NATIONAL HURRICANE CENTER
CENTRAL PACIFIC HURRICANE CENTER
TROPICAL CYCLONE REPORT[1]

HURRICANE ERICK

(EP062019)

27 July–4 August 2019

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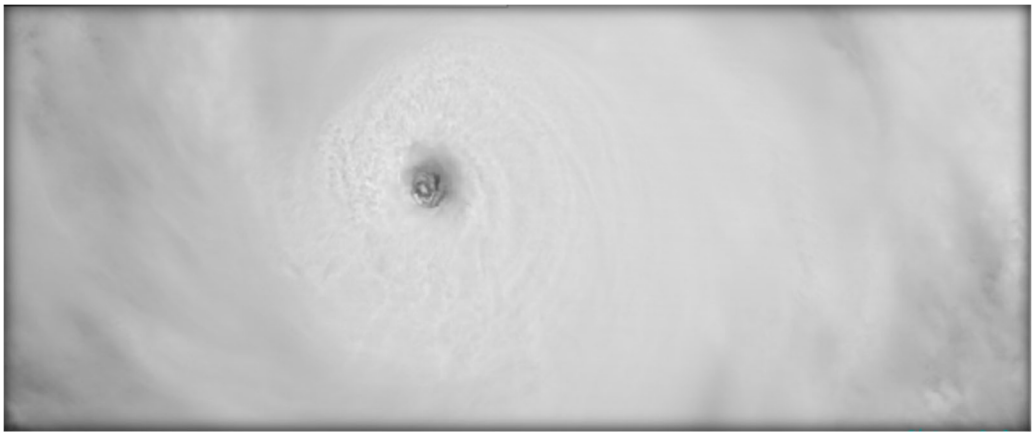
23 April 2021



GOES-17 VISIBLE IMAGE AT 2022 UTC 30 JULY 2019 OF ERICK NEAR PEAK INTENSITY (COURTESY CIMSS)

Erick formed in the southwestern portion of the eastern Pacific basin and became a hurricane before moving into the central Pacific. The cyclone then rapidly intensified into a category 4 (on the Saffir-Simpson Hurricane Wind Scale) major hurricane in the central Pacific. Erick eventually moved south of the Island of Hawaii as a tropical storm before dissipating a few days later well west of the Hawaiian Islands.

[1] Original report released 25 September 2019. Updated 23 April 2021 to include best track analysis, map, summary, verification, impacts, and damage from the Central Pacific Hurricane Center.

Hurricane Erick

27 JULY–4 AUGUST 2019

SYNOPTIC HISTORY

The tropical wave that led to the development of Tropical Depression Three[2] in the Atlantic basin eventually caused the formation of Erick. The westward-moving wave departed the west coast of Africa on 12 July and moved across the eastern Caribbean Sea on 18 July. Very little convection was noted in association with the wave in the Caribbean Sea or even the eastern Pacific until 22 July, when a sizable area of convection formed south of southeastern Mexico. This enhanced thunderstorm activity continued for over a day in a large region, supported by a favorable environment behind a very strong (~4 standard deviation) convectively coupled Kelvin wave (Fig. 1). As a result of this convection, a broad area of low pressure was noted by 24 July about 900 n mi south of Cabo San Lucas, Mexico, with some primitive bands observed while the low continued to move westward. The system, however, still took a couple of days to develop, partially because of moderate northeasterly wind shear. A convective burst early on 27 July produced a better-defined low pressure area, leading to tropical depression formation near 1200 UTC that day about 1000 n mi southwest of Cabo San Lucas. The system became a tropical storm 6 h later. The "best track" chart of the tropical cyclone's path is given in Fig. 2, with the wind and pressure histories shown in Figs. 3 and 4, respectively. The best track positions and intensities are listed in Table 1[3].

Erick was slow to intensify at first while it continued to move quickly westward, probably due to the circulation being elongated from northeast to southwest and the presence of dry mid-level air. By late on 28 July, however, the low-level center re-formed to the south, closer to the mid-level circulation, and the storm began to strengthen. In an environment of lighter shear and warm SSTs, Erick started to rapidly intensify late on 29 July, becoming a hurricane at 1800 UTC that day about 1100 n mi east-southeast of Hilo, Hawaii. The cyclone had turned to the west-northwest by then, steered by a large subtropical high to the north. Erick continued to rapidly intensify, strengthening 50 kt in the 24 h after it became a hurricane, and it reached its peak intensity of 115 kt in the central Pacific basin around 1800 UTC 30 July.

Weakening of Erick commenced slowly on 31 July, and then accelerated during the first two days of August. Weakening began as Erick moved north of the ridge axis aloft and outflow became restricted within the southwest quadrant. By the end of 31 July, Erick's general west to west-northwest motion slowed as the deep ridge to its north eroded and the hurricane encountered southwest winds aloft generated by an upper-level trough centered north of the

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[2] Zelinsky, David. "Tropical Cyclone Report: Tropical Depression Three." National Oceanic and Atmospheric Administration / National Weather Service / National Hurricane Center, 19 Aug. 2019, https://www.nhc.noaa.gov/data/tcr/AL032019_Three.pdf

[3] 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.

Hawaiian Islands. On 1 and 2 August, the tropical cyclone moved into a region of increasing southwest winds aloft and stronger vertical wind shear. The result was steady weakening from a category 2 hurricane on 1 August to a tropical storm as it passed about 170 n mi south of the Island of Hawaii on early 2 August.

Strong vertical wind shear persisted over Erick through the remainder of its existence as a tropical cyclone. Erick maintained tropical storm intensity through 3 August, but as deep convection periodically flared and collapsed, the system was downgraded to a tropical depression early on 4 August. It is worthy of mention that the flaring convection also led to erratic forward motion of the tropical cyclone. An increasingly shallow circulation was unable to maintain persistent organized deep convection, and Erick was deemed a post-tropical remnant low at 0000 UTC 5 August while located over 500 n mi west-southwest of the Hawaiian Islands. The remnant low of Erick continued on a westward motion for several days, moving west of the central Pacific basin on 8 August.

METEOROLOGICAL STATISTICS

Observations in Erick (Figs. 3 and 4) 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 (PHFO), the Joint Typhoon Warning Center (JTWC), objective Advanced Dvorak Technique (ADT) estimates and Satellite Consensus (SATCON) 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 Erick.

The peak intensity of Erick was based on consensus satellite estimates from PHFO and SAB.

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

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Erick was not well anticipated (Table 2). Although a low chance (<30%) of genesis was given 102 h prior to the eventual formation in the 5-day outlook and 54 h prior in the 2-day outlook, the lead-time in the medium category (40–60% chance) was much shorter (only 54 and 18 h, respectively). The probabilities didn't reach the high category (>60%) in the 2-day outlook until 6 h before genesis. Model guidance was mixed during the days before genesis, with the CMC and GFS generally not forming the cyclone, while the ECMWF, and to some extent the UKMET, were more consistent showing the genesis of Erick.

A verification of NHC official track forecasts for Erick given in Table 3a. Official forecast track errors were much greater than the mean official errors for the previous 5-yr period. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b. NHC forecasts had a noticeable bias of being too slow and too far to the north, which matched the biases seen in the eastern Pacific track consensus TVCE model, especially early in Erick's lifecycle (Fig. 5). The UKMET and ECMWF models were very strong performers for Erick, while the GFS and HWRF models struggled. Even the corrected-consensus guidance (HCCA/FSSE) did not improve upon the simple TVCE much, if at all.

A verification of NHC official intensity forecasts for Erick is given in Table 4a. Official forecast intensity errors were somewhat greater than the mean official errors for the previous 5-yr period through 24 h, then lower than the long-term average except at 72 h. Notably, the errors at the 36 and 48 h periods were much lower than the previous 5-yr means, despite the OCD5 errors being quite high, suggesting a skillful forecast. This appears to be due to NHC correctly anticipating slow intensification at first, followed by a period of rapid intensification. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b. The NHC forecast beat most of the guidance, and only the corrected-consensus guidance (HCCA/FSSE) had more skill than the official forecasts. It is also worth noting that those two models greatly improved upon the simple intensity consensus (IVCN) for Erick through 72 h. In terms of specific models, the LGEM and SHIPS models had very high errors for this cyclone, while the CTCI model had the best dynamical model forecast.

A verification of the CPHC official track forecasts for Erick is given in Table 5a. CPHC official track errors were lower than the mean official errors for the previous 5-yr period. A homogeneous comparison of the CPHC official track errors with selected guidance models is given in Table 5b. CPHC outperformed most guidance through 72 h, while most guidance members exhibited smaller errors than CPHC at 96 and 120 h. The notable exception was CMCI, which had smaller errors than CPHC beyond 24 h. It is worthy of mention that OCD5 was, by far, the best performing guidance member at 96 and 120 h, although the number of forecasts were rather small.

A verification of the CPHC official intensity forecasts for Erick is given in Table 6a. CPHC official forecast intensity errors were lower than the mean official errors for the previous 5-yr period, with the exception of a slightly greater error at 12 hr. CPHC official intensity errors changed little through the forecast periods, leading to very low errors beyond 48 h. A homogeneous comparison of the CPHC official intensity errors with selected guidance models is

given in Table 6b. In spite of the relatively low CPHC official errors, the statistical models (DSHP and LGEM) and consensus models (ICON and IVCN) mostly outperformed CPHC beyond 24 h.

There were no coastal watches and warnings associated with Erick.

Table 1. Best track for Hurricane Erick, 27 July–4 August 2019.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
27/1200	11.2	122.9	1006	30	tropical depression
27/1800	11.5	124.5	1005	35	tropical storm
28/0000	11.8	126.1	1005	35	"
28/0600	11.9	127.7	1005	35	"
28/1200	11.7	129.4	1005	35	"
28/1800	11.5	131.0	1004	40	"
29/0000	11.6	132.5	1001	50	"
29/0600	11.8	134.1	999	55	"
29/1200	12.1	135.8	996	60	"
29/1800	12.4	137.6	993	65	hurricane
30/0000	12.6	139.3	990	70	"
30/0600	12.9	140.7	983	80	"
30/1200	13.2	142.2	966	100	"
30/1800	13.4	143.6	952	115	"
31/0000	13.8	144.9	952	115	"
31/0600	14.1	146.0	955	110	"
31/1200	14.3	147.0	958	105	"
31/1800	14.6	148.1	961	100	"
01/0000	15.0	149.2	968	90	"
01/0600	15.3	150.3	978	80	"
01/1200	15.5	151.5	982	75	"
01/1800	15.6	152.7	986	70	"
02/0000	15.8	154.0	993	60	tropical storm
02/0600	16.1	155.4	998	50	"
02/1200	16.4	156.8	1001	45	"
02/1800	16.6	158.0	1003	40	"
03/0000	16.8	158.9	1005	35	"
03/0600	16.9	160.5	1005	35	"
03/1200	17.0	162.2	1005	35	"
03/1800	17.2	163.4	1005	35	"

04/0000	17.7	164.6	1006	30	tropical depression
04/0600	18.0	165.7	1006	30	“
04/1200	18.3	166.6	1006	30	“
04/1800	18.8	167.5	1007	30	“
05/0000	19.0	168.5	1008	25	low
05/0600	19.2	169.5	1008	25	“
05/1200	19.4	170.4	1008	25	“
05/1800	19.5	171.3	1008	25	“
06/0000	19.5	172.1	1008	25	“
06/0600	19.5	173.1	1008	25	“
06/1200	19.5	174.1	1008	25	“
06/1800	19.6	174.9	1008	25	“
07/0000	19.7	175.7	1009	20	“
07/0600	19.8	176.8	1009	20	“
07/1200	20.1	178.0	1009	20	“
07/1800	20.7	179.2	1009	20	“
08/0000	21.0	180.0	1009	20	“
30/1800	13.4	143.6	952	115	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%)	54	102
Medium (40%-60%)	18	54
High (>60%)	6	18

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Erick. 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	37.2	56.9	79.2	99.1	122.7	126.2	152.5
OCD5	43.5	77.1	109.4	139.5	165.2	156.4	166.5
Forecasts	11	11	11	11	11	11	11
OFCL (2014-18)	21.1	32.2	41.8	51.8	75.7	101.1	133.7
OCD5 (2014-18)	34.0	69.7	109.0	148.4	223.5	285.5	356.7

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Erick for forecasts made 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	41.0	57.6	76.2	85.5	100.4	108.5	145.6
OCD5	47.7	73.3	104.7	129.4	138.0	128.0	**137.6**
GFSI	48.1	77.9	104.6	125.4	150.4	139.6	**129.2**
HWFI	44.9	78.9	108.1	129.5	150.6	130.7	**131.4**
HMNI	**40.2**	69.9	96.0	118.1	149.9	176.0	202.4
EGRI	**23.6**	**30.0**	**36.2**	**43.0**	**63.0**	**101.0**	**144.5**
EMXI	**35.8**	**40.0**	**42.7**	**48.7**	**57.7**	**56.6**	**79.7**
NVGI	47.3	66.2	98.3	135.6	204.4	292.2	414.3
CMCI	46.0	71.5	92.4	101.2	**87.0**	**67.8**	**106.4**
CTCI	**39.3**	68.0	85.5	103.9	160.5	225.3	277.3
TVCE	**36.0**	**54.3**	**73.3**	88.2	108.5	122.8	146.5
TVCX	**34.3**	**50.4**	**67.8**	**78.7**	**99.8**	110.6	**135.6**
GFEX	**37.6**	**54.9**	**70.4**	**82.0**	**95.7**	**92.9**	**103.0**
HCCA	**33.2**	**48.8**	**59.3**	**70.8**	**91.8**	**99.5**	**129.4**
FSSE	**39.0**	62.8	80.9	96.9	116.6	150.6	196.0
AEMI	47.2	68.8	89.3	100.8	110.0	115.6	160.4
TABS	42.2	70.6	92.8	93.4	**66.9**	**73.4**	**87.9**
TABM	**33.7**	**41.8**	**63.0**	**78.9**	114.3	168.0	241.6
TABD	**35.3**	60.1	96.0	134.2	227.4	351.1	515.6
Forecasts	8	8	8	8	8	8	8

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Erick. 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	6.4	10.9	**10.9**	**12.3**	19.1	15.5	**4.5**
OCD5	8.8	17.2	25.6	32.5	29.8	22.2	16.2
Forecasts	11	11	11	11	11	11	11
OFCL (2014-18)	6.1	10.0	12.2	13.7	15.5	15.4	15.7
OCD5 (2014-18)	7.9	13.1	16.7	19.2	21.8	22.9	22.1

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Erick for forecasts made 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	7.8	12.8	11.7	12.2	13.3	10.6	3.3
OCD5	10.4	19.9	29.7	36.7	25.7	17.1	16.2
HWFI	11.7	16.1	17.7	16.6	13.6	11.1	5.1
HMNI	9.1	14.2	16.6	17.8	17.6	**6.4**	8.9
DSHP	10.6	18.0	21.6	28.0	28.7	14.1	3.3
LGEM	10.4	20.7	28.0	34.0	30.6	14.6	6.4
ICON	10.1	14.8	19.8	22.9	18.6	**9.6**	4.7
IVCN	9.8	14.0	17.6	18.6	13.6	**8.6**	6.0
CTCI	9.0	**12.7**	11.9	12.9	13.9	**7.0**	11.0
GFSI	11.3	21.6	28.4	33.1	31.3	16.8	7.0
EMXI	11.4	27.1	36.8	42.9	33.1	12.8	4.4
HCCA	8.9	**11.7**	**11.2**	12.3	**12.2**	**8.1**	5.1
FSSE	8.7	**12.2**	12.0	**11.9**	**12.4**	**10.0**	11.3
Forecasts	9	9	9	9	9	9	9

Table 5a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (kt) for Erick. CPHC mean errors for the previous 5-yr period are shown for comparison. CPHC 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	**22.4**	**35.3**	**51.1**	**57.0**	**71.0**	**123.4**	**165.0**
OCD5	30.3	47.9	67.8	81.1	109.6	92.2	40.2
Forecasts	21	19	17	15	11	7	3
OFCL (2014-18)	26.7	40.8	53.9	68.8	106.5	144.0	185.2

Table 5b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Erick for forecasts made in the central North Pacific basin. Errors smaller than the CPHC official forecast are shown in boldface type. The number of CPHC official forecasts shown here are 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	23.0	35.3	51.1	57.0	71.0	122.1	165.0
OCD5	29.4	47.9	67.8	81.1	109.6	**78.0**	**40.2**
GFSI	31.9	55.3	76.2	88.0	114.2	148.2	238.7
HWFI	32.9	53.2	78.1	94.4	116.1	137.1	**156.7**
HMNI	25.7	41.9	58.1	66.4	85.2	**114.1**	**145.6**
EGRI	24.5	**34.3**	53.1	63.5	**69.8**	**105.1**	174.8
EMXI	27.5	44.5	66.2	79.5	**66.1**	**107.3**	**141.6**
NVGI	29.5	62.3	108.9	156.9	245.5	288.3	373.6
CMCI	24.7	37.3	**49.2**	**50.7**	**41.3**	**63.6**	**119.1**
CTCI	38.4	66.7	98.3	128.1	162.2	222.5	250.0
TVCE	25.5	39.3	57.2	68.1	81.5	**119.1**	**162.7**
TVCX	25.9	39.2	56.5	69.5	82.6	**120.0**	165.8
GFEX	26.5	44.0	61.6	76.0	85.8	124.7	188.0
HCCA	24.8	36.2	54.0	66.1	71.5	**118.3**	169.8
FSSE	24.5	37.0	54.0	64.8	80.1	137.0	183.3
AEMI	24.9	42.6	68.6	91.2	122.9	185.8	253.1
Forecasts	19	19	17	15	11	6	3

Table 6a. CPHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Erick. CPHC mean errors for the previous 5-yr period are shown for comparison. CPHC 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	6.0	**4.7**	**6.5**	**7.0**	**4.1**	**5.0**	**5.0**
OCD5	6.9	11.3	14.8	18.4	17.0	16.6	24.0
Forecasts	21	19	17	15	11	7	3
OFCL (2014-18)	5.8	9.2	11.8	13.3	15.7	17.4	18.4

Table 6b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Erick for forecasts made in the central North Pacific basin. Errors smaller than the CPHC official forecast are shown in boldface type. The number of CPHC official forecasts are 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	6.1	4.7	6.5	7.0	4.1	5.0	5.0
OCD5	7.2	11.3	14.8	18.4	17.0	16.8	24.0
HWFI	9.7	10.1	7.8	8.6	6.5	**4.2**	6.3
HMNI	8.4	10.8	12.8	9.7	6.5	8.3	6.3
DSHP	6.6	6.4	**6.4**	**5.4**	**3.5**	**4.8**	**4.3**
LGEM	6.5	5.9	7.5	**5.9**	**3.6**	**2.2**	**1.7**
ICON	7.0	6.8	**5.3**	**4.3**	**3.8**	**2.2**	**2.7**
IVCN	7.1	6.8	**5.3**	**3.3**	**3.5**	**2.3**	**3.3**
CTCI	7.9	8.4	8.8	8.3	5.0	**3.5**	5.3
GFSI	8.7	10.2	9.2	8.0	5.5	**3.7**	5.0
EMXI	8.7	8.9	11.8	14.2	15.8	9.2	**1.0**
HCCA	6.6	6.6	**5.8**	**4.3**	4.5	6.3	8.7
FSSE	7.3	7.3	7.3	**5.9**	5.7	5.2	7.3
Forecasts	19	19	17	15	11	6	3

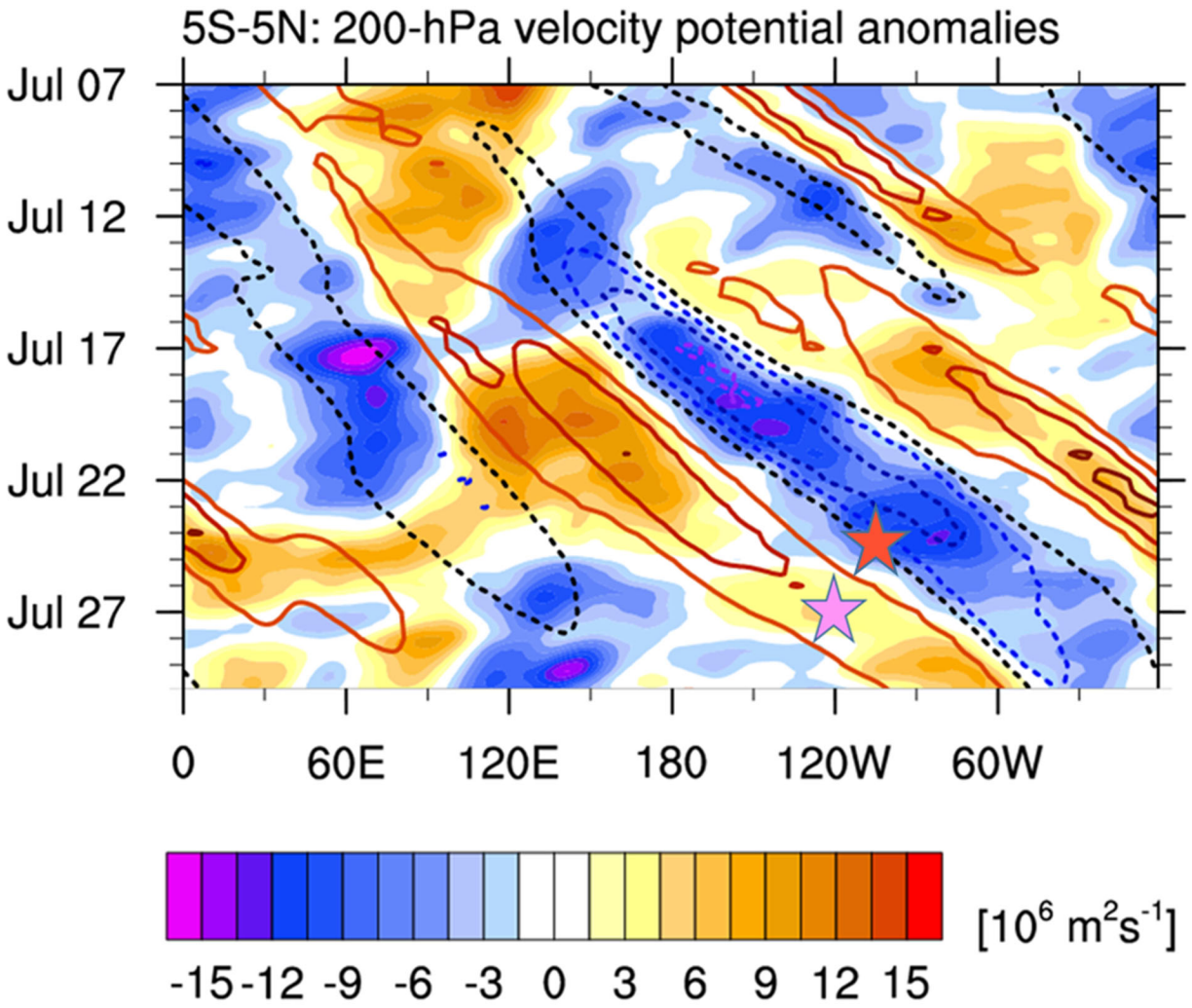

Figure 1. GFS velocity potential anomalies at 200 mb (VP200) from 5°N–5°S (shaded, x 10^6 m^2 s^{-1}) in July 2019. The shading shows unfiltered VP200 anomalies where negative (positive) values represent mass divergence (convergence). Contours show CCKW-filtered VP200 anomalies; dashed lines represent upper-level divergence (convectively active). The contour interval begins at 1 standard deviation with a 1 standard deviation increment. The red star is the position where the broad predecessor low of Erick was noted, and the pink star is the position where Erick formed. Figure from Michael Ventrice, IBM/The Weather Channel in collaboration with the University of Albany, Albany NY.

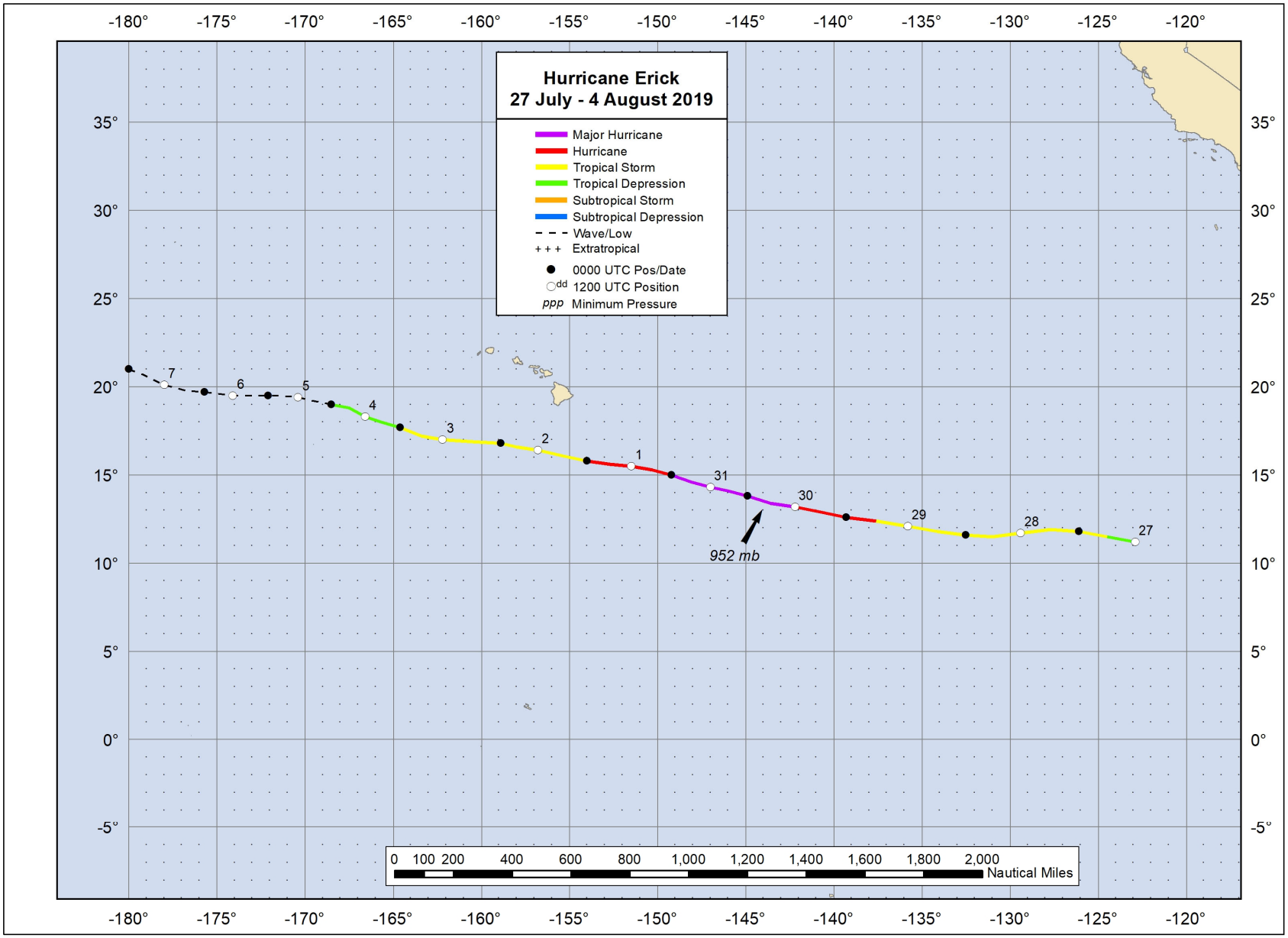

Figure 2. Best track positions for Hurricane Erick, 27 July–4 August 2019.

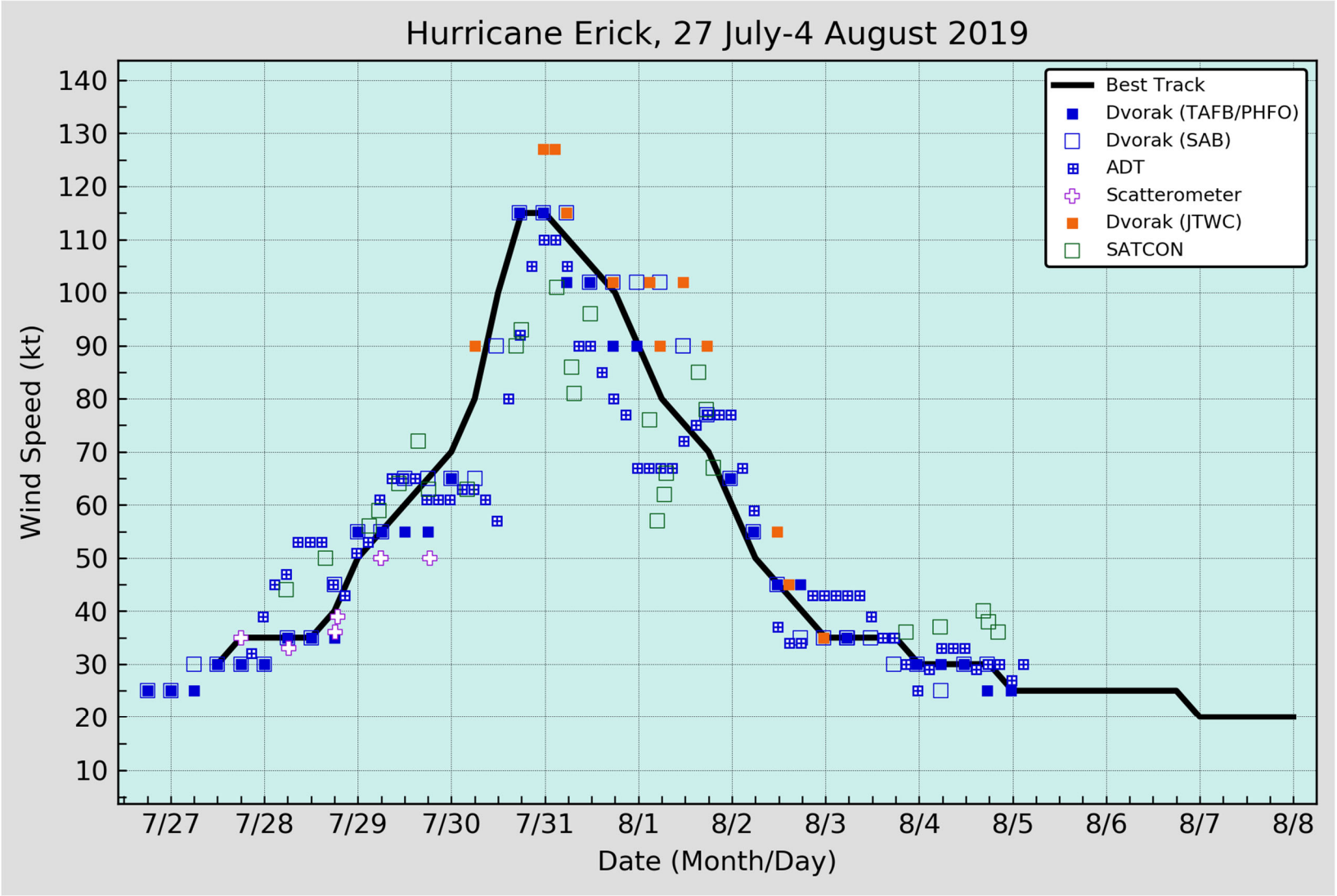

Figure 3. Selected wind observations and best track maximum sustained surface wind speed curve for Hurricane Erick, 27 July–4 August 2019. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

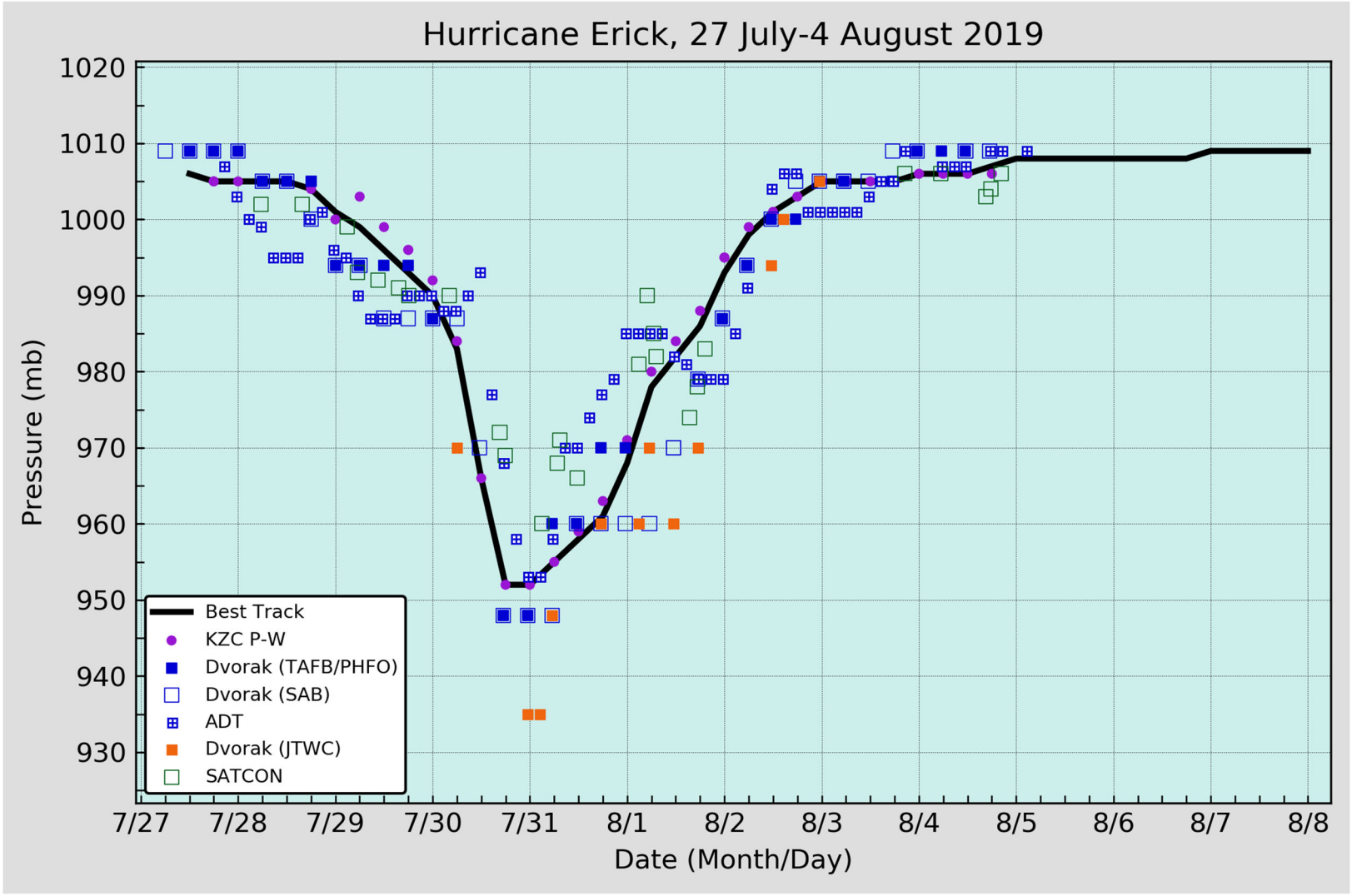

Figure 4. Selected pressure observations and best track minimum central pressure curve for Hurricane Erick, 27 July–4 August 2019. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. KZC P-W refers to pressure estimates derived using the Knaff-Zehr-Courtney pressure-wind relationship. Dashed vertical lines correspond to 0000 UTC.

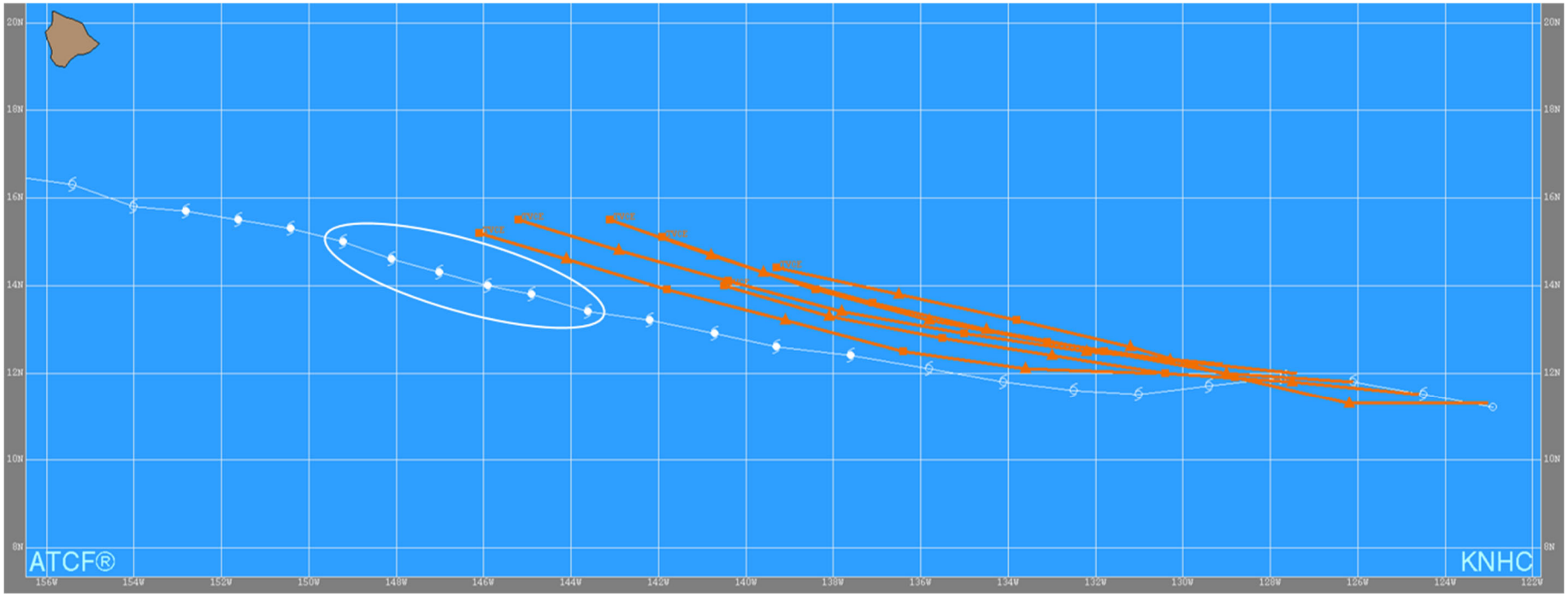

Figure 5. 72-h TVCE model forecasts for the first 6 forecasts made for Erick (12 UTC 27 July–18 UTC 28 July, orange lines). The verifying positions are in the white oval. Note the forecasts were much too slow and poleward biased.