

Preliminary Report
Hurricane Georges
15 September - 01 October 1998

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Georges (pronounced Zhorzh) was the second deadliest and second strongest hurricane within the Atlantic basin during the 1998 season. Its 17 day journey resulted in seven landfalls, extending from the northeastern Caribbean to the coast of Mississippi, and 602 fatalities -- mainly in the Dominican Republic and Haiti.

a. Synoptic History

Georges originated from a tropical wave, observed by satellite and upper-air data, which crossed the west coast of Africa late on 13 September. Rawinsonde data from Dakar, Senegal showed an attendant 35 to 45 knot easterly jet between 550 and 650 millibars (mb). On the 14th, visible satellite imagery depicted a large, well-defined cloud system in association with the wave and meteorologists at the Tropical Prediction Center/National Hurricane Center (NHC) Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB) of the National Environmental Satellite, Data, and Information Service, and the Air Force Weather Agency (AFGWC) began satellite-based Dvorak intensity classifications. By early on the 15th, ship reports indicated the presence of a closed surface circulation in this system and it is estimated that a tropical depression formed at 1200 UTC, centered about 300 n mi south-southwest of the Cape Verde Islands in the far eastern Atlantic, as shown in the post-storm "best-track" - see Table 1 and Figure 1. During the next 24 hours the tropical depression continued to become better organized as banding features developed and deep convection formed over the center. The system became a tropical storm at 1200 UTC on 16 September while centered about 620 n mi west-southwest of the Cape Verde Islands. Georges moved on a persistent west-northwest course for the next ten days, a classic Cape Verde-type track, in response to a mid- to upper-level tropospheric ridge which strengthened with height.

Georges continued to gradually strengthen over the next several days, reaching hurricane intensity around 1800 UTC on 17 September when a banding-type eye feature became evident in satellite imagery. By the 19th, an upper-level anticyclone was well-established over Georges and satellite pictures

suggested that the hurricane was beginning to strengthen rapidly, as indicated by the cooling cloud tops, increased symmetry of the deep convection, and the warming and contracting of the well-defined eye.

By early afternoon on the 19th, the first U.S. Air Force Reserve (USAFR) reconnaissance aircraft reached the hurricane and measured maximum flight-level winds of 146 knots and a minimum central pressure of 938 mb - confirming the intensification trend noted in satellite imagery. Georges' winds were increased to 125 knots at 1800 UTC on the 19th making it a category four hurricane on the Saffir-Simpson Hurricane Scale.

Several Global Positioning System (GPS) dropwindsondes were deployed within the eye-wall region of the hurricane during these reconnaissance missions. Near-surface (below 200 feet) wind estimates from these drops indicate maximum winds from 134 knots to 150 knots. On this basis, Georges is estimated to have reached a peak intensity of 135 knots at 0600 UTC on the 20th while located about 285 n mi east of Guadeloupe in the Lesser Antilles. Although GPS Dropwindsondes data is still being evaluated by scientists at the National Oceanic and Atmospheric Administration (NOAA) Hurricane Research Division, preliminary research suggests that the observed near-surface winds approximate one-minute values. For additional information on the GPS Dropwindsondes, please see Franklin (1997) and Franklin et. al. (1997).

Shortly after 0600 UTC 20 September, the hurricane began a marked weakening trend with the eye becoming indiscernible in satellite pictures, or to aerial reconnaissance by that afternoon. Examination of water vapor satellite imagery and satellite-derived wind analyses from the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin suggest that one possible factor responsible for the weakening could have been upper-level northerly vertical wind shear induced by an upper-level anticyclone located over the eastern Caribbean. By the evening of the 20th, the central pressure had risen 26 mb and Georges weakened. It then made the first two of its seven landfalls in the Lesser Antilles, first in Antigua then in St. Kitts and Nevis, early on the 21st with maximum sustained surface winds of 100 knots.

By mid-morning of the 21st an upper-level low over Cuba, denoted in water vapor imagery, was moving westward away from Georges thereby reducing the possibility of Georges moving to the northwest, away from Puerto Rico. Later in the afternoon, the shear appeared to diminish and the outflow aloft improved but Georges never fully recovered due in part to the circulation's interaction with Puerto Rico. Georges made landfall in southeast Puerto Rico with sustained surface winds of 100 knots on the evening of the 21st. The hurricane moved inland over Puerto Rico and weakened slightly and then moved into the Mona Passage early on the 22nd. Georges began to re-intensify while over the Mona Passage and made landfall later that morning in the Dominican Republic, about 75 n mi east of Santo Domingo with estimated

sustained surface winds of 105 knots.

During the next 21 hours Georges weakened as it moved slowly across the mountainous terrain of the Dominican Republic and Haiti, where it produced copious rains resulting in deadly flash floods and mud slides. The system emerged into the Windward Passage on the morning of the 23rd with 65 knot maximum winds. Georges changed little before making landfall in eastern Cuba later that afternoon, about 25 n mi east of Guantanamo Bay. The system retained hurricane status while moving slowly west-northwestward across the northern coast of Cuba, exiting the northern coast by late afternoon on the 24th. Satellite imagery showed that the system retained a fairly impressive upper-level outflow pattern during its crossing of both Hispaniola and Cuba.

Once back over water, the hurricane began to re-intensify. Satellite pictures showed that a band of deep convection developed east of the center early on the 25th which expanded throughout the morning. Georges made landfall during mid-morning of the 25th in Key West, Florida with a minimum central pressure of 981 mb and maximum winds of 90 knots. After moving away from Key West, Georges turned more to the northwest, then north-northwest, and gradually slowed down on the 26th and 27th. This occurred in response to the mid-tropospheric anticyclone north of the hurricane shifting eastward into the southeastern United States. The hurricane made landfall near Biloxi, Mississippi on the morning of the 28th with estimated maximum sustained one-minute winds of 90 knots and a minimum central pressure of 964 mb. After landfall, the system meandered around southern Mississippi and was downgraded to a tropical storm on the afternoon of the 28th.

Georges became quasi-stationary for the next 6 to 12 hours moving in a cyclonic loop over southern Mississippi. The tropical storm began moving in a generally northeast to east direction early on the 29th and was downgraded to a tropical depression by mid-morning while located about 30 n mi north-northeast of Mobile, Alabama. Georges continued to move eastward at 5 to 10 knots on the 29th and 30th. By early morning of 1 October, the system dissipated near the northeast Florida/southeast Georgia coast, although a very weak remnant low did emerge over the western Atlantic during the day. However, the remnant circulation merged with a frontal zone by late on the 1st.

b. Meteorological Statistics

The best-track intensities in Table 1 were obtained from the data in Figures 2 and 3 which depict the curves of minimum central sea-level pressure and maximum sustained one-minute average "surface" (10 meters above ground level) wind speed, respectively, as a function of time. These figures also contain data upon which the curves are based: USAFR and NOAA aircraft reconnaissance data, satellite-based Dvorak-technique intensity estimates from

TAFB, SAB, and AFGWC, and estimates from synoptic data analyses after landfall.

1. Wind and Pressure Data

The bulk of the aerial reconnaissance flights into Georges were done by the USAFR "Hurricane Hunters". The Hurricane Hunters flew 17 missions, and made 81 center fixes while NOAA aircraft performed six missions contributing 24 center fixes. The highest wind speed reported was 152 knots (at 700 mb) at 0112 UTC 20 September by the NOAA aircraft. The lowest central pressure reported was 937 mb at 0613 UTC 20 September by the Hurricane Hunters with a corresponding maximum flight-level wind of 144 knots. During this period, subjective Dvorak intensity estimates from TAFB, SAB and AFGWC were T6.5 (127 knots/935 mb) and objective-based Dvorak estimates ranged between T6.5 and T7.0 (140 knots/921 mb), all in good agreement with GPS dropwindsonde pressure and wind estimates.

George's track brought it into range of several National Weather Service Doppler radars (WSR-88D - Weather Surveillance Radar-1988 Doppler) specifically; San Juan, Puerto Rico, Key West, FL, New Orleans, LA and Mobile, AL. The WSR-88D in San Juan, Puerto Rico measured winds near 100 knots aloft at 0205 UTC 22 September while the center was located over central Puerto Rico. Dr. Joshua Wurman of the University of Oklahoma was operating his dual doppler radar (Doppler-on-Wheels DOW) during Georges' landfall in Biloxi, Mississippi. Around 0855 UTC 28 September, the radar showed maximum wind near 107 knots, which represents a 2 to 5 second gust. For further information on the DOW radar project, please refer to Wurman (1998).

Several land-based locations within the Caribbean recorded sustained hurricane-force winds during Georges passage including Hamilton Airport and VITEMA/Herman Hill in St. Croix, Cyril E. King Airport in St. Thomas, and all the official reporting sites in Puerto Rico. The highest sustained wind and gust reported at an official site was 78 knots and 93 knots, respectively, at Roosevelt Roads Naval Station (TJNR) at 2302 UTC 21 September. These, as well as other selected surface observations for Georges, are listed in Table 2. The highest unofficial wind report received in the Caribbean was a wind gust of 153 knots (at an elevation of about 700 feet) from the island of Saba of the Netherlands Antilles at 1044 UTC 21 September. The corresponding minimum pressure recorded at the site was 971.9 mb.

As is often the case in the Caribbean, many unofficial weather reports are relayed to the NHC via amateur radio operators. These observations are invaluable in helping to determine conditions in locations with no official weather reporting equipment. Table 3 lists selected amateur radio surface weather reports for Georges. One of the most important observations reported was in Fajardo, Puerto Rico where the Civil Defense office measured a sustained wind of 96 knots with gusts to 113 knots at 2130 UTC 21 September.

Operationally, this report was the basis of making Georges a category 3 hurricane at landfall in Puerto Rico .

The USAFR reconnaissance reported a maximum flight-level wind of 117 knots and a minimum central pressure of 962 mb near the time of landfall in southeast Dominican Republic.

Surface reports received from the *Instituto de Meteorologica* in Cuba indicate that the maximum 1-minute surface wind observed was 71 knots at Punta Lucrecia, Holguin while the highest gust of 80 knots was measured at Sagua La Grande, Villa Clara. The minimum central pressure recorded over Cuba was 988 mb in Cayo Coco. All of these reports occurred as Georges moved out of Cuba and into the Florida Straits where it began to restrengthen.

The maximum sustained 2-minute wind recorded at Key West, FL was 48 knots at 1353 UTC 25 September with the peak gust of 76 knots; the minimum central pressure reported was 982.5 mb. It should be noted that due to equipment/power failure around 1500 UTC a higher wind and a lower pressure value likely occurred. The highest gust recorded in the Florida Keys was 96 knots at the Monroe County Emergency Operations Center in Marathon. The Sombrero Key C-MAN buoy (SMKF1) recorded a maximum sustained wind of 82 Knots with a peak gust to 92 Knots at 1500 UTC 25 September. Moreover, this buoy recorded hurricane-force winds for a three hour period (1300 - 1600 UTC). This, along with other National Data Buoy Center (NDBC) observations, can be found in Table 4.

Georges made its final landfall near Biloxi, Mississippi around 1130 UTC on 28 September with maximum sustained surface winds of 90 knots and a minimum central pressure of 964 mb. The USAFR aircraft reported a 960 mb pressure at 0503 UTC. The lowest pressure measured by a land station was 964.9 mb at 1055 UTC 28 September at Keesler Air Force Base (KBIX) in Biloxi, MS; Harrison County Civil Defense in Gulfport, MS recorded 967.2 mb at 1015 UTC. The NOAA ship Oregon II measured a minimum central pressure of 970 mb at 0830 UTC 28 September while in port in Pascagoula, MS. On the 28th, Keesler Air Force Base (KBIX) in Biloxi, MS reported sustained hurricane-force winds (65 Knots) at 0855 UTC. At 0755 UTC, KBIX reported wind gusts of 109 knots, and 149 knots at 0855 UTC 28 September. The latter value is considered to be invalid based on the following: 1) DOW dual doppler maximum wind measurements made at the same time at KBIX were near 107 knots (considered a 2-5 second gust); 2) the anemometer at KBIX is a hot-wire anemometer which has been shown to be prone to major errors in heavy rain, e.g., the erroneous 205 knot wind gust in Typhoon Paka (Hagemeyer, 1998); 3) USAFR dropwindsonde data from the same time period measured a peak wind of 101 knots at 920 mb. An Texas Instrument WR25 anemometer, operated by Mississippi Power and Light one mile north of the beach in Biloxi, measured a wind gust of 102 Knots.

Reconnaissance data from the USAFR aircraft suggest that the boundary layer and inner core of the Georges never fully recovered from its passage

across Hispaniola and Cuba. Despite an apparently healthy cloud and outflow pattern and a small, but gradual, drop in the minimum central pressure of 13 mb (975-962 mb) in a 36-hour period from early on the 26th to the evening of the 27th, the eye was never able to become re-established. Most of the vortex messages from the 26th through the 28th reported a partially-formed eyewall - mostly open to the west or southwest. Also, eyewall GPS dropwinsonde data near landfall in Mississippi suggest that the winds at the surface were 20-30% below those at flight level (10,000 feet). This is in stark contrast to eyewall samples taken when Georges was near peak intensity just east of the Leeward Islands where the surface winds, on average, were equal to or greater than those at 10,000 feet.

Table 4 contains all known ship observations which reported winds of tropical storm-force (34 knots) or higher associated with Georges. The highest wind observation was 44 knots from Ship PJKP at 1500 UTC 29 September in the Gulf of Mexico. The highest significant wave height reported by a ship was 13 feet (WFLG at 0900 UTC 22 September and C6JN at 1800 UTC 29 September) while the highest value recorded at a NDBC buoy was near 36 feet at 42040 in the Gulf of Mexico.

2. Storm Surge Data

The storm surge was estimated to be near 10 feet in Fajardo, Puerto Rico while values of 4 to 6 feet were typical in the Florida Keys. Preliminary storm surge estimates along the central and east Gulf Coast range from 5 to 9 feet in Louisiana and Mississippi (maximum of 8.9 feet at Point A La Hache, LA and Point Cadet, Biloxi, MS) to 5 to 12 feet in Alabama (5 to 10 feet in Mobile County and 7 to 12 feet in Baldwin County). The two highest values received from Alabama are 9.3 feet which occurred in west Mobile Bay, and 11.9 feet in Fort Morgan. In the Florida Panhandle, the storm surge in Escambia, Santa Rosa, and Okaloosa Counties was estimated to be 5 to 10 feet. Of course breaking waves superimposed on the storm surge will result in even higher water marks. At the time of this writing, official United States Corps of Engineers/ Geological Survey (USCE/USGS) storm surge site survey values have not been received.

3. Rainfall Data

Georges was a substantial rain-producer in portions of the Caribbean and the central/eastern Gulf of Mexico coast. In the U.S. Virgin islands, rainfall totals were generally between 3 and 8 inches. In Puerto Rico, the maximum official two-day USGS rain gage measurement was 24.62 IN in Lago El Guineo near Villalba while the maximum Cooperative Observer (CO-OP) two-day total reported was 28.36 inches in Jayuya. Figure 3 shows the USGS rainfall analysis for Puerto Rico in 5-inch isohyets - of particular interest is the large swath of 10-15 inch values.

No surface-based rainfall estimates are available from the Dominican

Republic or Haiti, two of the hardest-hit countries. Satellite-derived rainfall estimates suggest that as much as 39 inches of rain may have fallen over portions of the Dominican Republic and Haiti over a 24-hour period ending around 1200 UTC on the 23rd. Over Cuba, the *Instituto de Meteorologica* reported a maximum storm total of 24.41 inches in Limonar.

Rainfall in the Florida Keys was considerably less than what was seen over Cuba or Hispaniola, with Key West recording 8.38 inches. In contrast, storm totals along the Gulf Coast were noticeably higher owing to the hurricane's marked deceleration. The maximum rainfall total from an official observation site was 24.24 inches at Eglin AFB (KVPS) in the Florida Panhandle while the highest storm total was 29.66 inches from a CO-OP in Bay Minette, AL. Rainfall totals generally ranged from 10 to 20 inches over most of southern Mississippi and Alabama, and the Florida Panhandle - see Figure 4. In response to the heavy rains, widespread river flooding occurred in southern Mississippi from 30 September through 2 October flooding homes and forcing evacuations. The Tchoutacabouffa River at D'Iberbville, MS set a record crest of 19 feet at 0200 UTC 30 September.

4. Tornadoes

Most of the reported tornado activity associated with Georges occurred in Florida and Alabama with a total of 28 tornadoes estimated to have touched down, mostly in northwest Florida. No deaths were directly attributable to these tornadoes. Two tornadoes were also reported in Puerto Rico.

c. Casualty and Damage Statistics

Table 5 lists the deaths and insured damage estimates associated with Georges. The 602* direct deaths attributed to Georges make it the 19th deadliest tropical cyclone in the Atlantic basin this century (Rappaport and Partagas, 1995). Most of the deaths associated with Georges (Table 6) occurred in the Dominican Republic and Haiti, due mainly to flash flooding and subsequent mud slides in high terrain regions. The lone direct death in the United States, which was freshwater flood-related, occurred in Mobile, Alabama.

Insured property damage estimates supplied by the Property Claims Services Division of the American Insurance Services Group estimates that Georges caused a total of \$2.955 billion in damage in the United States including Puerto Rico and the U.S. Virgin Islands (see Table 6 for individual state totals). These estimates exclude storm surge damage. To determine the total estimated damage, a ratio of 2:1 is applied to the insured property damage; this is based on comparisons done in historical hurricanes. Thus, the total estimated damage from Georges is \$5.9 billion. *Note - in 2011 the U.S. damage estimate (including Puerto Rico and the U.S.V.I.) was revised to \$6.365 billion.*

* - This represents the best estimate received to-date and is subject to later revision. Totals which appear in Table 6 from the Dominican Republic and Haiti are government-based estimates as reported in media accounts.

In Puerto Rico, there was considerable damage to homes throughout the island. A total of 72,605 homes were damaged, of which 28,005 are estimated to have been completely destroyed. During the hurricane, over 26,000 people were in shelters. In the Dominican Republic upwards of 185,000 were left homeless by Georges and 100,000 remained in shelters through mid-October

as electricity and water service remain out in most of the country. Across Haiti, government officials stated that 167,332 had been left homeless by the hurricane.

The agricultural industry in Puerto Rico was hit hard by Georges with estimates of 95% of the plantain and banana crop destroyed along with 75% of the coffee crop.

Despite Georges' weakened state when it moved across Cuba, it had a substantial impact. A total of 60,475 homes were damaged of which 3,481 were completely destroyed. As was the case in Puerto Rico, the agricultural sector was hard hit with major losses at banana plantations in eastern Cuba.

The damage to dwellings in the United States was not as extensive as that experienced across the Caribbean. In the Florida Keys 1536 homes were damaged of which 173 were completely destroyed, many of which were mobile homes. Some roof and structural damage was also reported along the coast of Mississippi.

In the first 60 days or so after Georges made its final landfall in Mississippi, the American Red Cross spent \$104 million on relief services in the United States Virgin Islands, Puerto Rico, Alabama, Louisiana, Mississippi, the Florida Keys and the Florida Panhandle. This makes it the most expensive disaster aid effort in the organization's 117-year history.

d. Forecast and Warning Critique

Overall, the track forecasts for Georges were generally good. The low average errors of CLIPER show that the hurricane followed a climatologically-favored path.

The average track model and official forecast errors for Georges are listed in Table 6. The average official forecast errors are well below the most recent 10-year average. These values represent a 47% to 60% improvement over the 10-year official averages: 60% at 12 hr, 56% at 24 hr, 56% at 36 hr, 53% at 48 hr, and 47% at 72 hr. It should be noted that the slow motion of Georges over the north central Gulf of Mexico contributed to the low errors.

Not surprisingly, most of the track model guidance did quite well with Georges. In fact, with the exception of BAMS and a few periods of the AVNI,

AVNO and A98E, the average errors of all the other track models were below the 10-year official averages. This includes the United Kingdom Meteorological Office (UKM/UKMI) and the European Centre for Medium Range Weather Forecasting (EMX) models. Moreover, LBAR had slightly smaller average errors than the official forecast from 12 to 36 hr (although the EMX 48 hr error was 84 n mi the sample size is too small to make any meaningful conclusions). It should be mentioned, however, that although the GFDL track errors were well below the 10-year official forecast errors, it had a distinct left-bias over the Gulf of Mexico, insisting on turning Georges westward into central and southwest Louisiana.

While the average official track errors are exemplary, the average intensity errors are unimpressive. The mean absolute errors, and associated biases, for the official forecast, SHIPS, the GFDL and GFDI, and SHIFOR are listed Table 7. The official mean intensity forecast errors are within 10% of the most recent 10-year official average with the exception of 72 hr (16%). SHIPS and the GFDI are in fairly good agreement with the official forecast errors while the GFDL is considerably higher at 12 and 24 hr. The official NHC forecast shows a positive bias (i.e. the intensity was over-forecast) for all periods as opposed to the negative bias of the 10-year official average. SHIPS also shows a positive bias for all but the 12 hr period, owing to the absence of land recognition in the model, while both the GFDI and GFDL has a distinct negative bias throughout, with that of the GFDL considerably larger. Of more interest are the biases at specific times.

Examination of the intensity forecast history of Georges shows several interesting trends. The first five official forecasts after the system attained tropical storm strength under-forecast the intensity an average of 18 knots between 12 to 48 hr and 44 knots at 72 hr. While SHIPS' intensity errors were comparable to the official forecast, the GFDL fared worse with 29 knots between 12 and 48 hr and 55 knots at 72 hr. These forecasts represent the period when Georges went through its rapid intensification phase.

The intensity forecasts from 1800 UTC 19 September to 0600 UTC on 20th show a significant positive bias. This is when Georges went through a marked weakening trend. During this period, both the official NHC forecast and SHIPS over-forecast the intensity an average of about 21 knots between 12 and 48 hr; at 72 hr the errors were 43 knots and 36 knots, respectively. The GFDL showed lower errors for this period with a mostly negative bias. Several of the 12 hr forecasts under-forecast the intensity by 50 knots. These data highlight our limited skill level in forecasting rapid, abrupt changes in intensity.

Table 8 lists the various watches and warnings issued in association with Georges. Since Georges was well-forecast, the lead times on the hurricane warnings were more than sufficient to allow for the completion of protective actions. A total of nearly 897,000 residents evacuated portions of south and west central Florida including about 100,000 people in Dade County, and

35,000 in the Florida Keys in response to the mandatory evacuation order issued by the Monroe County Emergency Management.

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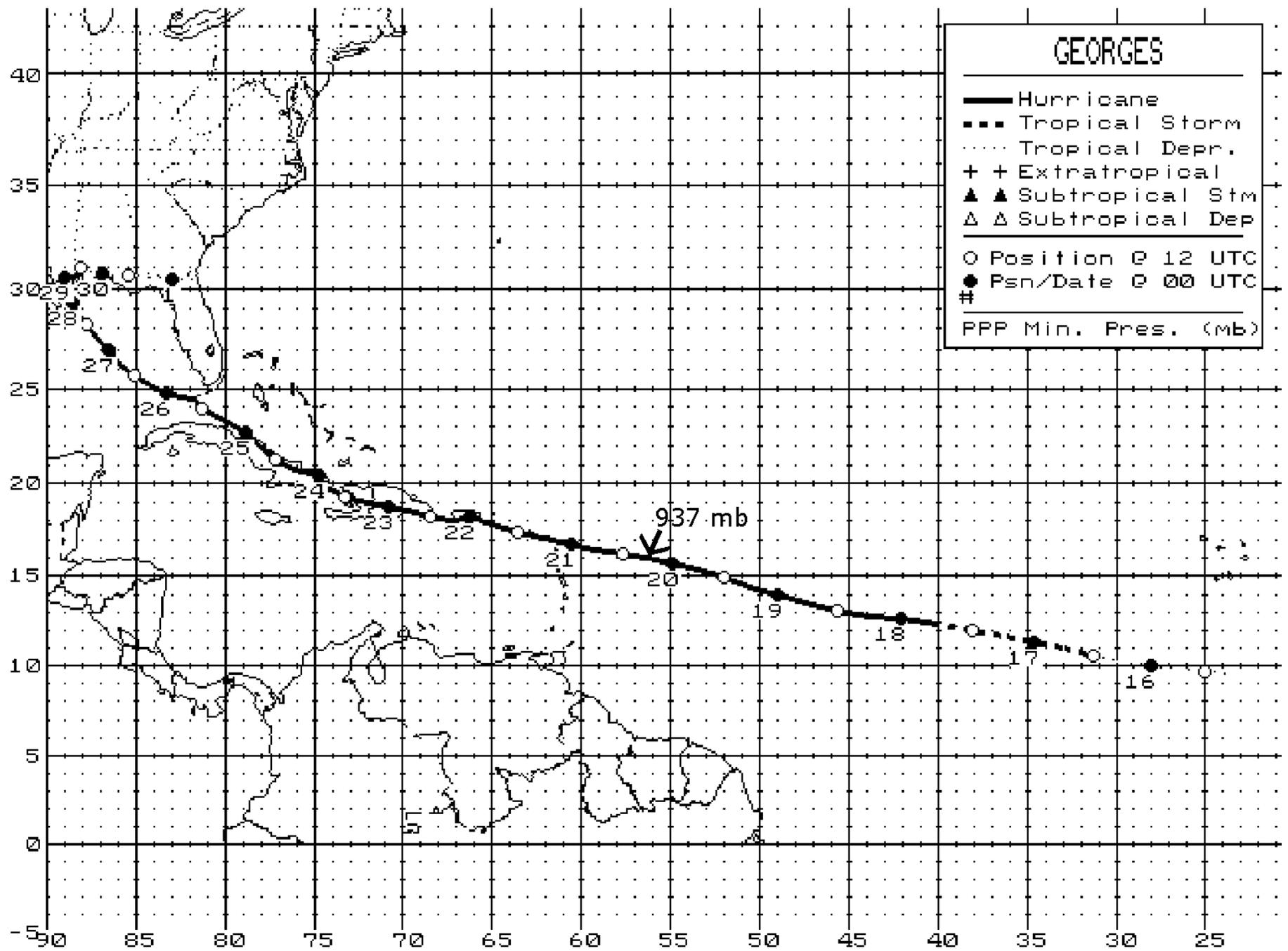


Figure 1. Best Track for Hurricane Georges, 15 September - 1 October, 1998.

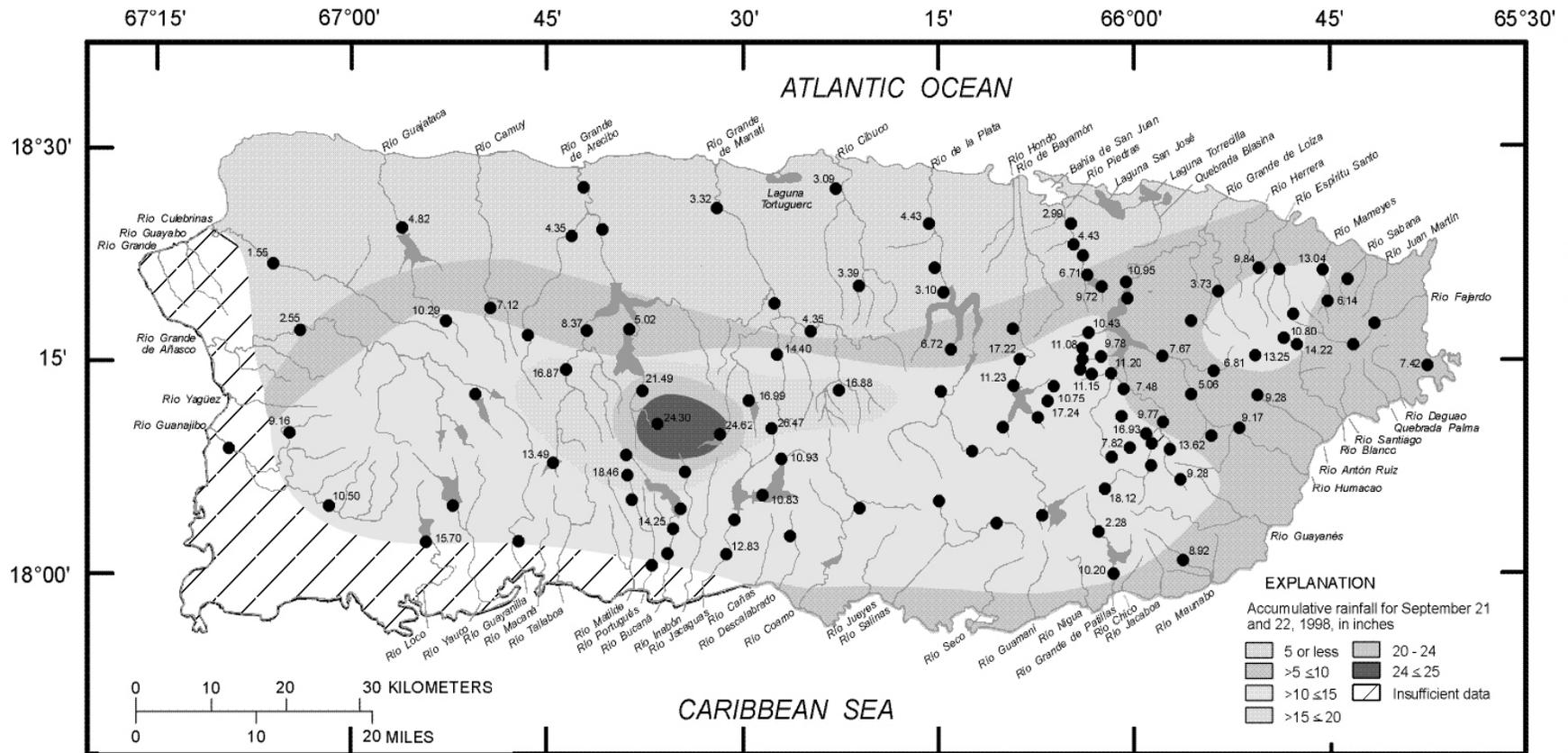


Figure 4.

Preliminary rainfall analysis for Puerto Rico for Hurricane Georges, 21-22 September 1998. (Source: U.S. Geological Survey)

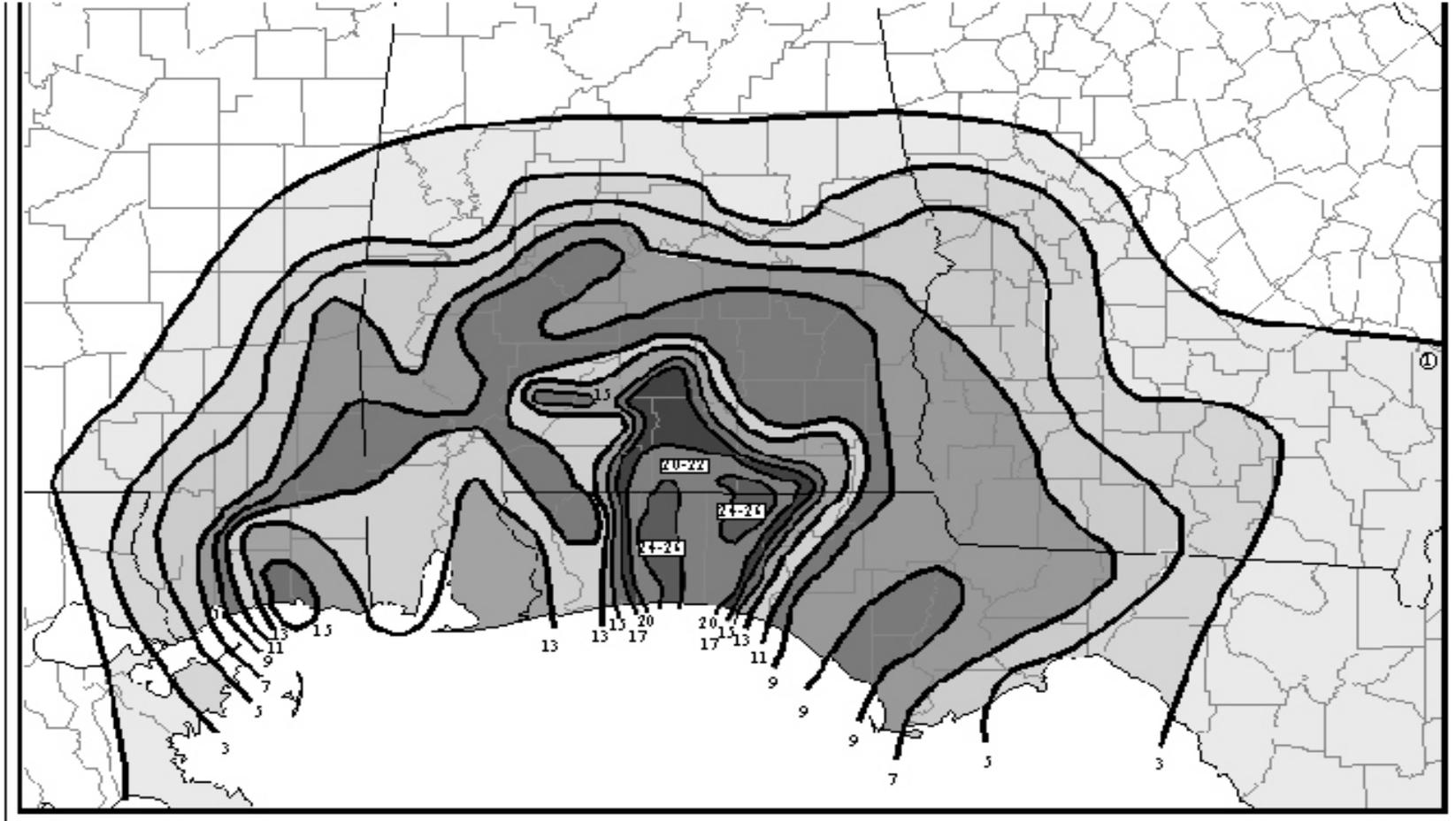


Figure 5.

Preliminary rainfall analysis for the Gulf Coast for Hurricane Georges, 28-30 September 1998.
(Source: NOAA/NWS/Southeast River Forecast Center)

Table 1.

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
09/15/1200	9.7	25.1	1009	30	Tropical Depression
1800	9.8	26.5	1009	30	" "
16/0000	10.0	28.1	1009	30	" "
0600	10.3	29.7	1009	30	" "
1200	10.6	31.3	1005	35	Tropical Storm
1800	11.0	32.9	1003	35	" "
17/0000	11.3	34.6	1000	45	" "
0600	11.7	36.3	997	50	" "
1200	12.0	38.1	994	55	" "
1800	12.3	40.0	987	65	Hurricane
18/0000	12.5	42.0	984	70	" "
0600	12.8	43.9	977	80	" "
1200	13.1	45.7	973	85	" "
1800	13.5	47.4	970	90	" "
19/0000	13.9	49.0	970	90	" "
0600	14.4	50.6	965	95	" "
1200	14.9	52.0	954	110	" "
1800	15.4	53.5	949	125	" "
20/0000	15.7	54.9	939	130	" "
0600	16.0	56.3	937	135	" "
1200	16.2	57.7	939	130	" "
1800	16.4	59.2	956	115	" "
21/0000	16.7	60.6	963	100	" "
0600	17.1	62.1	966	100	" "
1200	17.4	63.6	966	95	" "
1800	17.8	65.0	972	90	" "
22/0000	18.2	66.3	970	90	" "
0600	18.0	67.4	972	95	" "
1200	18.2	68.5	964	105	" "

Table 1 (continued).

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
22/1800	18.6	69.7	970	95	Hurricane
23/0000	18.8	70.8	980	70	" "
0600	19.0	72.1	990	65	" "
1200	19.3	73.3	996	65	" "
1800	19.8	74.3	994	65	" "
24/0000	20.5	74.9	992	65	" "
0600	20.8	76.0	991	65	" "
1200	21.3	77.2	990	70	" "
1800	21.9	78.0	989	75	" "
25/0000	22.7	79.0	987	80	" "
0600	23.4	80.2	986	85	" "
1200	23.9	81.3	982	90	" "
1800	24.6	82.4	975	90	" "
26/0000	24.8	83.3	974	90	" "
0600	25.2	84.2	975	90	" "
1200	25.7	85.1	974	90	" "
1800	26.2	85.9	975	90	" "
27/0000	27.0	86.5	969	95	" "
0600	27.6	87.2	970	95	" "
1200	28.2	87.8	962	95	" "
1800	28.8	88.3	962	95	" "
28/0000	29.3	88.5	961	95	" "
0600	29.8	88.7	964	90	" "
1200	30.4	88.9	965	90	" "
1800	30.6	88.9	984	65	" "
29/0000	30.6	89.0	986	50	Tropical Storm
0600	30.6	88.4	992	40	" "
1200	31.0	88.1	994	30	Tropical Depression
1800	30.9	87.5	996	30	" "

Table 1 (continued).

Preliminary Best Track - Hurricane Georges, 15 September - 01 October 1998.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
30/0000	30.8	86.9	998	30	Tropical Depression
0600	30.7	86.3	1000	30	" "
1200	30.7	85.4	1002	25	" "
1800	30.6	84.2	1004	25	" "
10/01/0000	30.5	83.0	1006	25	" "
01/0600	30.5	81.8	1008	20	" "
01/1200					Dissipated
20/0600	16.0	56.3	937	135	Minimum Pressure
L A N D F A L L S					
21/0430	17.0	61.7	966	100	ANTIGUA 3 SM SE of Falmouth
21/0800	17.2	62.6	966	100	ST. KITTS 8 SM SE of Basseterre
21/2200	18.1	65.8	968	100	PUERTO RICO 20 SM SW of Fajardo
22/1230	18.2	68.7	962	105	DOMINICAN REPUBLIC 84 SM E of Santo Domingo
23/2130	20.1	74.5	993	65	CUBA 30 SM E of Guantanamo Bay
25/1530	24.5	81.8	981	90	Key West, Florida
28/1130	30.4	88.9	964	90	Biloxi, Mississippi

Table 2.
Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kt) ^a	Peak Gust (kt)	Date/ Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total Rain (in)
U.S. Virgin Islands								
St. Croix								
Hamilton Airport	976.0		64	79	21/184			6.79
Viterna/Hermon Hill			71	81	21/181			
Maria Hill [@]	972.2		78	98	21/153			
Jolly Hill								7.41
Estate The Sight/CO-OP								2.63
Annaly/CO-OP Observer								5.30
East Hill/CO-OP Observer								6.20
St. Thomas								
Cyril E. King Airport	991.0		66	81	21/203			4.99
Bonne Resolution Gut								6.02
National Park Service Guinea								5.70
Wintberg/CO-OP Observer								2.26
St. John								
USGS Rain Gage								3.41
Coral Bay/CO-OP Observer								3.41
Catherineburg/CO-OP Observer								2.40
								7.56
Puerto Rico								
Luis Munoz Marin Intl. Airport	979.7		69	81	21/231			5.26
Roosevelt Roads NS (TJNR)	971.4		76	93	21/225			4.57
Ponce (TJPS)			65	85	22/033			
Quebradillas [@]	978.4		78	85	22/024			
Naranjito (Barrio Guadiana Alto) [@]				109	22/004			
Rincon [@]	983.1		87	113	22/044			
Mayaguez Bo Guanajibo	976.9							
Cupey Rio Piedras/CO-OP	974.5							9.39
Isabela KP4MYO [@]			89	143	22/061			
Yabucoa [@] (Courtesy of Sun Oil			65	83	21/214			
USGS Rain Gages								
Caguas								28.67
Lago El Guineo / Villalba								24.62
Rio Saliente at Coabey Ne Jayuya								24.30
Rio Portuguez at Tibes								18.46
Quebrada Salvatierra / San								16.93
Rio Grande de Arecibo / Utuado								16.87
Lago Garzas / Adjuntas								13.49
River Espiritu Santo / Rio Grande								13.04
NWS CO-OP Observer Rainfall								
Jayuya								28.36
Orocovis (Cacao)								23.62
Coamo								22.50
Mayaguez City								21.30
Cayey								20.97
Maricao								18.75
Juana Diaz (Guayabal)								17.35
Ponce								13.83
San Lorenz								12.99
Yauco								9.62
Trujillo Alto								8.33

Table 2 (Continued).
Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total Rain (in)
Cuba								
Punta Lucrecia			71					
Sagua La Grande				80				
Cayo Coco	988.0							
Guantanamo Bay			60		20/0245			8.98
Limonar								24.41
Bermeja								20.32
Santiago de Cuba								18.54
Nueva								12.44
Ciego de Avila								7.91

^a Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.

^c Storm surge is water height above normal astronomical tide level.

^e Estimated.

^g Gage failed at 27/1945UTC.

[#] Preliminary estimate.

^o Unofficial observer data.

^b Date/time is for sustained wind when both sustained and gust are listed.

^d Storm tide is water height above NGVD.

^f Power failed shortly after this observation; a higher value may have occurred.

^h Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.

Table 2 (continued).
Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total Rain (in)
Florida								
Leesburg	1013.3	25/1953	19	31	25/2218			1.19
Sanford	1013.6	25/2055	20	30	25/1834			1.81
Patrick AFB (KCOF)	1013.5	25/1955	15	23	25/1943			
Titusville (KTIX)	1011.9	25/1550	20	40	25/1550			1.69
Miami Intl. Airport (KMIA)			33	44	25/1056			0.94
Tamiami Airport			33	57	24/2318			
NWSFO MIA/TPC								1.76
Homestead								3.50
Tavernier								8.41
Duck Key			70	84	25/XXXX			
Marathon Airport (KMTH)				58	25/1100			
Marathon/Monroe EOC				96	25/XXXX			
Vaca Key						4-5		
Grassy Key						4-5		
Cudjoe Key						5-6		
Ramrod Key						5-6		
Big Pine Key						5-6		
Summerland Key						5-6		
New Port Richey (RRF)	1011.4	25/1953	20	36	25/2153			1.71
St. Pete/Clearwater (KPIE)	1010.7	25/1953	24	34	25/2117			0.65
St Petersburg (KSPG)	1010.1	25/1953	23	35	25/2331			
Tampa Airport (KTPA)	1010.6	25/2056	20	30	25/2116			1.23
McDill AFB (KMCF)	1010.8	25/1955	20	37	25/2100			1.04
Old Port Tampa			11	33	25/2150			
Sunshine Skyway			29	33	25/2150			
Winter Haven (GIF)	1012.2	25/1953	19	31	25/2146			0.89
Sarasota/Brad Airport (KSRQ)	1009.0	25/1853	29	36	25/1926			2.14
Punta Gorda (PGD)	1009.5	25/2053	30	42	25/1816			0.42
Fort Myers (KFMY)	1008.2	25/1753	31	38	25/1732			0.70
Regional SW Airport (RWS)	1007.7	25/1653	24	37	25/1703			
Naples			31	48	25/1855			
Inverness (INVF1)								0.46
Ruskin (KTBW)								1.43
Arcadia/Horse CK (ARHF1)								3.02
Levy County							2-4 ^e	
Citrus County							1-3 ^e	
Hernando County							2-3 ^e	
Pasco County							1 ^e	
Pinellas County							2-3 ^e	
Hillsborough County							2-3 ^e	
Manatee County							3 ^e	
Sarasota County							3-4 ^e	
Charlotte County							4-5 ^e	
Lee County							2-3 ^e	
Tallahassee Airport (KTLH)	1003.3	30/0752	24	29	29/2224			6.42
FSU Weather Station				39	26/2129			

^a Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.
^c Storm surge is water height above normal astronomical tide level.
^e Estimated.
^g Gage failed at 27/1945UTC.
[#] Preliminary estimate.
^o Unofficial observer data.

^b Date/time is for sustained wind when both sustained and gust are listed.
^d Storm tide is water height above NGVD.
^f Power failed shortly after this observation; a higher value may have occurred.
^h Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.

Table 2 (continued).
Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Time (UTC)	Sust. Wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total Rain (in)
Florida (continued)								
Apalachicola (KAQQ)			28	33	29/1311			
Panama City Airport (KPAM)			24	37	29/0605			
Munson (NE of Milton)								38.46
Bay Minette								29.66
Andalusia								26.90
Milton (CO-OP)								25.06
Milton School								14.62
Milton/Whiting Field (NSE)	992.5	n/a	38	50	28/0240			18.41
Destin (DTS)	999.4	29/2353	33	49	28/0156			6.21
Hurlburt AFB (HRT)	1000.0	29/2200	44	69	29/0216			17.08
Crestview (KCEW)	999.6	29/2253	28	43	28/2005			19.98
Eglin AFB (KVPS)	994.0	29/2300	42	79	28/0642			24.24
Pensacola APT (KPNS)	998.7	29/0953	44	58	28/0321			15.78
Pensacola NAS (KNPA)	997.9	29/0956	40	61	27/2200			12.84
Pensacola EM Office				61	28/0235			
Pensacola (TV Station)								26.83
Shell Point Sailboard Club				39	29/2045			
St. Teresa Beach				49	29/2225			
Pensacola Beach						7.7		
Choctawhatchee Bay						5.2		
Destin Harbor						5.2		
Panama City Beach						5.2		
Alabama								
Mobile Regional Airport (KMOB)	989.9	28/0921	44	55	28/0924			15.02
Mobile Brookley Field (BFM)	989.9	28/0853	47	54	27/2240			
Evergreen (GZH)	999.6	29/2041	31*	39*	29/0353			7.67
Fairhope AG. Station				56	28/0709			14.57
Fairhope (CO-OP)								15.82
Grand Bay AG. Station				52	28/1811			
Semmes AG. Station				43	28/1836			17.84
Alabama Port								13.66
Atmore Nursery (CO-OP)								15.15
Bay Minette (CO-OP)								29.66
Brewton								14.80
Brewton AG Center								16.34
Brewton (CO-OP)								18.44
Leakesville (CO-OP)								11.44
Niceville								19.53
Alberta (CO-OP)								9.90
Georgiana (CO-OP)								19.15
Jackson (CO-OP)								12.76
Thomasville (CO-OP)								10.20
Whatley (CO-OP)								15.15
Mobile Downtown								13.13
Greenville (CO-OP)								18.15
Andalusia (TV Station)								26.90
Gulf Breeze								26.87
Jay								18.19
Spanish Port								19.86
Camden (CO-OP)								10.77
Gulf Shores						9.0*		
Bayou La Batre						8.8*		
Downtown Mobile						8.5*		
Fort Morgan - Gulf						8.5*		
Mobile Bay - Belle Fontaine						8.3*		

Table 2 (continued).
Hurricane Georges selected surface observations, September 1998.

Location	Pres. (mb)	Date/ Tme (UTC)	Sust. Wind (kts) ^a	Peak Gust (kts)	Date/ Time (UTC) ^b	Storm Surge (ft) ^c	Storm Tide (ft) ^d	Total Rain (in)
Alabama (continued)								
Weeks Bay						6.5*		
Fort Morgan - Bay						5.8*		
Ono Island						5.4*		
Dauphin Island - Bay						5.3*		
Mississippi								
Gulfport Airport (KGPT)			42	63	28/0931 ^f			
Keesler AFB (KBIX)	964.9	28/1055	65		28/0855			9.18
Pascagoula/Trent Lott Airport (KPQL)			36	47	27/2306 ^f			
Gulfport Harbor - Harrison County CD			53	69	28/1015	8.1		
Gulfport - 1 MI North of Beach (Courtesy of MS Power and Light)				102 ^h	n/a			
Gulfport - Harrison County CD	967.2	28/1015						
Pascagoula CO-OP Observer								16.68
Ocean Springs								15.68
Vancleave								14.81
Wiggins								13.25
Lyman								9.85
Pass Christian Harbor						6.2		8.79
Pascagoula - Bayou Chico						9.6*		
Biloxi - Black Bay						8.8*		
Gulfport						7.6*		
Pass Christian						6.4*		
Bay St. Louis						5.8*		
Louisiana								
New Orleans Intl. Airport (KMSY)	996.6	28/1052	35	46	28/1137 ^f			
New Orleans Lakefront APT (KNEW)	994.5	28/0953	39	48	28/0911 ^f			
Slidell (KSIL)			31	42	28/0401 ^f			0.87
Lake Pontchartrain								
East Lake - Rigolets			37	54	28/0910	5.8		
Mid Lake - Pontchartrain Causeway			42	59*	28/1020	4.7		
West Lake - Frenier			33*	45	28/0110	4.7		
North Lake - Mandeville			21	42	28/0840			
New Orleans Audubon Park								0.88
Slidell CO-OP Observer								1.48
Covington CO-OP Observer								1.11
Bogalusa CO-OP Observer								2.98
West End Marina						5.3		
Industrial Canal						7.3		
North End Causeway						4.3		
Lake Borgne								
Bayou Bienvenu						7.4		
Bayou Dupre						6.4		
Plaquemines Parish - East Side								
NE Gardene Bay (13 MI ESE of Pointe A La Hache)							8.9 ^f	

^a Standard NWS ASOS and C-MAN averaging period is 2 min; buoys are 8 min.
^c Storm surge is water height above normal astronomical tide level.
^e Estimated.
^g Gage failed at 27/1945UTC.
[#] Preliminary estimate.
[@] Unofficial observer data.
^{*} - U.S. Army Corps of Engineers Data (Mobile District)

^b Date/time is for sustained wind when both sustained and gust are listed.
^d Storm tide is water height above NGVD.
^f Power failed shortly after this observation; a higher value may have occurred.
^h Maximum gusts recorded (time unknown) higher gusts may have occurred; anemometer height 30 feet AGL.

Table 3.

Hurricane Georges selected amateur radio surface weather reports, September 1998.

REPORTING STATION CALL SIGN	LOCATION	DATE/TIME (UTC)	PRESSURE (mb)	SUSTAINED WIND (MPH)	PEAK WIND (MPH)
W. Resto	Cayey PR-18.1N/66.15W	21/2300		17	51
KRRF	PR/18.4N 66.9W	22/0300	1008.5	80-90	80-90
KP4SC	Puerto Rico/Ponce	21/0020		60+	60+
WP4MTG	Puerto Rico/Fajardo	21/2340		113	113
WP4MZA	Puerto Rico/Fajardo CD	21/2115		110*	125-130*
		21/2130		110*	117-130*
		21/2140		80*	110*
KP4RF	Puerto Rico/Carilina	21/2230		42*	62*
		21/2230		55*	93*
K4FCZ	Vieques Isl/18.1N56.2W	21/1449	1009.1	30-40	30-40
		21/2000	974.6	Over 100	
		21/2020	967.8	35-40	50
N5NG	Culebra Island	21/1739		58-69	
		21/2238	998.0	58	69
N2PB	St. Croix	21/1109	1008.8	20-35	42
		21/1145	1007.1	20-35	42
		21/XXXX	1006.4	45	
		21/1316	1005.4	35-50	
		21/1502	990.2	55-60	
		21/1528	981.4	50-60	90
NP2L	St. John	21/1303	1007.5	20-35	43
		21/1400	1004.9	48*	54*
		21/1615	996.8	90	143
		21/XXXX	1001.3	74-76	85
VP2VQN	Tortolla Island	21/1200		40-45	
8R1BB/NP2	St. Thomas	21/1237		35+	60+
KV4FZ	St. Croix EOC	21/0107	1013.2		
		21/1033	1011.5	58	
		21/1424		46	63
		21/1452		46	81
		21/1800		58	104

* - measured

Table 4.

Hurricane Georges selected National Buoy Data Center (NBDC) observations, September 1998.

Location	Press (mb)	Date/Time (UTC)	Sust. Wind (kt) ^a	Peak Gust (kt)	Date/Time (UTC) ^b	Significant Wave Height (FT)
CMAN Stations						
Lake Worth, FL (LKWF1)	1010.0	25/1100	30	35	25/1400	
Fowey Rocks, FL (FWYF1)	1006.3	25/1000	45	52	25/1000	
Molasses Reef, FL (MLRF1)	1003.1	25/0800	46	53	25/1400	
Long Key, FL (LONF1)	1000.0	25/1000	47	58	25/1400	
Sombrero Key, FL (SMKF1)	994.5	25/1300	81	92	25/1500	
Sand Key, FL (SANF1)	990.5 ^c	25/1300	56	71	25/1400	
Dry Tortugas, FL (DRYF1)	976.3	25/2000	59	68	26/0000	
Venice, FL (VENF1)	1011.6	30/0900	24	27	30/1800	
Keaton Beach, FL (KTNF1)	1005.4	30/0900	30	37	29/2300	
Cedar Key, FL (CDRF1)	1007.2	30/1000	29	34	30/0500	
Cape San Blas, FL (CSBF1)	1003.2	30/0800	38	43	29/1900	
Dauphin Island, AL (DPIA1)	987.0	28/0800	59	71	28/0600	
Grand Isle, LA (GDIL1)	997.3	28/0100	40	50	27/2000	
Southwest Pass, LA (BURL1)	989.1	27/2200	54	63	27/2200	
NOAA Buoys						
42003 (25.9N / 89.9W)	983.2	26/1800	51	66	26/2000	23.5
42039 (28.8N / 86.0W)	1002.6	27/0700	43	56	27/0300	22.5
42036 (28.5N / 84.5W)	1009.2	27/0100	34	48	26/1800	17.4
42040 (29.2N / 88.3W)	963.4	27/2300	54	68	27/1900	35.7
42007 (30.1N / 88.8W)	983.5 ^c	28/0400	44 ^c	54 ^c	27/2100	16.0 ^c
NDBC Buoy						
41522 (14.3N/58.7W)			35		20/1852	
34-Knot Ship Reports						
PJPS (13.3N / 67.0W)	1011.0	19/1800	35		19/1800	6.6
WFLG (19.5N / 66.4W)	1015.0	22/0900	38		22/0900	13.1
DHPK (23.3N / 71.9W)	1009.0	23/0600	35		23/0600	9.8
FNZP (24.0N / 87.8W)	1009.4	27/0600	43		27/0600	3.3
LAVD4 (29.1N / 87.0W)	1004.5	29/0600	37		29/0600	9.8
PJKP (29.3N / 85.7W)	1002.9	29/1500	44		29/1500	9.8
C6JN (29.4N / 87.8W)	1002.1	29/1800	35		29/1800	13.1
PFEI (27.7N / 85.1W)	1006.4	30/1200	39		30/1200	6.6

^a Standard NWS C-MAN averaging period is 2 min; buoys are 8 min.^b Date/time is for sustained wind when both sustained and gust are listed.^c Buoy failed shortly after this observation; a lower pressure and a higher wind and wave height may have occurred.

Table 5.

Deaths and insured damage estimates associated with Hurricane Georges. Death figures based on reports from respective governments and/or media sources. United States damage estimates courtesy of the American Insurance Services Group/PCS Division.

LOCATION	Deaths	Damage Estimate (\$ Billions)
<i>Antigua</i>	2	
<i>St. Kitts and Nevis</i>	4	0.402[®]
<i>U.S. Virgin Islands</i>	0	0.050
<i>Puerto Rico</i>	0	1.750
<i>Dominican Republic</i>	380*	>1.0[®]
<i>Haiti</i>	209*	
<i>Bahamas</i>	1	
<i>Cuba</i>	6	
<i>United States (Mainland)</i>		
Florida	0	0.340
Mississippi	0	0.665
Alabama	1	0.125
Louisiana	0	0.025
United States Total	1	2.955
<i>Storm Total</i>	602	

* - These are the best estimates received to-date; subject to revision at a later date.

® - Estimates from media reports - no official figures have been received.

Table 6.

Preliminary track forecast evaluation of Hurricane Georges - heterogeneous sample. Errors in nautical miles for tropical storm and hurricane stages with number of forecasts in parenthesis. Numbers in italics represent forecasts which were better than the official forecast.

Forecast Technique	Period (hours)				
	12	24	36	48	72
CLIP	30 (50)	56 (48)	85 (46)	112 (44)	169 (40)
GFDI	32 (50)	60 (48)	76 (46)	95 (44)	148 (40)
GFDL*	32 (50)	60 (48)	77 (46)	92 (44)	135 (40)
LBAR	25 (50)	45 (48)	64 (46)	90 (44)	140 (40)
AVNI	41 (36)	74 (34)	115 (32)	170 (28)	358 (24)
AVNO*	81 (40)	97 (38)	119 (36)	149 (32)	277 (28)
BAMD	34 (50)	67 (48)	104 (46)	147 (44)	242 (40)
BAMM	37 (50)	74 (48)	113 (46)	154 (44)	245 (40)
BAMS	58 (50)	108 (48)	159 (46)	211 (44)	307 (40)
NGPI	28 (42)	52 (41)	86 (40)	118 (39)	181 (37)
NGPS*	34 (22)	39 (21)	60 (20)	91 (20)	152 (19)
UKMI	36 (47)	71 (45)	98 (42)	128 (38)	178 (34)
UKM*	31 (24)	58 (23)	89 (22)	121 (20)	166 (18)
A90E	30 (50)	62 (48)	105 (46)	159 (44)	220 (40)
A98E	30 (50)	62 (48)	105 (46)	169 (44)	254 (40)
A9UK	31 (22)	53 (21)	72 (20)	89 (20)	129 (18)
EMX		70 (10)		84 (9)	125 (9)
NHC Official	28 (50)	49 (48)	71 (46)	87 (44)	117 (40)
NHC Official 10-Year Average (1988-1997)	47 (1838)	88 (1633)	127 (1449)	165 (1284)	248 (1006)

* - Output from these models was unavailable at time of forecast issuance.

Table 7.

Mean absolute intensity forecast errors for Hurricane Georges - homogeneous sample. Number in parenthesis below 10-Year averages is the number of cases.

Forecast Technique	Period (hours)				
	12	24	36	48	72
SHIPS	8.9 (-0.1)	14.7 (0.8)	18.6 (1.3)	20.6 (2.8)	25.5 (6.1)
GFDI	11.0 (-6.2)	15.1 (-3.1)	17.8 (-2.1)	19.7 (-3.0)	24.0 (-8.2)
GFDL*	20.4 (-19.7)	18.5 (-16.8)	18.2 (-13.7)	18.5 (-13.6)	22.7 (-16.2)
SHFR	10.3 (0.8)	17.7 (0.9)	22.3 (-1.2)	25.2 (-3.2)	28.4 (-6.0)
NHC Official	7.2 (0.2)	13.1 (1.5)	15.9 (3.9)	18.3 (7.4)	25.3 (3.8)
Number of Cases	50	48	46	44	40
NHC Official 10-Year Average (1988-1997)	7.0 (-1.5) (1905)	12.0 (-2.3) (1724)	15.9 (-3.8) (1548)	18.5 (-5.2) (1373)	21.4 (-5.8) (1062)

* - Output from this model is unavailable at time of forecast issuance.

Table 8.
Watch and warning summary, Hurricane Georges, September 1998.

Date/Time (UTC)	Action	Location
18/2100	Hurricane Watch Issued	St. Lucia to Anguilla including Saba and St. Maarten.
19/1500	Hurricane Watch Extended North/East	St. Lucia northward and then northwestward to the British/U.S. Virgin Islands
19/2100	Hurricane Warning Issued	Dominica northward to Anguilla except St. Barthelemy and the French portion of St. Martin.
19/2100	Hurricane Watch Issued	Puerto Rico
20/0300	Tropical Storm Warning	St. Lucia and Martinique
20/0900	Hurricane Warning extended westward	Dominica north and west to Puerto Rico
20/2100	Hurricane Watch Issued	Dominican Republic
21/0900	Hurricane Warning extended westward	Dominica north and west to the Dominican Republic
21/0900	Tropical Storm Warning and Hurricane Watch discontinued	Martinique to St. Lucia
21/1500	Hurricane Watch extended north and west	North coast of Haiti from St. Nicolas to the border of the Dominican Republic / Southeast Bahamas, the Turks and Caicos Islands.
21/1500	Hurricane Warning discontinued	All islands east of the Virgin Islands except Antigua, Barbuda, and the French Islands of St. Barthelemy and St. Martin.
21/1500	Hurricane Warning discontinued	Antigua, Barbuda, and the French Islands of St. Barthelemy and St. Martin.
21/1900	Hurricane Watch Issued	Eastern Cuba from the Province of Las Tunas to Guantanamo
22/0300	Hurricane Warning extended westward	U.S. & British Islands, Puerto Rico, Dominican Republic, Haiti, the Southeast Bahamas, the Turks and Caicos Islands.
22/0900	Hurricane Warning discontinued	U.S. & British Virgin Islands
22/1500	Hurricane Warning Issued	Eastern Cuba from the Province of Las Tunas to Guantanamo, the Central Bahamas from Acklins to Cat Island
22/1500	Hurricane Watch Issued	Eastern Cuba for the Provinces of Camaguey to Sancti Spiritus
22/1500	Hurricane Warning discontinued	Puerto Rico
23/0900	Hurricane Warning Issued	Eastern Cuba for the Provinces of Camaguey to Sancti Spiritus / Central Bahamas.
23/0900	Hurricane Watch Issued	South Florida from Deerfield Beach southward on the east coast...and from south of Bonita Beach on the west coast including the Florida Keys.

Table 8 (continued).
 Watch and warning summary, Hurricane Georges September, 1998.

Date/Time (UTC)	Action	Location
23/0900	Hurricane Watch Issued	Western Cuba for the Provinces of Villa Clara, Cienfuegos and Matanzas/Northwest Bahamas.
23/1500	Tropical Storm Warning Issued	Jamaica
23/1500	Hurricane Warning discontinued	Dominican Republic
23/2100	Tropical Storm Warning Issued	Cayman Islands...Cayman Brac and Little Cayman.
24/0600	Hurricane Warning discontinued	The Southeast Bahamas, the Turks and Caicos Islands.
24/0900	Hurricane Warning Issued	Northwest Bahamas/ South Florida from Deerfield Beach southward on the east coast...and from south of Bonita Beach on the west coast including the Florida Keys.
24/0900	Hurricane Watch Issued	Florida east coast north of Deerfield Beach to Stuart...and the Florida west coast north of Bonita Beach to Longboat Key.
24/0900	Hurricane Warnings discontinued	Haiti
24/1500	Tropical Storm Warnings discontinued	Cayman Islands...Cayman Brac and Little Cayman.
24/2100	Tropical Storm Warning Issued	Florida east coast north of Deerfield Beach to Stuart.
25/0300	Hurricane Warning Issued	Florida west coast north of Bonita Beach to Longboat Key.
25/0300	Tropical Storm Warning Issued	Florida west coast north of Longboat Key to Bayport.
25/0300	Hurricane Warnings discontinued	Central Bahamas.
25/0500	Hurricane Watch discontinued	Florida east coast Deerfield Beach to Stuart.
25/0700	Hurricane Warnings discontinued	Cuba
25/0700	Hurricane Watch discontinued	For Cuba east of Matanzas to Pinar Del Rio.
25/1300	Hurricane Warning changed to a Tropical Storm Warning	Florida east coast from north of Florida City to Deerfield Beach.
25/1500	Hurricane Watch Issued	Gulf Coast from Morgan City Louisiana to St. Marks Florida.
25/1500	Hurricane Warnings discontinued	Northwest Bahamas.
25/2100	Tropical Storm Warnings discontinued	Florida east coast from north of Florida City to Deerfield Beach.

Table 8 (continued).
 Watch and warning summary, Hurricane Georges, September 1998.

Date/Time (UTC)	Action	Location
25/2100	Hurricane Warnings discontinued	Florida east coast south of Florida City to Key Largo.
26/0300	Hurricane Warning changed to a Tropical Storm Warning	Florida Keys south of Key Largo and Florida west coast south of Bayport.
26/0300	Hurricane Watch discontinued	For Cuba east of Matanzas to Pinar Del Rio.
26/0900	Tropical Storm Warnings discontinued	Florida west coast from Longboat Key to Bayport.
26/1200	Tropical Storm Warnings discontinued	Florida Keys south of Key Largo and the Florida west coast south of Longboat Key
26/1500	Hurricane Warning Issued	Morgan City, Louisiana to Panama City, Florida.
26/1500	Tropical Storm Warning and a Hurricane Watch	Panama City, Florida to St. Marks, Florida.
26/1500	Hurricane Watch	Morgan City, Louisiana to Intracoastal City, Louisiana.
27/2100	Hurricane Watch discontinued	Panama City, Florida to St. Marks, Florida.
28/0300	Hurricane Watch discontinued	Morgan City, Louisiana to Intracoastal City, Louisiana.
28/1500	Hurricane Warning discontinued	Destin, Florida to Panama City, Florida.
28/1500	Tropical storm Warning discontinued	Panama City, Florida to St. Marks, Florida.
28/1500	Hurricane Warning changed to a Tropical Storm Warning	Grand Isle, Louisiana to Morgan City, Louisiana.
28/2100	Hurricane Warning changed to a Tropical Storm Warning	Grand Isle, Louisiana to Destin, Florida
28/2100	Tropical Storm Warning discontinued	Grand Isle, Louisiana to Morgan City Louisiana.
29/0300	Tropical Storm Warning discontinued	Grand Isle, Louisiana to the Mouth of the Mississippi River, Louisiana.
29/0900	Tropical Storm Warning discontinued	Mouth of the Mississippi River to Pascagoula, Mississippi.
29/1500	Tropical Storm Warnings discontinued	Pascagoula, Mississippi to Destin, Florida.