NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT

HURRICANE CELIA

(EP042016)

6 – 15 July 2016

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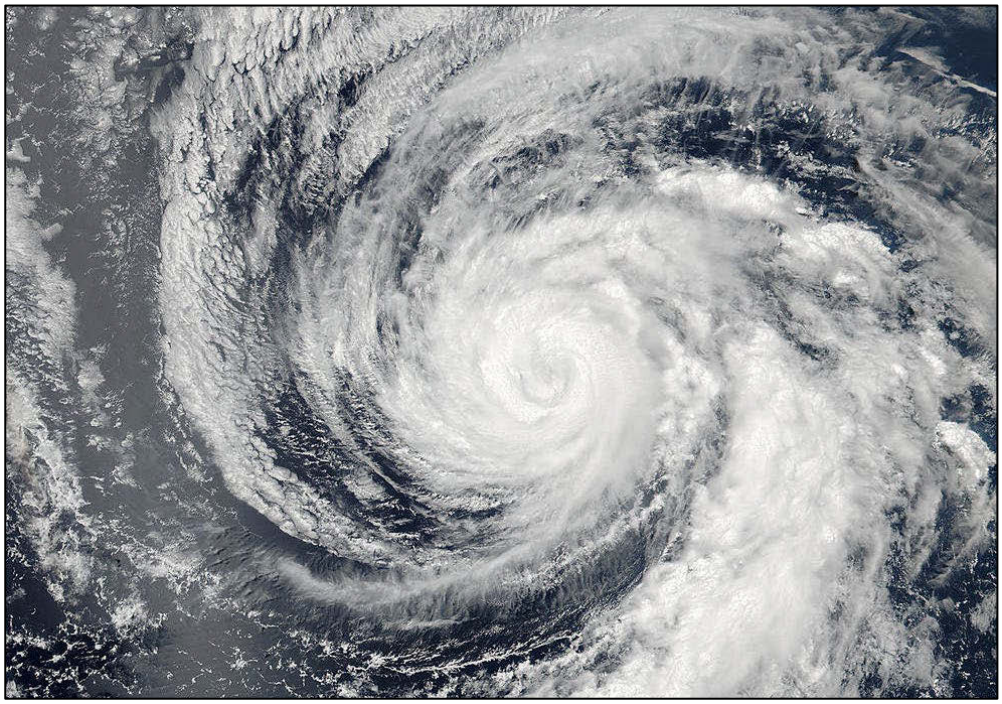

VISIBLE IMAGE OF CELIA NEAR PEAK INTENSITY AT 2205 UTC 11 JULY FROM THE SUOMI NATIONAL POLAR-ORBITING PARTNERSHIP (NPP) SATELITE. IMAGE COURTESY OF THE NASA GODDARD RAPID RESPONSE TEAM.

Celia was a category 2 hurricane (on the Saffir-Simpson Hurricane Wind Scale) that remained over the open waters of the eastern North Pacific Ocean.

[1] Original report dated 25 January 2017. Updated 6 June 2019 to correct intensity at 0600 UTC 10 July in Table 1.

Hurricane Celia

6 – 15 JULY 2016

SYNOPTIC HISTORY

Celia developed from a tropical wave that departed the west coast of Africa on 22 June and crossed the Atlantic Ocean and Caribbean Sea with limited shower activity. The wave crossed Central America on 1 July and moved over the far eastern North Pacific Ocean shortly thereafter, where a favorable phase of the Madden Julian Oscillation (MJO) was passing through. The positive MJO phase helped to cause a gradual increase in convection near the wave during the next few days. On 5 July, a broad area of low pressure developed in association with the wave several hundred n mi south of Manzanillo, Mexico. The low became better defined early the next day, when thunderstorm activity increased and became better organized and a tropical depression formed around 1800 UTC 6 July, about 475 n mi south-southwest of Manzanillo. 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].

The depression moved westward to west-northwestward to the south of a subtropical ridge that extended westward from northern Mexico. Moderate southeasterly shear and dry mid-level air caused the convection to become a little less organized on 7 July, but early the next day deep convection increased within a couple of curved bands around the center of the tropical cyclone, and the depression became a tropical storm by 1200 UTC 8 July. Around this time, Celia began moving westward over a region of anomalously cool waters caused by the passage of Hurricane Blas less than a week before. This caused the convection to decrease in coverage, and despite favorable atmospheric conditions Celia only strengthened a little during the following 24 h. By 1800 UTC 9 July, Celia began moving over warmer waters west of Blas' cool wake, and the tropical storm began to strengthen at a faster rate. Celia's inner-core convection increased and became more symmetric early on 10 July, and by 1800 UTC Celia attained hurricane strength when a ragged banding eye formed.

Although intrusions of dry air caused some breaks in the convective banding, Celia continued to strengthen and a large eye became apparent in microwave satellite imagery (Fig. 4). Celia reached its estimated peak intensity of 85 kt at 1800 UTC 11 July when it was located about 1000 n mi west-southwest of the southern tip of the Baja California peninsula (cover figure). The hurricane turned west-northwestward when it reached the western portion of the strong subtropical ridge. Celia began to weaken on 12 July when it began moving over slightly cooler waters and into a more stable air mass, and it weakened to a tropical storm at 0600 UTC 13 July about 1200 n mi west of the southern tip of the Baja California peninsula. Deep convection

[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.

continued to gradually decrease in coverage over the next couple of days while Celia moved west-northwestward over waters around 24°C. The tropical cyclone moved into the Central Pacific basin shortly after 0600 UTC 15 July. Cool waters and unfavorable thermodynamic conditions caused the associated deep convection to dissipate later that day, and although the system still had winds of 35 kt, Celia became a post-tropical cyclone by 0600 UTC 16 July.

The post-tropical cyclone continued moving westward across the Central Pacific basin within the low-level easterly trade wind flow. A strong surface high pressure system to the north of Celia helped maintain an area of 35- to 40-kt winds over the northern semicircle of the low during the next several days, while an interaction with an upper-level trough produced intermittent and disorganized convection over the northern portion of the circulation. Marginal sea-surface temperatures and strong westerly vertical wind shear, however, prevented the convection from persisting or having enough organization for the system to be considered a tropical cyclone. The low passed about 225 n mi north of the Big Island of Hawaii on 18 July and about 100 n mi north of Kauai the following day. A couple of days later, the winds associated with Celia weakened below gale force, and the low degenerated into a trough of low pressure by 1800 UTC 21 July when it was located about 750 n mi west-northwest of Kauai.

METEOROLOGICAL STATISTICS

Observations in Celia (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). Observations in the Central Pacific basin include Dvorak satellite intensity estimates from the Central Pacific Hurricane Center (CPHC) and the Joint Typhoon Warning Center. Satellite-based intensity estimates also include objective observations from the Advanced Dvorak Technique (ADT) 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 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 Celia.

Celia's estimated peak intensity of 85 kt is based on a blend of objective and subjective Dvorak intensity estimates.

There were no ship reports of tropical storm force winds in association with Celia. On 17 July, the center of the post-tropical cyclone passed very close to drifting buoy 43508, which reported a minimum pressure of 1003.4 mb at 1200 UTC. The cyclone also passed near NOAA buoys 51000 and 51101 on 18-19 July. Buoy 51000 near 23.5°N 153.8°W recorded a minimum pressure of 1007.4 mb at 0950 UTC 18 July, and buoy 51101 reported a sustained wind of 28 kt and a gust to 37 kt at 2306 UTC 19 July, as well as a minimum pressure of 1008.8 mb at 2350 UTC 19 July.

While the post-tropical cyclone passed to the north of the Hawaiian Islands, a band of enhanced tropical moisture moved from east to west across the islands. As a result, rainfall totals

of 1 to 2.5 inches were observed across portions of Kauai, Oahu, Maui, and the Big Island of Hawaii during 18-19 July. These rains resulted in the issuance of several flood advisories by the National Weather Service (NWS) forecast office in Honolulu during the afternoon and evening of 18 July.

Large swells generated by Celia and its remnants produced wave heights of up to 10 ft along the east-facing shores of the Hawaiian Islands on 16-19 July. High surf advisories were issued by the NWS Honolulu to warn of the dangerous surf conditions.

CASUALTY AND DAMAGE STATISTICS

There were two direct deaths[3] associated with Celia, but no reports of damage. Large swells generated by Celia and its remnants affected the east-facing shores of the Hawaiian Islands. These swells produced rough surf that caused two drowning deaths on the southeastern shore of the island of Oahu on 16 July.

There were no reports of damage associated with Celia or its remnants.

FORECAST AND WARNING CRITIQUE

Although the development of a tropical cyclone was anticipated, the timing of Celia's genesis was not well predicted. The potential for tropical cyclone formation was first introduced into the Tropical Weather Outlook at 1800 UTC 2 July, about 96 h before formation occurred. The 5-day probability of genesis was raised to the medium (40-60%) category 66 h before development, and to the high category (>60%) 42 before formation occurred (Table 2). The 48-h probabilities of development remained in the low category until 18 h before formation and were not raised to the high category until 6 h before development.

A verification of NHC official track forecasts for Celia is given in Table 3a. Official forecast track errors were much lower than the mean official errors for the previous 5-yr period. In fact, 3-, 4-, and 5-day mean official track forecast errors for Celia were about 30%, 45%, and 55% percent lower than the 5-year average errors, respectively. The OCD5 errors were also much lower than average at these time periods, which suggests that the track forecasts for Celia were less difficult than average. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. The NHC forecasts had lower errors than nearly all of the individual track models at most lead times. However the consensus models TVCX, TVCE, and GFEX had slightly lower mean errors than the official forecast at several forecast lead times.

[3] Deaths occurring as a direct result of the forces of the tropical cyclone are referred to as "direct" deaths. These would include those persons who drowned in storm surge, rough seas, rip currents, and freshwater floods. Direct deaths also include casualties resulting from lightning and wind-related events (e.g., collapsing structures). Deaths occurring from such factors as heart attacks, house fires, electrocutions from downed power lines, vehicle accidents on wet roads, etc., are considered indirect" deaths.

A verification of NHC official intensity forecasts for Celia is given in Table 4a. Official forecast intensity errors were lower than the 5-year mean errors at each verifying lead time through 96 h, but had slightly larger than average errors at 120 h. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The HWRF (HWFI) model exhibited slightly lower mean errors than the official forecast at all forecast times except 12 h, and the GFDL (GHMI) and CTCI models performed better at 72, 96, and 120 h. The NHC forecasts were also beaten by the intensity consensus models, ICON and IVCN, at each forecast lead time except 12 h.

Since Celia was a tropical cyclone for only a brief time within the Central Pacific basin, no verification statistics are available for any forecasts issued by the CPHC.

No coastal tropical cyclone watches or warnings were issued for Celia.

Table 1. Best track for Hurricane Celia, 6-15 July 2016.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
06 / 0000	11.5	106.3	1008	25	low
06 / 0600	11.7	107.0	1008	25	"
06 / 1200	11.9	107.7	1007	25	"
06 / 1800	12.1	108.4	1007	25	tropical depression
07 / 0000	12.2	109.1	1006	30	"
07 / 0600	12.2	109.8	1006	30	"
07 / 1200	12.2	110.5	1006	30	"
07 / 1800	12.2	111.2	1006	30	"
08 / 0000	12.3	111.6	1006	30	"
08 / 0600	12.4	111.9	1006	30	"
08 / 1200	12.6	112.3	1005	35	tropical storm
08 / 1800	13.0	112.9	1004	40	"
09 / 0000	13.6	113.8	1004	40	"
09 / 0600	14.0	115.1	1004	40	"
09 / 1200	14.3	116.4	1002	45	"
09 / 1800	14.4	117.4	1002	45	"
10 / 0000	14.5	118.4	1000	50	"
10 / 0600	14.7	119.5	1000	50	"
10 / 1200	14.8	120.6	994	60	"
10 / 1800	14.8	121.7	989	65	hurricane
11 / 0000	14.9	122.8	986	70	"
11 / 0600	14.9	123.9	980	75	"
11 / 1200	15.0	125.0	977	80	"
11 / 1800	15.1	125.8	972	85	"
12 / 0000	15.3	126.6	972	85	"
12 / 0600	15.8	127.4	972	85	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
12 / 1200	16.4	128.1	975	80	"
12 / 1800	17.0	129.0	982	70	"
13 / 0000	17.6	129.9	986	65	"
13 / 0600	18.2	130.9	989	60	tropical storm
13 / 1200	18.7	131.9	992	55	"
13 / 1800	19.2	133.1	995	50	"
14 / 0000	19.7	134.2	1000	45	"
14 / 0600	20.1	135.2	1000	45	"
14 / 1200	20.6	136.3	1000	45	"
14 / 1800	21.1	137.3	1000	45	"
15 / 0000	21.6	138.5	1001	45	"
15 / 0600	21.9	139.6	1003	40	"
15 / 1200	22.1	140.8	1004	35	"
15 / 1800	22.2	142.0	1004	35	"
16 / 0000	22.3	143.2	1005	35	low
16 / 0600	22.4	144.5	1005	35	"
16 / 1200	22.5	145.8	1005	35	"
16 / 1800	22.7	147.0	1005	35	"
17 / 0000	23.0	148.1	1004	35	"
17 / 0600	23.3	149.1	1003	40	"
17 / 1200	23.6	150.0	1003	40	"
17 / 1800	23.7	150.9	1004	40	"
18 / 0000	23.7	152.0	1005	40	"
18 / 0600	23.7	153.2	1006	40	"
18 / 1200	23.7	154.5	1007	40	"
18 / 1800	23.7	156.0	1007	40	"
19 / 0000	23.8	157.3	1007	40	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
19 / 0600	23.8	158.6	1008	35	"
19 / 1200	23.9	159.9	1008	35	"
19 / 1800	24.1	161.2	1008	35	"
20 / 0000	24.2	162.4	1008	35	"
20 / 0600	24.3	163.8	1008	35	"
20 / 1200	24.4	165.3	1009	35	"
20 / 1800	24.4	166.9	1009	35	"
21 / 0000	24.5	168.5	1010	35	"
21 / 0600	24.8	170.1	1010	35	"
21 / 1200	25.0	171.7	1011	30	"
21 / 1800					dissipated
11 / 1800	15.1	125.8	972	85	maximum winds 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%)	30	96
Medium (40%-60%)	18	66
High (>60%)	6	42

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Hurricane Celia, 6-15 July 2016. 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	**20.7**	**32.6**	**43.9**	**49.3**	**61.5**	**68.5**	**67.6**
OCD5	35.3	68.0	101.1	125.5	165.3	189.7	204.9
Forecasts	35	33	31	29	25	21	17
OFCL (2011-15)	23.4	36.4	47.2	59.4	89.0	123.6	159.5
OCD5 (2011-15)	36.6	74.2	116.5	159.7	245.6	331.1	427.4

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Hurricane Celia, 6-15 July 2016. 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	21.7	32.8	42.1	45.5	56.4	60.9	63.4
OCD5	34.6	67.9	99.4	124.8	173.1	198.9	213.0
GFSI	22.7	33.4	44.4	61.0	74.0	68.0	71.3
GHMI	26.4	38.9	44.5	48.3	56.7	98.5	192.9
HWFI	25.4	39.8	49.5	61.6	88.1	119.1	169.8
EGRI	22.7	33.4	44.2	53.5	74.3	113.5	165.2
EMXI	**20.2**	35.1	45.7	50.5	65.5	73.9	**58.6**
CMCI	24.4	43.0	63.4	84.5	110.3	114.0	112.6
NVGI	33.9	52.9	68.6	77.7	88.9	107.8	170.6
CTCI	21.9	**32.3**	**40.7**	50.1	65.1	79.2	104.3
GFNI	27.4	40.2	50.2	57.6	81.7	105.2	148.4
AEMI	22.7	34.1	44.1	58.1	74.9	71.8	78.7
TVCX	21.8	**30.3**	**35.9**	**41.0**	**48.0**	**49.1**	**56.9**
GFEX	**21.1**	**31.7**	**39.2**	47.0	59.9	64.1	57.7
TCON	22.4	33.1	**39.8**	**45.4**	**52.7**	**49.8**	**60.8**
TVCE	21.8	**30.9**	**37.7**	**41.6**	**48.4**	**46.8**	**58.7**
LBAR	31.8	64.3	101.3	146.0	243.5	263.2	222.7
BAMD	30.0	49.4	62.6	71.1	90.3	93.9	107.7
BAMM	30.2	47.2	59.3	70.0	98.7	107.5	98.0
BAMS	27.8	41.5	50.9	67.0	115.3	132.9	127.6
Forecasts	30	30	29	27	23	19	15

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Hurricane Celia, 6-15 July 2016. 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	**4.0**	**6.5**	**7.3**	**8.8**	**12.2**	**13.8**	15.9
OCD5	5.4	8.2	10.6	12.3	13.5	15.6	11.5
Forecasts	35	33	31	29	25	21	17
OFCL (2011-15)	5.9	9.8	12.5	14.0	15.5	16.3	14.9
OCD5 (2011-15)	7.7	12.8	16.4	18.8	21.1	20.9	19.7

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Hurricane Celia, 6-15 July 2016. 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	3.9	6.6	7.3	8.9	12.3	14.0	16.6
OCD5	5.6	8.5	10.6	12.3	13.8	15.8	**10.3**
GHMI	6.1	8.2	8.5	9.3	**9.5**	**8.9**	**8.0**
HWFI	4.9	**6.4**	**7.0**	**7.9**	**10.9**	**10.9**	**15.6**
ICON	4.9	**5.6**	**6.1**	**8.2**	**9.7**	**9.6**	**12.4**
IVCN	4.8	**5.8**	**6.2**	**8.5**	**8.8**	**8.8**	**11.2**
DSHP	5.3	8.2	12.0	14.8	19.0	22.0	24.8
LGEM	5.3	7.1	8.9	10.5	**10.8**	**9.9**	**9.9**
CTCI	4.3	6.6	9.0	10.3	**9.2**	**6.5**	**11.1**
GFSI	4.6	7.8	11.4	16.1	21.7	21.6	20.1
EMXI	5.1	8.2	10.6	13.0	18.0	19.4	16.8
GFNI	5.3	8.0	9.6	10.6	**10.9**	**7.5**	**5.8**
Forecasts	32	32	31	27	24	20	16

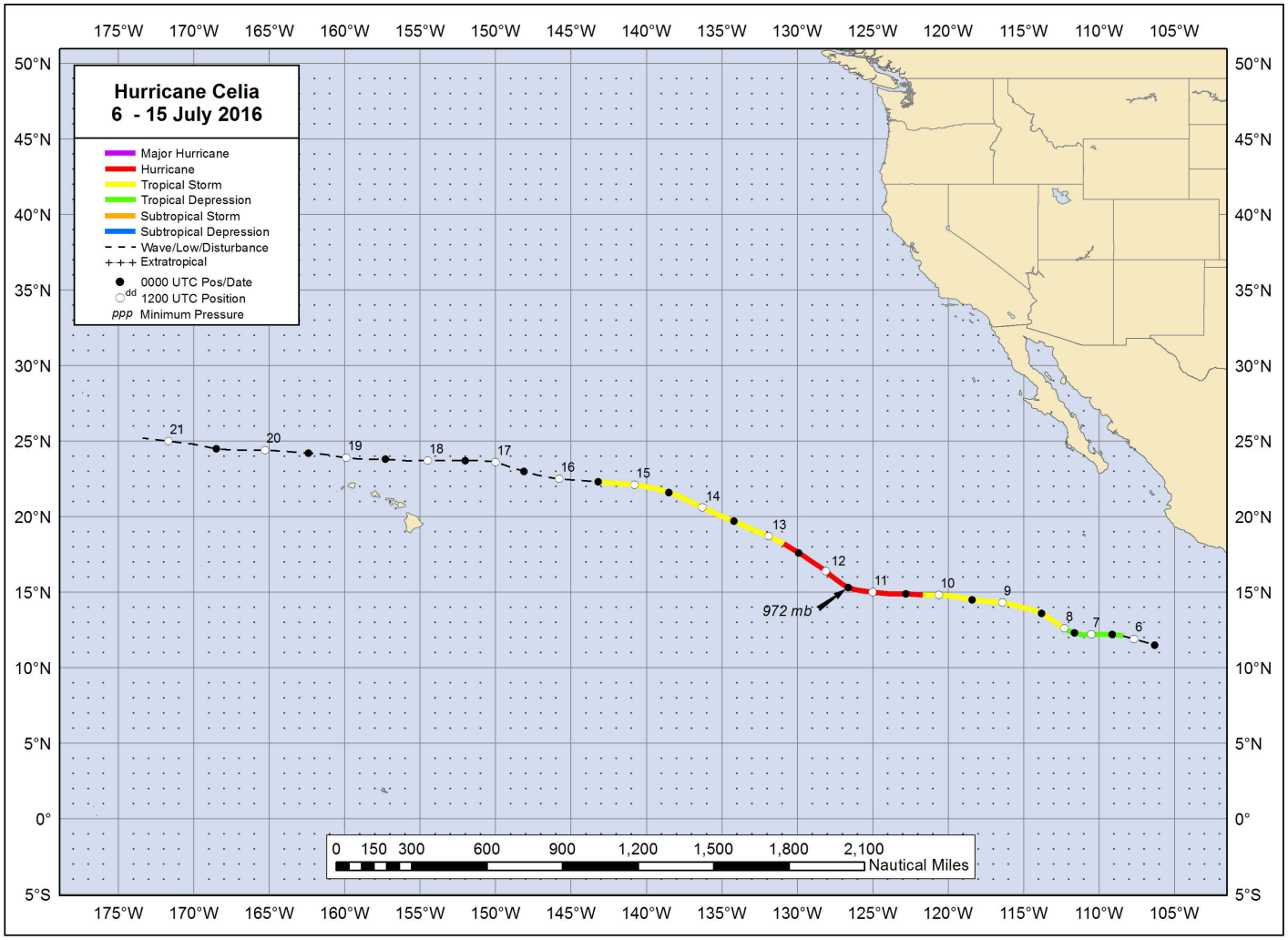

Figure 1. Best track positions for Hurricane Celia, 6-15 July 2016.

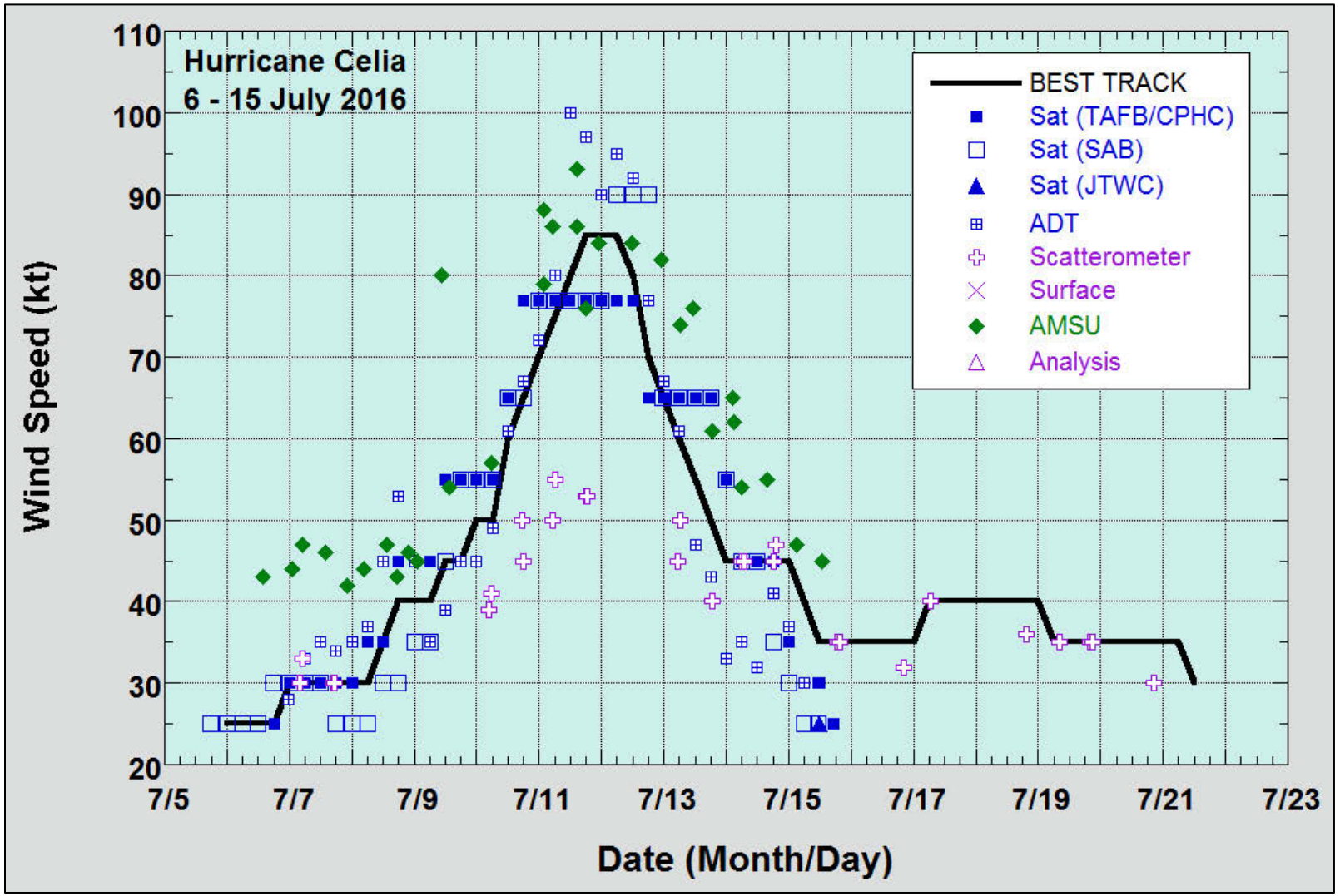

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Celia, 6-15 July 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies technique. Dashed vertical lines correspond to 0000 UTC.

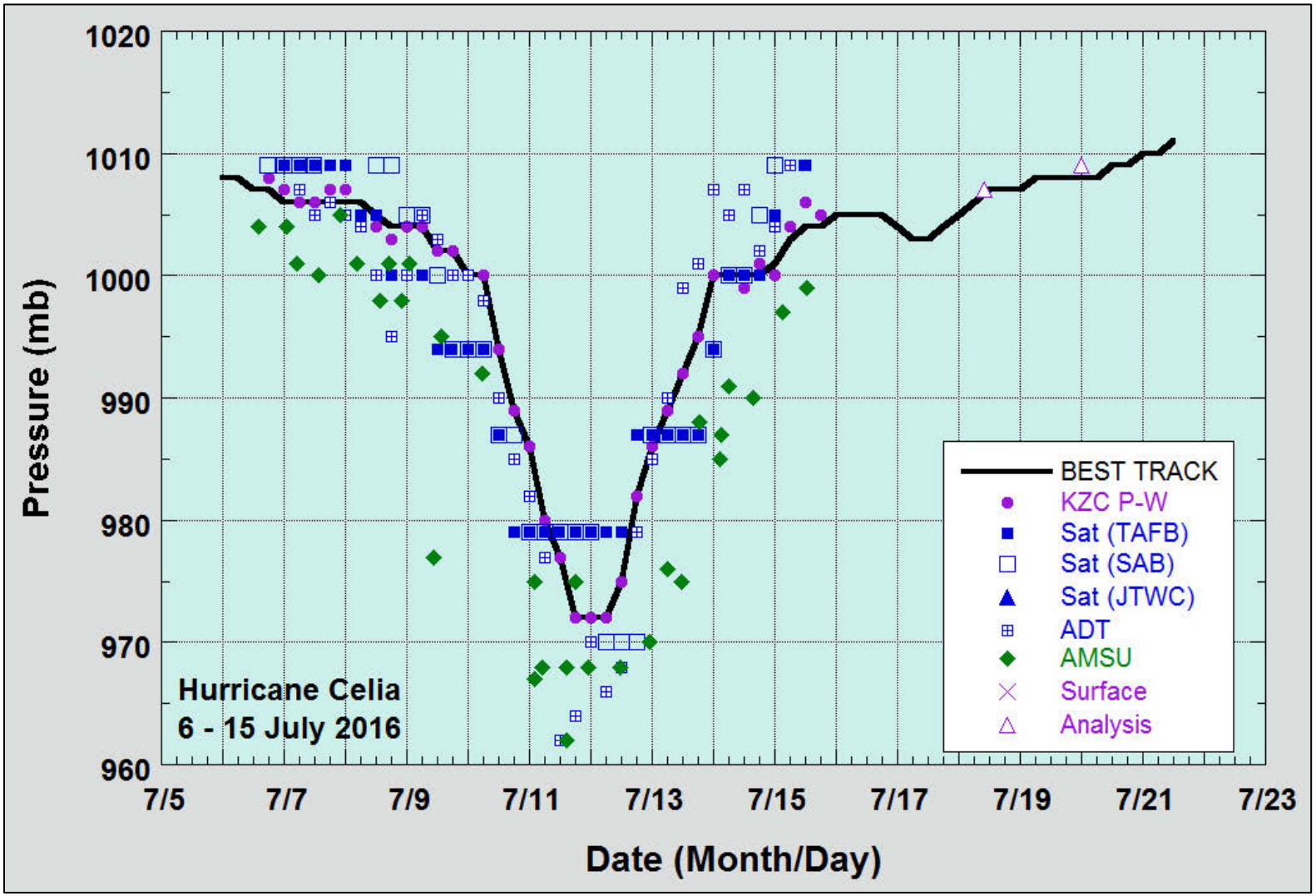

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Celia, 6-15 July 2016. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. AMSU intensity estimates are from the Cooperative Institute for Meteorological 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.

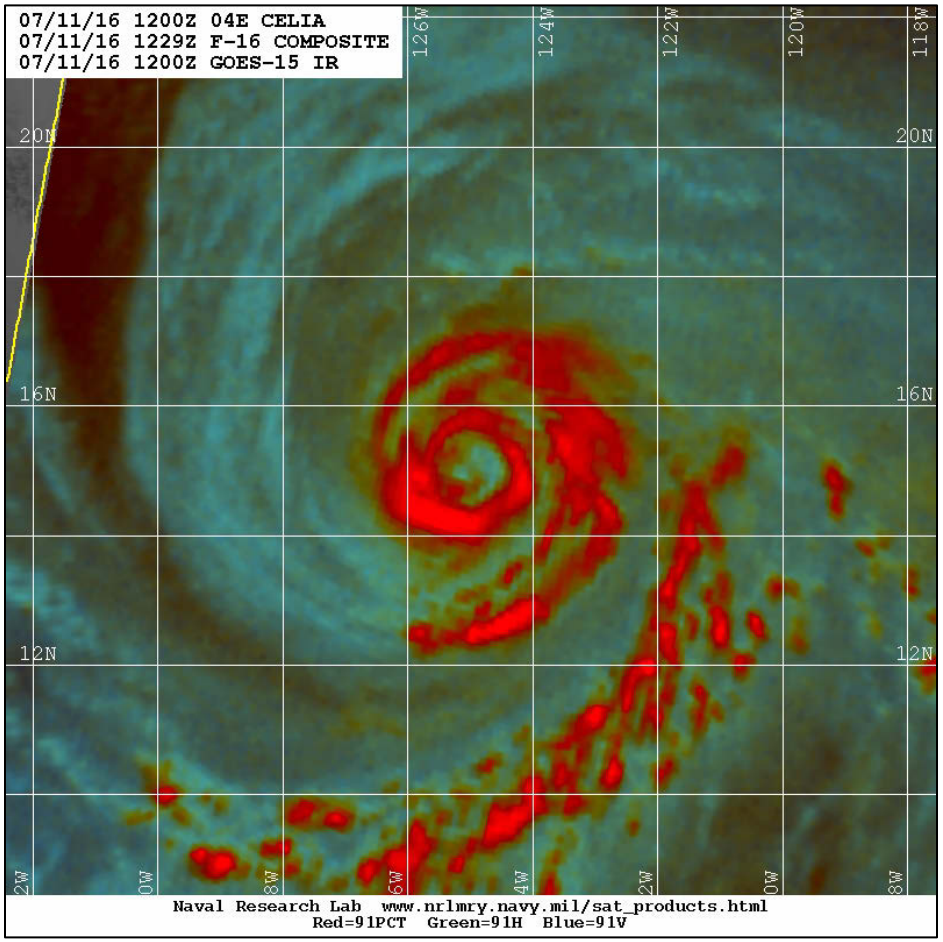

Figure 4. Special Sensor Microwave Imager/Sounder (SSMIS) image of Hurricane Celia's large eye at 1229 UTC 11 July 2016. Imagery courtesy of the Naval Research Laboratory.