

PRELIMINARY REPORT
HURRICANE GILBERT
08 - 19 SEPTEMBER 1988

SYNOPTIC HISTORY

On 3 September a westward moving tropical wave showing no signs of organization emerged from the northwest African coast over the open waters of the North Atlantic. During the next several days a broad low pressure area associated with the tropical wave developed over the Atlantic midway between Africa and the Lesser Antilles with ship reports indicating the circulation extended nearly to the equator. An organized circulation center was not evident on satellite imagery until the system was approaching the Windward Islands on 8 September. On 9 September the low was classified by satellite as the 12th tropical depression of the 1988 hurricane season when it was located about 400 miles east of Barbados. See Figure 1.

The depression moved on a west northwest course around 15 knots with satellite and reconnaissance reports indicating that it had attained tropical storm strength as it moved over the Lesser Antilles the afternoon of 9 September. Tropical Storm Gilbert rapidly strengthened on 10 September and was classified as a hurricane by that evening.

Gilbert continued to strengthen as it brushed the south coast of Hispaniola, then passed directly over the island of Jamaica as a category 3 hurricane on the Saffir-Simpson Scale with sustained winds of 110 knots and a minimum pressure of 960 mb(28.35 inches). Following the passage of the center across Jamaica, Gilbert went through a remarkable intensification period with the pressure falling from 960 mb(28.35 inches) to 888 mb(26.22 inches) in 24 hours. The 888 mb pressure was observed by a NOAA plane near 19.5N and 83.3W at 2152 UTC on 13 September and is the lowest sea level pressure ever recorded in the Western Hemisphere. At the same time the plane measured 160 knot sustained winds at 10,000 feet with a peak wind of 173 knots. During the period of rapid strengthening Gilbert continued on a west northwest course at 15 knots under the influence of a persistent high pressure to the north. The center passed a short distance southeast of Grand Cayman Island with a wind gust of 136 knots recorded there at 1900 UTC. See Table 2.

The center of Gilbert crossed over the northeast portion of the Yucatan Peninsula on 14 September as a category 5 hurricane, the first category 5 hurricane to make landfall in the western hemisphere since Camille in 1969. The hurricane lost strength quite rapidly as the eye moved across the Yucatan Peninsula with the minimum pressure rising to around 950 mb(28.05 inches) by the time the center emerged over the southwest Gulf of Mexico. Gilbert continued on the same west northwest course around 15 knots across the Gulf and reached the northeast Mexican coast just north of the town of La Pesca around 2200 UTC on 16 September as a category 3 hurricane.

The center of the weakening storm passed south of Monterrey, Mexico on 17 September then turned toward the north and moved across western Texas and into Oklahoma as a heavy rain storm on 18 September. It finally merged with a developing frontal low pressure system over Missouri on 19 September.

The synoptic six-hourly positions by latitude and longitude, along with lowest sea level pressure, maximum winds and classification can be found in Table 1. The track of Hurricane Gilbert with 0000 UTC and 1200 UTC positions is shown in Figure 1.

METEOROLOGICAL STATISTICS

Weather observations in the three landfall areas were difficult to obtain. The only weather office to measure the maximum winds in Gilbert was Kingston, Jamaica which reported sustained winds of 101 knots with gusts to 122 knots. An unofficial report of 105 knots with gusts to 128 knots was measured by a ham radio operator located 15 miles northeast of Kingston. There were no official reports of maximum winds near the center in the landfall areas of Mexico. Along the lower Texas coast winds in the Brownsville area gusted to 58 knots with gusts to 72 knots reported near Port Isabel by an observer with a truck mounted anemometer. A gust of 53 knots was observed by the National Weather Service in Corpus Christi. See Table 2.

Likewise no minimum pressure readings in the eye of Gilbert were reported as it moved ashore in Mexico. The weather office in Kingston had a minimum pressure of 964.8 mb in the eye. The pressure was estimated to be near 900 mb when the eye of Gilbert moved over Cozumel, Mexico. See Table 1.

Torrential rains accompanied the hurricane with between 5 and 10 inches falling over the coastal sections and much greater amounts in the mountainous areas of Jamaica and Mexico. Massive flooding in the Monterrey, Mexico area caused many of the deaths attributed to Gilbert. Rains of 2 to 4 inches fell across south Texas with local amounts of more than 8 inches observed near Aransas Pass.

A 15 to 20 foot storm surge (rise of the level of the sea) likely occurred along the immediate coast near and just to the north of where the center moved inland over the northeast Yucatan peninsula. A surge of 8 to 13 feet struck the coast of eastern Mexico near and just to the north of landfall. There was a report of a 9 foot surge topped by 30 foot waves on the northeast coast of Jamaica. Tides of 3 to 5 feet above normal were reported along the Texas coast with a number of low-lying roads under water. There was considerable beach erosion on Padre Island. See Table 2 for details of meteorological statistics.

At least 29 tornadoes were observed across south Texas with most of the damage occurring in the San Antonio area. This total included 10 in the Lower Rio Grande Valley, 5 around Corpus Christi and at least a half a dozen in the San Antonio area. The greatest destruction there occurred at the Air Logistics Center on Kelly Air Force base where a number of large storage hangers were destroyed with damage estimated near 22 million dollars. A tornado in Del Rio destroyed 15 homes and damaged 50 others with damage estimated to be nearly 2 million dollars.

CASUALTY AND DAMAGE STATISTICS

The death toll from Gilbert was reported to be 318 people. Several countries in the Caribbean reported deaths, with the death toll of 202 from Mexico being by far the largest. The only deaths in the United States were due to tornadoes in San Antonio, Texas with 3 people killed in that city. The latest death statistics by country: Mexico 202, Jamaica 45, Haiti 30, Guatemala 12, Honduras 12, Dominican Republic 5, Venezuela 5, United States 3, Costa Rica 2 and Nicaragua 2.

The estimated damage throughout the area was probably near five billion dollars. Jamaica had nearly two billion dollars damage and in Mexico damage was estimated between one and two billion dollars. Reports from the Mexican government indicate that more than sixty thousand homes were destroyed in that country. The

most extensive damage over the United States was in San Antonio where damage caused by a number of tornadoes amounted to 30 million dollars. Elsewhere over south Texas damage was confined to beach erosion along Padre Island and in the Lower Rio Grande where high winds and a few tornadoes downed a number of trees, signs and power lines. Total damage in the United States was estimated to be between 40 and 50 million dollars.

FORECAST AND WARNING CRITIQUE

Warnings generally conformed with the track of Gilbert over the Caribbean. Due to the possible strengthening of the system into a tropical storm as it approached the Lesser Antilles, a tropical storm watch could have been issued for a portion of the Windward Islands. Over the Gulf of Mexico hurricane warnings were issued from Tampico, Mexico to Port O'Connor, Texas. In retrospect, this warning area is probably excessive. However, the size and strength of the hurricane, plus the uncertainty of the forecast track, made this size warning necessary. North of Port O'Connor a hurricane watch was issued for the remainder of the Texas coast. This was reasonable since many of the guidance products from NHC and NMC forecast a turn toward the north as the hurricane approached the Texas coast. See Table 3 for a summary of the warnings. The time between when a hurricane warning was issued until the center crossed the coast was about 22 hours for Jamaica, 26 hours for the Yucatan peninsula and 34 hours for eastern Mexico. Hurricane watches were issued 9 to 15 hours prior to the warnings for these areas. Of course weather conditions deteriorated well before the "center" arrived, but these lead times generally provided sufficient times for preparations. Similar warning lead times were provided for other warned areas.

Most of the NHC objective forecast techniques handled Gilbert's track rather well during the period the hurricane was in the Caribbean. The NHC83 made an excellent 72-hour forecast when Gilbert was just east of Jamaica. The model forecast landfall over northeastern Yucatan within a few hours of the actual time the eye moved over the Yucatan peninsula. Over the Gulf of Mexico most of the techniques forecast a turn toward the northwest with landfall on the Texas coast. After the hurricane moved into the southwest Gulf of Mexico the NHC Cliper model was best at forecasting the point of landfall. On one occasion the NMC QLM hurricane model forecast did rather well through 48 hours, but forecast a turn toward the southwest in the last 24 hour period.

Figure Captions:

Figure 1. Best track of Hurricane Gilbert, 8 - 19 September 1988.

Figure 2. Minimum central surface pressure versus time for Hurricane Gilbert, 8 - 16 September 1988.

Figure 3. Maximum one-minute surface wind speed versus time for Hurricane Gilbert, 8 - 16 September 1988.

Table Captions:

- Table 1. Preliminary best track, Hurricane Gilbert, 08-19 September 1988.
- Table 2. Hurricane Gilbert surface observations, 08-19 September 1988.
- Table 3. Watches and warnings issued on Hurricane Gilbert,
- Table 4. Probability forecasts for 1988 landfalling U.S. tropical cyclones.

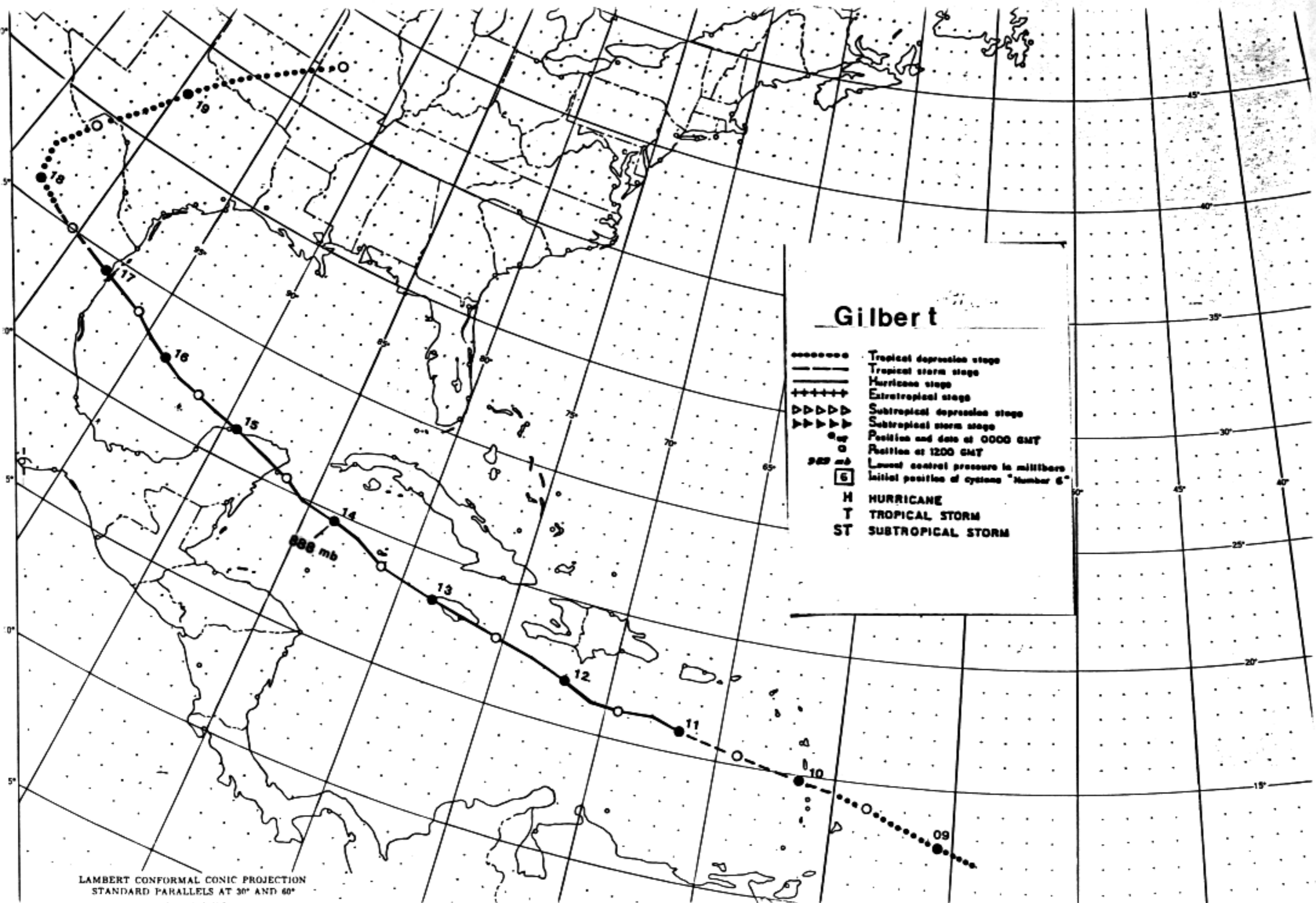
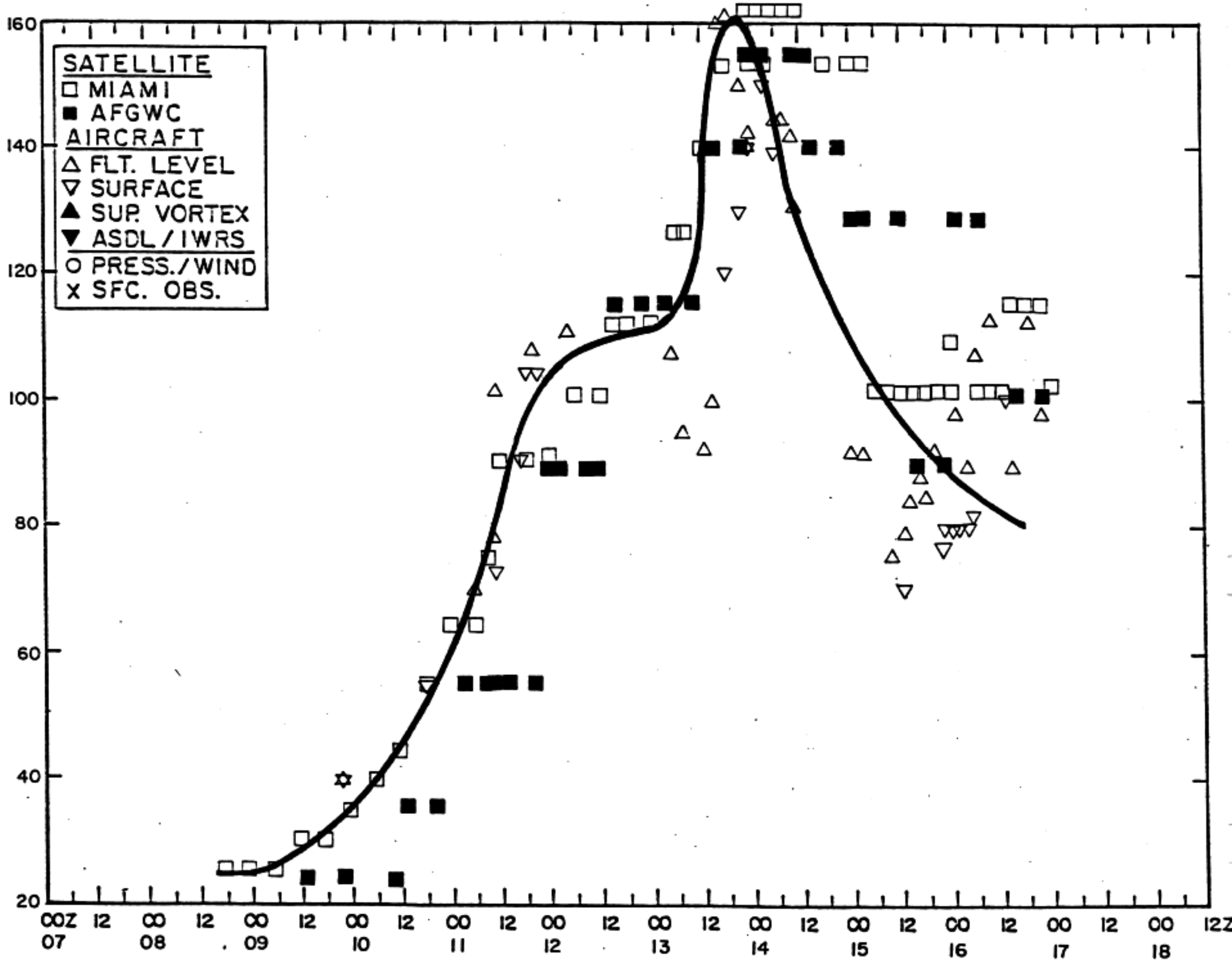


Figure 1. Hurricane Gilbert track, 9-19 September 1988.

WIND SPEED (KTS.)

-8-



DATE - TIME (UTC)

Table 1. Preliminary best track, Hurricane Gilbert, 08 - 19 September 1988

date/time (UTC)	position		pressure (mb)	wind speed (knots)	stage	
	lat.	lon.				
08/1800	12.0	54.0	1008	25	Tropical Depression	
09/0000	12.7	55.6	1007	25	"	"
0600	13.3	57.1	1006	30	"	"
1200	14.0	58.6	1005	30	"	"
1800	14.5	60.1	1004	35	Tropical	Storm
10/0000	14.8	61.5	1002	40	"	"
0600	15.0	62.8	998	45	"	"
1200	15.3	64.1	995	50	"	"
1800	15.7	65.4	992	55	"	"
11/0000	15.9	66.8	989	65	Hurricane	
0600	16.2	68.0	982	80	"	"
1200	16.1	69.5	975	95	"	"
1800	16.2	70.7	970	100	"	"
12/0000	16.8	72.0	964	105	"	"
0600	17.3	73.7	962	110	"	"
1200	17.6	75.3	960	110	"	"
1800	18.0	76.9	960	110	"	"
13/0000	18.3	78.5	960	110	"	"
0600	18.5	79.7	952	115	"	"
1200	18.8	81.1	934	125	"	"
1800	19.4	82.5	905	140	"	"
14/0000	19.7	83.8	888	160	"	"
0600	19.9	85.3	889	155	"	"
1200	20.4	86.5	892	145	"	"
1800	20.9	87.8	925	130	"	"
15/0000	21.3	89.5	944	100	"	"
0600	21.6	90.7	949	90	"	"
1200	21.9	91.7	950	85	"	"
1800	22.1	92.8	950	90	"	"
16/0000	22.5	93.8	949	100	"	"
0600	22.9	94.8	946	110	"	"
1200	23.7	95.9	948	115	"	"
1800	23.9	97.0	950	115	"	"
17/0000	24.4	98.2	964	80	"	"
0600	24.8	99.3	988	50	Tropical	Storm
1200	25.0	100.5	996	35	"	"
1800	25.4	101.9	1000	30	Tropical Depression	
18/0000	26.0	103.2	1002	30	"	"
0600	27.6	103.7	1004	30	"	"
1200	29.3	102.6	1005	25	"	"
1800	30.9	101.1	1005	25	"	"
19/0000	32.7	99.7	1005	25	"	"
0600	34.5	98.0	1002	25	"	"
1200	37.5	93.5	1001	25	"	"
Landfall:						
12/1700	17.8	76.8	960	115	Hurricane	
14/1500	20.7	87.0	900	140	"	
16/2200	24.2	97.8	955	110	"	

Table 2. Hurricane Gilbert surface observations, 08-19 September 1988

Location	Lowest Pressure (mb)	Date/time (UTC)	Max. Wind (kt)	Date/time (UTC)	Tide* (ft)	Rain† (in)
Jamaica						
Kingston	964.8	12/1815	101 G122	12/1730Z	5	
15 NE Kingston			105 G128			
NE coast					9	
Grand Cayman Island	976.5	13/1300	119 G136	13/1900	5	
Mexico						
No reports received						
United States(Texas)						
Brownsville	995.3	16/2135	41 G58	16/1809		5.38
South Padre Is.	997.6	16/2210	58 G72	17/0118	6	
Corpus Christi	1006.8	16/1952	32 G53	17/0631		2.65
N. Padre Is.			37 G50		4.4	
Flour Bluff(east Corpus)						4.69
Beeville NAS						4.50
Victoria	1009.8	15/2055	25 G35	15/2119		1.22
Galveston	1011.0	15/2100	22 G34	16/1254	4.2	0.25
Port Arthur	1012.0	15/2115	20 G27	15/2048	4	0.05

* Height above normal

† Storm total

TABLE 3. WATCHES AND WARNINGS ISSUED ON HURRICANE GILBERT.

<u>LOCATION</u>	<u>TYPE</u>	<u>EFFECTIVE</u>	<u>DISCONTINUED</u>
Southern coast of Dominican Republic	Tropical Storm Warning	10/2200Z	12/1300Z
Barahona Peninsula of Dominican Republic	Hurricane Watch	10/2200Z	11/0230Z
Barahona Peninsula of Dominican Republic	Hurricane Warning	11/0230Z	12/1300Z
Southern coast of Dominican Republic	Hurricane Watch	11/0230Z	12/0100Z
Southern coast of Haiti	Hurricane Warning	11/1000Z	12/1900Z
Jamaica	Hurricane Watch	11/1000Z	11/1900Z
South coast of Cuba east of Cabo Cruz	Hurricane Watch	11/1600Z	12/1300Z
Jamaica	Hurricane Warning	11/1900Z	13/1300Z
Cayman Islands	Hurricane Watch	12/1000Z	12/1300Z
South coast of Cuba east of Camaguey	Hurricane Warning	12/1300Z	12/2200Z
Cayman Islands	Hurricane Warning	13/1300Z	14/0700Z
South coast of Cuba east of Camaguey to Cienfuegos	Hurricane Watch	12/1300Z	13/0100Z
Northeast Yucatan from Felipe Carrillo Puerto to Progreso including Cozumel and Cancun	Hurricane Watch	12/2200Z	13/1300Z
Western Cuba for the province of Pinar Del Rio and Isle of Youth	Hurricane Watch	13/0100Z	13/1300Z

TABLE 3. Continued

<u>LOCATION</u>	<u>TYPE</u>	<u>EFFECTIVE</u>	<u>DISCONTINUED</u>
Northeast Yucatan from Felipe Carrillo Puerto to Progreso including Cozumel and Cancun	Hurricane Warning	13/1300Z	15/1000Z
Western Cuba for the province of Pinar Del Rio and Isla of Youth	Hurricane Warning	13/1300Z	15/0700Z
Yucatan peninsula south of Felipe Carillo Puerto to Chetumal on the east coast and south of Progreso to Champoton on the west coast	Hurricane Warning	14/1000Z	15/1000Z
Northern district of Belize	Hurricane Watch	14/1300Z	14/1600Z
Texas coast from Brownsville to Port Arthur	Hurricane Watch	15/0100Z	16/1900Z
Northeast Mexico from Tampico northward	Hurricane Watch	15/0100Z	15/1200Z
Texas coast from Brownsville to Port O'Connor	Hurricane Warning	15/1200Z	17/0400Z
Northeast Mexico from Tampico northward	Hurricane Warning	15/1200Z	17/1000Z

TABLE 4 Chances of the center of Hurricane Gilbert passing within 65 miles of (contd) listed locations by date and time (AST or EDT...both same) indicated; probabilities in percent.

ADVISORY DATE/TIME	11/NOON	11/6PM	12/MID	12/6AM	12/NOON	12/6PM	13/MID	13/6AM
PROBABILITY TIME	14/8AM	14/2PM	14/8PM	15/2AM	15/8AM	15/2PM	15/8PM	16/2AM
MDCB 17.6N 71.4W	62	65	79	—	—	—	—	—
MTPP 18.6N 72.4W	35	14	23	—	—	—	—	—
MDPP 19.8N 70.7W	4	—	—	—	—	—	—	—
MTCA 18.3N 73.8W	42	38	65	83	—	—	—	—
MBJT 21.5N 71.2W	3	—	—	—	—	—	—	—
MYMM 22.4N 73.0W	5	3	2	—	—	—	—	—
MYSM 24.1N 74.5W	5	4	4	—	—	—	—	—
MYEG 23.5N 75.8W	7	6	6	3	—	—	—	—
MYAK 24.1N 77.6W	8	8	7	5	—	—	—	—
MYNN 25.1N 77.5W	6	6	6	5	—	—	—	—
MYGF 26.6N 78.7W	4	6	5	5	—	—	—	—
MMVR 19.2N 96.1W	—	2	2	3	4	5	6	6
MMFR 18.5N 92.6W	4	4	4	5	4	7	8	7
MMMD 21.0N 89.7W	6	7	8	10	11	13	17	17
MKJP 17.9N 76.8W	26	33	45	66	—	—	6	—
MKJS 18.5N 77.9W	22	27	34	56	—	—	98	—
MUGM 20.0N 75.1W	19	15	16	11	—	—	—	—
SKSP 12.6N 81.7W	3	—	2	—	—	—	—	—
MUCM 21.4N 77.9W	14	14	14	13	8	—	—	—
MUCF 22.1N 80.5W	12	14	13	16	15	12	5	3
MUSN 21.6N 82.6W	12	—	14	19	22	25	24	21
MUHA 23.0N 82.4W	10	12	12	14	16	14	9	8
MUAN 21.9N 85.0W	9	12	12	15	19	21	25	26
MNPC 14.1N 83.4W	6	4	—	2	—	—	—	—
MNBL 12.0N 83.9W	2	—	—	—	—	—	—	—
MWCG 19.3N 81.4W	15	17	19	28	42	55	74	86
MHNJ 16.5N 85.9W	8	7	9	8	6	6	5	3
MZBZ 17.5N 88.3W	7	7	8	4	7	8	9	8
MGPB 15.7N 88.6W	6	5	5	4	—	—	3	—
MMCZ 20.5N 86.9W	9	10	11	13	16	18	25	27
MARATHON FL	7	9	9	10	11	7	4	3
MIAMI FL	6	7	7	7	9	5	3	—
W PALM BEACH FL	4	6	5	6	6	5	—	—
FT PIERCE FL	3	5	5	5	5	4	—	—
COCOA BEACH FL	—	4	—	5	5	4	—	—
DAYTONA BEACH FL	—	3	—	4	4	4	—	—
KEY WEST FL	8	10	9	11	11	9	5	4
MARCO ISLAND FL	5	8	7	8	8	7	4	4
FT MYERS FL	4	7	6	7	8	7	4	4
VENICE FL	—	6	5	7	8	7	5	4
TAMPA FL	—	5	3	6	6	6	4	4
CEDAR KEY FL	—	3	3	5	5	5	4	4
ST MARKS FL	—	—	2	4	5	4	3	4
APALACHICOLA FL	—	—	2	4	5	5	4	5
PANAMA CITY FL	—	—	2	4	5	5	4	5
PENSACOLA FL	—	—	—	3	4	4	4	5
MOBILE AL	—	—	—	—	4	4	4	5
GULFPORT MS	—	—	—	—	4	4	4	5
BURAS LA	—	—	—	3	5	5	5	7
NEW ORLEANS LA	—	—	—	—	4	4	4	6
NEW IBERIA LA	—	—	—	—	—	—	4	6
PORT ARTHUR TX	—	—	—	—	—	—	3	5
GALVESTON TX	—	—	—	—	—	—	4	6
FREEPORT TX	—	—	—	—	—	—	4	6
PORT O CONNOR TX	—	—	—	—	—	—	3	6
CORPUS CHRISTI TX	—	—	—	—	—	—	5	5
BROWNSVILLE	—	—	—	—	—	—	5	7

TABLE 4 Chances of the center of Hurricane Gilbert passing within 65 miles of
(contd) listed locations by date and time (AST or EDT...both same) indicated;
probabilities in percent.

ADVISORY DATE/TIME	13/NOON	13/6PM	14/MID	14/6AM	14/NOON	14/6PM	15/MID	15/6AM
PROBABILITY TIME	16/8AM	16/2PM	16/8PM	17/2AM	17/8AM	17/2PM	17/8PM	18/2AM
MMVR 19.2N 96.1W	5	4	4	5	5	3	—	—
MMFR 18.5N 92.6W	7	5	4	4	3	—	—	—
MMMD 21.0N 89.7W	22	21	33	46	53	—	—	—
MUAN 21.9N 85.0W	39	32	23	—	—	—	—	—
MZBZ 17.5N 88.3W	4	4	—	—	—	—	—	—
MMCZ 20.5N 86.9W	54	45	69	—	—	—	—	—
MMSO 23.8N 98.2W	6	7	9	11	12	14	18	20
MMIM 22.2N 97.9W	6	6	7	9	11	11	14	14
MMTX 21.0N 97.4W	6	5	6	8	9	8	9	7
MARCO ISLAND FL	4	3	—	—	—	—	—	—
FT MYERS FL	4	3	—	—	—	—	—	—
VENICE FL	5	4	—	—	—	—	—	—
TAMPA FL	4	4	2	—	—	—	—	—
CEDAR KEY FL	4	4	2	—	—	—	—	—
ST MARKS FL	4	5	3	2	2	—	—	4
APALACHICOLA FL	5	6	4	3	2	—	—	5
PANAMA CITY FL	5	6	5	4	3	—	—	5
PENSACOLA FL	5	7	6	5	4	3	2	5
MOBILE AL	5	7	7	6	5	4	3	5
GULFPORT MS	6	8	8	7	6	5	3	5
BURAS LA	7	9	9	8	7	6	4	6
NEW ORLEANS LA	6	8	9	8	7	6	5	6
NEW IBERIA LA	6	8	9	9	9	8	7	6
PORT ARTHUR TX	5	7	9	10	10	10	10	7
GALVESTON TX	5	8	10	10	11	12	12	9
FREEPORT TX	5	7	10	11	11	12	13	11
PORT O CONNOR TX	5	7	10	11	11	13	15	14
CORPUS CHRISTI TX	5	7	9	11	11	14	16	17
BROWNSVILLE	6	8	10	12	13	16	21	23

TABLE 4 Chances of the center of Hurricane Gilbert passing within 65 miles of listed locations by date and time (AST or EDT...both same) indicated; probabilities in percent.

ADVISORY DATE/TIME	15/NOON	15/6PM	16/MID	16/6AM	16/NOON
<u>PROBABILITY TIME</u>	<u>18/8AM</u>	<u>18/2PM</u>	<u>18/8PM</u>	<u>19/2AM</u>	<u>19/8AM</u>
MMSO 23.8N 98.2W	43	24	31	39	40
MMIM 22.2N 97.9W	26	10	13	10	—
MMTX 21.0N 97.4W	15	2	3	—	—
APALACHICOLA FL	4	—	—	—	—
PANAMA CITY FL	4	—	—	—	—
PENSACOLA FL	4	—	—	—	—
MOBILE AL	4	2	2	4	—
GULFPORT MS	4	2	2	4	—
URAS LA	5	2	2	5	—
NEW ORLEANS LA	5	3	3	4	—
NEW IBERIA LA	6	6	6	5	—
PORT ARTHUR TX	7	10	9	8	5
GALVESTON TX	9	12	11	11	7
FREEPORT TX	11	14	13	13	9
PORT O CONNOR TX	14	17	16	19	15
CORPUS CHRISTI TX	18	20	19	26	23
BROWNSVILLE	27	32	35	46	54