

Tropical Cyclone Report  
Hurricane Richard  
(AL192010)  
20-25 October 2010

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Updated 9 August 2011 for landfall time and longitude.

Richard was a late season tropical cyclone that formed in the western Caribbean Sea and struck Belize as a category 2 hurricane (on the Saffir-Simpson Hurricane Wind Scale).

a. Synoptic History

On 15 October, satellite pictures indicated an area of disturbed weather within a persistent and broad trough over the southwestern Caribbean Sea on 15 October, west of the coast of Colombia. Convection associated with the disturbance changed little in organization during the next day or so as it drifted westward. The interaction of the disturbance with a tropical wave moving into the region on 17-18 October resulted in a convective burst and the development of a mid-level cyclonic circulation offshore of the northeastern coast of Nicaragua early on 18 October. Convection diminished later that day, but a subsequent burst of deep convection early on 19 October led to the formation of a surface low pressure area about 135 n mi north of Cabo Gracias a Dios, Nicaragua. The weak low moved northwestward to north-northwestward around the periphery of a low- to mid-level ridge located to its east. The circulation became slightly better defined early the next day, and it is estimated that a tropical depression formed about 170 n mi north of Cabo Gracias a Dios around 0600 UTC 20 October. 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<sup>1</sup>.

The depression turned northward and then northeastward while its forward speed decreased in response to a shortwave trough passing through the southeastern United States on 19 and 20 October. Moderate southwesterly shear and dry middle- to upper-level air associated with this feature prevented additional development during this time, and the center of the broad low-level circulation remained exposed to the west of a pulsating mass of deep convection. The trough in the southeastern states moved into the western Atlantic on 20 and 21 October, and a

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<sup>1</sup> 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 *bt* directory, while previous years’ data are located in the *archive* directory.

low- to mid-level ridge built behind it over the Gulf of Mexico, causing the depression to turn eastward and then southeastward. As the trough moved out, the southwesterly shear decreased enough for the depression to strengthen into a tropical storm around 1200 UTC 21 October while located about 180 n mi northeast of Cabo Gracias a Dios. During the next couple of days, the low- to mid-level ridge north of the cyclone shifted eastward. This caused Richard to nearly complete an anticyclonic loop by 23 October as it gradually turned southward, southwestward, and then westward. Although southwesterly shear decreased further around this time, the entrainment of lingering dry mid- to upper-level air near and to the west of the storm hampered significant development.

As the mid-level ridge strengthened further, Richard began to increase its forward speed on a course just north of due west late on 23 and 24 October. The storm environment moistened and the shear remained low, allowing Richard to strengthen. A banding eye became evident in satellite pictures early on 24 October, and Richard became a hurricane around 0600 UTC that day while located about 180 n mi east-southeast of Belize City, Belize. A steady rate of intensification continued after 0600 UTC that day, and the hurricane is estimated to have made landfall with an intensity of 85 kt around 0040 UTC 25 October near Gales Point, Belize, about 20 n mi south of Belize City. Moving inland over Belize, Richard weakened to a tropical storm over the mountainous terrain of northern Guatemala 12 h later. Further weakening occurred as the cyclone turned west-northwestward to northwestward around the western periphery of the low- to mid-level ridge to its east late on 25 October and early on 26 October. Richard became a tropical depression about 115 n mi south of Campeche, Mexico, at 1800 UTC 25 October and degenerated into a remnant low 6 h later about 20 n mi southeast of Ciudad del Carmen, Mexico. In a high westerly shear environment the non-convective remnant low dissipated in the eastern Bay of Campeche about 18 h later.

#### b. Meteorological Statistics

Observations in Richard (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, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from 10 flights of the 53<sup>rd</sup> Weather Reconnaissance Squadron of the U. S. Air Force Reserve Command. Data and imagery from NOAA polar-orbiting satellites, the NASA Tropical Rainfall Measuring Mission (TRMM), the European Space Agency's Advanced Scatterometer (ASCAT), Defense Meteorological Satellite Program (DMSP) satellites, among others, and the Belize radar were also useful in constructing the best track of Richard.

The maximum flight-level (700 mb) wind measured in Richard was 86 kt in the northeast quadrant of the circulation at 2030 UTC 24 October, and a minimum pressure of 981 mb was observed two minutes earlier. The maximum SFMR wind estimate was 77 kt around 2000 UTC. The crew on the plane indicated that the eyewall became better defined at the time of the last fix, suggesting an increase in system organization. Moreover, radar data from Belize suggest that this trend continued until landfall (Fig. 4). The estimated landfall intensity of 85 kt and 977 mb is based on an extrapolation of the deepening rate observed from the period of reconnaissance

coverage until the time of landfall. Satellite imagery indicated that Richard remained well-organized for several hours after moving inland before weakening.

There were no ship reports of tropical-storm-force winds in association with Richard. Selected surface observations from land stations and buoys are given in Table 2. Several unofficial wind observations of tropical-storm-force winds were received from a sparsely populated area of west-central Belize to the south of the track of Richard's center.

#### c. Casualty and Damage Statistics

According to press reports, there was one death directly attributed to Richard. A man died when the boat on which he and two others were sailing capsized in the region where the hurricane made landfall. An indirect death occurred when a man was mauled to death by a jaguar that escaped when its cage was struck and opened by a fallen tree.

The center of Richard passed close to the Bay Islands of Honduras, but the effects there were minimal. Media reports indicate that Richard caused widespread power outages, downed trees, ripped off roofs and caused minor structural damage in Belize. One report indicates that there was \$32 million U.S. dollars in damage to the citrus industry, with about 80% of the grapefruit and nearly 25% of the orange crop lost. Total damage estimates associated with Richard are reported to be in excess of \$80 million U.S. dollars.

#### d. Forecast and Warning Critique

The genesis of Richard was reasonably well forecast. The disturbance from which Richard developed was introduced into the Tropical Weather Outlook with a low (0 to 20%) chance of genesis 96 h prior to its formation. The probability of genesis was raised to a medium chance (30 to 50% chance) 48 h later but only reached a high chance (greater than 60% chance) 9 h before genesis occurred.

A verification of NHC official track forecasts for Richard is given in Table 3a. Official forecast track errors were much lower than the mean official errors for the previous 5-yr period at all forecast times. However, no meaningful conclusions can be drawn at 96 and 120 h, given the small sample sizes at those times. Official errors were especially small at 36 and 48 h (about a half of the 5-yr mean), as forecasts not only correctly anticipated Richard's slow movement but also its anti-cyclonic looping motion. It should be noted that OCD5 errors for Richard were lower than the 5-yr means through 48 h, indicating that the short-term forecasts were easier than average. OCD5 errors beyond 72 h were greater than the 5-yr means, especially at 96 and 120 h, indicative of a more difficult forecast at those times. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The EMXI, AEMI, and TVCN performed as well or better than the official forecast at 12 and 24 h. A number of models beat the official forecast at 72 and 96 h, with the UKMI and BAMD excelling the most.

A verification of NHC official intensity forecasts for Richard is given in Table 4a. Official forecast intensity errors were lower than the mean official errors for the previous five-year period at all forecast times. Of note, errors at 48 and 72 h were about half of the 5-yr mean.

A comparison of OCD5 errors for Richard with the 5-yr mean values indicates that Richard was easier to forecast through 48 h but more difficult after that time compared to a typical system. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. DSHP and LGEM beat the official forecast at 24 and 36 h. Otherwise, the official forecast was superior to the guidance through 96 h.

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

#### *Acknowledgements*

Wind data from west-central Belize were provided by Mr. Henry Plett, a private weather observer in Belize.

Table 1. Best track for Hurricane Richard, 20-25 October 2010.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
19 / 1800	17.2	83.4	1008	30	low
20 / 0000	17.7	83.2	1008	30	"
20 / 0600	17.8	82.8	1008	30	tropical depression
20 / 1200	17.8	82.3	1008	30	"
20 / 1800	17.6	81.8	1008	30	"
21 / 0000	17.3	81.3	1007	30	"
21 / 0600	17.0	80.9	1007	30	"
21 / 1200	16.7	80.6	1006	35	tropical storm
21 / 1800	16.3	80.4	1006	35	"
22 / 0000	16.0	80.5	1007	35	"
22 / 0600	15.9	80.7	1005	35	"
22 / 1200	15.8	81.0	1006	35	"
22 / 1800	15.8	81.5	1006	40	"
23 / 0000	15.8	82.1	1006	40	"
23 / 0600	15.8	82.6	1004	45	"
23 / 1200	15.9	83.1	1000	50	"
23 / 1800	16.0	83.6	998	55	"
24 / 0000	16.2	84.3	995	60	"
24 / 0600	16.5	85.2	992	65	hurricane
24 / 1200	16.8	86.3	990	75	"
24 / 1800	17.0	87.3	984	80	"
25 / 0000	17.2	88.2	977	85	"
25 / 0040	17.2	88.7	977	85	"
25 / 0600	17.4	89.2	988	65	"
25 / 1200	17.7	90.0	997	40	tropical storm
25 / 1800	18.0	90.8	1000	30	tropical depression
26 / 0000	18.4	91.5	1002	25	low
26 / 0600	19.1	92.3	1004	25	"
26 / 1200	20.1	92.9	1004	20	"
26 / 1800					dissipated
25/0030	17.2	88.3	977	85	Landfall near Gales Point, Belize
25 / 0000	17.2	88.2	977	85	Maximum wind and minimum pressure

Table 2. Selected surface observations for Hurricane Richard, 20-25 October 2010.

Location	Minimum Sea Level Pressure		Maximum Surface Wind Speed			Storm surge (ft) <sup>c</sup>	Storm tide (ft) <sup>d</sup>	Total rain (in)
	Date/time (UTC)	Press. (mb)	Date/time (UTC) <sup>a</sup>	Sustained (kt) <sup>b</sup>	Gust (kt)			
<b>Belize</b>								
Belize City	25/0100	1003.4		32 <sup>e</sup>	54			1.73
Near Orange Walk – 17.25N 88.98W (elev 12 m)			25/0300	35 <sup>e</sup>	58			
Near Orange Walk – 17.25N 89.0W (elev 45 m)			25/0300	45 <sup>e</sup>	80			
Near Orange Walk – 17.3N 89.05W (elev 11 m)			25/0300	39 <sup>e</sup>	78			
Near Orange Walk – 17.3N 89.05W (elev 11 m)			25/0300	33 <sup>e</sup>	69			
<b>Honduras</b>								
Roatan			24/1400	40	50			7.64
<b>Buoys</b>								
42057 – 16.8N 81.5W	22/0900	1008	22/1900	34	41			

<sup>a</sup> Date/time is for sustained wind when both sustained and gust are listed.

<sup>b</sup> Except as noted, sustained wind averaging periods for C-MAN and buoy averaging periods are 8 min

<sup>c</sup> Storm surge is water height above normal astronomical tide level.

<sup>d</sup> Storm tide is water height above National Geodetic Vertical Datum (1929 mean sea level).

<sup>e</sup> Sustained wind averaging period of one minute

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Richard, 20-25 October 2010. Mean errors for the five-year period 2005-9 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Richard)	<b>20.7</b>	<b>29.6</b>	<b>32.0</b>	<b>41.2</b>	<b>70.8</b>	<b>130.5</b>	<b>107.7</b>
OCD5 (Richard)	32.8	67.7	123.0	194.6	362.4	564.6	691.1
Forecasts	19	17	15	13	9	5	1
OFCL (2005-9)	31.8	53.4	75.4	96.8	143.8	195.6	252.1
OCD5 (2005-9)	46.9	97.3	155.4	211.6	304.8	387.9	467.8

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Richard, 20-25 October 2010. 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	21.0	31.3	32.9	41.5	76.4	147.5	
GFSI	22.4	35.3	49.8	68.9	79.9	<b>100.6</b>	
GHMI	28.6	47.3	58.3	77.6	106.7	301.0	
HWFI	32.3	51.3	60.2	76.0	155.9	338.9	
NGPI	25.1	35.9	45.5	67.3	115.9	<b>117.9</b>	
UKMI	24.6	35.8	42.9	56.1	<b>73.5</b>	<b>120.2</b>	
EMXI	21.5	<b>30.8</b>	38.7	55.1	136.0	254.3	
AEMI	21.3	<b>30.6</b>	43.3	58.0	85.2	<b>130.9</b>	
TVCN	<b>19.9</b>	<b>29.1</b>	34.6	41.8	<b>61.9</b>	160.2	
TVCC	<b>20.5</b>	32.6	43.6	58.1	77.5	152.9	
LBAR	33.0	80.4	138.4	201.1	458.2	775.0	
BAMD	28.0	47.3	56.2	56.3	<b>62.3</b>	<b>91.6</b>	
BAMM	29.4	48.6	67.0	97.8	164.2	236.1	
BAMS	39.2	82.2	122.6	153.4	218.7	271.7	
Forecasts	16	13	12	12	8	4	



Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Richard, 20-25 October 2010. Mean errors for the five-year period 2005-9 are shown for comparison. Official errors that are smaller than the five-year means are shown in boldface type.

	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (Richard)	<b>5.0</b>	<b>10.0</b>	<b>9.7</b>	<b>8.8</b>	<b>7.8</b>	<b>17.0</b>	<b>5.0</b>
OCD5 (Richard)	6.9	7.9	12.5	17.4	22.3	23.8	21.0
Forecasts	19	17	15	13	9	5	1
OFCL (2005-9)	7.0	10.7	13.1	15.2	18.6	18.7	20.1
OCD5 (2005-9)	8.6	12.5	15.8	18.2	21.0	22.7	21.7

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Richard, 20-25 October 2010. 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	5.0	10.0	9.7	8.8	7.8	17.0	5.0
HWFI	10.5	17.1	20.5	20.6	18.0	39.4	63.0
GHMI	9.3	13.8	17.9	20.5	25.0	43.2	<b>2.0</b>
DSHP	6.3	<b>6.4</b>	<b>8.5</b>	10.4	9.8	18.2	<b>2.0</b>
LGEM	6.4	<b>7.1</b>	<b>9.4</b>	11.8	11.6	19.4	<b>2.0</b>
ICON	7.7	10.6	11.8	12.1	13.0	28.6	16.0
IVCN	7.9	11.1	12.3	12.8	12.0	26.2	16.0
Forecasts	19	17	15	13	9	5	1

Table 5. Watch and warning summary for Hurricane Richard, 20-25 October 2010.

Date/Time (UTC)	Action	Location
21 / 2100	Tropical Storm Watch issued	Honduran/Nicaraguan border to Limón
22 / 1500	Tropical Storm Watch changed to Tropical Storm Warning/Hurricane Watch	Honduran/Nicaraguan border to Limón
22 / 2100	Tropical Storm Watch issued	Limon to Honduran/Guatemalan border
22 / 2100	Tropical Storm Watch issued	Belize
22 / 2100	Tropical Storm Warning issued	Bay Islands of Honduras
22 / 2100	Hurricane Watch issued	Chetumal to Punta Guesa
22 / 2100	Hurricane Watch issued	Bay Islands of Honduras
23 / 0300	Tropical Storm Warning issued	Honduran/Nicaraguan border to Honduran/Guatemalan border
23 / 1500	Tropical Storm Watch changed to Tropical Storm Warning	Belize
23 / 1500	Tropical Storm Warning changed to Hurricane Warning	Bay Islands of Honduras
23 / 1500	Tropical Storm Watch discontinued	All
23 / 1500	Tropical Storm Warning modified to	Honduran/Nicaraguan border to Limón
23 / 1500	Tropical Storm Warning issued	Chetumal to Punta Guesa
23 / 1500	Hurricane Watch discontinued	Honduran Bay Islands
23 / 1500	Hurricane Warning issued	Limón to Puerto Cortes

23 / 1800	Tropical Storm Warning changed to Hurricane Warning	Belize
24 / 1500	Tropical Storm Warning discontinued	Honduran/Nicaraguan border to Limón
24 / 1500	Hurricane Watch discontinued	Honduran/Nicaraguan border to Limón
24 / 2100	Tropical Storm Warning discontinued	Puerto Cortes to Honduran/ Guatemalan border
24 / 2100	Hurricane Warning discontinued	Limón to Puerto Cortes
24 / 2100	Hurricane Warning discontinued	Bay Islands of Honduras
25 / 0300	Hurricane Watch changed to Tropical Storm Warning	Chetumal to Punta Guesa
25 / 0900	Tropical Storm Warning discontinued	All
25 / 0900	Hurricane Warning discontinued	All

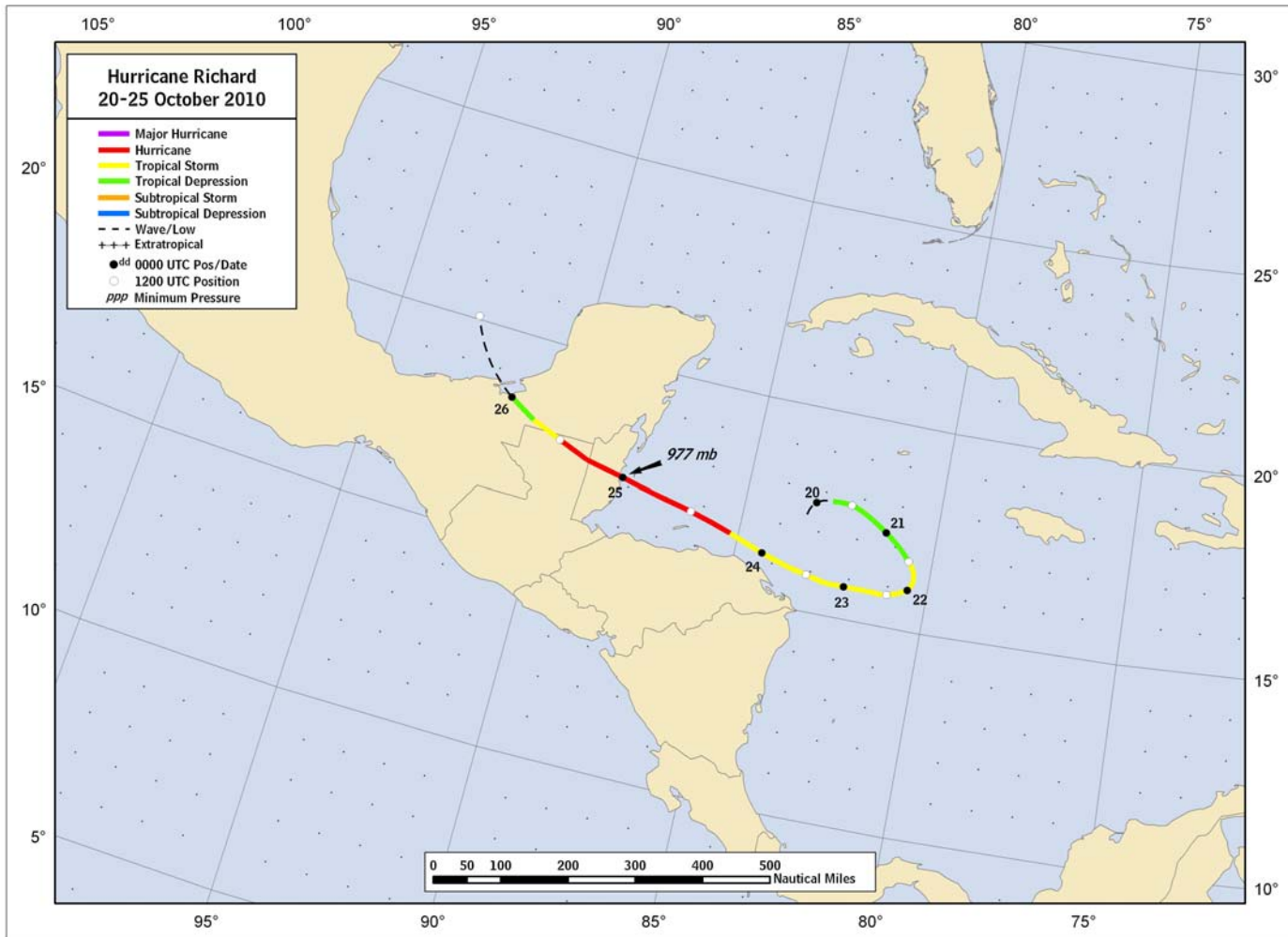


Figure 1. Best track positions for Hurricane Richard, 20-25 October 2010.

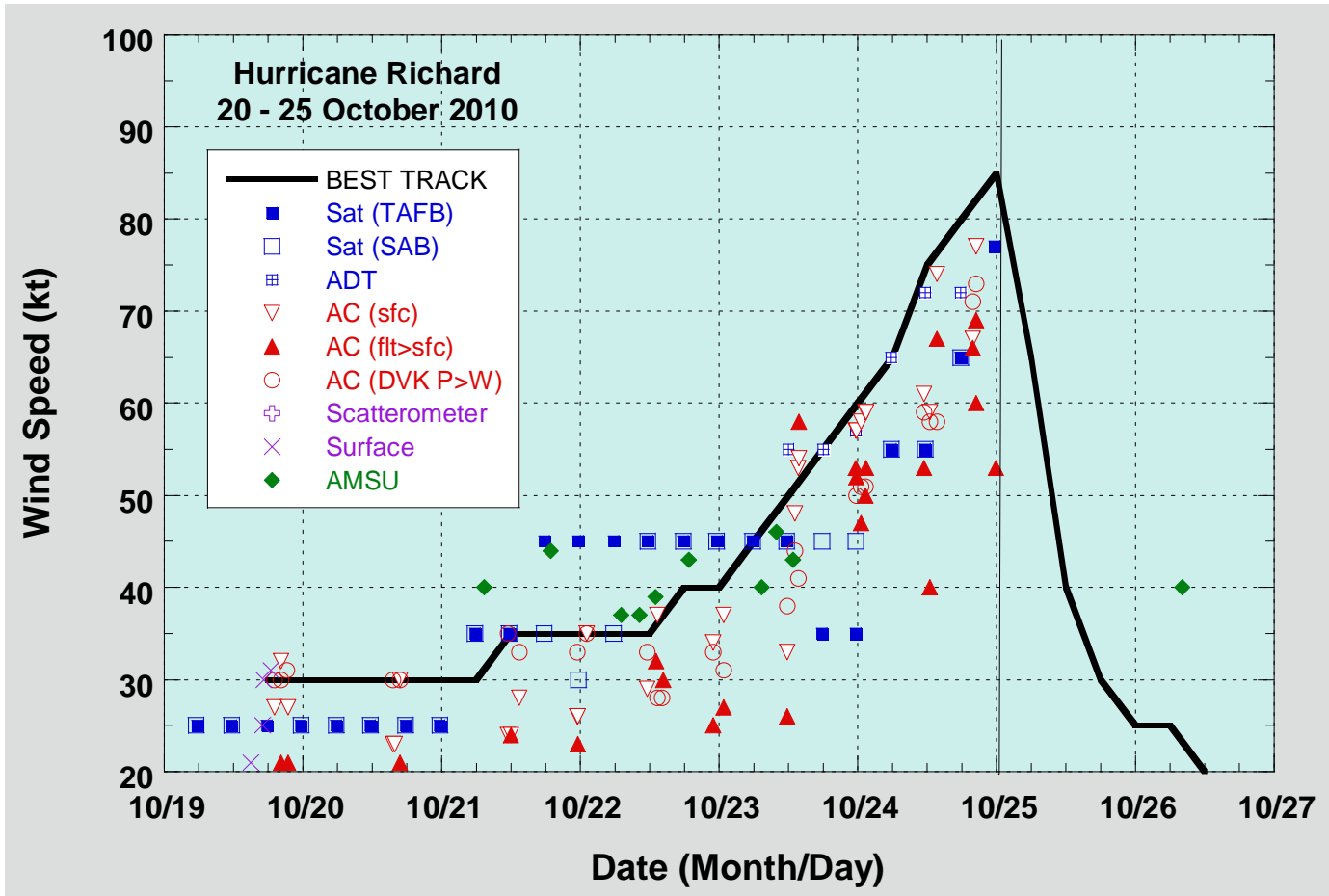


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Richard, 20-25 October, 2010. Aircraft observations have been adjusted for elevation using 90%, 80%, and 80% adjustment factors for observations from 700 mb, 850 mb, and 1500 ft, respectively. 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). Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC.

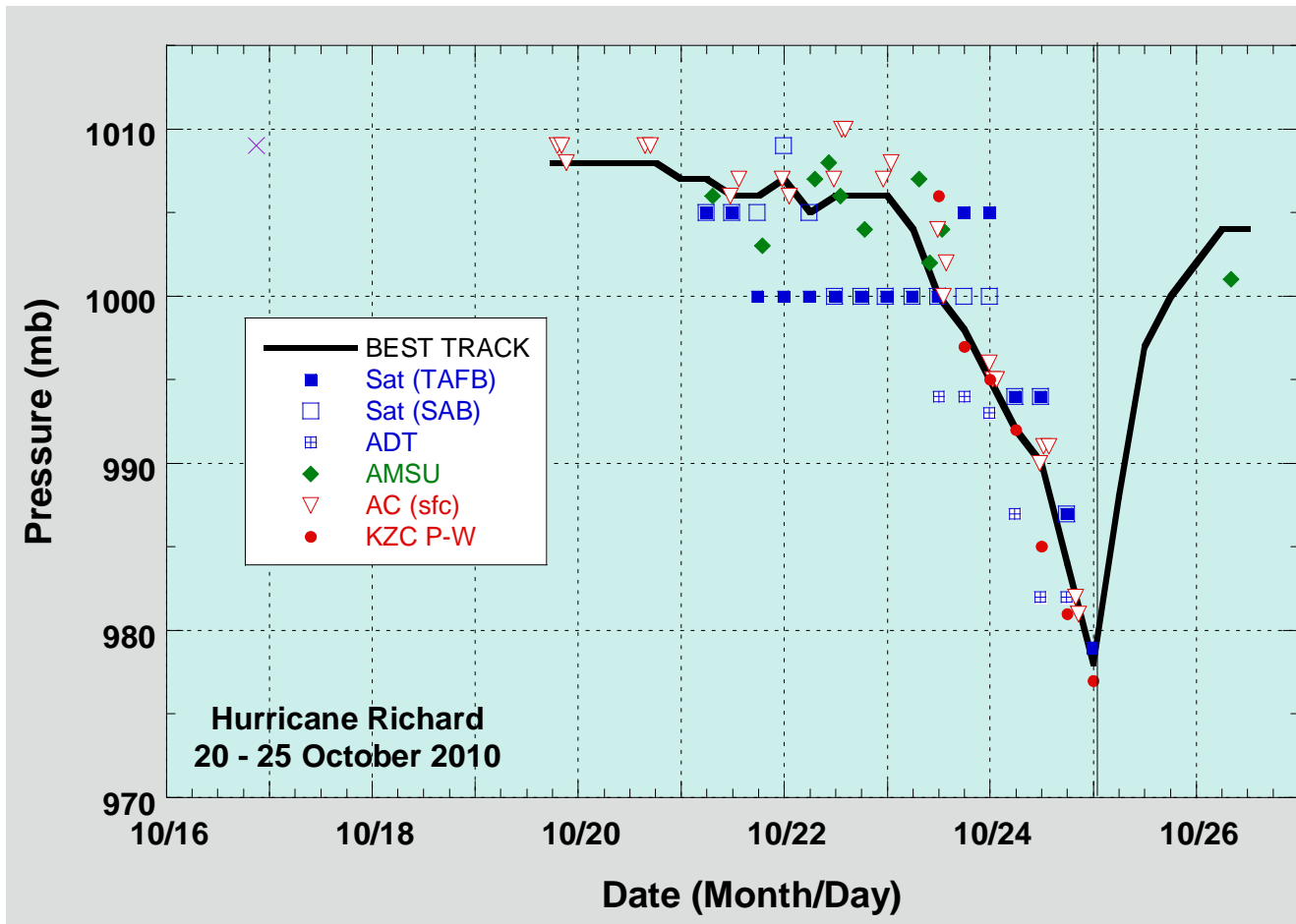


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Richard, 20-25 October 2010. Advanced Dvorak Technique estimates represent linear averages over a three-hour period centered on the nominal observation time. Dashed vertical lines correspond to 0000 UTC. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship.

Figure 4. A 0030 UTC 25 October 2010 radar image of Richard close to the time of landfall. Image courtesy of the Belize Weather Service.

