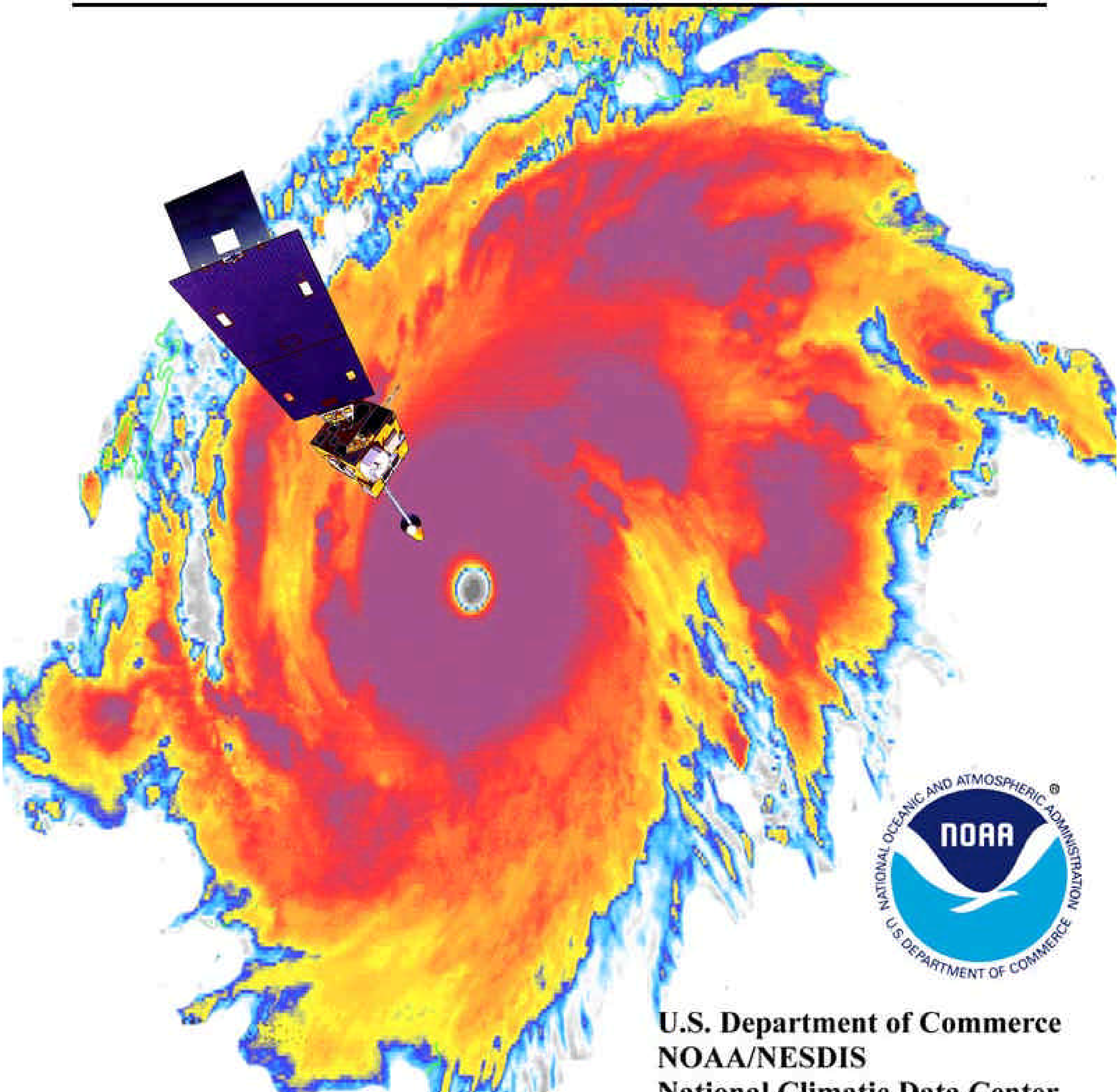
Technical Report 99-01

1998 Atlantic Tropical Storms

Views from the NOAA Satellites



U.S. Department of Commerce
NOAA/NESDIS
National Climatic Data Center
Asheville, North Carolina, 28801
March 1999

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A. Graumann, N. Lott

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Introduction

This annual report is a preliminary summary of the 1998 Atlantic Hurricane season which provides a synopsis of each named tropical storm using textual information obtained from the National Hurricane Center's *Summary of the 1998 Atlantic Season* report and the National Weather Service's *Preliminary Storm Data* reports. Selected satellite and doppler radar imagery were used for key times of each storm. The tables of station precipitation data were created from NWS cooperative and airport stations. The numbers for deaths and damages were obtained from several sources including the NHC Preliminary Hurricane Reports, Federal Emergency Management Agency (FEMA), and state emergency management agencies. These numbers are subject to revision.

The colorized satellite images from the GOES-8 satellite were created using one of the long-wave infrared channels (~10.7μm), which measures radiated energy from the earth and atmosphere. The radiance counts were calibrated and converted to brightness temperatures and then scaled to an arbitrary color range, which best displays clouds of various types and heights. The scale ranges from black, indicating the warmest surfaces, to maroon, indicating the coldest surfaces (see fig. 1). Land and ocean surfaces are relatively much warmer than cloud tops, and hence, appear gray to almost black in the series of infrared images within this report. In some cases, color was manually edited to land and ocean areas to further enhance the images. The visible satellite images were created using the Imager visible channel (.52μm-.75μm) which measures reflected energy in terms of albedo. The visible images are displayed in a gray scale (0-255). The satellite images within this report along with many more tropical storm images are on-line under the satellite resources section at www.ncdc.noaa.gov/ol/satellite/olimages.html.

1998 Atlantic Hurricane Summary

The 1998 hurricane season will be remembered for a number of reasons, but, by far, it will be remembered as the most deadly hurricane season in over 200 years. One of the most powerful hurricanes on record, Hurricane Mitch, is blamed for an estimated 11,000 deaths in Central America. Not since the Hurricane of 1780, which took over 20,000 lives, was there such a deadly storm in the Caribbean Sea region. Other noteworthy tidbits for this season are: Mitch set a record for strongest hurricane in October; the 4-year period, 1995-1998, saw 33 hurricanes, the most hurricanes in any consecutive 4-year group; and for the first time this century, there were four simultaneously occurring hurricanes in the Atlantic, as shown in this GOES colorized infrared image (fig. 2) taken on September 26.

As El Niño was the main contributing factor to last season's minimal hurricane activity, this year's explosive activity was directly related to the rapid reversal of El Niño conditions to La Niña conditions during late spring and early summer. La Niña is a weather phenomenon marked by colder than normal sea surface temperatures along the eastern and central equatorial Pacific and is known to impact the weather patterns around the globe. Soon after when La Niña conditions formed, the Atlantic Basin witnessed the formation of 10 named storms within a period of just 36 days from August 19 through September 23. Favorable (weak) wind shear and above normal sea surface temperatures in portions of the Atlantic Basin contributed to this development.

Table 1 gives the name, date range, minimum central pressure, maximum sus-tained wind speed, highest Saffir-Simpson category, estimated number of deaths, and damage estimates of each storm.

Table 1 - 1998 Atlantic Basin Tropical Storms and Hurricanes

	Name	Dates	Minimum Pressure (millibars)	Max Wind Speed (knots)*	Saffir-Simpson Scale**	Deaths †	Damages#
1	Alex	07/27-08/02	1000	50	n/a	0	none reported
2	Bonnie	08/19-08/30	954	100	3	3	$1 billion
3	Charley	08/21-08/24	1000	60	n/a	20	$50 million
4	Danielle	08/24-09/03	960	90	2	0	$100 million
5	Earl	08/31-09/03	985	85	2	3	$ 79 million
6	Frances	09/08-09/13	990	55	n/a	1	$500 million
7	Georges	09/15-10/01	937	135	4	602	$5.9 billion
8	Hermine	09/17-09/20	999	40	n/a	0	none reported
9	Ivan	09/19-09/27	975	80	1	0	none reported
10	Jeanne	09/21-10/01	969	90	2	0	none reported
11	Karl	09/23-09/28	970	90	2	0	none reported
12	Lisa	10/05-10/09	995	65	1	0	none reported
13	Mitch	10/22-11/05	905	155	5	11,000	$10 billion
14	Nicole	11/24-12/01	979	75	1	0	none reported

* Estimated maximum 1-minute average wind speed.

** Saffir-Simpson Hurricane Scale. Indicates maximum strength of the storm during its lifetime. Categories: **1** (64-82 kts), **2** (83-95 kts), **3** (96-113 kts), **4** (114-135 kts), and **5** (over 135 kts)

† Estimated number of deaths from direct causes. Does not include indirect deaths. Includes deaths in U.S., Caribbean, and Central America.

Damages are estimated based on several sources.

Following is a synopsis of each storm.

Alex - Well into the hurricane season, the first tropical storm, named Alex, formed over the eastern tropical Atlantic about 350 miles south-southwest of the Cape Verde Islands on July 27. It quickly became a tropical storm late on the following day. It moved generally west northwestward, reaching peak intensity of 50 kts late on July 30 (fig. 3). At that time, Alex was located about 900 miles east of the Lesser Antilles. The system weakened and quietly dissipated about 300 miles northeast of the Leeward Islands on August 2.

Bonnie - Sixteen days after Alex dissipated, a tropical wave over the Atlantic about 900 miles east of the Leeward Islands was spotted on August 19. Within 24 hours it became a tropical storm and moved on a west to northwestward track skirting the Leeward Islands. Late on the 21st, the storm strengthened into a hurricane located about 200 miles north-northeast of eastern Hispaniola. Bonnie strengthened to its maximum winds of 100 kts late on the 23rd while located about 175 miles east of San Salvador in the Bahamas. The GOES-8 colorized infrared image (fig. 4) shows a well organized storm, with strong convection (indicated in dark red) nearly surrounding the center, although the eye itself does not appear in this image, probably due to some weakening while taking a pause in its forward movement. At this point, model forecasts were in disagreement as to where the storm would head next; however, it appeared that southeast coastal U.S. was under the gun. On August 24, at 5pm EDT, the Tropical Prediction Center issued a Hurricane Watch from Savannah, Georgia to the North Carolina/Virginia border. Bonnie continued to move west to northwest over the next 48 hours while maintaining its strength as a category 3 hurricane. As the center neared the coast, its forward speed slowed. By around 16:45 EDT, the Raleigh doppler radar showed Bonnie's eyewall had moved over the Kure Beach vicinity (fig. 5). Notice that the eyewall does not completely encircle the center of the storm. Interestingly enough, the eye wall is completely absent to the west and southwest side of the center. An enhanced GOES satellite image (fig. 6) taken at the same time as the radar image confirms an ill-defined center at the coastline with a tiny hole in the clouds just west of Cape Fear. The coldest cloud tops (maroon color), indicating the heaviest wind and rain, remain over the warm waters of the Gulf Stream Current.

As Bonnie pivoted northeastward along the North Carolina coast during the night of August 26-27, it weakened to a category 1 storm in the early morning hours of the 27th before moving near the Onslow/Pender county line. The storm then continued to move slowly northeast at speeds of 10 mph or less. Bonnie was downgraded to a tropical storm during the afternoon of the 27th , but later re-strengthened into a hurricane when it moved away from Kitty Hawk, North Carolina, late on August 27. Unlike most tropical storms, Bonnie's strongest winds encompassed a broad semicircle on its east side, which fortunately, was over water. The most damaging winds were contained in the precursor rain bands where localized downbursts produced significant damage, especially along the coast of Carteret county which appeared to sustain the most damage from the storm. The slow movement of the storm contributed to excessive rainfall amounts with totals of 7-10 inches common across eastern North Carolina. Table 2 lists selected weather stations reporting 3.00 inches or greater. Just north of Wilmington, over 14.00 inches of rain was officially reported. For comparison, a NEXRAD storm total precipitation map is included (fig. 7). The NEXRAD precipitation totals are somewhat underestimated in southeastern North

Table 2 - Bonnie Precipitation Totals (>3.00") from Selected Reporting Stations

Amounts listed are for totals of at least 3.00 inches. List includes National Weather Service stations, cooperative stations, as well as various river forecasting network gauges.

STATION	COUNTY	ST	ELEV(ft)	LAT	LON	RAIN(")
WILMINGTON 7 N	NEW HANOVER	NC	40	34.32N	77.92W	14.61
HOFFMAN FOREST	ONSLOW	NC	44	34.83N	77.30W	11.94
JACKSONVILLE	ONSLOW	NC	24	34.72N	77.43W	11.34
CHERRY POINT	CRAVEN	NC	36	34.90N	76.88W	11.03
MOOREHEAD 2WNW	CATERET	NC	10	34.73N	76.73W	10.78
SOUTHPORT 5 N	BRUNSWICK	NC	20	34.00N	78.01W	10.57
CEDAR ISLAND	CARTERET	NC	8	34.98N	76.30W	9.58
WILMINGTON	NEW HANOVER	NC	31	34.28N	77.91W	9.45
WILLARD 4 SW	PENDER	NC	55	34.67N	78.05W	9.35
BAYBORO 3 E	PAMLICO	NC	10	35.15N	76.72W	8.12
GREENVILLE	PITT	NC	32	35.63N	77.40W	8.20
WARSAW 5 E	DUPLIN	NC	110	35.00N	78.03W	7.20
NORFOLK WSO	PRINCESS ANNE	VA	24	36.90N	76.20W	6.88
SHALLOTTE	BRUNSWICK	NC	20	33.92N	78.38W	6.50
LONGWOOD	BRUNSWICK	NC	40	34.02N	78.55W	6.42
TRENTON	JONES	NC	30	35.07N	77.35W	6.42
KINGSTON 5 SE	LENOIR	NC	55	35.22N	77.53W	6.14
BELHAVEN 5 SE	BEAUFORT	NC	8	35.50N	76.68W	6.06
WILSON 3 SW	WILSON	NC	110	35.70N	77.95W	5.56
WILLIAMSTON 1 E	MARTIN	NC	20	35.85N	77.03W	5.55
WASHINGTON	BEAUFORT	NC	14	35.53N	77.02W	5.50
ELIZABETHTOWN	BLADEN	NC	60	34.63N	78.58W	5.49
COLUMBIA	TYRRELL	NC	10	35.73N	76.13W	5.38
BACK BAY WL RFG	VIRGINA BEACH	VA	10	36.67N	75.92W	5.20
KINGSTON AG RSRCH	LENOIR	NC	60	35.37N	77.55W	4.86
SNOW HILL	GREENE	NC	95	35.53N	77.86W	4.80
CLINTON 2 NE	SAMPSON	NC	158	35.02N	78.28W	4.62
SUFFOLK LKE KILBY	N/A	VA	22	36.73N	76.60W	4.46
EDENTON	CHOWAN	NC	20	36.18N	76.78W	4.35
GOLDSBORO 4 E	WAYNE	NC	109	35.43N	77.97W	4.36
NEW HOLLAND	HYDE	NC	2	35.45N	76.18W	4.29
ROCKY MOUNT 8 ESE	NASH	NC	110	35.85N	77.89W	4.15
GOLDSBORO	WAYNE	NC	109	35.45N	77.97W	4.08
AURORA 6 N	BEAUFORT	NC	20	35.38N	76.78W	4.02
ROCKY MOUNT 6 SW	NASH	NC	130	35.90N	77.88W	3.80
PLYMOUTH 5 E	WASHINGTON	NC	20	35.87N	76.65W	3.72
ENFIELD	HALIFAX	NC	110	36.18N	77.68W	3.66
WHITESVILLE	COLUMBUS	NC	50	34.27N	78.70W	3.50
SMITHFIELD	JOHNSTON	NC	150	35.52N	78.35W	3.02

Carolina, where the heaviest amounts were reported, possibly due to the Raleigh radar station being located 100 miles away, and due to NEXRAD occasionally underestimating rainfall in tropical systems. Since much of the region had experienced below normal rainfall during the summer months, the resulting flood was not as damaging as it could have been. Nevertheless, flooding of poor drainage and low lying areas predominated. Coastal and storm surge flooding were reported to be not as extensive as with Hurricanes Fran or Bertha, but several locations did report significant problems. The hardest hit area was Belhaven, where storm surge flooding along the Pungo River flooded two-thirds of the homes in the area with water levels as high as 6 feet above normal. Many docks, piers and bulkheads were damaged or destroyed by the storm. Along the North Carolina outer banks, soundside flooding from the Pamlico Sound late on the 27^{th} and early on the 28^{th} produced water levels 4-6 feet above normal in Manteo on Roanoke Island and over portions of Hatteras Island, where Route 12 was closed briefly due to high water. Storm surge at the beaches of Onslow and Carteret counties was generally 3-5 feet above normal with moderate beach erosion. North Topsail Beach lost most of its protective dunes constructed after severe beach erosion caused Bertha and Fran in 1996. Tens of thousands of tires, which made up part of an artificial reef, washed up on the shore of Bogue Banks. Wind damage was greatest along Bogue Banks, where two hotels and one department store lost roofs. The hurricane also produced seven confirmed tornadoes during the afternoon and evening of the 26^{th}. Three deaths were caused by Bonnie and the damages were estimated to be at least $1 billion with severe agricultural damage.

Charley - The first tropical system born in the Gulf of Mexico this season, Charley, developed from an area of low pressure that was drifting northwestward from the southeast Gulf of Mexico. The system, which formed into a depression early on August 21, was centered about 275 miles off the south Texas coast. It soon strengthened into a tropical storm later that day. Charley reached its peak intensity of 60 kts shortly before moving inland near Port Aransas, Texas, early on August 22. The GOES colorized IR image (fig. 8) was taken shortly before landfall. After landfall, the surface circulation weakened to near dissipation, but a slow moving circulation aloft persisted in the vicinity of Del Rio, Texas. Initially, Charley moved steadily westward during the day on Saturday, August 22, and produced the heaviest rain in its northeast quadrant. Rainfall rates throughout the morning and into the afternoon were generally between 1 and 2 inches per hour. As the storm center approached the Hill Country, an elevated area west of San Antonio, Texas, it began to slow and stall. At this point, rainfall totals reached 3 to 6 inches over much of south central Texas, as confirmed by doppler radar (fig. 9) and surface reports (table 3). The core of the heaviest rainfall appears to have occurred around Del Rio, Texas, where official reports showed almost 18 inches of rain had fallen within 2 days. The National Weather Service station at the Del Rio Airport officially measured 17.03 inches of rain in 24 hours, making it the wettest day ever recorded. Fortunately, most of the flood damages only occurred to roads and crops in the fields. Advance warnings helped reduce casualties and injuries; however, at least 20 people lost their lives in Texas and Mexico. A preliminary total damage figure stands near $50 million for Texas.

Table 3 - Charley Precipitation Totals (>4.00") from Selected Reporting Stations

STATION	COUNTY	ST	ELEV(ft)	LAT	LON	RAIN(")
DEL RIO 2 NW	VAL VERDE	TX	1026	29.37N	100.92W	17.99
DEL RIO AIRPORT	VAL VERDE	TX	999	29.38N	100.56W	17.75
CARTA VALLEY 4 W	VAL VERDE	TX	1780	29.80N	100.73W	12.95
BRACKETTVILLE 22N	KINNEY	TX	1675	29.60N	100.47W	10.94
ROCKSPRINGS 26SSW	EDWARDS	TX	1690	29.68N	100.41W	9.30
CAMP WOOD	REAL	TX	1470	29.68N	100.02W	8.50
LEAKY	REAL	TX	1622	29.73N	99.77W	8.39
UTOPIA	UVALDE	TX	1338	29.58N	99.52W	8.28
TARPLEY	BANDERA	TX	1404	29.67N	99.28W	8.05
HONDO	MEDINA	TX	876	29.33N	99.13W	8.04
VANDERPOOL 4 N	BANDERA	TX	1825	29.80N	99.58W	7.91
PRADE RANCH	REAL	TX	2052	29.92N	99.77W	7.89
AMISTAD DAM	VAL VERDE	TX	1157	29.47N	101.03W	7.60
BRACKETTVILLE	KINNEY	TX	1118	29.32N	100.42W	7.50
VANDERPOOL	BANDERA	TX	2265	29.82N	99.57W	7.35
FLORESVILLE	WILSON	TX	400	29.13N	98.17W	7.31
REFUGIO 3 SW	REFUGIO	TX	45	28.27N	97.30W	7.30
SAN MARCOS	HAYS	TX	612	29.85N	97.95W	5.87
PALACIOS	MATAGORDA	TX	12	28.73N	96.25W	5.74
MEDINA LAKE	MEDINA	TX	1169	29.52N	98.92W	5.70
DANEVANG	WHARTON	TX	70	29.05N	96.23W	5.56
ROCKSPRINGS	EDWARDS	TX	2400	30.02N	100.22W	5.53
SHEFFIELD	PECOS	TX	2170	30.70N	101.83W	5.53
MEDINA 2 W	BANDERA	TX	1705	29.78N	99.28W	5.52
HUMBLE PUMP STN	SUTTON	TX	2200	30.37N	100.30W	5.42
YOAKUM	LAVACA	TX	325	29.27N	97.12W	5.42
PALACIOS FAA AP	MATAGORDA	TX	16	28.72N	96.25W	5.39
NORTHINGTON RCH	KENDALL	TX	1524	29.87N	98.65W	5.23
FREEPORT	BRAZORIA	TX	8	28.98N	95.38W	5.21
SAN ANTONIO AP	BEXAR	TX	809	29.53N	98.47W	4.99
SABINAL	UVALDE	TX		29.33N	99.48W	4.83
SAN ANTONIO 8 NNE	BEXAR	TX	788	29.53N	98.48W	4.66
SPRING BRANCH	COMAL	TX	1030	29.87N	98.40W	4.59
DILLEY	FRIO	TX	550	28.68N	99.18W	4.50
SAN MARCOS	HAYS	TX		29.85N	97.95W	4.48
PEARSALL	FRIO	TX	635	28.88N	99.08W	4.45
HUNT 10 W	KERR	TX	2095	30.05N	99.52W	4.43
MATAGORDA 2	MATAGORDA	TX	10	28.68N	95.97W	4.40
WHARTON	WHARTON	TX	111	29.32N	96.10W	4.37
BOERNE	KENDALL	TX	1422	29.80N	98.72W	4.36
BATESVILLE	ZAVALA	TX	745	28.95N	99.62W	4.30
VICTORIA	VICTORIA	TX	104	28.85N	96.92W	4.29
COTULLA	LA SALLE	TX	452	28.45N	99.22W	4.28
SABINAL	UVALDE	TX	949	29.33N	99.48W	4.28

Danielle - The tropical depression that was to become Danielle formed early on August 24 about 700 miles west of the Cape Verde Islands. It reached tropical storm status later that day. Moving west to northwestward, Danielle rapidly strengthened into a hurricane and reached the first of several peak intensities near 90 kts while centered about 1040 miles east of the Leeward Islands. For the next several days the hurricane continued moving west-northwestward, grad-ually slowing in forward speed. Danielle slowly curved more northward during the last two days in August, passing well east of the Bahamas. Figure 10 shows a GOES visible image taken on the morning of August 31. It shows a relatively symmetrical hurricane, which at that time had estimated maximum sustained winds of 85 kts. The hurricane's circulation dominates this region of the Atlantic for several hundred miles as denoted by the number of spiral bands indicating good surface inflow. Despite its close proximity to the U.S. southeast coast, Danielle posed no threat to the mainland as it continued on its curve toward the northeast at increasing forward speed. On September 2, Danielle passed about 230 miles northwest of Bermuda. Wind speeds at Bermuda briefly reached tropical storm force (+34 kts). Danielle lost tropical char-acteristics about 260 miles east southeast of Cape Race, Newfoundland, late on September 3.

Earl - About a week after Charley dumped enormous amounts of rain in southern Texas, a new western Gulf of Mexico tropical system was born, named Earl. It had a poorly defined center that was difficult to track. Fortunately for Texas, Earl appeared to be moving northward when it first formed and then northeastward, becoming a hurricane about 150 miles south-southeast of New Orleans, Louisiana, on September 2. After briefly attaining estimated 85 knot sustained winds, Earl made landfall over the Florida panhandle near Panama City as a category 1 hurricane shortly after midnight on September 3, as depicted by the GOES colorized IR image in figure 11. Note that most of the activity is on the east side of the system as indicated by the large red area. The west flank of the storm is nearly devoid of convective activity indicating strong windshear.

The storm surge along the Florida Big Bend coast ranged from 6 to 12 feet above normal tide levels. Significant beach erosion occurred along coastal Walton county, as well as Carrabelle Beach and Alligator Point. Bay County experienced the worst urban and small stream flooding since Hurricane Opal in 1995. Flooding occurred along the St. Marks River at Newport, Florida, where a crest of eight feet was measured. In Bay County, fresh water flooding damaged 1,049 homes, 3 businesses, and 50 other structures. Three homes were destroyed. The Gulf Highlands subdivision in Panama City Beach suffered the worst flooding with up to five feet of water inside homes. Many other homes and businesses were damaged to some degree from flooding. Also, power outages were common.

Earl soon weakened to tropical storm strength after making landfall and became extratropical while moving northeastward through Georgia during the day on September 3. Earl was directly responsible for three deaths and damages of approximately $79 million. Two fishermen died when their boat capsized in 16 to 20 foot seas offshore of Panama City Beach, Florida. Two persons were injured, one each in Walton and Jackson counties.

Table 4 - Earl Precipitation Totals (>6.00") from Selected Reporting Stations

STATION	COUNTY	ST	ELEV(ft)	LAT	LON	RAIN(“)
PANAMA CITY 5 NE	BAY	FL	32	30.22N	85.60W	14.38
KERSHAW	LANCASTER	SC	500	34.55N	80.88W	10.14
APPLING 2NW	COLUMBIA	GA	370	33.57N	82.33W	9.30
CORDELE	CRISP	GA	308	31.98N	83.78W	9.28
NICEVILLE	OKALOOSA	FL	60	30.53N	86.50W	9.08
WEWAHITCHKA	GULF	FL	42	30.12N	85.20W	8.90
QUITMAN 2 NW	BROOKS	GA	187	30.48N	83.35W	8.77
MOUNT GILEAD	MONTGOMERY	NC	220	35.20N	80.07W	8.22
ALTHA	CALHOUN	FL	20	30.53N	85.17W	7.55
AMERICUS	SUMTER	GA	490	32.05N	84.25W	7.42
AUGUSTA WSO AP	RICHMOND	GA	148	33.37N	81.96W	7.30
PARR	FAIRFIELD	SC	258	34.30N	81.33W	7.22
WARRENTON	WARREN	GA	510	33.37N	84.57W	7.19
PELION	LEXINGTON	SC	450	33.72N	81.27W	7.10
LOUISVILLE	JEFFERSON	GA	322	33.02N	82.38W	7.04
LITTLE MOUNTAIN	NEWBERRY	SC	711	34.20N	81.42W	6.83
DUBLIN	LAURENS	GA	230	32.55N	82.92W	6.80
MONROE	UNION	NC	586	34.97N	80.50W	6.74
CRISP CO PWR DAM	WORTH	GA	245	31.85N	83.95W	6.72
DE FUNIAK SPRINGS	WALTON	FL	230	30.73N	86.07W	6.69
EASTMAN 1 W	DODGE	GA	400	32.20N	83.20W	6.69
WINNSBORO	FAIRFIELD	SC	560	34.37N	81.10W	6.65
AUGUSTA	RICHMOND	GA	100	33.37N	81.95W	6.63
COLUMBIA	RICHLAND	SC		34.05N	81.22W	6.61
ALBANY 3 SE	DOUGHERTY	GA	180	31.53N	84.13W	6.55
GIBSON	GLASCOCK	GA	540	33.25N	82.60W	6.54
CHIPLEY 3 E	WASHINGTON	FL	130	30.78N	85.48W	6.51
DE FUNIAK SPRINGS	WALTON	FL	230	30.73N	86.07W	6.50
APALACHICOLA WSO	FRANKLIN	FL	20	29.73N	85.03W	6.49
PLAINS SW GA EXP	SUMTER	GA	500	32.05N	84.37W	6.35
GREAT FALLS	CHESTER	SC	356	34.55N	80.88W	6.35
NEWBERRY	NEWBERRY	SC	476	34.28N	81.63W	6.35
MOULTRIE 2 ESE	COLQUITT	GA	340	31.17N	83.75W	6.30
ALBEMARLE	STANLEY	NC	610	35.36N	80.18W	6.25
WOODRUFF	GADSDEN	FL	107	30.72N	84.87W	6.19
LINCOLNTON	LINCOLN	GA	480	33.80N	82.47W	6.15
COLQUITT 2 W	MILLER	GA	153	31.10N	84.46W	6.15
THOMASVILLE 3NE	THOMAS	GA	260	30.88N	83.93W	6.14
CAMDEN	KERSHAW	SC	140	34.24N	80.66W	6.11
SALUDA	SALUDA	SC	480	33.98N	81.77W	6.05
MARIANNA	JACKSON	FL		30.84N	85.18W	6.01

Many locations along the path of the storm easily received four to six inches of rain from the Florida panhandle, across central Georgia, and throughout the central Carolinas. The highest official amount came from Panama City, Florida, with 14.38 inches (see table 4).

Frances - On September 8 another disturbance formed in the western Gulf of Mexico about 160 miles east of Brownsville, Texas. The depression drifted southward for about a day, and became a tropical storm on September 10. Frances moved north to northwestward, moving inland across the Texas coast just north of Corpus Christi early on September 11 (fig. 12). By that time Frances had strengthened to 55 kts. Frances' center moved in a small loop over southeastern Texas weakening to a depression and then moved northward to the Texas/Oklahoma border north of Dallas where it dissipated on September 13. A remnant low pressure and rainfall area could be tracked northward to Iowa a day later. Frances caused one death and an estimated $500 million in damages.

Georges - The second strongest hurricane of the season, Georges formed in the far eastern Atlantic from a tropical wave early on September 15. It became a tropical storm on the morning of the 16th. By late afternoon on the 17th, satellite imagery indicated that Georges developed an eye and had become a hurricane. Georges moved on a general west to west-northwest course at 15 to 20 mph for the next several days. During this period Georges is estimated to have reached a peak intensity of 135 kts, which places it in the upper limit of a category 4 storm. The minimum central pressure of 937 mb occurred early on the 20th while Georges was located about 420 miles east of Guadeloupe in the Lesser Antilles Islands. The colorized GOES IR image (fig. 13) taken at 0645 UTC, September 20, shows a fully developed hurricane with a distinct eye, the hallmark of a powerful hurricane.

Georges' first of many landfalls occurred at Antigua in the Leeward Islands late on the 20th, where it left two dead and severe destruction throughout the island. Later that night, Georges struck hard in St. Kitts and Nevis, killing three people and damaging an estimated 80% of all homes. The U.S. Virgin Islands were also hit, but fortunately, no fatalities were reported. Damage was not nearly as severe as when Hurricanes Hugo (1989) and Marilyn (1995) struck the islands, due to the strict Federal Emergency Management Agency (FEMA) codes for rebuilding.

On the evening of the 21st, Georges broad-sided Puerto Rico along the south coast with estimated maximum winds of 100 kts. Damages there are estimated to exceed $2 billion with three direct deaths. Power and water supplies were cut-off to about 80% of the 3.8 million people on the island. FEMA estimates 33,113 homes were destroyed in Puerto Rico, with nearly 50,000 more incurring damages. The storm destroyed over 75% of the coffee and plantain crops, and 65% of the poultry industry was wiped out. Georges weakened very little while over Puerto Rico, and while it approached the Dominican Republic the eye was much more apparent, indicating strengthening was occurring at the heart of the storm. In figure 14, an early morning GOES visible taken on September 22, confirms that Georges was still a powerfull hurricane.

By that afternoon, Georges had moved well into Hispaniola Island from the south coast with estimated maximum winds of 105 kts. The country of Dominican Republic suffered the greatest number of casualties where over 210 people perished. About 100,000 people were left homeless and much of the country’s infrastructure was left in shambles. An estimated $1 billion in damges occurred. Haiti, the neighboring country, fared no better with 94 deaths and much in ruin. As expected, Georges weakened after crossing the mountainous terrain of Hispaniola Island, but its circulation was still well intact. By the afternoon of the following day, Georges made landfall in extreme eastern Cuba with estimated maximum winds of 65 kts. Cuba was spared the full brunt of the storm as it moved along the northern coast of Cuba during the 24th, but nevertheless, at least five people were killed and over 40,000 homes were destroyed or damaged. Georges headed to the Florida straits early on the 25th and re-intensified somewhat as it approached the Florida Keys. Its center passed just west of Key West, Florida, around noontime with estimated maximum winds of 90 kts. The GOES colorized IR image taken at 1632 UTC (fig. 15) shows a somewhat disorganized eye located between Key West and the Dry Tortugas. The Key West doppler radar base reflectivity image (fig. 16), taken about the same time as the GOES image, confirms this position and shows most of the heaviest rainbands occurring primarily east of the center. More than 1400 homes suffered some damage and more than 150 homes were completely destroyed, including 75 houseboats on so-called "Houseboat Row." All Key West residents were without power. Fortunately, no direct fatalities were reported.

Hurricane Georges continued its northwestward motion for the next 48 hours, then turned a few degrees northward while slowing down as it approached the central Gulf of Mexico coastline. Georges made landfall along the Mississippi coast near Biloxi between 300 and 500 AM CST, September 28. Both the NEXRAD base reflectivity product (fig. 17) and GOES-8 colorized IR image (fig. 18), taken 45 minutes apart, show a distinct center with the northern part of the eye wall crossing over the mainland. Georges maximum sustained winds were estimated at 90 kts just before landfall. Some of the winds recorded across southwest Alabama and northwest Florida were as follows: Mobile Regional Airport, sustained winds of 44 knots, gusts to 55 knots; Pensacola Regional Airport, sustained winds of 44 knots, gusts to 58 knots; Pensacola Naval Air Station, sustained winds of 40 knots, gusts to 61 knots; Hurlburt Air Force Base in Mary Esther, sustained winds of 44 knots with gusts to 69 knots; Eglin Air Force Base in Valparaiso had sustained winds of 42 knots with gusts to 79 knots; and Dauphin Island C-Man Buoy reported gusts to 71 knots. The lowest recorded sea level pressure was 989.9 millibars at Mobile Regional Airport.

Within ten hours after landfall, the eye of the storm disappeared as indicated by radar (fig. 19). It meandered over land and weakened to a tropical storm later that day. Georges was downgraded to a tropical depression by mid-morning on September 29 while located about 35 miles north-northeast of Mobile, Alabama. The remnant weak circulation center moved off the Georgia/South Carolina coast on October 1, becoming involved with a frontal zone and dissipating. Georges dumped upwards of 30 inches of rain in portions of the Florida panhandle. Figure 20 shows estimated rainfall totals for the duration of the event beginning September 26, 18:34 UTC through September 30, 8:20 UTC by the Mobile, Alabama NEXRAD station. The heaviest rainfall occurred east of the center within three distinct bands. It appears that the NEXRAD-derived precipitation amounts drop off somewhat from the center as compared to surface reports, probably due to the radio signal attenuating to a degree as it passed through

Table 5 - Georges Precipitation Totals (>10.00") from Selected Reporting Stations

STATION	COUNTY	ST	ELEV(ft)	LAT	LON	RAIN(")
ANDALUSIA 3 W	COVINGTON	AL	250	31.30N	86.53W	24.07
BAY MINETTE 3 NNW	BALDWIN	AL	278	30.93N	87.80W	23.70
ROBERTSDALE 5 NE	BALDWIN	AL	175	30.63N	87.65W	23.44
CRESTVIEW	OKALOOSA	FL	190	30.78N	86.52W	20.11
CHATOM	WASHINGTON	AL	285	31.47N	88.25W	20.10
NICEVILLE	OKALOOSA	FL	60	30.52N	86.50W	19.53
GREENVILLE	BUTLER	AL	470	31.85N	86.65W	19.30
VALKARAISO	OKALOOSA	FL		30.50N	86.50W	19.19
GEORGIANNA	BUTLER	AL	300	31.67N	86.73W	19.15
BREWTON 3 ENE	ESCAMBIA	AL	160	31.13N	87.05W	18.44
BREWTON 3 SSE	ESCAMBIA	AL	85	31.05N	87.05W	18.10
MARY ESTHER	OKALOOSA	FL		30.42N	86.68W	18.01
WALLACE 2 E	ESCAMBIA	AL	205	31.22N	87.18W	17.88
DE FUNIAK SPRGS	WALTON	FL	230	30.73N	86.07W	17.55
MILTON EXP STN	SANTA ROSA	FL	217	30.78N	87.13W	17.08
PASCAGOULA 3 NE	JACKSON	MS	11	30.40N	88.48W	16.76
FAIRHOPE 2 NE	BALDWIN	AL	23	30.55N	87.88W	15.82
PENSACOLA REG AP	ESCAMBIA	FL	112	30.48N	87.18W	15.78
OCEAN SPRINGS	JACKSON	MS	10	30.23N	88.67W	15.67
ATMORE ST NURSERY	ESCAMBIA	AL	300	31.16N	87.43W	15.15
WHATLEY	CLARKE	AL	170	31.65N	87.72W	15.15
MOBILE WSO AP	MOBILE	AL	204	30.68N	88.24W	15.02
VANCLEAVE	JACKSON	MS	27	30.48N	88.67W	15.01
GENEVA	GENEVA	AL	145	31.05N	85.88W	14.46
KINSTON	COFFEE	AL	270	31.23N	86.18W	14.27
GULFPORT BRNTWD	HARRISON	MS	19	30.42N	89.03W	13.59
PENSACOLA	ESCAMBIA	FL	30	30.33N	87.30W	13.51
EVERGREEN	CONECUH	AL	290	31.45N	86.95W	13.47
PINE APPLE	WILCOX	AL	250	31.87N	86.98W	13.34
JACKSON	CLARKE	AL	220	31.53N	87.93W	12.96
ELBA	COFFEE	AL	195	31.42N	86.07W	12.51
D'IBERVILLE	HARRISON	MS		30.48N	88.90W	12.23
BILOXI	HARRISON	MS	26	30.40N	88.92W	12.11
EVERGREEN	CONECUH	AL	290	31.45N	86.93W	12.02
CODEN	MOBILE	AL	12	30.38N	88.23W	11.82
BILOXI WLOX-TV	HARRISON	MS	10	30.38N	88.98W	11.82
COFFEEVILLE L&D	CHOCTAW	AL	46	31.77N	88.13W	11.78
BEATRICE	MONROE	AL	178	31.73N	87.20W	11.77
THOMASVILLE	CLARKE	AL	405	31.92N	87.73W	11.71
GENEVA	GENEVA	AL	106	31.03N	85.83W	11.57
CLAIBORNE	MONROE	AL	50	31.62N	87.55W	11.48
JONES BLUFF L&D	LOWNDES	AL	146	32.32N	86.78W	10.95
CAMDEN 3 W	WILCOX	AL	235	32.03N	87.32W	10.77
LEAKESVILLE	GREENE	MS	51	31.15N	88.56W	10.65

PUERTO RICO SITES:

STATION	COUNTY	ST	ELEV(ft)	LAT	LON	RAIN(”)
COMERIO	COMP4	PR	604	18.22N	66.22W	25.68
JAYUYA*	JAYP4	PR	1560	18.22N	66.57W	18.13
CIDRA	CIEP4	PR	1279	18.35N	66.13W	17.19
OROCOVIS	RORP4	PR	500	18.22N	66.40W	16.76
CAGUAA*	CAIP4	PR	1475	18.13N	66.05W	15.74
OROCOVIS	BAUP4	PR	773	18.23N	66.45W	14.38
SAN LORENZO*	SLJP4	PR	330	18.17N	65.98W	14.27
PONCE	PCYP4	PR	253	18.07N	66.58W	14.25
NAGUABO*	NGIP4	PR	2020	18.28N	65.78W	13.78
SAN LORENZO	SLKP4	PR	490	18.15N	65.95W	13.54
JUNCOS	GUSP4	PR	1115	18.25N	65.83W	13.18
AIBONITO	AIBP4	PR	850	18.15N	66.22W	12.32
GURABO	GURP4	PR	137	18.25N	65.97W	12.01
RIO GRANDE	VEDP4	PR	40	18.36N	65.81W	11.83
CAGUAS	CAJP4	PR	426	18.25N	66.10W	11.04
CAGUAS	BZAP4	PR	623	18.28N	66.08W	11.03
TRUJILLO ALTO	TRUP4	PR	49	18.35N	66.00W	10.92
VILLALBA	TOVP4	PR	525	18.13N	66.47W	10.92
COAMO	ZLBP4	PR		18.12N	66.24W	10.90
NAGUABO	NGHP4	PR	640	18.28N	65.79W	10.53
LARES	LARP4	PR	951	18.30N	66.87W	10.27

* data incomplete

heavier rain bands closer to the radar site. However, the overall pattern appears to match the ground reports.

Severe flooding, high winds, and isolated tornadoes caused extensive damage across parts of southern Alabama, Mississippi, and the Florida panhandle. Most of the destruction along the coastal areas was caused by a very high storm surge. Surges along the coast were estimated at 7 to 12 feet in Mobile and Baldwin counties and 5 to 10 feet in Escambia, Santa Rosa and Okaloosa counties in northwest Florida. Downtown Mobile had a surge of around 8.5 feet, with high "water" covering Water Street. Bayou La Batre had a surge of 8.8 feet and many businesses and homes had water in them. The surge on the west end of Dauphin Island caused the most damage where 80 homes were damaged with approximately forty completely destroyed. Many water front homes on the west end of the island were pushed across the island and ended up either against other homes or scattered across the sand. Major beach erosion occurred along the coast from Dauphin Island to Destin. Nearly 900,000 residents were without power at some point during the storm. One death was reported. During its 17 day span as a tropical storm, Georges caused a total of 602 deaths and total U.S. damages estimated at $5.9 billion (including Puerto Rico) with an additional $4 billion damages throughout the Caribbean.

Hermine - A broad area of low pressure located over the northwest Caribbean drifted into the Gulf of Mexico. From its remains, Hermine became a tropical depression on September 17. After moving on a looping track for a couple of days, the system strengthened into a tropical storm about 180 miles south-southwest of New Orleans on September 19. After reaching a peak intensity of 40 kts, Hermine moved northward and crossed the coast of Louisiana near Cocodrie.

Figure 21 shows an early morning visible satellite image of a very disorganized Hermine over southeastern Lousianna. No casualties or significant damages were reported.

Ivan - The fifth hurricane of the season, Ivan formed from a tropical wave located about 200 miles to the southwest of the Cape Verde Islands. It remained over the eastern Atlantic moving toward the northwest and north for several days. The cyclone became a tropical storm on September 20 when it was about 500 miles west of the Cape Verde Islands. Three days later Ivan became a hurricane about 900 miles southwest of the Azores. After turning toward the northeast Ivan strengthened to a peak intensity of 80 kts 300 miles west of the Azores early on the 26th. Ivan was one of four Atlantic hurricanes captured by this visible GOES satellite image (fig. 22) at that time. Ivan turned toward the east and weakened while passing over cooler waters to the north of the Azores. It became extratropical early on the 27th.

Jeanne - An unusually strong disturbance moved off the African continent on September 20 and quickly became a tropical storm early on September 21, while close to the west coast of Africa. Jeanne wasted no time becoming a hurricane the following day. It brushed the Cape Verde Islands while moving west-northwestward for a couple of days, reaching a peak intensity of 90 kts on the 24th (fig. 23) about 650 miles west of those islands. The hurricane turned toward the north over the east-central Atlantic late on the 26th, then toward the northeast and east-northeast. Jeanne weakened to a tropical storm on September 29. It dropped below tropical storm strength near the Azores and lost its tropical characteristics late on the 30th.

Karl - The sixth tropical storm to form within an already busy September month, Karl developed from a small non-tropical low pressure area that was tracked from the coast of the Carolinas. It became a tropical depression on September 23 about 60 miles west-northwest of Bermuda. Karl moved eastward and became a tropical storm later that day about 240 miles east-northeast of Bermuda. It moved toward the northeast and strengthened to a maximum intensity of 90 kts late on September 26, when a well-defined eye was observed (see figures 2 and 22). At that time it was centered about one thousand miles east northeast of Bermuda. Accelerating toward the northeast, Karl weakened to a tropical storm late on the 27th over cooler waters about 200 miles west northwest of the Azores. It became extratropical while moving north of the Azores on September 28.

Lisa - An uneventful hurricane, Lisa moved mostly northward over the eastern north Atlantic Ocean. It formed about midway between the Cape Verde Islands and the Lesser Antilles and quickly strengthened into a tropical storm. Lisa briefly became a 65 knot hurricane on October 9 (fig. 24) when located about 425 miles west-northwest of the westernmost Azores and then rapidly lost its tropical characteristics.

Mitch - Hurricane Mitch, the strongest October hurricane ever recorded, formed in the southwest Caribbean Sea from a tropical wave about 360 miles south of Kingston, Jamaica, late on October 21. The system initially moved slowly westward and intensified to a tropical storm. Mitch then moved slowly northward, then north-northwestward on the 23rd and 24th while gradually gaining strength. Early on October 24, Mitch became a hurricane. Later that day, as it turned toward the west, Mitch began to intensify rapidly over the very warm waters of the western Caribbean Sea.

In about 24 hours its central pressure dropped 52 mb to 924 mb by the afternoon of October 25. Figure 25 shows a well developed hurricane structure with its circulation dominating much of the western Caribbean basin. Further strengthening took place as the central pressure plummeted to 905 mb when Mitch was about 40 miles southeast of Swan Island on the afternoon of October 26. The GOES colorized IR image (fig. 26) was taken at the time when Mitch reached maximum strength. The eye is perfectly formed and appears cloud-free. Mitch's barometric pressure reading is the lowest ever recorded in the month of October in the Atlantic basin (including the Caribbean Sea and Gulf of Mexico), and is the fourth lowest ever recorded for an Atlantic hurricane this century, tying with the historic Hurricane Camille in 1969. At its peak intensity, the maximum sustained winds were estimated to be 155 knots, making it a top category 5 hurricane.

After passing over Swan Island, Mitch began to gradually weaken on October 27 while moving slowly west then southwest toward the Bay Islands off the coast of Honduras. The center passed very near the island of Guanaja, wreaking havoc there. From mid-day on the 27th to early on the 29th, the minimum central pressure rose 59 millibars. The center of the hurricane meandered near the north coast of Honduras from late on the 27th through the 28th before making landfall during the morning of the 29th about 70 miles east of La Ceiba with 85 knot winds. The GOES visible satellite image (fig. 27) taken later that day shows a weakening but still dangerous storm. Its eye is no longer visible. Mitch moved southward over Honduras and weakened to a tropical storm early on the 30th, and became a depression on the 31st. The cyclone generated torrential rains over portions of Honduras and Nicaragua where severe flooding caused deadly mudslides and major damages to the countries' infrastructures. Heavy rains also occurred in neighboring countries.

Although Mitch originally dissipated near the Guatemala/Mexico border Sunday afternoon, November 1, the remnants continued to produce locally heavy rainfall over portions of Central America and eastern Mexico for the next couple of days. On November 3, a low-level circulation became evident in the eastern Bay of Campeche, and an Air Force reserve reconnaissance aircraft investigating the system reported tropical storm-force winds and a 997 mb central pressure. Thus, Mitch had regenerated into a tropical storm on the afternoon of the 3rd while located about 55 miles west-southwest of Campeche, Mexico. Mitch weakened to a depression early on the 4th as it moved inland over the northwest Yucatan Peninsula. The center re-emerged over the south central Gulf of Mexico by mid-morning on the 4th, regaining tropical storm strength, and began to accelerate to the northeast due to a frontal zone moving through the eastern Gulf of Mexico. Mitch made landfall on the morning of the 5th in southwest Florida near Naples with maximum sustained winds near 50 mph. By mid-afternoon of the 5th, Mitch moved offshore of south Florida and became extratropical. The total death toll estimates from Mitch range from 9,000 to 11,000, and damage estimates are as high as $20 billion, much of that in Central America.

Nicole - formed from a non-tropical low pressure system about 700 miles west of the Canary Islands and moved west-southwest for a few days. Nicole strengthened somewhat before encountering strong upper-level winds, which weakened it into a low pressure area on November 26. However, Nicole was tenacious and regenerated into a tropical storm the next day. It turned northward and northeastward, strengthening into a hurricane late on November 29 while located about 770 miles southwest of the westernmost Azores. Nicole strengthened to a peak intensity of 75 kts and passed a few hundred miles west of the Azores early in December as shown in fig. 28.

List of Figures

Fig.1 Color vs. Temperature (C) Scale for GOES Infrared Imagery

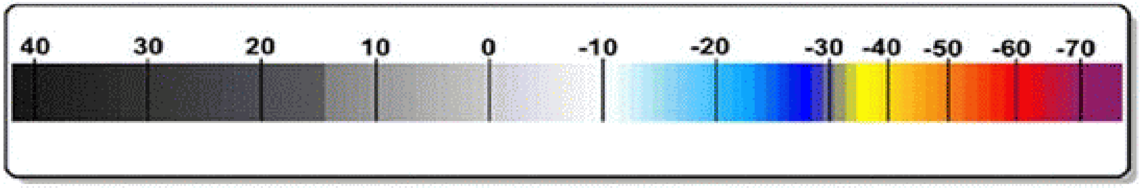


Fig.2 Four Atlantic Hurricanes - Georges, Ivan, Jeanne & Karl

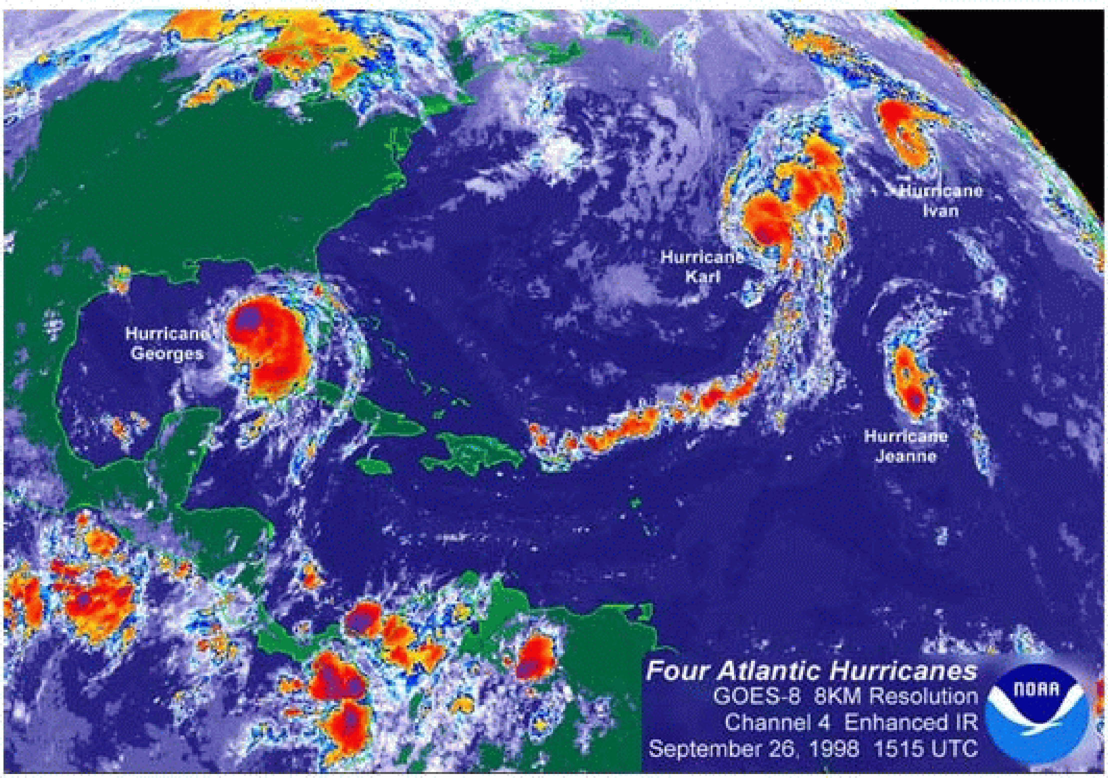


Fig.3

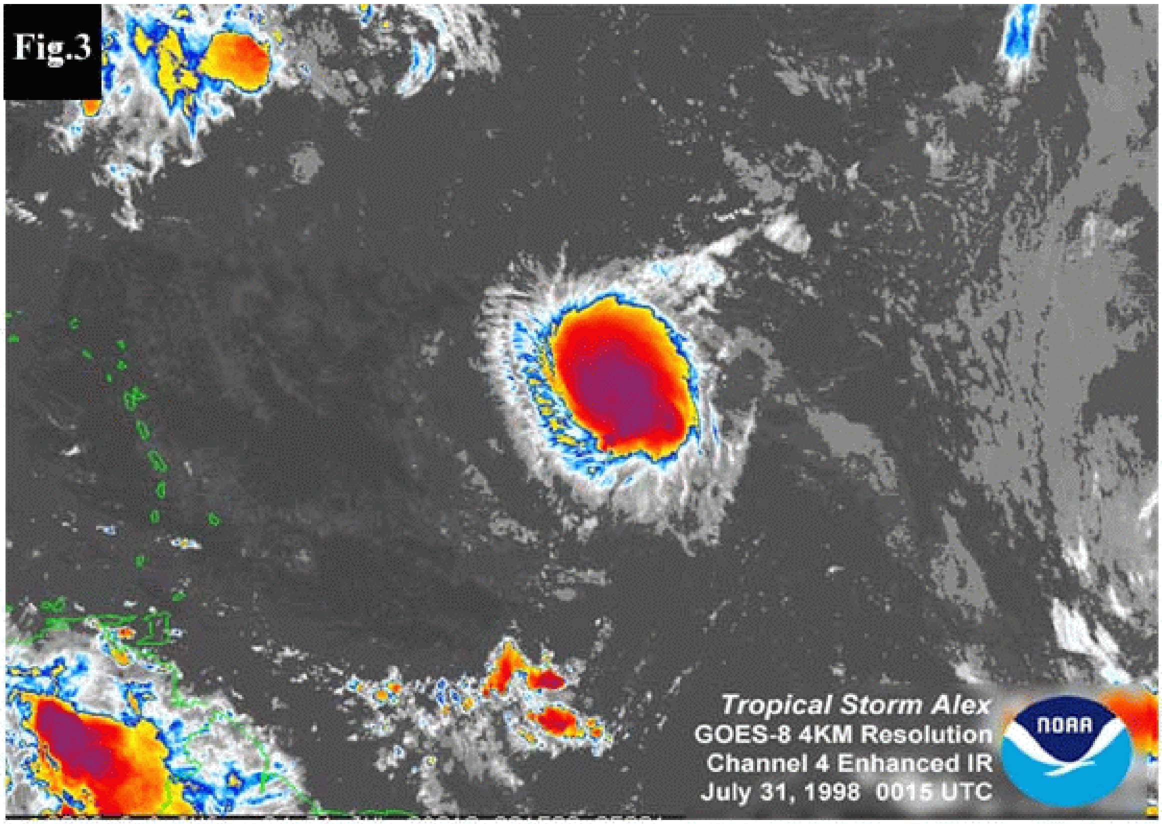

Tropical Storm Alex
GOES-8 4KM Resolution
Channel 4 Enhanced IR
July 31, 1998 0015 UTC

Fig.4

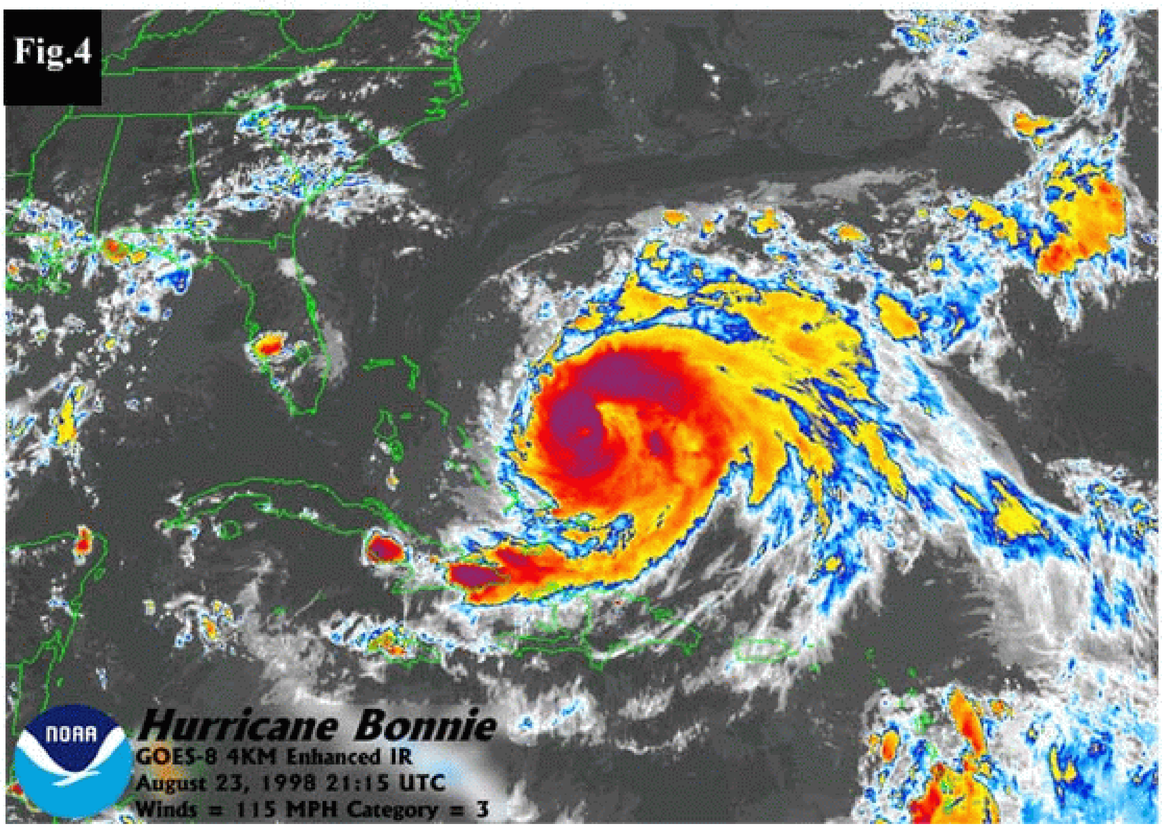
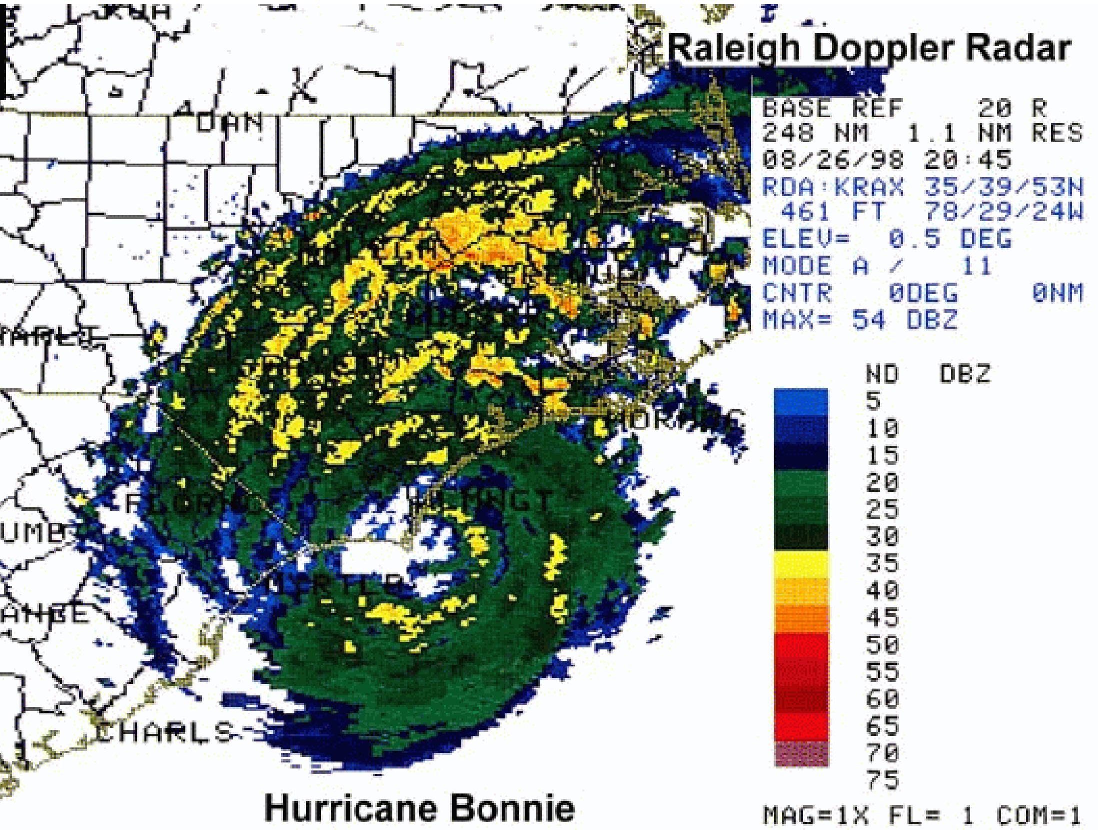

Hurricane Bonnie
GOES-8 4KM Enhanced IR
August 23, 1998 21:15 UTC
Winds = 115 MPH Category = 3

Fig.5


Raleigh Doppler Radar
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248 NM 1.1 NM RES
08/26/98 20:45
RDA:KRAX 35/39/53N
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ELEV= 0.5 DEG
MODE A / 11
CNTR 0DEG 0NM
MAX= 54 DBZ
ND DBZ
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
DAN
CHARLT
COLUMB
ORANGE
CHARLS
Hurricane Bonnie
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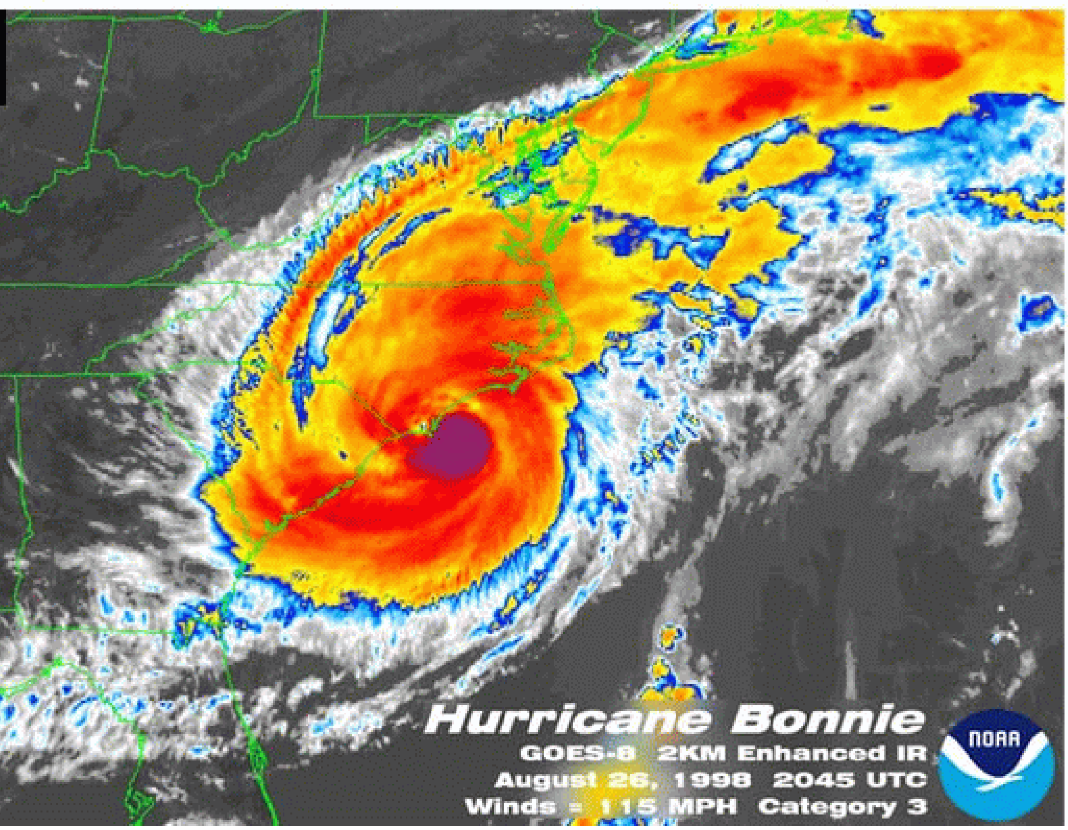
Fig.6


Hurricane Bonnie
GOES-8 2KM Enhanced IR
August 26, 1998 2045 UTC
Winds = 115 MPH Category 3
NOAA

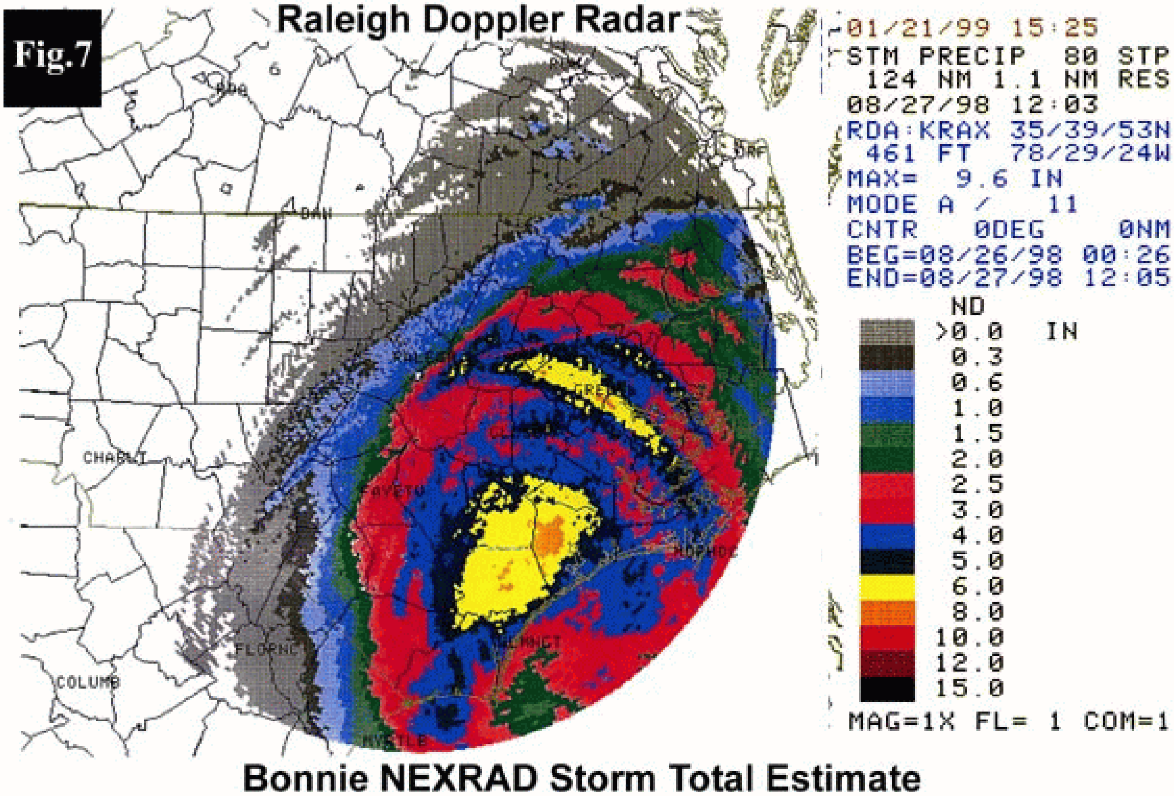


Fig.7
Raleigh Doppler Radar
01/21/99 15:25
STM PRECIP 80 STP
124 NM 1.1 NM RES
08/27/98 12:03
RDA:KRAX 35/39/53N
461 FT 78/29/24W
MAX= 9.6 IN
MODE A / 11
CNTR 0DEG 0NM
BEG=08/26/98 00:26
END=08/27/98 12:05
ND
>0.0 IN
0.3
0.6
1.0
1.5
2.0
2.5
3.0
4.0
5.0
6.0
8.0
10.0
12.0
15.0
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Bonnie NEXRAD Storm Total Estimate

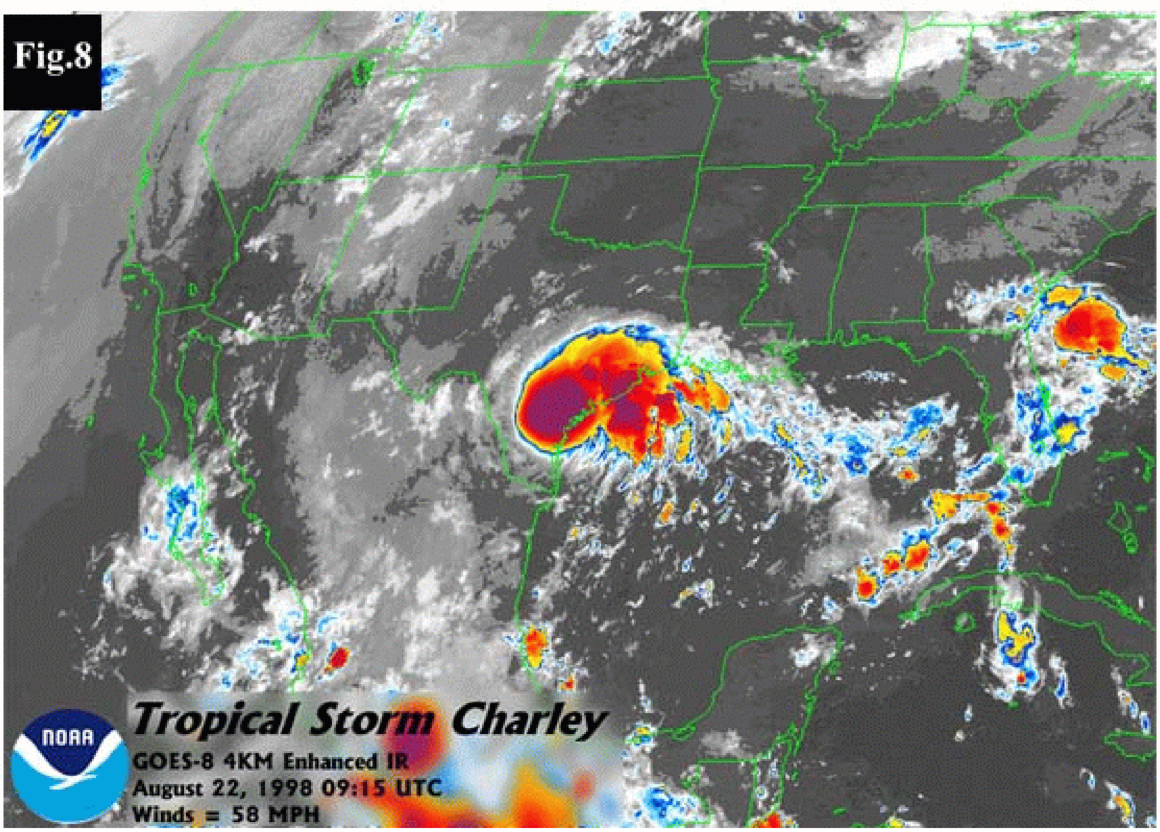

Fig.8
Tropical Storm Charley
GOES-8 4KM Enhanced IR
August 22, 1998 09:15 UTC
Winds = 58 MPH

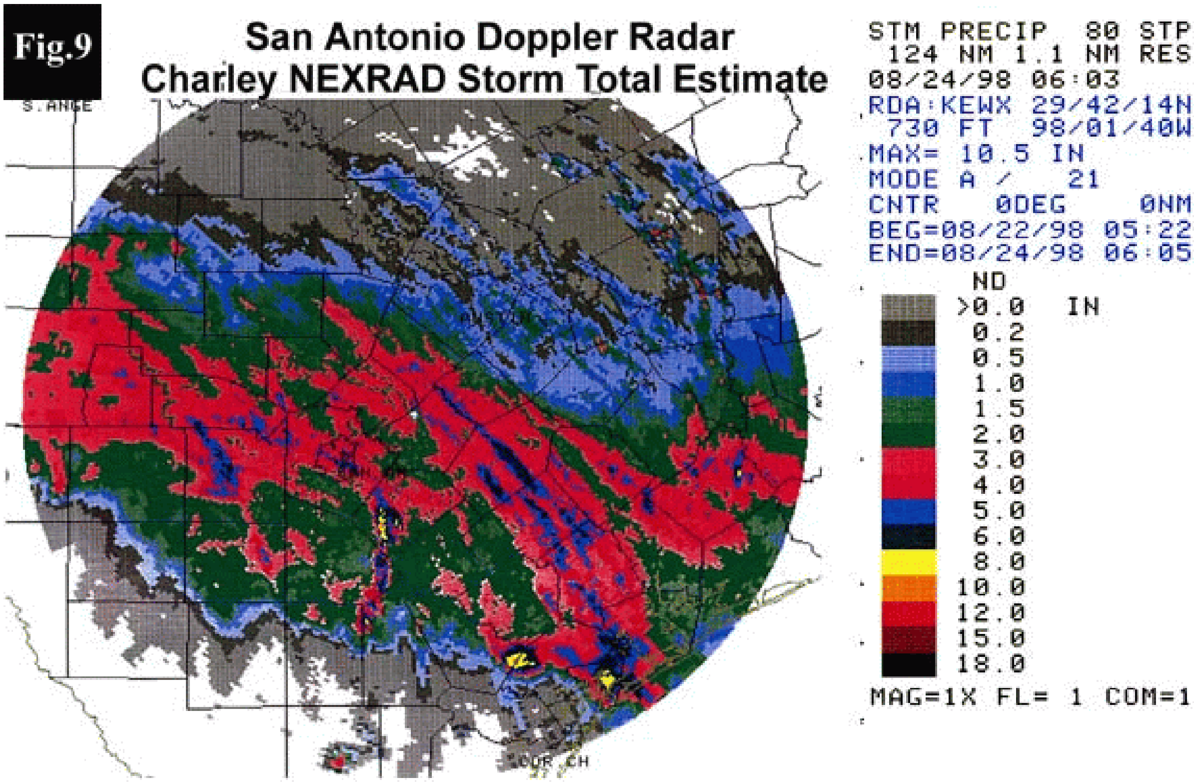
Fig.9
San Antonio Doppler Radar
Charley NEXRAD Storm Total Estimate
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730 FT 98/01/40W
MAX= 10.5 IN
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CNTR 0DEG 0NM
BEG=08/22/98 05:22
END=08/24/98 06:05
ND
>0.0 IN
0.2
0.5
1.0
1.5
2.0
3.0
4.0
5.0
6.0
8.0
10.0
12.0
15.0
18.0
MAG=1X FL= 1 COM=1

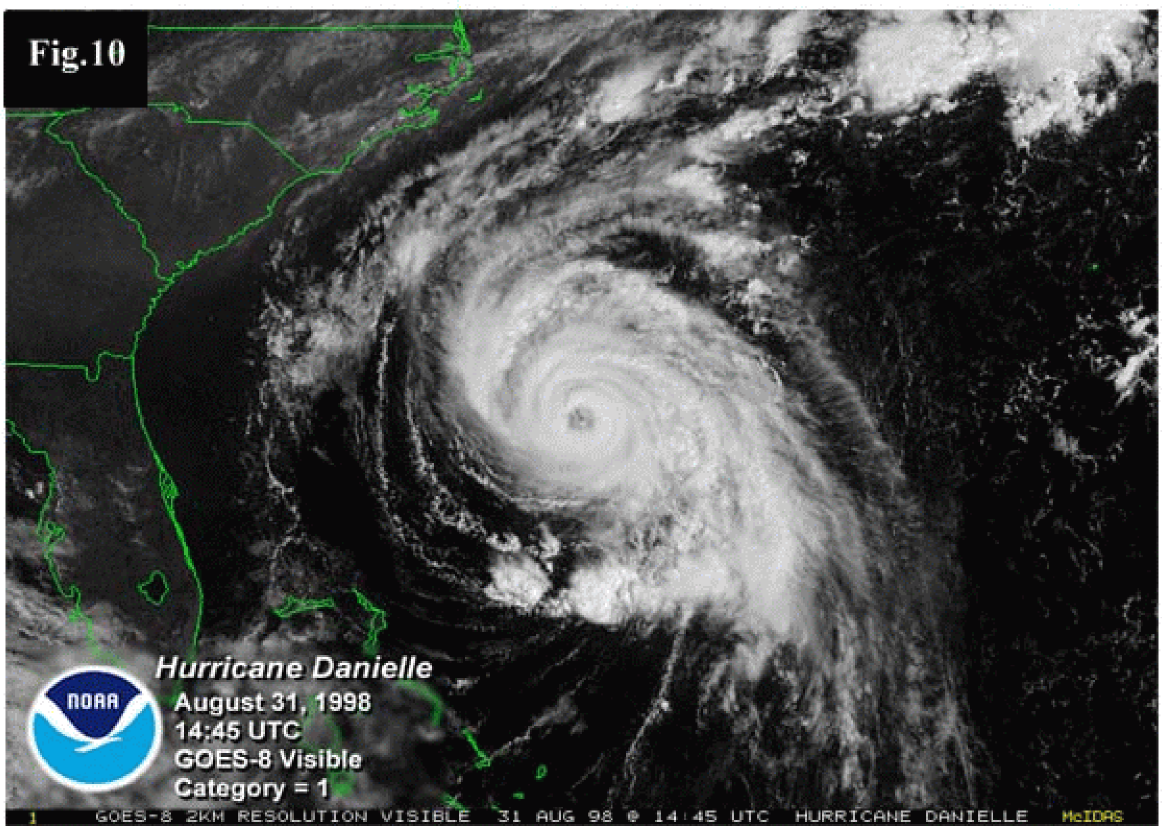


Fig.10
Hurricane Danielle
August 31, 1998
14:45 UTC
GOES-8 Visible
Category = 1
NOAA
GOES-8 2KM RESOLUTION VISIBLE 31 AUG 98 @ 14:45 UTC HURRICANE DANIELLE McIDAS

Fig.11

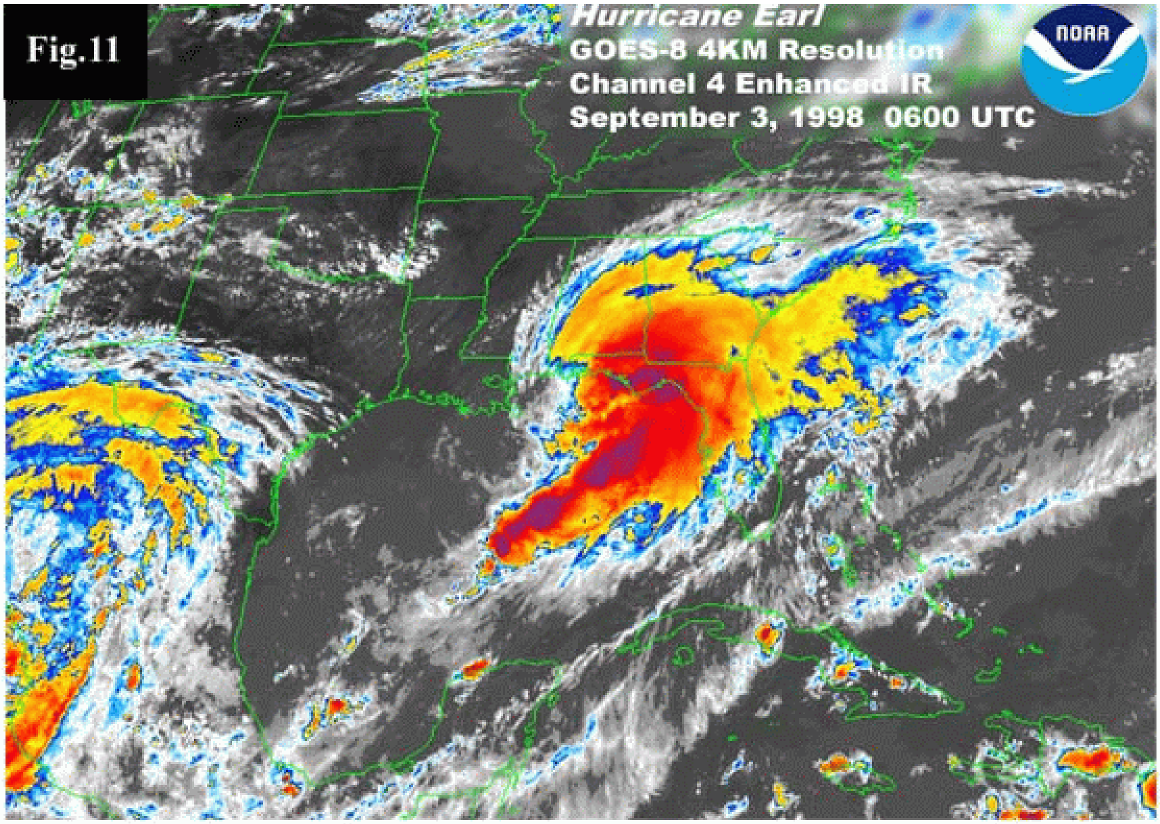

Hurricane Earl
GOES-8 4KM Resolution
Channel 4 Enhanced IR
September 3, 1998 0600 UTC
NOAA

Fig.12

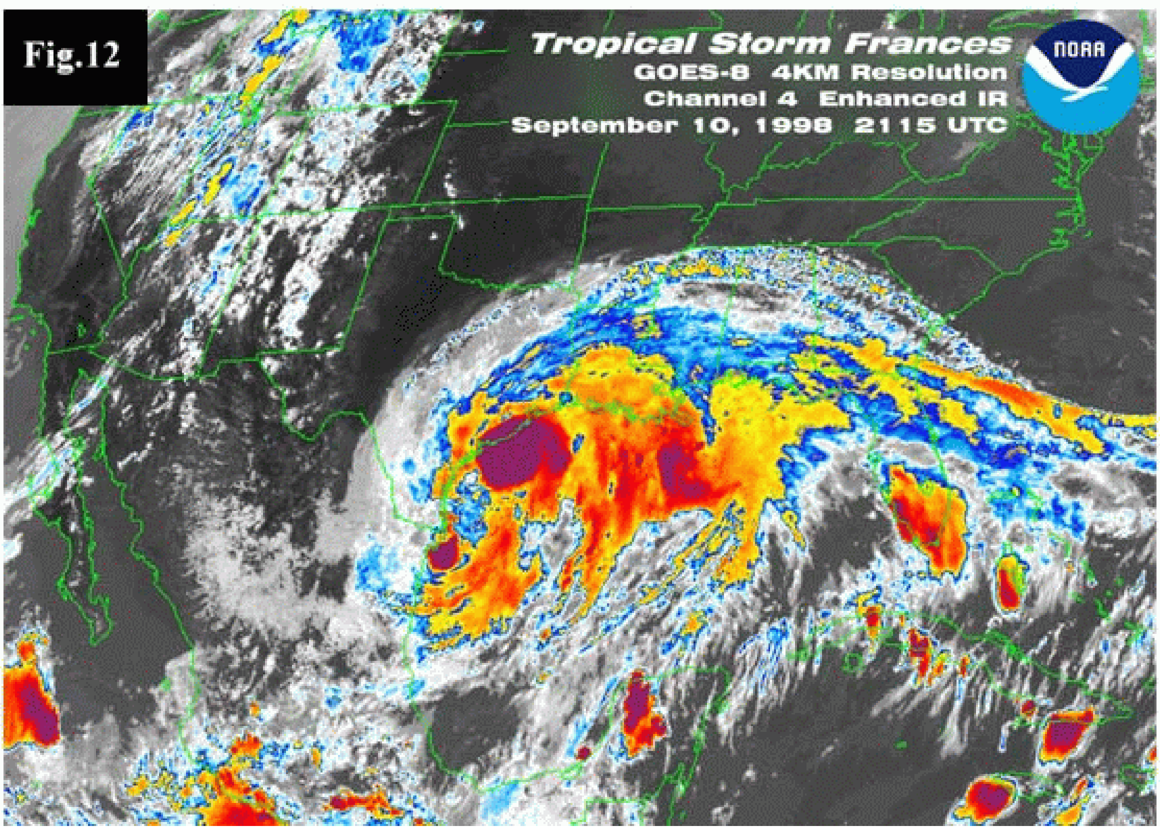

Tropical Storm Frances
GOES-8 4KM Resolution
Channel 4 Enhanced IR
September 10, 1998 2115 UTC
NOAA

Fig.13

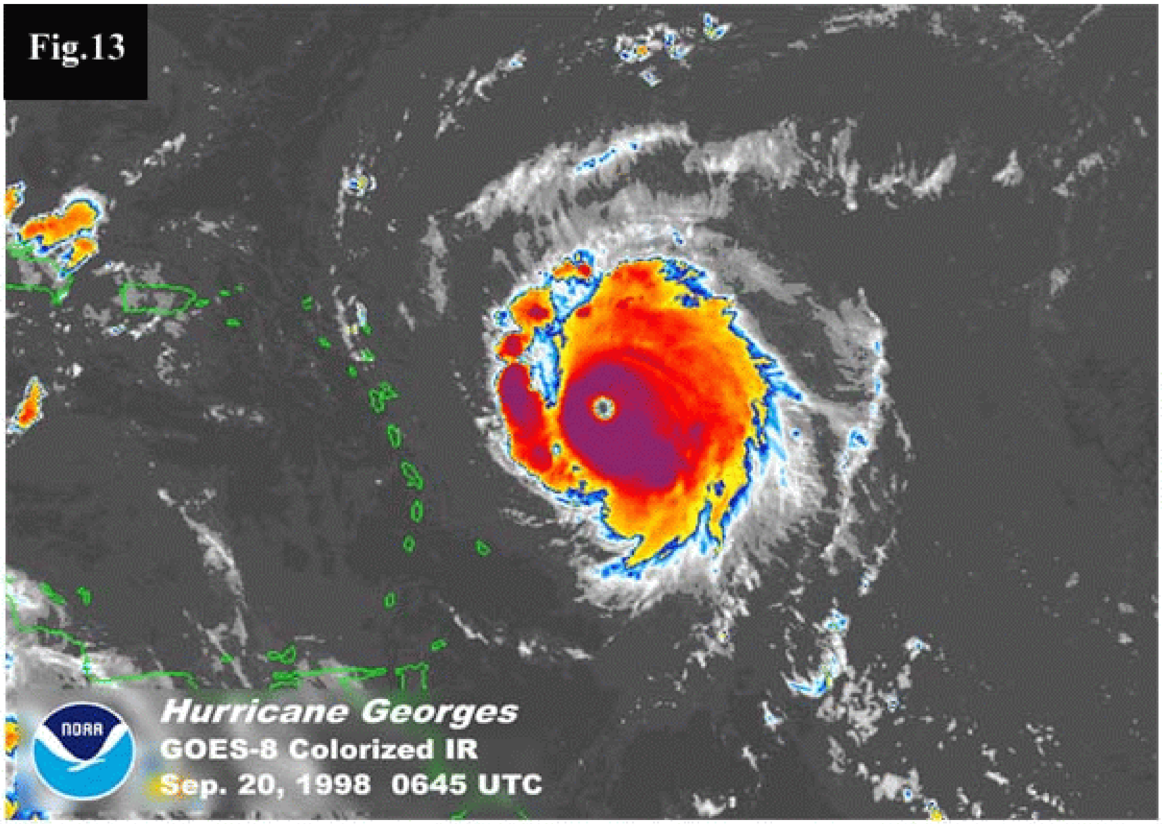
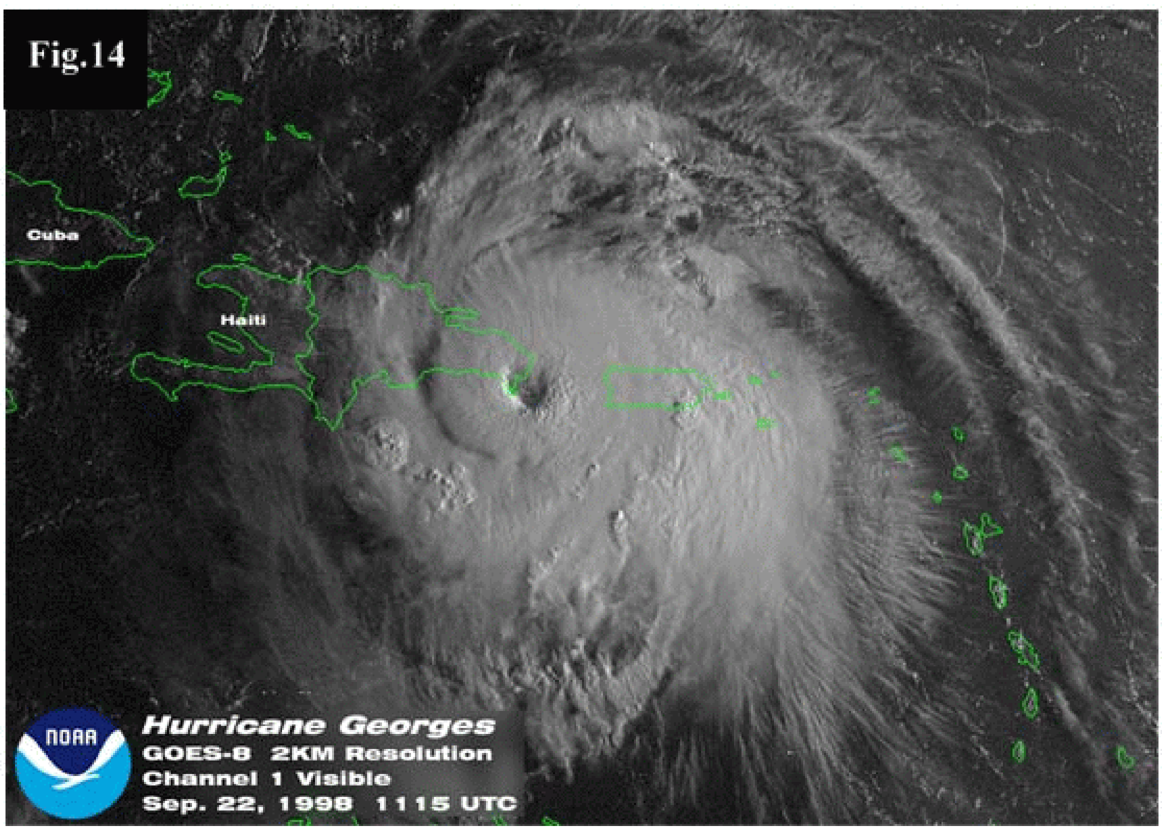

Hurricane Georges
GOES-8 Colorized IR
Sep. 20, 1998 0645 UTC

Fig.14


Cuba
Haiti
Hurricane Georges
GOES-8 2KM Resolution
Channel 1 Visible
Sep. 22, 1998 1115 UTC

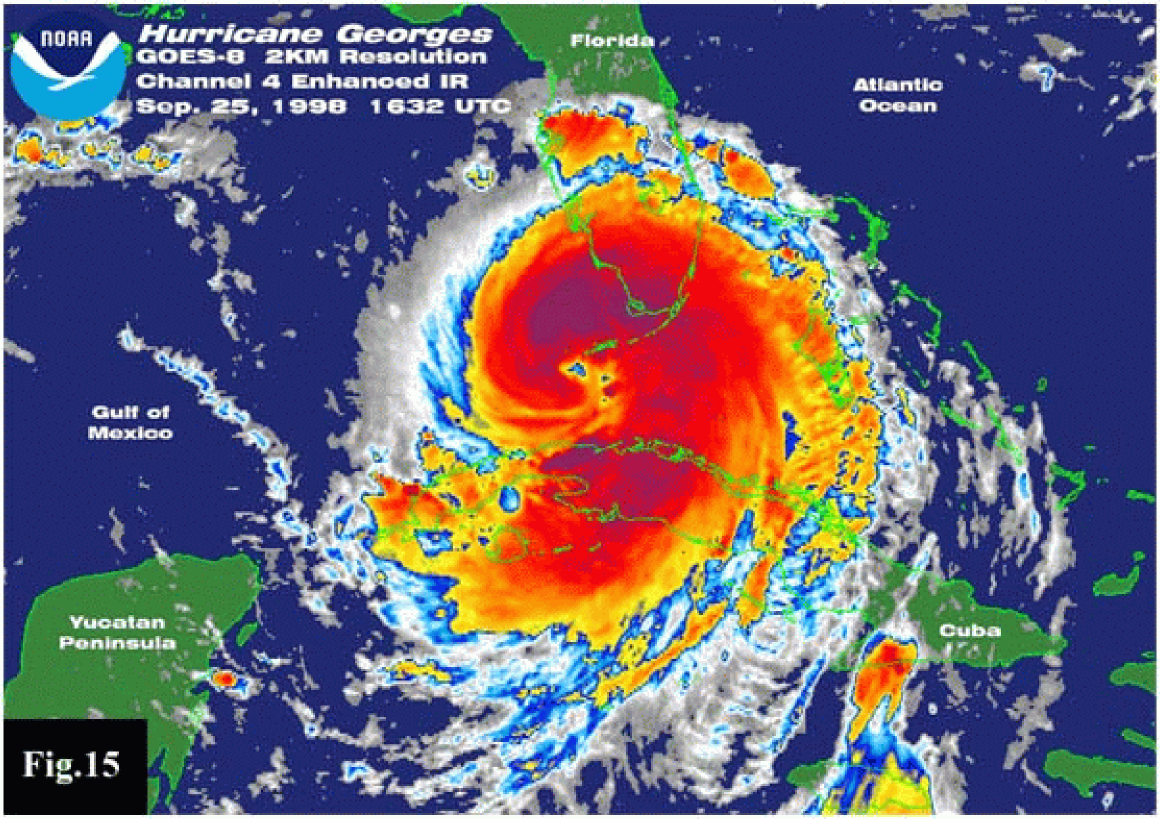
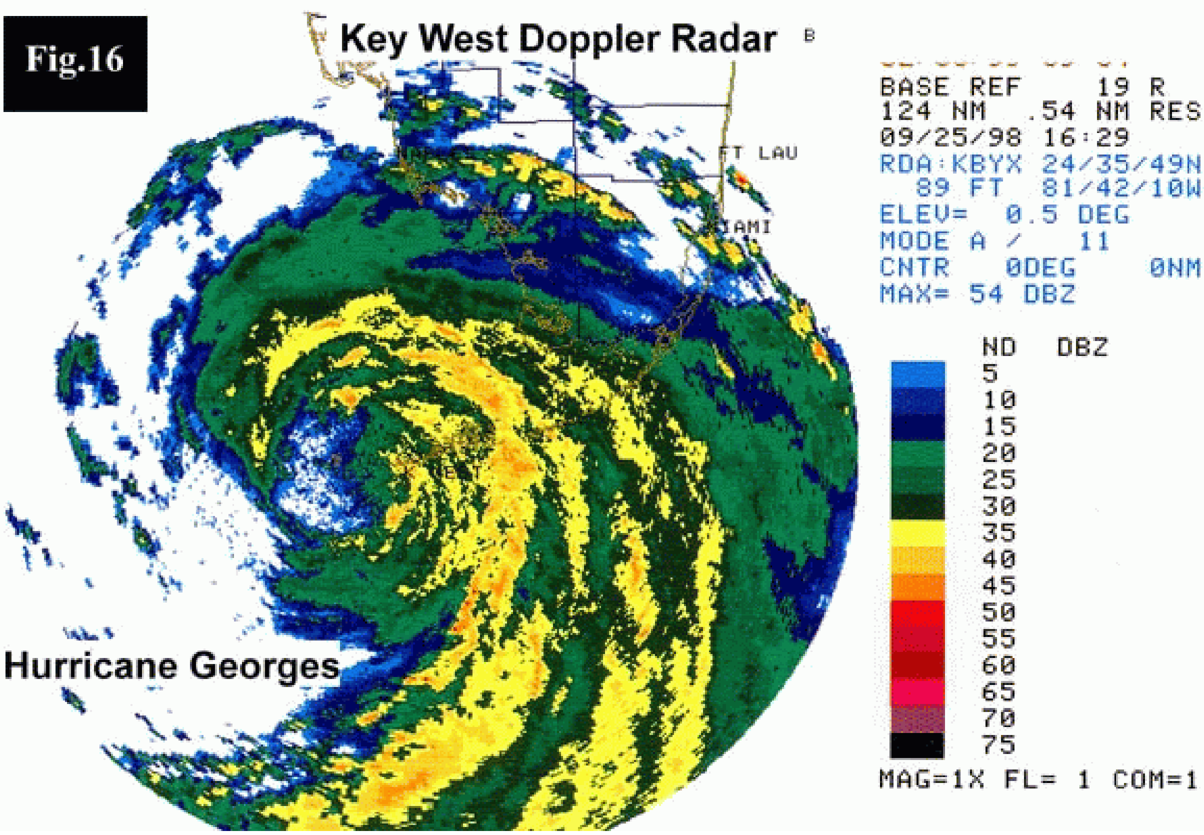

Hurricane Georges
GOES-8 2KM Resolution
Channel 4 Enhanced IR
Sep. 25, 1998 1632 UTC
NOAA
Florida
Atlantic Ocean
Gulf of Mexico
Yucatan Peninsula
Cuba

Fig.15


Key West Doppler Radar
Hurricane Georges
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09/25/98 16:29
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89 FT 81/42/10W
ELEV= 0.5 DEG
MODE A / 11
CNTR 0DEG 0NM
MAX= 54 DBZ
ND DBZ
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
MAG=1X FL= 1 COM=1

Fig.16

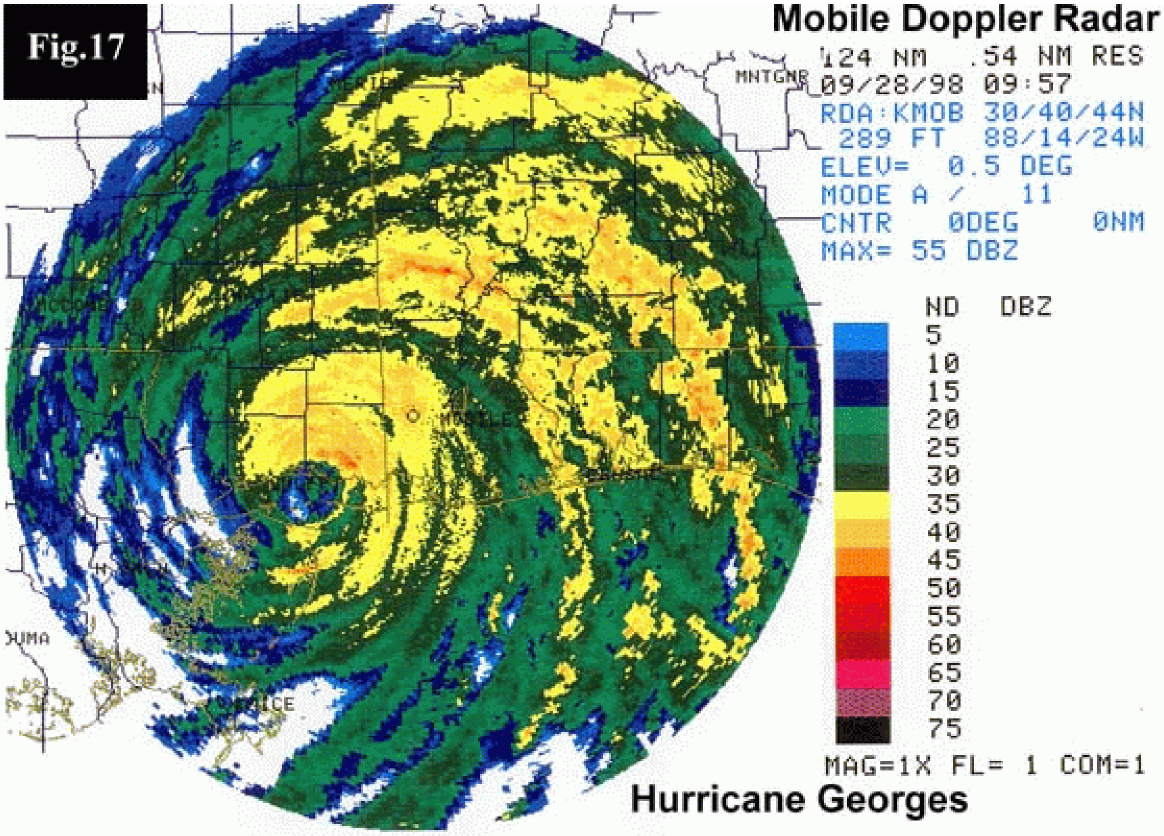
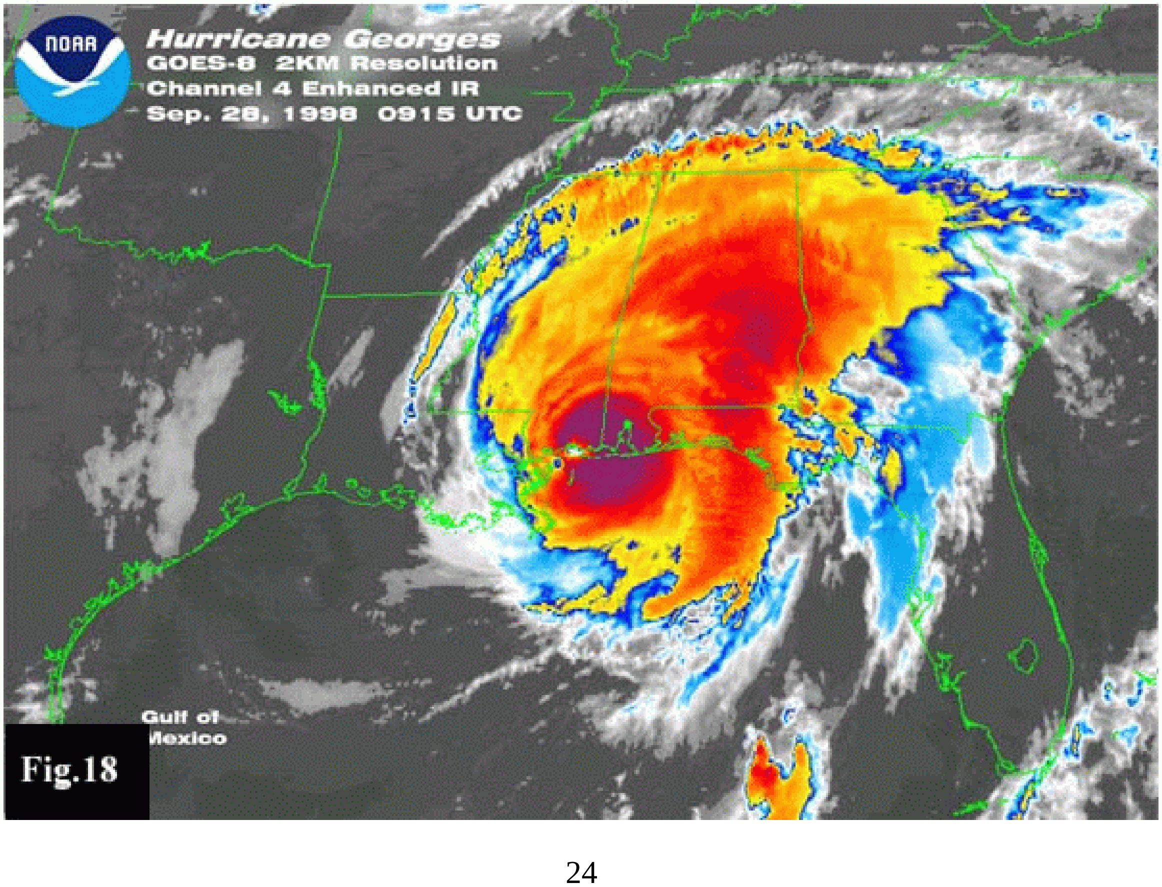


Fig.17
Mobile Doppler Radar
124 NM .54 NM RES
09/28/98 09:57
RDA:KMOB 30/40/44N
289 FT 88/14/24W
ELEV= 0.5 DEG
MODE A / 11
CNTR 0DEG 0NM
MAX= 55 DBZ
ND DBZ
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
MAG=1X FL= 1 COM=1
Hurricane Georges


NOAA
Hurricane Georges
GOES-8 2KM Resolution
Channel 4 Enhanced IR
Sep. 28, 1998 0915 UTC
Gulf of
Mexico
Fig.18

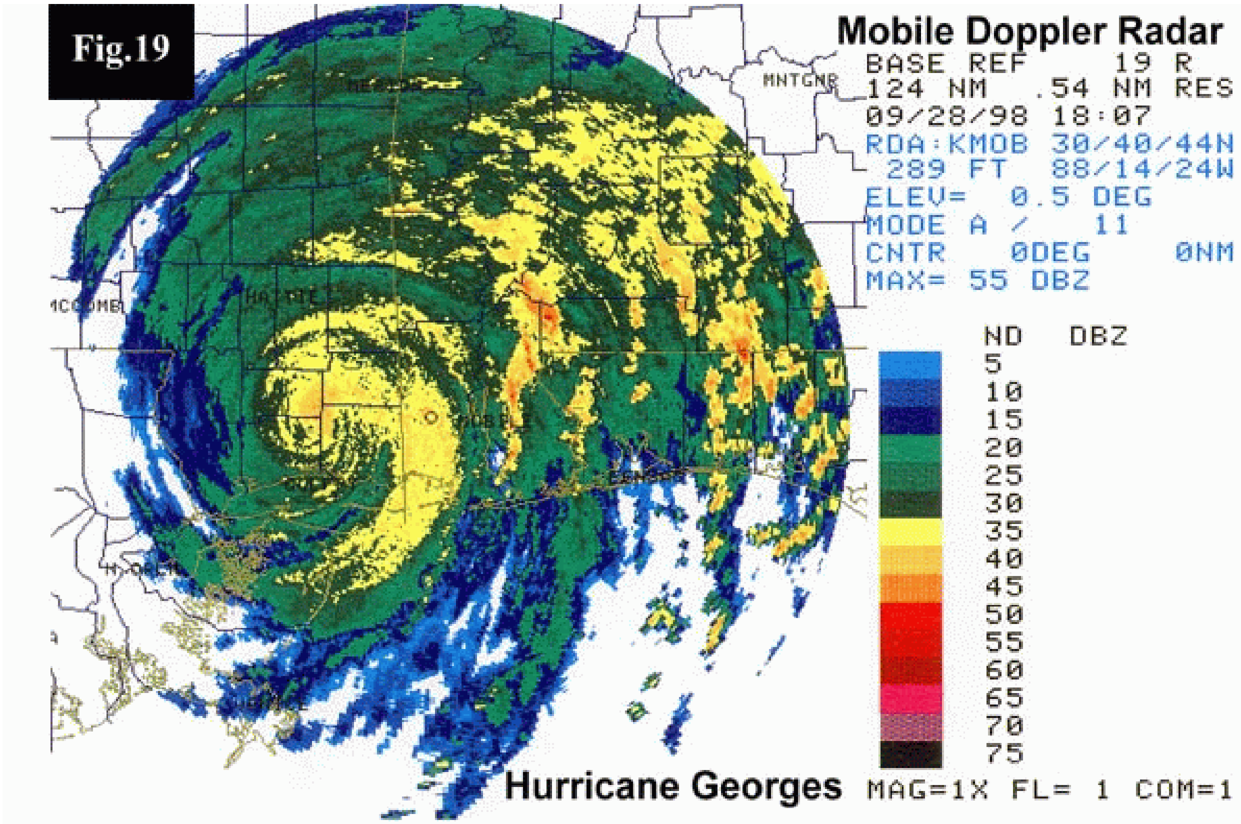


Fig.19
Mobile Doppler Radar
BASE REF 19 R
124 NM .54 NM RES
09/28/98 18:07
RDA:KMOB 30/40/44N
289 FT 88/14/24W
ELEV= 0.5 DEG
MODE A / 11
CNTR 0DEG 0NM
MAX= 55 DBZ
ND DBZ
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
Hurricane Georges
MAG=1X FL= 1 COM=1

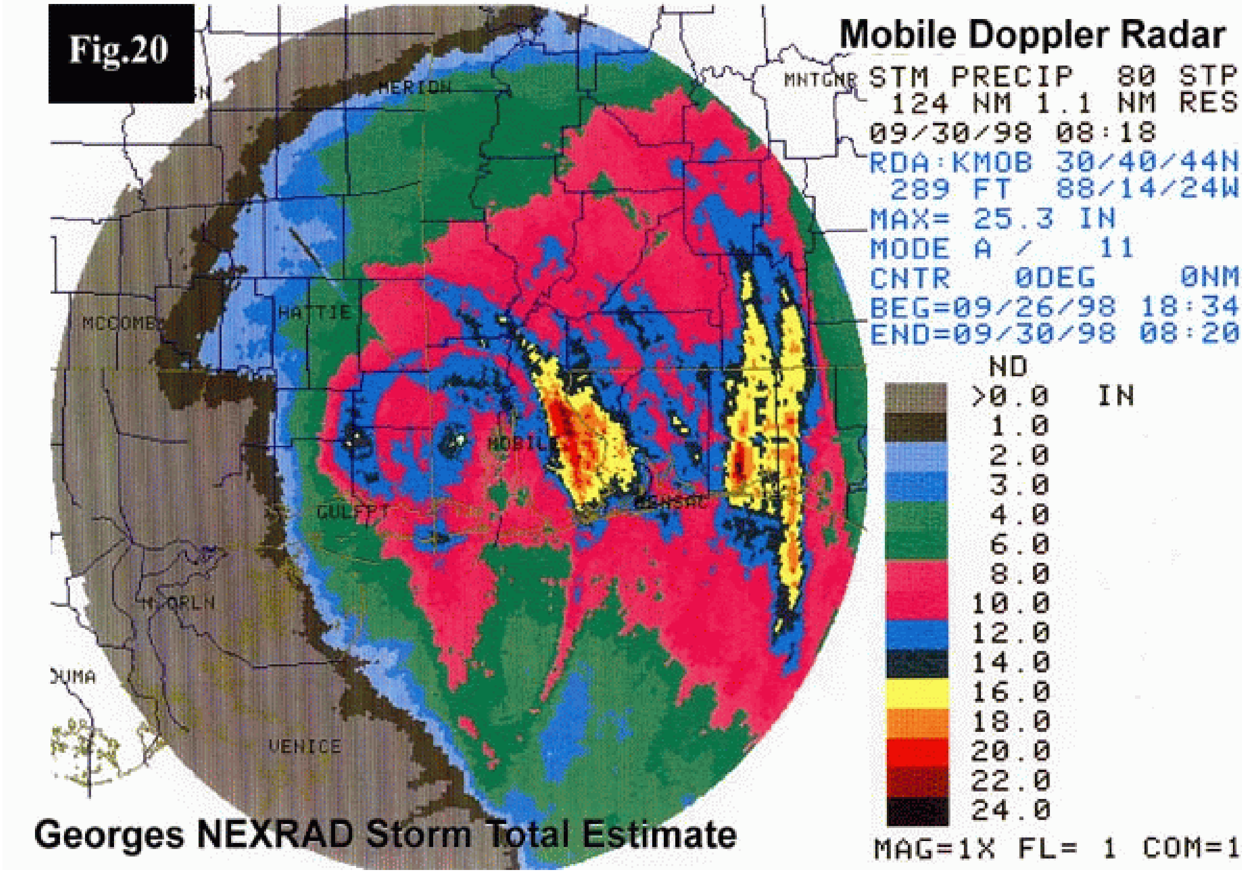
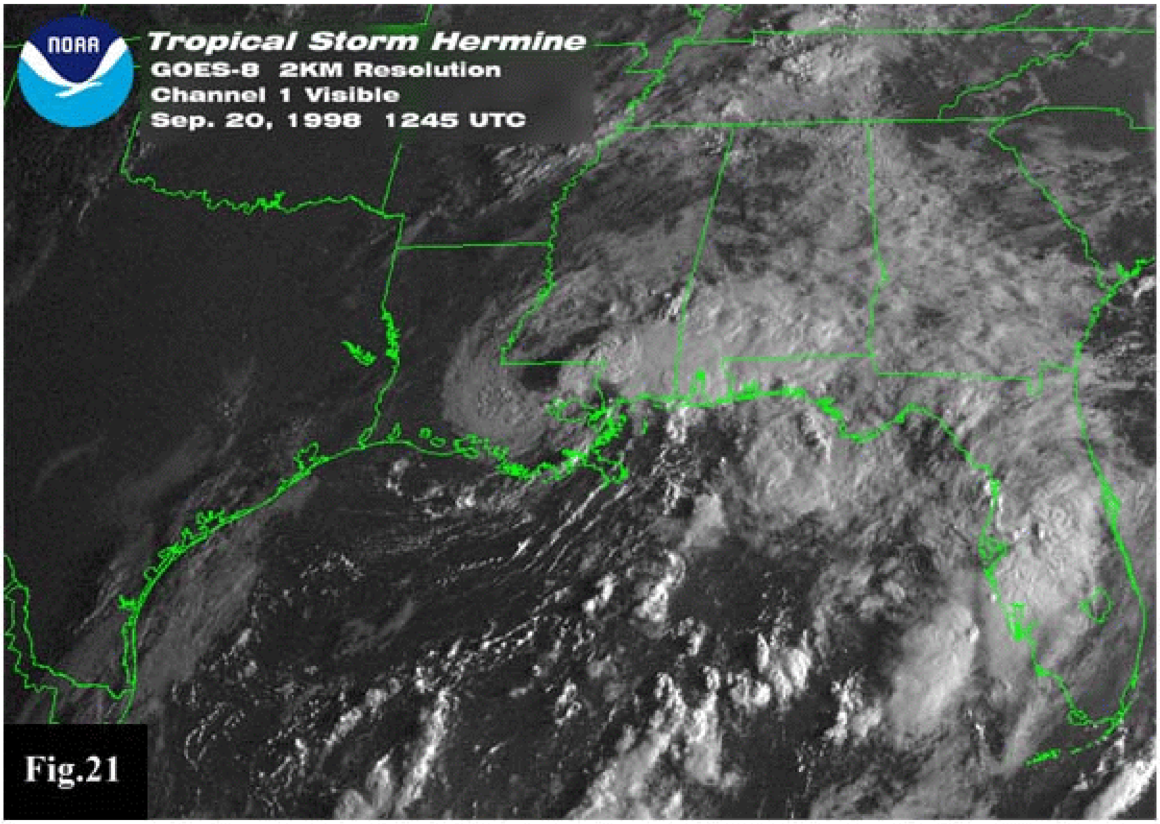


Fig.20
Mobile Doppler Radar
STM PRECIP 80 STP
124 NM 1.1 NM RES
09/30/98 08:18
RDA:KMOB 30/40/44N
289 FT 88/14/24W
MAX= 25.3 IN
MODE A / 11
CNTR 0DEG 0NM
BEG=09/26/98 18:34
END=09/30/98 08:20
ND
>0.0 IN
1.0
2.0
3.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
MERIDN
HATTIE
MCCOMB
MOBILE
GULFPT
N.ORLN
VENICE
Georges NEXRAD Storm Total Estimate
MAG=1X FL= 1 COM=1


Tropical Storm Hermine
GOES-8 2KM Resolution
Channel 1 Visible
Sep. 20, 1998 1245 UTC
Fig.21

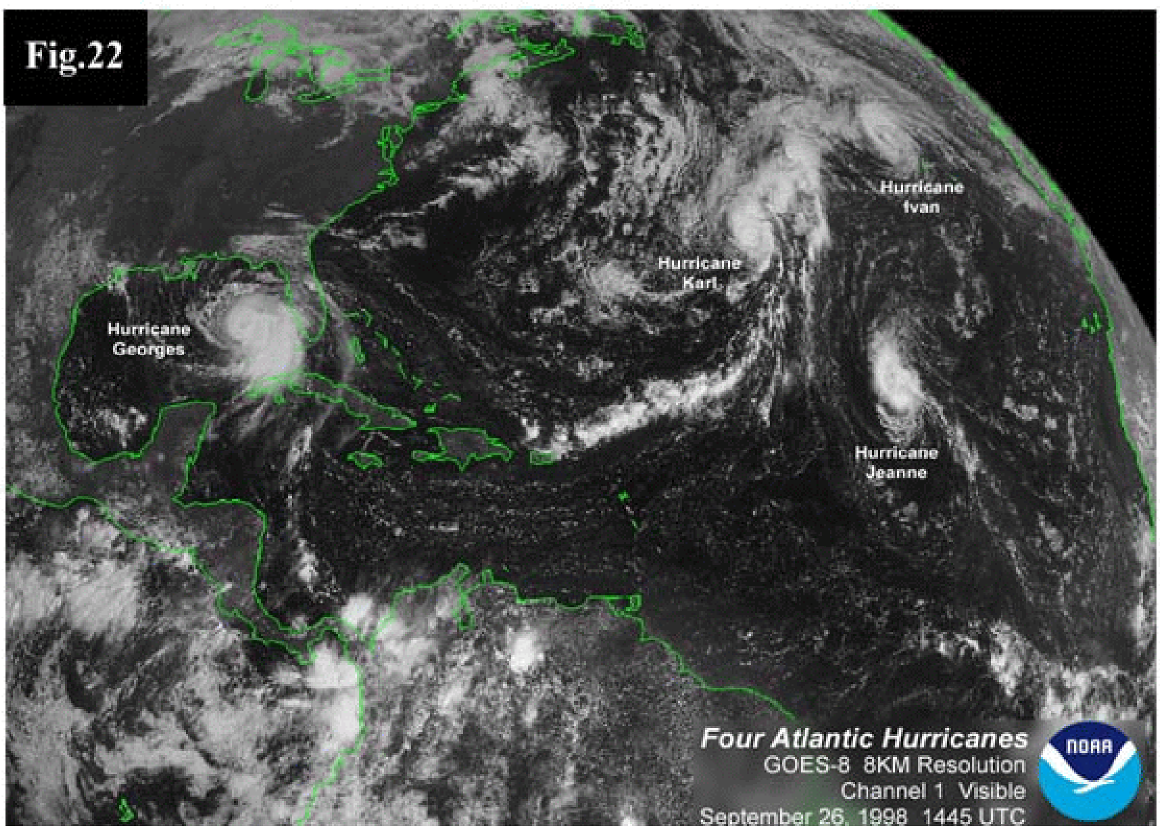


Fig.22
Hurricane Ivan
Hurricane Karl
Hurricane Georges
Hurricane Jeanne
Four Atlantic Hurricanes
GOES-8 8KM Resolution
Channel 1 Visible
September 26, 1998 1445 UTC

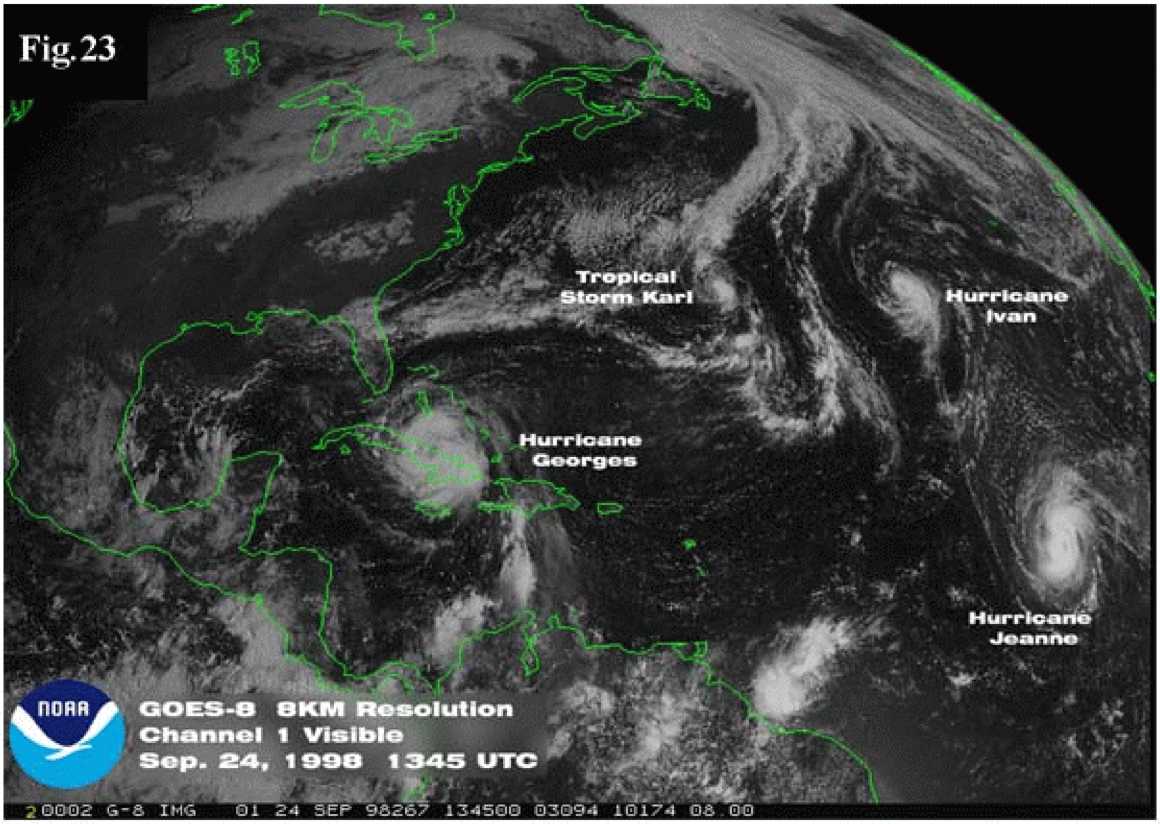


Fig. 23
Tropical
Storm Karl
Hurricane
Ivan
Hurricane
Georges
Hurricane
Jeanne
GOES-8 8KM Resolution
Channel 1 Visible
Sep. 24, 1998 1345 UTC
20002 G-8 IMG 01 24 SEP 98267 134500 03094 10174 08.00

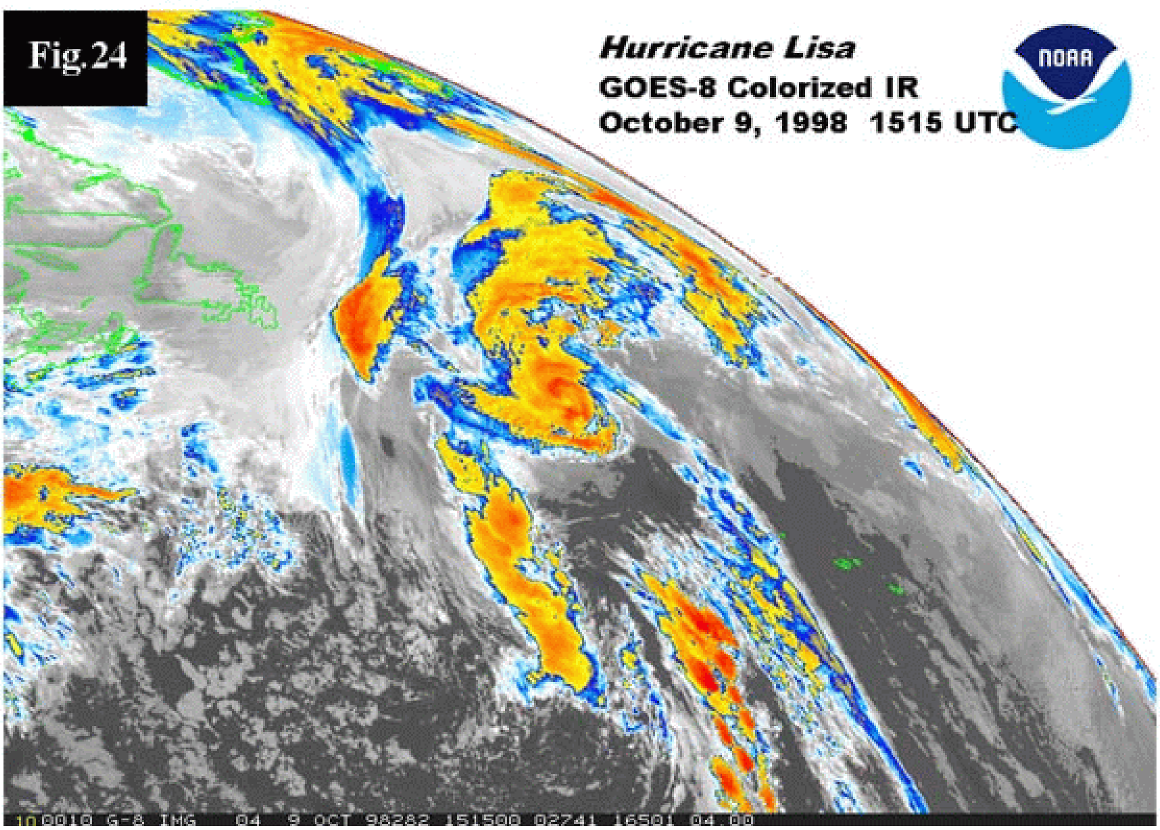


Fig. 24
Hurricane Lisa
GOES-8 Colorized IR
October 9, 1998 1515 UTC

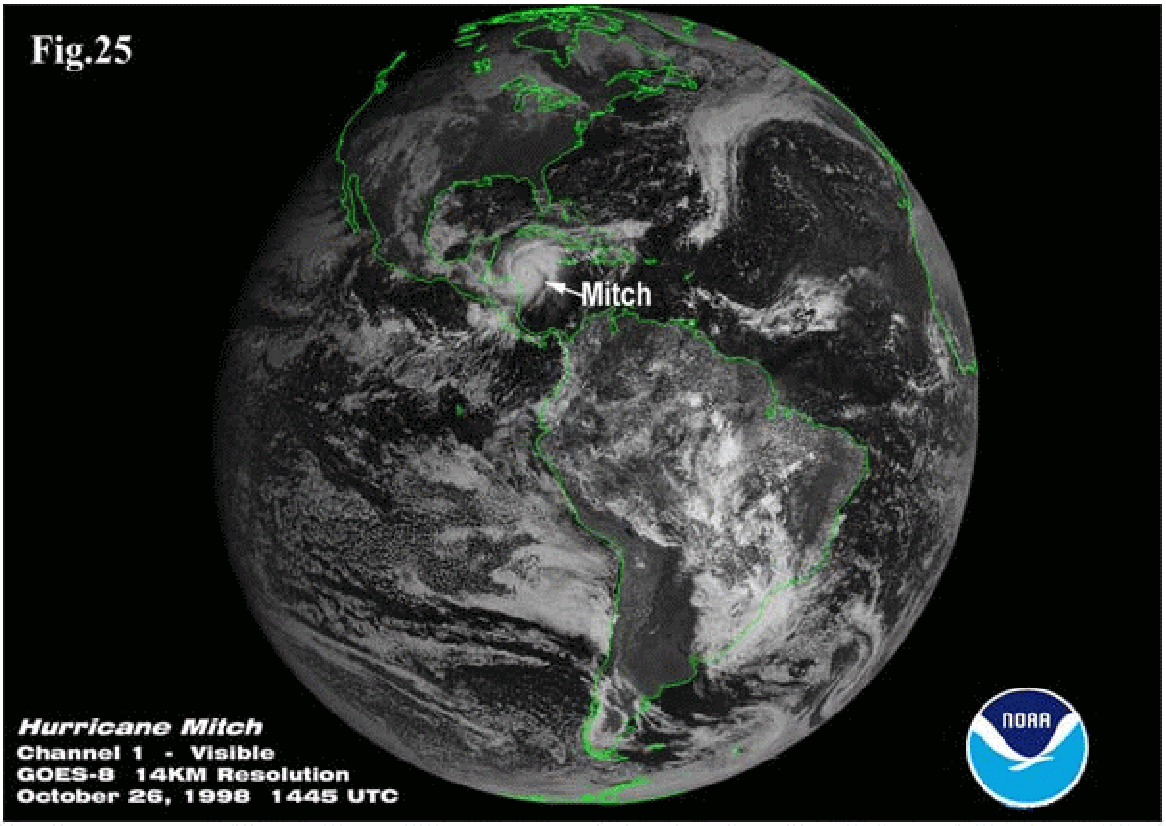

Mitch
Hurricane Mitch
Channel 1 - Visible
GOES-8 14KM Resolution
October 26, 1998 1445 UTC
NOAA

Fig.25

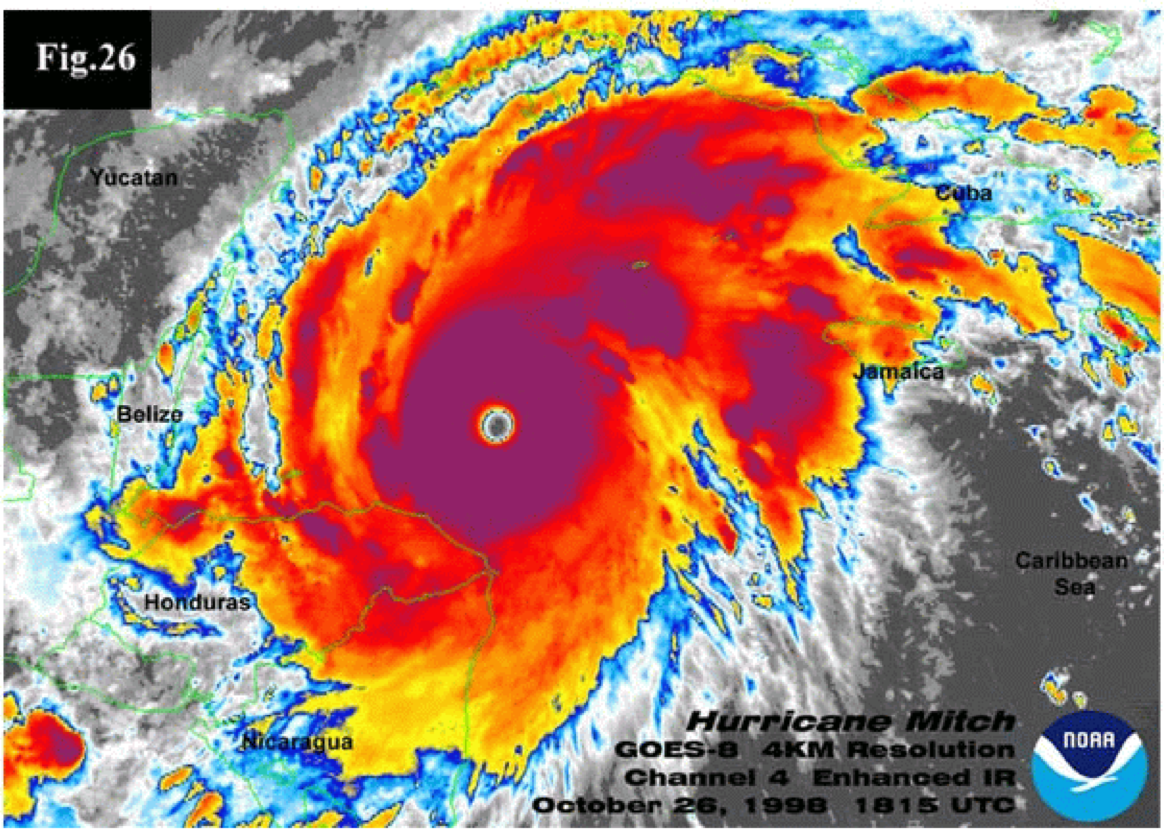
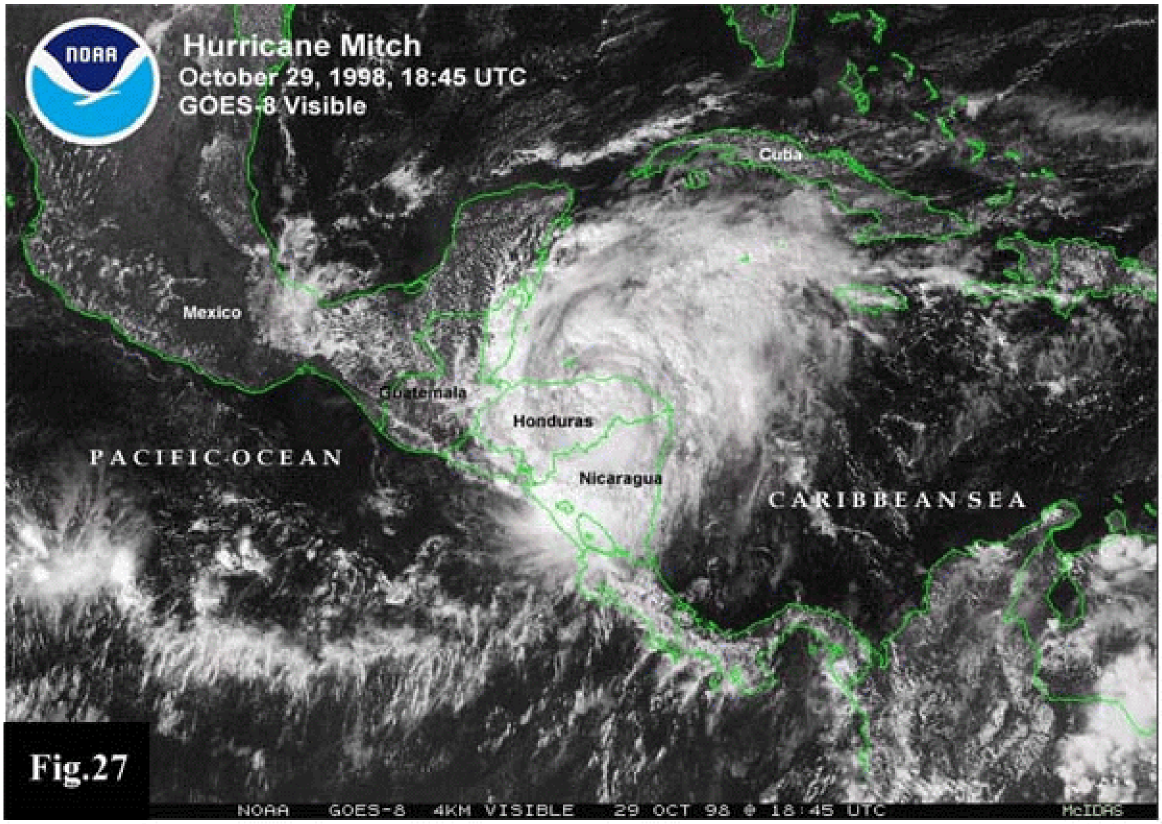

Yucatan
Cuba
Jamaica
Belize
Honduras
Caribbean Sea
Nicaragua
Hurricane Mitch
GOES-8 4KM Resolution
Channel 4 Enhanced IR
October 26, 1998 1815 UTC
NOAA

Fig.26


Hurricane Mitch
October 29, 1998, 18:45 UTC
GOES-8 Visible
Cuba
Mexico
Guatemala
Honduras
PACIFIC OCEAN
Nicaragua
CARIBBEAN SEA
Fig.27
NOAA GOES-8 4KM VISIBLE 29 OCT 98 @ 18:45 UTC
McIDAS

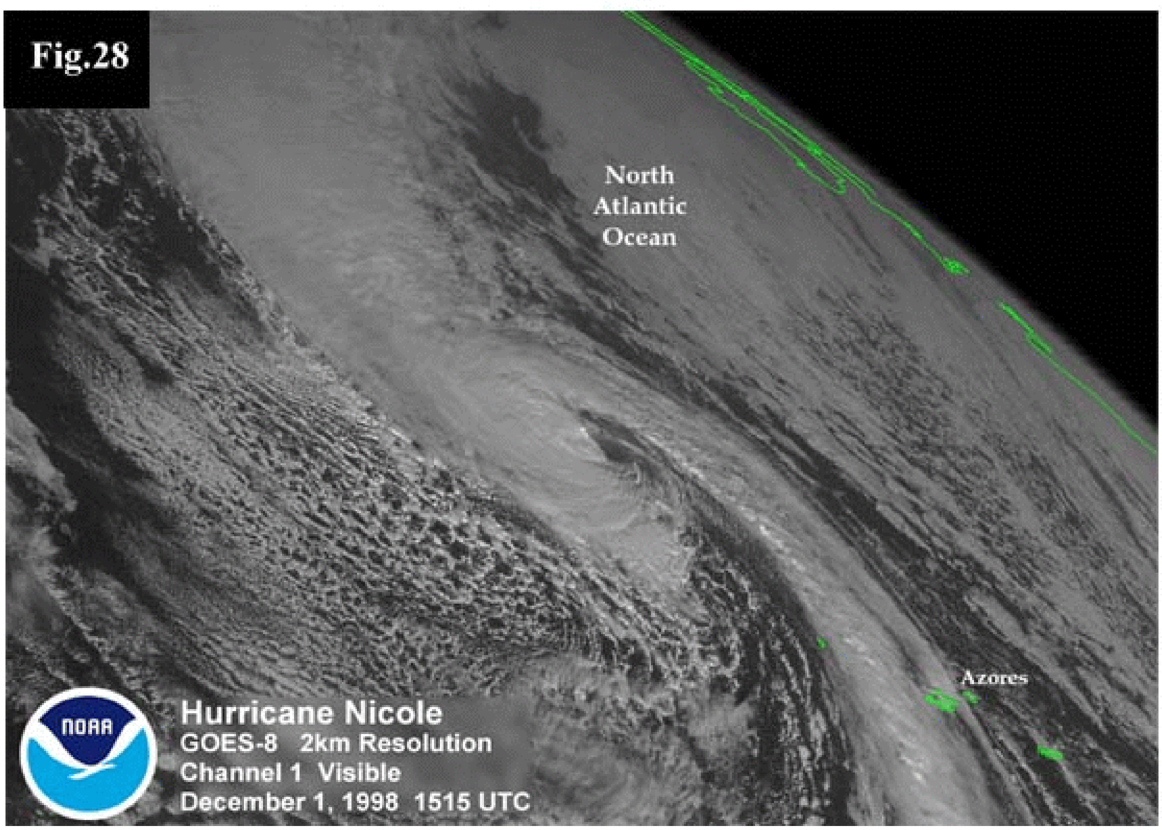
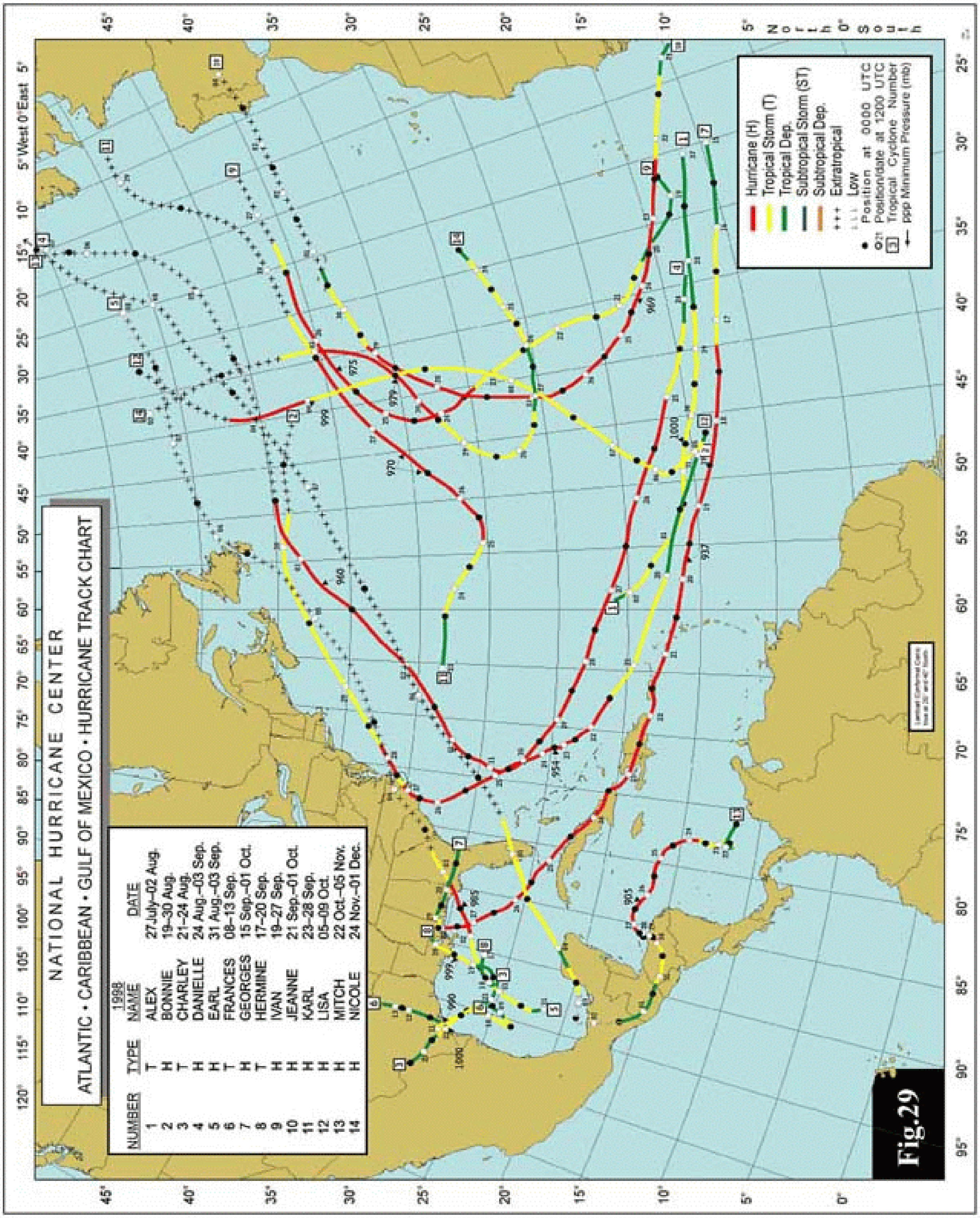


Fig.28
North
Atlantic
Ocean
Azores
Hurricane Nicole
GOES-8 2km Resolution
Channel 1 Visible
December 1, 1998 1515 UTC


NATIONAL HURRICANE CENTER
ATLANTIC • CARIBBEAN • GULF OF MEXICO • HURRICANE TRACK CHART
NUMBER TYPE 1998 NAME DATE
1 T ALEX 27 July–02 Aug.
2 H BONNIE 19–30 Aug.
3 T CHARLEY 21–24 Aug.
4 H DANIELLE 24 Aug.–03 Sep.
5 H EARL 31 Aug.–03 Sep.
6 T FRANCES 08–13 Sep.
7 H GEORGES 15 Sep.–01 Oct.
8 T HERMINE 17–20 Sep.
9 H IVAN 19–27 Sep.
10 H JEANNE 21 Sep.–01 Oct.
11 H KARL 23–28 Sep.
12 H LISA 05–09 Oct.
13 H MITCH 22 Oct.–05 Nov.
14 H NICOLE 24 Nov.–01 Dec.
Hurricane (H)
Tropical Storm (T)
Tropical Dep.
Subtropical Storm (ST)
Subtropical Dep.
Extratropical
Low
Position at 0000 UTC
Position/date at 1200 UTC
Tropical Cyclone Number
ppp Minimum Pressure (mb)
Fig.29