NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE HILARY

(EP092017)

21–30 July 2017

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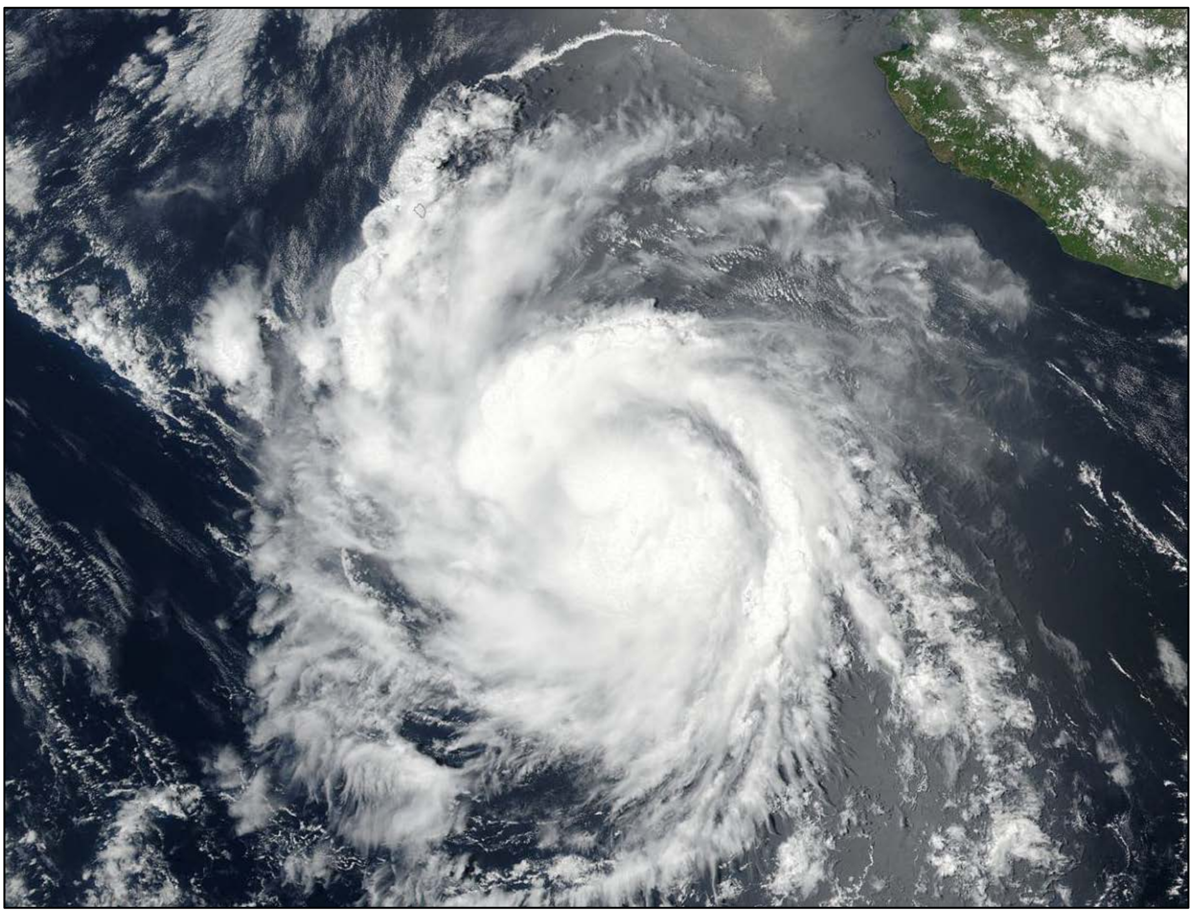

HURRICANE HILARY NEAR ITS PEAK INTENSITY AT 2154 UTC 25 JULY 2017. VISIBLE IMAGE FROM THE NASA-NOAA SUOMI NPP SATELLITE COURTESY OF THE NASA GODDARD MODIS RAPID RESPONSE TEAM.

Hilary was a category 2 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that remained over the open Pacific Ocean, well offshore of the coasts of mainland Mexico and the Baja California peninsula.

Hurricane Hilary

21–30 JULY 2017

SYNOPTIC HISTORY

Hilary originated from a tropical wave that emerged off the coast of western Africa on 10 July. The wave moved westward across the tropical Atlantic Ocean and the Caribbean Sea for the next several days, producing minimal shower activity until the disturbance reached Central America on 19 July. After crossing into the eastern North Pacific the next day, a low pressure system formed along the wave axis, accompanied by the development of curved convective bands by late on 20 July. Thunderstorm activity continued to steadily increase and became better organized during the ensuing 24-h period, resulting in the formation of a tropical depression by 1200 UTC 21 July about 450 n mi south-southeast of Puerto Angel, 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 1[1].

The depression moved slowly northwestward parallel to and about 300 n mi offshore of the south-central and southwestern coasts of Mexico for the next week. Although the cyclone moved through a rather favorable environment — sea-surface temperatures (SST) near 29°C, moist mid-level air with humidity values greater than 70%, and weak 850–200-mb vertical wind shear of less than 5 kt — the cyclone didn't strengthen for the next 24 h. The lack of intensification could have been due to a relatively large 90-n-mi radius of maximum winds (RMW). Hilary achieved tropical storm status around 1200 UTC 22 July when the cyclone was located about 460 n mi south-southeast of Acapulco, Mexico.

Hilary steadily strengthened during the next four days while it continued on a west-northwestward track at forward speeds of less than 10 kt. During this time, the RMW steadily contracted to about 5 n mi, and Hilary underwent a 24-h period of rapid intensification (RI) between 1800 UTC 23 July and 1800 UTC 24 July, with most of the RI occurring in the 12-h period from 1800 UTC 23 July to 0600 UTC 24 July (Fig. 4). The hurricane reached an estimated peak intensity of 95 kt, while possessing a pronounced eye with a diameter of about 10 n mi, at 0000 UTC 26 July when located about 390 n mi south of the southern tip of Baja California Sur, Mexico (Fig. 5).

Soon after Hilary reached its peak intensity, northerly vertical wind shear increased to more than 15 kt, causing the compact hurricane to begin a steady weakening trend. By 0000 UTC 28 July, the cyclone moved over SSTs less than 26.5°C, further enhancing the weakening process (Fig. 4), and Hilary became a tropical storm when located about 500 n mi west-southwest of the southern tip of Baja California Sur, Mexico. Steady weakening continued over the next three days,

[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.

and Hilary became a post-tropical cyclone by 0000 UTC 31 July, with the remnant low dissipating by 0600 UTC 1 August when the system was located about 1000 n mi west-northwest of the southern tip of Baja California Sur, Mexico.

METEOROLOGICAL STATISTICS

Observations in Hilary (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 the Advanced Microwave Sounding Unit (AMSU), the NASA Global Precipitation Mission (GPM), 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 Hilary.

The 95-kt estimated peak intensity of Hilary is based on an average of satellite intensity estimates of T5.0/90 kt from SAB and 99 kt from UW-CIMSS AMSU. The estimated minimum central pressure of 969 mb is based on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship for an intensity of 95 kt.

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

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Hilary was not forecast particularly well. The potential for tropical cyclone development was first mentioned in the Tropical Weather Outlook with a low probability of formation (< 40%) at 1200 UTC 19 July in the 5-day period, only 48 h before genesis occurred. The 5-day probability of formation was increased to the medium category (40–60%) 36 h before development, and to the high category (> 60%) only 18 h before formation occurred (Table 2). The 48-h probability of formation did not reach the medium category until 12 h before genesis occurred and never reached the high category. The reason for the poor genesis forecasts was prolonged moderate-to-strong, easterly vertical wind shear of near 20 kt was expected to persist longer than what actually occurred.

A verification of NHC official track forecasts (OFCL) for Hilary is given in Table 3a. These errors are comparable to the mean official errors for the previous 5-yr period at 12-72 h. However, at the longer time ranges of 96 h and 120 h, OFCL track errors were more than 25% smaller than the 5-yr average. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. OFCL forecasts were outperformed by all of the ensemble, consensus, and weighted models (e.g., FSSE and HCCA) at nearly every forecast interval. In contrast, however, the NHC official track forecasts were superior to the ECMWF (EMXI) model forecasts at all times, and bested the GFS (GFSI) model at all times except for the 48- and 72-h periods.

A verification of NHC official intensity forecasts for Hilary is given in Table 4a. Official forecast intensity errors are comparable to the previous 5-yr period. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. Although OFCL intensity errors were comparable with the 5-yr-mean errors, the NHC official intensity forecasts were outperformed by nearly every available intensity model through 36 h, including the climatology-persistence model, OCD5, which is the baseline model used to determine forecast skill. However, NHC intensity errors were better than most of the model guidance from 48-120 h. Although the OFCL intensity forecasts accurately captured the timing of the Hilary's peak intensity, the hurricane's maximum intensity was overforecast by an average of about 15 kt, and intensities during the weakening phase also exhibited a significant high bias, a combination which led to the overall poor performance of the NHC official intensity forecasts (Fig. 6).

There were no coastal watches and warnings associated with Hilary.

Table 1. Best track for Hurricane Hilary, 21–30 July 2017.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
20 / 1200	7.8	85.9	1010	20	low
20 / 1800	8.0	87.5	1010	20	"
21 / 0000	8.3	89.1	1009	20	"
21 / 0600	8.5	90.7	1009	25	"
21 / 1200	8.8	92.3	1008	30	tropical depression
21 / 1800	9.0	93.9	1007	30	"
22 / 0000	9.2	95.4	1006	30	"
22 / 0600	9.6	96.9	1006	30	"
22 / 1200	10.0	98.3	1005	35	tropical storm
22 / 1800	10.7	99.4	1005	35	"
23 / 0000	11.6	100.1	1005	35	"
23 / 0600	12.2	101.0	1004	35	"
23 / 1200	12.6	101.7	1003	40	"
23 / 1800	13.0	102.4	1001	45	"
24 / 0000	13.4	103.0	998	55	"
24 / 0600	13.7	103.5	992	65	hurricane
24 / 1200	14.0	104.0	989	70	"
24 / 1800	14.4	104.6	985	75	"
25 / 0000	14.8	105.4	981	80	"
25 / 0600	15.0	106.3	976	85	"
25 / 1200	15.2	107.3	974	90	"
25 / 1800	15.5	108.3	973	90	"
26 / 0000	15.9	109.3	969	95	"
26 / 0600	16.1	110.4	972	90	"
26 / 1200	16.4	111.6	972	90	"
26 / 1800	16.6	112.6	974	85	"
27 / 0000	16.8	113.6	976	85	"
27 / 0600	17.1	114.6	977	80	"
27 / 1200	17.4	115.4	986	70	"
27 / 1800	17.7	116.2	988	65	"
28 / 0000	18.1	116.9	990	60	tropical storm
28 / 0600	18.5	117.5	992	60	"
28 / 1200	18.9	118.0	994	55	"
28 / 1800	19.4	118.6	995	55	"
29 / 0000	20.0	119.5	995	55	"
29 / 0600	20.5	120.4	996	55	"
29 / 1200	21.1	121.2	996	55	"
29 / 1800	21.8	122.0	998	50	"
30 / 0000	22.5	123.0	999	50	"
30 / 0600	23.2	124.1	1000	50	"
30 / 1200	24.0	125.3	1002	50	"

30 / 1800	24.7	126.6	1003	45	"
31 / 0000	25.3	127.9	1006	35	low
31 / 0600	26.0	129.0	1008	30	"
31 / 1200	26.7	130.0	1009	25	"
31 / 1800	27.2	131.1	1010	25	"
01 / 0000	27.6	132.1	1010	25	"
01 / 0600					dissipated
26 / 0000	15.9	109.3	969	95	maximum intensity and minimum pressure

Table 2. 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 (<40%)	24	48
Medium (40%-60%)	12	36
High (>60%)	—	18

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Hilary, 21–30 July 2017. 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	23.4	**31.1**	**41.3**	**52.8**	**72.0**	**77.7**	**108.0**
OCD5	31.3	60.6	91.2	117.4	145.2	145.2	158.2
Forecasts	36	34	32	30	26	22	18
OFCL (2012-16)	22.2	33.9	43.8	54.8	80.0	108.9	145.1
OCD5 (2012-16)	35.7	72.0	112.2	150.2	217.0	271.0	340.2

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Hilary, 21–30 July 2017. 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	16.6	25.1	37.8	55.7	87.1	95.8	136.6
OCD5	25.2	57.1	88.7	115.1	139.2	145.5	169.7
GFSI	17.7	28.6	39.6	**51.3**	**82.3**	116.5	157.3
EMXI	19.5	36.4	55.6	78.2	134.0	155.5	209.6
CMCI	21.8	45.5	77.5	108.0	160.5	186.4	204.0
NVGI	25.9	49.4	74.8	106.2	181.0	227.8	340.4
AEMI	19.4	29.9	38.8	**48.7**	**76.9**	**93.8**	**103.1**
HWFI	17.9	26.7	39.0	**55.5**	87.2	138.1	224.1
HCCA	**15.1**	**23.8**	**34.4**	**49.8**	92.8	110.3	**132.2**
FSSE	**16.3**	**24.6**	**34.8**	**51.2**	**85.9**	**92.5**	**125.5**
TVCE	**15.2**	**21.1**	**31.5**	**48.2**	**76.1**	**92.7**	**122.8**
TVCX	**15.1**	**23.2**	**34.4**	**51.5**	**84.3**	100.2	**135.4**
GFEX	**16.2**	**25.0**	**35.0**	**47.4**	91.6	105.4	**123.8**
TABD	23.2	45.9	64.6	71.4	90.4	112.3	164.3
TABM	25.6	47.9	69.1	76.6	**70.2**	129.7	**133.4**
TABS	39.7	85.6	115.4	103.3	**61.1**	153.7	**124.4**
Forecasts	29	27	25	23	19	15	11

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Hilary, 21–30 July 2017. 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	**4.4**	**8.7**	13.0	14.3	**13.8**	**13.9**	17.8
OCD5	4.6	7.6	11.2	12.8	13.8	13.5	7.1
Forecasts	36	34	32	30	26	22	18
OFCL (2012-16)	5.8	9.4	11.8	13.2	15.0	15.7	14.9
OCD5 (2012-16)	7.6	12.2	15.7	18.1	20.6	21.8	20.0

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Hilary, 21–30 July 2017. 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	4.1	7.7	11.0	11.6	13.0	15.0	21.0
OCD5	**3.8**	**5.5**	**7.4**	**8.1**	14.6	**14.3**	**4.9**
GFSI	5.5	**7.3**	11.4	13.8	17.1	18.5	**18.7**
EMXI	7.2	12.9	19.3	25.4	36.1	40.0	28.2
HWFI	4.7	**7.5**	**10.5**	13.1	18.2	21.1	23.9
CTCI	5.0	8.5	13.4	18.1	24.1	25.4	30.0
DSHP	**3.9**	**6.6**	**9.4**	12.0	13.7	18.6	21.3
LGEM	**3.8**	**6.2**	**9.1**	12.0	13.7	**10.4**	**8.5**
ICON	**3.9**	**5.8**	**8.8**	11.8	14.4	16.5	**16.8**
IVCN	**3.9**	**6.4**	**10.0**	13.4	16.5	18.8	**20.1**
HCCA	**3.8**	**6.0**	**9.8**	14.6	15.8	20.4	21.3
Forecasts	23	22	20	19	15	11	10

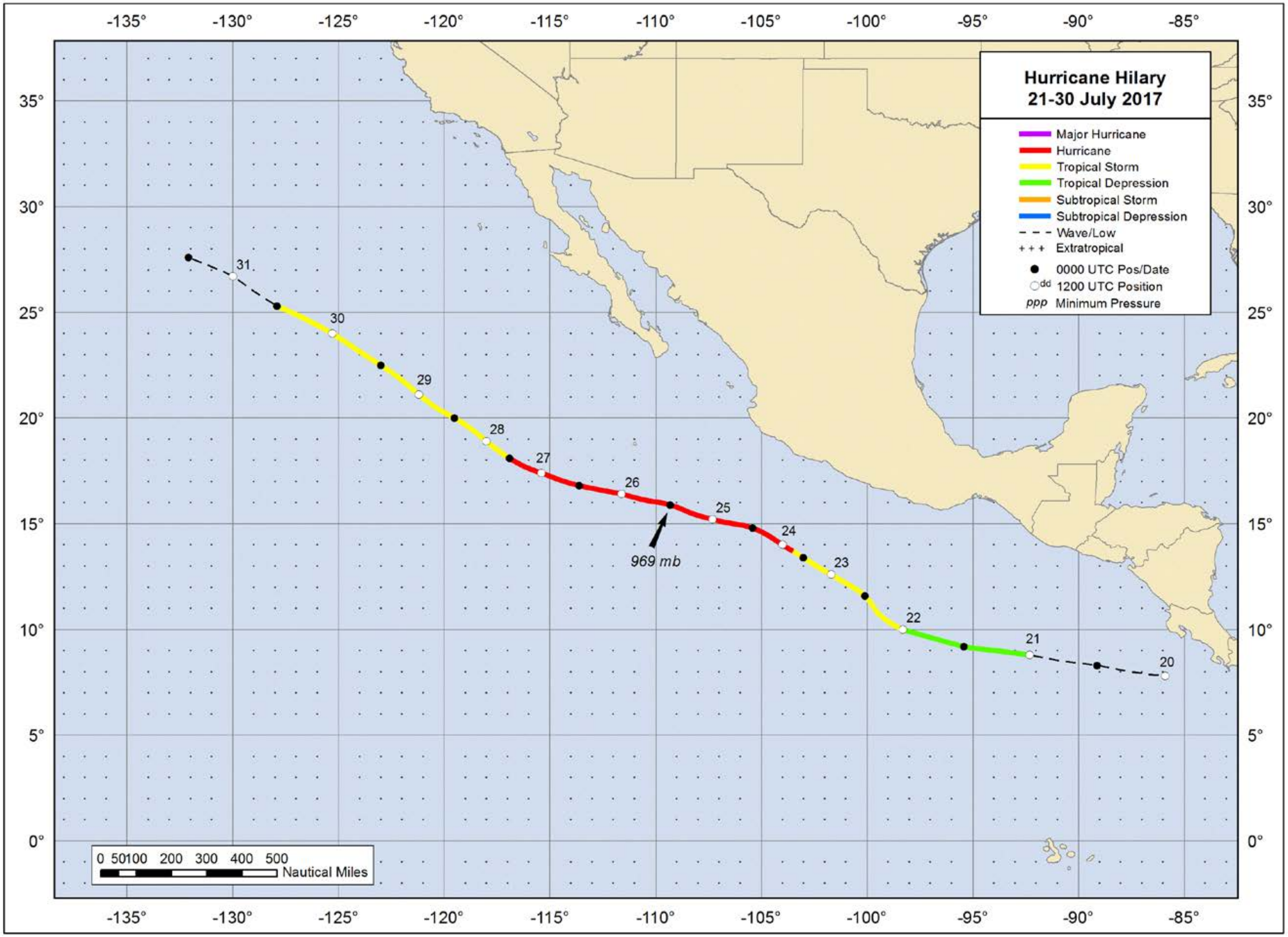

Figure 1. Best track positions for Hurricane Hilary, 21–30 July 2017.

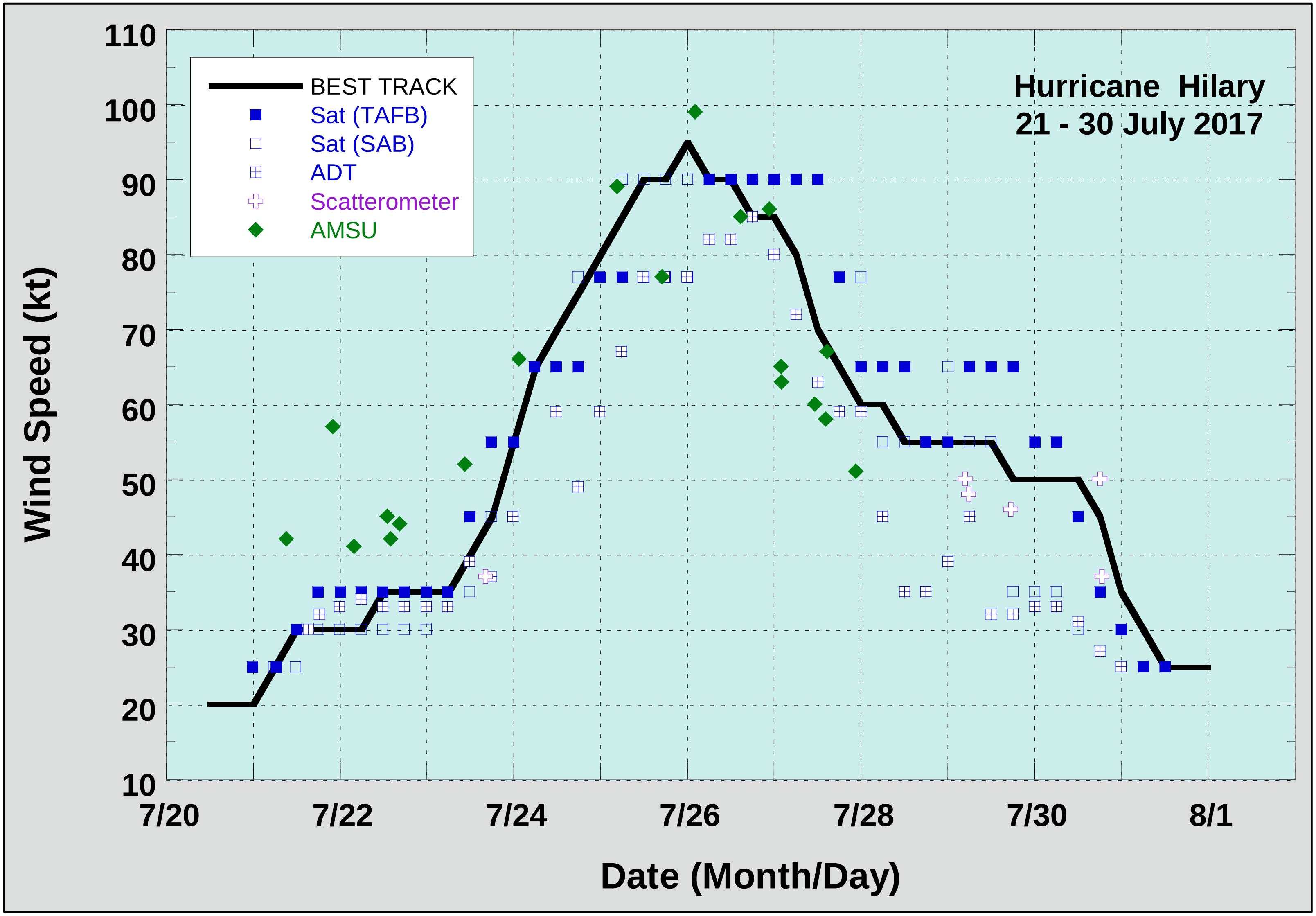

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Hilary, 21–30 July 2017. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

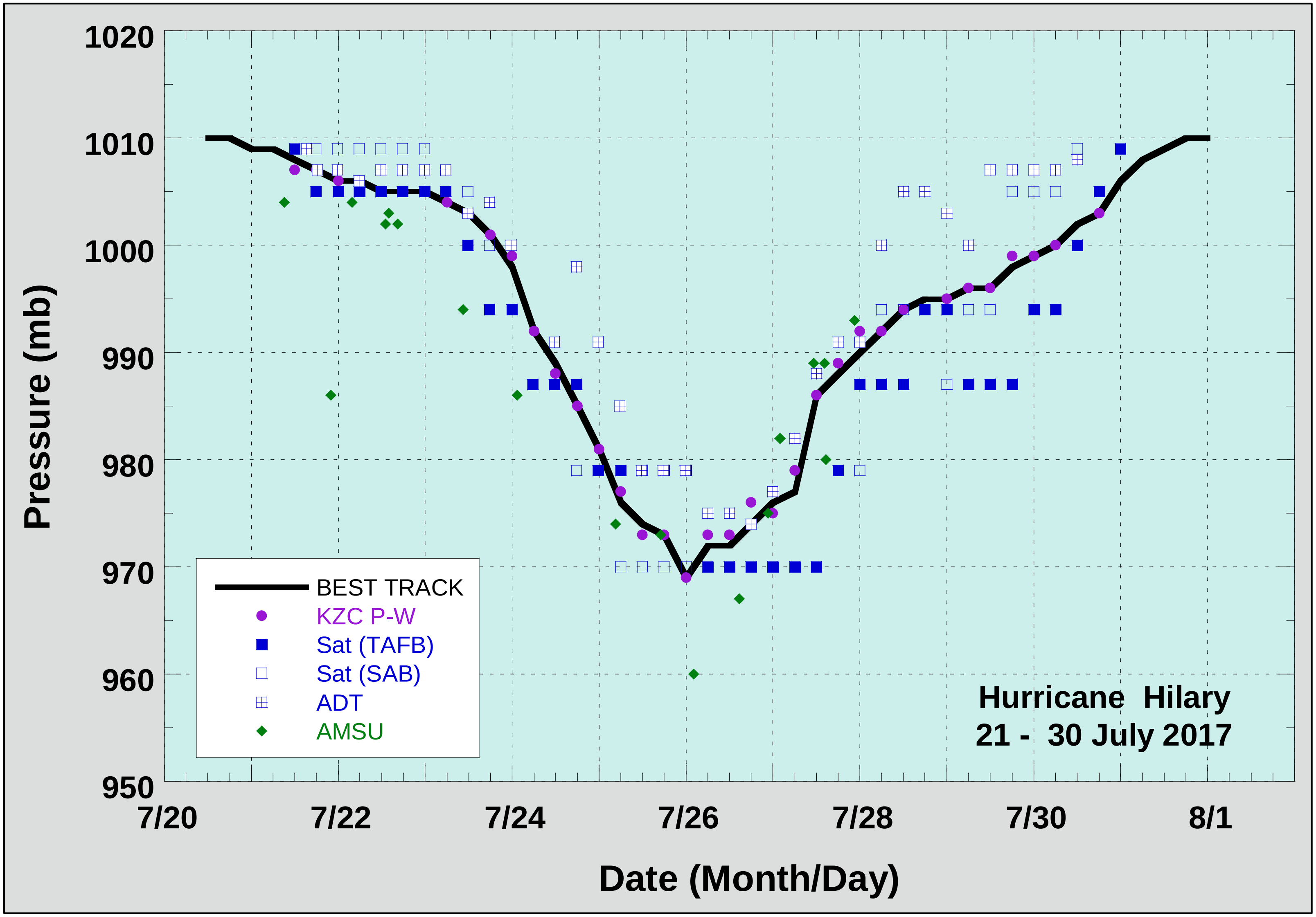

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Hilary, 21–30 July 2017. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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.

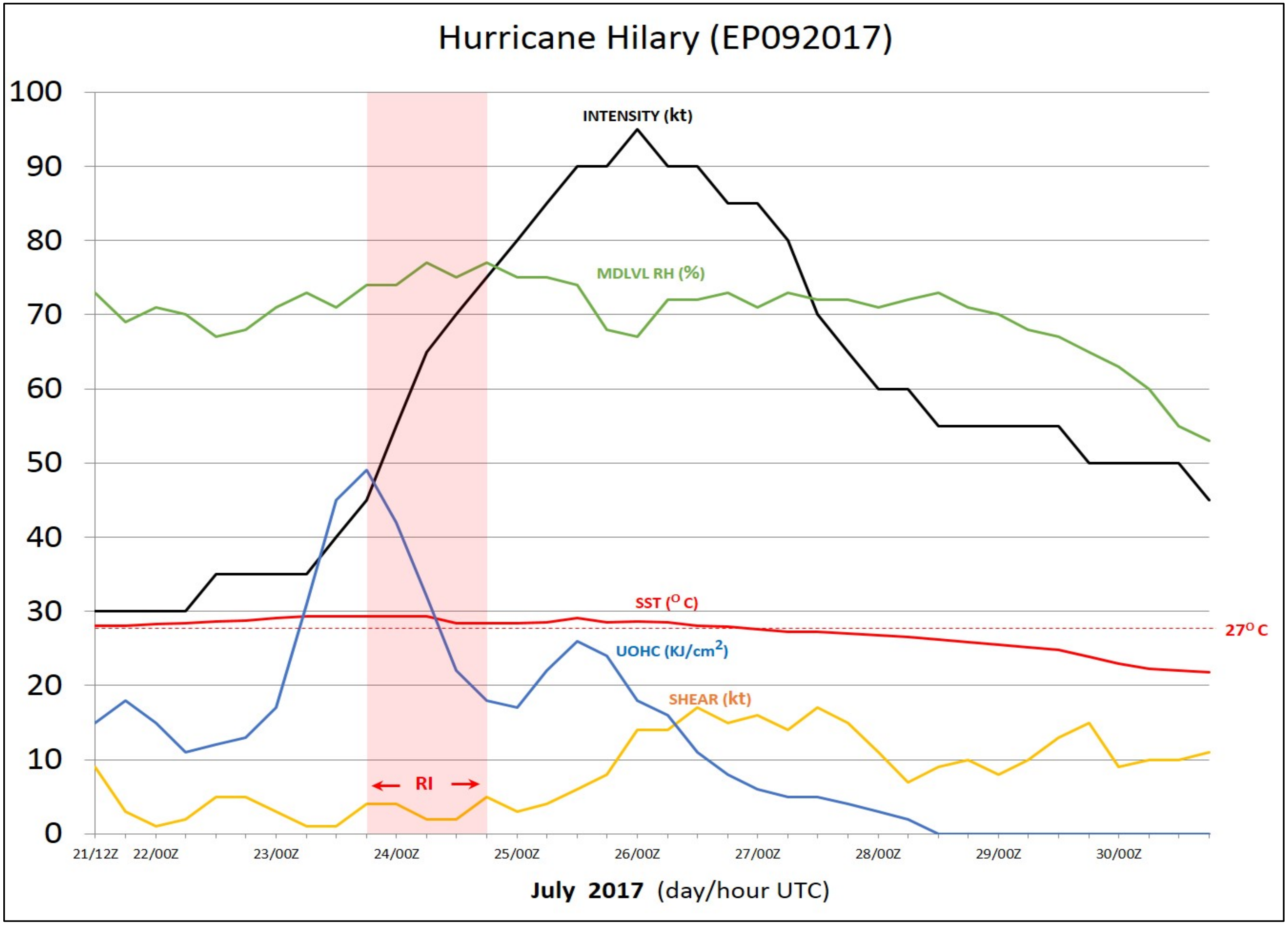

Figure 4. Graph of Hurricane Hilary's intensity versus GFS-based SHIPS model analyzed environmental parameters: 850−200-mb vertical wind shear (**SHEAR**), sea-surface temperature (**SST**), upper-ocean heat content (**UOHC**), and 700−500-mb average relative humidity (**MDLVLRH**). Time period covered is from 1200 UTC 21 July to 1800 UTC 30 July 2017, which includes the rapid intensification (**RI**/red shading) cycle.

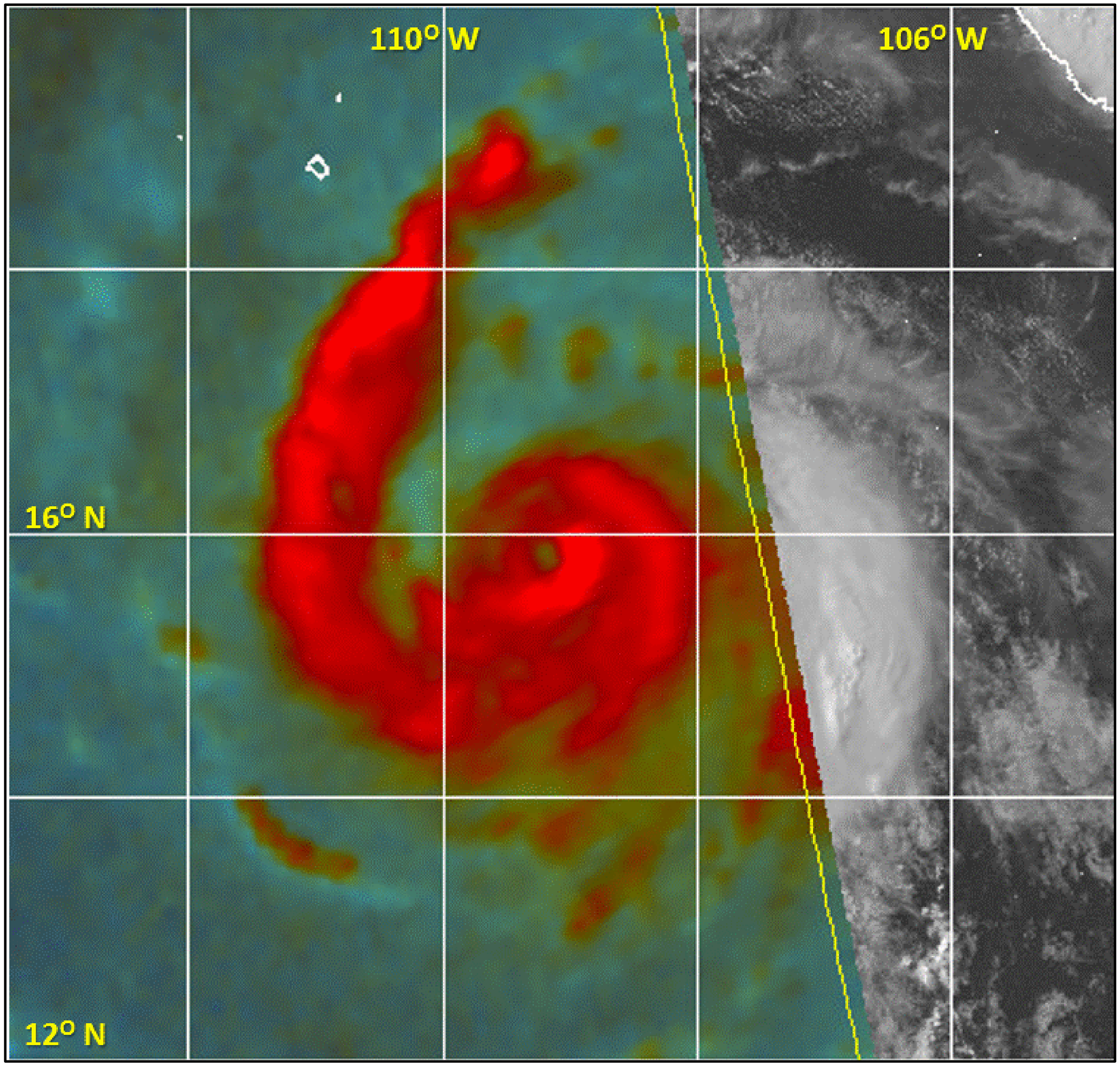

Figure 5. Special Sensor Microwave Imager/Sounder (SSMI/S) color composite image showing a well-defined, mid-level eye feature when Hilary was near its peak intensity of 95 kt (image courtesy U.S. Navy Fleet Numerical Meteorology and Oceanography Center, Monterey, CA).

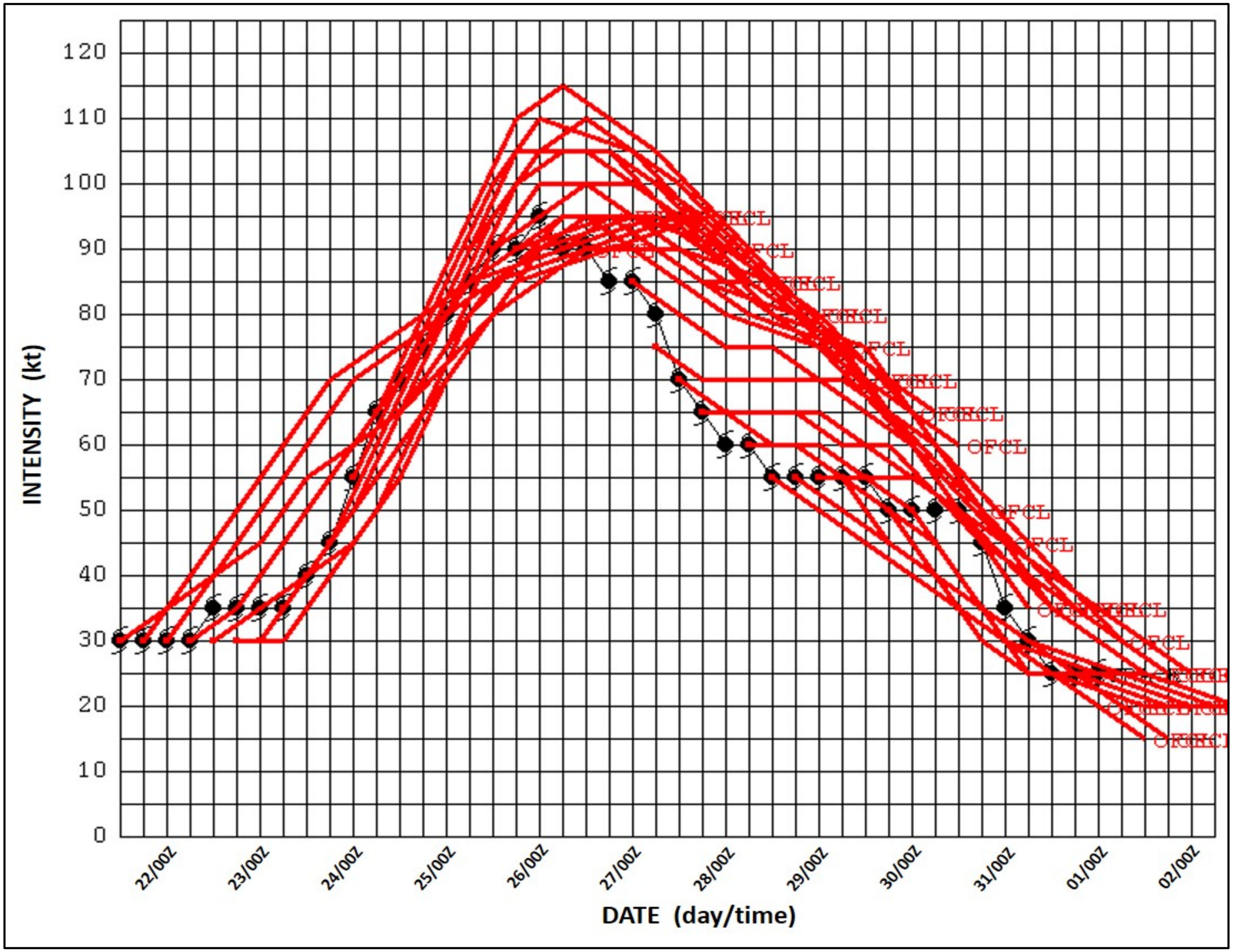

Figure 6. Selected official intensity forecasts (solid red lines, with 0, 12, 24, 36, 48, 72, 96, and 120 h forecast times indicated) for Hurricane Hilary, 21–30 July 2017. The best track is given by the solid black line with positions given at 6 h intervals.