, 1813

One of the most destructive storms in the city's history struck Charleston, South Carolina, and hurricane winds were also reported at Georgetown and Camden. Later reports of gales as far north as Maryland make it apparent that the storm moved across inland portions of North Carolina.

July 1, 1814

A tropical storm of unknown path spawned a tornado near Charleston, South Carolina, and prolonged heavy rain is known to have fallen on parts of North Carolina.

September 3-4, 1815

Often confused with the historic New England hurricane of later in the same month, this appears to have been a major storm in its own right. The center apparently moved northward somewhat to the east of Wilmington, passing very close to New Bern and Elizabeth City. Many trees were blown down. Tides at New Bern reached ten or more feet above normal, covering waterfront streets with several feet of water which demolished and carried away a number of buildings.

September 10-11, 1820

A tropical storm apparently moved inland on the northern South Carolina coast and back out to sea near Cape Hatteras, causing gales and heavy rains over much of coastal North Carolina.

September 2-3, 1821

A fast moving hurricane which journeyed from just south of Puerto Rico on the 1st in a recurving path across North Carolina from Cape Lookout to Norfolk on the 3rd, caused considerable damage at Morehead City and very likely to all of the North Carolina coast north of there. It was a “tremendous storm” in Norfolk which caused much wind damage in town and to ships in the harbor. Its path took it to the New York City area where severe damage resulted and thence into New England.

September 27-28, 1822

A very severe storm moved inland with its center north of Charleston, South Carolina, apparently proceeding rapidly northward across central North Carolina. Violent winds and torrential rains are known to have affected Raleigh and Hillsborough, with trees blown down and roofs damaged.

June 3-4, 1825

This early season hurricane spread destruction from Cuba to New England. In North Carolina, the tide rose six feet at New Bern and 14 feet at Adams Creek. More than 20 vessels were driven ashore at Ocracoke, 27 near Washington and a number at New Bern. Coastal plantations were inundated near the South River and there was heavy loss of crops and livestock. There was considerable damage near the waterfront in New Bern.

November 17-18, 1825

The schooner *Harvest* was wrecked on the North Carolina coast, probably near Nags Head, and five or more persons lost in what may have been a late season hurricane.

August 24-25, 1827

A hurricane from the Windward Islands struck the coast at Cape Hatteras, and broke the Diamond Shoals Lightship loose from its moorings. Two of the ship's crew were washed overboard and drowned. The ship was driven southwestward by the storm across the shoals and all the way to Portsmouth, where she was grounded at night. Although she survived the rough journey without complete destruction, the lightship was never launched again, and treacherous Diamond Shoals was without a lightship for several years. Severe both on and offshore, the storm caused damage at least from Charleston, South Carolina to Baltimore, Maryland, including “...considerable mischief...” at and near Wilmington, and extending inland as far as Winston-Salem.

August 15-17, 1830

The first effects of this storm were felt on the North Carolina coast on the 15th, although it was severe at Charleston, South Carolina on the 16th and at New York on the 17th. At New Bern all vessels were blown from their moorings and many damaged. At Wilmington "...the water in the river rose, it is said, higher than known for 20 years " and there was much wind damage in town. The storm was "terrible" at Smithville (Southport). Many vessels were driven ashore on the south coast. Recently constructed jetties, presumably near Wilmington or Smithville (Southport) were swept away. In the Edenton area damage was mostly to crops.

September 4, 1834

A small hurricane came inland near the North Carolina-South Carolina line. Wilmington received the full brunt of the storm. Very heavy rains inland produced heavy flooding on the Cape Fear and Neuse Rivers and the wind blew down trees in central North Carolina.

August 18-20, 1837

The following information was from the press, mostly from the Wilmington Advertiser: "On the afternoon of Friday, the 18th, the wind shifted to the northeast...before midnight the storm increased...uprooted trees, streets washed into gullies, roads obstructed and bridges carried out...two new inlets are formed opposite M'Rae's of Peden Sound." "The community and neighboring country have suffered from a storm which we fear has been felt throughout the country." On Friday the 18th, the winds were easterly and the rains heavy, during the 10 night, winds became northeasterly and the rains very heavy. Before midnight the wind had become ruinous, all the bridges between Wilmington and Waynesborough (Goldsboro) except over Smith's Creek were destroyed. A bridge three miles south of Washington was swept away, as were most of the water mills in the area. A brig was driven ashore at Smithville (Southport). "The gale was certainly the most violent we have ever witnessed and the quantity of water...greater than has ever been known." "The storm was less severe at Charleston and Norfolk than at Wilmington. The Northeast (Cape Fear) River...has been four feet higher than ever known to be."

October 9, 1837

A hurricane known as "Racer's Storm", whose history can be traced from near Jamaica across the Yucatan Peninsula to the Texas coast, thence back eastward across the Gulf States to the Atlantic, lay offshore near the North Carolina coast on October 9th. Off the North Carolina coast, near Ocracoke, it destroyed the passenger steamboat *Home*, bound from New York to Charleston, with the loss of about 90 of its 130 passengers and crew. At least two other vessels were lost: the *Cumberland* at Core Bank and the *Enterprise* at Bodie Island.

October 29, 1837

Another severe storm is listed for this month, reported felt at Hatteras on this date. There is no information on its force or damage.

August 28-30, 1839

A hurricane moved up the Atlantic Coastal waters, apparently passed just offshore from Cape Hatteras. Trees were blown down and bridges washed out in the Elizabeth City area, and of the 15 vessels at Ocracoke only three escaped damage. Winds of tremendous force were reported at Washington.

July 12-15, 1842

A very destructive hurricane swept the entire North Carolina coast, apparently with the most force in the Ocracoke-Portsmouth area. Many ships are believed to have been lost and many persons drowned, but in most of these cases there is no record as to names of ships or persons. Many houses were wrecked and washed away, and many livestock on the Outer Banks drowned. For destruction affecting the inhabitants of the Banks, this is believed to have been one of the most severe storms of history.

August 24, 1842

A hurricane of similar severity to that of July struck about the same area, and caused the known loss of three ships and eight persons. The brig *Kilgore* was wrecked at Currituck, the *Pioneer* at Ocracoke and the *Congress* at Cape Hatteras.

September 7-8, 1846

A hurricane moved up from the south had apparently approached slowly, and the long northeasterly fetch had piled up an unusual amount of water into the sounds. On September 7th at about 11 a.m., the wind shifted and came from the southwest, and piled the waters onto the Banks and sweeping them back over the ocean. This created the present Hatteras and Oregon Inlets, the former on the night of September 7th and latter on September 8th. The schooner *Mary Anna* was lost off Hatteras on September 8th.

October 12, 1846

The “Great Hurricane of 1846” struck the Florida Keys with great violence and then moved up inland across central North Carolina. There is no information on damage in the state, but some must have occurred inland as the storm passed, since it later did extensive damage at Baltimore, Philadelphia, and New York City.

July 18, 1850

Dispatchers from Wilmington and Elizabeth City mentioned a “tremendous storm” and “great damage” from a storm which later hit New England.

August 24, 1850

A severe gale from this storm was reported in Wilmington, where the damage to the town itself was apparently light. However, the railroad bridge over Quankey Creek was “...lifted and thrown down by the wind.” Much corn was blown down. The schooner *H. Wescott* was driven ashore in the gale at the entrance to Cape Fear. A pilot boat sank after colliding with a steamer in the gale near Smithville (Southport).

August 23-27, 1851 (Fig. 3)

Having moved northward from Florida, this storm caused gales on at least the southern portion of the North Carolina coast.

September 7, 1853 (Fig. 4)

First detected in the Cape Verde Islands area on August 30th, the path of this storm can be traced through September 11th. After following a path toward the northwest through the tropical Atlantic, the center recurved toward the north on the 6th near latitude 30 degrees north, passed off Cape Hatteras on the 7th, and then moved off toward the northeast. Very heavy rains occurred in at least the southern coastal section of North Carolina and a brig was lost off Cape Hatteras on the 7th.

September 7-9, 1854 (Fig. 5)

A very destructive hurricane swept the Atlantic Coast from Florida to New York. It caused much damage, gave extraordinarily high tides at Charleston on the 7th and was felt at Norfolk, Virginia on the 9th. Presumably this storm raked the North Carolina coast principally on the 8th.

August 19, 1856 (Fig. 6)

This tropical storm developed over the Gulf Stream southeast of Cape Fear and then moved inland across Carteret County including the southern Outer Banks. Although winds did not cause much damage across eastern North Carolina, very heavy rainfall accompanied the storm. The system became known as the Connecticut “Charter Oak” storm later on as it passed offshore just south of Cape Cod.

August 31-September 1, 1856 (Fig. 7)

A “perfect tempest” accompanied this hurricane in the Wilmington area, where the wind blew hard from the north or northeast for about two days and then veered to south or

southwest. There was considerable damage to crops, especially rice. At that time, Wrightsville Beach was said to have been one-half mile wide and covered with live oak trees. Water swept across Wrightsville, washed away most of the oaks (the remainder died within a few days) and sweeping debris across the Sound onto the mainland. Breakers beat on areas one-half mile inland from the sound and at an elevation of 30 feet.

September 9-12, 1857 (Fig. 8)

Newspaper accounts credit this hurricane with being one of the most violent in recent years and state that it was most severely felt near Cape Hatteras on the 9th and 10th and other parts of the North Carolina coast on the 11th and 12th. Several ships were lost. At Wilmington, the storm was quite violent, as was the case at New Bern, where the tide rose above the wharves and into the streets. Even though merchants moved their goods to upper storerooms, the height of the tide was such that barrels of turpentine and other goods drifted into the streets.

November 1-(date unknown), 1861 (Fig. 9)

Seventy-five vessels, up to that time the largest fleet ever assembled under a U. S. commander, were scattered by a terrific gale encountered off Cape Hatteras. At least two vessels sank and at least seven men drowned. One or more vessels was wrecked and salvaged by Confederates. The strong winds associated with this storm apparently lasted several days.

August 18-22, 1871 (Fig. 10)

The effects of this storm were prolonged, lasting in the southern coastal areas from the 18th until the 22nd. Very high tides began in the Wilmington area on the 18th, and heavy rains and strong winds began on the 19th, lasting until the 22nd. The winds were most severe at Smithville (Southport) on 13 the night of the 19th (Saturday), rocking houses and throwing down large trees. Two little schooners were capsized and sunk near Smithville (Southport).

October 25, 1872 (Fig. 11)

A storm moved out of the Gulf of Mexico directly across Florida at Jacksonville, thence back inland near Charleston, South Carolina, and northward across North Carolina east of Raleigh. Winds of gale force occurred over a considerable area and very heavy rains ranging from four to eight inches fell at Weldon, Tarboro, and Norfolk, Virginia.

September 19-20 and 23-24, 1873 (Fig. 12 – Fig. 13)

Two storms of similar paths passed in rapid succession through the coastal waters of North Carolina. Both originated in the Gulf of Mexico, moved across Florida and passed near Cape Fear and Cape Hatteras. Neither seemed to have had any direct severe effect on the state, but, perhaps as forerunner of the storm which passed near Cape Fear on the

night of the 19th to 20th, a severe squall with indications of tornadoes struck near Wilmington during the very early morning of the 19th. At Wrightsville Sound, where a "perfect hurricane" blew for an hour, it was the "severest ever experienced."

September 28, 1874 (Fig. 14)

The center of this hurricane passed just east of Charleston, South Carolina, and west of Wilmington and Norfolk, Virginia. Highest winds (maximum velocity) at Wilmington were southeast 45 mph then southwest 50 mph, and at Cape Hatteras southeast 75 mph. The destruction was very great in the Wilmington area, with large trees uprooted and carried a considerable distance. At places along Water Street the waves on the Cape Fear River were above the wharf. At Smithville (Southport) the storm was reported very disastrous, with several houses blown down, the warehouses on the garrison wharf completely destroyed, and the Oceanhouse demolished. The Spanish barque *Arrina* was blown over in ten fathoms of water. Telegraph lines and several railroad bridges were destroyed, and the corner of the new post office blown down. Thirty-three percent of the rice crop along the river was damaged.

September 17, 1876 (Fig. 15)

A severe hurricane struck the coast near the North Carolina-South Carolina line. The anemometers at Wilmington and Cape Hatteras were disabled after indicating north at 60 mph and southwest at 73 mph respectively. The British bark *Excelsior* was driven ashore two miles below Wilmington. The military camp at New River was destroyed and two men drowned. At Wilmington, where the full fury of the storm struck very early in the morning, it was the most fearful in many years. Trees 14 were uprooted, buildings were shaken and uprooted. A bridge on Market Street was washed away. Two box cars and a shed were said to have been driven uphill by the wind. Water rose "unprecedently" high in the sounds, "flooding everything in reach." Marsh hens were driven inland and many killed with sticks; some took refuge in houses. There was great damage at Masonboro Sound, Wrightsville, Smithville (Southport), and Brunswick. Many ships were lost. Captain C. C. Morse at Wrightsville lost 1,400 terrapins.

September 29, 1877 (Fig. 16)

Meteorological reports track this storm along a typical path considerably offshore from Wilmington to Cape Hatteras. Owing to a slow rate of movement, it was severely felt from Cape Lookout to Cape Henry, Virginia, where steady northeast gales and high seas persisted. News accounts said that the path was similar to that of the storm of September 16th to 19th, 1876. In the Wilmington area, heavy rains began on the morning of the 27th and continued at least until the 29th; the gales in this area blew with considerably severity on the night of the 28th. All roads in the area were flooded and streams greatly swollen.

October 3-4, 1877 (Fig. 17)

Believed to have been the same storm observed over St. Vincent and Grenada on September 21st, this long-lived and violent hurricane crossed the Gulf of Mexico and moved inland near New Orleans, Louisiana on October 2nd. It moved northeastward across North Carolina just east of the mountains, causing a terrific storm in the vicinity of the Albemarle Sound. The attendant floods carried away all bridges and wharves in that area and seriously damaged crops remaining in fields. The steamship *Magnolia f*oundered off Hatteras, and ships were wrecked all along the Atlantic coast northward to New England.

September 12, 1878 (Fig. 18)

This hurricane moved almost due north from Florida Keys to Lake Erie. A great many ships were disabled and wrecked. The steamer *City of New York* reported the hurricane lasted 40 hours between Cape Hatteras and Charleston, South Carolina. Highest reported winds were as follows: Smithville (Southport) southeast 48 mph, Wilmington southeast 30 mph, Sloop Point 65 mph and Cape Lookout southeast 75 mph.

October 23, 1878 "MAJOR" (Fig. 19)

After crossing Cuba on the 21st and moving generally northward, this hurricane moved inland between Wilmington and Morehead City. The storm was very severe at sea and struck the Outer Banks with full hurricane force. Maximum winds of 100 mph were recorded at Cape Lookout and 82 mph at Portsmouth, both from the southeast. On the coast of the mainland, winds apparently were much lighter; the maximum registered at Smithville (Southport) was 32 mph from the east and at Wilmington 36 mph from the northwest. The steamer *City of Houston* was lost on Frying Pan Shoals and a great many ships were damaged or lost in the storm all along the coast.

August 18, 1879 "EXTREME" (Fig. 20)

A severe hurricane, charted from a position over the Bahamas on the 17th on a coastwise path to a position off Eastport, Maine, on the 19th. Although the center was plotted as passing inland near Wilmington and back out to sea near Norfolk, Virginia, winds were highest at Cape Lookout. At 6 a.m. the anemometer cups were blown away when indicating 138 mph and the wind was afterward estimated to have reached 168 mph. Anemometers were also destroyed at Hatteras, Fort Macon, Kitty Hawk, Portsmouth, and Cape Henry, Virginia, with speeds estimated at 100 mph or more. A ship report indicated waves forty feet high from the trough to the crest. This storm was perhaps most destructive in the Morehead City-Beaufort area, where damage was reported to have included two hotels destroyed, the Atlantic and Ocean View, and 1,000 feet of railroad track torn up. All wharves were washed away and the chimneys of most houses were blown away. One schooner was known to have wrecked on Cape Hatteras and wrecks of others were said to have been in view from near Beaufort. On the Outer Banks, the storm caused great destruction at Diamond City, which was near Cape Lookout.

August 27, 1881 (Fig. 21)

Although not of extraordinary intensity according to meteorological reports from North Carolina stations [maximum wind reported at Smithville (Southport) was east 50 mph, at Fort Macon 38 mph], this storm must have been of tremendous size and intensity at sea. It was reported from Morehead City that skies were blackened with sea birds moving inland 30 hours in advance of the storm, and that the fish also retreated inland, passing up the Newport River in such numbers that they became so wedged in the following day A...that they could not move either up or down." This story is from the Report of the Chief Signal Officer; the source is unknown. Heavy losses of life and property were reported on the Georgia and South Carolina coast, and considerable damage along the southern part of the North Carolina coast. The storm center moved inland near Savannah, Georgia, where maximum winds of 60 mph were recorded, and continued as an identifiable low pressure area westward to Memphis, Tennessee, and up the Mississippi River Valley into Canada.

September 9, 1881 (Fig. 22)

The center of this severe hurricane moved northward across Wilmington-Wrightsville Beach area about 1 p.m., and proceeded slowly northward to near Norfolk, Virginia, and then northeast out to sea. Maximum five-minute wind recorded at Smithville (Southport) was northeast at 60 mph. At Smithville (Southport) it was reported as the most violent storm in 50 years, with the town "covered with fallen trees, scattered fences and the debris of demolished buildings." "All pilot boats in the harbor were sunk, and loaded vessels driven ashore." At Wrightsville, the tide "marked a height never before witnessed," water washed over the turnpike, carrying large quantities of earth out to sea making the road impassable; some bath houses were washed away and others destroyed. The wind blew with extreme violence, shifting from easterly through south to westerly around noon "blowing with redoubled fury, crushing buildings and tearing up the largest trees." At Wilmington the wind recorder had been indicating a speed of 90 mph for four minutes when the anemometer wires broke. It was considered the most severe storm there since 1822 and 1838, and property damage was estimated at $100,000, a considerable sum in those days.

September 10-11, 1882 (Fig. 23)

A tropical cyclone moved across Cuba to the central Gulf of Mexico then turned to a northeasterly movement. It crossed central Georgia and western sections of South Carolina on the 10th and entered North Carolina near Charlotte on the 11th. The storm continued moving northeast and moved offshore near the lower end of the Chesapeake Bay. Newspaper articles on this storm were mainly for coastal southeast North Carolina. On Sunday the 10th the weather was described as "extremely disagreeing" and caused many people to pass up going to church. At Wrightsville Beach and Masonboro Sound the wind blew quite a gale, heavy rain fell and the tide was very high. At Topsail Beach a cyclone (possible tornado) destroyed two houses and damage to crops, trees, fences and

other property was considerable. At Middle Sound (near Wilmington) the gale caused great destruction to trees and fences and fallen trees blocked roads. At Smithville (Southport) there was a series of storms with wind and rain of short duration. On Monday, Wilmington had quite windy weather with threatening skies with the barometer falling rapidly during the afternoon.

September 21-23, 1882 (Fig. 24)

A tropical storm formed near the northern Bahama Islands and moved north. The storm moved into North Carolina near Cape Lookout on the 22nd then moved into the Chesapeake Bay before moving out to sea on the 23rd. Newspaper articles on this storm were few. On Friday the 22nd the storm signal was flying. The weather had quite a stormy appearance. A gentleman from one of the sounds (Wilmington area) reported that geese had taken refuge on the sounds; a sure sign of a storm on the coast. The heaviest rainstorm since 1842 fell at Tarboro in the northern coastal plain. The storm caused immense damage to crops. Bridges were swept away, and the Wilmington and Weldon Railroads suffered extensive damage. A train ran into a washout and was smashed, seriously injuring the express messenger. Rainfall in a few hours totaled 7.70 inches.

October 11-13, 1882 (Fig. 25)

A tropical cyclone moved over western Cuba to northern Florida on the 11th and moved across southeast Georgia out to sea. The storm moved parallel to the southeast coast of North Carolina on the 12th and moved well out to sea on the 13th. Newspaper articles on this storm were primarily for the Wilmington area. On Wednesday the 11th rain poured in torrents for a good portion of the day. A hurricane in south Georgia was expected to make landfall at Wilmington. The storm signal was raised early in the day and shipping was warned to prepare for a gale.

Rainfall for 24-hours at the Signal Office in Wilmington was 4.30 inches. The gale, though not amounting to a cyclone (hurricane) was pretty severe Wednesday night. Wilmington reported wind 26 mph (5-minute average), Smithville (Southport) 35 mph and Fort Macon 42 mph. The Signal Service line between Wilmington and Fort Macon was down but up again on Thursday.

September 11, 1883 “MAJOR” (Fig. 26)

First identified at Martinique on the 4th, this hurricane moved steadily on a curved path northwest, swinging north, and passed inland near Smithville (Southport) on the 11th. Maximum winds at Smithville (Southport) were from the southeast at 93 mph at 8:20 a.m. Newspaper accounts stated that the wind blew at a speed of 81 mph for seven hours. Many fences and buildings of light construction were destroyed and trees uprooted. Telegraph and telephone lines were blown down. Leaves on trees afterward looked as if frostbitten, due to the effect of salt spray. The damage at Smithville (Southport) was

reported at $8,000 to $10,000, but this evidently did not include many vessels which broke from their moorings and were driven ashore in the vicinity. The storm was reported very disastrous to vessels between Hatteras and Wilmington, with much wreckage drifting onto shore near Wilmington. The land on the western side of the Cape Fear River was reported "flooded by the immense body of water driven up the river." Considerable crop damage due to violent wind and rain was reported as far inland as Harnett County. There were 53 deaths in North Carolina.

August 25, 1885 "EXTREME" (Fig. 27)

Discovered in the Bahamas on the 23rd, this severe hurricane moved inland near Savannah, Georgia, and passed across North Carolina just west of Wilmington and Hatteras. Maximum 5-minute winds of 98 mph were recorded at Smithville, 92 mph at Fort Macon and 52 mph at Wilmington and Hatteras, all from the south or southwest. At Smithville (Southport) the anemometer was blown away at 5:15 p.m. with the 98 mph wind, and winds were estimated to have reached 125 mph during the next half hour. The damage at Smithville (Southport) was estimated at over $100,000, while that at Charleston, South Carolina, was estimated at $1,690,000. The storm was severe in Wilmington and there was considerable damage to property at Morehead City. As a result of this destructive storm it was proposed that a weather reporting network be set up in the West Indies and Mexico.

October 12, 1885 (Fig. 28)

A disturbance initially observed southwest of Florida on the morning of the 10th strengthened and moved slowly north through that state, passing west of Jacksonville and Savannah, reaching southwestern Virginia about midnight of the 12th. Northeasterly to southeasterly gales resulted all along the North Carolina coast, giving maximum velocities from 44 to 56 mph. High tides at Smithville (Southport) submerged the entire waterfront and flooded a few stores. At both Wilmington and Smithville (Southport) the tide was reported as the highest in ten years. Some flooding occurred in New Bern. A schooner was wrecked at Hatteras Inlet.

June 19-20, 1886 (Fig. 29)

Although it struck land in northwest Florida, this hurricane retained much force as it moved northeast just east of the North Carolina Mountains causing heavy rains and widespread squally weather throughout the state. "Dangerous winds" were reported offshore; the highest recorded on land was 40 mph from the northeast at Kitty Hawk.

June 30-July 1, 1886 (Fig. 30)

Being quite similar to the previous case, this hurricane retained considerable strength as it moved over land from northwest Florida to North Carolina, this time through the Piedmont. Heavy rains and gales occurred. A maximum wind of 47 mph from the

northeast was recorded at Fort Macon on June 30th, and of 42 mph from the southeast at Kitty Hawk on July 1st.

August 20, 1887 (Fig. 31)

Damage was heavy from this severe hurricane which was first spotted several hundred miles northeast of Puerto Rico on the 16th, then moved rapidly along practically the "classic" path, passing east of Hatteras on the 20th. Maximum five-minute wind was 82 mph at Hatteras. The storm was said to have been severe in the Pamlico Sound area, where many vessels were lost and houses blown down. News dispatches concerning this storm ranged from flippant "We had an elegant breeze last night. Some extreme southern friends became excited. Others thought the breeze superb" (from Morehead City) to "The storm of Saturday did great damage to the coast" two days later. The anemometer blew away at Kitty Hawk, where the observer stated that the fury of the storm was indescribable. As was usually the case when a hurricane struck or passed nearby, the Outer Banks telegraph line was damaged, so that little or no information came from that area for at least several days.

October 20, 1887 (Fig. 32)

This hurricane which moved inland on the Gulf coast near New Orleans swept across Georgia and the Carolinas and then out to sea. Damage in North Carolina, if any, was likely slight.

October 31, 1887 (Fig. 33)

Increasing in intensity after crossing the Florida Peninsula from the Gulf of Mexico on the 29th, this storm moved northeast at some distance off the Atlantic Coast, "accompanied by heavy gales, especially on the coasts of North Carolina and Virginia." The wind reached a velocity of 70 mph at Kitty Hawk, with heavy rain; telegraph poles were blown down on the Outer Banks.

October 11, 1888 (Fig. 34)

A hurricane first noted in the eastern Gulf of Mexico on the 10th moved rather rapidly northeast, crossing North Carolina just west of a Wilmington-Norfolk, Virginia, line. In spite of the inland path, the storm produced a maximum 5-minute wind of 60 mph at Wilmington on the 11th and was "attended during the 11th and 12th by destructive hurricane over the adjacent ocean."

November 25, 1888 (Fig. 35)

A disturbance moved with increasing force from several hundred miles east-northeast of Puerto Rico on the 17th to the Bahamas on the 22nd, then turned northeast and passed off Hatteras at a distance of one or two hundred miles on the 25th. In spite of the distance offshore, the maximum 5-minute wind at Hatteras was 66 mph on the 25th, and 50 mph

at Norfolk, Virginia, on the 26th. Some damage was reported to shipping off the North Carolina coast, and at Norfolk, Virginia, high tides were reported as flooding the lower part of the city, with very destructive winds, telegraph lines blown down, and vessels blown from moorings.

September 9-12, 1889 (Fig. 36)

Believed to have originated about September 1st to the east of the Windward Islands, the center of this hurricane was near Puerto Rico on the 5th and moved to a position off the Virginia Capes about the 10th, where it stagnated for several days. Most of the force of the storm was felt from Virginia to New York, where it was very destructive but gales and unusually high tides and swells were reported along the northern half of the North Carolina coast. At Nags Head the storm was said to have been severe but no great damage was done except for cutting of a new (or re-opening of an old) inlet. Communications lines to Hatteras were down.

September 24, 1889 (Fig. 37)

A hurricane moved inland on the Gulf coast on the 22nd and passed northeast across western North Carolina on the 24th. This must have been a very large storm, as it caused southeasterly gales along the south Atlantic Coast. Cautionary signals were ordered at Wilmington, and a steamer arriving there reported very rough weather off Frying Pan Shoals. Winds (presumably at Frying Pan) are reported to have blown from the south-southeast at 70 mph between 7 and 8 a.m. on the 24th.

June 16, 1893 (Fig. 38)

After crossing northern Florida from the Gulf of Mexico, the center of this hurricane skirted the coast of Georgia and the Carolinas, passing out to sea again near or north of Cape Hatteras. Winds at Southport reached a maximum velocity of 55 mph from the south. Damage was apparently light.

August 23, 1893 (Fig. 39)

A hurricane advanced over the southern Atlantic to the West Indies and passed to the east of Hatteras on the 23rd, causing wind velocities of 70 mph from the northeast at Kitty Hawk and 60 mph from the north at Hatteras. No damage of consequence was reported.

August 27-29, 1893 (Fig. 40) “Great”

Skirting the east coast of Florida and moving inland between Jacksonville, Florida, and Savannah, Georgia, this hurricane passed near Charlotte and then curved to the northeast. There was much destruction in the south Atlantic states. Wind velocities reached 72 mph from the south at Southport on the 28th and 50 mph from the south at Kitty Hawk on the 28th and 29th. Newspaper accounts stated the velocity was 72 mph from the south at Wilmington. A number of ships were lost at sea off the North Carolina coast and several

were wrecked on the coast in the Cape Fear area. Wrightsville Beach was evacuated. At Kernersville, “a terrific cyclone struck here at five o'clock this morning (the 28th). A hundred houses wrecked and a woman killed. Many were injured. Factories, stores and residences were unroofed and some were blown away.” At Oxford a large brick warehouse was wrecked. These storms were probably tornadoes spawned in the fringes of the hurricane. At Wilmington, “the river tide was the highest ever known here. All the wharves being submerged, a number of vessels were wrecked on the coast.” Rainfall totaling three to eight inches accompanied the hurricane over practically the entire state, with amounts up to five inches in 24 hours. One to two thousand lives were lost in South Carolina.

October 13, 1893 (Fig. 41) “Great”

Crossing the South Carolina coast somewhat north of Charleston, the storm center moved directly northward, its eye passing nearly over Raleigh. The highest reported wind in North Carolina was 94 mph at Southport. In the Wilmington area, the tide and overflow of water were reported as the highest known to date, being 16 inches above the high water mark of 1853. Damage to the Wilmington waterfront was estimated at $150,000. Great destruction was reported to forests, crops and property, and to shipping. Two children were crushed when a tree fell on a house in Sampson County. A total of 22 lives were lost in North Carolina from this storm.

October 22, 1893 (Fig. 42)

First spotted north of the Bahamas on the 21st, this storm of less than hurricane force moved rapidly north, passing near Hatteras on the afternoon of the 22nd. The highest reported wind was 54 mph from the northeast on the 22nd at Kitty Hawk.

September 27-28, 1894 (Fig. 43)

Moving in a sweeping curve across San Domingo (now the Dominican Republic), Haiti, and Cuba, the hurricane center went briefly out to sea again after crossing Florida and then struck the coast between Savannah, Georgia, and Charleston, South Carolina. It moved northeastward just a short distance inland through South Carolina and southeastern North Carolina, entering the ocean again a few miles north of Hatteras. Maximum 5-minute wind velocities reached 60 mph at Kitty Hawk and 54 mph at Southport from the southeast on the 27th. Schooners were reported wrecked in the Ocracoke and Cape Fear areas.

October 9-10, 1894 (Fig. 44)

First noted off the coast of Panama and Colombia on the 1st and having crossed the coast of northwest Florida on the 8th, this hurricane then moved northeastward, passing across eastern North Carolina on the 9th. Although it had been over land for a few days, it retained sufficient strength to cause winds with maximum velocities of 58 mph from the

southeast at Kitty Hawk on the 9th and 60 mph from the southwest at Hatteras and 58 mph from the southwest at Kitty Hawk on the 10th.

September 29, 1896 (Fig. 45)

A hurricane moved north from the western tip of Cuba, entered Florida near Cross City, then continued north through the central Carolinas and central Virginia. Evidently this storm had minimum effects on North Carolina. No other data is available.

September 21-24, 1897 (Fig. 46)

Although there is some doubt as to its path, the center of this tropical storm probably passed near Hatteras. Highest reported wind was 50 mph (maximum, 5-minute velocity) at Hatteras. According to ship reports, the storm was very intense a short distance offshore. High winds and high water were reported at New Bern.

October 20, 1897 (Fig. 47)

A rapidly moving storm of tropical origin passed northeastward just off Hatteras on this date, and caused maximum winds of 44 mph at Hatteras and 60 mph at Cape Henry, Virginia. Rains of from one to seven inches fell on the North Carolina Coastal Plain, with the heaviest amounts on the immediate coast.

October 24-26, 1897 (Fig. 48)

Moving northeast just off the coast, this storm seemed to offer only fringe effects to North Carolina on the 24th. Then, the storm apparently turned a complete loop out in the ocean during the 25th and moved west onto the coast a little north of Hatteras by the morning of the 26th.

October 2, 1898 (Fig. 49)

Although the hurricane center moved inland on the Georgia coast, it caused heavy surf far enough north to wash across Carolina Beach, destroying some property there.

August 16-18, 1899 (CAT 4) (Fig. 50)

The hurricane which moved slowly northward across the Outer Banks in the vicinity of Hatteras during August 16th to 18th was one of the most severe on record for that area. After causing tremendous destruction and loss of life in Puerto Rico, the storm moved northward in a curving path off the south Atlantic coast. Approaching Hatteras, its forward movement slowed considerably, while at the same time it increased in strength. By early morning of the 17th, the wind was blowing from the northeast 70 mph at Hatteras; by early afternoon it had reached 93 mph, with extreme velocities of 120 to 140 mph. The anemometer then blew away but stronger winds probably occurred. The Weather Bureau observer at Hatteras reported that “the entire island” was covered with

water to a depth of four to 10 feet; there were no more than four houses in which the tide did not rise to a depth of one to four feet. All fishing piers and equipment were destroyed, and all bridges were swept away. A great proportion of homes on the island were damaged. About ten vessels, including a large steamship, were wrecked. There was much destruction at Diamond City, which was located in the vicinity of Cape Lookout. Flooding of much of the coastal areas and strong winds and heavy rains inland as far as Raleigh did great damage to crops. It was reported that it was impossible to estimate the damage in dollars and cents. Between 20 and 25 lives were lost.

October 30-31, 1899 (CAT 2) (Fig. 51)

This hurricane, which struck the North Carolina Coast on the morning of October 31st, 1899, caused great destruction and damage. After forming in the Caribbean Sea on the 23rd, the storm moved north, passing over Cuba and then up to the Carolina coast. The point where the center made landfall is unknown, but from the behavior of the winds at coastal and inland points and from the fact the tides were very high at Wrightsville Beach, the center probably hit the coast somewhere below Wrightsville Beach, then moved across the state, very likely passing somewhat east of Raleigh. Highest wind reported was 72 mph (sustained 5-minute velocity) at Kitty Hawk, but sustained winds of 40 mph were reported inland to the center of the state. At Wrightsville Beach, water was reported as eight feet above normal high tide and two feet higher than in the August hurricane “or ever before.” Water came over the wharves in Wilmington and flooded some streets and there was much flooding and damage in New Bern, Morehead City, and Beaufort. At Southport, it was “the worst storm ever.” One steamer was wrecked on the coast and 10 smaller vessels were driven ashore. Inland, many trees were uprooted. One person was reported killed and damage was conservatively estimated as more than $200,000.

October 13, 1900 (CAT 1) (Fig. 52)

A disturbance of less than hurricane strength passed northward across Florida, entered the Atlantic again near Jacksonville, Florida. It struck land again on the North Carolina coast near Cape Hatteras. There were no records of damage or unusually strong winds in the state.

2.5. Twentieth Century

July 11, 1901 (CAT 1) (Fig. 53)

Although not severe in the Caribbean area where it formed, this hurricane strengthened rapidly as it moved northward off the south Atlantic coast. When it reached the latitude of North Carolina, it abruptly changed course, moved south along the North Carolina coast then inland into eastern South Carolina. There were no record of damages. Highest wind (maximum velocity) was 62 mph from the west at Hatteras.

September 15, 1903 (CAT 1) (Fig. 54)

The origin and intensity of this storm is somewhat obscure, but it probably advanced northwestward from the subtropical ocean south of Bermuda. It recurved near latitude 35o north, then passed east of Hatteras. Winds on the 15th reached maximum velocities of 60 mph from the northwest at Hatteras, and 72 mph from the east at Kitty Hawk. News dispatches in North Carolina papers stated that the storm was disastrous in Florida and very bad in Delaware. Lack of damage reports from North Carolina may have been due to failure of communications on the Outer Banks, which frequently occurred during storms.

September 14, 1904 (CAT 1) (Fig. 55)

Having formed over the tropical Atlantic Ocean, this hurricane gathered force north of the West Indies and moved northwestward, passed inland along the South Carolina coast, north of Charleston, then crossed the eastern section of North Carolina and re-entered the ocean north of Norfolk, Virginia. Maximum wind velocity reported in North Carolina was from the southwest at 51 mph at Hatteras. Wind and rain did considerable damage to crops in eastern and central North Carolina. Apparently the storm gained additional strength as it moved northward along the middle Atlantic coast, where winds were reported as high as 100 mph. Severe storms or “cyclones” were reported at Mt. Olive, Faison, and Durham along with considerable damage and one death. These may have been tornadoes in the general hurricane circulation. Trains were halted by high water on the Neuse River.

September 17, 1906 (CAT 3) (Fig. 56)

There was considerable damage to shipping along the coast from Charleston, South Carolina, to Wilmington. As this hurricane approached the coast from the east-southeast, the center moved inland probably a little south of Myrtle Beach, South Carolina. Winds reached maximum velocities of 50 mph from the northeast at Wilmington on the 17th. Cottages, a hotel, and other property were damaged at Wrightsville Beach as breakers swept across the island and sound, and rolled “high up on the Mainland.” The trolley car trestle to Wrightsville gave way. There was some damage at Southport and Carolina Beach. Estimated sea level pressure at Cape Fear was 27.90 inches.

July 30, 1908 (CAT 1) (Fig. 57)

After this storm passed well off the east coast of Florida, and moved northward in a path east of Georgia coast, the center of this hurricane skirted along coast of the Carolinas from Myrtle Beach to Hatteras and then offshore. Highest reported wind was 58 mph at Hatteras, but apparently the storm piled up considerable water on the North Carolina coast to the south of Hatteras. This, combined with torrential downpours (10.73 inches in 72 hours at New Bern and nine inches at Kinston) caused much flooding in the eastern counties. Wind driven water covered Wrightsville Beach (which had been evacuated) and destroyed considerable property. Damage was “immense”, but no injuries or fatalities were reported. At New Bern, this was the “worst storm in history.” This “great storm” raged over all of eastern North Carolina and the extensive flooding brought all forms of travel to a standstill.

August 31-September 1, 1908 (CAT 1) (Fig. 58)

The storm center was apparently close to Hatteras on the morning of September 1st, having approached from the southeast. It was reported to have caused abnormally high tides at Wrightsville Beach. No sustained winds of more than 50 mph were reported. Flooding on the lower Cape Fear at this time, due to heavy rainfall several days earlier and probably aggravated by the storm tides, was “by far the worst flooding in history.”

October 19-20, 1910 (CAT 1) (Fig. 59)

A hurricane of considerable intensity when it struck Cuba and crossed the Florida Peninsula in mid-October retained sufficient force as it passed northeastward off the Carolina coast to cause unusually high tides in the Wilmington area. The maximum wind was only 24 mph there, but seas caused some damage on the beaches, including the partial destruction of a steel pier.

September 3, 1913 (CAT 1) (Fig. 60)

After moving from a location northeast of the Bahama Islands to off the North Carolina coast, this hurricane turned toward the west and moved inland between Hatteras and Beaufort early on September 3rd, passed south of Raleigh that afternoon. The highest wind reported was from the southeast at 74 mph at Hatteras. There was great damage to property and crops over the eastern portion of the state, especially the Pamlico Sound area, due to high water from the sound. The greatest losses were in the vicinity of Washington and New Bern, where wind-driven water was said to have risen 10 feet above previous high water marks. Large railroad bridges at Washington and New Bern were washed away. Communication lines were downed over a large area; for a time it was feared that all people on Ocracoke had perished. Crops suffered severely, with considerable wind and rain damage as far west as Durham. At Goldsboro the storm was “the worst in history”; it was very severe in Tarboro, Wilson, Farmville and Durham. Five lives were lost; property damage was estimated at $3 million.

July 14-16, 1916 (TS) (Fig. 61)

The known history of this hurricane is brief and its known path short; it was northeast of the Bahama Islands on July 12th, and was charted as having moved directly northwest, across the South Carolina coast on the 14th and into the North Carolina mountains on the 15th. It exhausted itself in the mountains, caused the heaviest rainfall of record.
The greatest amount recorded was at Altapass, where 22.22 inches fell in the 24-hour period ending at 2 p.m. on the 16th. This was, at the time, the greatest 24-hour amount known for the entire United States. Landslides occurred in the mountains, killing several persons; crops, highways, bridges and railroads suffered great damage. A maximum wind of 60 mph from the east was recorded at Charlotte on the 14th. No damage of consequence occurred on the North Carolina coast.

July 19, 1916 (CAT 1) (Fig. 62)

Northward movement from the Windward Islands took this hurricane some distance off Hatteras on the 19th, caused maximum winds from the north at 50 mph. The effects of the storm on the North Carolina coast were minor.

September 6, 1916 (TS) (Fig. 63)

A tropical storm moved north from the Bahamas crossed the North Carolina coast near Southport, then continued north through the coastal plains before beginning to dissipate near the Virginia line. No other information was available on this storm.

September 22, 1920 (CAT 1) (Fig. 64)

Of obscure origin, but apparently approached from the southeast, this was a hurricane of small diameter as it crossed the North Carolina coast during the night of the 22nd, passing inland near Wilmington. Winds were said to have reached 72 mph at the mouth of the Cape Fear River, carried the lightship several miles west of the position where it was anchored. A steamship off the coast estimated the wind at 90 mph. A house was blown off its foundation and demolished in Wilmington, perhaps by a small tornado spawned by the larger storm. Similar small severe windstorms were reported in Pitt County, where one person was killed and many injured, and a number of buildings wrecked.

August 25, 1924 (CAT 1) (Fig. 65)

North Carolina felt strong fringe effects of this hurricane, which moved rapidly north-northeast from the Bahamas and passed just east of Hatteras during the evening of the 25th. The highest reported winds were at Hatteras, where a maximum velocity of 74 mph from the northwest was recorded. Damage to the coast was apparently light, but two drownings were reported. Ocracoke was partially inundated by the high water.

December 2, 1925 (CAT 1) (Fig. 66)

The path of this hurricane took it from the Caribbean Sea across southern Florida and then north-northeast along the coast to North Carolina, where it moved inland between Wilmington and Hatteras about 6 p.m. on December 2nd. After passing through the northern coastal counties, the storm center moved out to sea again near Cape Henry, Virginia. Hatteras reported a maximum velocity of 62 mph from the west. Damage was considered to be slight. It is rare for a true hurricane to occur so late in the year.

September 18-19, 1928 (CAT 1) (Fig. 67)

Although this severe hurricane caused much destruction and more than 1,800 fatalities as it moved north through Florida, it lost much of its wind force as it passed through coastal Georgia and South Carolina and into eastern North Carolina. However, it caused very heavy rains in North Carolina. Resulting floods were severe and the highest on record on at least parts of the Cape Fear River. At Fayetteville, where the bankfull stage was 35 feet, the river reached a height of 64.7 feet; at Elizabethtown, the river rose to 41.3 feet compared to a bankfull stage of 20 feet. Flooding at Lumberton was “the worst in history.” Many highways were closed due to flooding and washouts of roads and bridges.

October 1-2, 1929 (CAT 1) (Fig. 68)

Following a prolonged and erratic journey which included slow westward movement through the Bahamas and the Florida Straits, this hurricane turned northeast and struck land near Panama City, Florida, late on September 30th, from which point it recurved toward the northeast. As was the case in the previous year, the storm weakened greatly in wind force as it moved inland, came into North Carolina from the southwest, caused very heavy rains and severe floods. Stages on the Cape Fear River were almost as high as the record set the previous year. At Fayetteville, the river rose 41 feet in a 24-hour period. Rainfall was “record breaking” and caused thousands of dollars damage to roads, crops and businesses. North Carolina “floundered in flood.”

September 12, 1930 (CAT 1) (Fig. 69)

The “Santo Domingo Hurricane”, so called from its passage directly across that city early in its path, swept through Haiti and along the entire length of Cuba. The storm then turned northeast and passed across the Florida Peninsula, its center moved through the offshore waters of the North Carolina coast on September 12th. Maximum winds at Hatteras were from the north at 60 mph, and two ships off Diamond Shoals reported hurricane force winds. Scattered minor wind damage was reported from Atlantic Beach to Hatteras.

August 22-23, 1933 (CAT 2) (Fig. 70)

This hurricane originated well to the east of the Windward Islands, and after a long journey over the Atlantic Ocean it crossed the North Carolina coast moving from the

southeast. The center passed almost directly over Cape Hatteras, where the maximum wind velocity was 64 mph. There was “great damage” in northeast North Carolina, due to “severe gales and high tides, largely the latter.” Many localities were swept by the “worst gale in years.” Tides rose several feet above normal in Norfolk, Virginia. There was considerable crop damage as far inland as Granville County. Storm damage was estimated at $250,000.

September 15-16, 1933 (CAT 3) (Fig. 71)

A hurricane which formed near the Leeward Islands on the 10th moved northwest and then north, increased in intensity and struck the coast a little west of Hatteras about 8 a.m. on the 16th. The maximum wind velocity was 76 mph, estimated because a portion of the anemometer had blown away. Winds were estimated at 125 mph in New Bern and Beaufort. Damage was heavy from a short distance south of New Bern to the Virginia line. Wind and high water did great damage at New Bern where water reached a height of three to four feet in some streets, said to be two feet higher than the previous record which occurred in September, 1913. Old residents in Beaufort said the storm was the worst they had ever experienced. Up to 13 inches of rain fell on the Outer Banks. At least 21 lives were lost and damage totaled at $3 million. High winds and waves and piling up of water in the Pamlico and Albemarle Sounds, caused the deaths and left hundreds without food or shelter. It was reported that in several coastal towns hardly a building was standing.

September 8, 1934 (CAT 1) (Fig. 72)

This hurricane moved up from the south and passed over or slightly east of Cape Hatteras, caused a maximum wind velocity of 65 mph at Hatteras. There was no known loss of life, and damage was apparently slight. Rains of up to 10 inches fell in the Beaufort area.

September 5-6, 1935 (TS) (Fig. 73)

This hurricane was known as the “Great Labor Day Hurricane,” but evidently had minimum effect on North Carolina. The hurricane dates ranged from the 29th of August to September 10th. The hurricane crossed the Bahamas; then moved up the west coast of Florida north into central portions of the Carolinas before moving out to sea near the Virginia Capes. No additional information was available.

September 18, 1936 (CAT 2) (Fig. 74)

This was one of the most severe hurricanes on record at Hatteras, where it caused an average 5-minute wind speed of 80 mph., with gusts much higher. Winds of 90 mph were reported at Manteo. Since the storm center passed over or slightly east of Hatteras, damage was confined principally to the northern half of the coast and was estimated at $25,000 to roads and bridges and $30,000 to buildings and piers. Damage to crops was heavy. The highway from Currituck to Norfolk, Virginia was washed out. There was

some damage in Elizabeth City. Tides were very high at Manteo and Hatteras. About 35 feet of beach was cut away at Nags Head.

September 21, 1938 (CAT 1) (Fig. 75)

"The Great New England Hurricane of 1938" passed a short distance off Hatteras on September 21st moving north, caused maximum winds from the northwest at 61 mph. Heavy rains fell on eastern North Carolina from the 16th through the 21st, gales, rough seas and high tides affected the northern coast as the hurricane passed. Another low pressure storm following one of the typical hurricane paths from the Yucatan across Florida and passed up the Carolina coasts on September 29th was apparently not of great intensity nor of clearly tropical character. A similar storm followed a nearly similar path late October, passed just inland of Hatteras on the 24th.

August 11-17, 1940 (CAT 1) (Fig 76)

A severe hurricane which drove inland at Savannah, Georgia, on the 11th drifted in a horseshoe pattern over the North Carolina mountains before dissipating over eastern North Carolina on the 17th. The winds gradually subsided but torrential rains fell for several days over North Carolina, caused one of the most serious general river flood situations in the history of the State. Wind damage was negligible in North Carolina.

August 1, 1944 (CAT 1) (Fig. 77)

A hurricane formed east of the Bahamas on July 30th, then moved northwest over open water until it struck the North Carolina coast in the vicinity of Southport about 8 p.m. on August 1st. The storm was of small diameter. At Oak Island, where the wind indicator failed, the wind was estimated at 80 mph. Wilmington reported an extreme one-minute windspeed of 52 mph with gusts to 72 mph. Damage at Carolina Beach was extensive and was due mainly to the unusually high tide and heavy seas which washed upon the beach and battered to pieces or undermined many dwellings and business places. Two fishing piers were demolished. Damage at Wrightsville Beach was less extensive, but two piers were partially wrecked and many roofs damaged. Thousands fled to Wilmington to escape the danger. In Wilmington, many roofs and windows were damaged and power and communication lines downed. In Brunswick, New Hanover, Pender, and Onslow counties, damage to corn was estimated at 35%, tobacco 15%, and cotton 10%. Total damage was estimated at $2 million. Several persons were injured but there were no fatalities and more than 10,000 people were evacuated from beach areas in advance of the storm.

September 14, 1944 (CAT 3) (Fig. 78)

The "Great Hurricane" of September 1944 caused destruction to 900 miles of the Atlantic coast from Hatteras north. Moving up from the south, the center of the hurricane passed,

a short distance east of Hatteras, caused a wind velocity of 110 mph (extreme, estimated) and the lowest barometric pressure on record at that locality to that date. Cape Henry, Virginia, reported a wind velocity of 134 mph (extreme) with gusts estimated to 150 mph. Because the center passed slightly east of Hatteras, damage to the south coast was slight, but the central and northern coastal areas suffered a loss of 108 buildings destroyed and about 675 damaged, amounted to an estimated $450,000 loss. Crop losses were estimated at $1 million. There was heavy damage in Elizabeth City and the Nags Head area. Damage to property and crops west of the 77th meridian was negligible. One person was killed in North Carolina and four were injured. The Coast Guard cutters *Jackson* and *Bedloe* capsized and sank while protecting a Liberty Ship torpedoed off the North Carolina coast.

October 20, 1944 (TS) (Fig. 79)

The third tropical storm to affect North Carolina in 1944 was of minor intensity with maximum winds at Wilmington from the south at 37 mph when the storm center passed just west of there. It moved directly across the coastal plain to Norfolk, Virginia, dropped up to four inches of rain but caused little wind damage.

June 25, 1945 (CAT 1) (Fig. 80)

After weakening as it passed across Florida from the Gulf of Mexico, this hurricane regained strength when it reached the Atlantic, but weakened again as it struck the North Carolina coast very near Hatteras about midnight June 25th. The maximum wind was 52 mph from the northwest at Hatteras, with gusts to 70 mph reported from Oak Island. Rains of around eight inches fell in the southern coastal area with 8.24 inches in 18 hours at Wilmington. Wrightsville Beach and Carolina Beach were evacuated. Most coastal communication lines were down. No deaths or injuries were reported.

September 17, 1945 (CAT 1) (Fig. 81)

This severe hurricane, first noted in the Leeward Islands on September 11th, passed from south to north through Florida, then north through the central sections of South and North Carolina on the 17th. Although the force of the storm had diminished greatly before it reached North Carolina, it produced torrential rains of as much as eight inches in the state. Having been preceded by a three to five day period of heavy rains, the hurricane's precipitation fell on ground already saturated and most of it ran off into the streams. Major flooding occurred on rivers in the eastern half of North Carolina which were already in flood state from preceding rains. The Cape Fear River reached the highest levels of record. Moncure reached 39.0 feet on the 18th (flood stage 20 feet); Fayetteville 68.9 feet on the 21st (flood stage 35 feet) and Elizabethtown 43.2 feet on the 23rd (flood stage 20 feet). Loss of life was reported as “small,” but economic losses “very large.” Large areas of crop lands were flooded and water reached the eaves of many dwellings in the lower Cape Fear Basin. Small dams broke in Richmond County, resulted in flash floods of exceptional height.

July 6, 1946 (TS) (Fig. 82)

A small tropical disturbance moved north-northeast along the coast of South Carolina during July 5th, and passed inland over North Carolina near Wilmington early on the 6th. Winds up to 66 mph were reported at Elizabeth City, but highest winds were only 50 to 60 mph at Carolina and Wrightsville Beaches. This storm caused heavy rains in the coastal areas, ranging up to 7.84 inches at Manteo. This storm gained greater strength after it moved northeast out of North Carolina.

No deaths or injuries resulted and damage was slight at Wilmington and the beach areas.

October 9, 1946 (XT) (Fig. 83)

This hurricane passed over the western tip of Cuba in a northerly direction and moved into Florida around Tampa, then continued north through the central Carolinas. The storm crossed the North Carolina line just east of Charlotte, became extratropical, then moved northeast to the coast just south of Norfolk, Virginia. The storm must have had minimum effects on the state. No other information was available.

October 12-15, 1947 (CAT 1) (Fig. 84)

After it struck southern Florida on October 11th, this hurricane moved northeast to a point well off the South Carolina coast, then took a sharp turn to the west and struck the coast near Savannah, Georgia. Although the center remained well to the south of North Carolina throughout its entire life, as it headed toward Georgia wind-driven seas caused water to pile up along the South Carolina and southern portion of the North Carolina coasts. Lowlands along the North Carolina coast were flooded, waters pushed up the mouth of the Cape Fear River surging into the streets of Wilmington. Waterfront homes in Morehead City were evacuated. Rains up to seven inches fell in a three-day period at Hatteras and along the southeastern slopes of the mountains in southwestern North Carolina. No deaths or injuries resulted in North Carolina; damages apparently were light.

August 24, 1949 (CAT 1) (Fig. 85)

A hurricane which formed about 300 miles north of Puerto Rico on the 21st moved first toward the west northwest, then curved north, passed directly over *Diamond Shoals Lightship*, off Cape Hatteras, on the 24th, then turned northeast out to sea.
The wind reached 73 mph at Hatteras and rains up to four inches fell in that area, but there were almost no effects a few miles inland. An estimated $50,000 damage to property resulted, mostly in and near Buxton. Thousands of trees were broken in Buxton woods. Two deaths were attributed to the storm.

August 28, 1949 (TS) (Fig. 86)

The remnant of a hurricane which did great damage in Florida the night of August 26th passed across North Carolina from Charlotte to Winston-Salem on the 28th. Winds in this state were barely gale force, but several small tornadoes developed in the Eastern Piedmont section of North Carolina, destroyed many farm buildings and a few homes. Rainfall amounts up to six inches fell in connection with the decaying hurricane, caused some of the heaviest river flooding in several years.

1950 and 1951

In each of these years tropical storms passed northward at some distance off Hatteras, having only slight effect on the North Carolina coast.

August 31, 1952 - ABLE (TS) (Fig. 87)

No hurricane had any serious wind effect on North Carolina in 1952. Hurricane Able entered the South Carolina coast on August 30th and passed through central North Carolina with greatly diminished force on the 31st, caused rains up to about six inches in the Piedmont and western coastal plain. This resulted in considerable flooding of streams and an estimated $50,000 in damages, mostly to highway bridge approaches.

August 13, 1953 - BARBARA (CAT 1) (Fig. 88)

Hurricane Barbara formed northeast of the Bahama Islands on August 11th, increased in force and moved northward to a position east of Florida on the 12th and struck the coast of North Carolina between Morehead City and Ocracoke about 10:00 p.m. on the 13th. After sweeping northward along the Outer Banks to near the Virginia line, she took a northeasterly course out to sea. Highest reported winds were gusts to 90 mph at Hatteras and Nags Head. Torrential rains fell, ranging from six or more inches on the coast down to a mere sprinkle 100 miles inland.

Property damage was estimated at $100,000, mostly to coastal dwellings of poorer construction. Crop damage was an estimated $1 million, mostly due to corn blown down in fields.

One death was attributed to the storm, a man having been swept from a pier at Wrightsville Beach and presumably drowned. There were two injuries.

August 30, 1954 - CAROL (CAT 2) (Fig. 89)

After forming near the northeastern Bahama Islands on August 26th, Hurricane Carol drifted slowly northward for several days. She then began an accelerating north-northeast movement and passed just to the east of Cape Hatteras about 9 or 10 p.m. on the 30th. The North Carolina coastal areas were thus on the weaker side (the west) of the storm;

highest wind speeds on land were gusts to 55 mph at Wilmington, 65 mph at Cherry Point, and 90 to 100 mph at Cape Hatteras.

The effect of Hurricane Carol on the North Carolina coast was not severe and the property damage at any given locality was light. Over the length of the coast, however, damage totaled an estimated quarter of a million dollars. Crop damage resulted mostly from corn and soybeans being blown down in fields. Property damage consisted mostly of fishing piers and roofs and television antennas in the coastal areas. About 1,000 feet of paved highway was undermined on the Outer Banks by high tides.

There was no loss of life in North Carolina, but great destruction and 60 deaths resulted in the New England states where Carol struck on the 31st.

September 10, 1954 - EDNA (CAT 1) (Fig. 90)

Hurricane Edna followed a similar but slightly more eastward path than that of Carol. The center passed about 60 miles east of Cape Hatteras early in the night of September 10th. Highest winds were around 75 mph in gusts on the Outer Banks.

The damage to North Carolina from Edna was minor but widespread in the coastal area. Television aerials, roofs and piers were damaged along most of the coastline. A section of the Outer Banks highway was washed out and the corn crop was damaged two to three percent over a large area. Total property damage was estimated at $75,000 and crop damage at $40,000. There were no deaths due to Edna in North Carolina, but as was the case with Carol, New England suffered severely when this hurricane hit that section on the 11th.

October 15, 1954 - HAZEL (CAT 4) (Fig. 91)

Hurricane Hazel, the most destructive storm in the history of North Carolina at that time, left death and devastation in its wake from Haiti to southeast Canada. Following are excerpts from the official report of the Raleigh Weather Bureau Office concerning this storm.

The storm center entered the North Carolina coast at a point almost exactly coincident with the South Carolina line with a central pressure of somewhat lower than 28 inches of mercury at about 10 a.m.. From there it moved north in slightly curved path that took the center east of Whiteville and Clinton, west of Goldsboro, Wilson, and Nashville, and across the Virginia line in or near Warren County, North Carolina, about 2:30 p.m., the lowest pressure having risen to about 28.50 inches. The center was apparently quite large, since “eye” characteristics were reported from points ten to fifteen miles on either side of the path just described.

Wind-driven tides devastated the immediate ocean front from the South Carolina line to Cape Lookout. All traces of civilization on that portion of the immediate waterfront between the state line and Cape Fear were practically annihilated.

Grass-covered dunes some 10 to 20 feet high along and behind which beach homes had been built in a continuous line five miles long simply disappeared, dunes, houses and all. The paved roadway along which the houses were built was partially washed away, partially buried beneath several feet of sand. The greater part of the material from which houses had been built was washed from one to two hundred yards back into the edge of the low-lying woods which cover the leeward side of the islands. Some of this material is identifiable as having been parts of houses, but the greater portion of it is ground to unrecognizable splinters and bits of masonry. Of the 357 buildings which existed on Long Beach, 352 were totally destroyed and the other five damaged. Similar conditions prevailed on Holden Beach, Ocean Isle, Robinson, and Colonial Beach. In most cases it is impossible to tell where the buildings stood. Where grassy dunes stood, there is now only flat, white, sandy beach.

Northeastward up the coast from Cape Fear to Cape Lookout the degree of devastation is not as great, but ocean front property is damaged an average of perhaps fifty percent along the entire stretch. North of Cape Lookout beach damage is relatively light. Tidewater rose into the lower lying portions of cities along broad mouthed rivers emptying on the coast; considerable damage was done to residential and business property in Washington, and some lesser flooding occurred in New Bern and Elizabeth City. Inland, out of reach of the rising waters, a tremendous area of North Carolina received damage from high winds. An estimated one-third of all buildings east of the 80th meridian received some damage. Roofs were the most likely hit, with damage ranging from one loose shingle or a bent TV aerial to the entire frame and cover lifted off. Radio towers, outdoor theaters and signboards were overturned, twisted, or otherwise damaged.

It is impossible to evaluate the loss of timber and shade trees. In the city of Raleigh alone, an average of two or three trees fell per block. Remarkably few fell on houses, but those few did real destruction. A dozen other cities in the eastern two-thirds of the state fared similarly, while few old country estates with orderly arrangements of oaks or elms escaped the loss of one or more.

In the forests the damage is variable, but its total is tremendous. In the worst places, hundreds of trees per mile can be counted simply in driving along the highway; most of these are uprooted and thrown flat to the ground, but many were blown down by a straight-line windstorm, while in others small-scale tornadic action is apparent. Most of the latter that we have actually seen is in the area around Goldsboro, where young pine forests are dotted with fifty-foot swaths where every tree is twisted off at ten to twenty feet above the ground.

At least ten stations in North Carolina reported the highest 24-hour rainfall amounts of record in connection with “Hazel.” These record amounts ranged from around six and a half inches at Burlington, High Point, and Lexington up to 9.72 inches at Carthage, located in the Sandhills. The U. S. Geological Survey reports that their special rain gage at Robbins, several miles north of Carthage, measured 11.25 inches. This gage is not a part of the Weather Bureau cooperative network. Rainfall in the

eastern half of the storm was astonishingly light, several stations reporting less than an inch. There are few wind records available for comparison. Wilmington, which has moved to a new location within the past few years, reports a top gust of 98 mph, fastest minute 82 mph, and maximum five minutes 61 mph, all from the southeast, at 10:42 a.m.. The previous fastest minute at Wilmington is listed as 65 mph. At Raleigh-Durham wind speeds are indicated only by dial; this was watched closely during the height of the storm, and gusts to 90 mph were observed.

Estimates based on observation of the dial give a highest one-minute speed of 73 mph and a maximum five-minute speed of 62 mph. All these maxima were from the west-northwest, and occurred between 1:30 and 1:35 p.m.. The previous fastest minute on record in Raleigh was 66 mph, and the maximum five-minute speed 56 mph. Winds during Hazel were estimated as high as 120 mph in gusts by observers in Goldsboro, Kinston, and Faison. No barometric low pressure records are known to have been broken.

There are nineteen known dead in North Carolina because of the hurricane; most of them were at or near the beach, but two or three were inland, dying from electrocution, falls or falling objects. An estimated 200 persons were injured. Property damage estimates are still on unofficial basis, and vary. An Associated Press survey of the beaches indicates $36 million damage on the North Carolina beach area.

The wide coverage of wind damage inland is borne out by the fact that thirty North Carolina counties report damage to school buildings. We believe that the total inland crop and property damage in North Carolina is close to $100 million.

August 12, 1955 - CONNIE (CAT 3) (Fig. 92)

Hurricane Connie moved north onto the North Carolina coast very close to Cape Lookout about 8:30 a.m. on August 12th. The storm center passed north through the coastal counties, passed just east of Oriental, Belhaven, Plymouth, and Elizabeth City and crossed the Virginia line near Norfolk about midnight.

For several days, Connie had traveled a sluggish path which, combined with the large-scale wind pattern over the North Atlantic, piled up a wall of high water along the North Carolina coast. This slow movement of the storm through the state aggravated the situation and thousands of acres of farm land were flooded as well as low lying residential areas around the sounds. The prolonged pounding of high waves against the coast caused tremendous beach erosion estimated to have been worse than that caused by Hazel in 1954. Tides on the immediate coast from Southport to Nags Head were reported at about seven feet above normal, while the water of the sounds and near the mouths of rivers rose an estimated five to eight feet above normal.

While the hurricane was still out to sea, a tornado struck at Penderlea on the evening of August 10th, and destroyed five buildings and injured one person. Highest winds directly

associated with Connie when the storm reached North Carolina were barely of hurricane force, the highest reliable report being northeast 72 mph with gusts to 83 mph at Wilmington.

This storm brought torrential rains, which ranged from around 12 inches near Morehead City down to one to two inches in the eastern Piedmont.

No deaths or injuries were directly attributable to this storm in North Carolina.

Hurricane Diane followed so closely after Connie that it was impossible to assess damage due to each storm. The official estimate of losses from the two hurricanes was $80 million, including $60 million in crops (and salt water damage to crop lands) and $20 million in beach and other property damage.

August 17, 1955 - DIANE (CAT 2) (Fig. 93)

Even before the damage from Hurricane Connie could be properly estimated, Hurricane Diane struck North Carolina.

Hurricane Diane entered the coast near Carolina Beach about 6 a.m. on August 17th. The storm center then followed a nearly straight line course north-northwest across Wilmington, passed west of Clinton and Raleigh, directly across Durham and thence to the Virginia line slightly west of Danville, and left the state about 6:30 p.m.

The highest wind reported was northeast 74 mph at Wilmington Airport. Structural damage due to wind alone was rather light, but crops previously windblown in Connie were further damaged as far west as near Raleigh.

Tides in connection with Diane were in general more severe than those with Connie, both on the ocean and in the sounds and rivers. Tides ranged from five to nine feet above mean low water on the beaches and estimated five to nine feet above normal in parts of the sounds and the rivers emptied into the sounds. Water was three feet above floor level in the business district of Belhaven, while water was “waist deep” in parts of Washington and New Bern.

Beach erosion caused by Diane was severe. Thousands of acres of farmland were again flooded with salt water. One thousand people were evacuated from low lying sections of towns on the sounds and adjoining rivers.

Heavy rains fell near the path of the storm center, amounting generally to four to eight inches during the period August 15th to 18th.

No deaths or injuries were officially attributed to Hurricane Diane in North Carolina.

September 19, 1955 - IONE (CAT 3) (Fig. 94)

The center of Hurricane Ione entered the North Carolina coast from the south near Salter Path, about 10 miles west of Morehead City, about 5 a.m. on September 19.

Moving slowly and somewhat erratically north, the center passed a little west of Cherry Point, Oriental, and Belhaven, then curved to the northeast, passed to the southeast of Elizabeth City and left the coast near the Virginia line very early on the 20th.

When Ione entered North Carolina, her highest winds were over 100 mph in gusts. The storm weakened steadily as she passed through the state; highest winds were near 70 mph when it moved out to sea. The highest sustained (one-minute) wind speed was north-northeast 75 mph at Cherry Point, with gusts to 107 mph.

Structural damage due to wind alone was rare, although many roof shingles were blown off and television antennas damaged, mostly in the eastern half of the Coastal Plain. The principle damage was due to water. Since the approach of Hurricane Connie on August 10th, North Carolina had been repeatedly drenched with heavy rains. More than 30 inches fell on the wettest portions of the state between the 10th and the approach of Ione; the additional 16 inches that fell on those same areas in connection with Ione brought 45-day rainfall totals up to figures without precedent in North Carolina weather history. In the 41-day period, August 11th through September 20th, the cooperative weather substation at Hofmann Forest (6 miles southwest of Maysville) received a total of 48.90 inches of rain. Approximately one-third of the unprecedented amount of rain fell in about 30 hours with Hurricane Ione. At the same time, prolonged easterly winds drove tide water onto the beaches and into the sounds and their estuaries to height of three to ten feet above normal. The result was inundation of the greatest area of eastern North Carolina ever known to have been flooded. At New Bern the depth of water was the greatest of record, being about 10.5 ft above mean low water, with 40 city blocks flooded. Thousands of acres of farmland were flooded and thousands of homes were invaded by water to depths ranging up to four feet. Several hundred homes were washed away.

A total of seven deaths in North Carolina were attributed to Ione, five from drowning and two from automobile accidents brought on by flood water. Injuries from the storm were negligible.

Estimates of property damage from Hurricane Ione were:

Agricultural	$46,000,000
Public Utilities	1,000,000
Highways and Bridges	1,000,000
Beach Property	10,000,000
Other Property	30,000,000
TOTAL	$88,000,000

September 26-27, 1956 - FLOSSY (XT) (Fig. 95)

Originated near Yucatan and moved north across the Gulf of Mexico, Flossy was of considerably less than hurricane force when she reached North Carolina on September 26th, having crossed northwest Florida, Georgia, and South Carolina on the way from the Gulf. Peak wind gusts in central and eastern North Carolina were 45 to 60 mph from the northeast, tapered off westward to 20 mph in the mountains. Rain was the most important feature of the storm in North Carolina, and this fell heaviest in the western half of the state. Coming after two months of dry weather, the rain was largely beneficial. Tides did not exceed about five feet, and no damage was reported from minor flooding which occurred on the Outer Banks. Crops in fields in eastern North Carolina were blown about, with some loss in quality and possibly some reduction in yield.

September 27, 1958 - HELENE (CAT 3) (Fig. 96)

Helene passed just off the North Carolina coast from Wilmington to Hatteras. The eye of the storm remained offshore at all times. Even so, the highest winds of record were recorded at Wilmington, with peak gust at 135 mph and fastest one-minute speed 85 mph. There was some beach erosion due to seas and tides, but this was minimized by the passage of the storm at the time of astronomical low tide. Highest tides on the ocean beaches were generally estimated at three to five feet above normal. Tides were higher on the southern edge of the Pamlico Sound, where a sudden rise following the wind shift as the storm center passed brought the tides to seven or eight feet above normal. Structural and crop damage, due almost entirely to the high winds, were estimated at $11 million. A few houses on the coast were completely destroyed, but most structural damage was to roofs.

September 30, 1959 - GRACIE (TS) (Fig. 97)

Hurricane Gracie entered the South Carolina coast south of Charleston, crossed the North Carolina line west of Charlotte just after midnight on the morning of September 30th, and moved rapidly north across the state in a few hours. Tides reached two to three feet above normal on the southern coast of North Carolina on the 29th. Storm rainfall was light on the coast, but ranged upward to eight or nine inches at a few places in the mountains.

July 29, 1960 - BRENDA (TS) (Fig. 98)

The center of tropical storm Brenda moved into North Carolina at about 5 p.m. July 29th at the junction of the North Carolina-South Carolina line with the Atlantic Coast, moving northeast out of the state near Norfolk, Virginia, about midnight. Heaviest rain was 7.50 inches at Wilson. There were gusts to 62 mph at New Topsail Beach. Little damage was reported.

September 11, 1960 - DONNA (CAT 3) (Fig. 99)

One of the most destructive storms in United States history, Hurricane Donna affected the entire length of the Atlantic coast from Florida to Maine. In North Carolina, the center passed inland over the coast between Wilmington and Morehead City. Tides of six to eight feet above normal, combined with winds, caused severe damage at many points. Maximum winds were of hurricane force, with Wilmington reporting a peak gust of 97 mph. The storm center moved north during the night of the 11th along a path slightly east of a line from Wilmington to Norfolk, Virginia. Wind gusts were in excess of 100 mph and tides four to eight feet above normal. Coastal communities suffered heavy structural damage from Wilmington to Nags Head, with considerable beach erosion. The corn crop was badly blown from the coast to fifty miles inland, some trees were down and there was scattered damage to houses about the same distance. One person was electrocuted, three drowned, two crushed by falling trees, and two killed in a traffic accident in which weather was a factor. An estimated 100 persons were injured sufficiently to require medical attention. Two tornadoes were observed in connection with Donna in North Carolina, one in Bladen County and one in Sampson County. Estimated damages were well up in the millions.

September 20, 1961 - ESTHER (CAT 1) (Fig. 100)

The eye of Hurricane Esther remained well off the North Carolina coast throughout its northward course, being more than 100 miles from the nearest point on the Outer Banks at its closest approach on September 20th. At this distance, the western side of the storm was rather dry, and rainfall in North Carolina was light. Winds were in no case destructive over any North Carolina land area, and no deaths, no injuries or serious property damage have been attributed to the storm.

Tides on the North Carolina coast at the height of the storm ranged one to five feet above normal, mostly around three feet. Some of the flooding of the Outer Banks highway and some minor beach erosion resulted from these tides and accompanying seas. Lowest sea level pressure reported at a land station was 29.48 inches at Cape Hatteras at 4 a.m. September 20th; highest winds at Hatteras were 36 mph from the north at 4:56 a.m. September 20th. Sustained winds of 36 mph were also reported from Nags Heads, with gusts to 58 mph. These were from the northwest at 12:10 p.m. on the 20th.

August 28, 1962 - ALMA (CAT 1) (Fig. 101)

Alma moved in a northeast path along the Outer Banks passing just east of Hatteras during the morning of August 28th. Highest wind gusts recorded were from the north-northeast at 35 mph at Nags Head. No deaths or injuries were reported, and only minor property damage.

October 18-19, 1962 - ELLA (NR) (Fig. 102)

Although the center of Hurricane Ella never came within 200 miles of the North Carolina coast, near gale winds and pounding seas affected the coast for two days. The large size of the storm, the fact that it stood nearly stationary for more than two days, and the presence of high pressure over inland areas to the north caused persistent northeast winds occasionally up to gale force, above normal tides and rough seas. Damage was almost confined to beach erosion.

October 19-27, 1963 - GINNY (NR) (Fig. 103)

This storm was remarkable mainly for the long period of time its seas and tides pounded the North Carolina coast. First discovered north of the Dominican Republic on the 16th, she moved steadily north for three days, then turned northwest with her center reaching a point about 200 miles southeast of Cape Hatteras late on the 9th. There, she slowly described a small circle to the right, remained from 50 to 200 miles off the North Carolina coast through the 22nd. Then she described a larger, roughly elliptical figure, which carried her to a position about 75 miles off St. Augustine, Florida, early on the 24th and thence back northeast through the coastal waters, curved with the coastline and remained 50 to 100 miles offshore. Having completed the ellipse at a position off Wilmington on the 26th, she moved slowly east, then finally north, reached Nova Scotia on the 29th. Rough seas affected the North Carolina coast for more than a week caused extensive erosion. One beach house was undermined and fell in the surf, but otherwise, there was little structural damage. There was some damage to unharvested crops. Heavy rain was confined to areas near the coast and no destructive winds reached the shore.

August 29-September 1, 1964 - CLEO (NR) (Fig. 104)

A small but moderately intense hurricane came from Cuba directly north up the Florida east coast, crossed Georgia and entered western South Carolina, passed over into North Carolina near Charlotte on the 30th. From there she moved in a broad curve northeast and east past Elizabeth City about midnight of the 31st. There were no direct winds of destructive force in North Carolina, but associated tornadoes struck the state at three different times. The most serious destroyed several blocks of Laurinburg, injured 15 people, on the afternoon of the 29th. Heavy rains accompanied Cleo, especially in northeast North Carolina, caused some flash-flooding, and some damage to crops. In nearby parts of Tidewater, Virginia, ten to fourteen inches fell, most of it in a 12-hour period.

September 13, 1964 - DORA (NR) (Fig. 105)

This large and powerful storm moved inland south of Jacksonville, Florida, on the 9th, passed slowly west and northwest to southeast Alabama on the 12th. Then she moved rapidly northeast and directly up the North Carolina coastline, passed offshore north of Hatteras on the night of the 13th.

The storm was weakened as it passed over land, and winds in North Carolina were not generally of destructive force. However, associated with her approach and passage were a waterspout and two small tornadoes near the coast. Seas and tides were sufficient to cause some beach erosion and heavy rains on the northern coast flooded the beach highway halting traffic for 48 hours.

September 21-23, 1964 - GLADYS (NR) (Fig. 106)

This storm, whose center remained well offshore throughout its entire history, was nevertheless sufficiently powerful to be felt on the Outer Banks. Lying several hundred miles to the southeast on the 20th, she approached the North Carolina coast very slowly and recurved, the center reached its nearest point at about 140 miles off Hatteras on the 22nd. The long period of onshore winds as the storm approached and passed caused high tides and rough seas which broke over the dunes at numerous places on the Outer Banks. There were no destructive winds or heavy rain on land.

October 16, 1964 - ISABELL (CAT 1) (Fig. 107)

Isbell moved from western Cuba northeast across southern Florida, turned gradually north and inland near Morehead City on the 16th. The storm was weakened and apparently lost its identity as it moved near Elizabeth City before noon on the 17th. Notwithstanding Isbell's weakness, she caused the lowest pressure and the highest winds recorded in North Carolina in connection with any of the 1964 tropical cyclones. Gusts to 75 mph from the northeast were recorded at Elizabeth City at 10 a.m. on the 16th. No wind damage of importance was reported. Rainfall was erratic and not generally extremely heavy. Some local amounts, however, were sufficient to cause flash-flooding and considerable damage was reported to have occurred to peanuts in northeast North Carolina due to wet soils.

1965

1965 was the first year since 1957 in which no tropical storm had significant effects on North Carolina.

June 11 - 12 1966 - ALMA (CAT 1) (Fig. 108)

Widely publicized as the earliest in the season of any hurricane ever to cross a United States coastline, Alma did not cross the coastline of North Carolina. Passing from the Gulf across northwest Florida and southeast Georgia, the center, weakened in crossing land, entered the Atlantic near the southern tip of South Carolina, passing about 50 miles south of Wilmington the morning of the 11th. That night she regained hurricane force and moved first east, then north, past Hatteras at a distance of 100 to 200 miles. Highest gusts on land in North Carolina were about 60 mph and highest tides near five feet above normal. Coastal sections of North Carolina had four to eight inches of rain. There were no deaths or injuries and both beach erosion and property damage were light.

September 10,16-17, 1967 - DORIA (TS) (Fig. 109)

Hurricane Doria moved in every direction around the compass at some time or other during her life. Doria formed about 250 miles east of Jacksonville, Florida on the 4th of September and reached tropical storm force on the 9th then began moving rapidly to the northeast. She reached hurricane intensity on the 10th of September and passed 100 miles southeast of the North Carolina Capes. Damage along the North Carolina coast was minor.

Doria moved due east on the 11th and diminished to less than hurricane force. She stalled on the 12th and regained hurricane force. The storm began to move in a westerly direction on the 13th, reached the Virginia Capes on the 16th, then diminished to tropical storm strength. She moved south, made landfall near the Virginia-North Carolina border and continued south across the North Carolina Capes and back to the sea on the 17th. Damage was minor with water levels about two feet above normal on the sounds.

June 7-13, 1968 - ABBY (NR) (Fig. 110)

Abby was a minimal hurricane that began just off the coast of Honduras. She moved north crossing the western tip of Cuba and continued north making landfall just south of Tampa, Florida. The storm crossed Florida then turned northwest moving across southeast Georgia and into the Carolinas. She reached North Carolina on the 9th near Charlotte. Abby then recurved across extreme northeast South Carolina and into the offshore waters before returning to a northeast course. The depression then skimmed across the North Carolina outer banks and out into the Atlantic during the 12th and 13th. Rainfall up to five inches were reported along the path of the storm in North Carolina. Charlotte reported 5.11 inches of rain. A tornado touched down near Monroe and again near Charlotte on the 7th. Damage in the Charlotte area was estimated in excess of $30,000. Charlotte reported a wind gust of 46 mph from the northwest on the 9th. Asheville reported just over two inches of rain.

October 19-20, 1968 - GLADYS (CAT 1) (Fig. 111)

Hurricane Gladys developed in the western Caribbean Sea. The storm moved north, crossed the western section of Cuba and reached a position just west of Tampa, Florida, late on the 18th of the month. Gladys crossed Florida, and exited just south of Jacksonville on the morning of the 19th. The storm then moved northeast along the coast skirting the North Carolina outer banks on the 20th.

North Carolina benefited the most from Hurricane Gladys. Weather Service Offices at Cape Hatteras and Wilmington reported that the storm did minor damage and there were no deaths or injuries reported in the state. For most of the two day period moderate rain soaked into previously dry soil. Total rainfall during the two days ranged generally from two to five inches but there were some reports up to eight inches. Wind gusts to 98 mph from the north were reported by the Coast Guard Stations at Ocracoke and Cape Hatteras.

The following wind gusts were reported:

Cape Hatteras Weather Station 79 mph

Cape Lookout 90 mph

Atlantic Beach 69 mph

Topsail Beach 63 mph

Wilmington Weather Station 39 mph

Carolina Beach 53 mph

With the winds mostly from northwest to north directions tides ran only two to three feet above normal with only minor beach erosion. Sea level pressure readings ranged from a low of 29.17 inches at Cape Hatteras Weather Station to a high of 29.58 inches at Wilmington Weather Station.

September 8, 1969 - GERDA (NR) (Fig. 112)

Hurricane Gerda originated off the African coast, moved to the Bahamas, then into central Florida as a tropical depression. From Florida the storm moved northeast 100 miles off the coast of South Carolina. Charleston reported winds of only 20 mph. She increased to hurricane strength about 210 miles south-southwest of Cape Hatteras on the 8th, then moved rapidly northeast with a forward speed of 40 mph. While winds close to the storm's center were about 90 mph, winds at Cape Hatteras, some 60 miles to the west, were 27 mph with gusts to 36 mph from the north-northeast. Tides were 1.5 ft above normal at Ocracoke Island. Rainfall at Cape Hatteras was 1.32 inches. Lowest sea level pressure ranged from 29.51 inches at Cape Hatteras to 29.70 inches at Wilmington. Wilmington reported winds of 11 mph from the southwest and a rainfall total of 0.79 inch.

1970

No hurricanes or tropical storms affected North Carolina.

August 27, 1971 - DORIA (TS) (Fig. 113)

Doria spawned off the African coast and moved east to 200 miles east of Daytona Beach, Florida, on the 25th before increasing to tropical storm force on the 26th. The storm moved in a northerly direction, making landfall near Atlantic Beach on the 27th. Wind gusts of 69 mph were measured at Atlantic Beach and gusts to 58 mph were reported along the Outer Banks and the shores of the Pamlico and Albemarle Sounds. Winds at Wilmington gusted to 30 mph from the north, Cape Hatteras had gusts to 54 mph from the south and Elizabeth City reported gusts to 60 mph. Rainfall totals ranged from 4.17

inches at Cape Hatteras to 2.19 inches at Wilmington. Lowest pressure was 989 mb (29.20 inches) at Atlantic Beach.

Streets and highways in many areas were blocked by flood waters and some mudslides. Considerable damage was done to water and sewer systems. In some areas flooding severely damaged residential and industrial properties. In most areas wind damage was minimal.

September 30-October 1, 1971 - GINGER (CAT 1) (Fig. 114)

Ginger will be noted for her longevity. The storm was tracked for 31 days, during 20 of which she was a hurricane. Ginger developed just east of the Bahamas, moved east and south of Bermuda to well east of Bermuda, then curved back west moving just south of Bermuda on the 23rd. The storm stopped her southwest movement on the 27th and headed to the northwest toward the North Carolina coast, making landfall on the 30th near Atlantic Beach. The landfall was near the same place where Doria moved inland one month earlier. The storm was a dissipating depression by the 1st of October. On the second, she moved into southern Virginia, then turned east and moved out to sea.

As Ginger approached the North Carolina coast wind gusts to 92 mph were reported by Atlantic Beach. Gusts from 40 to 75 mph were common along the Outer Banks and the shores of the Pamlico Sound. Maximum sustained winds were less than 50 mph over eastern North Carolina and southern Virginia. The following wind gusts were reported:

Atlantic Beach northwest 92 mph

Cape Hatteras southeast 70 mph

Topsail west-northwest 58 mph

Holden Beach west-northwest 35 mph

Wilmington west-northwest 44 mph

Raleigh north 46 mph

Charlotte north-northeast 30 mph.

Water levels on the Pamlico Sound and its estuaries ran four to seven feet above normal. At Washington, Aurora, New Bern, and Cherry Point, tides were all six feet or more above normal. Tides on the ocean front ran two to four feet above normal from Norfolk, Virginia, to Morehead City.

Rainfall was heaviest along the shores of the Pamlico Sound, where 10 to 13 inches doused several east central North Carolina counties. It was here that crops suffered heavily. Thousands of acres of corn and soybeans were seriously affected with damage of

$10 million. This was the greatest impact of any hurricane on North Carolina since Donna in September, 1960. Rainfall totals greater than 10 inches were reported at Bayboro, Belhaven, Aurora, and on Roanoke Island. Cape Hatteras reported 9.68 inches of rain, Raleigh 3.50 inches, Charlotte 2.21 inches, and Wilmington 1.19 inches. Property damage was minor in most areas. In areas of flooding, it was termed light to moderate.

There were no deaths or injuries related to the storm in North Carolina.

June 20-21, 1972 - AGNES (TS) (Fig. 115(a-b))

Agnes developed off the Yucatan Peninsula moved north, making landfall near Panama City, Florida. The storm weakened to tropical depression status upon making landfall on the 19th. The depression moved northeast through central Georgia and central South Carolina and into the coastal plains of North Carolina on the 21st.

The depression increased to tropical strength over northeast North Carolina before moving out to sea near Norfolk, Virginia, the night of the 21st.
On the 21st, while the storm was over the Carolinas, a secondary low developed to the west of Agnes. These combined to give western sections of the Carolinas some of the worst floods on record.

Heaviest rains occurred along the eastern slopes of the Blue Ridge Mountains from about Greenville, South Carolina, to Lake Lure, northeast to the Danbury-Reidsville, Virginia, area. Rain fell from the 19th through the 21st but much of the total rainfall occurred in less than 48 hours. Mt. Mitchell had a storm total of 10.6 inches. Throughout the eastern Carolinas, rain was relatively light. East of a line Charleston-Columbia-Raleigh totals were generally less than four inches with even less along the coast. Wilmington had a storm total of 2.52 inches while Cape Hatteras had only 0.43 inches.

Major river flooding followed flash flooding of mountain and piedmont streams. Severe flooding occurred on the Yadkin-Pee Dee system and the Dan River. Lesser flooding occurred along the Catawba, Saluda, Rock, Congree, Lumber, and Broad Rivers.

The Yadkin River on the 22nd crested 14.6 feet above flood level and reached Yadkin College on the afternoon of the 22nd. The Pee Dee caused severe flooding from Blewett Lake (near the South Carolina line) to Cheraw, South Carolina. The flooding began on the 22nd and continued for four days.

Winds in the storm were generally light with gusts mostly 30 to 35 mph. However, Cape Hatteras reported a gust to 62 mph from the west-northwest on the 21st as the storm increased to tropical strength.

The Yadkin River in North Carolina flooded more than 86,000 acres. Total losses in the Basin were estimated at $4,220,000 with more than $3,500,000 mainly to agriculture (growing crops). Street flooding in Elkin, Yadkin College, and other river towns

accounted for the remainder. Two deaths occurred in North Carolina: one in Surry County when a canoe overturned and another in Iredell County when a man driving a tractor was swept away in the flood waters. Estimates of flooding in the Catawba, Congaree, and Reedy River Basins totaled $32,000 which was mostly minor home and trailer home damage and some crop damage. Total damage in North Carolina was estimated at $4,280,000.

September 8- 9, 1972 - DAWN (NR) (Fig. 116)

Dawn originated off the African coast and moved to the southeast coast of Florida. She then recurved and moved well to the northeast of Cape Hatteras, increasing to hurricane strength on the 7th. The storm looped to the west coming within 200 miles of Cape Hatteras on the 8th and 9th. Gale force winds occurred along the outer banks of Cape Hatteras but none were reported inland. No significant damage or loss of life occurred with Dawn. The storm then moved southeast and eventually by the 13th to the west before dissipating near Charleston, South Carolina on the 14th.

October 25-26, 1973 - GILDA (NR) (Fig. 117)

Tropical Storm Gilda moved from the northwest Caribbean Sea across central Cuba and continued on a northeast course reaching a midway point between Cape Hatteras and Bermuda on the 25th. The storm then became extratropical before continuing its northeast movement. Seas and swells generated by the storm pounded the Atlantic Coast beaches from New Jersey to Florida, causing minor beach erosion. Gale force winds affected the northern outer banks of North Carolina. There were no deaths or injuries from the storm in North Carolina.

1974

No tropical cyclones affected North Carolina.

June 28, 1975 - AMY (TS) (Fig. 118)

Tropical Storm Amy developed off the east coast of Florida on June 26th. Amy then moved north reaching a point off the North Carolina coast on the 28th. She then meandered slowly to the east before moving northeast. The high winds and heavy rains remained off the North Carolina coast, however, the slow movement caused prolonged northeast wind flow which produced large swells and tides of two to four feet above normal on the North Carolina outer banks. The swells and high tides caused some beach erosion and temporary flooding of roads, but damage was minor.

October 26-27, 1975 - HALLIE (TS) (Fig. 119)

Hallie developed just north of the Bahamas on the 24th and moved in a northerly direction; remaining about 100 miles off the Florida and Georgia coasts. As the storm approached the Carolinas, she turned to a northeasterly direction and skirted the North

Carolina Outer Banks on the 27th. Tides ran one to two feet above normal along the Virginia and North Carolina coasts but damage was not significant, and there were no casualties.

August 9, 1976 - BELLE (NR) (Fig. 120)

Originating off the African coast on the 28th of July, Belle moved westward to a position just east of the Bahamas on the 5th of August. She reached tropical storm strength on the evening of August the 6th and hurricane strength late afternoon on the 7th.

Belle moved in a northerly direction passing within 100 miles of the North Carolina Outer Banks on the 9th. With the passage of the storm on the 9th, Cape Hatteras had a sustained one-minute average wind speed of 37 mph with gusts to 63 mph. Frisco and Hatteras Place on the Outer Banks reported estimated wind gusts to 75 mph. Farther south, Wilmington reported northwest wind 16 mph with gust to 18 mph. Total rainfall from the storm at Cape Hatteras was 3.70 inches. Wilmington did not report any rainfall associated with the storm. Lowest pressure readings ranged from 29.38 inches at Cape Hatteras to 29.74 inches at Wilmington. Tides of three feet above the road surface were observed at points along the North Carolina Outer Banks. Damage in North Carolina was minor with no deaths or injuries reported with the storm.

August 20-21, 1976 - DOTTIE (TS) (Fig. 121)

Dottie originated in the Gulf of Mexico about 150 miles northwest of Key West, Florida, on August 17th, moved southwest to the Florida Keys, then into southern Florida. The storm then began moving in a northerly direction moving into the Atlantic near Palm Beach. She continued moving north, making landfall near Charleston, South Carolina on the evening of the 20th. Dottie weakened to a low pressure center in South Carolina and moved south into the Atlantic on the 22nd.

Wind gusts 40 to 45 mph were recorded at beach locations near Wilmington. Tides at Atlantic Beach were reported as 3.5 ft above normal but generally ran one to two feet above normal. Carolina Beach had a storm rainfall of 7.78 inches with amounts of four to six inches over the remainder of coastal North Carolina near Wilmington. Wilmington had a total storm rainfall of 4.28 inches.

Damage from the storm, mainly beach erosion, was minor. No deaths or injuries were reported in North Carolina.

1977

There were no significant tropical cyclones that affected North Carolina.

September 1-2, 1978 - ELLA (NR) (Fig. 122)

Hurricane Ella formed in the central North Atlantic Ocean on the 28th of August and moved in a west-northwest direction. The storm was within 400 miles of the North Carolina Outer Banks on the 1st of September. However, Ella changed to a northeast movement on the morning of the 2nd and moved at a forward speed increasing to 40 mph.

The only damage was some beach erosion on the Outer Banks and to the tourist industry, as this was a Labor Day Weekend and a hurricane watch had been posted for the Outer Banks of North Carolina on the 1st.

September 5, 1979 - DAVID (TS) (Fig. 123(a-b))

Hurricane David originated near the Cape Verde Islands on August 25th, moved in a westerly direction, then changed to a northwest direction and made landfall near Palm Beach, Florida, on September 3rd. The storm moved back out to sea near Cape Canaveral and moved north making landfall again near Savannah, Georgia, on September 4th. Diminished to tropical strength, David moved through the central Carolinas on the 4th and 5th of September; then continued on a northeast track through New England. David was a large storm and even though he remained well inland over North Carolina, gale force winds were produced well out to sea.

Damage in North Carolina was primarily beach erosion and flooding along the coastal sections. No major damage was reported but gale force winds were observed along the coast. The following wind gusts were reported:

Wrightsville Beach southeast 60 mph

Wilmington southeast 46 mph

New River south-southeast 54 mph

Atlantic Beach south-southeast 53 mph

Cherry Point south 41 mph

Cape Hatteras south 43 mph

Raleigh east 36 mph

Tides ran three to five feet above normal. Water levels on the Pamlico River ranged from two to seven feet. Rainfall over the coastal sections ranged from seven to 10 inches. In the Piedmont section Raleigh reported 2.67 inches.

No deaths or injuries were reported in North Carolina.

1980

There were no significant tropical cyclones affecting North Carolina.

August 20-21, 1981 - DENNIS (TS) (Fig. 124)

Dennis originated off the African coast and moved west to south of Cuba then turned to a northerly track. The storm crossed Cuba on the 16th and moved into south Florida and back out to sea near Cape Canaveral on the 19th.

The storm moved in a northerly direction skirting the Carolina coasts on the 20th and 21st. The highest wind reported along the North Carolina coast was a gust to 45 mph at Cedar Island. Rainfall amounts of around five to 10 inches were reported along the Carolina coasts. Damage was minor.

June 18-19, 1982 (ST) (Fig. 125)

A disturbance moving north into the central Gulf of Mexico on June 17th interacted with a strong upper-level trough and moved rapidly northeast across northern Florida as a developing subtropical storm on the morning of June 18th. The subtropical storm skirted the North Carolina coast on June 19th and raced northeast, passing south of Nova Scotia on June 20th.

Damage along the North Carolina coast was minor. Cape Hatteras reported a 1-minute wind speed of 25 mph from the south on the 18th and 19th. Rainfall at Cape Hatteras for the two days totaled 3.70 inches with 3.03 inches of the total falling on the 18th. On the morning of June 19th a tug boat about 100 miles east of Cape Hatteras reported hurricane-force gusts and seas 30 to 35 feet. Wilmington reported a 1-minute wind speed of 23 mph from the southwest on the 19th. Rainfall at Wilmington for the 18th and 19th totaled 3.73 inches with 2.72 of the total amount falling on the 18th.

1983

There were no significant tropical cyclones that affected North Carolina.

September 9-14, 1984 - DIANA (CAT 2) (Fig. 126(a-b))

Diana was first observed as a developing low on the end of a frontal trough just north of the Bahama Islands September 8th. On the 9th, Diana approached within 150 miles of the Florida coast. On September 10th Diana had intensified to hurricane force and was moving north-northeast on a course parallel to the Georgia and South Carolina coasts. Over the next two days (11th and 12th) Diana intensified to a high category three and moved close to Cape Fear. The hurricane stalled off Cape Fear for about 30 hours making an anticyclonic loop. Diana crossed the North Carolina coast near Long Beach as a minimal category two hurricane around 3 a.m. Thursday September 13th, during

low tide. After making landfall, Diana weakened to tropical storm strength and then moved northeast along the coastal sections of North Carolina exiting into the Atlantic near Oregon Inlet.

Damage over southeast North Carolina amounted to around $80 million with about one third of the amount agricultural damage. There was considerable roof damage in New Hanover and Brunswick Counties, especially on the Barrier Islands. Widespread tree and power line damage occurred in New Hanover County.

Spotty tree and structural damage also occurred in Pender, Sampson, Bladen, and Columbus counties. The falling trees also resulted in property damage throughout all these counties. Damage in New Hanover County amounted to around $30 million and in Brunswick County around $20 million.

Severe beach erosion occurred from southern Pender County south along the New Hanover County beaches. Hurricane tide around 5.5 ft occurred at Carolina Beach. Widespread fresh water flooding occurred in New Hanover, Brunswick, Pender, Columbus, Bladen, Sampson and Duplin Counties. Rainfall amounts up to 15.5 inches were reported. The National Weather Service Office in Wilmington reported 13.72 inches from 5 a.m. on the 11th to 7:15 a.m. on the 14th. The heavy rainfall in association with the winds caused widespread tree uprootings and months of cleanup work.

Dam failures occurred at Boiling Springs (Brunswick County), Roseboro (Sampson County), and Faison (Duplin County). The lower reaches of the Cape Fear River reached levels at or a little above bankfull. There were no confirmed tornadoes associated with Hurricane Diana in North Carolina.

There were three deaths related to Diana: a person preparing for the storm suffered a fatal heart attack and two people were killed in accidents on water covered roads including the Shelter Manager in Brunswick County.

The highest sustained wind occurred while Diana was still out to sea. Oak Island Coast Guard Station on the 11th reported a sustained wind speed of 115 mph. When Diana made landfall the highest sustained wind was around 92 mph. Around the time of landfall, the National Weather Service Office in Wilmington reported a sustained wind of 46 mph with a gust to 74 mph. The National Weather Service Office at Cape Hatteras reported a sustained wind speed of 31 mph with a gust to 45 mph on the morning of the 14th. Diana exited the North Carolina coast on the morning of the 15th.

October 12-15, 1984 - JOSEPHINE (NR) (Fig. 127)

A depression formed just east of the Bahama Islands on October 7th. Drifting west on the 8th, the storm increased to tropical storm strength. It turned north on the 9th and increased to hurricane strength on the 10th. Josephine was a large and long-lived storm and affected the major shipping lanes of the North Atlantic for several days.

The combination of Hurricane Josephine and a large high-pressure system to the north, while the storm was moving slowly parallel to the east coast, created strong winds over an extensive area. The winds combined with abnormally high astronomical tides and large waves produced damage to marine installations and caused severe beach erosion along the Outer Banks of North Carolina.

July 24-26, 1985 - BOB (NR) (Fig. 128)

Bob became a tropical storm in the Gulf of Mexico southwest of Fort Myers, Florida, on July 22nd. Bob crossed the Florida peninsula near Fort Myers on the 23rd and headed north. He increased to minimal hurricane force before making landfall near Beaufort, South Carolina, late on the 24th. The storm weakened over land and moved north through the central Carolinas reaching western sections of Virginia on the 26th.

Even though Bob made landfall far south of North Carolina, the highest wind from the storm in the Carolinas was a wind gust to 83 mph at Holden Beach produced by spiral bands. The National Weather Service in Wilmington reported a sustained wind speed of 29 mph with a gust to 43 mph. Wilmington had a storm total of nearly 2.5 inches of rain and Red Springs in Robeson County reported nearly 6.5 inches. There was minor damage and no deaths attributed to Bob.

September 26-27, 1985 - GLORIA (CAT 3) (Fig. 129(a-b))

Hurricane Gloria originated as a tropical depression off the west coast of Africa September 15th and drifted west across the Atlantic. The storm increased to hurricane strength on the 22nd and turned to a northwesterly movement. In the early morning hours of the 26th, Gloria was about 400 miles southeast of Cape Hatteras and moving northwest. The storm turned to a more northerly course and moved over Cape Hatteras on the Outer Banks about 2 a.m. on the 27th. After making landfall at Cape Hatteras, she turned to a northeasterly movement making landfall again on the south shore of Long Island, New York.

Damage over North Carolina amounted to around $8 million with severe beach erosion and flooding on the Outer Banks. One death was attributed to the storm when a tree fell on a mobile home, killing a man.

The strongest winds occurred to the east of storm. Diamond Shoals Tower, about 15 miles southeast of Cape Hatteras, recorded a sustained wind speed of 98 mph with a gust to 120 mph. Cape Hatteras had a low pressure reading of 947.5 mb (27.98 inches), making Gloria a category three hurricane. Cape Hatteras reported sustained wind speed of 74 mph with a gust to 86 mph. Norfolk, Virginia, Naval Air Station reported sustained winds of 67 mph with a gust to 91 mph. Frying Pan Tower about 50 miles southeast of Wilmington reported 62 mph sustained wind with a gust to 71 mph. Jacksonville had a gust to 49 mph, while Wilmington had a sustained wind of only 26 mph.

Highest tides were about four feet above normal in the Wilmington area, six feet in the Cherry Point area and six to eight feet on the Outer Banks.

The heaviest rainfall was 7.09 inches at New Bern followed by 7.00 inches at Cherry Point and 3.36 inches at Jacksonville. Cape Hatteras reported only 2.10 inches and Wilmington only 1.46 inches.

November 22, 1985 - KATE (TS) (Fig. 130)

Kate originated just northeast of the Virgin Islands between the 13th and 14th. Kate increased to hurricane force on the 16th and began moving west. Kate moved to the north-central coast of Cuba on the 19th and then moved in a northerly direction making landfall in the Florida Panhandle near Mexico Beach on the 21st. Kate weakened to tropical force over the Florida Panhandle and then moved northeast across south Georgia and into the Carolina coastal waters on the 22nd. The storm turned to an easterly direction and continued to weaken with the remnants of the storm passing over Bermuda on the 24th.

This storm had little effect on North Carolina. On the 22nd, the National Weather Service in Wilmington reported a sustained wind speed of 29 mph with a gust to 40 mph. Frying Pan Tower about 50 miles southeast of Wilmington had a sustained wind of 43 mph with a gust to 47mph. Wilmington had 1.83 inches of rain.

June 7- 8, 1986 - ANDREW (TS) (Fig. 131)

Andrew originated as a tropical depression near the northern Bahama Islands on the 5th of June. The storm moved in a northerly direction and increased to tropical storm force on the 6th. As the storm approached the Carolinas, he turned to a northeasterly direction with the center passing about 60 miles to the east of Cape Hatteras. The storm dissipated at sea east of Cape Hatteras.

The highest winds were to the east of the storm with no sustained gale force winds occurring over land. The storm had little effect on North Carolina. However, a drowning death in the state was attributed to Andrew.

August 17-18, 1986 - CHARLEY (CAT 1) (Fig. 132)

Charley originated in the eastern Gulf of Mexico just west of Tampa, Florida on the 12th. The depression moved into south Georgia then moved east exiting Georgia around Savannah on the 15th. Charley increased to tropical storm force on the 16th and drifted in an easterly direction south of North Carolina. The storm increased to hurricane force on the 17th and turned north and moved across the Outer Banks. Charley then decreased to less than hurricane force and moved northeast. Charley was classified as a hurricane for only 24 hours.

Hurricane Charley barely reached hurricane force as it crossed the Outer Banks. Sustained wind speeds did not reach hurricane force as reported by land stations. Winds gusting from 75 to 80 mph were recorded from Swan Quarter in Hyde County north along the Outer Banks. Cape Lookout and Atlantic Beach reported gusts to 58 mph and farther south Wilmington had a gust to 29 mph.

Rainfall from the storm ranged from around 0.5 inches at Wilmington to around 2.75 inches on the Outer Banks. Damage in North Carolina was relatively light, resulting primarily from tidal flooding and downed trees. One death in North Carolina was attributed to Charley as a motorist attempting to cross a flooded causeway near Maneto was drowned.

1987-1988

There were no significant tropical storms affecting North Carolina.

September 21-22, 1989 - HUGO (CAT 3) (Fig. 133(a-b))

Hugo originated off the African coast and moved to near the Cape Verde Islands and developed into a tropical depression on the 10th. He continued moving west and became a tropical storm on the 11th and a hurricane on the 13th. On the 15th Hugo turned to a west-northwest course and moved across the northeast tip of Puerto Rico on the morning of the 18th. After moving past Puerto Rico, the storm turned to a northwesterly course and was a few hundred miles east of Florida on the 21st. Hugo then turned to a more northerly course and headed for the Carolinas.

Hugo made landfall near Charleston, South Carolina at Sullivans Island around midnight. on the 21st. After making landfall Hugo began to weaken and turned to a north-northwest course passing near Shaw Air Force Base (Sumter, South Carolina) around 4 a.m. and had weakened to tropical storm force just south of Charlotte by 6 a.m. As Hugo moved into North Carolina, his forward speed began to increase, and by late afternoon was moving at 40 mph to the north. Hugo moved rapidly across extreme western Virginia, West Virginia, eastern Ohio and to near Erie, Pennsylvania, by evening on the 22nd where he transformed into an extratropical storm.

Hurricane Hugo made landfall near Charleston as a category four hurricane. Hugo was estimated to be minimal category three in Brunswick County, North Carolina (due to storm surge and battering of beach front homes) and was tropical storm force in the Charlotte area. Damage figures are astronomical and Hugo was the costliest hurricane ever to make landfall on the U. S. mainland. Damage in South Carolina was estimated at four billion dollars; in the Charlotte area and the surrounding counties to Hickory damage was around one billion dollars. Some wind damage was also reported in the southern coastal plains of North Carolina. Damage in the coastal counties of North Carolina was primarily in Brunswick County where over $70 million damage was reported. Over 120 homes on the beaches of Long Beach and Ocean Isle Beach were destroyed by the

battering of the storm surge or condemned because of the damage. Several homes on Holden Beach suffered the same effects.

Severe beach erosion occurred in Brunswick County, with many sections of the barrier island beaches dune system cut or eliminated. Some beach erosion occurred from New Hanover County to Onslow County. Oceanfront fishing piers were severely damaged in Brunswick, New Hanover, Pender, and Onslow counties.

The total number of deaths associated with Hurricane Hugo was estimated at 82 as follows: South Carolina 27, North Carolina 7, Virginia 6, New York 1, Puerto Rico 12, U. S. Virgin Islands 6, Antigua and Barbuda 1, Guadeloupe 11, Montserrat 10, and St Kitts and Nevis 1.

When Hugo made landfall near Charleston, South Carolina, the highest sustained wind speed (1-minute average) was estimated to be around 138 mph. A ship anchored in the Sampit River five miles west of Georgetown reported a sustained wind speed of 120 mph (anemometer was on the ship's mast at 61 feet elevation). Gusts of 99 mph were reported in Columbia and a gust to 109 mph at Shaw Air Force Base (Sumter). Folly Beach Coastal-Marine Automated Network (C-MAN) station had a sustained wind speed of 85 mph with a gust to 107 mph.

In North Carolina, Charlotte reported the highest sustained wind speed 69 mph with a gust to 87 mph. Hickory had a gust of 81 mph. A 70 mph gust was reported on the Cape Fear River by a pilot boat between Southport and Ft. Caswell. Holden Beach had a gust to 59 mph. Greensboro reported a gust to 54 mph, Wilmington a gust to 53 mph, and Cape Hatteras a gust to 35 mph.

Storm tides in South Carolina were near 20 feet at Bulls Bay, McClellanville 13 to 16 feet, Myrtle Beach 13 feet, Folly Beach 10 to 12 feet, and Charleston 10 feet.

Storm tides in North Carolina were highest in Brunswick County ranging from 8 to 10 feet. From New Hanover County north along the coast storm tides were around five feet.

The storm total rainfall of 8.10 inches was reported near Charleston, South Carolina and 5.98 inches at Summerville, South Carolina.

Storm total rainfalls for North Carolina were as follows: Boone 6.91 inches, Charlotte 3.16 inches, Asheville 1.93 inches, Greensboro 1.43 inches, Wilmington 0.79 inches, Cape Hatteras 0.60 inches, and Raleigh 0.45 inches.

1990

No tropical storms or hurricanes affected North Carolina.

August 18-19, 1991 - BOB (CAT 3) (Fig. 134(a-b))

Bob originated from the remnants of an old frontal trough east of the Bahama Islands on August 15th and became a tropical depression on the 16th. The system moved northwest and developed into a tropical storm late on the 16th and a hurricane on the 17th about 200 miles of Daytona Beach, Florida. The hurricane then began to turn north and northeast while accelerating to a position about 30 miles east of Cape Hatteras on August 19th. Bob quickly headed north and made landfall near Newport, Rhode Island, late on the 19th.

Highest sustained wind speeds at landfall were estimated near 80 mph with gusts on Block Island of 100 mph along with a barometric pressure reading of 964 mb (28.47 inches). Diamond Shoals Light C-MAN about 20 miles east of Cape Hatteras reported a minimum low pressure of 962 mb (28.41 inches) and maximum sustained winds of 85 kt (98 mph) with gusts to 97 kt (112 mph) early on the 19th.

Damage from Bob amounted to $780 million for the U.S. mainland with around $4 million in North Carolina. Power was knocked out to 2.1 million homes and businesses from the Outer Banks of North Carolina into New England.
Storm tides of 15 to 17 feet were observed at landfall in Buzzard's Bay, Massachusetts, with seas of greater than 25 feet along the North Carolina Outer Banks.

Six confirmed tornadoes were seen in association with Bob, including five in North Carolina. Thirteen additional unconfirmed tornadoes were reported with nine in wooded areas on Hatteras Island, North Carolina.

The total number of deaths associated with Hurricane Bob was set at 17 and distributed as follows: Connecticut 6, Maine 3, New Hampshire 2, New York 2, Nova Scotia 2, North Carolina 1, and South Carolina 1.

Rainfall totals ranged up to nearly eight inches along the path of Bob including 5.30 inches at Cape Hatteras.

September 22-25, 1992 - DANIELLE (TS) (Fig. 135)

Danielle originated within a persistent area of low pressure aided by a tropical wave off the southeast U. S. coast. The system attained tropical depression status about 175 miles south of Cape Hatteras on the 22nd and became a tropical storm that evening. After making a clockwise loop off the Carolina coast on the 23rd, Danielle turned north and strengthened to 70 mph while paralleling the coast through the 25th. Danielle moved inland over the Delmarva Peninsula late on the 25th and then proceeded to dissipate over Pennsylvania on the 26th.

Most of the tropical storm force winds remained offshore of the Outer Banks with the highest speeds over land observed at Cape Charles, Virginia, where sustained winds of near 50 mph occurred. The highest storm surge reported was 5.4 feet at Cape Hatteras.

Significant beach erosion also was seen along the Outer Banks from Cape Hatteras north, although flooding and damage remained minor.

Two deaths resulted from a sailboat being sunk by high seas to the east of New Jersey with no injuries reported in North Carolina with Danielle.

August 30-31, 1993 - EMILY (CAT 3) (Fig. 136(a-b))

Emily developed from a tropical wave that passed across the Cape Verde Islands on August 17th and moved west, becoming a tropical depression on the 22nd of August about 700 miles east of Puerto Rico. The system passed north of the Leeward Island and became a tropical storm about 900 miles east of Florida on the 25th and reached hurricane strength on the 26th. Emily veered toward the north and northwest on the 30th and intensified to category three strength until the eye wall reached the Outer Banks of North Carolina on the 31st.

Maximum winds were recorded east of the center with Diamond Shoals Light Tower recording sustained speeds of 86 kt (99 mph) and a peak gust to 128 kt (147 mph). The National Weather Service office in Buxton measured sustained winds of 52 kt (60 mph) with gusts to 85 kt (98 mph). Estimates from the Hurricane Research Division indicated surface speeds to as high as 100 knots (115 mph) over Pamlico Sound.

Due to the center of Emily passing parallel and just offshore the Outer Banks, storm surge along the ocean front was only a few feet above normal with more extensive soundside flooding from Pamlico Sound observed as Emily passed north of the region. A storm surge flood height of 10.2 feet above sea level at Buxton was the highest reported value due to flooding from the sound. The maximum rainfall recorded was 7.5 inches at Buxton.

Two swimming deaths occurred at Nags Head on September 1st. Damage in North Carolina was $35 million, mainly on Hatteras Island. Five hundred and fifty three dwellings suffered enough damage to be declared uninhabitable with about 160,000 people evacuated from the barrier islands of North Carolina.

November 17-18, 1994 - GORDON (CAT 1) (Fig. 137(a-b))

Gordon developed along a tropical wave along the east coast of Nicaragua and moved slowly north becoming a tropical depression on the 8th. As the system moved back into the western Caribbean Sea, he strengthened to a tropical storm on the 10th and headed northeast toward Cuba and Haiti. After moving through the islands, Gordon moved back to the northwest before turning northeast and crossing Florida on the 16th. Upon leaving Florida, Gordon accelerated northeastward and intensified to become a hurricane on the 17th. As steering currents became weak, the hurricane abruptly turned northwest toward North Carolina before stalling offshore. After making a small counter-clockwise loop just offshore, the storm headed back south and weakened to dissipation along the Florida east coast by the 20th.

June 5-7, 1995 - ALLISON (NR) (Fig. 138(a-c))

Allison originated from a tropical wave over the western Caribbean Sea on June 1st and became a tropical depression west of Belize on June 3rd. The system headed northward into the Yucatan Channel on June 3rd and deepened into a minimal hurricane over the southeast Gulf of Mexico on the 4th. Allison made landfall on the coast of north Florida on June 5th and became extratropical upon moving across the Carolinas on the 6th and 7th.

The highest sustained wind of 75 mph was estimated by an Air Force Hurricane Hunter aircraft on the 5th while reports of 40 to 50 mph were the maximum speeds observed at landfall along the Florida coast.

The main effects from Allison over North Carolina resulted from heavy rainfall amounts of 4 to 6 inches along the coastal regions.

The total damage figure due to Allison was $1,700,000 with estimated $860,000 in Florida and $800,000 in Georgia mainly due to tornadoes.
One death in Cuba was attributed by the storm while there were no direct deaths in the U. S. due to Allison.

August 18-20, 1995 - FELIX (CAT 1) (Fig. 139(a-b))

Felix originated from a tropical wave over the eastern Atlantic on the 6th and became a depression on the 8th about 400 miles southwest of the Cape Verde islands. The system strengthened to a tropical storm on the 8th as it tracked west toward the Leeward Islands. Felix became a hurricane on the 11th and quickly intensified to a category four storm north of the Leeward Islands on August 13th. The hurricane weakened and turned more toward the northwest by the 15th as it neared Bermuda before heading for the North Carolina coast. The system weakened to a minimal hurricane over colder water while stalled well east of Cape Hatteras on the 19th and finally lifted north and became extratropical east of Newfoundland during the 22nd.

Although Felix never made landfall in North Carolina, large swells generated by the storm caused rough surf and severe beach erosion along the Outer Banks. Highway 12 on the Outer Banks sustained heavy erosion and overwash in many locations.

While the loss in property damage was low, eight people died from drowning due to Felix, three off the North Carolina coast and five along the New Jersey beaches.

September 9-10, 1995 - LUIS (CAT 4) (Fig. 140(a-b))

Luis was a large and powerful Cape Verde hurricane that only produced residual effects along the North Carolina coast from heavy surf and above normal tides. The storm wreaked havoc across the Leeward Islands where 16 deaths and two-and-a-half billion

dollars in damages were attributed to the 120 mph winds and storm tides. Luis produced 30 foot swells off the North Carolina coast with 12 foot waves along south and east facing beaches. Severe beach erosion and damage to many piers occurred in Carteret and Onslow Counties with some minor overwash along the Outer Banks. Luis also was responsible for producing sea heights to around 98 feet as he passed east of Newfoundland on the 11th.

October 5, 1995 - OPAL (NR) (Fig. 141(a-b))

Opal developed from a tropical wave that moved across the Caribbean Sea toward the Yucatan Peninsula and became a depression near Cozumel, Mexico on the 25th. The depression drifted slowly north across the Yucatan Channel and strengthened to a tropical storm on September 30th. Upon entering the southern Gulf of Mexico, Opal became a strengthening hurricane and accelerated northeast toward the Florida panhandle on October 3rd. Opal made landfall near Pensacola Beach, Florida, on the 4th and then moved rapidly north into the Ohio Valley before dissipating on the 5th.

At her peak, Opal had sustained winds near 140 mph over the open waters of the Gulf of Mexico and made landfall as a weaker category three storm. Rainfall was the major cause of damage especially across western North Carolina where Highlands recorded 8.95 inches and Robinson Creek with 9.89 inches lead to widespread flash flooding.

Overall property damage associated with Opal was in excess of three billion dollars mainly along the Gulf Coast with 59 deaths in her wake. One death occurred in North Carolina when a tree fell on a mobile home.

June 19-20, 1996 - ARTHUR (TS) (Fig. 142(a-c))

Arthur originated from a tropical wave that passed across the northern Leeward Islands on the 16th and became a tropical depression near Grand Bahama Island late on the 17th. The depression moved north-northwest and became a tropical storm on August 19th. Arthur's center crossed over Cape Lookout on the 20th with the center passing through the Pamlico Sound and Cape Hatteras National Seashore and into the Atlantic that evening. The system accelerated northeast and was declared extratropical well north of Bermuda on the 21st.

The highest observed winds were noted at the C-MAN offshore station at Frying Pan Shoals with sustained winds of 40 mph with gusts to 47 mph at an elevation of approximately 80 feet. Over land, sustained surface winds of 38 mph and a gust to 45 mph were observed from Ocracoke Island on the North Carolina Outer Banks.

The greatest rainfall total of five inches occurred in Georgetown County, South Carolina. Several areas over the coastal plains of South Carolina and North Carolina reported between two and four inches.

Surf at five to seven feet was observed off the North Carolina coast in the vicinity of Cape Lookout.

No deaths or significant damage including beach erosion was reported with Arthur.

July 12, 1996 - BERTHA (CAT 2) (Fig. 143(a-c))

Bertha originated from a tropical wave which passed from Africa into the Atlantic Ocean on July 1st and became a depression over the central tropical Atlantic on the 5th. The system continued on a brisk westerly course and strengthened to hurricane force while crossing the Leeward and Virgin Islands on the 8th. Bertha then proceeded on a northwest course north of Puerto Rico and headed for the Carolinas during the 10th of July. The hurricane made landfall midway between Wrightsville Beach and Topsail Island around 4 p.m. on July 12th. Although Bertha had weakened while offshore, she suddenly re-gained category two status just 12 hours prior to landfall. The hurricane was quickly
downgraded to tropical storm status as it passed north over the coastal plain of North Carolina and into the Mid-Atlantic states before becoming extratropical on the 14th.

Highest sustained winds were estimated to have been around 90 mph at landfall with Jacksonville/North Topsail Beach measuring speeds near 85 mph with gusts in excess of 100 mph. Higher gusts were also noted offshore with the C-MAN station at Frying Pan Shoals Light Tower located southeast of Wilmington seeing speeds up to 115 mph. Storm surge flooding was most significant along south facing beaches between Cape Fear and Cape Lookout where average surge heights of around five feet were observed. Swansboro saw the most damage from storm surge flooding where a surge of more than six feet pushed water into many businesses on the waterfront. An estimated 5,000 homes were damaged mainly due to the storm surge. Rainfall amounts of five to eight inches also lead to minor fresh water flooding and combined with storm surge to enhance levels seen along the Albemarle and Pamlico Sounds.

Serious flooding from the Pamlico Sound was reported in Belhaven, Washington, and New Bern. Belhaven saw its previous record flood level of 6.6 feet eclipsed by the seven foot surge of Bertha. Surge heights of around seven feet were also observed in Washington where extensive damage to homes and business occurred along the adjacent Pamlico and Neuse Rivers.

In addition, severe beach erosion, roof damage, destroyed piers, fallen trees, and damage to crops lead to federal disaster declaration across coastal North Carolina. Total figures put damage across North Carolina at $270 million.

Eight deaths were contributed to Bertha, with only one in North Carolina which was due to a traffic accident.

September 5, 1996 - FRAN (CAT 3) (Fig. 144(a-c))

Fran was another Cape Verde hurricane that was similar to Bertha a couple months earlier. She tracked from off the African coast as a tropical wave and made the long track across the southern Atlantic to coastal North Carolina. The system was hampered early on due to her proximity to another stronger hurricane, Edouard, which passed well east of the North Carolina coast just a few days prior to Fran's landfall. Fran reached her strongest intensity just northeast of the central Bahamas on September 4th and then moved toward the Carolina coast, making landfall over southeast North Carolina just west of Cape Fear at 7:30 p.m. on the 5th. The hurricane then slowly weakened to a tropical storm early on the 6th as she passed across the Raleigh-Durham area of central North Carolina. Fran became a depression while moving across western Virginia on the 6th and was declared extratropical over the eastern Great Lakes on September 8th.

Maximum sustained winds at landfall were estimated around 115 mph with higher gusts in streaks associated with rainbands across Brunswick, New Hanover, Pender, Onslow, and Carteret counties. The highest unofficial gusts recorded were around 130 mph along Hewletts Creek in Wilmington and 120 mph in Wrightsville Beach. Hurricane force winds also spread well inland with major damage to homes, trees, and power lines seen over inland areas from Fayetteville north to Raleigh including the Virginia border counties. Over 4.5 million people in the Carolinas were without power in the aftermath of Fran.

Extensive storm surge flooding of eight to 13 feet damaged or completely destroyed many beachfront homes southwest of Cape Lookout and caused destruction to piers and boats along much of the coastal community. The high water levels and storm surge exceeded some levels established by Hazel, a category four storm back in 1954. Severe beach erosion also was noted, especially from Emerald Isle and Topsail Beach south where Bertha had left little or no dune protection in her wake. Some minor flooding was also reported along the Pamlico Sound but below the levels of Bertha a couple months earlier.

Rainfall amounts exceeded six inches in many areas along the path of Fran with Doppler Radar estimates of up to 12 inches in Pender and Brunswick counties. Extensive fresh water flooding resulted from Fran with the Neuse and Cape Fear Rivers seeing record crest levels and prolonged flooding into late September. The Neuse River in Kinston reached a crest level of 23.3 feet which was only second to the unofficial high water mark of 25 feet seen in 1907. This resulted in severe flooding of homes and businesses with damage amounting to $30 million in Lenoir County.

Overall property damage with Fran was 3.2 billion dollars with the worst economic damage being over two billion dollars in North Carolina alone.

Fran was indirectly responsible for a total of 34 deaths of which 21 occurred in North Carolina mainly from flash flooding and vehicle accidents.

October 7-8, 1996 - JOSEPHINE (XT) (Fig. 145(a-c))

Josephine followed Arthur, Bertha, and Fran in making her the fourth tropical system to visit eastern North Carolina in 1996. Josephine formed from a low pressure wave in the Bay of Campeche and became a depression on October 4th. The system moved north and became a tropical storm on the 6th, reaching minimal hurricane intensity over the northeast Gulf of Mexico on October 7th. The hurricane crossed the coast along the Florida panhandle on the 8th and proceeded northeast while becoming extratropical over the Carolinas during the 8th.

Maximum sustained winds associated with Josephine in North Carolina were around 65 mph in Southport along the south coast.

Rainfall totals of three to seven inches occurred over the eastern Carolinas, including 5.13 inches at Myrtle Beach and 3.38 inches in Wilmington. This produced significant small stream and urban flooding across Brunswick, Bladen, Columbus, New Hanover, Pender, and Onslow Counties. In the wake of Fran, many larger rivers flooded and remained in flood stage until the middle of the month.

Storm tides of six to nine feet were observed on south and east facing beaches from Cape Lookout to around Cape Fear, with one to two feet reported along the Outer Banks. Significant beach erosion occurred along the south facing beaches in Brunswick County with six feet of sand lost at Long Beach and three feet at Yaupon and Caswell beaches.

Josephine spawned several tornadoes which caused damage to trees and mobile homes in Brunswick county, five miles south of Supply, as well as in locations from New Bern north to Bath, in the central coast.

No significant injuries or deaths can be attributed to Josephine.

July 24, 1997 - DANNY (TS) (Fig. 146(a-c))

Danny originated over the north-central Gulf of Mexico from an old, non-tropical low pressure area and was classified a depression off the southern Louisiana coast on July 16th. The system plodded eastward parallel to the northern Gulf coastal area while strengthening to tropical storm status late on the 17th. Danny obtained minimal hurricane strength near the Mississippi River delta early on the 18th. The system made landfall across southeast Louisiana on the 18th and again around Mobile Bay, Alabama, on the 19th. After meandering along the Gulf Coast for several days, Danny lifted slowly northeast and headed for the Carolinas on the 22nd and 23rd. The weak circulation of Danny crossed northern North Carolina the morning of the 24th and intensified back to tropical storm strength while approaching the coast along the Virginia/North Carolina border the afternoon of the 24th.

After brushing southeast Massachusetts, Danny finally passed well offshore and was absorbed into a frontal zone over the Atlantic on July 27th.

Significant inland flooding was seen along the path of Danny across western North Carolina around Charlotte where eight to 12 inches was recorded.

Danny spawned several tornadoes over South Carolina with numerous observations of tropical storm force winds across North Carolina from Raleigh east to the coast around Elizabeth City.

Two fatalities occurred in Charlotte due to flooding and one in South Carolina due to a tornado.

August 26-27, 1998 - BONNIE (CAT 3) (Fig 147(a-c))

Hurricane Bonnie developed over the tropical Atlantic on August 19th approximately 675 miles east of the Leeward Islands and moved on a general west-northwest track. Bonnie gradually strengthened, becoming a hurricane early on August 22nd. Bonnie's motion slowed to less than 10 miles an hour on the 23rd as it intensified into a category 3 hurricane with sustained winds of 115 mph just east of the Bahamas. After the 23rd, Bonnie moved toward the southeast United States coast in the general direction of the Carolinas. As the center neared the North Carolina coast on August 26th, the forward speed slowed to nearly stationary. The center of Bonnie drifted along the coast, with the western part of the eye moving across extreme southeast Brunswick County and over eastern New Hanover County. The center officially came onshore a short distance northeast of Wilmington during the late evening of the 26th and early morning of the 27th. Bonnie then moved slowly northeast over extreme eastern North Carolina, emerging off the Outer Banks near Kitty Hawk early on the 28th. After being downgraded to a tropical storm while over land, Bonnie re-strengthened into a hurricane with 75 mph winds as it moved back into the Atlantic. Bonnie weakened back to a tropical storm as it moved northeast over the Atlantic and into cooler waters. It finally lost its tropical characteristics on August 30th south of Cape Race, Newfoundland.

Maximum sustained winds with Bonnie were around 55 mph in Wilmington, with gusts to 89 mph at Kure Beach along the south coast. Other amateur observations included peak winds of 120 mph at the State Port and 115 mph at Wrightsville Beach.

Rainfall totals of 8 to 11 inches were recorded in portions of eastern North Carolina.

Storm tides of seven to ten feet were observed on south facing beaches from Cape Lookout to Cape Fear, while a storm surge of 6 feet was reported in Pasquotank and Camden Counties along the Albemarle Sound. This produced significant beach erosion with two to three feet of overwash in many spots.

There was significant tree, roof and structural damage, plus widespread power outages

primarily in eastern North Carolina. The total insured damages were estimated to be around $240 million.

A weak tornado was reported in the town of Edenton in Chowan County.

One fatality occurred in Currituck County due to a tree falling into a house.

Bonnie was the third hurricane to directly hit the coast of North Carolina during the past three years.

September 4, 1998 – EARL (ET) (Fig. 148 (a-c))

Earl formed from a strong tropical wave that exited the west coast of Africa on August 17th. The wave moved steadily west through the Lesser Antilles on the 23rd before acquiring tropical depression status in the Gulf of Mexico early on August 31st. The depression then strengthened to Tropical Storm Earl about 500 mi southwest of New Orleans, Louisiana during the afternoon of the 31st. Earl headed north and northeast toward the Gulf Coast over the next couple of days before gaining minimal hurricane strength during the morning of September 2nd about 120 miles southeast of New Orleans. After briefly reaching category 2 status, Earl made landfall near Panama City, Florida as a Category 1 hurricane during the early morning hours of September 3rd. Earl then moved northeast and weakened, becoming extratropical over Georgia during the afternoon of the 3rd. The system accelerated northeast across the Carolinas on September, 4th exiting the Mid Atlantic coast late that afternoon.
Earl spawned several tornadoes over the Carolinas, one of which was responsible for 1 death in St. Helena, South Carolina on September 3rd. Heavy rainfall associated with Earl was mainly confined to the Piedmont and Sandhills where totals of 3 to 5 inches occurred, with isolated 7 inch totals in Stanly and Montgomery counties. Rainfall along the coast was in the 1 to 3 inch range with isolated 5 inch amounts across the Cape Fear region. This only resulted in minor flooding over these locations otherwise damage due to rainfall or wind in North Carolina was minimal.

In addition, no significant injuries or deaths were attributed to Earl in North Carolina.

September 4-5, 1999 - DENNIS (TS) (Fig 149(a-c))

Dennis formed in the western Atlantic a couple hundred miles east of the Turks and Caicos Islands late on August 23rd. The system moved slowly west-northwest for the next five days. Dennis intensified into a tropical storm on the afternoon of the 24th and a hurricane early on the 26th. Dennis reached peak intensity of 105 mph (Category 2), on the afternoon of the 28th and maintained this intensity until early on the 30th while paralleling the lower southeast U.S. coast. The hurricane lashed the Carolina coast on the 30th and part of the 31st with sustained tropical storm force winds, gusts to hurricane force, large waves and high surf. The hurricane turned northeast away from the coast on the morning of the 30th and began to accelerate later that day while moving to the east-northeast. Dennis stalled about 150 miles east of Cape Hatteras on the morning of the

31st and then began to drift westward and weaken. During the first couple of days of September, Dennis continued to weaken and was downgraded to a tropical storm as it drifted slowly to the southwest along the lower Outer Banks. The storm turned to the northwest on the 4th and made landfall over the Outer Banks between Cape Lookout and Ocracoke as a tropical storm.

Dennis was a larger-than-average western Atlantic hurricane that was erratic in both track and intensity. Although it never made landfall as a hurricane, it affected the North Carolina coast with hurricane force winds, heavy rains, prolonged high surf, and beach erosion.

Dennis' first pass near the coast of the Carolinas on August 30th caused sustained tropical storm force winds with gusts to hurricane force in coastal North Carolina. The maximum reported sustained winds were 61 mph with gusts to 89mph at Oregon Inlet. It is not clear whether sustained hurricane force winds affected the coast, however gusts to 111 mph at Wrightsville Beach and 98 mph at Hatteras Village suggest that sustained hurricane force winds may have occurred along the coasts of New Hanover and Dare counties.

The landfall of Dennis on September 4th produced tropical storm force winds over portions of eastern North Carolina, with the Cherry Point Marine Corp Air Station reporting 47 mph sustained winds with gusts to 61mph.

Storm tides of 3 to 5 ft above normal were reported along much of the North Carolina coast on both August 30th and September 4th. Areas along the Neuse River reported tides of 8 to 10 ft above normal tide level on August 30th, while areas along the Pamlico River saw similar values on the 4th. Minor ocean overwash occurred at Carolina Beach, Wrightsville Beach and Topsail Beach.

Since Dennis meandered off the North Carolina coast for several days, the above normal tides were unusually prolonged. This led to extensive beach erosion along portions of the North Carolina coast.

The maximum reported rainfall total was 19.13 inches at Ocracoke NC, with 6 to 10 inches reported elsewhere over portions of eastern North Carolina ending a prolonged dry spell.

No deaths are known due to winds, rains, storm tides or tornadoes associated with Dennis.

September 16, 1999 - FLOYD (CAT 2) (Fig 150(a-c))

Floyd's origin can be traced to a tropical wave that emerged from western Africa on September 2nd. Tropical Depression Eight formed September 7th about 1000 miles east of the Lesser Antilles). The system was upgraded to Tropical Storm Floyd on September

8th, and then became a hurricane on September 10th. Early on September 12th, Floyd turned west and began a major strengthening episode. Hurricane Floyd reached its peak intensity on September 13th when sustained winds reached 156 mph(top end of Category 4).

The hurricane came within 110 miles of Cape Canaveral as it paralleled the Florida coast on September 15th. Floyd then moved slightly east of north and increased in forward speed, coming ashore near Cape Fear just after midnight on September 16th. At the time of landfall, Floyd was a Category 2 hurricane with maximum winds of 104 mph. Floyd continued to accelerate north-northeast after landfall. Its center passed over extreme eastern North Carolina and over Norfolk Virginia during the morning of September 16th. The storm then weakened to a tropical storm and moved swiftly along the coasts of the Delmarva Peninsula and New Jersey, reaching Long Island by the evening of September 16th. The system was extratropical by the time it reached the coast of Maine on September 17th.

Sustained winds of 96 mph with gusts to 122 mph were measured by a University of Oklahoma portable anemometer (10-meter height) near Topsail Beach on September 16th. Storm surge values as high as 10 feet were reported along the coast.

Much of Floyd's impact was due to extreme rainfall. Although Floyd was moving quickly, its large circulation interacted with a pre-existing frontal zone over central North Carolina. Rainfall totals of 4 to 12 inches were common across eastern North Carolina. Within this region, two areas of extreme rainfall occurred with totals as high as 15 to 20 inches recorded in portions of eastern North Carolina. At Wilmington, the storm total of 19.06 inches included a 24-hour record of 15.06 inches.

This heavy rainfall caused widespread flooding and flash flooding in North Carolina. The flooding was the most damaging in the State's history. Some rivers in eastern North Carolina were already in flood due to 5 to 10 inches of rainfall from Hurricane Dennis which occurred about a week prior to Floyd. The extreme rainfall produced by Floyd across the state caused widespread flooding on larger rivers and tributaries as well as flash flooding on smaller streams and creeks. Nine record floods occurred on rivers in North Carolina.

Damage was over $3 billion; there were 35 deaths; 7000 homes destroyed; 17,000 homes uninhabitable; 56,000 homes damaged; most roads east of I-95 flooded; the Tar River crested 24 feet above flood stage; over 1500 people were rescued from flooded areas; over 500,000 customers without electricity at some point; 10,000 people housed in temporary shelters; much of Duplin and Greene Counties under water; severe agricultural damage throughout eastern NC; "Nothing since the Civil War has been as destructive to families here," said H. David Bruton, the state's Secretary of Health and Human Services.

October 17-18, 1999 - IRENE (CAT 1) (Fig 151(a-c))

Hurricane Irene originated from a broad area of low pressure in the southwest Caribbean Sea. The low gradually became better organized over a period of several days and a tropical depression formed on the 13th. Tropical storm strength was reached later that day with the center about 230 miles south of the Isle of Youths Cuba. Irene moved north, then north-northeast, making landfall on the Isle of Youth on the 14th. The center of Irene continued north-northeast over western Cuba and into the Florida Straits and post analysis indicates that Irene became a hurricane around this time. The center passed over Key West Florida early on the 15th. At this time, most of the hurricane force winds were east of the center and the lower to middle Florida Keys. Later that day the center made landfall on the Florida peninsula near Flamingo and moved across southeast Florida. The center of Irene moved offshore near Jupiter Florida later on the 15th. It retained hurricane strength as it moved north parallel to the Florida coast. Irene then turned and accelerated to the northeast just east of the Outer Banks early on the 18th. After passing the Outer Banks, Irene rapidly intensified and reached a peak intensity of 105 mph on the 18th. Irene continued northeast and was absorbed by an extratropical low on the 19th.

Maximum sustained winds over land associated with Irene were near 40 mph along the North Carolina beaches, with some gusts to around 65 mph just offshore.

Average rainfall totals of three to seven inches occurred over eastern North Carolina, including 4.68 inches at Cherry Point and 6.69 inches at Elizabethtown. Ernul reported the highest maximum amount of 11.00 inches.

Tides were estimated 1 to 2 feet above normal except possibly 3 feet above normal on south facing beaches of Brunswick and New Hanover counties.

Overwash occurred at Oak Island, causing moderate erosion to bulldozed dunes built after Floyd. Minor overwash occurred at the north end of Carolina Beach in New Hanover County, where Canal Drive was flooded on the sound side.

No deaths were attributed to Irene in North Carolina.

2.6. Twenty First Century

September 23-24, 2000 – HELENE (ET) (Fig. 152 (a-c))

Helene developed from a tropical wave that emerged off the African coast on September 10th. The wave moved west and became a tropical depression on the afternoon of the 15th over the open waters of the central Atlantic Ocean. The system then weakened back to a tropical wave upon crossing the Leeward Islands on the 17th. The remnants continued westward and reacquired tropical depression status northwest of Grand Cayman Island on September 19th. The depression turned northwest over the next couple of days and became a tropical storm in the southeast Gulf of Mexico during the morning of the 21st. Helene continued to move northward over the next day making landfall as a tropical storm near Fort Walton Beach, Florida on the 22nd. The storm then moved northeast over the southeast states as a depression during the 23rd and 24th finally emerging off the Virginia coast late on September 24th. As the system passed through North Carolina and approached the coast, tropical storm force winds developed just offshore mainly north of Cape Hatteras.

Rainfall associated with Helene was mainly confined to southern and eastern North Carolina. Totals ranged from 5 to 7 inches in Brunswick and New Hanover counties to only 1 to 3 inches elsewhere. Rainbands associated with Helene produced some gusty winds however the majority of the stronger speeds stayed just offshore.

The one casualty associated with Helene was a man killed in a tornado in South Carolina as the tropical depression moved through the region on September 23rd.

2001

There were no significant tropical cyclones that affected North Carolina.

September 10, 2002 - GUSTAV (TS) (Fig 153(a-c))

Hurricane Gustav formed from a subtropical low pressure area between Bermuda and the Bahamas on September 8th, and moved west northwest, before turning north and passing between Cape Hatteras and Diamond Shoals Light Tower as a Tropical Storm on September 10th. Gustav turned northeastward when it reached the Hatteras area, then strengthened while accelerating northeastward on the 11th of September. Gustav made landfall as a hurricane over the southern part of Nova Scotia on September 12th.

The strongest winds with Gustav were along and just offshore of the Outer Banks, where the Coastal Marine Automated Network station at Diamond Shoals reported 60 mph sustained winds with a gust to 70 mph. The Cape Hatteras Coast Guard station also reported a gust of 78 mph.

Storm surge flooding of 5 to 6 feet above normal tide levels occurred along the inland side of the Outer Banks in Hyde and Dare counties. This occurred during a period of strong northwesterly winds following the passage of the center of Gustav. Storm tides of 3 to 4 feet above normal were reported in Cedar Island and along the Neuse River. Tides were 1 to 2 feet above normal elsewhere along the coast of North Carolina.

Storm total rainfalls were 2 to 5 inches over portions of the Outer Banks including a 4.90 inch total at Ocracoke. One weak tornado also occurred during Gustav near Ocracoke.

Gustav directly caused one death - a swimmer at Myrtle Beach, South Carolina who suffered injuries from high surf and died two days later. Forty people had to be rescued from storm surge in Hatteras at the height of the storm. Damage to property and vehicles in North Carolina was estimated at about $100,000.

October 12, 2002 - KYLE (TS) (Fig 154(a-c))

Kyle formed from a non-tropical low pressure system in the central North Atlantic Ocean on September 19th about 750 miles east-southeast of Bermuda. Kyle strengthened and became Subtropical Storm Kyle on September 21st when it was about 680 miles east of Bermuda. The system gradually acquired warm-core tropical characteristics and is estimated that Kyle became a tropical storm on the 22nd about 760 miles east of Bermuda. Kyle briefly intensified to a hurricane on September 25th about 550 miles east-southeast of Bermuda before weakening. Kyle weakened below tropical storm strength on September 30th and made a slow counter-clockwise loop about 300 miles west of Bermuda from October 5th through the 8th. Afterwards, Kyle moved westward and then northwestward before making landfall along the South Carolina coast late on October 11th.

After making its first landfall near McClellanville, South Carolina around noon on October 11th, Tropical Storm Kyle moved northeastward and skirted the remaining upper coastline of South Carolina. Its center moved inland again a few hours later near Long Beach, North Carolina and then weakened to a tropical depression late on October 11th near Surf City, North Carolina. The system then strengthened back into a tropical storm over Pamlico Sound that evening before exiting the eastern portion of the state near Nags Head during the early morning hours of October 12th. The cyclone eventually merged with a cold front later on the 12th, when it was located about 280 miles south-southwest of Nantucket, Massachusetts.

Kyle lasted for 22 days making it the third longest-lived Atlantic tropical cyclone, after Ginger of 1971 and Inga of 1969.

As a result of the relatively weak sustained winds at landfall, Kyle caused no significant structural damage and only minor beach erosion was reported along the coast with storm surge values of around 1 foot.

Rainfall totals were generally less than 2 inches with a few isolated amounts of 5 to 6 inches reported along the coast. This resulted in only minor urban flooding.

The Cape Fear region experienced the highest wind gusts with Kyle as both Bald Head Island and the State Port saw gusts to near 50 mph.

At least 4 tornadoes were reported across eastern South Carolina and southeastern North Carolina during Kyle's passage. In South Carolina, a tornado touched down in Georgetown, severely damaging 5 mobile homes and a car. Twenty-five additional structures sustained at least minor damage. Eight people were injured.

In eastern North Carolina, a damaging tornado touched down near Pantego, in Beaufort County. The tornado flipped one mobile home, blew the roof off of one house, and destroyed 7 hog houses on Benson Farms, which resulted in damage of nearly $2 million. Weaker tornadoes touched down in Belvoir and overturned two mobile homes and knocked a house off its foundation. Another weak tornado touched down east of Washington, North Carolina causing no damage. No injuries were reported with any of the North Carolina tornadoes.

The total reported insured losses associated with Kyle were approximately $2.5 million.

No deaths were reported in association with Kyle.

July 3, 2003 – BILL (TD/ET) (Fig. 155(a-c))

Bill developed from a low pressure system that moved north off the Yucatan Peninsula on June 28th. The system intensified to a tropical depression in the early morning of June 29th and became a tropical storm over the south central Gulf of Mexico later that morning. The system continued to move north and made landfall as a tropical storm near King Lake in southern Louisiana during the afternoon of June 30th. Bill quickly weakened to a tropical depression as it moved northeast across Mississippi and Alabama before becoming extratropical near the border of Tennessee and Virginia during the predawn hours of July 2nd. The system then became absorbed into a frontal system over Virginia on the 3rd and passed northeast off the Mid Atlantic coast by September 4th.

Bill was a weak system when it impacted North Carolina with average rainfall totals of 1 to 3 inches. However some isolated spots across the Southern Mountains saw totals of up to 7 inches. This resulted in some minor stream flooding which did produce one fatality when a 10-year old boy drowned in Holly Spring Creek in Raleigh.

No wind or tornado damage was reported with the passage of Bill.

September 18, 2003 - ISABEL (CAT 2) (Fig 156(a-c))

Isabel formed from a tropical wave that moved westward from the coast of Africa on September 1st. The system tracked westward and intensified into a tropical depression on the 6th, with the depression becoming Tropical Storm Isabel six hours later.

Isabel turned west northwestward on September 7th and intensified into a hurricane. Strengthening continued for the next two days while Isabel moved between west-northwest and northwest. Isabel turned westward on the 10th and maintained this motion until September 13th. Isabel strengthened to a Category 5 hurricane on the 11th.

The hurricane turned west northwestward on September 13th, northwestward on the 15th, and north northwestward on the 16th. However the system gradually weakened on September 15th and caused the system to fall below major hurricane status on the 16th. It maintained Category 2 status for the next two days while the overall size of the hurricane increased. Isabel made landfall near Drum Inlet, North Carolina on September 18th as a Category 2 hurricane with winds near 100 mph, then weakened as it moved across eastern North Carolina. It weakened to a tropical storm over southern Virginia, then lost tropical characteristics as it moved across western Pennsylvania on September 19th. Extratropical Isabel moved northward into Canada and was absorbed into a larger baroclinic system moving eastward across south central Canada early the next day.

The highest winds recorded with Isabel were along the Outer Banks where Duck saw sustained speeds of 69 mph with gusts to 92 mph. Other gusts included Ocracoke 105 mph, Harkers Island Bridge 98 mph, and Cape Hatteras Pier 96 mph.

The heaviest rainfall occurred in Craven, Carteret, Pamlico, Hyde, Washington, Pitt, Edgecombe, Halifax and Northampton Counties, with flooding of streets and low lying areas. Rainfall amounts were on average in the 4 to 8 inch range with Havelock seeing 6.05 inches and Newport 5.87 inches. Rainfall totals of greater than 7 inches occurred across Northampton County near the Virginia border where 7.83 inches was observed.

The highest storm tides occurred across the lower reaches of the Neuse and Pamlico rivers where waters levels rose from 6 to 10.5 feet above normal. On the Neuse river the highest surge was between Clubfoot Creek and Adams Creek where the water rose to 10.5 feet above normal. Clubfoot Creek rose to 9.5 feet, 1.5 feet higher than during hurricane Dennis in 1999. Significant flooding was reported in the Harlowe area in Craven County, and in the town of Oriental in eastern Pamlico County. Water levels rose between 6 and 7 feet on the Pamlico river with flooding in the city of Washington. Storm tides of 6 to 8 feet occurred along the Outer Banks with major ocean overwash. Flooding on Ocracoke was significant with waist high water in many areas at the height of the storm.

Major ocean overwash and beach erosion due to storm surge and battering wave action occurred across the Outer Banks especially in Dare and Hyde counties. Piers were destroyed or sustained heavy damage in Nags Head, Rodanthe, and Frisco. Motels in

Hatteras Village were moved off their foundations as well as some homes. A new inlet was carved between Frisco and Hatteras Village along Highway 12. In addition, many sections of Highway 12 were reported to have been washed out or covered with debris southward to Ocracoke. Fifteen foot stretches of pavement on both sides of a bridge near Ocracoke were washed away. A beach access ramp was also completely destroyed.

Significant water level rises on the Neuse and Pamlico rivers resulted in flooding of many homes across Craven, Eastern Carteret, and Eastern Pamlico Counties. Winds in excess of hurricane force resulted in numerous trees and power lines down with loss of electricity to hundreds of thousands of people over inland eastern North Carolina.

No tornadoes were reported in North Carolina.

No direct storm related fatalities were reported in North Carolina. However one person was killed trying to restore electricity in Carteret County.

August 3, 2004 - ALEX (CAT 1) (Fig 157(a-c))

Alex formed from a low pressure system located about 200 miles east of Jacksonville, Florida. The system became a tropical depression on July 31st and strengthened to a tropical storm on August 1st.

Alex began to move northeastward early on August 2nd, taking a track that would slowly approach the coastline of the Carolinas over the next 36 hours. During this period Alex strengthened, becoming a hurricane during the early morning of August 3rd, when it was centered about 65 miles south-southeast of Cape Fear.

Alex continued to strengthen on August 3rd as it neared the North Carolina Outer Banks. The hurricane's maximum sustained winds reached 100 mph. Alex made its closest approach to land during the afternoon of the 3rd, with its center located about 9 miles southeast of Cape Hatteras, while the western eyewall of the hurricane raked the Outer Banks.

After passing the Outer Banks, Alex turned away from land and accelerated. The system strengthened and became a major hurricane (Category 3) on August 5th, about 385 miles south-southwest of Halifax, Nova Scotia. By late on the 5th Alex had moved north of the Gulf Stream and weakened to a tropical storm on the 6th and became extratropical a few hours later about 830 miles east of Cape Race Newfoundland. The circulation of Alex was absorbed into a larger extratropical low late on August 7th.

Although the center of Alex remained offshore (and therefore Alex technically did not make landfall), the western portion of the eyewall passed over the Outer Banks on August 3rd. The highest gust accepted as accurate was an unofficial report from a storm chaser of 102 mph in Hatteras Village, with a maximum sustained wind report of 75 mph at about the same time. A five-minute mean wind of 74 mph was reported from a 10-meter anemometer at Avon Pier.

The highest measured rainfall amount associated with Alex, 7.55 inches, occurred at Ocracoke, with 5.62 inches reported in Beaufort. Doppler radar data indicated a large area of 4 to 8 inch accumulations across extreme Southeastern Craven County, Eastern Carteret County northeastward across Hyde and Dare counties.

The highest estimated surge values, related to soundside flooding from the Pamlico Sound, was on the Outer Banks at Buxton, Hatteras Village, and on Ocracoke Island. Storm surge values were estimated in the 4 to 6 feet range with the highest levels occurring at Buxton and Ocracoke Village where surges up to 6 feet were estimated. Flooding of this magnitude had not occurred on Ocracoke Island for nearly 20 years when hurricane Gloria brushed by the area in 1985. Water levels rose to 2 to 4 feet above normal across portions southern Craven County, Downeast Carteret County, and Eastern Pamlico County, along the lower reaches of the Neuse and Pamlico rivers. Clubfoot and Adams Creek on the lower Neuse rose to 4 feet above normal. Water levels rose to 2 to 2 1/2 feet in the New Bern area. Water levels rose to 1 to 2 feet across western sections of the Albemarle Sound including the Roanoke River. Storm surge was estimated at 1 to 2 feet along the coast of the Outer Banks from Cape Hatteras northward. A surge of 1 foot or less occurred along the coast including Core and Bogue Banks.

Erosion was significant due to soundside flooding on Core Banks, especially on Ocracoke Island, and on the Outer Banks from Buxton to Hatteras Inlet. Major ocean overwash occurred from soundside flooding on Hatteras Island near Hatteras Inlet. Minor erosion occurred on the coast of the Outer Banks north of Cape Hatteras with moderate erosion in the Buxton area.

No tornadoes were reported in eastern North Carolina.

Significant wind and water damage occurred from Buxton southward on the Outer Banks and across Ocracoke Island where hundreds of vehicles and homes were flooded from soundside storm surge. Hurricane force winds resulted in minor structural damage to homes and businesses and caused extensive damage to trees including downed power lines. Electricity was not restored to some areas for 2 to 3 days. Significant erosion occurred mainly on the soundside of the Outer Banks from Buxton southward and on Ocracoke Island.

No injuries or fatalities were reported in North Carolina with Alex. However a 26 year-old male drowned in strong waves and residual rip currents off of Nags Head, two days after the passage of Alex.

August 13, 2004 - BONNIE (XT Remnant) (Fig 158(a-c))

Bonnie developed from a tropical wave that crossed Dakar, Senegal on July 29th, and moved westward for several days. The system became a tropical depression on August 3rd when it was located about 360 miles east of Barbados in the Lesser Antilles. The depression moved westward about 25 mph before weakening and being downgraded to a

tropical wave over the Caribbean Sea. After the storm reached the western Caribbean Sea, it redeveloped and became a tropical depression again about 100 miles southeast of the western tip of Cuba on August 8th. The depression then moved toward the west-northwest across the Yucatan Channel and became Tropical Storm Bonnie near the northeastern tip of the Yucatan Peninsula. Bonnie moved north and northeast, and made landfall near Saint Vincent and Saint George Islands just south of Apalachicola, Florida as a tropical storm. Bonnie then weakened into a depression as it moved northeast, passing through the Carolinas as an extratropical low during the early morning hours of August 13th. It finally became a weak remnant low just south of Cape Cod on August 14th.

Although winds with Bonnie over North Carolina were weak, the system did spawn a deadly tornado during the predawn hours on August 13th just southeast of Rocky Point in Pender County. There were 3 deaths (2 adults, 1 child) with the tornado as well as 29 others injured. In addition 17 homes were destroyed, with 25 others suffering major damage as well as 2 businesses. In all total damage cost was 1.27 million dollars.

Rainfall amounts associated with the remnants of Bonnie were light with the heavier totals of 1 to 3 inches across the southern coast of North Carolina. The system was weak when entering coastal North Carolina with little beach erosion or increased coastal water levels.

August 14, 2004 – CHARLEY (TS) (Fig 159(a-c))

Charley originated from a tropical wave that passed off the west coast of Africa on August 4th. The wave slowly became defined and was classified a tropical depression on August 9th, centered about 100 miles south-southeast of Barbados. Late on the 9th, the depression moved rapidly west into the southeastern Caribbean Sea and strengthened into Tropical Storm Charley early on August 10th. Fairly steady strengthening continued while the storm moved into the central Caribbean Sea, and when Charley approached Jamaica on August 11th, it became a hurricane. The hurricane slowed passing Jamaica with the core remaining just southwest of the southwest coast of the island during the evening of 11th. Charley then turned northwestward, and headed for the Cayman Islands and western Cuba. It continued to strengthen, reaching Category 2 status on August 12th, just after passing northeast of Grand Cayman. The hurricane then turned toward the north-northwest, its center passing just east of the east coast of the Isle of Youth during the evening of the 12th. The eye crossed the south coast of western Cuba as a Category 3 storm during the early morning hours of August 13th and proceeded toward the Florida Straits. Charley weakened slightly over the lower Straits of Florida and turned northward, passing over the Dry Tortugas midday on the 13th.

The intensifying hurricane then turned northeast and accelerated toward the southwest coast of Florida during the afternoon of August 13th. Charley's maximum winds increased to Category 4 strength before making landfall on the southwest coast of Florida near Cayo Costa, during the late afternoon of the 13th with maximum sustained winds near 145 mph. Charley's eye passed over Punta Gorda, and the eyewall struck that city

and neighboring Port Charlotte with devastating results. Continuing north northeastward at a slightly faster forward speed, the hurricane traversed the central Florida peninsula, before moving off the northeast coast of Florida near Daytona Beach as a Category 1 around midnight on August 14th.

After moving into the Atlantic, the hurricane re-strengthened slightly as it accelerated north northeastward toward the coast of South Carolina. Charley came ashore again near Cape Romain, South Carolina mid morning on the 14th as a weakening hurricane with highest winds of about 80 mph. The center then moved just offshore before making another landfall at North Myrtle Beach, South Carolina around midday, with intensity near 75 mph. Charley soon weakened to a tropical storm during the afternoon over southeastern North Carolina just west of Wilmington, where it began to interact with an old frontal zone. By the evening of the 14th, the center moved back into the Atlantic in the vicinity of Virginia Beach, Virginia, as an extratropical system. Charley's extratropical remnant moved rapidly north northeastward, and became absorbed into a frontal zone near southeastern Massachusetts on August 15th. At the time, Charley was the strongest hurricane to hit the United States since Andrew in 1992.

Wind, tornadoes, and flooding caused the most significant damage across eastern North Carolina, especially across the Coastal Plain counties, and Outer Banks Dare County. Highest wind speeds were located across Brunswick, New Hanover, and Pender counties as well as the adjacent coastal waters. The highest wind gust report came from the Mercer Pier in Wrightsville Beach where a wind gust to 86 mph was observed. A wind gust to 92 mph was observed at the Wilmington State Port with an instrument that was 65 feet high. 60 to 70 mph wind gusts and one weak tornado resulted in mostly minor to moderate damage to 171 homes and businesses in Onslow County, with damage estimated at 6 million dollars. A tornado resulted in damage to seven condos and several homes in Kitty Hawk in Dare County causing an estimated $500,000 dollars in damages. Duplin County reported 10 to 20 percent of their crops damaged from the storm while Lenoir County received significant fresh water flooding. 40 to 60 mph winds were observed across the remainder of eastern North Carolina with minor structural damage observed. Downed trees and power lines resulted in sporadic electrical power interruptions. There were five tornadoes reported in eastern North Carolina on the 14th associated with Charley. These were in Onslow, Pitt, (mainland) Hyde, Tyrrell, and (Outer Banks) Dare counties.

Storm surge was minimal with the highest values occurring during the afternoon hours of August 14th. The highest estimated surge values along the coast were across the Onslow County coast, and across Bogue Banks in Carteret County where 2 to 3 foot surges were seen. Water levels rose up to 2 feet across the lower reaches of the Neuse and Pamlico rivers, and across portions of the Outer Banks.

Minor beach erosion occurred along the coastal sections of eastern North Carolina as a result of the combination of 2 to 3 foot surges, and large waves of up to 8 feet on the immediate coast, especially along south facing beaches.

A large area of 4 to 6 inch rainfall occurred across the coastal plain counties of eastern North Carolina with flash flooding reported in Onslow, Jones, Lenoir, Greene and Pitt counties.

Overall damage totaled 25 million dollars in North Carolina.

However no significant injuries or fatalities were reported with Charley.

September 8, 2004 – FRANCES (TD) (Fig 160(a-c))

Frances was a Cape Verde-type hurricane that reached a peak intensity of Category 4. It affected the Bahamas as a Category 3 hurricane and the Florida east coast as a Category 2 hurricane.

Frances developed into a topical depression over the eastern Atlantic Ocean, 800 miles west-southwest of the Cape Verde Islands during the morning of August 24th. The system continued moving west and became a tropical storm late on the 25th, approximately 1400 miles east of the Lesser Antilles.

Frances became the 4th hurricane of the 2004 Atlantic hurricane season late on August 26, 1000 miles east-southeast of the Lesser Antilles. The system continued to strengthen and became the third major (Category 3) hurricane in the Atlantic basin of the season during the evening of August 27th, while located 800 miles east of the Leeward Islands. Frances then intensified further, becoming the second Category 4 hurricane in the Atlantic Basin in 2004 late on the 28th, with winds of 135 mph, and centered 700 miles east of the Leeward Islands.

Frances weakened slightly to a Category 3 hurricane on August 29th before tracking within 150 miles of the northern Leeward Islands late on the 30th. Frances regained Category 4 status by late afternoon on August 31st, 145 miles north of San Juan, Puerto Rico. Frances made a direct hit on the Turks and Caicos Islands as a Category 4 hurricane on September 1st. The hurricane passed 35 miles north of Grand Turk, with maximum sustained winds of 125 mph.

The storm moved slowly across the Bahamas between September 2nd and September 4th. Frances weakened from a Category 4 to a Category 3 storm as the hurricane passed over San Salvador, Eleuthra Island, and very close to Freeport, Grand Bahamas. Frances finally made landfall near Sewall's Point, FL, during the early morning hours on September 5th as a Category 2 storm. The winds were sustained at 105 mph at landfall. Frances moved west-northwest across east-central Florida early Sunday morning. The system was downgraded to a tropical storm late on September 5th near Tampa before emerging into the northeastern Gulf of Mexico. Frances regained tropical storm status as it moved across the northeast Gulf of Mexico on September 6th. The storm made a

second landfall at Saint Mark's, FL, later on the 6th, with maximum sustained winds of 65 mph.

Frances weakened rapidly and was downgraded to a depression as it moved north-northwest across southwestern Georgia during the evening of the 6th. The system remained at tropical depression status as it moved slowly across Georgia on the 7th.

The remnants of Frances moved into the southwestern mountains of North Carolina during the early morning hours of September 8th. The storm center then tracked north along the spine of the Appalachian Mountains of western North Carolina, northeastern Tennessee, and southwestern Virginia during the remainder of the 8th. The system became extratropical over West Virginia early on September 9th. The cyclone then turned eastward across northern New England and southeastern Canada, dissipating over the Gulf of St. Lawrence late on the 10th.

Wind gusts between 40 and 60 mph buffeted the Appalachian Mountains. Numerous trees were downed and flooding was widespread.

Several rain bands produced torrential rainfall, local damaging winds, and several tornadoes across the Piedmont and Sandhills of North Carolina. Several weak tornadoes produced minor damage to trees and buildings over Columbus, Robeson, Anson, Hoke, Moore, Lee, Orange, Harnett, and Mecklenburg Counties. The strongest tornado in central North Carolina damaged a home on Rye Road in Hoke County, downed numerous trees, destroyed a car, and damaged the roof of a house.

Frances dropped between 6 and 10 inches of rain across much of western North Carolina with amounts exceeding a foot in several sections of the mountains including isolated reports of rainfall totals in excess of 18 inches. The maximum reported rainfall was 18.07 inches at Linville Falls in western North Carolina. Severe flooding occurred along several creeks in the city of Asheville where numerous streets, several businesses, and houses were flooded. Significant flooding also occurred along the Watauga River in the Northwest Mountains where many roads were inundated. Rainfall amounts dropped dramatically farther east across the Foothills and Piedmont. Across eastern North Carolina, rainfall amounts averaged between 1 and 2 inches.

The heavy rain also produced 28 landslides across western North Carolina resulting in considerable damage to homes and property throughout the mountains.

No fatalities were reported in North Carolina with Frances.

August 29, 2004 – GASTON (TD) (Fig 161(a-c))

Gaston was a Category 1 hurricane that made landfall along the central South Carolina coast. After moving inland, Gaston produced heavy rainfall across portions of the Carolinas and Virginia.

The genesis of Gaston can be traced to a cold front that moved off the coast of the Carolinas into the Atlantic on August 22nd, and drifted southward the following day before stalling on the 24th. Low pressure along the front slowly strengthened and finally developed into a tropical depression on the 24th, about 115 miles east-southeast of Charleston, South Carolina

Initially the depression drifted slowly southward before turning westward and strengthening to a tropical storm on the 28th, about 130 miles southeast of Charleston. Strengthening continued on August 28th and 29th as the system turned more northwestward, with Gaston acquiring hurricane strength just before it made landfall near Awendaw, South Carolina, between Charleston and McClellanville, during the morning of August 29th. Maximum sustained winds were estimated near 75 mph. The tropical cyclone then steadily weakened while moving northward across northeastern South Carolina.

On August 30th Gaston weakened to a tropical depression over northeastern South Carolina. Gaston then turned north northeastward and the cyclone crossed eastern North Carolina and southeastern Virginia during the day. Gaston regained tropical storm strength by the evening of August 30th, while the center was still inland near Yorktown, Virginia. Gaston moved across the southern portion of Chesapeake Bay and crossed the Delmarva Peninsula early on August 31st. The tropical cyclone then accelerated northeastward, passing about 60 miles south of Nantucket Island, Massachusetts later that day. Gaston strengthened slightly as it continued to accelerate to the east-northeast, before becoming extratropical south of the Canadian Maritimes on September 1st.

The highest wind gusts in North Carolina were observed at the Laurinburg-Maxton Airport where a wind gust reached 45 mph as well as at the Fayetteville Regional Airport and the Elizabeth City Coast Guard Air Station where gusts reached 39 mph.

Rain bands well in advance of Gaston produced a tornado over Hoke County on the 29th, damaging several homes and trees.

A swath of 2 to 4 inches of rain fell along Gaston's path in central North Carolina with isolated reports of 5 to 6 inches of rain. Locations across the western Sandhills saw the heaviest with as much as 6.21 inches observed in eastern Montgomery County.

No injuries or fatalities were reported in North Carolina with Gaston.

September 17-18, 2004 – IVAN (TD) (Fig 162(a-c))

Ivan was a classical, long-lived Cape Verde hurricane that reached Category 5 strength three times during its life cycle. It was also the strongest hurricane on record that far south east of the Lesser Antilles. Ivan caused considerable damage and loss of life as it passed through the Caribbean Sea.

Ivan developed from a large tropical wave that moved off the west coast of Africa on August 31st and became a tropical depression early on September 1st. Despite a relatively low latitude (9.7°N), development continued and it is estimated that the cyclone became Tropical Storm Ivan on September 3rd. Ivan continued on a generally westward motion south of 10 degrees latitude and steadily strengthened, becoming a hurricane at on September 5th centered about 1000 miles east of Tobago in the southern Windward Islands. After reaching hurricane strength, Ivan went through a couple periods of rapid strengthening followed by weakening before it passed just south-southwest of Grenada as a Category 3 storm on the 8th. After passing Grenada, Ivan strengthened to a Category 5 storm in the Caribbean Sea and headed west-northwestward toward Jamaica. The storm turned west and passed just south of Jamaica on September 11th while weakening back to a Category 4 hurricane.

Later that day Ivan began moving west northwestward away from Jamaica. The system rapidly intensified to Category 5 strength a second time, before weakening to a Category 4 system on the 12th. The weakening trend was short-lived and Ivan re-strengthened to Category 5 for its third and final time when it was about 80 miles west of Grand Cayman Island. On September 13th, Ivan turned northwestward over the northwestern Caribbean Sea, and finally passed through the Yucatan channel just off the extreme western tip of Cuba. Shortly after emerging over the southern Gulf of Mexico early on the 14th, Ivan turned north-northwestward and then northward while weakening. Ivan finally moved inland across the barrier islands of Alabama, and then turned north-northeastward across eastern Mobile Bay and weakened into a tropical storm 12 hours later over central Alabama. A gradual turn to the northeast occurred shortly thereafter and Ivan became a tropical depression late on September 16th over northeast Alabama. A northeastward motion continued for the next 36 hours taking Ivan across western North Carolina and Virginia before merging with a frontal system and became an extratropical low over the Delmarva peninsula on September 18th.

The wind gusts across the North Carolina mountains and foothills were generally associated with the circulation center of the remnants of Ivan as it moved across the Appalachians. Wind gusts across the Piedmont and Coastal region were often influenced by convective rain bands. Some of the highest gusts include 79 mph at Raleigh-Durham, 51 mph at Burlington, and 47 mph at Fayetteville.

Rain bands associated with Ivan produced several tornadoes over the Piedmont of North Carolina. One tornado hit Stokesdale in northwestern Guilford County followed by several more touchdowns in Rockingham County, Moore County, and Chatham County. A strong downburst, associated with a convective rain band, hit the Raleigh-Durham International Airport producing a wind gust of 79 mph. This downburst produced significant damage to a terminal and flipped several small planes. This was the strongest gust of wind to be recorded at the airport location.

A swath of 3 to 6 inches of rain fell across the North Carolina Mountains associated with Ivan. There were reports of 7 to 10 inches of rain along the higher terrain with isolated

reports in excess of 11 inches. This resulted in severe flooding and damage in many mountain counties including up to 45 landslides across the western Carolinas.

Eight fatalities in North Carolina were directly related to Ivan. Five of these deaths occurred in Macon County near Franklin where the Peeks Creek mudslide wiped out 20 to 30 homes. The debris from this slide flowed at 33 miles per hour – 45,000 cubic feet per second.

September 28, 2004 – JEANNE (TD) (Fig 163(a-c))

Jeanne produced heavy rain over Guadeloupe, Puerto Rico and the Dominican Republic and caused an estimated 3000 or more deaths in Haiti, from torrential rainfall flooding. Jeanne hit the northern Bahamas and then the central Florida east coast as a Category 3 hurricane.

Jeanne formed from a tropical wave that moved from Africa to the eastern tropical Atlantic Ocean on September 7th. The wave moved uneventfully across the Atlantic until a tropical depression formed from it on the 13th as it approached the Leeward Islands. The depression continued to move toward the west-northwest before strengthening to a tropical storm on September 14th while it moved slowly over the Leeward Islands. Continuing west northwestward, its circulation moved slowly over the Virgin Islands and the center moved inland over southeastern Puerto Rico on September 15th when maximum sustained surface winds reached 70 mph. The center moved across Puerto Rico, then over the Mona Passage and inland at the eastern tip of the Dominican Republic. Jeanne was a hurricane with 80 mph winds while over the Mona Passage and during the Dominican Republic landfall, but then weakened over the rough terrain of Hispaniola. By the afternoon of September 17th, the cyclone briefly weakened to a depression and moved over Atlantic waters just north of Hispaniola. On September 18th and in a weakened condition, the system moved slowly westward before stalling. Jeanne remained in a weak steering flow that persisted for five days. Jeanne first moved slowly northward over the southeastern Bahamas as a tropical storm and then moved in an anticyclonic loop about 500 miles east of the northwestern Bahamas. Jeanne gradually strengthened to a hurricane with 100 mph winds by the time it completed this loop on September 23rd. The storm moved over its own previous track on the 24th and briefly weakened before turning westward and strengthening to Category 3 status on September 25th as the center moved over Abaco Island and then Grand Bahama Island in the northern Bahamas. Jeanne made landfall on the east coast of Florida early on September 26th as a Category 3 hurricane.

Jeanne then moved across central Florida while weakening and began to turn northwest passing just north of Tampa as a tropical storm during the afternoon of September 26th. The system then weakened to a tropical depression about 24 hours later while moving northward across central Georgia. The depression moved over the western Carolinas, Virginia, and the Delmarva Peninsula on September 28th. It merged with a frontal zone and became extratropical late on the 28th while moving eastward off of the U.S mid-Atlantic coast.

Rain bands associated with Jeanne produced several tornadoes over the Sandhills and Piedmont of North Carolina. Tornado touchdowns were reported in Moore, Richmond and Wake Counties resulting in minor damage.

A swath of 2 to 4 inches of rain with localized amounts in excess of 6 inches fell across the North Carolina Mountains, foothills and western Piedmont but only produced minor flooding.

No fatalities were reported in North Carolina with Jeanne.

July 7, 2005 – CINDY (XT Remnant) (Fig 164(a-c))

Cindy was the first of five named tropical cyclones that developed during an unusually active month of July.

The tropical wave that eventually developed into Cindy moved westward off the coast of Africa on June 24th. The wave moved quickly westward for the next three to five days passing across the Caribbean Sea before becoming a tropical depression on July 3rd just east of Chetumal, Mexico. The depression continued on a slow west-northwestward track across the east coast of the Yucatan peninsula on July 4th. After moving inland, the cyclone turned northwestward and accelerated, becoming a tropical storm on the 5th over the central Gulf of Mexico. The system then moved slowly north and became a minimal hurricane on the July 6th just offshore of Grand Isle, Louisiana. After moving inland over extreme southeastern Louisiana, Cindy turned northeastward and weakened to a tropical storm before making a second landfall southwest of Waveland, Mississippi later on the 6th. Cindy quickly weakened to a tropical depression over southern Mississippi and then continued in a northeastward direction across southwestern and central Alabama to northern Georgia, where it merged with a stationary frontal system and became an extratropical low. The system then moved northeastward along the eastern slopes of the Appalachian Mountains of western North Carolina and western Virginia, and emerged off the mid-Atlantic coast the afternoon of July 8th.

The remnants of Cindy produced scattered wind damage across the Piedmont and Foothills, including 8 tornadoes.

Rainfall was heaviest across the mountains where totals of 4 to 6 inches occurred with a range from around 2 inches in central North Carolina to less than an inch along the coast. This resulted in only minor flooding over the higher terrain.

No deaths or injuries were reported in North Carolina with Cindy.

September 14, 2005 – OPHELIA (CAT 1) (Fig 165(a-c))

Hurricane Ophelia was a Category 1 hurricane that brushed the North Carolina Outer Banks, its center staying just offshore the coast. The storm’s erratic and slow movement

in the vicinity of the North Carolina coastline was similar to Hurricane Bonnie in August 1998, and Dennis in August 1999.

Ophelia formed from a non-tropical weather system. A cold front moved off the eastern coast of the United States on September 1st. The front moved southeastward and became part of an elongated trough of low pressure that extended from Tropical Depression Lee east of Bermuda to near the Florida Peninsula. Two areas of low pressure formed on the front on September 4th. The eastern low, south of Bermuda, eventually became Hurricane Nate. The western low, near the Bahamas, became Ophelia.

The pre-Ophelia low initially drifted southward before turning northward on September 5th while slowly becoming better organized. The system strengthened into a tropical depression early on September 6th between Andros and Grand Bahama Islands.

The depression moved generally northward, crossing Grand Bahama on September 6th. It then moved north-northwestward parallel to the east coast of Florida, reaching a position about 70 miles east-northeast of Cape Canaveral on the 7th. The cyclone became a tropical storm early on September 7th, and gradually strengthened during the next 24 hours as Ophelia made a slow counter-clockwise loop off the Florida east coast.

Ophelia was briefly a hurricane late on September 8th, with the cyclone weakening back to a tropical storm about 6 hours later. A similarly short-lived hurricane phase occurred late on September 9th while Ophelia moved east-northeastward away from Florida. Ophelia became a hurricane for a third time on September 10th, this time holding hurricane status for 36 hours. The cyclone made a slow clockwise loop during September 11th while weakening back to a tropical storm on September 12th due to Ophelia passing over its wake of up-welled cooler water. After completing the loop, the storm drifted northwestward on September 13th.

Ophelia moved slowly northward early on the 14th and became a hurricane for the fourth time. A gradual turn toward the north-northeast brought the northern portion of the 50 mile wide eye over the coast of North Carolina near Cape Fear later that day, although the actual center of circulation stayed offshore. Ophelia moved generally east-northeastward parallel to the North Carolina coast for much of September 14th and 15th, with the northern eyewall passing over the coastal area from Wilmington to Morehead City. During this time, the hurricane reached its peak intensity of 85 mph, although these winds remained offshore.

Ophelia turned eastward late on September 15th while passing south of Cape Hatteras and then weakened back to a tropical storm during the 16th. The storm then turned northeastward and accelerated late on the 16th which brought the center about 60 miles southeast of the Massachusetts coast on September 17th and near the southern coast of Nova Scotia on September 18th. Ophelia gradually lost organization during this period, and it became extratropical early on the 18th.

The stronger winds with Ophelia raked the southeast North Carolina coast from Cape Fear north to the Outer Banks. Although the eye never came ashore, the eyewall stayed over much of the coast for up to 24 to 36 hours. The strong winds in the eyewall caused significant damage in coastal areas such as Morehead City, Beaufort, Atlantic Beach, Emerald Isle, including the rest of Bogue Banks and Downeast Carteret County. The worst wind damage was primarily limited to Carteret and Onslow Counties where winds partially destroyed a few structures, ripped off roofs, shingles, and knocked down trees and fences. Damage to structures across these two counties was estimated at over 20 million dollars. Some of the stronger wind gusts observed include: 93 mph at Cedar Island , 84 mph at Bald Head Island, 83 mph at Cape Hatteras (KHSE), 79 mph at Wrightsville Beach, 63 mph in Beaufort (KMRH) (before ASOS outage), 75 mph at Cherry Point (KNKT), 51 mph in New Bern (KEWN), 63 mph in Jacksonville (KNCA), and 92 mph at Cape Lookout (CLKN7). Estimated winds along Bogue Banks (in Emerald Isle, about 4 miles east of the Highway 58 bridge to mainland Carteret County) were 60 to 70 mph sustained, with gusts to 80 mph. There was also an unofficial report of a gust to 103 mph in Davis.

Flooding from excessive rainfall occurred across much of the coastal region. On average storm total rainfall amounts were between 5 and 12 inches with some of the heaviest over Brunswick County where 100 billion gallons of water was estimated across the county. This produced up to 4 feet of water across many bridges and roadways. 9.39 inches of rain fell at the National Weather Service Weather Forecast Office in Newport. Storm total rainfall amounts of more than a foot were also seen in isolated locations such as Oak Island where 17.50 inches was observed. This produced damage to over 200 structures on the island.

Flooding from storm surge was more significant, inundating many portions of the coast, especially in areas on the western side of the Pamlico Sound and along the Neuse, Pamlico and Newport rivers. Water levels in Beaufort County (near Washington) along the Pamlico River reached 4 feet above normal. New Bern reached 5 feet above normal. Locations along the lower Neuse River in Craven County reported water levels of 8 to 9 feet above normal. Areas along the Newport River just north of Morehead City experienced water levels 4 to 5 feet above normal, while portions of Beaufort had water levels about 4 feet above normal, and the Morehead City waterfront observed a 2 foot surge. Salter Path along Bogue Banks as well as Topsail Beach saw a 3 to 5 foot sound-side surge. The winds and flooding observed in Hurricane Ophelia were below that seen in Hurricane Isabel in September, 2003. However, areas along Bogue Banks from Emerald Isle east to Atlantic Beach experienced higher winds than in Isabel.

Higher than normal ocean water levels combined with high surf to produce significant to severe beach erosion along the coast from Cape Fear to Bogue Banks. Many dune breaches were attributed to the heavy surf with 90 percent of over dune beach stair accesses washed away at Topsail Island and Surf City. The resulting dollar cost just due to erosion alone along the coast and barrier islands was estimated in the millions.

Thousands lost power across much of southeast North Carolina although no tornadoes were reported.

No significant injuries or fatalities were attributed to Ophelia in North Carolina.

June 14, 2006 – ALBERTO (TD) (Fig 166(a-c))

Alberto developed from an area of disturbed weather that persisted for several days over Central America and the northwestern Caribbean Sea. The system acquired tropical depression status on Saturday, June 10th in the Yucatan Channel. The depression moved slowly northwest and developed into Tropical Storm Alberto during the evening of June 10th, with maximum sustained winds of 45 mph. Alberto reorganized and reached its maximum intensity with sustained winds of 70 mph late on June 12th when centered just south of Apalachicola, Florida. Alberto moved onshore around noon on the 13th near Adams Beach, Florida with maximum sustained winds of 50 mph.

Alberto moved north across northern Florida and southeastern Georgia during the afternoon and evening hours on June 13th. Alberto was still a tropical storm at midnight on Wednesday, June 14th while it was centered over eastern Georgia. Alberto was then downgraded to a tropical depression during the early morning hours of June 14th while it was centered over South Carolina. The depression then moved into southern North Carolina during the morning of the 14th and was declared extratropical.

A shield of torrential rain developed in an arc to the north and northwest of the storm as it moved into North Carolina with corresponding rainfall rates of more than 3 inches per hour. The orientation of the precipitation shield (a band stretching from northeast to southwest) and its northeast translation resulted in excessive rainfall totals especially over central North Carolina. Raleigh-Durham International Airport (RDU) shattered the precipitation record for June 14th with 5.64 inches of rain and it also broke the all time daily precipitation record. Rainfall amounts ranged between 2 and 5 inches in a corridor from near Rockingham to Raleigh to Roanoke Rapids with some locations near Raleigh receiving between 6 and 8 inches of rain. Local media reports stated that the Raleigh-Wake 911 center received more than 1,076 calls for help while police and fire fighters in Wake County performed 47 water rescues. Crabtree Creek in Raleigh rose over 17 feet during the 14th before cresting nearly a foot higher than levels seen with Fran back in 1996.

The heavy rainfall resulted in one fatality in Franklin County where an 8 year old boy drowned while chasing a ball going down in the drainage system.

There were no tornadoes attributed to Alberto in North Carolina.

August 31, 2006 – ERNESTO (TS) (Fig 167(a-c))

Ernesto initially developed when Tropical Depression five organized just west of the southern Windward Islands during the afternoon on August 24th. The system moved west-northwest and became a Tropical Storm late on August 25th when centered south of San Juan, Puerto Rico. Ernesto continued on a west-northwest course for a few days and briefly reached category 1 hurricane status just south of Haiti on August 27th.

Ernesto weakened as the system interacted with land mass over Haiti and Cuba beginning late on the 27th and continuing through early on the 29th. Ernesto maintained its weak Tropical Storm intensity on August 29th and the tropical storm moved onshore in South Florida very late on the 29th. Ernesto weakened as it moved northward across Florida. The system reemerged into the Atlantic Ocean near Cape Canaveral, Florida as a Tropical Depression very late August 30th.

Ernesto strengthened throughout the day on August 31th with maximum sustained winds reaching 70 mph during the afternoon. The Tropical Storm made landfall in Brunswick County near Long Beach, North Carolina just before midnight August 31th. Ernesto moved north across the Coastal Plain of North Carolina on September 1st, reaching southeastern Virginia as a Tropical Depression during the late afternoon on Friday. The system became extratropical late Friday evening as it moved across eastern Virginia.

In eastern North Carolina, some homes and businesses were damaged by strong winds. Wind gusts to 74 mph occurred at Wrightsville Beach with gusts to 70 mph common near the mouth of the Cape Fear River in southeast North Carolina. Three tornadoes occurred along the south coast in Onslow and Carteret Counties resulting in minor property damage. Strong winds also downed trees and power lines in coastal areas of North Carolina.

Heavy rain resulted in the flooding of several homes across the coastal regions. Rainfall totals of 8 to 10 inches were observed in a narrow swath just east of the track from the Cape Fear region northeast across parts of the Coastal Plain. Amounts across the coastal sections ranged from 4 to 7 inches while totals of 2 to 5 inches were seen farther west into the Piedmont.

For days following landfall, rain-induced river floods inundated several homes, such as in Chinquapin along the Northeast Cape Fear River north of Wilmington. Storm surge caused minor coastal flooding and beach erosion along the immediate Atlantic coastline. The surge along bays and rivers, such as the Pamlico and Pungo Rivers in Beaufort County and Collington Harbor in Dare County, flooded several homes and businesses.

No deaths occurred with Ernesto in North Carolina.

3. SUMMARY

North Carolina tropical cyclone days (days that the storm affected North Carolina) in the 19th, 20th, and 21st centuries totaled 327 (data prior to 1800 was not used due to scarcity of data), which averages out to approximately 1.6 tropical cyclone days per year.

The total tropical cyclone days and percentage of occurrences by month follows:

June	28 Tropical cyclone days 8.6 %
July	21 Tropical cyclone days 6.4 %
August	84 Tropical cyclone days 25.8 %
September	119 Tropical cyclone days 36.2 %
October	67 Tropical cyclone days 20.6 %
November	7 Tropical cyclone days 2.1 %
December	1 Tropical cyclone days 0.3 %

From mid August through October 75 % of the tropical cyclone days occurred.

Extremes for 19th, 20th, and 21st century North Carolina Hurricanes:

Earliest	June 3-4, 1825
Latest	December 1, 1925
Most Intense	Hazel (CAT 4), October, 1954
Costliest	Floyd (CAT 2), September, 1999
Highest Wind	August 18, 1879, Cape Lookout estimated winds of 168 mph. (Several reports of 150 mph occurred with Hazel in 1954)
Worst Flooding	Floyd (CAT 2), September, 1999
Most Deaths	53 deaths were recorded September 11, 1883
Highest Storm Tide	18 feet at Calabash associated with Hazel in 1954

Dating back to 1899, no Category 5 hurricane has made landfall in North Carolina.

ACKNOWLEDGMENTS

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FIGURES

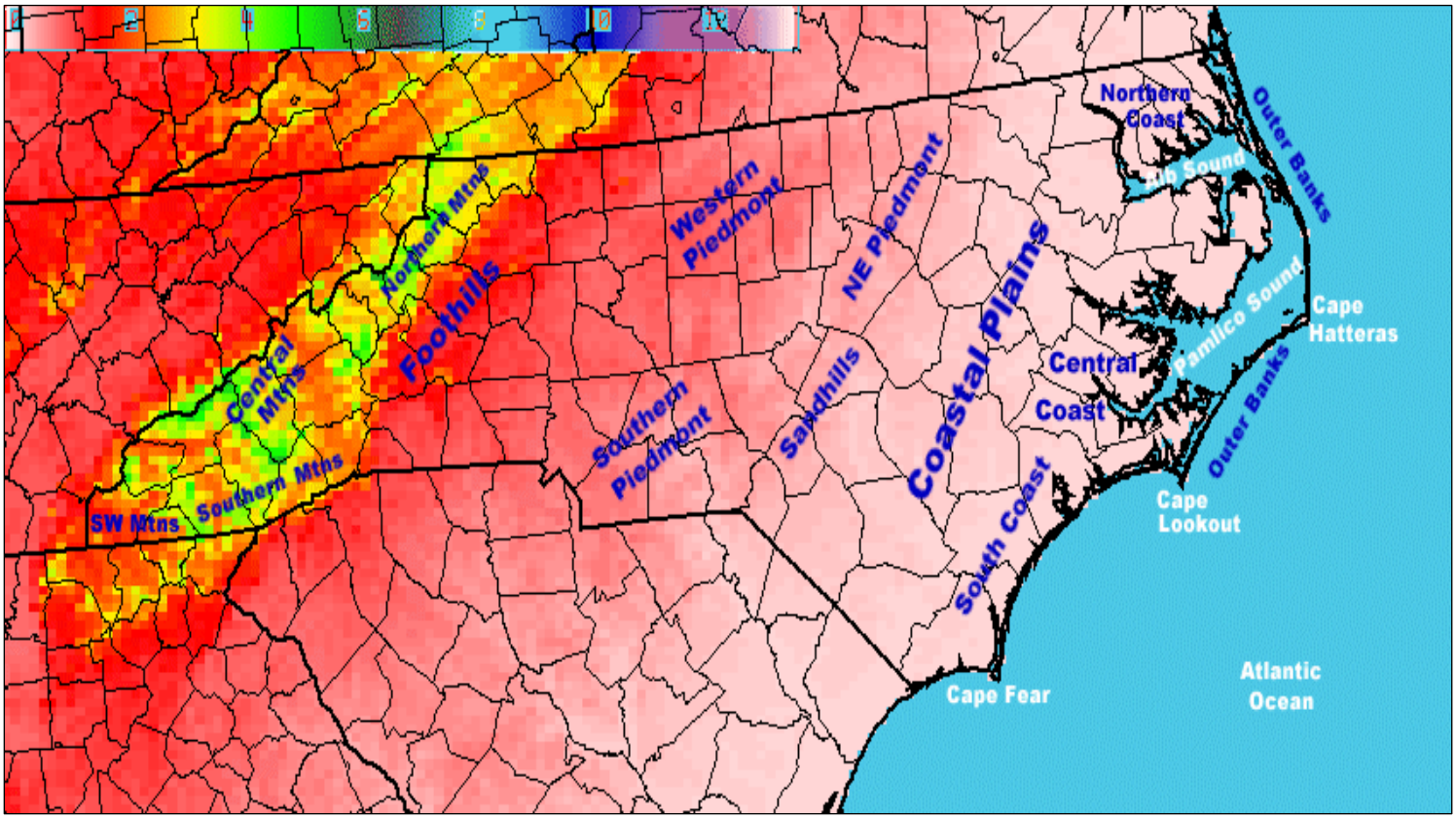

Fig. 1: North Carolina geographical/topographical depiction (thousands of feet).

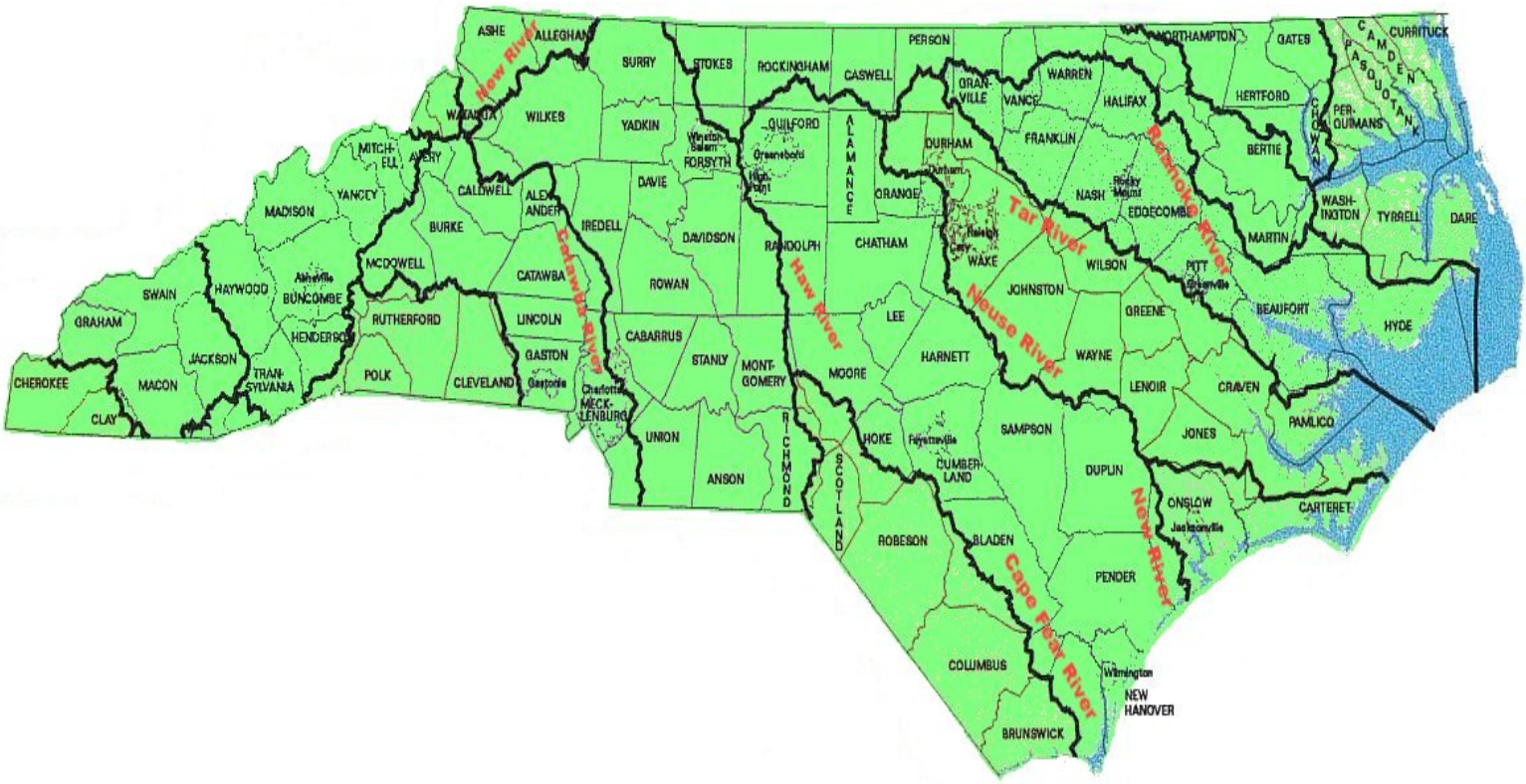

Fig. 2: Outline of North Carolina by counties including cities and rivers.
Credit: Southeast River Forecast Center (SERFC).

Color Key Table for Storm Track Strength Segments That Follow

Tropical Depression	Tropical Storm	Category 1	Category 2	Category 3	Category 4	Category 5	Extratropical

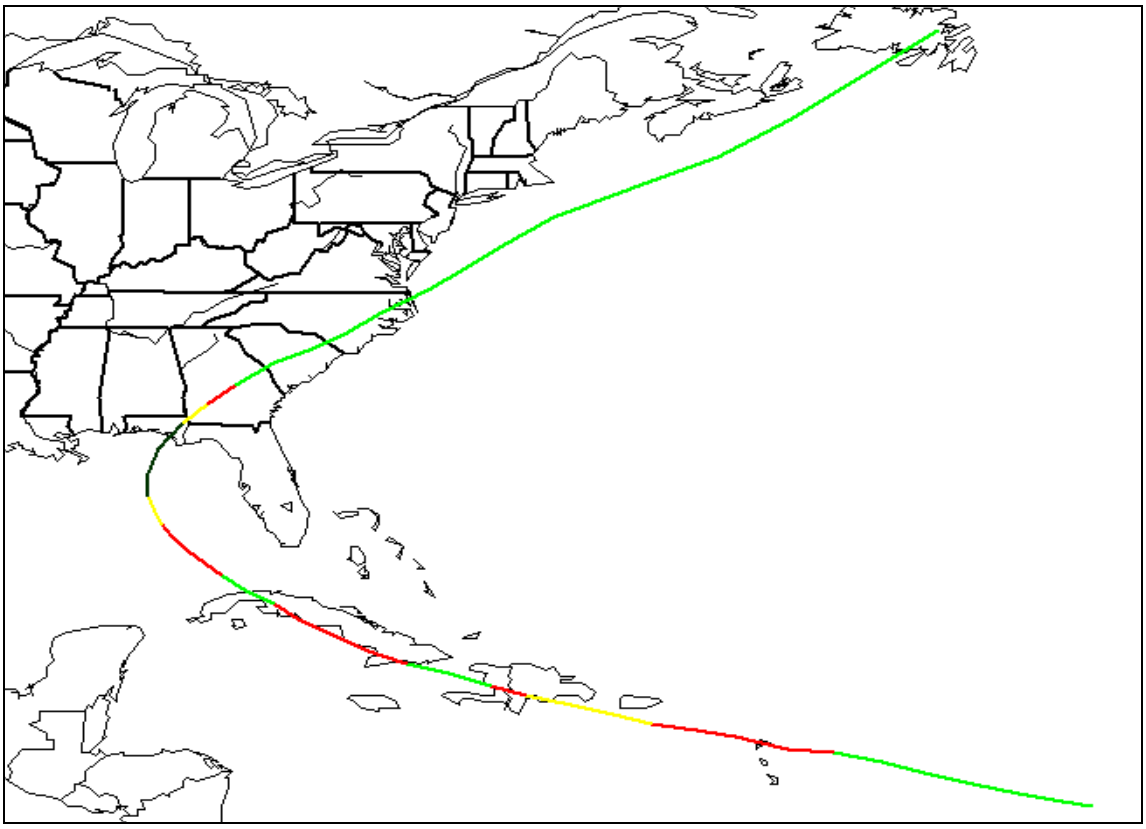

Fig. 3: August 23-27, 1851

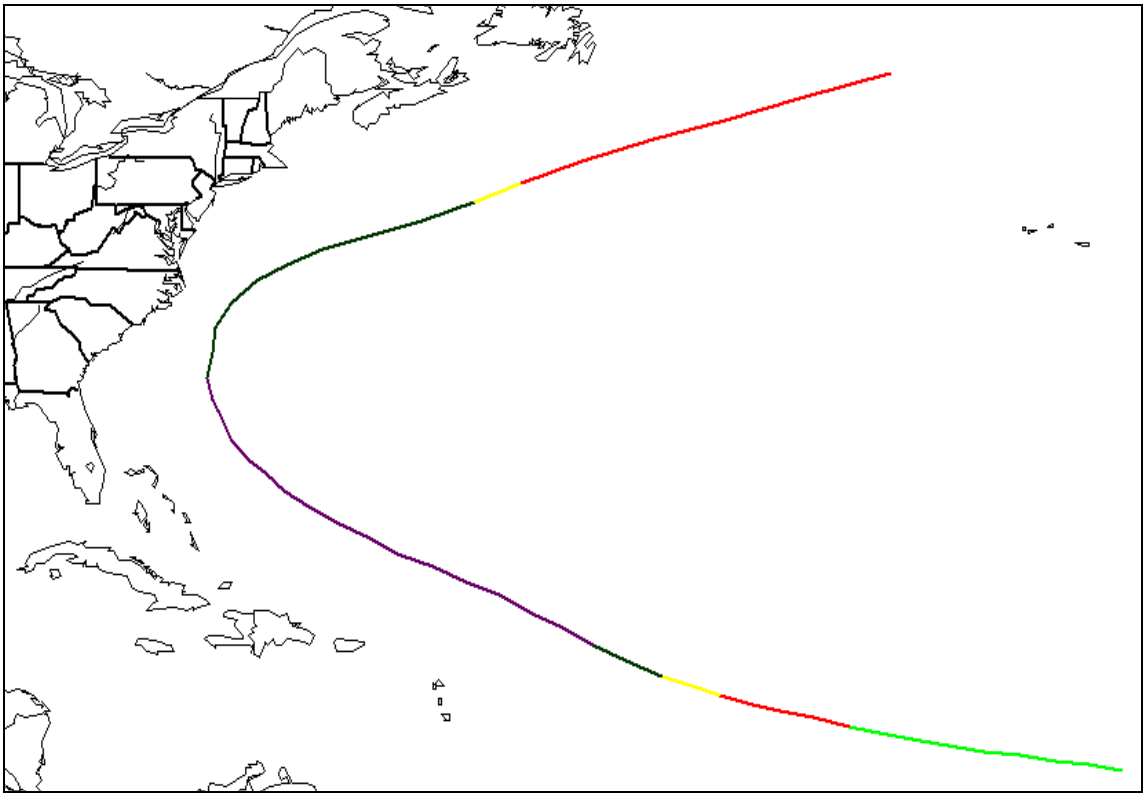

Fig. 4: September 7, 1853

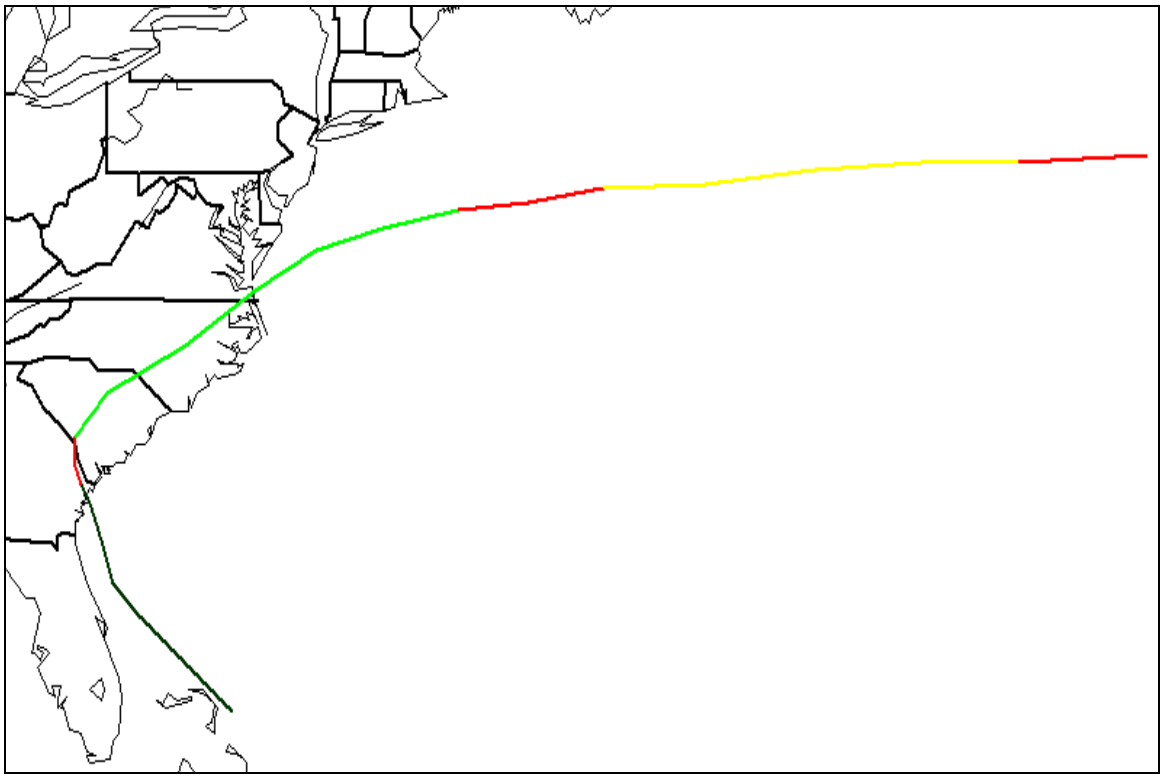

Fig. 5: September 7-9, 1954

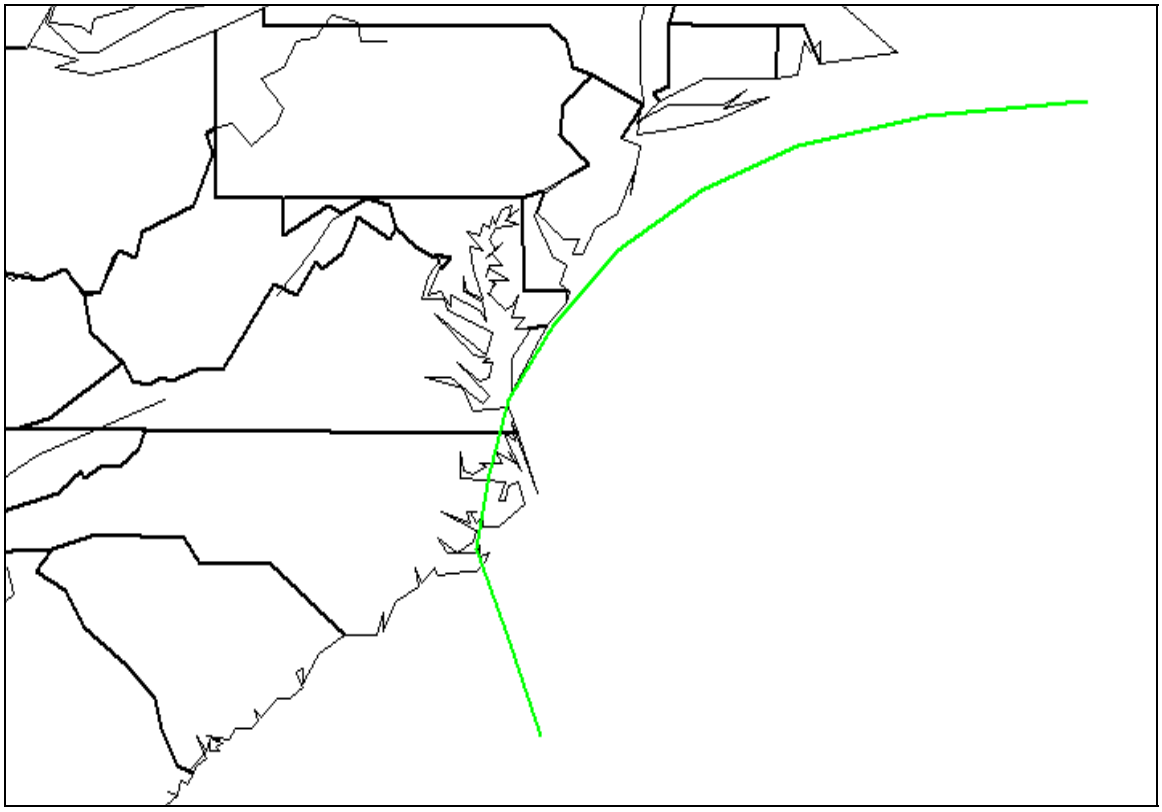

Fig. 6: August 19, 1856

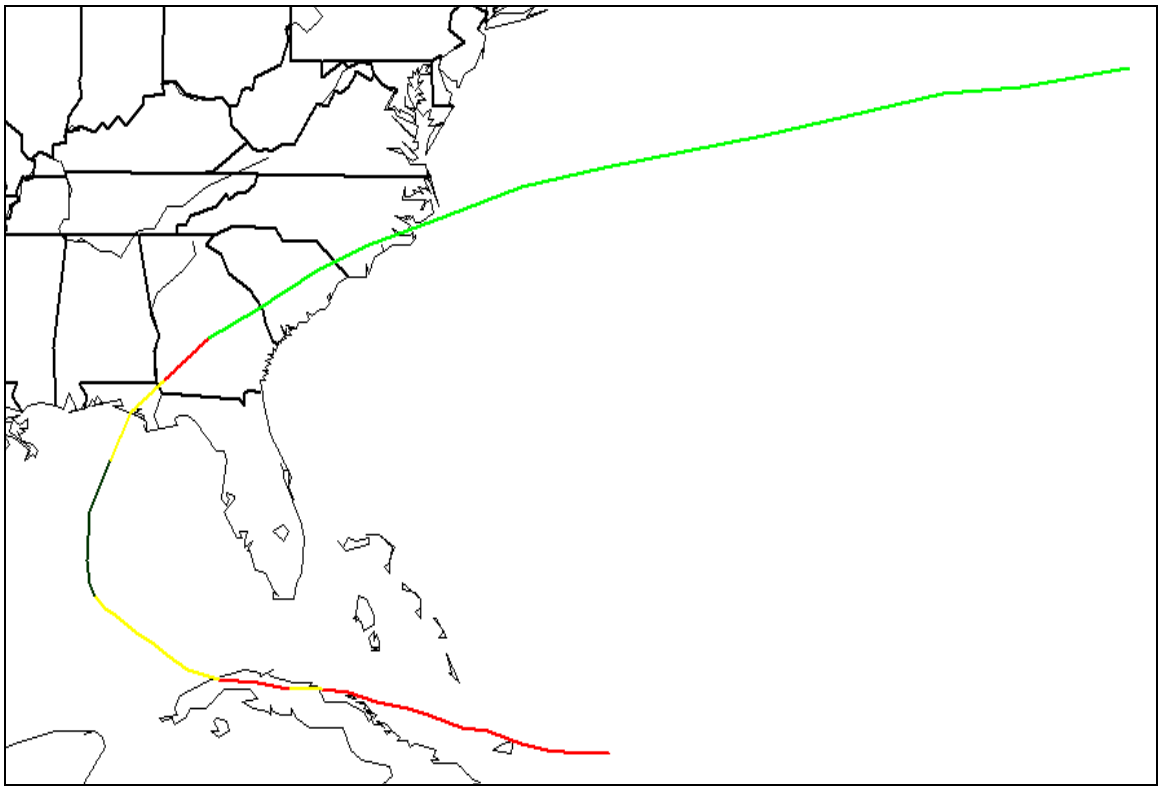

Fig. 7: August 31-September 1, 1856

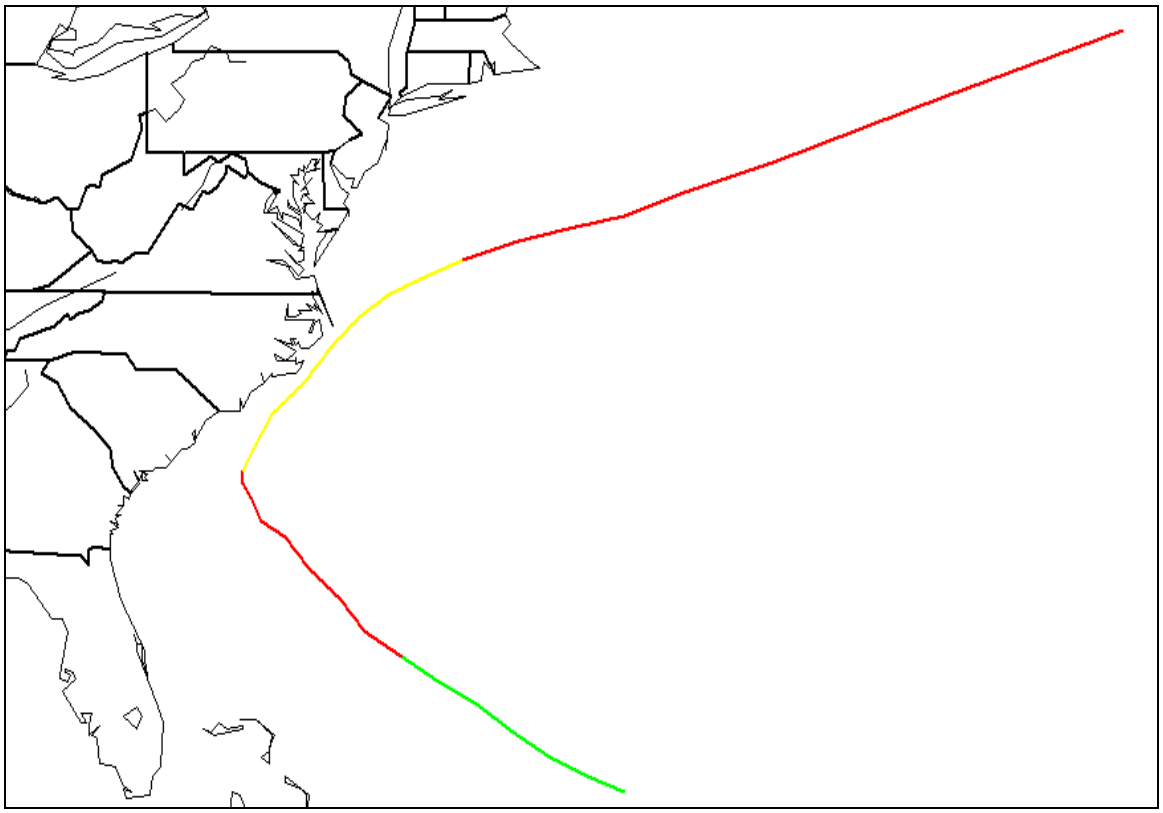

Fig. 8: September 9-12, 1857

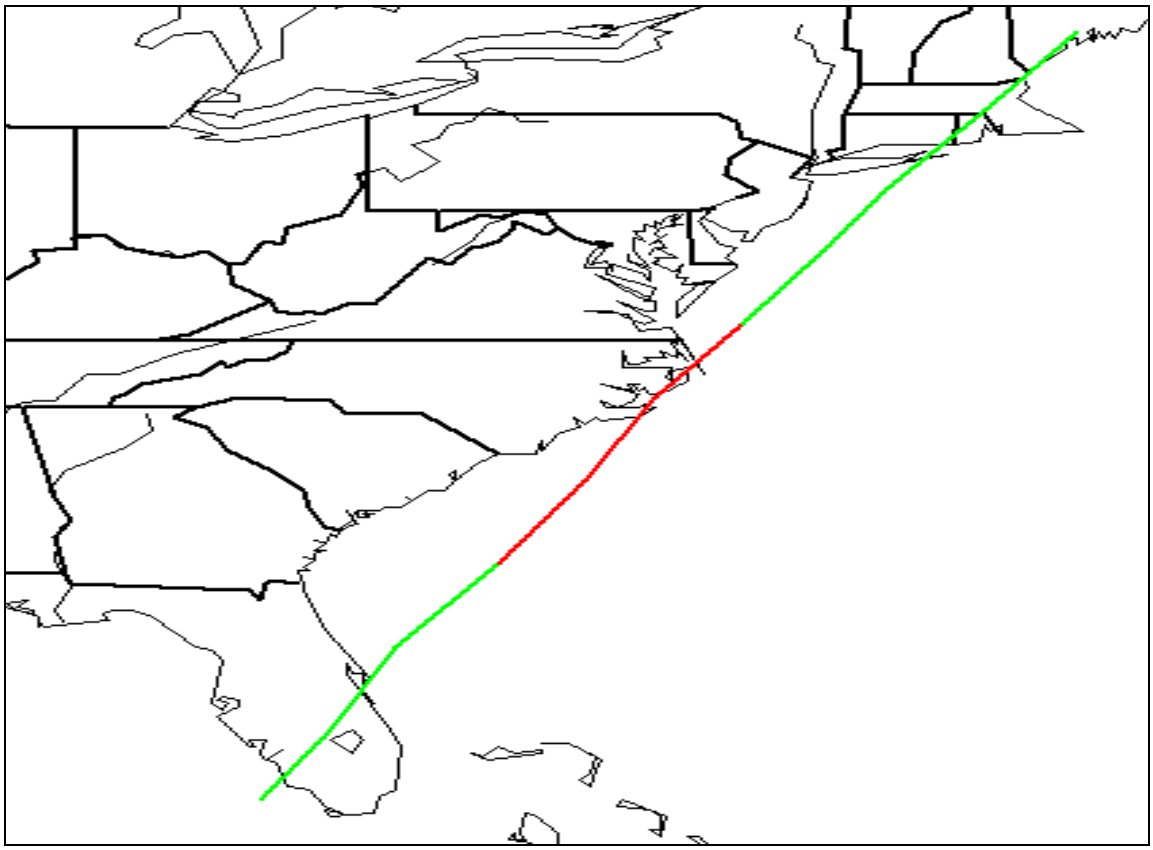

Fig. 9: November 1, 1861

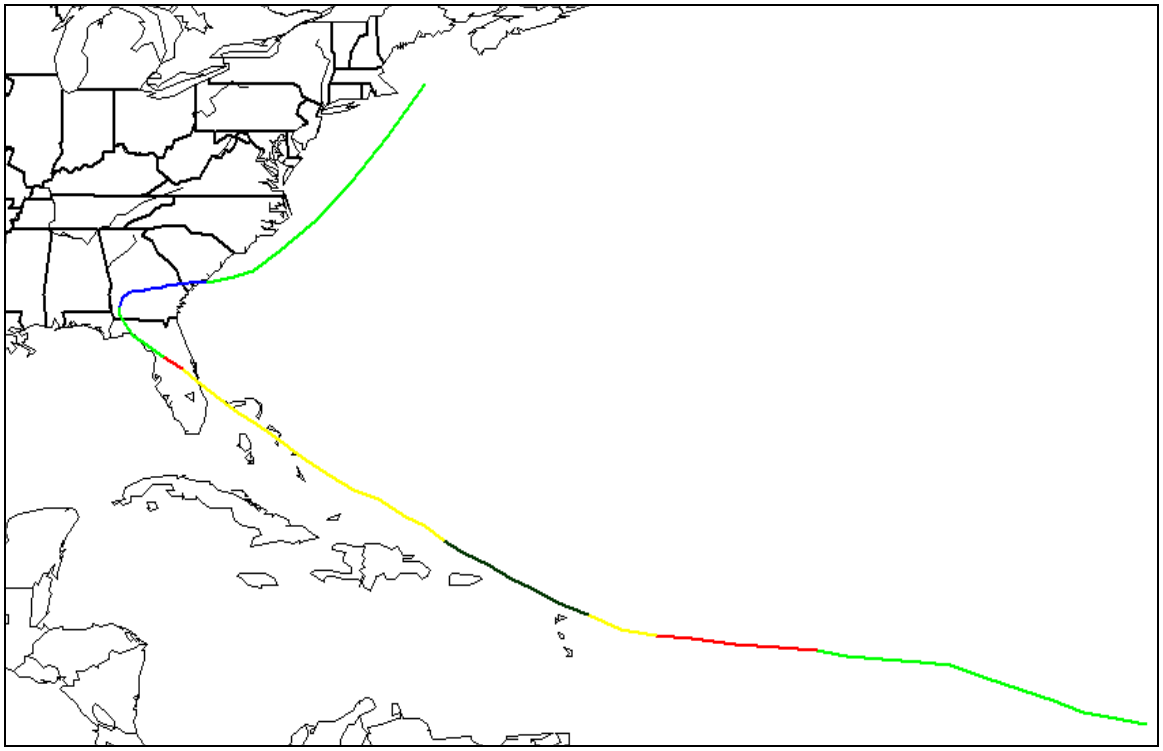

Fig. 10: August 18-22, 1871

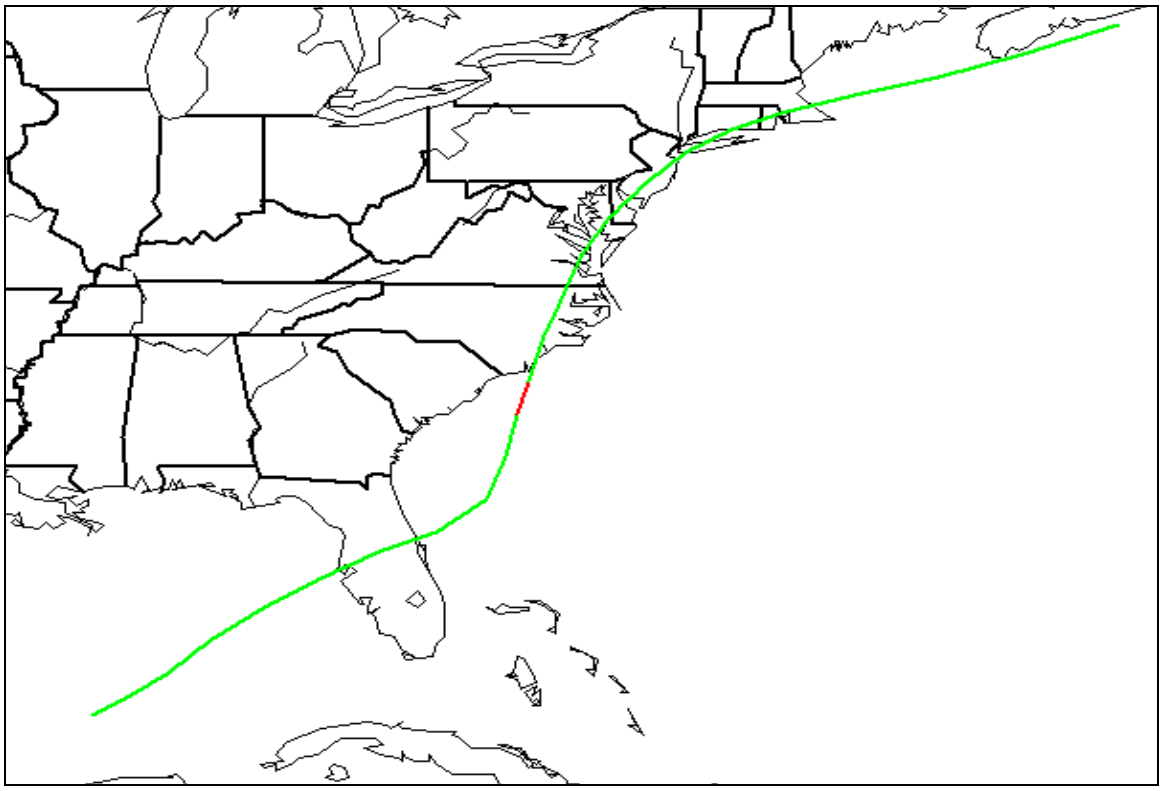

Fig. 11: October 25, 1872

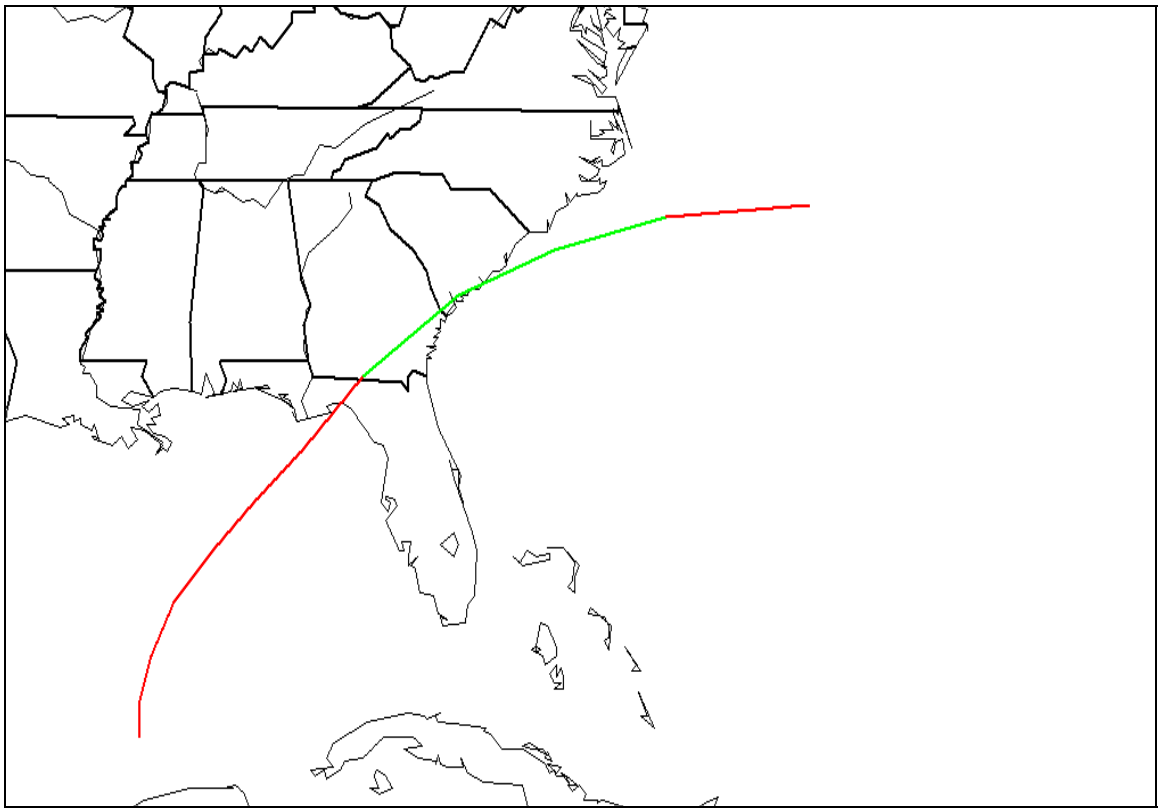

Fig. 12: September 19-20, 1873

Fig. 13: September 23-24, 1873

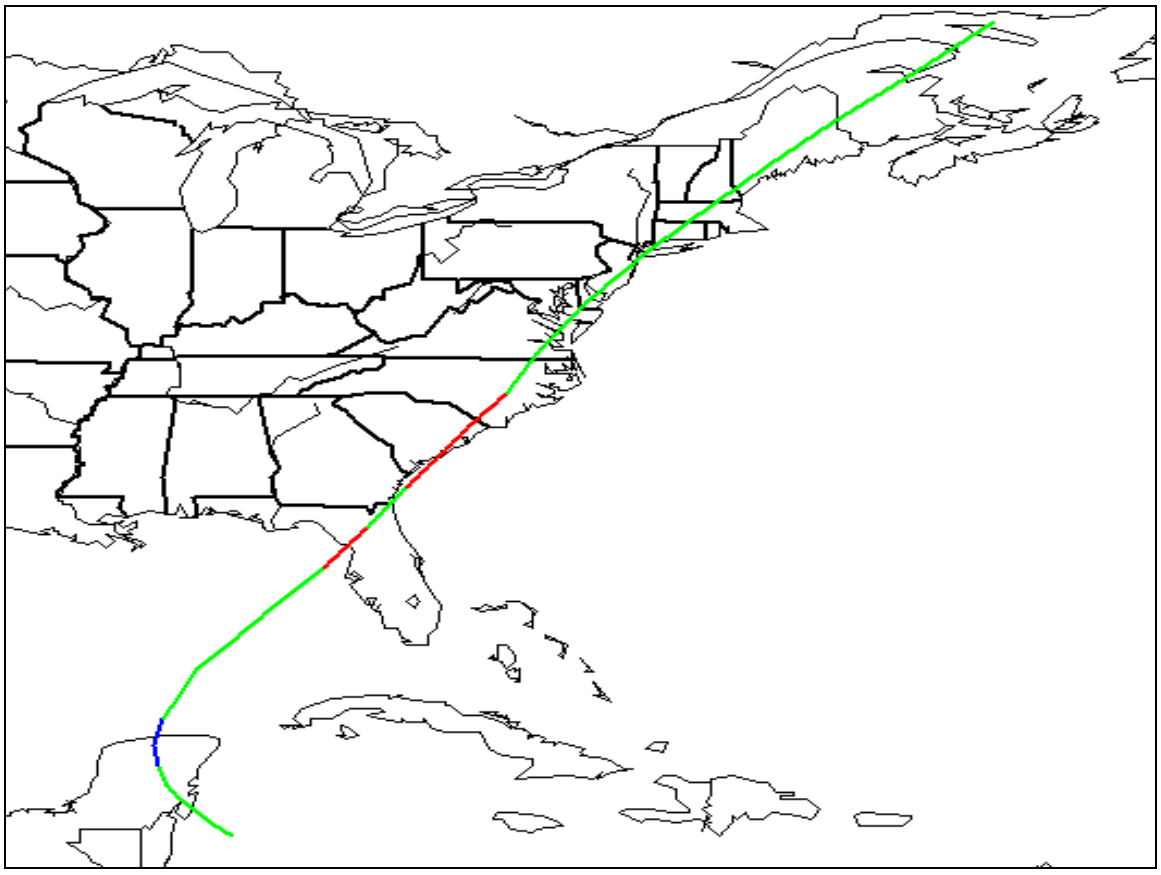

Fig. 14: September 28, 1874

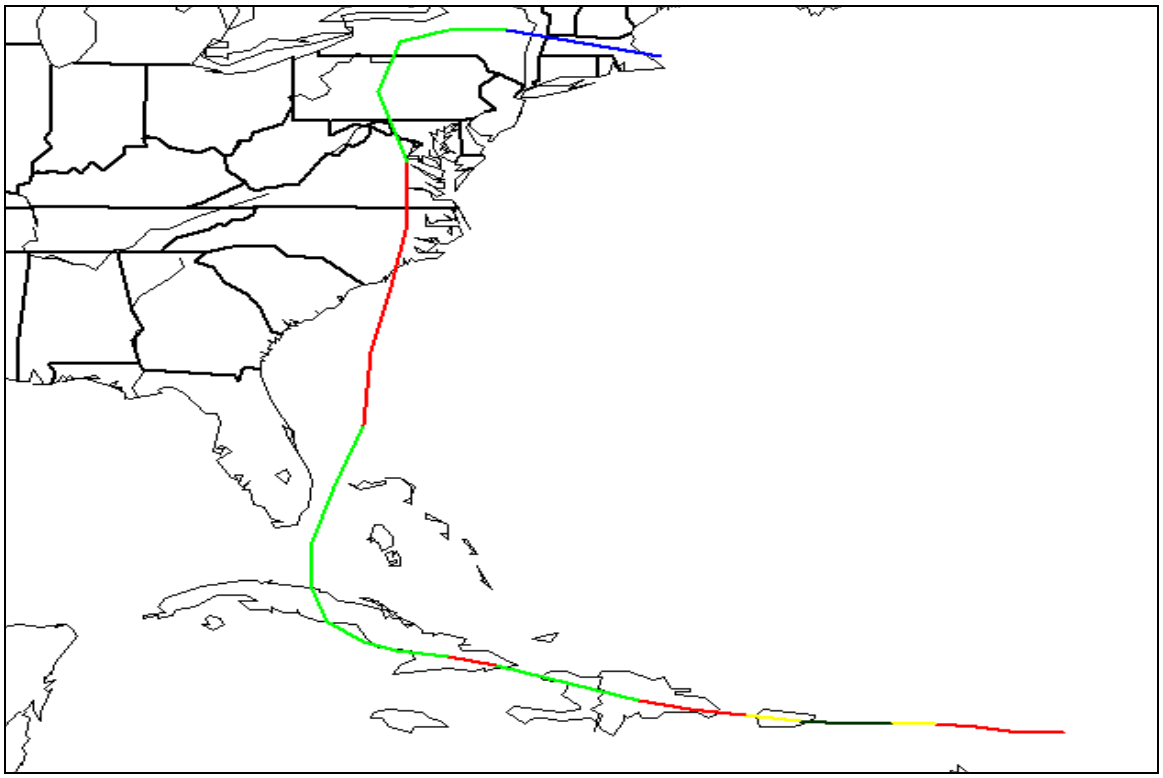

Fig. 15: September 17, 1876

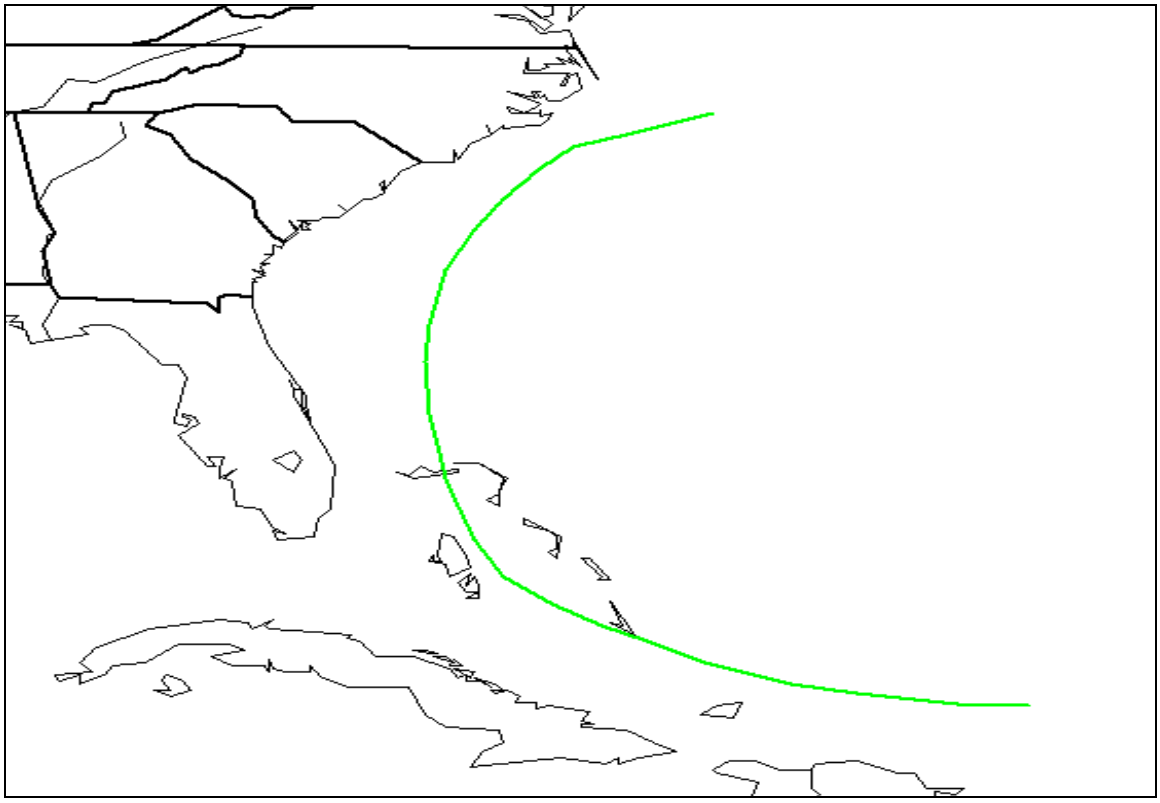

Fig. 16: September 29, 1877

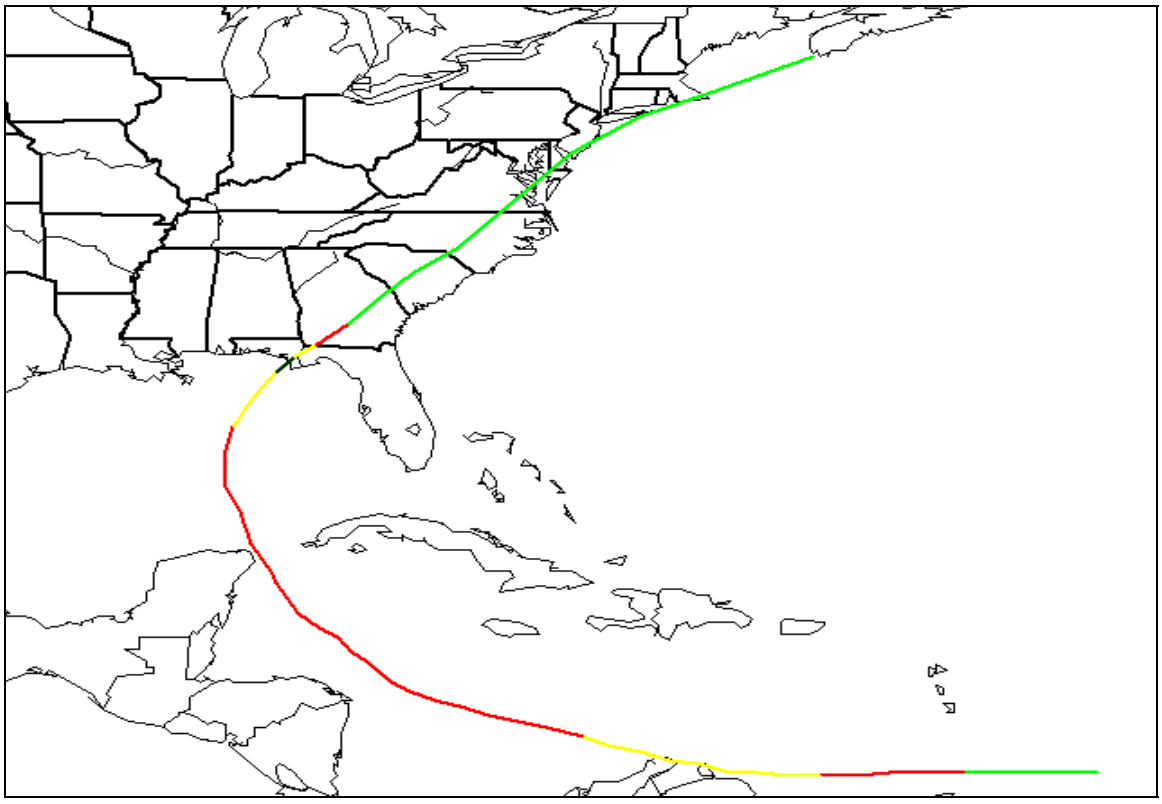

Fig. 17: October 3-4, 1877

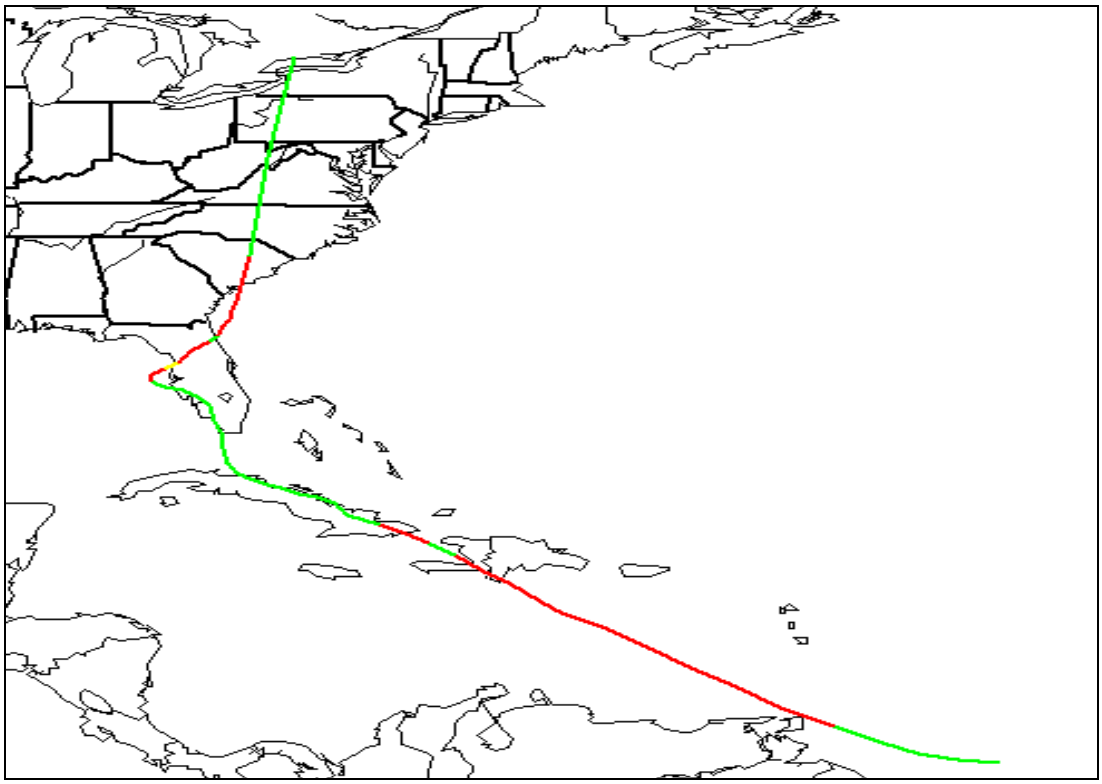

Fig. 18: September 12, 1878

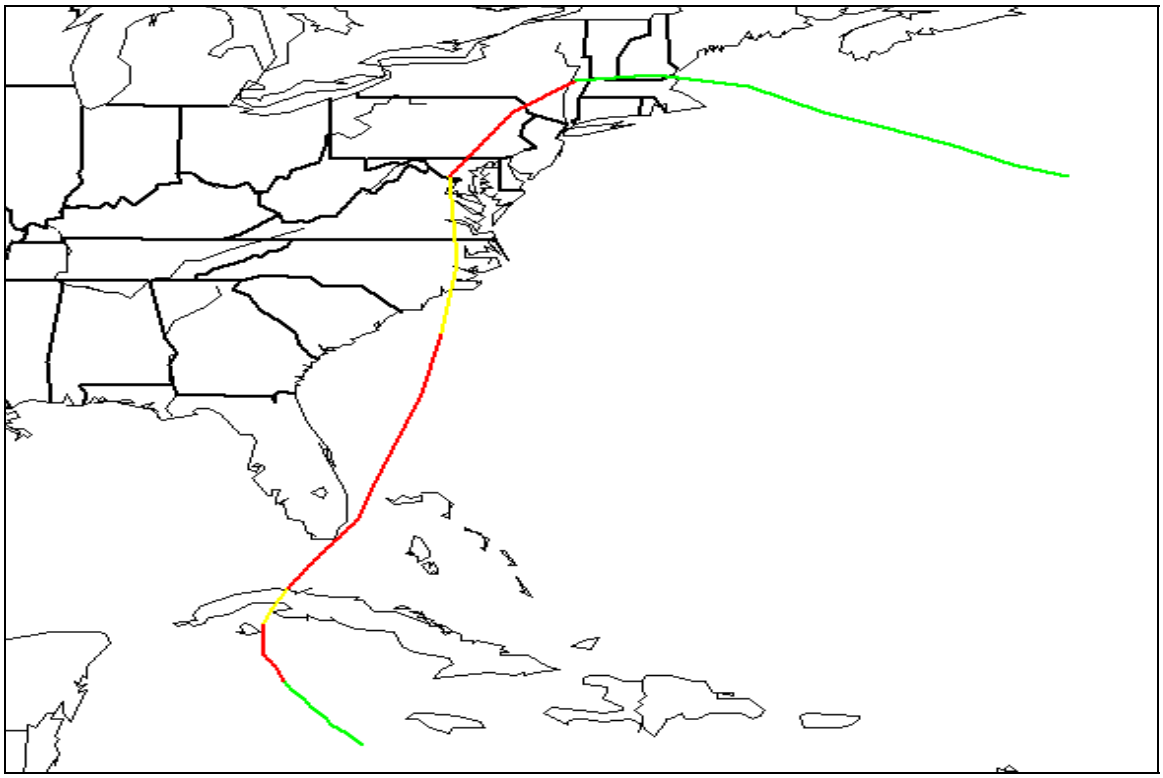

Fig. 19: October 23, 1878

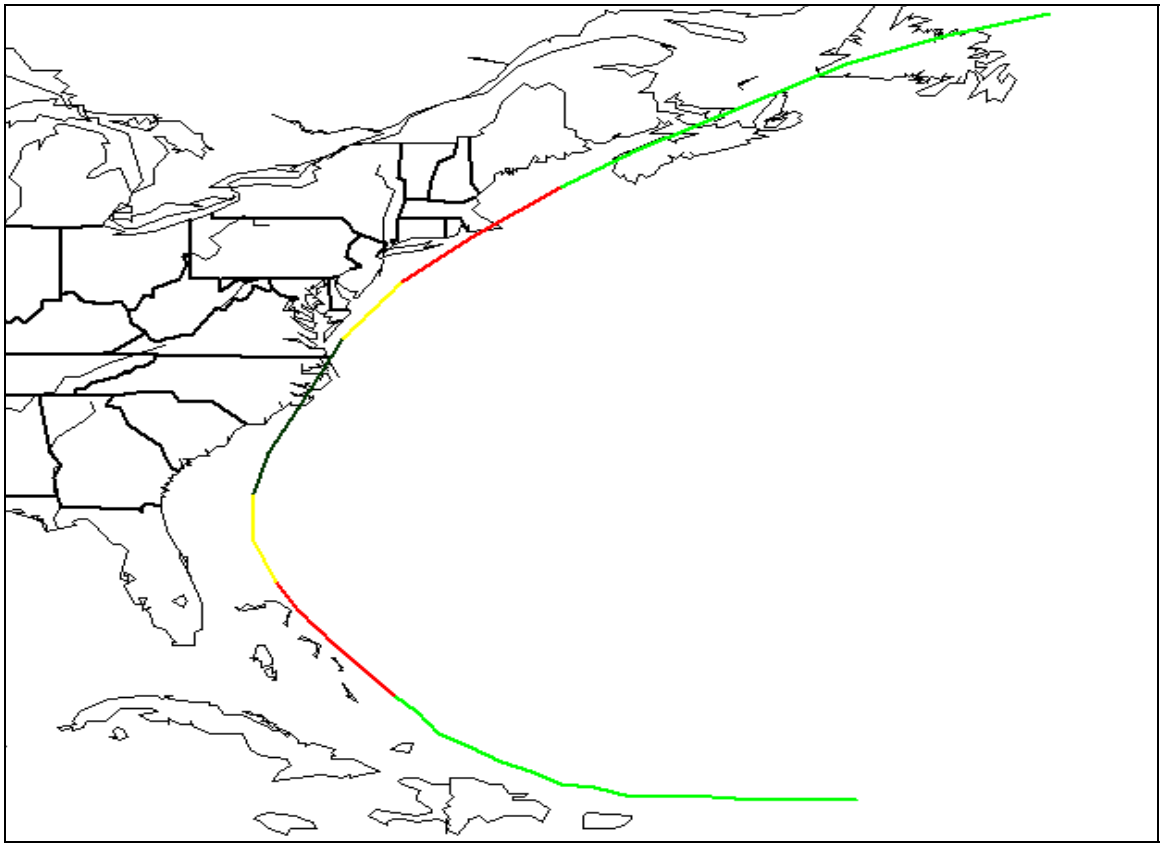

Fig. 20: August 18, 1879

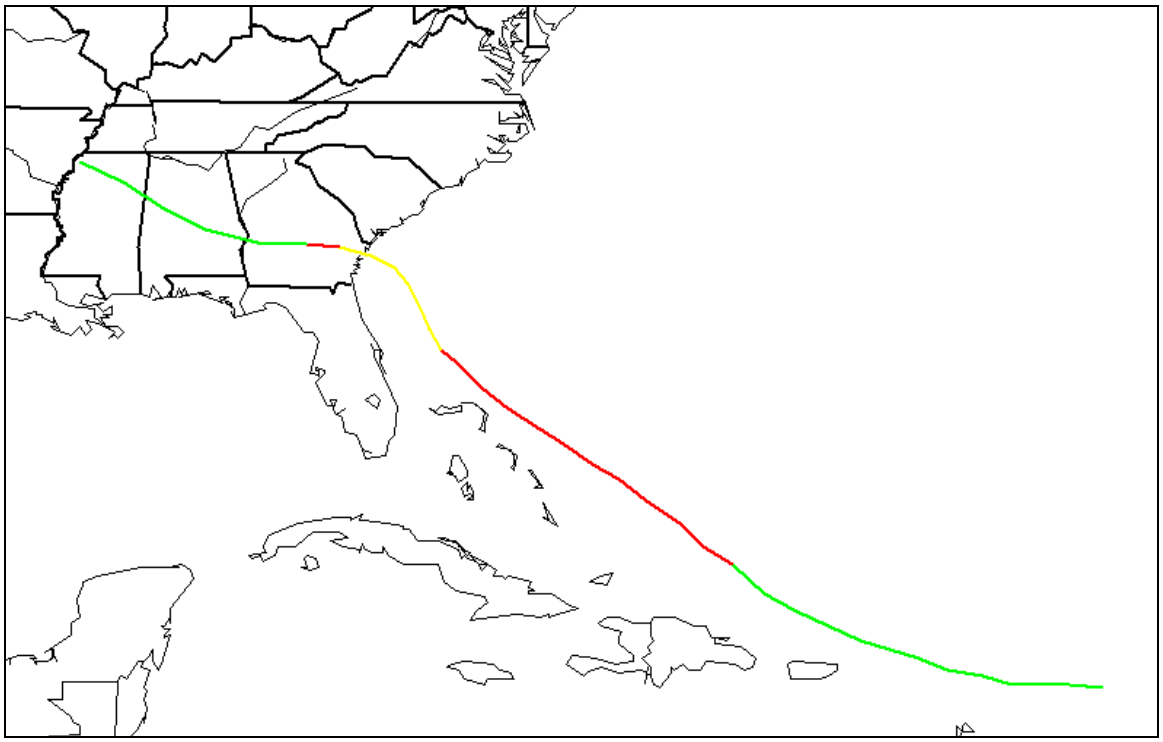

Fig. 21: August 27, 1881

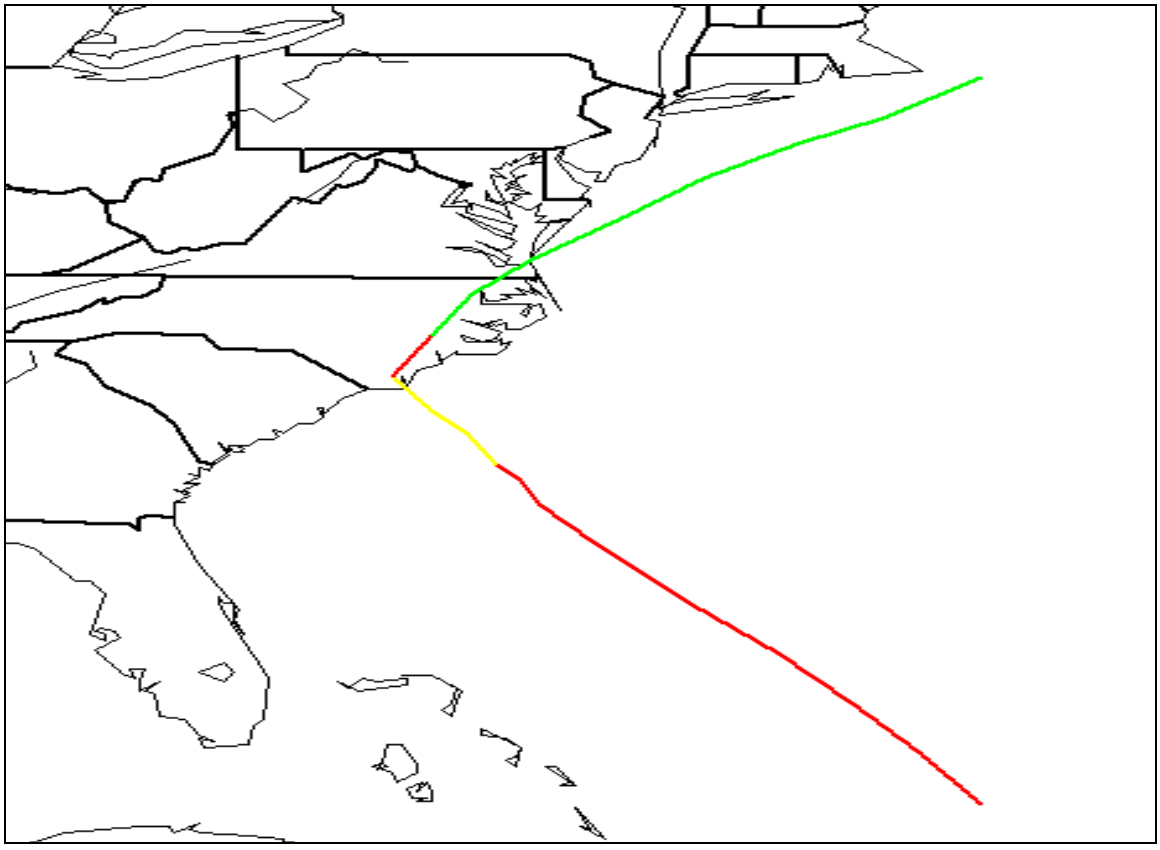

Fig. 22: September 9, 1881

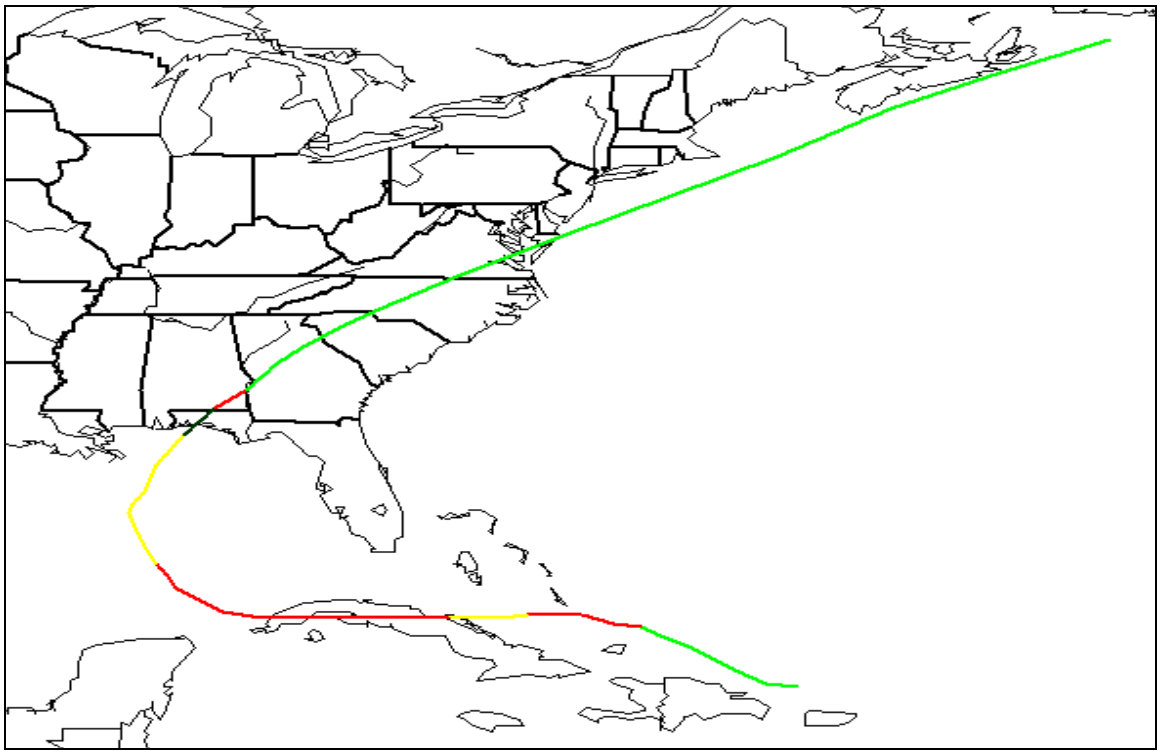

Fig. 23: September 10-11, 1882

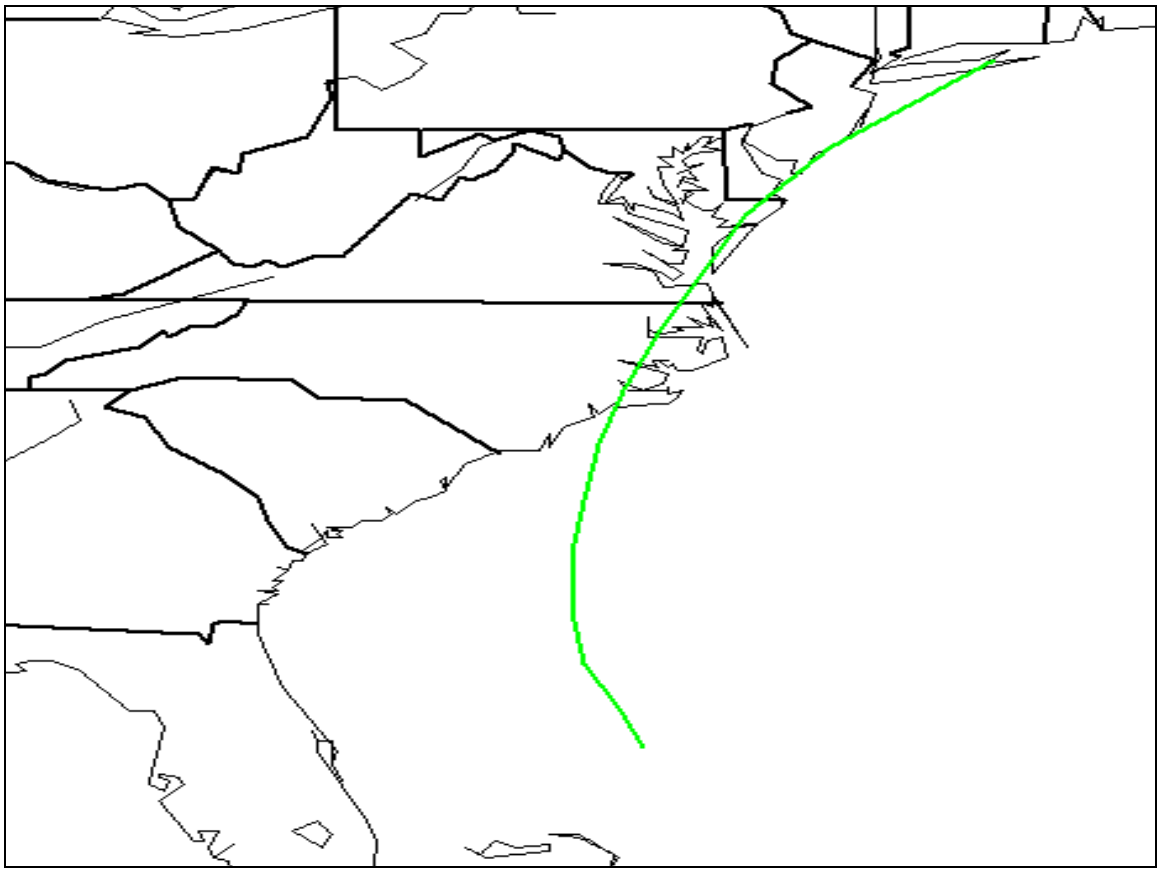

Fig. 24: September 21-23, 1882

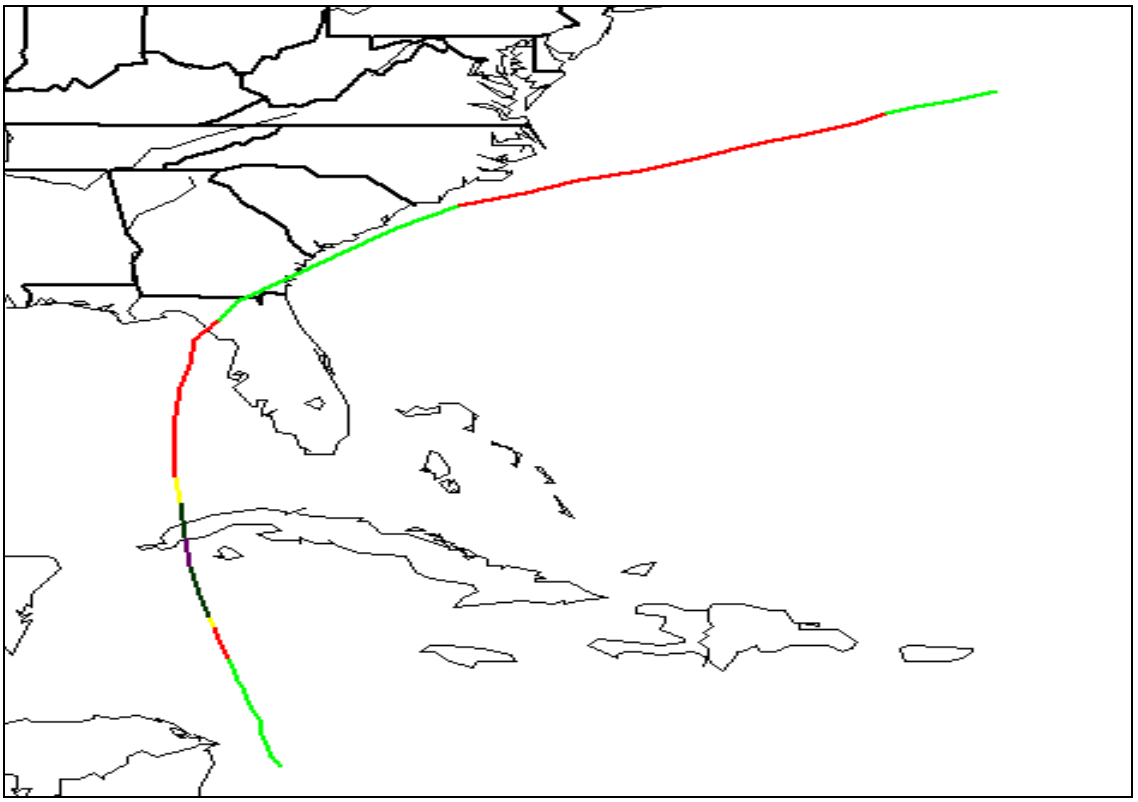

Fig. 25: October 11-13, 1882

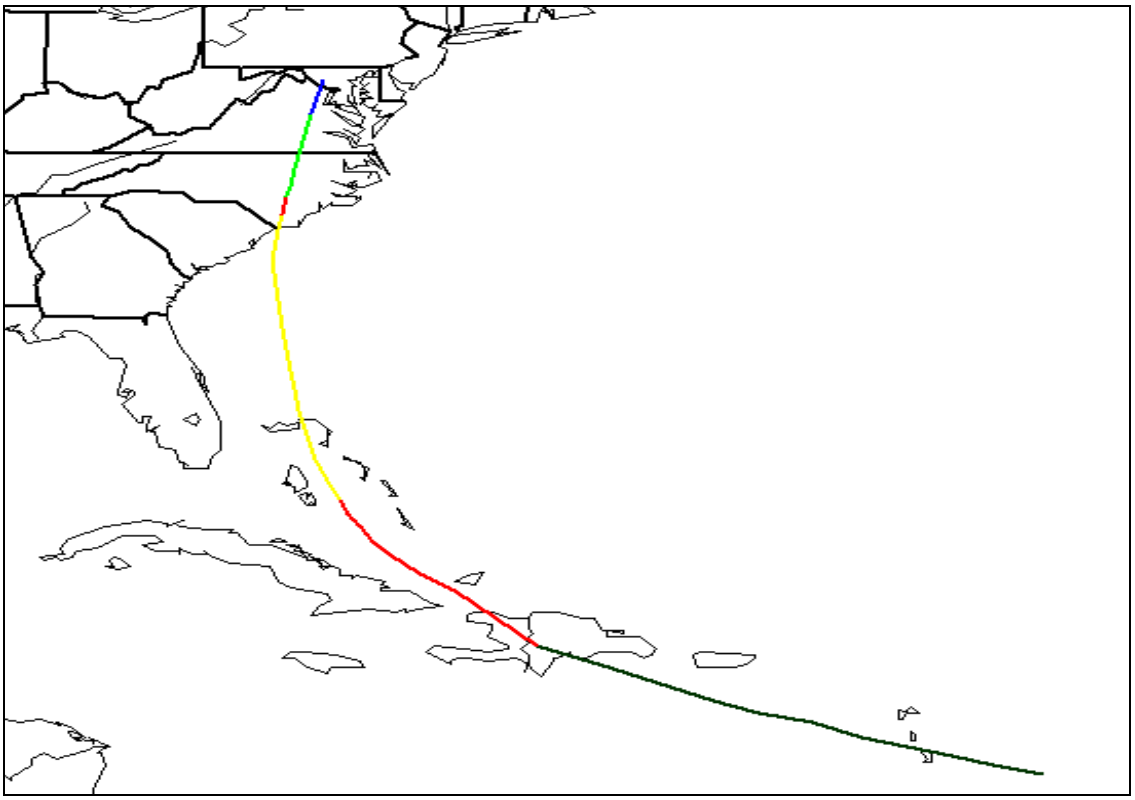

Fig. 26: September 11, 1883

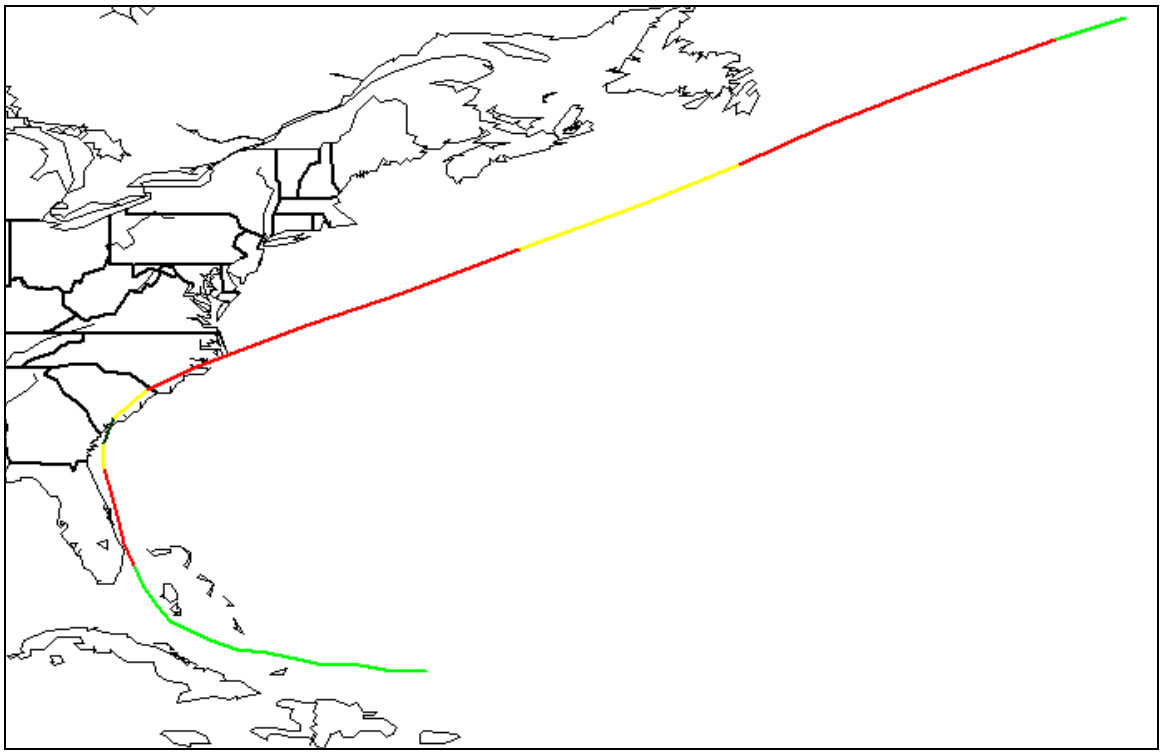

Fig. 27: August 25, 1885

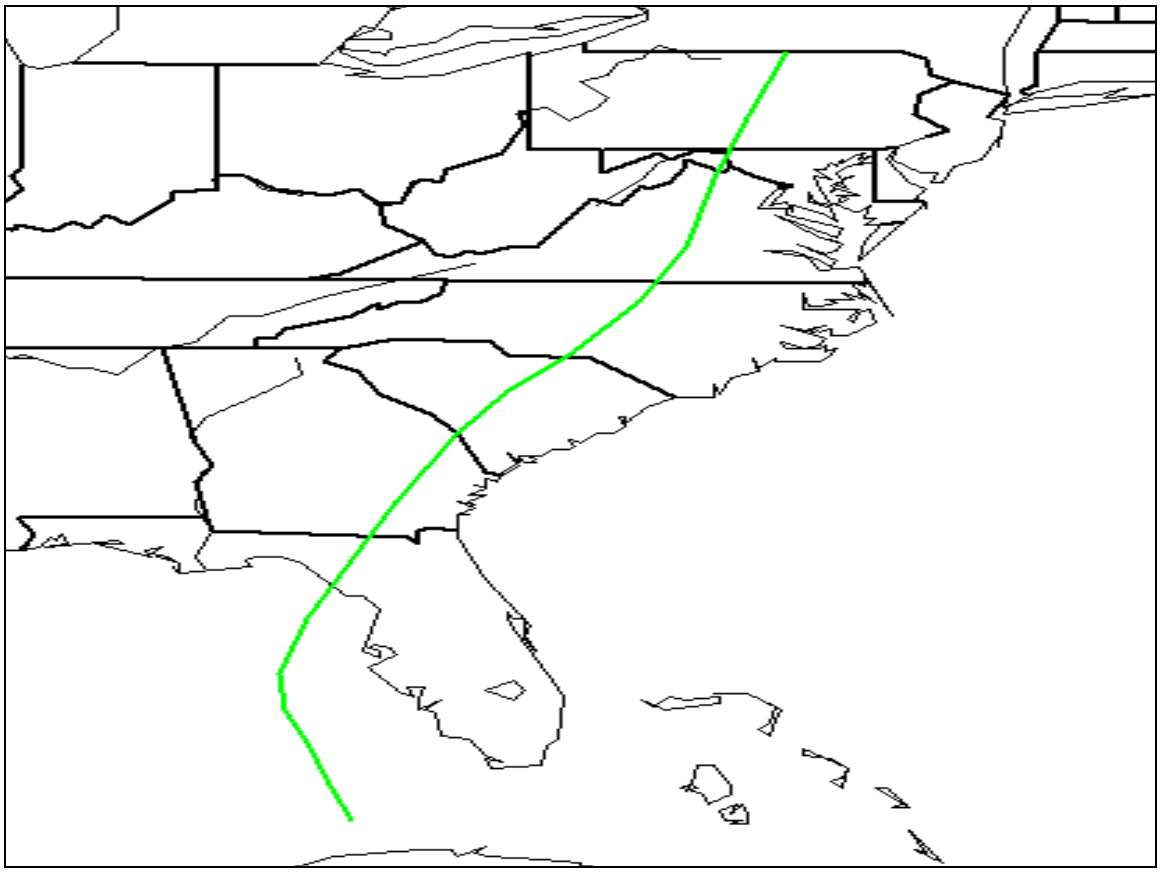

Fig. 28: October 12, 1885

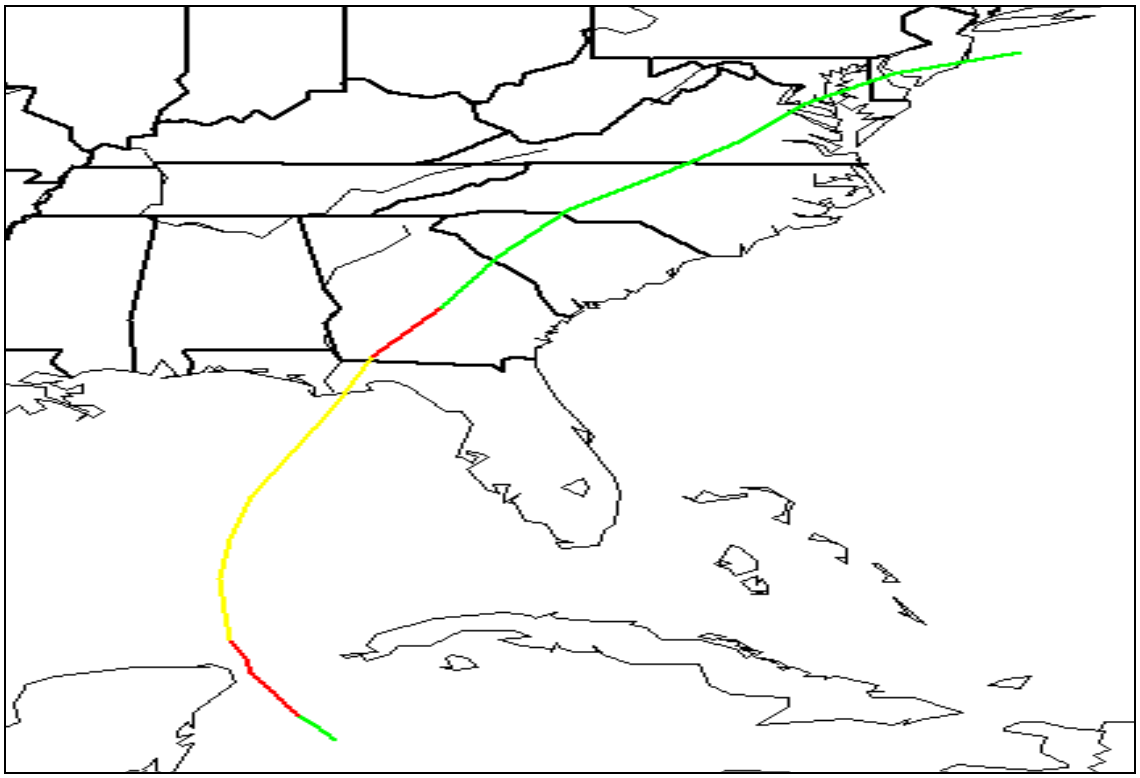

Fig. 29: June 19-20, 1886.

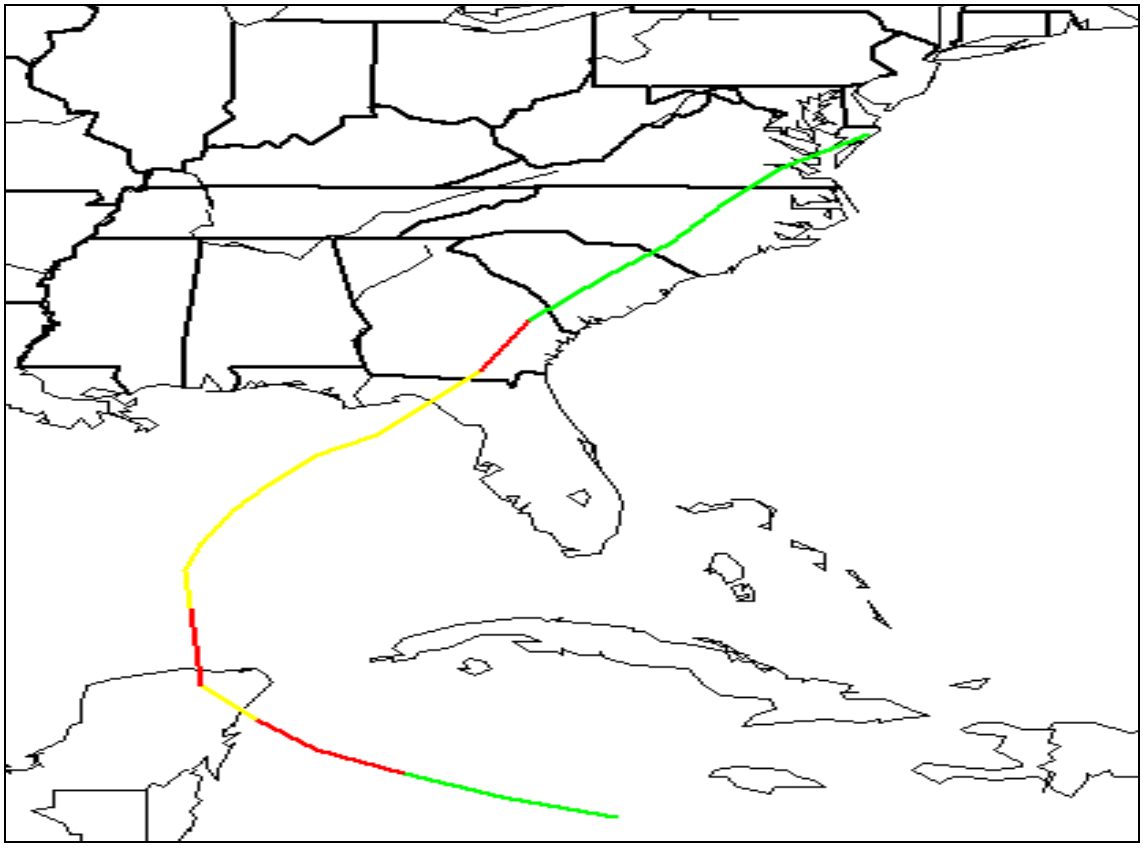

Fig. 30: June 30-July 1, 1886.

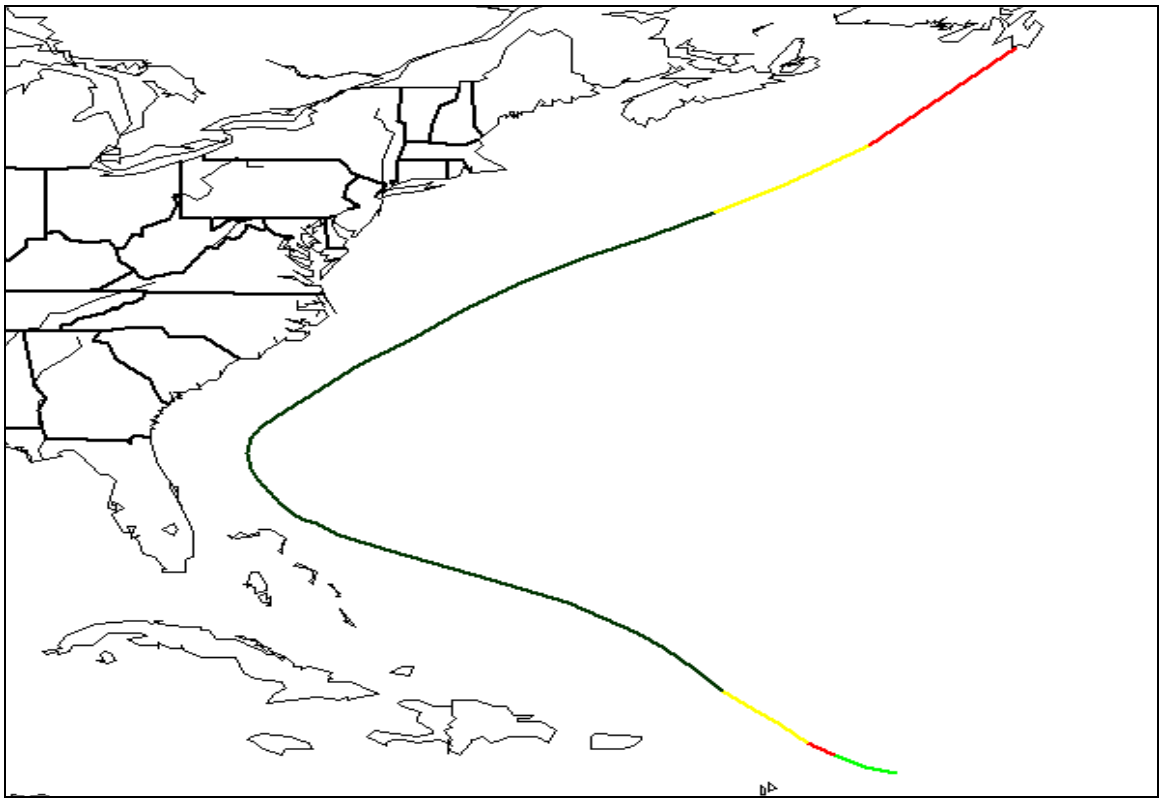

Fig. 31: August 20, 1887.

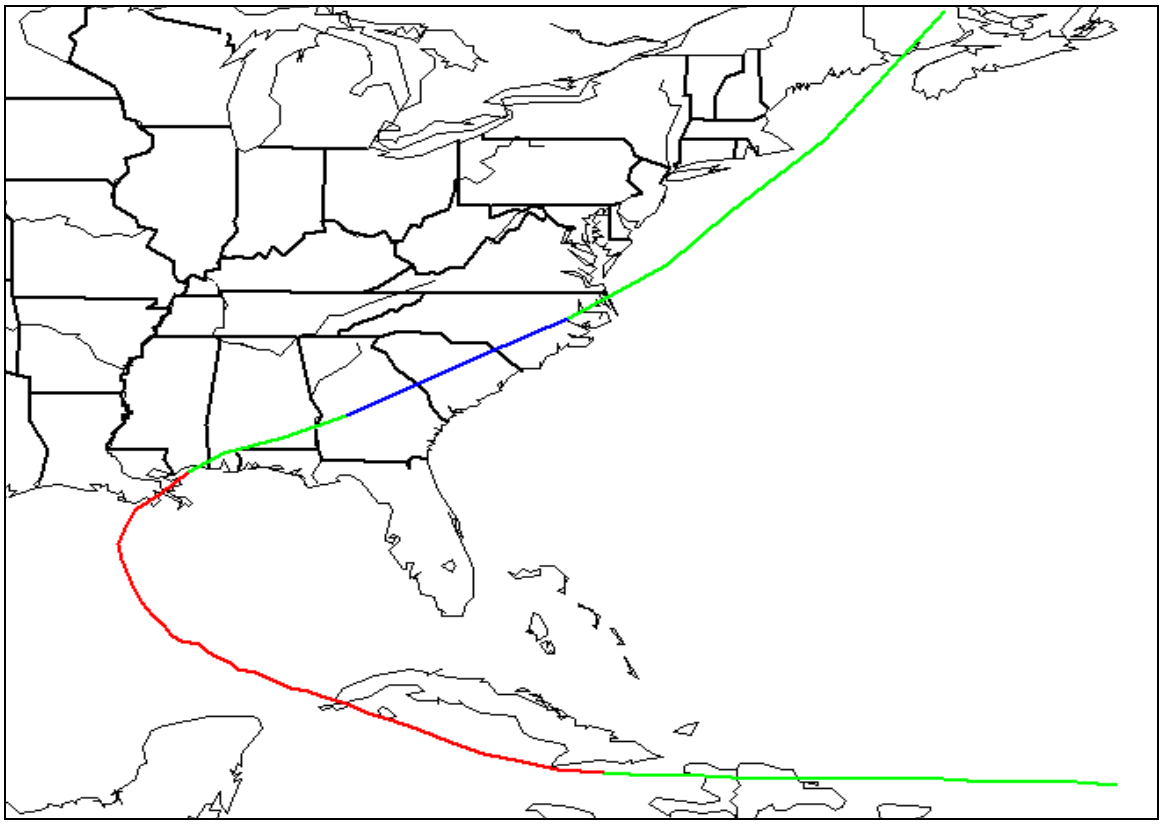

Fig. 32: October 20, 1887

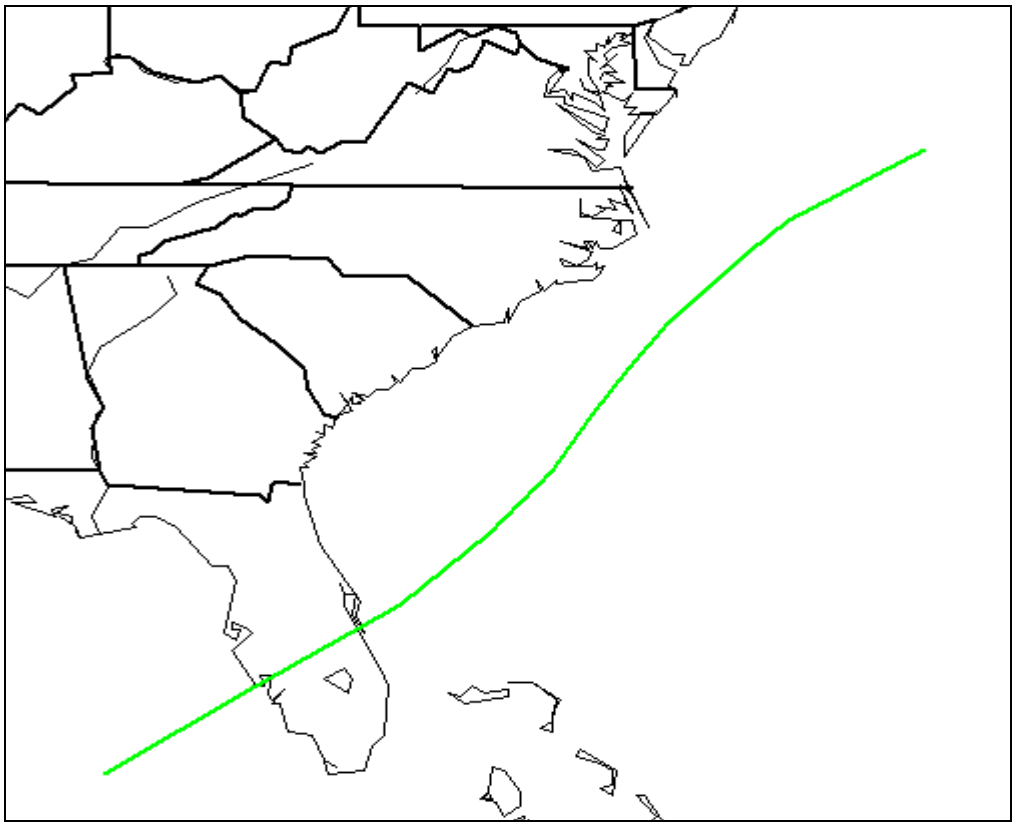

Fig. 33: October 31, 1887.

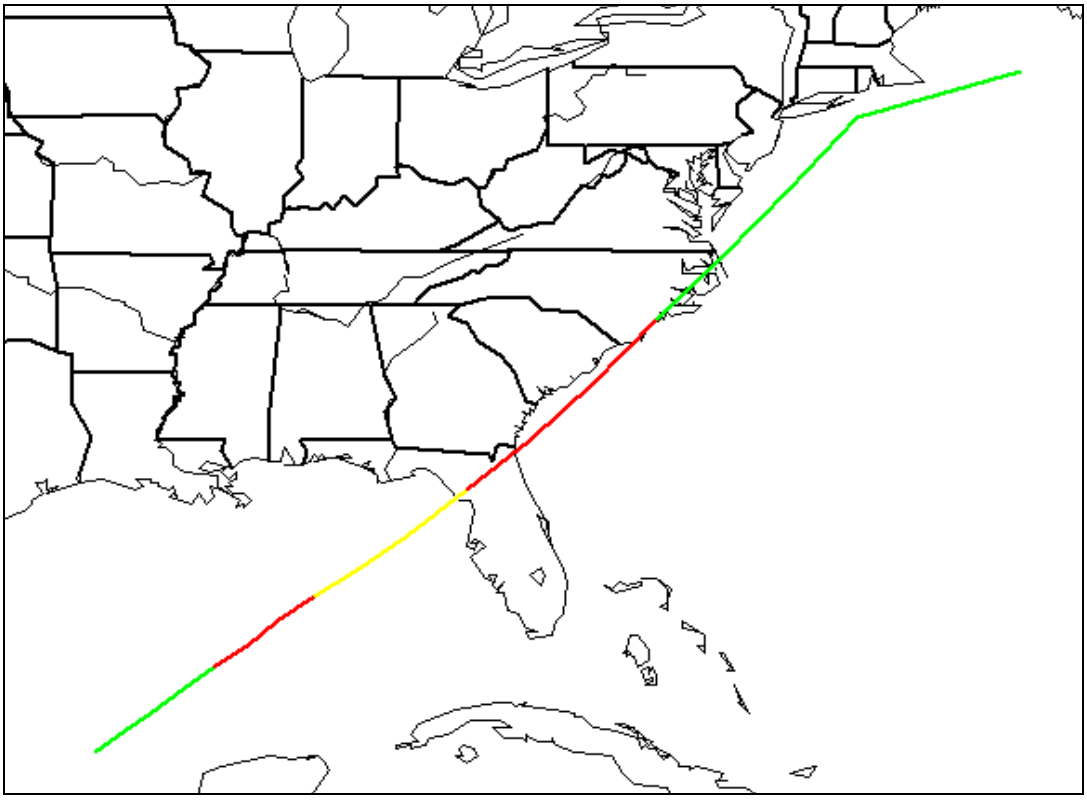

Fig. 34: October 11, 1888.

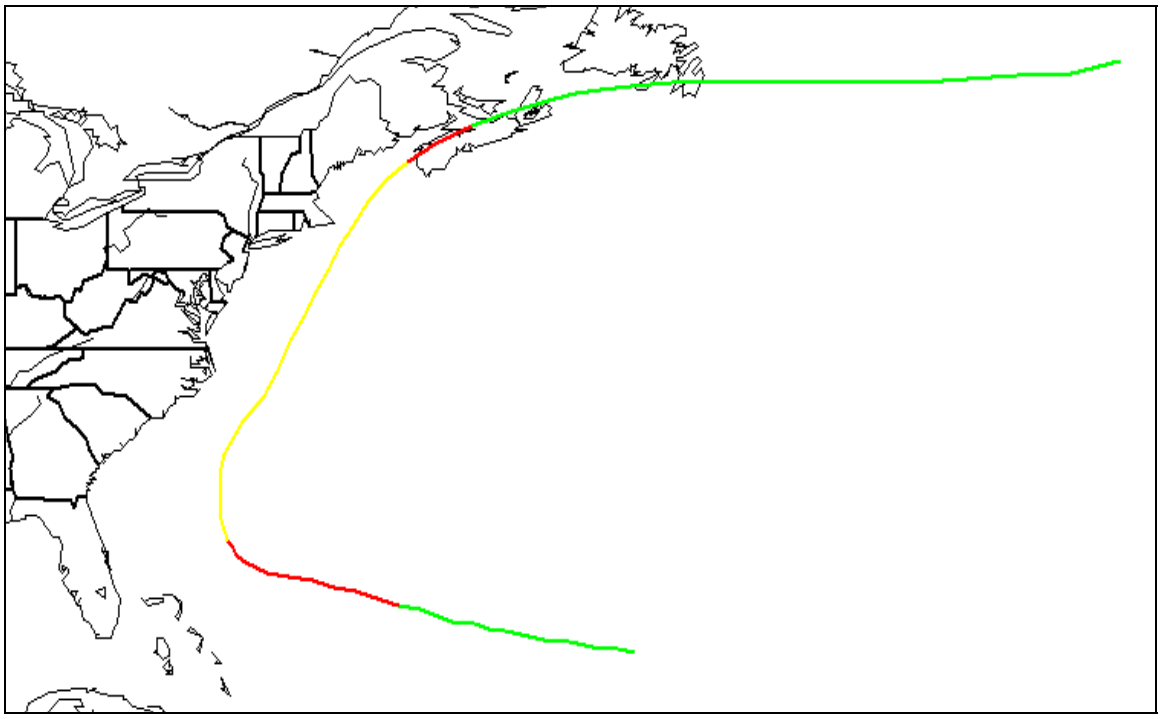

Fig. 35: November 25, 1888.

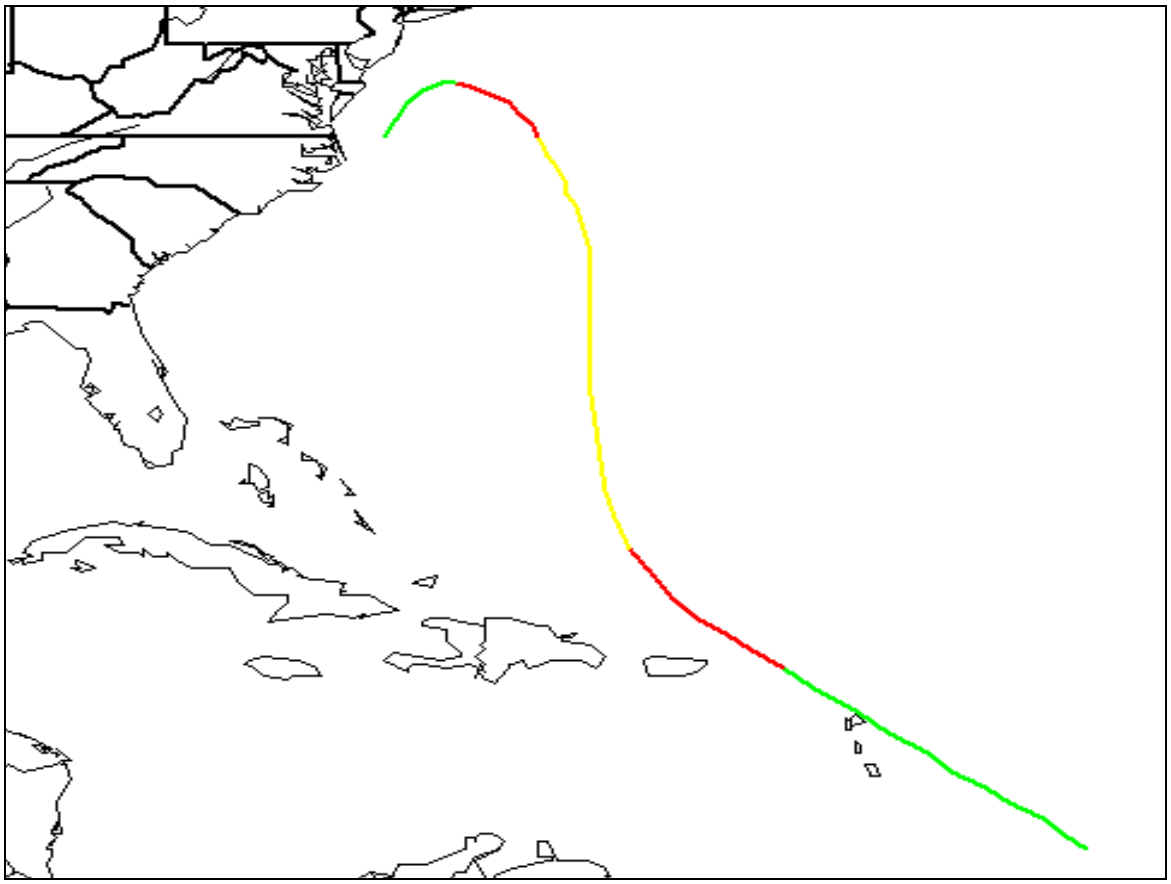

Fig. 36: September 9-12, 1889.

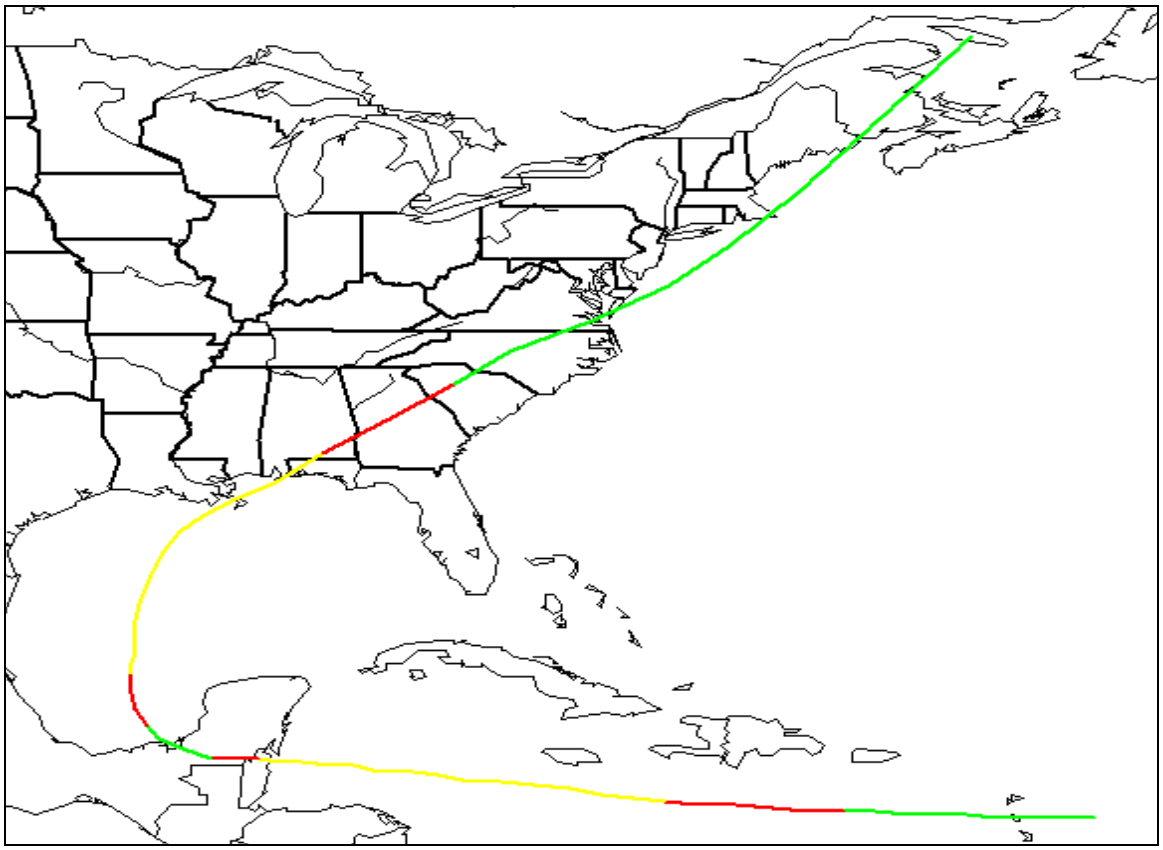

Fig. 37: September 24, 1889.

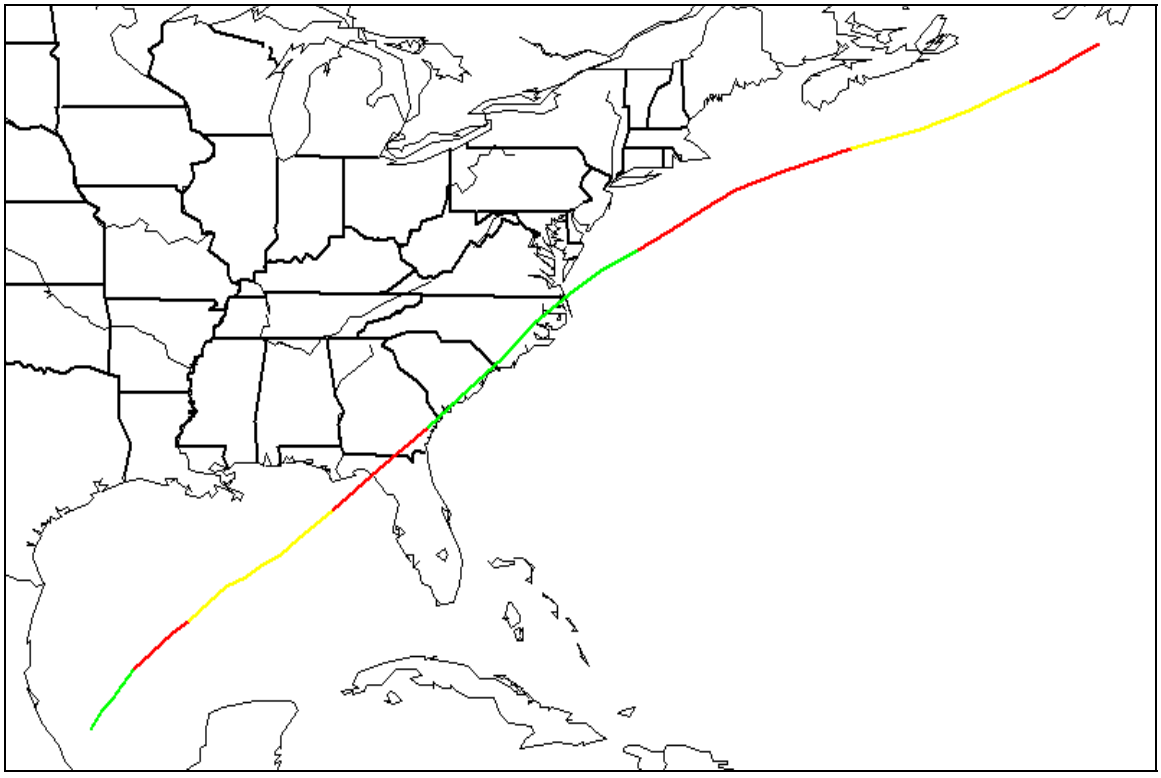

Fig. 38: June 16, 1893.

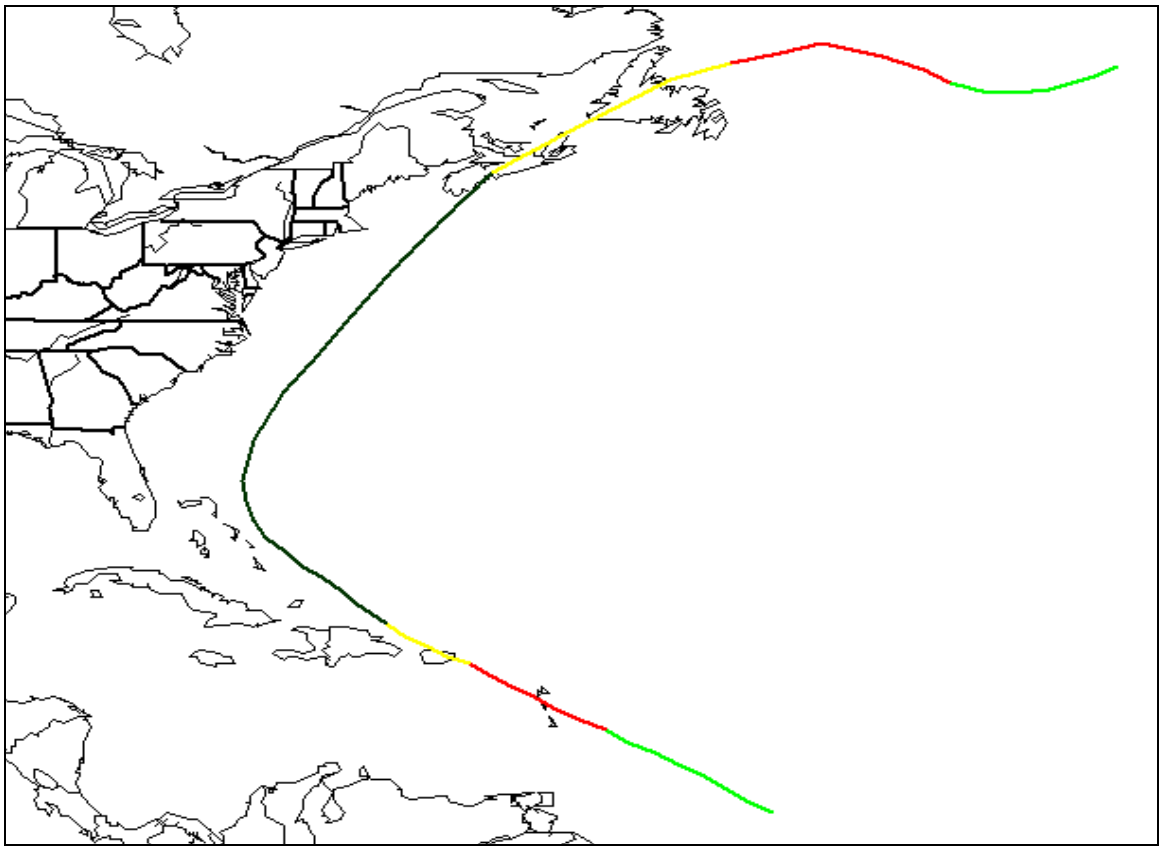

Fig. 39: August 23, 1893

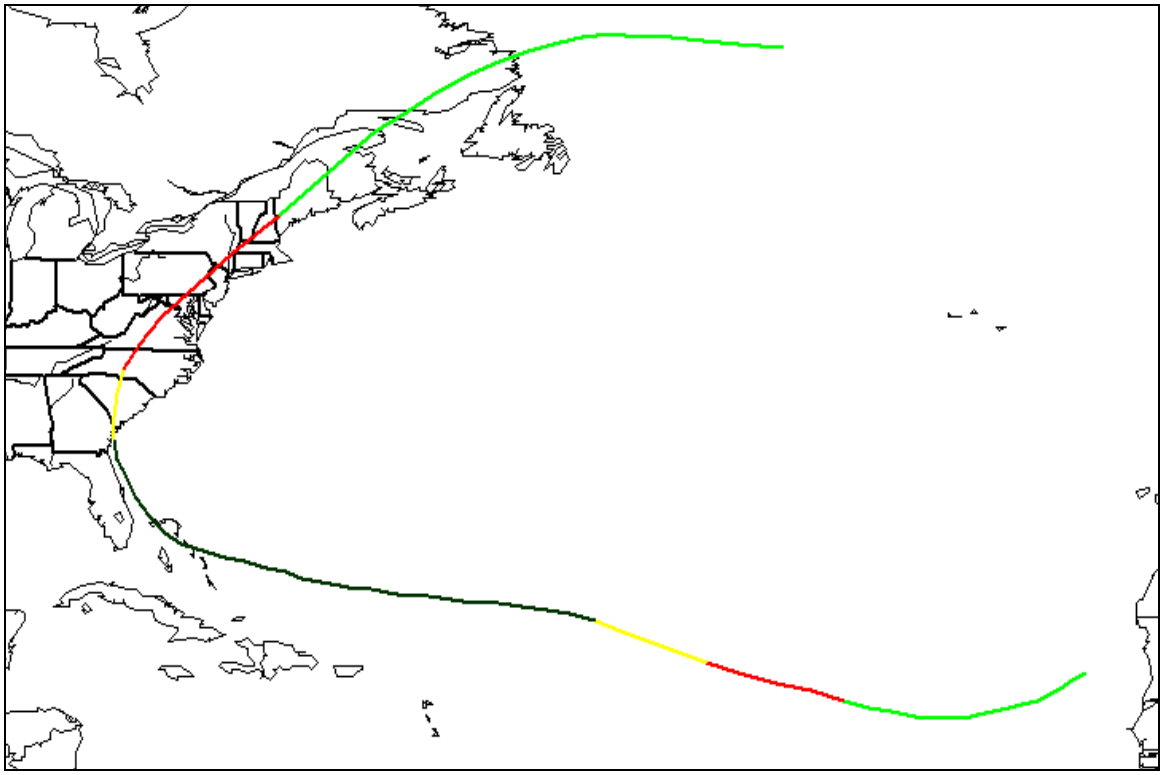

Fig. 40: August 27-29, 1893.

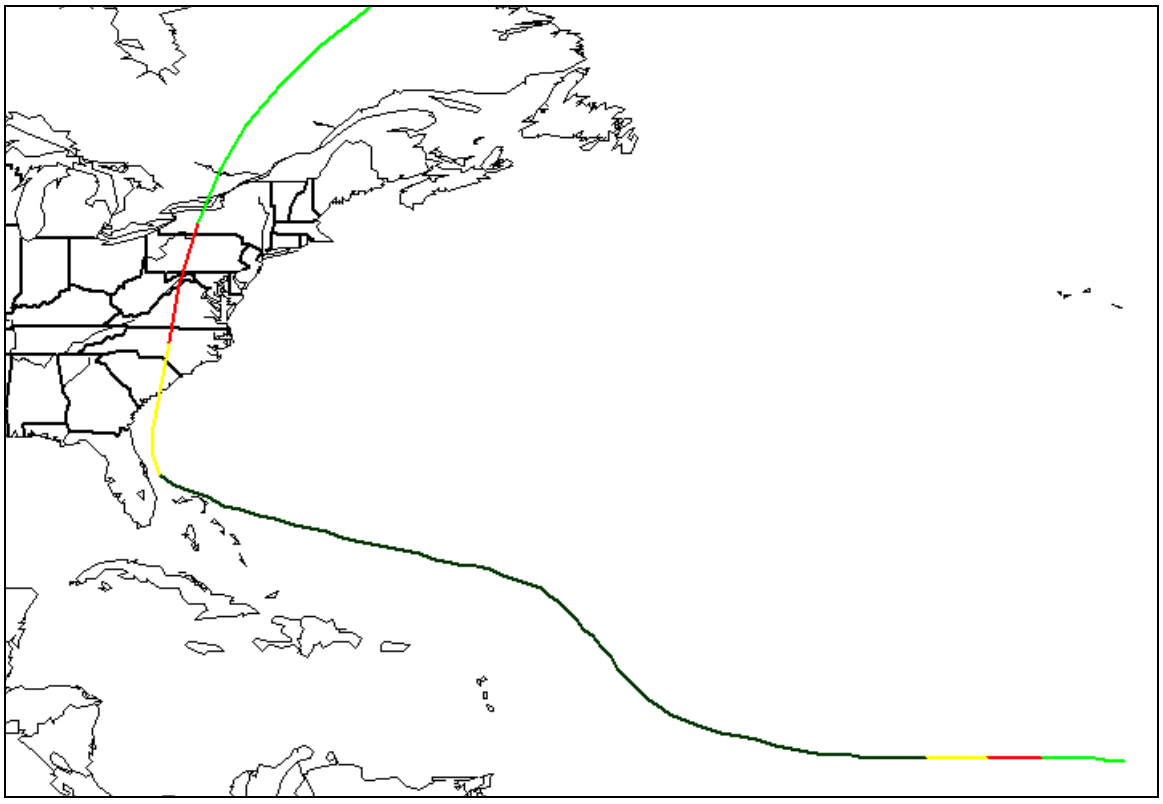

Fig. 41: October 13, 1893.

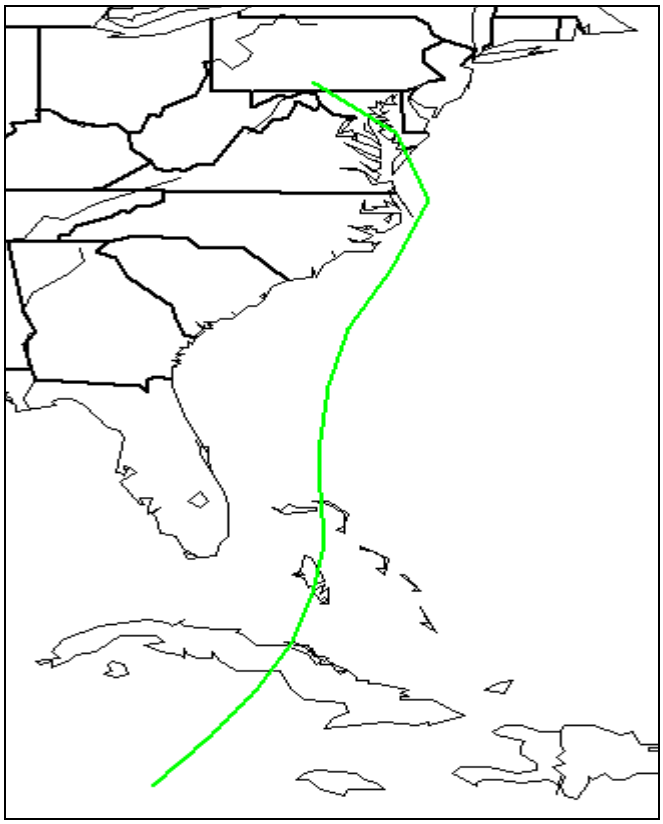

Fig. 42: October 22, 1893.

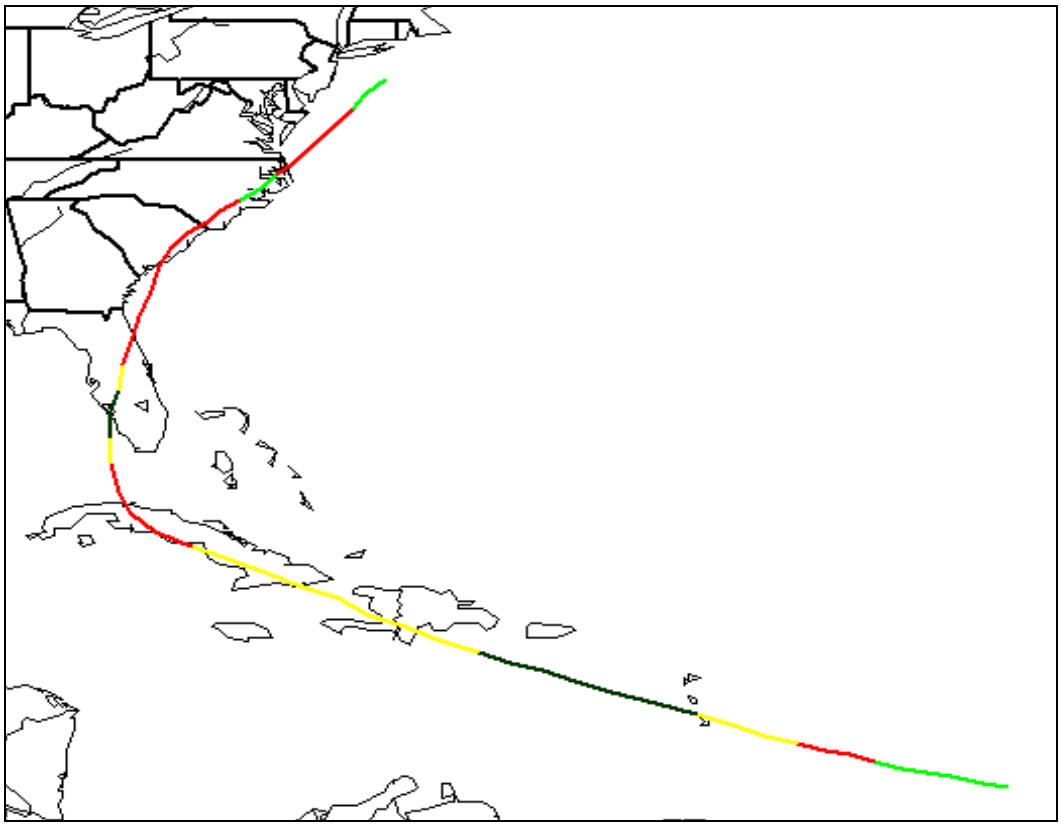

Fig. 43: September 27-28, 1894.

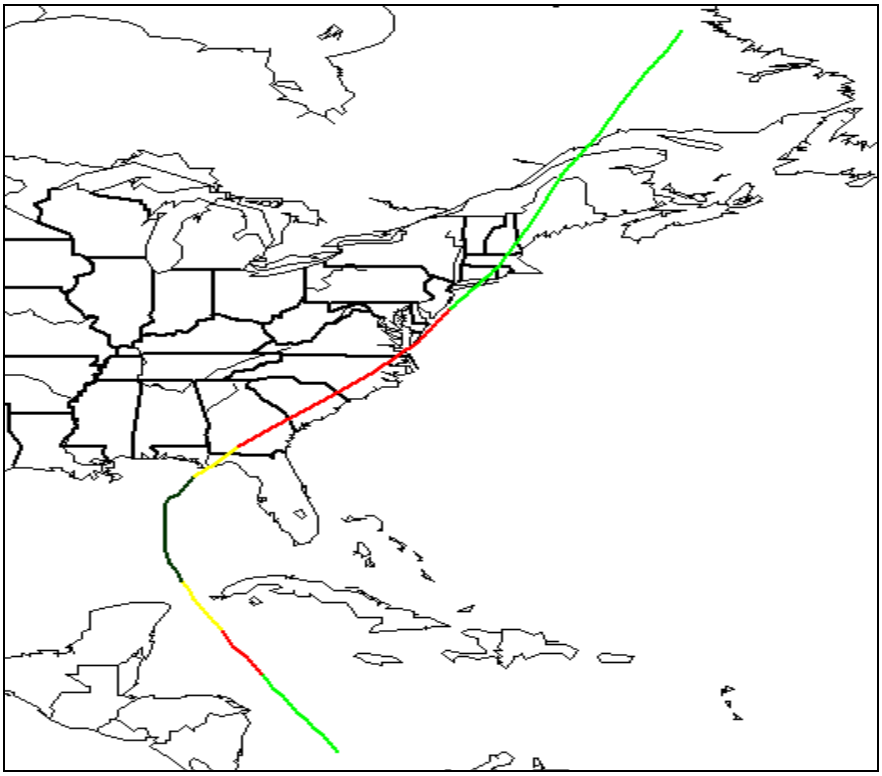

Fig. 44: October 9-10, 1894.

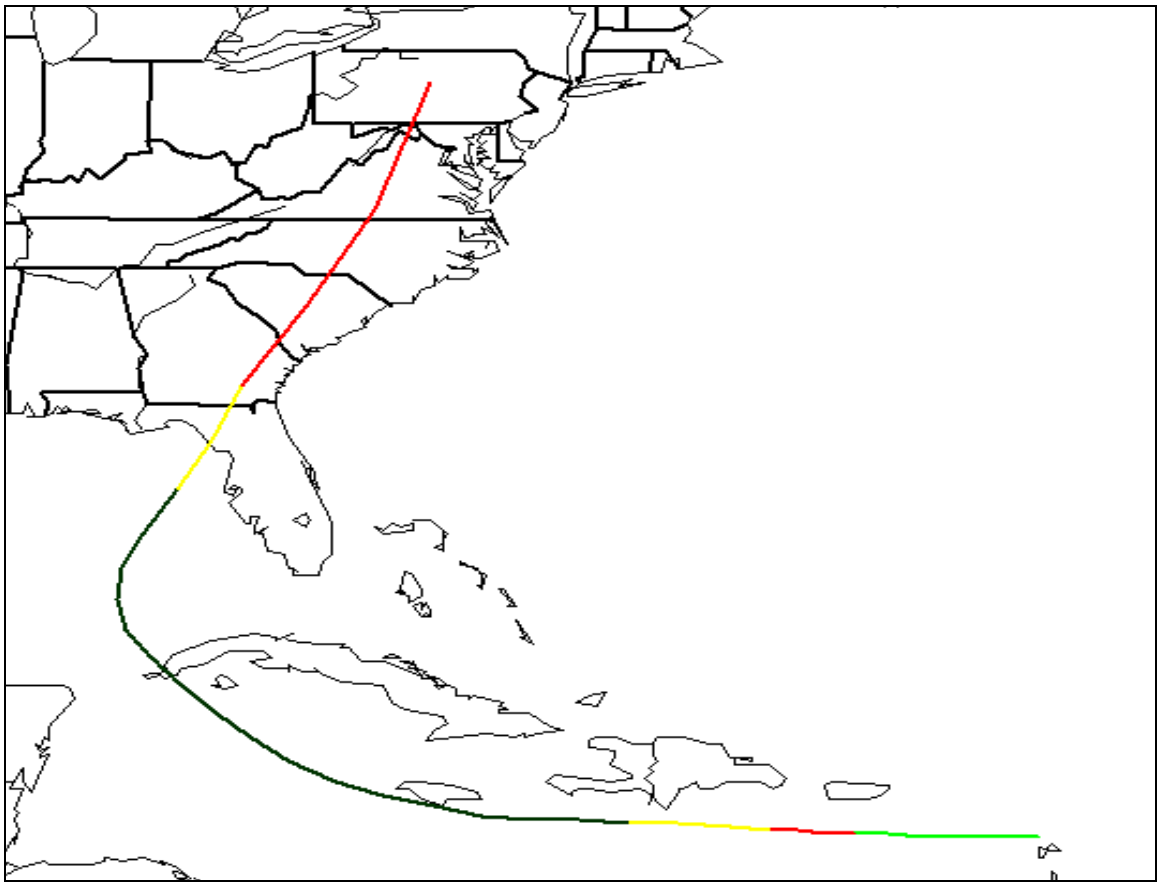

Fig. 45: September 29, 1896.

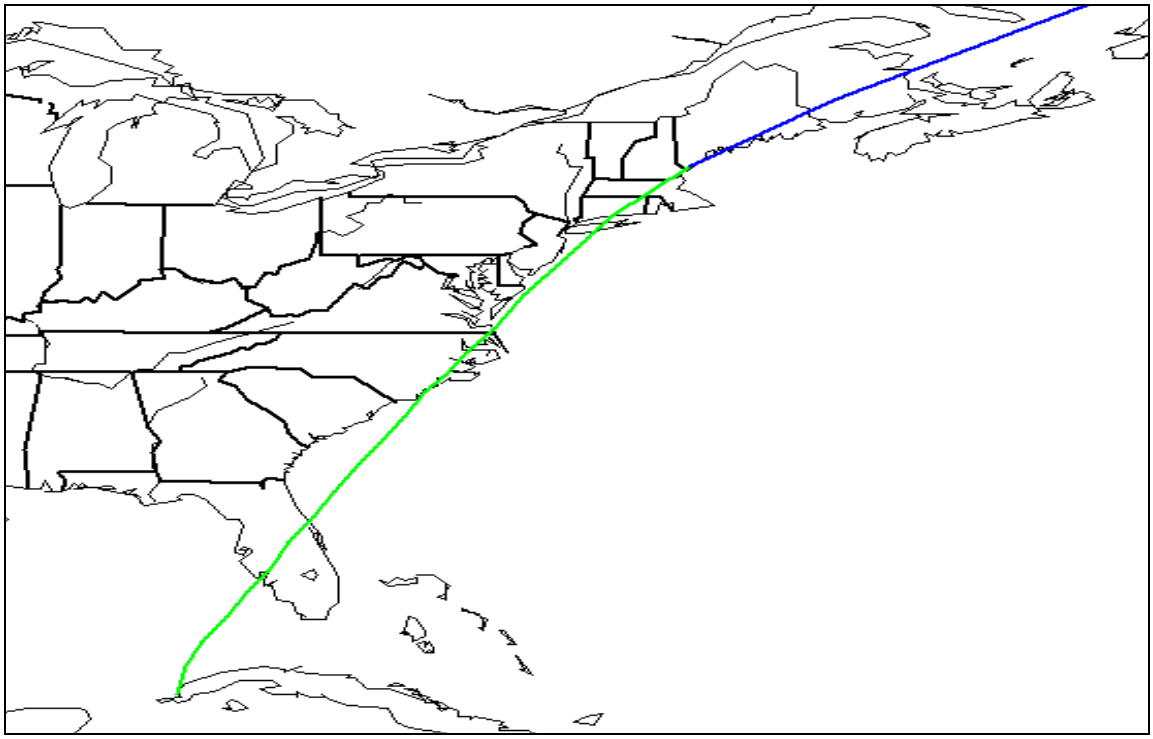

Fig. 46: September 21-24, 1897.

Fig. 47: October 20,1897.

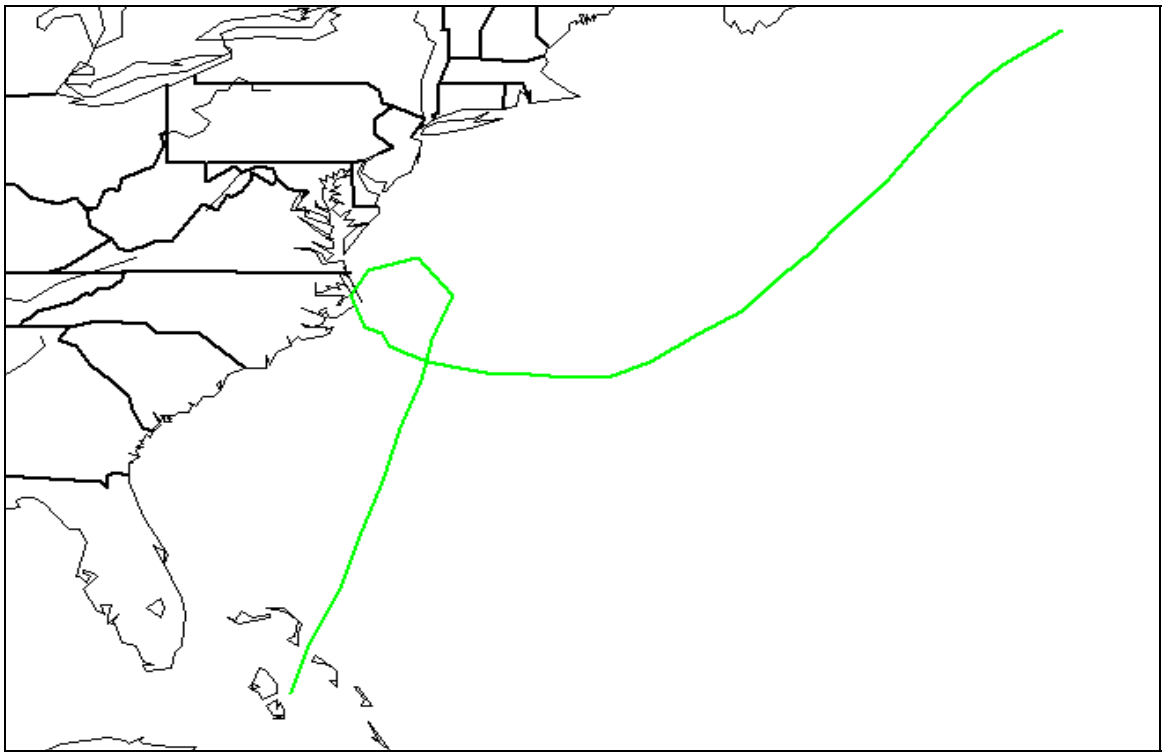

Fig. 48: October 24-26, 1897.

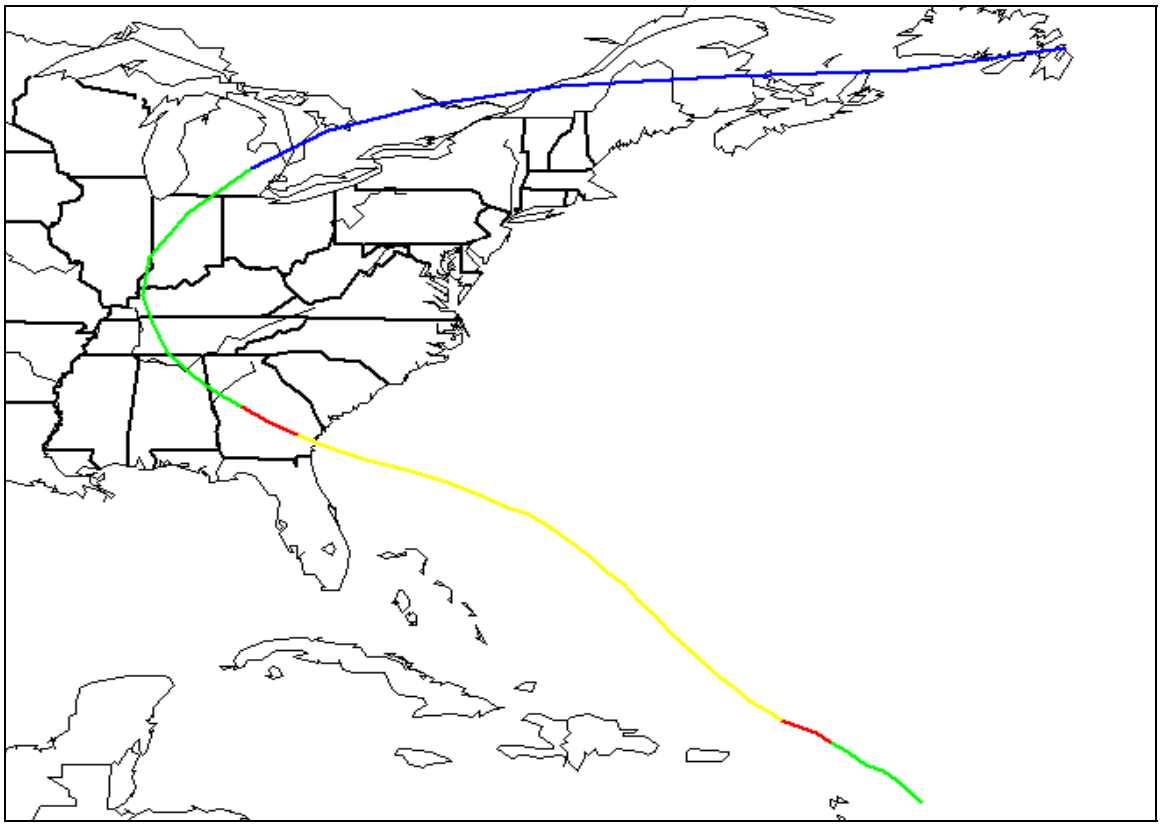

Fig. 49: October 2, 1898.

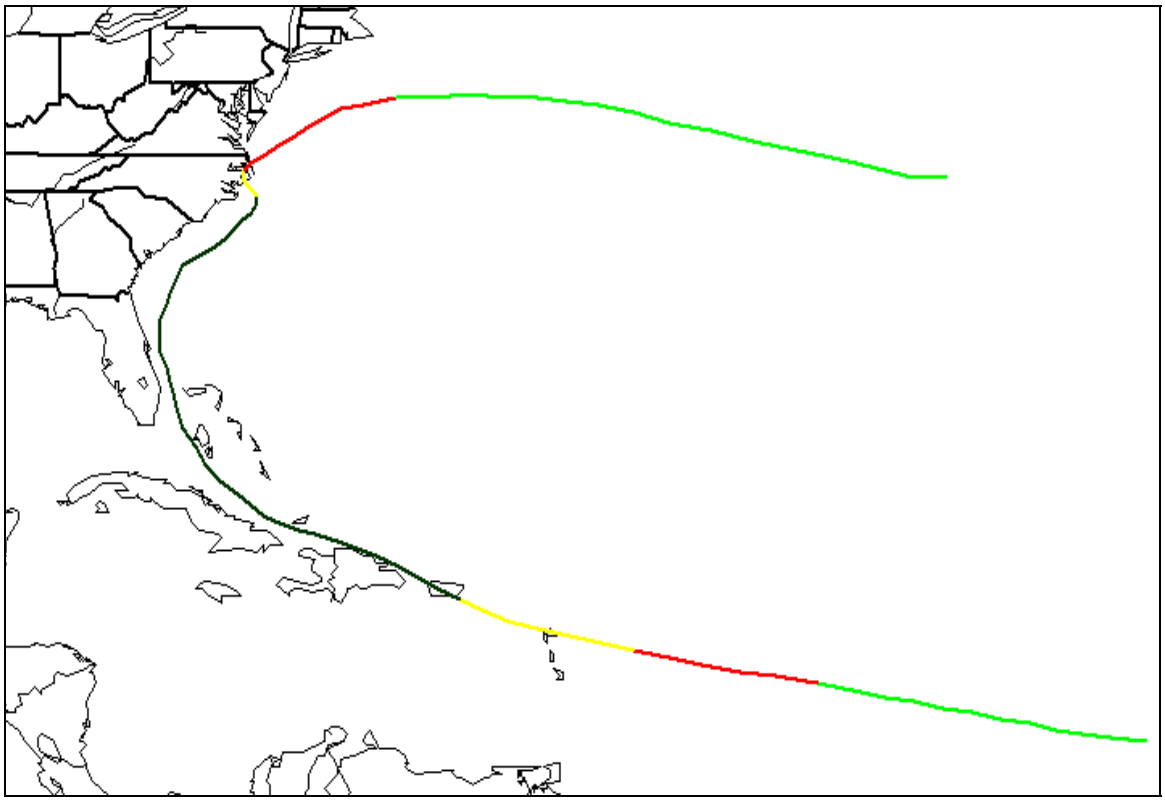

Fig. 50: August 16-18, 1899.

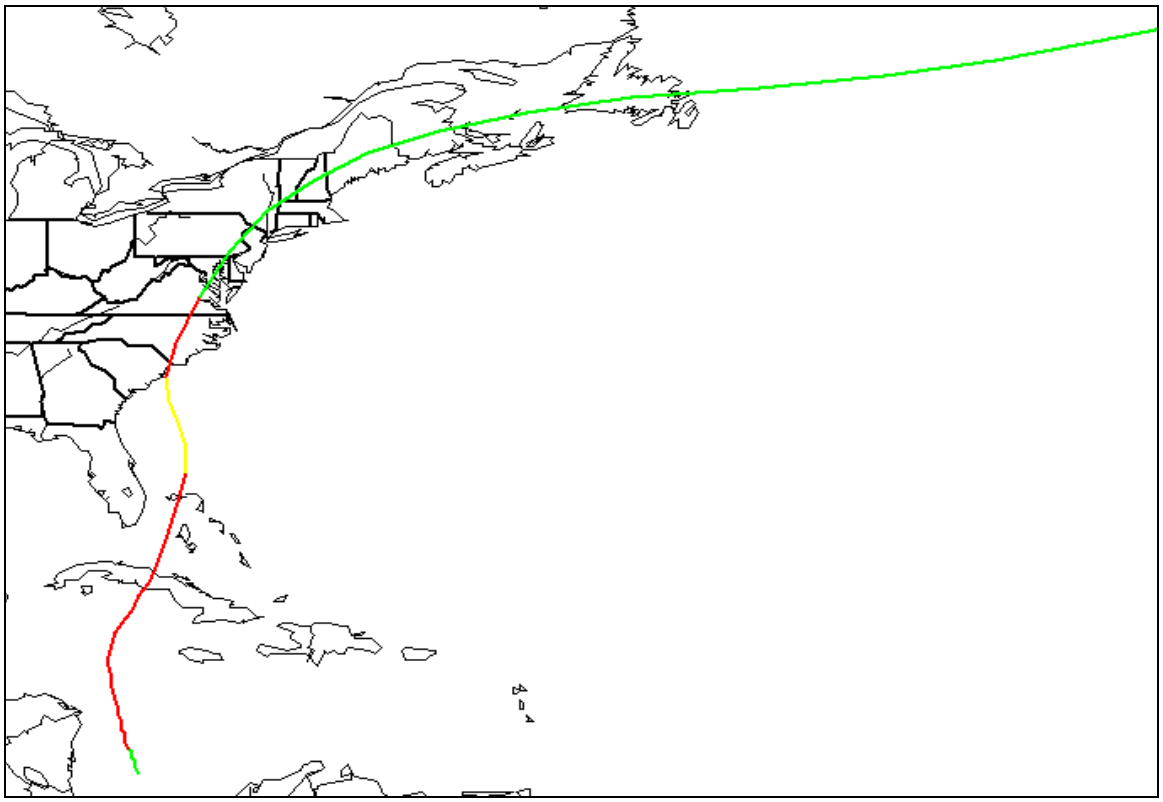

Fig. 51: October 30-31, 1899.

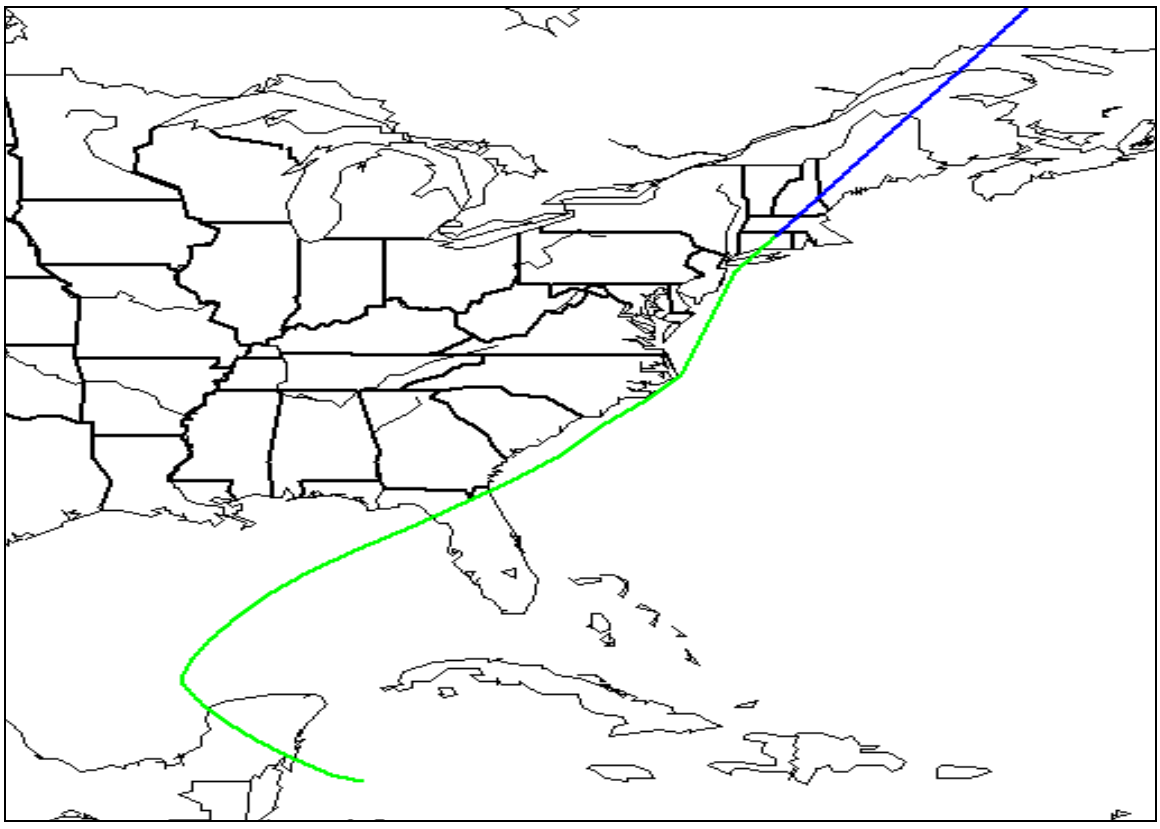

Fig. 52: October 13, 1900.

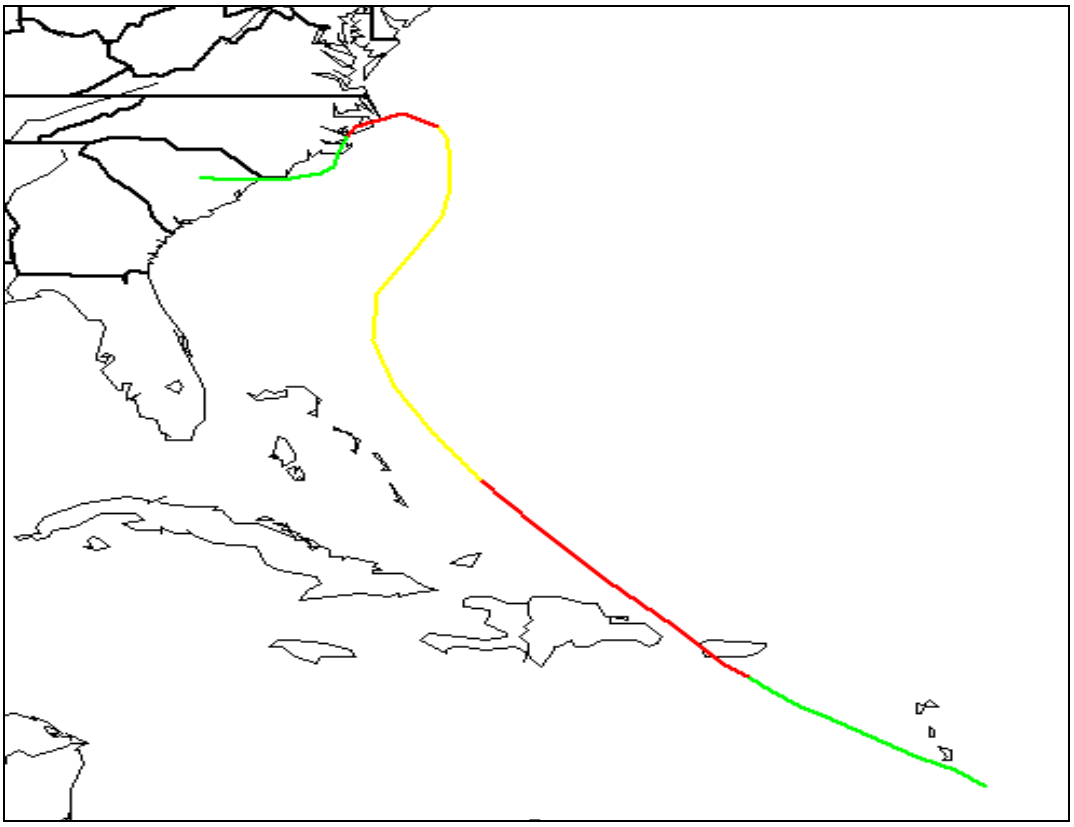

Fig. 53: July 11, 1901.

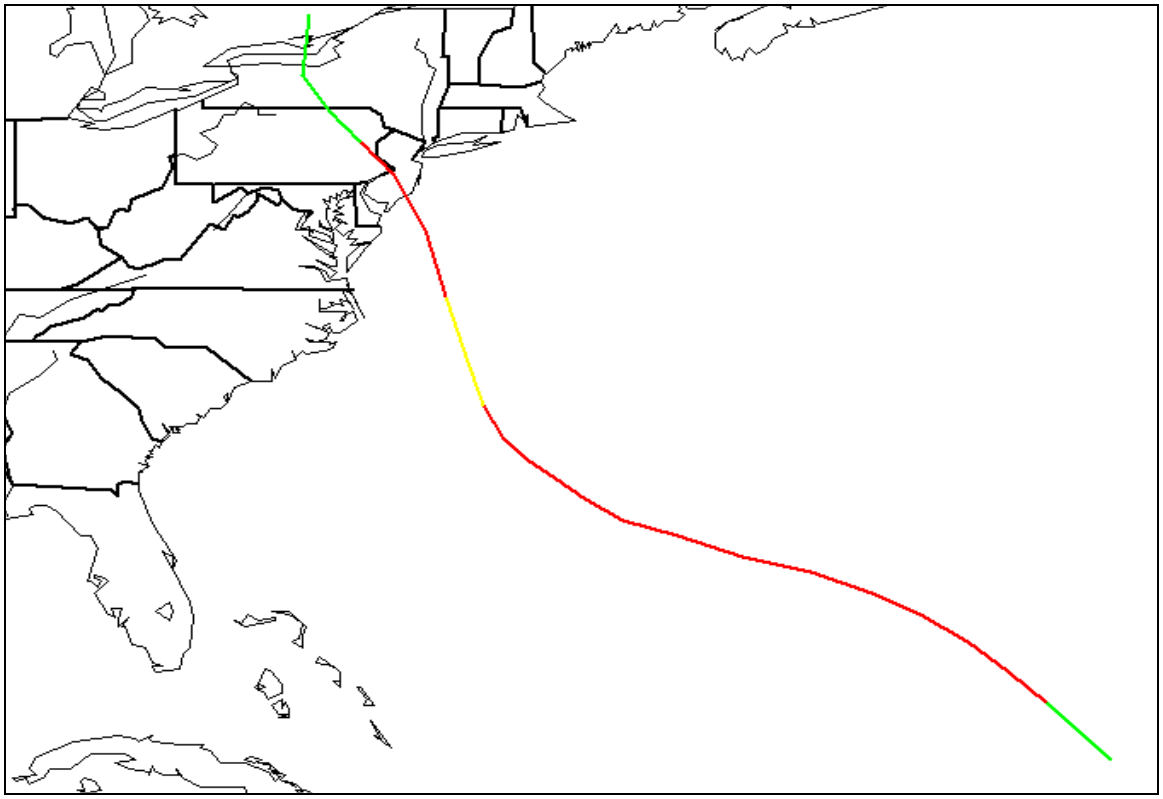

Fig. 54: September 15, 1903

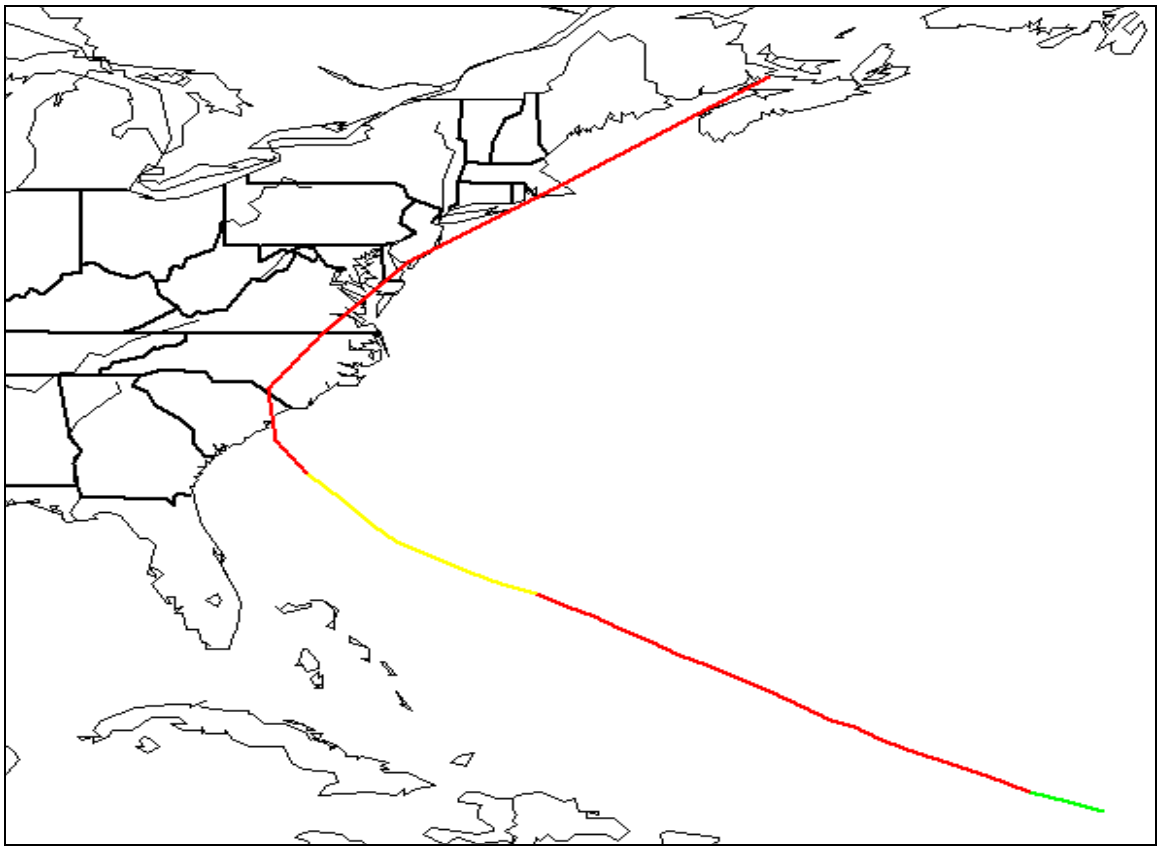

Fig. 55: September 14, 1904.

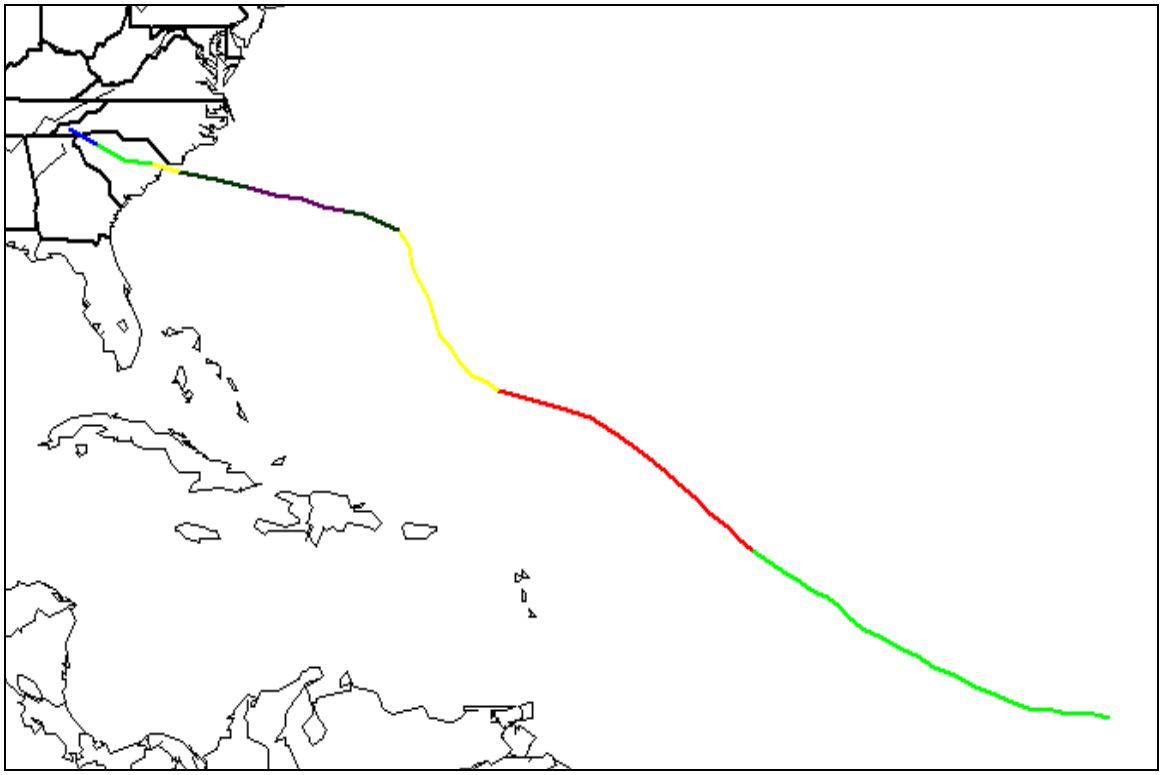

Fig. 56: September 17, 1906.

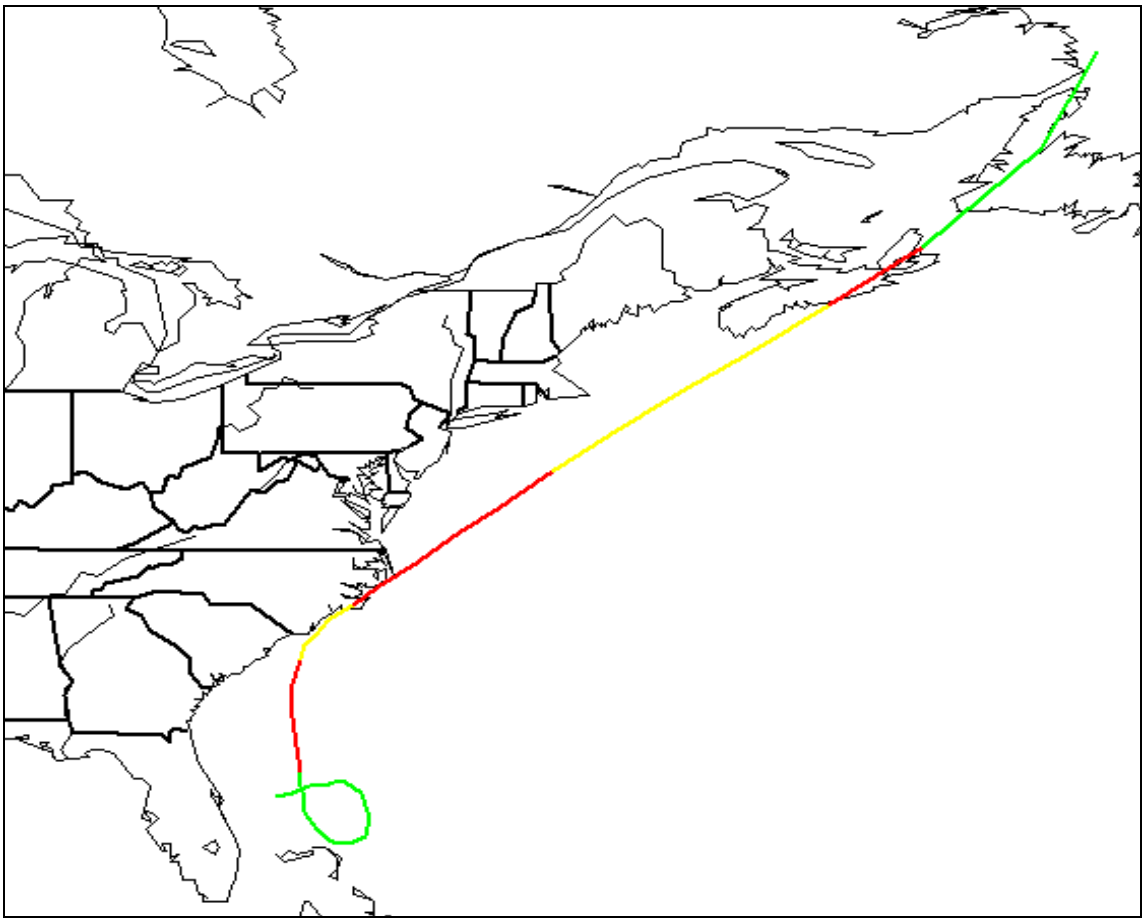

Fig. 57: July 30, 1908.

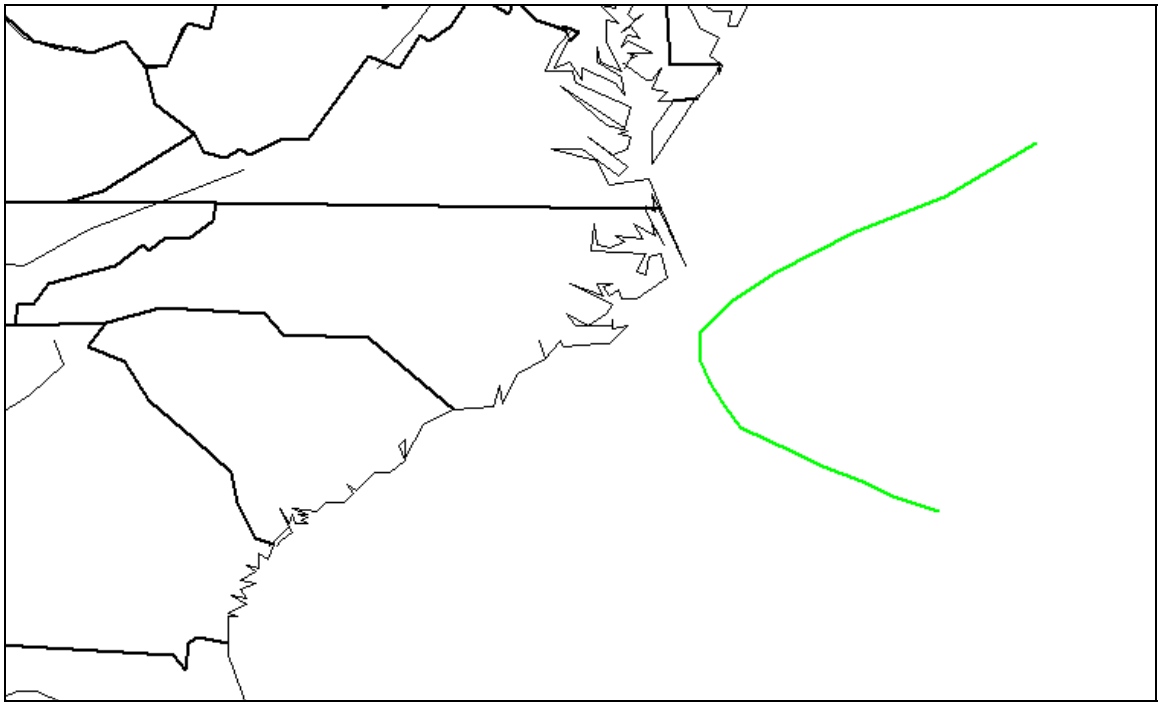

Fig. 58: August 31-September 1, 1908.

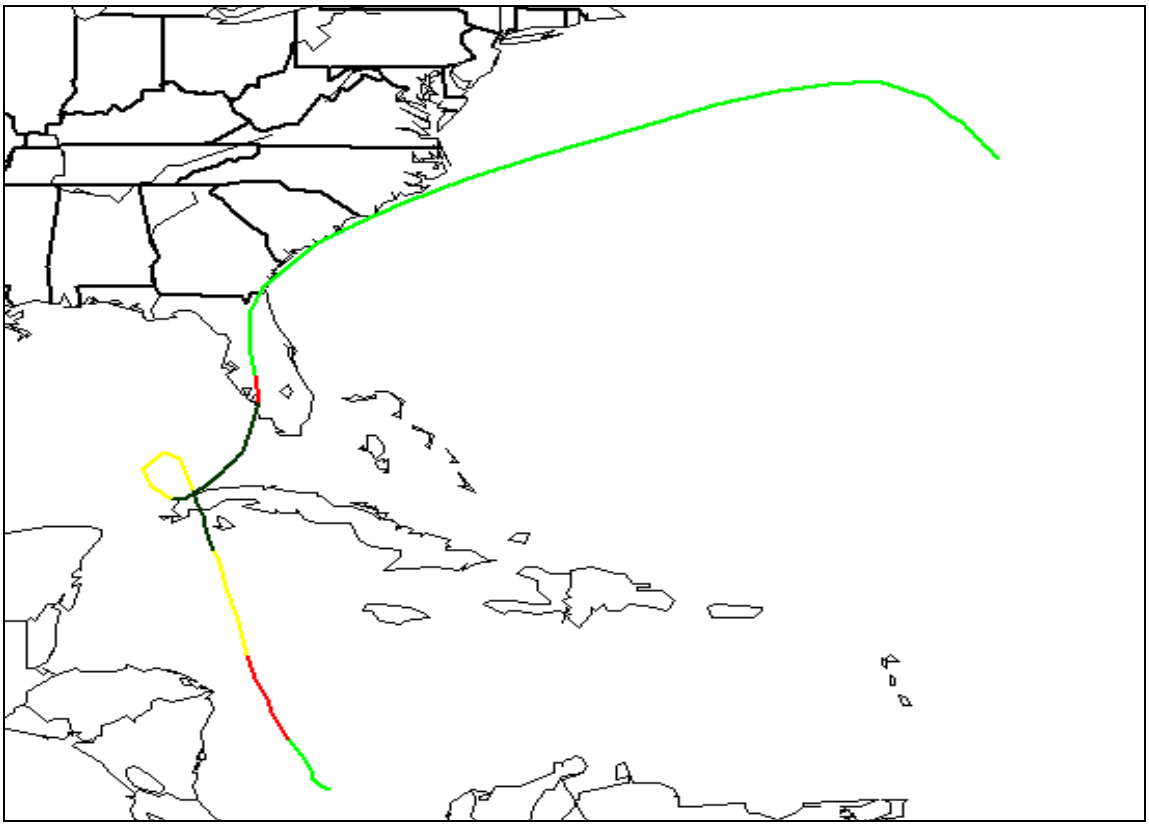

Fig. 59: October 19-20, 1910.

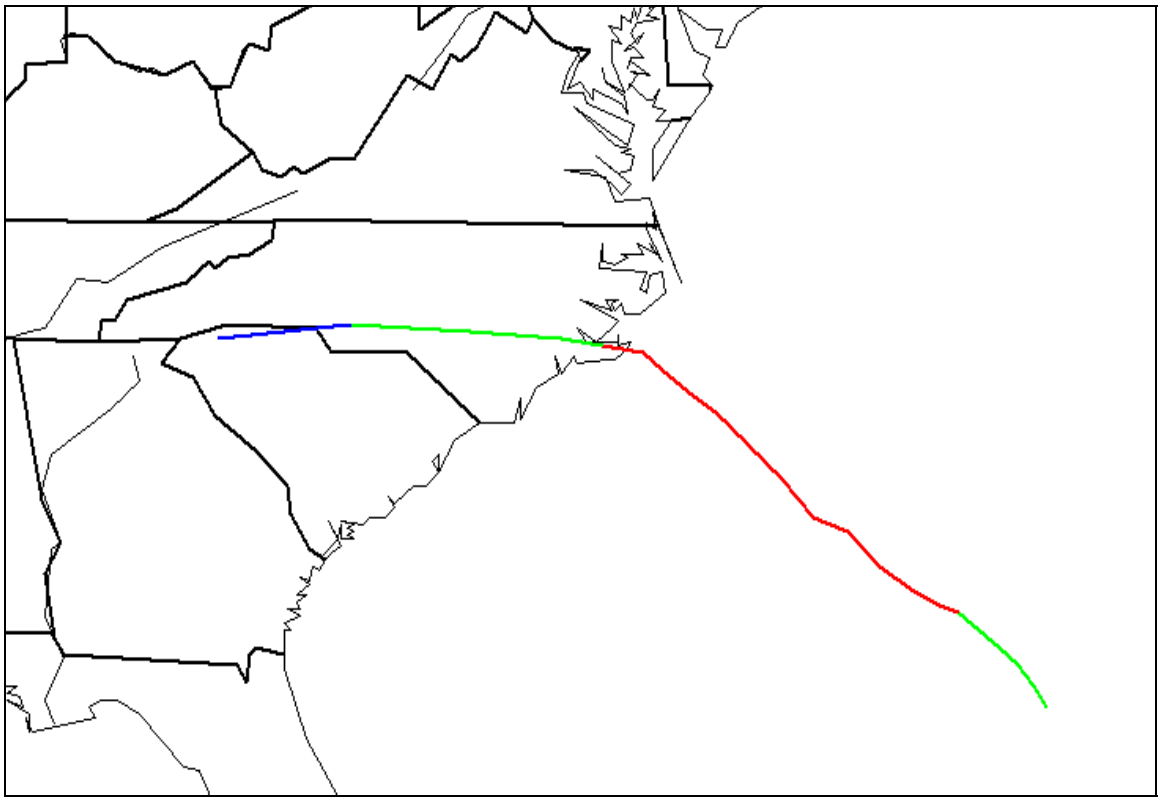

Fig. 60: September 3, 1913.

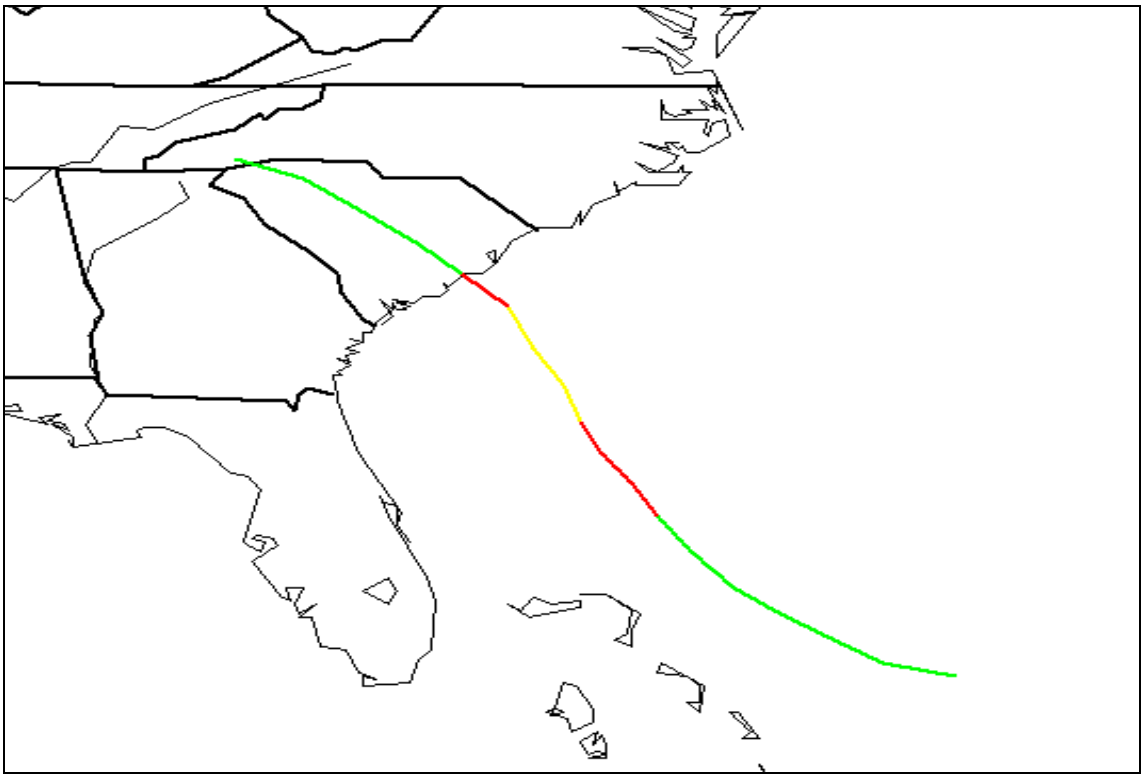

Fig. 61: July 14-16, 1916.

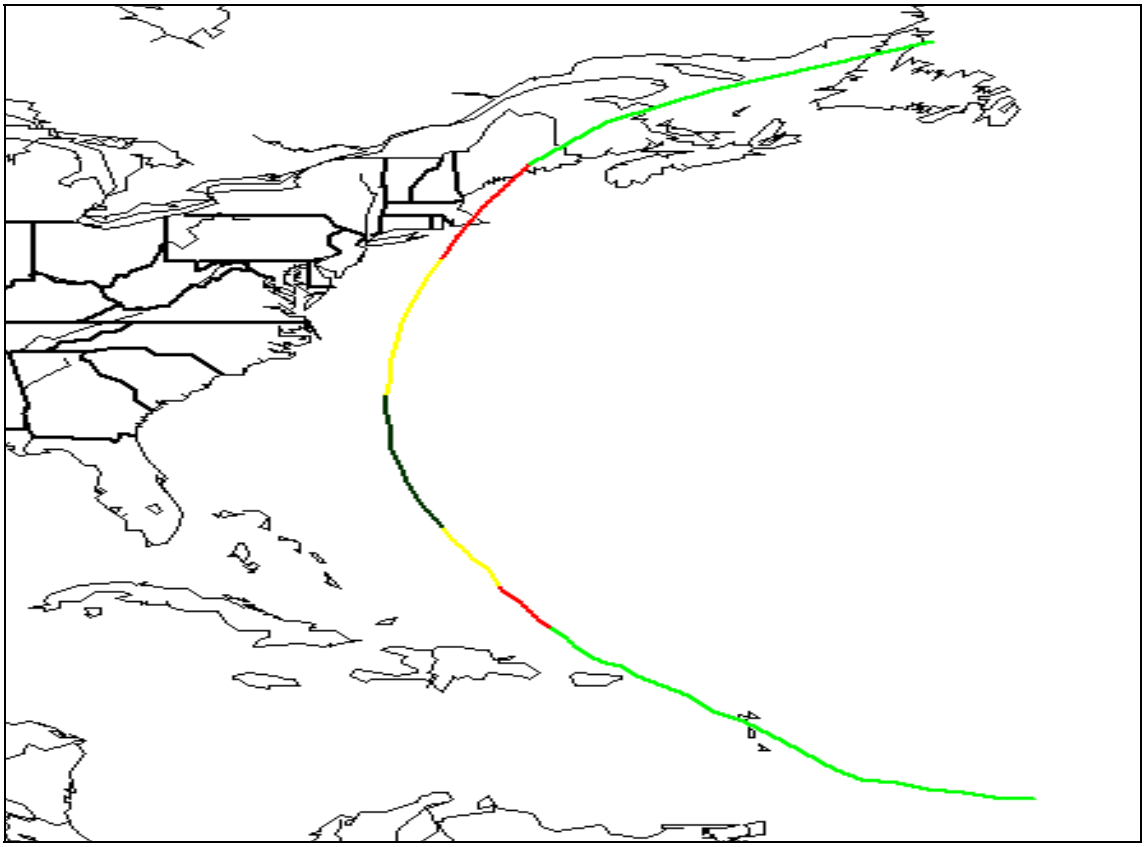

Fig. 62: July 19, 1916.

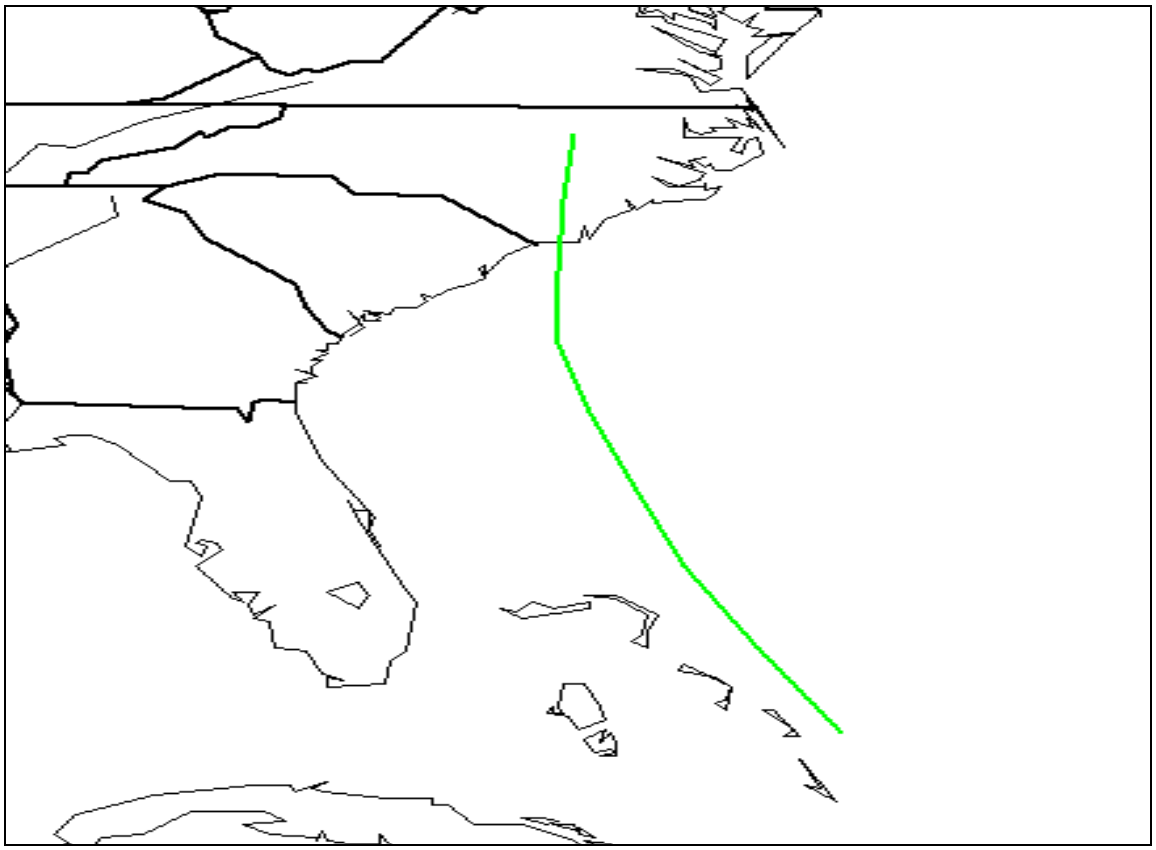

Fig. 63: September 6, 1916.

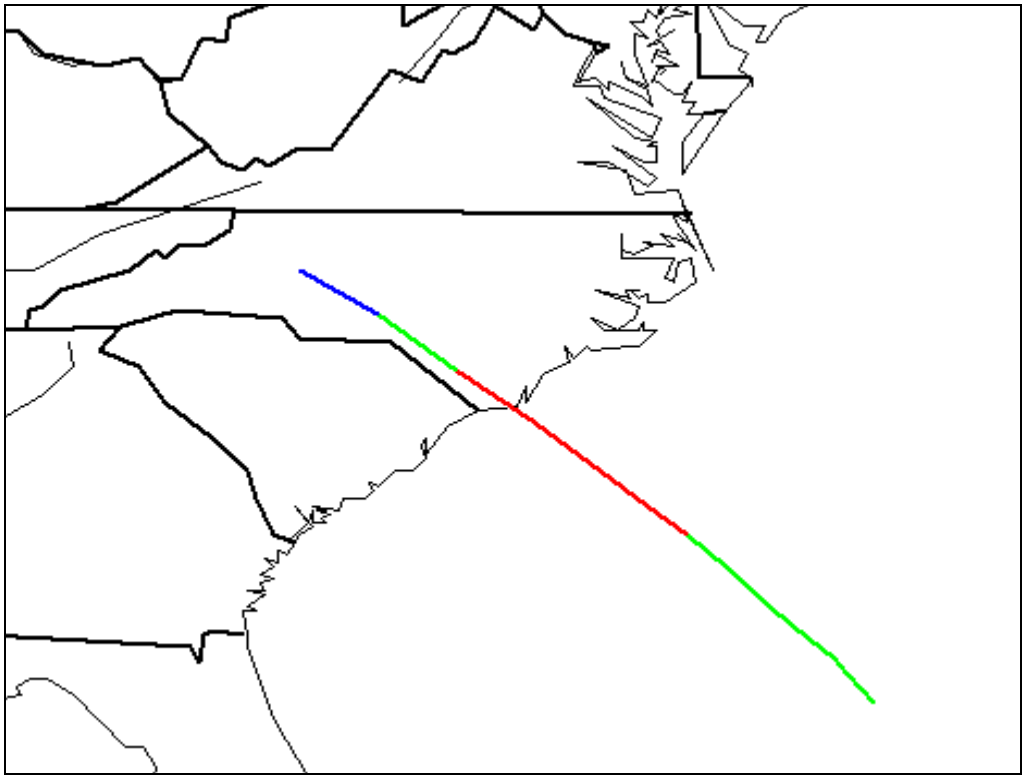

Fig. 64: September 22, 1920.

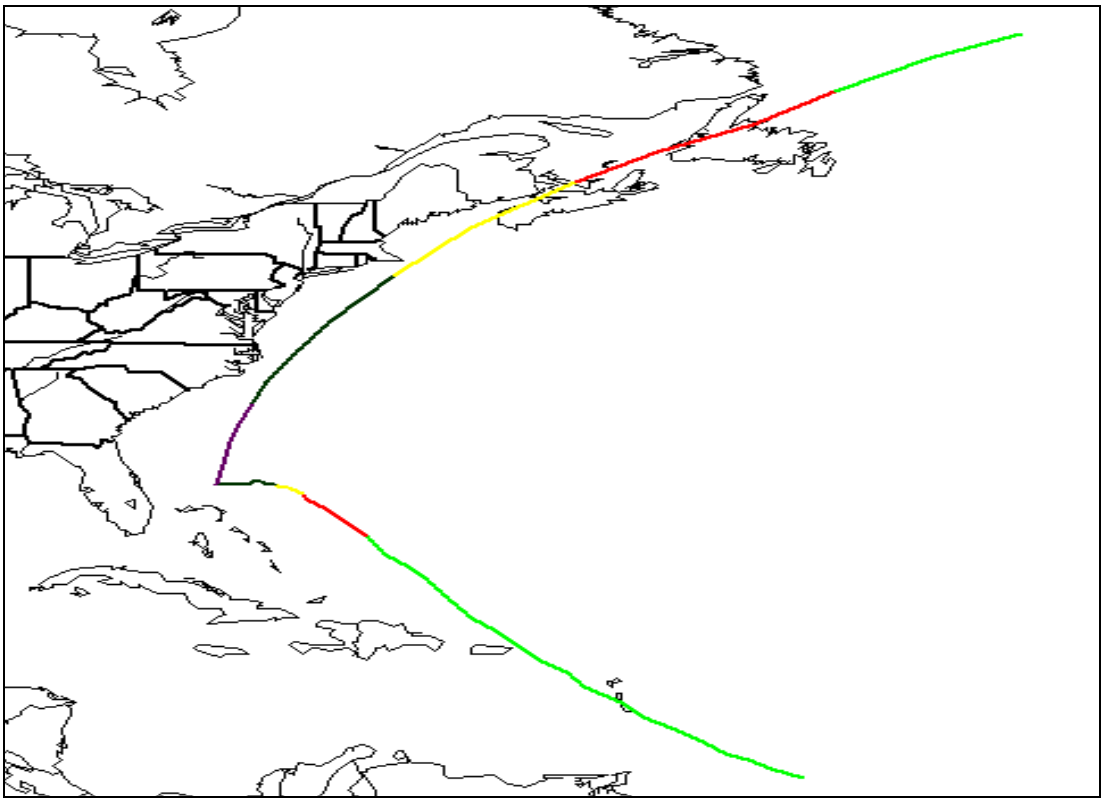

Fig. 65: August 25, 1924.

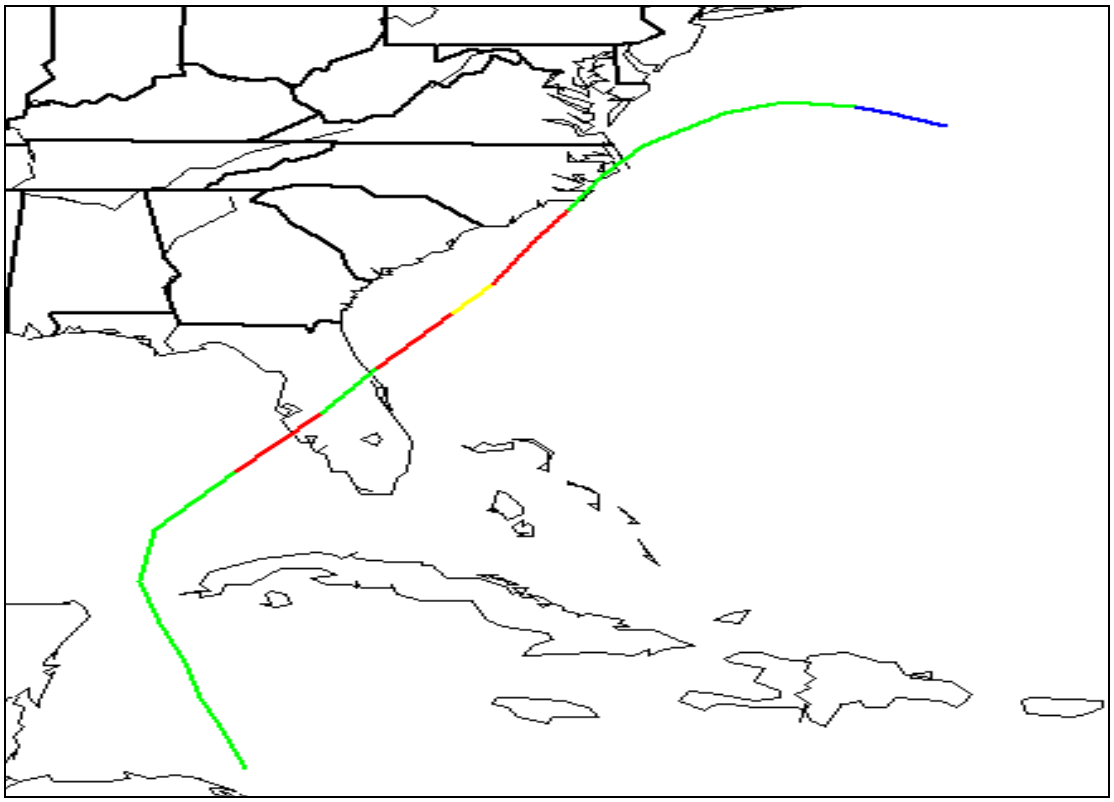

Fig. 66: December 2, 1925.

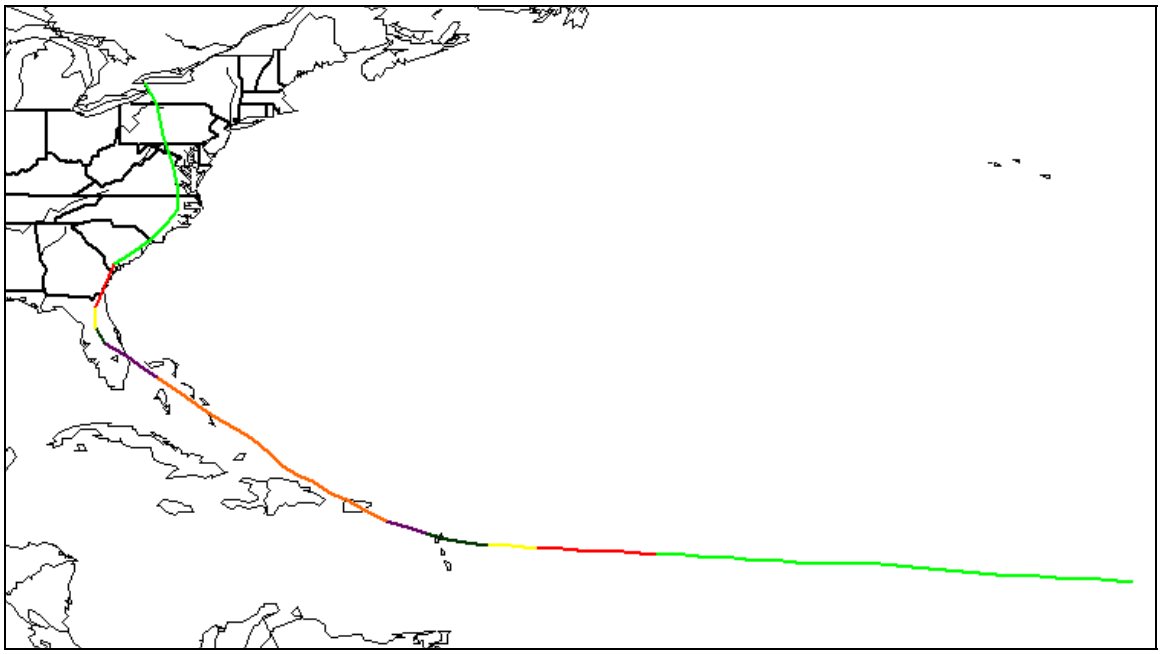

Fig. 67: September 18-19, 1928.

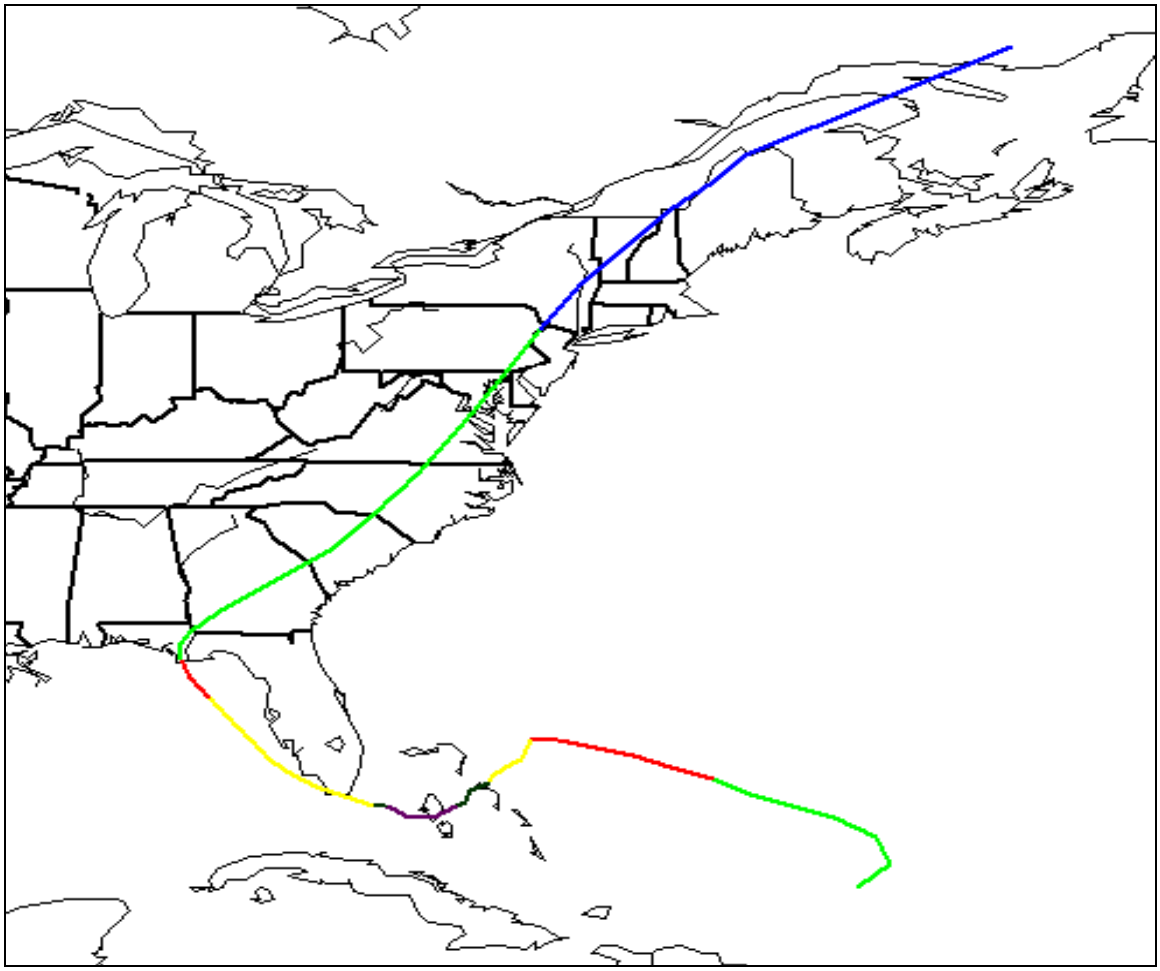

Fig. 68: October 1-2, 1929.

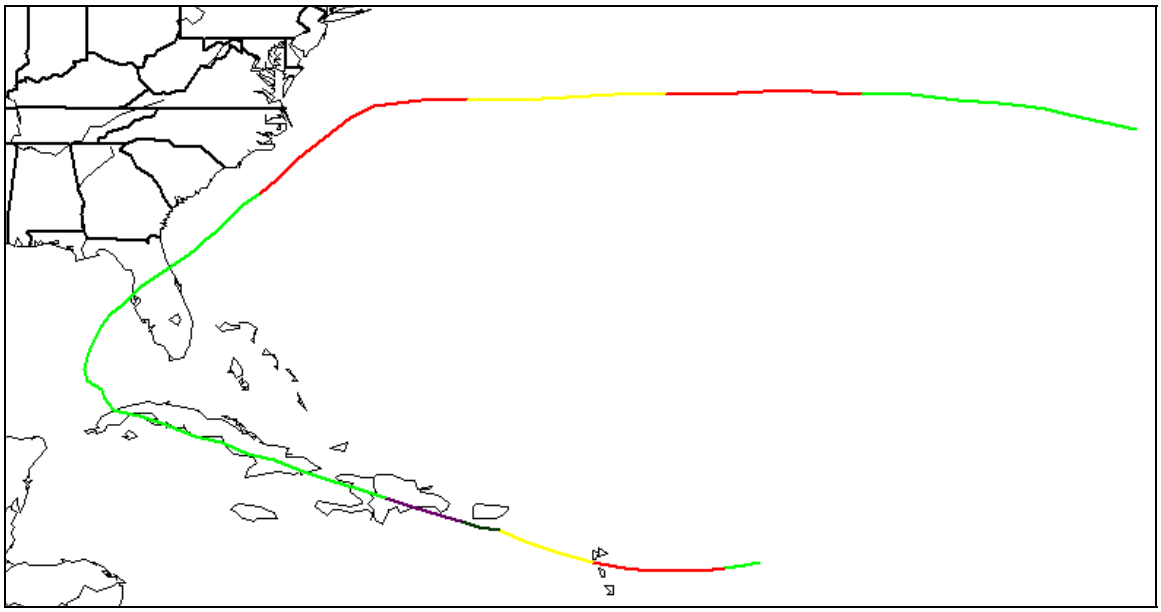

Fig. 69: September 12, 1930.

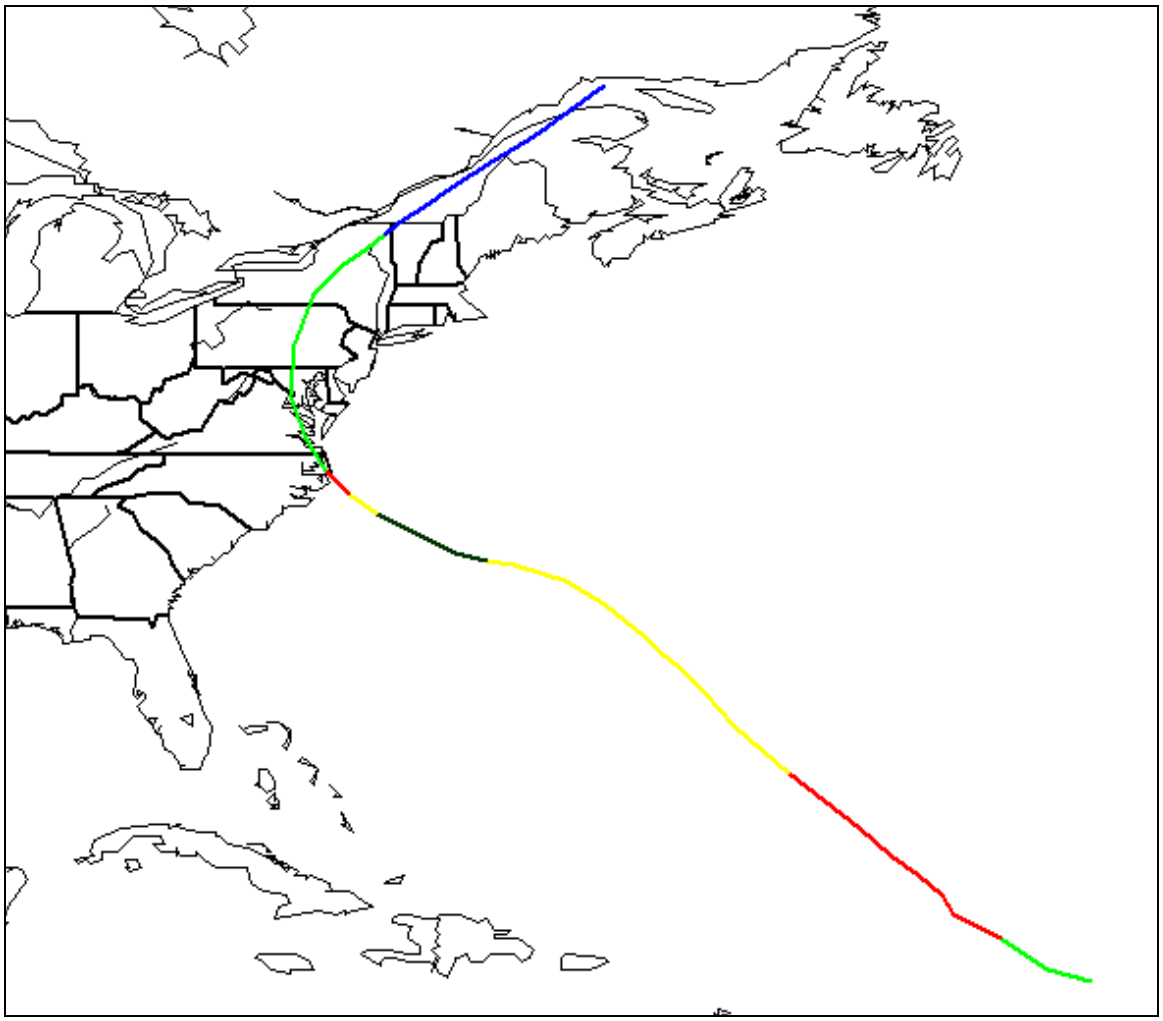

Fig. 70: August 22-23, 1933.

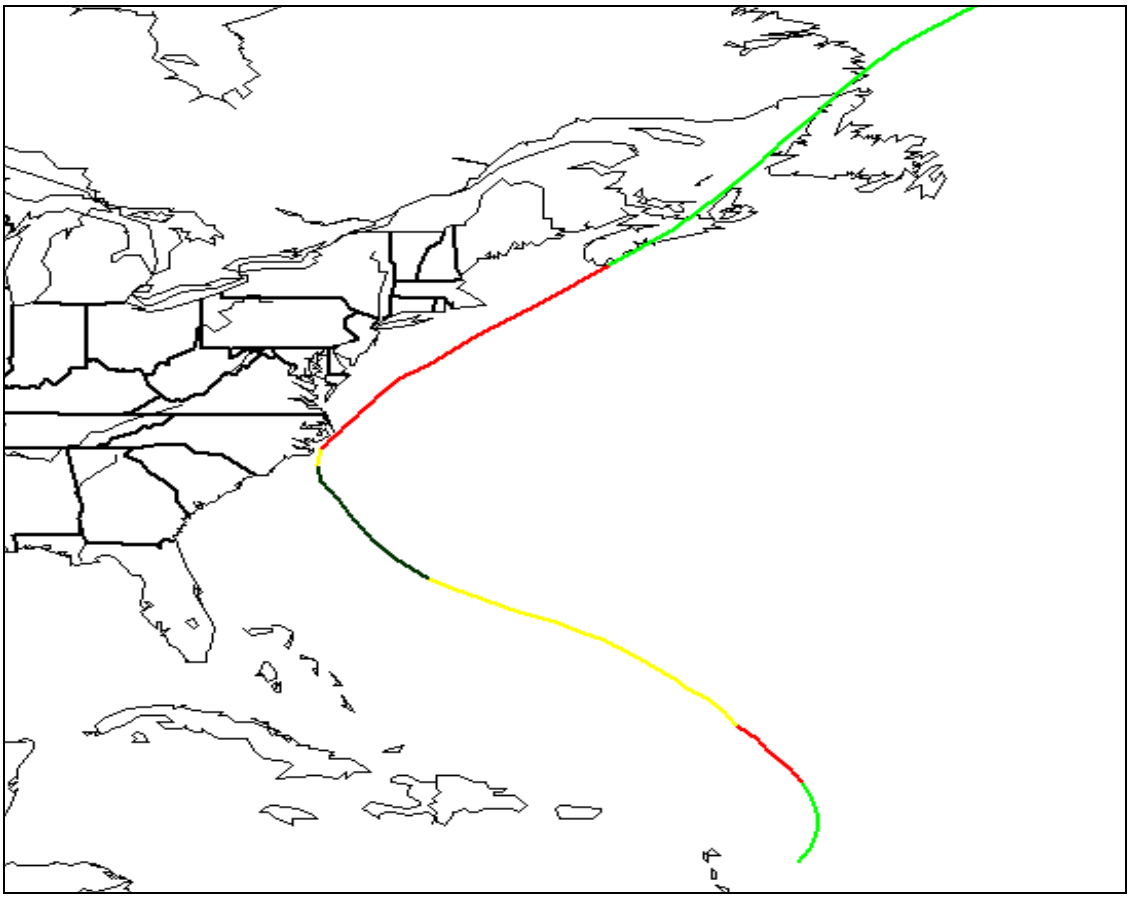

Fig. 71: September 15-16, 1933.

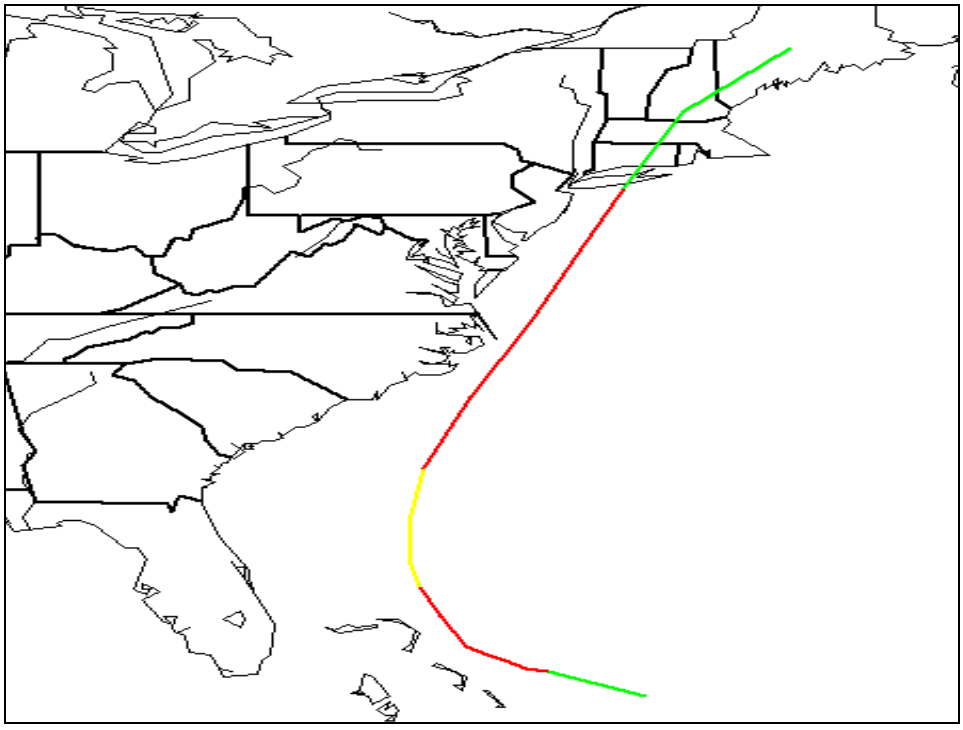

Fig. 72: September 8, 1934.

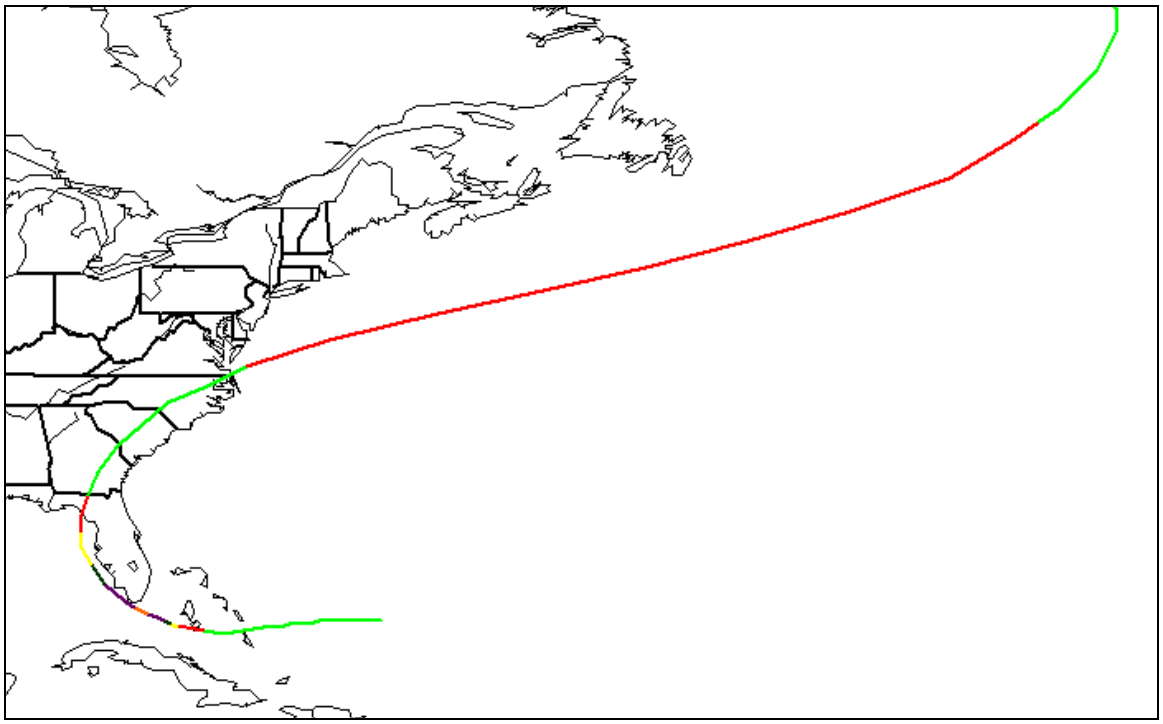

Fig. 73: September 5-6, 1935.

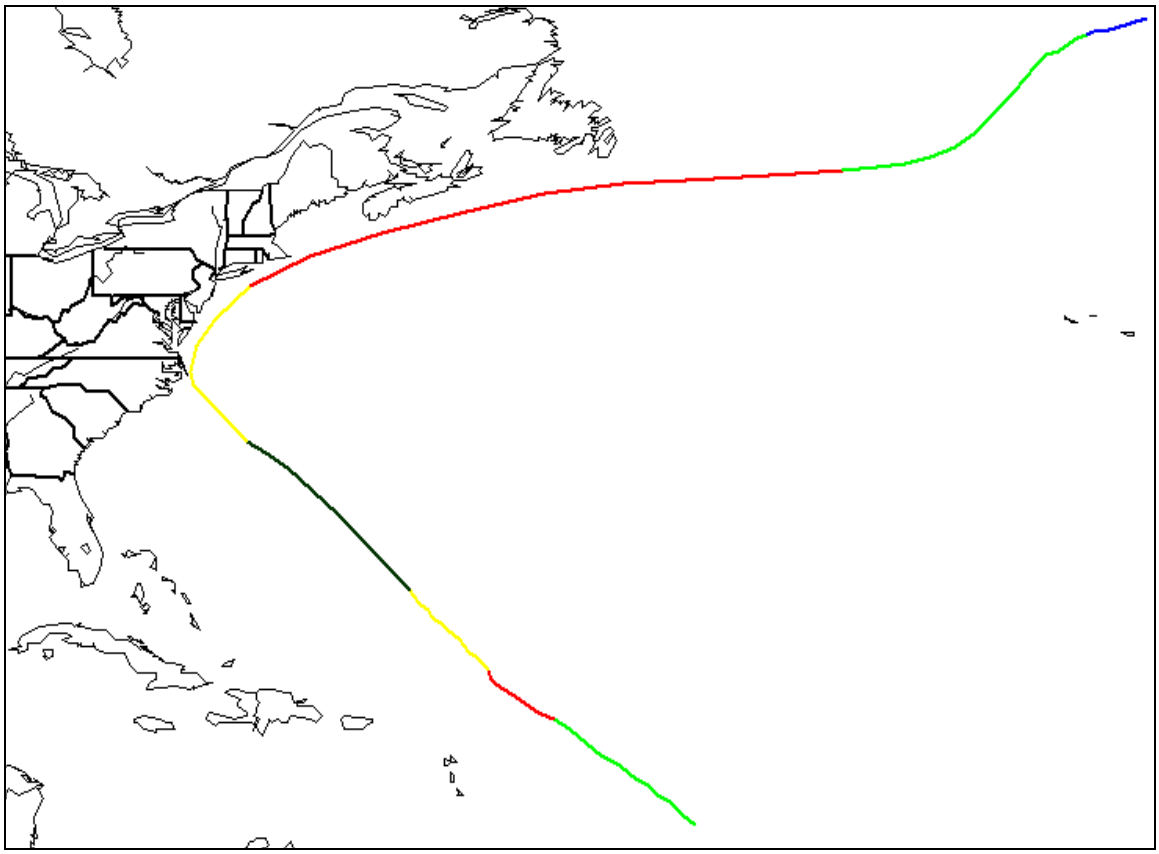

Fig. 74: September 18, 1936.

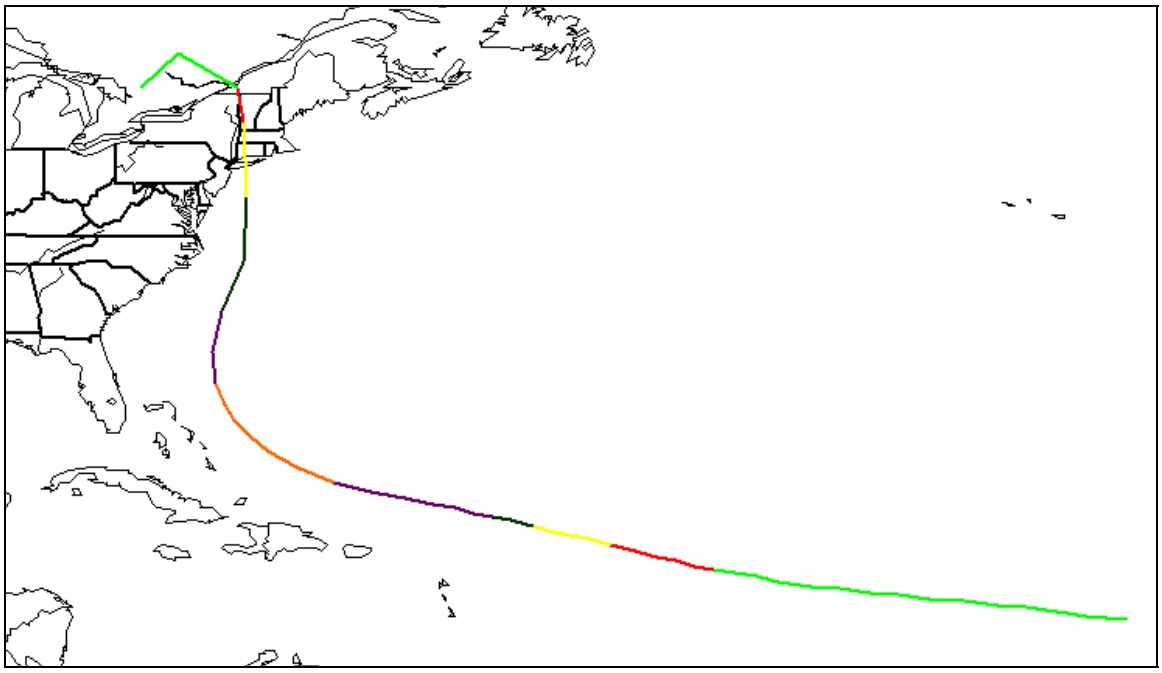

Fig. 75: September 21, 1938.

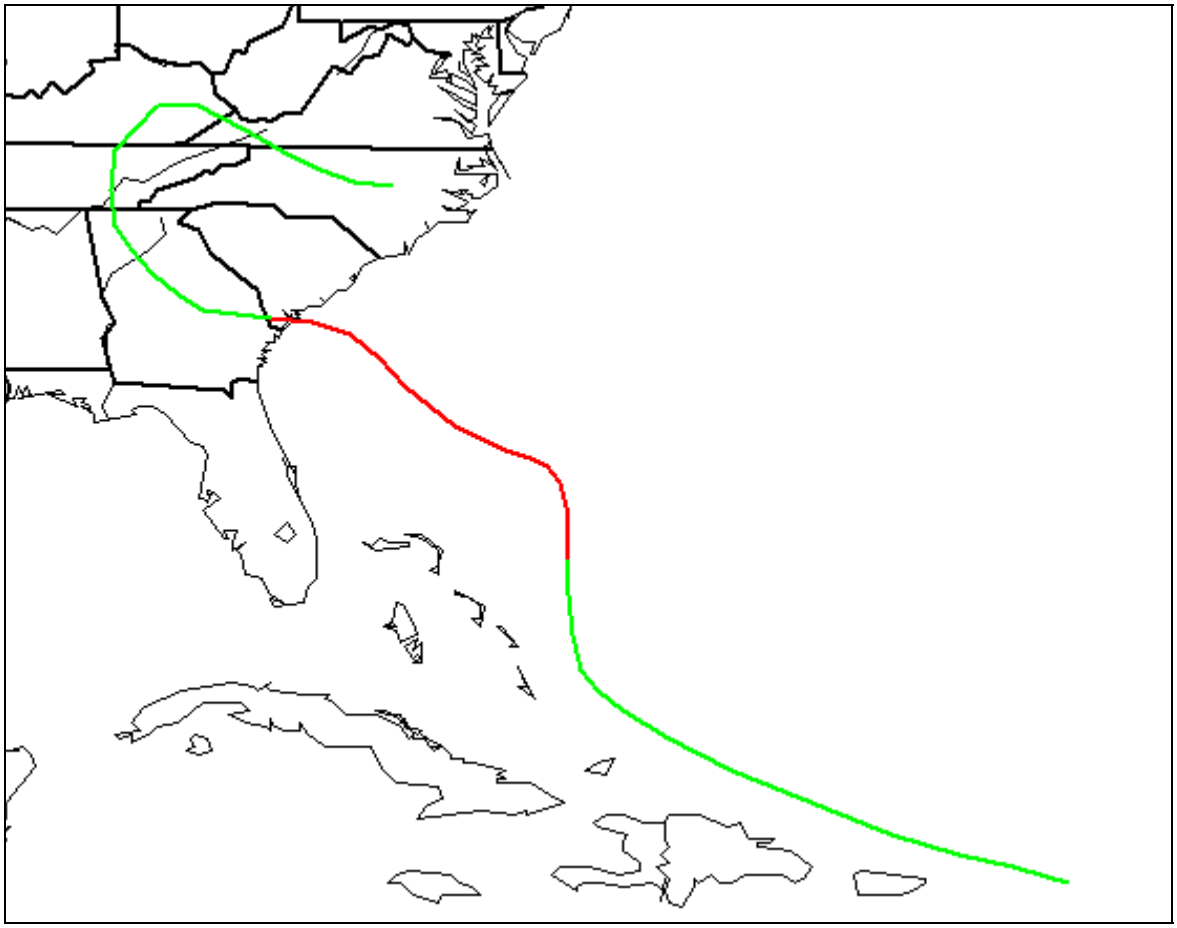

Fig. 76: August 11-17, 1940.

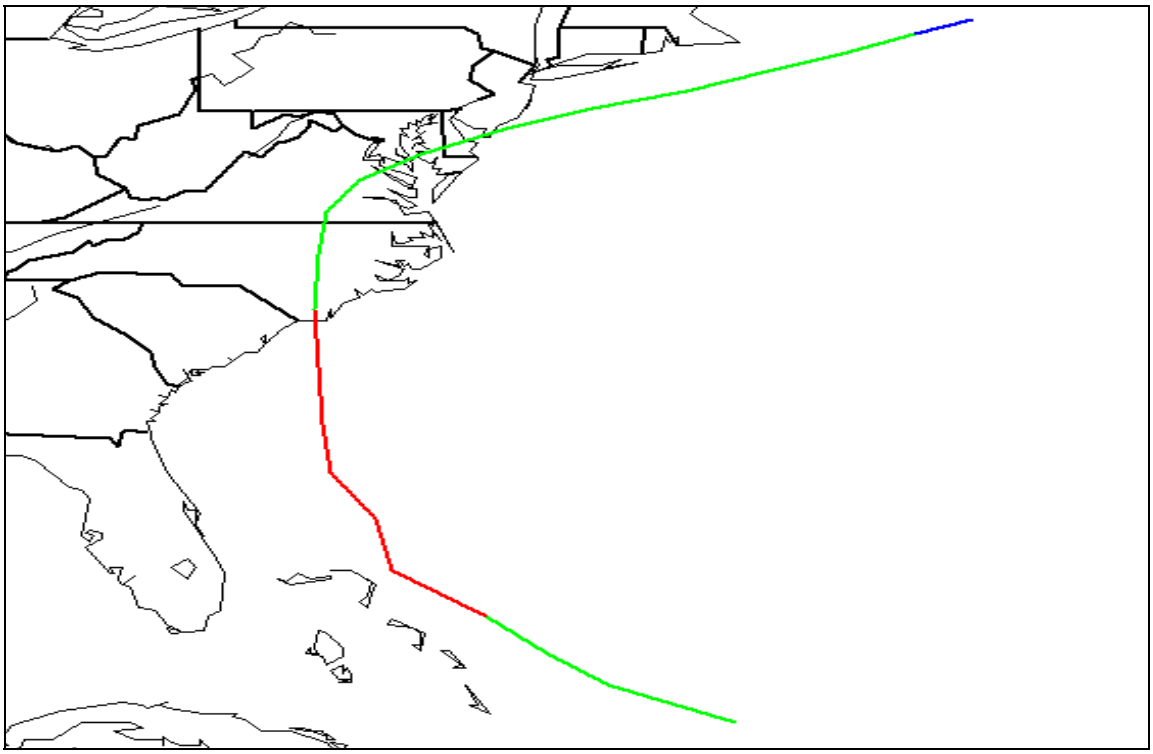

Fig. 77: August 1, 1944.

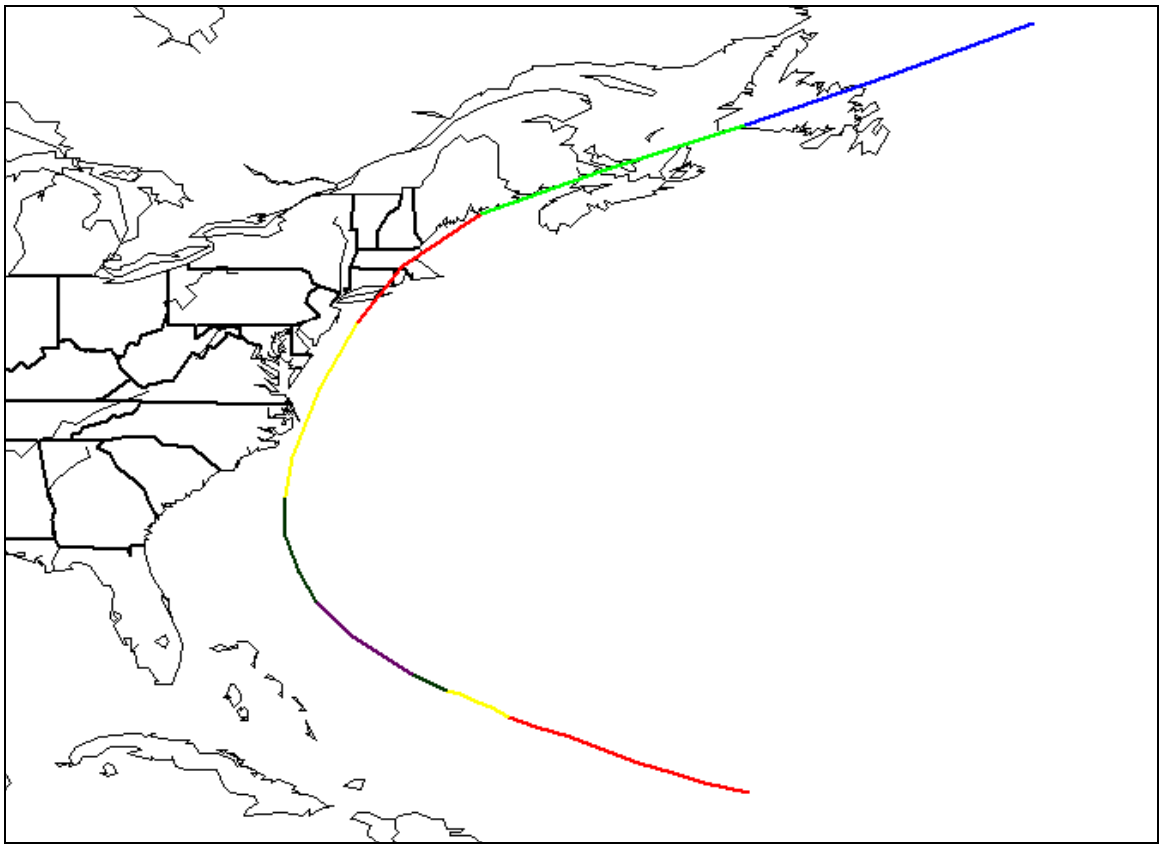

Fig. 78: September 14, 1944.

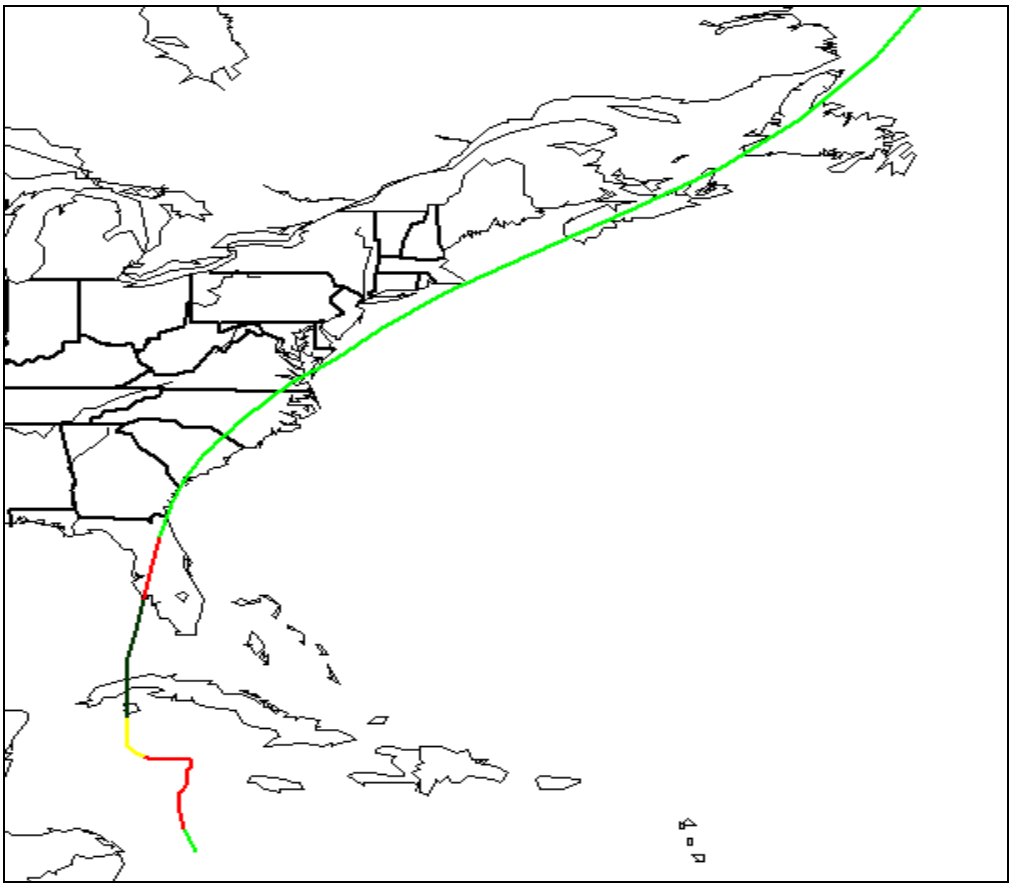

Fig. 79: October 20, 1944.

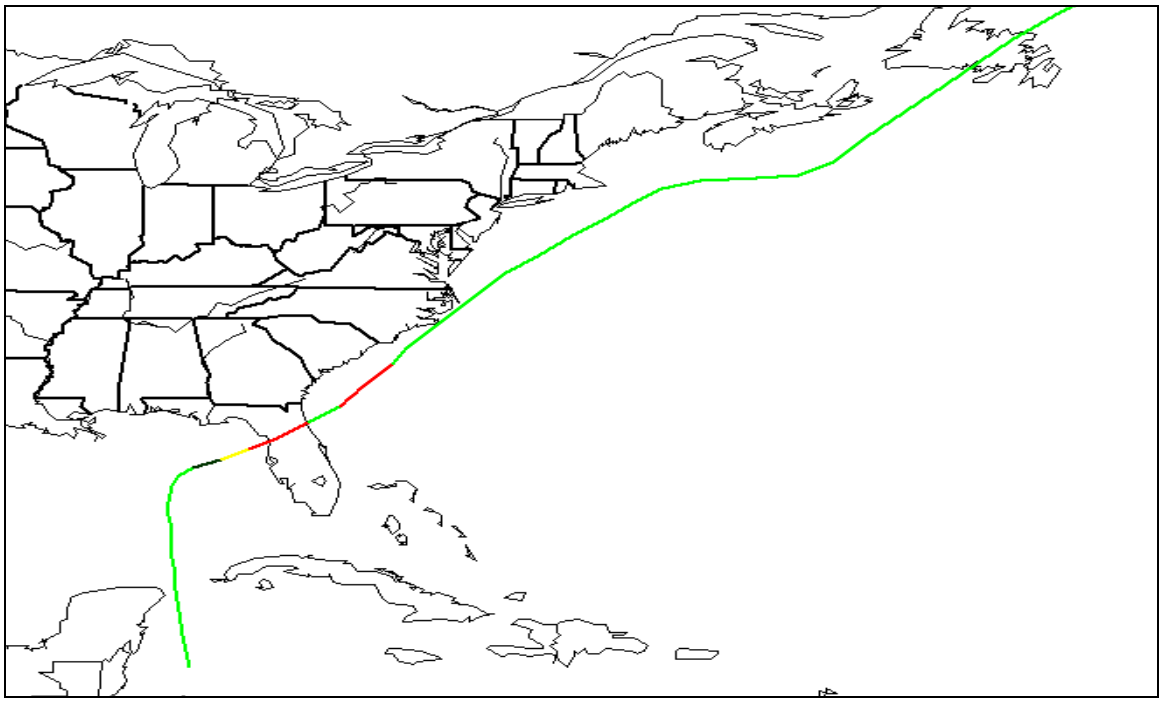

Fig. 80: June 25, 1945.

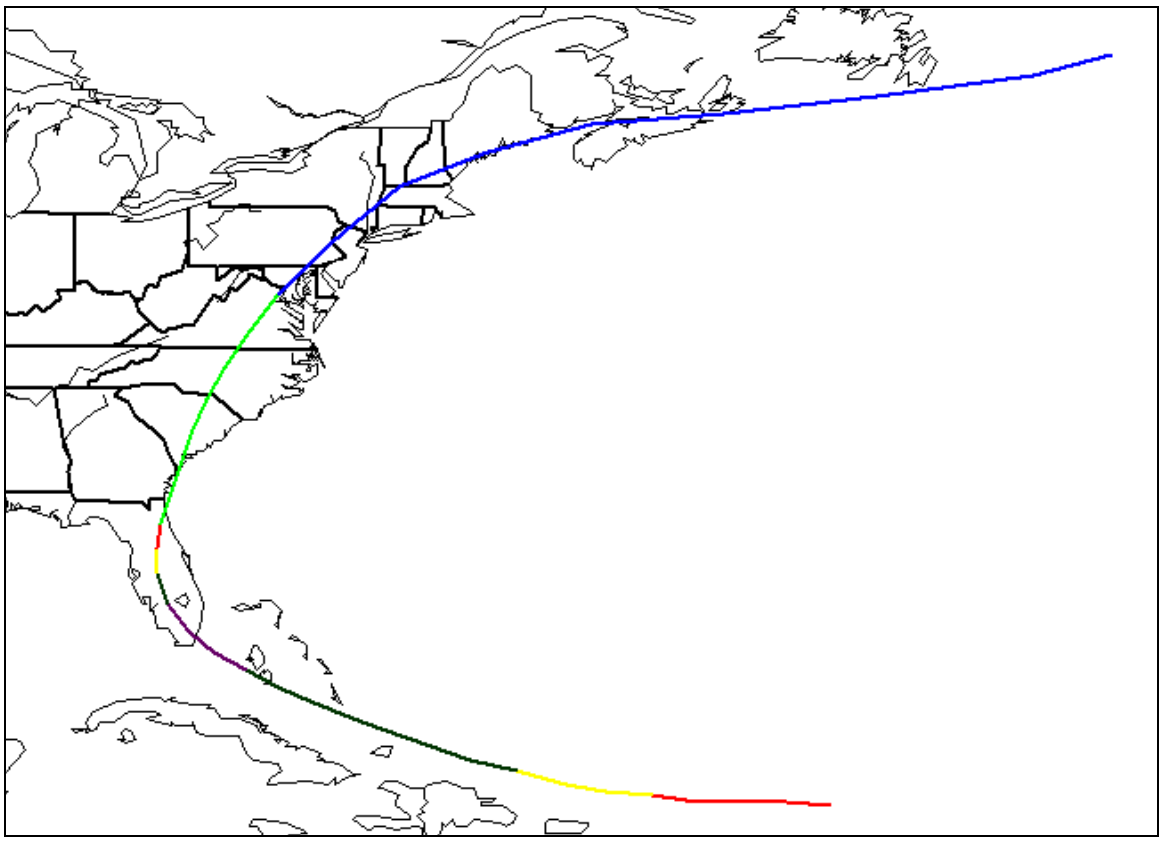

Fig. 81: September 17, 1945.

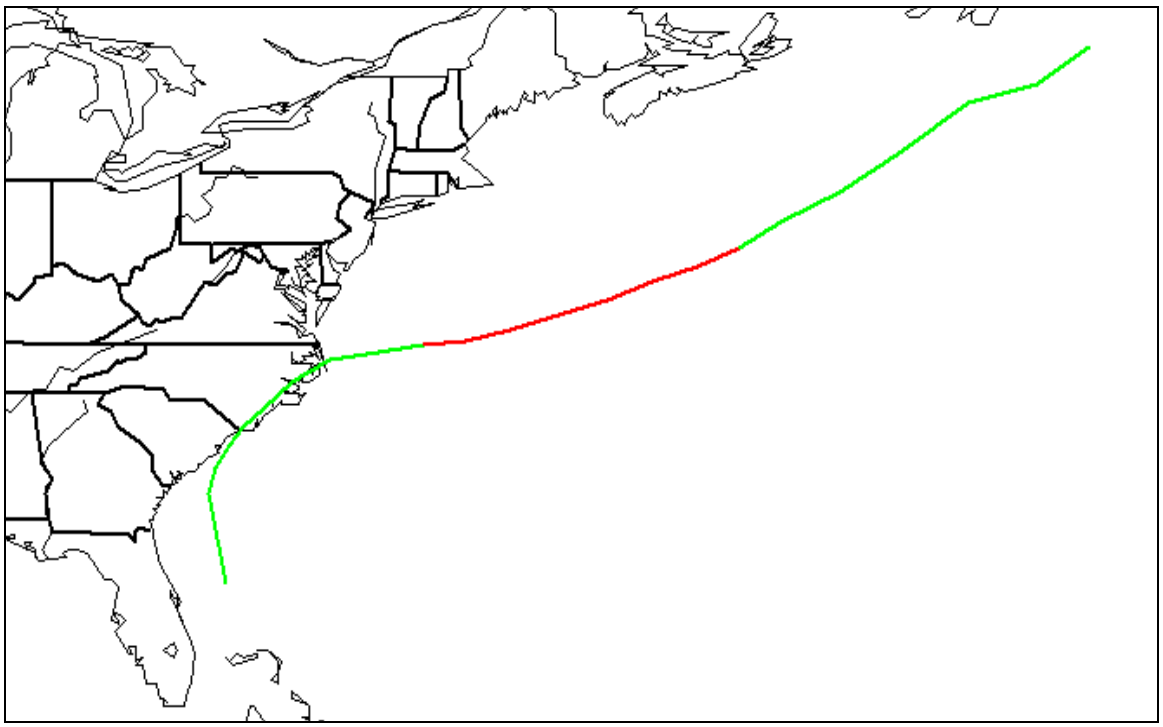

Fig. 82: July 6, 1946.

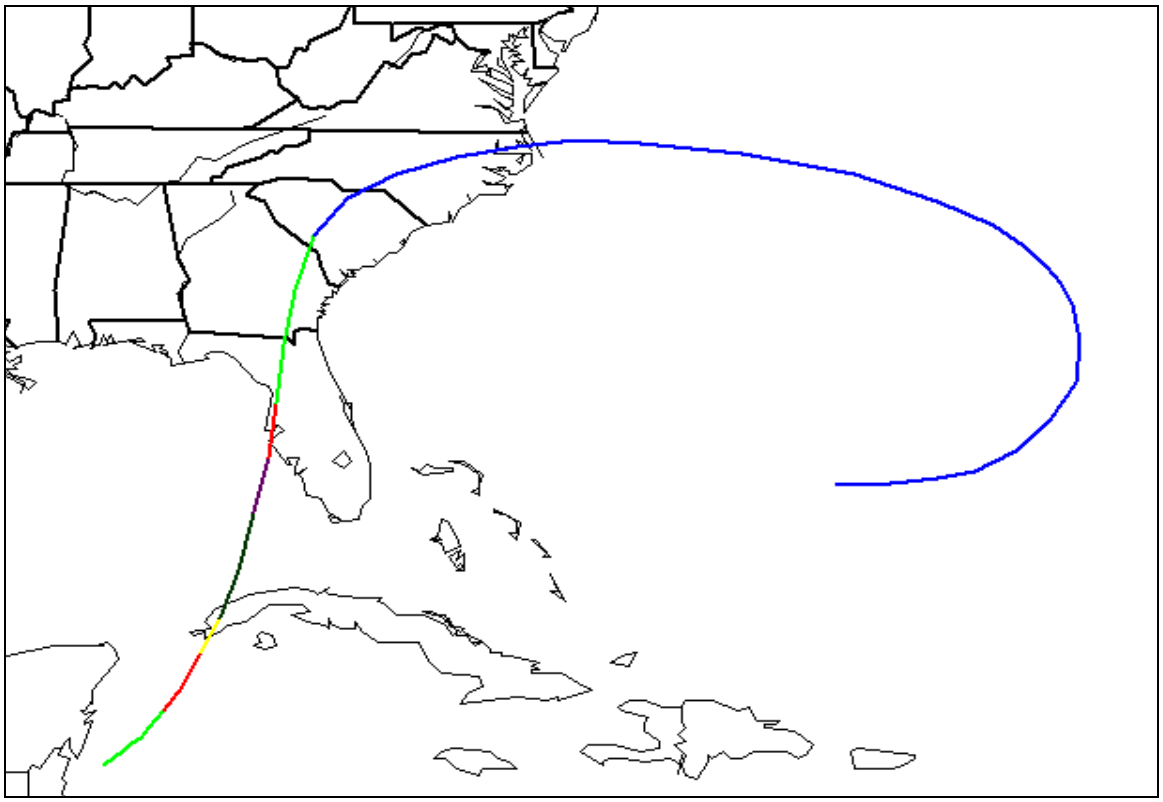

Fig. 83: October 9, 1946.

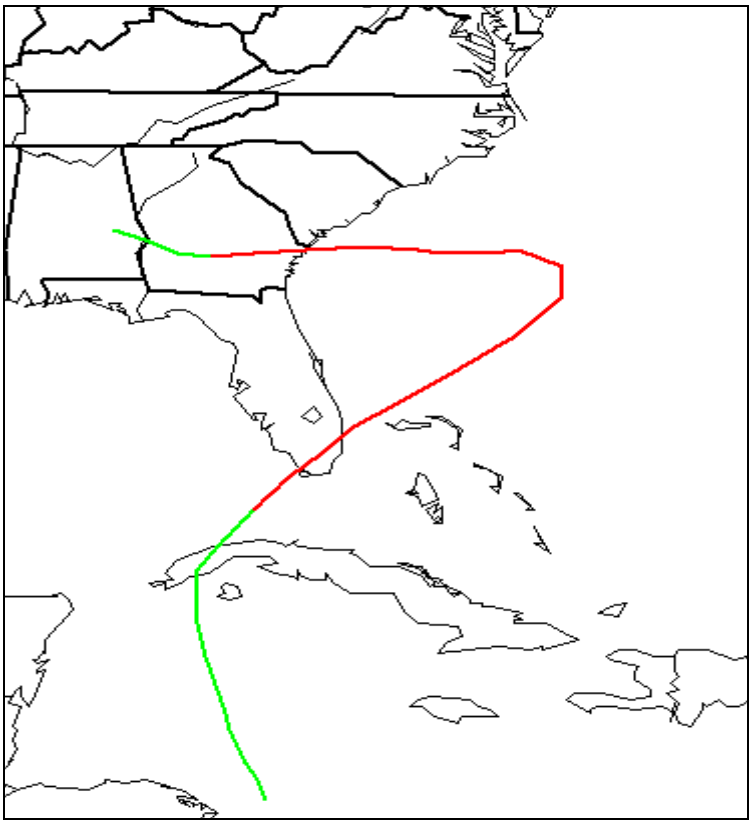

Fig. 84: October 12-15, 1947.

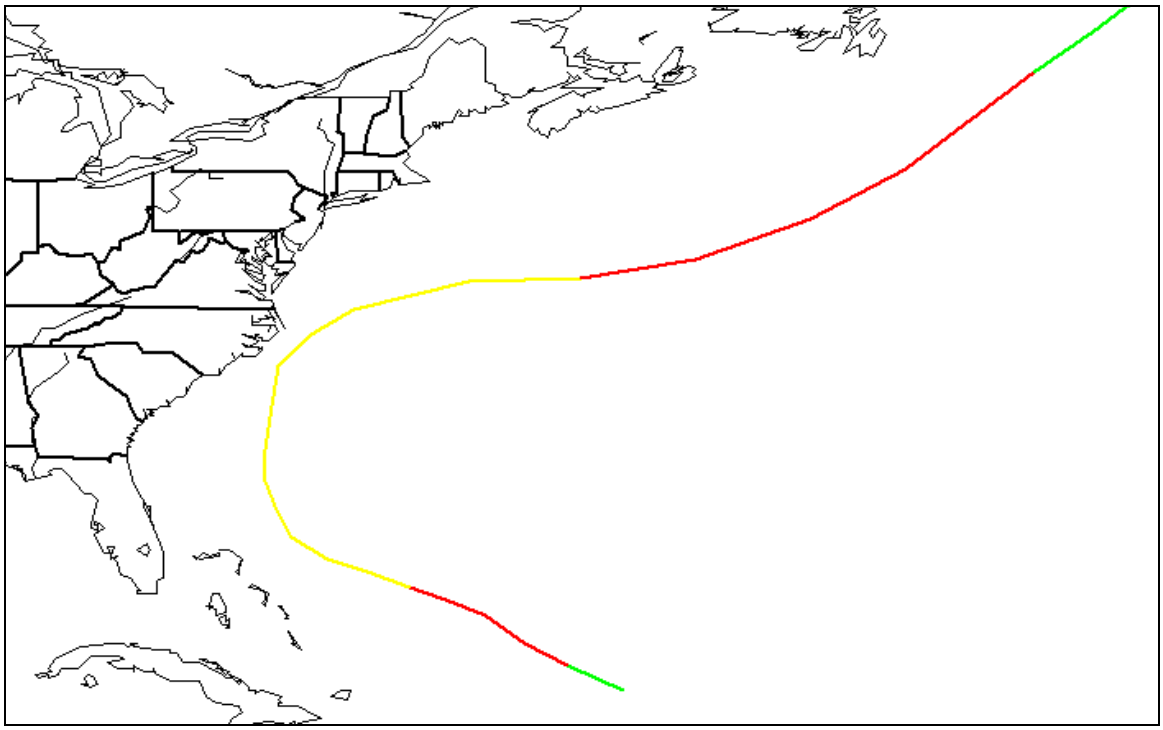

Fig. 85: August 24, 1949.

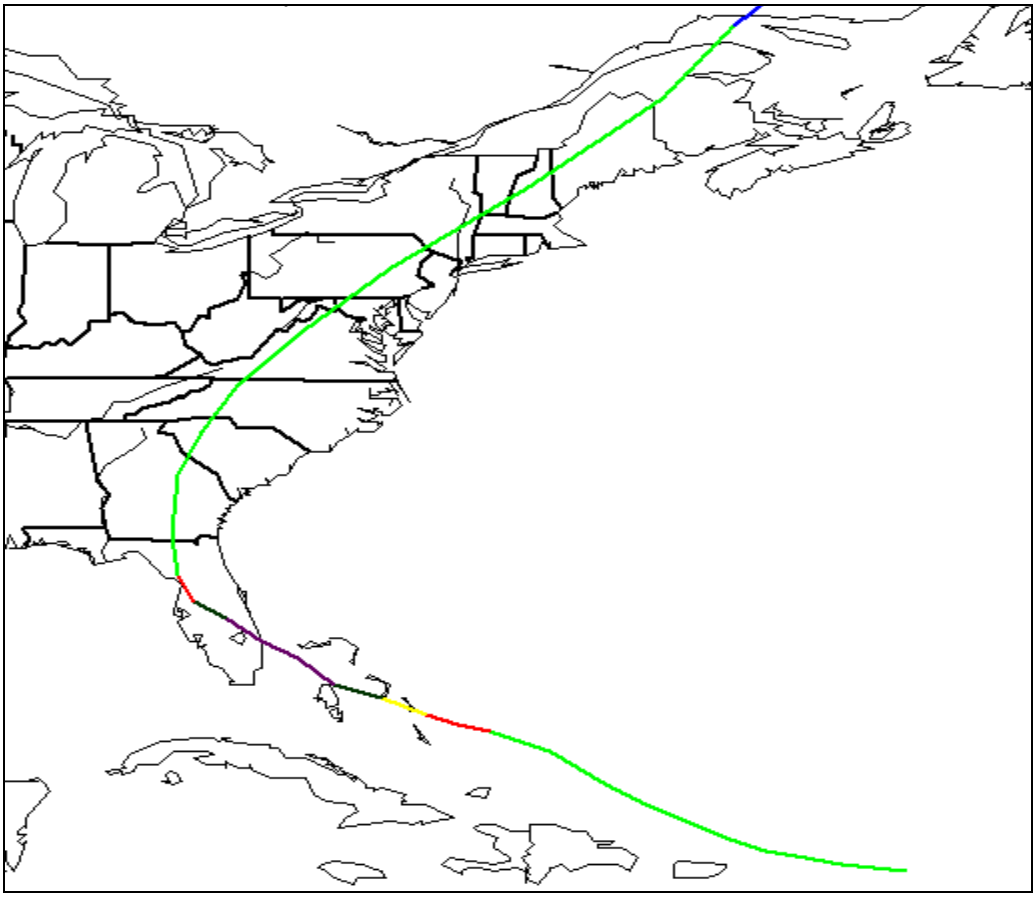

Fig. 86: August 28, 1949.

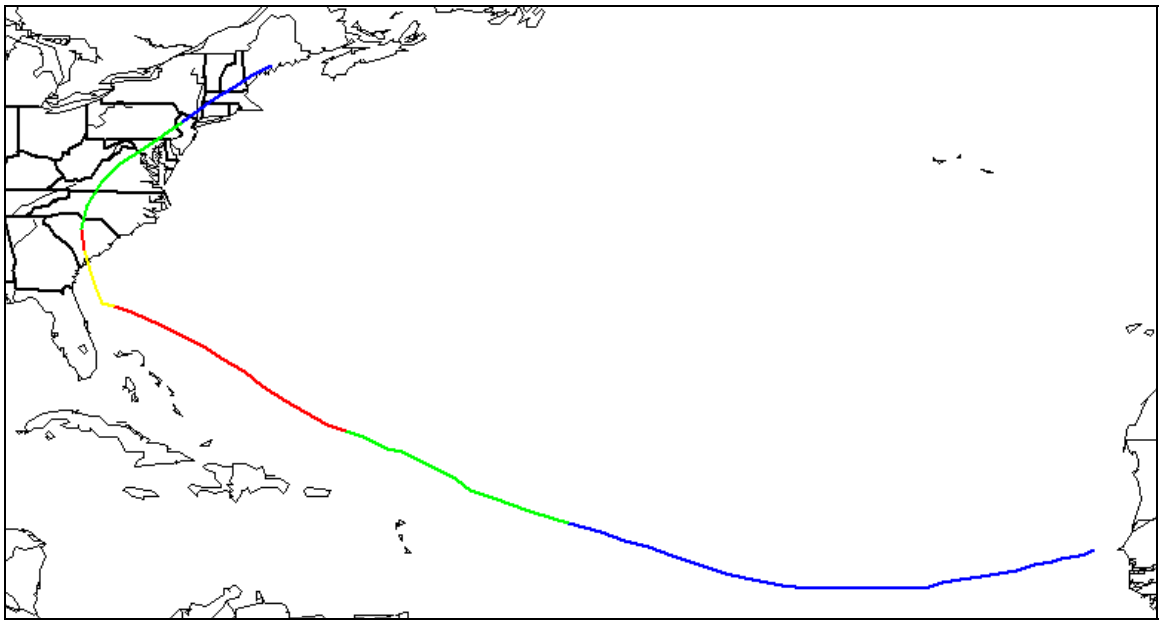

Fig. 87: August 31, 1952. *ABLE*.

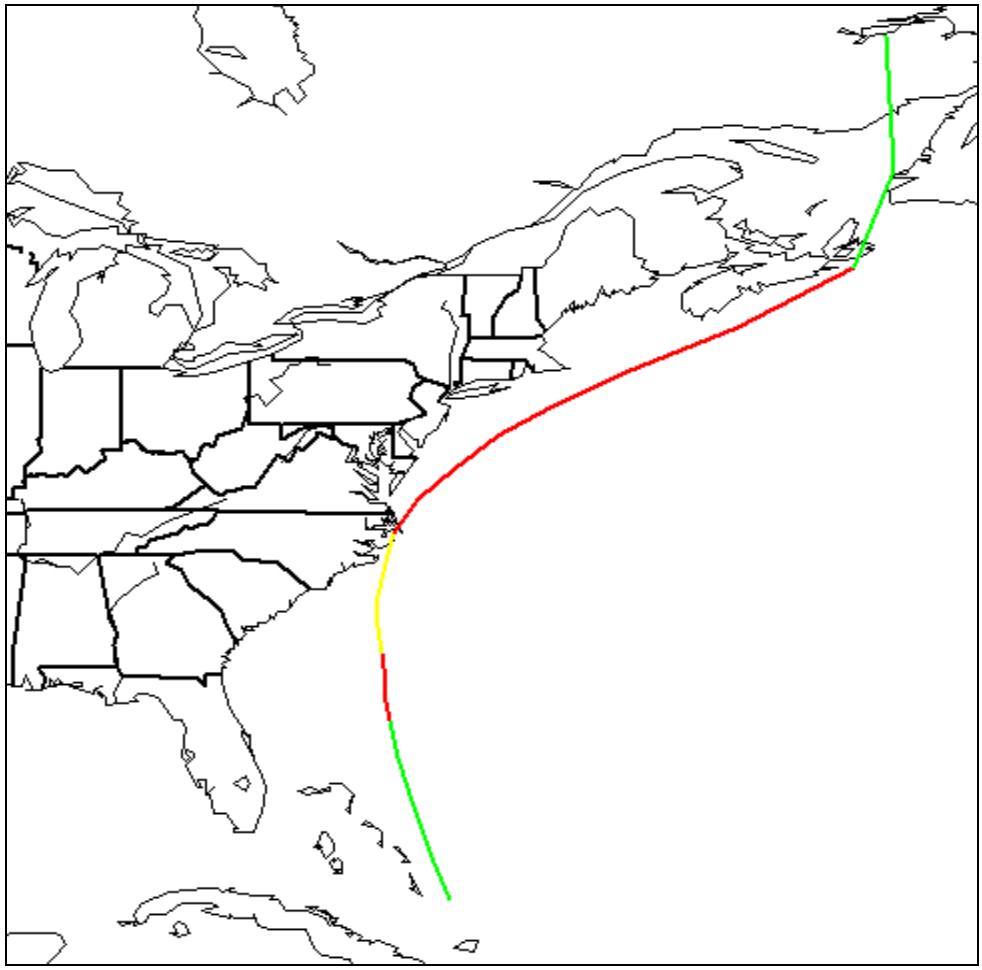

Fig. 88: August 13, 1953. *BARBARA*.

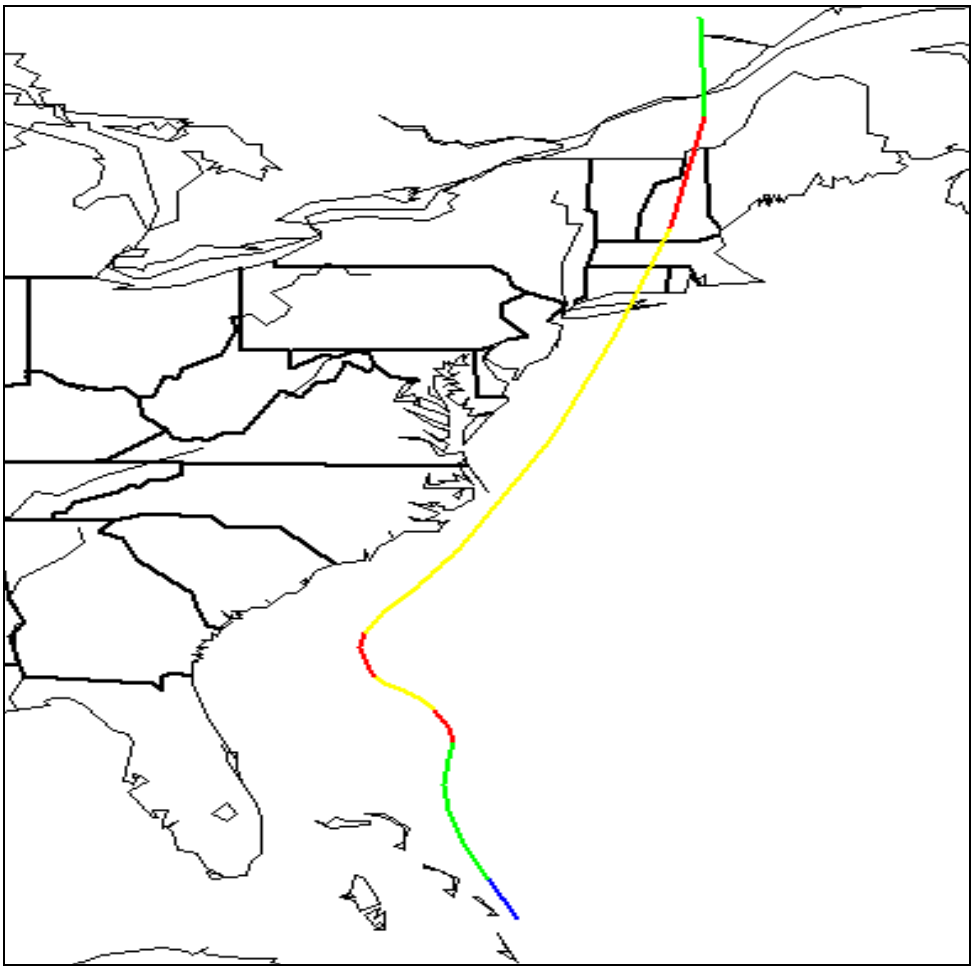

Fig. 89: August 30, 1954. *CAROL*.

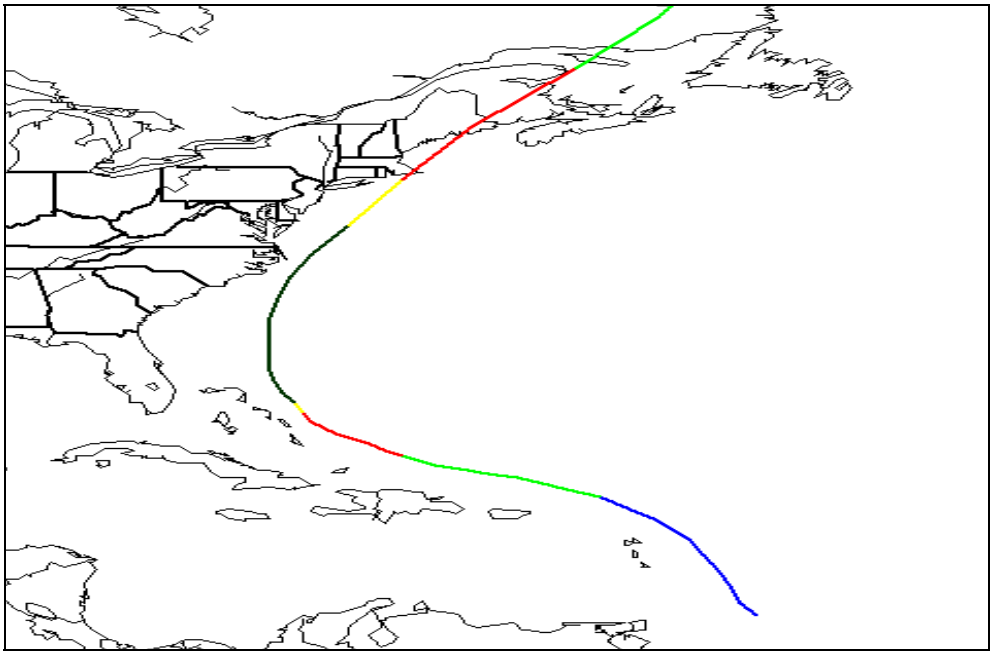

Fig. 90: September 10, 1954. *EDNA*.

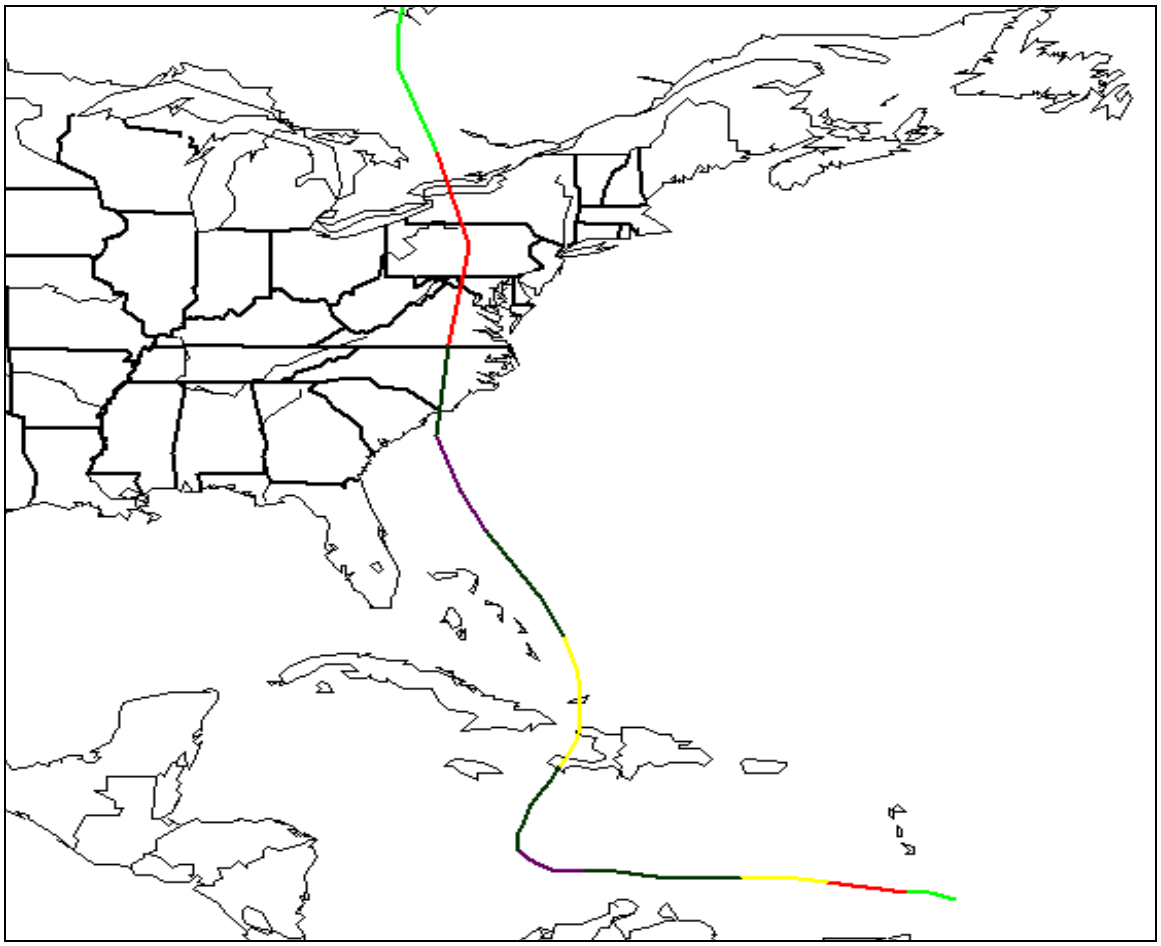

Fig. 91: October 15, 1954. *HAZEL*.

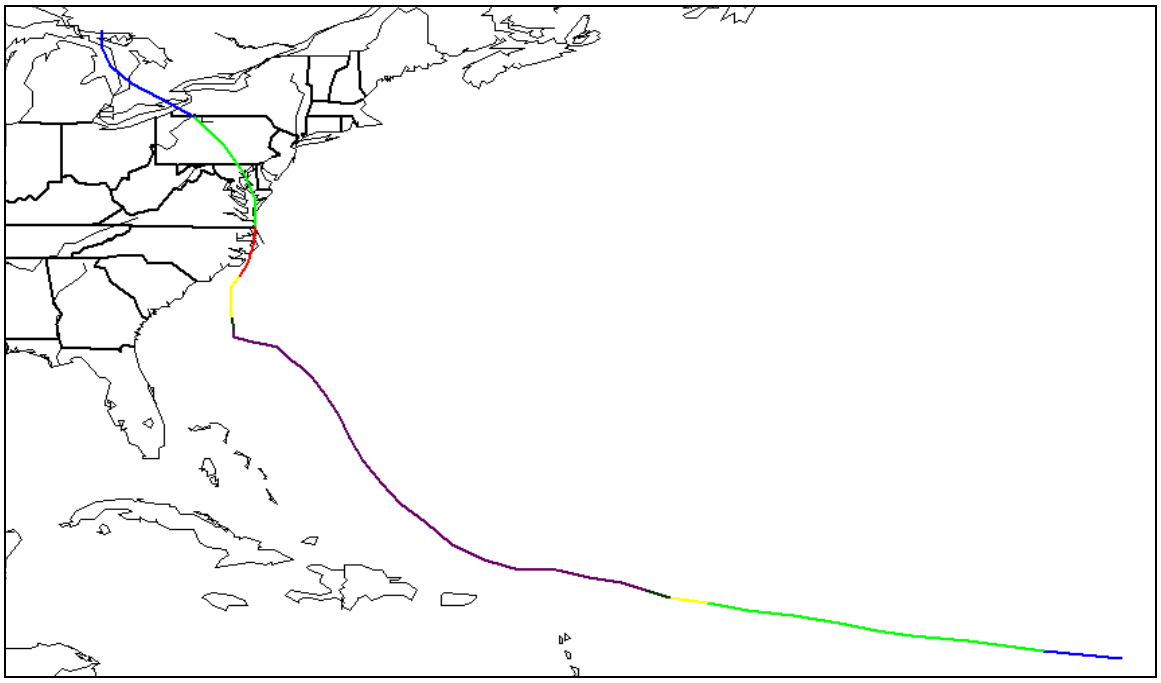

Fig. 92: August 12, 1955. *CONNIE*.

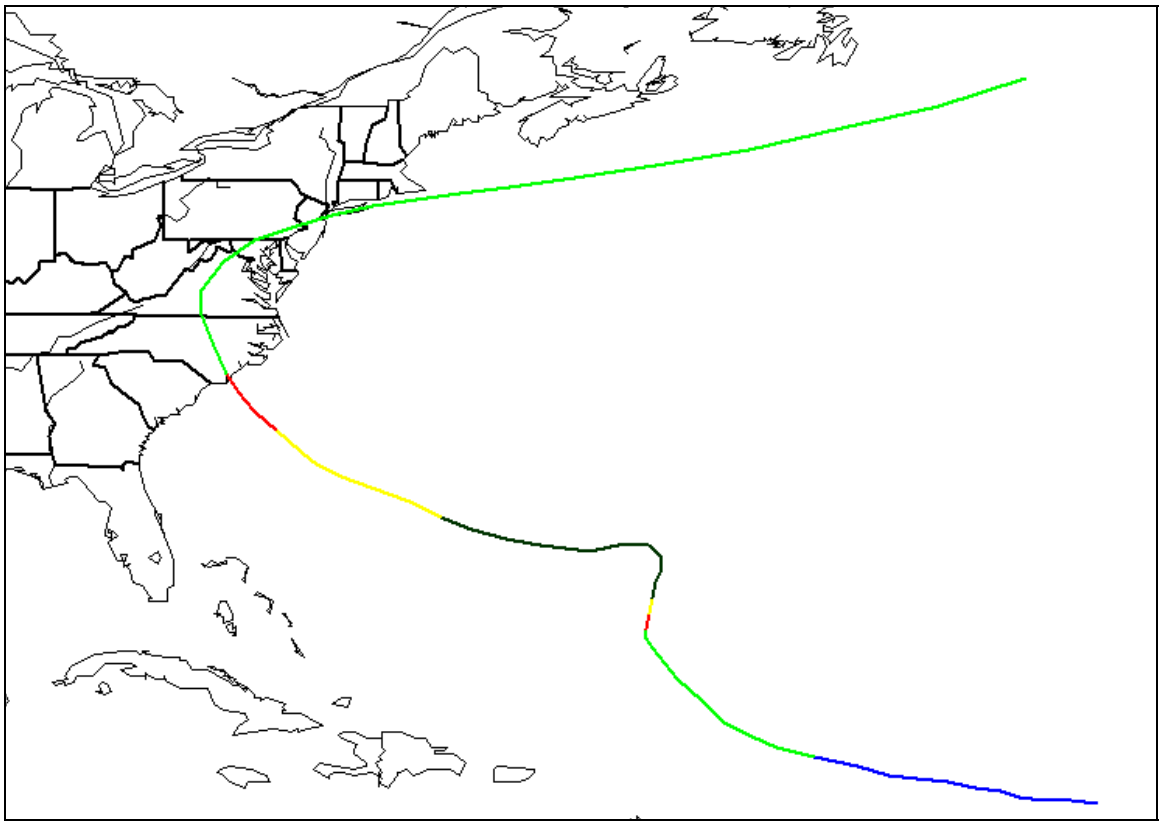

Fig. 93: August 17, 1955. *DIANE*.

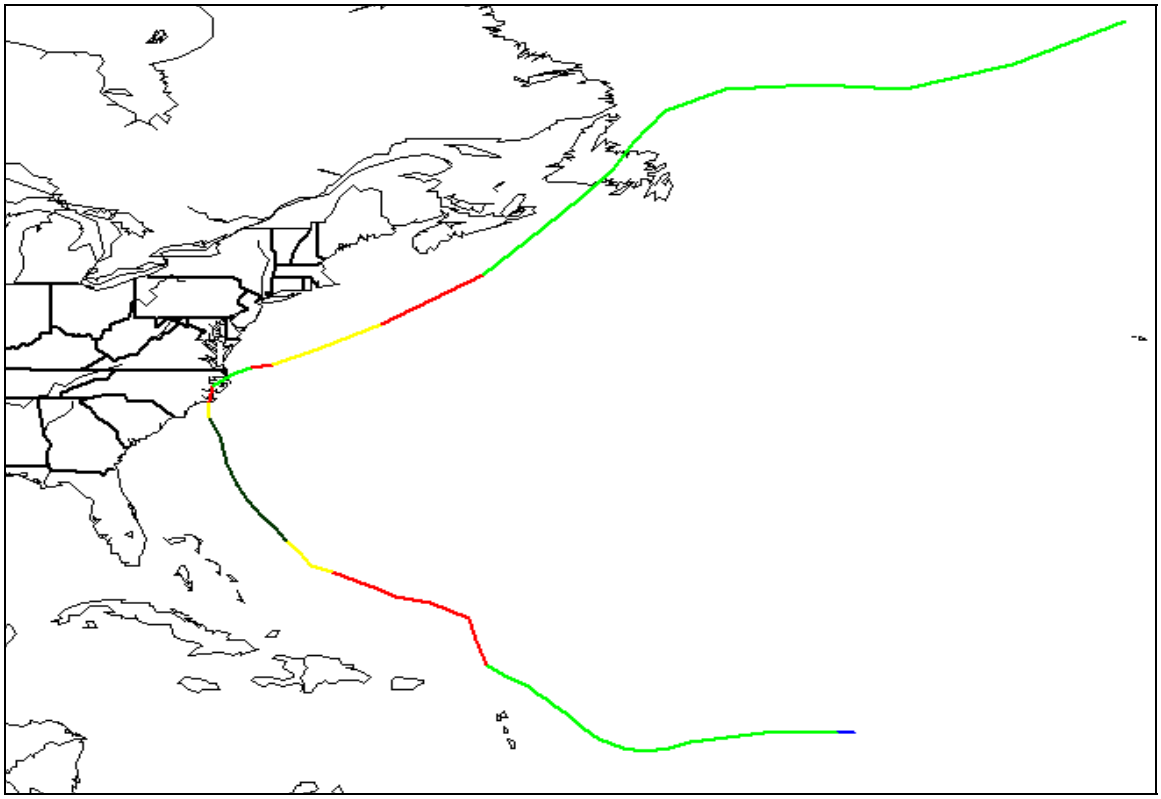

Fig. 94: September 19, 1955. *IONE*.

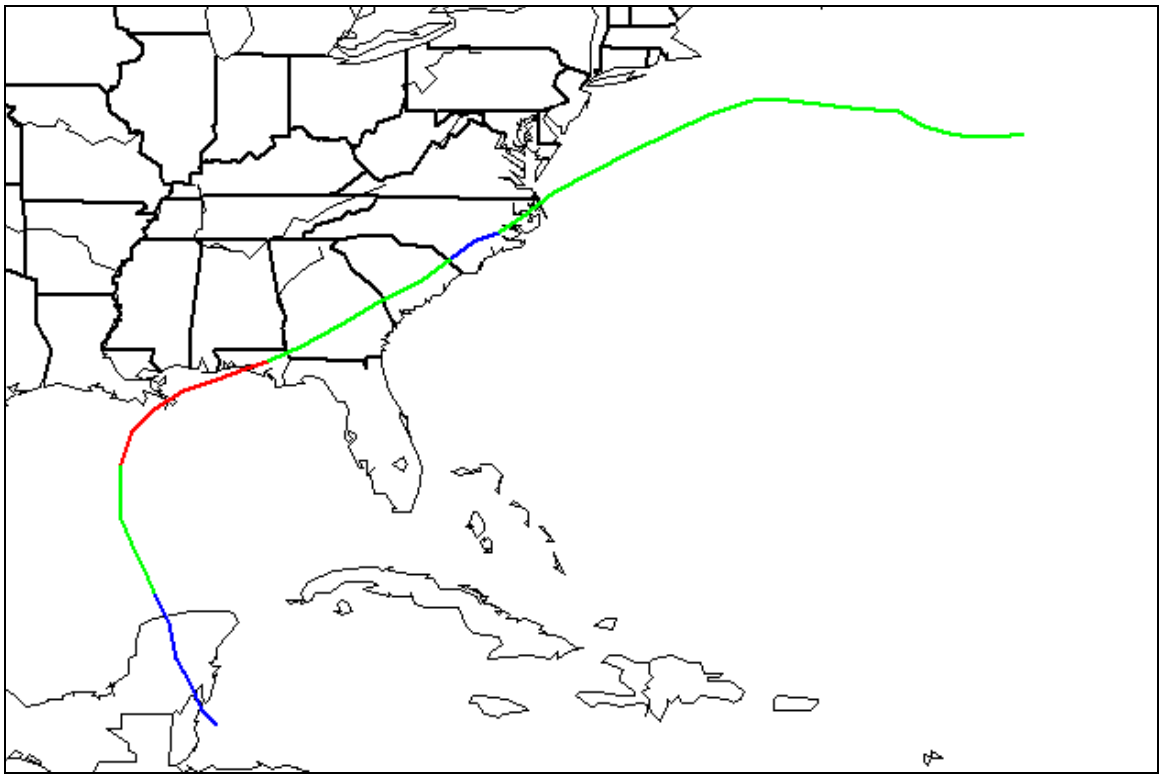

Fig. 95: September 26-27, 1956. *FLOSSY*.

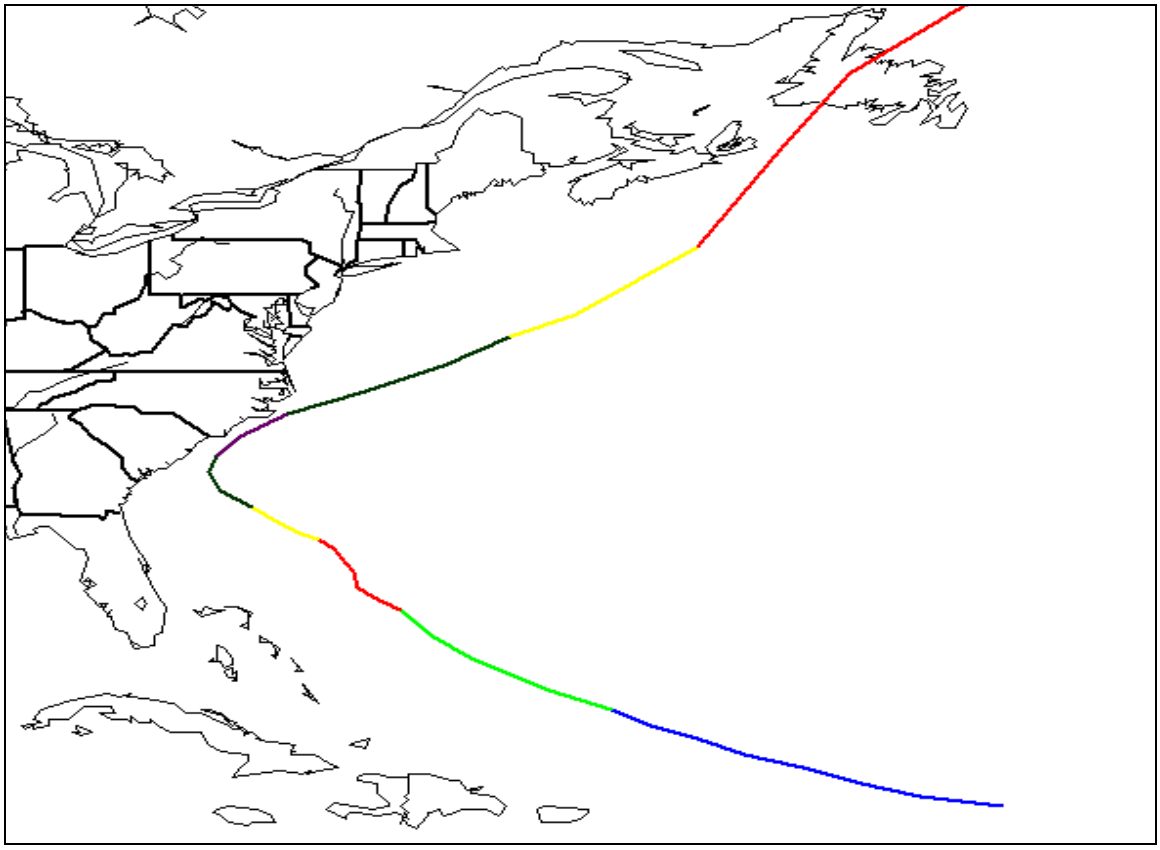

Fig. 96: September 27, 1958. *HELENE*.

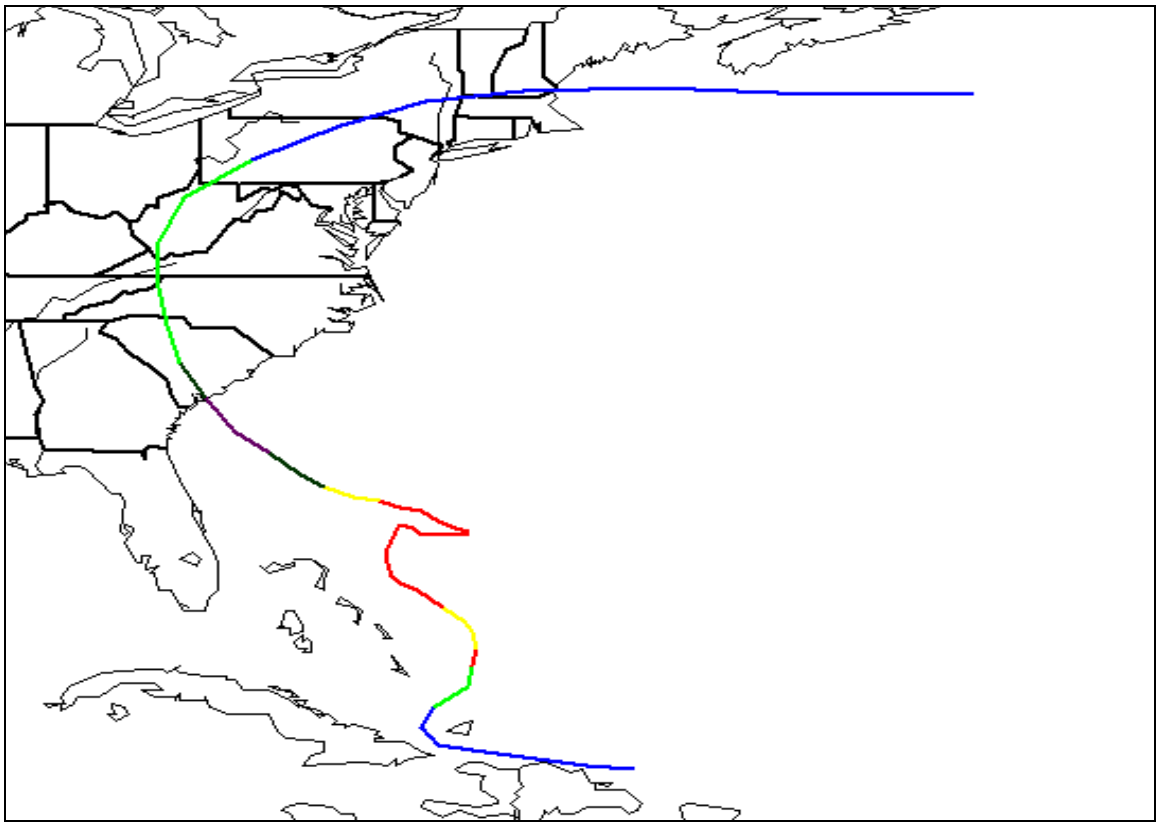

Fig. 97: September 30, 1959. *GRACIE*.

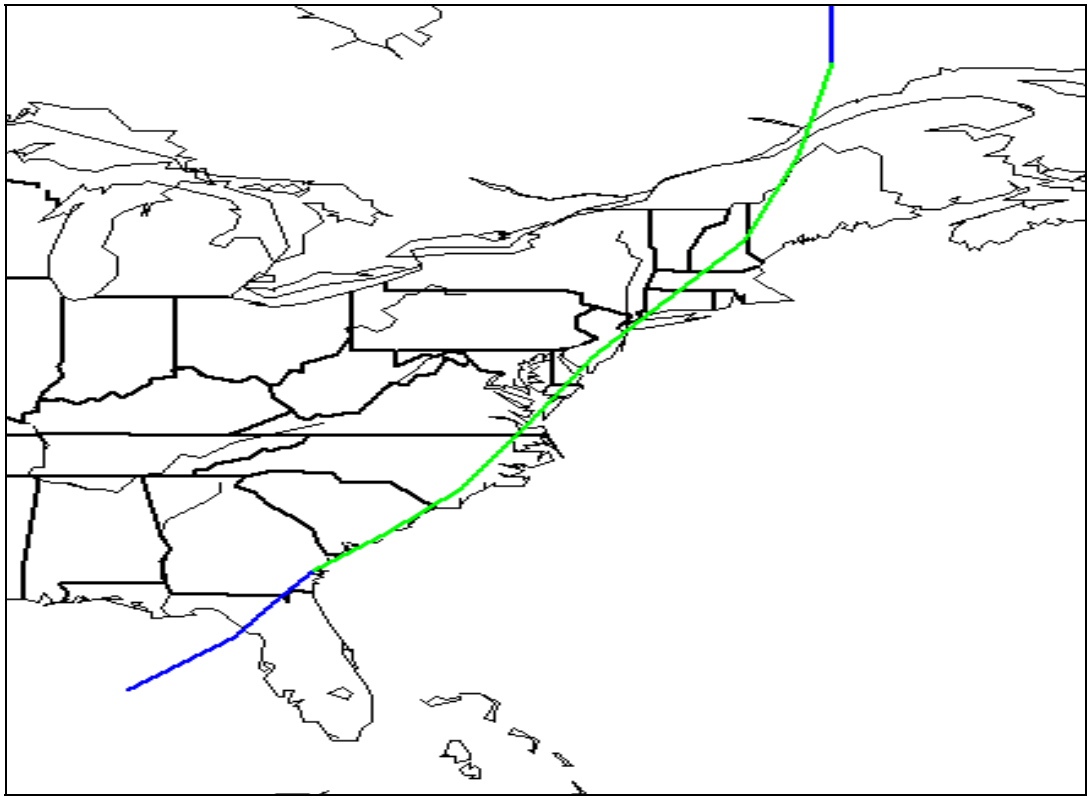

Fig. 98: July 29, 1960. *BRENDA*.

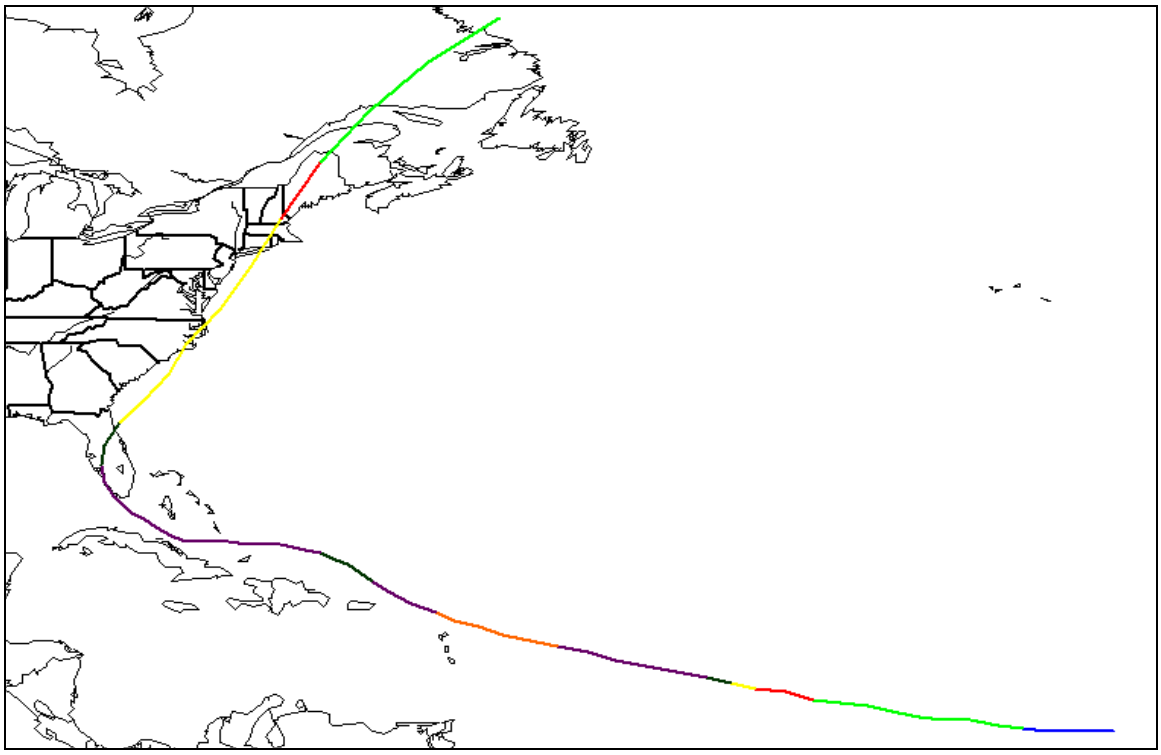

Fig. 99: September 11, 1960. *DONNA.*

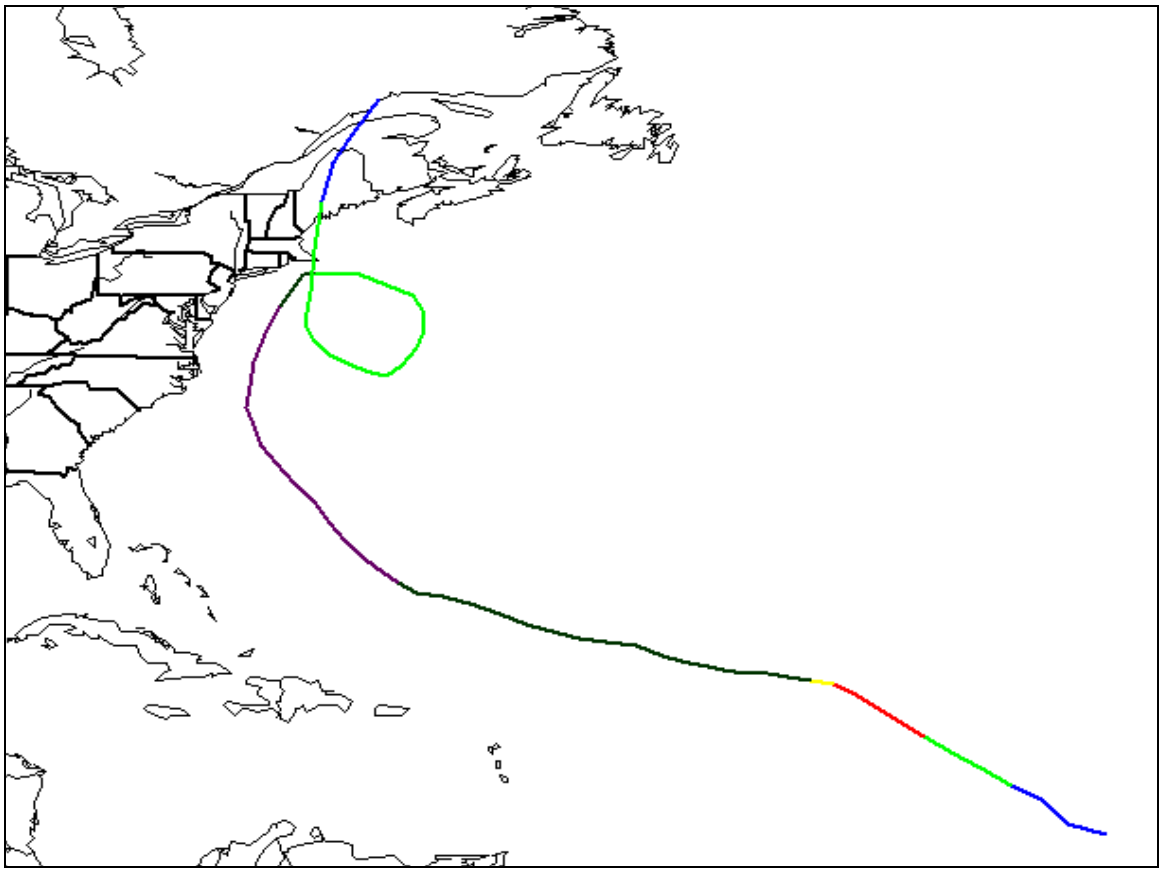

Fig. 100: September 20, 1961. *ESTHER.*

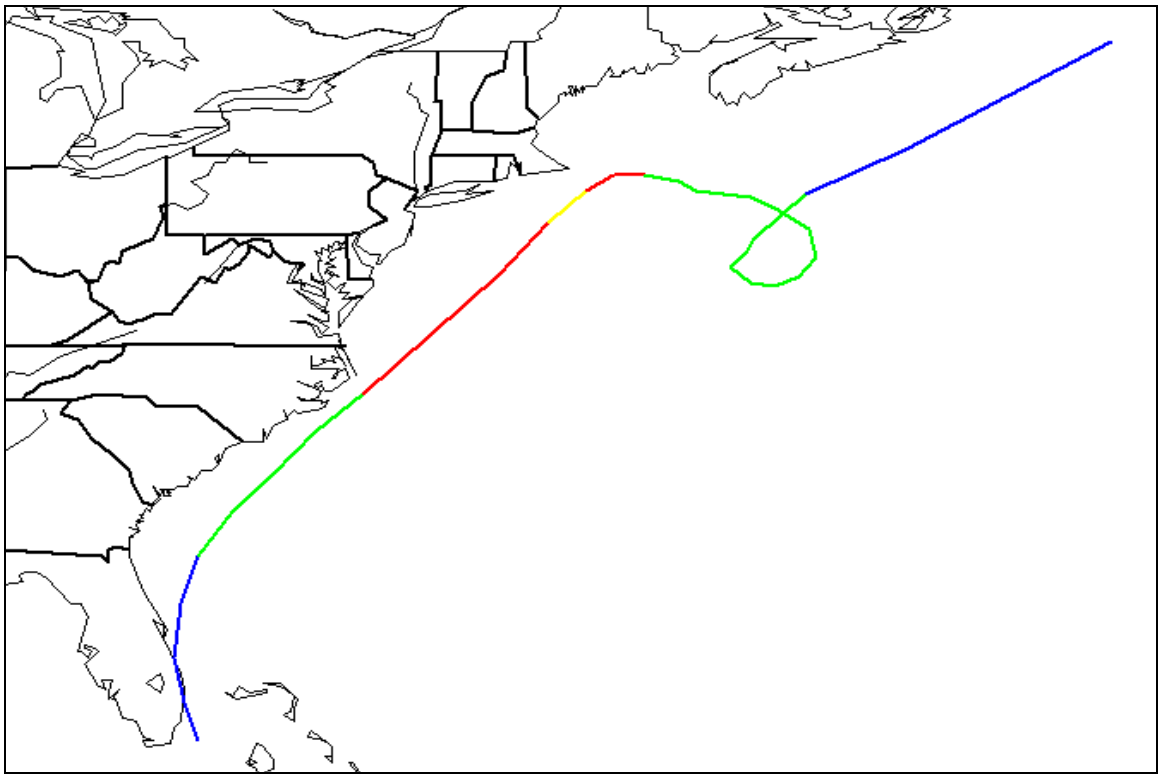

Fig. 101: August 28, 1962. *ALMA*.

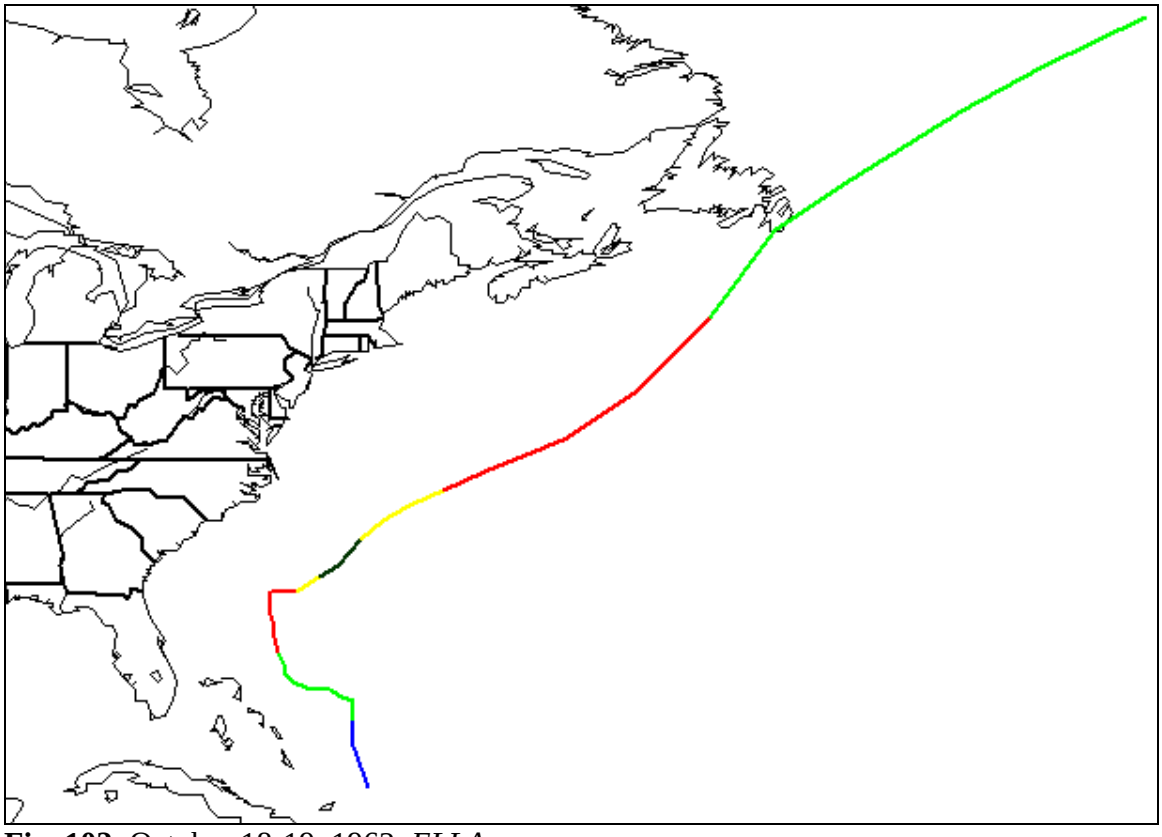

Fig. 102: October 18-19, 1962. *ELLA*.

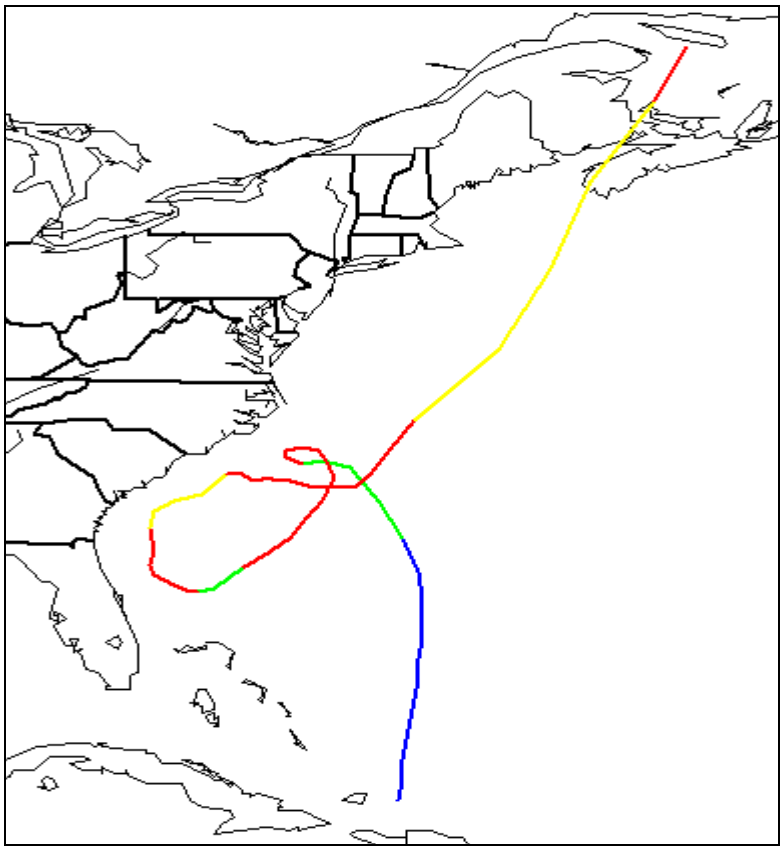

Fig. 103: October 19-27, 1963. *GINNY*.

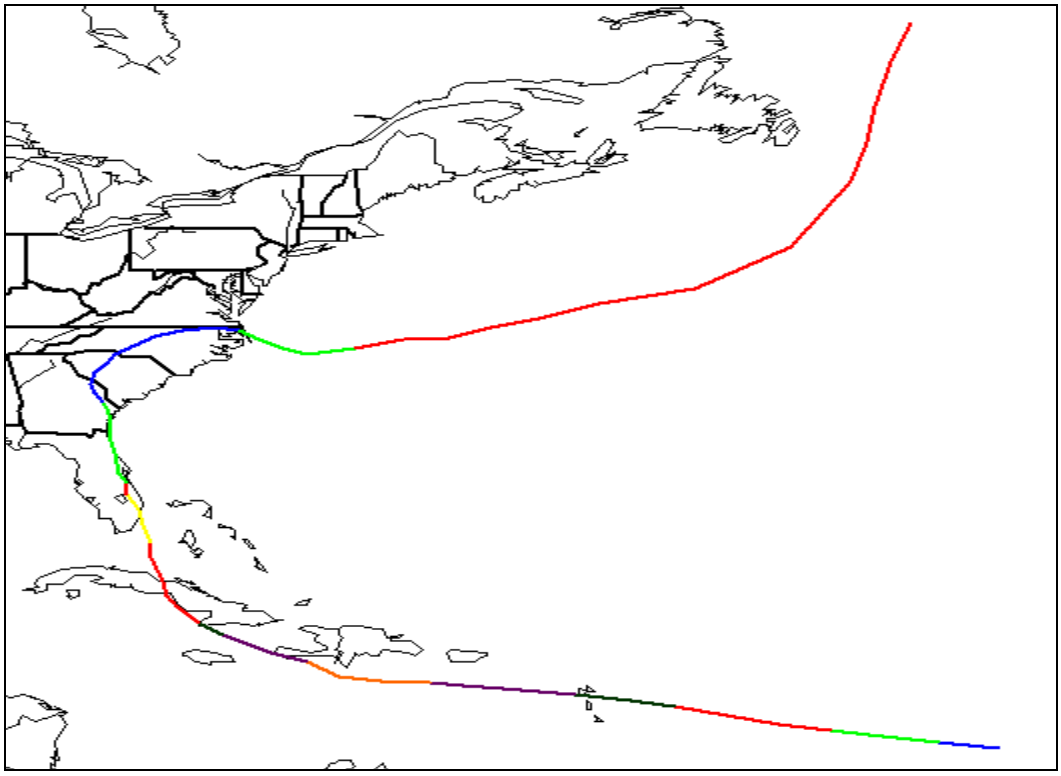

Fig. 104: August 29-September 1, 1964. *CLEO*.

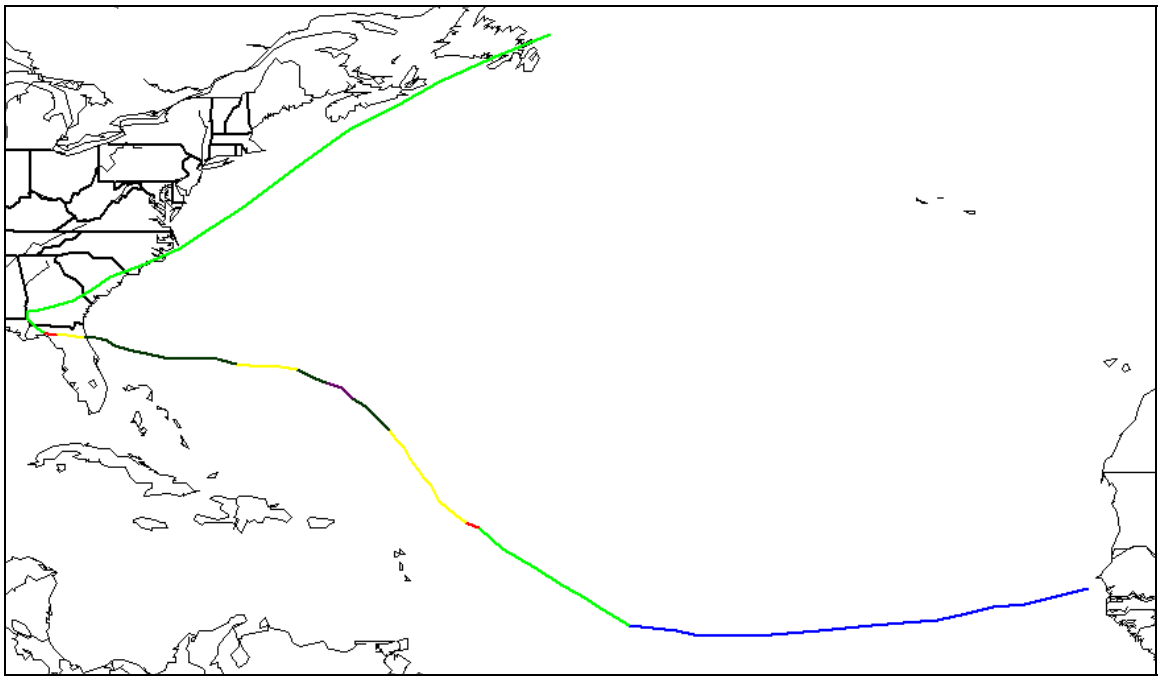

Fig. 105: September 13, 1964. *DORA*.

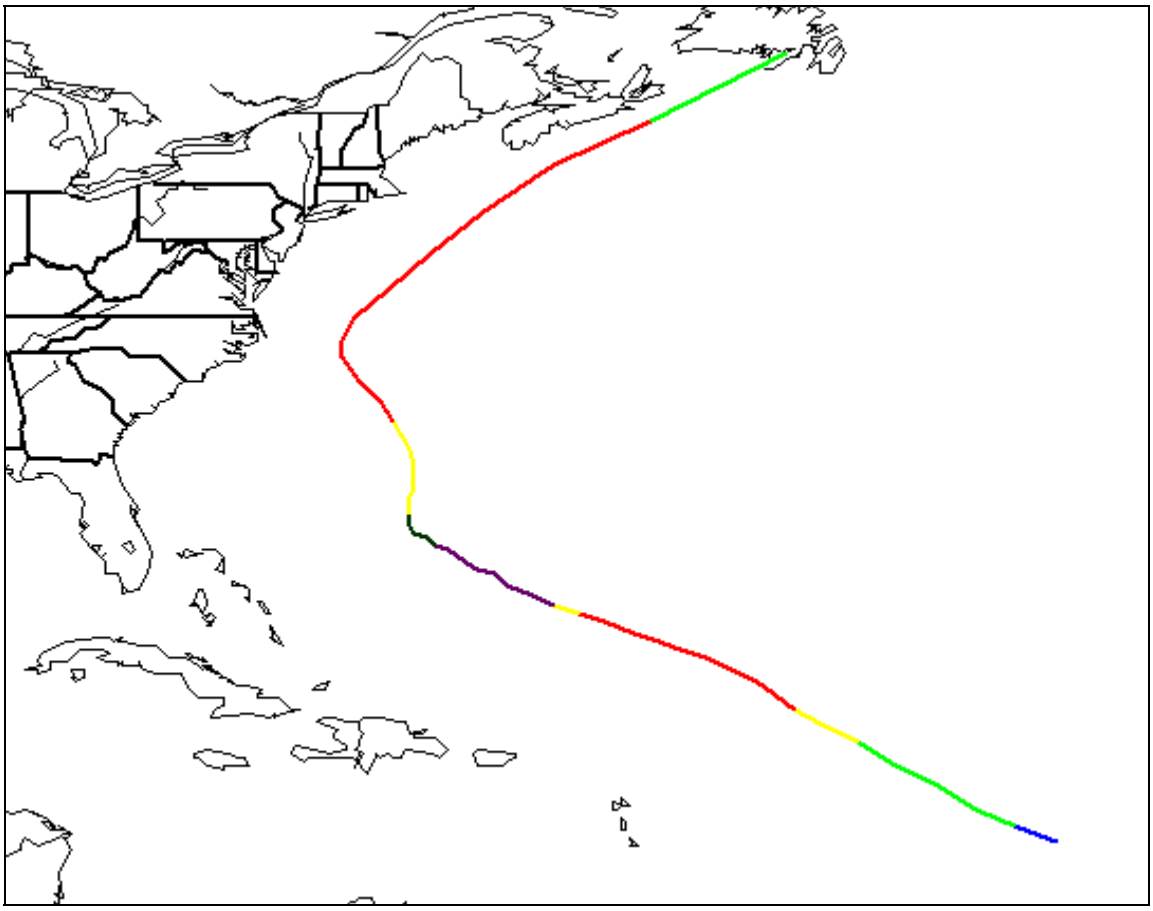

Fig. 106: September 21-23, 1964. *GLADYS*.

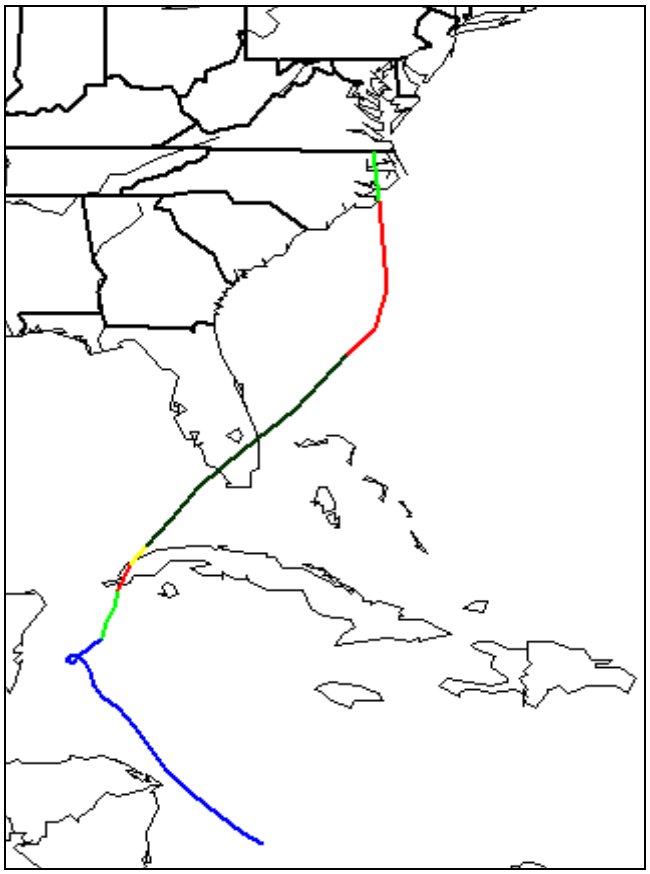

Fig. 107: October 16, 1964. *ISABELL*.

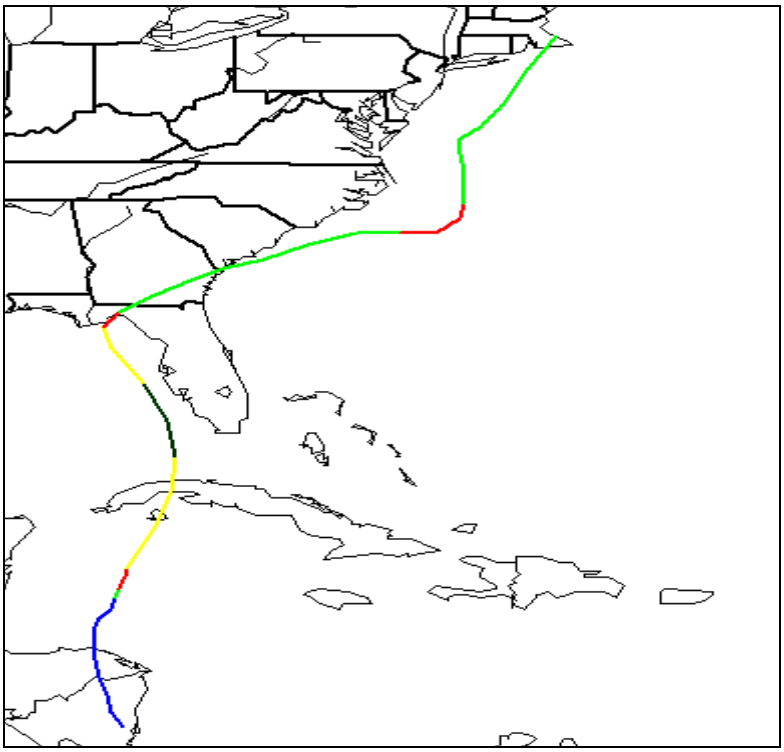

Fig. 108: June 11-12, 1966. *ALMA*.

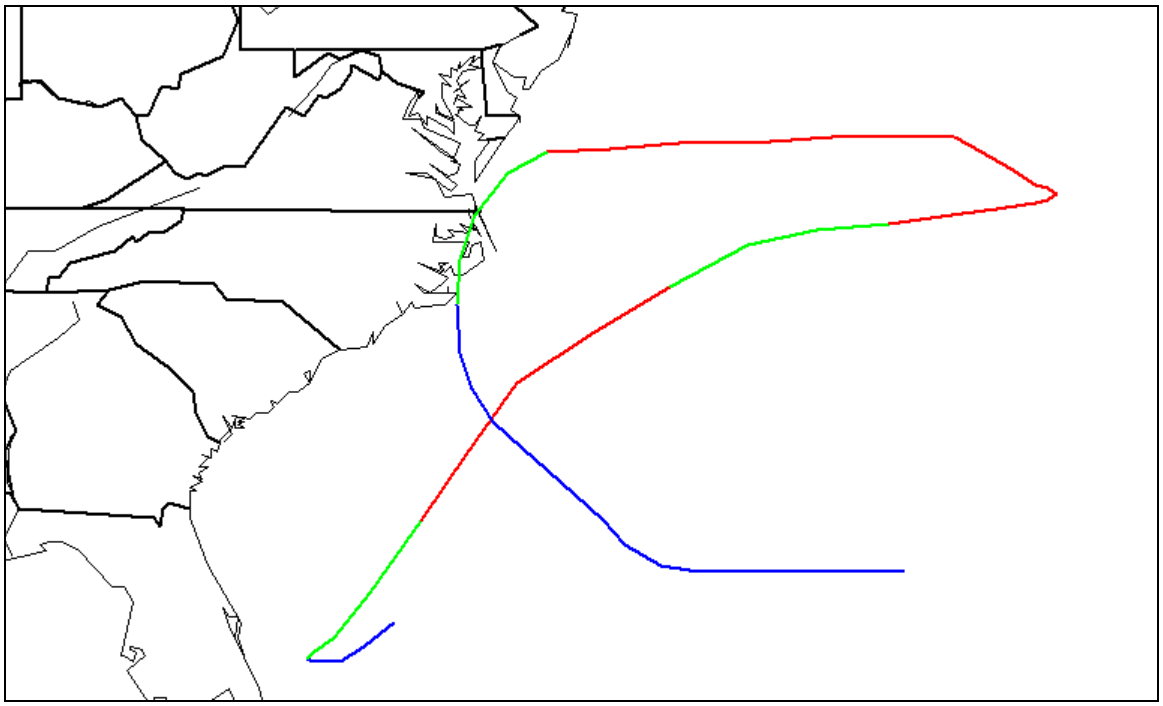

Fig. 109: September 10, 16-17, 1967. *DORIA*.

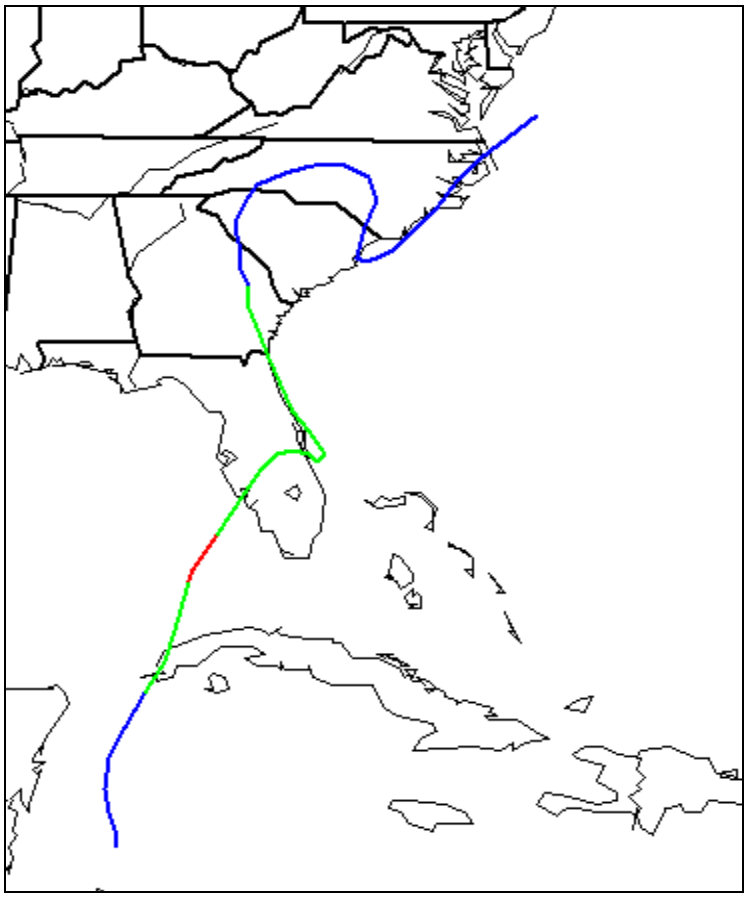

Fig. 110: June 7-13, 1968. *ABBY*.

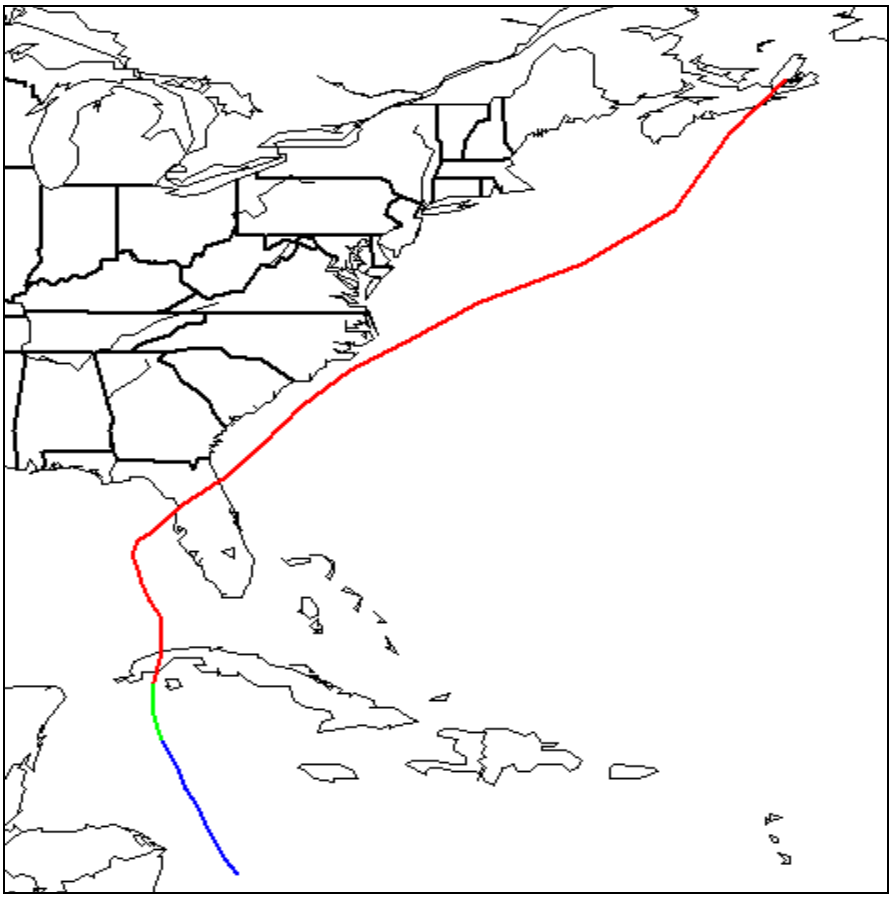

Fig. 111: October 19-20, 1968. *GLADYS*.

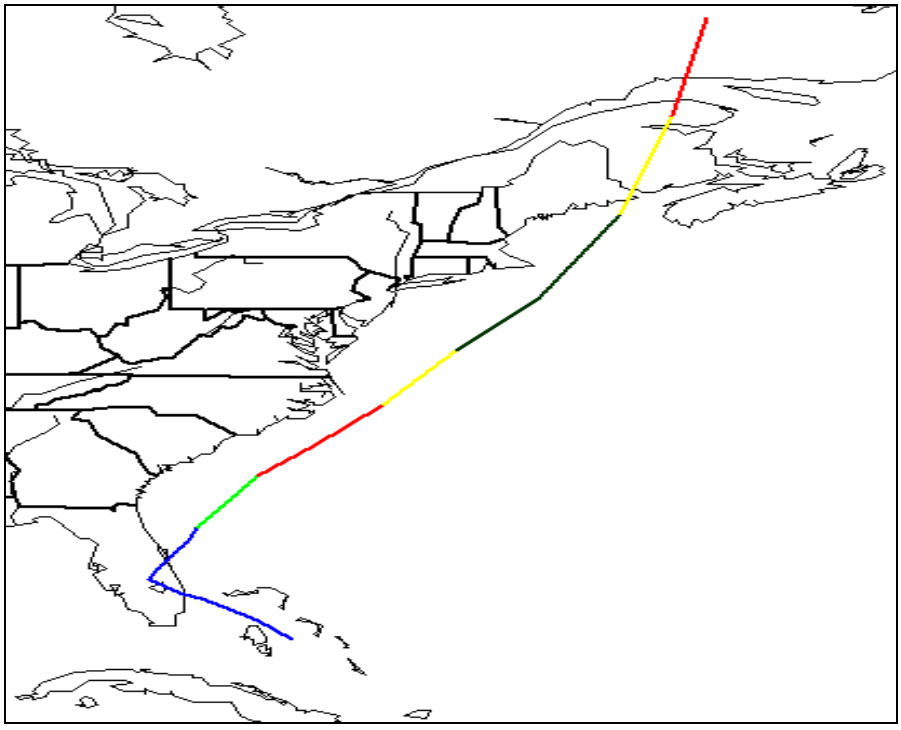

Fig. 112: September 8, 1969. *GERDA*.

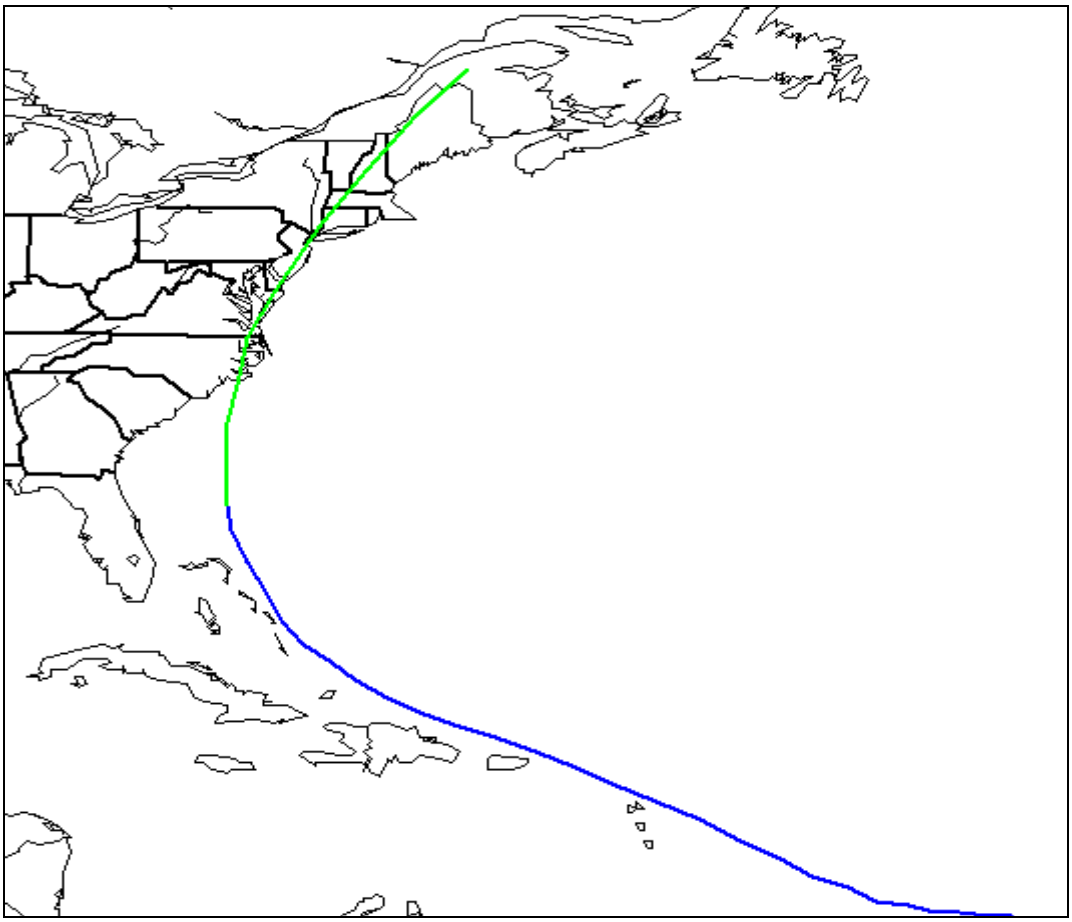

Fig. 113: August 27, 1971. *DORIA*.

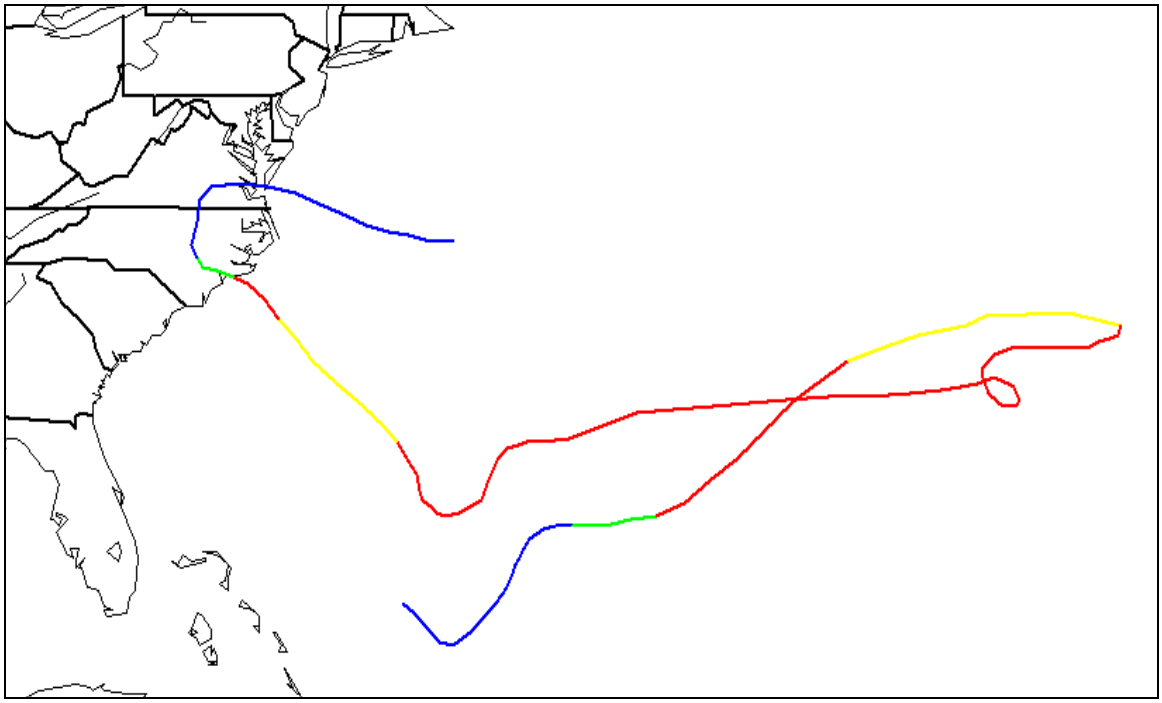

Fig. 114: September 30-October1, 1971. *GINGER*.

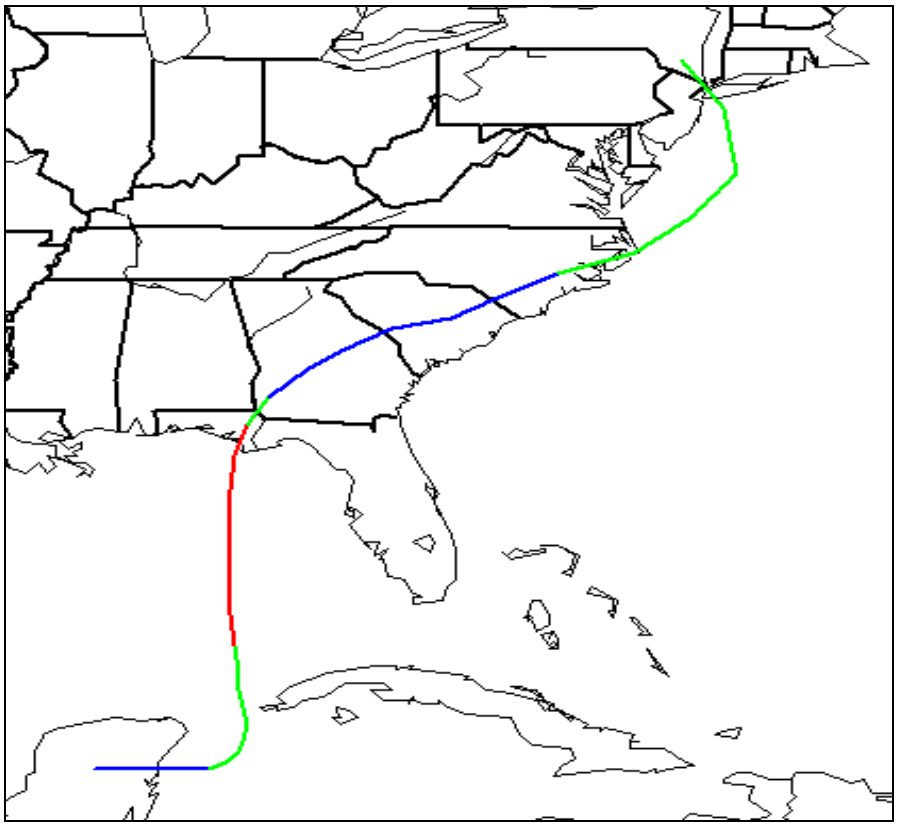

Fig. 115(a): June 20-21, 1972. *AGNES.*

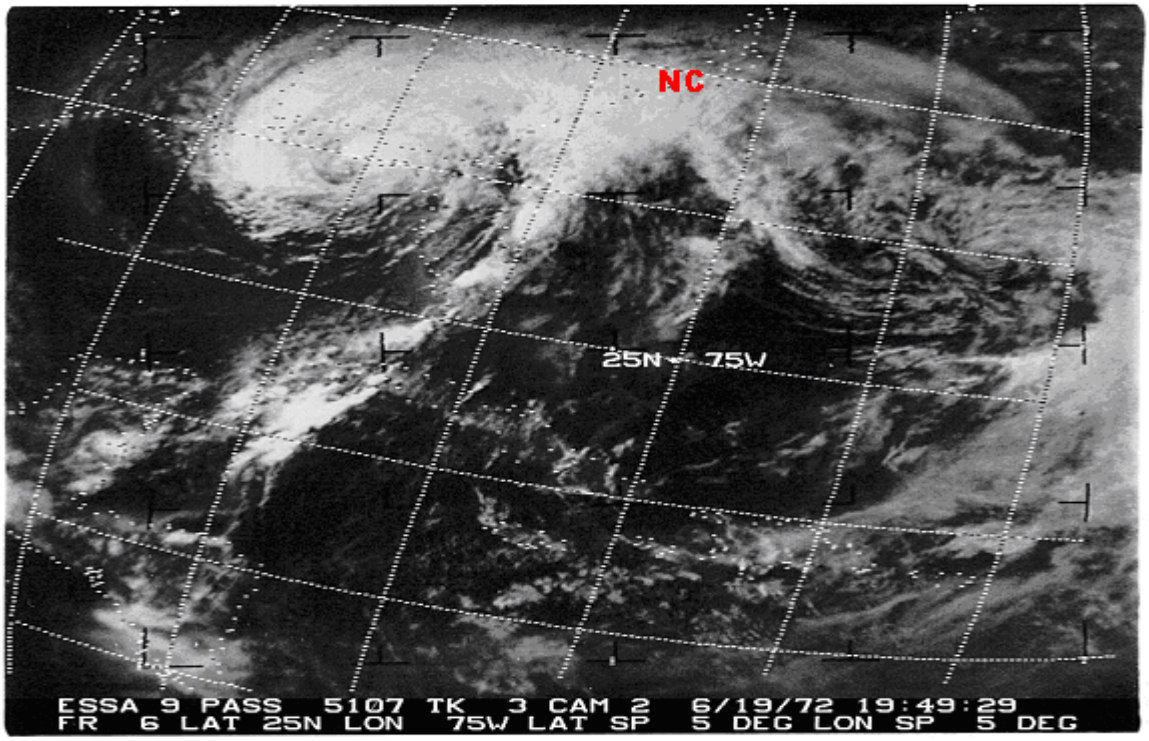

Fig. 115(b): IR image, AGNES, 1949 UTC, June 19, 1972. *Credit: National Climatic Data Center (NCDC).*

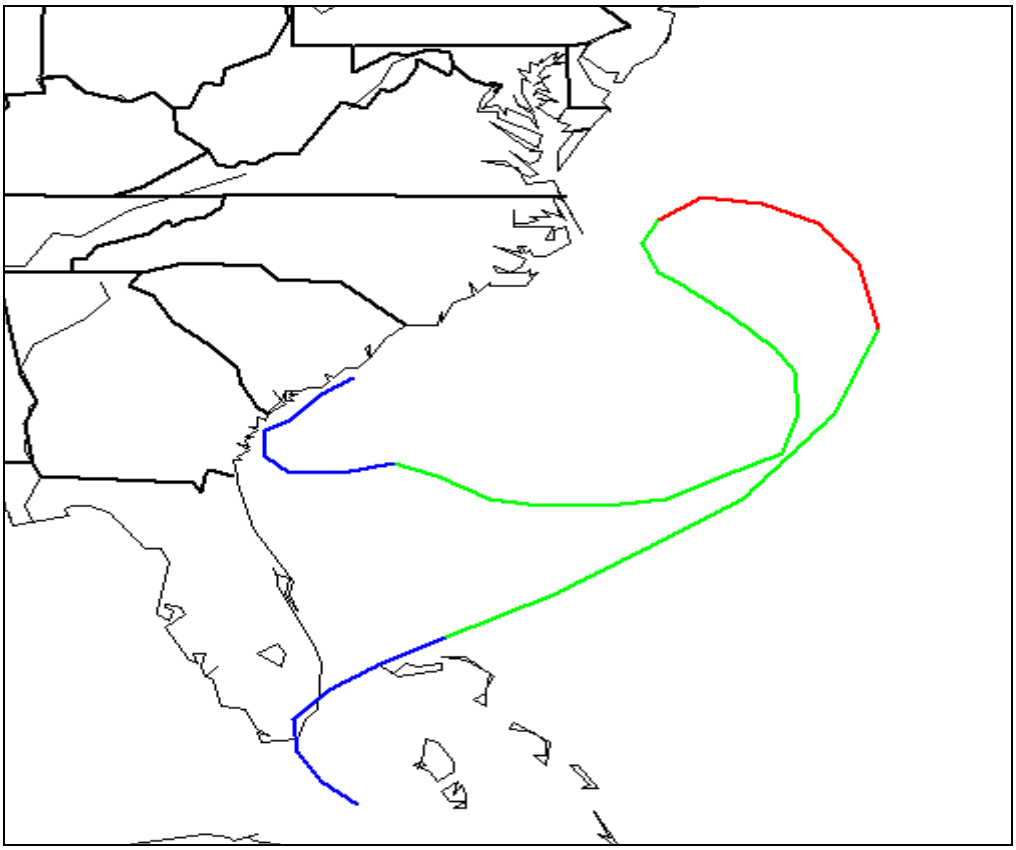

Fig. 116: September 8-9, 1972. *DAWN*.

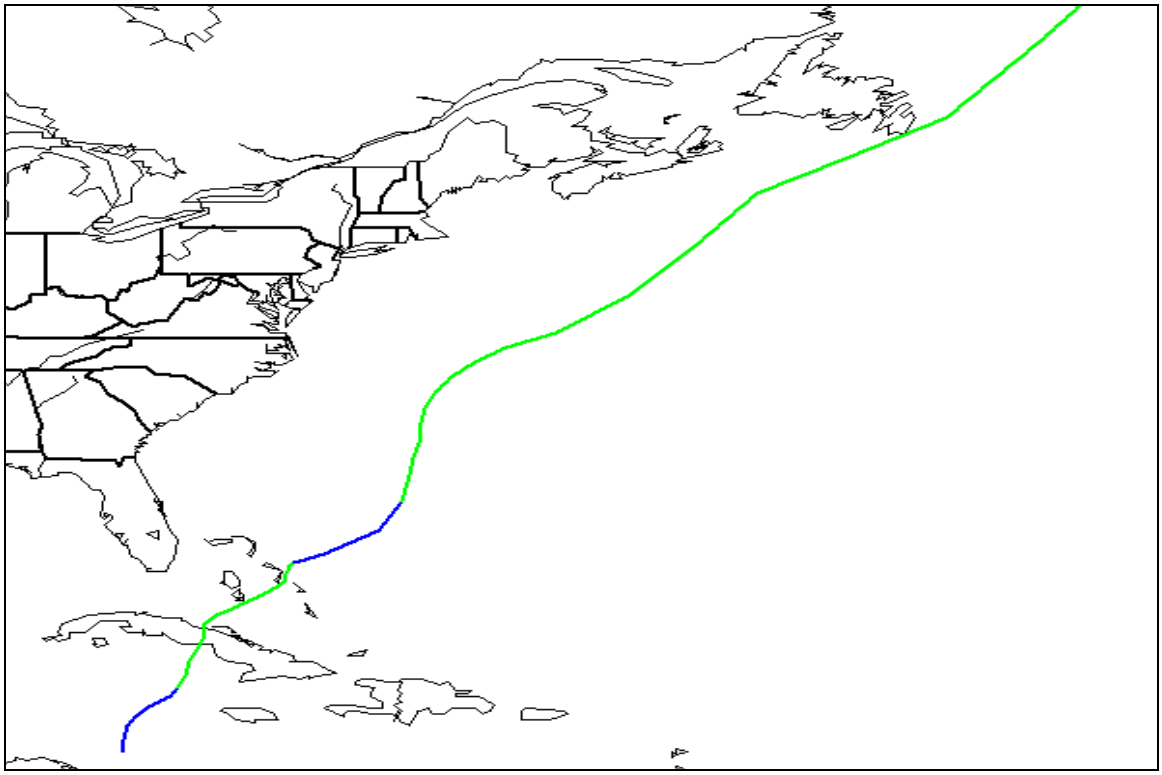

Fig. 117: October 25-26, 1973. *GILDA*.

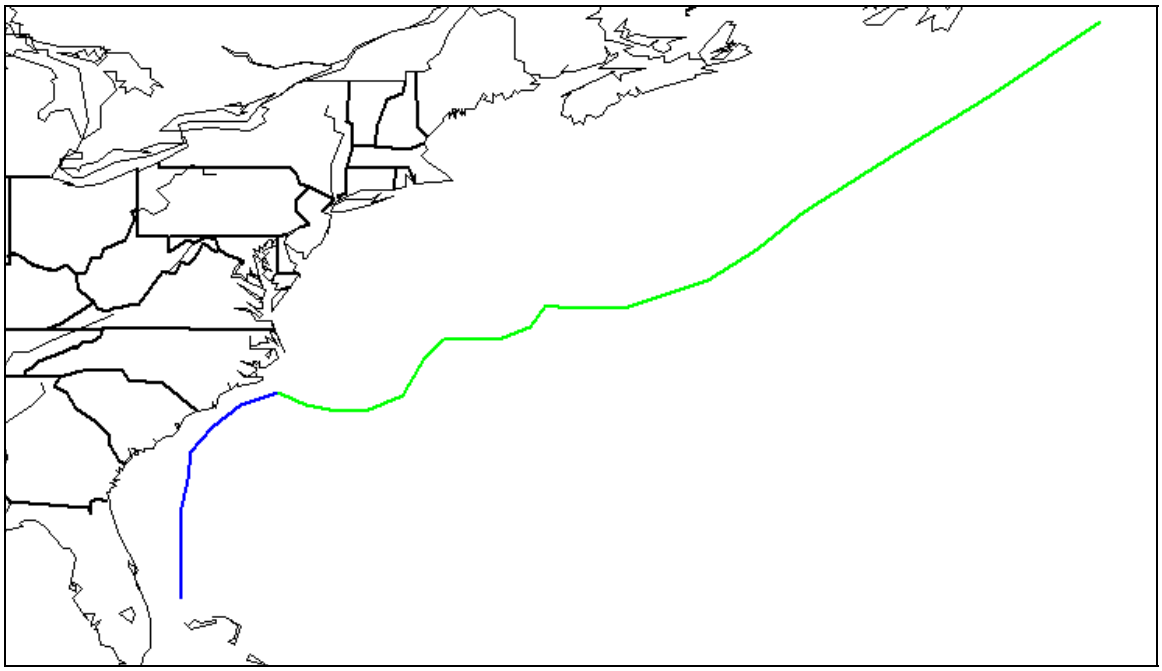

Fig. 118: June 28, 1975. *AMY*.

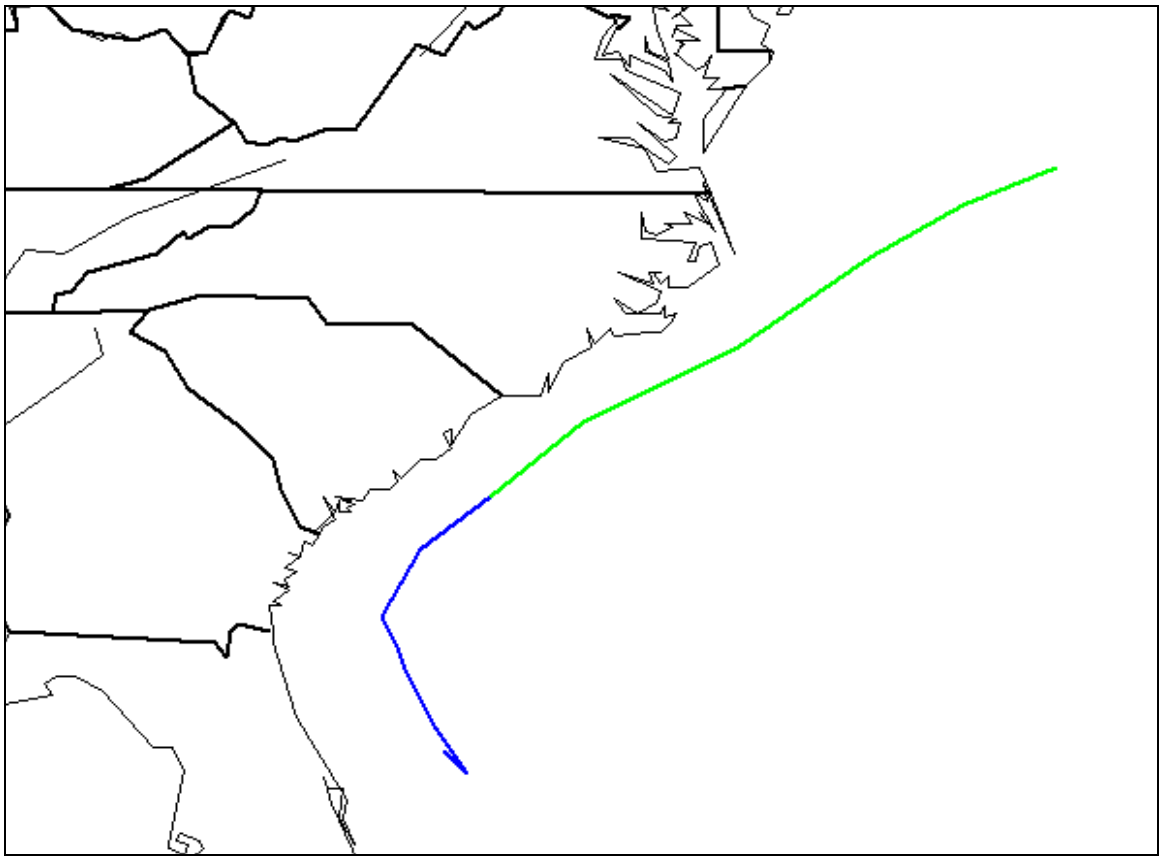

Fig. 119: October 26-27, 1975. *HALLIE*.

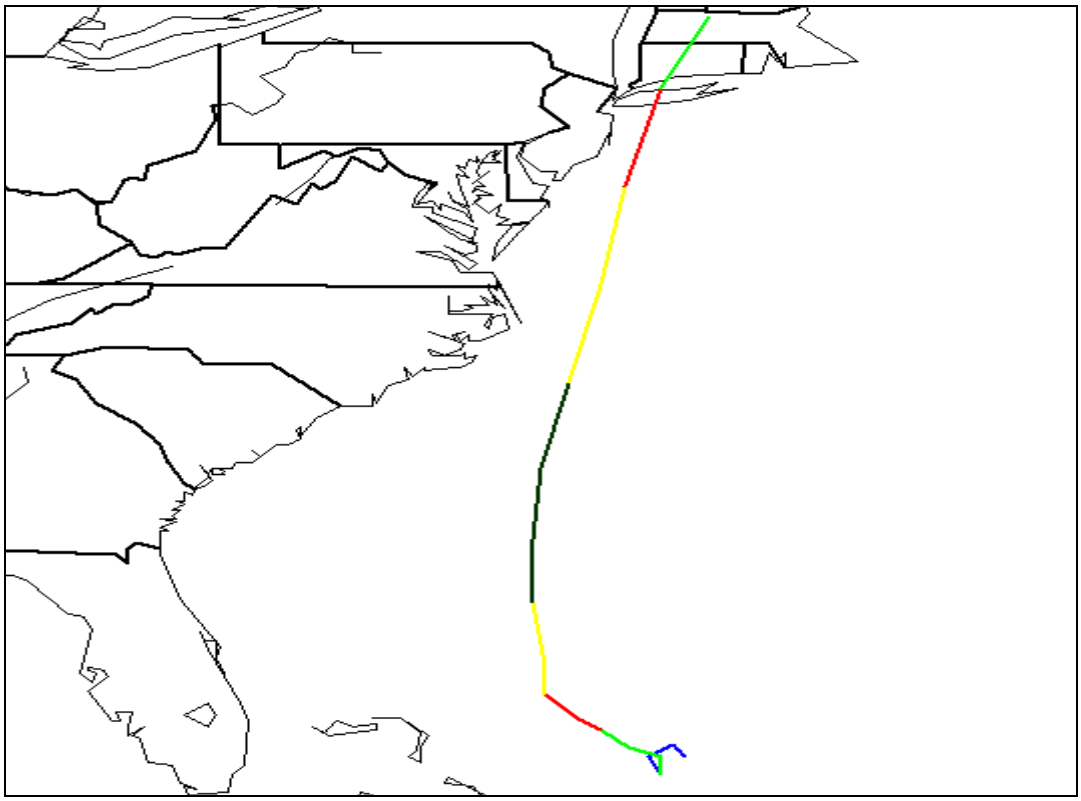

Fig. 120: August 9, 1976. *BELLE*.

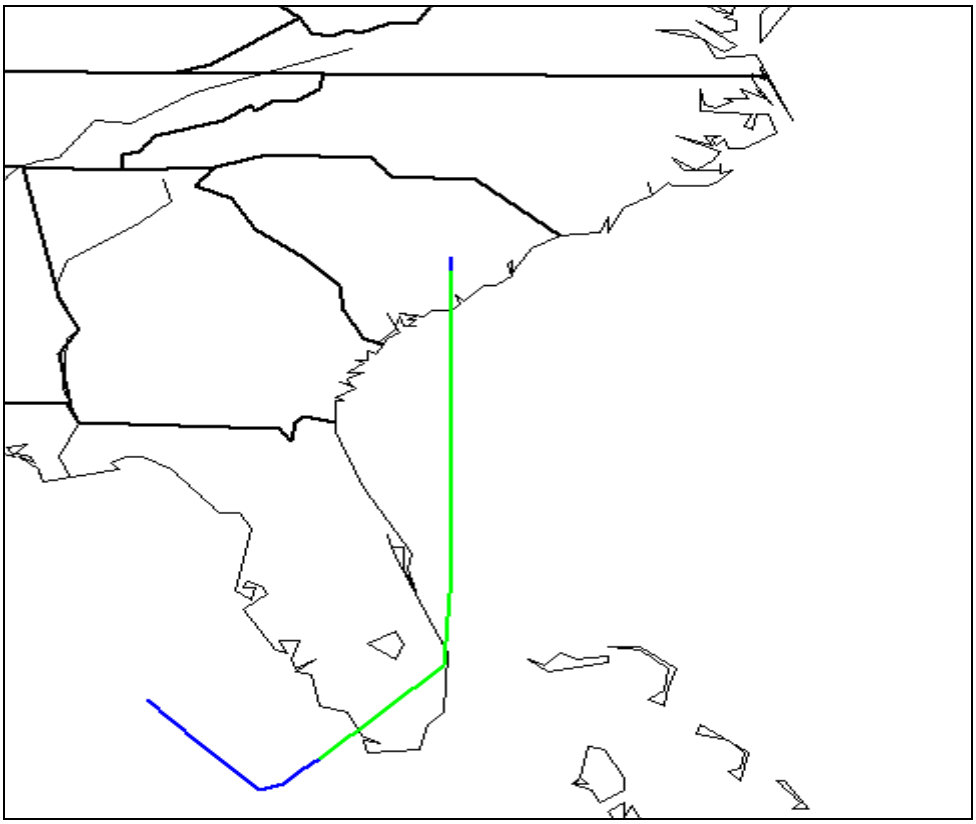

Fig. 121: August 20-21, 1976. *DOTTIE*.

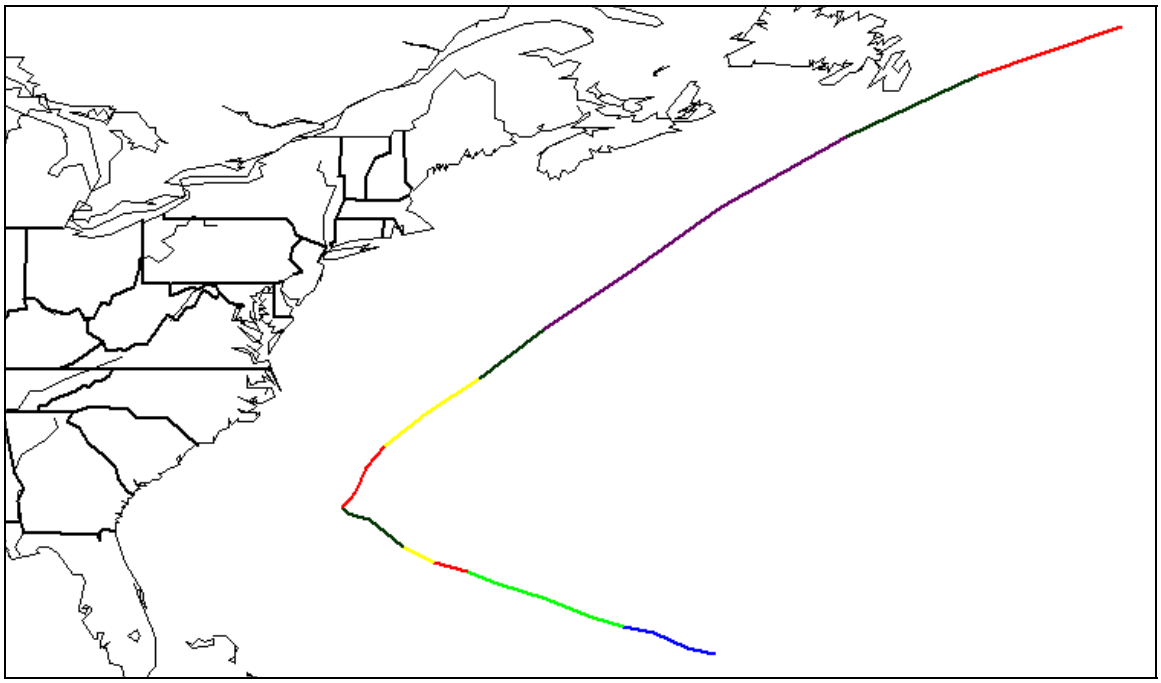

Fig. 122: September 1-2, 1978. *ELLA*.

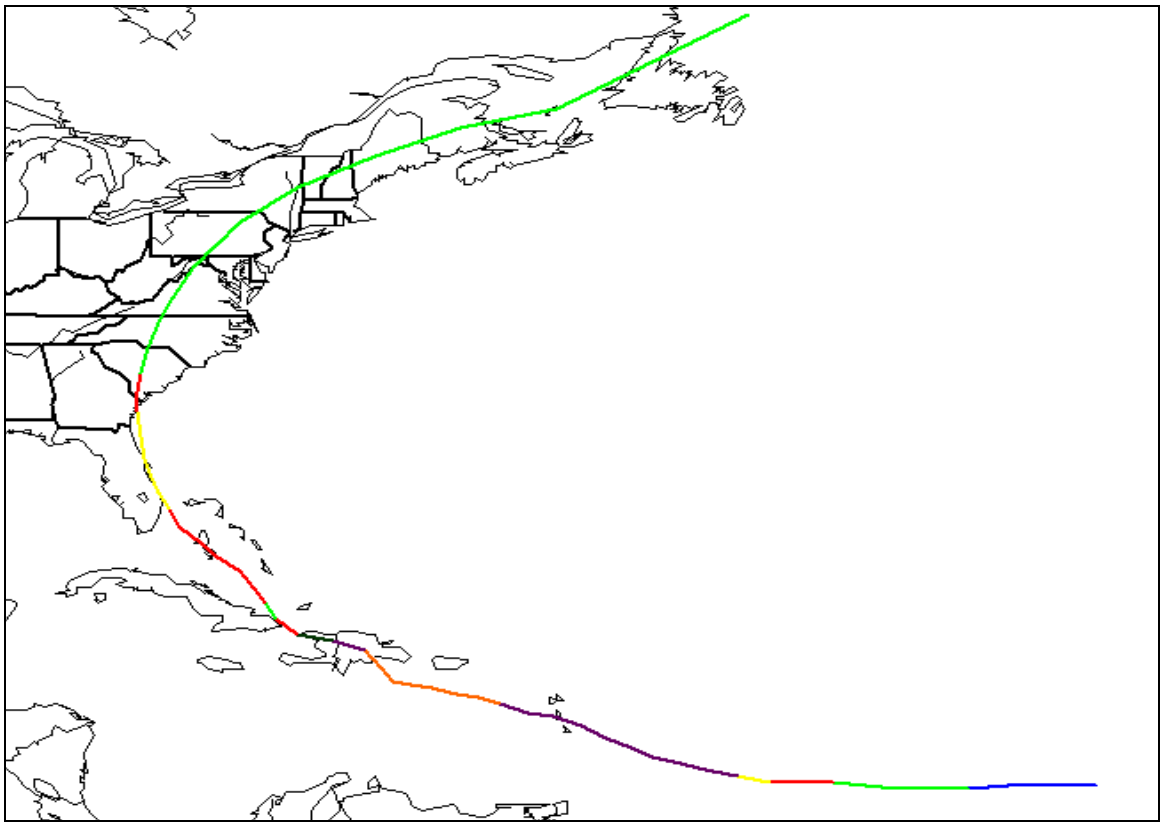

Fig. 123(a): September 5, 1979. *DAVID*.

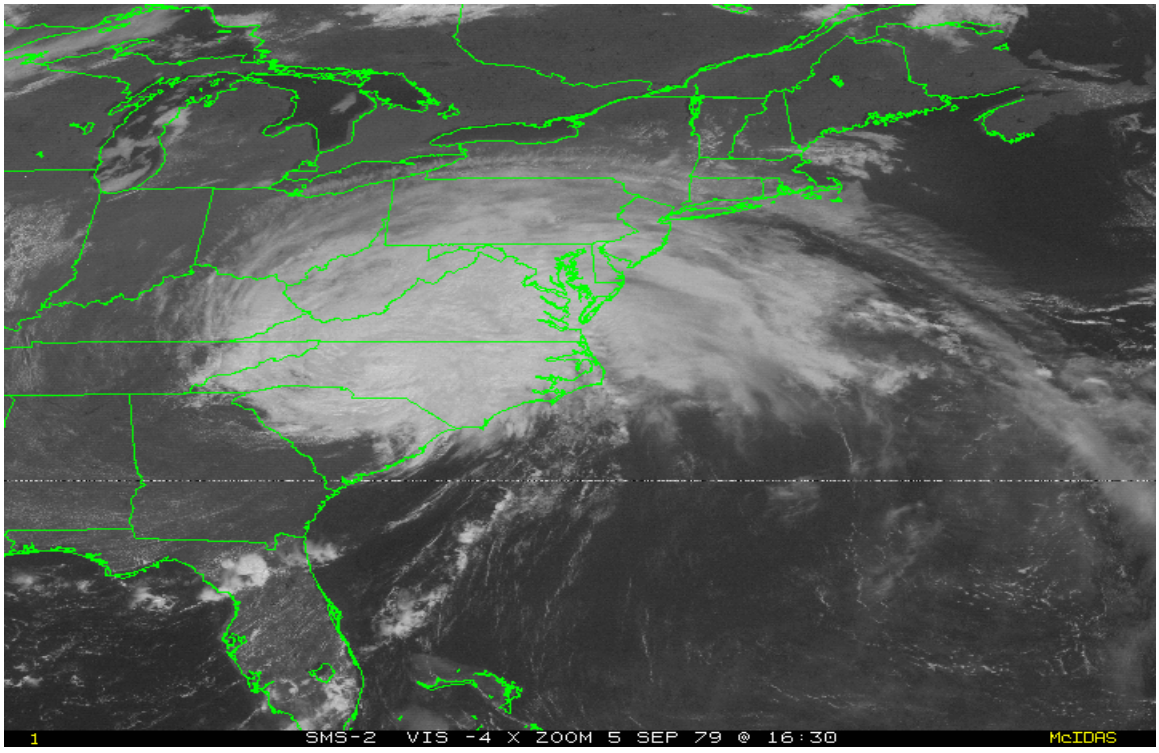

Fig. 123(b): Visible image, DAVID, 1630 UTC, September 5, 1979. *Credit: National Climatic Data Center (NCDC).*

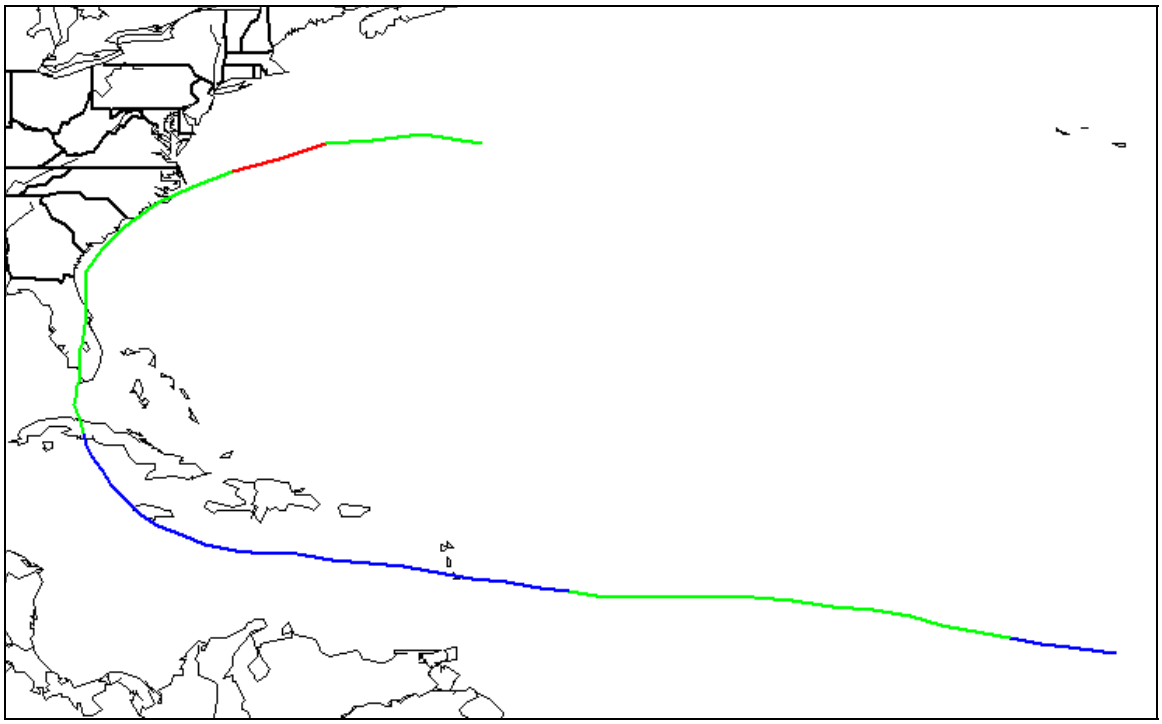

Fig. 124(a): August 20-21, 1981. *DENNIS*.

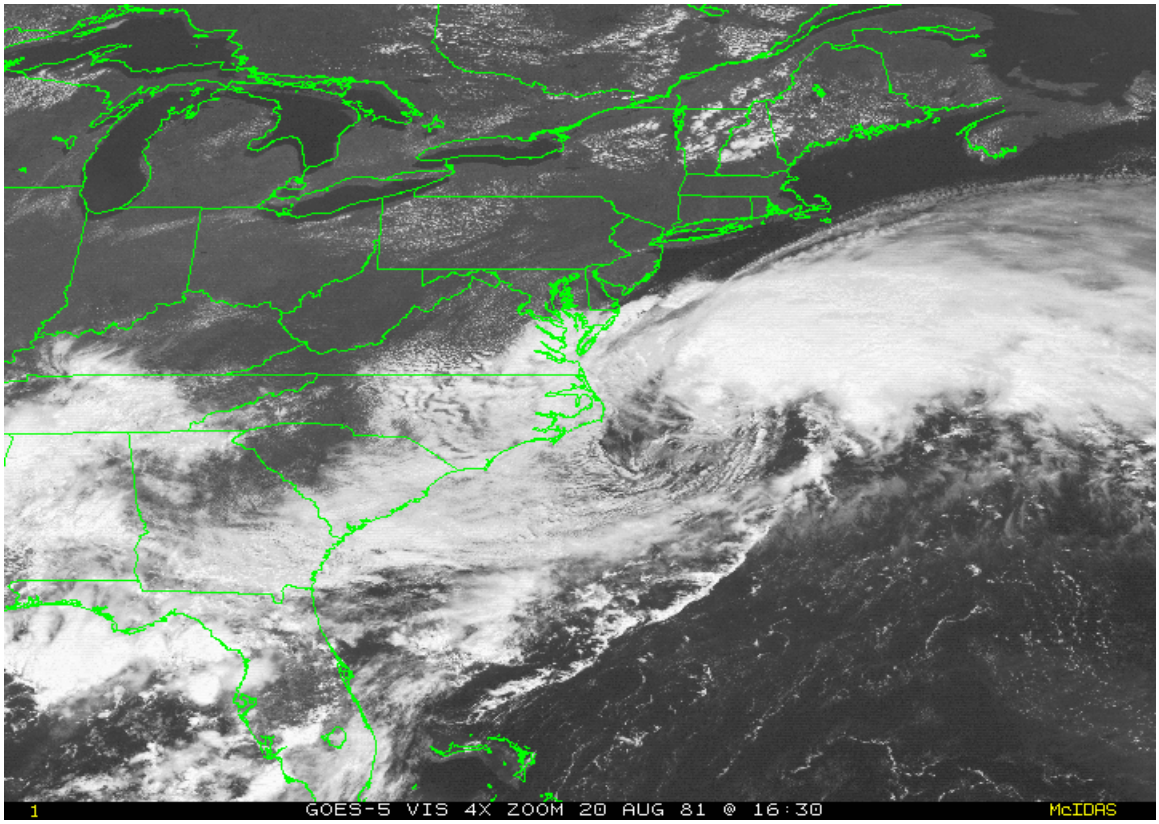

Fig. 124(b): Visible Image, DENNIS, 1630 UTC, August 20, 1981. *Credit: National Climatic Data Center (NCDC).*

Fig. 125(a): June 18-19, 1982. *SUBTROPICAL STORM (ST).*

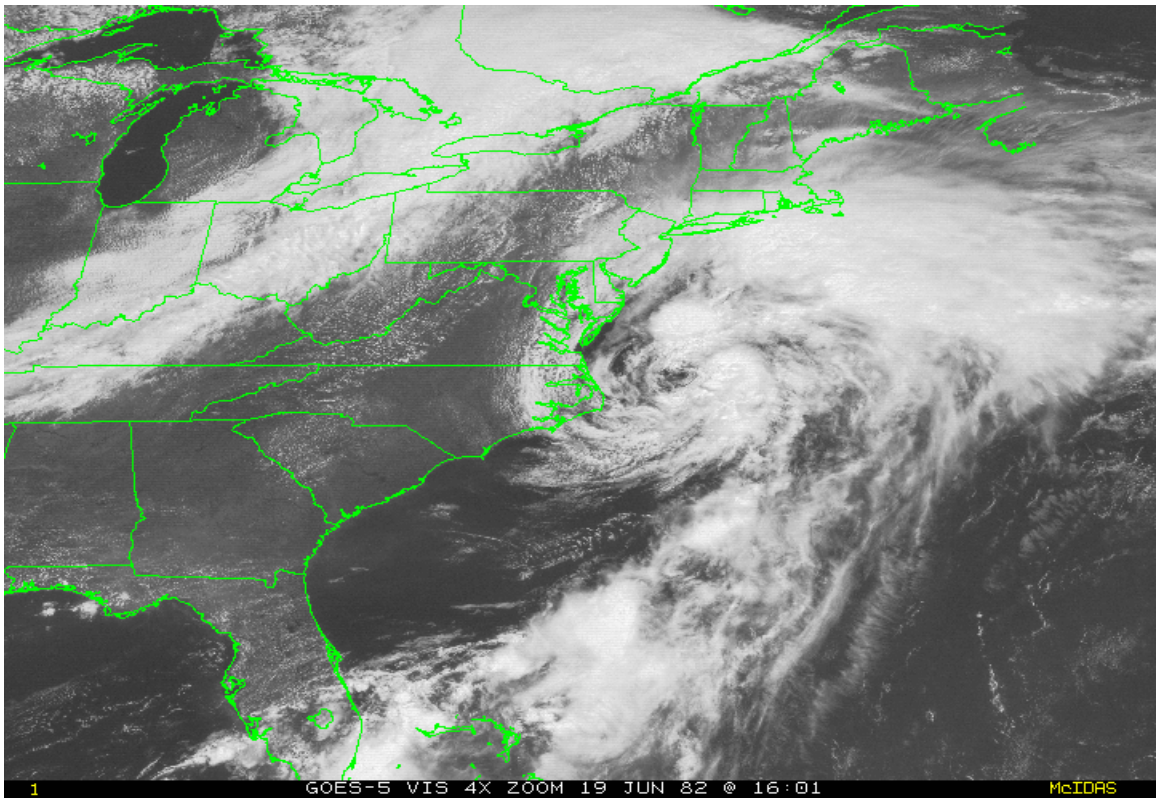

Fig. 125(b): Visible Image, ST, 1601 UTC, June 19, 1982. *Credit: National Climatic Data Center (NCDC).*

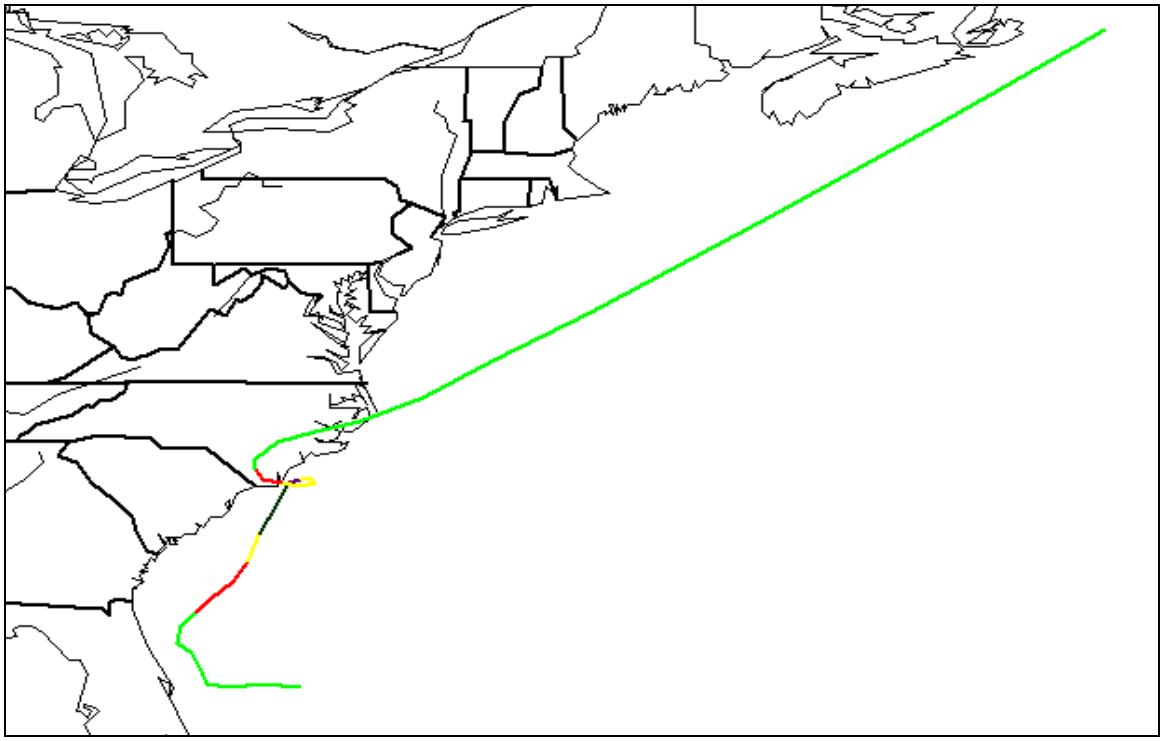

Fig. 126(a): September 9-14, 1984. *DIANA*.

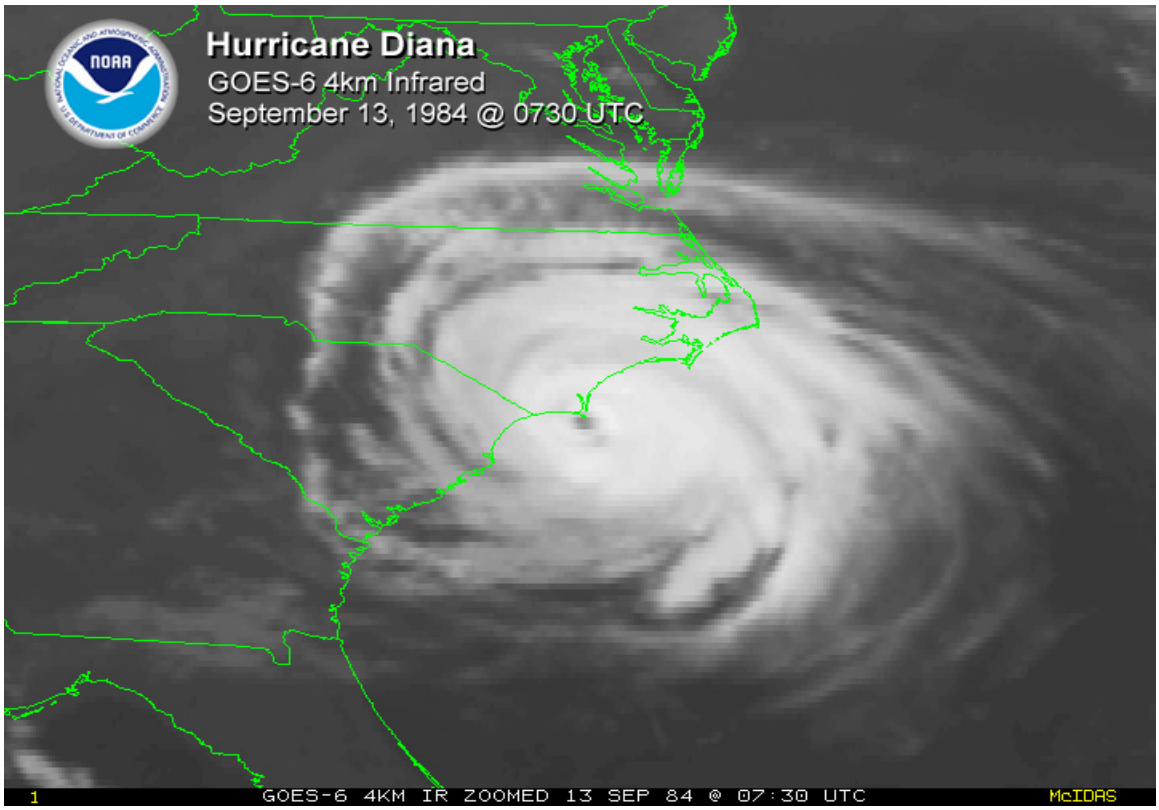

Fig. 126(b): IR image, DIANA, 0730 UTC, September 13, 1984. *Credit: National Climatic Data Center (NCDC).*

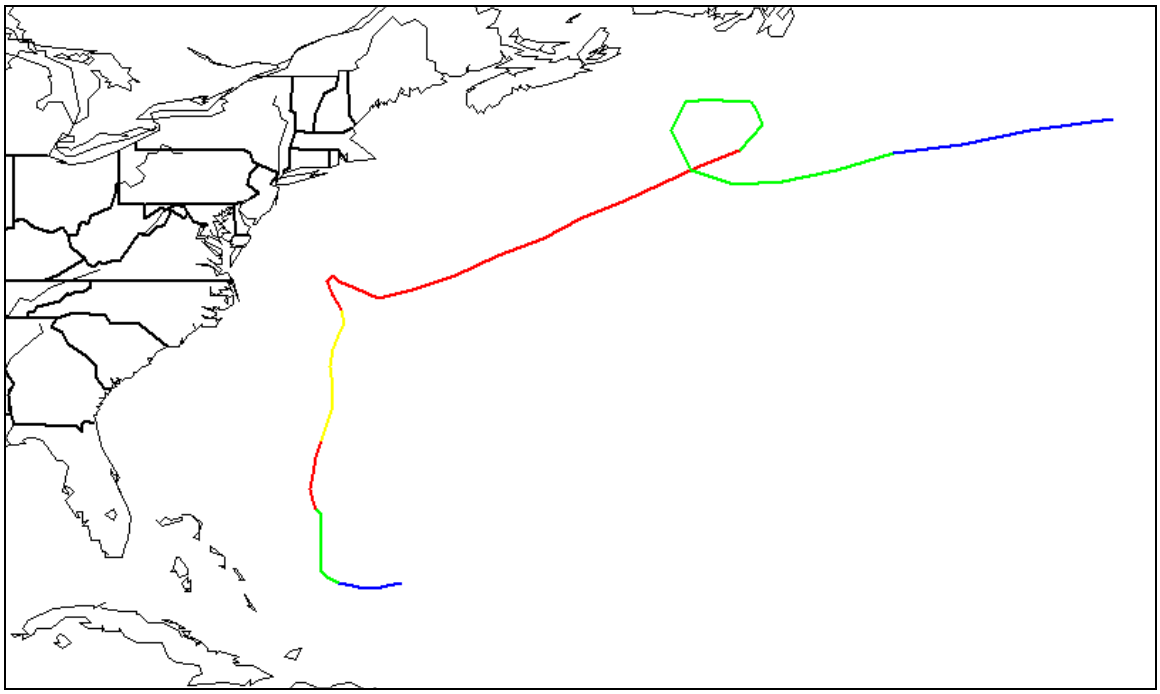

Fig. 127(a): October 12-15, 1984. *JOSEPHINE*.

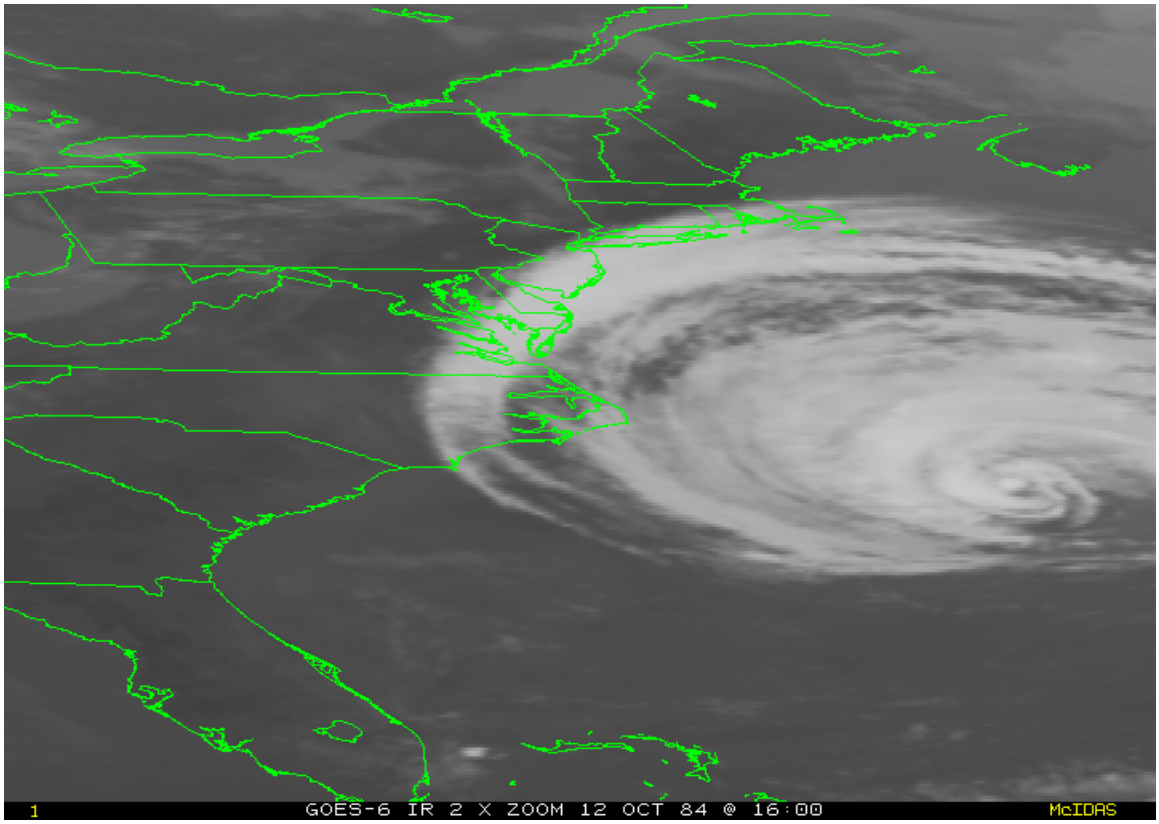

Fig. 127(b): IR Image, JOSEPHINE, 1600 UTC, October 12, 1984. *Credit: National Climatic Data Center (NCDC).*

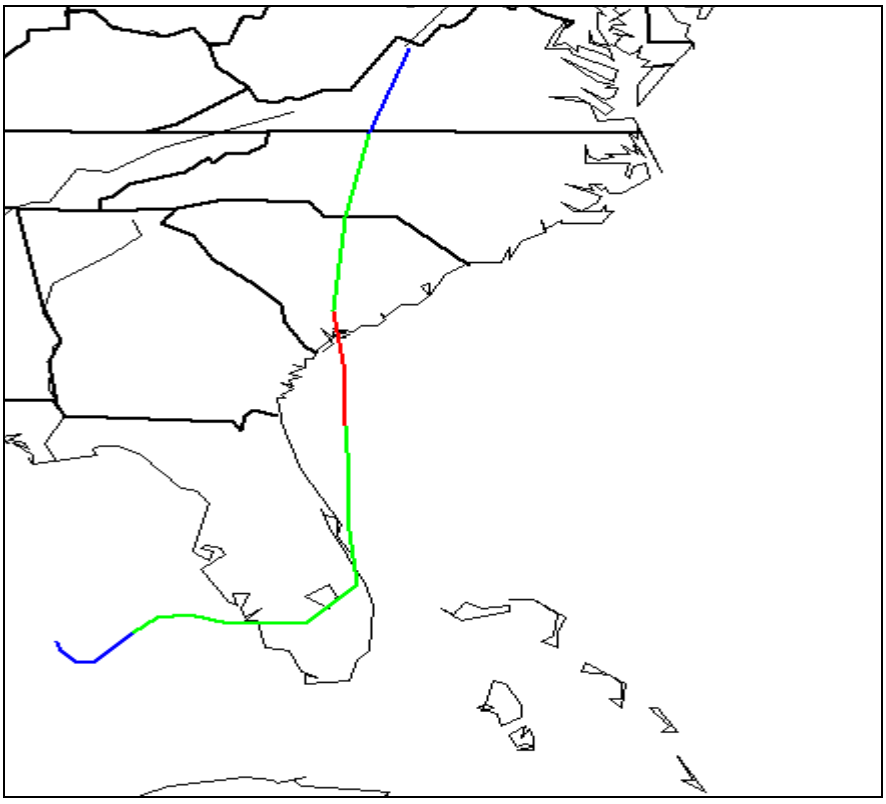

Fig. 128(a): July 24-26, 1985. *BOB.*

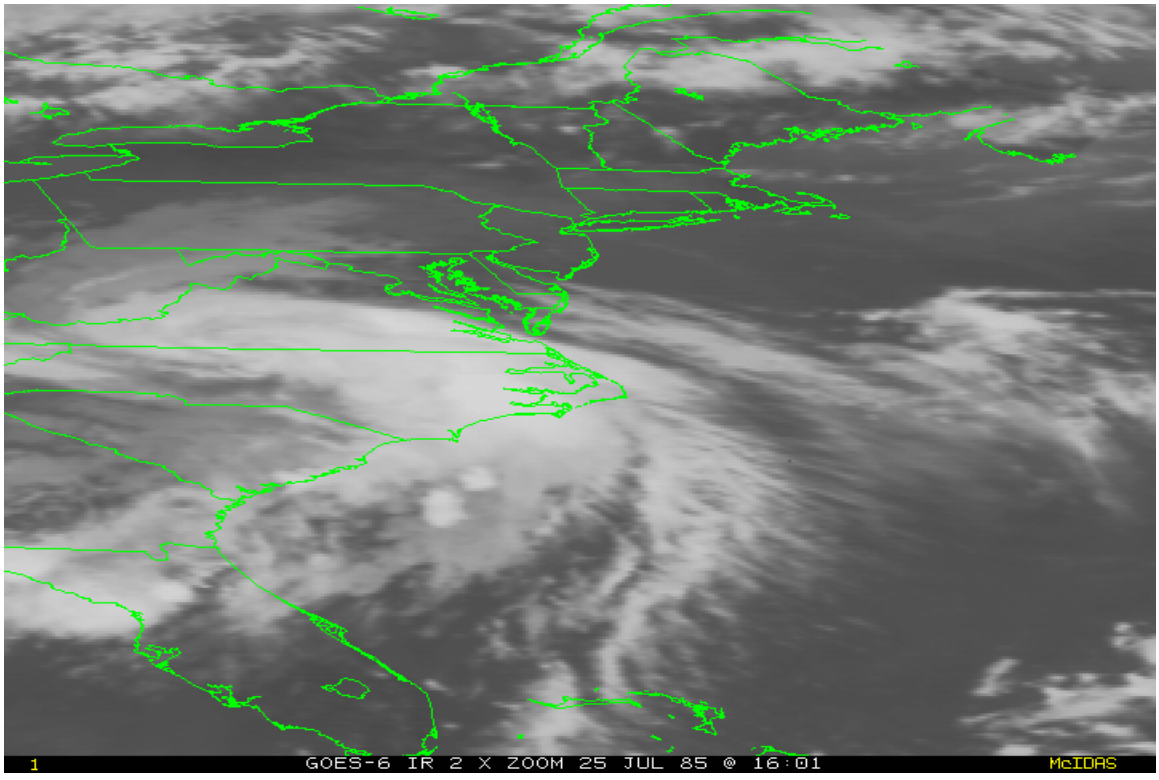

Fig. 128(b): IR Image, BOB, 1601 UTC, July 25, 1985. *Credit: National Climatic Data Center (NCDC).*

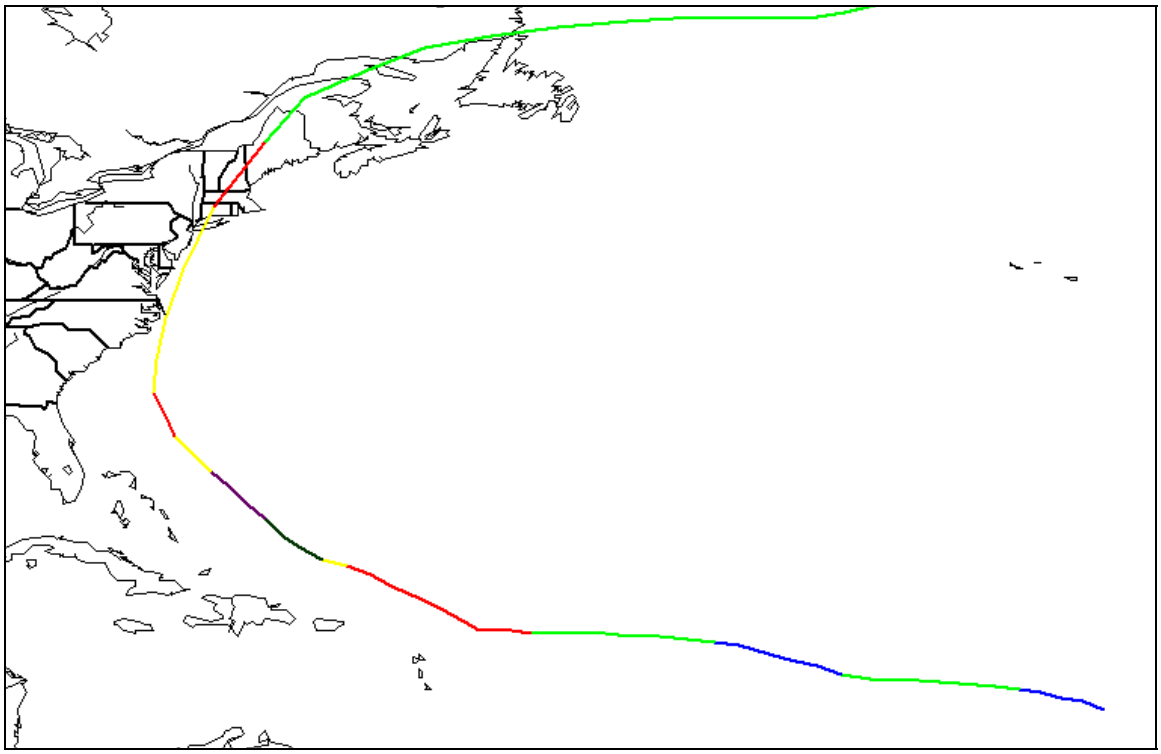

Fig. 129(a): September 26-27, 1985. *GLORIA.*

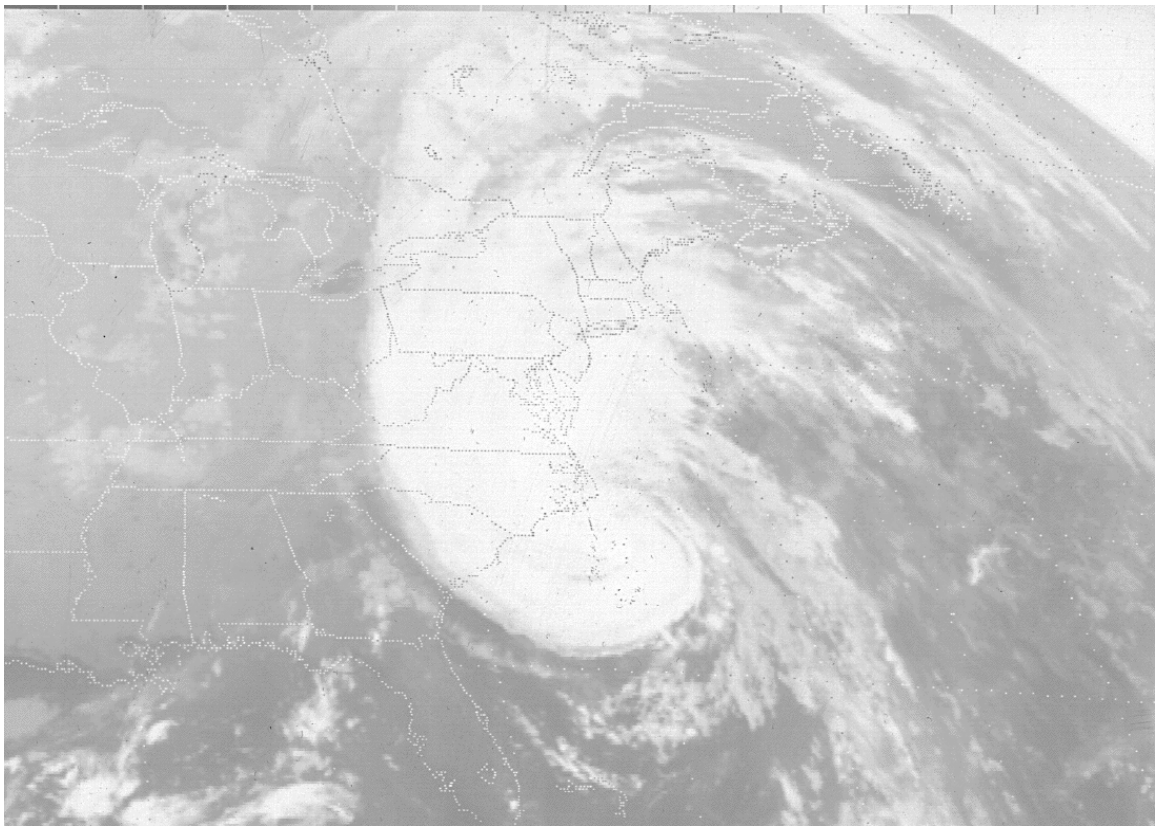

Fig. 129(b): IR image, GLORIA, September 26, 1985. *Credit: National Climatic Data Center (NCDC).*

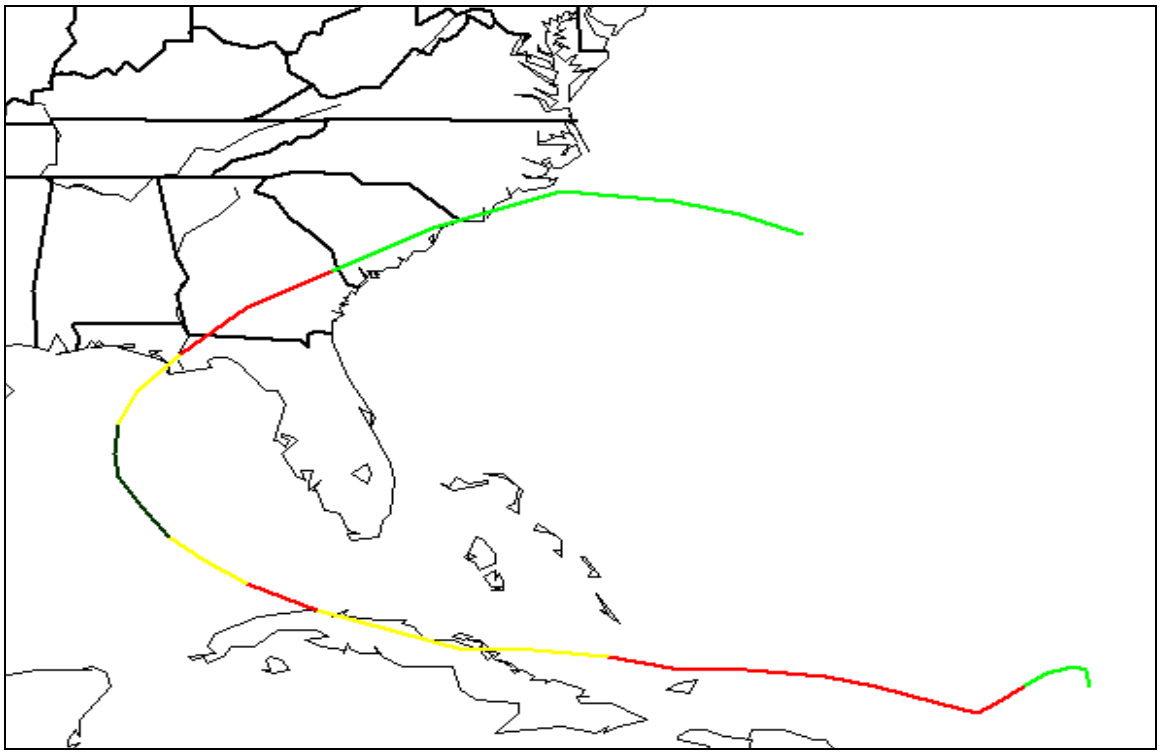

Fig. 130(a): November 22, 1985. *KATE*.

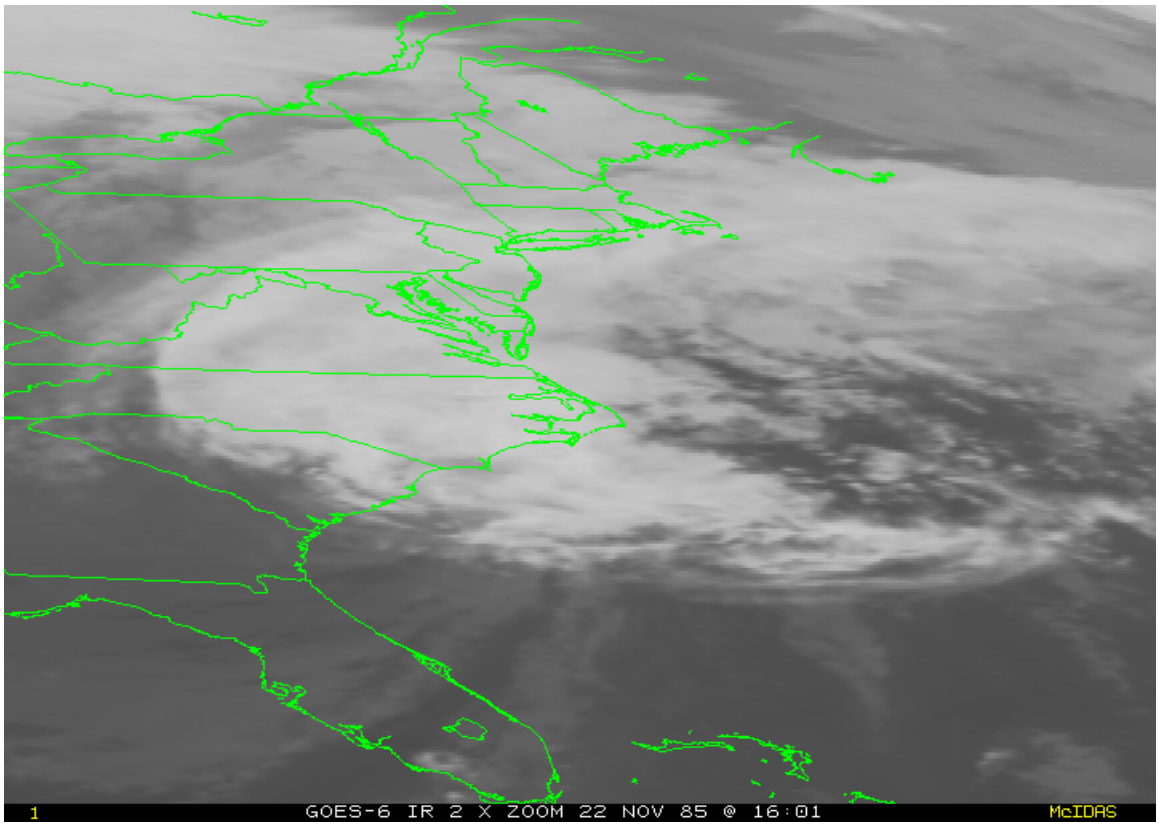

Fig. 130(b): IR Image, KATE, 1601 UTC, November 22, 1985. *Credit: National Climatic Data Center (NCDC).*

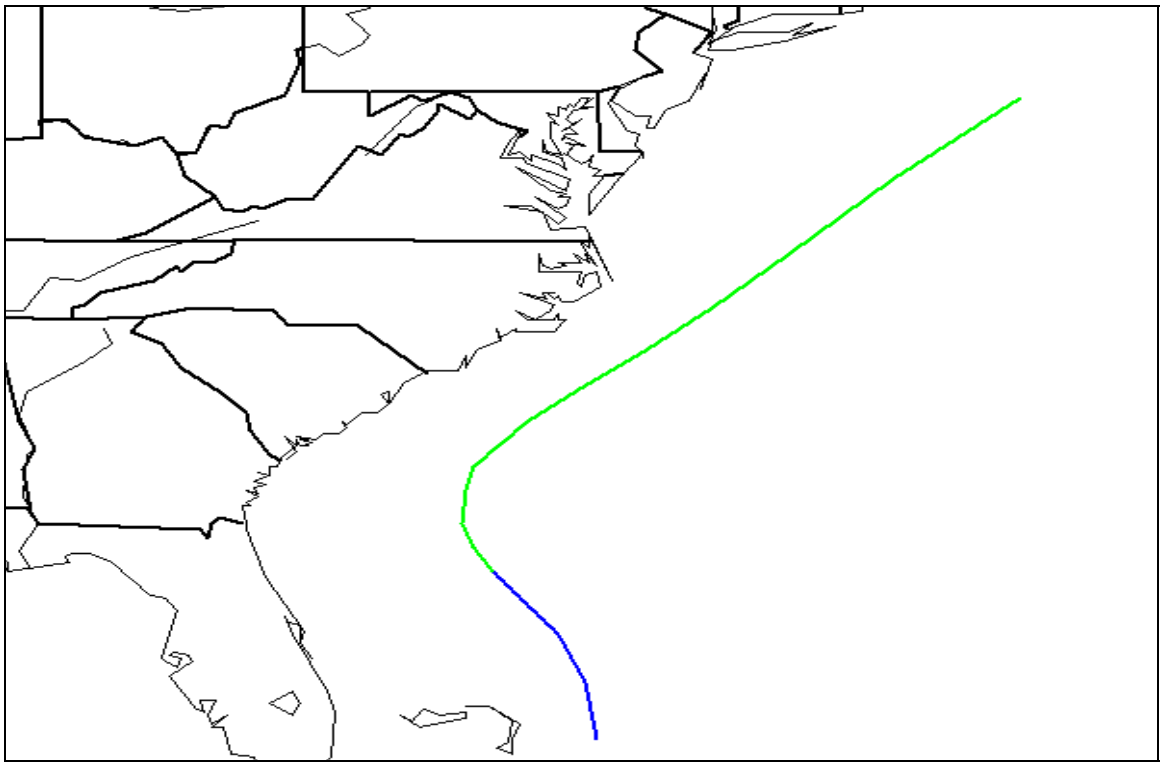

Fig. 131(a): June 7-8, 1986. *ANDREW*.

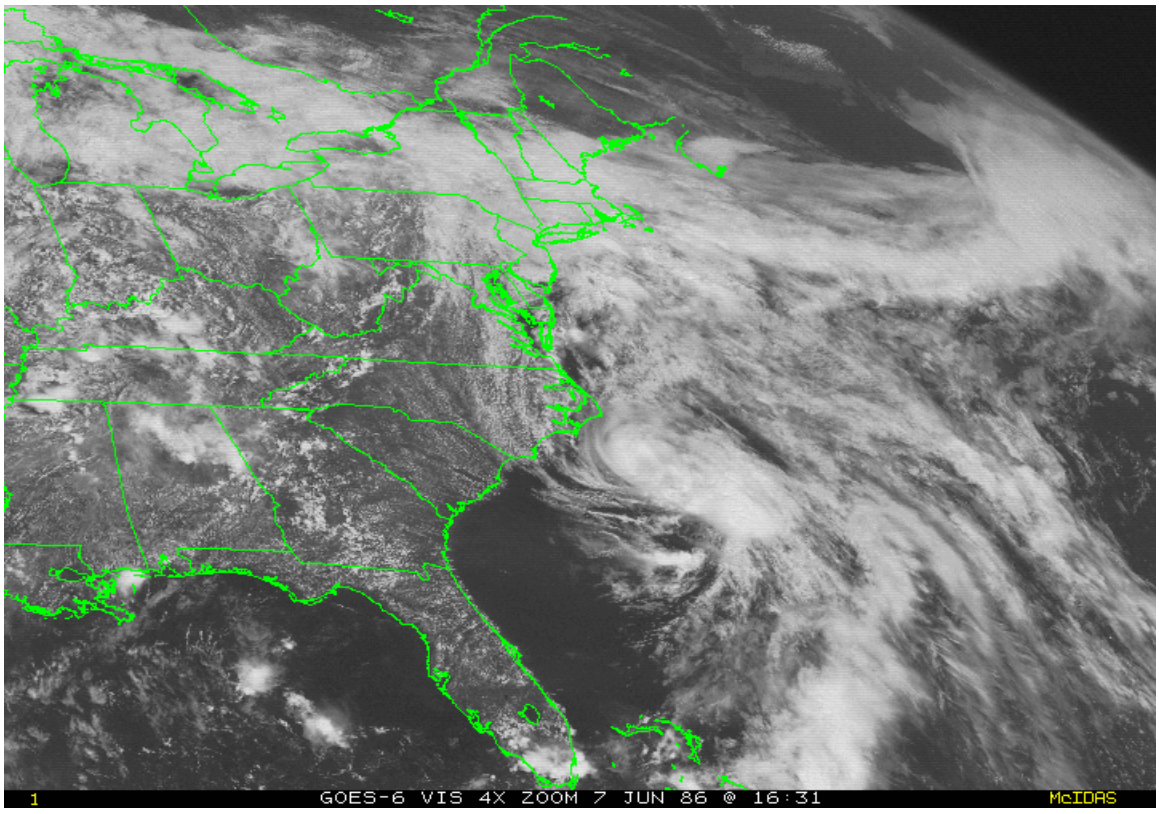

Fig. 131(b): Visible Image, ANDREW, 1631 UTC, June 7, 1986. *Credit: National Climatic Data Center (NCDC).*

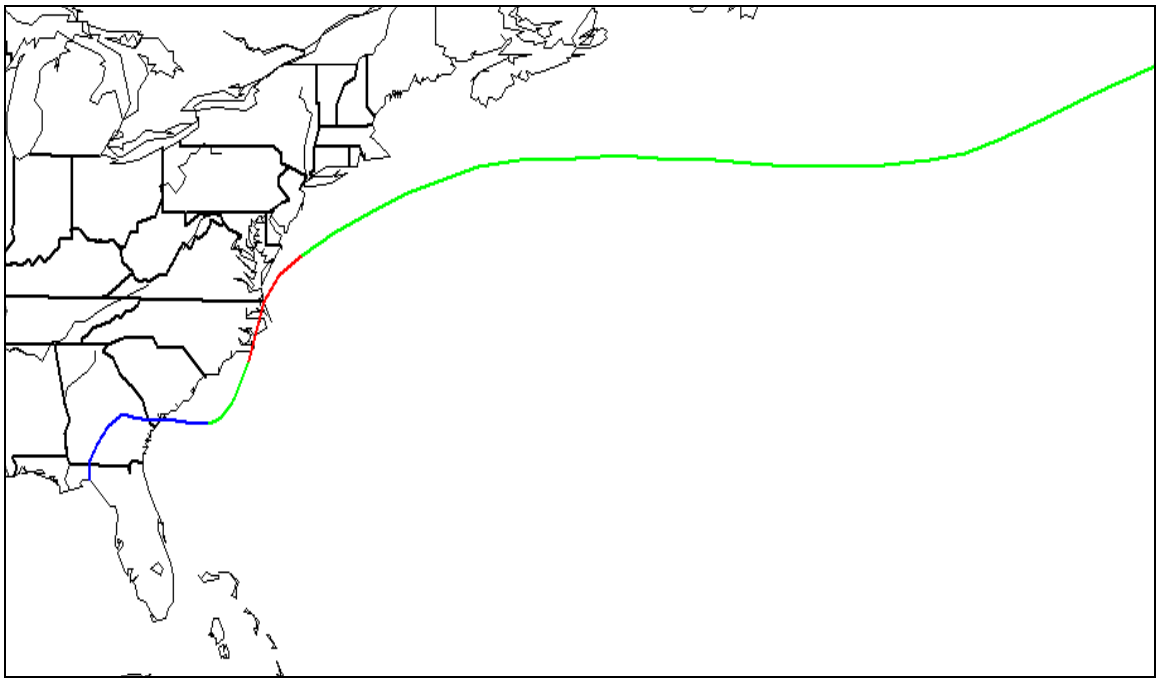

Fig. 132(a): August 17-18, 1986. *CHARLEY.*

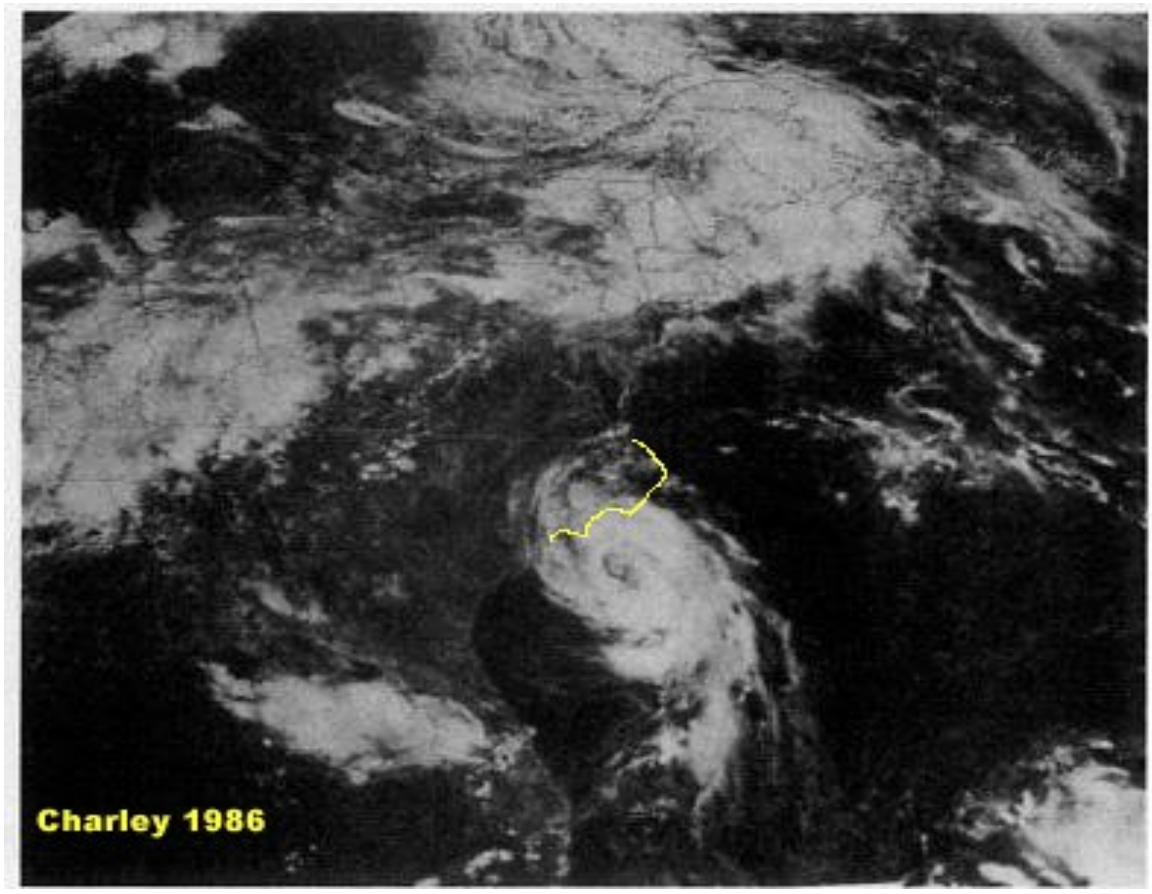

Fig. 132(b): Visible Image, CHARLEY, August 17, 1986. *Credit: National Climatic Data Center (NCDC).*

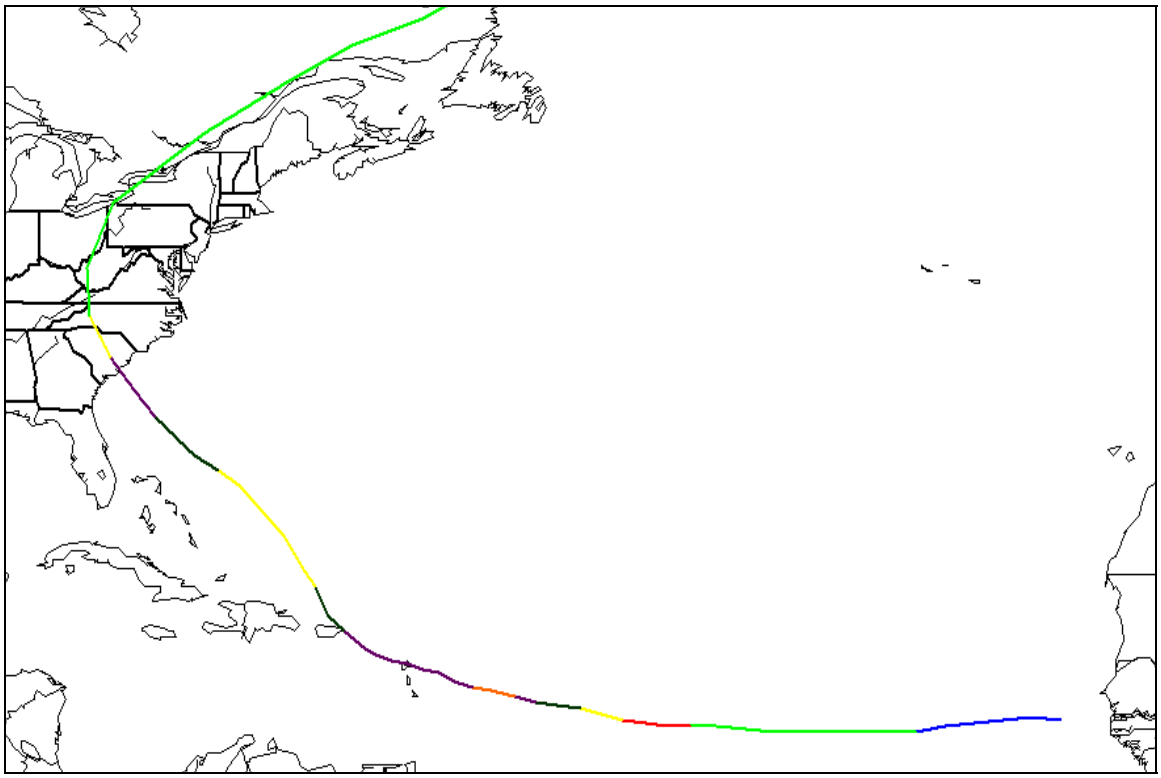

Fig. 133(a): September 21-22, 1989. *HUGO*.

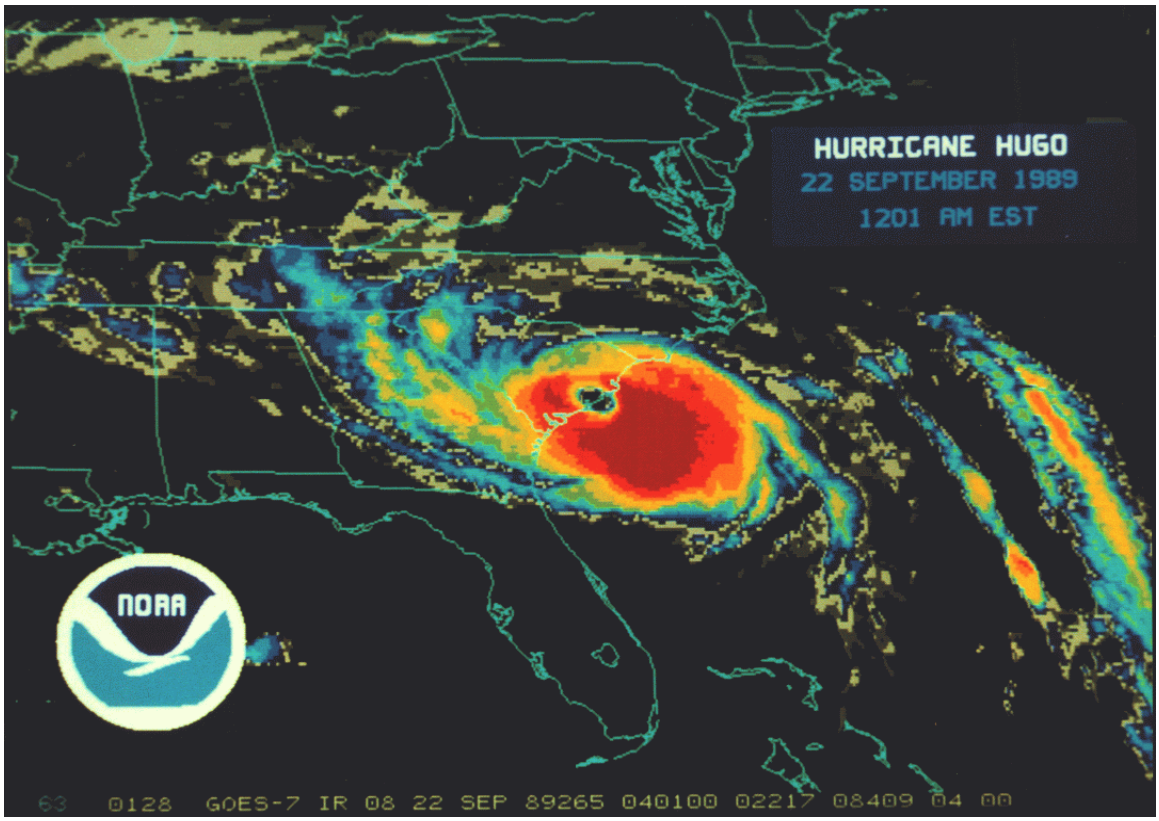

Fig. 133(b): IR image, HUGO, 0401 UTC, September 22, 1989. *Credit: National Climatic Data Center (NCDC).*

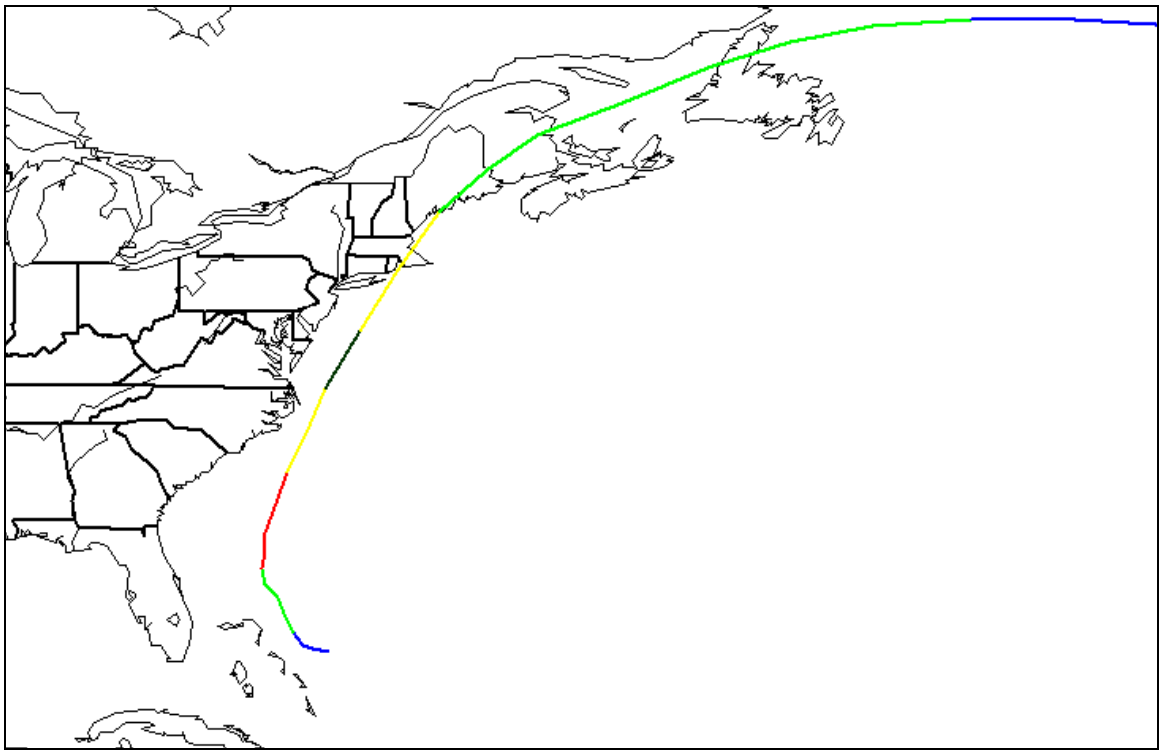

Fig. 134(a): August 18-19, 1991. *BOB.*

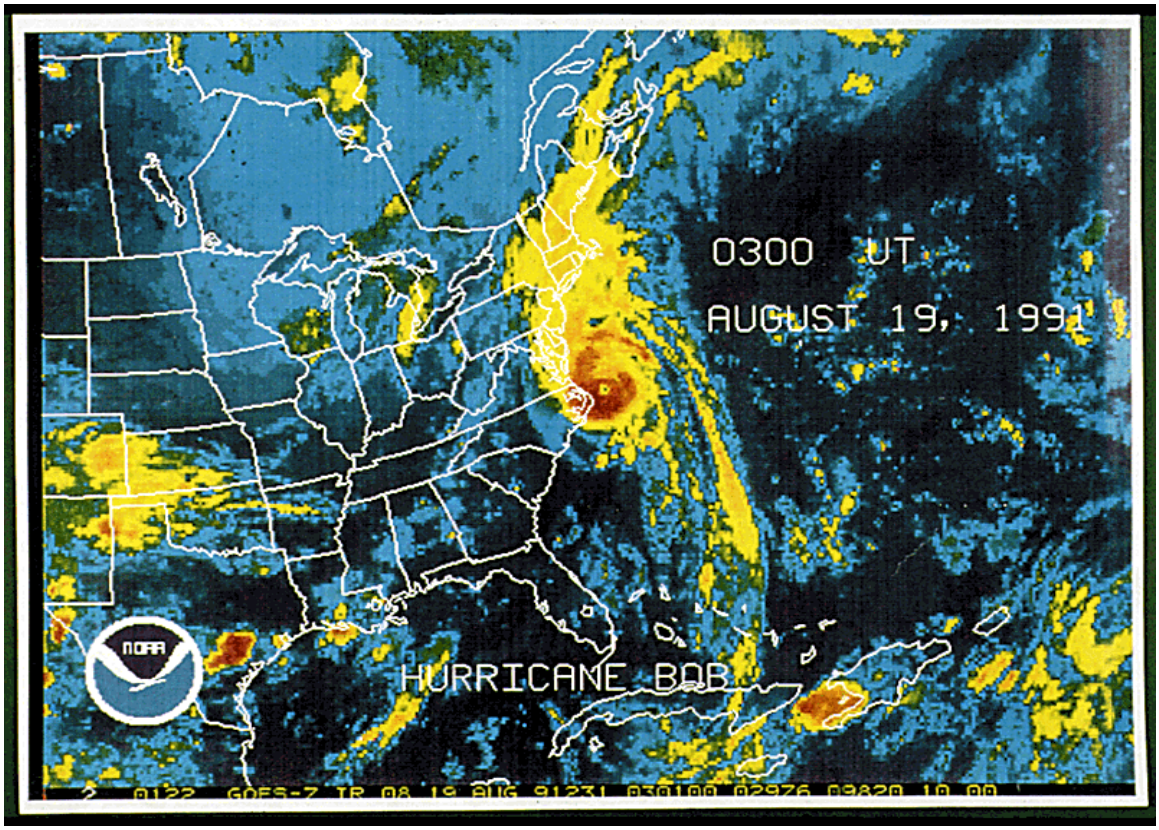

Fig. 134(b): IR image, BOB, 0300 UTC, August 19, 1991. *Credit: National Climatic Data Center (NCDC).*

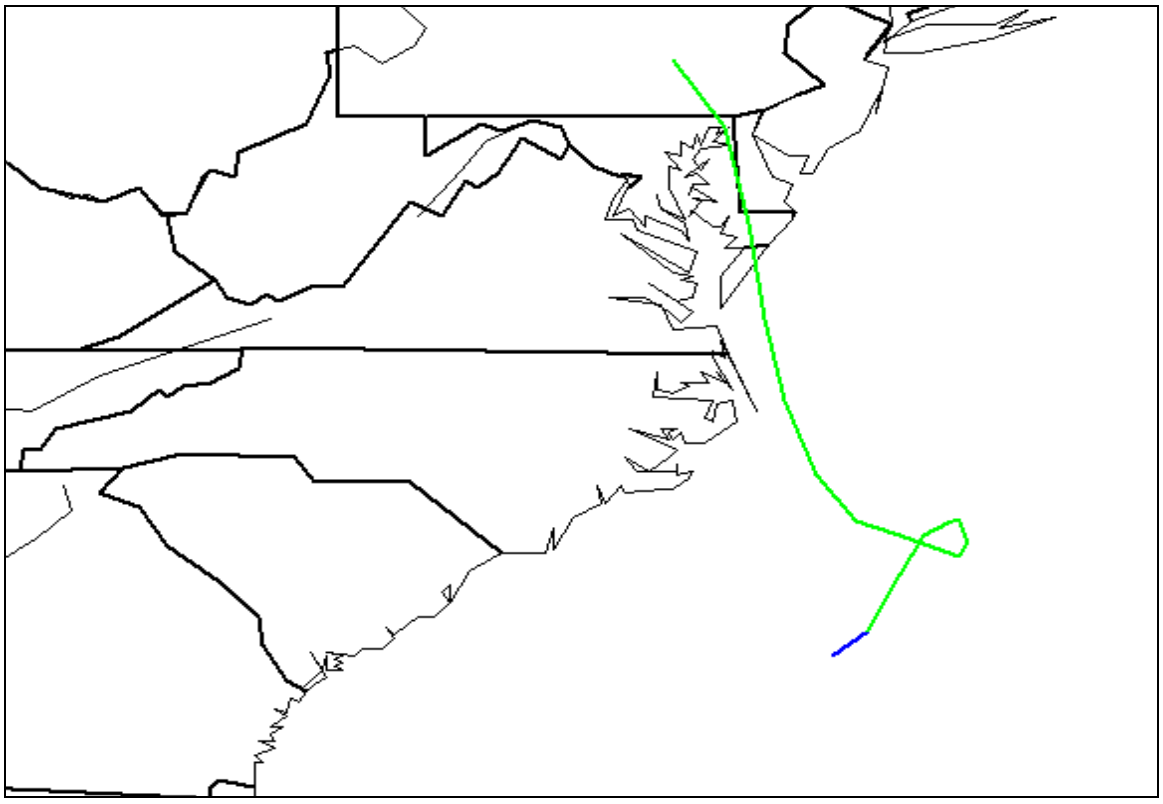

Fig. 135(a): September 22-25, 1992. *DANIELLE*.

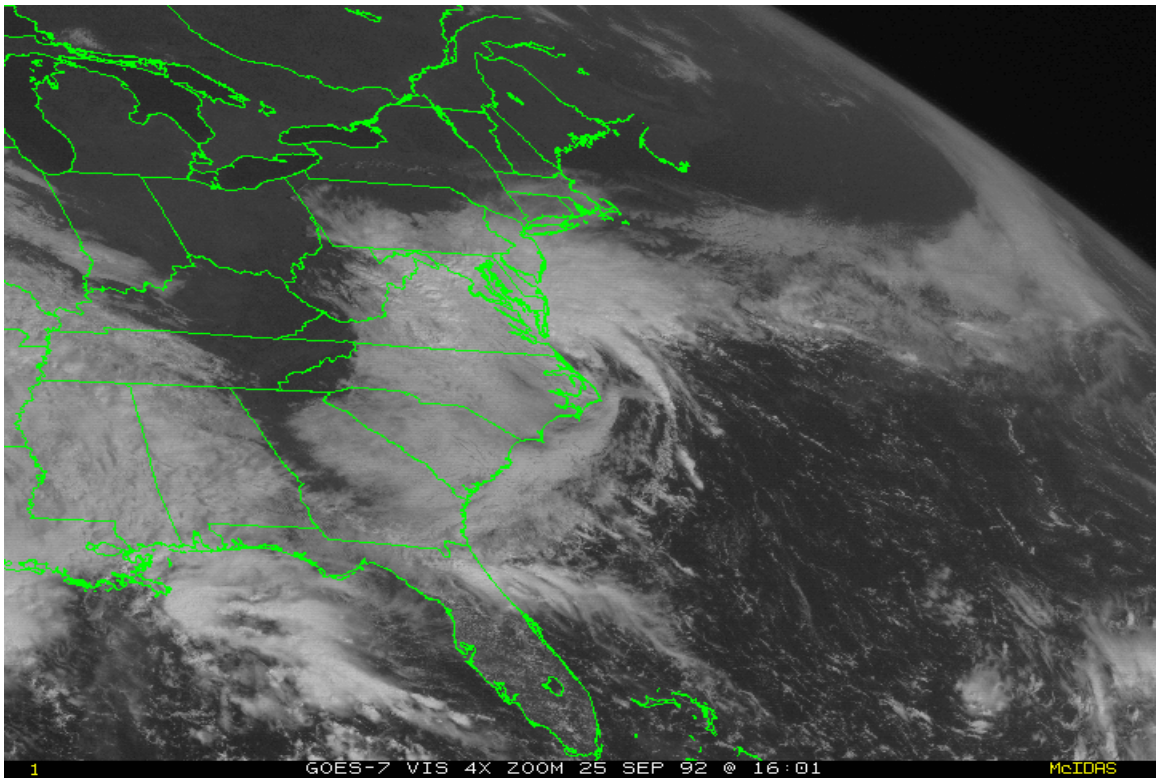

Fig 135(b): Visible Image, DANIELLE, 1601 UTC, September 25, 1992. *Credit: National Climatic Data Center (NCDC).*

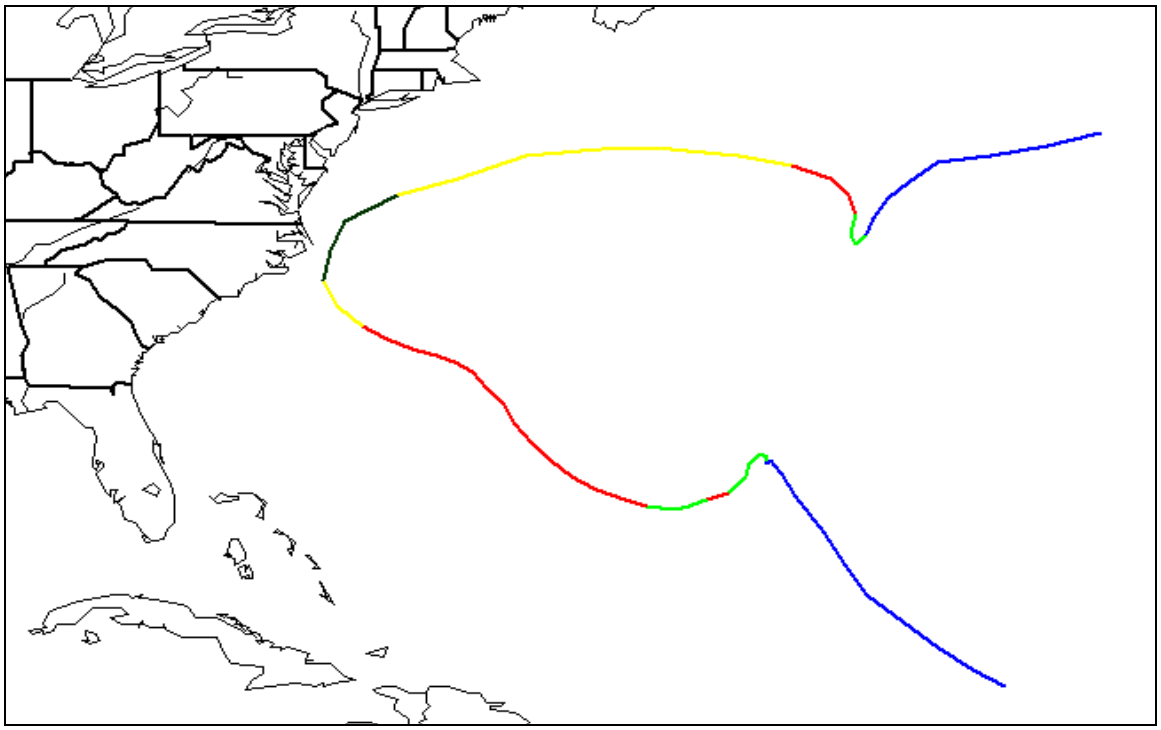

Fig. 136(a): August 30-31, 1993. *EMILY*.

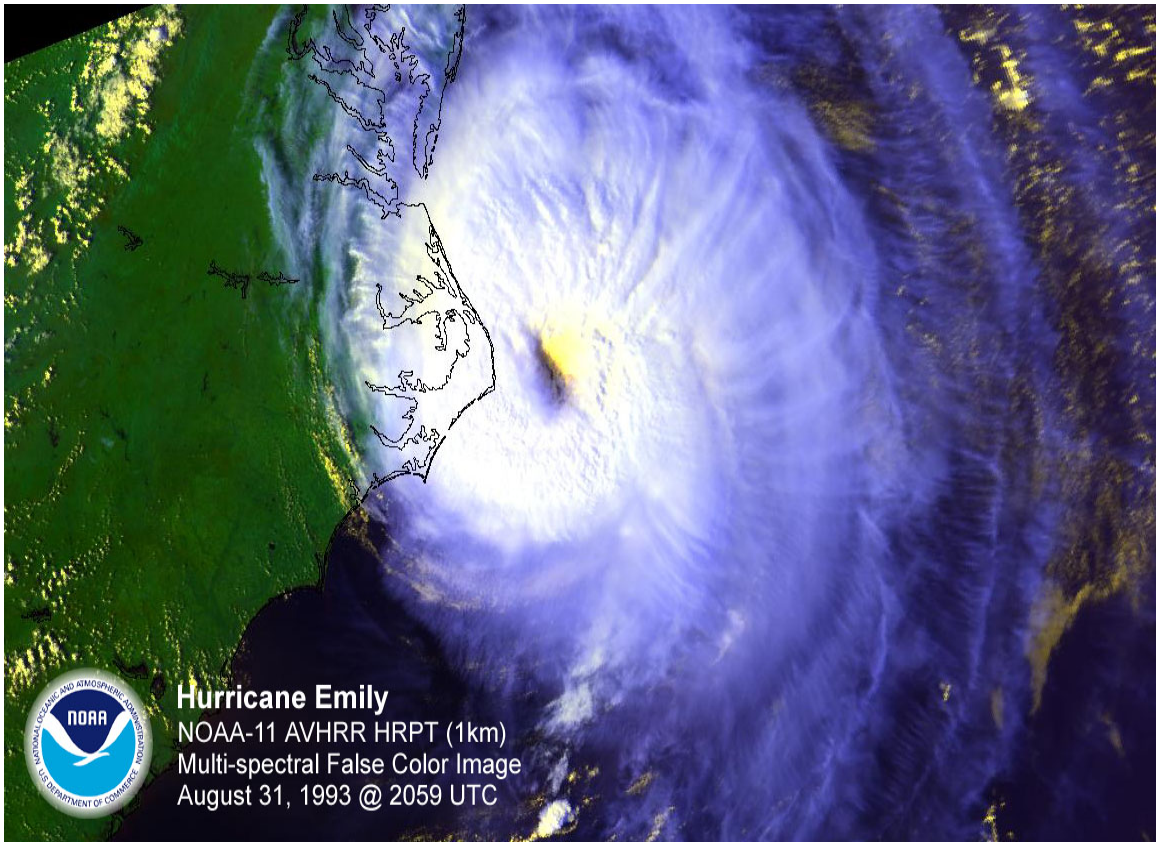

Fig. 136(b): Visible image, EMILY, 2059 UTC, August 31, 1993. *Credit: National Environmental Satellite, Data, and Information Service (NESDIS).*

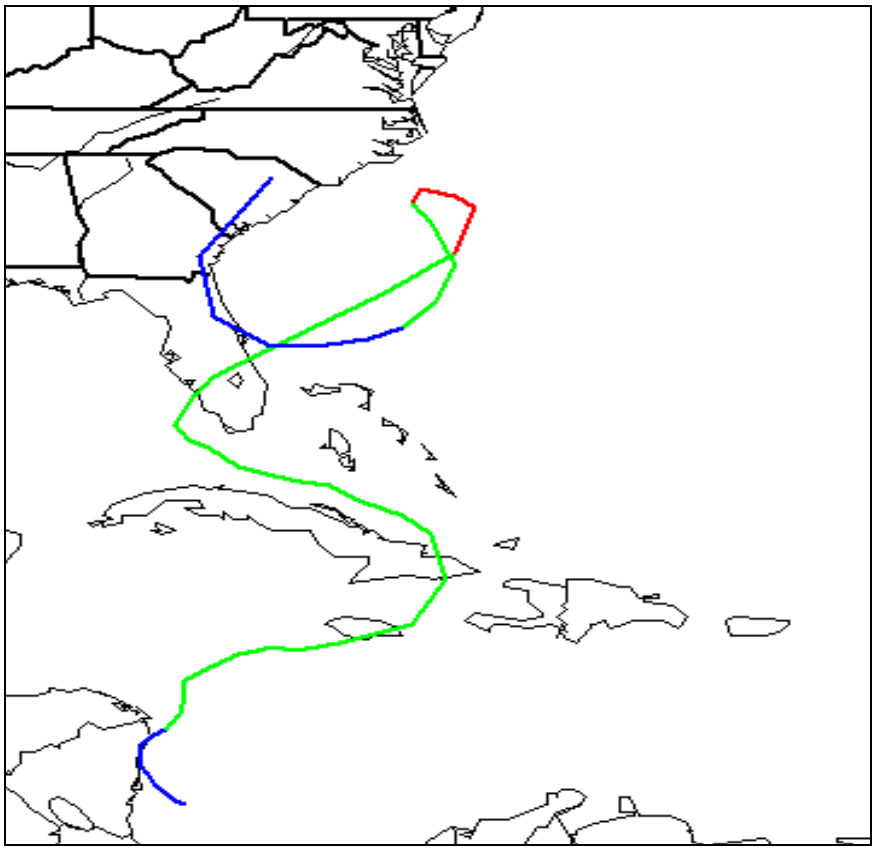

Fig. 137(a): November 17-18, 1994. *GORDON*.

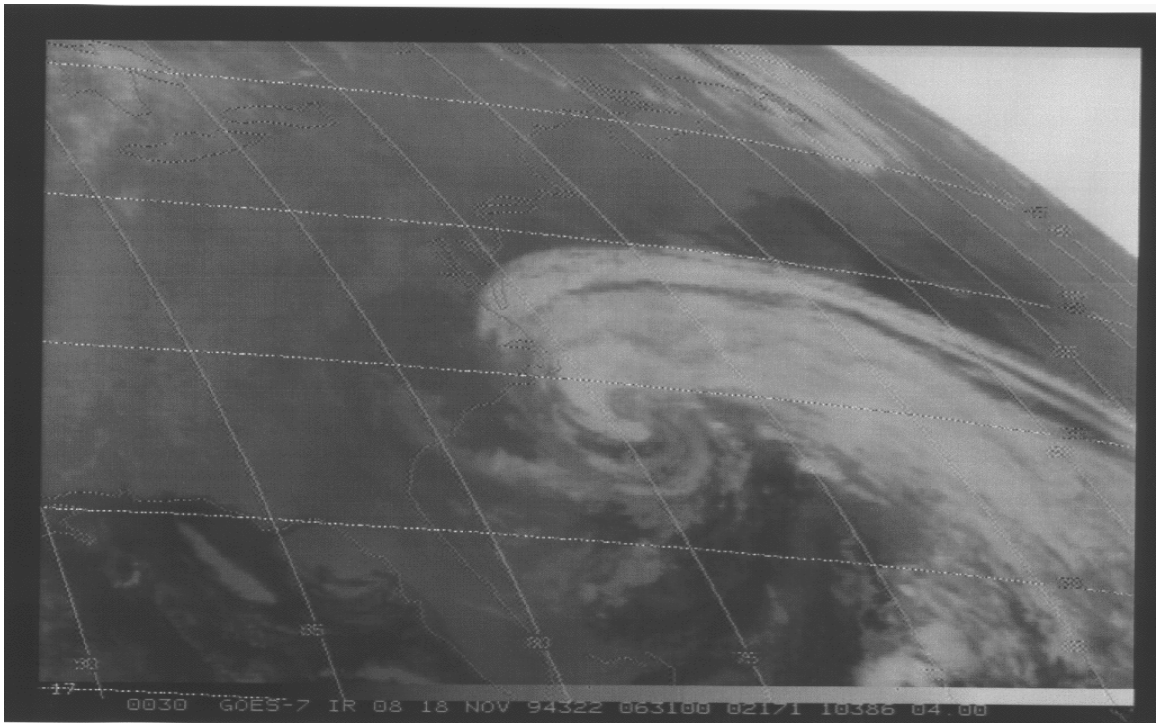

Fig. 137(b): IR image, GORDON, 0631 UTC, November 18, 1994. *Credit: National Climatic Data Center (NCDC).*

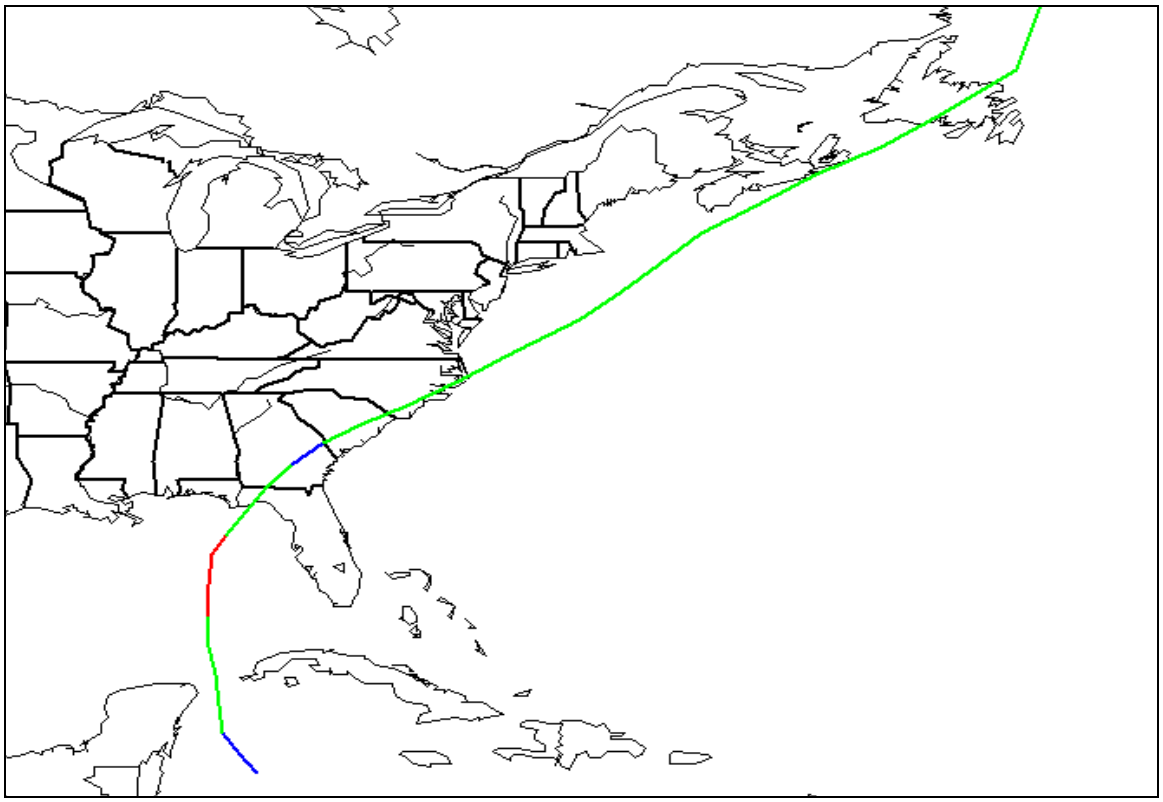

Fig. 138(a): June 5-7, 1995. *ALLISON*.

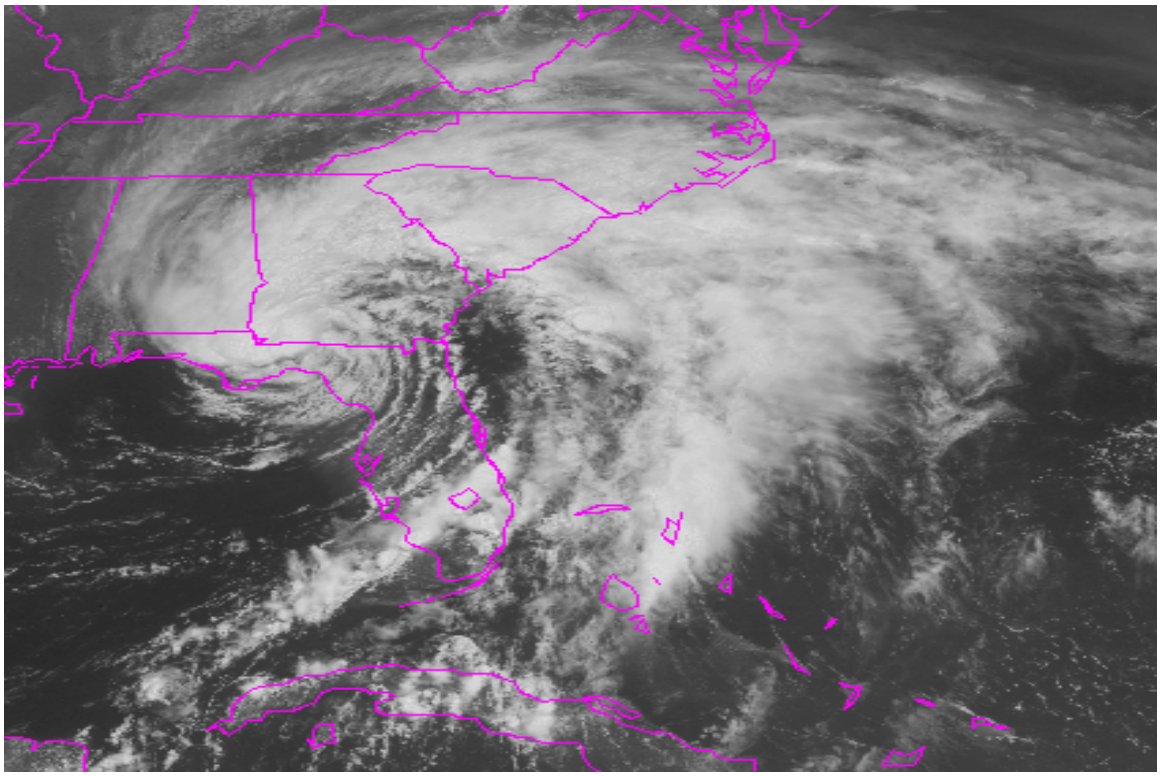

Fig. 138(b): Visible image, ALLISON, June 5, 1995. *Credit: National Environmental Satellite, Data, and Information Service (NESDIS).*

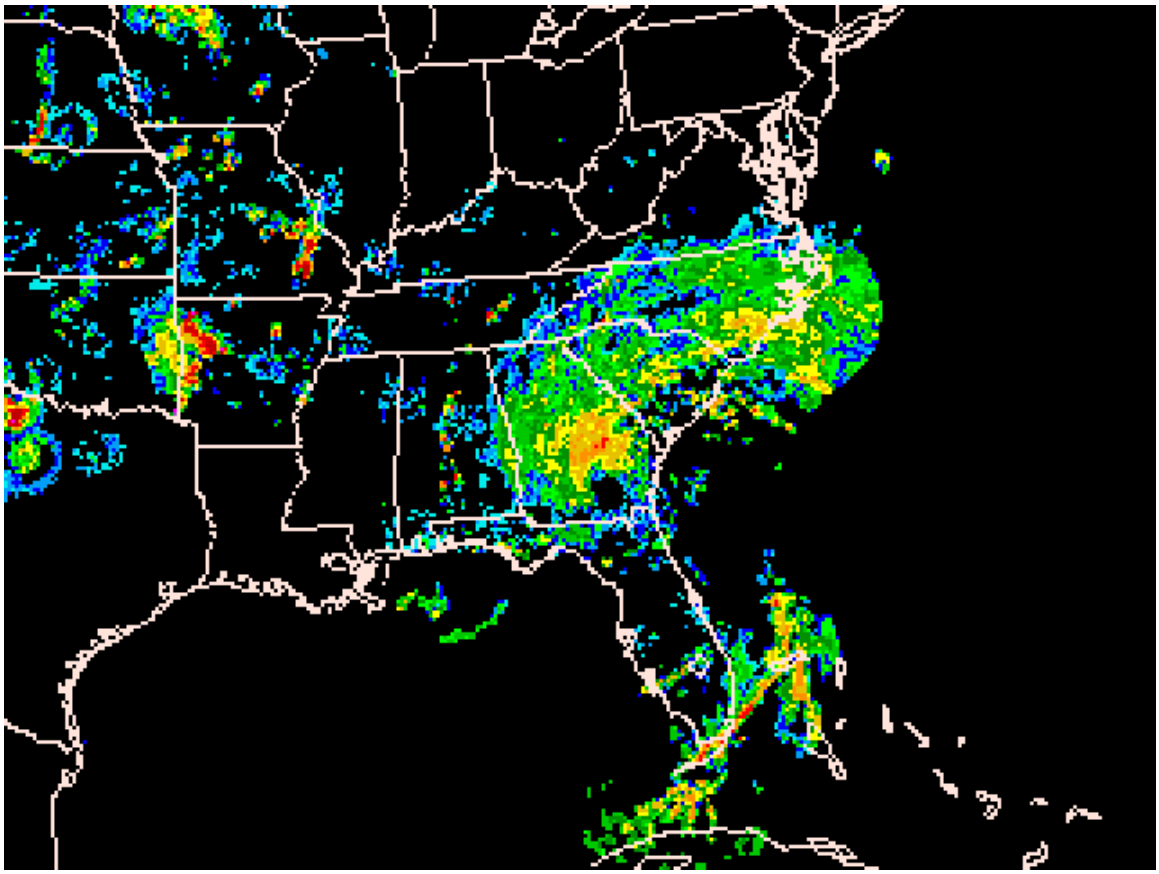

Fig. 138(c): Doppler composite reflectivity, ALLISON, 2300 UTC, June 5, 1995. *Credit: Storm Prediction Center (SPC).*

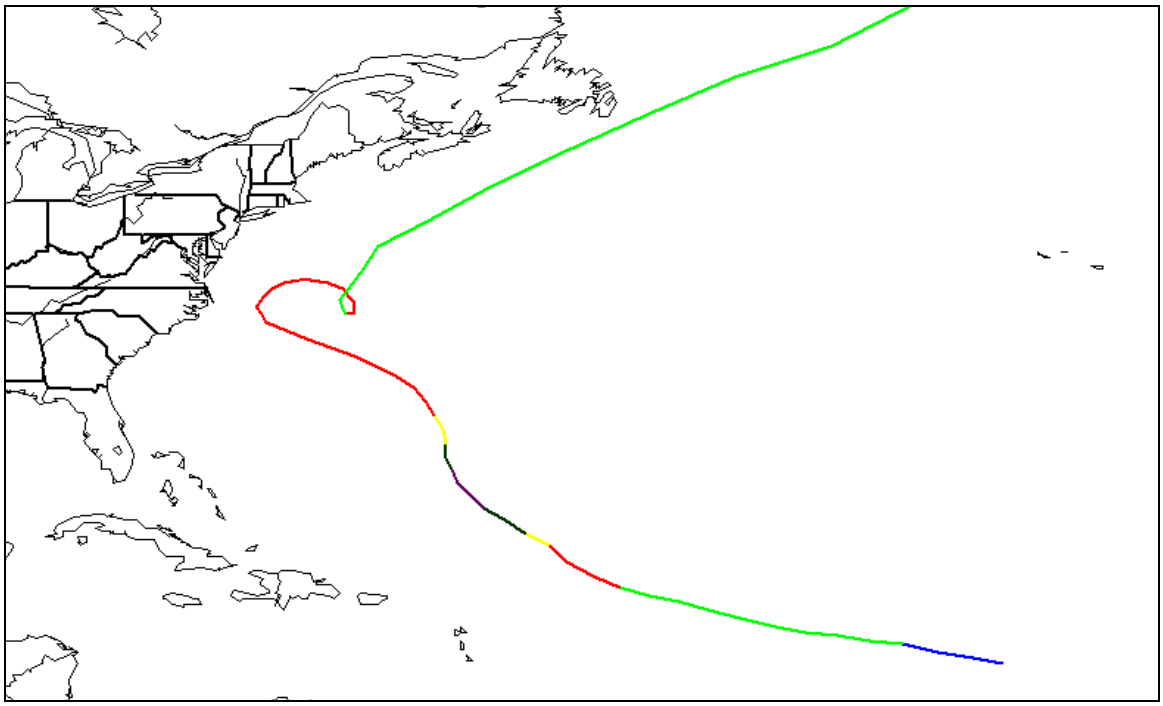

Fig. 139(a): August 18-20, 1995. *FELIX*.

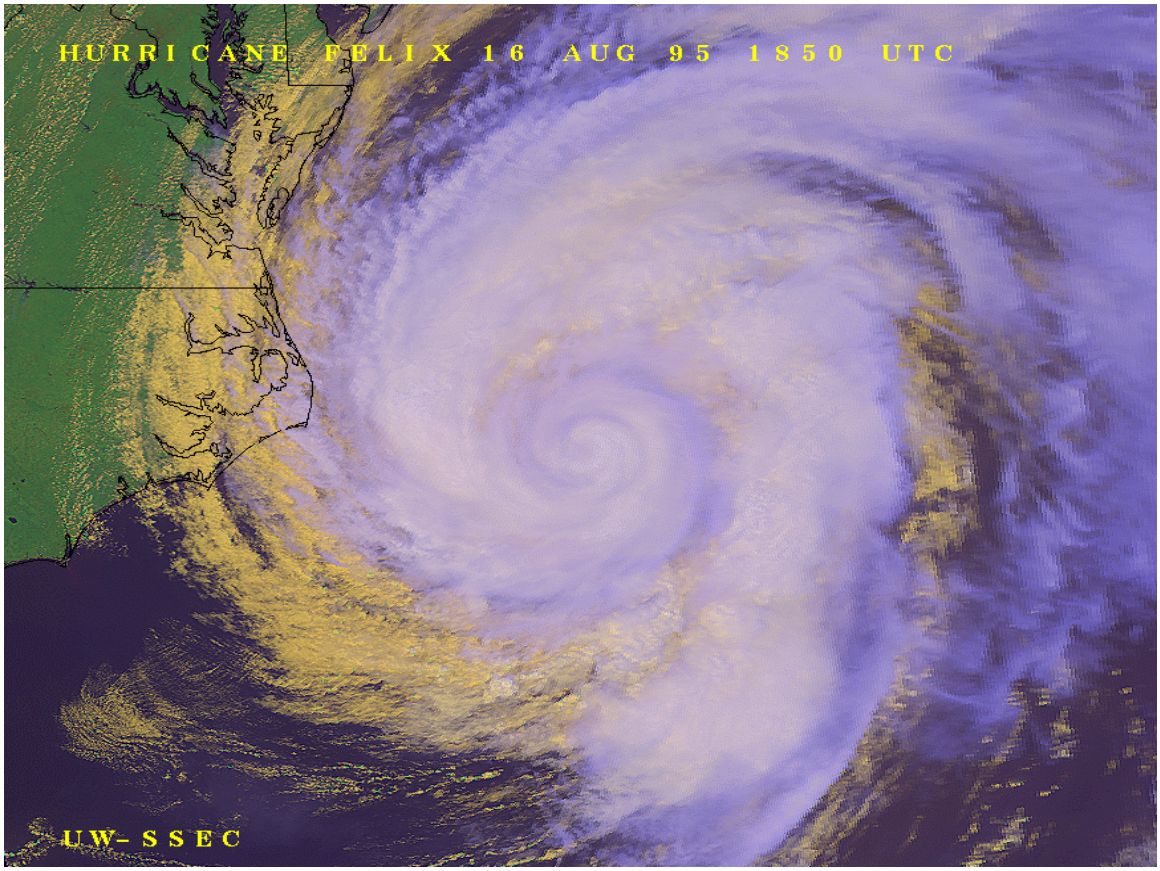

Fig. 139(b): Visible image, FELIX, 1850 UTC, August 16, 1995. *Credit: University of Wisconsin.*

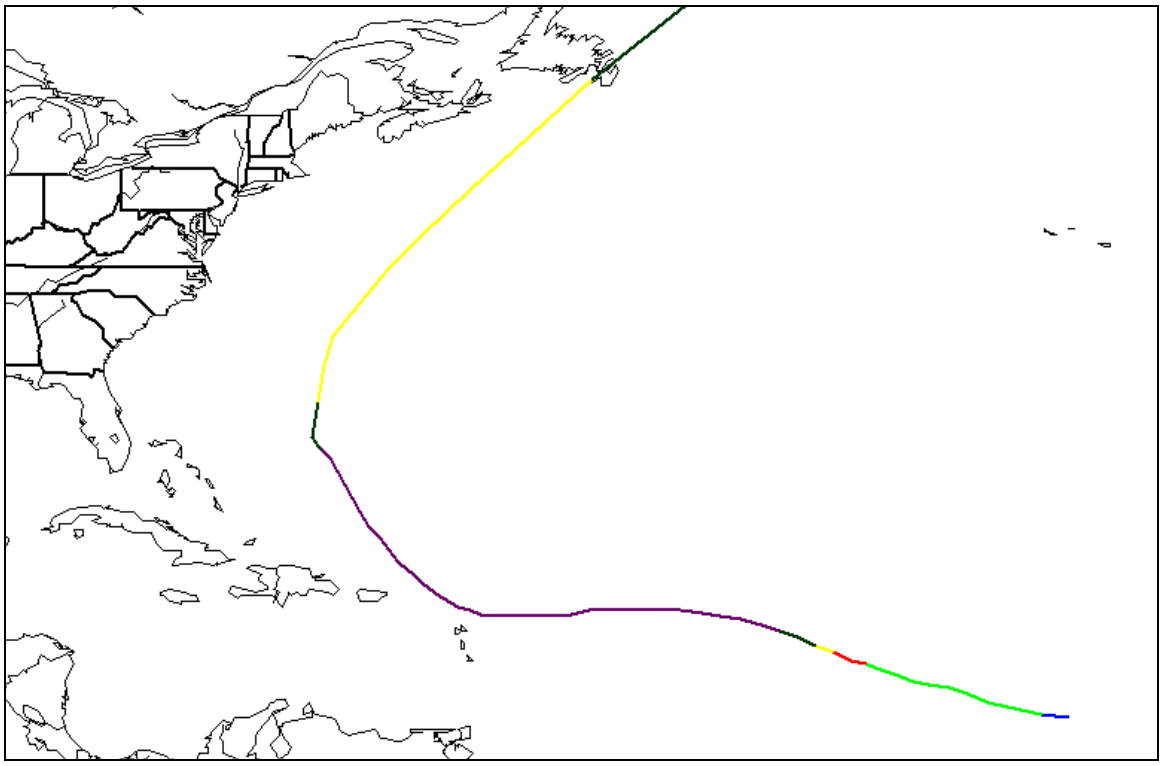

Fig. 140(a): September 9-10, 1995. *LUIS.*

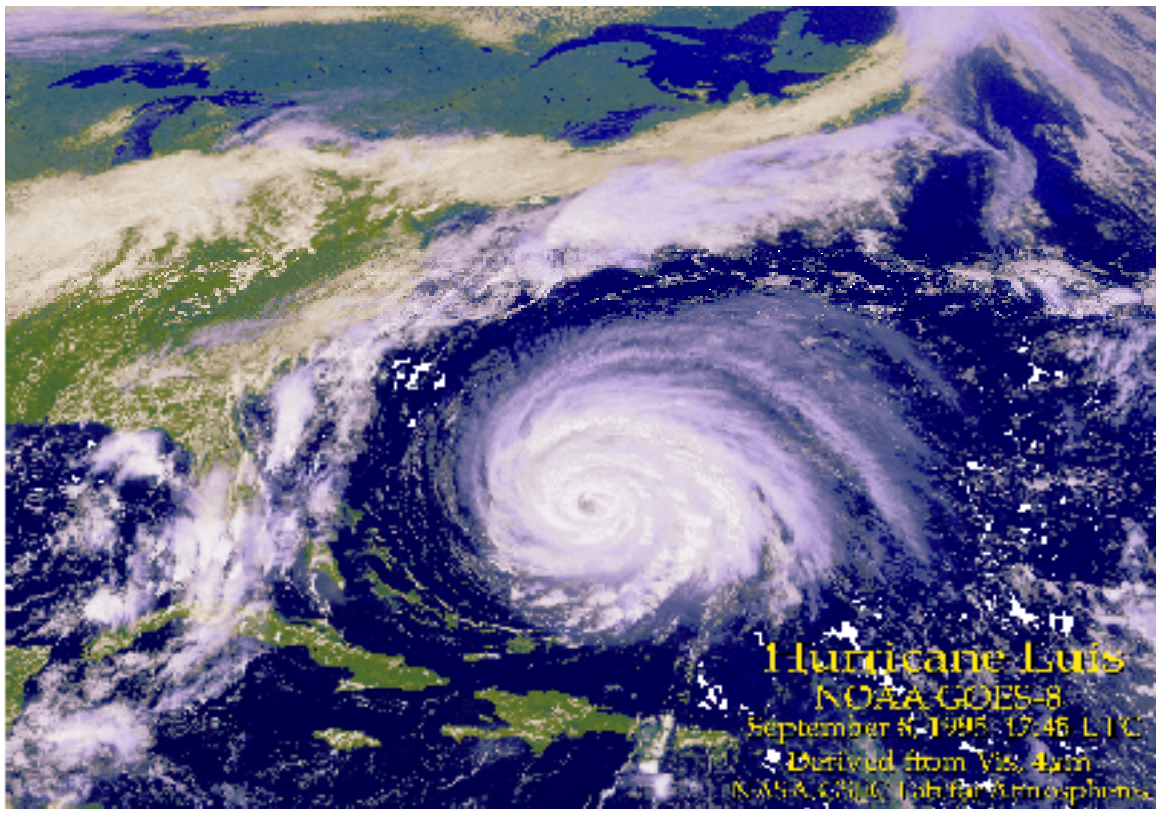

Fig. 140(b): Visible image, LUIS, 1745 UTC, September 8, 1995. *Credit: National Aeronautics and Space Administration (NASA).*

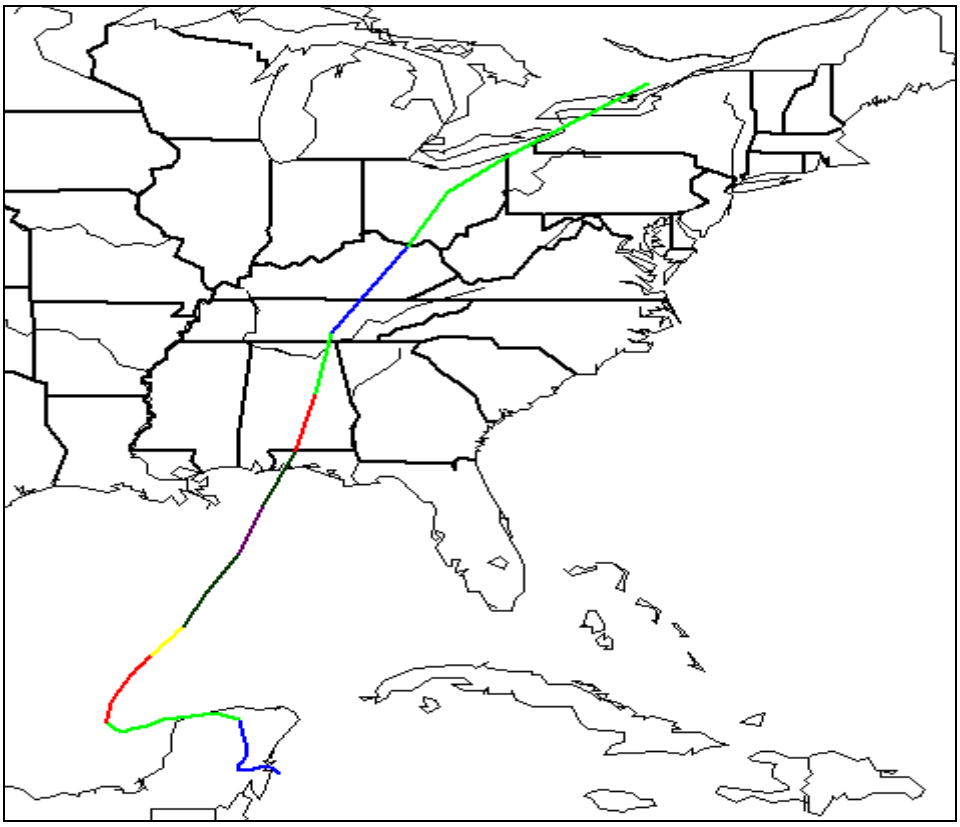

Fig. 141(a): October 5, 1995. *OPAL*.

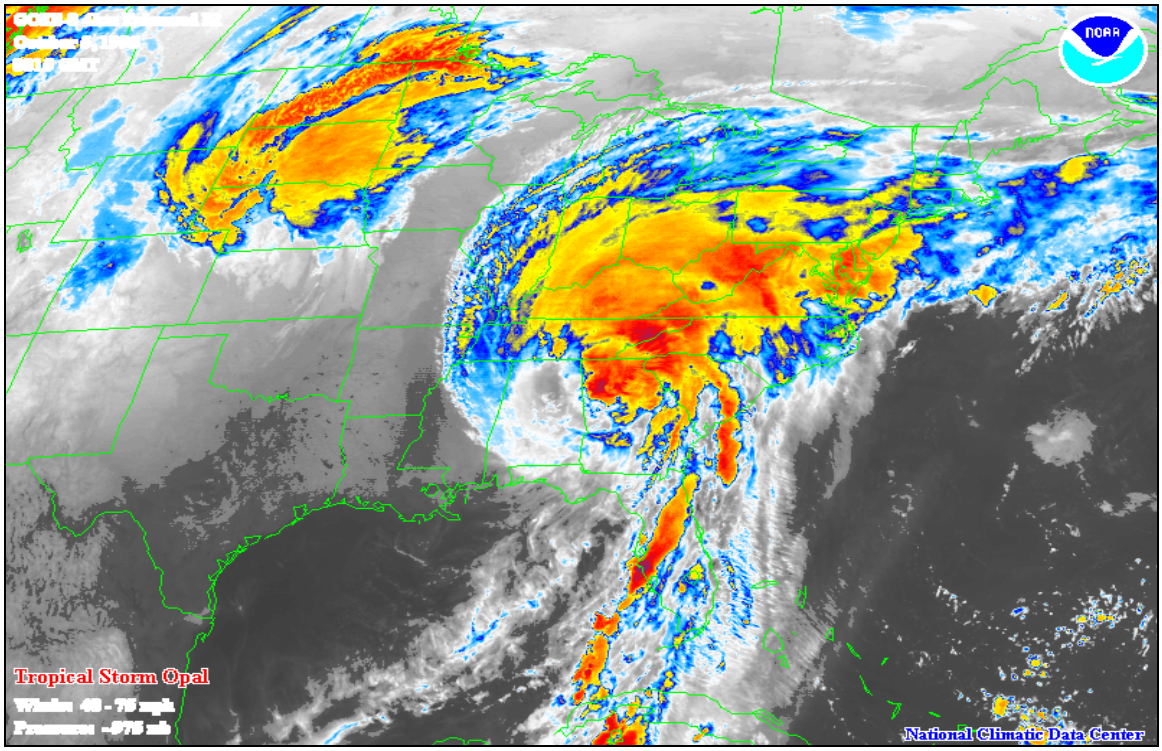

Fig. 141(b): IR image, OPAL, October 5, 1995. *Credit: National Climatic Data Center (NCDC).*

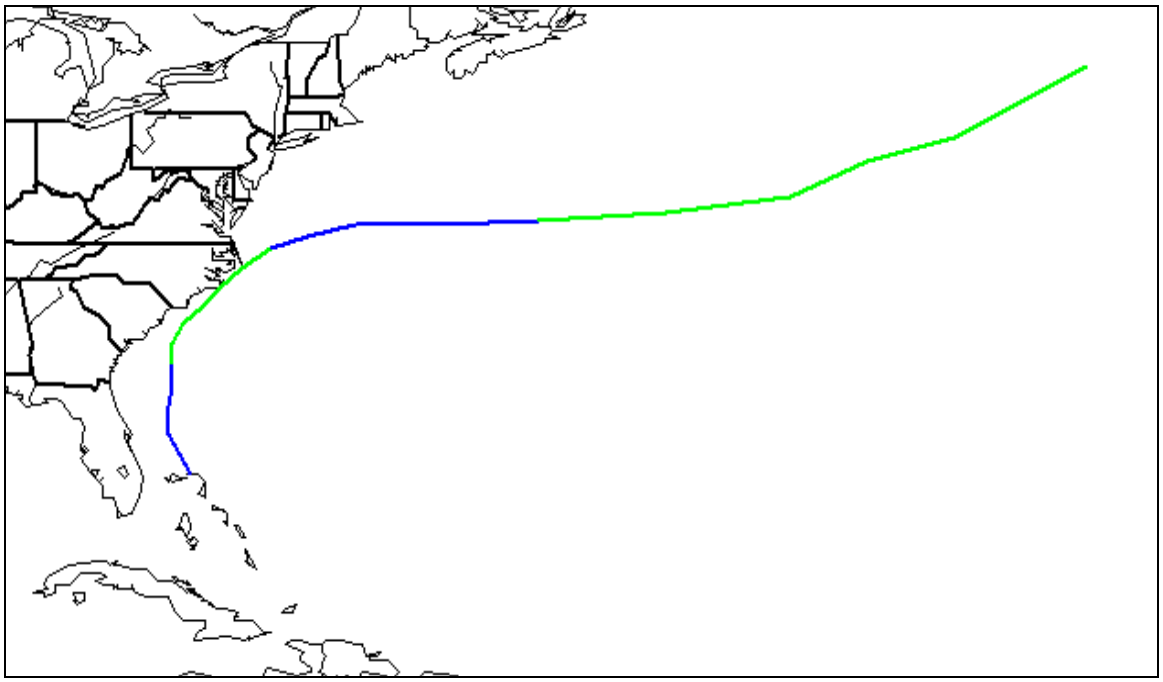

Fig. 142(a): June 19-20, 1996. *ARTHUR*.

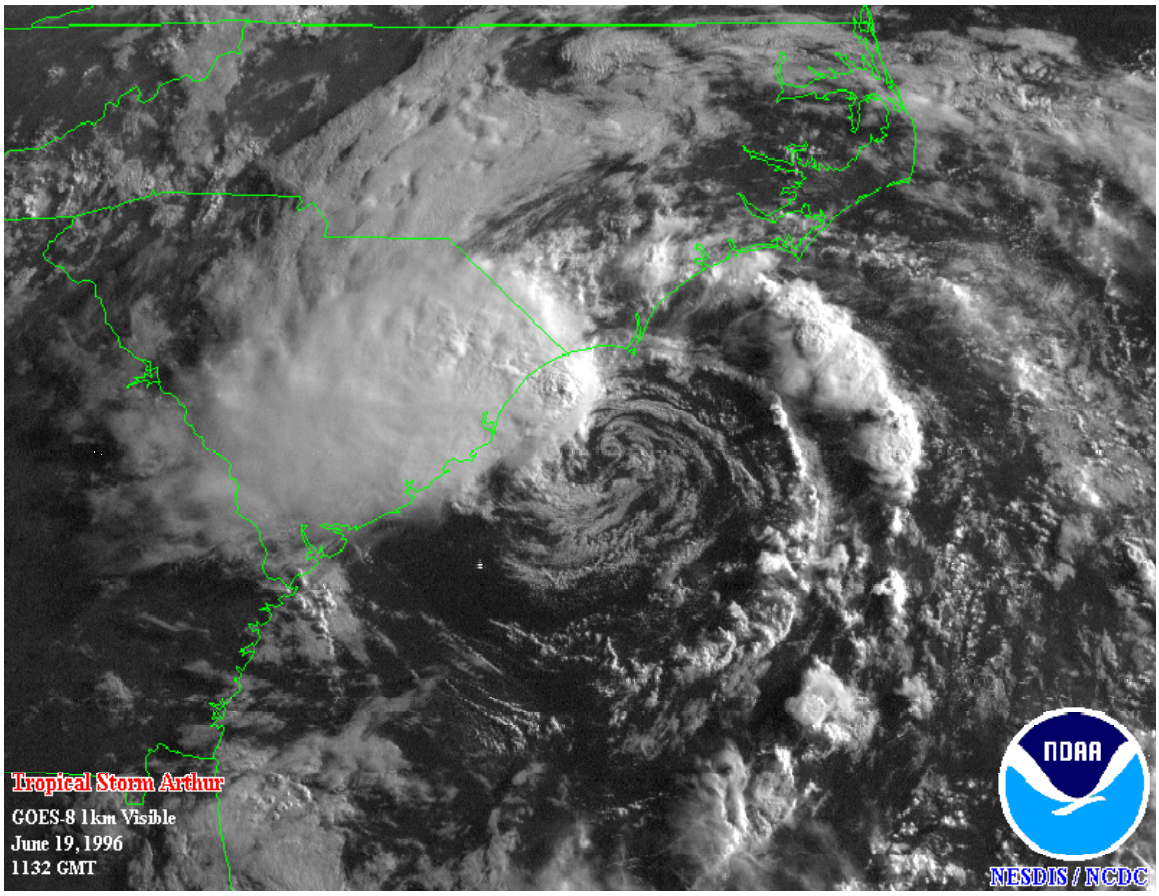

Fig. 142(b): Visible image, ARTHUR, 1132 UTC, June 19, 1996. *Credit: National Climatic Data Center (NCDC).*

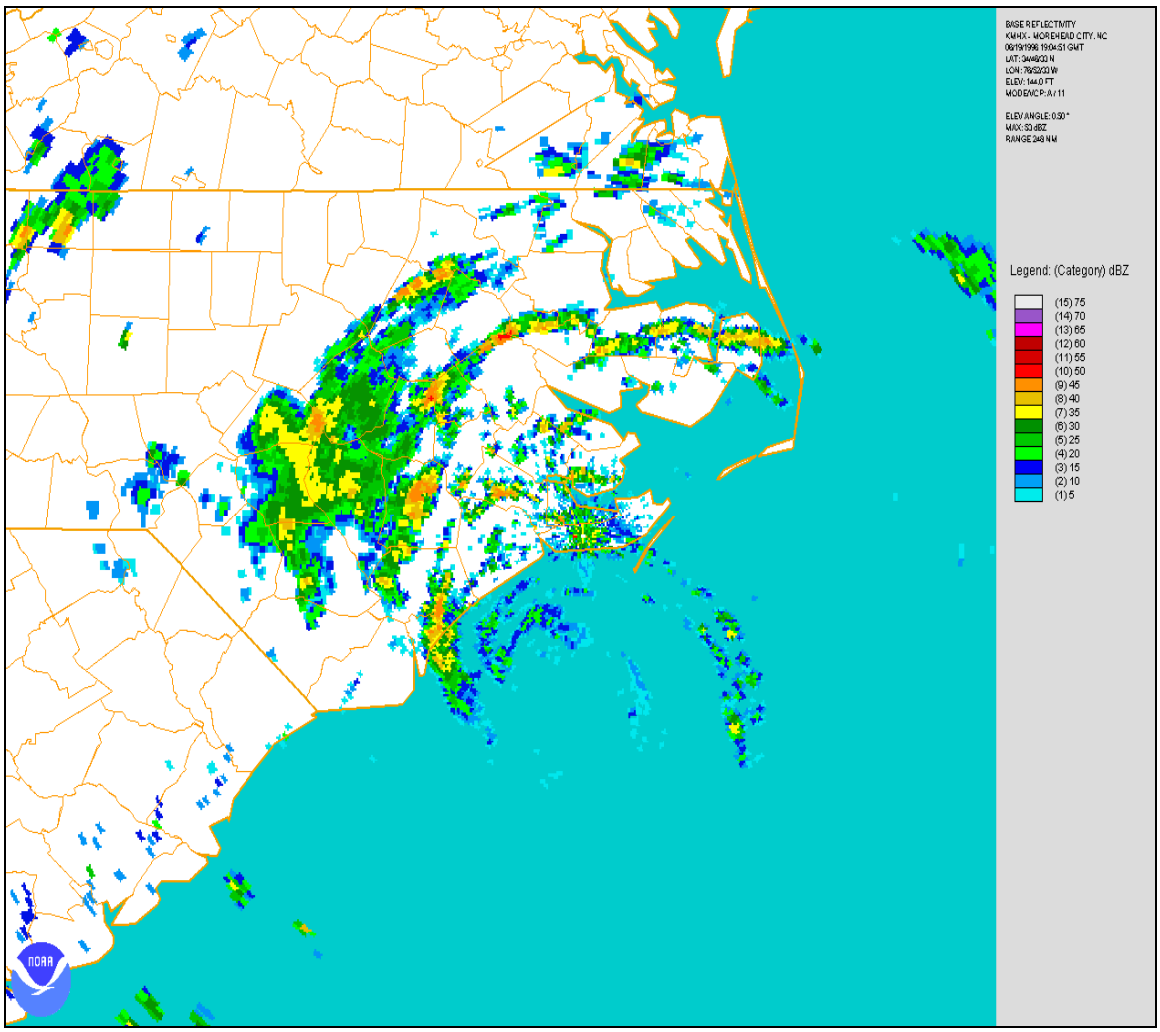

Fig. 142(c): KLTX Doppler base reflectivity, ARTHUR, 1904 UTC, June 1996. *Credit: National Climatic Data Center (NCDC).*

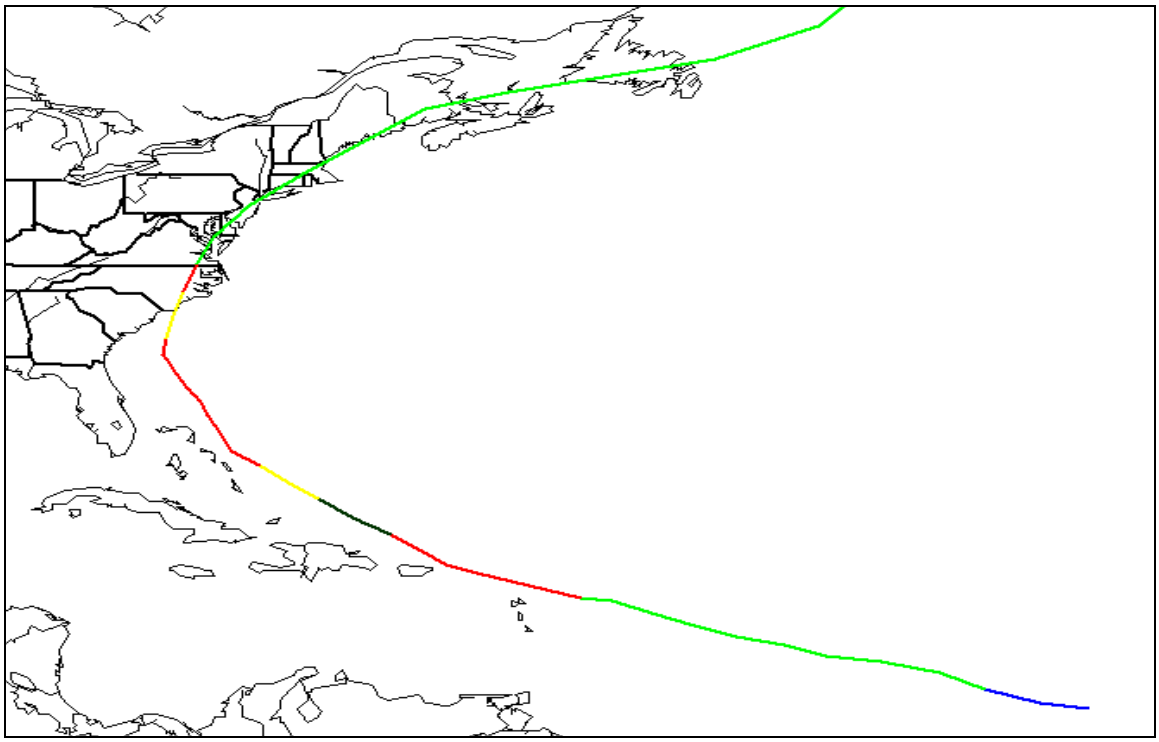

Fig. 143(a): July 12, 1996. *BERTHA*.

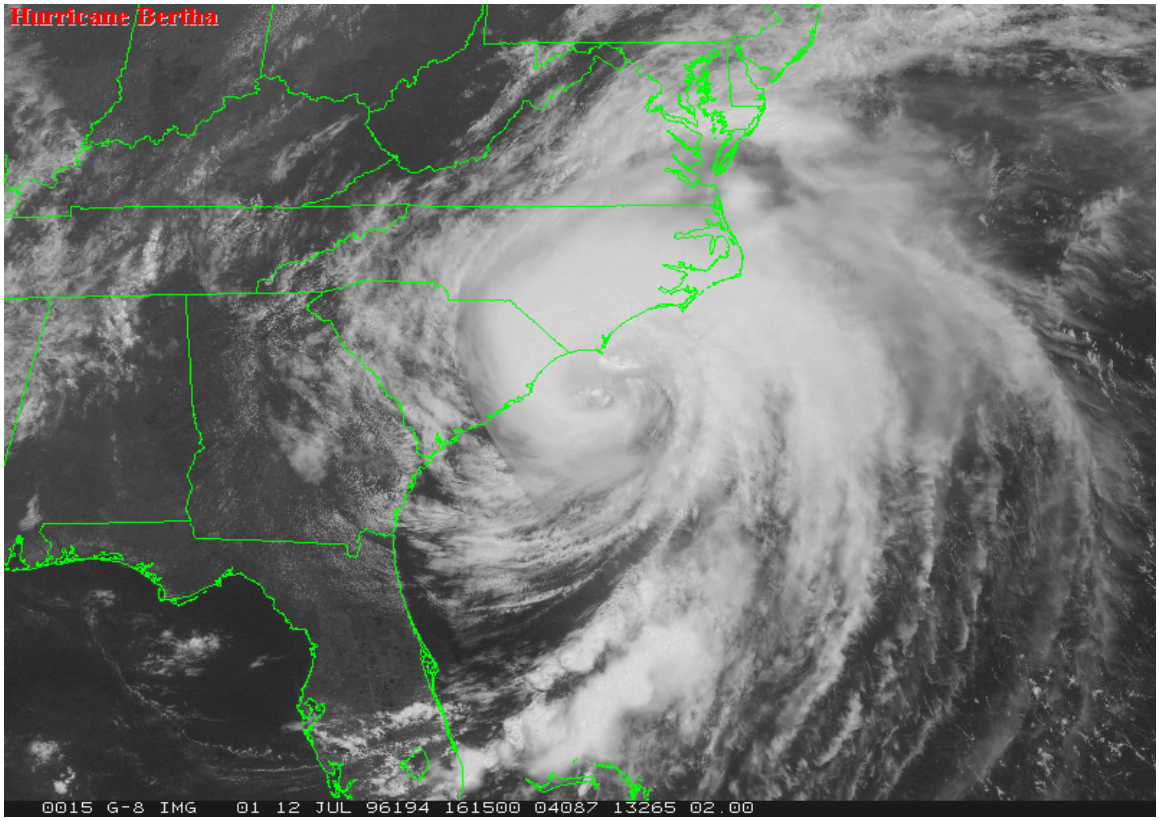

Fig. 143(b): Visible image, BERTHA, 1615 UTC, July 12, 1996. *Credit: National Climatic Data Center (NCDC).*

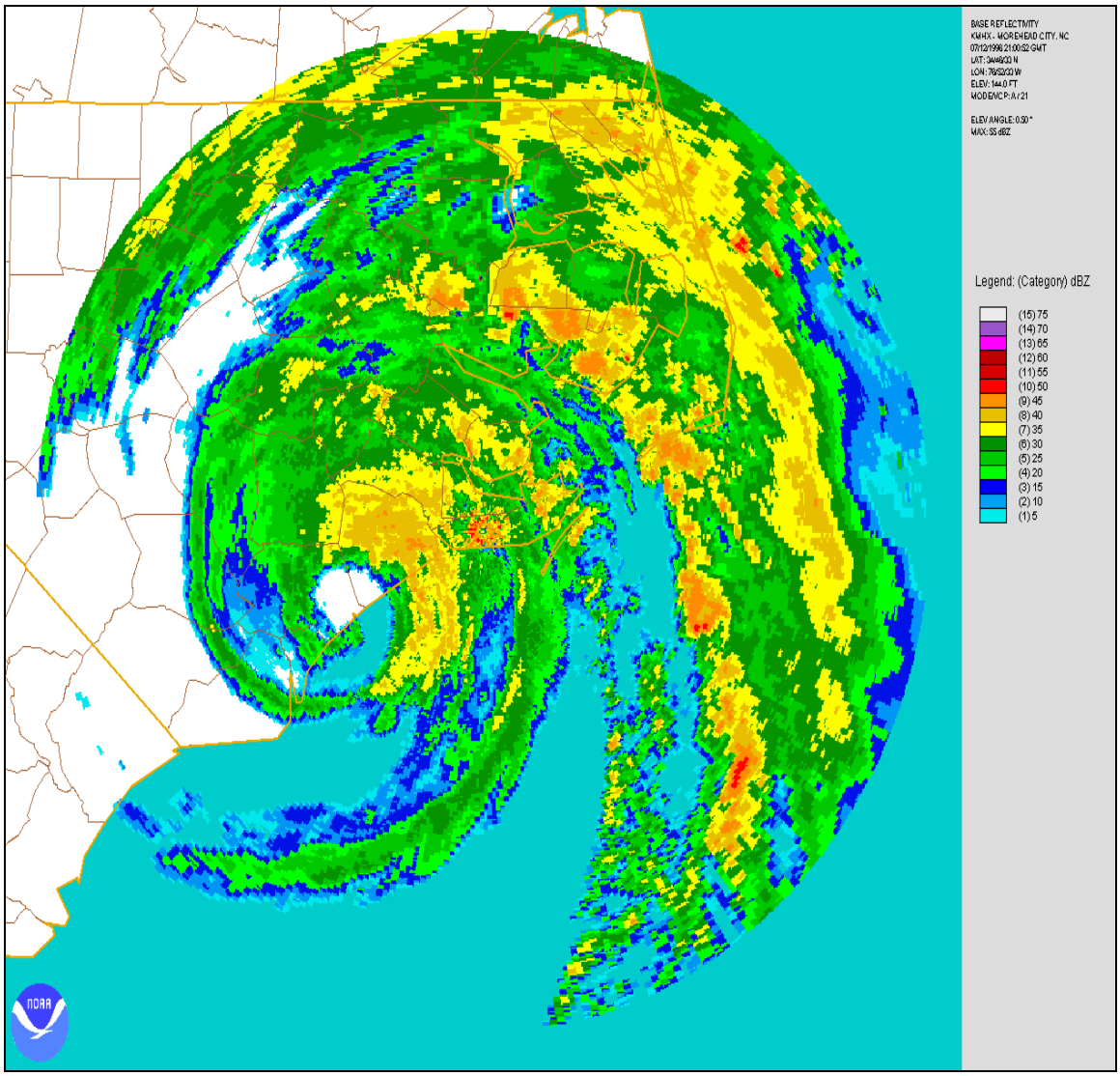

Fig. 143(c): KMHX Doppler base reflectivity, BERTHA, 2100 UTC, July 12, 1996.
Credit: National Climatic Data Center (NCDC).

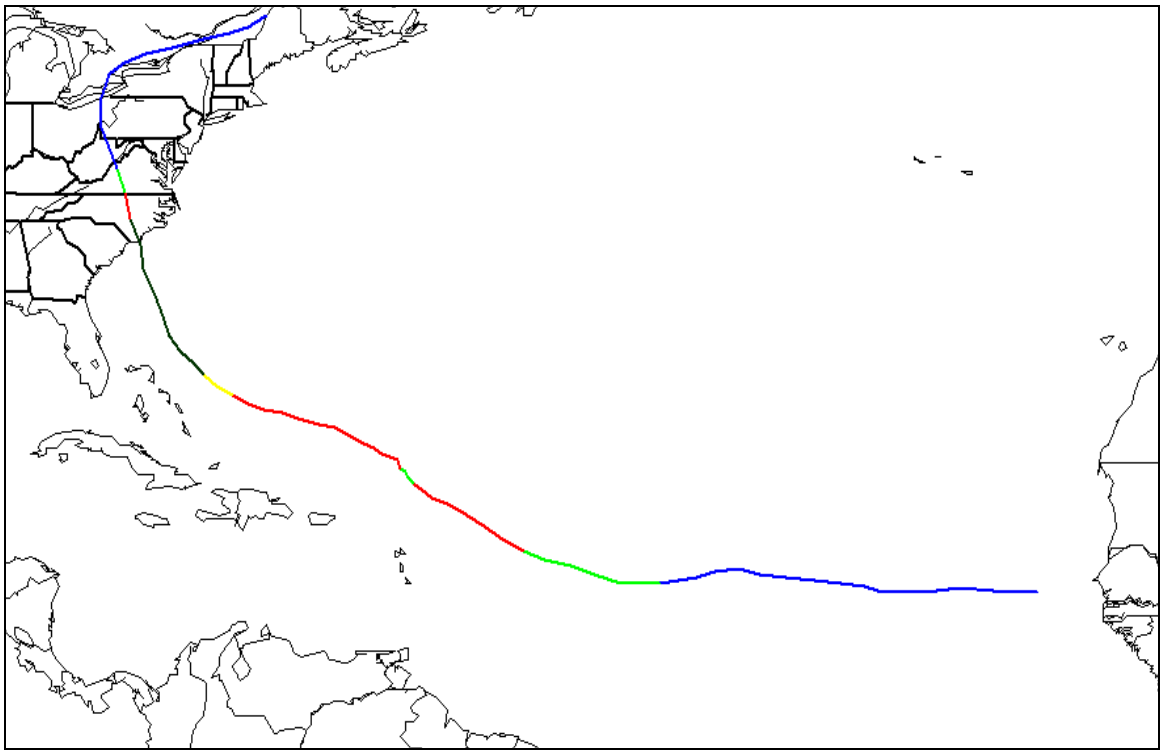

Fig. 144(a): September 5, 1996. *FRAN*.

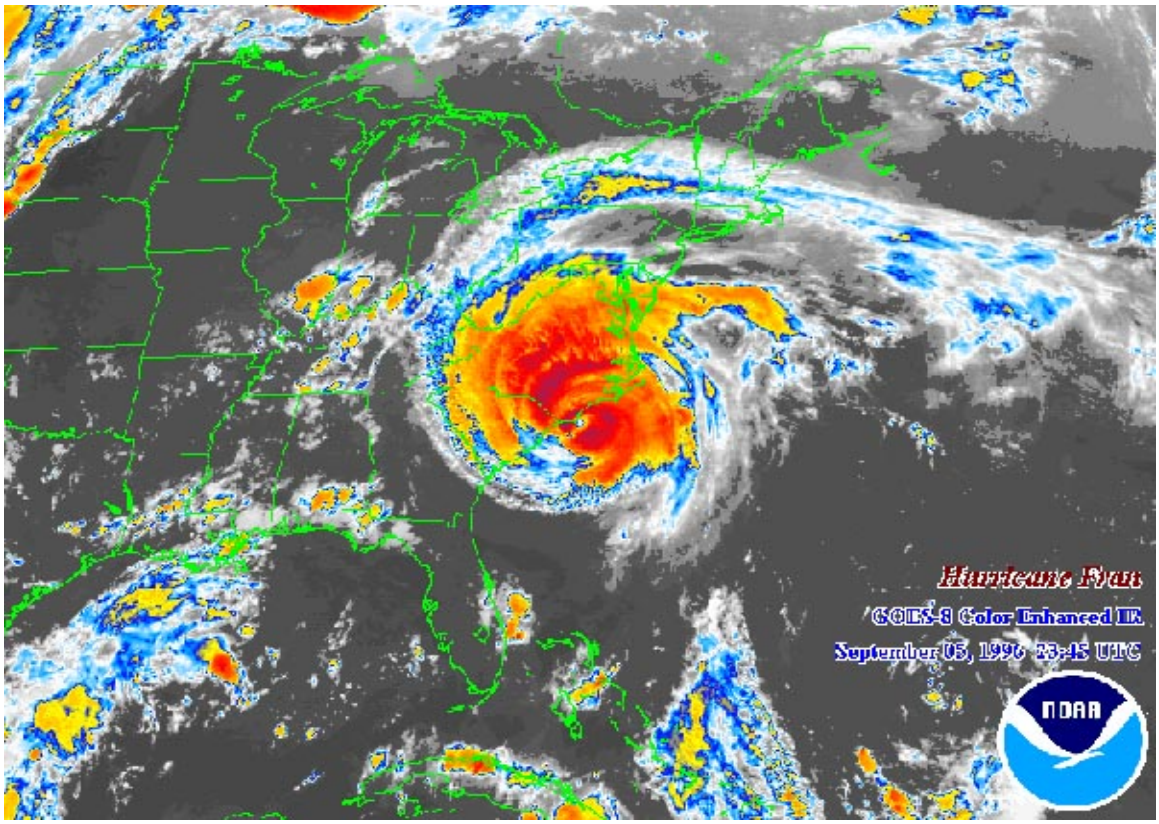

Fig. 144(b): IR image, FRAN, 2345 UTC, September 5, 1996. *Credit: National Climatic Data Center (NCDC).*

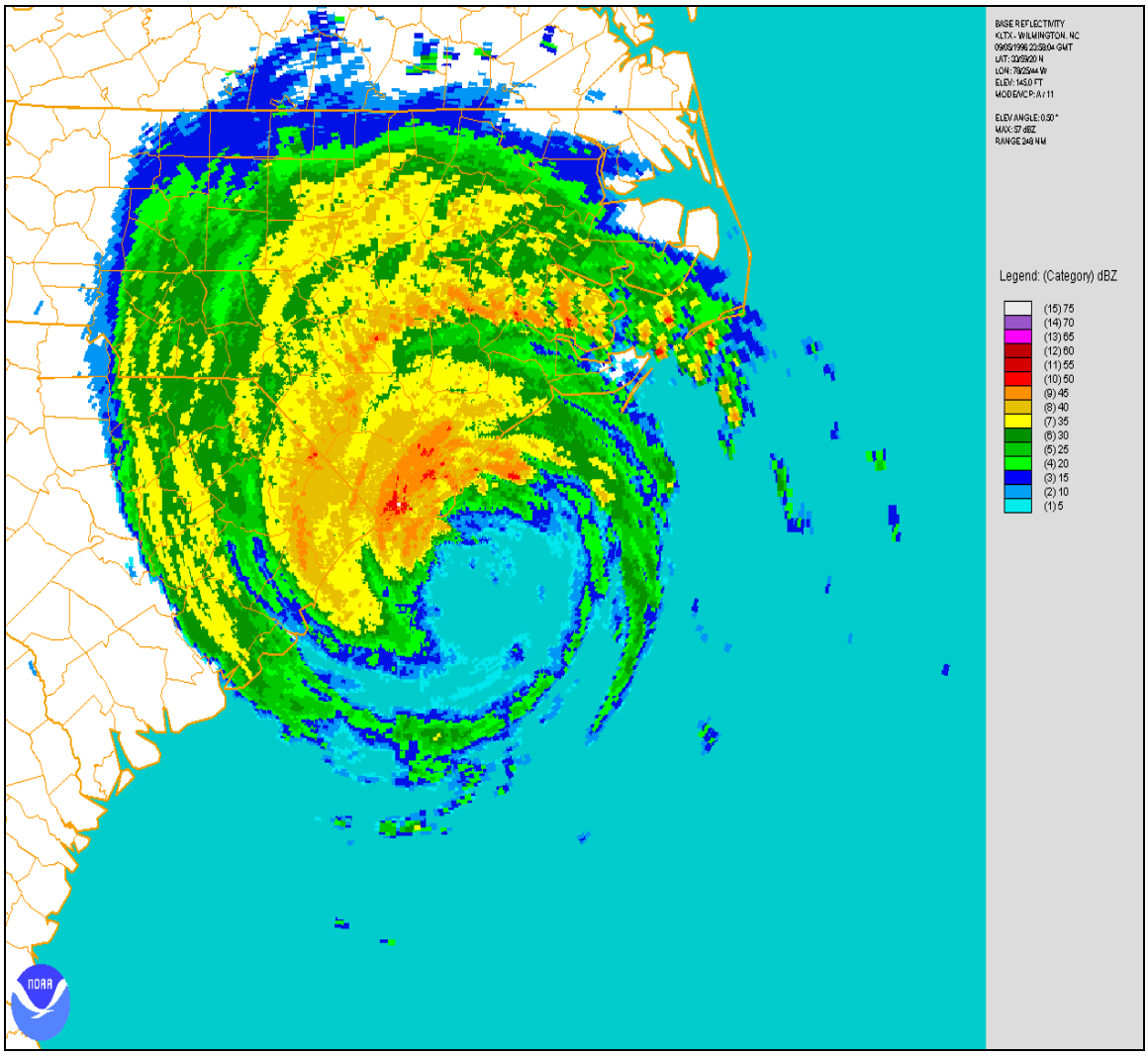

Fig 144(c): KLTX Doppler base reflectivity, FRAN, 2159 UTC, September 5, 1996. *Credit: National Climatic Data Center (NCDC).*

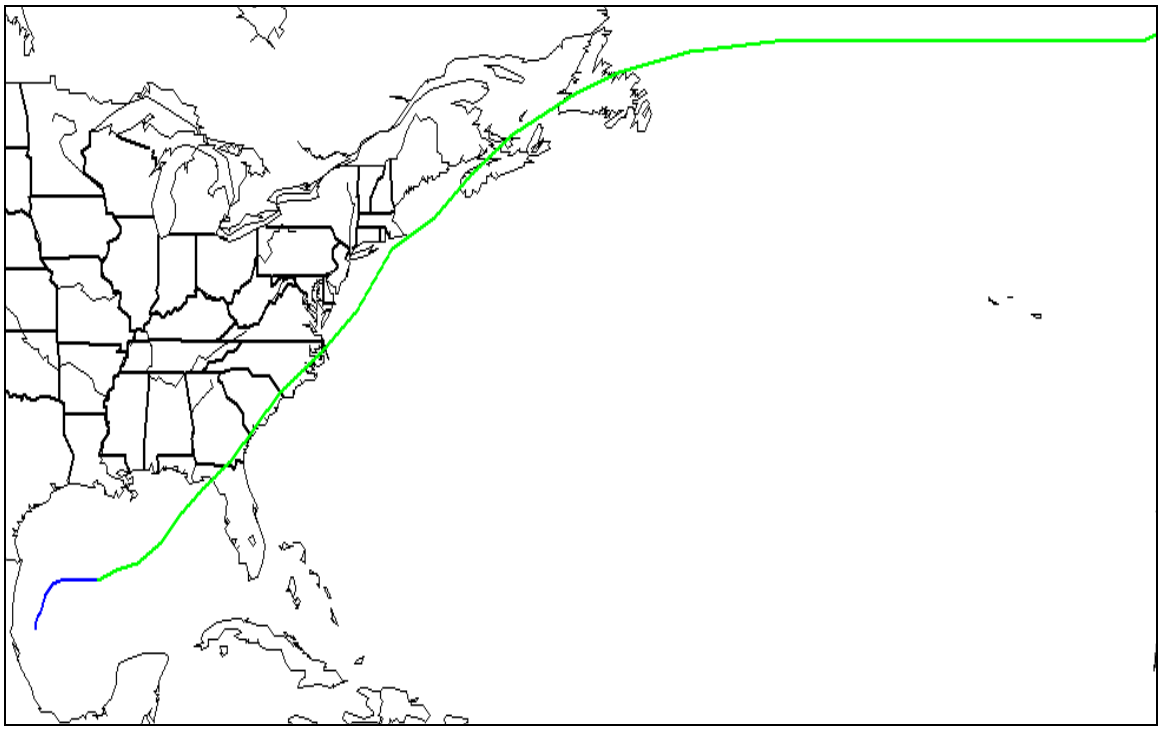

Fig. 145(a): October 7-8, 1996. *JOSEPHINE*.

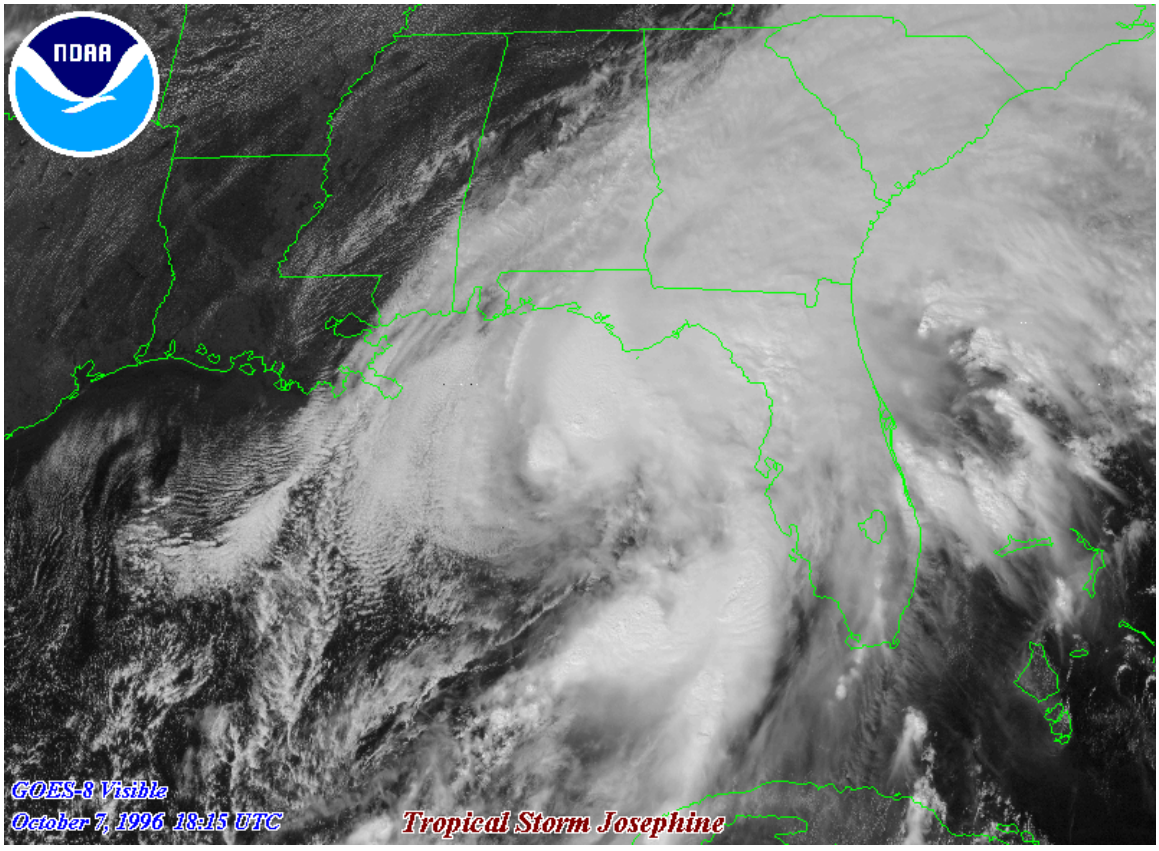

Fig. 145(b): Visible image, JOSEPHINE, 1815 UTC, October 7, 1996. *Credit: National Climatic Data Center (NCDC).*

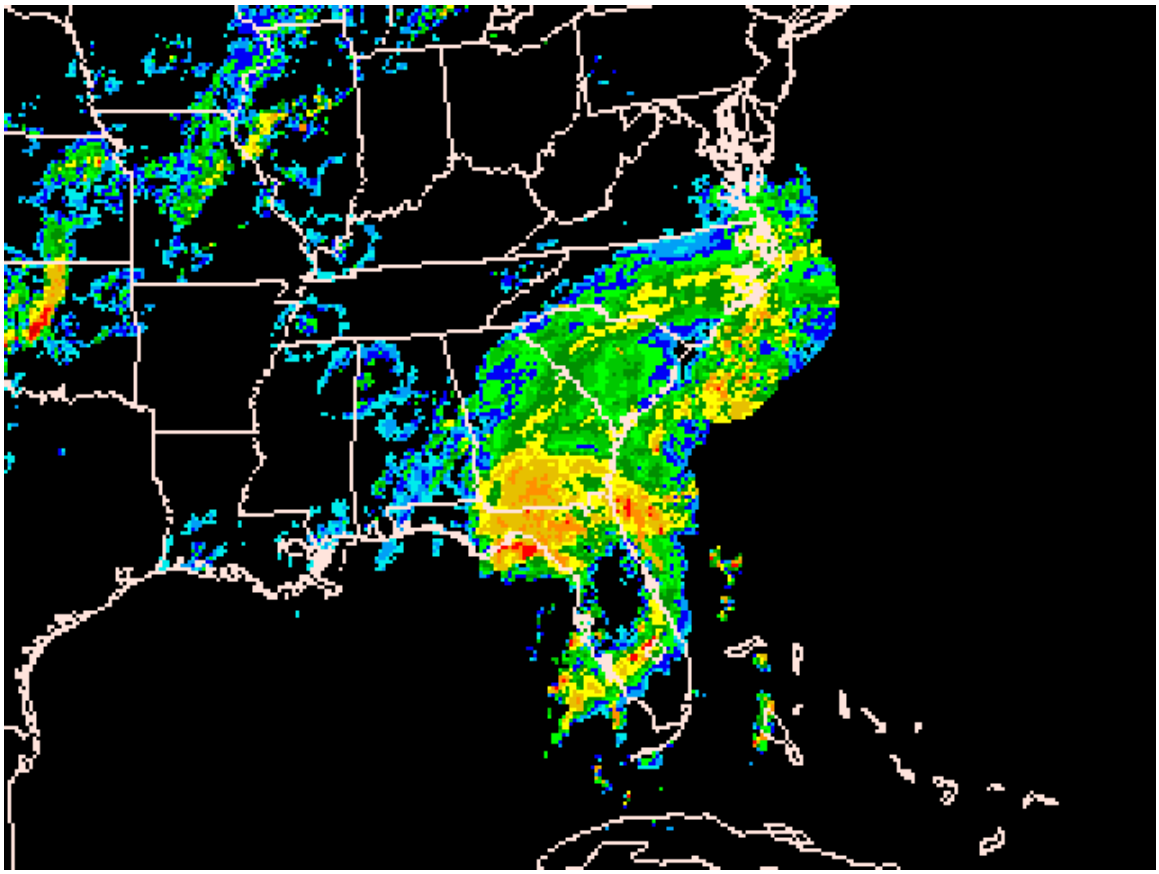

Fig 145(c): Doppler composite reflectivity, JOSEPHINE, 2300 UTC, October 7, 1996.
Credit: Storm Prediction Center (SPC).

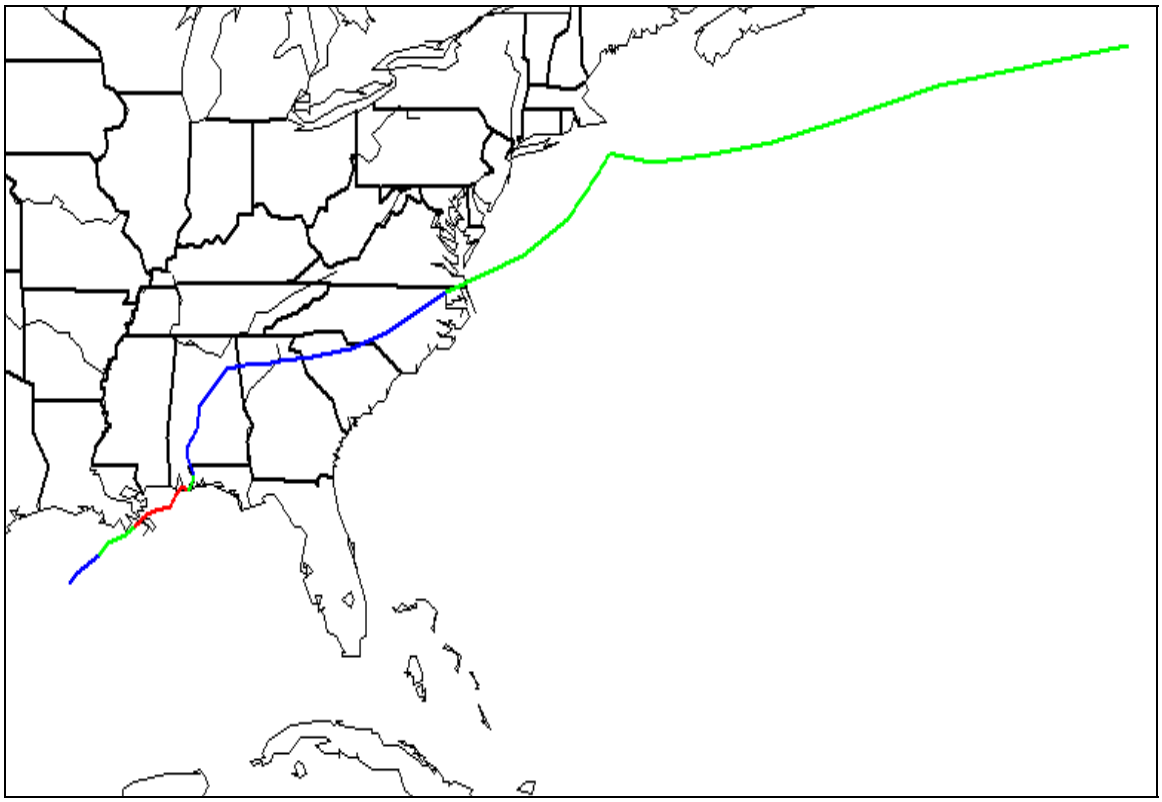

Fig. 146(a): July 24, 1997. *DANNY*.

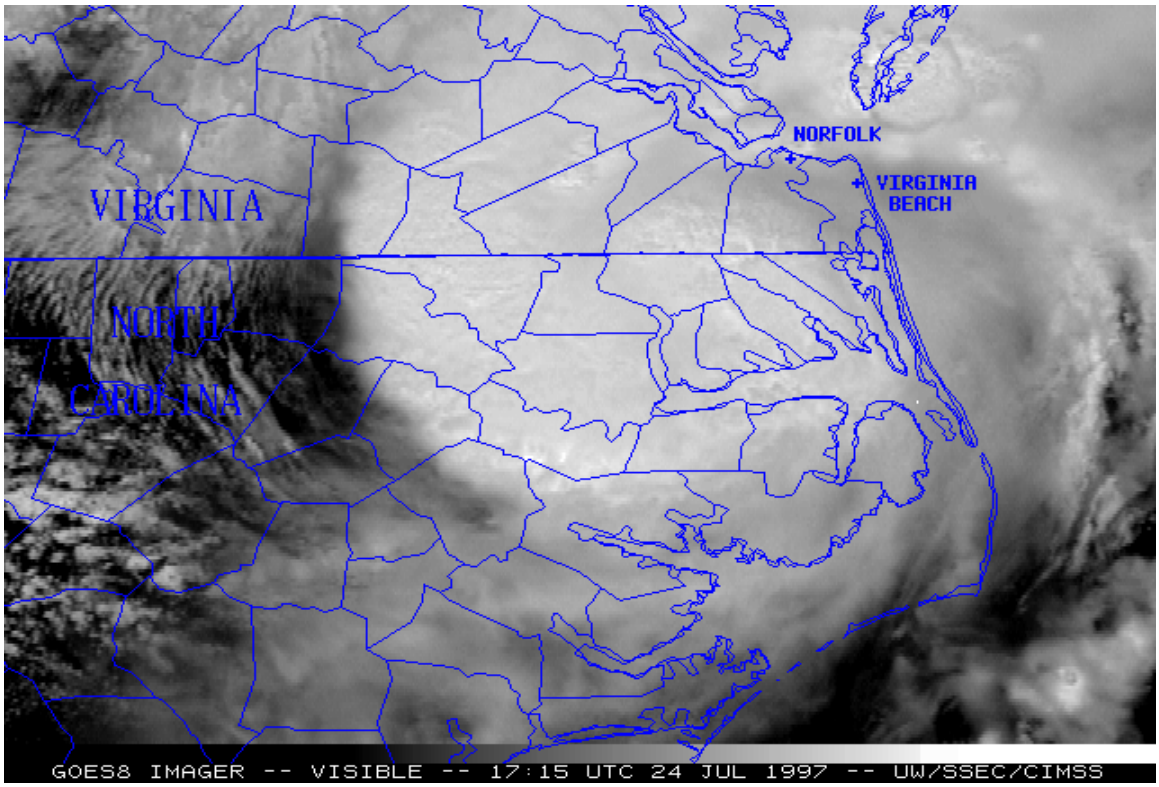

Fig. 146(b): Visible image, DANNY, 1715 UTC, July 24, 1997. *Credit: University of Wisconsin.*

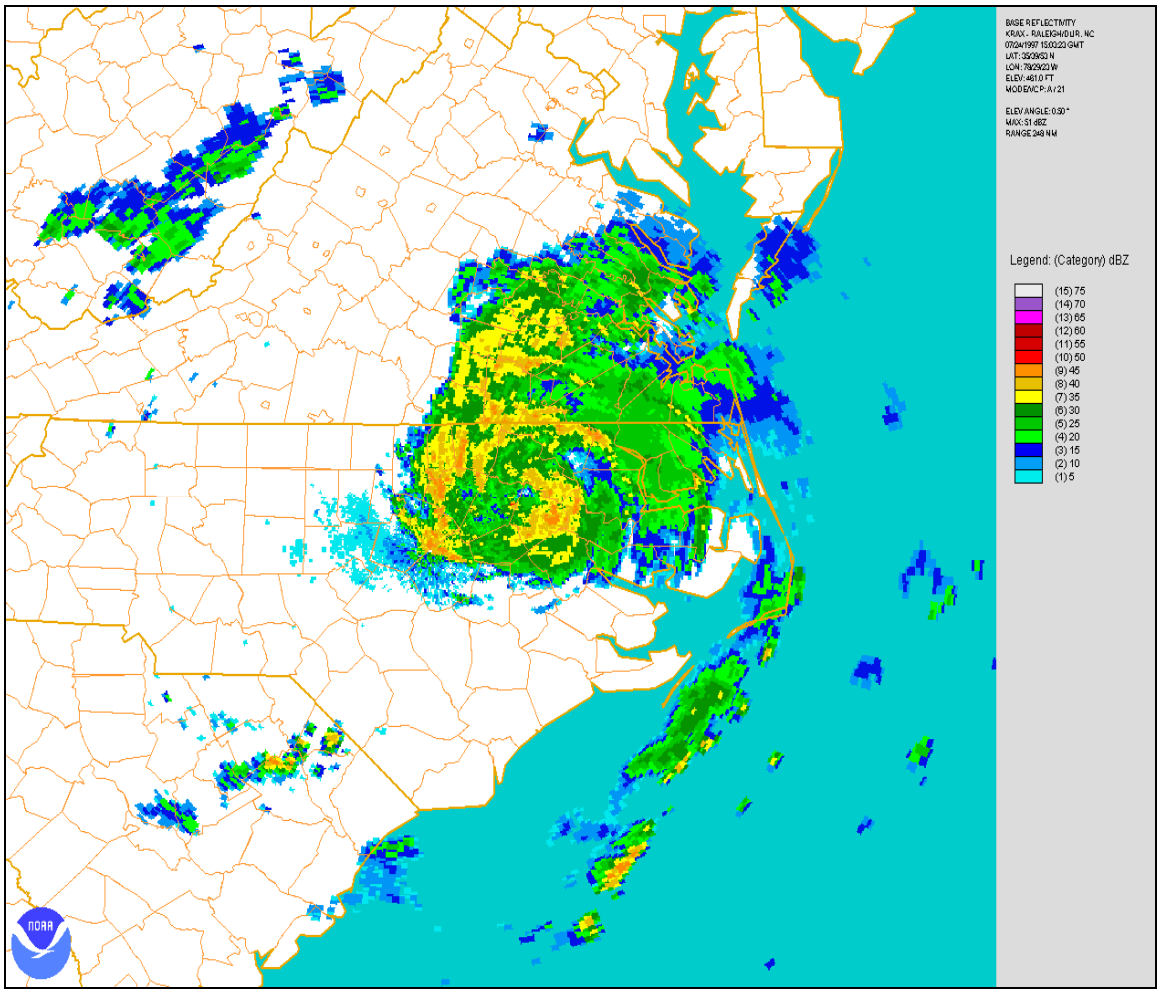

Fig. 146(c): KRAX Doppler base reflectivity, DANNY, 1500 UTC, July 24, 1997.
Credit: National Climatic Data Center (NCDC).

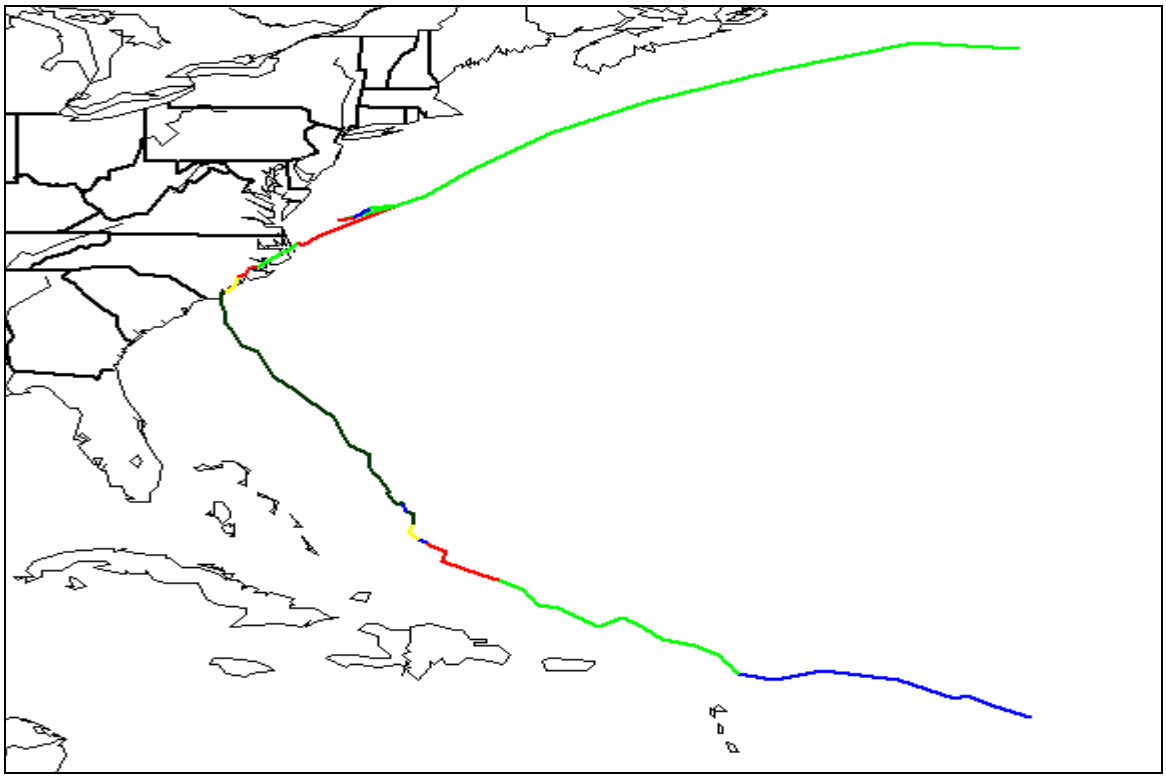

Fig. 147(a): August 26-27, 1998. *BONNIE*.

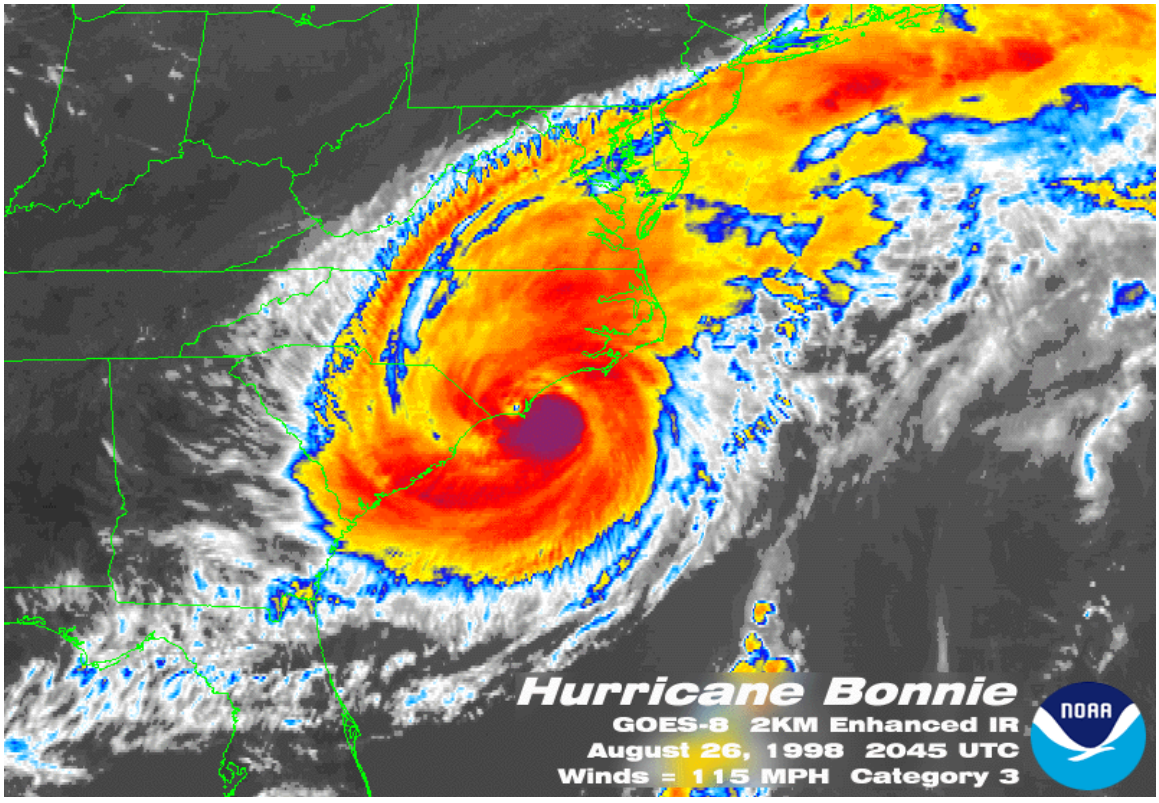

Fig. 147(b): IR image, BONNIE, 2045 UTC, August 26, 1998. *Credit: National Climatic Data Center (NCDC).*

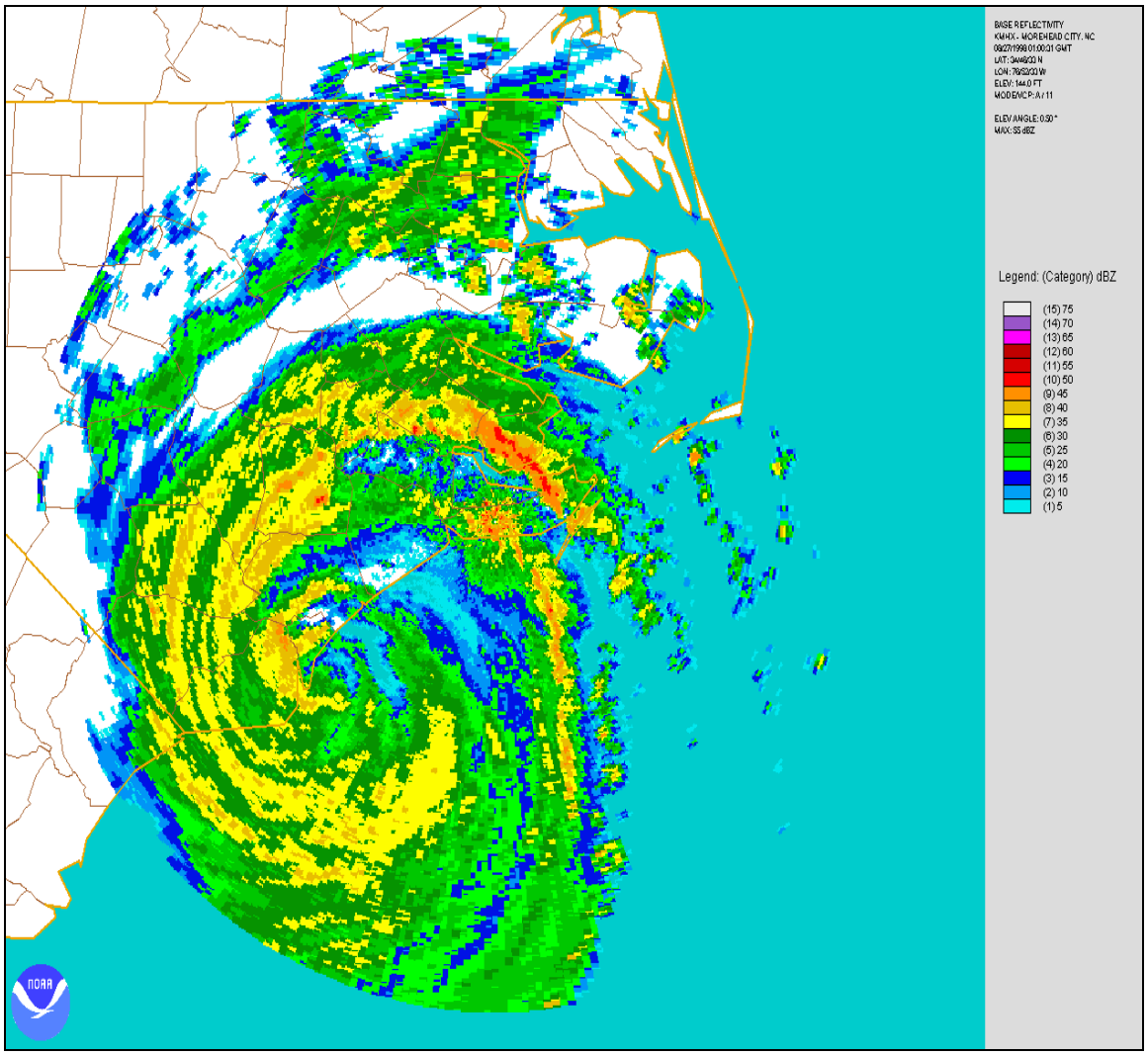

Fig. 147(c): KMHX base reflectivity, BONNIE, 0159 UTC, August 27, 1998. *Credit: National Climatic Data Center (NCDC).*

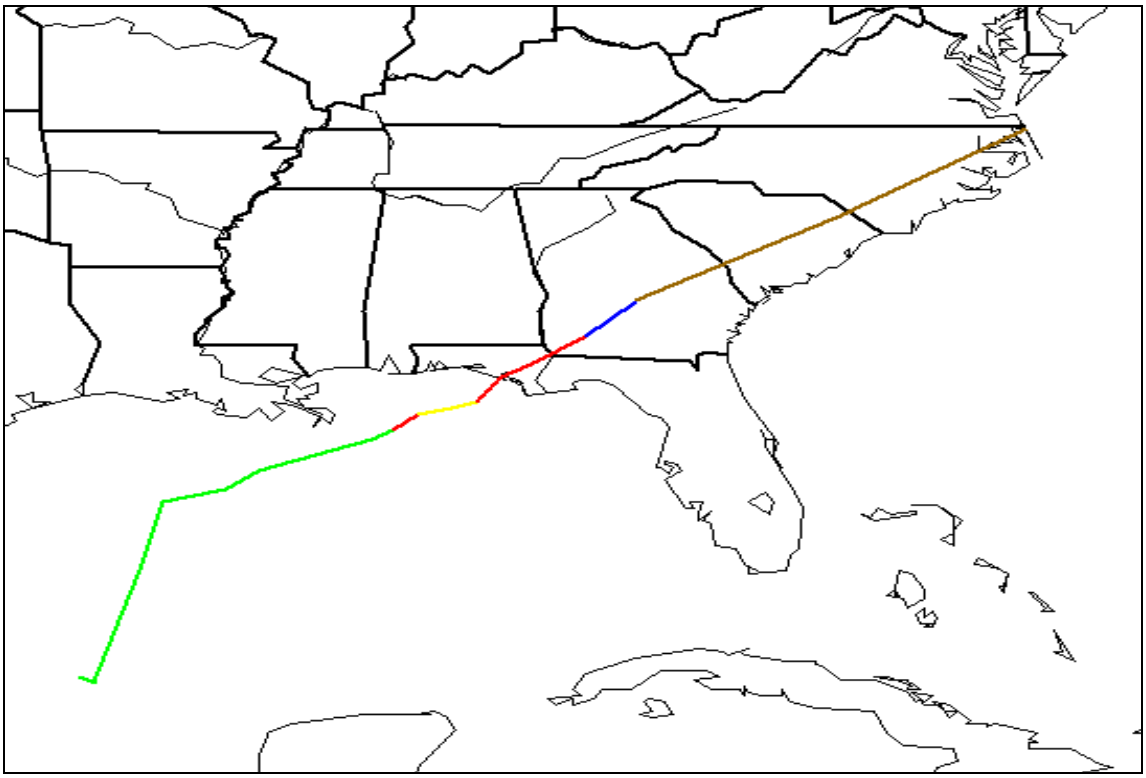

Fig. 148(a): September 4, 1998. *EARL*.

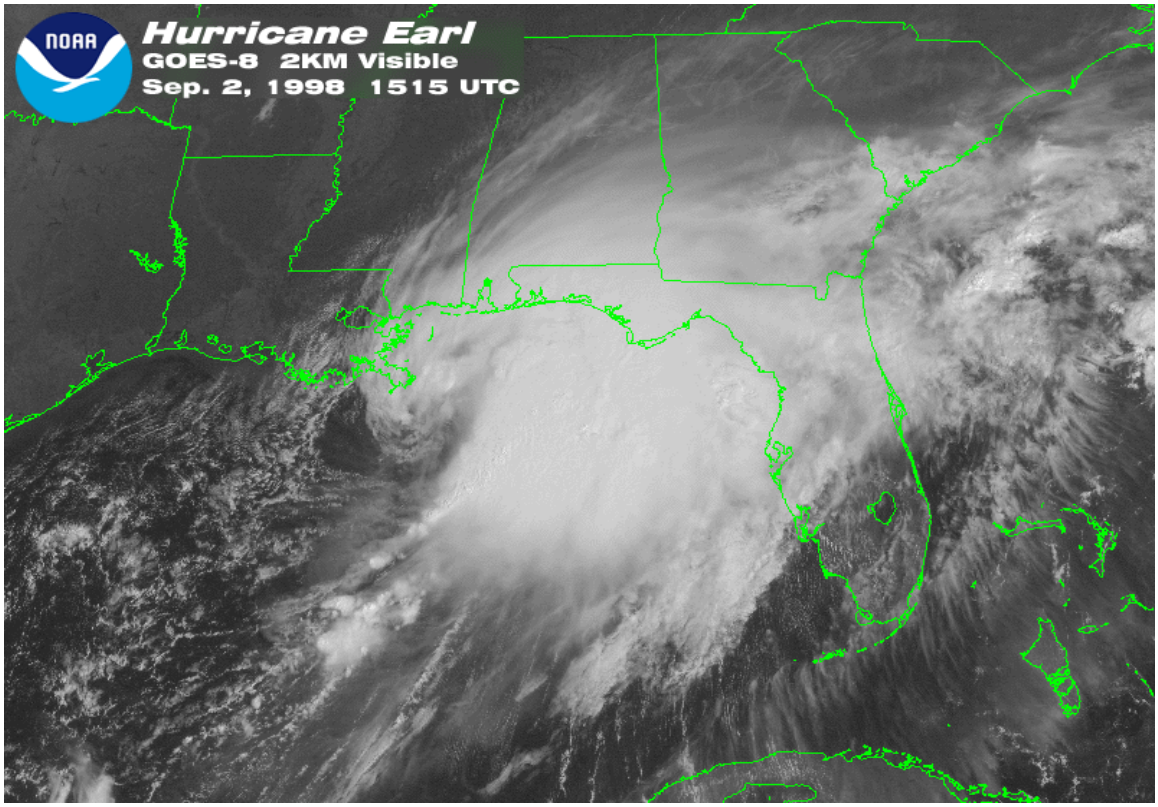

Fig. 148(b): Visible image, EARL, 1515 UTC, September 2, 1998. *Credit: National Climatic Data Center (NCDC).*

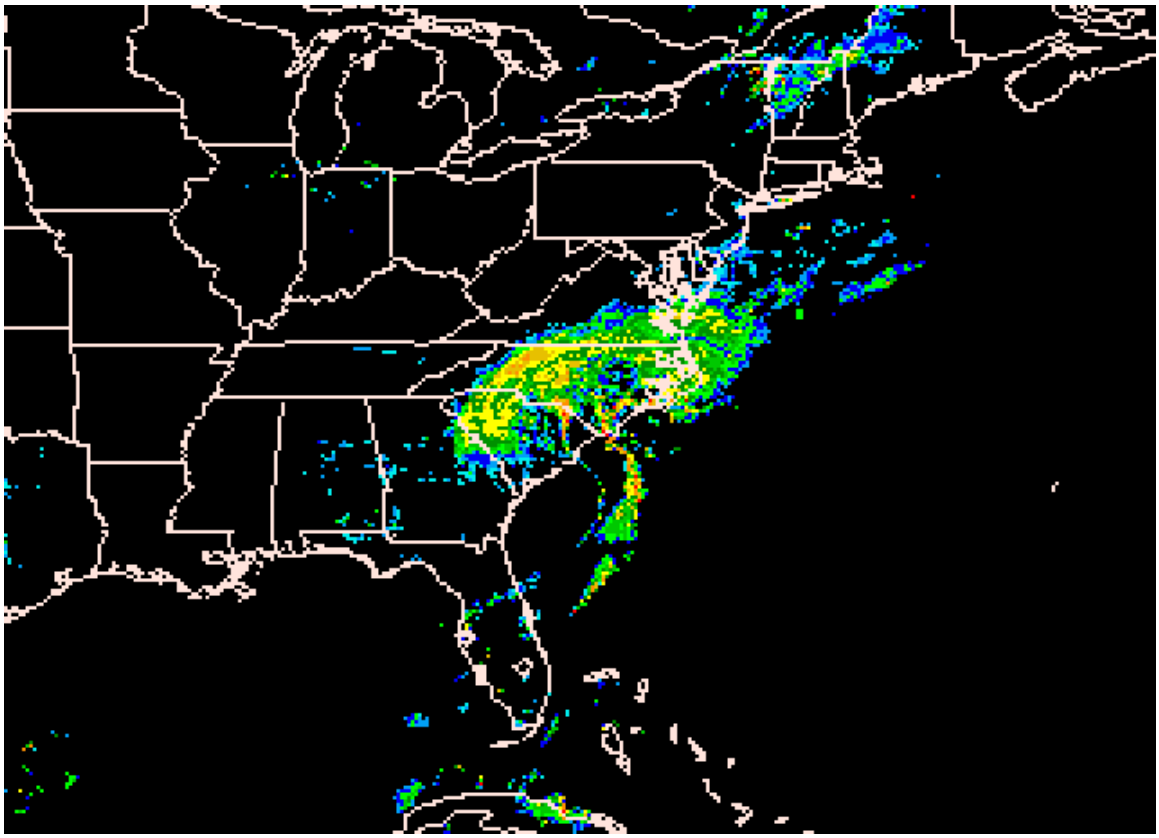

Fig. 148(c): Composite base reflectivity, Earl, 1000 UTC, September 4, 1998. *Credit: Storm Prediction Center (SPC).*

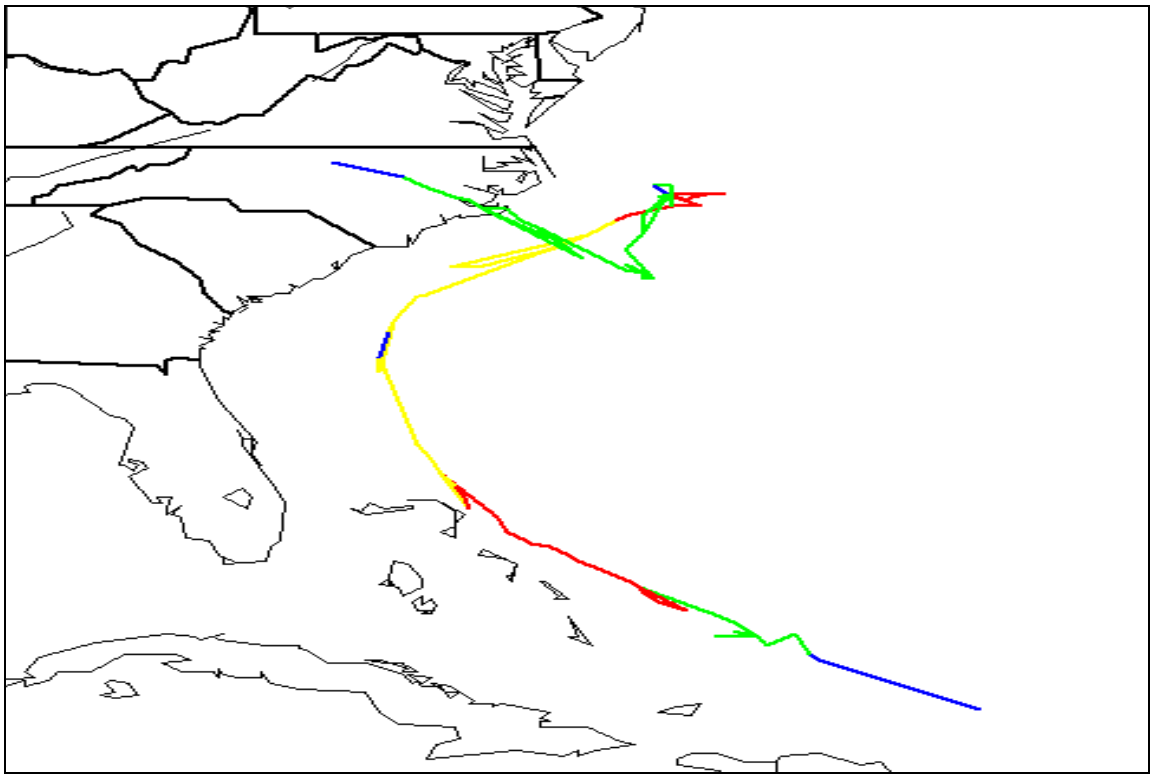

Fig. 149(a): September 4-5, 1999. *DENNIS.*

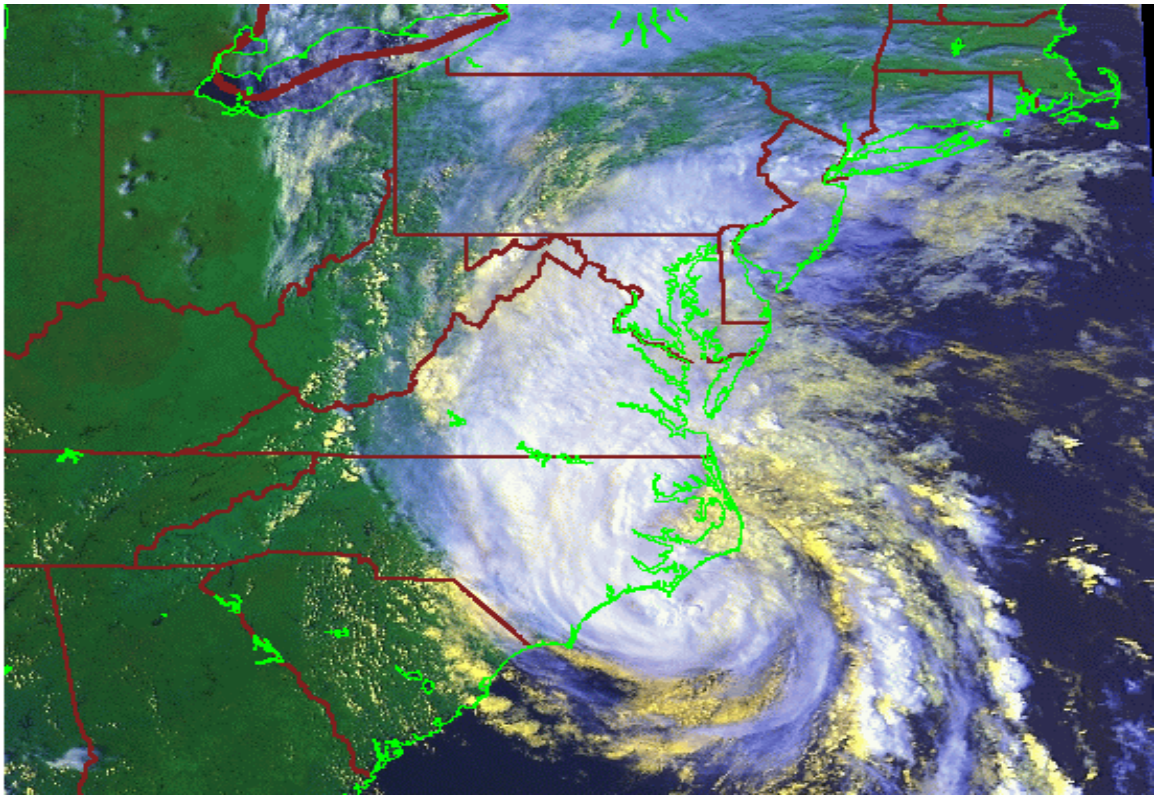

Fig. 149(b): Visible image, DENNIS, September 5, 1999. *Credit: National Aeronautics and Space Administration (NASA).*

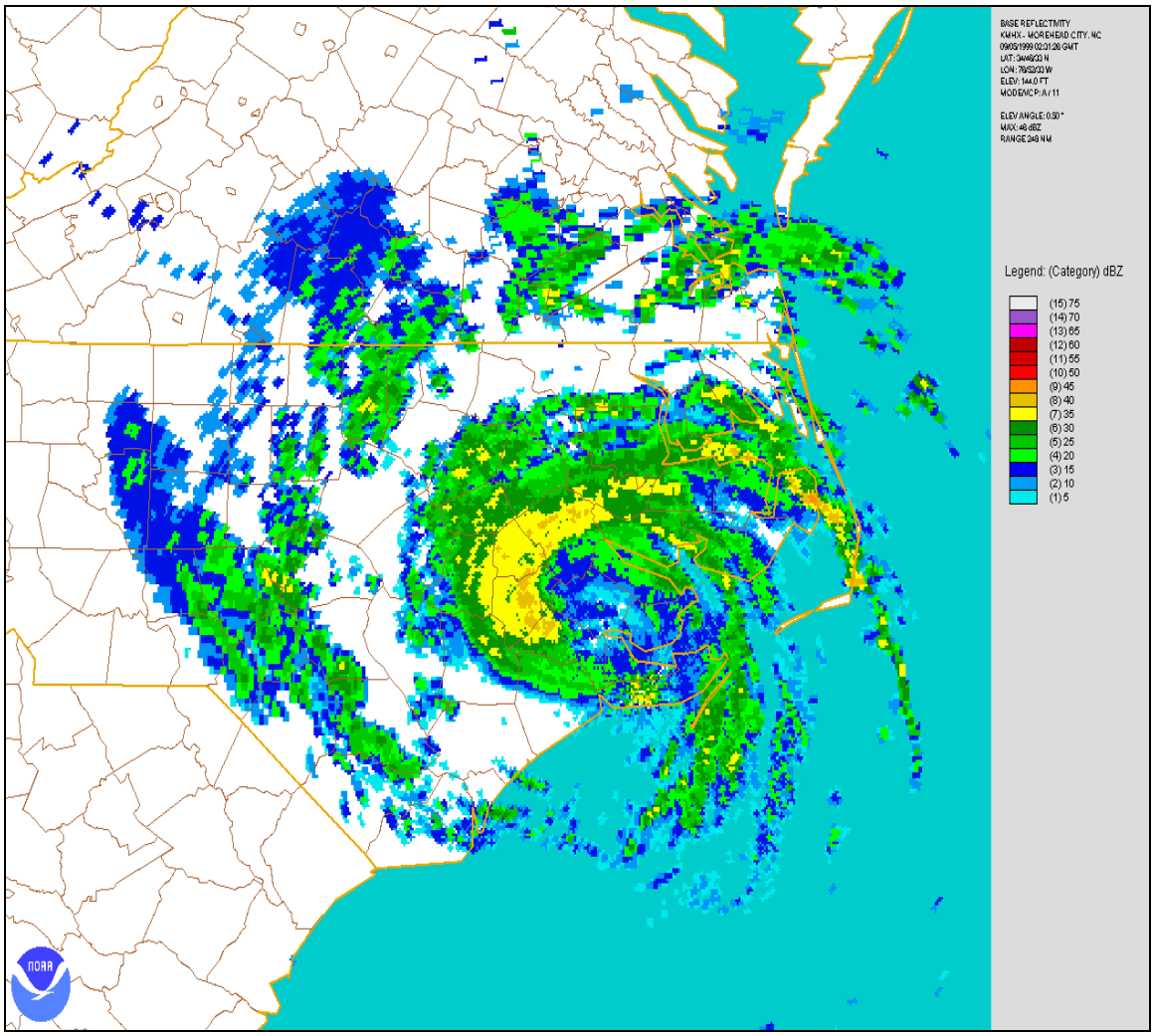

Fig. 149(c): KMHX Doppler base reflectivity, DENNIS, 0201 UTC, September 5, 1999. *Credit: National Climatic Data Center (NCDC).*

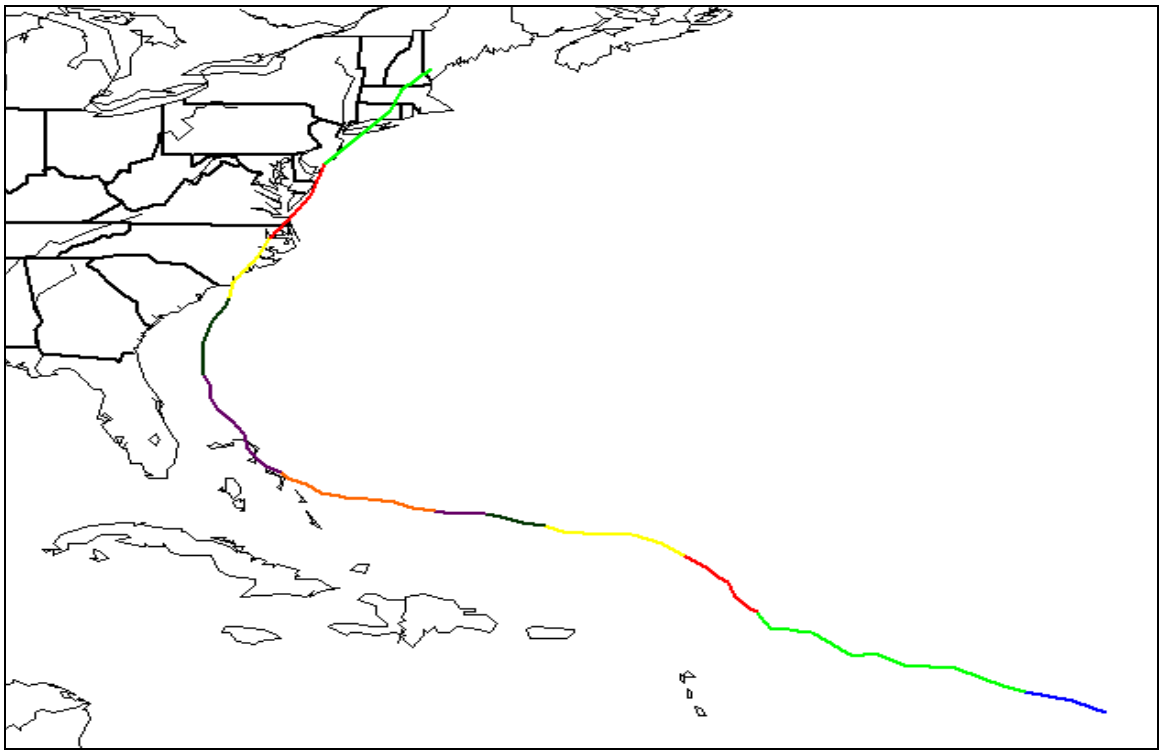

Fig. 150(a): September 16, 1999. *FLOYD.*

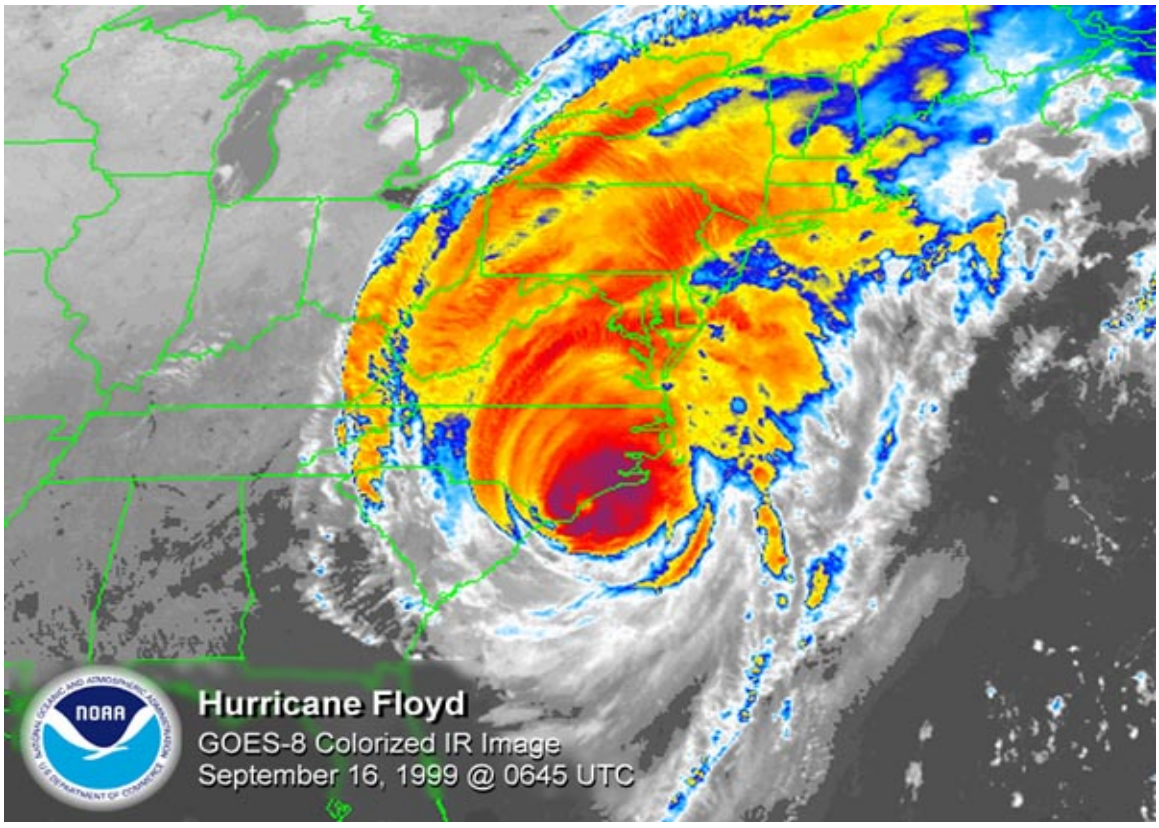

Fig. 150(b): IR image, FLOYD, 0645 UTC, September 16, 1999. *Credit: National Climatic Data Center (NCDC).*

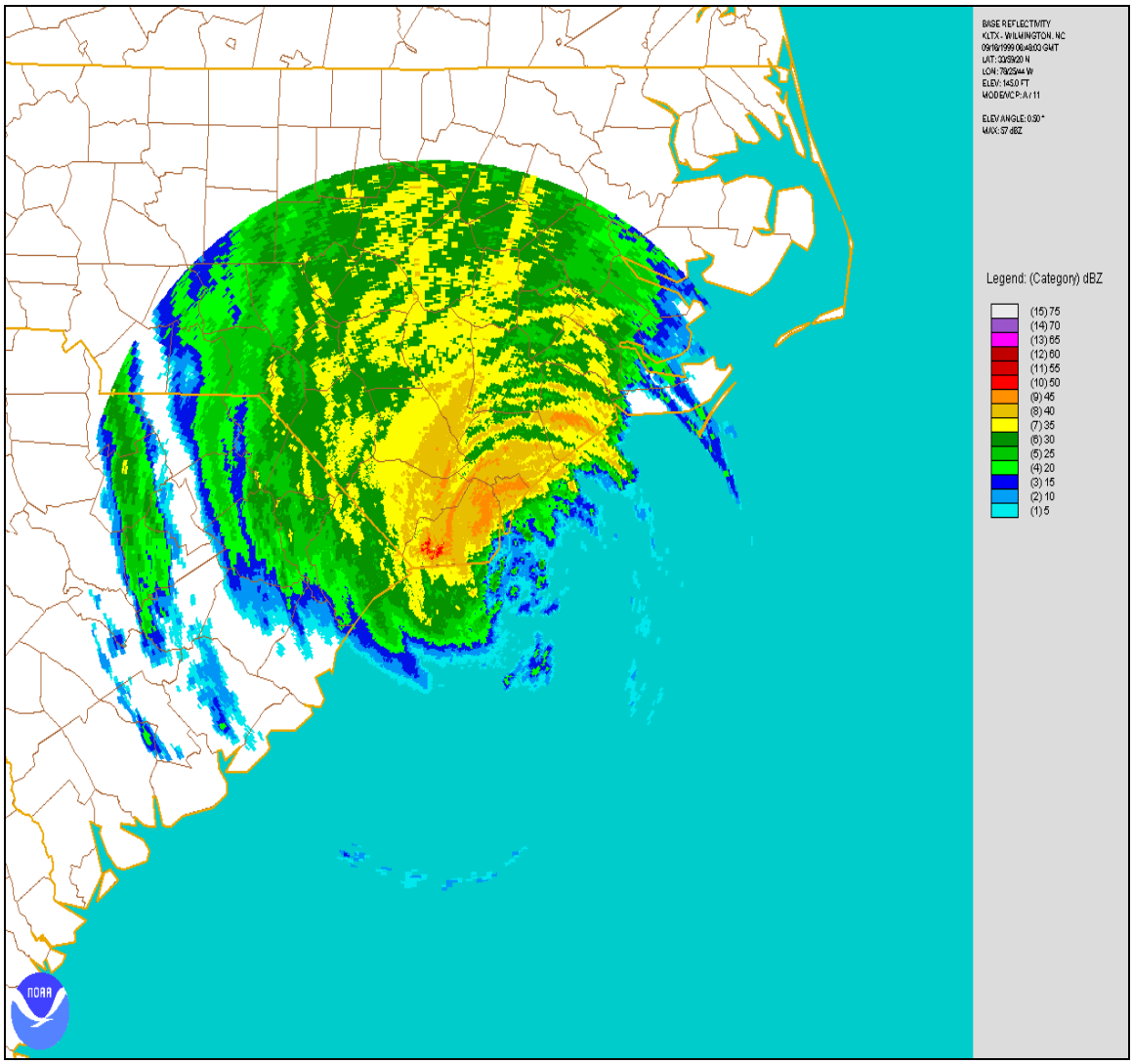

Fig. 150(c): KLTX Doppler reflectivity, FLOYD 0640 UTC, September 16, 1999.
Credit: National Climatic Data Center (NCDC).

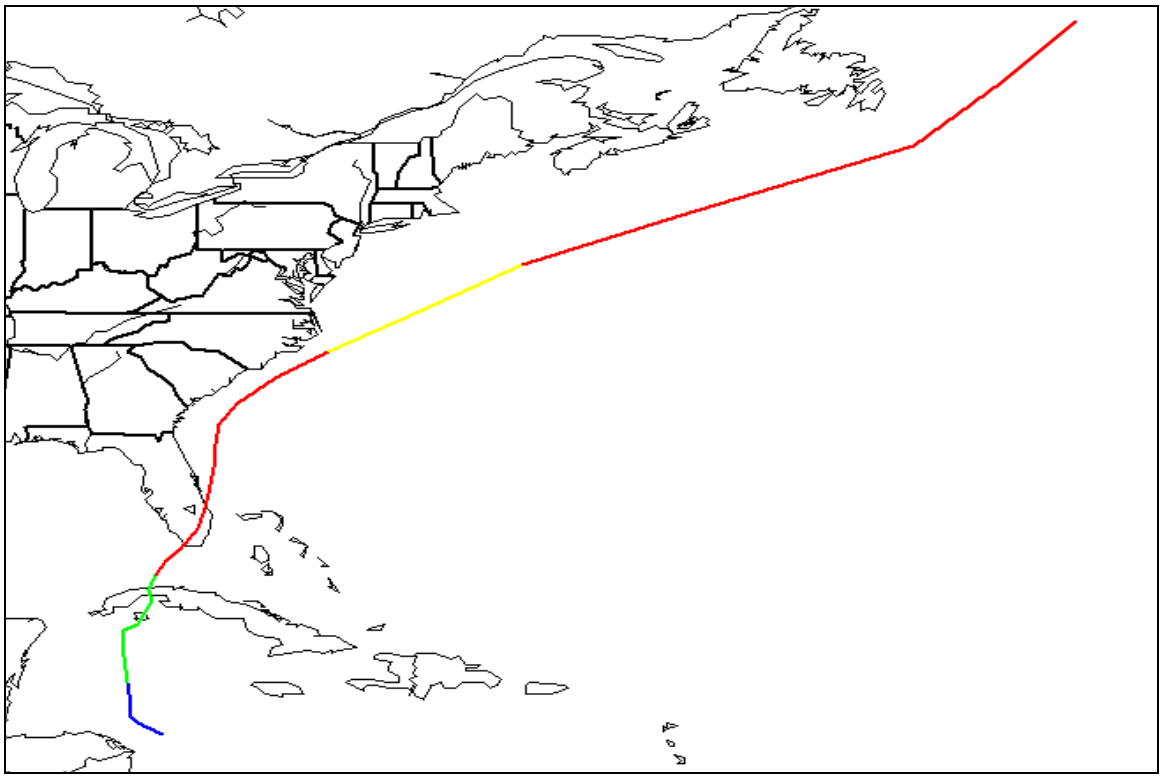

Fig. 151(a): October 17-18, 1999. *IRENE*.

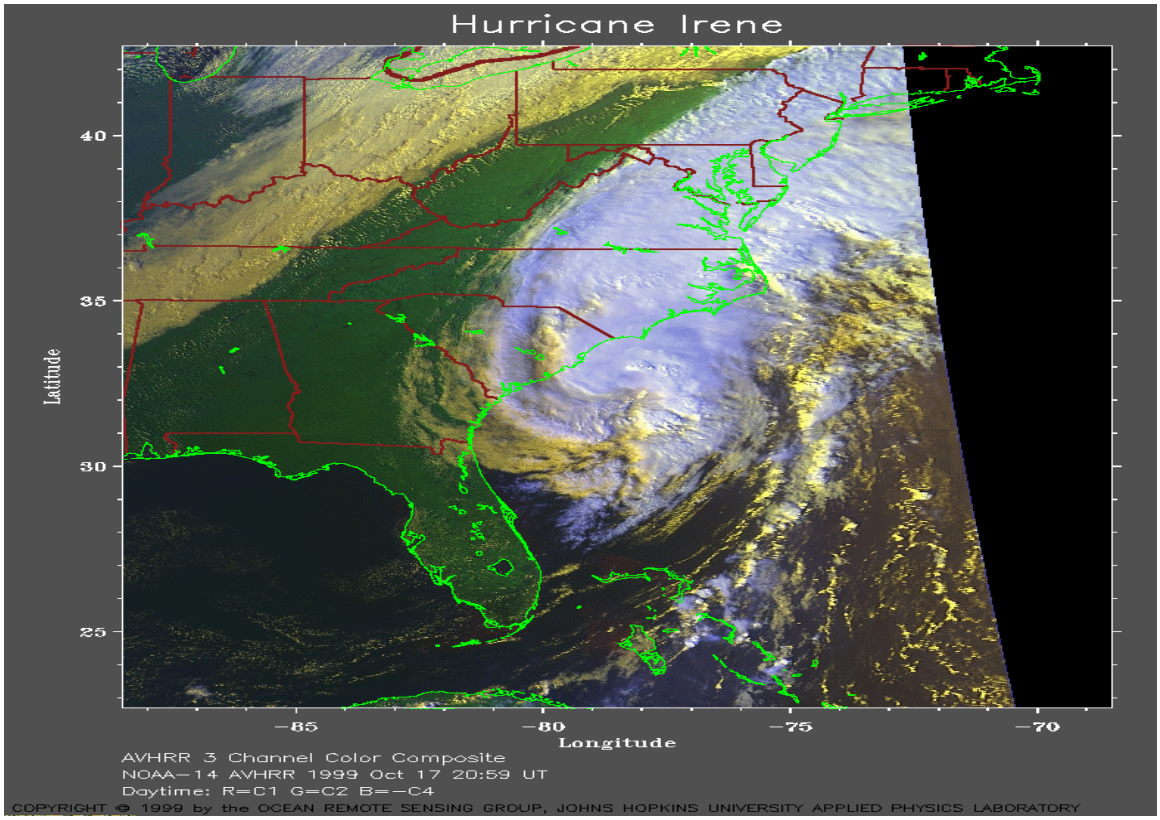

Fig. 151(b): Visible image, IRENE, 2059 UTC, October 17, 1999. *Credit: Johns Hopkins University.*

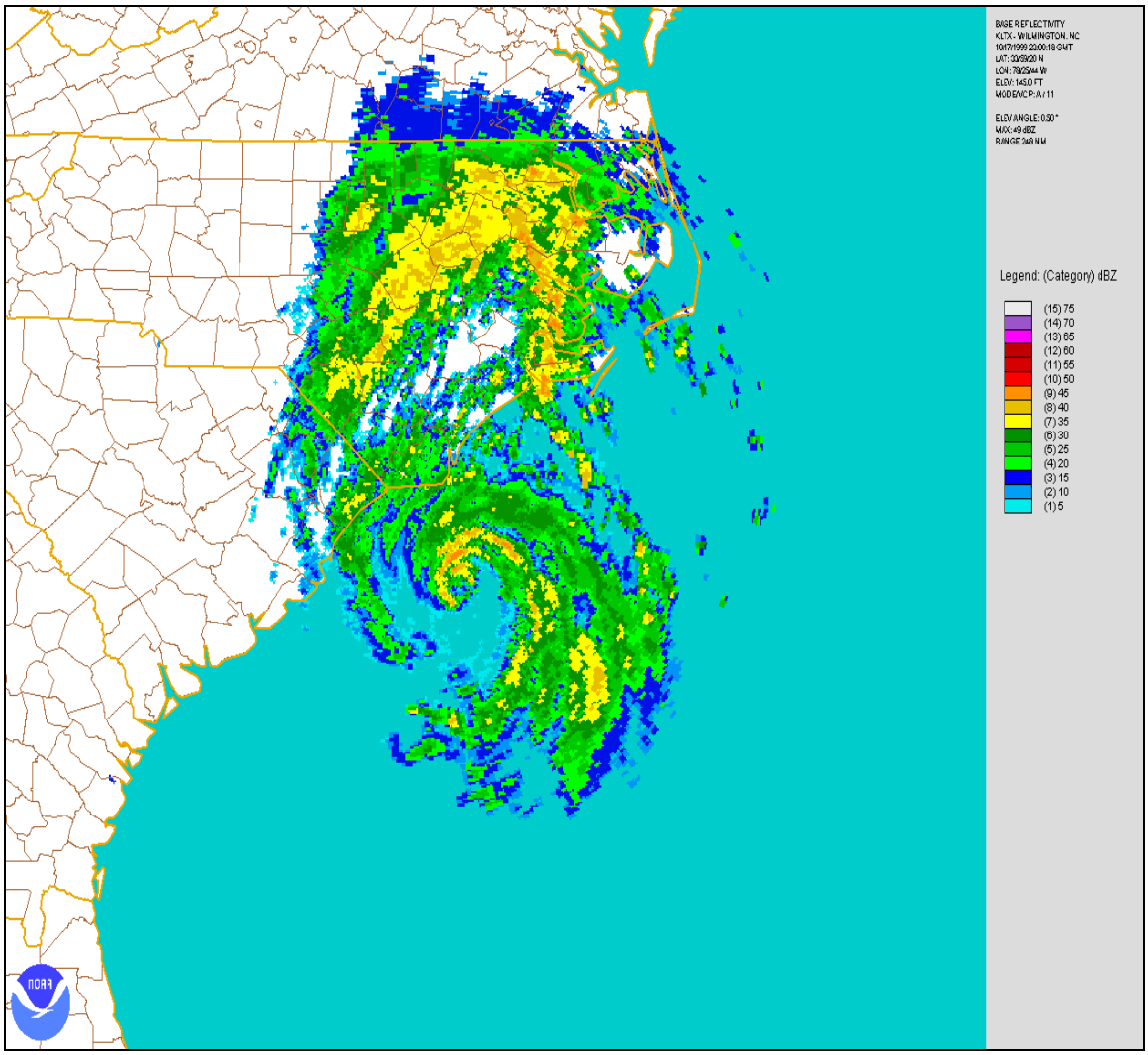

Fig. 151(c): KLTX Doppler base reflectivity, IRENE, 2000 UTC, October 17, 1999. *Credit: National Climatic Data Center (NCDC).*

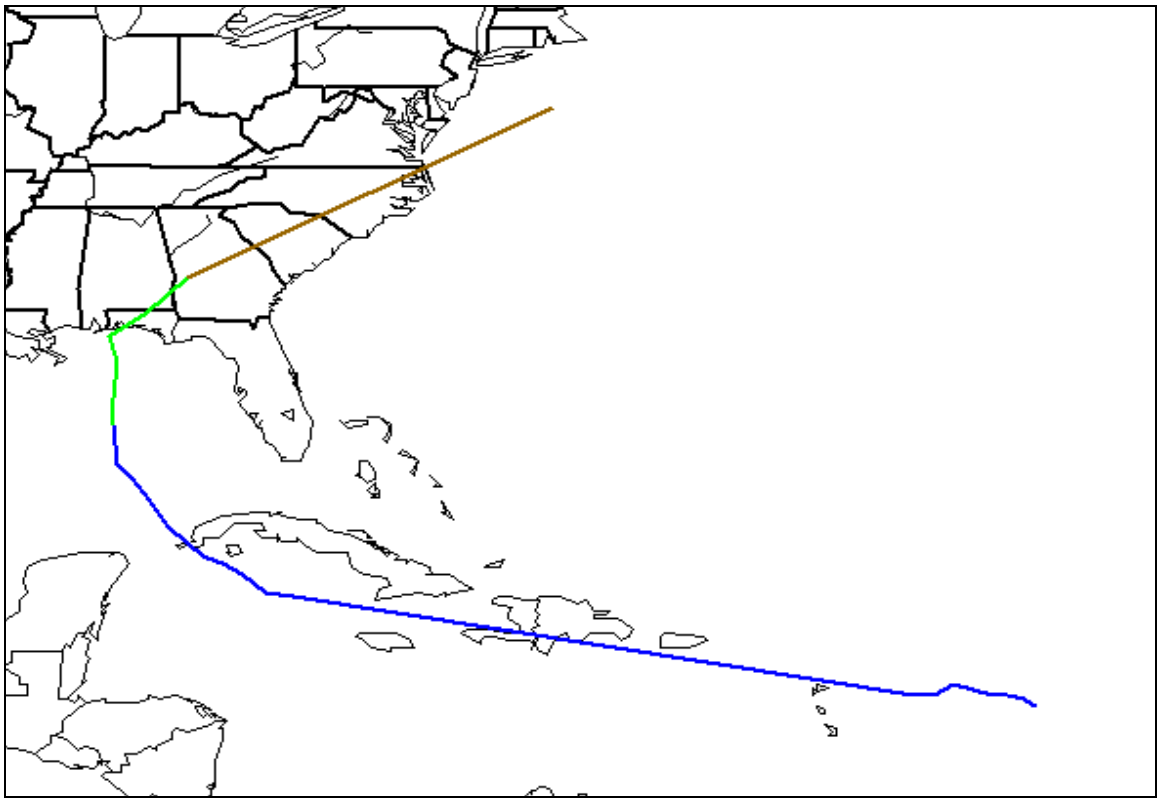

Fig. 152(a): September 24, 2000. *HELENE.*

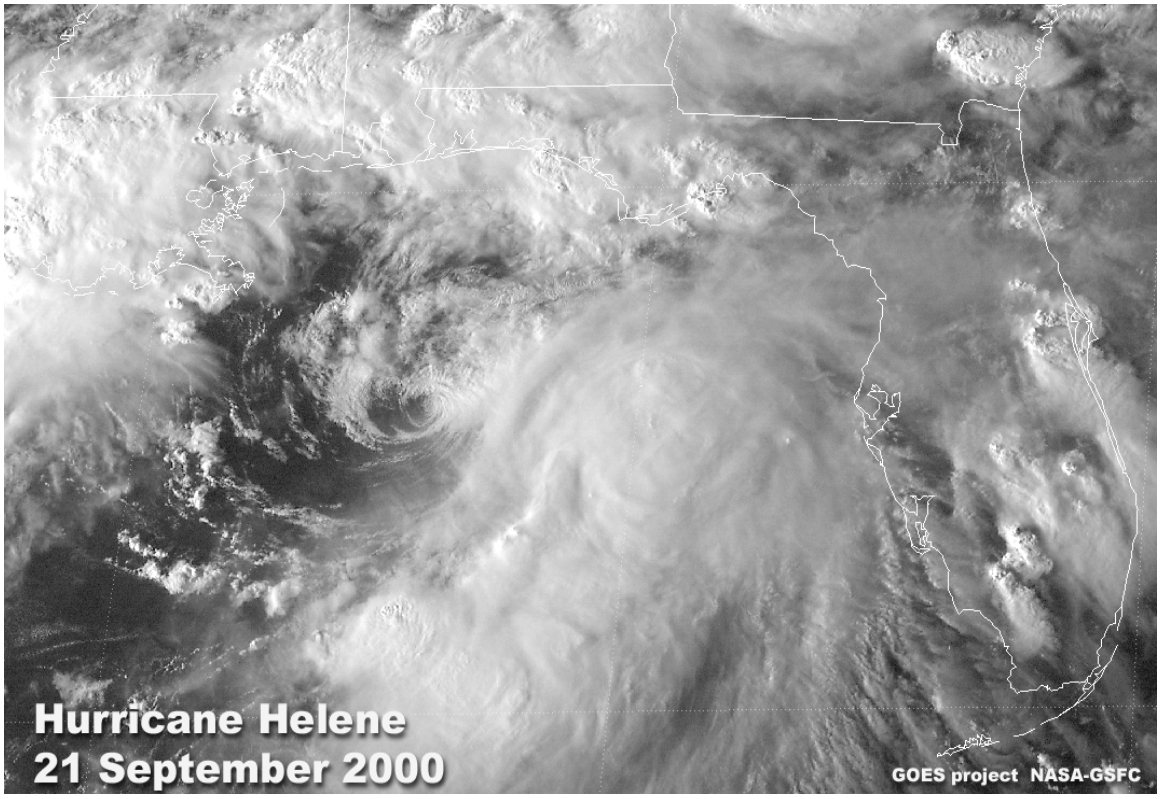

Fig. 152(b): Visible image, HELENE, September 21, 2000. *Credit: National Aeronautics and Space Administration (NASA).*

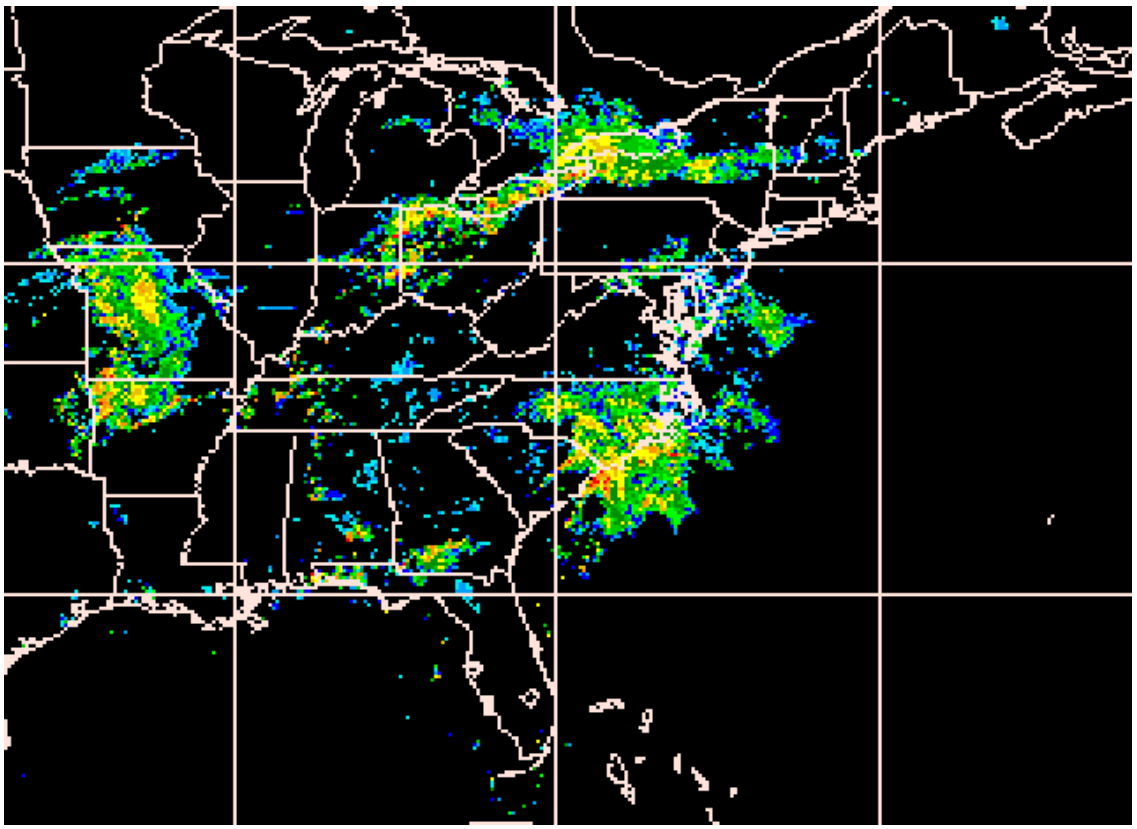

Fig. 152(c): Composite base reflectivity, HELENE, September 24, 2000. *Credit: Storm Prediction Center (SPC).*

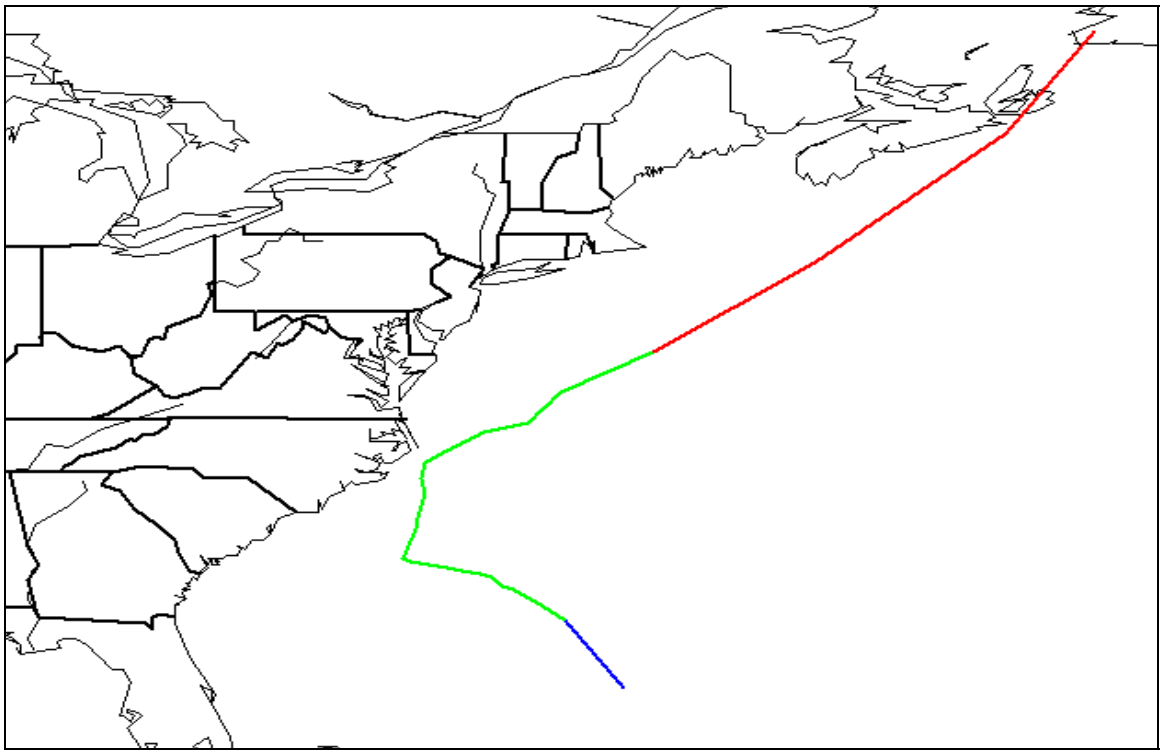

Fig. 153(a): September 10, 2002. *GUSTAV.*

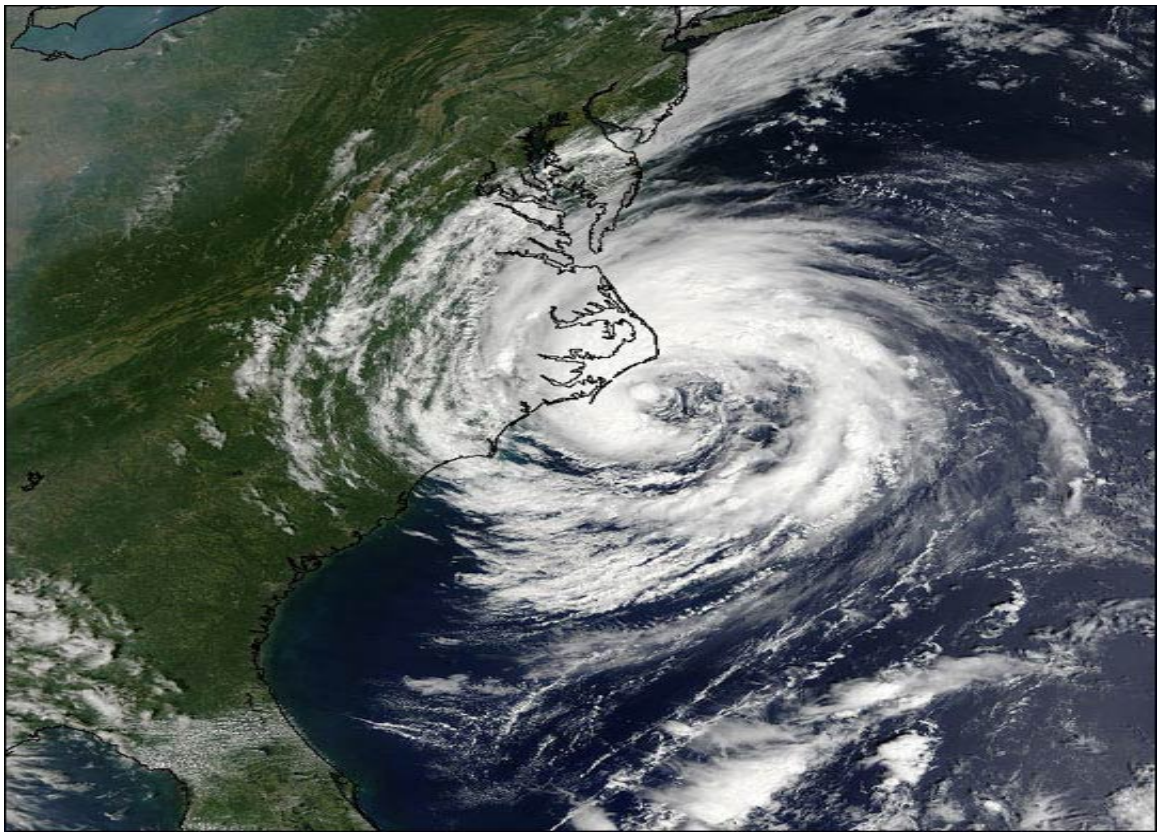

Fig. 153(b): Visible image, GUSTAV, September 10, 2002. *Credit: National Aeronautics and Space Administration (NASA).*

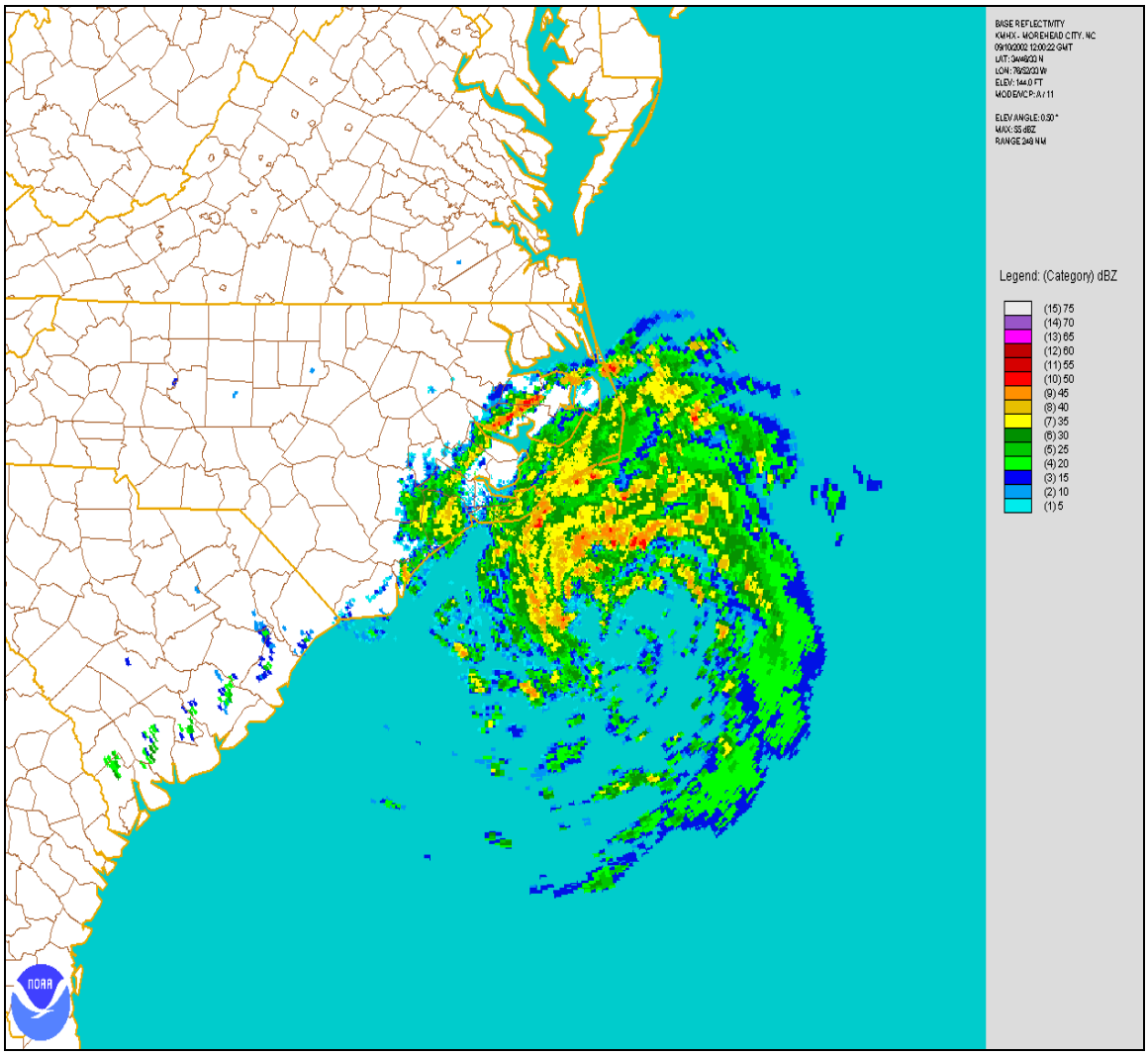

Fig. 153(c): Doppler composite reflectivity, GUSTAV, 1200 UTC, September 10, 2002. *Credit: National Climatic Data Center (NCDC).*

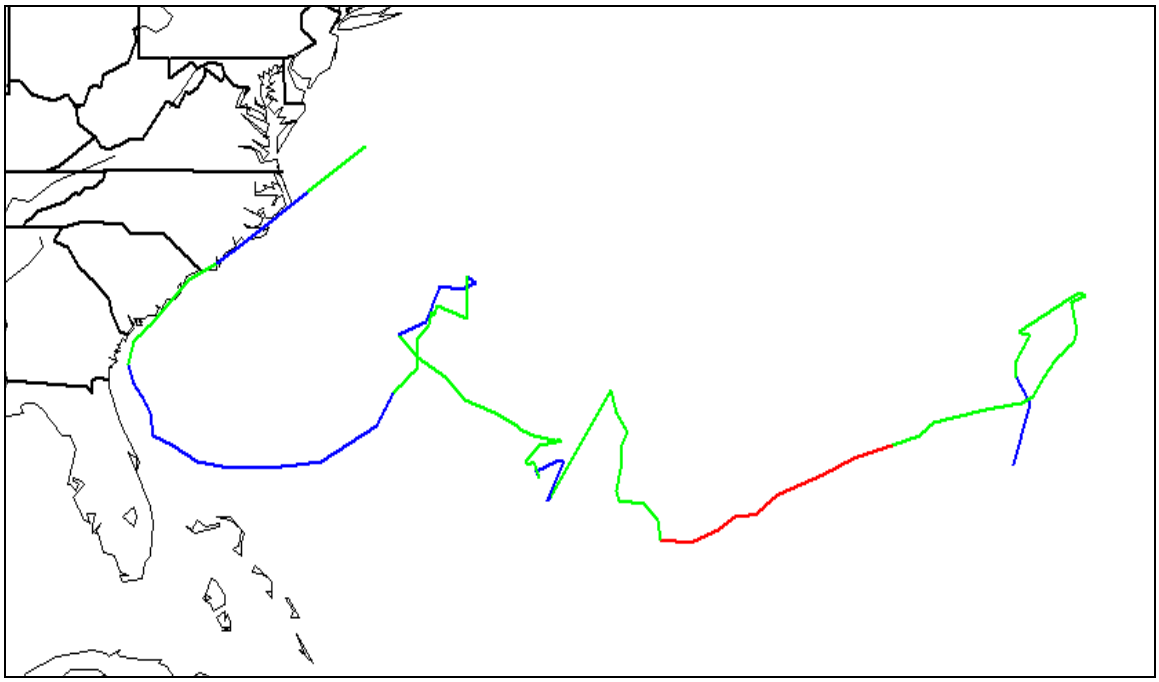

Fig. 154(a): October 12, 2002. *KYLE*.

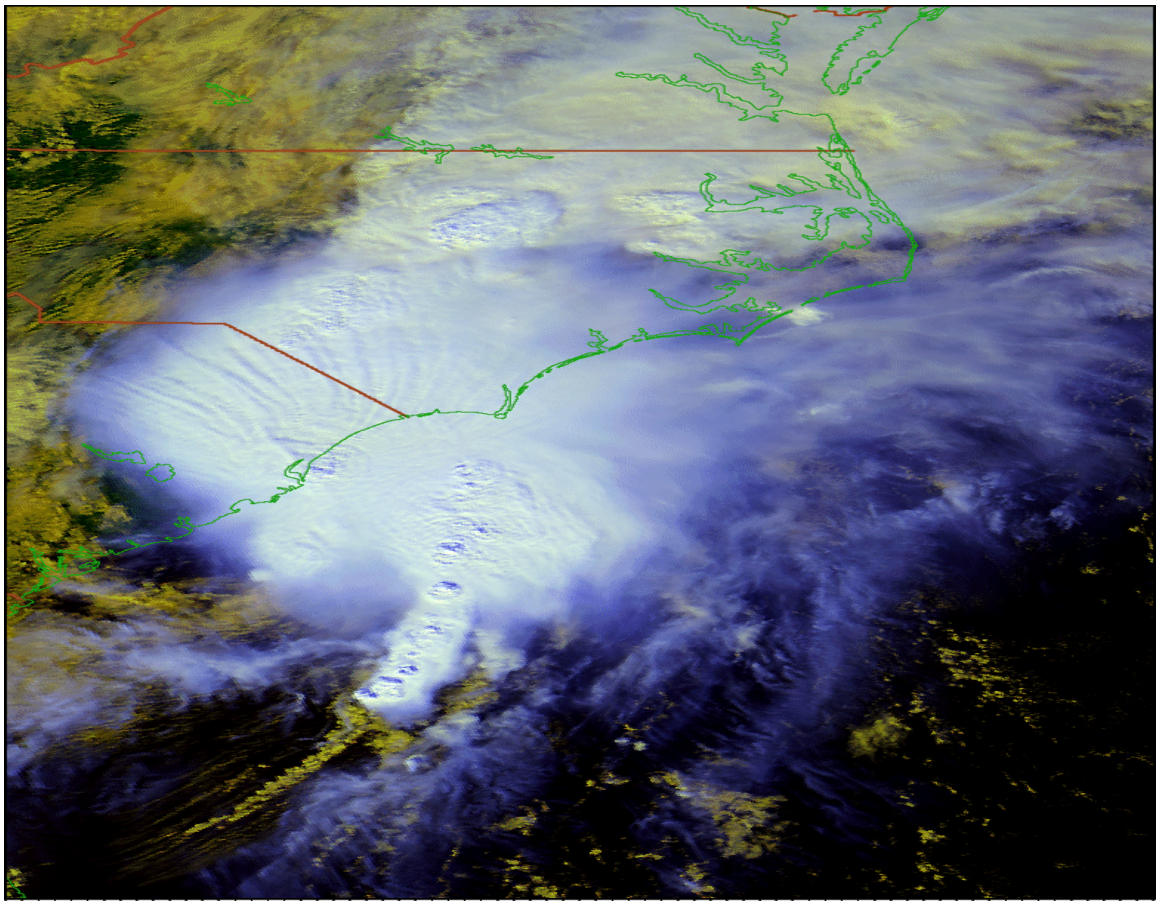

Fig. 154(b): Visible image, KYLE, 1400 UTC, October 11, 2002. *Credit: National Environmental Satellite, Data, and Information Service (NESDIS).*

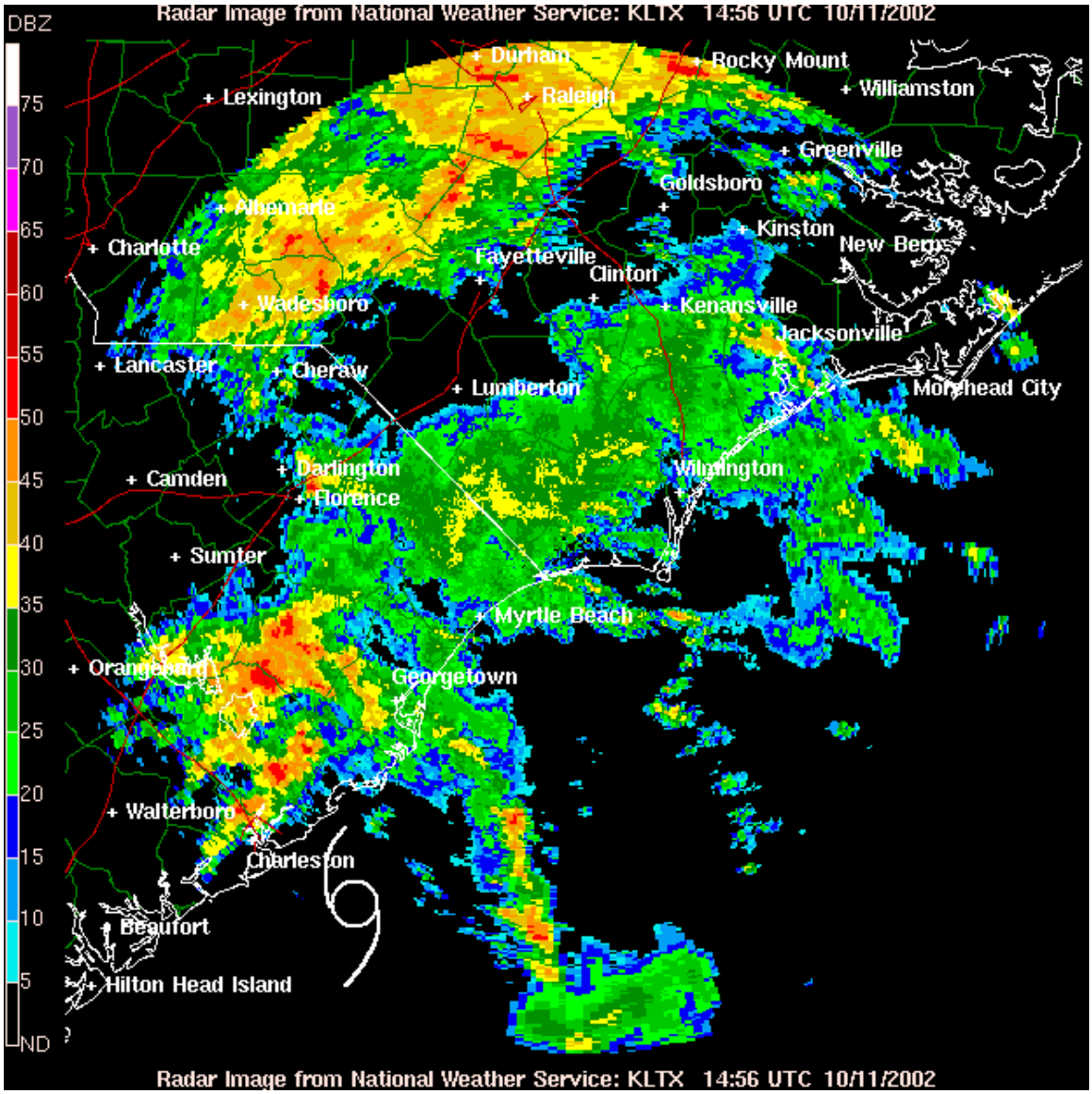

Fig. 154(c): KLTX Doppler base reflectivity, KYLE, 1456 UTC, October 11, 2002. *Credit: NWFO ILM.*

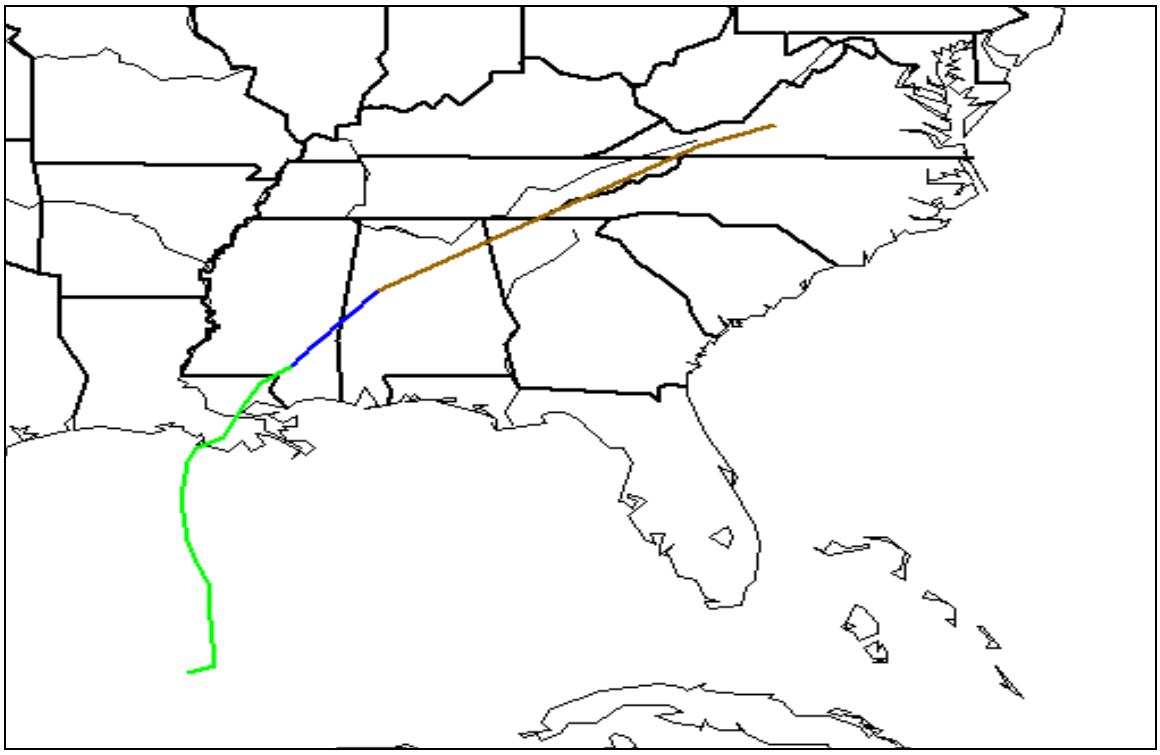

Fig. 155(a): July 3, 2003. *BILL.*

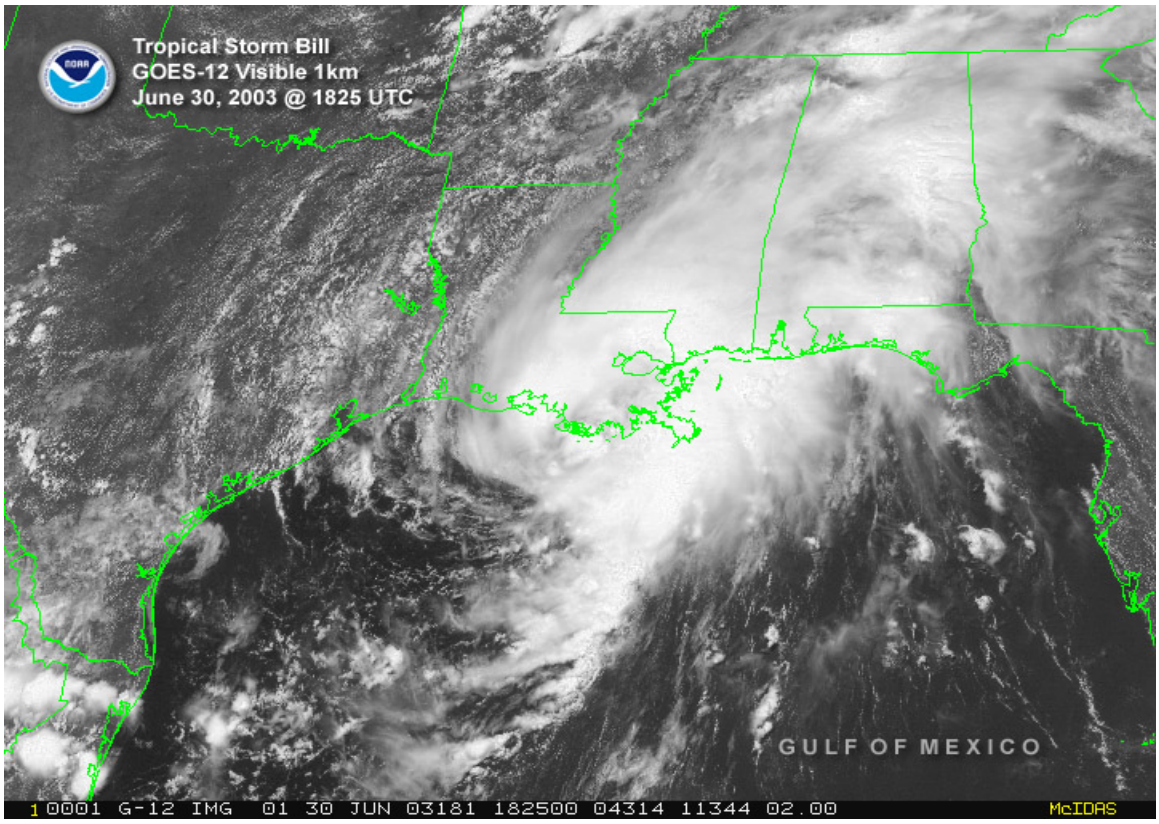

Fig. 155(b): Visible image, BILL, 1825 UTC, June 30, 2003. *Credit: National Climatic Data Center (NCDC).*

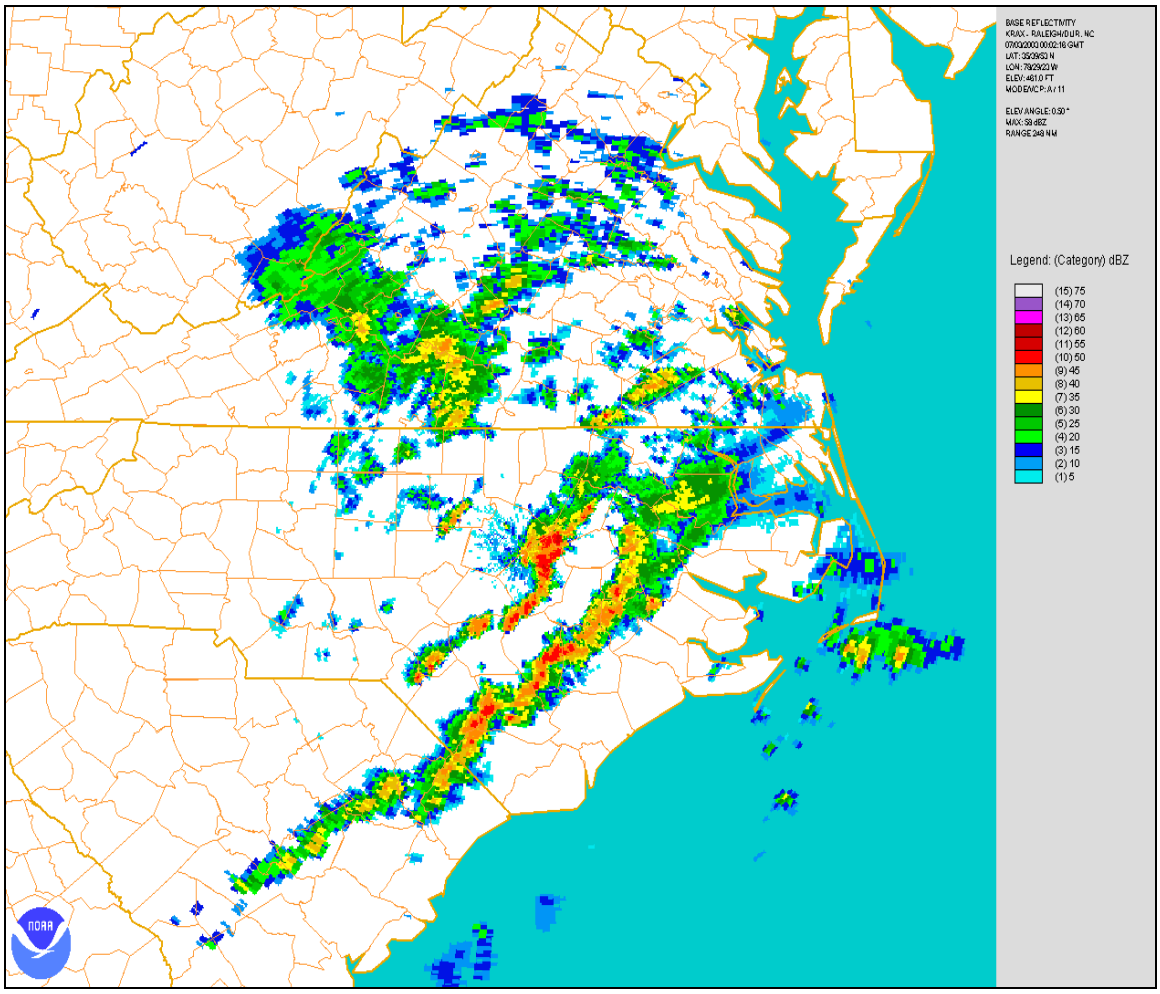

Fig. 155(c): KRAX base reflectivity, BILL, 0002 UTC, July 3, 2003. *Credit: National Climatic Data Center (NCDC).*

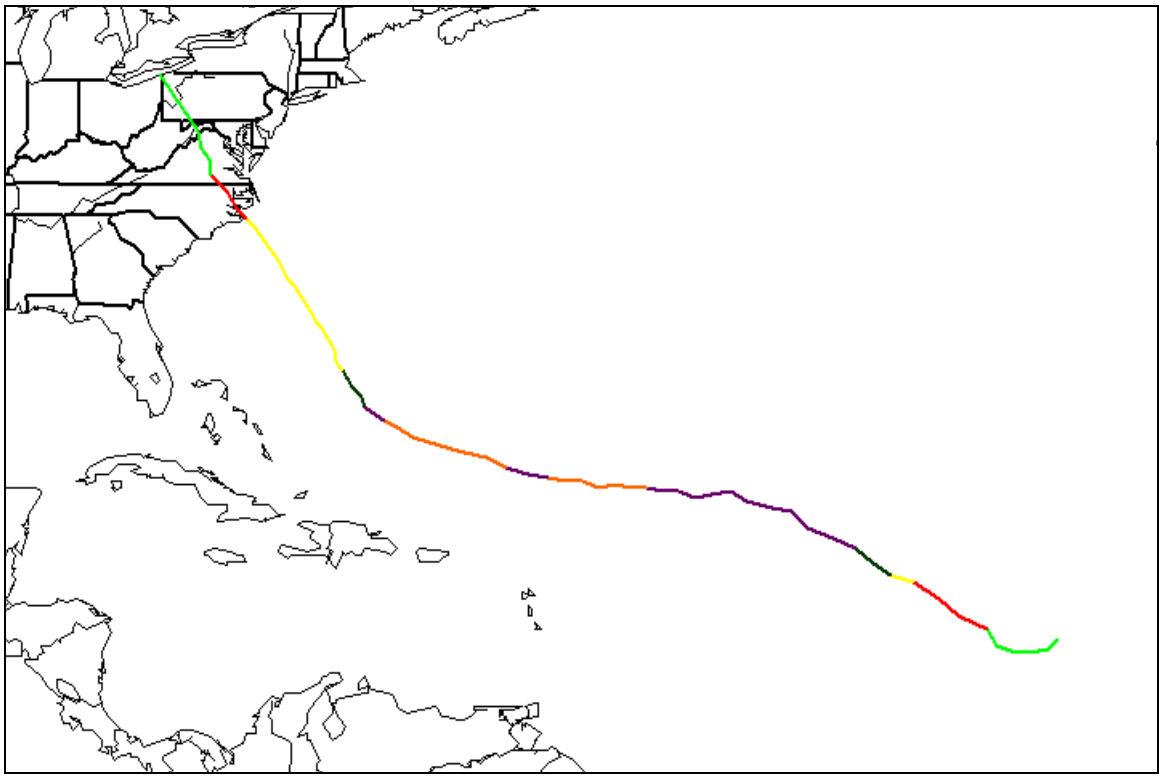

Fig. 156(a): September 18, 2003. *ISABEL*.

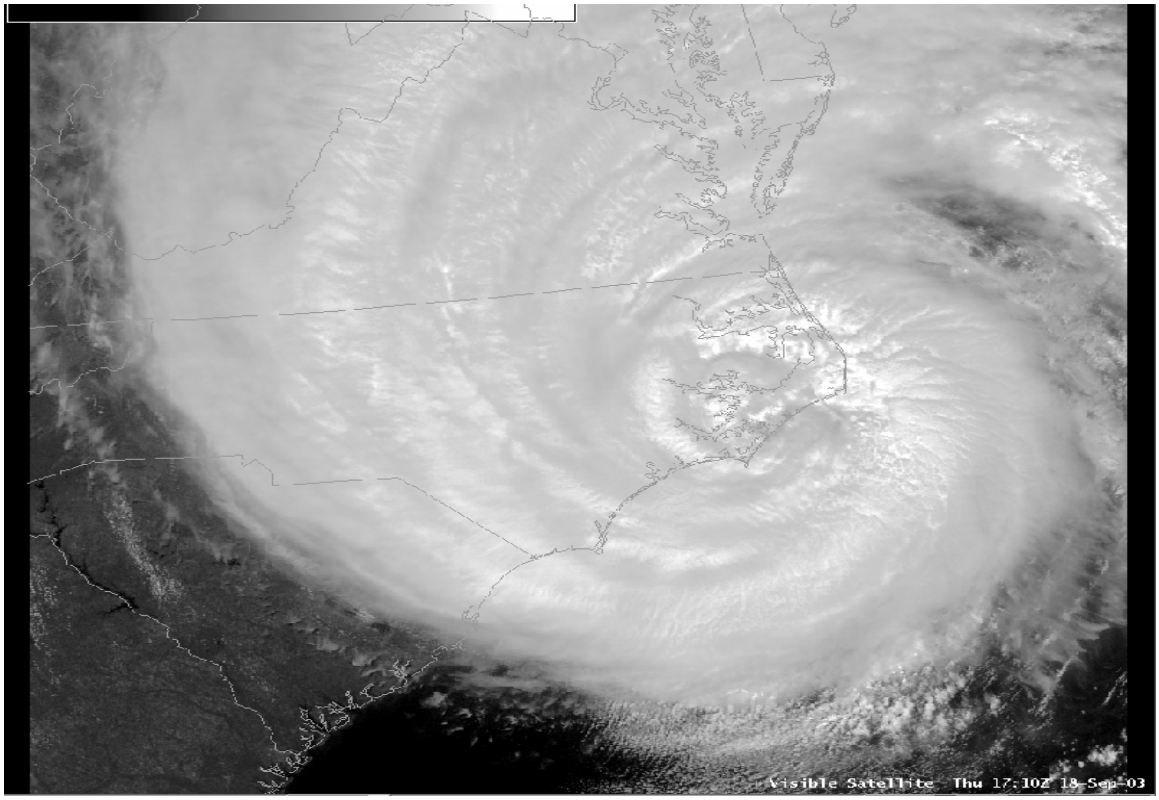

Fig. 156(b): Visible image, ISABEL, 1710 UTC, September 18, 2003. *Credit: National Climatic Data Center (NCDC).*

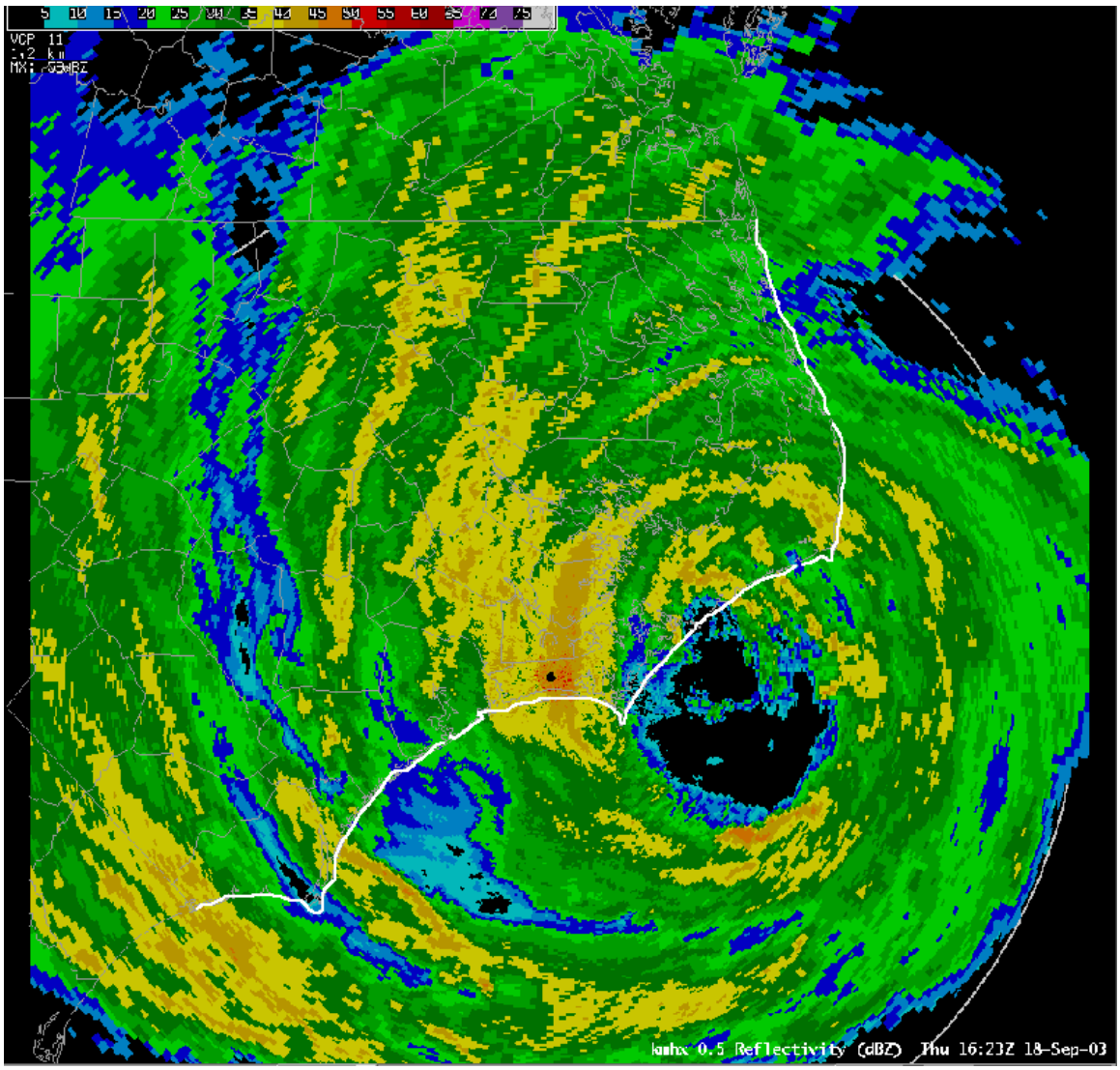

Fig. 156(c): KMHX base reflectivity (ISABEL) along the NC coast (white border), 1623 UTC, September 18, 2003. *Credit: NWFO MHX.*

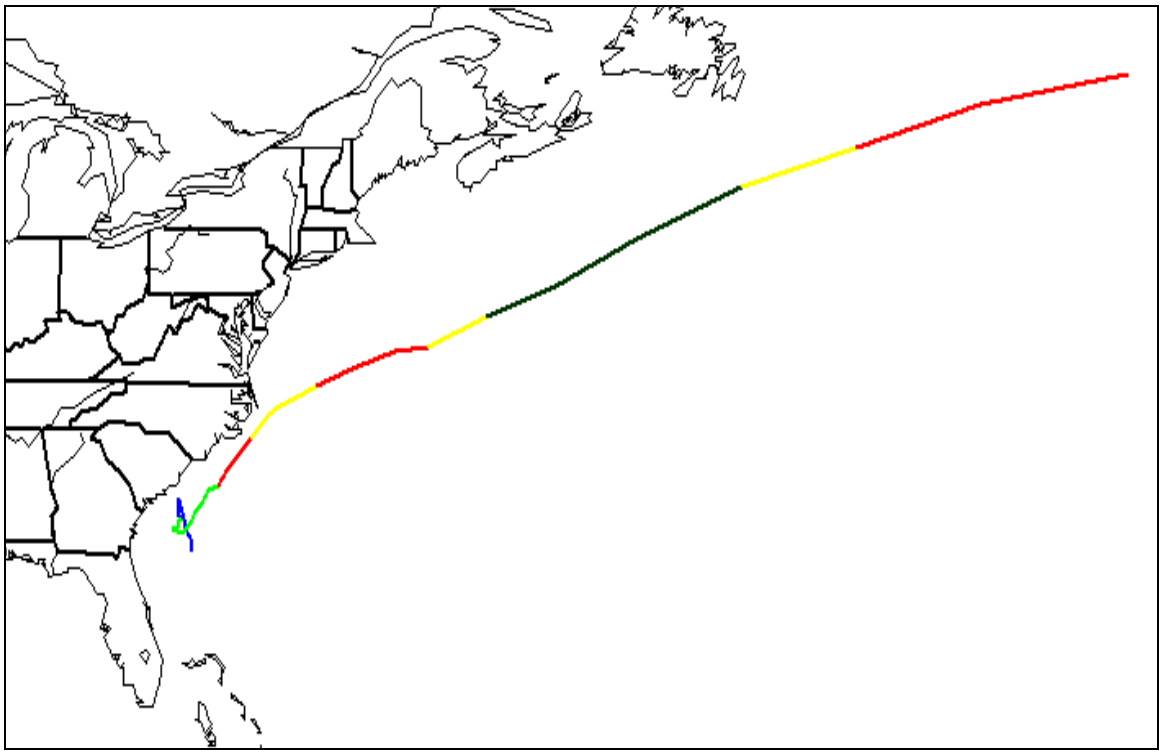

Fig. 157(a): August 3, 2004. *ALEX*.

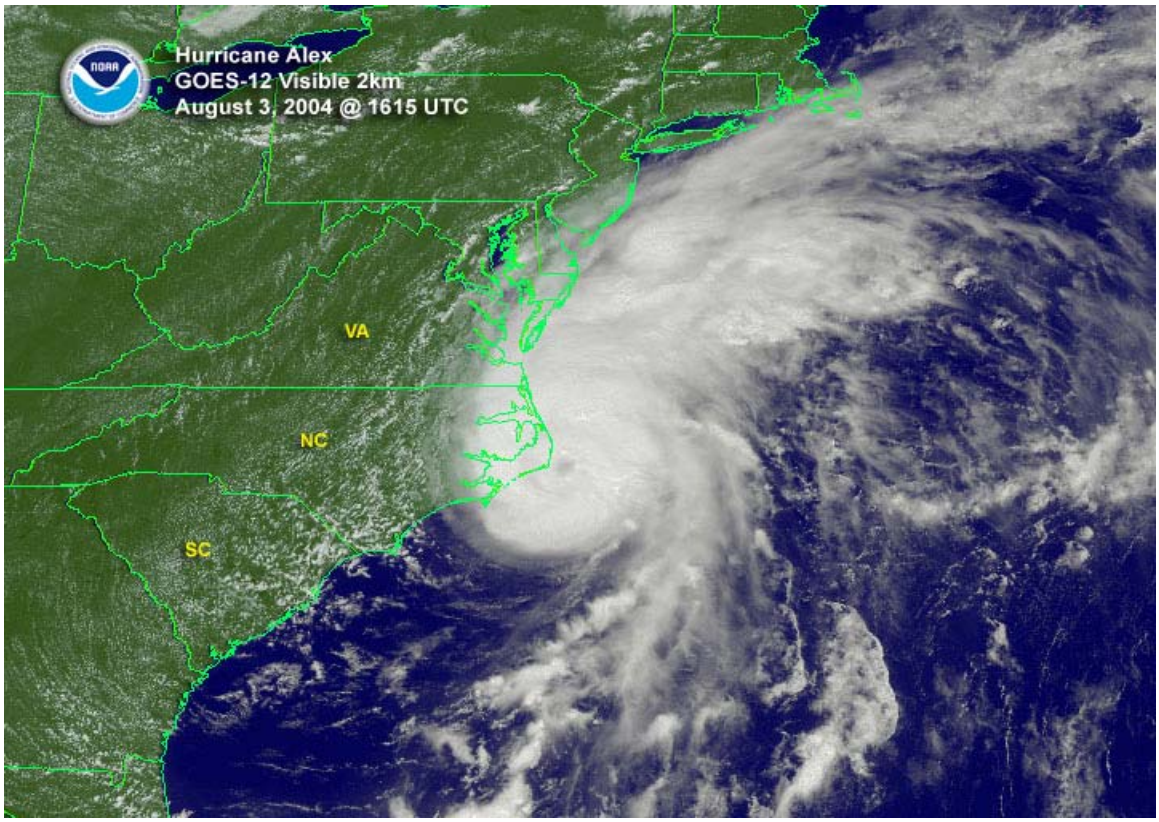

Fig. 157(b): Visible image, ALEX, 1615 UTC, August 3, 2004. *Credit: National Climatic Data Center (NCDC).*

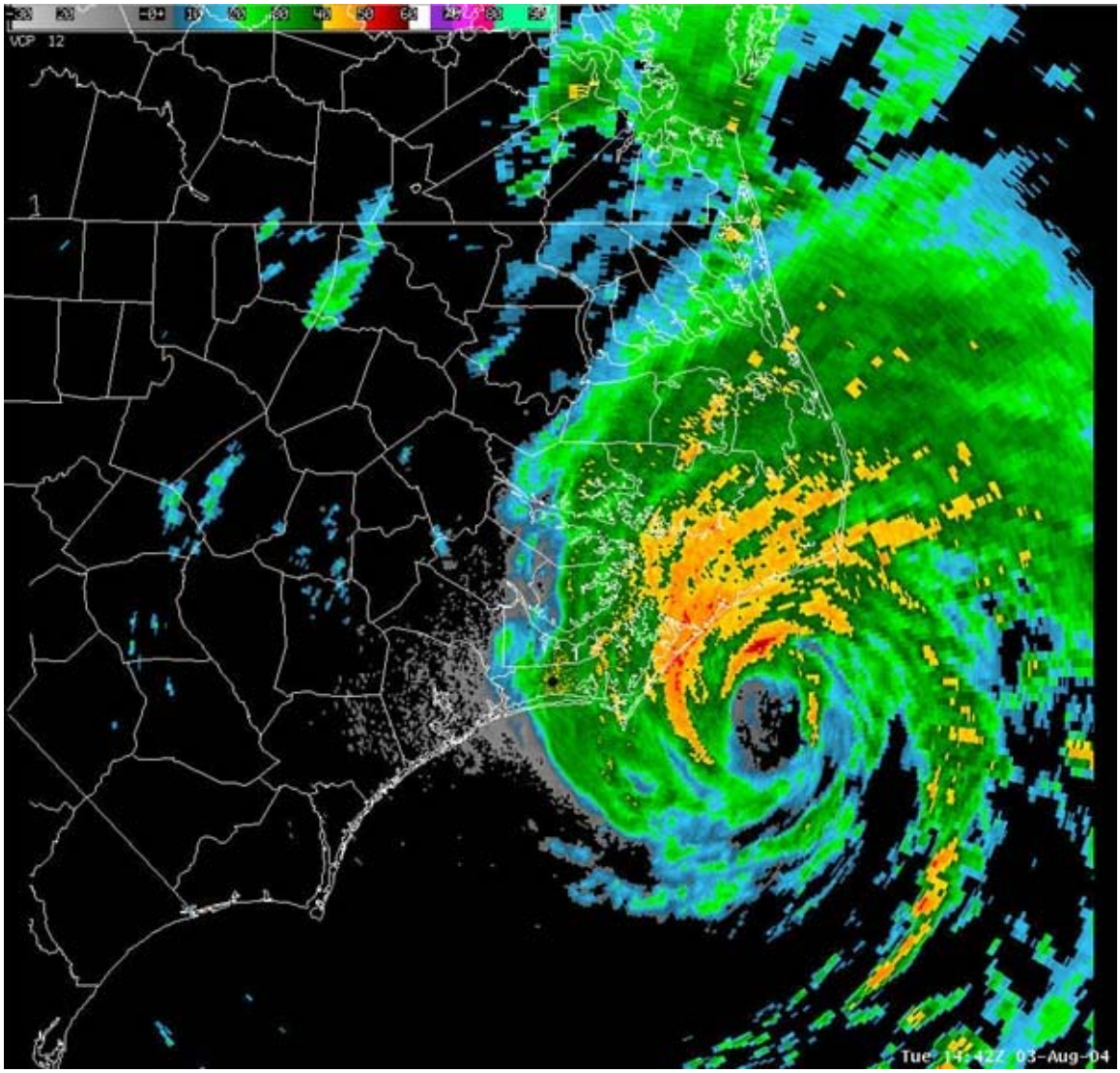

Fig. 157(c): KMHX Doppler base reflectivity, ALEX, 1442 UTC, August 3, 2004. *Credit: NWFO MHX.*

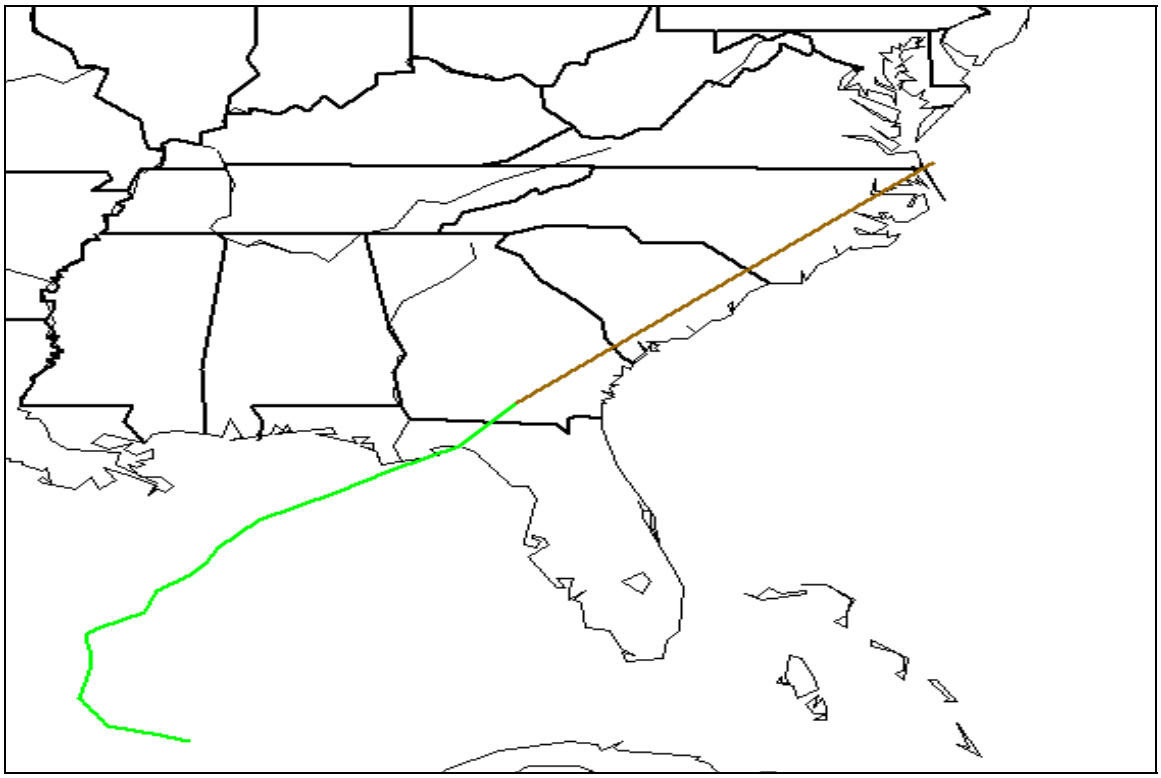

Fig. 158(a): August 13, 2004. *BONNIE*.

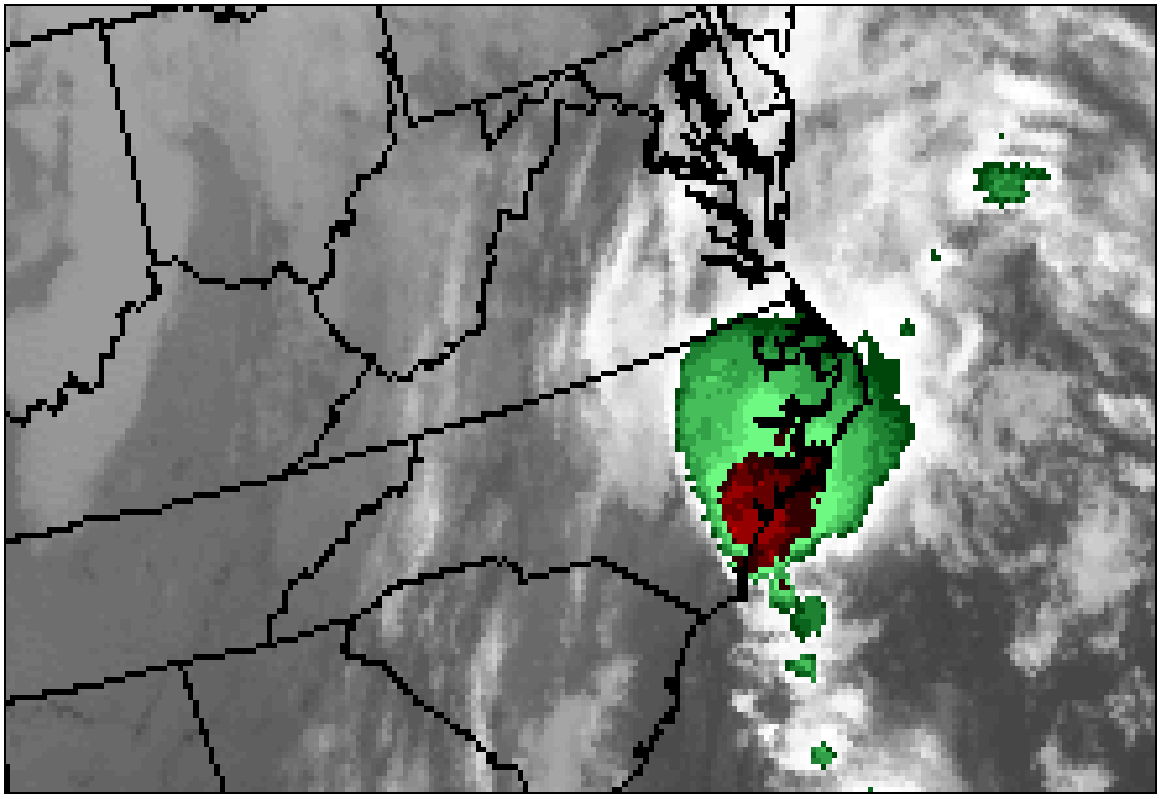

Fig. 158(b): IR image, BONNIE, 0830 UTC, August 13, 2004. *Credit: National Climatic Data Center (NCDC).*

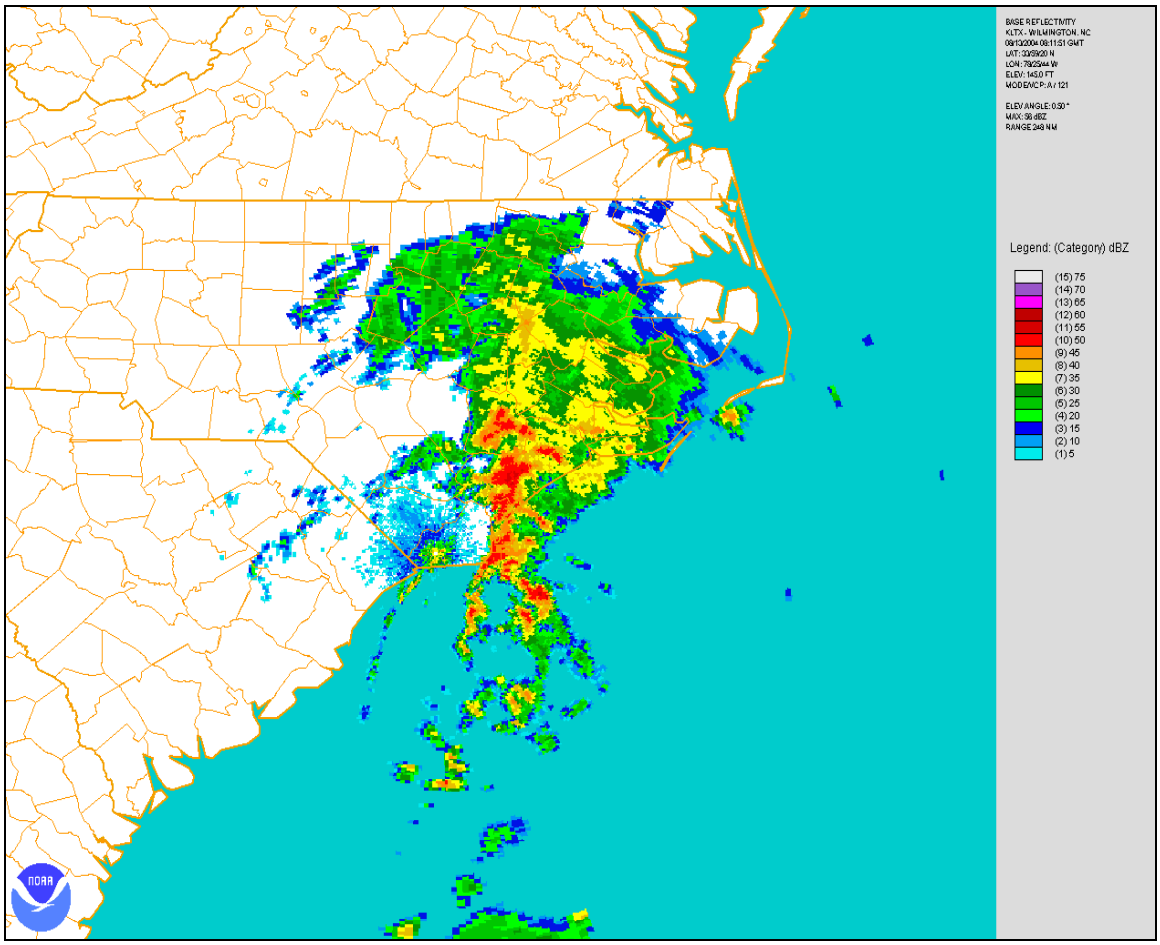

Fig. 158(c): Base reflectivity, BONNIE, 0811 UTC, August 13, 2004. *Credit: National Climatic Data Center (NCDC).*

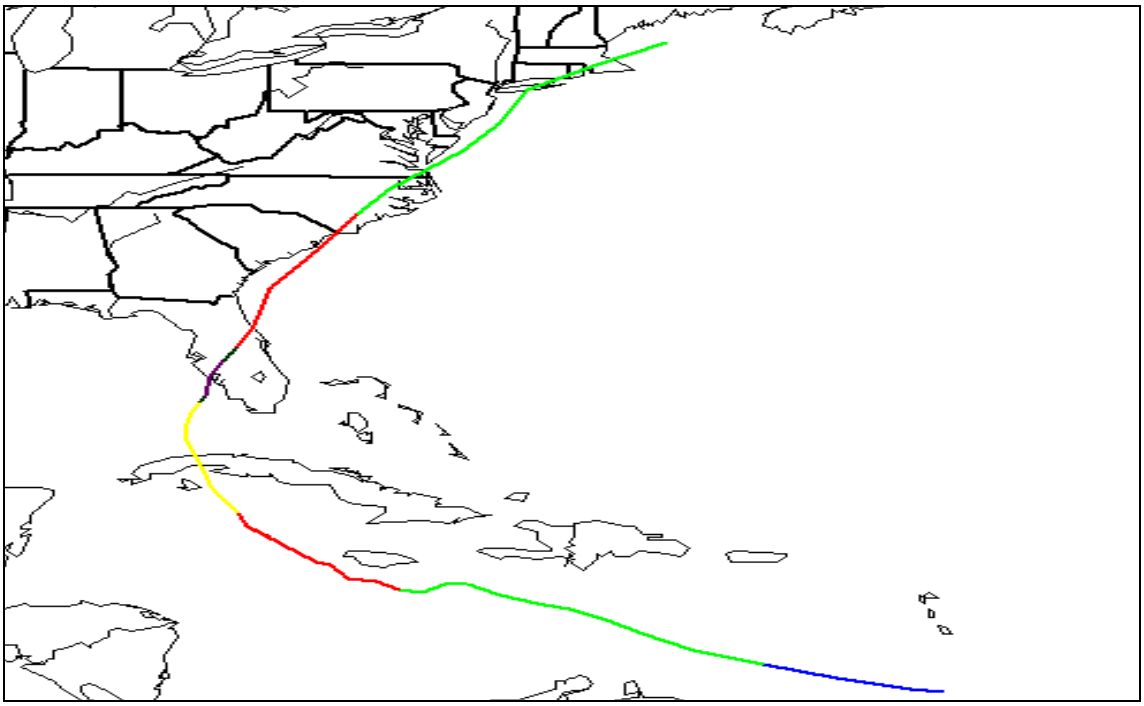

Fig. 159(a): August 14, 2004. *CHARLEY*.

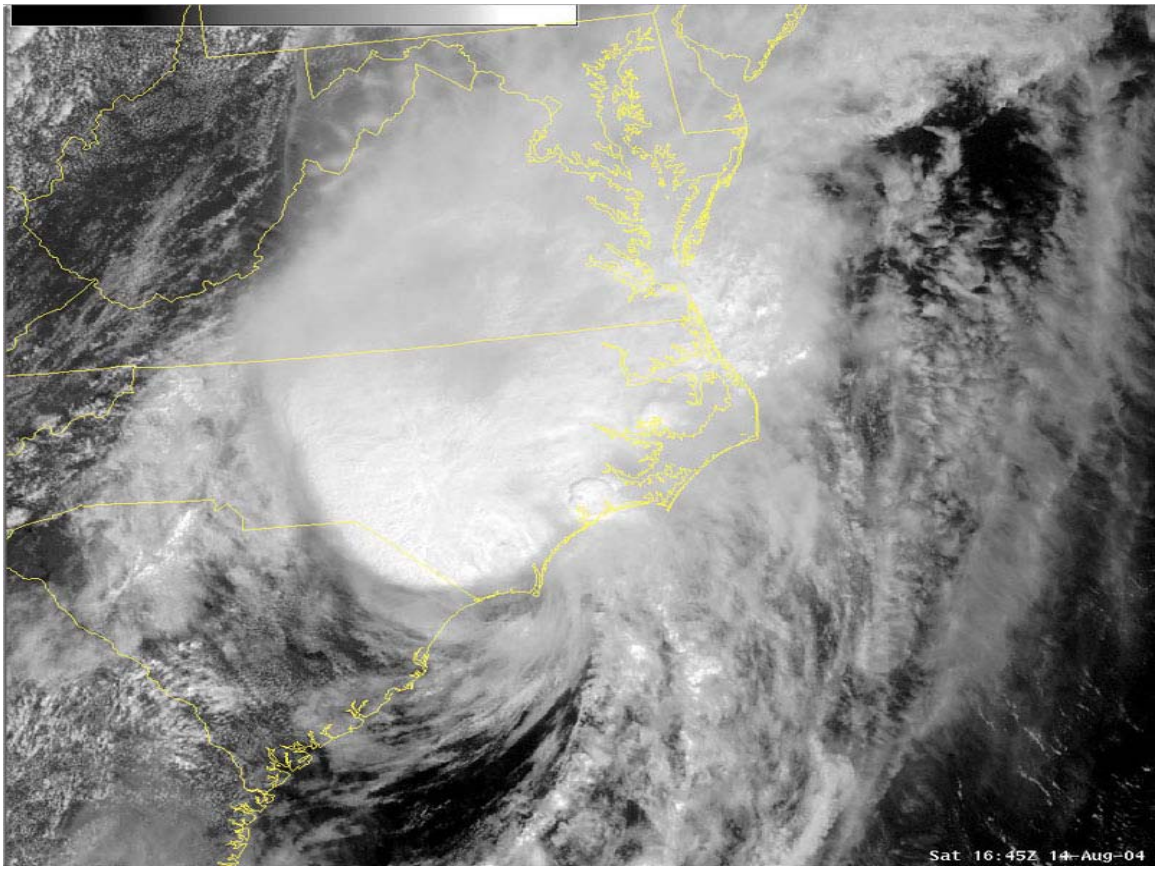

Fig. 159(b): Visible image, CHARLEY, 1645 UTC, August 14, 2004. *Credit: National Climatic Data Center (NCDC).*

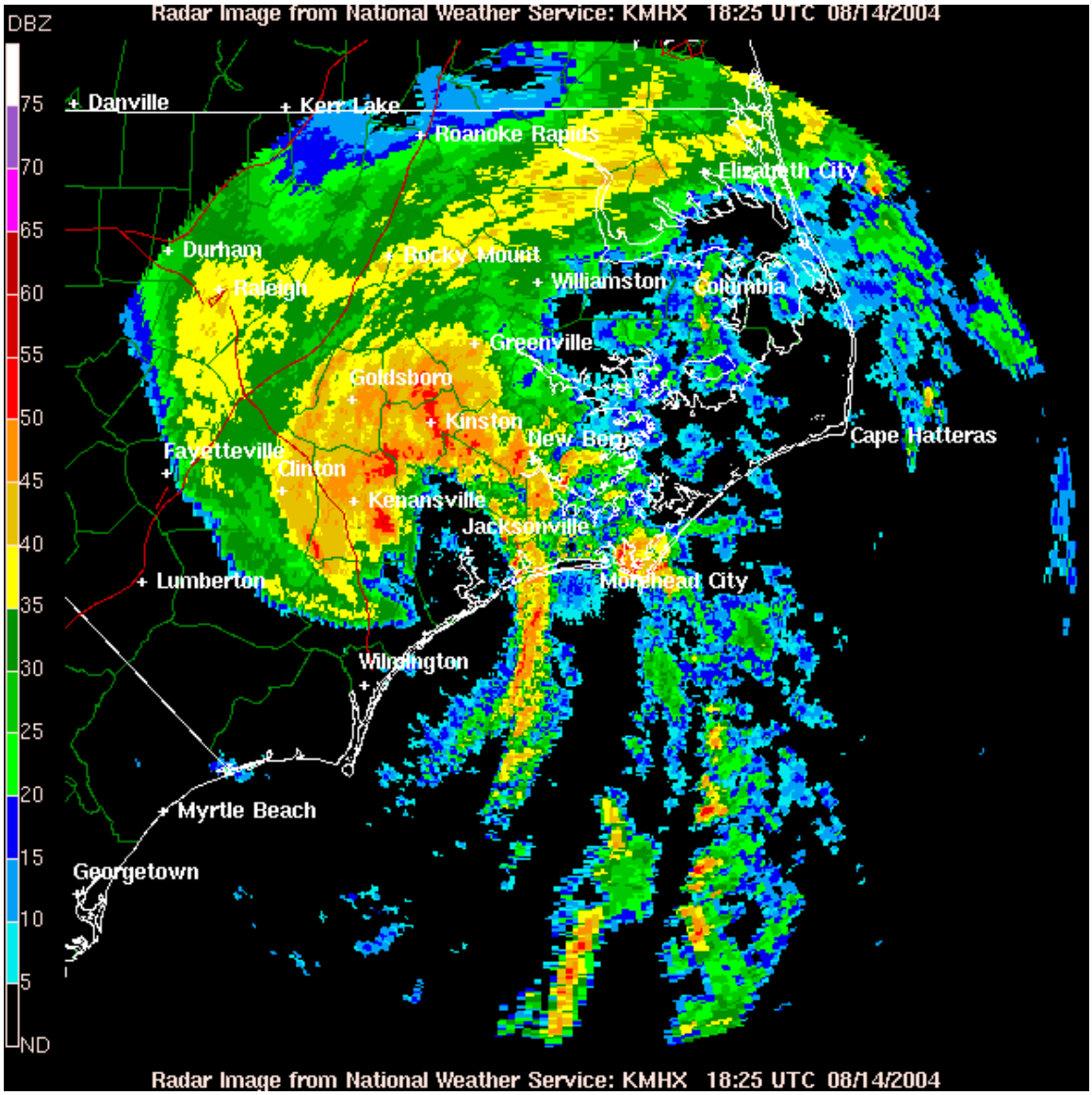

Fig. 159(c): KMHX Doppler base reflectivity, CHARLEY, 1825 UTC, August 14, 2004. *Credit: NWFO MHX*.

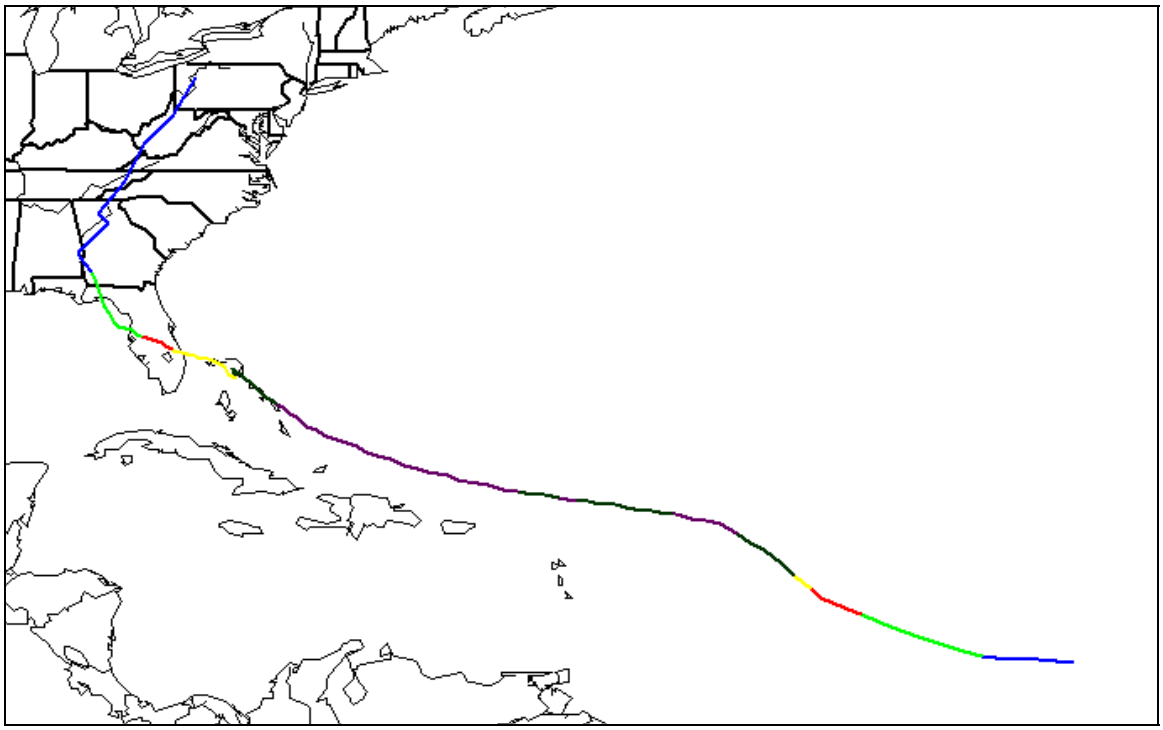

Fig. 160(a): September 8, 2004. *FRANCES*.

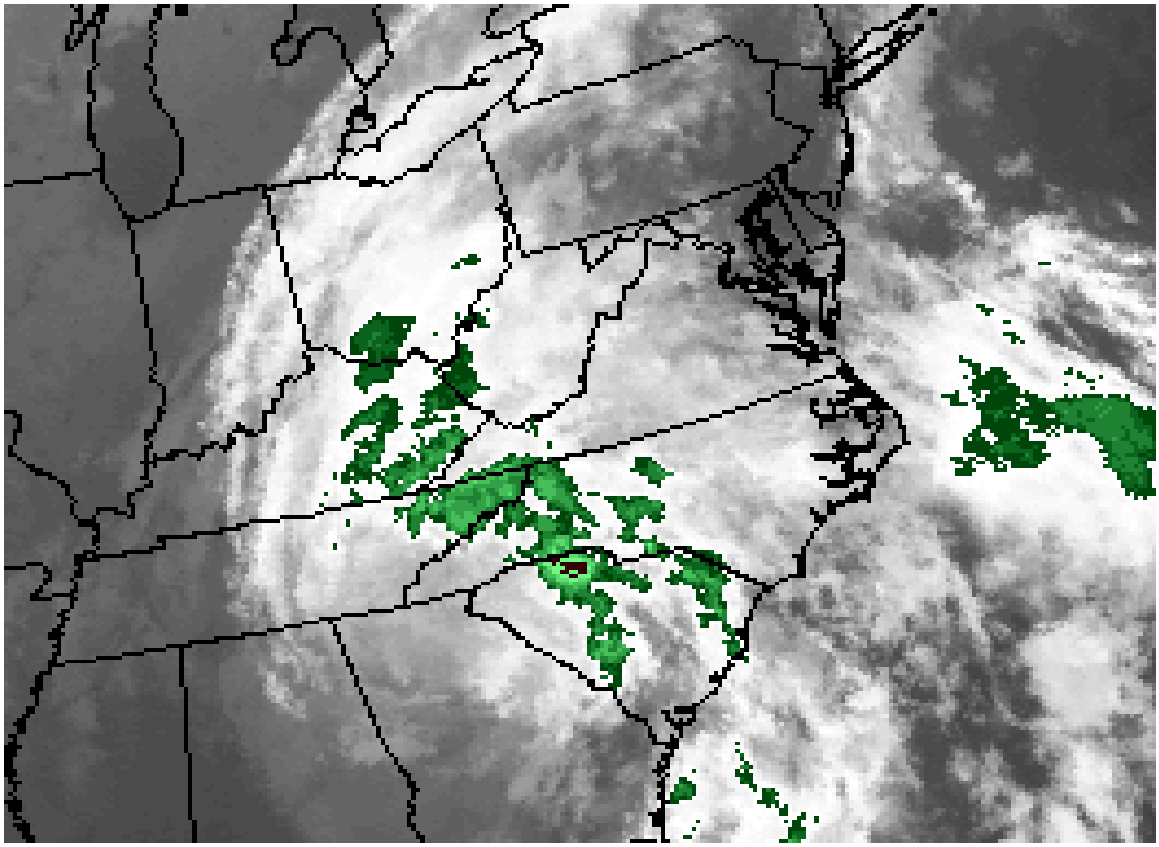

Fig. 160(b): IR image, FRANCES, 0315 UTC, September 8, 2004. *Credit: National Climatic Data Center (NCDC).*

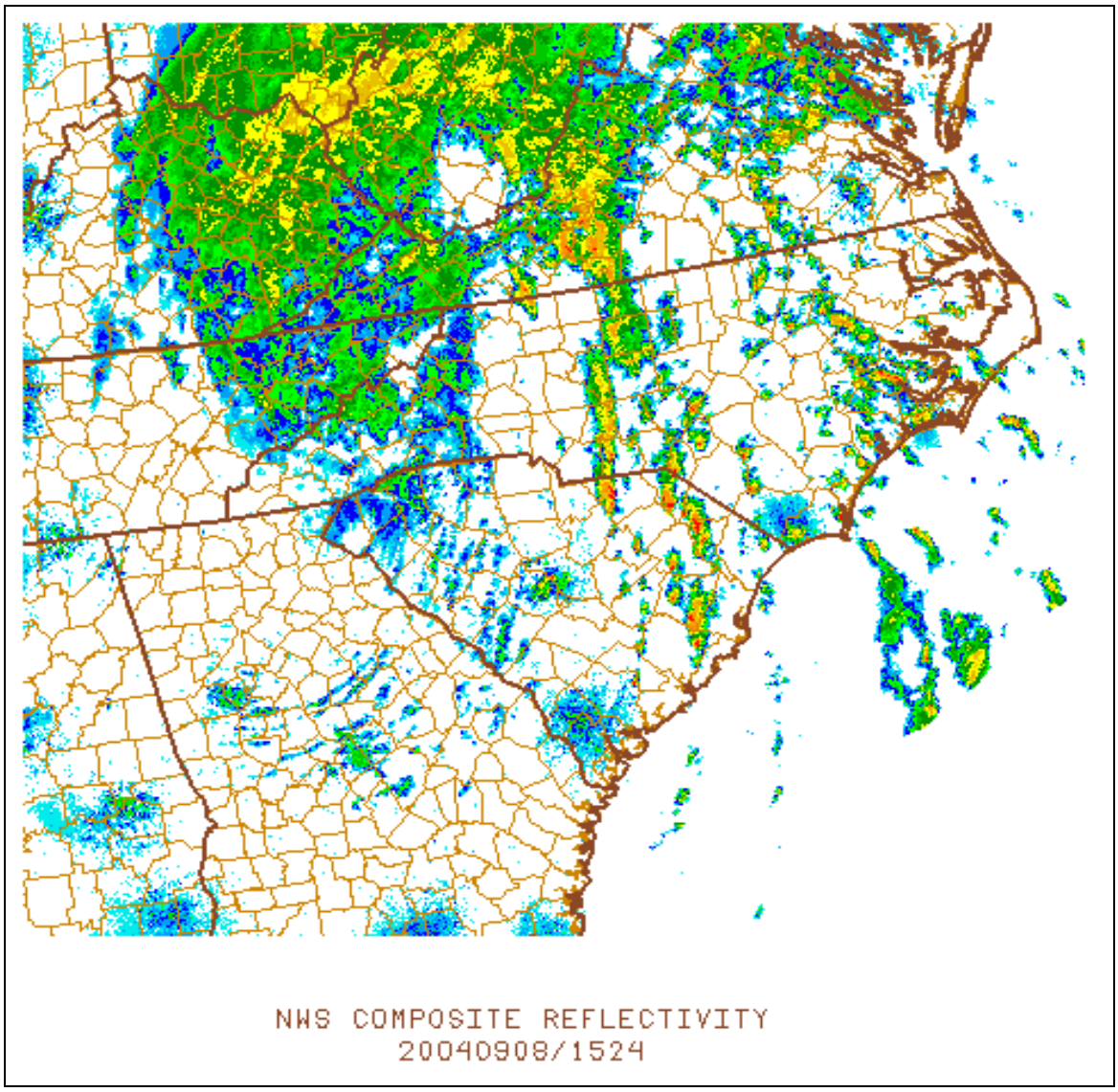

Fig. 160(c): Doppler composite reflectivity, FRANCES, 1524 UTC, September 8, 2004. *Credit: Storm Prediction Center (SPC).*

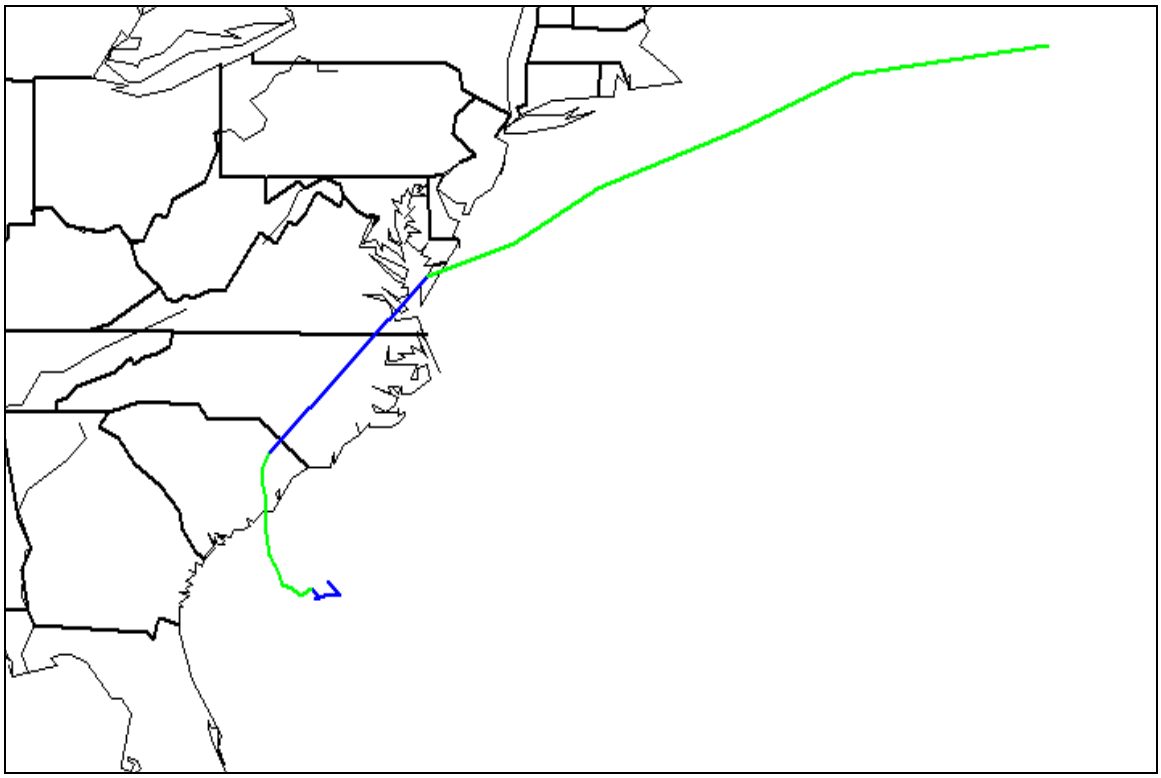

Fig. 161(a): August 29, 2004. *GASTON*.

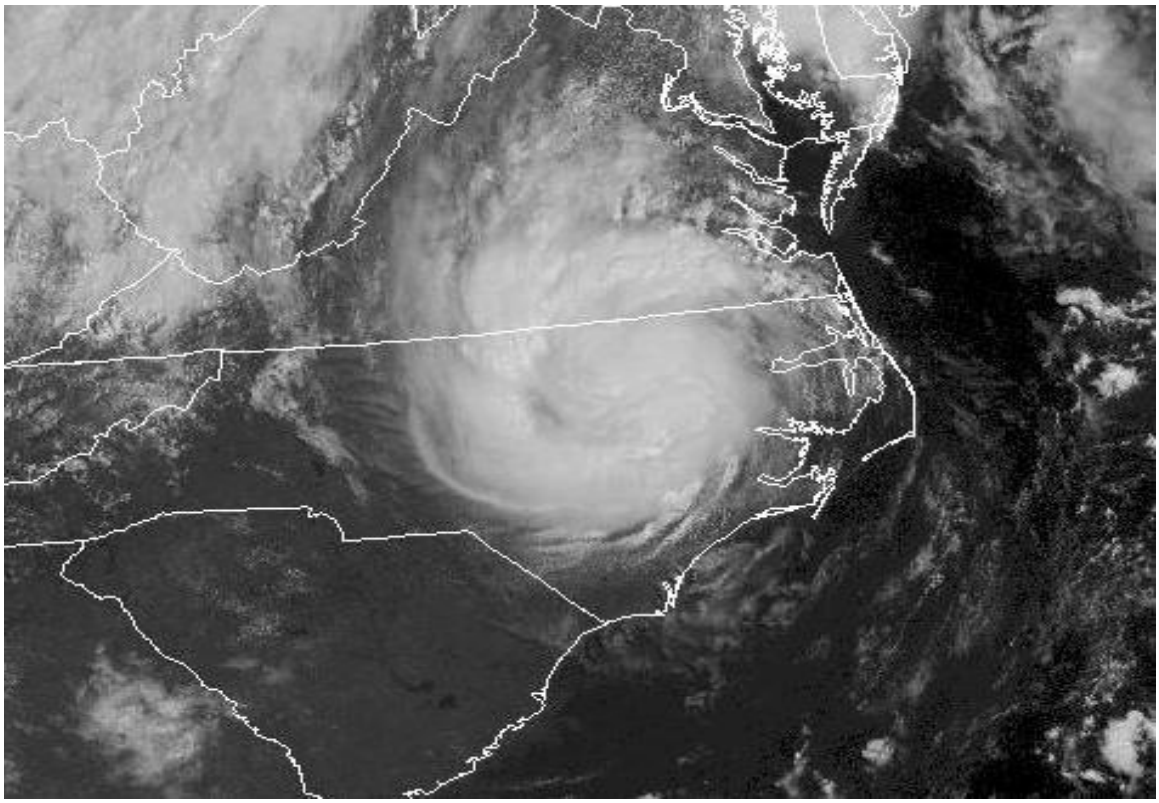

Fig. 161(b): Visible image, GASTON, 1100 UTC, August 30, 2004. *Credit: National Climatic Data Center (NCDC).*

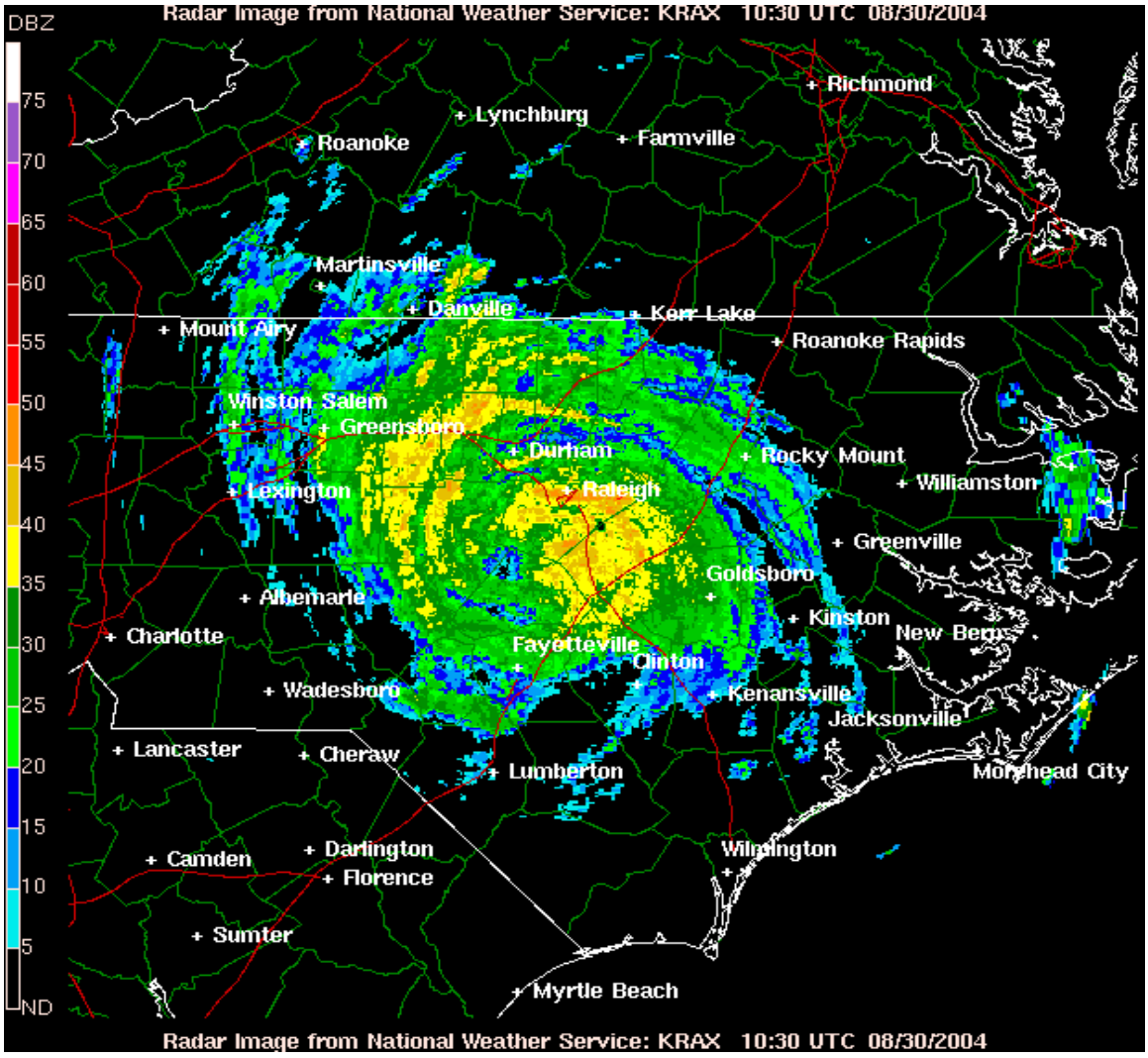

Fig. 161(c): KRAX Doppler base reflectivity, GASTON, 1030 UTC, August 30, 2004. *Credit: NWFO RAH.*

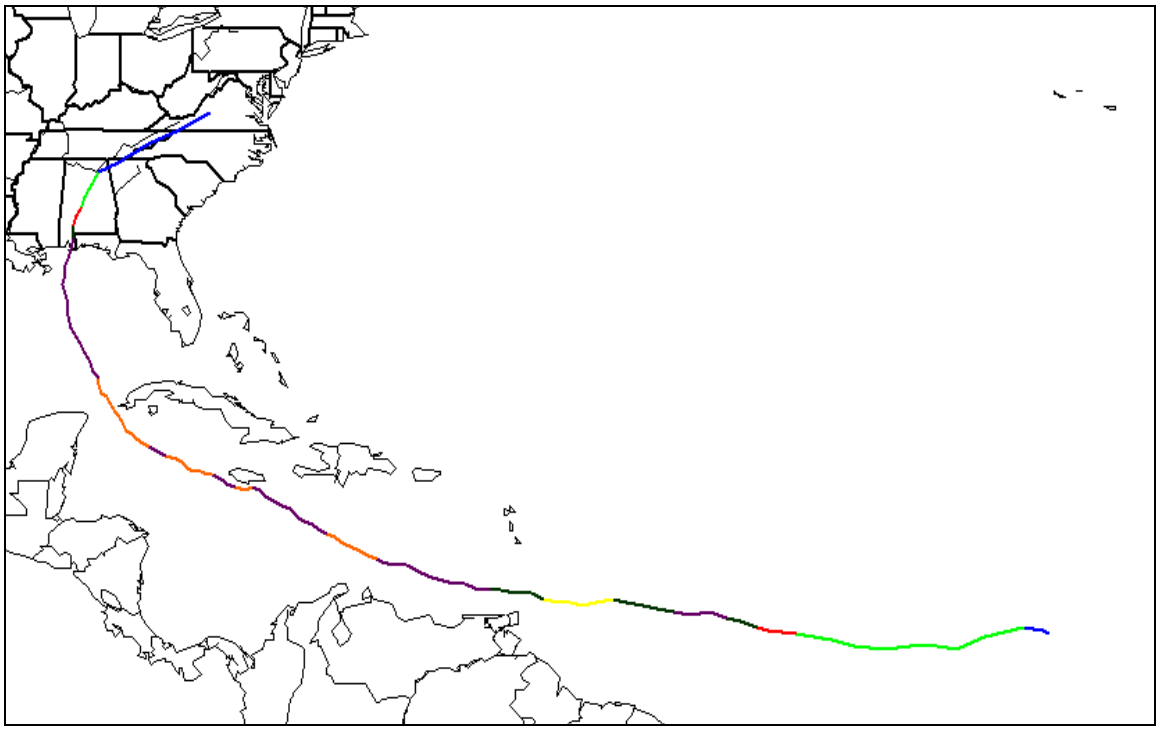

Fig. 162(a): September 17-18, 2004. *IVAN*

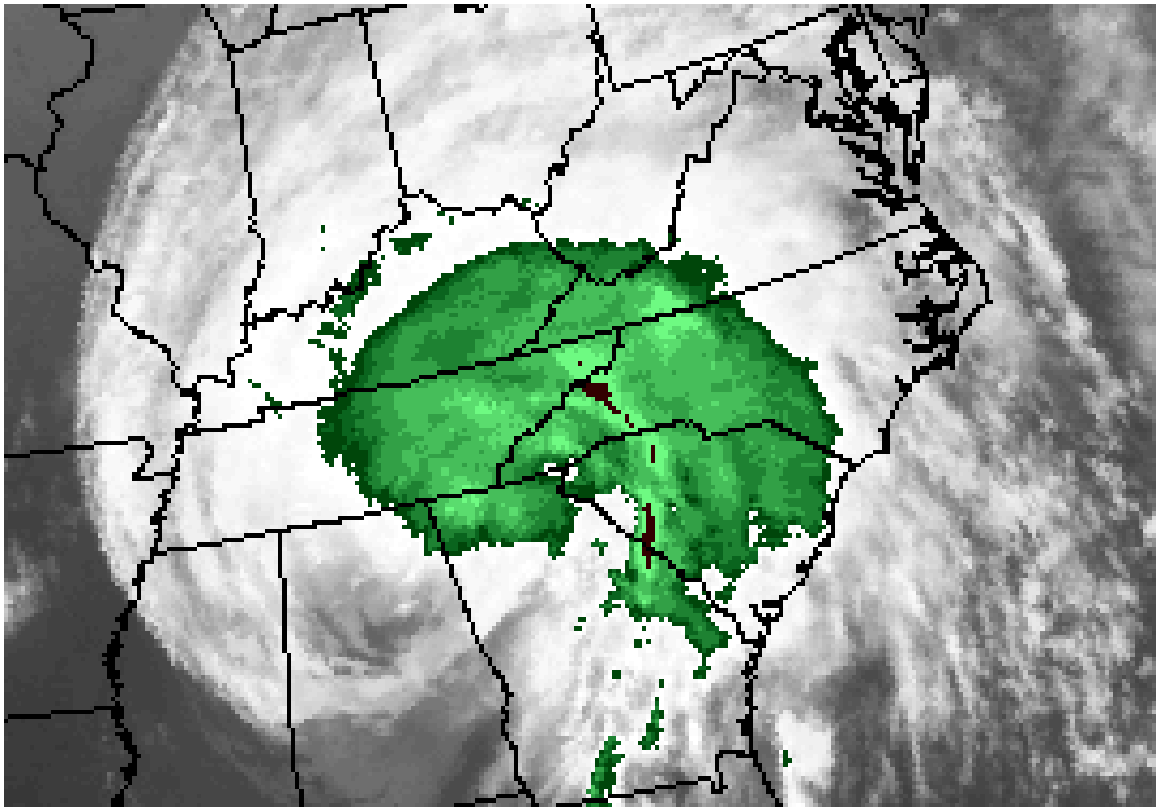

Fig. 162(b): IR image, IVAN, 0015 UTC, September 17, 2004. *Credit: National Climatic Data Center (NCDC).*

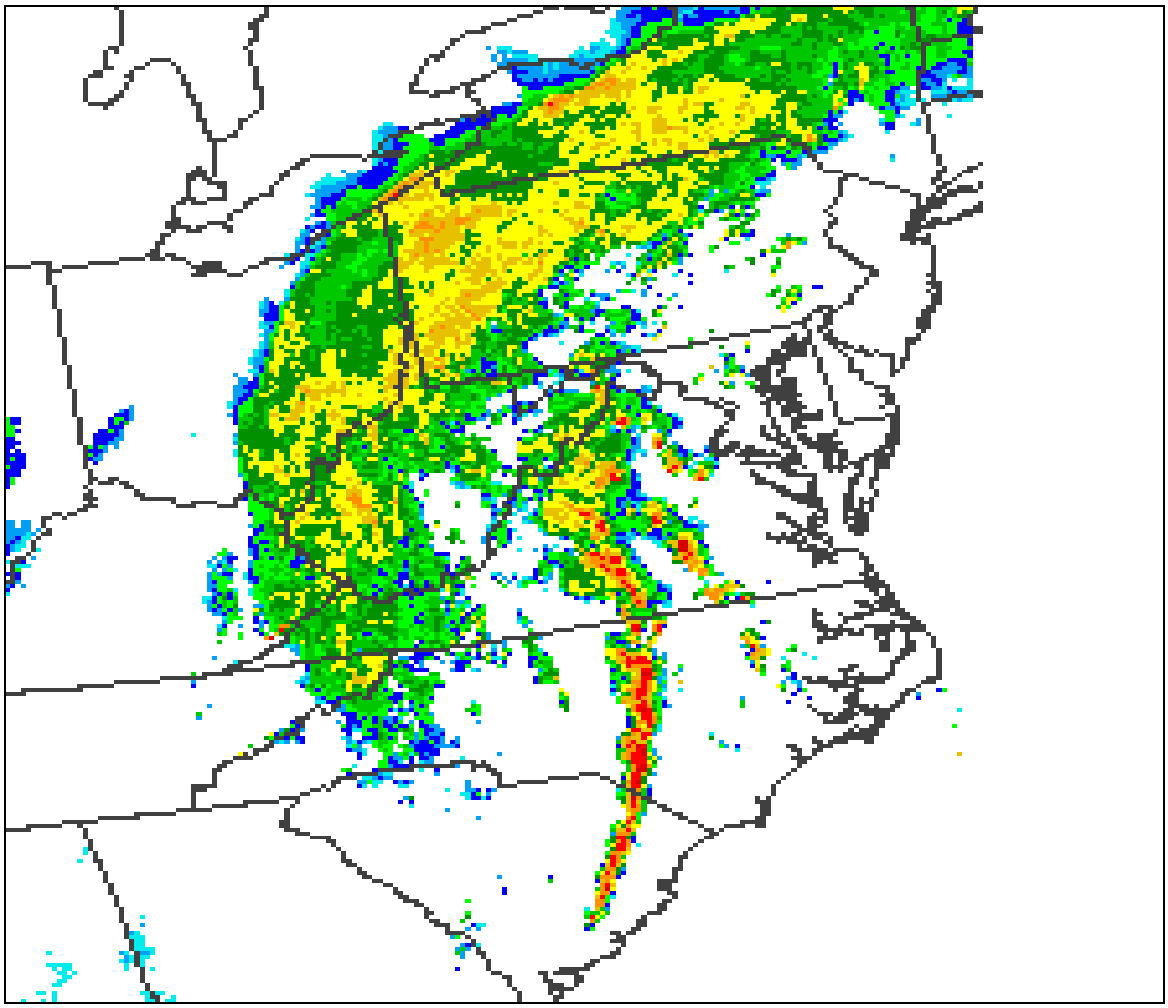

Fig. 162(c): Composite Doppler reflectivity, IVAN, 1600 UTC September 17, 2004. *Credit: Storm Prediction Center (SPC).*

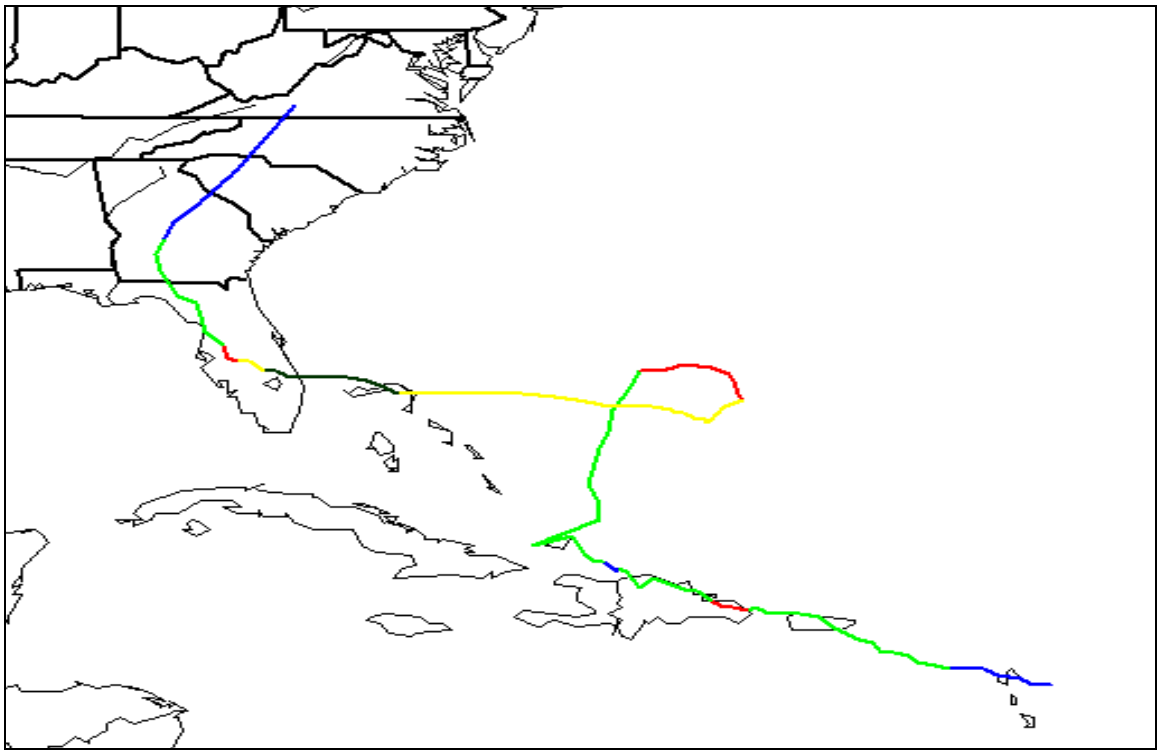

Fig. 163(a): September 28, 2004. *JEANNE*.

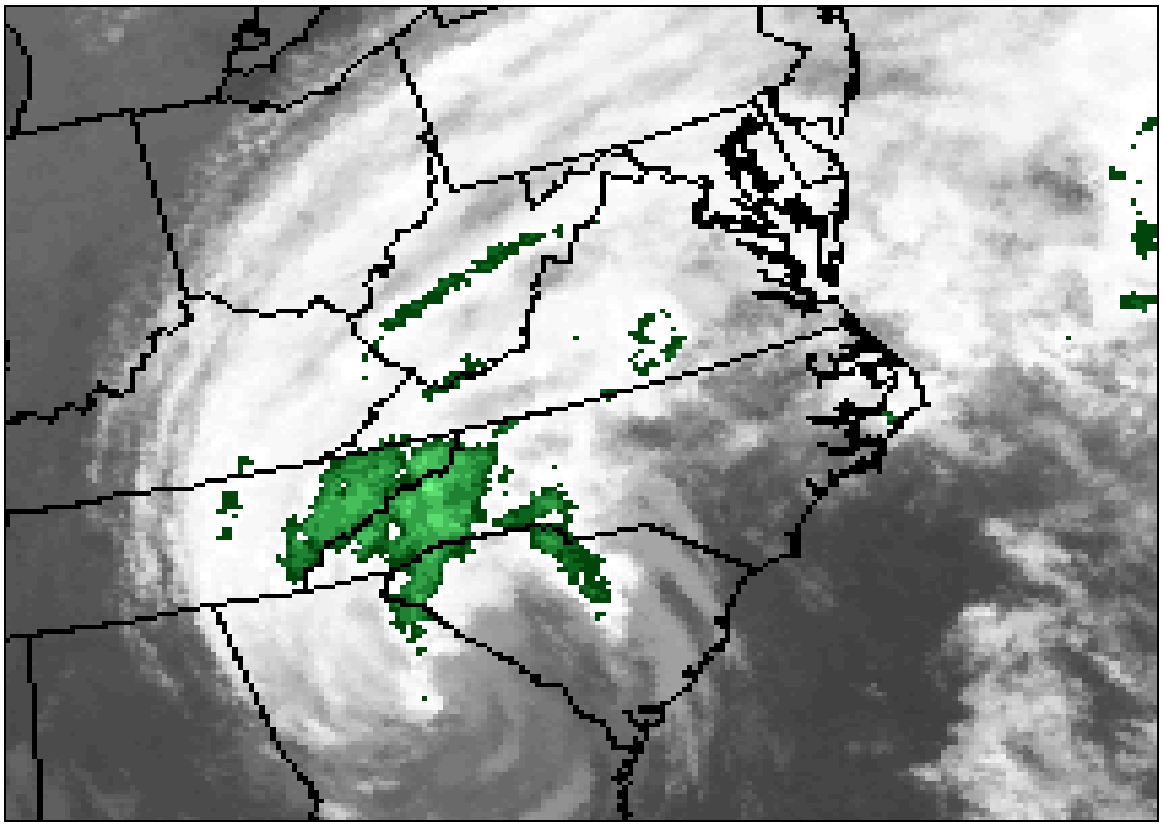

Fig. 163(b): IR image, JEANNE, 0200 UTC, September 28, 2004. *Credit: National Climatic Data Center (NCDC).*

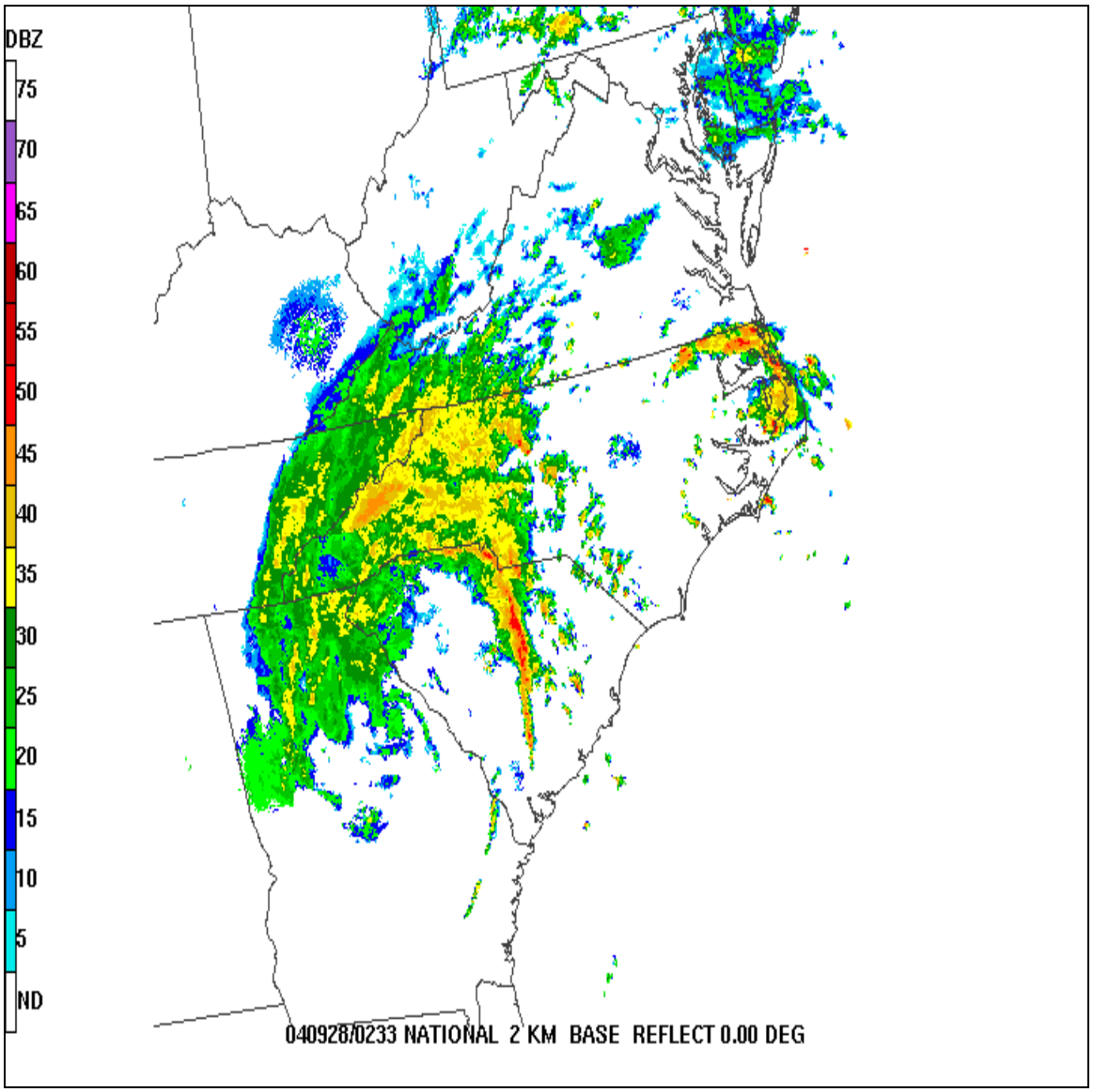

Fig. 163(c): Composite Doppler reflectivity, JEANNE, 0233 UTC, September 28, 2004. *Credit: Storm Prediction Center (SPC).*

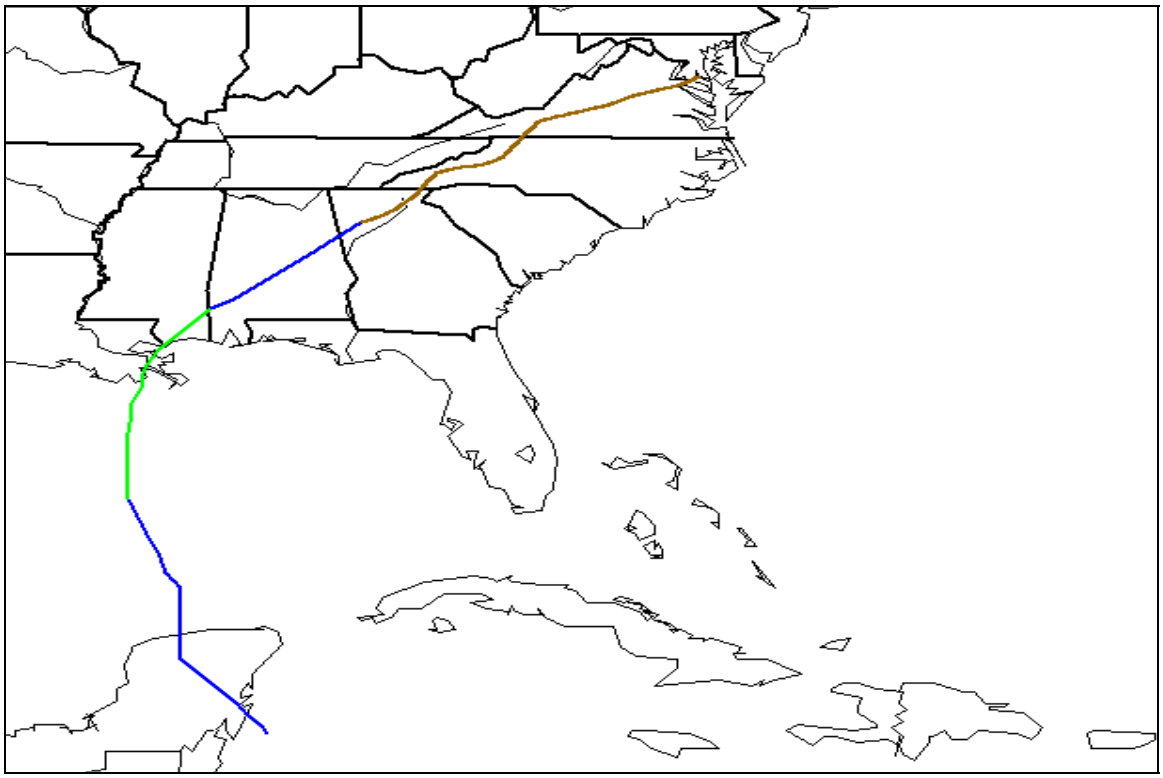

Fig. 164(a): July 7, 2005. *CINDY.*

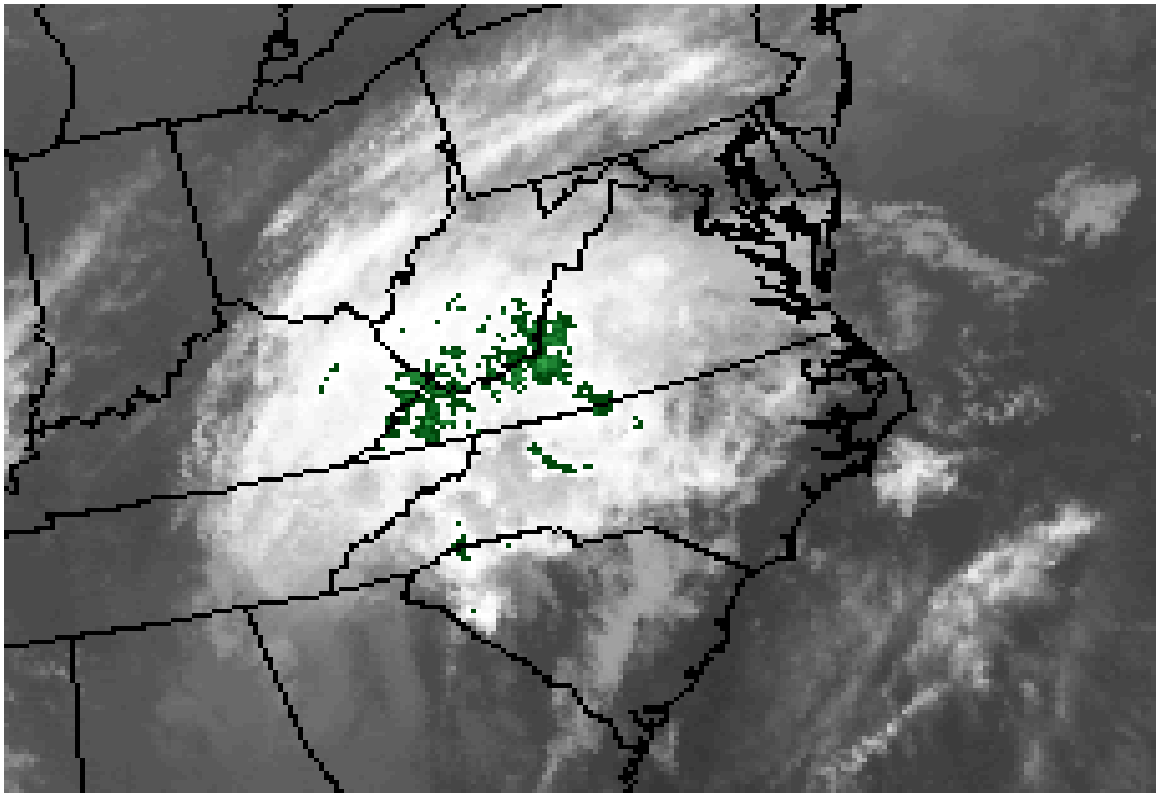

Fig. 164(b): IR image, CINDY, 1900 UTC, July 7, 2005. *Credit: National Climatic Data Center (NCDC).*

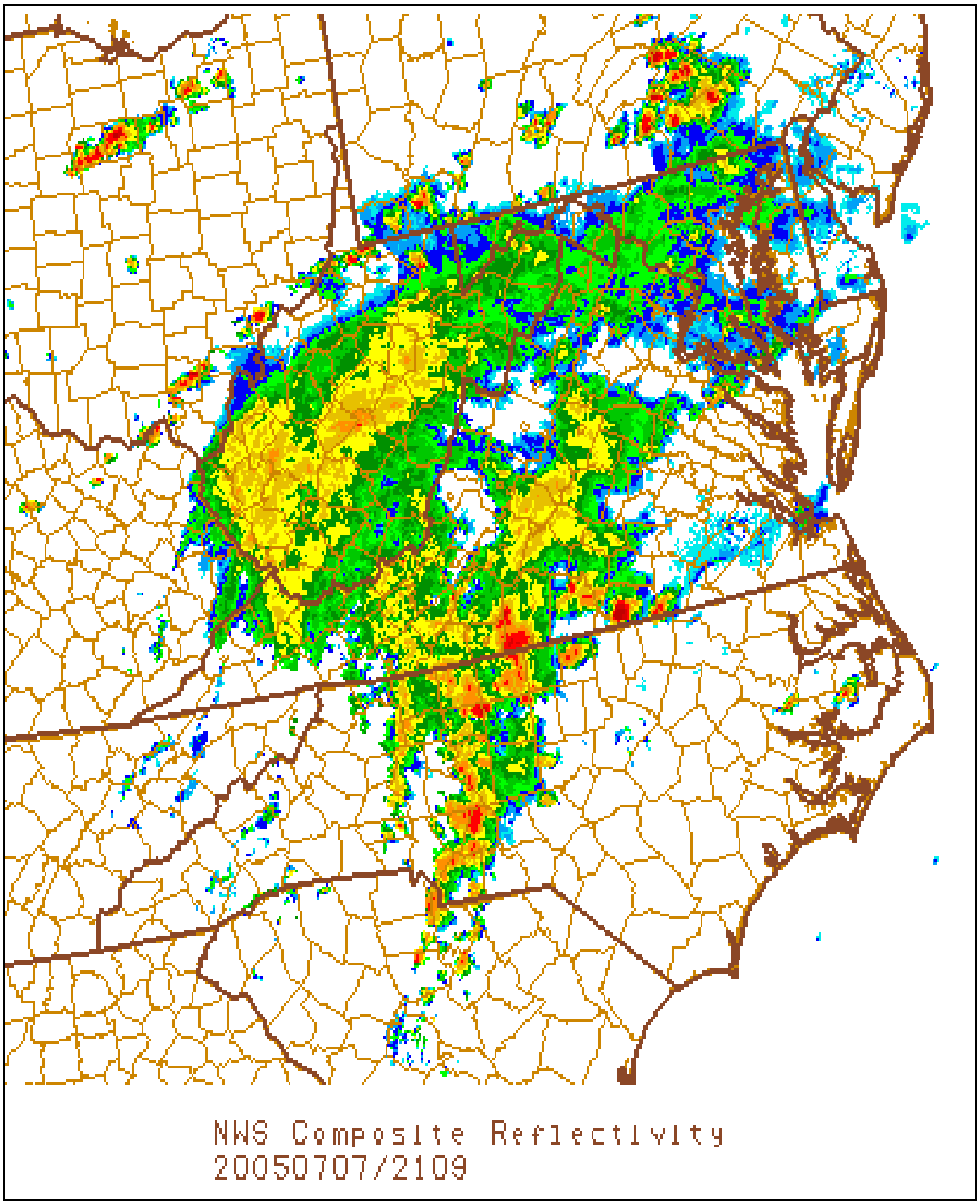

Fig. 164(c): Doppler composite reflectivity, CINDY, 2109 UTC, July 7, 2005. *Credit: Storm Prediction Center (SPC).*

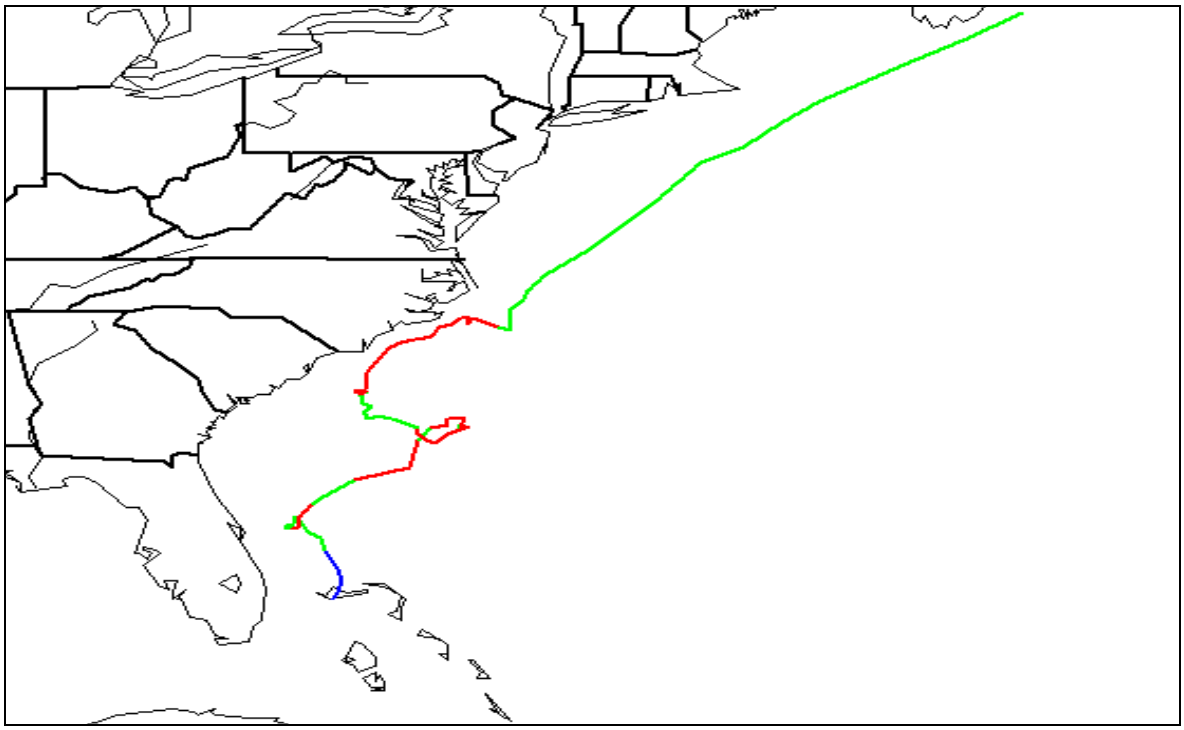

Fig. 165(a): September 14, 2005. *OPHELIA.*

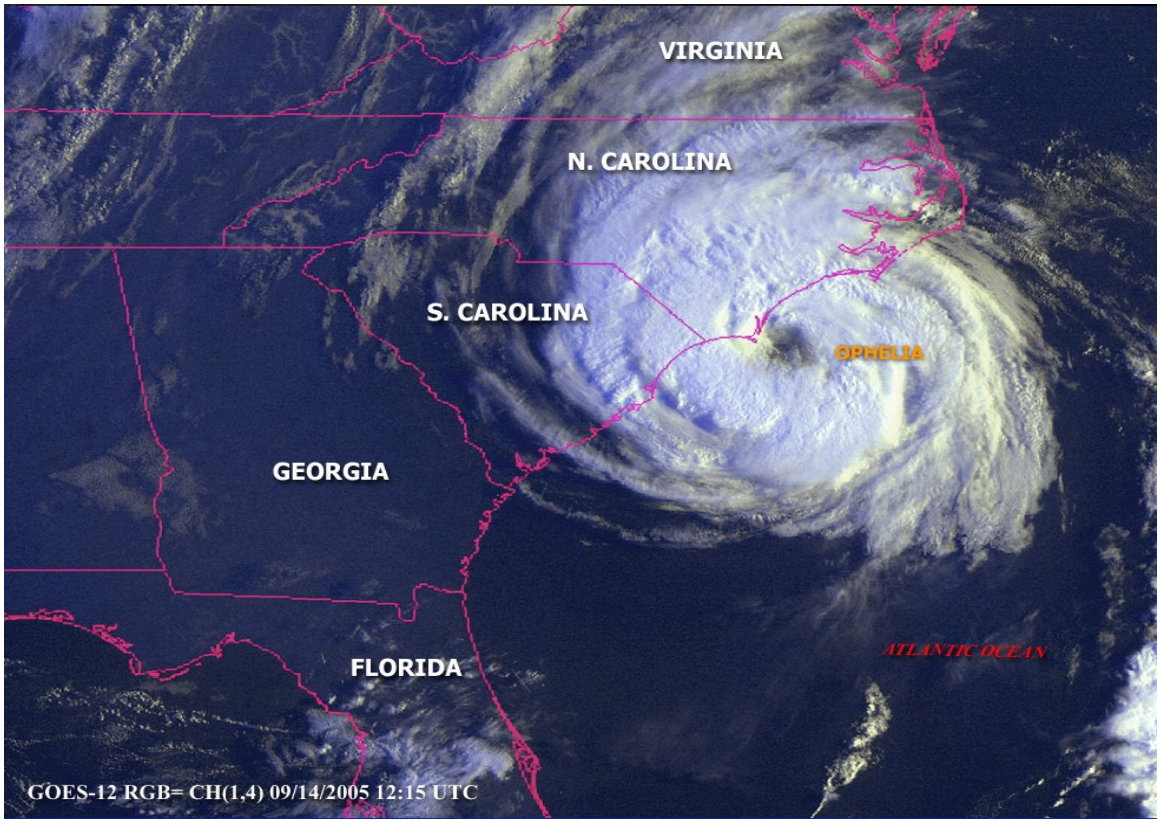

Fig. 165(b): Visible Image of Ophelia, 1215 UTC, September 14, 2005. *Credit: National Oceanic and Atmospheric Administration (NOAA).*

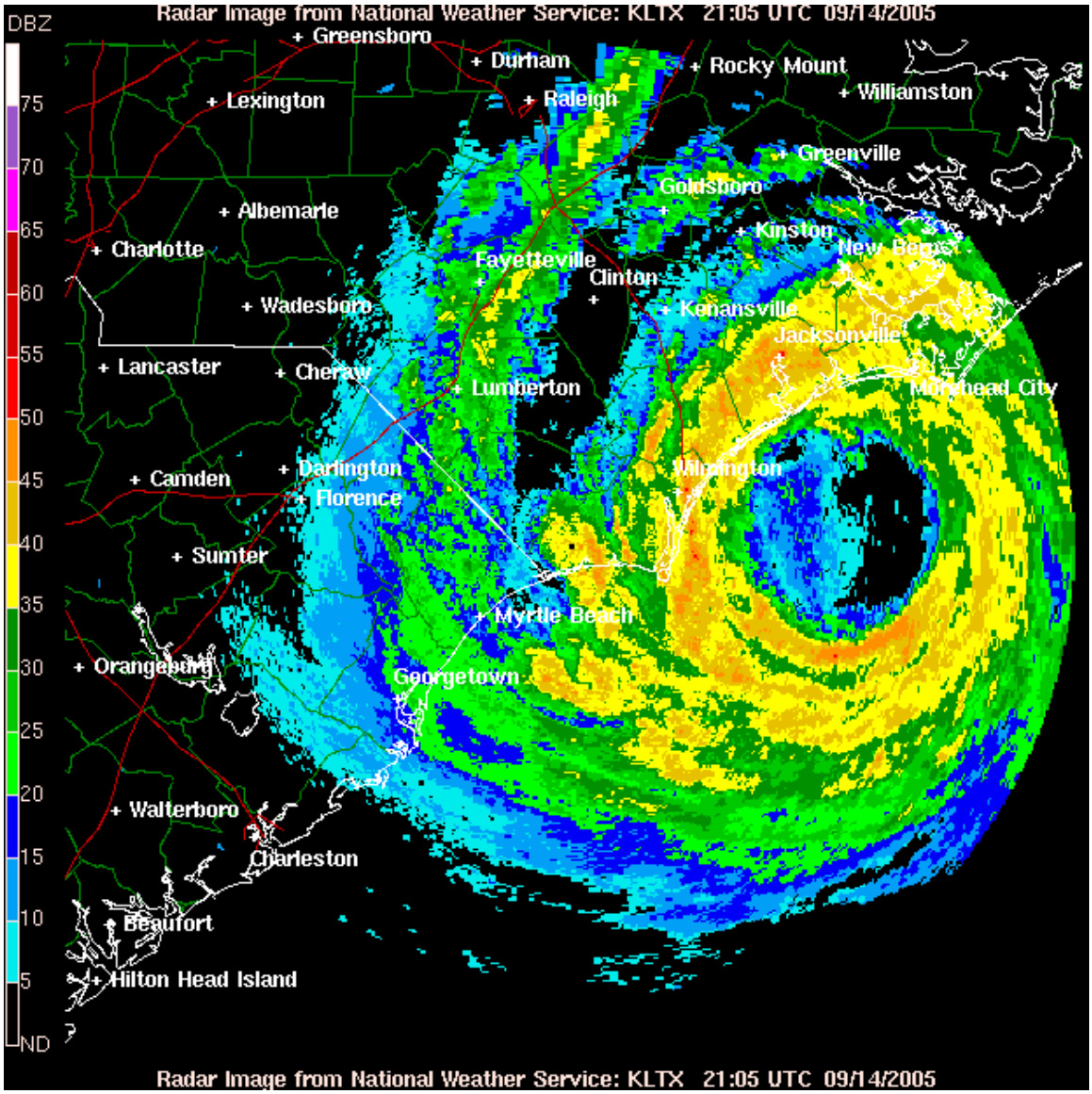

Fig. 165(c): LTX Doppler base reflectivity image, OPHELIA, 2105 UTC, September 14, 2005. *Credit: National Climatic Data Center (NCDC).*

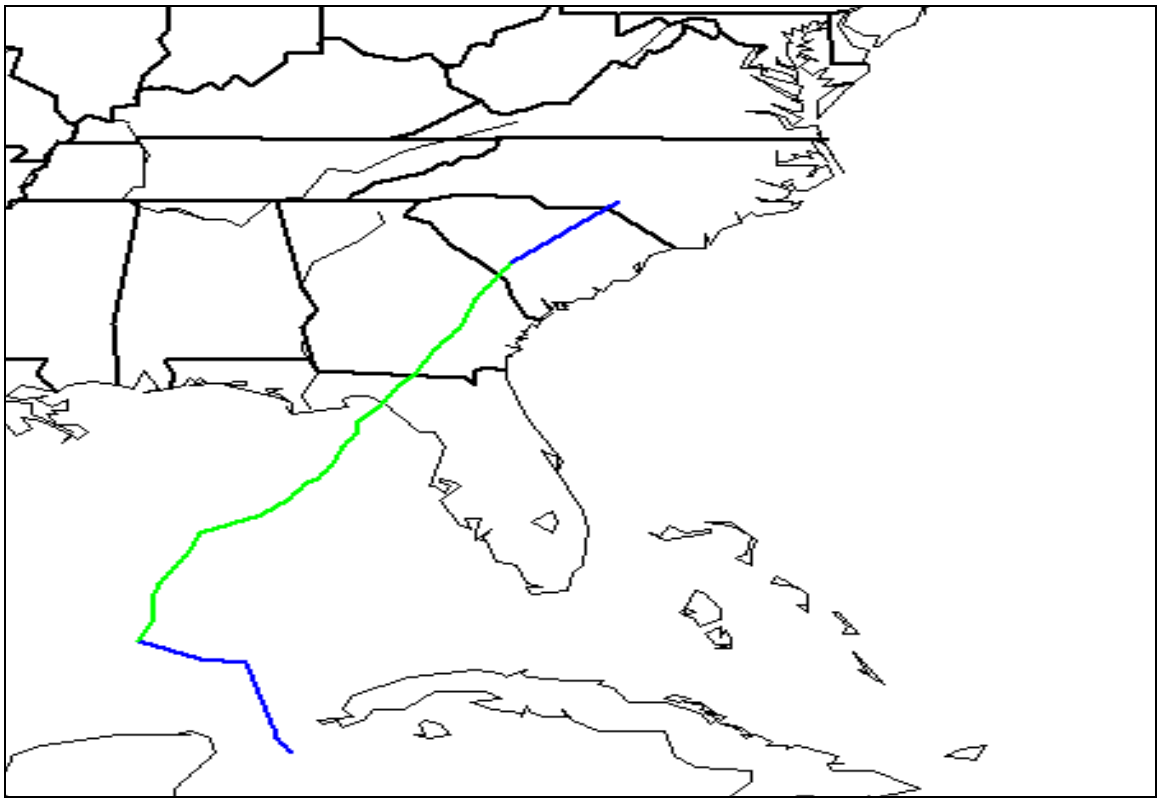

Fig. 166(a): June 14, 2006. *ALBERTO*.

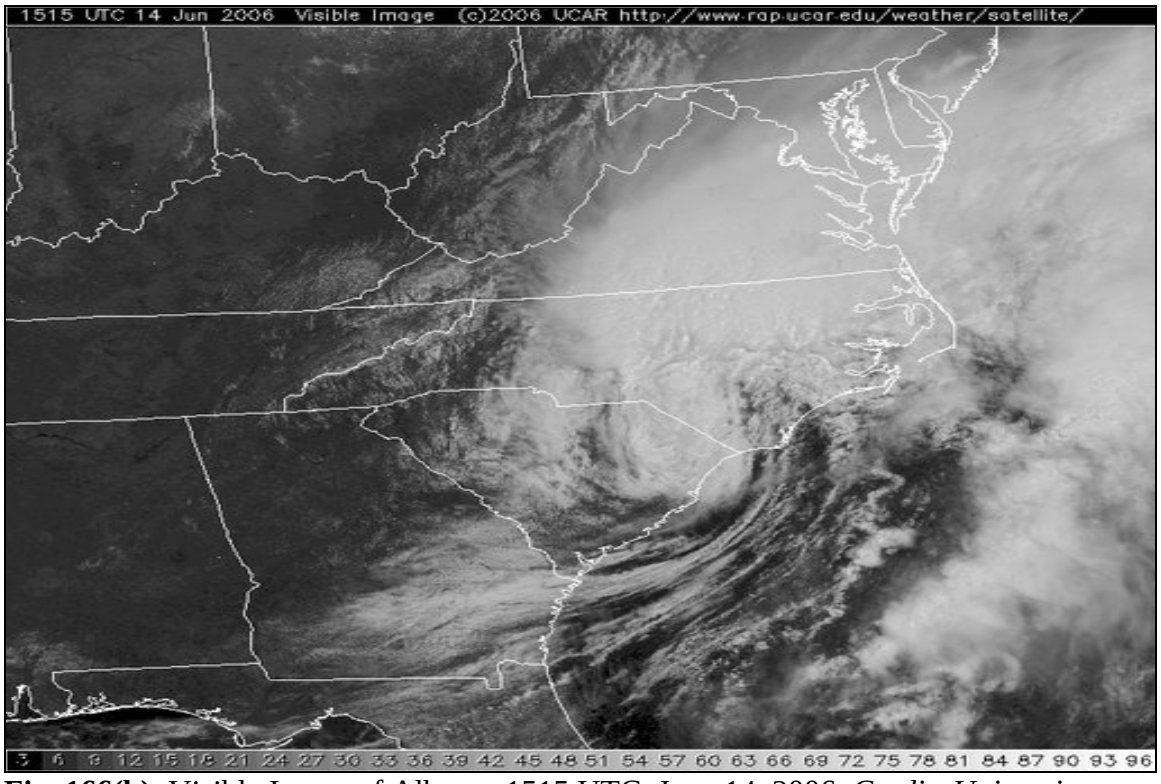

Fig. 166(b): Visible Image of Alberto, 1515 UTC, June 14, 2006. *Credit: University Corporation for Atmospheric Research (UCAR).*

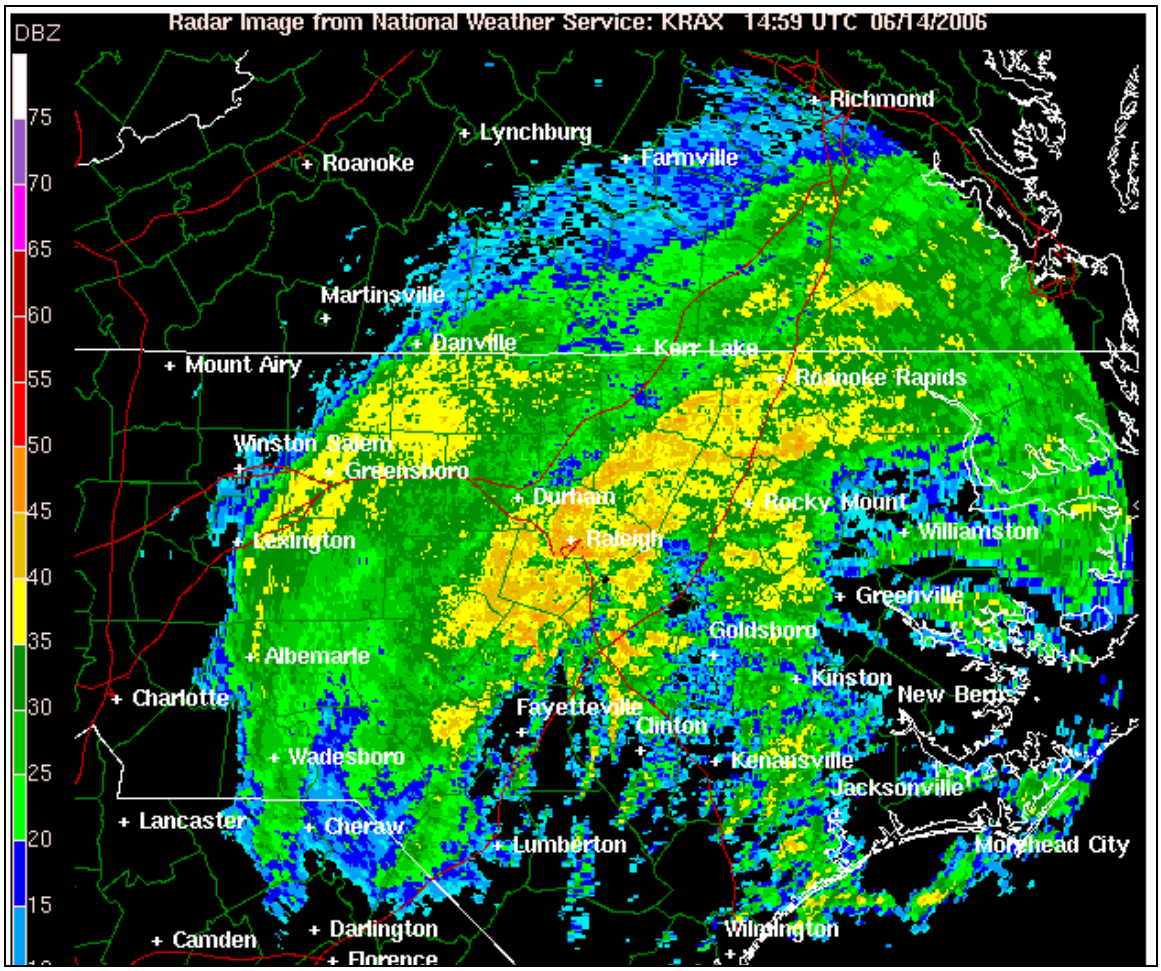

Fig. 166(c): KRAX Doppler base reflectivity image, ALBERTO, 1459 UTC, June 14, 2006. *Credit: National Climatic Data Center (NCDC).*

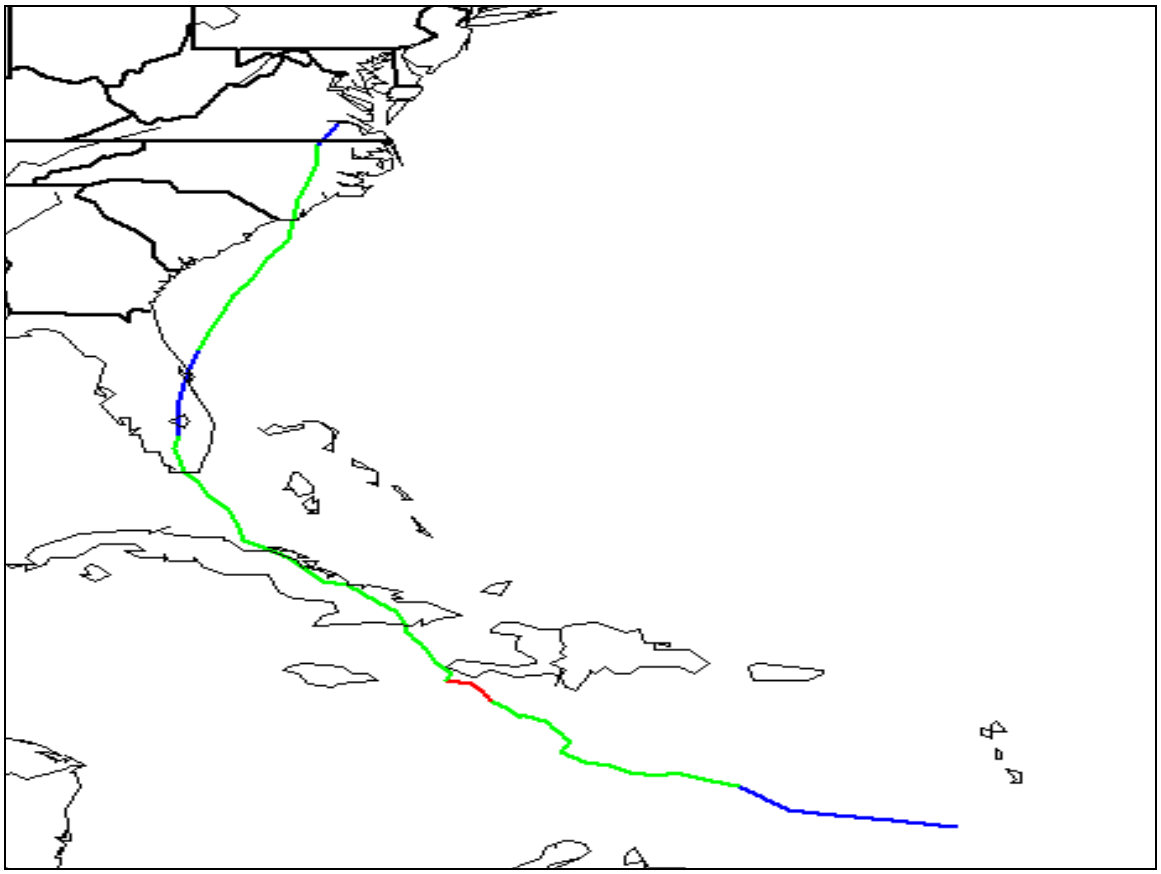

Fig. 167(a): August 31 – September 1, 2006. *ERNESTO.*

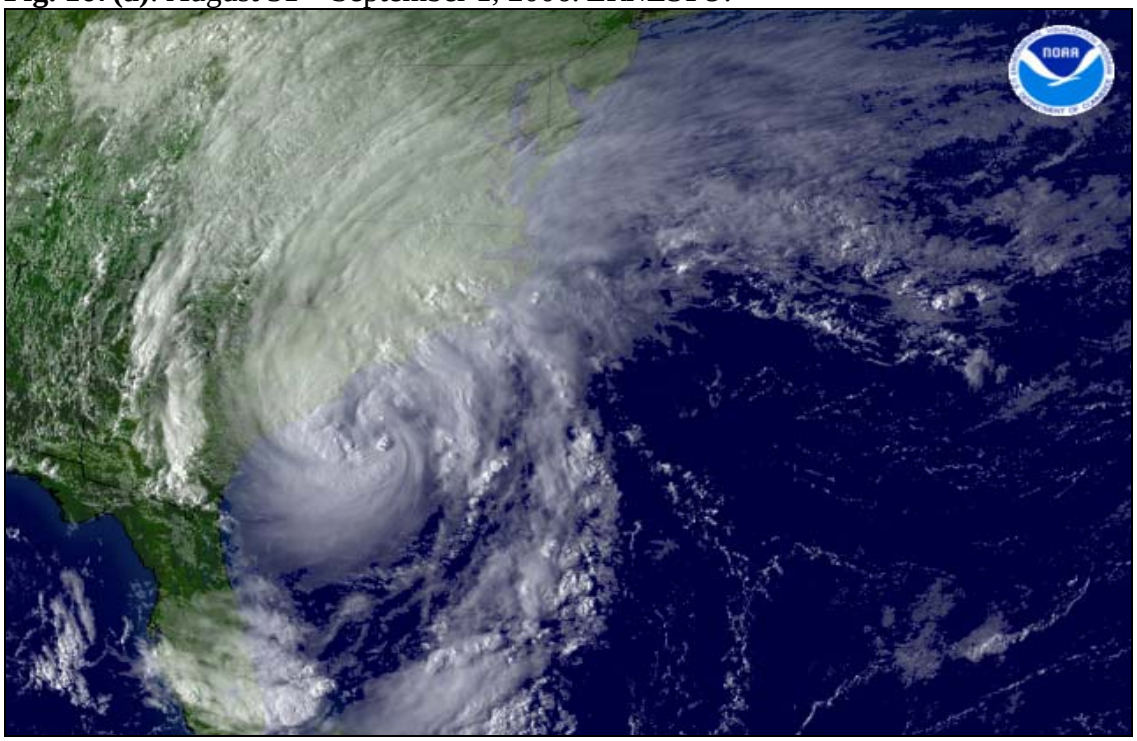

Fig. 167(b): Visible Image of Ernesto, 1600 UTC, August 31, 2006. *Credit: NWFO RAH.*

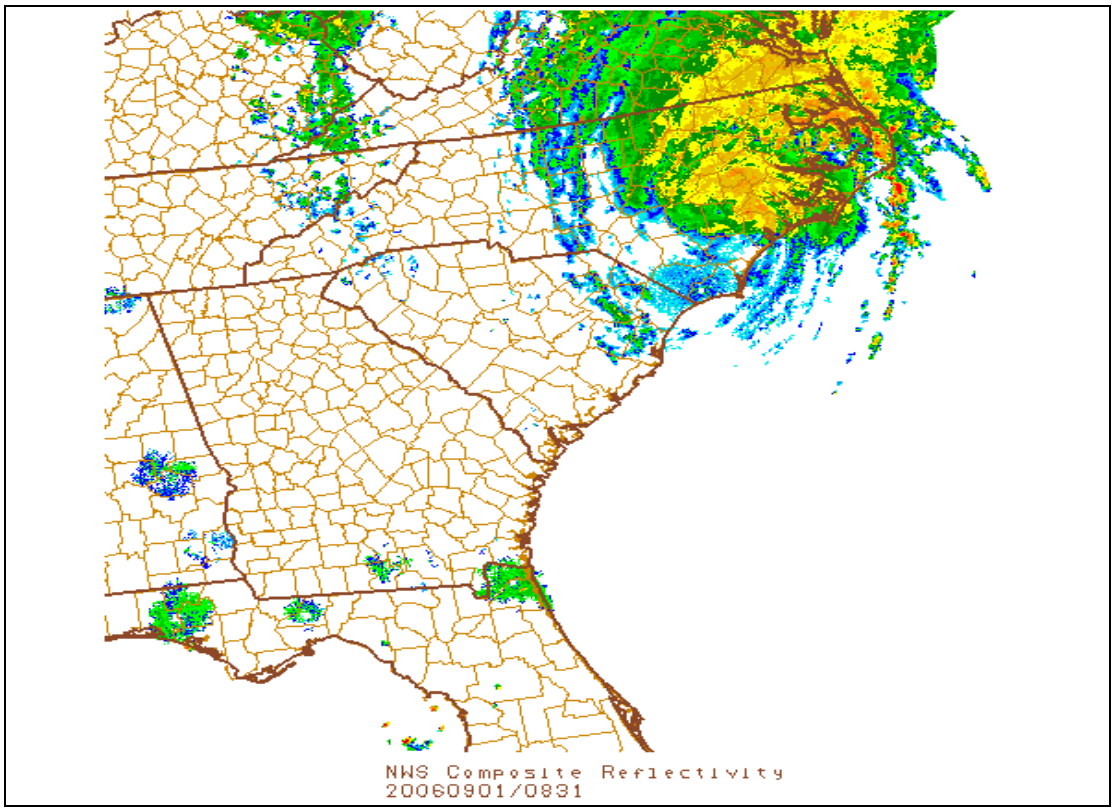

Fig. 167(c): Doppler composite base reflectivity image, ERNESTO, 0831 UTC, September 1, 2006. *Credit: Storm Prediction Center (SPC).*

APPENDIX A

ABBREVIATIONS USED IN THIS STUDY TO CLASSIFY TROPICAL CYCLONES

CAT = Category (Using Saffir/Simpson Scale 1 - 5)
TS = Tropical Storm (A tropical cyclone in which the maximum sustained surface wind (1-minute mean) ranges from 39 to 73 mph.) (34 to 63 knots)
ST = Subtropical Storm (A subtropical cyclone in which the maximum sustained surface (1-minute mean) is equal to or greater than 39 mph.) (34 knots)
XT = Extratropical storm (Tropical cyclones modified by interaction with a nontropical environment. No wind speed criteria. Wind may exceed hurricane force.)
NR = Not Rated (Cyclone in dissipation stage or minimal effects.)

SAFFIR-SIMPSON HURRICANE SCALE

CATEGORY ONE HURRICANE: WEAK

Winds: 75 - 95 mph (65 - 82 knots) at standard anemometer elevations (30 feet). Damage is primarily to shrubbery, trees, foliage and unanchored mobile homes. No real damage occurs to building structures. Some damage is done to poorly constructed signs.
Central pressure: 980 mb (28.94 inches) or greater.
Storm Surge: Nominally is four to five feet above normal. Low-lying coastal roads are inundated, minor pier damage occurs, some small craft in exposed anchorages break moorings.

CATEGORY TWO HURRICANE: MODERATE

Winds: 96 - 110 mph (83 - 95 knots) at standard anemometer elevations (30 feet). Considerable damage is done to shrubbery and tree foliage, some trees are blown down. Major structural damage occurs to exposed mobile homes. Extensive damage occurs to poorly constructed signs. Some damage is done to roofing material, windows and doors; no major damage occurs to building structures.
Central pressure: 965 - 979 mb (28.50 - 28.91 inches)
Storm Surge: Nominally is six to eight feet above normal. Coastal roads and low-lying escape routes inland are cut by rising water two to four hours before arrival of center. Considerable pier damage occurs and marinas are flooded. Small craft in unprotected anchorages break moorings. Evacuation of some shoreline residences and low-lying island areas is required.

CATEGORY THREE HURRICANE: STRONG

Winds: 111 - 130 mph (96 - 113 knots) at standard anemometer elevations (30 feet). Damage occurs to shrubbery and trees, foliage is blown off trees and large trees are blown down. Some roofing material damage occurs with some window and door damage

occurs. Some structural damage occurs to small residences and utility buildings. Mobile homes are destroyed. There is a minor amount of curtain wall failure.
Central pressure: 945 - 964 mb (27.91 - 28.47 inches)
Storm Surge: Nominally is nine to 12 feet above normal. Serious flooding occurs at the coast with many smaller structures near the coast destroyed. Larger structures are damaged by battering of floating debris. Low-lying escape routes inland are cut by rising water three to four hours before the center arrives. Flat terrain lower than five feet above sea level may be flooded inland eight miles or more. Evacuation of low-lying residences within several blocks of the shoreline may be required.

CATEGORY FOUR HURRICANE: VERY STRONG

Winds: 131 - 155 mph (114 - 135 knots) at standard anemometer elevations (30 feet.). Shrubs and trees are blown down and all signs are down. Extensive roofing material damage occurs with complete failure of roof structures on many small residences. Extensive window and door damage occurs. Complete destruction of mobile homes occurs. Some curtain walls experience failure.
Central pressure: 920 - 944 mb (27.17 - 27.88 inches)
Storm Surge: Nominally is 13 - 18 feet above normal. Terrain continuously lower than 10 feet above sea level may be flooded as far as six miles inland. Major damage occurs to lower floors of structures near the shore due to flooding and battering action. Low-lying escape routes inland may be cut by rising water three to five hours before the storm center arrives. Major erosion of beach areas occurs. Massive evacuation of all residences within 500 yards of the shoreline may be required and single-story residences on low ground within two miles of the shoreline may need to be evacuated.

CATEGORY FIVE HURRICANE: DEVASTATING

Winds: Greater than 155 mph (135 knots) at standard anemometer elevations (30 feet). Shrubs and trees are down. Roofing damage is considerable. All signs are down. Very severe and extensive window and door damage occur. Complete failure of roof structures occurs on many residences and industrial buildings. Extensive glass failures occur. There is some complete building failure and small buildings are overturned and blown away. Complete destruction of mobile homes occurs.
Central pressure: less than 920 mb (27.17 inches)
Storm Surge: Height is nominally greater than 18 feet above normal. Major damage occurs to lower floors of all structures located less than 15 feet above sea level and within 500 yards of the shoreline. Low-lying escape routes inland are cut by rising waters three to five hours before the storm center arrives. Massive evacuations of residential areas situated on low ground within five to 10 miles of the shoreline may be required.

APPENDIX B

HISTORY OF TROPICAL STORMS MAKING LANDFALL IN N. C. SINCE 1900 BROKEN DOWN BY GEOGRAPHICAL REGION

BRUNSWICK, NEW HANOVER, PENDER, & ONSLOW COUNTIES

DATE	NAME	DIRECT/ INDIRECT HIT	SCALE	LANDFALL POINT
9/17/06		I	3	Myrtle Beach
9/22/20		D	1	New Hanover
8/1/44		D	1	Southport
10/15/54	*Hazel	D	4	Brunswick County
8/17/55	Diane	D	1	Carolina Beach
9/27/58	Helene	I	3	Center Offshore
9/11/60	Donna	D	3	Bogue Banks
9/12/84	Diana	D	2	Fort Fisher
9/14/84				
9/22/89	Hugo	I	3	Charleston
7/12/96	Bertha	D	2	Wilmington
9/6/96	Fran	D	3	Cape Fear
8/27/98	Bonnie	D	3	Wilmington
9/16/99	Floyd	D	2	Cape Fear
10/12/2002	Kyle	D	TS	Cape Fear
8/14/2004	Charley	D	TS	Brunswick Cty
8/29/2004	Gaston	I	NR	Myrtle Beach
9/14/2005	Ophelia	I	1	New Hanover
8/31/2006	Ernesto	D	TS	Brunswick Cty

***Highlights of Hurricane Hazel**

Wind - 150 mph from Little River Inlet to Holden Beach and 125 mph at Wrightsville Beach
Surge - 18 feet from Calabash to Holden Beach , 14.6 feet at Wrightsville Beach and 8.2 feet on the Cape Fear River in Wilmington
Deaths - 19 Persons died in coastal Southeast North Carolina

Property Losses - $35 million on the beaches of Southeast North Carolina and an additional $100 million over inland sections.

CARTERET COUNTY

DATE	NAME	DIRECT/ INDIRECT HIT	SCALE	LOCATION
7/3/08		D	1	Cape Lookout
9/3/13		D	1	Cape Lookout
9/16/33		D	1	Cape Lookout
9/14/44		I	3	Cape Hatteras
8/13/53	Barbara	D	1	Ern Carteret Cty
10/15/54	Hazel	I	2	Brunswick Cty
8/12/55	Connie	I	3	Cape Lookout
9/19/55	Ione	D	3	Salter Path
9/27/58	Helene	I	3	Center Offshore
9/11/60	Donna	D	3	Bogue Banks
9/30/71	Ginger	D	1	Atlantic Beach
9/27/85	Gloria	I	2	Cape Hatteras
9/17/86	Charley	D	1	Ern Carteret Cty.
7/12/96	Bertha	I	2	Wilmington
9/6/96	Fran	I	3	Cape Fear
7/24/97	Danny	I	TS	Outer Banks
8/27/98	Bonnie	I	3	New Hanover
9/4/98	Dennis	I	TS	Outer Banks
9/16/99	Floyd	I	2	Cape Fear
10/12/2002	Kyle	D	TS	Bogue Banks
9/18/2003	Isabel	I	2	Drum Inlet
8/14/2004	Charley	I	TS	Brunswick Cty
9/14/2005	Ophelia	D	1	Offshore Atlantic Beach

***Highlights of Hurricane Floyd**

Damage - Over $3 billion especially across eastern North Carolina with 7000 homes destroyed, 17,000 uninhabitable, and 56,000 damaged mainly by flood waters. Most damaging flooding ever including severe agricultural damage.
Deaths - 35 deaths were reported with over 1500 people rescued from flooded regions
Surge – 10 feet along the southern North Carolina coast near Bogue Banks
Wind – 122 mph gust at Topsail Beach
Rainfall – New 128 year record of more than 19 inches at Wilmington

OUTER BANKS

DATE	NAME	DIRECT/ INDIRECT HIT	SCALE
10/13/00		**D**	**1**
7/11/01		**I**	**1**
9/15/03		**I**	**1**
7/30/08		**I**	**1**
9/01/08		**I**	**1**
9/3/13		**D**	**1**
8/25/24		**I**	**1**
12/2/25		**I**	**1**
9/12/30		**I**	**1**
8/23/33		**D**	**2**
9/16/33		**D**	**3**
9/8/34		**I**	**1**
9/18/36		**D**	**2**
9/21/38		**I**	**1**
9/14/44		**I**	**3**
6/25/45		**D**	**1**
7/16/46		**I**	**TS**
9/24/49		**I**	**1**
9/13/53	**Barbara**	**D**	**1**
7/30/54	**Carol**	**I**	**2**
9/10/54	**Edna**	**I**	**1**
8/12/55	**Connie**	**D**	**3**
9/27/56	**Helene**	**I**	**3**
9/11/60	**Donna**	**I**	**3**
9/20/61	**Esther**	**I**	**1**
8/28/62	**Alma**	**D**	**1**

10/27/63	**Ginny**	**I**	**NR**
9/23/64	**Gladys**	**I**	**NR**
10/16/64	**Isabell**	**D**	**1**
6/12/66	**Alma**	**I**	**1**
9/17/67	**Doria**	**I**	**TS**
10/20/68	**Gladys**	**I**	**1**
9/8/69	**Gerda**	**I**	**NR**
8/27/71	**Doria**	**I**	**TS**
10/1/71	**Ginger**	**I**	**1**
6/28/75	**Amy**	**I**	**TS**
8/8/76	**Belle**	**I**	**NR**
10/15/84	**Josephine**	**I**	**NR**
9/27/85	**Gloria**	**D**	**3**
8/18/86	**Charley**	**D**	**1**
8/19/91	**Bob**	**D**	**3**
9/24/92	**Danielle**	**1**	**TS**
8/31/93	**Emily**	**D**	**3**
11/18/94	**Gordon**	**I**	**1**
8/20/95	**Felix**	**I**	**4**
7/24/97	**Danny**	**I**	**TS**
9/4/99	**Dennis**	**D**	**TS**
9/16/99	**Floyd**	**I**	**2**
10/18/99	**Irene**	**I**	**1**
10/12/2002	**Kyle**	**I**	**TS**
9/10/2002	**Gustav**	**I**	**TS**
9/18/2003	**Isabel**	**D**	**2**
8/3/2004	**Alex**	**D**	**1**
8/14/2004	**Charley**	**I**	**TS**
9/14/2005	**Ophelia**	**D**	**1**

APPENDIX C

NORTH CAROLINA TROPICAL CYCLONE HISTORY BY MONTH

(NOTE: The rating given to storms in this report reflects the storm's intensity at the time it impacted North Carolina.

DATE	YEAR	RATING	NAME	LANDFALL/ TRACK
April				
10	**1789**	**XT**		**Northeast NC**
May				
None				
June				
3-4	**1825**	**NR**		**Gen coastal NC**
6-7	**1995**	**XT**	**Allison**	**FL/Along NC coast**
7-13	**1968**	**NR**	**Abby**	**GA-Inland NC**
7-8	**1986**	**TS**	**Andrew**	**Offshore NC**
11-12	**1966**	**CAT 1**	**Alma**	**Offshore NC**
14	**2006**	**NR**	**Alberto**	**Southern NC**
16	**1893**	**NR**		**Gulf Ern NC**
18-19	**1982**	**ST**		**Along NC coast**
19-20	**1886**	**NR**		**FL-Western NC**
19-20	**1996**	**TS**	**Arthur**	**Along NC coast**
20-21	**1972**	**TS**	**Agnes**	**FL-Inland NC**
23-26	**1586**	**NR**		**Offshore NC**
25	**1945**	**CAT 1**		**Gulf-Outer Banks**
28	**1975**	**TS**	**Amy**	**Offshore NC**
30-7/1	**1886**	**NR**		**FL-Coastal NC**
July				
1	**1814**	**NR**		**Unknown**
3	**2003**	**NR**	**Bill**	**NC**
5	**1971**	**NR**	**Arlene**	**Offshore NC**
6	**1946**	**TS**		**New Hanover Cty**
7	**2005**	**XT**	**Cindy**	**Western-Central NC**
11	**1901**	**CAT 1**		**Outer Banks**
12-15	**1842**	**NR**		**Along NC coast**

12	**1996**	**CAT 2**	**Bertha**	**S Coast-Inland NC**
14-16	**1916**	**TS**		**SC-Western NC**
18	**1850**	**NR**		**Along NC coast**
19	**1916**	**CAT 1**		**Offshore NC**
23-24	**1788**	**NR**		**Offshore NC**
24-26	**1985**	**NR**	**Bob**	**SC-Inland NC**
24	**1997**	**TS**	**Danny**	**FL-Inland/NE NC**
29	**1960**	**TS**	**Brenda**	**SC/NC Border**
30	**1827**	**NR**		**Unknown**
30	**1908**	**CAT 1**		**Offshore NC**

August

?	**1822**	**NR**		**Offshore NC**
1	**1944**	**CAT 1**		**Brunswick Cty**
2	**1795**	**NR**		**Offshore NC**
3	**2004**	**CAT 1**	**Alex**	**Near Outer Banks**
6	**1670**	**NR**		**Outer Banks**
9	**1976**	**NR**	**Belle**	**Offshore NC**
10	**1777**	**NR**		**Along coast NC**
10	**1781**	**NR**		**SC-Inland NC**
11	**1778**	**NR**		**Outer Banks**
11-17	**1940**	**CAT 1**		**GA/SC Border**
12	**1955**	**CAT 3**	**Connie**	**Outer Banks**
13	**1728**	**NR**		**SC & Along NC coast**
13	**1953**	**CAT 1**	**Barbara**	**Carteret Cty**
13	**2004**	**NR**	**Bonnie**	**Eastern NC**
13-14	**1971**	**NR**	**Beth**	**Offshore NC**
14	**2004**	**TS**	**Charley**	**Brunswick Cty**
15-17	**1830**	**NR**		**SC-Southeast NC**
16-18	**1899**	**CAT 4**		**Outer Banks**
17	**1955**	**CAT 2**	**Diane**	**New Hanover Cty**
17-18	**1986**	**CAT 1**	**Charley**	**Carteret Cty**
18	**1669**	**NR**		**Outer Banks**
18	**1750**	**NR**		**Along NC coast**

18-20	**1837**	**NR**		**SC-Coastal NC**
18-22	**1871**	**NR**		**Southeast NC**
18	**1879**	**EXTREME**		**New Hanover Cty**
19	**1856**	**TS**		**S Outer Banks**
18-19	**1991**	**CAT 3**	**Bob**	**Outer Banks**
19-20	**1995**	**CAT 1**	**Felix**	**Offshore NC**
20	**1887**	**NR**		**Offshore NC**
20-21	**1976**	**TS**	**Dottie**	**S Carolina**
20-21	**1981**	**TS**	**Dennis**	**Along NC coast**
22-23	**1933**	**CAT 2**		**Outer Banks**
23-27	**1851**	**NR**		**FL-Offshore NC**
23	**1893**	**NR**		**Offshore NC**
24-25	**1827**	**NR**		**Outer Banks**
24	**1842**	**NR**		**Along coast**
24	**1850**	**NR**		**Southeast NC**
24	**1949**	**CAT 1**		**Offshore NC**
25	**1885**	**EXTREME**		**Eastern NC**
25	**1924**	**CAT 1**		**Offshore NC**
26	**1591**	**NR**		**Offshore NC**
27-28	**1813**	**NR**		**SC-Inland NC**
27	**1881**	**NR**		**GA/SC Border**
27-29	**1893**	**GREAT**		**GA-Inland NC**
27	**1971**	**TS**	**Doria**	**Carteret Cty**
27	**1998**	**CAT 3**	**Bonnie**	**New Hanover Cty**
28-30	**1839**	**NR**		**Offshore NC**
28	**1949**	**TS**		**FL-Central NC**
28	**1962**	**CAT 1**	**Alma**	**Outer Banks**
29-9/1	**1964**	**NR**	**Cleo**	**GA-Central NC**
29	**2004**	**NR**	**Gaston**	**Eastern NC**
30	**1954**	**CAT 2**	**Carol**	**Offshore NC**
30-31	**1993**	**CAT 3**	**Emily**	**Outer Banks**
31	**1587**	**NR**		**Offshore NC**
31-9/1	**1856**	**TS**		**Eastern NC**
31-9/1	**1908**	**CAT 1**		**Near Outer Banks**
31	**1952**	**TS**	**Able**	**SC-Central NC**
31	**2006**	**TS**	**Ernesto**	**Brunswick Cty**

September

1-2	**1978**	**NR**	**Ella**	**Offshore NC**
2	**1775**	**NR**		**Northeast NC**
2-3	**1821**	**NR**		**Coastal NC**
3-4	**1815**	**NR**		**Coastal NC**
3	**1913**	**CAT 1**		**Carteret Cty**
4	**1834**	**NR**		**SC/NC Border**
4	**1998**	**NR**	**Earl**	**Eastern NC**
4-5	**1856**	**NR**		**Southeast NC**
4-5	**1999**	**TS**	**Dennis**	**Outer Banks**
5	**1797**	**NR**		**NC Coast**
5-6	**1935**	**TS**	**Great Labor Day**	**FL-Coastal NC**
5	**1979**	**TS**	**David**	**GA/SC Border**
5	**1996**	**CAT 3**	**Fran**	**SE/Inland NC**
6	**1667**	**NR**		**Outer Banks**
6-7	**1769**	**NR**		**Brunswick Cty**
6	**1916**	**TS**		**Brunswick Cty**
7-8	**1804**	**NR**		**SC-Inland NC**
7-8	**1846**	**NR**		**Offshore NC**
7	**1853**	**NR**		**Offshore NC**
7-9	**1854**	**NR**		**Coastal NC**
8	**1934**	**CAT 1**		**Near Outer Banks**
8	**1969**	**NR**	**Gerda**	**Offshore NC**
8-9	**1972**	**NR**	**Dawn**	**Offshore NC**
8	**2004**	**NR**	**Frances**	**Western NC**
9-12	**1857**	**NR**		**Offshore NC**
9	**1881**	**NR**		**New Hanover Cty**
9-12	**1889**	**NR**		**Offshore NC**
9-14	**1984**	**CAT 2**	**Diana**	**New Hanover Cty**
9-10	**1995**	**CAT 4**	**Luis**	**Offshore NC**
10	**1811**	**NR**		**SC-Inland**
10-11	**1820**	**NR**		**Outer Banks**
10-11	**1882**	**NR**		**Gulf-Inland NC**
10	**1954**	**CAT 1**	**Edna**	**Offshore NC**
10, 16-17	**1967**	**TS**	**Doria**	**NC/VA Border**
10	**2002**	**TS**	**Gustav**	**Offshore NC**
11	**1883**	**MAJOR**		**Brunswick Cty**
11	**1960**	**CAT 3**	**Donna**	**Southeast NC**
12	**1878**	**NR**		**FL-Inland NC**

12	**1930**	**CAT 1**		**Offshore NC**
13	**1964**	**NR**	**Dora**	**GA-Coastal NC**
14	**1904**	**CAT 1**		**SC-Eastern NC**
14	**1944**	**CAT 3**		**Offshore NC**
14	**2005**	**CAT 1**	**Ophelia**	**Cape Fear-Bogue Banks-Outer Banks**
15	**1752**	**NR**		**Along NC Coast**
15	**1903**	**CAT 1**		**Offshore NC**
15-16	**1933**	**CAT 3**		**Outer Banks**
16-17	**1713**	**NR**		**SC-Inland NC**
16	**1999**	**CAT 2**	**Floyd**	**Cape Fear**
17	**1876**	**NR**		**SC/NC Border**
17	**1906**	**CAT 3**		**SC/NC Border**
17	**1945**	**CAT 1**		**FL-Central NC**
17	**2004**	**NR**	**Ivan**	**Western NC**
18-19	**1928**	**CAT 1**		**GA-Eastern NC**
18	**1936**	**CAT 2**		**Near Outer Banks**
18	**2003**	**CAT 2**	**Isabel**	**Outer Banks**
19-20	**1873**	**NR**		**FL-Coastal NC**
19	**1955**	**CAT 3**	**Ione**	**Carteret Cty**
20	**1961**	**CAT 1**	**Esther**	**Offshore NC**
21-23	**1882**	**NR**		**Outer Banks**
21-24	**1897**	**NR**		**Near Outer Banks**
21	**1938**	**CAT 1**		**Offshore NC**
21-23	**1964**	**NR**	**Gladys**	**Offshore NC**
21-22	**1989**	**CAT 3**	**Hugo**	**SC-Inland NC**
22	**1920**	**CAT 1**		**Southeast NC**
22-25	**1992**	**TS**	**Danielle**	**NC/VA Border**
23	**1761**	**NR**		**Brunswick Cty**
23-24	**1785**	**NR**		**Outer Banks**
23-24	**1873**	**NR**		**FL-Coastal NC**
23-24	**2000**	**NR**	**Helene**	**Eastern NC**
24	**1889**	**NR**		**Gulf-Western NC**
26-27	**1956**	**XT**	**Flossy**	**Gulf-Ern NC**

26-27	**1985**	**CAT 3**	**Gloria**	**Outer Banks**
27-28	**1822**	**NR**		**SC-Inland NC**
27-28	**1894**	**NR**		**SC-Outer Banks**
27	**1958**	**CAT 3**	**Helene**	**Offshore NC**
28	**1806**	**NR**		**Outer Banks**
28	**1874**	**NR**		**SC-Coastal NC**
28	**2004**	**NR**	**Jeanne**	**Western NC**
29	**1877**	**NR**		**Offshore NC**
29	**1896**	**NR**		**FL-Central NC**
30-10/1	**1752**	**NR**		**Onslow Cty**
30	**1959**	**TS**	**Gracie**	**SC-Central NC**
30-10/1	**1971**	**CAT 1**	**Ginger**	**Carteret Cty**

October

1-2	**1929**	**CAT 1**		**FL-Central NC**
1-2	**1975**	**NR**	**Gladys**	**Offshore NC**
2	**1898**	**NR**		**Georgia**
3-4	**1877**	**NR**		**LA-Western NC**
5	**1995**	**NR**	**Opal**	**FL-Inland NC**
7-8	**1783**	**NR**		**North Carolina**
7-8	**1996**	**XT**	**Josephine**	**FL-Coast NC/SC**
9	**1837**	**NR**		**Offshore NC**
9-10	**1894**	**NR**		**Gulf-Eastern NC**
9	**1946**	**XT**		**FL-Central NC**
11-13	**1882**	**NR**		**GA-Along Coast NC**
11	**1888**	**NR**		**Gulf-Coastal NC**
12	**1846**	**NR**		**FL-Eastern NC**
12-15	**1947**	**CAT 1**		**Offshore NC**
12-15	**1984**	**NR**	**Josephine**	**Offshore NC**
12	**2002**	**TS**	**Kyle**	**Cape Fear-Bogue Banks**
13	**1893**	**GREAT**		**SC-Central**

				NC
13	1900	CAT 1		Outer Banks
15	1954	CAT 4	Hazel	Brunswick Cty
16	1964	CAT 1		Outer Banks
18-19	1749	NR		Along NC Coast
18-19	1962	NR	Ella	Offshore NC
18	1999	CAT 1	Irene	Offshore Outer Banks
19-20	1910	CAT 1		Offshore NC
19-27	1963	NR	Ginny	Offshore NC
19-20	1968	CAT 1	Gladys	FL-Exit NC
20	1887	NR		LA-Exit NC
20	1897	NR		Offshore NC
20	1944	TS		Brunswick Cty
22	1893	NR		Outer Banks
23	1878	MAJOR		Southeast NC
24-26	1897	NR		Outer Banks
25	1872	NR		FL-Inland NC
25-26	1973	TS	Gilda	Offshore NC
26-27	1975	TS	Hallie	Outer Banks
29	1837	NR		Offshore NC
30-31	1899	CAT 2		Brunswick Cty
31	1887	NR		FL-Offshore NC

November

1-?	1861	NR		Offshore NC
17-18	1825	NR		Outer Banks
17-18	1994	CAT 1	Gordon	Outer Banks
22	1985	TS	Kate	FL-Offshore NC
25	1888	NR		Offshore NC

December

2	1925	CAT 1		FL-Coastal SE NC

APPENDIX D

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