NATIONAL HURRICANE CENTER
TROPICAL CYCLONE REPORT

TROPICAL STORM GUILLERMO

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17–19 July 2021

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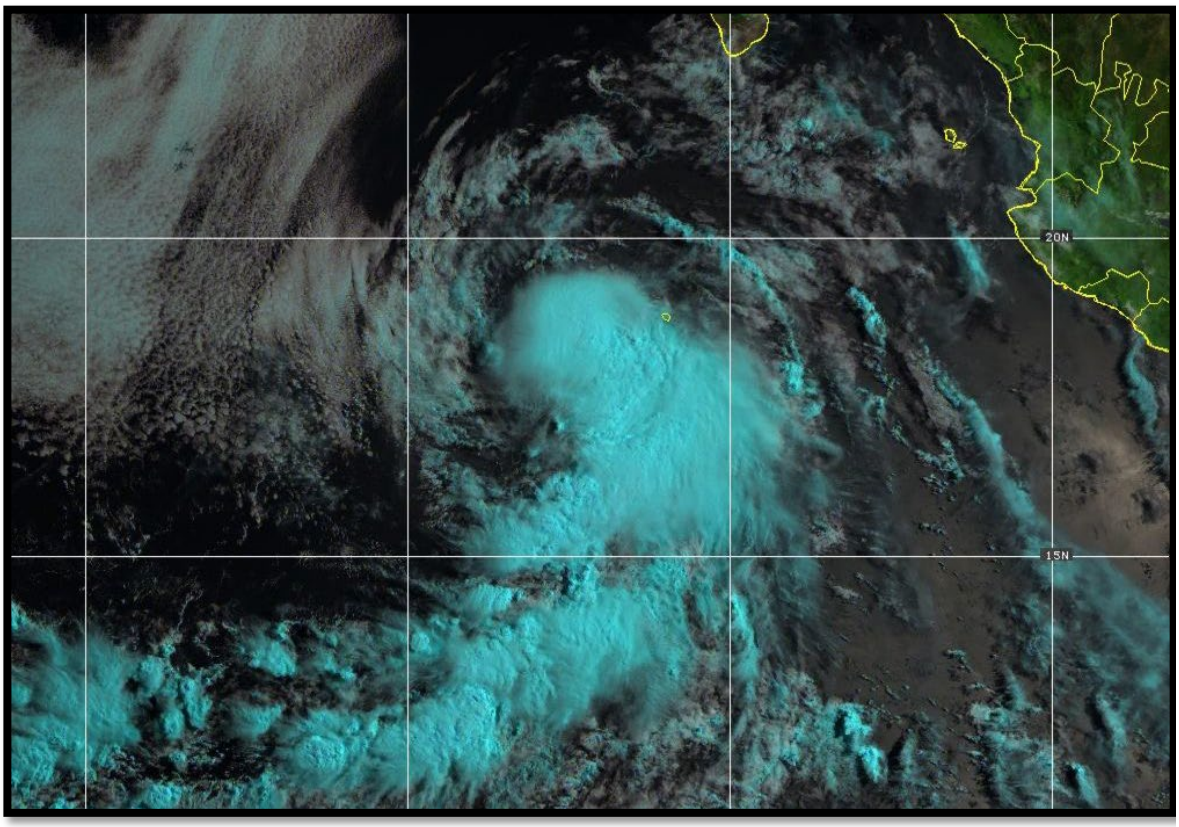

GOES-17 DAY CONVECTION ENHANCED VISIBLE IMAGE OF TROPICAL STORM GUILLERMO AT 1600 UTC 18 JULY 2021, AROUND THE TIME OF ITS PEAK INTENSITY.

Guillermo was a short-lived tropical storm over the eastern North Pacific Ocean that passed near Socorro and Clarion Islands but otherwise did not affect land.

Tropical Storm Guillermo

17–19 JULY 2021

SYNOPTIC HISTORY

Guillermo appears to have originated from a large tropical wave that moved off the west coast of Africa on 6 July. The wave maintained a high amplitude while it moved westward across the tropical Atlantic Ocean, and it reached the Lesser Antilles on 11 July with some increase in showers and thunderstorms over the eastern Caribbean Sea. Continuing westward, the wave crossed Central America on 13 and 14 July and subsequently moved over the waters of the far eastern North Pacific Ocean, where broad-scale low- to mid-level cyclonic vorticity was already in place. The arrival of the tropical wave into this pre-existing cyclonic environment caused further development and an increase of deep convection on 15 and 16 July, and a tropical depression is estimated to have formed by 0000 UTC 17 July while centered about 255 n mi south-southwest of Manzanillo, Mexico. The depression steadily strengthened and became a tropical storm by 1200 UTC that day while centered about 275 n mi 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[1].

When it formed, Guillermo was embedded in an environment of light northerly vertical wind shear and located over very warm water with sea surface temperatures between 29° and 30°C. A strengthening mid-tropospheric high centered over the southwestern United States steered Guillermo toward the west-northwest away from the coast of Mexico. The environment remained conducive for strengthening for a day or two, and Guillermo reached an estimated peak intensity of 50 kt by 1800 UTC 18 July while located about 335 n mi southwest of the southern tip of the Baja California peninsula. By that time, vertical shear had already turned out of the northwest, and it began to increase to moderate levels later in the evening, promptly causing Guillermo to begin a weakening trend.

In addition to the increase in shear, Guillermo began moving over waters cooler than 26°C on 19 July, and the cyclone maintained a nearly steady intensity of 35 kt for much of that day. The unfavorable conditions caused organized deep convection to dissipate late in the day, and Guillermo became a remnant low by 0000 UTC 20 July while centered about 660 n mi west-southwest of the southern tip of the Baja California peninsula. Low- to mid-level ridging to the north caused the remnant low to move a little faster toward the west and west-southwest during the day on 20 July, and the low's circulation opened up into a surface trough soon after 0000 UTC 21 July, about 1000 n mi west-southwest of the southern tip of the Baja California peninsula.

[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.

METEOROLOGICAL STATISTICS

Observations in Guillermo (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 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 Guillermo.

Guillermo's estimated peak intensity of 50 kt at 1800 UTC 18 July is based on maximum winds of 47 kt sampled by ASCAT-A at 1606 UTC and a SATCON estimate of 49 kt from 2052 UTC. Subjective Dvorak satellite intensity estimates peaked slightly lower at 45 kt. Guillermo's intensity fell quickly after it reached its peak, and two ASCAT passes from 0434 and 0526 UTC 19 July indicated that the maximum winds were no more than 35 kt by 0600 UTC that day. The estimated minimum pressure of 999 mb is based on the Knaff-Courtney-Zehr (KZC) pressure-wind relationship and is near a blend of Dvorak, ADT, and SATCON estimates.

Guillermo's center passed about 75 n mi southwest of Socorro Island early on 18 July, and an automated Mexican weather station on the island reported sustained winds of 26 kt and a gust to 38 kt at 1345 UTC. Guillermo's center also passed about 15 n mi north of Clarion Island early on 19 July, with a station there reporting sustained winds of 34 kt and a gust to 39 kt at 0815 UTC. There were no ship reports of winds of tropical storm force associated with Guillermo.

CASUALTY AND DAMAGE STATISTICS

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

FORECAST AND WARNING CRITIQUE

The genesis of Guillermo was well anticipated, although forecasting the timing of genesis was a little more challenging. Table 2 provides the number of hours in advance of formation with the first Tropical Weather Outlook (TWO) forecast in each likelihood category. Significant lead time was provided in the 5-day genesis forecasts, with the system first introduced in the TWO and given a low (<40%) chance of formation 192 h (8 days) prior to genesis. The 5-day chance of formation was increased to the medium (40–60%) category 162 h (6.75 days) and the high (>60%) category 138 h (5.75 day), respectively, before genesis occurred. Despite these probabilities, NHC forecasts had a tougher time anticipating genesis once it became more imminent, likely due to uncertainty in how quickly the broad incipient disturbance would develop

a well-defined circulation. The 2-day chance of formation was assigned a low probability 54 h (2.25 days) before genesis, but the probabilities only reached the medium and high categories 36 h and 18 h, respectively, before Guillermo formed.

A verification of the relatively small set of NHC official track forecasts for Guillermo is given in Table 3a. Official track forecast errors were greater than the mean official errors for the previous 5-yr period at 12 and 24 h but lower than the mean errors at 36 and 48 h. A homogeneous comparison of the official track errors with selected guidance models is given in Table 3b and Fig. 4[2]. The COAMPS-TC model (CTCI) and the GEFS ensemble mean (AEMI) had lower errors than the official forecasts at every available forecast time, but in general the NHC track forecasts had lower errors than the other typically reliable dynamical models. The multi-model variable consensus aids TVCE, TVCX, and TVDG also had lower errors than the official forecasts from 12 to 36 h.

A verification of NHC official intensity forecasts for Guillermo is given in Table 4a. Official intensity forecast errors were greater than the mean official errors for the previous 5-yr period at all available forecast times between 12 and 48 h. The NHC intensity forecasts had a high bias, forecasting Guillermo to get a little stronger and remain near peak intensity for a longer period of time compared to what actually occurred, and they did not predict the quick decrease in intensity on 19 July. A homogeneous comparison of the official intensity errors with selected guidance models is given in Table 4b and Fig. 5. Most of the intensity models and consensus aids had lower errors than the NHC official forecasts, but the NHC predictions were likely led astray, at least partially, by the SHIPS model (DSHP) and the HCCA consensus aid. DSHP, for example, had higher errors than the official forecasts from 24 to 48 h and showed Guillermo reaching very close to hurricane intensity during the first few forecast cycles. Some of the errors from the SHIPS model could have been because the GFS model, which is used as input for SHIPS atmospheric predictors, did not foresee the increase of moderate northwesterly shear over Guillermo on 18 and 19 July, which likely imported dry stable air into the storm's core. The SHIPS solutions also likely influenced the HCCA consensus aid, which had abnormally high intensity errors that were comparable to the NHC official forecasts. Much like for track, CTCI was a good performer and had the lowest overall intensity errors.

There were no coastal watches or warnings issued in association with Guillermo.

[2] The United Kingdom Met Office model (EGRI), the Canadian model (CMCI), and the Florida State Superensemble (FSSE) were not available for a few forecast cycles and thus were not included in the model comparison.

Table 1. Best track for Tropical Storm Guillermo, 17–19 July 2021.

Date/Time (UTC)	Latitude (°N)	Longitude (°W)	Pressure (mb)	Wind Speed (kt)	Stage
17 / 0000	15.0	105.6	1007	25	tropical depression
17 / 0600	15.7	107.0	1006	30	"
17 / 1200	16.3	108.3	1005	35	tropical storm
17 / 1800	16.8	109.3	1005	35	"
18 / 0000	17.2	110.3	1005	35	"
18 / 0600	17.5	111.2	1003	40	"
18 / 1200	17.9	112.2	1001	45	"
18 / 1800	18.3	113.4	999	50	"
19 / 0000	18.6	114.6	1001	45	"
19 / 0600	18.8	116.0	1004	35	"
19 / 1200	19.0	117.4	1005	35	"
19 / 1800	19.2	119.1	1006	35	"
20 / 0000	19.2	121.0	1007	30	low
20 / 0600	19.1	122.7	1007	30	"
20 / 1200	19.0	124.3	1007	30	"
20 / 1800	18.8	125.8	1007	30	"
21 / 0000	18.5	127.2	1007	30	"
21 / 0600					dissipated
18 / 1800	18.3	113.4	999	50	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	192
Medium (40%-60%)	36	162
High (>60%)	18	138

Table 3a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) track forecast errors (n mi) for Tropical Storm Guillermo, 17–19 July 2021. 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	60	72	96	120
OFCL	23.8	34.7	**39.6**	**47.7**				
OCD5	43.7	73.3	62.4	59.5				
Forecasts	8	6	4	2				
OFCL (2016-20)	21.3	33.1	44.0	54.6	65.3	76.0	95.9	116.6
OCD5 (2016-20)	33.1	69.4	107.8	147.0	183.4	219.7	280.2	342.0

Table 3b. Homogeneous comparison of selected track forecast guidance models (in n mi) for Tropical Storm Guillermo, 17–19 July 2021. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	23.8	34.7	39.6	47.7				
OCD5	43.7	73.3	62.4	59.5				
GFSI	**18.9**	39.2	55.9	91.3				
EMXI	**23.6**	45.9	62.8	95.9				
NVGI	35.6	64.8	98.5	188.4				
HWFI	31.4	49.4	67.0	69.8				
HMNI	26.8	36.4	**38.7**	57.6				
CTCI	**18.5**	**20.2**	**25.8**	**25.9**				
AEMI	**20.8**	**26.9**	**35.2**	**46.4**				
HCCA	**21.2**	**34.4**	40.6	53.4				
TVCE	**19.7**	**29.2**	**31.9**	50.4				
TVCX	**19.1**	**29.9**	**35.6**	54.1				
TVDG	**17.0**	**29.5**	**36.5**	56.0				
GFEX	**17.0**	**31.6**	43.4	70.6				
TABD	29.9	52.9	71.7	95.5				
TABM	28.8	35.5	**33.1**	**44.6**				
TABS	35.7	55.5	63.0	69.9				
Forecasts	8	6	4	2				

Table 4a. NHC official (OFCL) and climatology-persistence skill baseline (OCD5) intensity forecast errors (kt) for Tropical Storm Guillermo, 17–19 July 2021. 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	60	72	96	120
OFCL	6.9	10.8	15.0	20.0				
OCD5	5.0	12.2	10.0	3.5				
Forecasts	8	6	4	2				
OFCL (2016-20)	5.6	9.0	10.9	12.6	14.0	15.3	16.0	16.7
OCD5 (2016-20)	7.2	12.0	15.3	17.6	19.0	20.4	21.2	20.8

Table 4b. Homogeneous comparison of selected intensity forecast guidance models (in kt) for Tropical Storm Guillermo, 17–19 July 2021. Errors smaller than the NHC official forecast are shown in boldface type.

Model ID	Forecast Period (h)							
	12	24	36	48	60	72	96	120
OFCL	6.9	10.8	15.0	20.0				
OCD5	**5.0**	12.2	**10.0**	**3.5**				
HWFI	**6.8**	**10.7**	**10.0**	**12.5**				
HMNI	**6.1**	**10.7**	**10.5**	**6.0**				
DSHP	**5.6**	11.7	17.8	26.5				
LGEM	**5.4**	11.0	**11.8**	**11.5**				
ICON	**5.4**	**10.2**	**11.0**	**13.5**				
IVCN	**5.0**	**9.5**	**9.5**	**11.5**				
IVDR	**5.0**	**8.8**	**9.0**	**10.0**				
CTCI	**4.5**	**6.8**	**4.5**	**1.5**				
GFSI	**5.0**	**7.8**	**10.2**	**14.0**				
EMXI	7.5	11.5	**6.2**	**5.5**				
HCCA	**6.4**	11.5	**14.8**	**19.5**				
Forecasts	8	6	4	2				

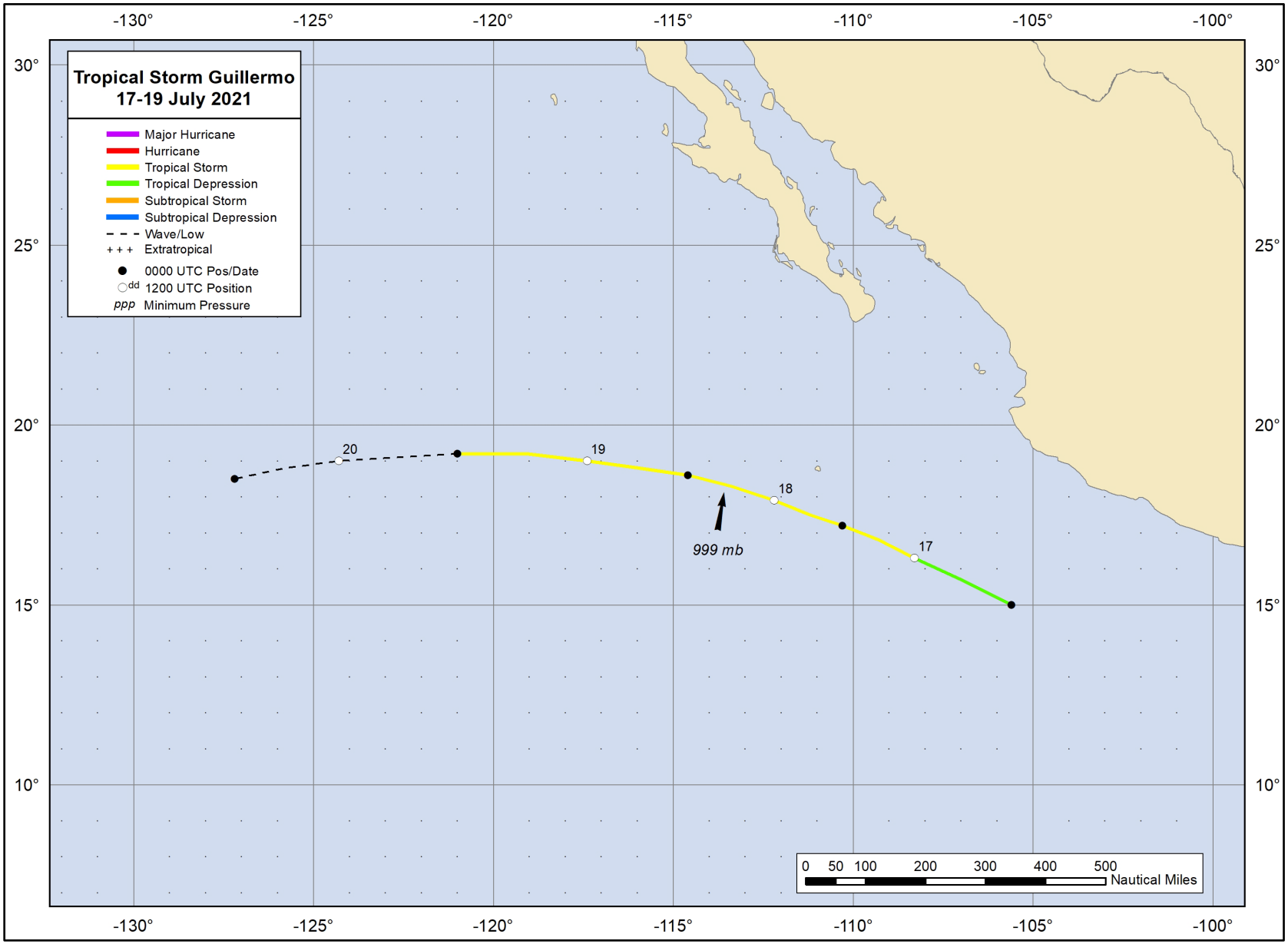

Figure 1. Best track positions for Tropical Storm Guillermo, 17–19 July 2021.

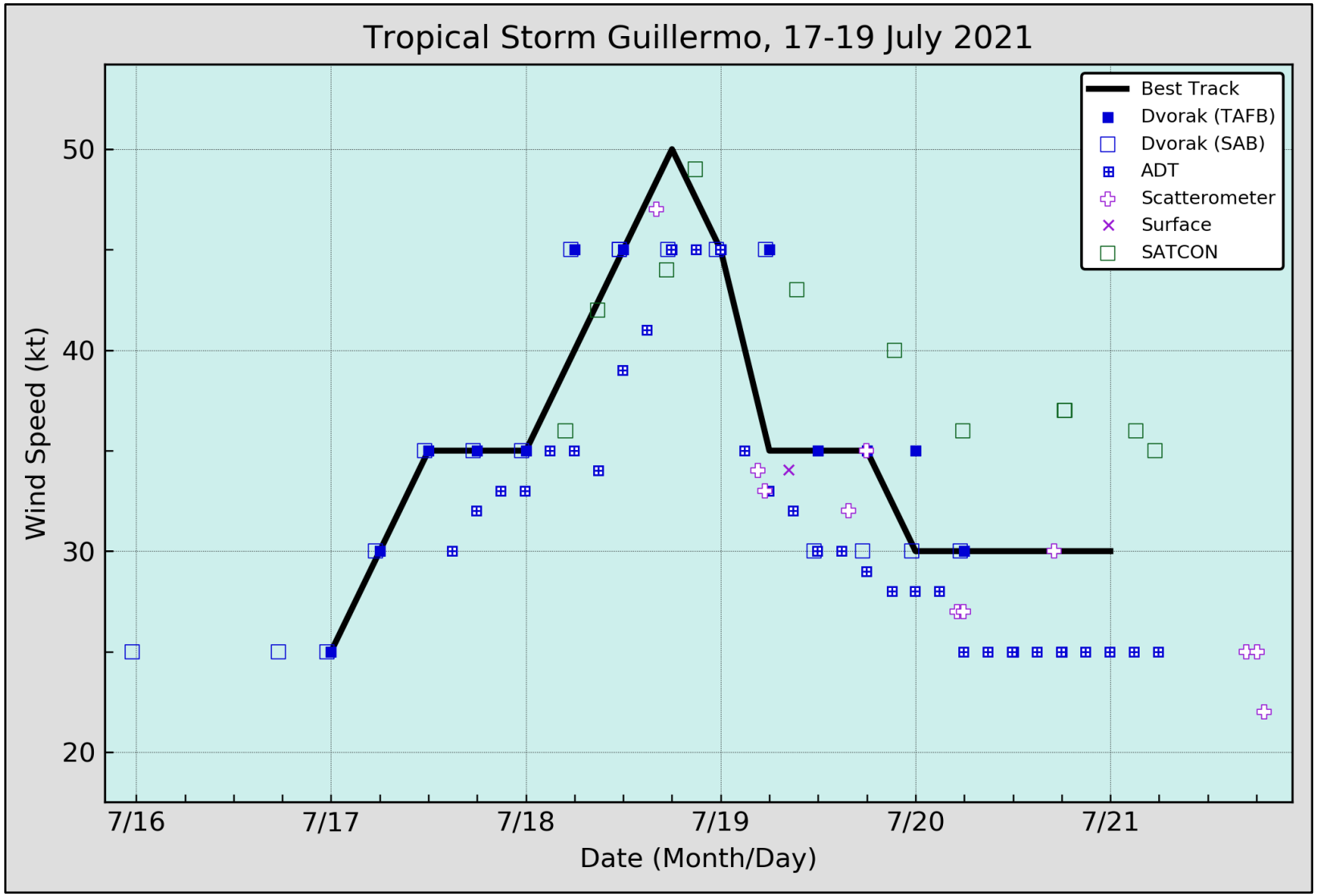

Figure 2. Selected wind observations and best track maximum sustained surface wind speed curve for Tropical Storm Guillermo, 17–19 July 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for Meteorological Satellite Studies. Dashed vertical lines correspond to 0000 UTC.

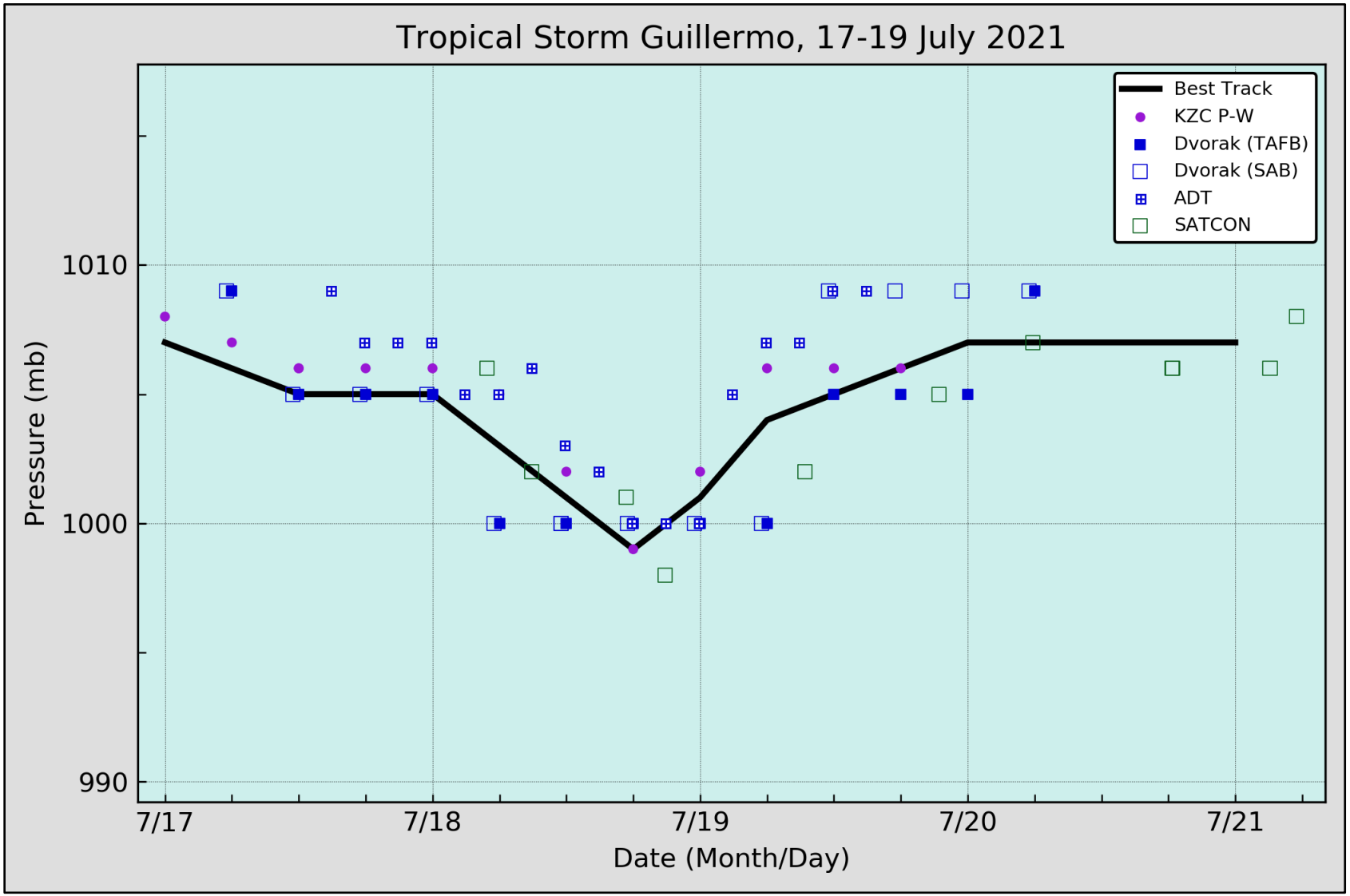

Figure 3. Selected pressure observations and best track minimum central pressure curve for Tropical Storm Guillermo, 17–19 July 2021. Advanced Dvorak Technique estimates represent the Current Intensity at the nominal observation time. SATCON intensity estimates are from the Cooperative Institute for 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.

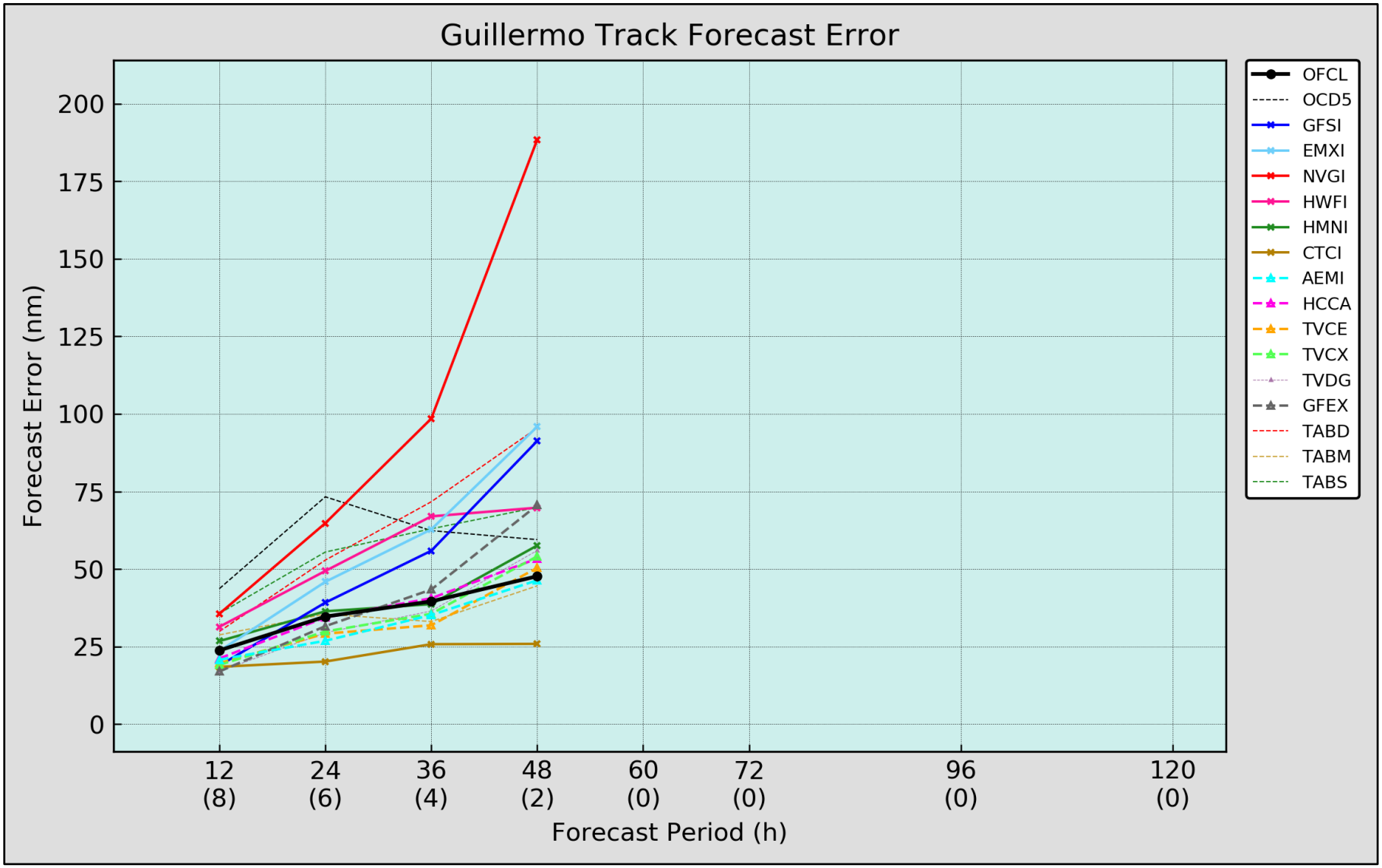

Figure 4. Homogeneous comparison of selected track forecast guidance model errors (in n mi) for Tropical Storm Guillermo, 17–19 July 2021. Official NHC track errors are denoted by the thick black line.

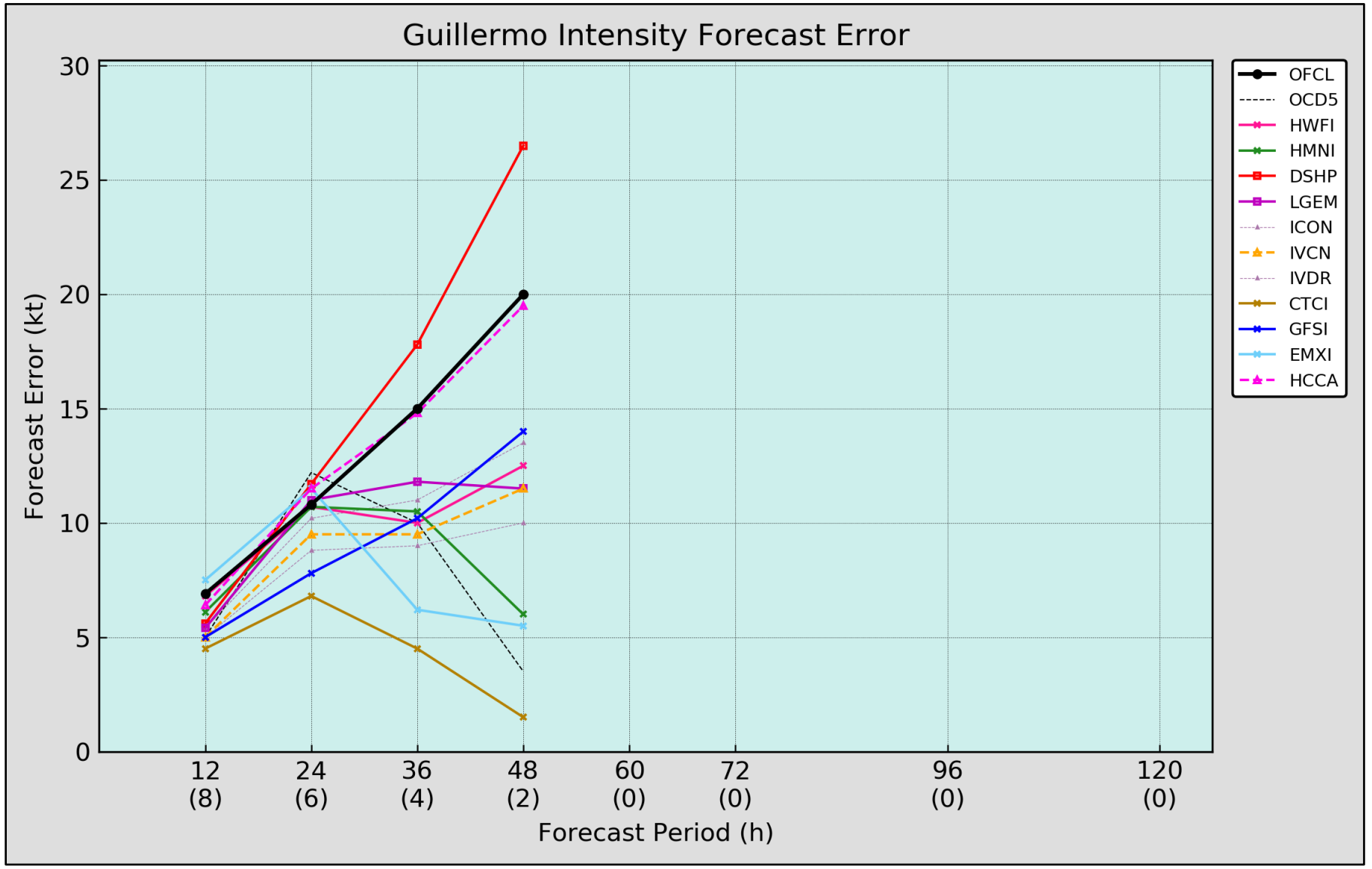

Figure 5. Homogeneous comparison of selected intensity forecast guidance model errors (in kt) for Tropical Storm Guillermo, 17–19 July 2021. Official NHC intensity errors are denoted by the thick black line.