

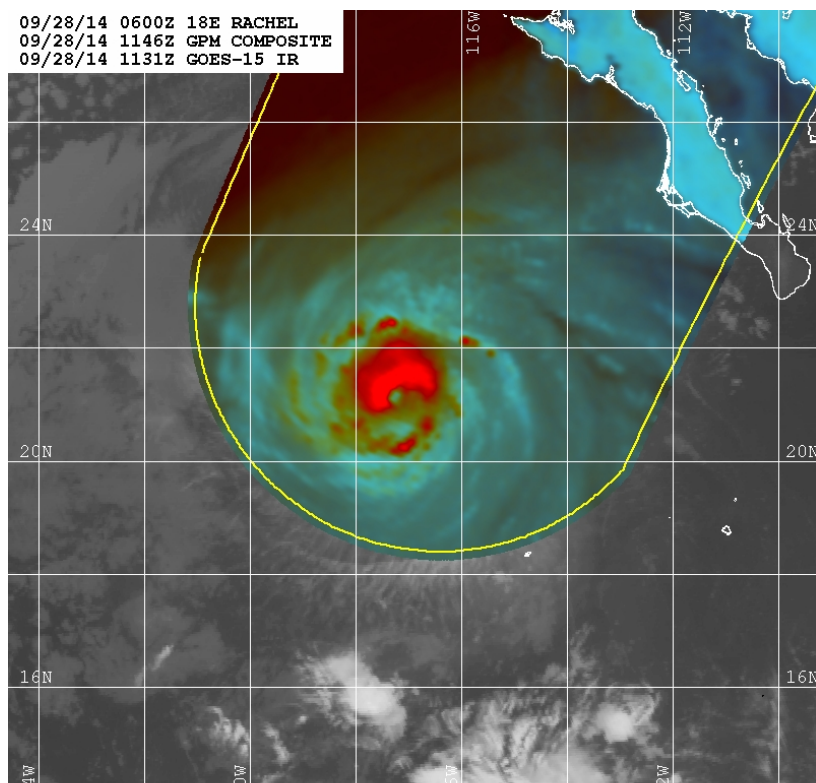


NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE RACHEL (EP182014)

24 – 30 September 2014

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National Hurricane Center
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Naval Research Lab www.nrlmry.navy.mil/sat_products.html
Red=89PCT Green=89H Blue=89V

89-GHZ IMAGE OF HURRICANE RACHEL NEAR PEAK INTENSITY FROM THE GLOBAL PRECIPITATION MEASUREMENT POLAR ORBITING SATELLITE (28 SEP 1146 UTC) – NAVAL RESEARCH LABORATORY

Rachel was a small tropical cyclone that reached category 1 status on the Saffir-Simpson Hurricane Wind Scale while paralleling the Mexican coast over the northeastern Pacific Ocean.

Hurricane Rachel

24 – 30 SEPTEMBER 2014

SYNOPTIC HISTORY

A large tropical wave with substantial convection exited the coast of west Africa on 7 September. The system developed further over the next few days and Tropical Depression Six (later Hurricane Edouard) formed in the eastern Atlantic Ocean on 11 September. The tropical wave that spawned Edouard continued westward with minimal deep convection for the next several days. On 19 September, the tropical wave crossed Central America and entered the northeastern Pacific Ocean. As it interacted with the pre-existing southwesterly surface flow, widespread but disorganized convection developed over the next few days. Early on 23 September, a well-defined surface low formed within the tropical wave in an environment of moderate northeasterly shear and in the inactive phase of the Madden-Julian Oscillation. Deep but very asymmetric convection developed and persisted in association with the low, and a tropical depression formed around 1800 UTC that day a couple of hundred nautical miles south of Acapulco, Mexico. 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 1¹.

The tropical cyclone moved westward and then west-northwestward around the periphery of a mid-level ridge centered over Mexico, and reached tropical storm strength at 0000 UTC 25 September about 275 n mi southwest of Manzanillo, Mexico. The moderate northeasterly vertical shear present at the cyclone’s genesis persisted for the next three days, allowing only a gradual intensification despite its traversing warm (28° C) waters and moving through a moist low- to mid-troposphere. Late on 26 September, the center of Rachel dissipated and a new center formed underneath deep convection located to the southwest, resulting in a southwestward kink in the system’s track as seen in Figure 1. After the center reformation, Rachel’s wind radii contracted and the system became a relatively small tropical cyclone. Rachel also turned northwestward around this time and its forward speed decreased, in response to a mid-latitude trough moving toward the west coast of the United States. On 27 September, the tropospheric vertical shear significantly decreased and Rachel began to steadily intensify, and the cyclone reached hurricane intensity around 1800 UTC on 27 September while located around 400 n mi west-southwest of the southern tip of Baja California, Mexico. However, environmental conditions remained

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 *bt* directory, while previous years’ data are located in the *archive* directory.

conducive for intensification for only another half day, and Rachel reached its estimated peak intensity of 75 kt between 0000 and 1200 UTC on 28 September (front cover figure). As Rachel turned north-northwestward into the weakness created by the aforementioned trough and slowed further, a combination of moderate to strong southwesterly vertical shear, cool waters, and a very dry mid-troposphere contributed toward a steady weakening. The system fell below hurricane strength at 0600 UTC 29 September while centered about 425 n mi west of the southern tip of Baja California. Rachel's deep convection dissipated around 0800 UTC 30 September as it drifted northward, and the system became a remnant low by 1200 UTC that day. The low meandered for a few more days before dissipating by 0600 UTC 3 October, about 60 n mi south of where it lost its status as a tropical cyclone.

METEOROLOGICAL STATISTICS

Observations in Rachel (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. 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 Cristina.

The analyzed peak intensity of 75 kt from 0000 to 1200 UTC 28 September is based on subjective Dvorak estimates of T4.5/77 kt and objective UW-CIMSS ADT values of T4.4/75 kt at 0000 and 0600 UTC that day.

There were no ship reports of winds of tropical storm force associated with Rachel.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

Table 2 indicates how far in advance of formation the NHC official genesis forecasts first reached the indicated likelihood categories. The genesis of Rachel was well forecast. The disturbance was introduced into the 120-hour Tropical Weather Outlook about four days before genesis, was boosted to the medium (30-50%) category about three days in advance of genesis, and was placed in the high (> 50%) category about two days before formation. In the 48-hour

Tropical Weather Outlook, the system was first introduced (at the medium category) about two days before formation and raised to the high category 36 hours before genesis.

A verification of NHC official track forecasts is given in Table 3a. Official forecast (OFCL) track errors were substantially lower than the mean official errors for the previous 5-yr period, although the climatology-persistence (OCD5) errors were also smaller than average. Interestingly, the official forecast errors would likely have been even lower had Rachel's center not reformed farther southwest. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The variable track consensus model (TVCE) provided the best overall forecasts for Rachel, with extremely low errors through three days, and the best dynamical model was the AEMI (the Global Forecast System ensemble mean). Otherwise, the official forecasts were generally superior to the rest of the guidance.

A verification of NHC official intensity forecasts is given in Table 4a. Official forecast (OFCL) intensity errors were generally lower than the mean official errors for the previous 5-yr period, except for the 72-h forecasts, although the climatology-persistence (OCD5) errors were also smaller than average. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. These errors were due to a low bias (not shown), as nearly all of the guidance – and also the official forecasts - did not anticipate the amount of intensification that was achieved and also tended to forecast weakening Rachel prematurely. The best performing individual model was the Hurricane Weather and Research (HWFI) dynamical model, while the Florida State Superensemble (FSSE) had the lowest overall errors and was comparable or better than the official forecasts.



Table 1. Best track for Hurricane Rachel, 24-30 September 2014.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
24 / 0000	14.5	102.6	1006	30	tropical depression
24 / 0600	14.8	103.8	1006	30	"
24 / 1200	14.9	105.0	1006	30	"
24 / 1800	15.1	106.1	1005	30	"
25 / 0000	15.3	107.0	1004	35	tropical storm
25 / 0600	15.7	108.0	1004	35	"
25 / 1200	16.1	109.1	1003	40	"
25 / 1800	16.7	110.3	1002	45	"
26 / 0000	17.3	111.4	1000	45	"
26 / 0600	17.7	112.6	1000	45	"
26 / 1200	18.1	113.8	999	45	"
26 / 1800	17.7	114.5	997	50	"
27 / 0000	18.2	115.1	995	55	"
27 / 0600	18.8	115.6	995	55	"
27 / 1200	19.3	116.0	995	55	"
27 / 1800	19.9	116.3	987	65	hurricane
28 / 0000	20.3	116.7	980	75	"
28 / 0600	20.8	117.0	980	75	"
28 / 1200	21.2	117.2	980	75	"
28 / 1800	21.7	117.4	982	70	"
29 / 0000	22.1	117.5	984	65	"
29 / 0600	22.4	117.5	986	60	tropical storm
29 / 1200	22.6	117.5	989	55	"
29 / 1800	22.8	117.5	992	50	"
30 / 0000	23.0	117.5	996	45	"
30 / 0600	23.2	117.5	1002	35	"
30 / 1200	23.3	117.5	1004	30	low
30 / 1800	23.1	117.5	1006	30	"
1 / 0000	22.9	117.4	1006	25	"
1 / 0600	22.8	117.4	1007	25	"



Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
1 / 1200	22.8	117.3	1007	25	"
1 / 1800	22.8	117.1	1008	20	"
2 / 0000	22.8	117.0	1008	20	"
2 / 0600	22.8	117.0	1008	20	"
2 / 1200	22.7	117.1	1008	20	"
2 / 1800	22.5	117.3	1008	20	"
3 / 0000	22.3	117.6	1008	20	"
3 / 0600					dissipated
28 / 0000	20.3	116.7	980	75	min pressure & max winds

Table 2. The table below indicates how far in advance of genesis the NHC Tropical Weather Outlook forecasts first reached the indicated likelihood categories for Rachel (note that the “Low” timings do not include forecasts of a 0% chance of genesis).

	Hours Before Genesis	
	48-Hour Outlook	120-Hour Outlook
Low (<30%)	54	102
Medium (30%-50%)	54	78
High (>50%)	36	54

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Rachel. 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	19.2	30.0	41.2	50.7	60.4	90.9	102.6
OCD5	32.3	65.7	86.6	108.6	187.9	215.3	253.5
Forecasts	22	20	18	16	12	8	4
OFCL (2009-13)	25.7	41.4	55.0	68.6	97.8	134.2	167.1
OCD5 (2009-13)	37.2	74.8	118.0	162.5	249.4	332.6	413.3

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Rachel. 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	19.0	32.2	43.0	49.2	63.4	96.6	130.8
OCD5	30.5	65.4	89.0	113.2	206.1	239.6	269.7
GFSI	21.4	39.7	55.6	62.5	108.6	173.4	257.9
AEMI	21.4	32.3	40.6	42.8	58.7	99.1	109.7
GHMI	23.9	41.8	56.3	72.2	123.2	227.8	377.5
HWFI	26.6	46.0	60.3	71.1	121.9	206.6	257.5
EMXI	22.4	39.5	51.4	56.5	74.9	90.9	187.7
CMCI	24.9	43.4	70.7	92.6	128.9	191.9	169.2
NVGI	30.5	46.4	51.5	69.1	130.8	114.3	76.7
GFNI	38.0	69.6	91.9	112.5	158.9	172.7	194.7
FSSE	19.2	32.3	46.3	56.7	74.1	98.8	136.0
TVCE	18.5	30.1	38.1	42.9	60.5	99.7	150.8
LBAR	34.3	79.5	120.6	174.1	319.0	631.8	943.0
BAMD	36.5	64.8	89.1	108.3	179.1	388.1	440.0
BAMM	29.7	55.4	75.5	95.7	155.2	275.4	467.0
BAMS	33.3	56.6	71.9	84.5	106.2	106.3	94.3
Forecasts	19	17	16	14	10	6	2

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Rachel. 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	4.8	6.3	6.9	10.6	15.4	15.0	11.3
OCD5	6.0	10.3	12.1	14.4	13.4	9.5	7.5
Forecasts	22	20	18	16	12	8	4
OFCL (2009-13)	6.1	10.4	13.4	14.5	15.0	16.4	16.1
OCD5 (2009-13)	7.7	12.7	16.4	18.8	20.5	20.3	20.8

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Rachel. 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	6.2	6.6	11.1	15.5	10.8	10.0
OCD5	6.8	11.5	13.6	16.1	14.6	6.5	10.5
DSHP	6.8	8.9	9.3	11.9	14.9	9.7	4.0
LGEM	7.2	10.9	12.2	14.4	17.1	7.7	5.0
HWFI	4.5	6.6	8.7	10.2	11.6	9.5	15.0
GHMI	5.5	7.3	11.0	13.9	19.3	13.2	7.5
IVCN	5.4	7.2	8.0	11.1	14.3	8.2	5.5
FSSE	5.1	6.2	6.0	9.2	13.0	5.2	1.0
GFSI	7.4	13.1	15.7	16.9	17.1	12.7	9.0
EMXI	7.9	14.5	18.6	21.4	22.3	14.8	7.5
Forecasts	19	17	16	14	10	6	2

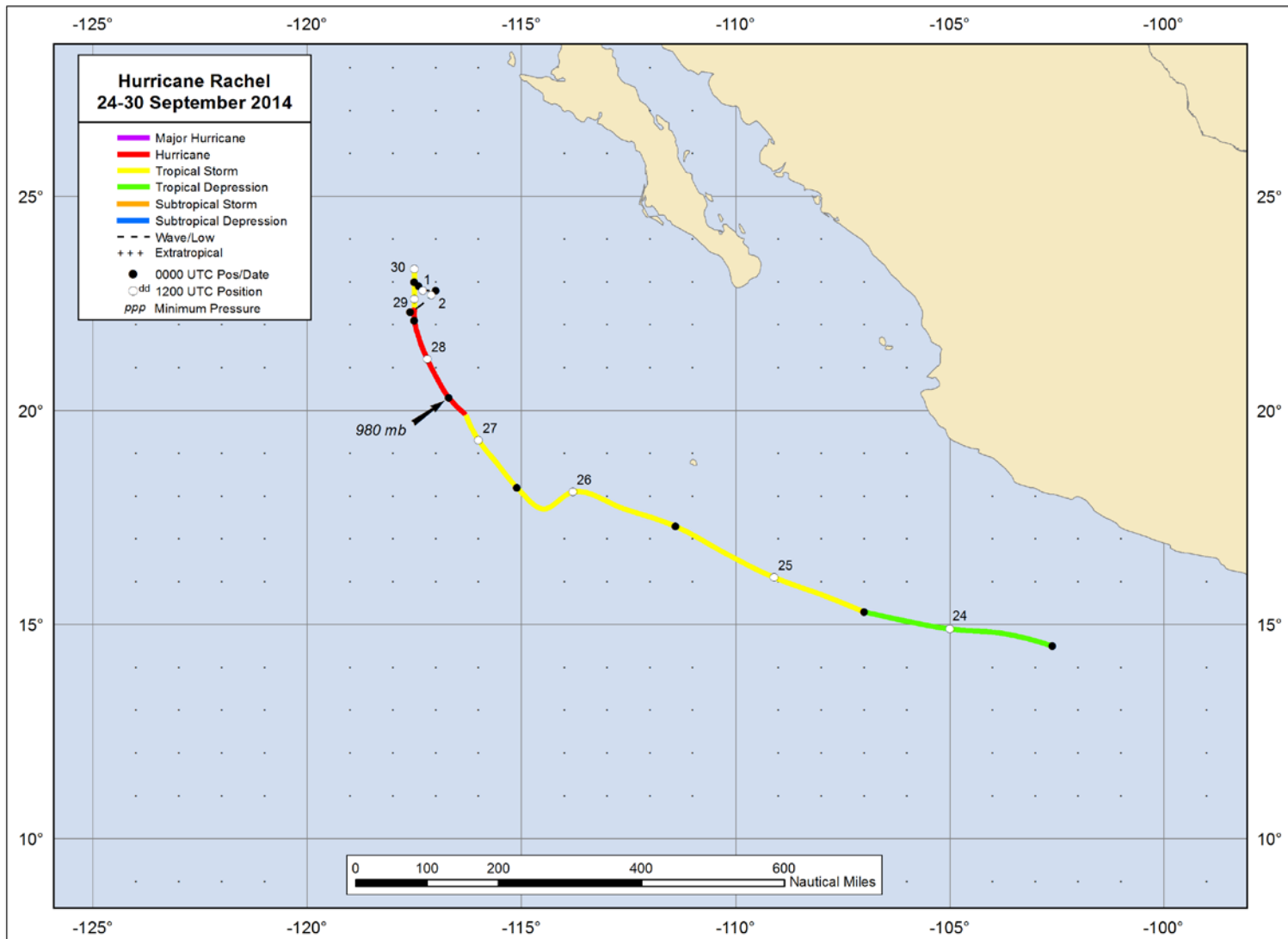


Figure 1. Best track positions for Hurricane Rachel, 24-30 September 2014.

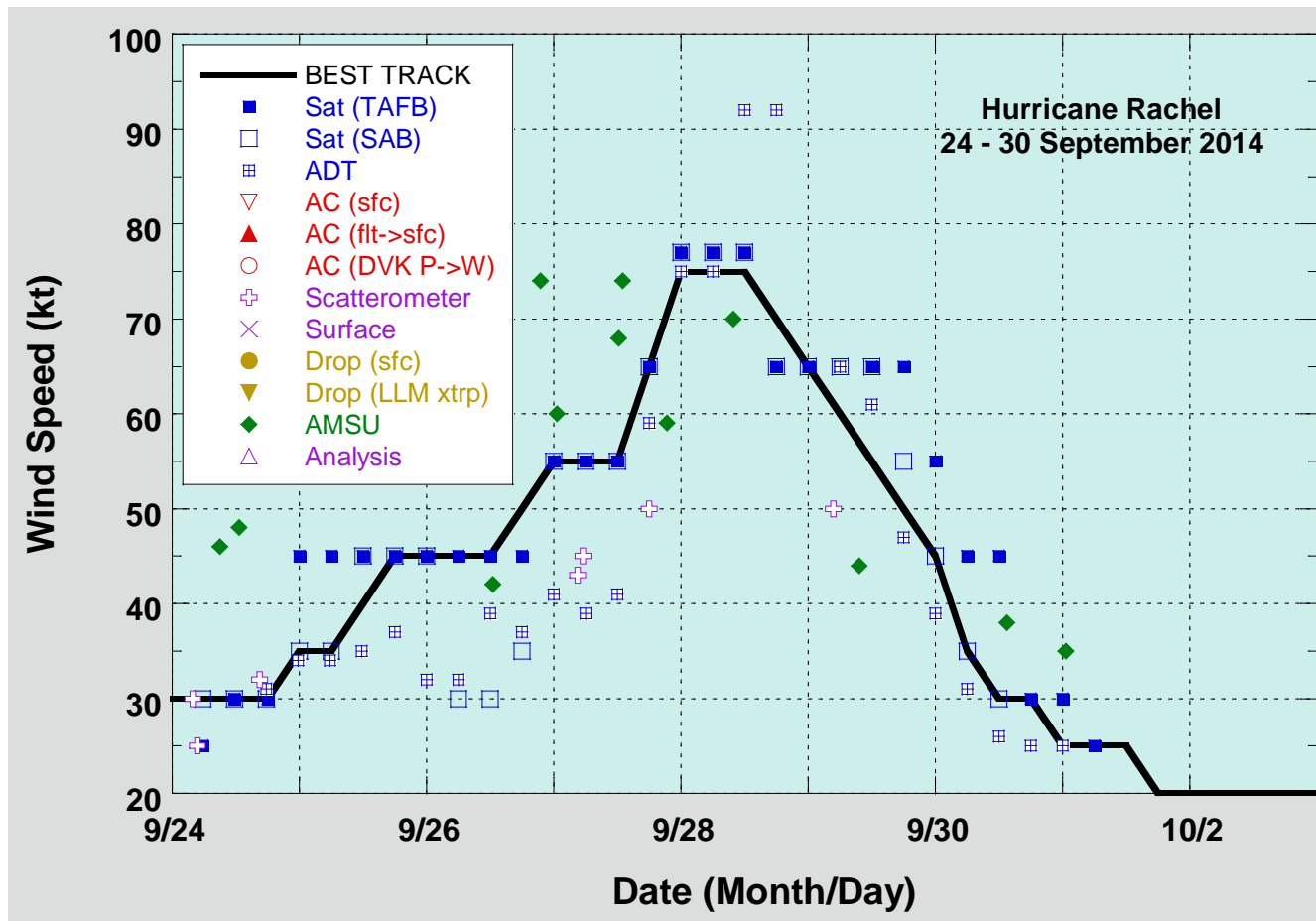


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Rachel. Advanced Dvorak Technique estimates represent the current intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

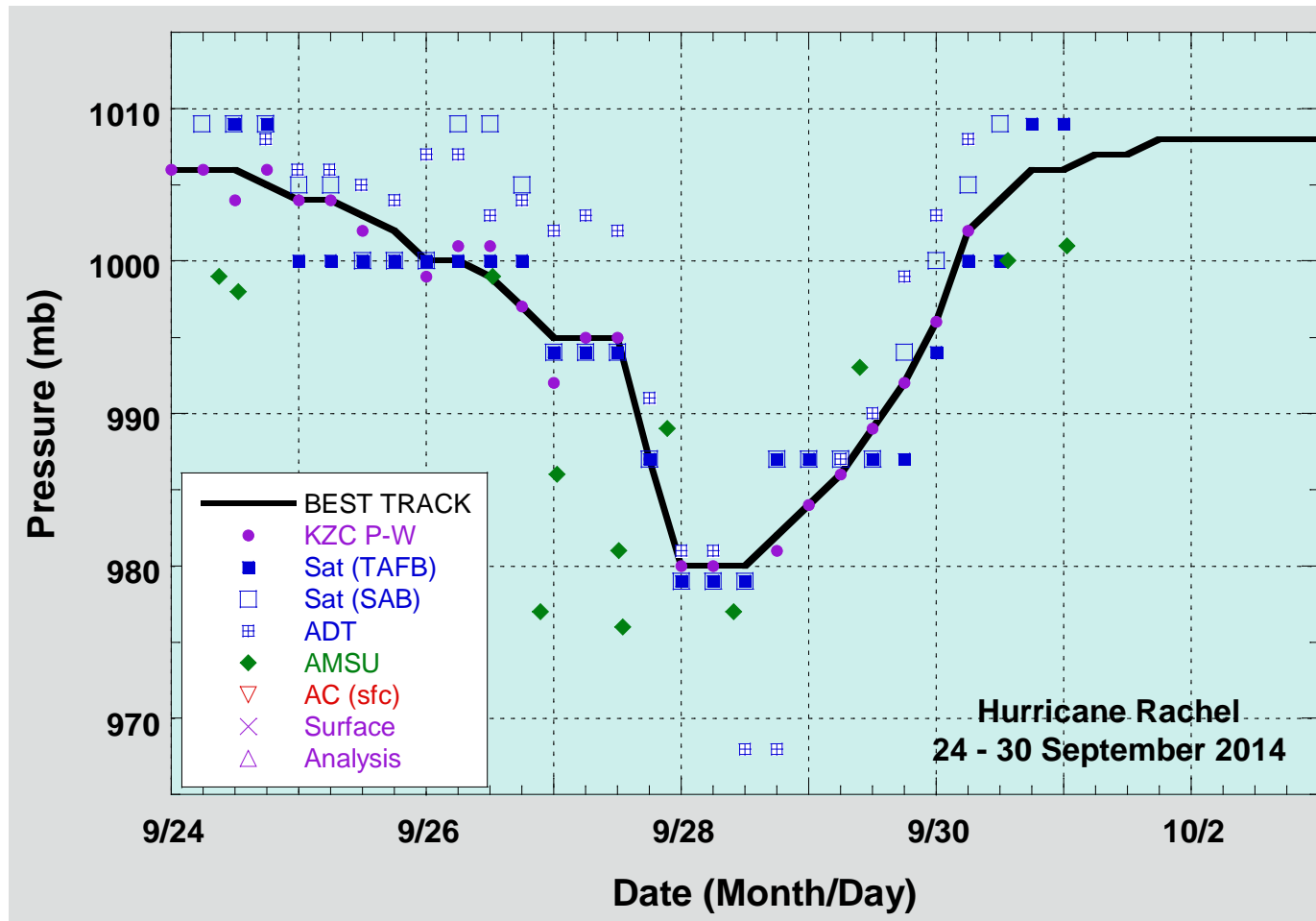


Figure 3. Selected pressure observations and best track minimum central pressure curve for Rachel. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.