Tropical Cyclone Report
Hurricane Humberto
(AL092007)
12-14 September 2007

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Humberto was a short-lived tropical cyclone that made landfall in extreme southeastern Texas as a strong category 1 hurricane (on the Saffir-Simpson Hurricane Scale). The hurricane is notable for its exceptionally rapid intensification near the coast of Texas from a tropical depression into a hurricane within 19 hours.

a. Synoptic History

The genesis of Humberto can be traced to the remnants of a frontal trough (the same front that spawned Gabrielle) that moved offshore of south Florida in the southeastern Gulf of Mexico on 5 September. This trough remained nearly stationary for a couple of days, then moved slowly west-northwestward for almost a week as high pressure built over the southeastern United States. The trough was located over the northwestern Gulf of Mexico on 11 September, and convection increased markedly near the trough axis on that day a couple hundred miles south of Galveston, Texas. Although thunderstorms diminished that night, a weak surface low had formed along the trough. Convection re-fired near the low early on 12 September, and was organized enough by 0900 UTC to estimate that a tropical depression had formed about 120 miles south of Galveston, Texas. The "best track" chart of the tropical cyclone's path is given in Fig. 1, with the wind and pressure histories shown in Figs. 2 and 3, respectively. The best track positions and intensities are listed in Table 1.

A ship report and radar data suggest that the depression quickly became a tropical storm near 1200 UTC 12 September, and moved slowly to the north. Intense thunderstorm activity in well-defined spiral bands continued near Humberto, and the small tropical cyclone continued to rapidly strengthen just offshore of the upper Texas coast. Later that day, the system turned to the north-northeast due to steering around a large middle-level high over the southeastern United States. Radar data indicate that the tropical storm became a hurricane about 20 miles south of High Island, Texas near 0400 UTC 13 September, and the cyclone reached an estimated peak intensity of 80 kt as it made landfall just east of High Island in McFaddin National Wildlife Refuge around 0700 UTC on 13 September. The hurricane moved over extreme southeastern Texas across the Beaumont/Port Arthur area, and entered southwestern Louisiana, weakening into a tropical storm about 75 miles west-northwest of Lafayette, Louisiana. The storm became a depression near Alexandria, Louisiana late on 13 September, and dissipated the next day over central Mississippi.

b. Meteorological Statistics

Observations in Humberto (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB), as well as flight-level, dropsonde, and stepped-frequency microwave radiometer (SFMR) observations from three flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command aircraft. Microwave satellite imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the NASA QuikSCAT, and Defense Meteorological Satellite Program (DMSP) satellites were also useful in tracking Humberto.

The initial development of Humberto was rather quick. Around 0300 UTC, almost all thunderstorm activity had dissipated with the low that eventually spawned Humberto, but convection increased dramatically between 0600-0900 UTC on 12 September. By 0900 UTC, enough convection had persisted near the low center for it to be considered a tropical depression. Only three hours later, ship data from the Tyco Decisive of 38 kt winds, concurrent with increasing radar winds of 35-40 kt between 7,000 to 9,000 ft from the Houston National Weather Service radar, suggested that the depression became a tropical storm near 1200 UTC.

Estimating the landfall intensity of Humberto is problematic because the hurricane was rapidly strengthening near landfall. Peak flight-level winds of 98 kt were measured at an altitude of 850 mb near landfall, corresponding to about 78 kt at the surface. SFMR data from the WC-130 aircraft measured surface winds of up to 85 kt just before landfall. However, the SFMR reading was taken in the shallow gulf waters and shoaling in this location introduces some uncertainty to the measurement. A dropsonde about an hour earlier in the eastern eyewall provided a surface wind estimate of 70 kt, derived from the lowest 150 m of the sounding. It is probable, however, that this single dropsonde did not capture the maximum winds. Peak winds noted from radar data from the National Weather Service office in Houston were about 100 kt at around 3000 ft, and an approximate reduction factor of 75-80% from the altitude suggests that 75-80 kt winds were observed near the surface. Vertical scans from the Houston and Lake Charles radars showed a deeper layer of 85-90 kt winds from 3000-9000 ft. Up to a 90% reduction of these deeper winds given the strong convection seems justified, resulting in an estimate of about 75-80 kt. A peak intensity of 80 kt is assigned for this hurricane after considering all data sources.

The highest official wind reported was from the C-MAN station at Sea Rim State Park in Texas. The station recorded 10-minute averaged sustained winds of 60 kt with gusts to 74 kt. However, this station likely did not receive the maximum winds in Humberto as radar data suggested the radius of maximum winds was several miles west of the station. An unofficial measurement of a wind gust to 101 kt was received from a barge located in the Golden Pass ship channel near the Texas/Louisiana border. Based on surface and reconnaissance wind reports and radar estimates, sustained hurricane-force winds were likely observed in only a small area up to about 15 miles wide in extreme southwestern Louisiana and southeastern Texas.

The rapid intensification of Humberto was aided by a couple of factors. The hurricane was a very small tropical cyclone, with 34 kt wind radii never exceeding 50 n mi. Small cyclones are more susceptible than large storms to rapid changes in intensity, up and down. Humberto also had unusually well-defined banding and core convective structures in its formative stage, which likely provided the framework that allowed for the rapid development that occurred 12 hours later.

The intensification rate in Humberto was one of the highest that has ever been observed for an initially weak tropical cyclone. It is estimated that the cyclone strengthened from a 25 kt low into an 80 kt hurricane within 24 hours. This rapid increase in intensity is rare, and only three other storms (Celia 1970, Arlene and Flora 1963) have intensified more in 24 hours from below tropical storm strength. The rapid formation of a hurricane near the shore has long been a concern emphasized by the National Hurricane Center in its outreach and preparedness talks. Humberto serves as a rare, important example.

The minimum central pressure estimated with Humberto was 985 mb, based on a dropsonde reading of 986 mb taken about 10 minutes before landfall, and a continuation of the large pressure falls of about 3 mb in the previous 45 minutes observed in the two dropsonde measurements prior to landfall. The lowest pressure noted from a land station was 988.5 at the Beaumont/Port Arthur airport, located well inland from the Gulf of Mexico.

Very heavy rains associated with Humberto were noted in a small area of extreme southeastern Texas and southwestern Louisiana. The maximum storm total precipitation was 14.13 at East Bay Bayou, Texas, and a large surrounding area of 3-5 inches stretched northeastward into central Louisiana. A map of the rainfall associated with the hurricane is found in Fig. 4.

The highest storm tide reported was 4.87 ft from the Texas Point gauge of the Texas Coastal Ocean Observation Network (TCOON). Storm surges of about 2-4 feet were commonly noted from just east of Galveston Bay, Texas eastward to near Lake Charles, Louisiana.

There was one preliminary report of a tornado near High Island, Texas, but a later storm survey suggested that the damage in that area was due to the winds of the hurricane itself.

c. Casualty and Damage Statistics

There was one death in Bridge City, Texas directly associated with Humberto when a car port fell on an elderly man when he went outside to check on his backyard. Twelve injuries were also noted in southeastern Texas, including snake bites, cuts, bruises and broken bones. Power outages at least 120,000 homes were reported in Texas and 13,000 customers lost power in Louisiana. Insured losses from Humberto are estimated to be less than 50 million dollars from the Insurance Services Office, and a rough estimate of total property damages is about 50 million dollars. The final damage figure is much lower than estimates earlier reported in the media. The low damage total is probably due to the small size of the system and the relatively unpopulated

area that it impacted. In addition, Hurricane Rita caused much more severe conditions to extreme southeastern Texas in 2005 and may have limited the amount of damage that could have been done by a small Category 1 hurricane. Most of the damage noted from Humberto was due to fresh water floods and wind, the latter knocking down trees and power lines and causing roof damage.

d. Forecast and Warning Critique

The timing of the genesis of Humberto was not well-anticipated. The system that eventually became Humberto was mentioned in the Tropical Weather Outlook products for four days prior to genesis with some development potential indicated for the last two days. The possibility of tropical depression formation, however, was not mentioned explicitly before genesis occurred.

The average official track errors for Humberto were 26, 50, and 89 n mi for the 12, 24, and 36 h forecasts, respectively. These forecast errors were lower than the average long-term official track errors through 36 h. A meaningful comparison of the various models is not possible due to the small number of forecasts, ranging from five at 12 h to one at 36 h. Overall, the first couple of official forecasts were a little too far to the west, and this was one factor in the unanticipated landfall intensity of the system. The first official forecast for Humberto, issued at 1500 UTC 12 September, had an implied landfall time 16-17 h later, or near 04-05 UTC. Humberto moved to the right of the forecast track, staying over water for another 2-3 hours. The 12 h track error for this forecast was 29 n mi, which is less than the long-term average 12-h error of 35 n mi. Despite the relatively small absolute track error, the oblique angle of approach to the coastline resulted in an error in the timing of landfall of a few hours, allowing the system to reach hurricane strength.

Average official intensity errors were 18, 12, and 5 kt for the 12, 24, and 36 h forecasts, respectively. For comparison, the average long-term official intensity errors are 6, 10, and 12 kt, respectively. The official forecast errors were much larger than average for Humberto in the 12 hr period, with a substantial low bias from the unexpected rapid intensification of the system. It is worth noting that no reliable model ever forecast the system to reach hurricane strength.

Table 3 lists the tropical cyclone watches and warnings that were issued for Humberto. A hurricane warning was issued only about 2 hours before landfall due to the unforeseen rapid intensification of the system. The tropical storm warning was issued as soon as it was determined that a tropical depression had formed, about 16 hours before landfall.

e. Acknowledgements

Almost all of the surface observations in this report were provided by the NWS Forecast Offices in Houston, Texas and Lake Charles, Louisiana and by the National Data Buoy Center (NDBC). David Roth of the Hydrometeorological Prediction Center supplied the rainfall graphic. Colin McAdie (NHC) provided access to and insightful analysis of archived WSR-88D radar data from the NWS Forecast Office in Lake Charles, Louisiana and Houston, Texas. SFMR data and analysis were provided by Eric Uhlhorn of the Hurricane Research Division of the Atlantic Oceanographic and Meteorological Laboratory at Virginia Key, FL. The NHC Hurricane Specialist unit also provided valuable input to this report.

Table 1. Best track for Hurricane Humberto, 12-14 September 2007.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
12 / 0600	27.3	95.0	1009	25	low
12 / 1200	27.8	95.1	1006	35	tropical storm
12 / 1800	28.3	95.0	1001	45	"
13 / 0000	28.8	94.8	997	55	"
13 / 0600	29.5	94.4	985	80	hurricane
13 / 1200	30.3	93.6	989	65	"
13 / 1800	31.0	92.9	1000	35	tropical storm
14 / 0000	31.7	92.3	1006	25	tropical depression
14 / 0600	32.4	91.3	1009	20	low
14 / 1200	32.7	90.2	1012	20	"
14 / 1800	-	-	-	-	dissipated
13 / 0600	29.5	94.4	985	80	minimum pressure
13 / 0700	29.6	94.3	985	80	landfall just east of High Island, Texas

Table 2. Selected surface observations for Hurricane Humberto, 12-14 September 2007.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)			
Texas								
Beaumont (BEAT2)								6.58
Buna-KRBT2 RAWS			13/1405		34			
Galveston Airport (KGLS)	13/0252	1007.0	13/0323	30	44			4.53
Galveston-Pleasure Pier	13/0406	1003.7	13/0336	43	56	1.68	3.62	
Galveston Pier 21	13/0400	1005.1				1.53	3.05	5.08
Lumberton (LLBT2)								3.32
McFaddin Wildlife Refuge- FADT2 RAWS			13/0735	52	65			
Orange 9 N (ORET2)								5.24
Orange County Airport (KORG)	13/0925	1003.4	13/0925	29	40[e]			
Southeast Texas Regional Airport (KBPT)	13/0927	988.5	13/0858	49	73			6.23
Louisiana								
Alexandria International (KAEX)	13/2043	1005.4	13/1857	25	35			3.48
Esler Regional Airport (KESF)	13/2120	1006.1	13/2148	20	30			3.20
Fort Polk (KPOE)	13/1753	1006.1	13/1655	20	34			
Fort Polk Self-Landing Strip (KDNK)	13/1753	1006.1	13/1653	27	36			
Lafayette Regional Airport (KLFT)	13/2213	1010.5	13/2056	21	28			3.09
Lake Charles Regional Airport (KLCH)	13/1352	1009.5	13/0936	29	36			3.08
Sulphur Southland Field (KUXL)	13/1140	1007.2	13/1240	28	37			
Buoy/C-MAN								
42035- E of Galveston 29.2°N 94.4°W (NCDC)	13/0450	991.7	13/0410	50	64			

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)			
CAPL1-Calcasieu Pass, LA (NOS)	13/1036	1009.4	13/0842	33	37	2.79	4.02	
SBPT2-Sabine Pass North, TX (NOS)	13/0900	1003.3	13/0900	42	58	2.60	4.07	
SRST2- Sea Rim State Park, TX 29.7°N 94.1°W (NDBC)	13/0800	997.0	13/0840	60	74			
Unofficial Texas								
Beaumont 2 SE								7.96
Beaumont 3 S								7.75
Beaumont 6 SE								7.64
Beaumont Carroll State Park (TCEQ)			13/0900	33[f]	65			
Beaumont Cathedral Christian School					46			
Beaumont KFDM-TV					43			
Beaumont Monsignor Kelly High School					49			
Beaumont Odom Academy					64			
Beaumont Richard Milburn Academy					55			
Beaumont St. Anne Catholic School					46			
Beaumont St. Anthony's Cathedral School					58			
Beaumont-Lamar (TCEQ)			13/0800		48[e]			
Bolivar at Loop 108 (TXDOT)			13/0353	35	43			7.01
Deweyville High School					37			
Eagle Point (TCOON)	13/0454	1007.8	13/0130		33	1.42	2.71	
East Bay Bayou at Jones and Allen								14.13
Fannett 2 NE								8.39
Fannett 2 SW								9.18
Galveston Bay-North Jetty (TCOON)	13/0406	1003.4	13/0412	43	52	1.23	2.95	
Galveston Bay-Rollover Pass (TCOON)			13/0624	52	66	1.98	4.33	
Galveston Bay-South Jetty	13/0500	1003.4	13/0400	45	65		3.24	

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	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)			
(TCOON)								
Galveston Causeway								3.23
Galveston Coast Guard (GLST2)								6.50
GIWW at SH 124 Bridge								9.84
Golden Pass Ship Channel					101			
Groves (TCEQ)			13/0800		42			
Hamshire (TCEQ)			13/0800	35[f]	63[e]			
Hamshire 2 WSW								8.19
Hamshire 5 SE								7.52
Hamshire 5 SSW								9.02
Hamshire 5 SW								10.71
Jamaica Beach (JBHT2)	13/0214	1007.3	13/0047	30	35	2.52	3.42	5.80
Jefferson County Airport (TCEQ)			13/0900	24[f]	64			
Lumberton Intermediate School					34			
Mauriceville SETRPC (TCEQ)			13/0900		43[e]			
Morgans Point (TCOON)						0.78	2.01	
Nederland Helena Park Elementary School					55			
Nederland High School (TCEQ)	13/0900	992.6	13/1000	25[f]	60			
Nederland Hillcrest Middle School					56			
Orange Anderson Elementary School					59			
Orange St. Mary Catholic School					58			
Port Arthur (TCOON)			13/0948	45	67	2.82	3.48	
Port Arthur 2 NNW	13/0909	989.4	13/0901	36				
Port Arthur City Service Center (TCEQ)			13/0800		70[e]			
Port Arthur Lamar State College					65			
Port Arthur SETRPC (TCEQ)			13/0900	43[f]	74[e]			
Port Arthur West (TCEQ)			13/0900	34[f]	67[e]			

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)			
Port Neches (TCEQ)			13/0900		44[e]			
Rainbow Bridge						2.81	3.43	
Rollover Pass at Gilchrist (TXDOT)			13/0624	48	58			8.31
Sabine Pass 3 NW								8.74
Sabine Pass School					60			
Sea Rim State Park 1 SE								8.54
Sea Rim State Park 6 NW								8.62
Sea Rim State Park 8 W								8.35
Sea Rim State Park 9 NW								8.27
Sea Rim State Park 2 W								8.07
Sea Rim State Park 7 W								7.67
Spindletop Bayou at SH 124 Bridge								8.11
Texas Point (TCOON)	13/0906	1004.7	13/0924	40	54		4.87	
Vidor Junior High School					51			
Vinton High School					48			
West Orange (TCEQ)			13/1000	27[f]	53[e]			
West Orange Starks Middle School					59			
Unofficial Louisiana								
Abbeville (ABBL1)								5.70
Alexandria 5 SSE (ADSL1)								3.03
Alexandria Power Plant (ALXL1)								3.30
Boyce 7 SW (BCLL1)								4.43
Crowley 2 NE (CROL1)								3.73
Cypremont Point						2.25	3.17	
De Ridder (DRIL1)								8.25
Elmer 2 SW (ELML1)								4.76
Jeanerette 5 NW (JENL1)								4.00
Jennings (JNNL1)								4.63

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft)[c]	Storm tide (ft)[d]	Total rain (in)
	Date/ time (UTC)	Press. (mb)	Date/ time (UTC)[a]	Sustained (kt)[b]	Gust (kt)			
Lafayette (LFYL1)								3.01
Lake Arthur 10 SW (LWRL1)								5.47
Lake Charles						2.03	2.96	
Lake Charles 7 NW (LCRL1)								3.45
LSU Dean Lee (LSUL1)								3.31
Moss Bluff (MBFL1)								3.53
Port of Lake Charles (LKCL1)								3.24

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Wind averaging periods is 10 min.
[c] Storm surge is water height above normal astronomical tide level.
[d] Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).
[e] Instrument failed
[f] Wind averaging period is 5 min.

Table 3. Watch and warning summary for Hurricane Humberto, 12-14 September 2007.

Date/Time (UTC)	Action	Location
12/1500	Tropical Storm Warning issued	Port O'Connor, Texas to Cameron, Louisiana
12/1500	Tropical Storm Watch issued	east of Cameron to Intracoastal City, Louisiana
12/2100	Tropical Storm Watch changed to Tropical Storm Warning	east of Cameron to Intracoastal City, Louisiana
13/0300	Tropical Storm Warning discontinued	Port O'Connor, Texas to Sargent, Texas
13/0515	Tropical Storm Warning changed to Hurricane Warning	east of High Island, Texas to Cameron, Louisiana
13/0900	Tropical Storm Warning discontinued	east of Sargent, Texas to west of High Island, Texas
13/1500	All warnings discontinued	Texas and Louisiana

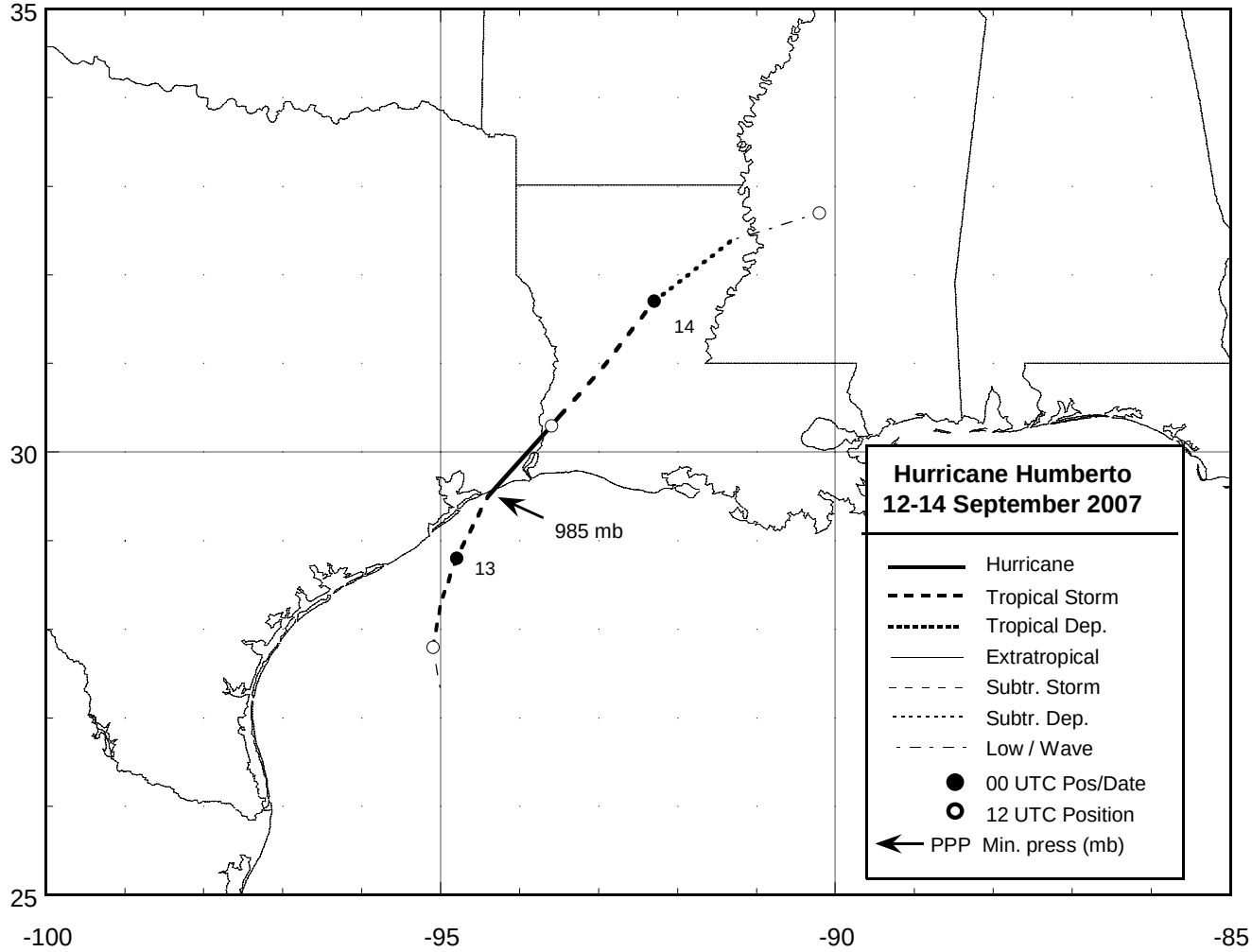

Figure 1. Best track positions for Hurricane Humberto, 12-14 September 2007. Track during the low stage is partially based on analyses from the NOAA Hydrometeorological Prediction Center.

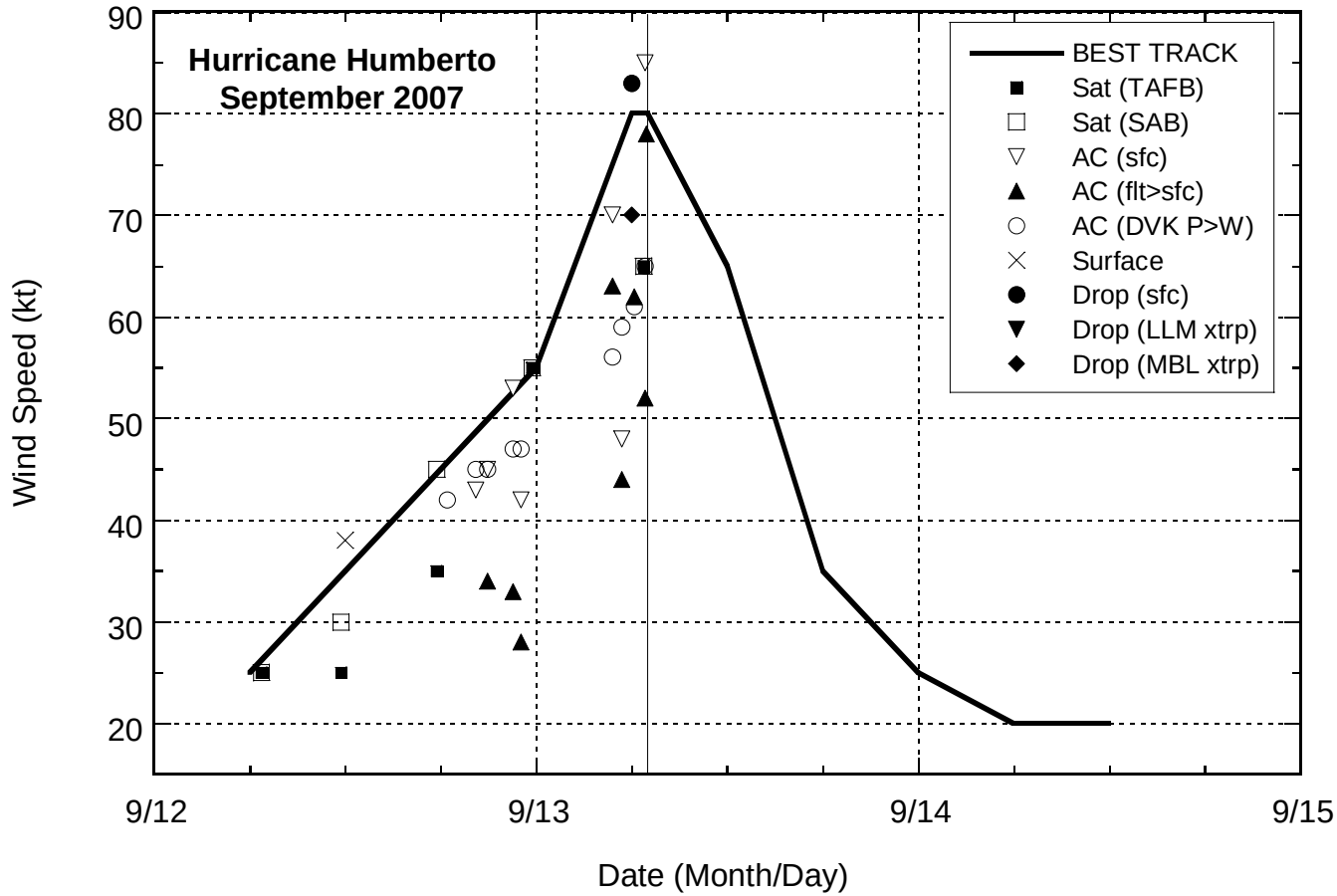

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Humberto, 12-14 September 2007. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% reduction factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. The thin vertical line indicates the time of landfall in Texas.

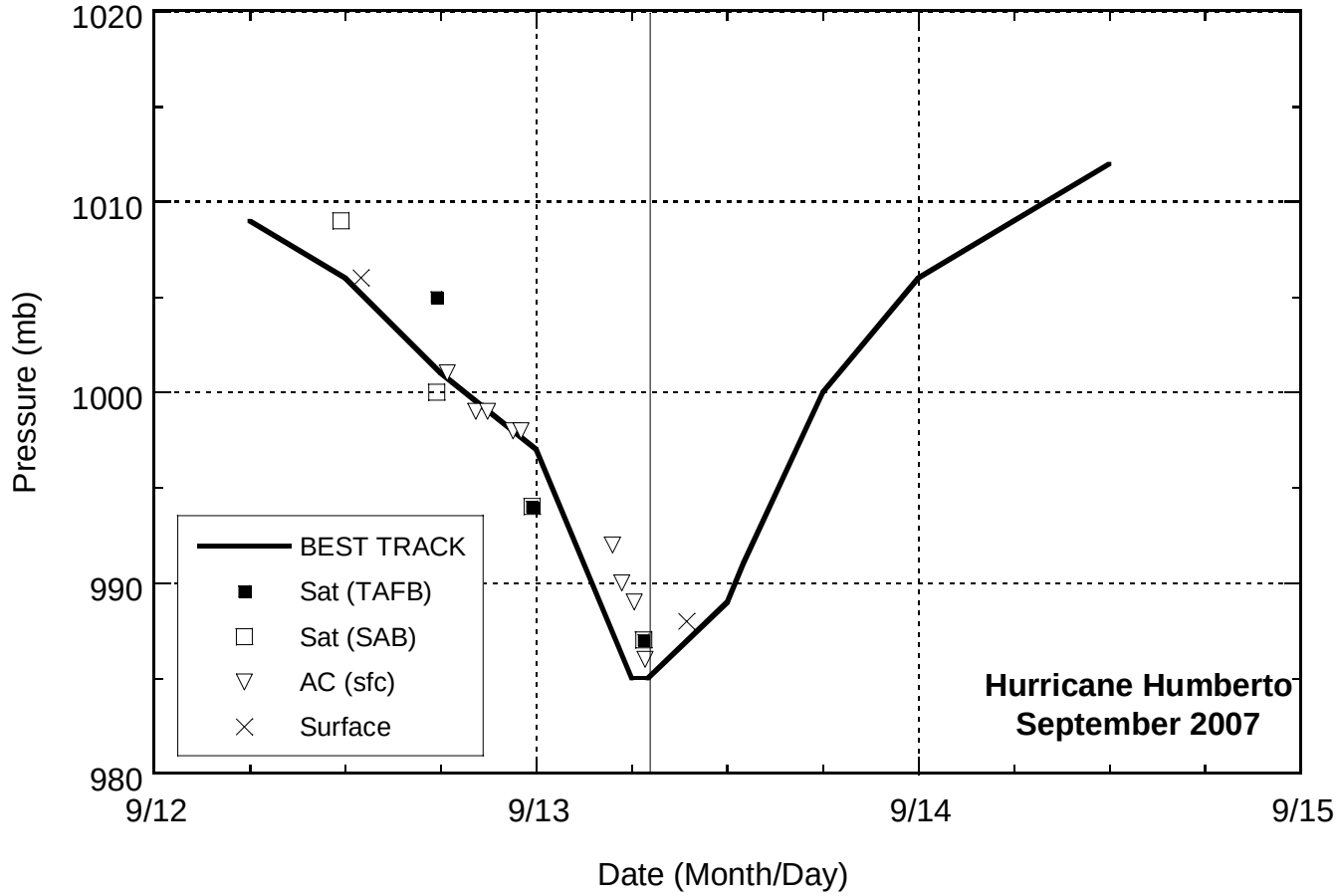

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Humberto, 12-14 September 2007. The thin vertical line indicates the time of landfall in Texas.

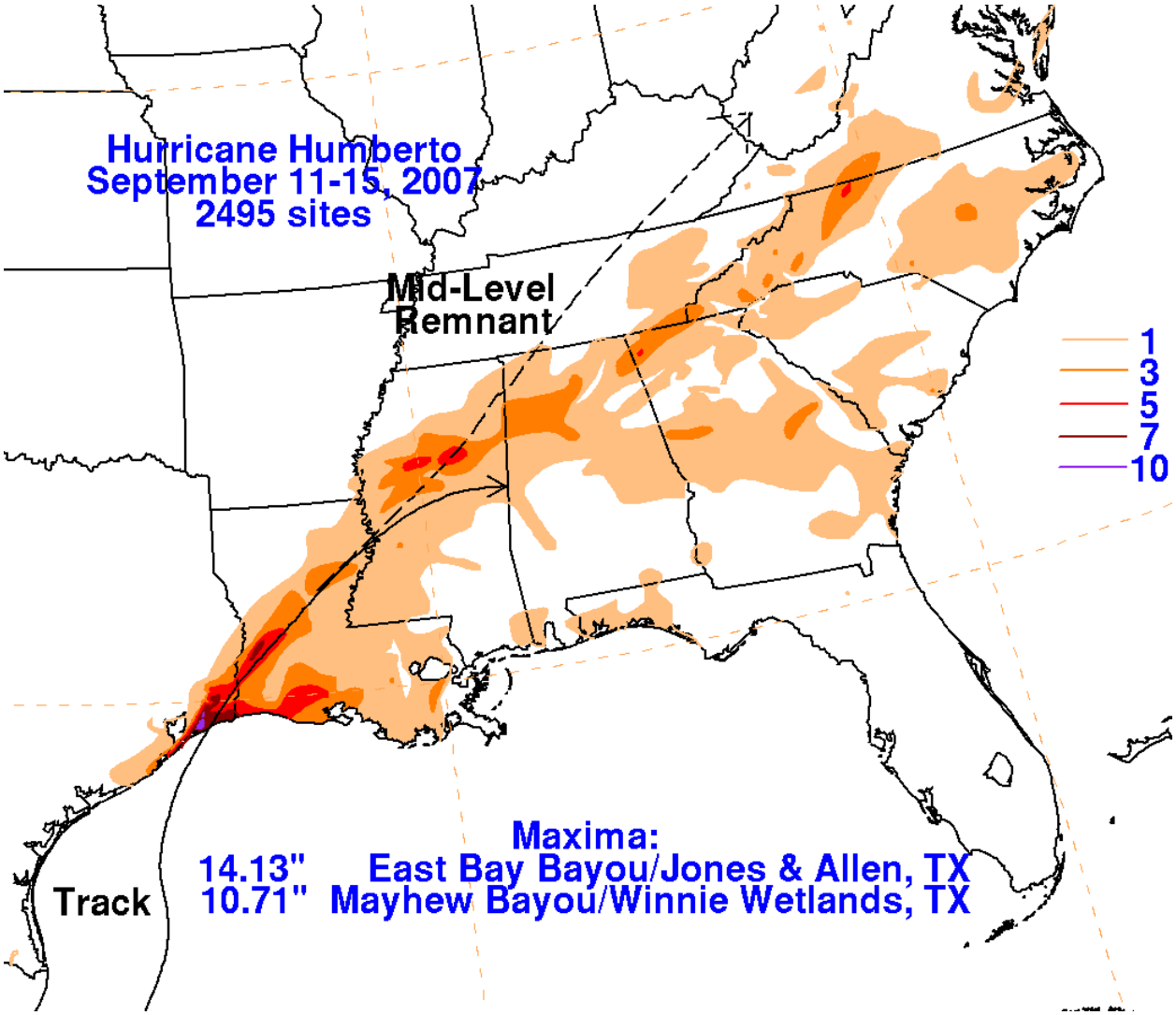

Figure 4. Storm total precipitation associated with Hurricane Humberto and its remnants over the southeastern United States. Figure courtesy David Roth at the Hydrometeorological Prediction Center, Camp Springs, MD.