Tropical Cyclone Report
Tropical Storm Hanna
12-15 September 2002

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Hanna was a poorly-organized tropical storm that nevertheless produced rip currents responsible for three deaths off the beaches of the Florida panhandle.

a. Synoptic History

Hanna formed in the Gulf of Mexico from a complex interaction of a tropical wave, an upper-level low, and a surface trough. In the days preceding genesis, a broad surface trough in the wake of Hurricane Gustav stretched from the western Atlantic across South Florida and into the central Gulf of Mexico. During this time a westward-moving tropical wave approached the Yucatan peninsula, and when the wave reached the Gulf of Mexico on 10 September a weak 1008-mb low formed on the western end of the surface trough. Initially, there was minimal convection associated with the combination of these two features; however, on 11 September an upper-level short-wave trough over the southern United States cut off over the central Gulf of Mexico, and convection began to develop to the east of the both the upper level low and the tropical wave/surface low. The convection became sufficiently organized to warrant a Dvorak classification at 1800 UTC that day, and over the next 6 hours convection developed closer to the surface low. Shortly before 0000 UTC 12 September a reconnaissance aircraft was able to locate a well-defined low-level circulation center, and with that the ninth depression of the season had formed about 250 n mi south of Pensacola Florida.

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. The cyclone initially had some non-tropical characteristics, including a westward tilt with height in association with the upper-low. Despite strong southwesterly shear and a disorganized convective structure, the depression became a tropical storm at 0600 UTC 12 September, about 225 n mi south of Pensacola. For the first 24 hours after genesis, the low-level circulation center rotated counter-clockwise around the middle and upper-level centers, first moving northeastward but turning to the southwest by late on 12 September. Moving slowly the following day, Hanna turned to the west and then to the north ahead of an approaching mid-level trough. Hanna strengthened and reached its peak intensity of 50 kt and 1001 mb at 0000 UTC 14 September about 60 n mi south of the mouth of the Mississippi River. In response to the approaching trough, Hanna accelerated northward early on 14 September and its exposed low-level circulation center began to become deformed and elongated. With nearly all the significant weather well to its east, Hanna's center of circulation passed over the extreme southeastern tip of Louisiana near 0800 UTC. Hanna then turned to the north-northeast and made its second landfall near the Alabama-Mississippi border near 1500 UTC. Maximum winds at both landfalls were near 50 kt. Hanna moved

northeastward across southern Alabama and weakened rapidly, dissipating by 1800 UTC 15 September. The remnants of the tropical cyclone then produced heavy rains as they moved rapidly across Georgia and the Carolinas.

b. Meteorological Statistics

Observations in Hanna (Figs. 2 and 3) include satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB) and the U. S. Air Force Weather Agency (AFWA), as well as flight-level and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Selected surface observations from land stations and data buoys are given in Table 2.

At 0600 UTC 12 September, buoy 42003 (at 25.9 °N, 86.0 °W, about 50 n mi south-southeast of the center) reported an 8-min mean wind of 32 kt. This observation is the basis for the assignment of tropical storm status at this time. Hanna's peak winds are estimated to be 50 kt, based on surface-adjusted flight-level winds of 46 kt at 2346 UTC 13 September and 47 kt at 1303 UTC 14 September, as well as a 47 kt 2-min wind from the Pensacola ASOS station at 1352 UTC 14 September.

The only ship to report tropical storm force winds was KRPP (**Nobel Star**), which reported winds of 37 kt and a pressure of 1006.0 mb at 0300 UTC 13 September, when it was about 45 n mi west-southwest of the center. Other observations of note include the aforementioned 47 kt report from Pensacola, the strongest sustained wind observation from a surface station. The highest gust reported was 59 kt at Pensacola Beach. An F0 tornado that blew down some trees was reported in south Mobile County Alabama. Gulfport Harbor reported a storm tide of 5.1 ft, and there were other reports in the 3-5 ft range (Table 2). Minor river flooding occurred along Spring Creek near Iron City, Georgia, where the river crested at 15.3 ft, 1.3 feet above flood stage.

Hanna and its remnants produced heavy rains across much of the southeastern states. These rains were largely confined to the eastern semicircle of the storm, with numerous reports of storm-total accumulations of between 5 and 10 inches. The highest reported storm total, 15.56 in, was from Donalsonville, Georgia.

c. Casualty and Damage Statistics

Three deaths are attributed to rip currents generated by Hanna. An adult male (age 20) drowned in rough surf near Pensacola Beach on the afternoon of the 14th. Two other adult males (ages unknown) drowned, one at Seagrove Beach (Walton County) on the 14th, and another at Panama City Beach on the 15th.

Storm effects were relatively minor, and insured losses did not meet the $25M threshold to be recorded by the American Insurance Services Group. Minor beach erosion was reported from Dauphin Island, Alabama, to Navarre Beach, Florida, as well as in the Florida counties of Walton,

Bay, and Gulf. Some storm tide flooding was reported on Dauphin Island and in Mobile County. Roughly 250 homes and 50 businesses were damaged from freshwater flooding in Donalsonville, Georgia. Data from the Georgia Farm Services Agency indicates agricultural damage, primarily to the cotton and peanut crops, amounted to nearly $19 million. There were several other apparently minor flooding events. Well after Hanna had made landfall and weakened to a tropical depression, there was a report of a roof being blown off a house in Donalsonville. Total damage is estimated at $20 million.

d. Forecast and Warning Critique

Average official track errors (with the number of cases in parentheses) for Hanna were 62 (8), 120 (6), 175 (4), and 225 (2), n mi for the 12, 24, 36, and 48 h forecasts, respectively. These errors are roughly 50% larger than the average official track errors for the 10-yr period 1992-2001 (43, 81, 115, and 148 n mi, respectively [Table 3]). Official track forecasts issued from 0000 UTC 12 September through 0600 UTC 14 September are shown in Fig. 4. The official forecasts consistently took Hanna northward to the coast too quickly, as they failed to anticipate the westward track of the storm prior to the 14th. Interestingly, much of the model guidance did capture some of the early counter-clockwise rotation of Hanna around the mid-level low; however, the official forecasts remained, conservatively, on the right-side of the guidance envelope showing a quicker motion toward the coast. Many of the guidance models had mean errors lower than those of the official forecast.

Official intensity forecasts correctly anticipated that Hanna would not strengthen much. Average official intensity errors were 2, 3, 4, and 13 kt for the 12, 24, 36, and 48 h forecasts, respectively. For comparison, the average official intensity errors over the 10-yr period 1992-2001 are 7, 11, 14, and 16 kt, respectively.

Table 4 lists the watches and warnings associated with Hanna. A tropical storm watch was issued at 1500 UTC 12 September, 41 hours prior to the first landfall of Hanna in extreme southeastern Louisiana. A tropical storm warning was issued at 0900 UTC 13 September, 23 hours prior to landfall. Tropical storm conditions were confined to the area under warning.

Acknowledgments

The National Weather Service (NWS) Forecast Offices in Mobile, New Orleans, and Tallahassee contributed surface observations for this report. The best track of Hanna after landfall is based in part on analyses from the NWS Hydrometeorological Prediction Center.

Table 1. Best track for Tropical Storm Hanna, 12-15 September 2002.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
12 / 0000	26.3	86.6	1001	30	tropical depression
12 / 0600	26.7	86.4	1001	35	tropical storm
12 / 1200	27.0	86.7	1001	35	"
12 / 1800	27.1	87.5	1001	35	"
13 / 0000	26.7	88.0	1001	35	"
13 / 0600	26.9	88.8	1002	40	"
13 / 1200	27.4	89.3	1002	45	"
13 / 1800	27.7	89.3	1003	45	"
14 / 0000	28.0	89.2	1001	50	"
14 / 0600	28.7	89.1	1003	50	"
14 / 1200	30.0	88.8	1003	50	"
14 / 1800	30.8	88.0	1005	30	tropical depression
15 / 0000	31.5	87.0	1009	20	"
15 / 0600	32.0	86.0	1011	20	"
15 / 1200	33.0	85.0	1014	20	"
15 / 1800					dissipated
14 / 0000	28.0	89.2	1001	50	minimum pressure/ maximum wind
14 / 0800	29.1	89.1	1003	50	landfall near mouth of Mississippi River
14 / 1500	30.4	88.4	1002	50	landfall near AL/MS border

Table 2. Selected surface observations for Tropical Storm Hanna, 12-15 September 2002.

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)			
Buoys								
42003 (25.9°N, 86.0°W)			13/0750	37				
42007 (30.1°N, 88.8°W)	14/1300	1003.5	14/1010	35	43			
42039 (28.8°N, 86.1°W)			13/1700		34			
42040 (29.2°N, 88.2°W)	14/0900	1005.0	14/0720	33	41			
CMAN stations								
Dauphin Is (DPIA1)	14/1400	1005	14/1230	41[e]	50		3.7	
Cape San Blas (CSBF1)	12/2300	1010.0	14/2040	33[e]	43			
SW Pass (BURL1)	14/0600	1005.4	14/0250	27	31			
Alabama								
Belle Fontaine								5.75
Mobile	14/1556	1006	14/1047	25	30			1.31
Coden (Co-op)								7.55
Fairhope								2.12
Florida								
Bay County							3	
Chipley (Co-op)								9.67
Crestview (Walker Elem.)								5.04
Destin (DTS)								4.65
Destin Middle School								5.41
Eglin AFB (VPS)			14/1857	32	41			2.77
Eglin A-5 (Santa Rosa Is.)	14/2038	1009.5	14/1556	35	48			3.45
Hurlburt Field (HRT)			14/1655	37	54			3.78
Mariana								7.20
Milligan								4.11
Niceville (Co-op)								3.66
Pensacola (PNS)	14/1353	1007	14/1352	47	57		3.4	3.05
Pensacola Beach			14/1430	43	59			
Pensacola NAS (NPA)			14/1437	41	48			

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)			
Tallahassee								6.32
Walton County							4	
Georgia								
Blakely								7.65
Donalsonville (Co-op)								15.56
Leesburg (Co-op)								5.11
Newton (Co-op)								7.00
Louisiana								
Bayou Dupre							4.30	
Boothville (BVE)	14/0902	1005.1						0.05
Industrial Canal							3.64	
Mississippi								
Gulfport Harbor							5.1	
Pascagoula (PQL)	14/1354	1005.8						
Waveland							4.78	

[a] Date/time is for sustained wind when both sustained and gust are listed.
[b] Except as noted, sustained wind averaging periods for C-MAN and land-based ASOS reports are 2 min; buoy averaging periods are 8 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] 10-min average.

Table 3. Preliminary forecast evaluation (heterogeneous sample) for Tropical Storm Hanna. Forecast errors for tropical storm and hurricane stages (n mi) are followed by the number of forecasts in parentheses. Errors smaller than the NHC official forecast are shown in bold-face type.

Forecast Technique	Forecast Period (h)				
	12	24	36	48	72
CLP5	84 (8)	150 (6)	215 (4)	325 (2)	
GFNI	**34 (5)**	**52 (3)**	**49 (1)**		
GFDI	75 (8)	133 (6)	227 (4)	409 (2)	
GFDL	63 (8)	**108 (6)**	**158 (4)**	356 (2)	
LBAR	70 (8)	120 (6)	196 (4)	370 (2)	
AVNI	72 (8)	**111 (6)**	**143 (4)**	**204 (2)**	
AVNO	65 (8)	**111 (6)**	**133 (4)**	**188 (2)**	
AEMI	74 (4)	**105 (4)**	**125 (3)**	**114 (1)**	
BAMD	70 (8)	122 (6)	205 (4)	342 (2)	
BAMM	**56 (8)**	**84 (6)**	**127 (4)**	**183 (2)**	
BAMS	63 (8)	**101 (6)**	**145 (4)**	**212 (2)**	
NGPI	63 (8)	**100 (6)**	**137 (4)**	**165 (2)**	
NGPS	**42 (8)**	**68 (6)**	**123 (4)**	**135 (2)**	
UKMI	**58 (7)**	**99 (5)**	**127 (3)**	**159 (2)**	
UKM	**51 (4)**	**95 (3)**	**146 (2)**	**176 (1)**	
A98E	85 (8)	130 (6)	198 (4)	318 (2)	
A9UK	101 (4)	141 (3)	210 (2)	280 (1)	
GUNS	**61 (7)**	**105 (5)**	**149 (3)**	243 (2)	
GUNA	64 (7)	**106 (5)**	**145 (3)**	232 (2)	
OFCL	62 (8)	120 (6)	175 (4)	225 (2)	
NHC Official (1992-2001 mean)	43 (2199)	81 (1965)	115 (1759)	148 (1580)	222 (1272)

Table 4. Watch and warning summary for Tropical Storm Hanna, 12-15 September 2002.

Date/Time (UTC)	Action	Location
12 / 1500	Tropical Storm Watch issued	East of Pascagoula MS to Suwanee River FL
13 / 0900	Tropical Storm Warning issued	Grand Isle LA to Apalachicola FL
14 / 0900	Tropical Storm Watch discontinued	East of Apalachicola to Suwanee River
14 / 1500	Tropical Storm Warning discontinued	Grand Isle to Pascagoula
14 / 1800	Tropical Storm Warning discontinued	East of Pascagoula to Apalachicola

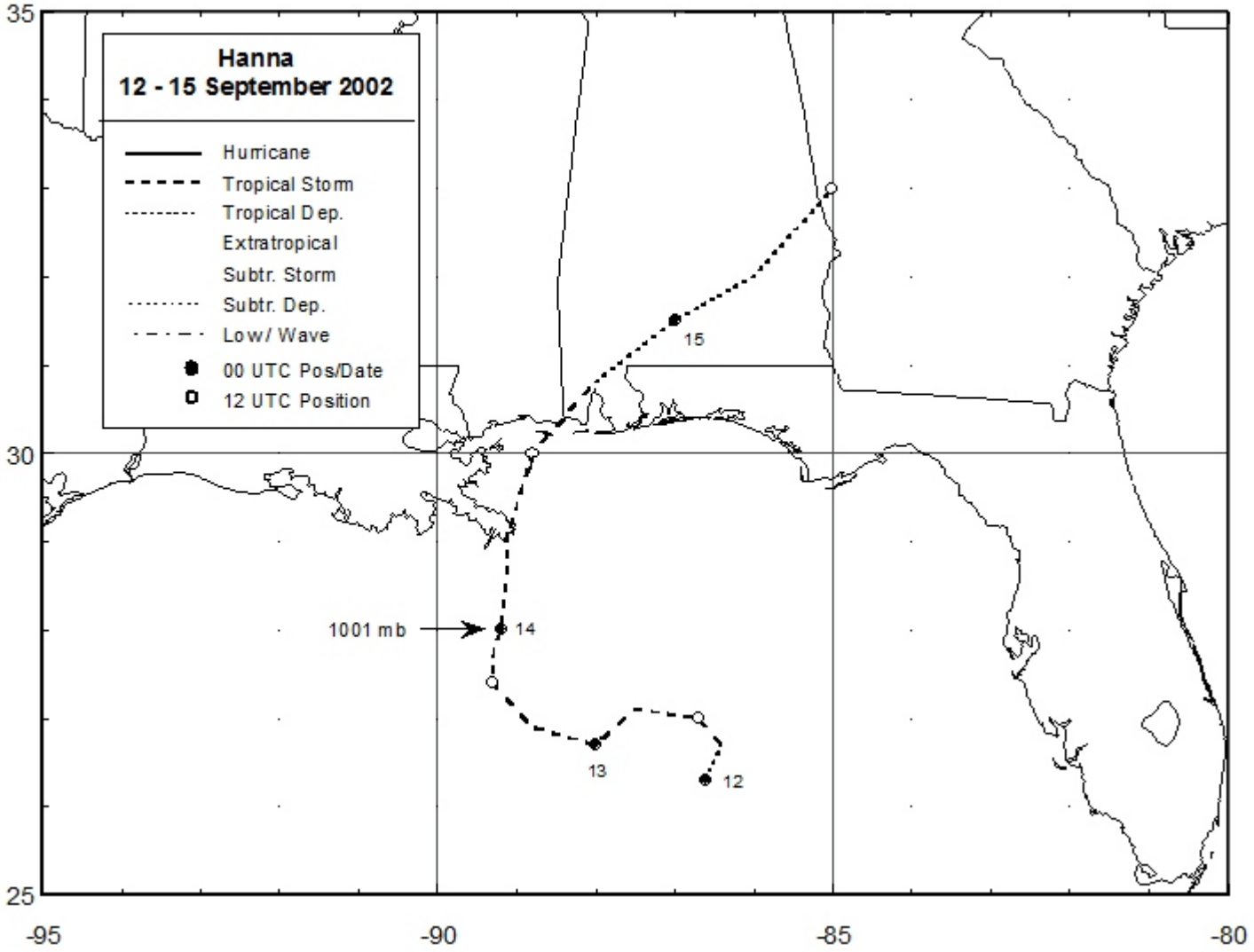

Figure 1. Best track positions for Tropical Storm Hanna, 12-15 September 2002.

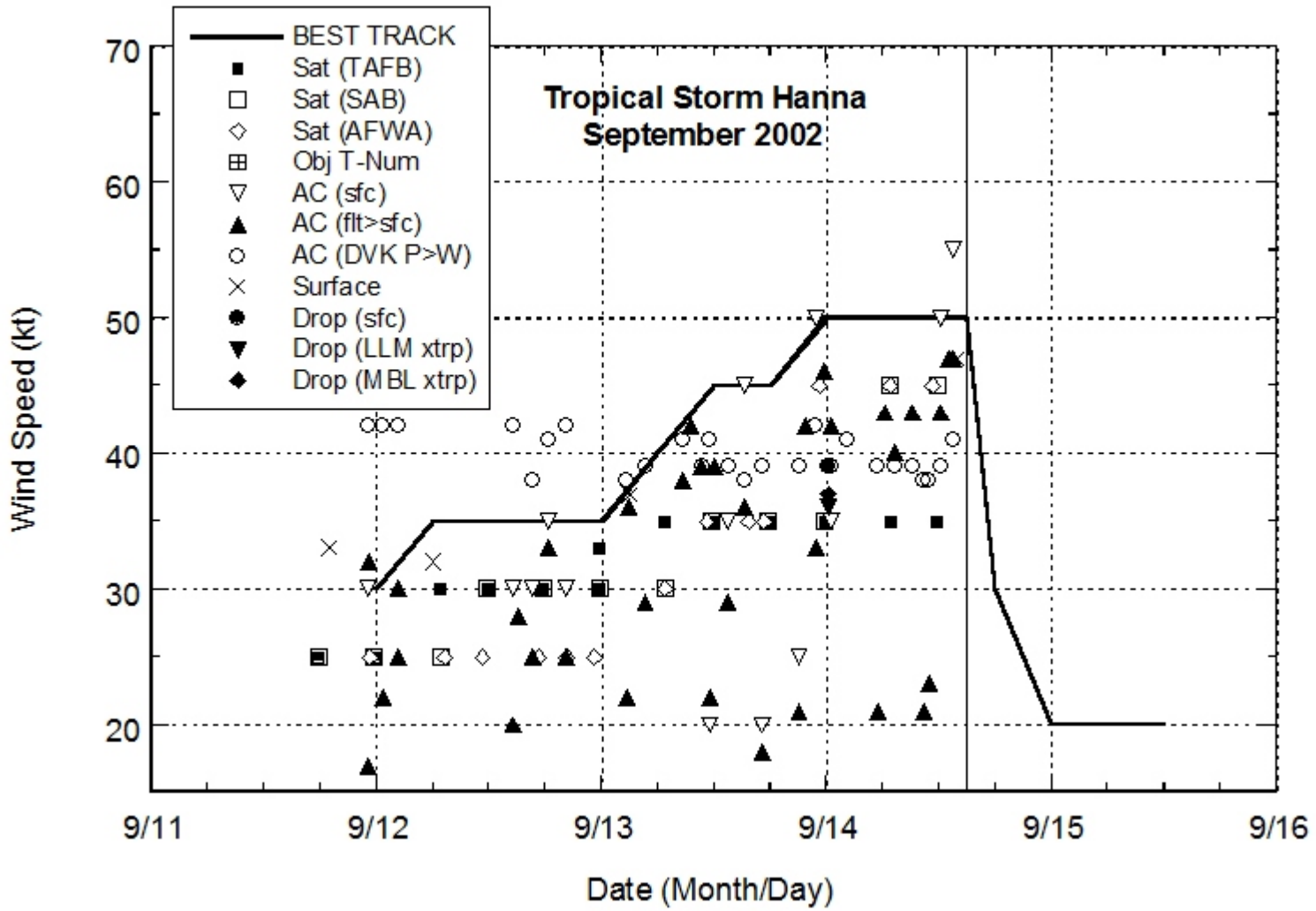

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Hanna, 12-15 September 2002. Aircraft observations have been adjusted for elevation using 80%, 75%, and 80% reduction factors for observations from 850 mb, 925 mb, and 1500 ft, respectively. Dropwindsonde observations include actual 10 m winds (sfc), as well as surface estimates derived from the mean wind over the lowest 150 m of the wind sounding (LLM), and from the sounding boundary layer mean (MBL). Hanna's landfall near the Alabama-Mississippi border is indicated by the solid vertical line.

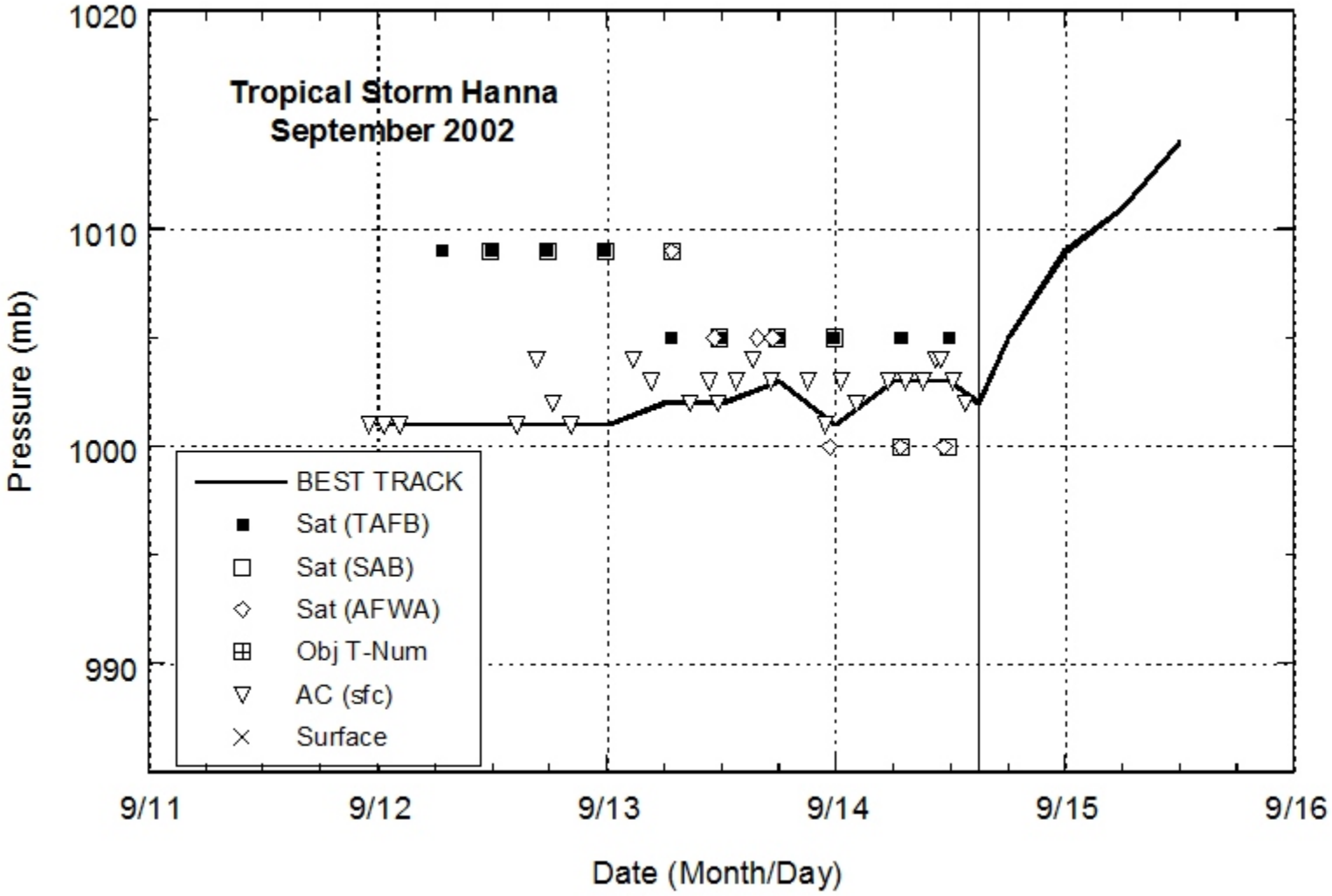

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Hanna, 12-15 September 2002. Hanna's landfall near the Alabama-Mississippi border is indicated by the solid vertical line.

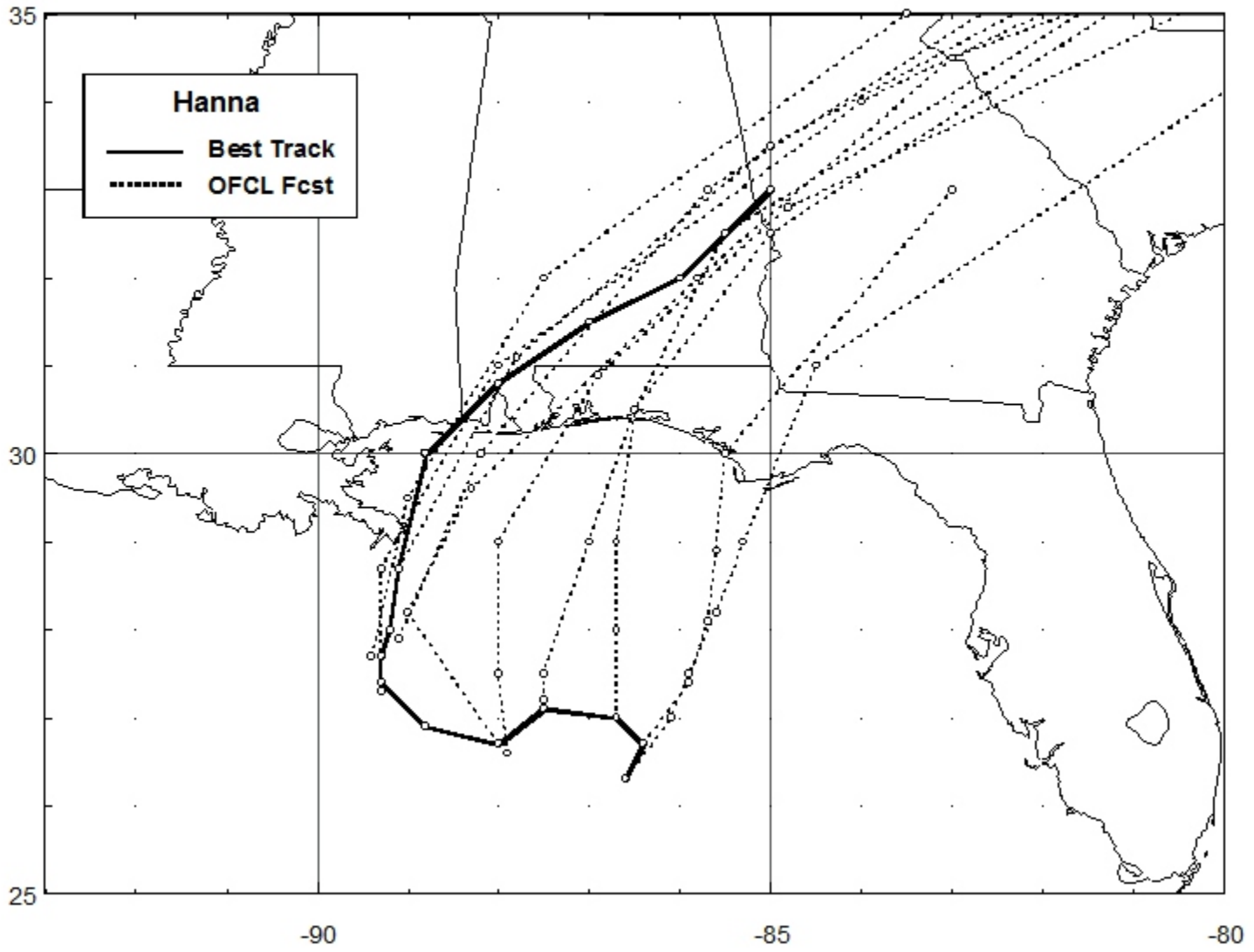

Figure 4. Selected official track forecasts (dashed lines, with 0, 12, 24, 36 ,48, and 72 h positions indicated) for Tropical Storm Hanna, 12-15 September 2002. The best track is given by the thick solid line with positions given at 6 h intervals.