

PRELIMINARY REPORT
HURRICANE CHANTAL
30 JULY TO 3 AUGUST 1989

by
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Hurricane Chantal was the first hurricane of the 1989 Atlantic season. Although Chantal was not a strong hurricane, it thoroughly tested preparedness efforts along the upper Texas coast while making landfall near High Island, Texas, between Galveston and Sea Rim State Park, on 1 August 1989.

a. Synoptic History

The system that provided the embryo for Chantal could not be traced back to Africa as a tropical wave, but first appeared on 24 July as an ITCZ disturbance near Trinidad just off the coast of South America. The system moved westward across the Caribbean with little development until approaching Honduras on the 27th. Beginning on the 27th, NHC highlighted the wave in the Tropical Weather Discussions (TWD), the Satellite Interpretation Messages (SIM), and in the Tropical Weather Outlooks (TWO). Even though the outflow was impressive on satellite imagery on the 27th, there was some uncertainty about the potential for development due to close proximity to land. Thus, the TWO's indicated that development...if any...would be slow.

By 1800 UTC on the 28th, synoptic reports indicated the possibility of a surface low near Belize City. However, during the next 24 hours the system was disorganized while over the Yucatan Peninsula. Beginning at 0230 UTC on the 30th, NHC indicated in the TWO's that there was some potential for development as the system was in the process of emerging off the coast near Merida, Mexico.

Satellite pictures at 0900 UTC on the 30th indicated that although the center was still close to the Yucatan Peninsula, the cloud pattern was becoming better organized. Ship data and satellite imagery confirmed that a tropical depression had formed and the first advisory on Tropical Depression Four was issued at 1900 UTC on the 30th. After the fact, it is estimated that the tropical depression likely formed in the south central Gulf of Mexico about 80 n mi north of the Yucatan Peninsula as early as 1200 UTC on the 30th.

Based on estimates by satellite analysts using the Dvorak technique, Tropical Storm Chantal likely formed 310 n mi southeast of Galveston, TX at 0600 UTC on the 31st. However, interpretation of infrared satellite imagery during the night can be misleading and NHC decided to wait for reconnaissance confirmation before formally upgrading the system. When the first Air Force reconnaissance plane arrived in the system at

1224 UTC on the 31st, the pressure was already down to 994 mb and the estimated surface winds were 45 knots (50 mph). Ship HZZB located 150 n mi east northeast of the center reported 50 knot (58 mph) winds at 1200 UTC. NHC issued a special advisory at 1300 UTC on the 31st upgrading the depression to a tropical storm. Outflow conditions favored continued strengthening and hurricane warnings were issued at that time from Freeport, TX to Morgan City, LA based on the anticipated motion of the center.

Normally the rate of development of a tropical system is one T number per day using the Dvorak technique. NHC satellite meteorologists classified the system as a T 1.5 at 1800 UTC on the 30th, a 2.5 at 0600 UTC on the 31st, and a 3.5 at 1800 UTC on the 31st. Thus the rate of development during that 24-hour period was two T numbers per day which is rapid.

Strengthening Tropical Storm Chantal moved toward the northwest at 10 knots, in response to weak ridging extending westward across Florida. During the afternoon of the 31st, an Air Force reconnaissance plane found 79 knot (91 mph) winds at 1500 feet and satellite pictures were showing better organization. Thus Chantal was formally upgraded to a hurricane at 2200 UTC.

Hurricane Chantal passed between oil rigs T81 and WC 459A, between W76 and P95, and to the west of P12 on its trek toward the upper Texas coast. At 0439 UTC on the 1st, WC 459A reported sustained winds of 61 knots (70 mph) with gusts to 69 knots (80 mph) at an elevation of 80 feet and a surface pressure of 993.7 mb. The hurricane was under continuous surveillance by both the Galveston and the Lake Charles radars when within about 100 n mi of the coast. Small scale fluctuations were noted in the radar positions but generally they were within about 10 n mi of the best track.

Chantal continued strengthening while approaching the Texas coast and at 1050 UTC reconnaissance reports were showing flight level winds of 82 knots (94 mph) at 850 mb (about 5000 feet) and the minimum pressure extrapolated to the surface was 984 mb. At 1156 UTC, about one hour prior to landfall, the pressure was 986 mb. Thus, Chantal reached its peak intensity just prior to the center making landfall at High Island, TX near 1300 UTC as a Category 1 hurricane on the Saffir/Simpson Hurricane Scale.

The center of Chantal continued moving northwestward passing close to Dayton, Conroe, just northeast of College Station, and just east of Waco before turning north northwestward to just west of Cleburne and east of Mineral Wells before dissipating in southwestern Oklahoma by 0600 UTC on 3 August 1989. Although the system could not be tracked at the surface beyond then, satellite pictures showed that the cloud shield traveled to eastern Kansas, eastern Iowa, Michigan, New York, and eventually joined cloudiness associated with a trough over New

England. That combined cloudiness passed over Newfoundland early on 7 August ahead of Hurricane Dean. The best track positions, the central pressure, and maximum sustained wind speeds every six hours are summarized in Figures 1-3 and in Table 1.

b. Meteorological Statistics

The center of Hurricane Chantal crossed the upper Texas coast at High Island near 1300 UTC on 1 August with sustained winds estimated at 70 knots (80 mph) and a minimum pressure of 986 mb. The highest winds reported at a coastal location were at Galveston where a sustained wind of 60 knots (69 mph) and a gust of 71 knots (82 mph) were observed. The highest sustained wind at Sea Rim State Park was 47 knots (54 mph) with a gust to 54 knots (62 mph). Sea Rim State Park had about 7 continuous hours with sustained winds of tropical storm force. The minimum pressure at Sea Rim State Park occurred at 1200 UTC, about one hour prior to landfall, when the surface winds were from the east southeast (120 degrees). At 1300 UTC, the wind was from the south southeast (160 degrees) and the pressure was 2.3 mb higher. The lowest pressure reported at a land station was 993.5 mb at Houston Intercontinental Airport at 1700 UTC. A summary of selected meteorological observations is presented in Table 2.

Rainfall associated with Chantal varied considerably. Houston's Hobby Airport reported 7.14 inches in 6 hours and 8.58 inches in 24 hours, whereas Houston Intercontinental Airport had only 1.21 inches in 6 hours and 2.05 inches in 24 hours. Unofficially, Friendwood, southeast of Hobby had a storm total of 20 inches and Clear Lake, northeast of Alvin, had 16 inches. Figure 4 shows that most of the rain in Chantal occurred on the left or southern side of the track producing serious flooding mainly in portions of Galveston, Brazoria, and Fort Bend Counties.

Tides at High Island were 7.0 feet MSL. Kemah reported 3.8 feet MSL and Galveston Flagship Pier had 3.5 feet MSL. Tides at Sabine Pass were 4 feet MSL. There was extensive beach erosion from High Island to Sea Rim State Park.

One confirmed tornado was reported on Crystal Beach (Galveston County) causing total destruction to a boat shed. A tornado touched down near Iota, LA uprooting several trees and moving a mobile home off its foundation.

c. Casualty and Damage Statistics

The main effects from Chantal were from flooding by torrential rains and beach erosion. Wind effects were relatively light. However, numerous trees, powerlines, fences and signs were blown down. There was some roof damage to homes, carports and mobile homes. About 3000 homes in Texas had either water or wind damage. Total damage is estimated to be near 100 million dollars.

Thirteen deaths are attributed to Chantal. Two teenage boys drowned in College Station (Brazos County) when their raft on which they were riding capsized in flood waters and they were swept into a drainage pipe. Two others on the raft managed to make it to safety. A 48 year old man drowned about 100 miles south of New Orleans as he attempted to leave an oil rig. A 74-foot "lift boat", Avco 5, capsized in the Gulf about 20 n mi off the coast south of Morgan City, LA. Four men were rescued but 10 others were trapped in the oil service vessel, of which seven are known drowned and three are missing and presumed drowned. (According to The Times Picayune, "a lift boat is equipped with three extendable legs allowing it to work in up to 65 feet of water. When a crew reaches a work site, the legs are lowered to the sea floor and the vessel's hull is jacked up above the waves to provide a steady platform for pipeline construction and maintenance chores. The Avco 5 overturned while heading for safety.") There were 18 persons rescued by U.S. Coast Guard helicopters and rescue boats. Most of those were fishermen whose boats capsized near the Bolivar Peninsula. Several of the rescues were near the jetties at Sabine Pass. A man was injured while evacuating a dredge barge in the coastal waters south of Lafayette, La. Hundreds of persons were evacuated by airboats and high water vehicles in flooded areas in Texas.

d. Forecast and Warning Critique

Figure 5 shows that the official forecasts for Chantal were consistent and very good. In fact the average official forecast error at 24 hours was 33 n mi, well below the average error for the 10-year period 1979-1988 of 111 n mi. BAM, SANBAR, and QLM performed worst of the track prediction models and in that order with the first having a 24-hour error of 117 n mi. Table 3 summarizes the warnings issued for Chantal and Table 4 shows that the probabilities focused on the Galveston to Port Arthur area.

Chantal was one of those hurricanes that developed rapidly in the Gulf of Mexico after emerging off the Yucatan Peninsula as a developing area of disturbed weather. Those developments often provide less time for taking action than desired, especially for the oil rig community. Nevertheless, the upper Texas coast was under a hurricane warning 15 hours prior to landfall. Rapid developments such as this are of great concern to the National Hurricane Center. Fortunately, Chantal only became a Category 1 hurricane even though NHC's advisories indicated the possibility that it could reach Category 2 strength prior to landfall.

Storm surges of 7 to 10 feet above normal were expected near and to the east of where the center made landfall. Actual tides at High Island were 7 feet MSL which included a 1.5-foot astronomical tide plus the storm surge. The over-prediction was based on the forecast of Chantal arriving at the coast as a category 2 hurricane.

Storm rainfall amounts of 10 to 15 inches were forecast to accompany Chantal. Actual storm totals approached 20 inches with 24-hour amounts in the 10-inch range. Chantal produced an unusual rainfall pattern. Rainfall maxima in landfalling hurricanes usually are to the right, or both to the right and left of the track looking toward land. Not only the rainfall maxima, but nearly all of the rainfall in Chantal was to the left (west and south) of the track.

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Table 1. Preliminary best track, Hurricane Chantal
30 July to 3 August 1989.

Date/Time (UTC)	Position		Pressure (mb)	Wind Speed (kt)	Stage
	Lat (N)	Lon (W)			
30/1200	22.5	90.0	1011	20	Tropical Depression
1800	23.5	90.2	1010	25	" "
31/0000	24.4	90.5	1009	30	" "
0600	25.4	91.0	1004	35	Tropical Storm
1200	26.2	91.7	995	50	" "
1800	27.1	92.2	993	55	" "
01/0000	27.9	92.8	991	65	Hurricane
0600	28.7	93.5	987	70	"
1200	29.5	94.3	984	70	"
1800	30.2	95.2	993	50	Tropical Storm
02/0000	30.8	96.1	1000	35	" "
0600	31.5	96.9	1004	25	Tropical Depression
1200	32.3	97.5	1007	20	" "
1800	33.3	98.0	1008	20	" "
03/0000	34.5	98.5	1009	20	" "
0600	dissipated				

01/1000	29.2	94.0	984	70	Minimum Pressure
01/1300	29.6	94.4	986	70	Landfall at High Island, TX

Table 2. Hurricane Chantal selected surface observations, 1 August 1989.

Location	Minimum sea-level pressure		Maximum surface wind speed (knots)			Storm tide (tide height above MSL) (ft)	Rain (24-hr total) (in)
	Pressure (mb)	Date/time (UTC)	1-minute average	Peak gust	Date/time (UTC)*		
Texas							
Houston Inter. Aprt.	993.5	1700	NE/28	NE/49	1550		2.05
Houston Hobby Aprt.	996.3	1538	W/35	W/66	1428		8.58
Houston WSO Alvin			24	39	1547		7.01
Galveston WSO	997.4	0935	NW/60	W/71	1132		6.56
Downtown Houston							4.25
Galveston Flagship Pier						3.5	
Galveston Pier 21						2.9	
Kemah						3.8	
High Island						7.0	
Port Arthur	1002.0	1220	26	43	1353		1.19
Sabine Pass						4.0	
Louisiana							
Lake Charles	1006.4	1026	150/23	140/32	1640		
Cameron						4.2	
New Orleans Moisant A.	1013.5	0100	130/24	130/36	31/1501		2.29
New Orleans Lakefront			120/14	120/24	0003		
Mid Lake Ponchartrain Cswy.			080/25	150/34	31/2000		
E. Lake Ponchartrain Hwy 11			160/22	160/33	31/1600		
Paris Road						3.26	
Mississippi							
Biloxi						2.5	

*Time of 1-min wind speed

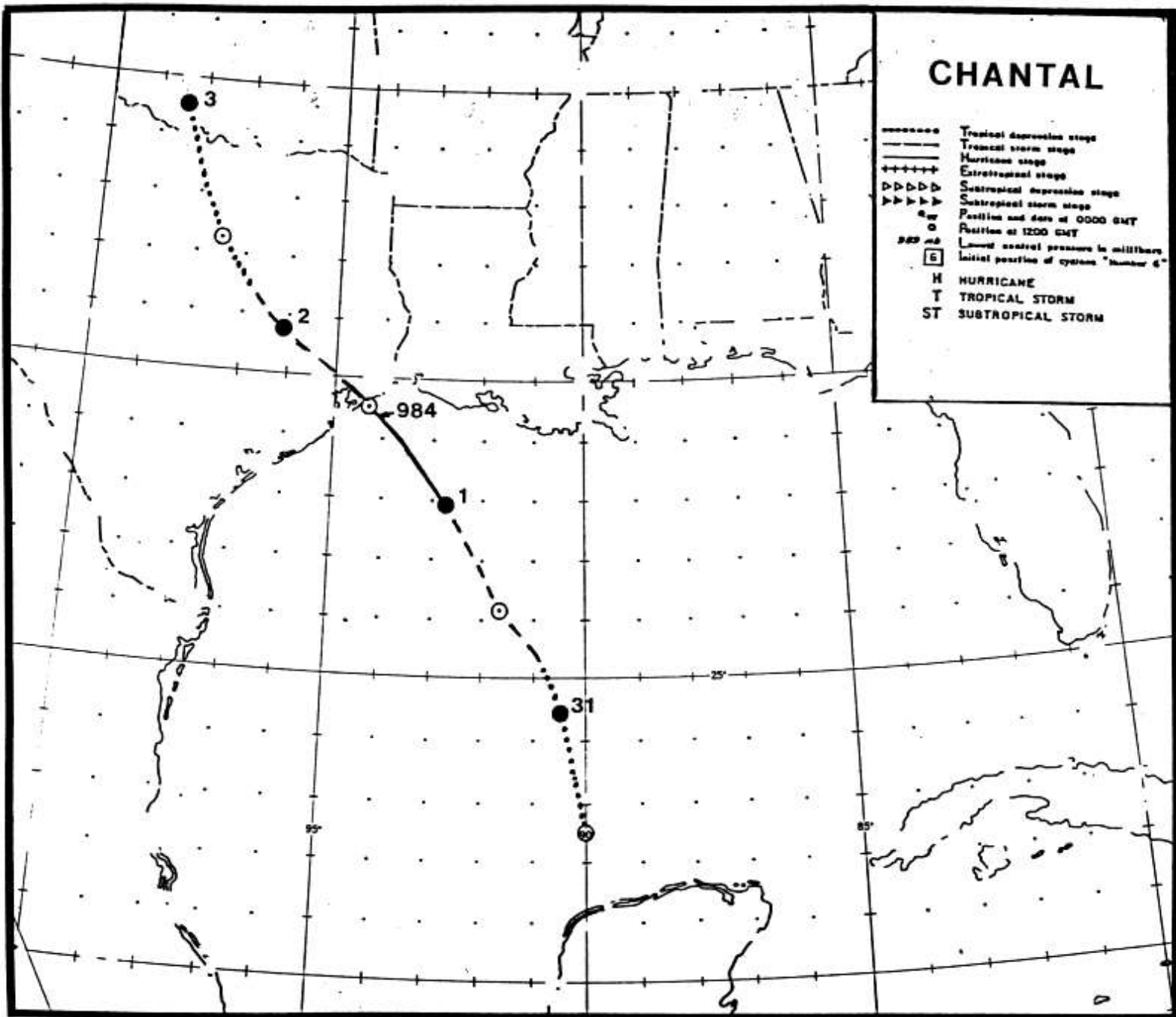


Fig. 1. Best track positions for Hurricane Chantal, 30 July to 3 August 1989.

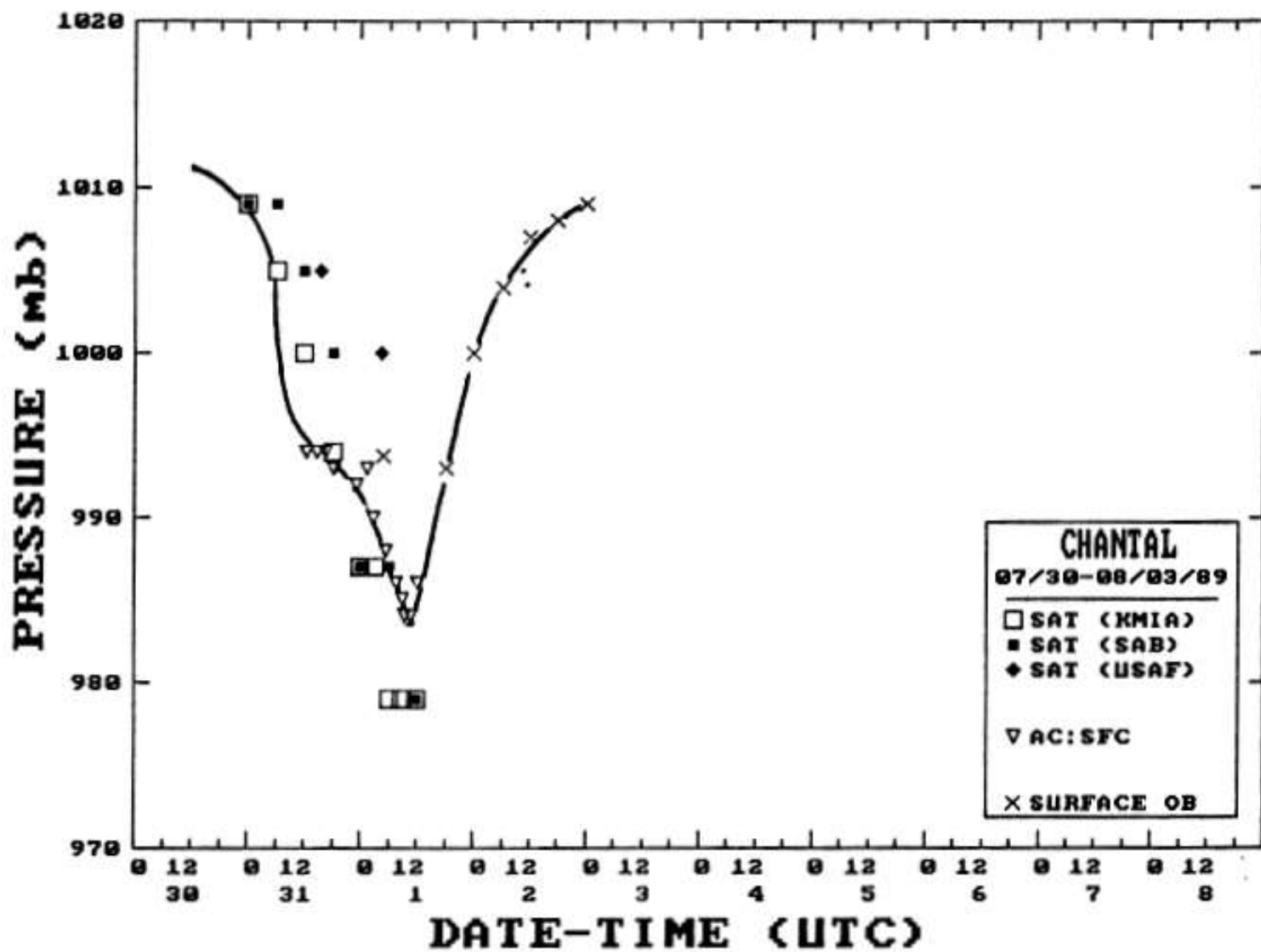


Fig. 2. Best track minimum central pressure curve for Hurricane Chantal, 30 July to 3 August 1989.

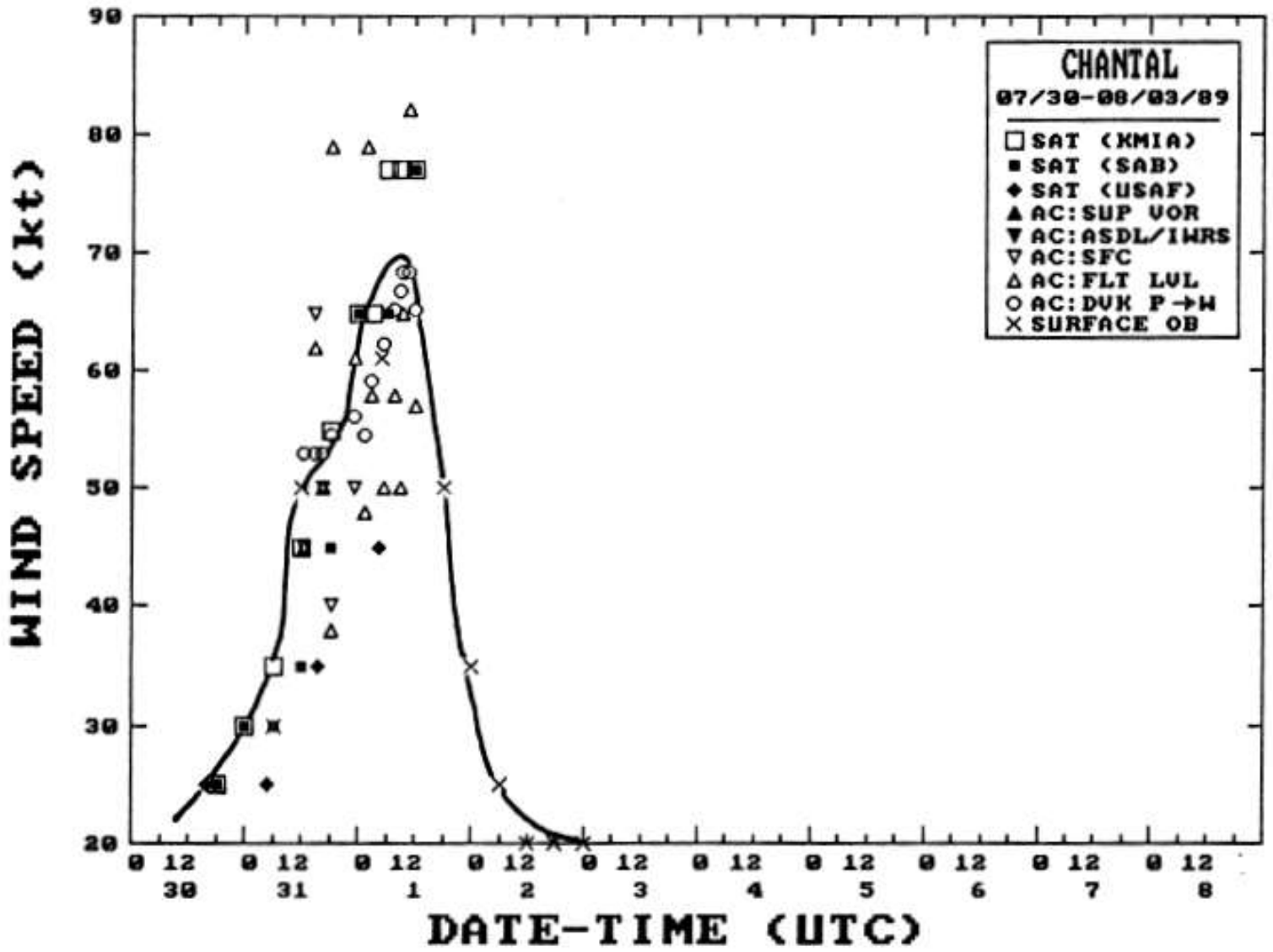


Fig. 3. Best track maximum sustained wind speed curve for Hurricane Chantal, 30 July to 3 August 1989.

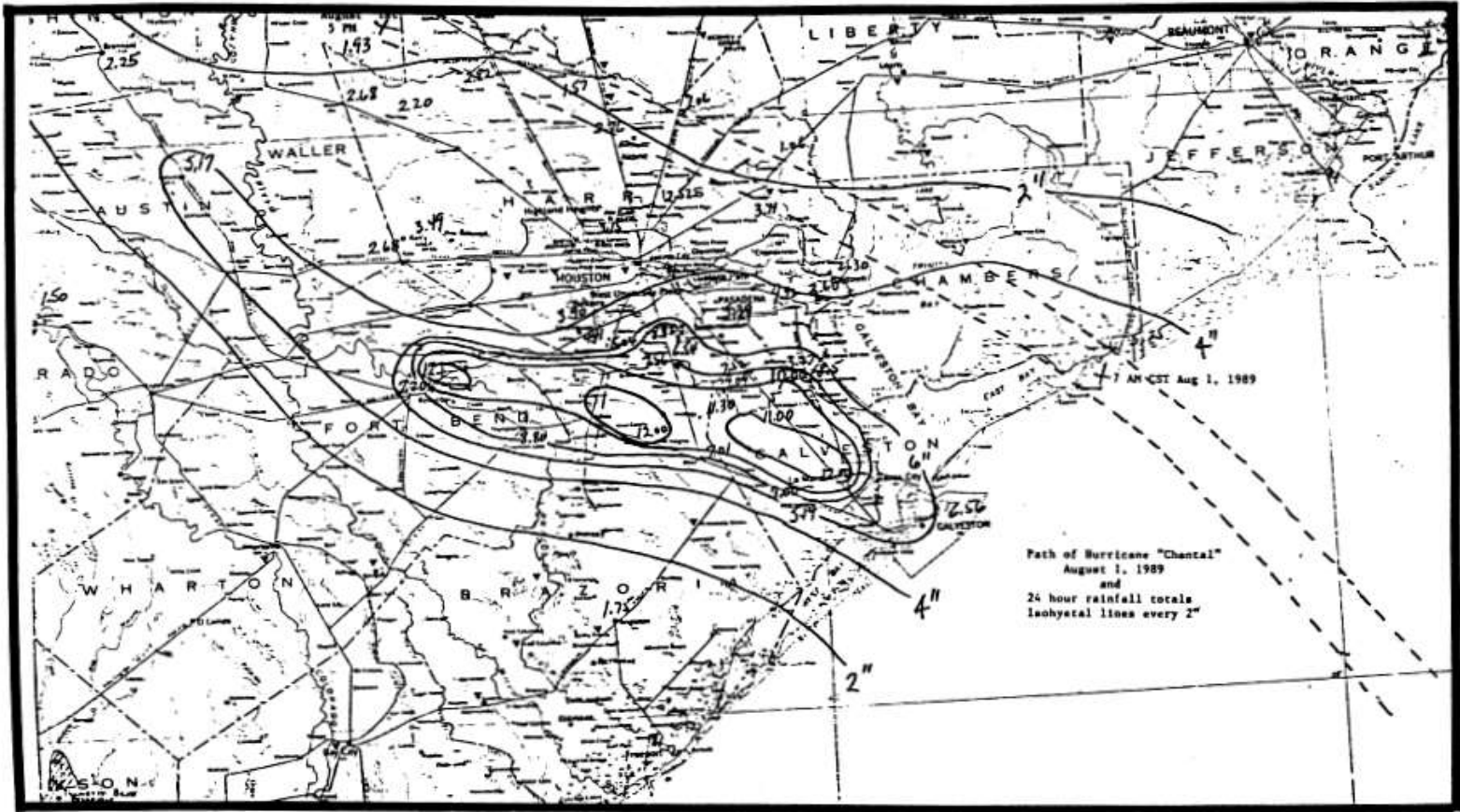


Fig. 4. Twenty-four hour rainfall totals for Hurricane Chantal.

Table 3. Warnings issued for Hurricane Chantal, July and August 1989.

Date/Time(UTC) Action	Location
31/1000 Tropical storm watch	Port O'Connor Texas to the mouth of the Mississippi River.
31/1300 Hurricane warning	Freeport Texas to Morgan City Louisiana.
Tropical storm warning	Port O'Connor Texas to Freeport and from Morgan City to Mobile Alabama.
01/1000 Discontinue tropical storm warning	Port O'Connor Texas to Freeport and from Morgan City to Mobile Alabama.
01/1600 Discontinue hurricane warning, change to tropical storm warning	Freeport Texas to Morgan City Louisiana.
01/1900 Discontinue tropical storm warning	Port Arthur Texas to Morgan City Louisiana.
02/0100 Discontinue tropical storm warning	Freeport to Port O'Connor Texas.

Table 4. Chances of the center of Hurricane Chantal passing within 65 miles of listed locations by date and time CDT indicated; probabilities in percent.

ADVISORY DATE/TIME <u>PROBABILITY TIME</u>	<u>30/5PM</u> <u>02/1PM</u>	<u>30/930PM</u> <u>02/7PM</u>	<u>31/5AM</u> <u>03/1AM</u>	<u>31/8AM</u> <u>03/1AM</u>	<u>31/11AM</u> <u>03/7AM</u>
ST MARKS FL	3				
APALACHICOLA FL	3		2		
PANAMA CITY FL	4		2		
PENSACOLA FL	7	3	5	3	2
MOBILE AL	9	6	7	5	4
GULFPORT MS	10	8	10	7	6
BURAS LA	12	11	12	9	8
NEW ORLEANS LA	13	13	15	12	12
NEW IBERIA LA	15	17	24	18	21
PORT ARTHUR TX	15	17	25	20	26
GALVESTON TX	16	18	25	22	28
FREESPORT TX	16	17	21	20	24
PORT O'CONNOR TX	15	14	16	16	16
CORPUS CHRISTI TX	13	11	12	11	11
BROWNSVILLE TX	11	8	8	7	6
GULF 29N 85W	3				
GULF 29N 87W	6	2	3	2	
GULF 28N 89W	12	8	7	6	4
GULF 28N 91W	20	30	43	29	35
GULF 28N 93W	23	37	51	46	63
GULF 28N 95W	18	20	21	24	26
GULF 27N 96W	15	14	13	15	13
GULF 25N 96W	12	8	6	7	4
MMSO 23.8N 98.2W	6	3	3		
MMTM 22.2N 97.9W	4				
MMTX 21.0N 97.4W	2				

Table 4. Chances of the center of Hurricane Chantal passing (contd) within 65 miles of listed locations by date and time CDT indicated; probabilities in percent.

ADVISORY DATE/TIME	31/5PM	31/8PM	31/11PM
<u>PROBABILITY TIME</u>	<u>03/1PM</u>	<u>03/1PM</u>	<u>03/7PM</u>
BURAS LA	3	2	
NEW ORLEANS LA	7	6	
NEW IBERIA LA	25	25	20
PORT ARTHUR TX	35	37	53
GALVESTON TX	32	33	52
FREEPORT TX	23	22	36
PORT O'CONNOR TX	10	8	15
CORPUS CHRISTI TX	2		3
GULF 28N 91W	37	40	24
GULF 28N 93W	99	99	99
GULF 28N 95W	22	22	30
GULF 27N 96W	5	3	4