NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM HANNA

(AL092014)

22 – 28 October 2014

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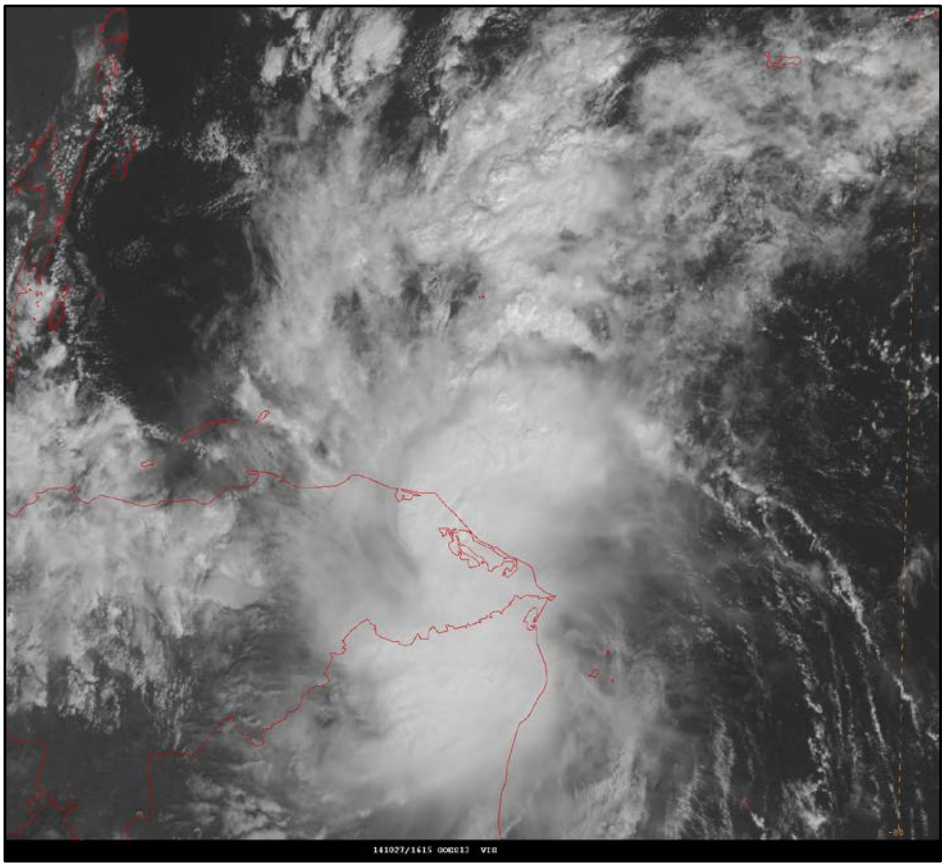

GOES-E VISIBLE SATELLITE IMAGE OF TROPICAL STORM HANNA AT 1615 UTC 27 OCTOBER AROUND THE TIME IT MADE LANDFALL NEAR THE NICARAGUA/HONDURAS BORDER.

Hanna had two brief periods as a tropical cyclone and made landfall as a tropical storm near the Nicaragua/Honduras border.

TROPICAL STORM HANNA

22 – 28 OCTOBER 2014

SYNOPTIC HISTORY

The genesis of Hanna was associated with the remnants of eastern Pacific Tropical Storm Trudy. Trudy made landfall along the southern coast of Mexico on 18 October. Although the low-level circulation of Trudy dissipated over the rugged terrain, the associated moisture and mid-level vorticity moved northward into the southwestern portion of the Bay of Campeche a day or so later. A weak area of surface low pressure developed in association with the mid-level feature around 0000 UTC 21 October about 60 n mi east of Veracruz, Mexico, and the low moved slowly eastward while producing disorganized showers and thunderstorms that day. An Air Force Reserve reconnaissance aircraft investigated the low on 21 October, and although the cyclone had a well-defined center, deep convection was not sufficiently organized for it to be declared a tropical depression at that time. Deep convection increased a few hours later, however, resulting in the formation of a tropical depression by 0000 UTC 22 October, when it was located about 150 n mi west of Campeche, Mexico in the Yucatan peninsula. 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[1].

The depression changed little during the next 12-18 h while it continued to move eastward to east-southeastward toward the Yucatan peninsula. After that time, southwesterly shear and dry air caused the cyclone to lose deep convection, and the system degenerated into a remnant low by 0000 UTC 23 October when it was located just to the west of the southwestern coast of the Yucatan peninsula. The remnant low made landfall a few hours later and weakened while it moved generally eastward across the southern Yucatan and northern Belize. The weak low moved over the northwestern Caribbean Sea on 24 October. Although the low was over warm water, it was located in an unfavorable environment of strong shear and dry air associated with a nearby frontal boundary. The low opened into a trough when it became entangled with the front around 0000 UTC 25 October, and the disturbance moved southeastward just east of the front during the next day or so.

The frontal boundary began weakening on 26 October, and the remnants of the depression became a little better organized as they slowed down and moved southeastward and then southward. Satellite images and surface observations indicate that the remnant trough developed into a small closed area of low pressure around 1200 UTC 26 October about 100 n mi east-northeast of the Nicaragua/Honduras border. The low then turned westward back toward the coast of Central America while deep convection gradually increased. It is estimated that the low became a tropical depression again by 0000 UTC 27 October, when it was located about 70

[1] A digital record of the complete best track, including wind radii, can be found on line at ftp://ftp.nhc.noaa.gov/atcf. Data for the current year's storms are located in the *btk* directory, while previous years' data are located in the *archive* directory.

n mi east of the Nicaragua/Honduras border. The cyclone strengthened to a tropical storm 6 h later and maintained minimal tropical storm strength until it moved inland over extreme northeastern Nicaragua around 1600 UTC 27 October. Hanna weakened to a tropical depression a couple of hours after it moved inland, and then degenerated into a remnant low over eastern Honduras by 0600 UTC 28 October. The remnant low moved over the Gulf of Honduras later that day, and although some deep convection did redevelop, it did not become sufficiently organized to regain tropical cyclone status before moving inland over Belize around 0300 UTC 29 October. The remnant low dissipated over northwestern Guatemala later that day.

METEOROLOGICAL STATISTICS

Observations in Hanna (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB) and the Satellite Analysis Branch (SAB). Observations also include flight-level, stepped frequency microwave radiometer (SFMR) from flights of the 53rd Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites including the Advanced Microwave Sounding Unit (AMSU), the NASA Tropical Rainfall Measuring Mission (TRMM), the European Space Agency's Advanced Scatterometer (ASCAT), and Defense Meteorological Satellite Program (DMSP) satellites, among others, were also useful in constructing the best track of Hanna.

There were no ship or land-based reports of winds of tropical storm force associated with Hanna.

Winds and Pressure

Hanna's estimated peak intensity of 35 kt, from 0600 UTC 27 October until landfall along the Nicaragua/Honduras border around 1600 UTC that day, is based on ASCAT data around 0300 UTC that showed maximum winds in the 30 to 35 kt range. The estimated minimum pressure of 1000 mb is based on data taken by the Air Force hurricane hunters when the cyclone was in the Bay of Campeche.

Rainfall

Although no rainfall totals are available, there were reports of heavy rains over the northeastern portion of Nicaragua and much of eastern Honduras associated with Hanna.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Hanna.

FORECAST AND WARNING CRITIQUE

The genesis of this tropical cyclone was not particularly well forecast (Table 2a). The disturbance that became the tropical depression in the Bay of Campeche was introduced with a low chance of development in the 5-day Tropical Weather Outlook (TWO) 78 h before genesis, and was included in the 2-day portion of the outlook 54 h before formation. The 5-day formation probability was raised to the medium category (30-50%) 60 h before genesis, and the short-range probability was raised to that category 36 h before development occurred. The forecast probabilities never reached the high category.

The reformation of the tropical cyclone was not well anticipated either (Table 2b). Although the remnants of the depression were included in the TWO 78 h before it redeveloped, the probability of formation never increased above the low category, primarily due to the limited time the system was expected to have over water before reaching Nicaragua and Honduras.

A verification of NHC official track forecasts for Hanna is given in Table 3a. Only a small number of forecasts were made for Hanna since it was a short-lived tropical cyclone. The official forecast track errors were similar to the mean official errors for the previous 5-yr period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Due to the very small sample, no meaningful comparisons can be made.

A verification of the small number of NHC official intensity forecasts for Hanna is given in Table 4a, and a homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b.

Watches and warnings associated with Hanna are given in Table 5.

Table 1. Best track for Tropical Storm Hanna, 22-28 October 2014. Positions and pressures given during the disturbance stage are representative values for the low-level vorticity center.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
21 / 0000	19.5	95.3	1002	25	low
21 / 0600	19.5	94.8	1002	25	"
21 / 1200	19.5	94.2	1001	25	"
21 / 1800	19.5	93.7	1000	30	"
22 / 0000	19.5	93.3	1000	30	tropical depression
22 / 0600	19.5	92.9	1001	30	"
22 / 1200	19.4	92.4	1002	30	"
22 / 1800	19.3	91.9	1003	30	"
23 / 0000	19.2	91.3	1004	25	low
23 / 0600	18.9	90.8	1005	20	"
23 / 1200	18.6	90.5	1006	20	"
23 / 1800	18.2	90.0	1007	20	"
24 / 0000	17.9	89.4	1008	20	"
24 / 0600	18.1	88.5	1008	20	"
24 / 1200	18.4	87.7	1008	20	"
24 / 1800	18.8	87.0	1008	20	"
25 / 0000	19.0	86.2	1008	20	disturbance
25 / 0600	18.8	85.3	1008	20	"
25 / 1200	18.3	84.5	1008	25	"
25 / 1800	17.7	83.7	1008	25	"
26 / 0000	17.1	82.9	1007	25	"
26 / 0600	16.5	82.2	1007	25	"
26 / 1200	16.0	81.8	1006	30	low
26 / 1800	15.5	81.8	1006	30	"
27 / 0000	15.1	82.0	1006	30	tropical depression
27 / 0600	15.0	82.4	1005	35	tropical storm

27 / 1200	14.9	83.0	1005	35	"
27 / 1600	14.9	83.3	1005	35	"
27 / 1800	14.9	83.5	1006	30	tropical depression
28 / 0000	15.0	84.3	1007	30	"
28 / 0600	15.4	85.2	1008	25	low
28 / 1200	15.9	85.9	1009	20	"
28 / 1800	16.5	86.7	1010	20	"
29 / 0000	16.8	87.6	1010	20	"
29 / 0600	16.9	88.6	1011	20	"
29 / 1200	16.9	89.6	1011	20	"
29 / 1800	16.8	90.5	1012	15	"
30 / 0000					dissipated
27 / 0600	15.0	82.4	1005	35	maximum wind
27 / 1600	14.9	83.3	1005	35	landfall near Nicaragua/Honduras border

Table 2a. Number of hours in advance of formation associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<30%)	54	78
Medium (30%-50%)	36	60
High (>50%)	-	-

Table 2b. Number of hours in advance of regeneration associated with the first NHC Tropical Weather Outlook forecast in the indicated likelihood category. Note that the timings for the "Low" category do not include forecasts of a 0% chance of genesis.

	Hours Before Genesis	
	48-Hour Outlook	**120-Hour Outlook**
Low (<30%)	78	78
Medium (30%-50%)	-	-
High (>50%)	-	-

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Hanna. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	33.1	-	-	-	-	-	**210.1**
OCD5	34.0	-	-	-	-	-	702.1
Forecasts	3	-	-	-	-	-	4
OFCL (2009-13)	28.8	45.5	61.2	77.8	114.5	158.4	208.2
OCD5 (2009-13)	48.2	100.1	160.2	220.8	326.6	410.7	479.4

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Hanna. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 3a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	33.1	-	-	-	-	-	211.0
OCD5	34.0	-	-	-	-	-	716.4
TCLP	**30.2**	-	-	-	-	-	680.9
GFSI	36.0	-	-	-	-	-	**123.6**
GHMI	**26.7**	-	-	-	-	-	312.1
HWFI	**11.0**	-	-	-	-	-	309.9
GFNI	44.0	-	-	-	-	-	532.7
AEMI	**21.1**	-	-	-	-	-	243.2
TVCA	**27.3**	-	-	-	-	-	214.7
LBAR	**33.0**	-	-	-	-	-	1030.3
BAMS	47.2	-	-	-	-	-	984.9
BAMM	**13.1**	-	-	-	-	-	629.1
BAMD	**20.7**	-	-	-	-	-	657.8
Forecasts	3	0	0	0	0	0	2

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Hanna. Mean errors for the previous 5-yr period are shown for comparison. Official errors that are smaller than the 5-yr means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.7	-	-	-	-	-	**2.5**
OCD5	3.3	-	-	-	-	-	9.5
Forecasts	3	-	-	-	-	-	4
OFCL (2009-13)	6.3	9.7	11.9	13.7	15.3	15.4	15.7
OCD5 (2009-13)	7.4	11.1	13.8	15.7	18.3	18.2	18.1

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Hanna. Errors smaller than the NHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 4a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	6.7	-	-	-	-	-	2.5
OCD5	**3.3**	-	-	-	-	-	9.5
TCLP	**0.7**	-	-	-	-	-	19.0
DSHP	**1.7**	-	-	-	-	-	7.3
LGEM	**0.3**	-	-	-	-	-	8.0
GHMI	**4.3**	-	-	-	-	-	5.0
HWFI	**6.0**	-	-	-	-	-	23.5
ICON	**1.3**	-	-	-	-	-	10.0
IVCN	**1.3**	-	-	-	-	-	10.0
Forecasts	3	0	0	0	0	0	4

Table 5. Watch and warning summary for Tropical Storm Hanna, 22-28 October 2014.

Date/Time (UTC)	Action	Location
22 / 0300	Tropical Storm Warning issued	Celestun to Frontera, Mexico
22 / 2100	Tropical Storm Warning changed to Tropical Storm Watch	Celestun to Frontera, Mexico
23 / 0000	Tropical Storm Watch discontinued	Celestun to Frontera, Mexico
27 / 1500	Tropical Storm Warning issued	Punta Patuca, Honduras to Puerto Cabezas, Nicaragua
27 / 2100	Tropical Storm Warning discontinued	Punta Patuca, Honduras to Puerto Cabezas, Nicaragua

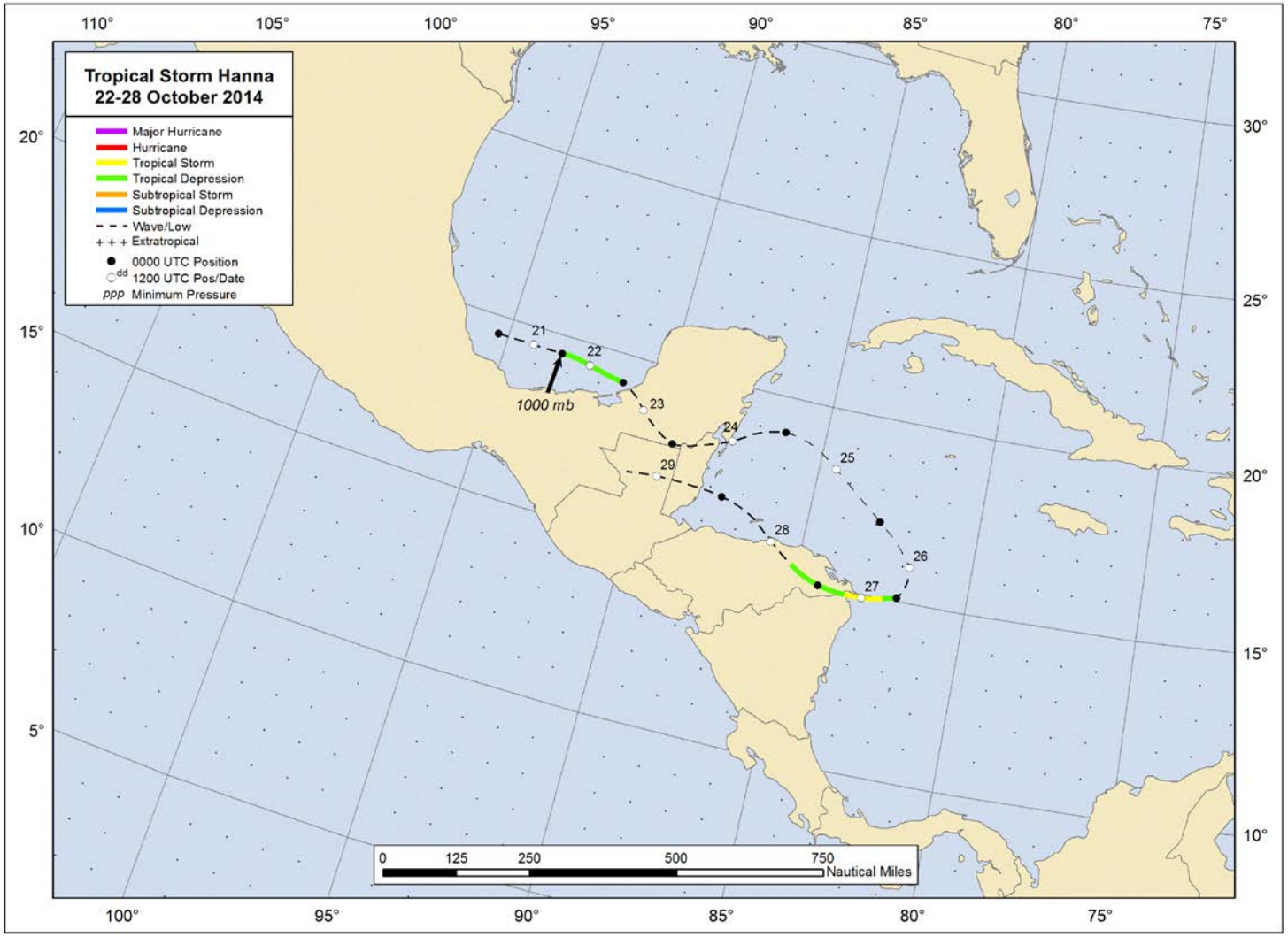

Figure 1. Best track positions for Tropical Storm Hanna, 22-28 October 2014.

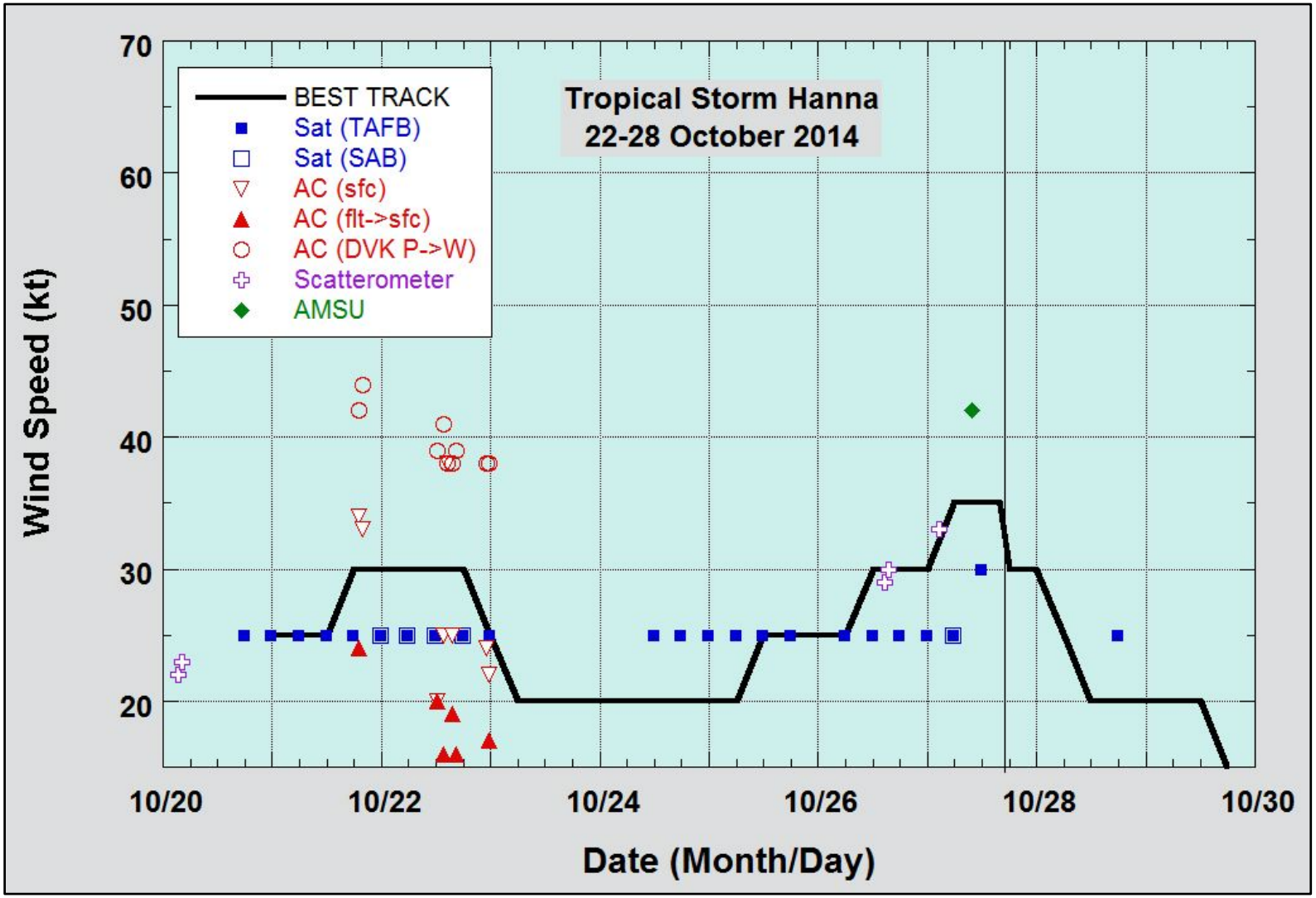

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Hanna, 22-28 October 2014. Aircraft observations have been adjusted for elevation using a 75% adjustment factor for observations from 925 mb. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.

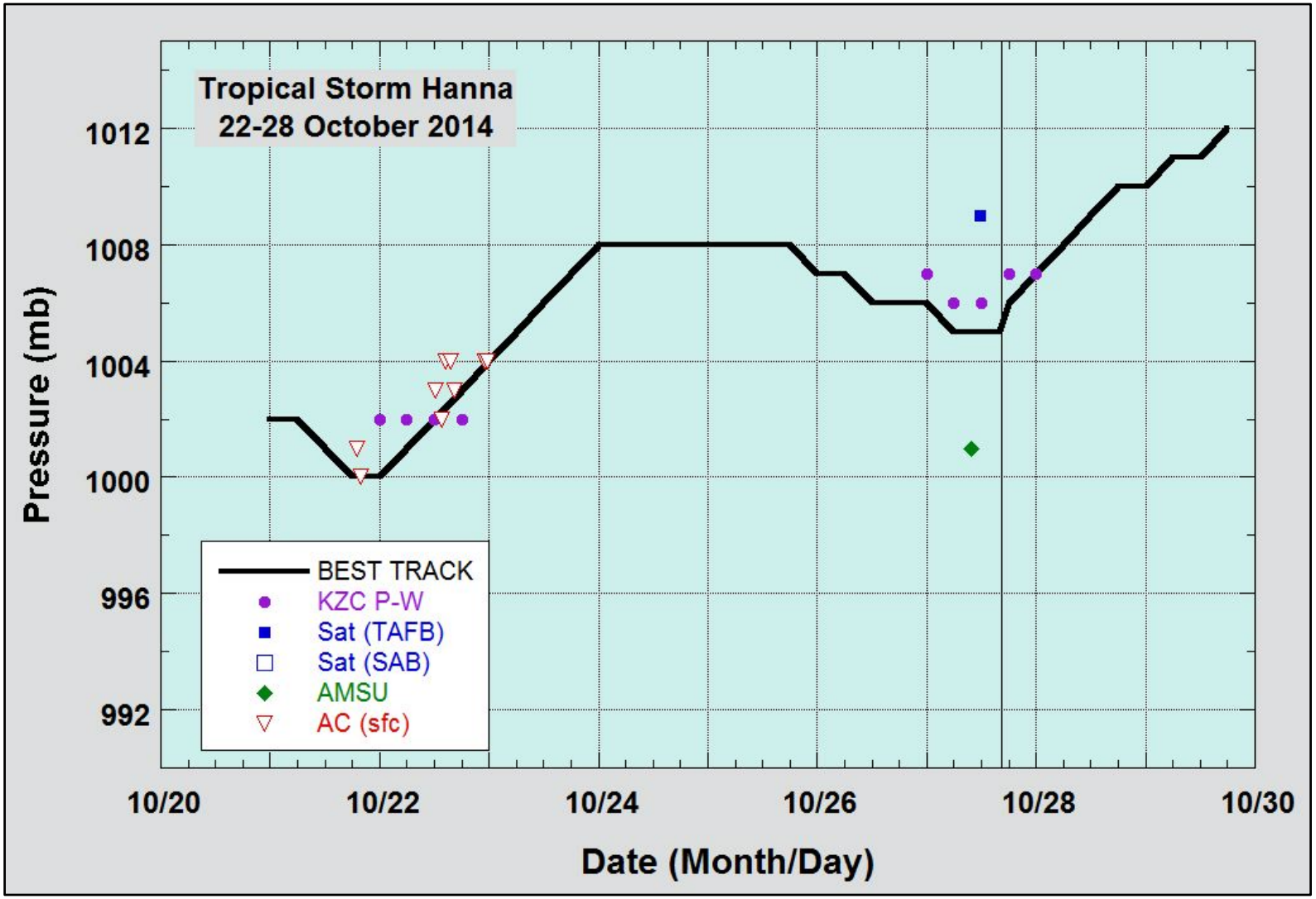

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Hanna, 22-28 October 2014. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC, and solid vertical lines correspond to landfalls.