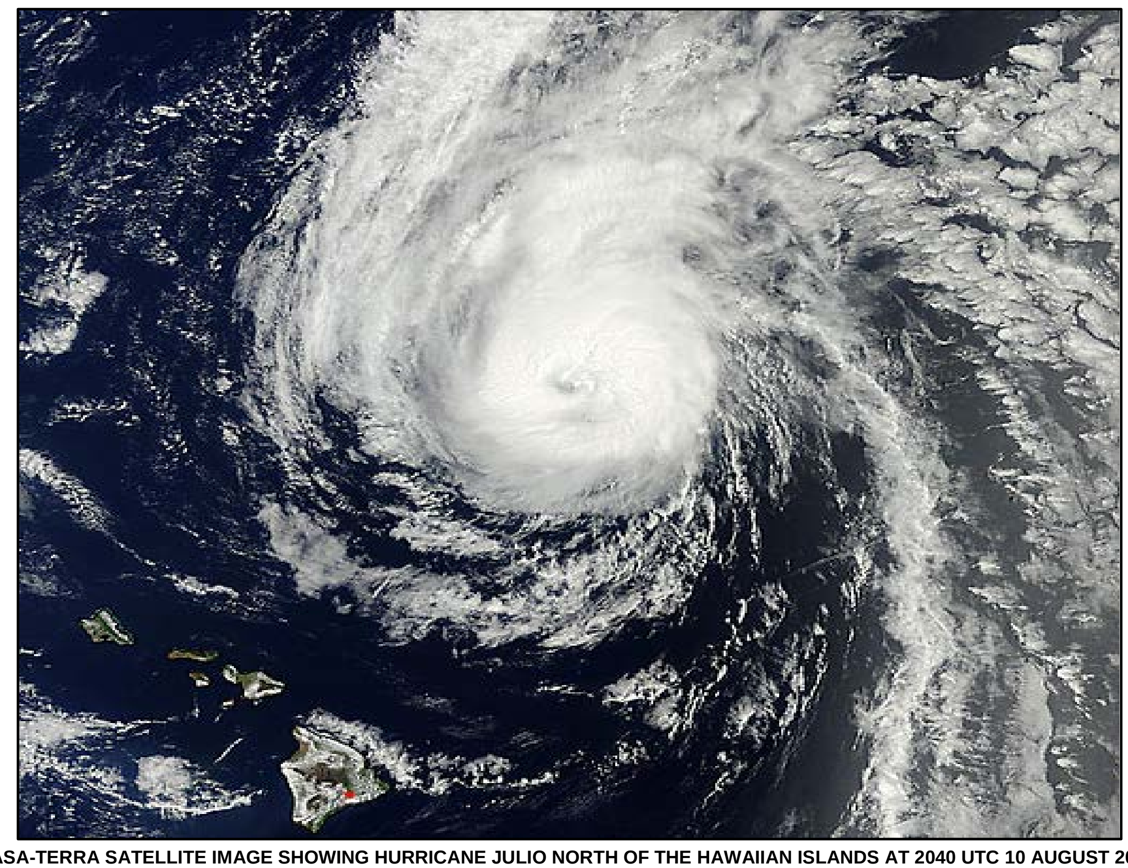
NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE JULIO

(EP102014)

4 – 15 August 2014

Stacy R. Stewart & Christopher Jacobson
National Hurricane Center & Central Pacific Hurricane Center
11 February 2016[1]



NASA-TERRA SATELLITE IMAGE SHOWING HURRICANE JULIO NORTH OF THE HAWAIIAN ISLANDS AT 2040 UTC 10 AUGUST 2014.

Julio was a category 3 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that remained over the open eastern and central North Pacific Ocean basins during its lifetime.

[1] Original report date 29 January 2015. Updated 11 February 2016 to include analysis from CPHC.

Hurricane JULIO

4 – 15 AUGUST 2014

SYNOPTIC HISTORY

Julio formed from a tropical wave that moved off of the west coast of Africa on 20 July. The wave produced only sporadic convection as it traversed quickly westward across the tropical Atlantic before it emerged over the eastern North Pacific Ocean on 28 July. On 31 July, a broad area of low pressure formed along the wave axis several hundred n mi south-southeast of Manzanillo, Mexico, accompanied by the development of deep convection. Over the next five days, associated convection steadily increased and the circulation became better defined while the disturbance moved west-northwestward, remaining well offshore of and paralleling the southwestern coast of Mexico. By 0000 UTC 4 August, deep convection had become sufficiently organized for the system to be designated as a tropical depression when it was located about 680 n mi south-southwest of the southern tip of Baja California Sur, Mexico. The depression turned westward and became a tropical storm 6 h later. 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[2].

Julio moved west-northwestward at about 15 kt for the next four days around the southwestern periphery of an expansive deep-layer subtropical high that extended from Mexico and the southwestern United States westward across the eastern North Pacific to north of the Hawaiian Islands. The cyclone steadily intensified over relatively warm waters and in an environment characterized by light northeasterly vertical wind shear. Julio became a hurricane two days later around 0600 UTC 6 August and reached its peak intensity of 105 kt two days after that near 0600 UTC 8 August, just prior to the cyclone reaching 140° W longitude. Although sea-surface temperatures at the time of peak intensity were only 25°-26° C, the 850-200 mb vertical wind shear was quite low at less than 5 kt. Radar data from an overpass by the NASA Tropical Rainfall Measuring Mission (TRMM) polar-orbiting satellite indicated deep convection with echo tops to near 15 km in the well-developed eyewall (Figs. 4 a, b).

Shortly after Julio crossed 140° W and moved into the Central Pacific basin, the hurricane began to weaken despite the favorable vertical shear conditions. A possible contributor to the rapid weakening between 0600 UTC 8 August and 0600 UTC 9 August was sea-surface temperatures beneath the cyclone decreasing by nearly 3° C as a result of cold upwelling (Figure 5). An Air Force Reserve Unit reconnaissance aircraft, which had been

[2] 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.

deployed to Honolulu to reconnoiter Hurricane Iselle just a few days earlier, conducted investigative missions into Julio on 9 and 10 August, and confirmed the weakening trend that had been indicated by satellite intensity estimates. Southwesterly vertical wind shear began to increase sharply on 10 August as the cyclone turned toward the northwest, causing Julio to weaken to a tropical storm by 0000 UTC 12 August, with the intensity leveling off at 55 kt about 12 h later.

By late on 12 August, the shear abated while Julio was moving back over warmer water, and the cyclone began a 24-h period of re-strengthening. Julio regained hurricane status early on 13 August, reaching a secondary peak intensity of 70 kt about 18 h later when it was located 450 n mi north of the Hawaiian Islands. Almost immediately after reaching this second peak intensity, the cyclone moved into unfavorable environmental conditions characterized by very dry mid-level air and strong upper-level southwesterly winds. As the vertical wind shear increased to more than 25 kt, Julio began to rapidly weaken while it meandered slowly northward, becoming a tropical storm early on 14 August and a tropical depression by 1200 UTC 15 August. Julio degenerated into a remnant low pressure system 6 h later and dissipated by 1200 UTC 18 August when it was located more than 1000 n mi north of the Hawaiian Islands.

METEOROLOGICAL STATISTICS

Observations in Julio (Figs. 2 and 3) include subjective satellite-based Dvorak technique intensity estimates from the Tropical Analysis and Forecast Branch (TAFB), the Satellite Analysis Branch (SAB), the Central Pacific Hurricane Center (CPHC), and the U.S. Joint Typhoon Warning Center (JTWC), plus objective Advanced Dvorak Technique (ADT) estimates from the Cooperative Institute for Meteorological Satellite Studies/University of Wisconsin-Madison (UW-CIMSS). Observations also include flight-level, stepped frequency microwave radiometer (SFMR), and dropwindsonde observations from flights of the 53rd Weather Reconnaissance Squadron (53WRS) 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 Julio.

There were no ship or buoy reports of tropical-storm-force winds associated with Julio.

Winds and Pressure

Julio's estimated peak intensity of 105 kt at 0600 UTC 8 August is based on a blend of satellite intensity estimates of T6.0/115 kt from TAFB, T5.7/107 kt from UW-CIMSS ADT, and T5.5/102 kt from SAB. The minimum pressure of 960 mb at 0600 UTC 8 August is based on the Knaff-Zehr-Courtney (KZC) pressure-wind relationship for an intensity of 105 kt.

The 53WRS conducted two reconnaissance missions into Hurricane Julio at the 700 mb level when the cyclone was located to the east and northeast of the Hawaiian Islands on 9 and 10 August, respectively. Those missions resulted in eleven center fixes. Maximum flight-level winds of 95 kt and 101 kt were observed at 1902 UTC 9 August and 0518 UTC UTC 10 August, respectively. The strongest SFMR surface wind measured during either mission was 81 kt at 2105 UTC 9 August. The strongest surface wind measured by a dropwindsonde in the eyewall was 73 kt at 0630 UTC 9 August.

The lowest pressure measured in the eye of Julio by a dropwindsonde was 977 mb at 0455 UTC 9 August. However, the dropwindsonde also reported a surface wind of 15 kt, so the minimum central pressure at that time is estimated to be 976 mb.

CASUALTY AND DAMAGE STATISTICS

There were no reports of damage or casualties associated with Julio. The cyclone passed about 350 n mi northeast of the main Hawaiian Islands on 10-11 August, keeping the associated moisture and heavy rainfall well northeast and north of the state. High surf advisories and warnings were issued by WFO Honolulu, and large swells generated by Julio affected east-facing shores of the Hawaiian Islands with high surf on 10-11 August.

On 10 August, an Air Force Reserve Unit reconnaissance aircraft and crew from the 53rd Weather Reconnaissance Squadron participated in a search and rescue effort for a disabled 42-foot sailboat caught in the path of Julio to the northeast of the Hawaiian Islands. All three persons on board the sailboat were later rescued by a container ship that diverted to the scene.

FORECAST AND WARNING CRITIQUE

The genesis of Julio was well forecast (Table 2). An area of disturbed weather was introduced into the NHC Tropical Weather Outlook (TWO) with a 20% (low) chance of formation in five days at 1800 UTC 30 July, 102 h prior to genesis. The system was assessed as having a medium chance (30%-50%) of development more than three days before genesis occurred, with a high chance (≥60%) of development indicated more than two days in advance. The 48-h genesis probability was increased to the high-chance category 48 h before tropical cyclone formation occurred.

A verification of NHC official track forecasts (OFCL) for Julio is given in Table 3a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period through 48 h, and were greater than the 5-yr average track errors at 72, 96, and 120 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. Although OFCL track forecasts were better than the majority of the available model guidance at nearly all forecast times, several models such as the EMXI, GFSI, AEMI, FSSE, and TVCE significantly outperformed the NHC official track forecasts.

A verification of NHC official intensity forecasts for Julio is given in Table 4a. In general, official intensity forecast (OFCL) errors were near to slightly above the mean official errors for the previous 5-yr period, except at 120 h where the OFCL errors were almost 30% better than average. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. In contrast to the track forecasts, the NHC official intensity forecasts outperformed most of the available intensity forecast guidance at all forecast times. The exception was in the 72-120 h periods where the OFCL forecasts were bettered by the HWFI, GFDI, and GHMI regional models, and also the two consensus models ICON and IVCN.

A verification of CPHC official track forecasts for Julio is given in Table 5a. Official forecast track errors were lower than the mean official errors for the previous 5-yr period at all forecast times through 120 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 5b. The official track forecast errors were lower than all individual model errors through 24 h, but were higher than the GFSI and EMXI errors at 48 h, and were higher than the majority of the model suite (with the notable exception of the EGRI) at 96 h and 120 h. The TVCE consensus outperformed the official track forecast at all forecast times.

A verification of CPHC official intensity forecasts for Julio is given in Table 6a. Official forecast intensity errors were lower than the mean official errors for the previous 5-yr period at all forecast times through 120 h. The official intensity errors were less than 10 kt at all forecast times, and were more than 50% better than the previous 5-yr average for 48 h through 120 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 6b. The official intensity errors were lower than all available model guidance through 36 h, however the HWRF intensity errors were lower than the official forecast beginning at 48 h, and the LGEM and IVCN intensity errors were also lower than the official forecast for 72 h through 120 h.

No tropical cyclone watches or warnings were required with Julio.

Table 1. Best track for Hurricane Julio, 4-15 August 2014.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
02 / 0000	12.5	111.2	1008	25	low
02 / 0600	12.5	111.2	1008	25	"
02 / 1200	13.2	111.9	1008	25	"
02 / 1800	13.4	112.5	1008	25	"
03 / 0000	13.7	113.2	1008	25	"
03 / 0600	13.8	114.0	1008	25	"
03 / 1200	13.8	114.8	1008	25	"
03 / 1800	13.7	115.6	1007	25	"
04 / 0000	13.5	116.6	1006	30	tropical depression
04 / 0600	13.5	117.7	1005	35	tropical storm
04 / 1200	13.5	119.2	1004	40	"
04 / 1800	13.5	120.7	1002	45	"
05 / 0000	13.5	121.9	1000	50	"
05 / 0600	13.6	123.0	1000	50	"
05 / 1200	13.8	124.0	1000	50	"
05 / 1800	14.0	125.3	997	55	"
06 / 0000	14.3	126.8	993	60	"
06 / 0600	14.7	128.2	989	65	hurricane
06 / 1200	15.1	129.7	985	70	"
06 / 1800	15.6	131.1	981	75	"
07 / 0000	16.2	132.5	979	80	"
07 / 0600	16.6	134.1	975	85	"
07 / 1200	16.8	135.6	971	90	"
07 / 1800	17.0	137.0	966	95	"
08 / 0000	17.3	138.4	963	100	"
08 / 0600	17.6	139.8	960	105	"
08 / 1200	17.9	141.2	964	100	"
08 / 1200	17.9	141.2	964	100	"
08 / 1800	18.3	142.6	968	95	"
09 / 0000	18.7	144.0	972	90	"
09 / 0600	19.2	145.4	976	85	"
09 / 1200	19.9	146.8	978	85	"
09 / 1800	20.7	148.2	980	85	"
10 / 0000	21.4	149.6	981	80	"
10 / 0600	22.2	150.7	982	80	"
10 / 1200	23.1	151.7	983	80	"
10 / 1800	24.0	152.5	982	80	"
11 / 0000	24.9	153.3	984	75	"
11 / 0600	25.6	154.0	986	70	"
11 / 1200	26.3	154.7	988	65	"
11 / 1800	26.9	155.4	988	65	"
12 / 0000	27.4	156.0	990	60	tropical storm
12 / 0600	27.9	156.6	991	60	"

12 / 1200	28.2	156.9	994	55	"
12 / 1800	28.6	157.3	994	55	"
13 / 0000	29.2	157.9	991	60	"
13 / 0600	29.7	158.4	987	65	hurricane
13 / 1200	30.1	158.9	985	65	"
13 / 1800	30.5	159.2	983	70	"
14 / 0000	30.8	159.2	986	65	"
14 / 0600	31.1	158.9	989	60	tropical storm
14 / 1200	31.3	158.4	993	55	"
14 / 1800	31.5	158.0	996	50	"
15 / 0000	31.8	157.6	999	45	"
15 / 0600	32.1	157.5	1002	40	"
15 / 1200	32.3	157.5	1005	30	tropical depression
15 / 1800	32.5	157.6	1007	30	low
16 / 0000	32.8	157.8	1008	30	"
16 / 0600	33.1	158.2	1009	30	"
16 / 1200	33.4	158.7	1010	30	"
16 / 1800	33.6	159.2	1011	25	"
17 / 0000	34.1	159.4	1012	25	"
17 / 0600	34.6	159.4	1013	25	"
17 / 1200	35.5	159.2	1014	25	"
17 / 1800	36.5	159.2	1014	20	"
18 / 0000	37.6	159.0	1014	20	"
18 / 0600	38.8	158.5	1014	20	"
18 / 1200					dissipated
08 / 0600	17.6	139.7	960	105	minimum pressure and maximum intensity

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 (<30%)	72	102
Medium (30%-50%)	60	78
High (>50%)	48	66

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Julio. 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**	**28.1**	**38.1**	**53.0**	98.1	166.9	250.4
OCD5	33.7	58.8	91.1	135.7	239.8	344.2	434.4
Forecasts	18	18	18	18	18	18	18
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 Julio. 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	20.0	29.2	39.1	52.4	93.3	158.8	322.7
OCD5	33.6	55.5	86.6	130.5	231.2	337.0	435.4
GFSI	23.7	34.4	**38.3**	**44.0**	**78.6**	**130.0**	**262.1**
AEMI	26.0	34.4	**37.8**	**41.8**	**66.0**	**114.1**	**214.0**
GHMI	22.2	38.7	50.7	67.5	123.1	198.1	415.6
GFDI	22.2	38.7	50.7	67.5	123.1	198.1	415.6
HWFI	24.7	33.6	49.2	65.7	100.0	**150.8**	**311.2**
EGRI	28.4	46.5	61.6	78.3	114.4	176.7	405.3
EMXI	**17.4**	**18.7**	**20.0**	**31.6**	**74.2**	**145.3**	**272.0**
CMCI	26.3	32.2	**37.1**	**39.2**	**57.7**	**119.5**	446.6
TCON	22.6	33.8	44.6	58.6	98.6	158.9	334.3
TVCE	**19.8**	29.6	**37.9**	**50.8**	**92.4**	**155.9**	**320.1**
FSSE	20.9	**27.7**	**34.0**	**46.2**	**88.8**	**154.3**	**285.3**
BAMS	32.0	53.9	79.9	104.2	161.1	238.5	375.6
BAMM	25.5	32.9	39.4	**48.9**	**61.5**	**82.8**	**157.6**
BAMD	20.1	**22.3**	**37.1**	52.8	**86.0**	**112.7**	**112.9**
LBAR	27.3	37.0	47.1	60.8	**67.1**	**116.8**	**249.2**
Forecasts	14	14	14	14	14	14	4

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Julio. 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	6.9	10.6	**10.8**	**13.9**	18.1	17.5	**11.4**
OCD5	9.2	14.1	16.7	20.6	27.6	27.9	21.3
Forecasts	18	18	18	18	18	18	18
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 Julio. 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	7.2	10.6	12.2	15.6	19.4	18.1	11.6
OCD5	9.7	14.8	18.6	22.2	28.4	27.5	20.6
HWFI	9.6	14.6	16.1	15.9	**17.1**	**16.3**	**11.3**
GHMI	13.6	17.8	20.6	22.1	21.8	**15.1**	**10.6**
GFDI	13.6	17.8	19.0	19.8	20.6	**17.6**	14.9
DSHP	7.9	12.4	15.8	17.8	19.4	18.1	14.2
LGEM	9.0	14.8	18.6	20.8	26.8	27.5	21.8
ICON	9.6	14.3	16.5	17.1	20.1	**17.6**	**10.8**
IVCN	9.6	14.3	16.5	17.1	20.1	**17.6**	**10.8**
FSSE	9.8	15.0	16.9	18.3	20.0	21.2	17.2
GFSI	9.9	14.3	16.1	17.3	19.9	21.4	16.3
EMXI	10.3	15.9	20.0	23.8	24.7	26.3	20.1
Forecasts	16	16	16	16	16	16	16

Table 5a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Julio. 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 (CPHC)	**19.1**	**34.0**	**48.1**	**70.7**	**148.7**	**267.5**	**427.0**
OCD5	30.4	65.1	107.9	142.5	251.1	386.0	516.3
Forecasts	28	26	24	22	12	8	8
OFCL (2009-13)	35.0	60.3	89.0	124.8	234.7	346.5	451.7

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Julio. Errors smaller than the CPHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 5a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (CPHC)	17.5	31.4	43.9	67.1	144.3	283.0	449.3
OCD5	27.6	57.8	99.4	136.2	241.7	378.8	500.8
GFSI	17.8	33.7	**43.6**	**57.2**	**137.4**	**157.1**	**285.0**
AEMI	20.7	42.3	58.4	84.1	158.8	**167.8**	**233.2**
GHMI	20.9	40.3	58.9	80.1	156.3	**268.1**	**409.8**
HWFI	19.3	34.6	46.1	**59.0**	**123.4**	**147.2**	**226.4**
EGRI	17.5	41.4	66.6	94.1	151.9	303.6	521.7
EMXI	14.7	32.0	47.5	**67.0**	**122.8**	**241.1**	**432.6**
TCON	**16.7**	33.1	45.7	**63.0**	**125.4**	**181.8**	**277.7**
TVCE	**14.9**	**30.8**	**42.5**	**59.3**	**116.3**	**190.2**	**301.9**
BAMS	26.0	52.8	88.3	125.6	224.3	350.9	**438.4**
BAMM	19.8	38.2	54.2	73.9	**90.3**	**91.1**	**155.7**
BAMD	37.4	69.2	92.0	110.7	**100.1**	**145.1**	**250.3**
Forecasts	21	19	17	16	9	6	6

Table 6a. CPC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Julio. 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 (CPHC)	**2.7**	**4.8**	**5.2**	**6.1**	**7.9**	**9.4**	**9.4**
OCD5	8.1	12.4	19.2	16.3	36.0	37.3	30.5
Forecasts	28	26	24	22	12	8	8
OFCL (2009-13)	4.8	8.5	11.3	13.6	22.2	26.0	27.9

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Julio. Errors smaller than the CPHC official forecast are shown in boldface type. The number of official forecasts shown here will generally be smaller than that shown in Table 6a due to the homogeneity requirement.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (CPHC)	2.7	4.8	5.2	6.1	7.9	9.4	9.4
OCD5	8.1	12.4	19.2	16.3	36.0	37.3	30.5
HWFI	4.2	5.1	5.2	**5.7**	**4.5**	**7.1**	**8.0**
GHMI	5.7	6.2	7.5	6.9	**4.7**	10.3	11.1
GFDI	5.7	6.2	6.5	7.2	**7.8**	12.6	18.0
DSHP	4.9	7.3	9.4	10.1	12.1	18.4	24.0
LGEM	4.4	6.4	8.0	8.2	**7.3**	**8.8**	**8.1**
ICON	4.3	5.5	6.7	6.8	**5.5**	**6.9**	**6.4**
IVCN	4.3	5.5	6.7	6.8	**5.5**	**6.9**	**6.4**
GFSI	4.3	6.1	7.5	8.5	15.2	15.3	15.5
Forecasts	28	26	24	22	12	8	8

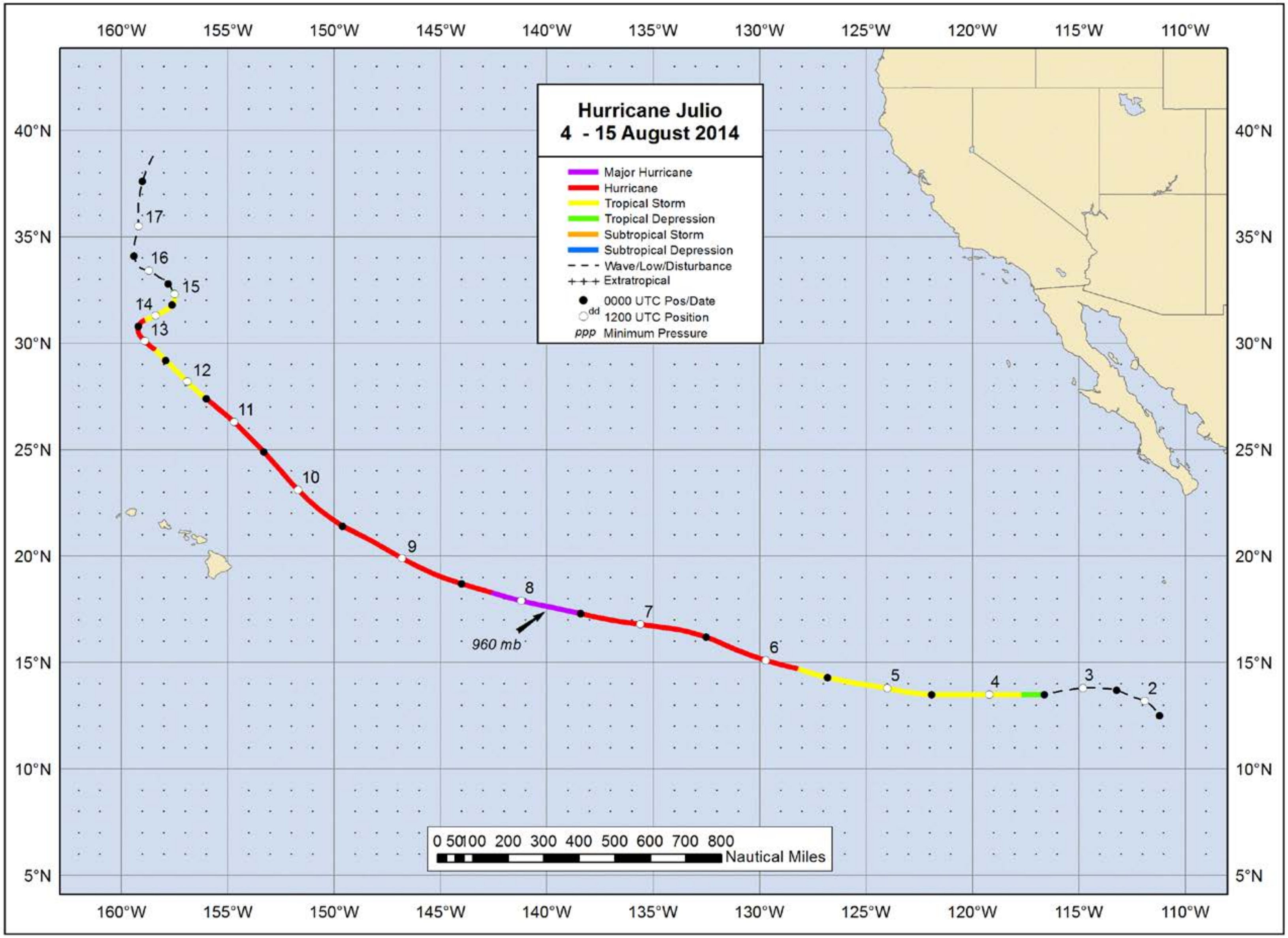


Figure 1. Best track positions for Hurricane Julio, 4-15 August 2014. Track east of 140° W longitude was prepared by the NHC and the track west of 140° W longitude was prepared by the CPHC.

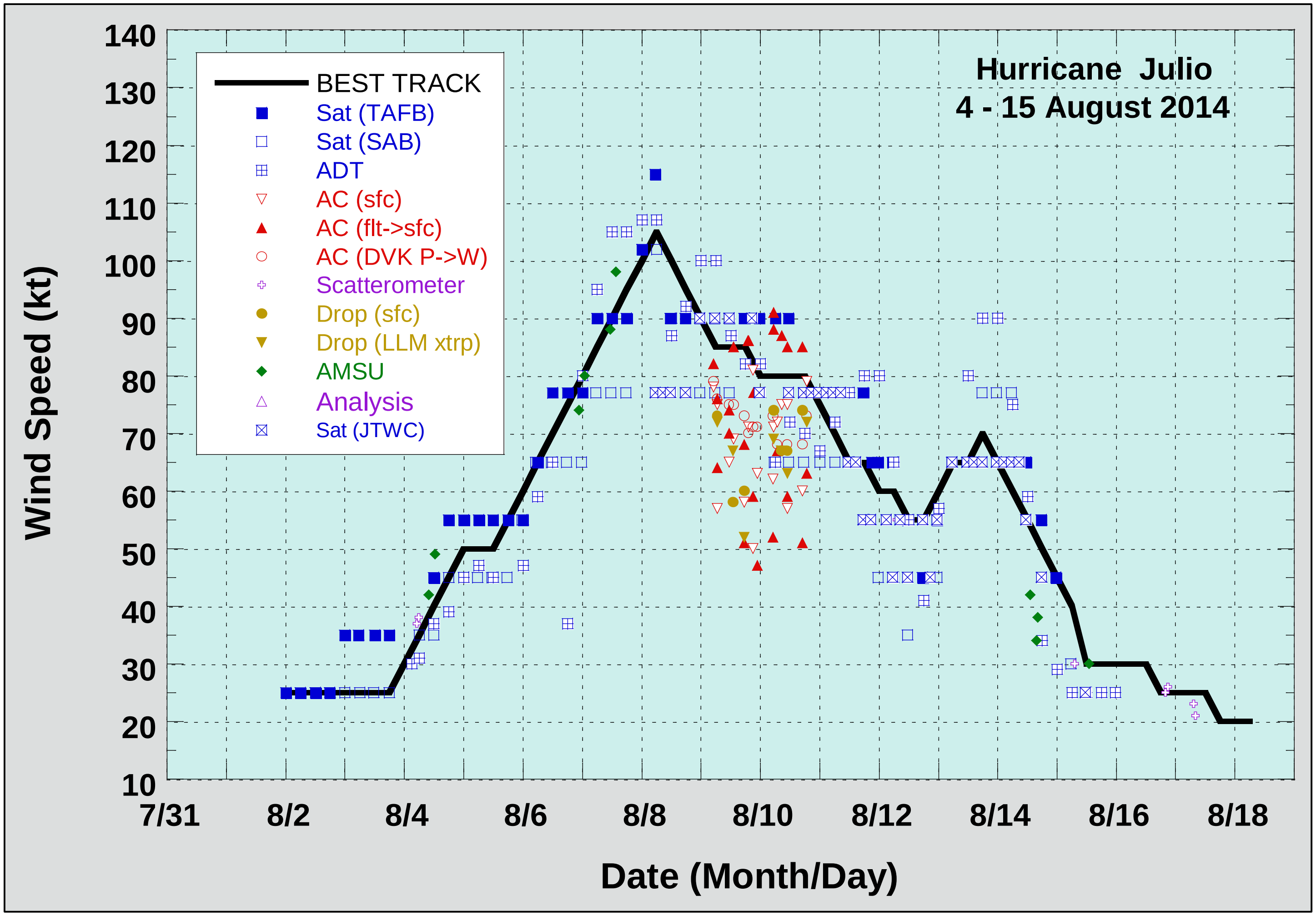


Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Julio, 4-15 August 2014. Aircraft observations have been adjusted for elevation using a 90% adjustment factor for observations from 700 mb. Dropwindsonde observations include actual 10 m winds (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 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. Best track data after 0600 UTC 8 August were produced by the Central Pacific Hurricane Center.

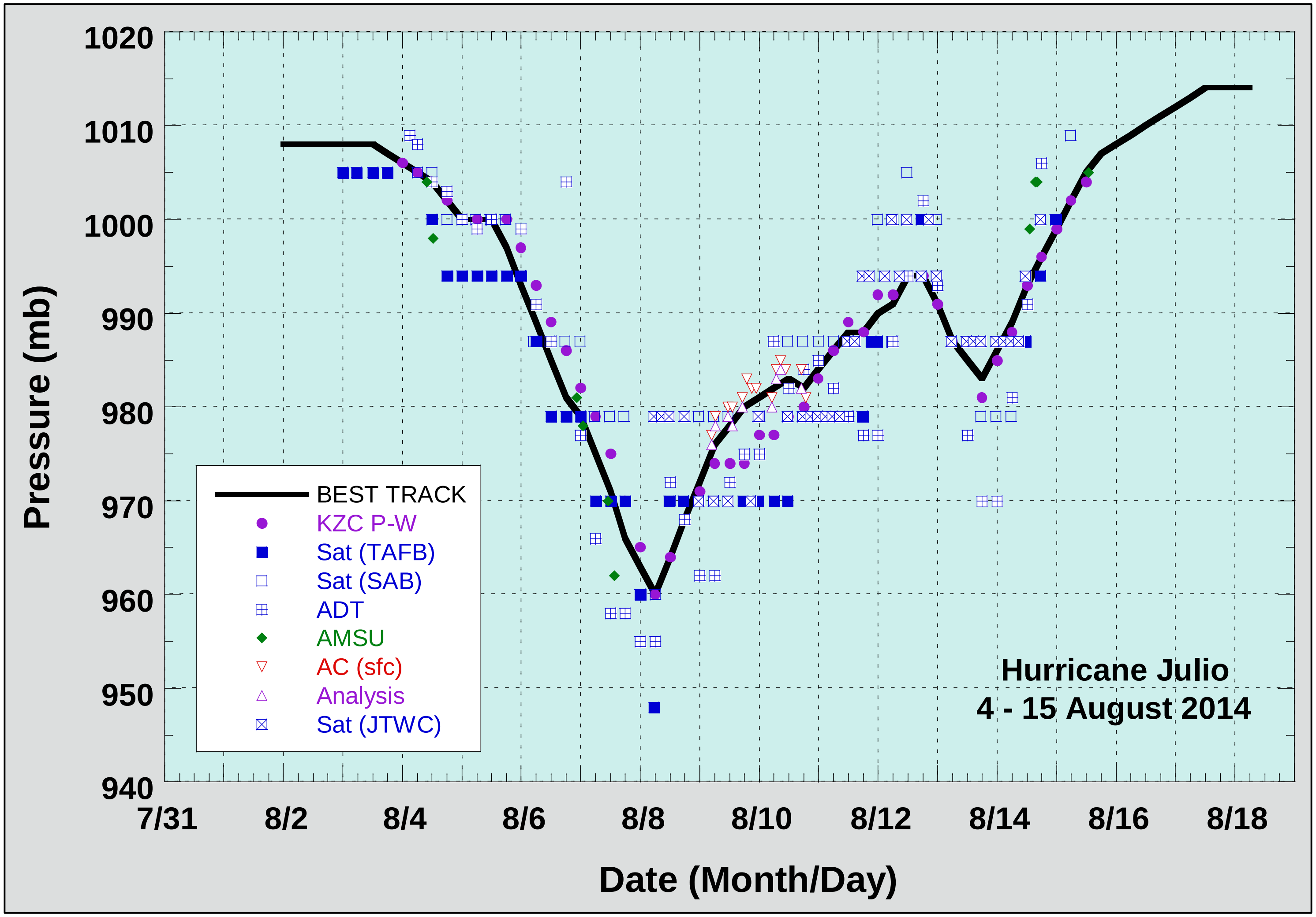


Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Julio, 4-15 August 2014. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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. Best track data after 0600 UTC 8 August were produced by the Central Pacific Hurricane Center.

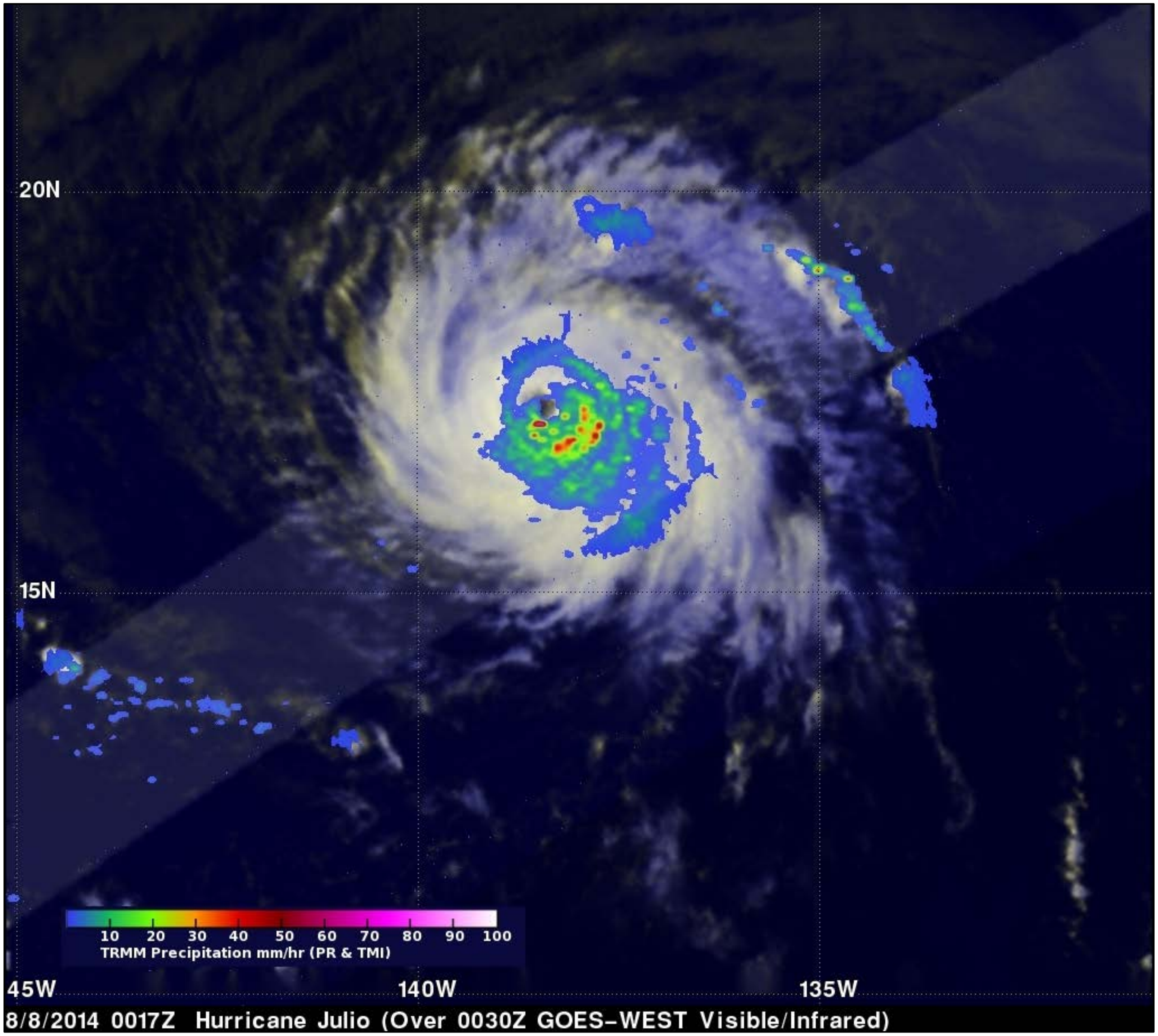


Figure 4a. NASA-TRMM satellite two-dimensional microwave data depiction of Julio at 0017 UTC 8 August overlaid onto GOES-W satellite imagery when the cyclone was a major hurricane, located just east of 140^{O} W longitude. (Image courtesy of NASA)

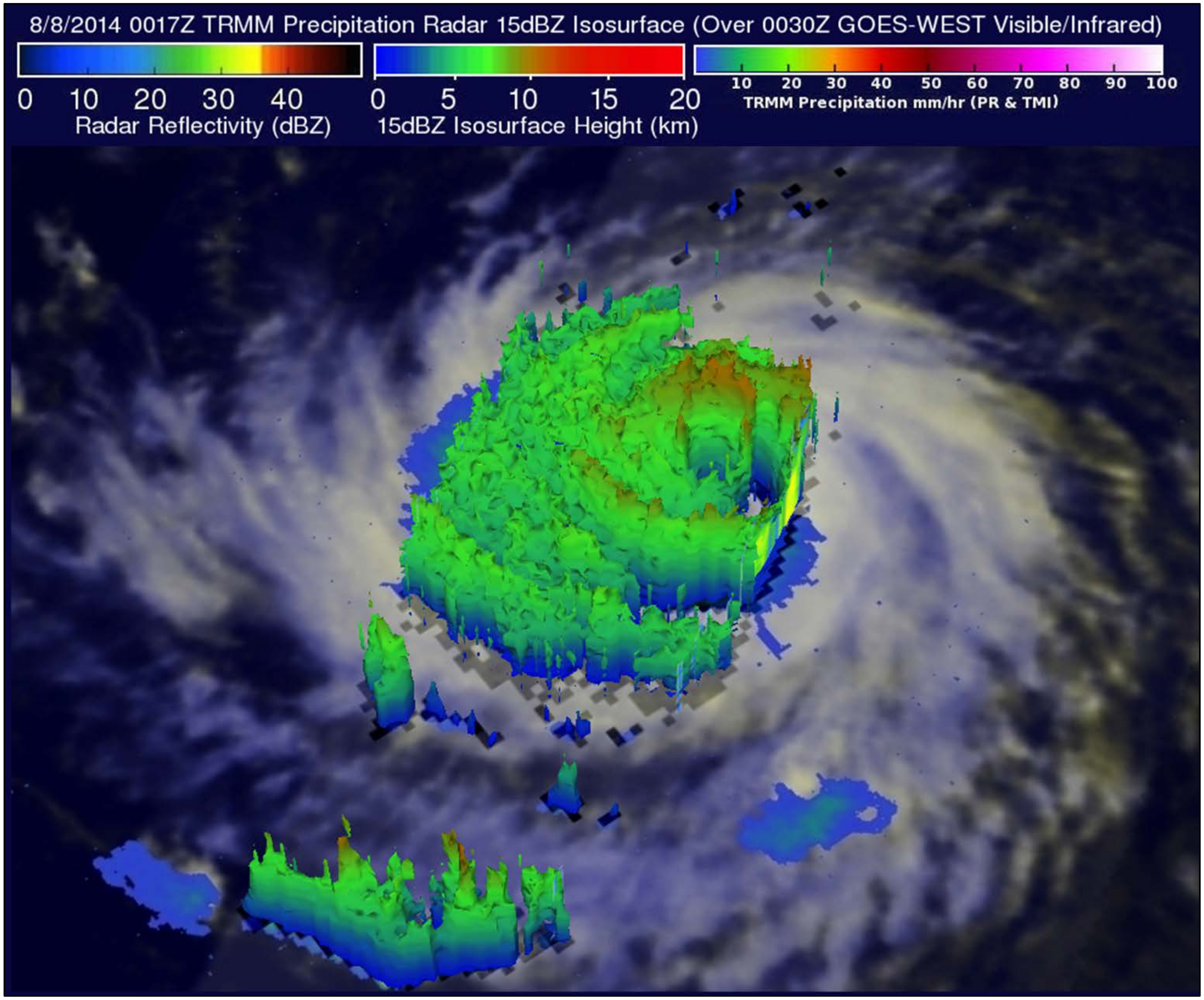


Figure 4b. NASA-TRMM three-dimensional depiction of Hurricane Julio using Precipitation Radar (PR) radar data that corresponds with Figure 4a. Strong convection (orange colors) was occurring in the northern eyewall of the cyclone. (Image courtesy of NASA)

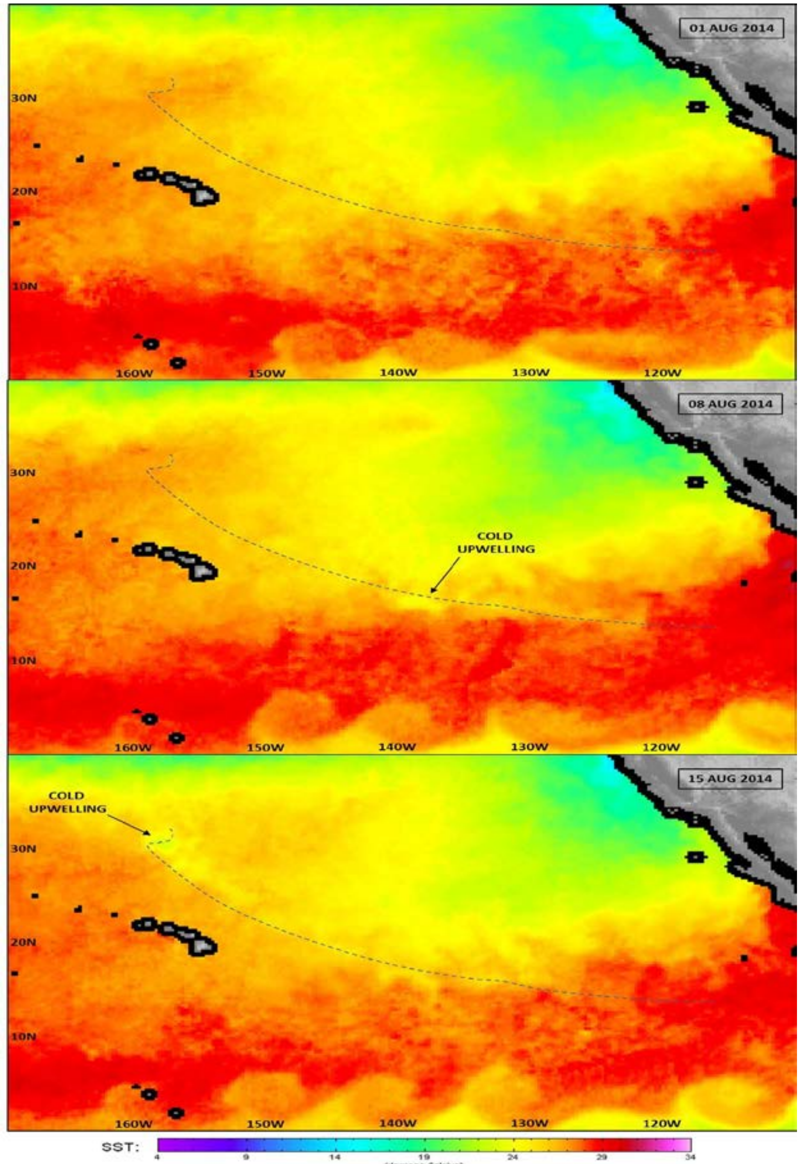


Figure 5. Sea-surface temperature analyses at 1200 UTC for 01 August (top), 08 August (middle), and 15 August 2014 (bottom) with the track of Hurricane Julio superimposed (dotted line). Images courtesy Remote Sensing Systems, San Jose, CA.