Tropical Cyclone Report
Hurricane Irwin
(EP112011)
6 – 16 October 2011

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Irwin was a category 2 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that meandered over the waters southwest of Mexico for about ten days, most of the time at an intensity below hurricane strength.

a. Synoptic History

Irwin appears to have developed from a breakdown of the Intertropical Convergence Zone (ITCZ). Three distinct areas of rotation developed along the ITCZ axis on 3 and 4 October, with the middle of the three initially becoming dominant (the eastern disturbance later became Hurricane Jova). The middle disturbance became a closed area of low pressure by 1800 UTC 4 October while centered about 620 n mi southwest of Manzanillo, Mexico, and produced disorganized deep convection as it moved west to west-northwestward over the next day or so. The convection consolidated into a curved band early on 6 October, and it is estimated that a tropical depression formed by 0600 UTC that day while centered about 735 n mi south-southwest of Cabo San Lucas, Mexico. The depression had already begun to rapidly strengthen and became a tropical storm 6 h later. The "best track" chart of Irwin'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].

Irwin moved west-northwestward on the southwest side of a weak mid-level ridge in an environment of light vertical wind shear and over sea surface temperatures of about 28°C. The cyclone continued to rapidly intensify, became a hurricane approximately 780 n mi southwest of Cabo San Lucas between 0000 and 0600 UTC 7 October, and reached a peak intensity of 85 kt by 1800 UTC that day. The environmental steering changed after that time, with the mid-level ridge to the northeast of Irwin being replaced by a mid-latitude trough and the hurricane beginning to interact with a large cyclonic gyre southwest of Mexico. As a result, the flow around Irwin collapsed, and the cyclone slowed down and turned north and northeastward on 8 October. At the same time, deep-layer easterly shear, likely produced by the upper-level outflow from Jova, caused the low-level center of Irwin to become exposed, and the hurricane rapidly weakened to a tropical storm by 1800 UTC 8 October.

[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.

Nearly all the deep convection dissipated early on 9 October, and Irwin's intensity decreased to 35 kt by 0600 UTC. Over the next three days, deep convection waxed and waned, and the cyclone's intensity changed little. Irwin accelerated toward the east during this period, steered by the flow near a mid-latitude trough over the southwestern United States and northwestern Mexico and a developing cut-off low southwest of Baja California. As Irwin turned toward the northeast around the cut-off low late on 12 October, deep-layer shear increased to near 20 kt, and again nearly all deep convection dissipated. This time significant convection was absent long enough for Irwin to weaken to a tropical depression at 0000 UTC 13 October, about 270 n mi west-southwest of Manzanillo.

Showers and thunderstorms redeveloped near the center, and Irwin re-strengthened to a tropical storm 18 h later. The storm became nearly stationary early on 14 October, but later that day a low- to mid-level ridge built over northwestern Mexico, causing Irwin to accelerate toward the south through early on 16 October. While moving southward, Irwin began to weaken for a final time as it encountered deep-layer northeasterly shear, drier air, and the cold wake from Hurricane Jova, and Irwin became a tropical depression at 1800 UTC 15 October about 235 n mi south-southwest of Manzanillo. Irwin degenerated to a remnant low 24 h later and moved with a generally slow northwestward motion for another two days or so. The remnant low ultimately dissipated after 1200 UTC 18 October, approximately 355 n mi southwest of Manzanillo.

b. Meteorological Statistics

Observations in Irwin (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), and objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison (UW-CIMSS). Data and imagery from NOAA polar-orbiting satellites (including UW-CIMSS Advanced Microwave Sounding Unit [AMSU] intensity estimates), 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 Irwin.

Irwin's analyzed peak intensity of 85 kt at 1800 UTC 7 October is based on a blend of subjective satellite intensity estimates of 77 kt and 90 kt from SAB and TAFB, respectively, and peak 3-h averaged ADT estimates of 85 kt from UW-CIMSS.

There were several ship reports of winds of tropical storm force associated with Irwin while the cyclone was near the Mexican coast. The *Monte Pascoal* (call sign DNCQ) and the *Duesseldorf Express* (call sign DGDD) reported respective sustained winds of 51 kt and 41 kt at 0000 UTC 14 October. However, a quality control analysis suggests that the historical wind reports from these ships had been running an average of 5 to 10 kt too high. Another ship, the *California Voyager* (call sign WDE5381), reported sustained winds of 35 kt and 37 kt on 14 October at 1600 and 1800 UTC, respectively.

c. Casualty and Damage Statistics

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

d. Forecast and Warning Critique

Irwin's genesis was generally well forecast. The disturbance from which Irwin developed was first introduced in the Tropical Weather Outlook and given a "low" (< 30%) chance of genesis over the next 48 h at 0000 UTC 2 October, 4.25 days before it became a tropical depression. As a closed low pressure system, it was given a "medium" (30 to 50%) chance 24 h before genesis and a "high" (>50%) chance 12 h before genesis.

A verification of NHC official track forecasts for Irwin is given in Table 2a. Official forecast track errors were comparable to the mean official errors for the previous 5-yr period at 12 and 24 h and were lower than the 5-yr means from 36 to 120 h. According to the CLIPER (OCD5) errors, Irwin's track was considerably more difficult to forecast than that of a typical eastern North Pacific tropical cyclone over the past 5 yr, yet the NHC official forecasts were skillful at all forecast times. A homogeneous comparison of the official track errors with selected guidance models is given in Table 2b. Despite Irwin's atypical track, the official forecasts were quite good and had lower errors than most of the track guidance at all forecast times. The only model forecasts that had lower errors than the official forecasts were the 48- through 96-h European Centre for Medium-Range Weather Forecasts (EMXI) model forecasts, the 48- and 96-h Florida State Superensemble (FSSE) forecasts, and the 36- and 48-h forecasts of the multi-model consensus TVCE.

A verification of NHC official intensity forecasts for Irwin is given in Table 3a. Official forecast intensity errors were greater than the mean official errors for the previous 5-yr period from 12 to 36 h and were lower from 48 to 120 h. According to SHIFOR (OCD5) errors, the short-range (12 to 24 h) intensity forecasts were a little more difficult than the respective intensity forecasts for a typical storm over the past 5 yr, but the longer-range (36 to 120 h) intensity forecasts were easier. This pattern is likely a result of the condensed 2- to 3-day period of rapid intensification and rapid weakening at the beginning of the cyclone's life, which does not affect the verification of the longer-range forecasts. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 3b. The official intensity forecasts showed only modest skill compared to the various intensity models. The U. S. Navy version of the GFDL hurricane model (GFNI) was the only model to have consistently lower errors than the official forecast (all times except 12 h). The other regional models, GHMI and HWFI, had comparable or lower errors than the official forecast through 36 h and higher errors from 48 to 120 h. There was no obvious pattern in the performance of the official forecasts relative to the statistical guidance.

There were no coastal watches or warnings associated with Irwin.

Table 1. Best track for Hurricane Irwin, 6 – 16 October 2011.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
04 / 1800	11.6	111.7	1009	25	low
05 / 0000	11.5	112.6	1009	25	"
05 / 0600	11.4	113.2	1009	25	"
05 / 1200	11.4	113.9	1009	25	"
05 / 1800	11.6	114.6	1009	25	"
06 / 0000	11.9	115.3	1007	25	"
06 / 0600	12.1	116.0	1006	30	tropical depression
06 / 1200	12.3	116.7	1004	35	tropical storm
06 / 1800	12.5	117.6	999	50	"
07 / 0000	12.9	118.5	995	60	"
07 / 0600	13.3	119.3	989	70	hurricane
07 / 1200	13.6	120.0	981	80	"
07 / 1800	13.8	120.5	977	85	"
08 / 0000	13.9	120.8	976	85	"
08 / 0600	14.1	121.0	980	80	"
08 / 1200	14.3	121.0	985	70	"
08 / 1800	14.4	120.9	991	60	tropical storm
09 / 0000	14.6	120.7	1001	45	"
09 / 0600	14.9	120.4	1004	35	"
09 / 1200	15.1	120.0	1004	35	"
09 / 1800	15.2	119.6	1003	40	"
10 / 0000	15.2	119.1	1003	40	"
10 / 0600	15.2	118.5	1003	40	"
10 / 1200	15.2	117.9	1003	40	"
10 / 1800	15.1	117.2	1003	40	"
11 / 0000	15.1	116.5	1004	35	"
11 / 0600	15.1	115.9	1004	35	"
11 / 1200	15.0	115.3	1003	40	"
11 / 1800	14.8	114.5	1001	45	"
12 / 0000	14.8	113.6	1001	45	"
12 / 0600	15.0	112.5	1002	40	"
12 / 1200	15.6	111.2	1002	40	"
12 / 1800	16.5	110.0	1003	35	"
13 / 0000	17.4	108.9	1004	30	tropical depression
13 / 0600	18.1	108.1	1004	30	"
13 / 1200	18.6	107.5	1004	30	"
13 / 1800	19.0	106.8	1003	35	tropical storm
14 / 0000	19.2	106.7	1002	35	"
14 / 0600	19.2	106.8	1002	35	"
14 / 1200	18.9	106.9	1002	40	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
14 / 1800	18.5	106.8	1003	40	"
15 / 0000	18.0	106.4	1003	40	"
15 / 0600	17.4	106.3	1003	35	"
15 / 1200	16.7	106.4	1003	35	"
15 / 1800	15.8	106.7	1004	30	tropical depression
16 / 0000	15.1	107.0	1004	30	"
16 / 0600	14.5	107.2	1005	30	"
16 / 1200	13.9	107.5	1006	30	"
16 / 1800	13.7	107.9	1006	30	low
17 / 0000	13.9	108.2	1007	25	"
17 / 0600	14.3	108.5	1007	25	"
17 / 1200	14.9	108.7	1008	20	"
17 / 1800	15.4	109.0	1009	15	"
18 / 0000	15.6	109.5	1009	15	"
18 / 0600	15.8	109.6	1010	15	"
18 / 1200	15.6	109.5	1010	15	"
18 / 1800					dissipated
08 / 0000	13.9	120.8	976	85	minimum pressure and maximum wind

Table 2a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Irwin, 6 – 16 October 2011. Mean errors for the 5-yr period 2006-10 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	**29.1**	50.6	**63.0**	**77.2**	**94.9**	**117.1**	**128.4**
OCD5	48.3	115.7	198.4	296.6	506.6	711.7	1003.3
Forecasts	40	38	36	34	30	26	22
OFCL (2006-10)	29.7	49.9	69.0	86.6	119.0	155.8	197.7
OCD5 (2006-10)	38.4	74.8	115.3	155.9	226.3	273.7	310.4

Table 2b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Irwin, 6 – 16 October 2011. 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 2a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL	25.1	39.0	44.4	57.0	88.4	110.4	92.8
OCD5	48.3	119.2	204.6	316.9	537.0	804.6	1104.2
GFSI	26.3	51.5	78.7	112.6	187.7	208.8	207.7
GHMI	31.2	55.1	73.3	93.0	141.8	168.2	216.2
HWFI	45.8	75.4	89.9	100.8	140.8	155.7	130.6
GFNI	41.4	68.2	83.4	100.5	203.7	281.7	307.8
NGPI	33.6	58.9	73.8	80.9	108.2	175.9	267.7
EGRI	33.6	55.3	66.3	74.4	103.5	156.2	257.7
EMXI	28.4	43.2	47.5	**48.9**	**60.9**	**78.0**	129.9
CMCI	42.8	80.1	118.8	155.5	208.1	191.8	190.9
AEMI	28.9	48.5	62.3	76.3	134.4	173.1	193.1
FSSE	26.3	41.5	46.3	**53.4**	93.6	**96.5**	100.9
TCON	26.2	43.0	51.4	58.6	101.1	119.7	127.2
TVCE	25.9	39.8	**43.5**	**49.0**	96.6	126.1	134.3
TVCC	30.1	41.5	44.9	62.9	150.8	392.7	495.1
GUNA	26.2	40.8	47.2	57.7	100.1	121.5	145.9
LBAR	35.5	80.5	125.7	173.0	255.6	384.9	493.9
BAMS	45.3	87.5	132.4	176.3	282.4	362.9	442.6
BAMM	43.4	94.4	145.1	179.2	210.8	276.9	395.5
BAMD	48.6	96.1	145.0	181.2	233.7	325.8	451.9
Forecasts	24	23	23	21	17	15	11

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Irwin, 6 – 16 October 2011. Mean errors for the 5-yr period 2006-10 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	6.8	12.4	15.1	**14.3**	**14.8**	**15.0**	**15.7**
OCD5	7.4	12.4	13.9	13.5	14.8	16.0	14.4
Forecasts	40	38	36	34	30	26	22
OFCL (2006-10)	6.3	10.5	13.7	15.1	17.1	18.6	18.0
OCD5 (2006-10)	7.3	11.9	15.3	17.6	19.0	20.3	21.1

Table 3b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Irwin, 6 – 16 October 2011. 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	6.0	11.2	14.2	14.5	16.2	18.7	17.2
OCD5	6.7	**11.1**	**12.8**	**13.5**	**15.6**	**15.7**	**14.3**
GHMI	**5.4**	**9.3**	**13.1**	18.3	29.2	37.0	32.8
HWFI	7.2	11.2	**14.0**	16.5	23.6	34.7	37.1
GFNI	6.2	**8.5**	**8.1**	**6.6**	**9.4**	**8.9**	**9.7**
FSSE	6.0	**10.4**	14.7	18.2	17.5	**15.7**	**13.8**
DSHP	**5.6**	**10.3**	15.2	18.4	18.2	**14.9**	**14.7**
LGEM	6.2	**10.1**	**13.6**	16.3	17.9	**15.9**	**15.2**
ICON	6.0	**9.3**	**13.1**	14.9	18.8	21.8	20.5
IVCN	**5.8**	**8.8**	**11.4**	**12.6**	16.5	19.1	17.9
Forecasts	34	33	31	29	25	19	16

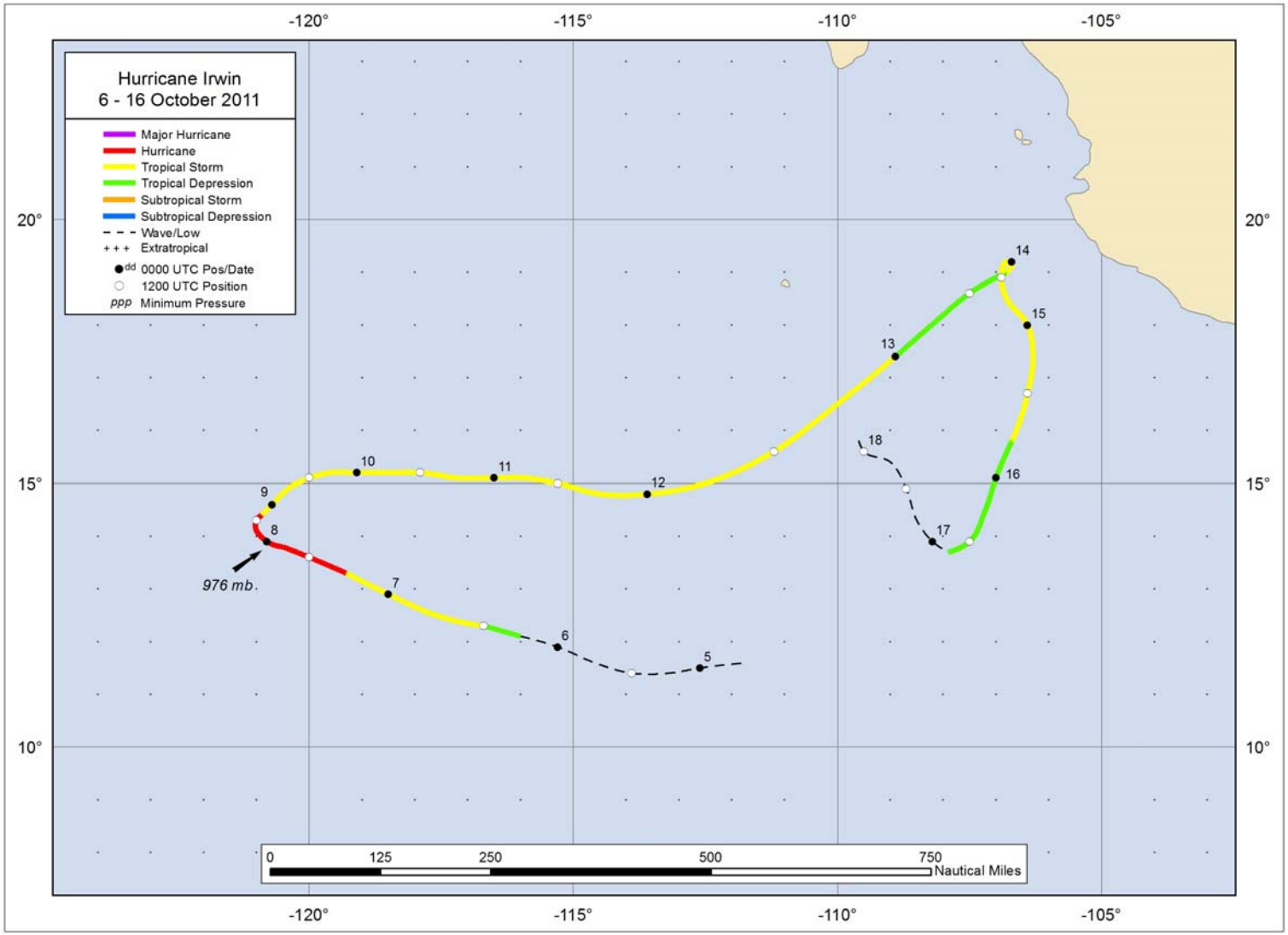

Figure 1. Best track positions for Hurricane Irwin, 6 – 16 October 2011.

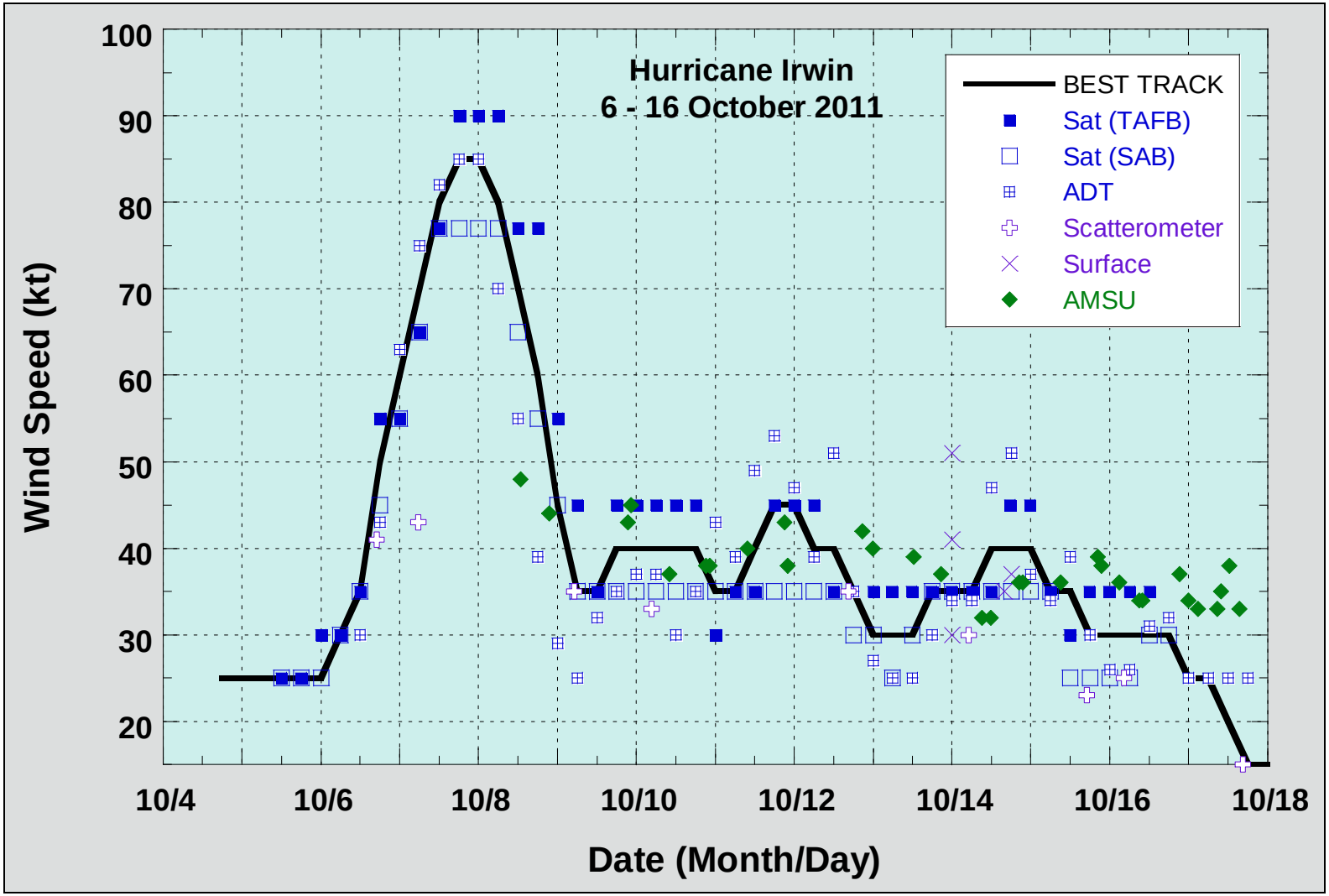

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Irwin, 6 – 16 October 2011. Advanced Dvorak Technique estimates from UW-CIMSS represent linear averages over a 3-h period centered on the nominal observation time. AMSU intensity estimates are from the UW-CIMSS technique. Dashed vertical lines correspond to 0000 UTC.

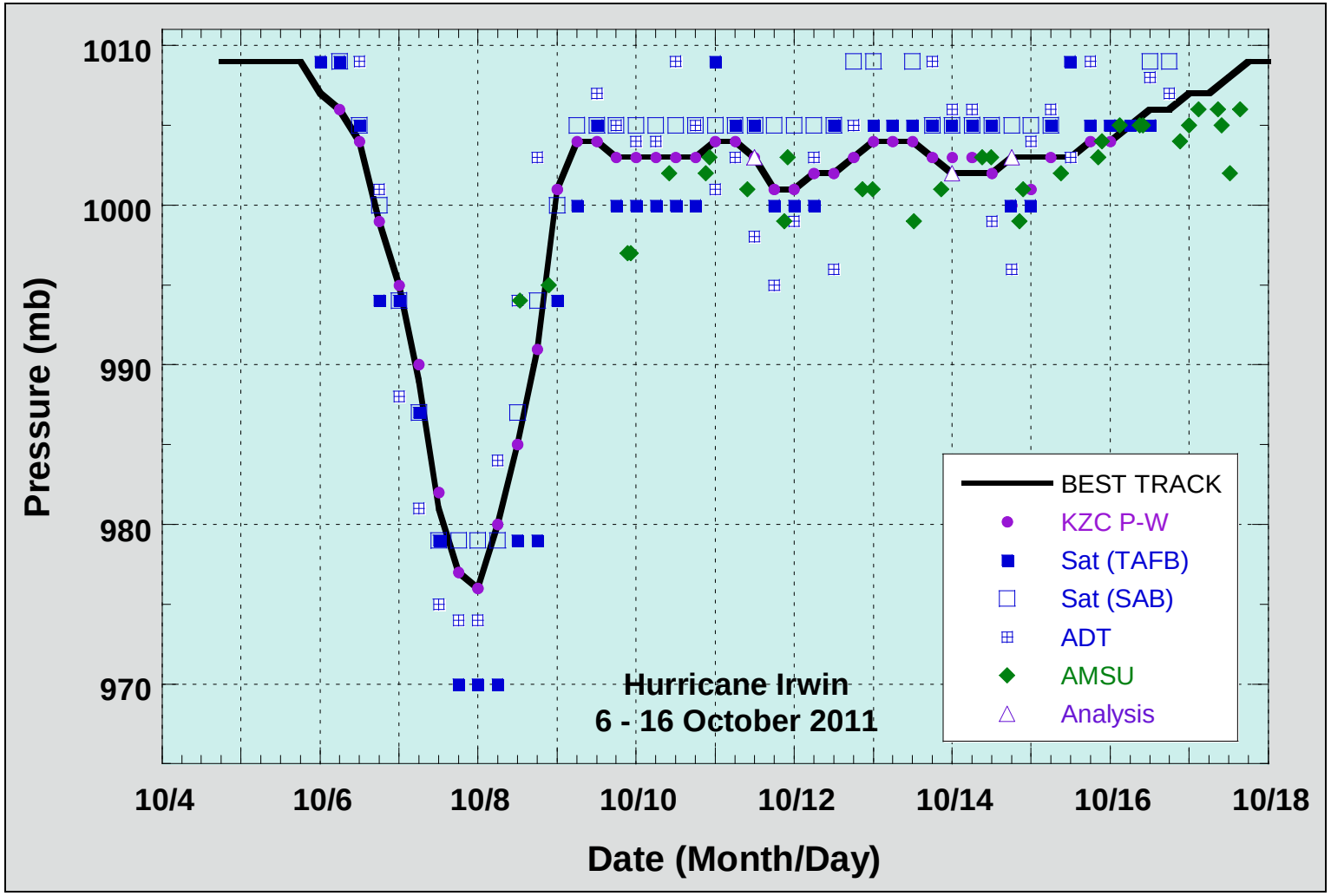

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Irwin, 6 – 16 October 2011. Advanced Dvorak Technique estimates from UW-CIMSS represent linear averages over a 3-h period centered on the nominal observation time. AMSU intensity estimates are from the UW-CIMSS technique. The KZC P-W values are obtained by applying the Knaff-Zehr-Courtney pressure-wind relationship to the best track wind data. Dashed vertical lines correspond to 0000 UTC.