NATIONAL HURRICANE CENTER TROPICAL CYCLONE REPORT[1]

HURRICANE FERNANDA

(EP062017)

11–22 July 2017

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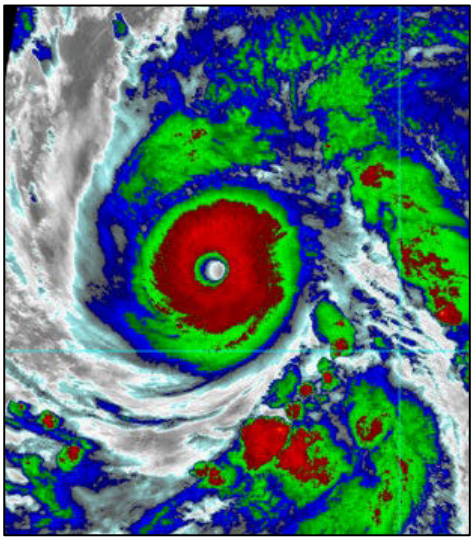

SUOMI NPP VIIRS INFRARED BAND IMAGE OF FERNANDA AT 0849 UTC 15 JULY 2017 NEAR THE TIME OF FERNANDA'S PEAK INTENSITY. IMAGE COURTESY OF CIRA/RAMMB.

Fernanda formed well south of the coast of Mexico and moved across much of the eastern North Pacific basin while reaching category 4 intensity on the Saffir-Simpson Hurricane Wind Scale. Fernanda weakened to a tropical storm before moving into the central North Pacific basin and dissipated well east of the Hawaiian Islands

[1] This report is based on Fernanda's history in the National Hurricane Center's area of responsibility in the eastern North Pacific basin (east of 140°W longitude). The report will be updated once the Central Pacific Hurricane Center completes its analysis of Fernanda in the central North Pacific basin (west of 140°W longitude).

Hurricane Fernanda

11–22 JULY 2017

SYNOPTIC HISTORY

The genesis of Fernanda can be traced back to a tropical wave that moved off the west coast of Africa on 26 June. The wave moved westward across the tropical Atlantic producing disorganized shower and thunderstorm activity before moving into the Caribbean Sea on 2 July. The wave crossed Central America on 3–4 July, entered the eastern Pacific basin by 5 July, and then passed well south of the southern coast of Mexico during the next few days. Shower and thunderstorm activity gradually began to increase on 10 July and a broad area of low pressure formed about 400 n mi south of Manzanillo, Mexico, while deep convection became better organized during the next day or so. A well-defined center developed in association with the low by 1800 UTC 11 July, marking the formation of a tropical depression about 650 n mi south of the southern tip of the Baja California peninsula. The "best track" chart of the 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 intensified slowly after formation while moving westward under the influence of a large mid-level ridge centered over western North America. By 1800 UTC 12 July, the cyclone reached tropical storm strength while located about 665 n mi south of the southern tip of the Baja California peninsula. Beginning at that time, Fernanda underwent a prolonged period of rapid intensification while in an environment of vertical wind shear of 10 kt or less and sea surface temperatures (SSTs) of 28-29°C. Fernanda's intensity increased by 30 kt, 75 kt, and 90 kt in the ensuing 24 h, 48 h, and 54 h, respectively. The cyclone reached hurricane status at 1800 UTC 13 July while located about 760 n mi south-southwest of the southern tip of the Baja California peninsula. A distinct eye became apparent in infrared satellite imagery on 14 July as Fernanda continued to intensify. The hurricane reached a peak intensity of 125 kt (category 4 on the Saffir-Simpson Hurricane Wind Scale) at 0000 UTC 15 July, with the satellite presentation featuring a clear eye surrounded by a thick ring of cloud top temperatures colder than -70°C (cover image). During this period of intensification, the tropical cyclone was steered westward and west-southwestward for a time under the influence of an expansive mid-level ridge that was building westward from North America across the eastern Pacific.

Fernanda turned west-northwestward on 15 July and continued on that heading through 17 July. During this time, the hurricane underwent an eyewall replacement cycle (ERC) while in a low-shear environment and over warm SSTs (Fig. 4). Fernanda weakened slightly during the ERC, but maintained category 4 strength until early on 17 July. The ridge centered northeast of Fernanda began to weaken, and the hurricane turned northwestward by early on 18 July. During

[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.

the next several days Fernanda moved over progressively cooler SSTs and into a lower-tropospheric environment that was drier and more stable. These factors led to slow weakening on 18 July. Faster weakening began on 19 July, with Fernanda becoming a tropical storm around 0600 UTC 20 July while located about 990 n mi east of the Big Island of Hawaii. Southwesterly vertical wind shear increased quickly to 30 kt later that day, and the low-level center of Fernanda's circulation became exposed before deep convection temporarily dissipated by 1800 UTC that day.

Fernanda crossed 140°W into the central North Pacific basin between 1800 UTC 20 July and 0000 UTC 21 July at an intensity of 45 kt. Fernanda was the first tropical cyclone to cross over from the eastern North Pacific basin in 2017 and the Central Pacific Hurricane Center (CPHC) began issuing advisories at 0300 UTC 21 July. The cyclone was already feeling the influence of 25 to 35 kt of southwesterly shear and had lost its deep convection during basin crossover. However, the low-level circulation center was easy to track given a very prominent low level cloud swirl. Deep convection flared within the northeast quadrant shortly after 0000 UTC 21 July and lasted through 0900 UTC 22 July, but this system never recovered strength in the face of the strong shear and SSTs of 25–26°C. The weakening tropical storm tracked generally toward the west-northwest, with forward motion becoming erratic with the final loss of deep convection near the end of its life. The Central Pacific Hurricane Center issued its last Fernanda advisory at 2100 UTC 22 July, when the remnant low was about 430 n mi east of the Big Island of Hawaii. The remnant low dissipated by 0600 UTC 23 July.

METEOROLOGICAL STATISTICS

Observations in Fernanda (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), the Central Pacific Hurricane Center (PHFO), and the Joint Typhoon Warning Center (JTWC), 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 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 Fernanda.

Fernanda's estimated peak intensity of 125 kt is based on Dvorak estimates of T6.5/127 kt from TAFB and SAB, and ADT estimates of 120-122 kt from 0000 to 0600 UTC 15 July. The minimum pressure of 948 mb is based on the Knaff-Zehr-Courtney pressure-wind relationship given an intensity of 125 kt.

There were no ship or land reports of tropical-storm-force winds in association with Fernanda.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis forecasts for Fernanda were very poor. Fernanda's precursor disturbance was first given a low (< 40%) chance of formation during the next 5 days only 18 h prior to formation (Table 2), and only gradual development was anticipated. The 5-day formation probability was raised to the medium (40-60%) category 12 h before genesis, but the 48-h formation chance remained in the low category until genesis had already occurred. These poor forecasts were due in part to poor forecasts of Fernanda's genesis from the GFS and ECMWF global models, which are typically given more weight when forecasting genesis. For example, GFS forecasts at 5- and 2-day lead times (Fig. 5a,b) showed only a weak wave at the 850-mb level. Forecasts from the ECMWF at the same lead times (Fig. 5c,d) showed higher values of relative vorticity at the 850-mb level, but still did not indicate a closed circulation.

A verification of NHC official track forecasts for Fernanda is given in Table 3a. Official forecast track errors (OFCL) were below or well below the mean official errors for the previous 5-yr period at all forecast lead times. Climatology-persistence (OCD5) track errors were also much smaller than the long-term mean OCD5 errors, suggesting that Fernanda's track was easier to forecast than that of a typical system. A homogeneous comparison of NHC OFCL track errors with selected guidance models is given in Table 3b. For forecast lead times of 12 through 36 h, OFCL outperformed all of the individual track guidance, and was only bested by the HFIP Corrected Consensus Aid (HCCA) and the FSU Superensemble (FSSE). HCCA was the best track guidance overall, with errors smaller than OFCL at all lead times. At longer lead times, OFCL continued to beat most of the individual models with the exception of the ECMWF (EMXI) and the GFS (GFSI), with GFSI having the smallest track errors at day 5. The GEFS ensemble mean (AEMI) and the simple TAB models also performed well at longer lead times.

A verification of CPHC official track forecasts for Fernanda is given in Table 3c. The verification sample size is quite small, with only five 12-hour points available and none available after 36 hours. CPHC track error for Fernanda was smaller than its floating five-year average at 24 and 36 hours, but larger at 12 hours. In general, the Canadian (CMCI) and EMXI global dynamical models performed best versus CPHC, while NAVGEM (NVGI), TABM, TABD, and HWRF did worse. CMCI was the top performer of all track guidance models used.

A verification of NHC official intensity forecasts for Fernanda is given in Table 4a. Official intensity forecast errors were near the mean official error for the previous 5-yr period at 12 h and below or well below the mean 5-yr errors at all other forecast lead times, particularly at 4-5 days. This is impressive since OCD5 intensity errors were near or only slightly below the long-term mean OCD5 errors, suggesting that the forecast difficulty for Fernanda's intensity was about average. A homogeneous comparison of NHC OFCL errors with selected guidance models is

given in Table 4b. Only the variable intensity consensus aid (IVCN), HCCA, and FSSE had smaller average errors than OFCL at multiple lead times.

During the period of Fernanda's rapid intensification, NHC OFCL forecasts anticipated strengthening, but generally underforecast the rate of intensity change (Fig. 6a). Several OFCL forecasts also overforecast the peak intensity of Fernanda on 14–15 July. The HWRF (HWFI; Fig. 6b) and Decay-SHIPS (DSHP; Fig. 6c) models also failed to capture the rapid intensification of Fernanda, with significant underforecasts of the cyclone's intensity. On average, DSHP 12–36-h forecasts during this period were 20-30% worse than OFCL, while HWFI 12–36-h forecasts were 40-70% worse. The HCCA (Fig. 6d) and FSSE corrected consensus aids did the best job of anticipating RI during this period, and had average errors 10-15% lower than OFCL at lead times of 24 and 36 h.

A verification of CPHC official intensity forecasts for Fernanda is given in Table 4c. CPHC intensity error for Fernanda was smaller than its floating five-year average at 12 hours, but larger at 24 and 36 hours. In general, EMXI, ICON and IVCN performed best versus CPHC, while LGEM and GFSI did worse. EMXI was the top performer for all intensity guidance models used.

No coastal watches or warnings were issued in association with Fernanda.

Table 1. Best track for Hurricane Fernanda, 11–22 July 2017.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
11 / 1800	12.2	108.4	1007	25	tropical depression
12 / 0000	12.2	109.4	1007	30	"
12 / 0600	12.1	110.2	1007	30	"
12 / 1200	12.0	111.0	1006	30	"
12 / 1800	11.9	111.8	1005	35	tropical storm
13 / 0000	11.8	112.6	1004	40	"
13 / 0600	11.7	113.5	1003	45	"
13 / 1200	11.5	114.5	1000	55	"
13 / 1800	11.3	115.5	995	65	hurricane
14 / 0000	11.1	116.5	987	75	"
14 / 0600	11.0	117.4	980	85	"
14 / 1200	10.8	118.3	972	95	"
14 / 1800	10.7	119.3	961	110	"
15 / 0000	10.7	120.3	948	125	"
15 / 0600	10.8	121.3	948	125	"
15 / 1200	11.0	122.3	953	120	"
15 / 1800	11.3	123.5	955	115	"
16 / 0000	11.6	124.7	955	115	"
16 / 0600	11.9	125.8	955	115	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
16 / 1200	12.2	126.9	955	115	"
16 / 1800	12.5	127.9	955	115	"
17 / 0000	12.8	128.8	956	110	"
17 / 0600	13.1	129.7	957	110	"
17 / 1200	13.5	130.5	959	105	"
17 / 1800	13.9	131.2	963	100	"
18 / 0000	14.4	131.8	967	95	"
18 / 0600	14.9	132.4	971	90	"
18 / 1200	15.4	132.9	971	90	"
18 / 1800	15.9	133.5	971	90	"
19 / 0000	16.4	134.1	976	85	"
19 / 0600	16.8	134.7	980	80	"
19 / 1200	17.1	135.3	983	75	"
19 / 1800	17.4	135.9	987	70	"
20 / 0000	17.7	136.6	990	65	"
20 / 0600	18.0	137.5	993	60	tropical storm
20 / 1200	18.1	138.7	999	55	"
20 / 1800	18.1	139.9	1004	45	"
21 / 0000	18.3	140.9	1000	45	"
21 / 0600	18.4	142.1	1000	45	"

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
21 / 1200	18.5	143.2	1002	40	"
21 / 1800	18.6	143.9	1004	35	"
22 / 0000	18.7	144.4	1004	35	"
22 / 0600	18.9	144.9	1004	35	"
22 / 1200	19.1	145.9	1005	35	"
22 / 1800	19.4	146.9	1009	30	low
23 / 0000	19.9	147.9	1009	30	"
23 / 0600					dissipated
15 / 0000	10.7	120.3	948	125	maximum wind 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%)	18	18
Medium (40%-60%)	-	12
High (>60%)	-	-

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Fernanda. 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 (NHC)	**14.5**	**26.7**	**39.5**	**50.9**	**72.1**	**91.3**	**124.7**
OCD5	24.3	51.6	82.3	110.5	158.8	192.1	228.5
Forecasts	36	36	36	35	31	27	23
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 Fernanda for forecasts originating in the eastern North Pacific basin. 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 (NHC)	14.4	24.9	36.8	47.4	69.4	91.1	132.1
OCD5	23.7	49.3	78.8	105.8	153.2	202.2	225.2
GFSI	16.6	29.9	45.2	61.4	84.3	**64.2**	**71.5**
HWFI	17.8	32.5	49.8	65.8	93.7	98.6	141.2
EGRI	16.6	27.9	44.3	60.0	98.6	166.8	251.8
EMXI	14.4	25.2	37.0	**46.6**	**64.4**	100.4	**124.6**
NVGI	25.2	49.5	76.4	104.6	155.6	201.5	273.1
CMCI	22.3	39.7	60.8	82.4	131.8	202.8	305.8
CTCI	18.7	34.9	54.3	73.7	105.4	138.0	190.0
TCON	15.5	26.5	39.7	51.9	79.0	98.0	136.2
TVCE	15.4	26.0	39.7	52.2	77.5	103.2	141.6
HCCA	**11.9**	**20.7**	**31.2**	**42.1**	**63.9**	**83.7**	**107.4**
FSSE	**12.9**	**19.9**	**30.7**	**42.3**	**68.3**	105.8	160.7
AEMI	15.4	25.7	37.3	47.8	**62.9**	**70.6**	**106.9**
TABS	29.7	59.2	76.9	91.0	94.1	103.4	**105.5**
TABM	20.6	37.8	60.5	87.2	112.5	**69.3**	**93.3**
TABD	22.6	43.1	67.2	86.2	106.3	**58.4**	**100.0**
Forecasts	33	33	33	32	29	22	18

Table 3c. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Fernanda for forecasts originating in the central North Pacific basin. Errors smaller than the CPHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (CPHC)	29.4	53.7	62.2				
OCD5	**19.9**	68.6	90.9				
GFSI	46.0	78.2	111.5				
AEMI	31.5	**43.7**	**58.8**				
HWFI	33.6	63.0	92.8				
EGRI	29.7	58.4	**59.1**				
EMXI	**21.6**	**43.2**	**61.7**				
NVGI	33.1	66.9	68.3				
CMCI	**21.9**	**25.6**	**23.5**				
CTCI	30.7	**50.3**	**42.5**				
TCON	34.4	64.0	78.2				
TVCE	31.4	**49.7**	**60.0**				
FSSE	**24.3**	**40.9**	**56.6**				
TABS	**25.5**	**20.4**	**51.4**				
TABM	33.0	78.6	144.4				
TABD	60.6	134.8	204.2				
Forecasts	5	3	1				

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Fernanda. 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 (NHC)	**5.6**	**7.8**	**8.9**	**9.7**	**11.1**	**8.1**	**6.7**
OCD5	7.4	11.7	14.3	16.9	19.9	20.5	22.6
Forecasts	36	36	36	35	31	27	23
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 Fernanda for forecasts originating in the eastern North Pacific basin. 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 (NHC)	5.9	8.2	9.2	9.7	8.6	7.5	5.6
OCD5	7.8	12.3	15.1	16.8	16.9	18.8	20.0
HWFI	6.6	9.0	10.5	11.4	13.8	10.2	9.9
DSHP	6.6	9.7	11.6	12.5	**8.4**	8.0	**5.4**
LGEM	7.1	10.6	13.6	15.2	14.2	14.2	12.7
ICON	6.2	**8.0**	9.4	10.3	8.6	7.9	7.6
IVCN	6.0	**7.6**	**8.5**	**8.8**	**6.4**	**6.9**	6.2
CTCI	6.8	9.3	10.7	11.5	11.4	13.0	11.8
GFSI	9.4	13.6	17.3	19.9	19.6	15.9	12.2
EMXI	8.5	14.6	20.0	25.8	32.7	35.5	35.2
HCCA	**5.8**	**7.3**	**8.0**	**6.8**	**6.4**	10.5	10.8
FSSE	**5.2**	**7.2**	**8.5**	9.9	12.1	17.1	18.3
Forecasts	33	33	33	32	29	22	18

Table 4c. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Fernanda for forecasts originating in the central North Pacific basin. Errors smaller than the CPHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)						
	12	24	36	48	72	96	120
OFCL (CPHC)	3.0	5.0	10.0				
OCD5	5.0	**2.3**	**6.0**				
ICON	3.8	**1.3**	**6.0**				
HWFI	5.2	6.7	**3.0**				
FSSE	3.0	**1.7**	**6.0**				
DSHP	4.8	**4.0**	10.0				
LGEM	5.6	5.0	10.0				
IVCN	4.0	**1.7**	**4.0**				
CTCI	5.4	5.0	**1.0**				
GFSI	5.6	11.0	12.0				
EMXI	5.8	**3.7**	**0.0**				
Forecasts	5	3	1				

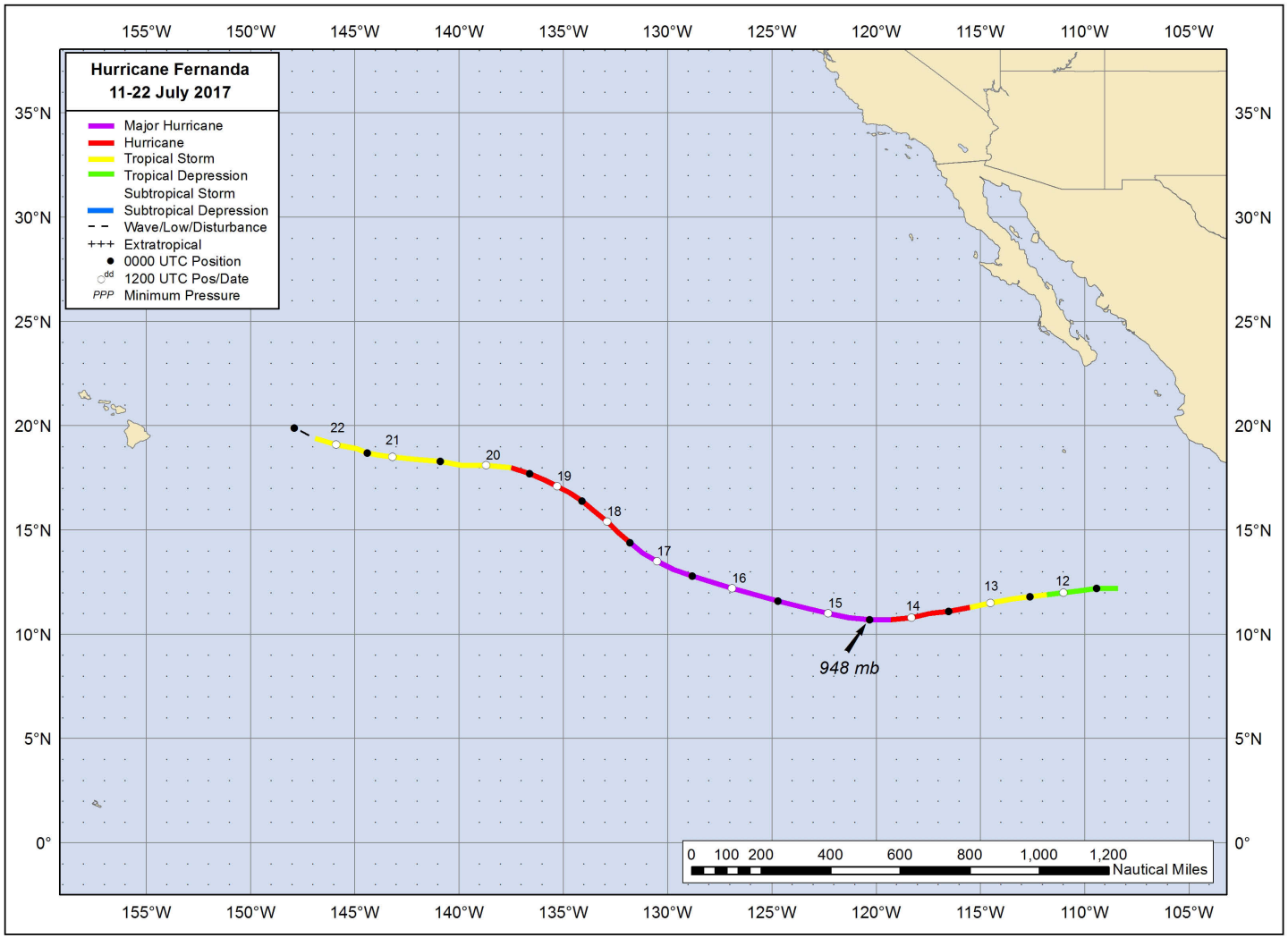

Figure 1. Best track positions for Hurricane Fernanda, 11–22 July 2017.

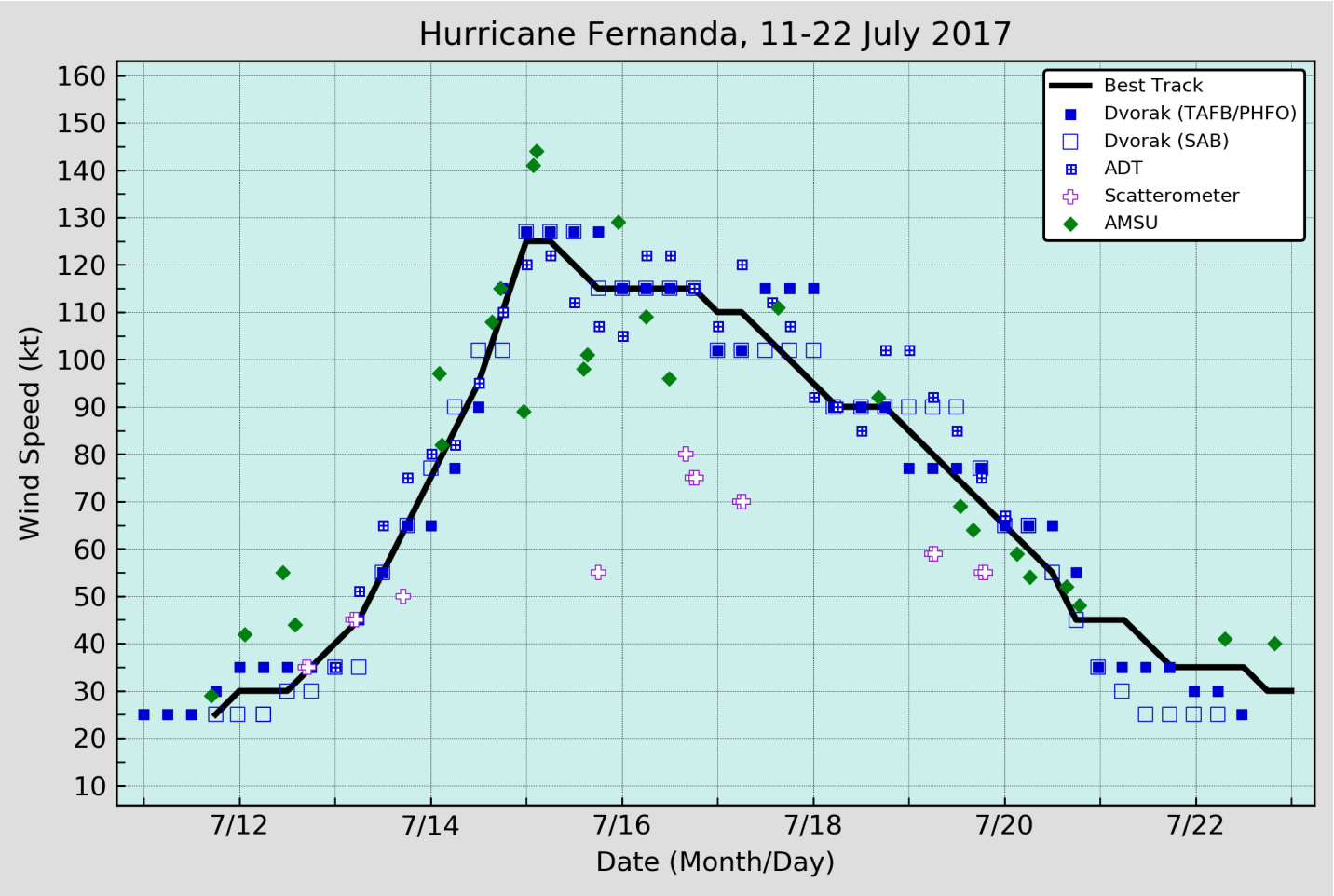

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Fernanda, 11–22 July 2017. Dashed vertical lines correspond to 0000 UTC.

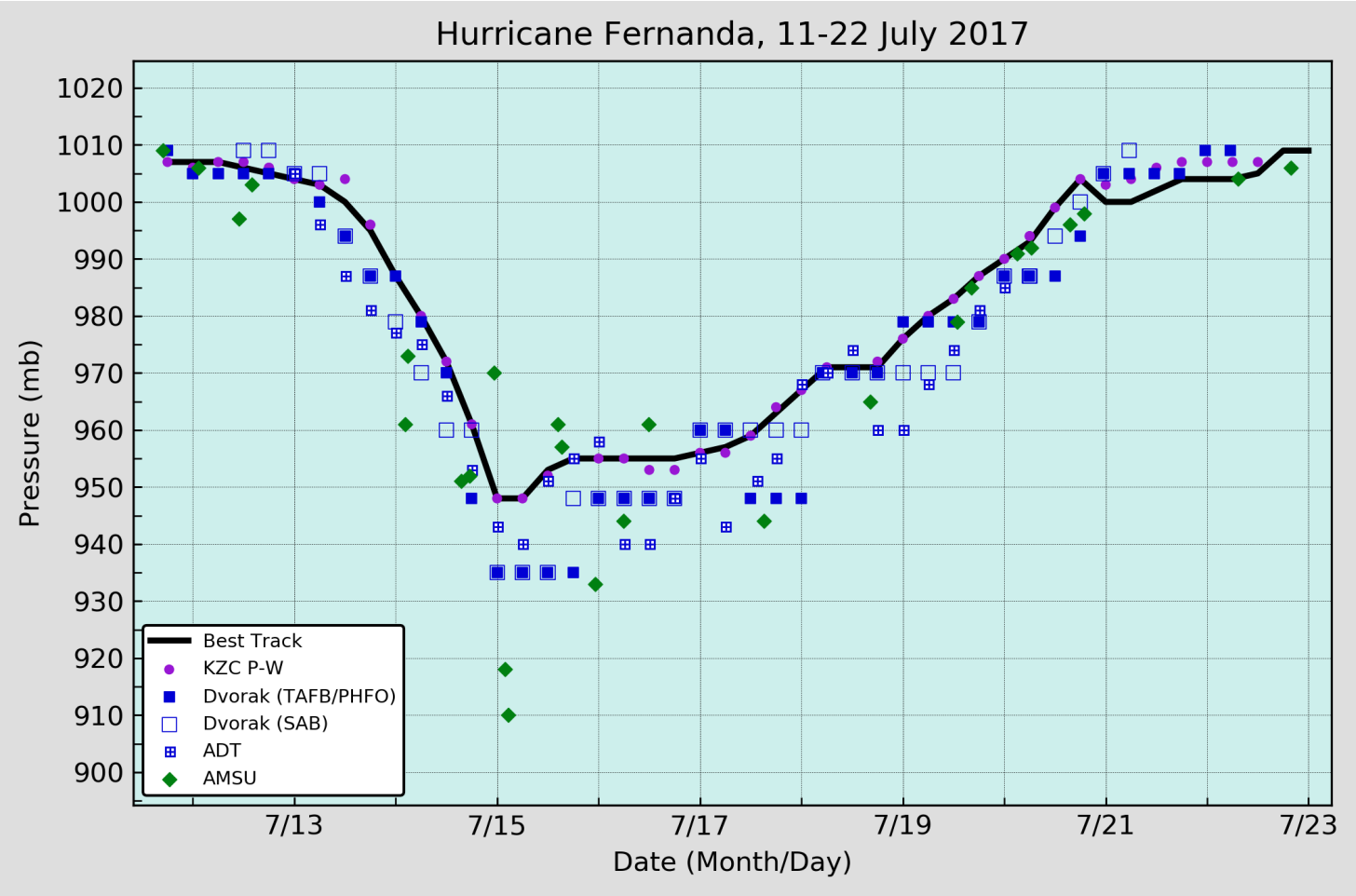

Figure 3. Selected pressure observations and best track minimum central pressure curve for Hurricane Fernanda, 11–22 July 2017. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.

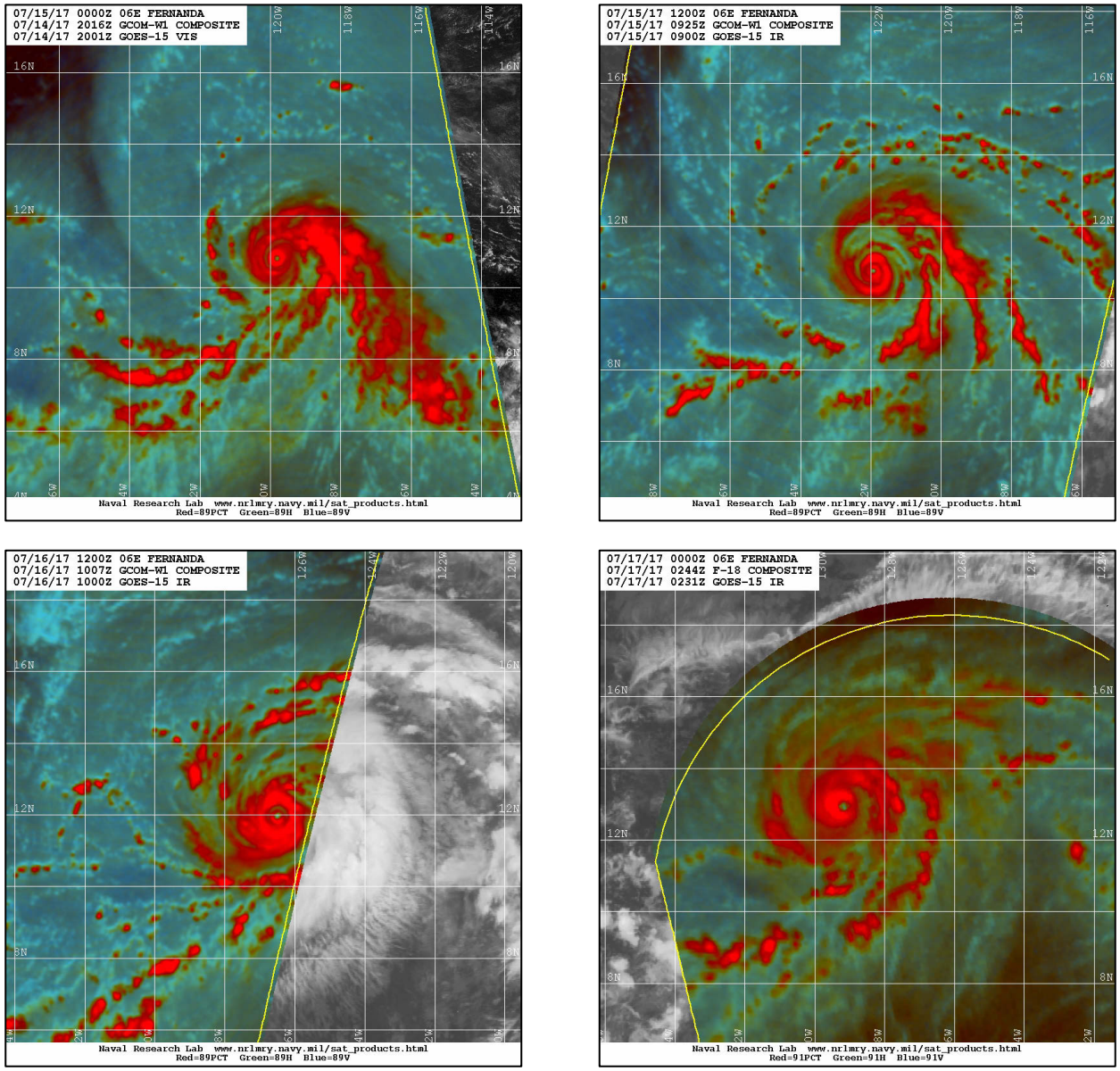

Figure 4. Series of 89–91-GHz color composite microwave images from 14–17 July 2017 during Fernanda's eyewall replacement cycle. Images courtesy of the U.S. Naval Research Laboratory tropical cyclone webpage.

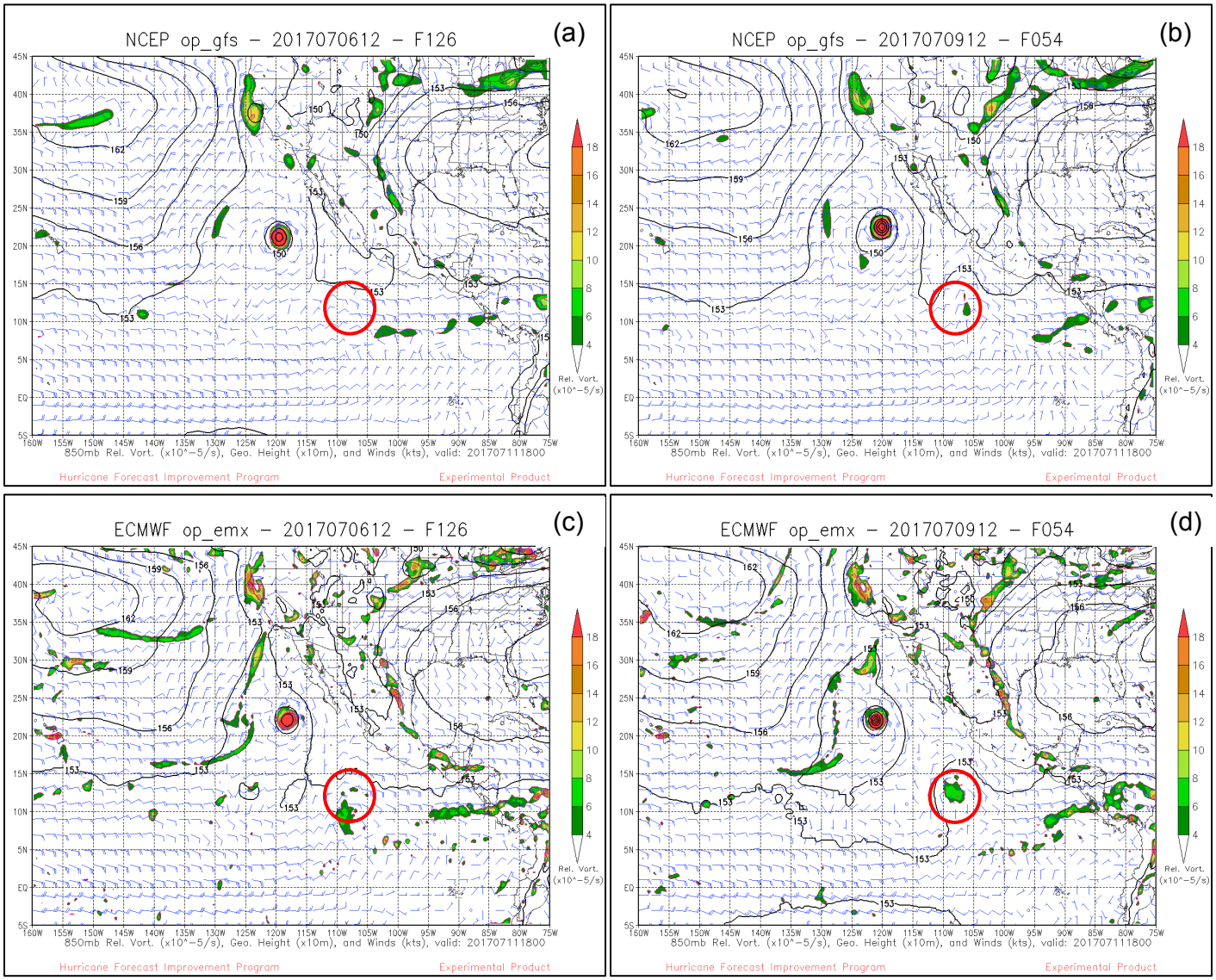

Figure 5. 850-mb geopotential height (contours, dam), relative vorticity (shaded, x 10^5 s^{-1}), and wind (barbs, kt) from (a) GFS 126-h forecast, (b) GFS 54-h forecast, (c) ECMWF 126-h forecast, and (d) ECMWF 54-h forecast valid at the time of Fernanda's genesis at 1800 UTC 11 July 2017. The red circles indicate the location of Fernanda's formation at 12.2°N 108.4°W.

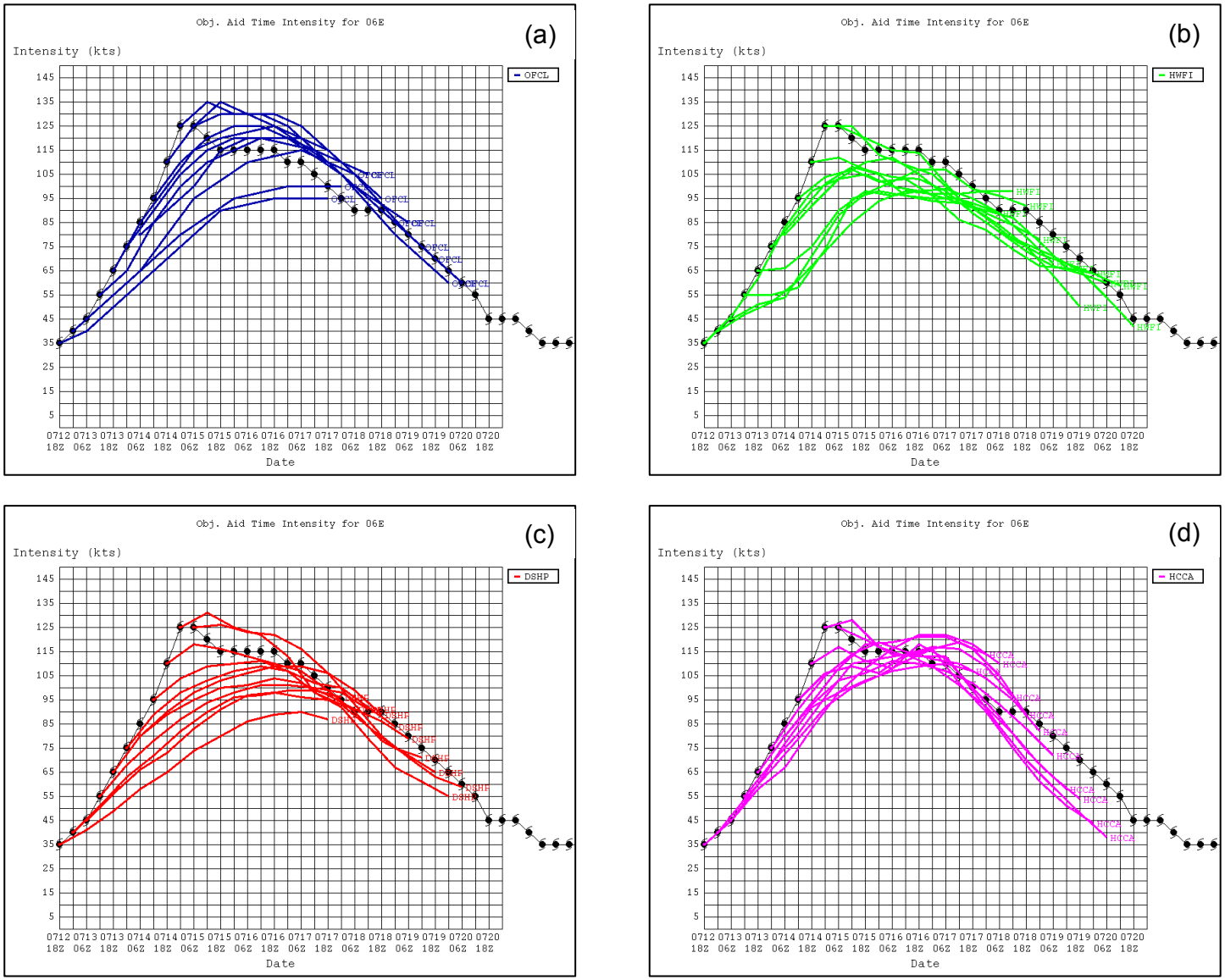

Figure 6. Intensity forecasts (colored lines, kt) for Fernanda from (a) OFCL, (b) HWRF (HWFI), (c) Decay-SHIPS (DHSP), and (d) the HFIP Corrected Consensus Aid (HCCA) for forecast cycles from 1800 UTC 12 July through 0600 UTC 15 July 2017. The best track intensity (kt) of Fernanda is shown by the black line with the hurricane symbols.